APPENDIX 13

Biodiversity Assessment Report




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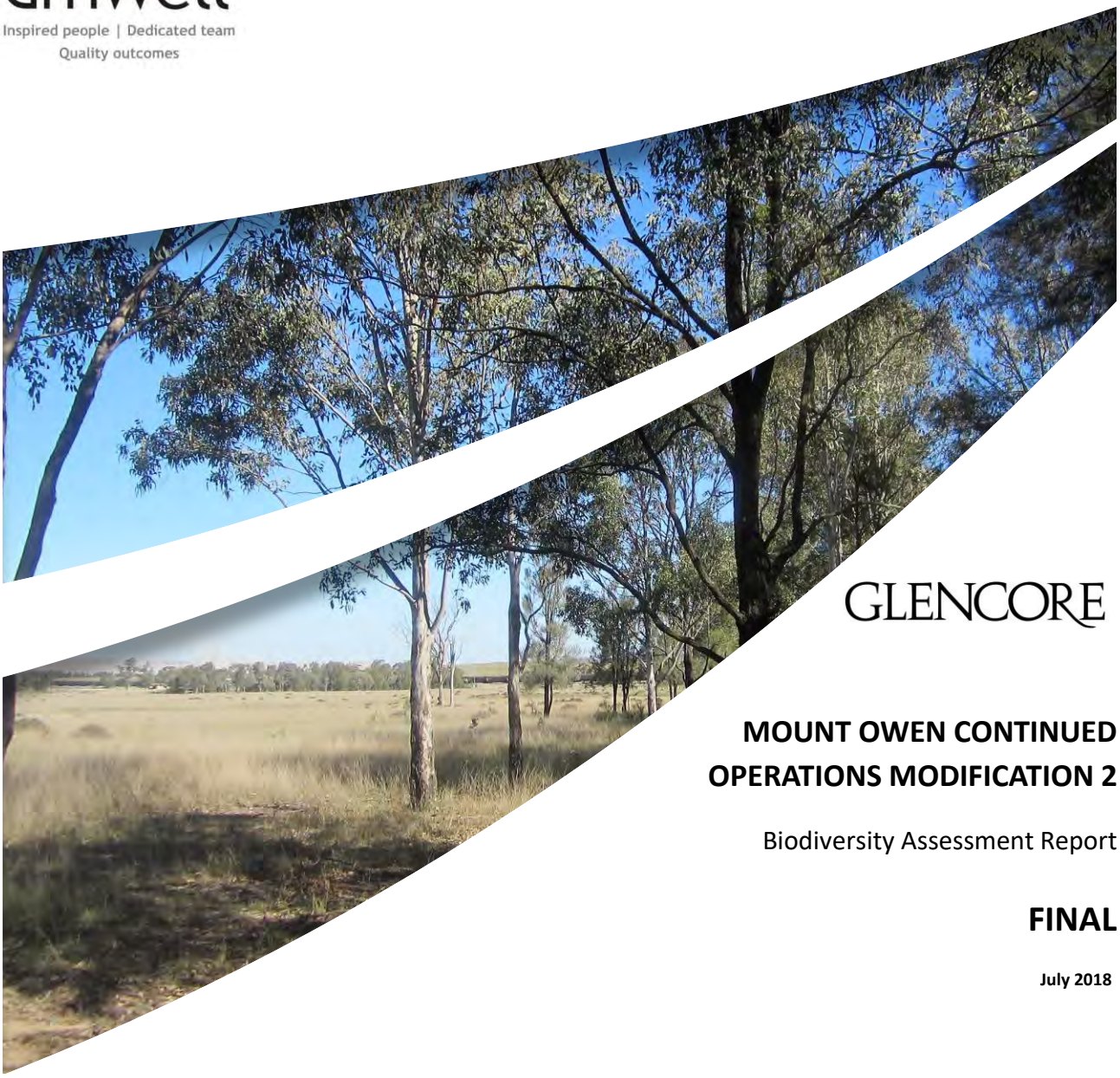

GLENCORE

MOUNT OWEN CONTINUED OPERATIONS MODIFICATION 2

Biodiversity Assessment Report

FINAL

July 2018

GLENCORE

MOUNT OWEN CONTINUED OPERATIONS MODIFICATION 2

Biodiversity Assessment Report

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
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Executive Summary

Mount Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Limited (Glencore), owns the three existing open cut operations in the Mount Owen Complex; Mount Owen (North Pit) and associated infrastructure, Ravensworth East (Bayswater North Pit) and Glendell (Barrett Pit).

Mount Owen received development consent (SSD-5850) from the Planning Assessment Commission for the Mount Owen Continued Operations Project (Continued Operations Project) in November 2016. In late 2015, Glencore obtained mining tenements associated with its acquisition of the Integra Underground Mine. Prior to this acquisition, non-Glencore ownership of these tenements constricted the approved North Pit mine plan that formed part of the Continued Operations Project development consent. Mount Owen now proposes to modify development consent SSD-5850 to allow for the optimisation of the North Pit mine plan to access the identified coal reserves (the Proposed Modification).

This Biodiversity Assessment Report (BAR) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) to assess the biodiversity impacts of the Proposed Modification. The BAR forms part of the Statement of Environmental Effects (SEE) for the Proposed Modification. It has been prepared in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (OEH 2014a) and the Framework for Biodiversity Assessment (FBA) (OEH 2014b) which sits under the policy and as applicable under Clause 27(1)(g) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*. This report has been prepared to accompany the application for approval of the Proposed Modification.

Following the application of appropriate avoidance and mitigation measures, the FBA assessment identified the following biodiversity credits required to offset the impacts of the Proposed Modification:

- 1,062 ecosystem credits for three native plant community types (six vegetation zones) occurring within the Development Footprint.
- 177 species credits for the brush-tailed phascogale (*Phascogale tapoatafa*).

The Proposed Modification was determined not to be a Controlled Action and does not require approval under the *Environment Protection and Biodiversity Conservation Act 1999*. As such, no further assessment of matters of national environmental significance (MNES) are included in this report.

Mount Owen is committed to delivering a biodiversity offset strategy that appropriately addresses the unavoidable loss of ecological values as a result of the Proposed Modification and meets the legislative requirements of the FBA. A biodiversity offset strategy for the Proposed Modification will involve in-perpetuity conservation achieved through the:

- establishment of proponent-managed Stewardship Site established in accordance with Part 5 of the *Biodiversity Conservation Act* 2016, achieved through the retirement of credits;
- purchasing credits on the open market; and/or
- paying into the Biodiversity Conservation Fund.

Glossary

BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology
BBCC	BioBanking Credit Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BCT	NSW Biodiversity Conservation Trust
BVT	Biometric Vegetation Type
CEEC	Critically Endangered Ecological Community
CMA	Catchment Management Authority Area
DECC	NSW Department of Environment and Climate Change (now OEH)
Development Footprint	The total impact zone associated with the Proposed Mount Owen Continued Operations Modification 2. The Proposed Disturbance Area is referred to throughout this report as the Development Footprint according to the FBA methodology.
DoEE	Commonwealth Department of the Environment and Energy
DNG	Derived Native Grasslands
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.
EEC	Endangered Ecological Community
EP	Endangered Population
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FBA	Framework for Biodiversity Assessment
GDEs	Groundwater-dependent Ecosystems
Glencore	Glencore Coal Pty Limited
GIS	Geographical Information System
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
LGA	Local Government Area
MGA	Map Grid of Australia
Mount Owen	Mt Owen Pty Limited
Mount Owen Complex	Current mining operations at the Mount Owen Complex include Mount Owen Mine (North Pit) and associated infrastructure, Ravensworth East Mine (Bayswater North Pit) and Glendell (Barrett Pit).
Mtpa	Million tonnes per annum
MNES	Matters of National Environmental Significance
NSW	New South Wales

OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PMST	Protected Matters Search Tool
Proposed Modification	Proposed Mount Owen Continued Operation Modification 2
SAT	Spot Assessment Technique
SEARs	Secretary of the Department of Planning and Environment
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.
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it
TEC	Threatened Ecological Community
TSC Act	NSW *Threatened Species Conservation Act 1995* (now repealed)
TSPD	Threatened Species Profile Database
UHSA	Upper Hunter Strategic Assessment
Umwelt	Umwelt (Australia) Pty Limited
VIS	Vegetation Information System

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1 Introduction

The Mount Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) north-west of Singleton, 24 km south-east of Muswellbrook and to the north of Camberwell (refer to Figure 1.1). Mount Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Limited (Glencore), currently owns three existing open cut operations in the Mount Owen Complex; Mount Owen (North Pit) and associated infrastructure, Ravensworth East (Bayswater North Pit (BNP)) and Glendell (Barrett Pit).

Mount Owen received development consent (SSD-5850) from the Planning Assessment Commission for the Mount Owen Continued Operations Project (Continued Operations Project) in November 2016. The Continued Operations Project development consent incorporates all previously approved operations at the Mount Owen Mine and Coal Handling and Preparation Plant (CHPP) and Ravensworth East Mine and allows for continued and expanded mining until 2031, now referred to as the 'Approved Operations'. Glendell Mine operates under a separate consent (DA 80/952) and does not form part of the Approved Operations.

In September 2017 Mount Owen modified SSD-5850 (Modification 1) to allow for the construction of a water pipeline from the Integra Underground Mine to the Mount Owen Complex and allow the integration of the Integra Underground Mine into the Greater Ravensworth Area Water and Tailings Scheme (GRAWTS). Mount Owen now proposes to further modify development consent SSD-5850 to allow for the optimisation of the North Pit mine plan to access coal reserves from the mining tenements obtained by Glencore through its acquisition of the Integra Underground Mine (the Proposed Modification).

1.1 Approval Pathway

The Proposed Modification is being sought as a modification to SSD-5850 under Section 96 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The *Biodiversity Conservation Act 2016* (BC Act) was implemented on 25 August 2017. The introduction of this legislation subsequently repealed the *Threatened Species Conservation Act 1995*. Under the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* where Proposed Modifications are identified as being a pending or interim planning application (in accordance with Clause 27 of this Regulation) the former planning provisions (i.e. FBA) still apply. Specifically, Clause 27(1)(g) relevantly defines a pending or interim planning application as:

in the case of development for the purposes of mining—an application for development consent under Part 4 of the Environmental Planning and Assessment Act 1979 (or for the modification of such a development consent) made within 2 years after the commencement of the new Act if the Secretary of the Department of Planning and Environment determines in writing (within 3 months after the commencement of the new Act) that the proponent had submitted before that commencement the conceptual project development plan for the mining project that is required by departmental policy before an application for development consent is made. Furthermore, Mount Owen completed the conceptual Proposed Modification development plan briefing in respect of the Proposed Modification with the Division of Resources and Geosciences (DRG) in the DP&E on 16 May 2017. In addition, initial surveys and preliminary assessments for the Proposed Modification commenced in July 2016.

On 24 November 2017, the Deputy Secretary under delegation from the Minister confirmed the occurrence of the conceptual mine plan meeting prior to the commencement of the BC Act. Accordingly, pursuant to Clause 27(1)(g) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* the Proposed Modification is considered a pending or interim planning application. On this basis, the application for the Proposed Modification can be made within two years of the commencement of the BC Act and the FBA process is applicable to the determination of the Proposed Modification and Part 7 of the BC Act does not apply.

As such, this Biodiversity Assessment Report has been prepared in accordance with the Framework for Biodiversity Assessment (FBA) and the *NSW Biodiversity Offsets Policy for Major Projects*. The Biodiversity Offset Strategy for the Proposed Modification is discussed in **Section 7**.

The Proposed Modification was determined not to be a Controlled Action and does not require approval under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). As such, no further assessment of matters of national environmental significance (MNES) are included in this report.

1.2 The Proposed Modification

The Proposed Modification will enable access to approximately 35 million tonnes (Mt) of additional run-of-mine (ROM) coal from the North Pit. Recovery of the additional coal reserves will result in approximately 46 hectares (ha) of additional disturbance (hereafter referred to as the Development Footprint, refer to **Section 1.4**) (refer to Figure 1.2), representing an increase of approximately 1.8 per cent (%) to the total disturbance area currently approved, and require an increased depth in the North Pit to provide for mining down to the Hebden Seam. The change to the North Pit mine plan will require the extension of the mine life through to 2037 (an additional 6 years).

Prior to the acquisition of the Integra Underground mining tenements, the mine plan design for the North Pit did not allow access to the deeper coal seams and was restricted to the east of the approved North Pit footprint. This resulted in the pit floor 'stepping up' as it progressed further southwards and the 'stepping in' of the mine plan along its eastern boundary. The acquisition of the Integra Underground Mine and associated mining tenements has removed this previous constraint and allows for deeper and extended coal extraction across the proposed modified North Pit.

The Development Footprint extends further east from the Proposed Modification pit boundary to provide for additional infrastructure such as water management structures and access. In addition, the northern extent of the Development Footprint is identified to provide for earthworks to shape and improve the final landform of the North Pit to tie into the surrounding topography, these works are located in proximity to the existing approved Bettys Creek diversion. It is not proposed to modify the existing Bettys Creek diversion in this area which continues through the South East Offset and South East Corridor Offset areas into Main Creek.

No changes are proposed to current mining methods, extraction limits, transportation methods, operational hours or workforce numbers. The Proposed Modification will utilise existing and approved infrastructure with the exception of proposed water management structures to manage water from the mining operation.

Table 1.1 provides a comparison between the Approved Operations and the Proposed Modification.

Table 1.1 Comparison between the Approved Operations and the Proposed Modification

Component	Approved Operations	Proposed Modification
Mining Method	Truck and excavator	No change to mining methods
Target Seams	Down to Hebden Seam Down to approximately 300 m depth	No change to target seams Down to approximately 380 m depth (average 340 m)
Total Reserve Recovered	Total of 257 Mt ROM coal (Ravensworth East – 48 Mt Mount Owen – 209 Mt)	Additional approximately 35 Mt ROM coal over the life of the mine (approximately 13% of total approved reserve)
Disturbance Area	Approved Disturbance Area of 2534 ha	Additional 46 ha disturbance (increase of 1.8% of total Approved Disturbance Area) Modification to SSD-5850 consent boundary to include Proposed Disturbance Area
Annual Production	Ravensworth East – 4 Mtpa Mount Owen – 10 Mtpa	No change to annual production limit
Mine Life	2031	2037
CHPP Capacity	Up to 17 Mtpa	No change to CHPP capacity
Management of Mining Waste	Emplacement of waste in-pit and out-of-pit, up to maximum existing approved height of 230 m. Tailings emplacement in Ravensworth East voids (including West Pit), within in-pit tailings cells in North Pit and/or BNP, and transfer under the GRAWTS to Liddell (subject to relevant approvals)	Emplacement of waste in Approved Disturbance Areas (up to maximum existing approved height) Tailings emplacement within West Pit, in-pit tailings cells in North Pit and/or BNP, and transfer under the GRAWTS
Water Management	Upper and Middle Bettys Creek Diversions Management of water within the water management system and GRAWTS Works to provide flood attenuation for Yorks Creek	No changes to existing approved creek diversions Extension of water management system to Proposed Disturbance Area and continued management of water within the GRAWTS Proposed amendments to design of existing water management system to provide flood attenuation for Yorks Creek
Operational Workforce	Up to approximately 660 at Mount Owen and up to 260 at Ravensworth East	Continued employment of existing Mount Owen workforce (up to approximately 660) for an additional 6 years
Hours of Operation	24 hours, 7 days per week	No change to hours of operation
Interactions with Integra Underground	Minimum 250 m separation subject to strict safety and operational controls	No change to minimum separation – implementation of safety and operational controls through integration of Glencore owned mining operations
Final Landform	Final voids at BNP and North Pit Final landform approved with commitments relating to landform design (including micro relief), conservation and water management considerations as part of further detailed mine design	No additional void in final landform Proposed changes to the final void arrangement in North Pit Final landform to be designed to incorporate detailed design commitments relating to landform design (including micro relief), conservation and water management considerations and be consistent with the existing progressive rehabilitation objectives in the development consent

1.3 Purpose and Scope of this Report

This report provides the findings of the Biodiversity Assessment of the Proposed Modification. It addresses the specific requirements of the FBA (OEH 2014b).

Specifically, this assessment:

- describes the existing terrestrial environment of the Development Footprint (refer to **Section 1.4**) being the Proposed Modification Disturbance Area
- identifies flora and fauna species and ecological communities within the Development Footprint that have the potential to be impacted by the Proposed Modification
- determines the presence or likelihood of occurrence of threatened flora and fauna species and populations and Threatened Ecological Communities (TECs) listed under the *Biodiversity Conservation Act 1995* (BC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- calculates the offset requirements for ecosystem credits and species credits generated as a result of the permanent impacts of the Proposed Modification in accordance with the FBA (OEH 2014b)
- provides an assessment of Matters of National Environmental Significance under the EPBC Act and
- describes the offset strategy to satisfy the impacts of the Proposed Modification.

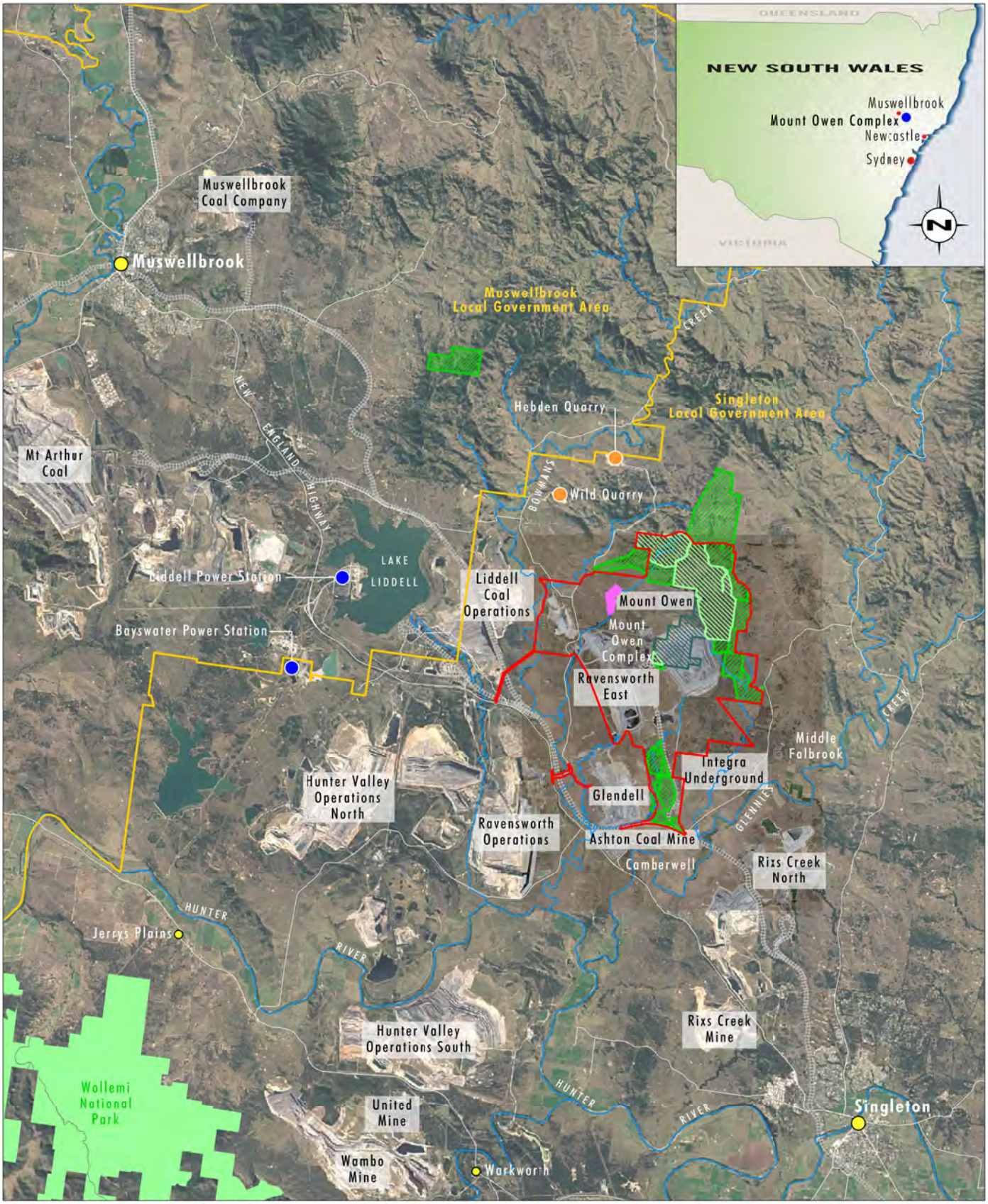

Image Source: Google Earth (2016), Glencore (2017)
Data Source: Glencore (2018), OEH (2013), Forest Corporation of NSW (2013)

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Legend

- SSD-5850 Consent Boundary
- Local Government Area Boundary
- Existing Biodiversity Offset Area
- Ravensworth State Forest
- Ravensworth State Forest within Approved Disturbance Area
- Yorks Creek Voluntary Conservation Area
- National Park
- Road
- Railway
- Drainage line
- Towns
- Power Stations
- Quarry

FIGURE 1.1

Upper Hunter Valley Context and Approved Mount Owen Operations

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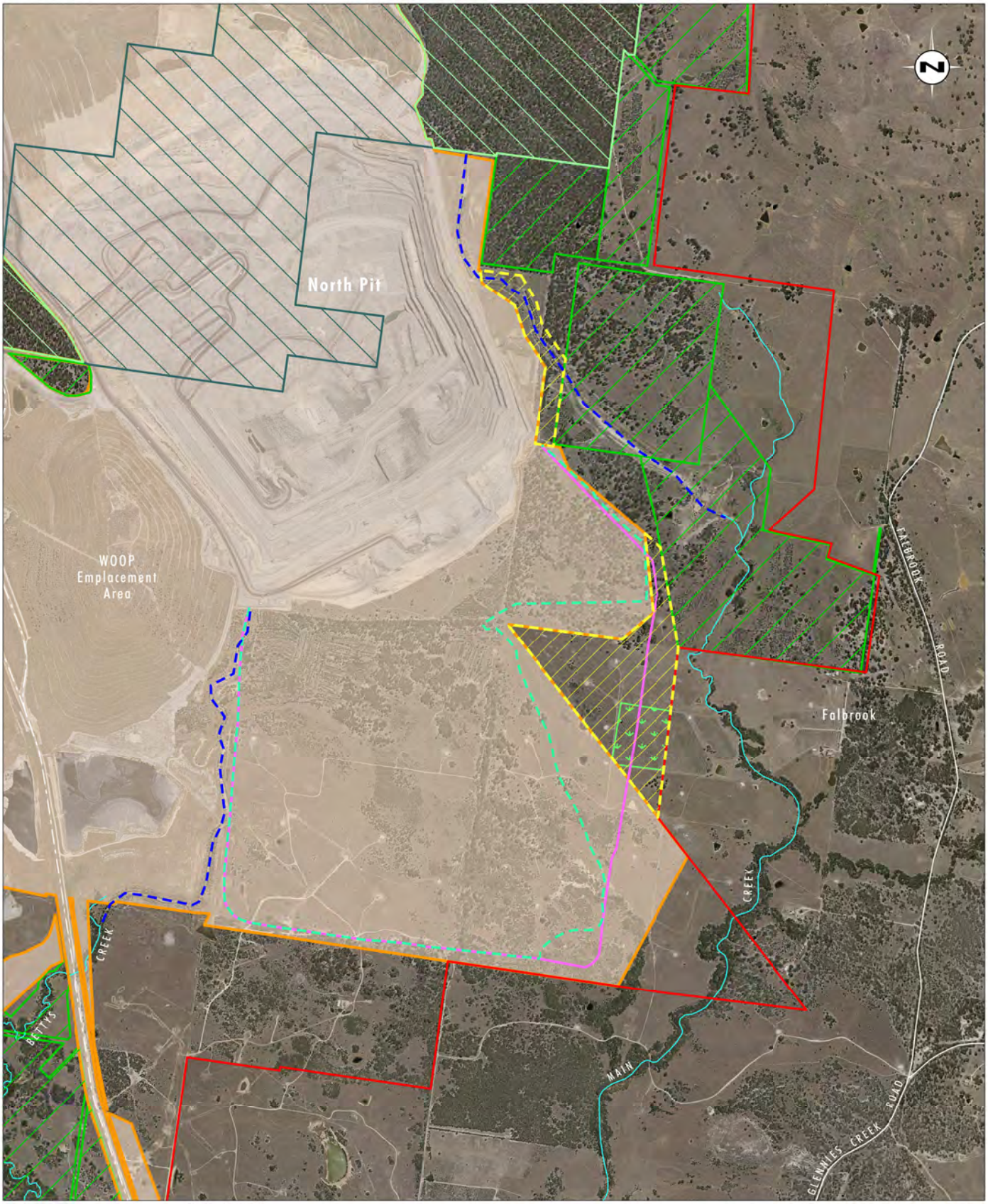

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Approved Disturbance Area
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- Existing Biodiversity Offset Area
- Ravensworth State Forest
- Ravensworth State Forest within Approved Disturbance Area
- Existing Bettys Creek Diversion
- Drainage Line
- Olive Grove (within the Proposed Disturbance Area)

FIGURE 1.2

Proposed Modification Overview

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1.4 Development Footprint Information

The Proposed Disturbance Area is here after referred to as 'Development Footprint' and represents permanent impacts outside existing Approved Disturbance Areas, as shown in **Figure 1.2**. The Development Footprint will be subjected to a range of disturbances as outlined in **Section 5**.

1.4.1 Location

The Development Footprint is situated approximately 20 km north-west of Singleton in the Hunter Valley of NSW (refer to **Figure 1.1**) within the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) bioregion and the Hunter IBRA subregion. Refer to **Figures 1.3** to **1.5** for the location of the Development Footprint and other relevant landscape features that pertain to the FBA assessment. Refer to **Table 1.2** for a summary of the Development Footprint's location in the landscape.

Table 1.2 Development Footprint Location in the Landscape

Mount Owen Continued Operations Modification 2	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Hunter
Major Catchment Area	Hunter-Central Rivers
Mitchell Landscape	Central Hunter Foothills
LGA	Singleton Council

1.4.2 Size

The Development Footprint covers approximately 46 hectares.

1.4.3 Local and Regional Ecological Context

The central Hunter Valley has been largely cleared of native vegetation, primarily for agriculture and other land uses, including mining and urban development. Similar land use patterns occur in the vicinity of the Mount Owen Complex and the Development Footprint, which is surrounded by agricultural land and coal mining operations, with scattered patches of native vegetation, the most significant of which is Ravensworth State Forest. Ravensworth State Forest and adjoining areas represents a significant link and refuge area between remnant patches of vegetation in the central Hunter Valley. Ravensworth State Forest is located in the north-east of the Mount Owen Complex and to the north of the Development Footprint (refer to **Figure 1.1**).

The central location of the vegetation in Ravensworth State Forest and the surrounds is important for its functionality as a fauna refuge and 'stepping stone' in a highly fragmented landscape. The remnant includes Ravensworth State Forest, including the New Forest Area, the existing Mount Owen Biodiversity Offset Areas, and other native woodland and forest vegetation that are connected to these conservation areas. The remnant provides an important link in the generally north/south movement of highly mobile species, from other sizeable remnants in the north-west, to large remnants to the south-east and south-west of the Development Footprint.

The majority of the existing vegetation within and surrounding the Mount Owen Complex exists as a result of extensive re-growth over the past 30 years (Umwelt 2014). The extant woodland in the Development Footprint is majority 'regrowth' or logged vegetation, that is, it has been previously cleared and its present extent is based entirely on natural regeneration or on targeted planting of canopy species. Riparian vegetation associated with Main Creek represents the oldest vegetation adjacent to the Development Footprint, generally pre-dating aerial photos from 1958 (Umwelt 2014).

The Development Footprint occurs in the Sydney Basin IBRA Bioregion and the Hunter subregion. The Hunter Valley is considered to be of great ecological significance given that it represents the only major break in the Great Dividing Range (linking coastal and inland areas of NSW), and includes an overlap between tropical and temperate climate zones (McVicar TR *et al.* 2015). The Hunter subregion contains 27 endangered ecological communities, eight endangered populations and 116 threatened animal species, listed under New South Wales legislation, of which 33 are also listed under Commonwealth legislation (McVicar TR *et al.* 2015). Twelve groundwater-dependent ecosystems have been identified in the Hunter subregion (McVicar TR *et al.* 2015).

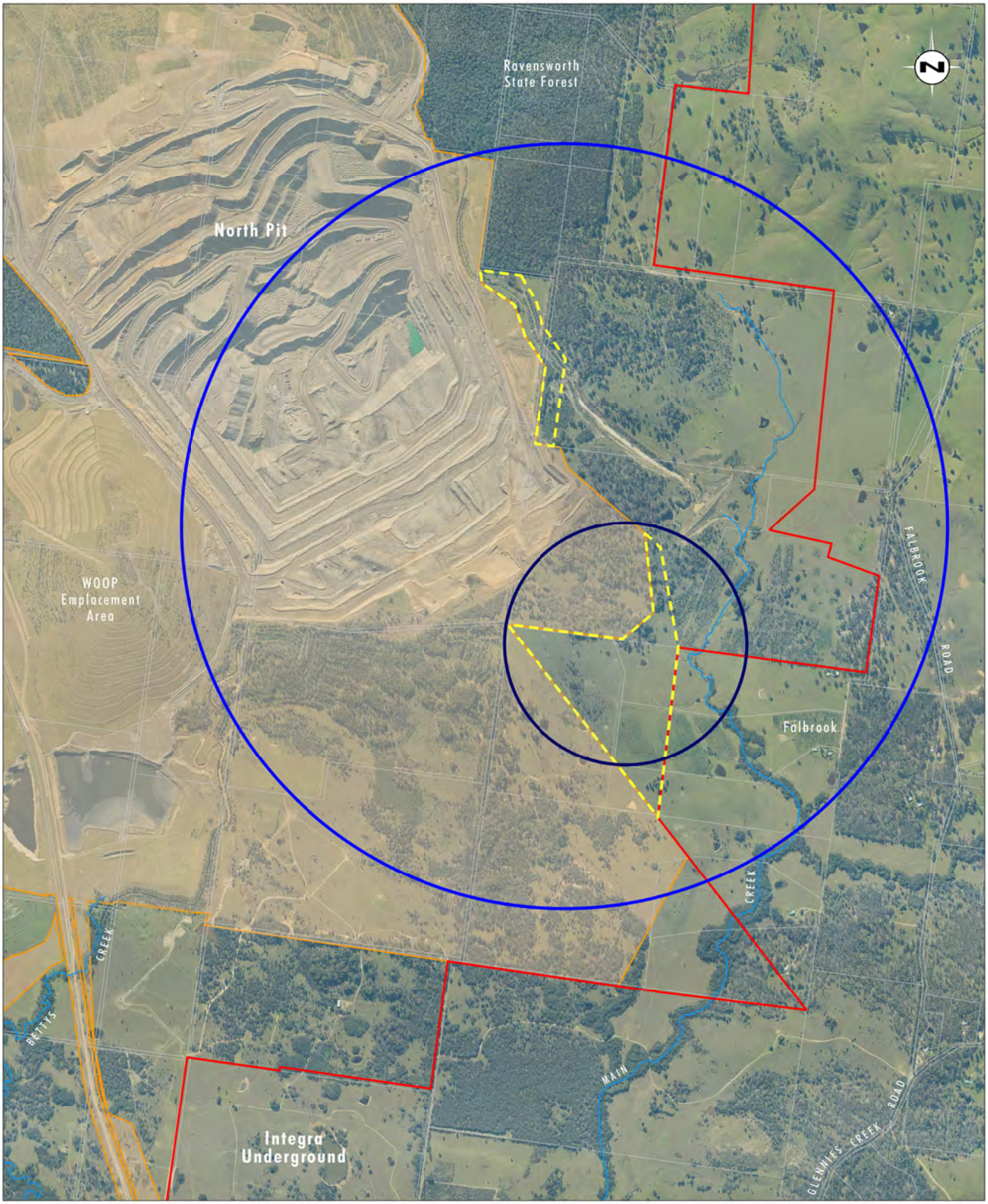

Image Source: Glencore (July 2017)
Data Source: Glencore (2018), OEH (2013), Department of Finance, Services & Innovation (2017)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- Approved Disturbance Area
- 100ha Assessment Circle
- 1000ha Assessment Circle
- Drainage Line

FIGURE 1.3

Site Map

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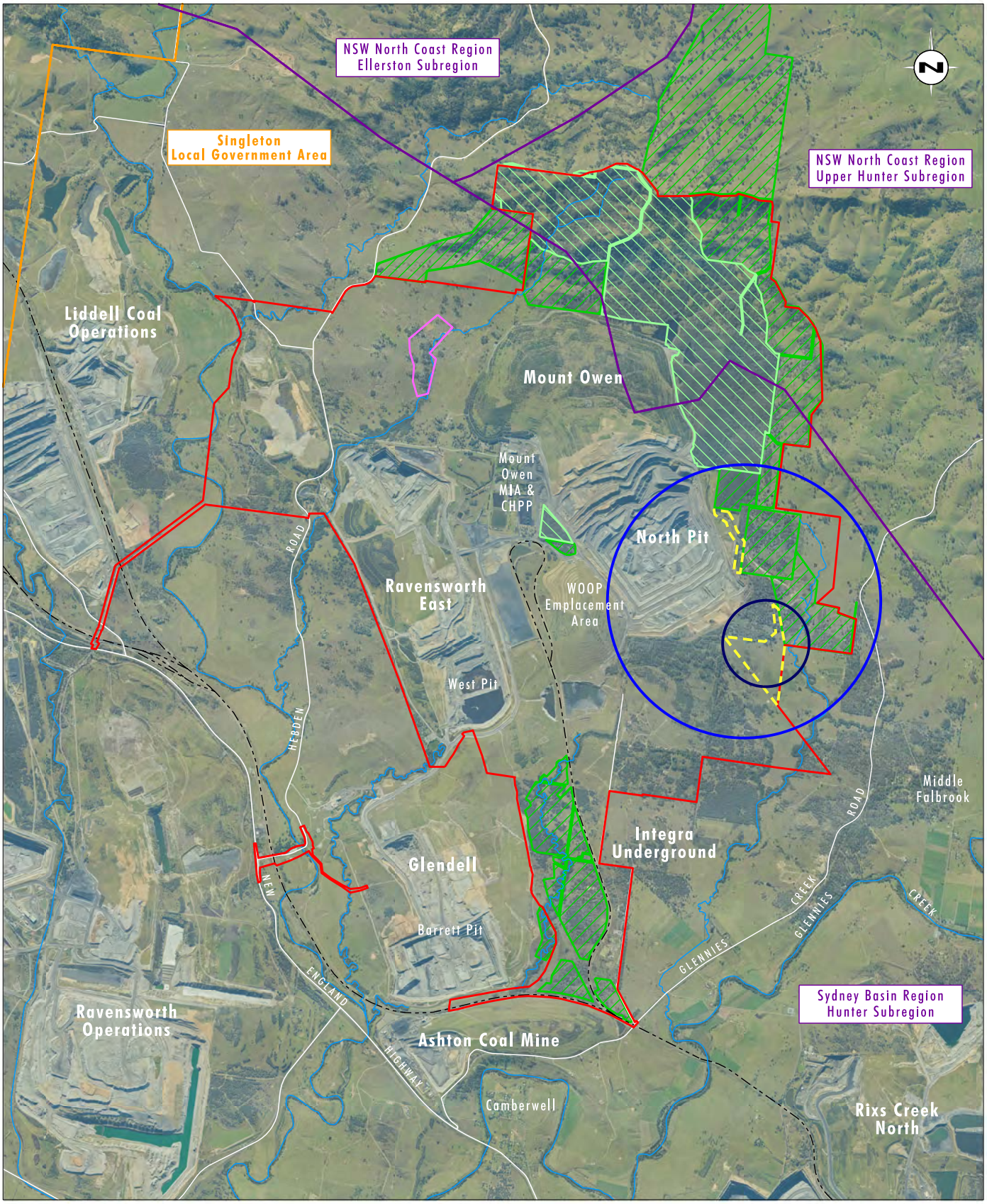

Image Source: Glencore (July 2017)
Data Source: Glencore (2018), OEH (2013), NPSW Estate (2016)

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- 100ha Assessment Circle
- 1000ha Assessment Circle
- Local Government Area Boundary
- IBRA Region/Subregion
- Existing Biodiversity Offset Areas
- Ravensworth State Forest
- Yorks Creek Voluntary Conservation Area
- Road
- Railway

FIGURE 1.4

Location Map
- IBRA Regions/Subregions
and Local Government Area

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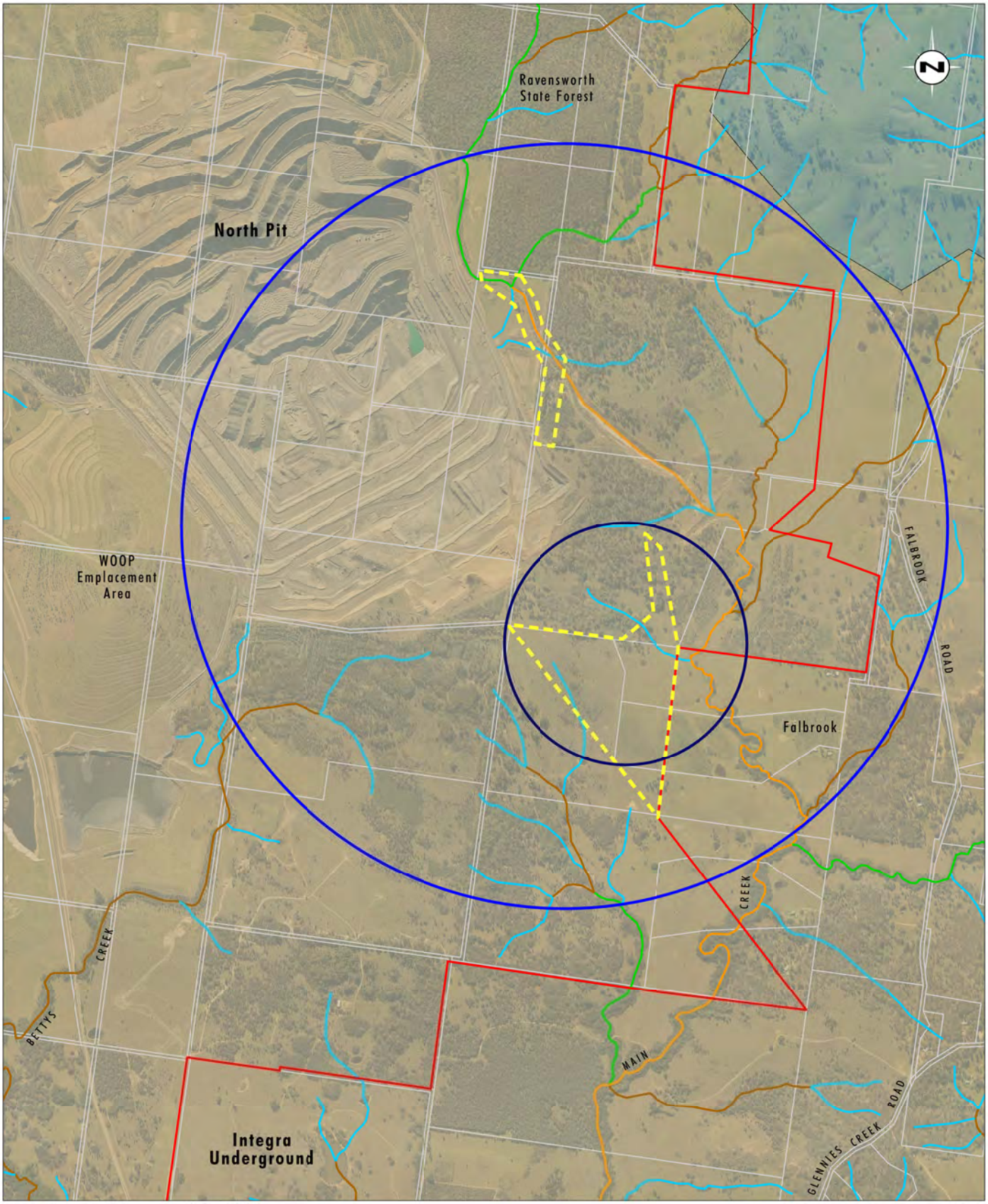

Image Source: Glencore (July 2017)
Data Source: Glencore (2018)), OEH (2013), Department of Finance, Services & Innovation (2017),

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- 100ha Assessment Circle
- 1000ha Assessment Circle

Mitchell Landscape:

- Central Hunter Foothills
- Scone-Gloucester Foothills

Stream Order:

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream

FIGURE 1.5

Location Map
Landscape Features

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20180416 11.24

1.5 Key Resources, Policies and Documents

The following key resources, policies and documents were used during the preparation of this BAR for the Proposed Modification:

- NSW Biodiversity Offsets Policy for Major Projects (OEH 2014a)
- Framework for Biodiversity Assessment (OEH 2014b)
- Credit Calculator for Major Proposed Modifications and BioBanking Operational Manual (OEH 2016a)
- BioBanking Assessment Methodology 2014 (OEH 2014c)
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities –Working Draft (DEC 2004)
- BioBanking Credit Calculator (Major Project Assessment Type) (BBCC 2017), accessed in November 2017
- BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2017a), accessed November 2017
- OEH Threatened Species Profile Database (TSPD) (OEH 2017b), accessed archived datasets November 2017
- Vegetation Information System (VIS) Classification Database (OEH 2017c), accessed November 2017
- NSW Guide to Surveying Threatened Plants (OEH 2016b) and
- Department of the Environment and Energy (DoEE) Protected Matters Search Tool (DoEE 2017), accessed November 2017.

1.6 Report Preparation

This BAR was prepared by Ryan Parsons (Senior Ecologist - Botanist), with review and technical direction from Kate Connolly (Senior Ecologist). Field surveys have been completed by several Umwelt ecologists, primarily by Ryan Parsons (Senior Ecologist – Botanist), Amy Nelson (Ecologist), Callum Vizer (Ecologist), James Garnham (Ecologist) and Rhys Osborne (Ecologist). Kate Connolly, Ryan Parsons and Amy Nelson are accredited under the TSC Act as BioBanking Assessors. In addition to this, Kate Connolly and Ryan Parsons are both accredited under the BC Act as BAM Assessors. Table 1.3 below outlines the details of the accredited BioBanking Assessors involved in the survey, calculations and reporting for the Proposed Modification.

Table 1.3 Accredited BioBanking Assessors and their Role on this Proposed Modification

Name	Assessor ID	Role on Proposed Modification
Kate Connolly ***Senior Ecologist***	177	• Technical review and input
Ryan Parsons ***Senior Ecologist - Botanist***	113	• Field surveys and biometric data collection • Application of the BBCC • Report preparation
Amy Nelson ***Ecologist - Botanist***	230	• Field surveys and biometric data collection • Report Preparation

1.6.1 Structure of the Report

The structure of the report is outlined below as per the requirements of Appendix 7 of the FBA (OEH 2014b):

- **Stage 1:**
  - Section 1 – provides the introduction to the report
  - Section 2 – outlines the methods used in the assessment and
  - Section 3 - outlines the results of the field surveys and BioBanking credit calculator application
- **Stage 2:**
  - Section 4 – describes the avoidance measures implemented and minimisation of impacts as part of the Proposed Modification
  - Section 5 – provides a summary of impacts in accordance with the FBA and
  - Section 6 – summarises the credit requirements for the Proposed Modification
- **Stage 3:**
  - Section 7 – outlines the Biodiversity Offset Strategy
- **Other sections:**
  - Section 8 – provides an assessment of Matters of National Environmental Significance (MNES) and
  - Section 9 - provides a list of references used throughout the report and assessment.

2 Methods

2.1 Landscape Features

2.1.1 Identifying Landscape Features

Landscape features within the Development Footprint and the inner and outer assessment circles were determined through reviewing aerial photography and relevant GIS layers. Landscape features that were reviewed included:

- IBRA bioregions and IBRA subregions
- Mitchell landscapes
- Rivers, streams and estuaries (using the Strahler (1952) ordering system)
- Wetlands
- Native vegetation extent and
- State and/or Regional Biodiversity Links.

2.1.2 Determining Landscape Value

Determining the 'Landscape Value' of the Development Footprint is calculated by assessing the following landscape attributes:

- Per cent Native Vegetation Cover
- Connectivity Value; and
- Patch Size.

2.1.2.1 Per cent Native Vegetation Cover

'Per cent Native Vegetation Cover' is determined by the current per cent native vegetation cover and the future per cent native vegetation cover within the outer assessment circle. This was determined using digital aerial photography interpretation using the Manifold GIS software package. Aerial photographs captured during July 2017 were used to digitise all native vegetation within the outer assessment circle. Further refinement of these areas was undertaken following field surveys of the Development Footprint.

The inner and outer assessment circles must be at a 1:10 ratio and one of the combinations from Table 8 of Appendix 4 of the FBA (OEH 2014b). Due to the size and configuration of the Development Footprint, it was determined that a 100 ha inner assessment circle and 1000 ha outer assessment circle was the most appropriate combination. The outer circle was centred on the Development Footprint, with the inner circle centred on the native vegetation area most impacted by the Proposed Modification (refer to **Figure 1.5**).

2.1.2.2 Connectivity Value

To determine the connectivity value, the Development Footprint was assessed for the presence of native vegetation connecting links, state, regional or local biodiversity links as required by the FBA (OEH 2014b).

Connecting links are present when an area of native vegetation in a Development Footprint is adjoined to and it is:

- in moderate to good condition and
- has a patch size of > 1 ha and
- is separated by a distance of < 100 m (or ≤ 30 m for non-woody ecosystems) and
- is not separated by a large waterbody, dual carriageway, wider highway or similar hostile link.

State biodiversity links are defined as links which have been identified as important on a state scale. State biodiversity links are identified in a plan approved by the Chief Executive of OEH or are a riparian buffer either side of a 6th order stream (using the Strahler (1952) ordering system) or greater, or either side of an important wetland or estuarine area.

Regional biodiversity links are recognised as important links at a regional scale. Regional biodiversity links are identified in a plan approved by the Chief Executive of OEH or are a riparian buffer either side of a 4th or 5th order stream.

2.1.2.3 Patch Size

A 'Patch' is an area of native vegetation that:

- occurs on the Development Footprint and
- is in moderate to good condition and
- includes native vegetation that has a gap of less than 100 m from the next area of moderate to good condition native vegetation (or ≤ 30 m for non-woody vegetation).

For site-based developments, the patch size is calculated for the Mitchell Landscape occurring within the Development Footprint. The patch may extend onto adjoining land that is not part of the Development Footprint. An assessment of the patch size class and the patch size score was then determined using Table 15 of the FBA (OEH 2014b).

2.2 Native Vegetation Assessment

2.2.1 Literature and Database Review

A review of previous documents and reports relevant to the Proposed Modification was undertaken. This included regional and sub-regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys undertaken in the vicinity of the Development Footprint and also relevant ecological database searches. The information obtained was used to inform survey design, and was also used to assist in the assessment of potentially occurring threatened and migratory species, endangered populations (EPs) and Threatened Ecological Communities (TECs).

Relevant documents included:

- Ecological Assessment for the Mount Owen Continued Operations Project (Umwelt 2014)
- Ecological Constraints Analysis for the Proposed Modification (Umwelt 2016)
- Upper Hunter Strategic Assessment – Greater Ravensworth Biodiversity Certification Assessment Report (Umwelt 2015a)
- Upper Hunter Strategic Assessment – Integra Coal Proposed Modification Biodiversity Certification Assessment Report (Parsons Brinckerhoff 2014)
- The Vegetation of the Central Hunter Valley, NSW (Peake 2006)
- Greater Hunter Native Vegetation Mapping (Sivertsen *et al* 2011)
- VIS Classification Database (OEH 2017c), accessed November 2017
- OEH Online Search Tool (OEH 2017d) for known/predicted threatened communities in the Hunter IBRA subregion
- DoEE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, accessed November 2017.

2.2.2 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Development Footprint was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment and vegetation community mapping of the Development Footprint.

Vegetation communities in the Development Footprint were mapped on-screen overlaying the July 2017 high resolution aerial photographs provided by Glencore. Mapping was undertaken using the Manifold System 8.0 Enterprise Edition GIS in a 32 bit mode. Use of GIS allowed zooming to a relatively large scale. Generally the minimum mapping unit for a vegetation zone was 0.1 ha.

2.2.3 Systematic Plot/Transect Surveys

A total of 14 floristic plots and 12 rapid assessments were conducted across the Development Footprint during the surveys undertaken for this assessment (refer to Figure 2.1). Of the total number of rapid assessments, three were undertaken within the Development Footprint in September 2016 for the purposes of vegetation reconnaissance associated with the ecological constraints assessment phase for the Proposed Modification. A number of other rapid assessments were undertaken in September 2016 in the wider locality of the Development Footprint. 14 floristic plots and nine rapid assessments were undertaken over three days in July 2017. Floristic plot data was collected in accordance with minimum requirements under the FBA (OEH 2014a).

Table 2.1 outlines the floristic survey effort in the Development Footprint.

Table 2.1 Adequacy of Vegetation Survey in the Development Footprint

Veg. Zone	Plant Community Type (PCT) ID/Biometric Vegetation Type (BVT) ID and Common Name *Condition Class*	Area in the Development Footprint (ha)	Number of Floristic Plots/Transects		Number of Rapid Assessments Completed
			Required	Completed	
1	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good*	5.00	3	3	4
2	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good -Plantation*	2.19	2	2	1
3	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good - Derived Native Grassland*	29.30	4	4	3
4	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good -Derived Native Grassland Olive Plantation*	6.81	3	3	1
5	PCT1692/HU906 Bull Oak Grassy Woodland of the Central Hunter Valley *Moderate to Good*	1.45	1	1	0
6	PCT1731/HU945 Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley *Moderate to Good*	0.20	1	1	1
N/A	Disturbed Land	0.94	0	0	1
N/A	Dam	0.48	0	0	1
	Total	**46.37**	**14**	**14**	**12**

2.2.3.1 Plot/Transect Data Collected

At each plot/transect data was recorded according to Section 5 of the FBA (OEH 2014b). This involved setting out 20 x 50 m and 20 x 20 m plots and a 50 m transect. The location of each quadrat was recorded using a hand-held GPS with accuracy of ± 5 m. The Map Grid of Australia (MGA) coordinate system was used. The location of the 14 plots/transects undertaken within the Development Footprint is shown in **Figure 2.1**.

At each plot/transect, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 m plot. Searches of each 20 x 20 m plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of the shrub, mid-storey, canopy and emergent layers were also thoroughly examined. Effort was made to search the tree canopy and tree trunks for mistletoes, vines and epiphytes.

For each flora species recorded in the plot, the following data was collected in accordance with Table 1 of the FBA (OEH 2014b):

- stratum/layer in which the species occurs
- growth form
- scientific name and common name
- cover
- abundance

At each standard flora plot, 10 points along a 50 m transect were assessed for:

- percentage native overstorey cover
- percentage native mid-storey cover

In addition, 50 points along a 50 m transect were assessed for:

- percentage native groundcover (grass)
- percentage native groundcover (shrubs)
- percentage native ground cover (other)
- percentage exotic plant cover

Additional details were also recorded in each quadrat, including soil texture, drainage and depth; site disturbances; physiography (position in the landscape); and vegetation structure (strata percentage covers, heights and dominant species). Photographic records were also taken at each site.

2.2.4 Meandering Transects

Meandering transects were walked through vegetation units across much of the Development Footprint. Opportunistic sampling of vegetation was undertaken along these transects, particularly searches for threatened and otherwise significant species, endangered populations and TECs. Meandering transects enable floristic sampling across a much larger area than plot-based survey, especially where the number of plots is limited. Records along transects supplemented floristic sampling carried out in plots, however, the data collected are in the form of presence records, rather than semi-quantitative cover abundance scores.

Meandering transects provided invaluable information on spatial patterns of vegetation that informed vegetation community mapping of the Development Footprint.

2.2.5 Previous Floristic Survey Effort in the Mount Owen Complex

Extensive previous floristic survey effort has been undertaken in the Mount Owen Complex within and adjacent to the Development Footprint over more than 20 years, resulting in a detailed understanding of the biodiversity occurring in the surrounding area. This includes:

Mount Owen Continued Operations Project

Flora field surveys were carried out in the Mount Owen Continued Operations Project Disturbance Area (Approved Disturbance Area) in late spring 2011, spring 2012 and in multiple seasons in 2014. Survey methods included vegetation survey plots, BioBanking plots, meandering transects, rapid assessment points and field reconnaissance to identify spatial arrangement of vegetation across the Approved Disturbance Area.

Figure 2.2 shows the floristic survey effort in the areas surrounding the Development Footprint undertaken for the Mount Owen Continued Operations Project.

Greater Ravensworth Upper Hunter Strategic Assessment

Floristic surveys in the Greater Ravensworth Upper Hunter Strategic Assessment (UHSA) Proposed Modification Area (including adjacent to the Development Footprint), were undertaken in March and April 2014 and focused on assigning vegetation mapping to biometric vegetation types (BVTs) as per the VIS database. This included:

- plot and transects as per BioBanking Assessment Methodology (BBAM) (OEH 2014b)
- qualitative and semi-quantitative rapid sampling plots
- meandering transects and
- digital photograph interpretation

Figure 2.2 shows the floristic survey effort in the areas surrounding the Development Footprint undertaken for the Greater Ravensworth UHSA.

2.2.6 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within plots and on meandering transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results. Updated taxonomy has been derived from PlantNET (Botanic Gardens Trust 2017).

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

2.2.7 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Development Footprint. Vegetation mapping involved the following key steps:

- preliminary review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- predicting the distribution of particular vegetation communities based on understanding the distribution of Biometric vegetation types (OEH 2017c) and plant communities as described by the Greater Hunter Native Vegetation Mapping (Sivertsen *et al* 2011) Project
- preparation of a draft vegetation community map based on interpretation of digital airborne imagery and preliminary delineation of vegetation community floristics
- ground-truthing of the vegetation map based on survey effort documented in **Section 2.2.3** to **2.2.5**
- revision of vegetation community floristic delineations based on plot data and
- revision of the vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

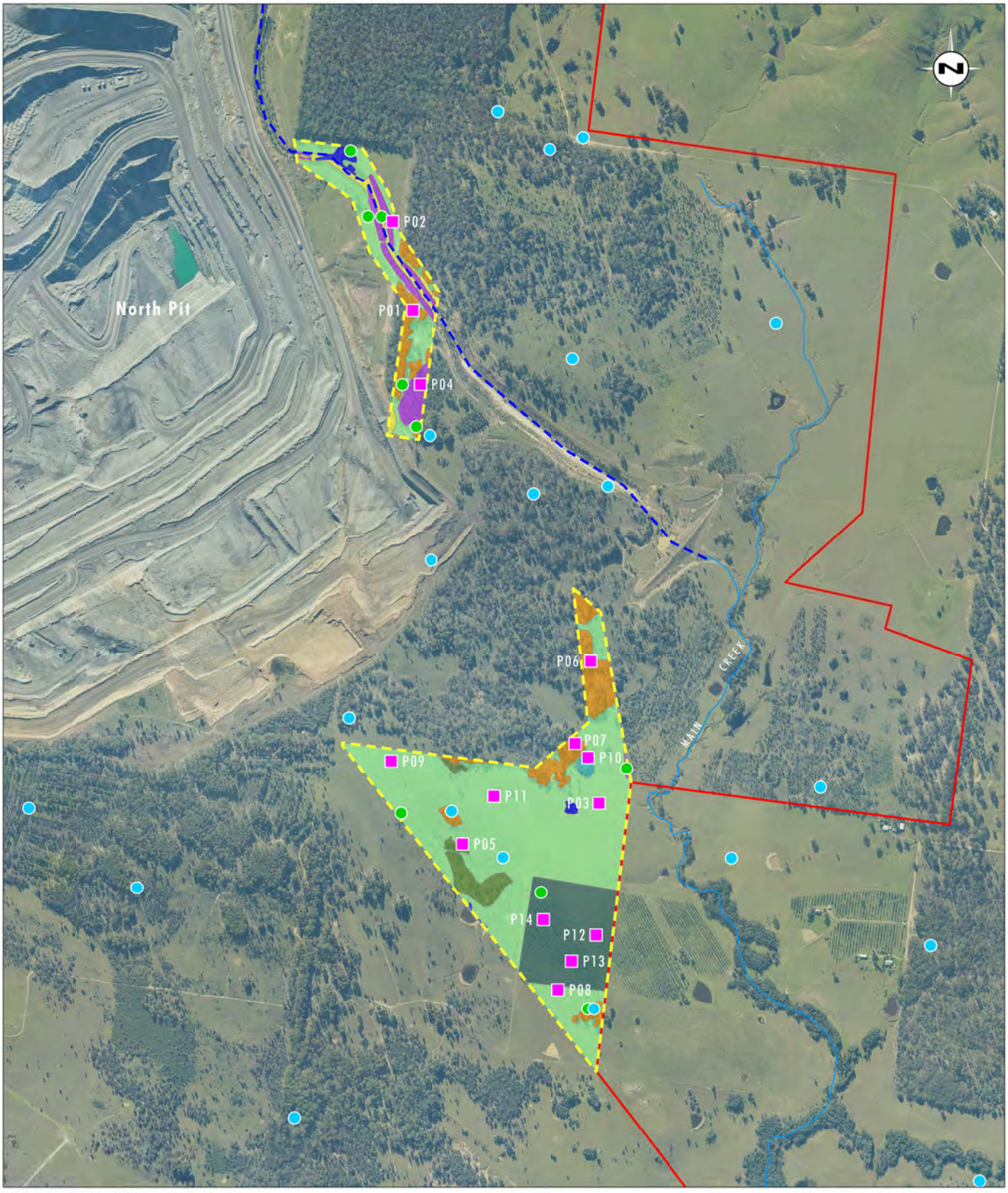

Image Source: Glencore (July 2017)
Data Source: Glencore (2017)

0 250 500 750m
1:15 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- Floristic Plot (July 2017)
- Semi-quantitative Rapid Assessment (July 2017)
- Semi-quantitative Rapid Assessment (September 2016)
- Existing Bettys Creek Diversion

Vegetation Communites:

- Zone 1 - HU815/PCT1601 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter - Moderate to Good
- Zone 2 - HU815/PCT1601 - Moderate to Good - Plantation
- Zone 3 - HU815/PCT1601 - Moderate to Good - Derived Native Grassland
- Zone 4 - HU815/PCT1601 - Moderate to Good - Derived Native Grassland - Olive Plantation
- Zone 5 - HU906/PCT1692 Bull Oak grassy woodland of the central Hunter Valley - Moderate to Good
- Zone 6 - HU945/PCT1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley - Moderate to Good
- Dam
- Disturbed Land

FIGURE 2.1

Flora Survey Effort

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20180416 11.29

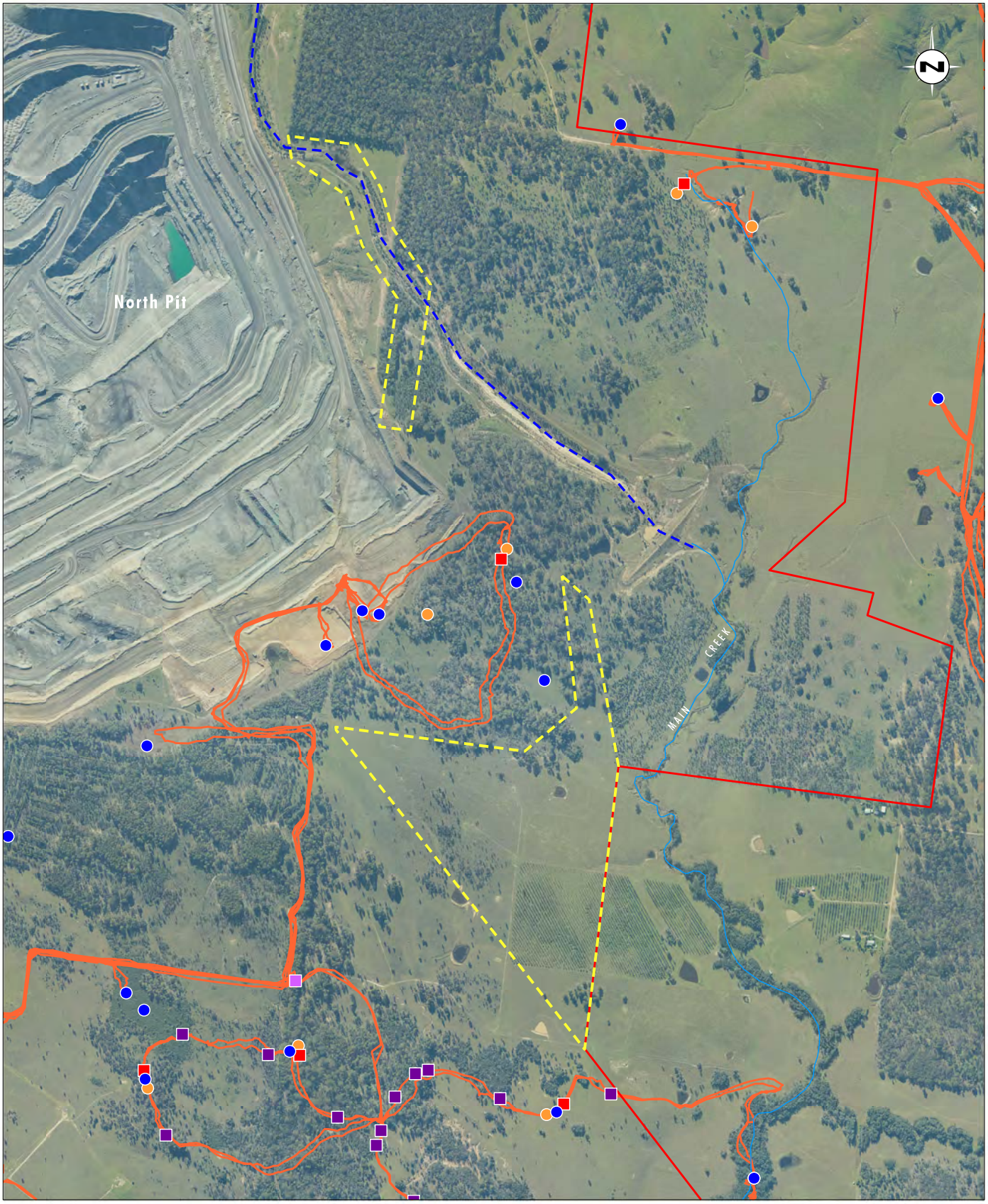

Image Source: Glencore (July 2017)
Data Source: Glencore (2017)

0 250 500 750m
1:15 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- UHSA Plots
- UHSA Qualitative Rapid Assessment
- UHSA Semi-quantitative Rapid Sampling Plot
- UHSA Meandering Transect
- MOCO Plots
- MOCO Rapid Vegetation Assessment
- Existing Bettys Creek Diversion
- Drainage Line

FIGURE 2.2

Flora Survey Locations from Previous Projects

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20180416 11.30

2.2.8 Threatened Ecological Community Delineation Techniques

Vegetation communities identified in the Development Footprint were compared to TECs listed under the Commonwealth EPBC Act and NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- full-floristic quadrat assessment, rapid assessments and meandering survey to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the NSW Scientific Committee and/or Commonwealth Threatened Species Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the Commonwealth DoEE and the NSW OEH
- comparison with other assessments of TECs in the region

2.2.9 Plant Community Type (PCT)/Biometric Vegetation Type (BVT) Allocation

Each of the vegetation communities described within the Development Footprint were aligned with an equivalent PCT/BVT as detailed in the VIS Classification Database (OEH 2017c). For each vegetation community described in the Development Footprint, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs/BVTs was generated. The profiles for each of the possible PCT/BVT were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform and distribution details.

Further detail regarding this allocation for individual PCT/BVTs is outlined in **Section 3.2.1.**

2.3 Threatened Species

2.3.1 Literature and Database Review

A review of previous documents and reports relevant to the Proposed Modification was undertaken. This included ecological reports, previous ecological surveys undertaken in the vicinity of the Development Footprint and also relevant ecological database searches. The information obtained was used to inform survey design, and was also used to assist in the assessment of potentially occurring ecosystem-credit and species-credit species. Relevant documents and resources included:

- Ecological Assessment for the Mount Owen Continued Operations Proposed Modification (Umwelt 2014)
- Ecological Constraints Analysis for the Proposed Modification (Umwelt 2016)
- Upper Hunter Strategic Assessment – Greater Ravensworth Biodiversity Certification Assessment Report (Umwelt 2015a)
- Upper Hunter Strategic Assessment – Integra Coal Proposed Modification Biodiversity Certification Assessment Report (Parsons Brinckerhoff 2014)

- Fauna Monitoring 2016 Annual Report for the Mount Owen Complex (Forest Fauna Surveys 2017)
- OEH Threatened Species Profile Database (TSPD) (OEH 2017b) for known/predicted threatened species in the Hunter IBRA subregion, accessed November 2017 through the archived dataset (http://www.environment.nsw.gov.au/projects/biometric-dataset.htm)
- OEH BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2017a), accessed November2017
- PlantNET (Botanic Gardens Trust) database search for threatened plants within a 10 kilometre radius search from Falbrook, accessed November 2017
- DoEE Protected Matters Search Tool (DoEE 2017) for known/predicted EPBC Act-listed TECs, accessed November 2017.

A preliminary assessment using the TSPD was undertaken which provided a list of species-credit species that might require survey and the suitable survey periods for each species. The results of these database searches, literature review and TSPD review were used to design the survey requirements for species-credit species so that adequate surveys were undertaken as part of the FBA.

Note: Ecosystem-credit species are predicted by the landscape attributes and are not required to be specifically targeted during field surveys.

2.3.2 Species-credit Flora Surveys

Targeted surveys and transects for cryptic and seasonal species-credit flora species were undertaken over the following survey periods, being:

- 26 to 30 September 2016
- 28 February to 2 March 2017
- 7 to 9 March 2017
- 9 to 12 October 2017
- 4 December 2017.

Furthermore, opportunistic species-credit flora species searches were undertaken during all other (i.e. fauna) surveys periods, including:

- 27 to 29 July 2016
- 3 to 6 April 2017
- 11 to 13 July 2017.

Species-credit flora surveys considered the following survey guidelines:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* – Working Draft (DEC 2004)
- *NSW Guide to Surveying Threatened Plants* (OEH 2016)
- *Draft Survey Guidelines for Australia's Threatened Orchids* (DoE 2013).

Extensive previous ecological surveys including targeted surveys for threatened flora species has been undertaken in the Mount Owen Complex within and adjacent to the Development Footprint over more than 20 years. This has included:

- targeted threatened flora surveys in October 2011, October 2012, January 2014, March and April 2014 for the Mount Owen Continued Operations Project (Umwelt 2014)
- targeted threatened flora surveys in March and April 2014 for the Greater Ravensworth Upper Hunter Strategic Assessment (Umwelt 2015a) and
- opportunistic observations during the Annual Mount Owen Complex Fauna Monitoring (Forest Fauna Surveys Pty Ltd 2017).

Table 2.2 identifies the species-credit flora species that were determined to potentially occur in the Development Footprint and therefore require targeted surveys and further assessment. Species-credit flora survey locations are shown in **Figure 2.3**.

Appendix A outlines the species-credit species identified in the literature review that were not considered likely to occur due to lack of suitable habitat and/or absence of local records and therefore did not warrant further assessment as per Section 6.5.1.6 of the FBA (OEH 2014b).

Table 2.2 Species-credit Flora Species Requiring Further Assessment and Survey

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
Austral toadflax ***Thesium australe***	V	V	3	September – February	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes grassy woodlands associated with kangaroo grass (*Themeda triandra*).
netted bottle brush ***Callistemon linearifolius***	V	-	1	September – March	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes dry sclerophyll forest.
Illawarra greenhood ***Pterostylis gibbosa***	E	E	3	June - September	Targeted threatened flora searches and walking transects were undertaken in September 2016 in suitable habitat totalling approximately 40 person hours of survey. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes open forests and woodlands.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
Ozothamnus tesselatus	V	V	1, 2, 3	All year	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes eucalypt woodlands.
pine donkey orchid ***Diuris tricolor***	V	-	1	September - October	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes grassy sclerophyll forest often in disturbed areas.
Pterosylis chaetophora	V	-	4	September-November	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes seasonally moist dry sclerophyll forest.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
scant pomaderris *Pomaderris queenslandica*	E	-	1	All year	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes sheltered woodlands with a shrubby understorey.
Singleton mint bush *Prostanthera cineolifera*	V	V	1	All year	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes open woodlands on exposed sandstone ridges.
slaty red gum *Eucalyptus glaucina*	V	V	1, 2, 3	All year	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes grassy woodland and dry eucalypt forest.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
small snake orchid ***Diuris pedunculata***	E	E	1	September - November	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes grassy slopes and flats.
small-flower grevillea ***Grevillea parviflora* subsp. *parviflora***	V	V	1	All year	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes heaths, shrubby woodland and open forests.
tall knotweed ***Persicaria elatior***	V	V	1	December - May	Targeted searches for this species was undertaken in suitable wetland habitat in conjunction with the February and March 2017 amphibian surveys and targeted searches in December 2017. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes damp areas such as dams, creeks and swamp forests.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
Weeping Myall (*Acacia pendula*) population in the Hunter catchment	EP	-	1, 2	All year	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this population includes open grasslands.
white-flowered wax plant ***Cynanchum elegans***	E	E	1	All year	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes sclerophyll forest and woodlands.
***Cymbidium canaliculatum* population in the Hunter Catchment**	EP	-	2	All year	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper Hunter Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. Suitable habitat for this species includes sclerophyll forest and woodlands.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
***Eucalyptus camaldulensis* population in the Hunter catchment**	EP	-	2	All year	Targeted threatened flora searches and walking transects were undertaken in September 2016 and October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012 (Umwelt 2014) as well as part of the Greater Ravensworth Upper ceec Strategic Assessment in March and April 2014 (Umwelt 2015a). Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.2** above. This species occurs on floodplains and riparian areas.
Prasophyllum* sp. Wybong	-	CE	3	October	Targeted threatened flora searches and walking transects were undertaken in October 2017 in suitable habitat totalling approximately 72 person hours of survey. Targeted threatened flora searches and walking transects were also undertaken in the wider locality as part of the Mount Owen Continued Operations Project in October 2011 and 2012. This species occurs in woodland and grassland communities.

^ Months that surveys are required according to the FBA Calculator and the archived datasets in the TSPD. Where this is unavailable, the relevant flowering/detection periods were sought from online species profiles (OEH or Commonwealth Species Profile and Threats Database - SPRAT).
1 = BioBanking Credit Calculator
2 = Bionet Atlas of NSW Wildlife
3 = Protected Matters Search Tool
4 = OEH assessment team requirement
*There is currently taxonomic uncertainty regarding the status of *Prasophyllum* sp. Wybong. This species is currently treated by the NSW herbarium *as Prasophyllum petilum* (listed as Endangered under the BC Act and EPBC Act), however the national authority regards it as a separate entity according to the Australian Plant Census.

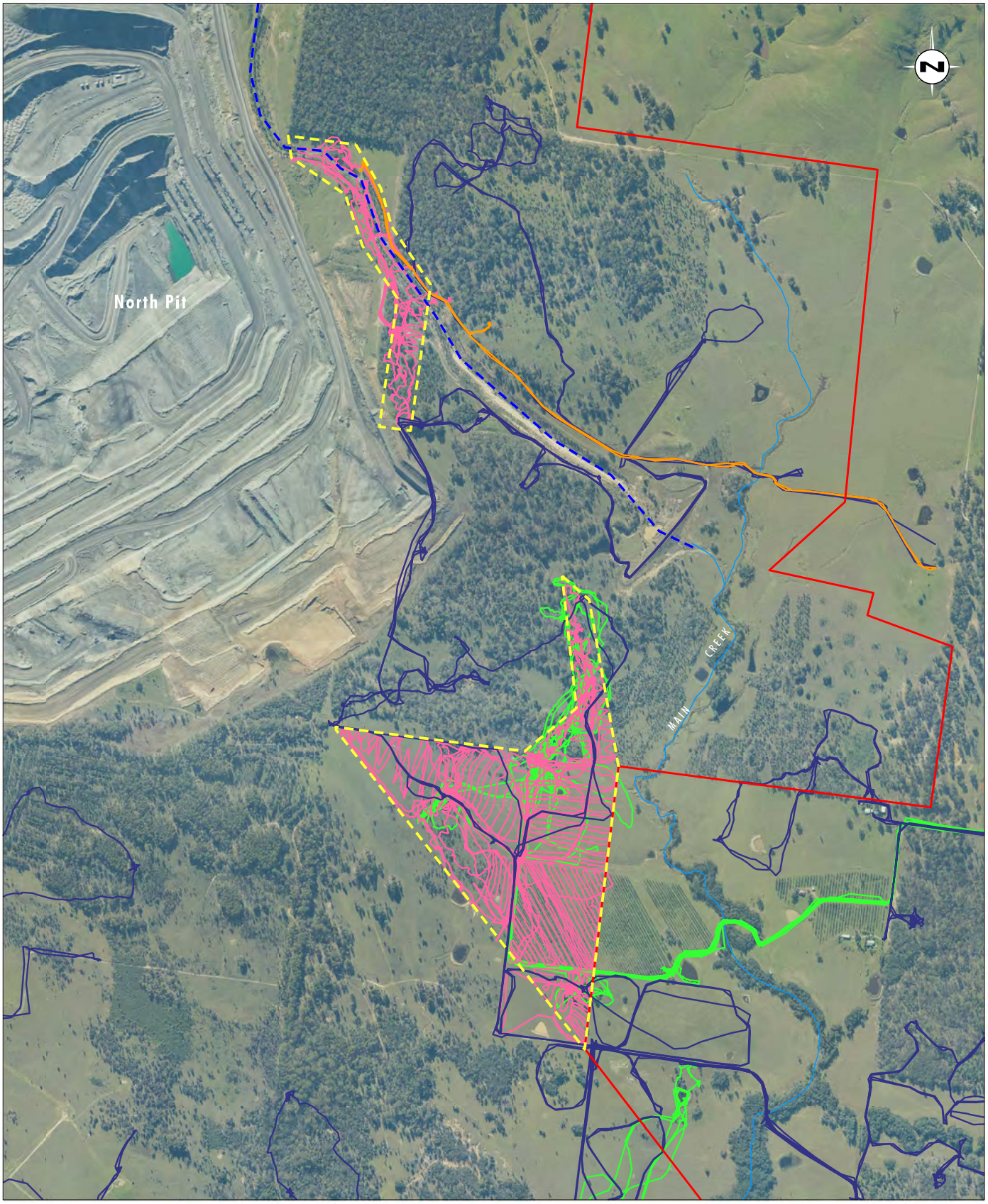

Image Source: Glencore (July 2017)
Data Source: Glencore (2017)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- Targeted Species-credit Flora Transect (Dec 2017)
- Targeted Species-credit Flora Transect (Oct 2017)
- Targeted Species-credit Flora Transect (Feb - Mar 2017)
- Targeted Species-credit Flora Transect (Sep 2016)
- Existing Bettys Creek Diversion
- Drainage Line

FIGURE 2.3

Targeted Species-credit Flora Transect Locations

File Name (A4): R10/3810_097.dgn
20180124 16.43

2.3.3 Species-credit Fauna Surveys

Targeted surveys of seasonal species-credit fauna species were undertaken over the following survey periods (refer to **Figure 2.4**), being:

- 27 to 29 July 2016
- 26 to 30 September 2016
- 28 February to 2 March 2017
- 7 to 9 March 2017
- 3 to 6 April 2017
- 11 to 13 July 2017
- 9 to 12 October 2017.

Species-credit fauna surveys considered the following survey guidelines:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* – Working Draft (DEC 2004)
- *Threatened Species Survey Guidelines – Amphibians* (DECC 2009)
- *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a)
- *Survey Guidelines for Australia's Threatened Mammals* (DSEWPC 2011)
- *Survey Guidelines for Australia's Threatened Frogs* (DEWHA 2010b)
- *Survey Guidelines for Australia's Threatened Bats* (DEWHA 2010c)
- *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPC 2011).

Extensive previous ecological surveys including targeted surveys for threatened fauna species has been undertaken in the Mount Owen Complex within and adjacent to the Development Footprint over more than 20 years (refer to **Figure 2.5**). This has included:

- diurnal bird and reptile surveys, Elliot A and B trapping, pitfall trapping, harp trapping, cage trapping, nocturnal spotlighting and call playback, targeted green and golden bell frog surveys and anabat echolocation recording over the last 20 years for the Mount Owen Complex Annual Monitoring Surveys
- fauna surveys including hair funnel sampling, bird searches, reptile searches, amphibian searches, spotlighting, call playback, Anabat echolocation call detection and harp trapping in August 2011, February and June 2012, January 2013 and March, April and July 2014. Targeted fauna surveys were also undertaken for green and golden bell frog (*Litoria aurea*) and regent honeyeater (*Anthochaera phrygia*)
- targeted species-credit fauna surveys including frog surveys targeting green and golden bell frog (*Litoria aurea*), spotlighting and SAT surveys targeting koala (*Phascolarctos cinereus*), remote camera surveys

targeting brush-tailed phascogale (*Phascogale tapoatafa*) and Anabat echolocation call detection for threatened microbats for the Greater Ravensworth Upper Hunter Strategic Assessment.

Table 2.3 identifies the species-credit fauna species that were determined to potentially occur in the Development Footprint and therefore require targeted surveys and further assessment. Species-credit fauna survey locations are shown in **Figure 2.4**.

Appendix A outlines the species-credit species identified in the literature review that were not considered likely to occur due to lack of suitable habitat and/or absence of local records and therefore did not warrant further assessment as per Section 6.5.1.6 of the FBA (OEH 2014b).

Table 2.3 Species-credit Fauna Species Requiring Further Assessment and Survey

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
brush-tailed phascogale ***Phascogale tapoatafa***	V	-	1, 2	All year	Bushnell Trophy Cam HD cameras were installed at 4 locations across the Development Footprint between February and March 2017. A further 10 cameras were set across the Development Footprint between July 2017 and October 2017, totalling 961 trap nights. At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were also undertaken in suitable habitat areas between the hours of 8.00 pm and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over three nights in October 2017 totalling approximately seven person hours of survey across the Development Footprint and included walking and driving transects. Areas targeted for spotlighting primarily comprised woodland patches dominated by eucalypt species. A total of seven person hours of survey were conducted across the Development Footprint. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.3** above. Remote camera surveys were also undertaken in the wider locality as part of the Greater Upper Hunter Strategic Assessment in March 2014 and Elliot trapping is undertaken annually as part of the monitoring surveys of the Mount Owen Complex.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
eastern pygmy-possum ***Cercartetus nanus***	V	-	1	All year	Bushnell Trophy Cam HD cameras were installed at 4 locations across the Development Footprint between February and March 2017. A further 10 cameras were set across the Development Footprint between July 2017 and October 2017, totalling 961 trap nights. At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter and honey. Cameras were set to take three photos in quick succession when movement was detected. Targeted hollow surveys were also undertaken across the Development Footprint using an inspection camera in February, March and October 2017. Three hollows suitable for the species that could be accessed with the inspection camera were surveyed. Tree hollows were inspected on several occasions throughout the survey period. Nocturnal spotlighting searches were also undertaken in suitable habitat areas between the hours of 8.00 pm and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over three nights in October 2017 totalling approximately seven person hours of survey across the Development Footprint and included walking and driving transects. Areas targeted for spotlighting primarily comprised woodland patches dominated by eucalypt species. A total of seven person hours of survey were conducted across the Development Footprint. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.3** above. Remote camera surveys were also undertaken in the wider locality as part of the Greater Upper Hunter Strategic Assessment in March 2014 and Elliot trapping is undertaken annually as part of the monitoring surveys of the Mount Owen Complex.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
green and golden bell frog ***Litoria aurea***	E	V	1, 2, 3	August – March	Multiple green and golden bell frog surveys were undertaken at two general waterbody locations within the Development Footprint in February, March, April and October 2017. Surveys included call playback sessions which began with a period of quiet listening for approximately 5 minutes followed by playing green and golden bell frog calls for approximately four minutes. Following call playback sessions, spotlight surveys were conducted, which involved searching the aquatic, fringing and terrestrial habitat and recording the number of any amphibian species seen or heard calling. Diurnal herpetological searches were undertaken in suitable terrestrial habitat in March and October 2017 and involved searching in fringing aquatic and terrestrial habitats. Diurnal surveys were conducted across three broad areas of suitable habitat in the Development Footprint. Weather conditions during the surveys were suitable for detecting green and golden bell frog. Temperatures ranged from 7.6 – 32.5 degrees and rainfall from 0 – 32.6 mm occurred during surveys. A total of 15 person hours of survey were conducted across the Development Footprint. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.3** above. Targeted green and golden bell frog surveys were also undertaken in the wider locality in March 2014 as part of the Greater Upper Hunter Strategic Assessment, in February 2012, January and February 2013 as part of the Mount Owen Continued Operations Project and is undertaken annually as part of the monitoring surveys of the Mount Owen Complex.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
green-thighed frog *Litoria brevipalmata*	V	-	1	October - March	Targeted green-thighed frog surveys were undertaken at two dam locations within the Development Footprint in October 2017. Surveys included call playback sessions which began with a period of quiet listening for approximately 5 minutes followed by playing green-thighed frog calls for approximately four minutes. Following call playback sessions, spotlight surveys were conducted, which involved searching the aquatic, fringing and terrestrial habitat and recording the number of any amphibian species seen or heard calling. Diurnal herpetological searches were undertaken in suitable terrestrial habitat in March and October 2017 and involved searching in fringing aquatic and terrestrial habitats. Diurnal surveys were conducted across three broad areas of suitable habitat in the Development Footprint. Weather conditions during, or preceding, the surveys were suitable for detecting the green thighed frog. This species is known to be detected from November to February after heavy rainfall events (Lemckert and Mahony 2008), and appears to call after very heavy rains from September to May. Two substantial rainfall events were recorded during surveys for this species. The first was a total daily rainfall period of 25.4 mm during the March surveys and the second was a daily total daily rainfall period of 32.6 mm preceding the April surveys. A total of six person hours of survey were conducted across the Development Footprint in 2017. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.3** above. Targeted amphibian surveys were also undertaken in the wider locality in March 2014 as part of the Greater Upper Hunter Strategic Assessment, in February 2012, January and February 2013 as part of the Mount Owen Continued Operations Project and is undertaken annually as part of the monitoring surveys of the Mount Owen Complex.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
koala ***Phascolarctos cinereus***	V	V	1, 2, 3	All year	Searches for signs of the presence of koalas were undertaken at nine locations across the Development Footprint in July 2017 using the Spot Assessment Technique (SAT). The koala SAT was undertaken in eucalypt dominated sites only as per the technique outlined in Phillips and Callaghan (2011). Searches were undertaken on and around the base of 30 trees at each survey site. The searches focused on signs of presence including scats at the base of trees and characteristic scratches on tree trunks. Furthermore, habitat assessments to determine the extent of potential koala feed trees were also undertaken across the vegetation communities of the Development Footprint. Nocturnal spotlighting searches were also undertaken in suitable habitat areas between the hours of 8.00 pm and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over three nights in October 2017 totalling approximately seven person hours of survey across the Development Footprint and included walking and driving transects. Areas targeted for spotlighting primarily comprised woodland patches dominated by eucalypt species. A total of seven person hours of survey were conducted across the Development Footprint. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.3** above. Targeted koala SAT and spotlighting surveys were also undertaken in the wider locality in March 2014 as part of the Greater Upper Hunter Strategic Assessment. Nocturnal call playback for koala was completed for the Mount Owen Continued Operations Project in 2012.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
pale-headed snake ***Hoplocephalus bitorquatus***	V	-	1	October - April	Targeted hollow surveys were undertaken across the Development Footprint using an inspection camera in February, March and October 2017. Two hollow-bearing trees containing three hollows suitable for the species that could be accessed with the inspection camera were inspected for use. These hollows were inspected on several occasions throughout the survey period. Furthermore, diurnal reptile searches were undertaken in suitable terrestrial habitat in February, March and October 2017 and involved searching under timber and rocks. Diurnal surveys were conducted across 11 broad areas of suitable habitat in the Development Footprint. Nocturnal spotlighting surveys involved walking a meandering transect within suitable habitat. A total of 24 person hours of survey were conducted across the Development Footprint. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.3** above.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
regent honeyeater ***Anthochaera phrygia***	CE	CE	1, 3	All year	Targeted winter bird surveys were undertaken across the Development Footprint in 14 locations in July 2016 and July 2017 and in other locations in the wider locality. These sessions began with a period of quiet listening for approximately 5 minutes. Regent honeyeater (and swift parrot) calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes between species calls. Following call playback sessions, bird surveys were conducted at each site for a minimum of 30 minutes totalling one person hour of survey per site. This involved walking a meandering transect and recording the number of any bird species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. The winter bird surveys targeted areas of quality habitat and flowering resources for the regent honeyeater and were timed to coincide with the known presence of the species in the Hunter Valley. Furthermore, habitat assessments to determine the extent of potential resource trees (as per the National Recovery Plan for the Regent Honeyeater (DoE 2016)) were also undertaken across the vegetation communities of the Development Footprint. A total of seven person hours of survey were conducted across the Development Footprint. Opportunistic observations were completed throughout all Umwelt survey periods outlined in **Section 2.3.3** above. Targeted winter bird surveys have been undertaken in the wider locality as part of the Mount Owen Continued Operations Project in August 2011, July 2012 and July 2014 and diurnal winter bird searches are undertaken as part of the monitoring in the Mount Owen Complex annually.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
southern myotis ***Myotis macropus*** **(breeding habitat only)**	V	-	2	October-March	The presence of threatened micro-bat species was surveyed using Anabat Express recorders at 8 locations within the Development Footprint in March and October 2017. At each site, the Anabat was positioned at an approximate 30 degree angle one metre above the ground in waterproof housing. Each detector was positioned towards potential micro-bat flyaways along areas of suitable habitat along Main Creek or near dams. The Anabat detector was programmed to start recording from one hour before sunset to one hour after sunrise. A total of 22 survey nights were undertaken across the Development Footprint. All recorded calls were analysed by Anna McConville of Echo Ecology using AnalookW (Version 4.1z) software. The identification of calls was undertaken with reference to Pennay *et al.* (2004) and through the comparison of recorded reference calls from north-eastern NSW and the Sydney Basin. Each call sequence ('pass') was assigned to one of five categories, being definite, probable, possible, species group and unknown. For the purposes of this assessment, definite and probable levels of confidence were treated as positive identifications. Furthermore, habitat assessments to determine the extent of potential breeding habitat for the southern myotis (as per the OEH Guidelines for Assessing Myotis Breeding Habitat (OEH 2016)) were also undertaken within the Development Footprint. This involved identifying any potential hollow roosting within areas of woodland within 200 metres of Main Creek.

Common Name *Scientific Name*	BC Act Status	EPBC Act Status	Source	Required Survey Period^	Survey Technique, Timing and Location
grey-headed flying-fox ***Pteropus poliocephalus*** **(breeding/roosting habitat only)**	V	V	2, 3	September - May	Searches for signs of the presence of grey-headed flying-fox camps were undertaken opportunistically throughout the Development Footprint during all Umwelt survey periods outlined in **Section 2.3.3** above. Suitable roosting habitat usually consists of forested areas near streams, rivers and creeklines. Nocturnal spotlighting searches were also undertaken in suitable habitat areas between the hours of 8.00 pm and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over three nights in October 2017 totalling approximately seven person hours of survey across the Development Footprint and included walking and driving transects. Areas targeted for spotlighting primarily comprised woodland patches. Spotlighting surveys were also undertaken in the wider locality as part of the Greater Upper Hunter Strategic Assessment in March 2014 and the Mount Owen Continued Operations Project in 2012. Diurnal and nocturnal searches are undertaken as part of the monitoring in the Mount Owen Complex annually.

^ Months that surveys are required according to the FBA Calculator and the TSPD. Where this is unavailable, the relevant flowering/detection periods were sought from online species profiles (OEH or Commonwealth SPRAT).
1 = BioBanking Credit Calculator
2 = Bionet Atlas of NSW Wildlife
3 = Protected Matters Search Tool

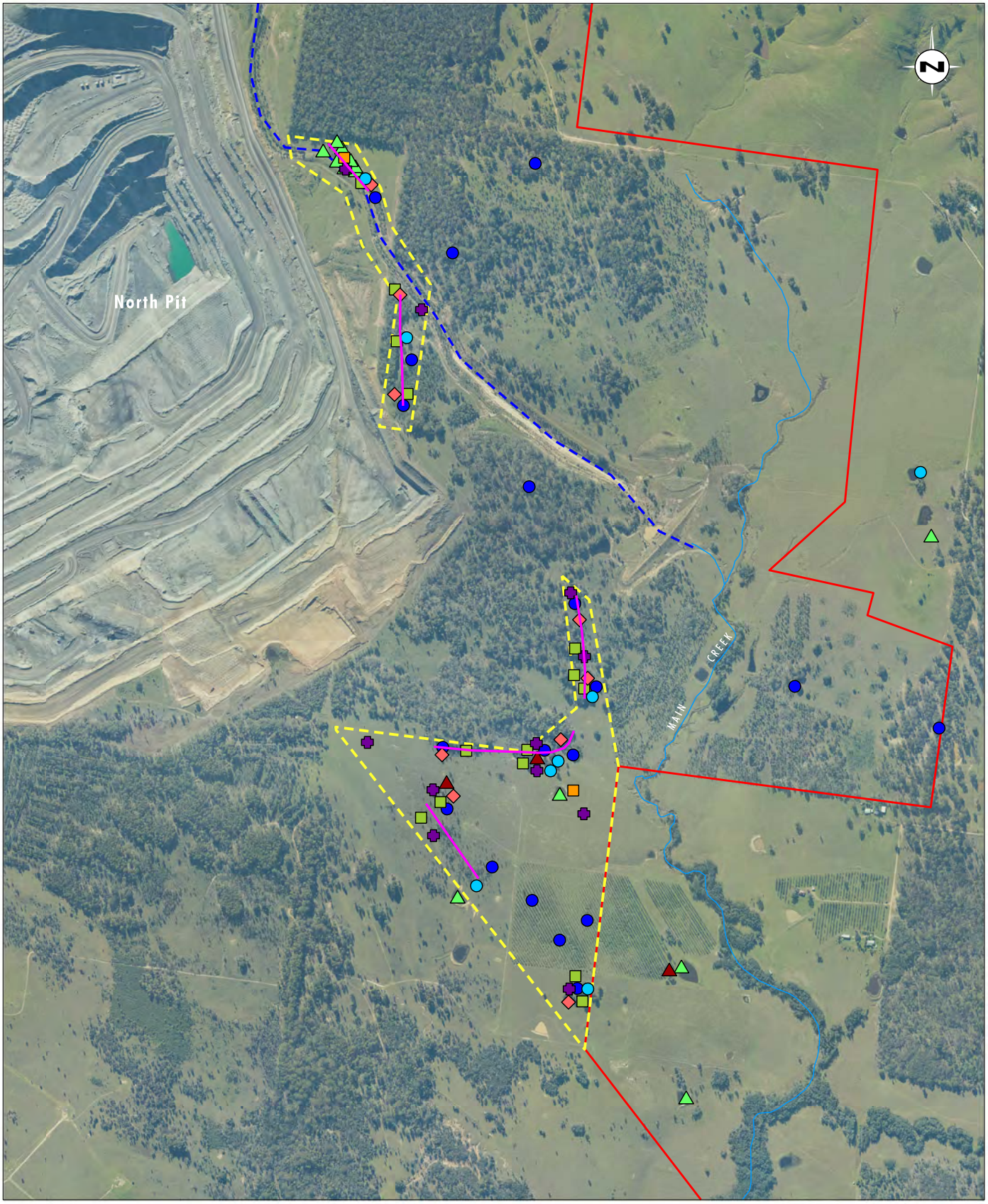

Image Source: Glencore (July 2017)
Data Source: Glencore (2017)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- Existing Bettys Creek Diversion
- Drainage Line

Proposed Modification Surveys (2016-2017):

- Anabat Survey
- Green and Golden Bell Frog Survey
- Hollow Inspection Survey
- Koala SAT Survey
- Remote Camera
- Herpetological Search
- Winter Bird Survey
- Spotlight Surveys
- Green-thighed Frog Survey

FIGURE 2.4

Targeted Species-credit Fauna Survey Effort

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20180416 11.32

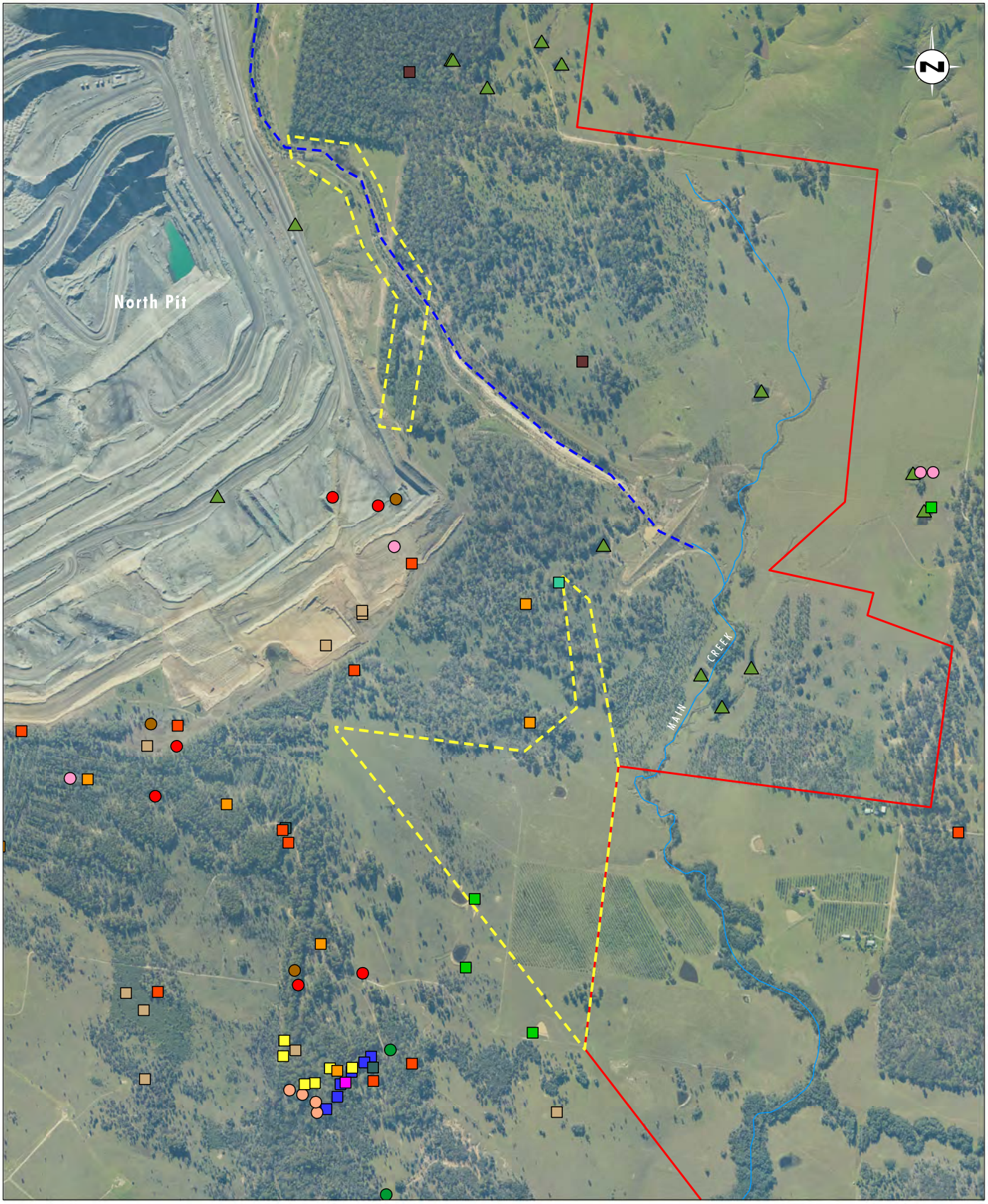

Image Source: Glencore (July 2017)
Data Source: Glencore (2017)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- Existing Bettys Creek Diversion
- Drainage Line

Previous Ecological Surveys:

- Diurnal Bird Survey
- Targeted Green and Golden Bell Frog Survey
- Koala SAT Survey
- Arboreal Elliot B and Arboreal Hair Funnel
- Anabat Survey
- Arboreal Hair Funnel
- Call Playback
- General Fauna Survey Location
- Habitat Condition Assessment
- Harp Trap Location
- Amphibian Survey Location
- Terrestrial Cage Trap
- Winter Bird Survey
- Remote Camera

FIGURE 2.5

Fauna Survey Locations from Previous Projects

File Name (A4): R10/3810_101.dgn
20180416 11.32

3 Results

3.1 Landscape Value

3.1.1 Landscape Features

The outer assessment circle contains the 4th order streams Bettys Creek and Main Creek. The outer assessment circle is also contained entirely in the Central Hunter Foothills Mitchell landscape and sizeable areas of native vegetation occur to the north, east and south. These landscape features are shown in **Figure 3.1**. Mitchell landscapes are shown on **Figure 1.5**.

Landscape features that were considered in the connectivity value scores for the Development Footprint are outlined in **Table 3.1** below.

Table 3.1 Landscape Features in Assessment Circles

Landscape Feature	Development Footprint
Mitchell Landscapes	Central Hunter Foothills
Rivers, Streams, Estuaries	4th order streams: • Bettys Creek diversion
Wetlands	None identified
Native Vegetation	333 ha in the outer assessment circle 40 ha in the inner assessment circle
Cleared Areas	Approximately 260 ha associated with the approved Mount Owen North Pit^ - in the outer assessment circle
State or Regional Biodiversity Links	None identified

^Based on July 2017 aerial photography

3.1.2 Landscape Value Scores

3.1.2.1 Per cent Native Vegetation Cover

Table 3.2 details the percent native vegetation cover before and after the proposed disturbance in the Development Footprint and the native vegetation per cent class entered into the BioBanking Calculator as per Table 9 of Appendix 4 of the FBA (OEH 2014b). Approximately a third of the 1000 ha circle is mapped as native vegetation, the remaining two thirds comprise mainly areas occupied by existing coal mine operations and grassland vegetation.

Table 3.2 Native Vegetation Cover in Assessment Circles

Assessment Circle	Pre-Development			Post-Development		
	Area of Native Veg (ha)	Native Veg Cover (%)	Native Veg % Class	Area of Native Veg (ha)	Native Veg Cover (%)	Native Veg % Class
Outer (1000 ha)	333	33	31-35	324	32	31-35
Inner (100 ha)	40	40	36-40	35	35	31-35

3.1.2.2 Connectivity Value

No state or regional significant biodiversity links were identified within a plan approved by the Chief Executive of OEH in the Sydney Basin IBRA Bioregion. However, the Development Footprint contains part of a regionally significant biodiversity link in the form of a riparian buffer 20 m either side of a 4th order stream (Bettys Creek diversion) as defined under the FBA (OEH 2014b) (refer to **Figure 3.1**).

Details of the connectivity value scores applicable for entry to the BBCC are shown in bold in **Table 3.3** below.

Table 3.3 Connectivity Value Score

Highest Category of Connecting Link	Connectivity Score	Definition	Description
Regionally Significant Biodiversity Link	9	An area identified by the assessor as being part of a regionally significant biodiversity link in a plan approved by the Chief Executive of OEH OR	Not identified
		A riparian buffer 20 m either side of a 4th or 5th order stream	**Bettys Creek Diversion**

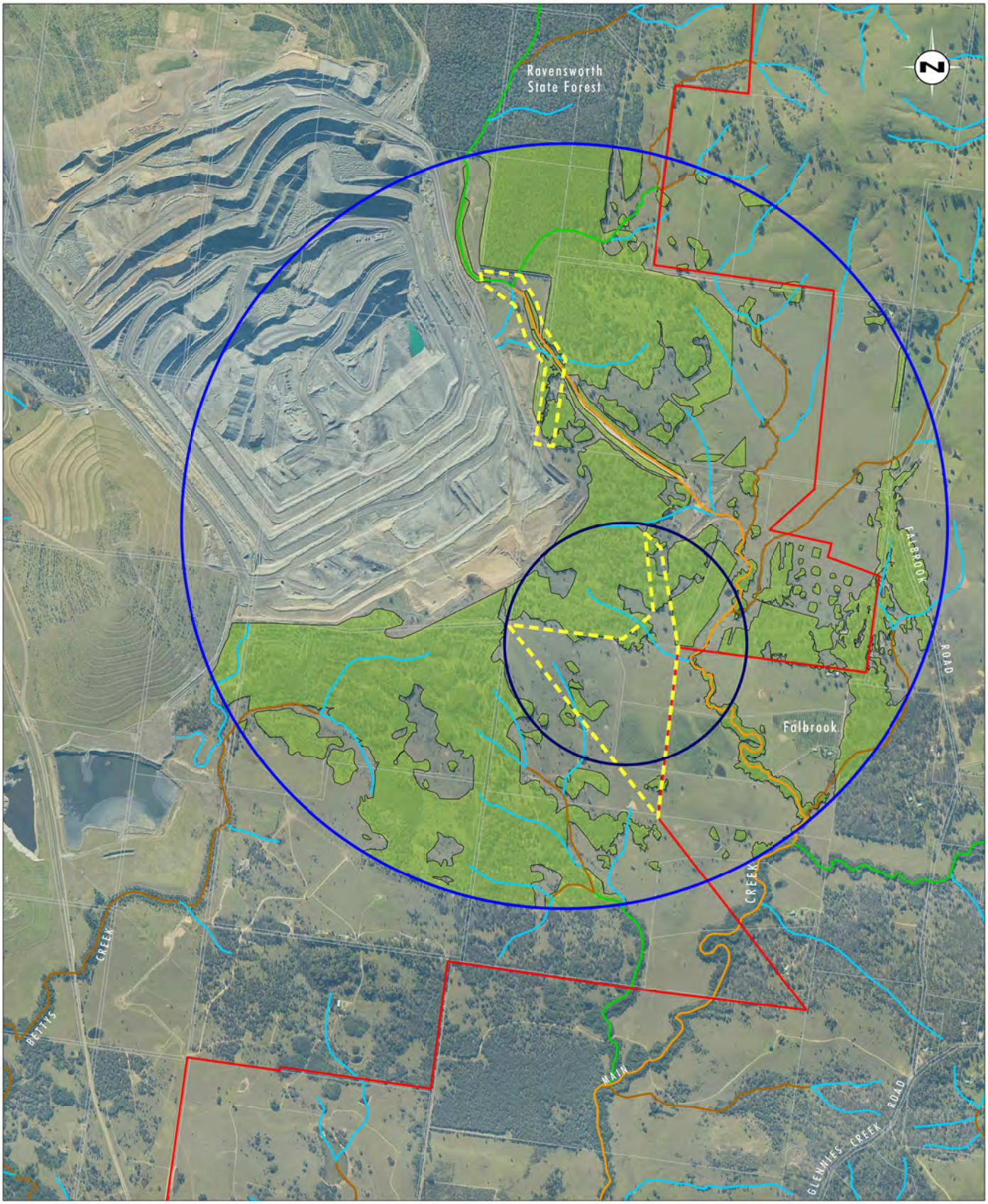

Image Source: Glencore (July 2017)
Data Source: Glencore (2017), OEH (2013), Department of Finance, Services & Innovation (2017),

0 0.25 0.5 1.0km
1:25 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- 100ha Assessment Circle
- 1000ha Assessment Circle
- Native Vegetation

Stream Order:

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream

FIGURE 3.1

Connectivity Value

File Name (A4): R10/3810_099.dgn
20171208 11.40

3.1.2.3 Patch Size

Table 3.4 below details the parameters that determined the Patch Size score as per Table 15 of Appendix 4 of the FBA (OEH 2014b).

Table 3.4 Patch Size Score Parameters

Mitchell Landscape	Central Hunter Foothills
Percent Native Vegetation Cleared	75%
Patch Size Class	>1001
Patch Size Score	**12**

3.1.2.4 Landscape Value Score

The landscape value score for the Development Footprint is 21.60, as calculated by the BBCC.

3.2 Native Vegetation within the Development Footprint

3.2.1 Biometric Vegetation Types and Vegetation Zones

Surveys of the Development Footprint identified three Plant Community Types (PCTs) across 6 condition classes being:

- HU815 Spotted Gum – Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter
    - *Moderate to Good Condition*
    - *Moderate to Good Condition – Plantation*
    - *Moderate to Good Condition – Derived Native Grassland*
    - *Moderate to Good Condition – Derived Native Grassland – Olive Plantation*
- HU906 – Bull Oak Grassy Woodland of the Central Hunter Valley – Moderate to Good Condition
    - *Moderate to Good Condition*
- HU945 – Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley
    - *Moderate to Good Condition.*

These PCTs were aligned with types described as part of the VIS Classification Database (OEH 2017c). The PCTs were then categorised into six vegetation zones (refer to **Figure 3.2**). The composition of these vegetation zones is outlined in **Sections 3.2.1.1** to **3.2.1.6** below and a flora species list for all plots surveyed is included in **Appendix B**.

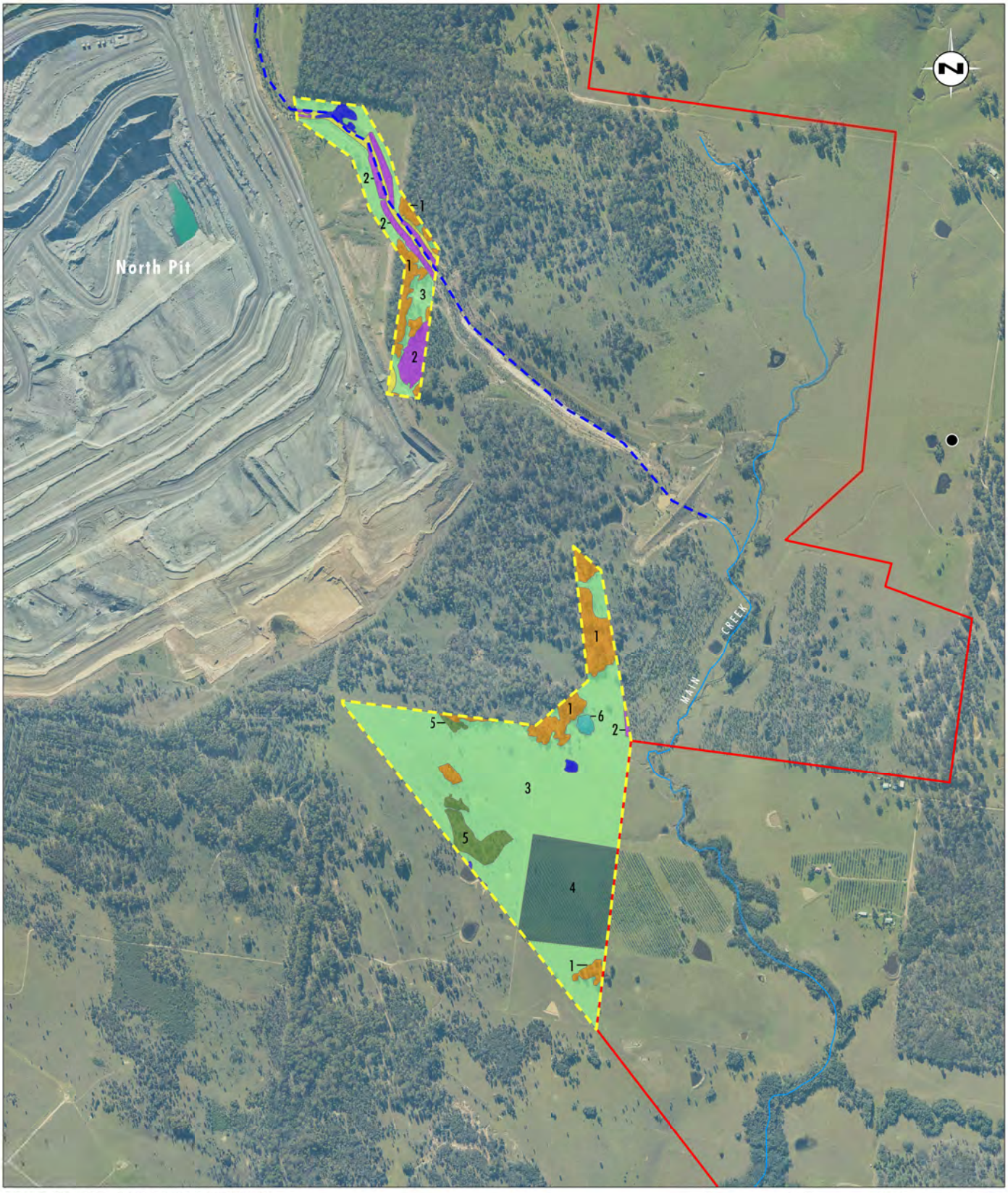

Image Source: Glencore (July 2017)
Data Source: Glencore (2017)

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Existing Bettys Creek Diversion

Vegetation Communites:

- Zone 1 - HU815/PCT1601 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter - Moderate to Good
- Zone 2 - HU815/PCT1601 - Moderate to Good - Plantation
- Zone 3 - HU815/PCT1601 - Moderate to Good - Derived Native Grassland
- Zone 4 - HU815/PCT1601 - Moderate to Good - Derived Native Grassland - Olive Plantation
- Zone 5 - HU906/PCT1692 Bull Oak grassy woodland of the central Hunter Valley - Moderate to Good
- Zone 6 - HU945/PCT1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley - Moderate to Good
- Dam
- Disturbed Land

FIGURE 3.2

Vegetation Zones in the Development Footprint

3.2.1.1 Zone 1 - HU815 - Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter– Moderate to Good Condition

PCT Name	Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	
Condition	Moderate to Good	
PCT Number	1601	
BVT Number	HU815	
Area (ha)	5.00	
Plots/Transects	Three (P01, P06 and P07)	
GHNVM Map Unit (Sivertsen *et. al* 2011)	MU083 - Spotted Gum; Narrow-leaved Ironbark; Red Ironbark Shrub; Grass Open Forest of the Central and Lower Hunter.	
HRVP Map Unit (Peake 2006)	MU 27 – Central Hunter Ironbark – Spotted Gum – Grey Box Forest	
General Description	This vegetation zone comprises woodland occupying the mid to lower slopes of the Development Footprint. In the northwest, this vegetation zone adjoins Ravensworth State Forest, while small remnant patches occur in the south.	
Canopy Description	This vegetation zone has a sparse canopy between 20-28 metres in height, dominated by spotted gum (*Corymbia maculata*), red ironbark (*Eucalyptus fibrosa*), grey box (*Eucalyptus moluccana*) and narrow-leaved ironbark (*Eucalyptus crebra*).	
Mid-storey Description	Generally, a small tree mid-storey is present, dominated by bull oak (*Allocasuarina luehmannii*). Regeneration of indicative canopy species is also often present.	
Shrub Layer Description	A very sparse shrub layer between 1 and 3 metres in height is present throughout this vegetation zone. Dominant species include blackthorn (*Bursaria spinosa*), hickory wattle (*Acacia implexa*), fan wattle (*Acacia amblygona*) and peach heath (*Lissanthe strigosa*).	
Ground Cover Description	This vegetation zone is characterised by a sparse ground layer less than 1.5 metres in height. Dominant grasses include red grass (*Bothriochloa macra*), barbed wire-grass (*Cymbopogon refractus*), purple wiregrass (*Aristida ramosa*) and hairy panic (*Panicum effusum*). Commonly recorded herbs include many-flowered mat-rush (*Lomandra multiflora*), blue flax-lily (*Dianella revoluta*), yellow burr-daisy (*Calotis lappulacea*), *Vittadinia sulcata*, Amulla (*Eremophila debilis*), forest nightshade (*Solanum prinophyllum*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*) and large tick-trefoil (*Desmodium brachypodum*).	
Introduced Species	Introduced species such as African olive (*Olea europaea* subsp. *cuspidata*), common prickly pear (*Opuntia stricta* var. *stricta*), scarlet pimpernel (*Lysimachia arvensis*), fireweed (*Senecio madagascariensis*), Cobblers pegs (*Bidens pilosa*), Paddys Lucerne (*Sida rhombifolia*) and black-berry nightshade (*Solanum nigrum*) are reasonably common within this vegetation zone.	

PCT Name	Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter
Condition	Moderate to Good
PCT Allocation	Vegetation Zone 1 was aligned with HU815 as it supports a high proportion of the characteristic species listed in the PCT description according to the VIS Classification Database (OEH 2017c). Of the 17 flora species listed on the database as characteristic for HU815, Vegetation Zone 1 supports 15 of them (88 per cent). This vegetation zone was also compared to the very similar spotted gum-dominated PCTs 1600 and 1601, however the number of characteristic species present is considerably lower with 11 (65 per cent) and 8 (53 per cent) species in common, respectively.
BC Act Status	This vegetation zone is consistent with the *Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* Endangered Ecological Community (EEC) listed under the BC Act. For further information, refer to **Section 3.2.3**.
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act. The contra-indicative species red ironbark (*Eucalyptus fibrosa*) is present at greater than 2 individuals per hectare on average across each patch and thus does meet the condition thresholds of the *Central Hunter Valley Eucalypt Forest and Woodland* Critically Endangered Ecological Community (CEEC).

3.2.1.2 Zone 2 - HU815 - Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter– Moderate to Good Condition – Plantation

PCT Name	Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	
Condition	Moderate to Good - Plantation	
PCT Number	1601	
BVT Number	HU815	
Area (ha)	2.19	
Plots/Transects	Two (P02 and P04)	
GHNVM Map Unit (Sivertsen *et. al* 2011)	MU083 - Spotted Gum; Narrow-leaved Ironbark; Red Ironbark shrub; grass open forest of the central and lower Hunter.	
HRVP Map Unit (Peake 2006)	MU 27 – Central Hunter Ironbark – Spotted Gum – Grey Box Forest	
General Description	This vegetation zone occurs on mid to lower slopes within the Development Footprint. In the north west, this vegetation zone has been planted as part of the Bettys Creek Diversion, while in the south this vegetation zone as been planted on the lower slopes adjacent to extant woodland of the same PCT.	
Canopy Description	This vegetation zone supports a uniform canopy 3-8 metres in height dominated by several eucalypt species. Dominant canopy species include spotted gum (*Corymbia maculata*), grey box (*Eucalyptus moluccana*), grey gum (*Eucalyptus punctata*), narrow-leaved ironbark (*Eucalyptus crebra*) and red ironbark (*Eucalyptus fibrosa*). Other tree species include swamp oak (*Casuarina glauca*), black she-oak (*Allocasuarina littoralis*) and prickly-leaved tea tree (*Melaleuca styphelioides*).	
Mid-storey Description	The mid-storey is sparse, comprising hickory wattle (*Acacia implexa*), green wattle (*Acacia irrorata*) and sickle wattle (*Acacia falcata*).	
Shrub Layer Description	The shrub layer is sparse, comprising fan wattle (*Acacia amblygona*), showy wattle (*Acacia decora*), notched bush-pea (*Pultenaea retusa*), spiny bush-pea (*Pultenaea spinosa*) and small-leaf bluebush (*Maireana microphylla*).	
Ground Cover Description	This vegetation zone is characterised by a very sparse ground layer less than 1 metre in height. Dominant grasses include weeping grass (*Microlaena stipoides*), red grass (*Bothriochloa macra*), barbed wiregrass (*Cymbopogon refractus*), purple wiregrass (*Aristida ramosa*), tall chloris (*Chloris ventricosa*) and couch (*Cynodon dactylon*). Commonly recorded herbs include many-flowered mat-rush (*Lomandra multiflora*), blue flax-lily (*Dianella revoluta*), kidney weed (*Dichondra repens*), yellow burr-daisy (*Calotis lappulacea*), blue trumpet (*Brunoniella australis*), whiteroot (*Pratia purpurascens*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*) and large tick-trefoil (*Desmodium brachypodum*).	

PCT Name	Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter
Condition	**Moderate to Good - Plantation**
Introduced Species	Several introduced species occur within this vegetation zone. Commonly recorded species include common prickly pear (*Opuntia stricta* var. *stricta*), scarlet pimpernel (*Lysimachia arvensis*), fireweed (*Senecio madagascariensis*), Cobblers pegs (*Bidens pilosa*), black-berry nightshade (*Solanum nigrum*), catsear (*Hypochaeris radicata*), Paddys Lucerne (*Sida rhombifolia*) and narrow-leaved cotton bush (*Gomphocarpus fruticosus*).
PCT Allocation	Vegetation Zone 2 was aligned with HU815 as it supports a high proportion of the characteristic species listed in the PCT description according to the VIS Classification Database (OEH 2017c). Of the 17 flora species listed on the database as characteristic for HU815, this vegetation Zone 2 supports 12 of these species (71 per cent).
BC Act Status	This vegetation zone is consistent with the *Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC listed under the BC Act. For further information, refer to **Section 3.2.3**.
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act. The contra-indicative species red ironbark (*Eucalyptus fibrosa*) is present at greater than 2 individuals per hectare on average across each patch and thus does meet the condition thresholds of the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC.

3.2.1.3 Zone 3 - HU815 - Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Derived Native Grassland - Moderate to Good Condition

PCT Name	Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter	
Condition	**Moderate to Good -Derived Native Grassland**	
PCT Number	1601	
BVT Number	HU815	
Area (ha)	29.30	
Plots/Transects	Four (P03, P08, P09 and P11)	
GHNVM Map Unit (Sivertsen *et. al* 2011)	MU083 - Spotted Gum; Narrow-leaved Ironbark; Red Ironbark shrub; grass open forest of the central and lower Hunter.	
HRVP Map Unit (Peake 2006)	MU 27 – Central Hunter Ironbark – Spotted Gum – Grey Box Forest	
General Description	This vegetation zone occurs primarily on the lower slopes within the Development Footprint. This vegetation zone is derived from adjacent areas of HU815.	
Canopy Description	Not present.	
Mid-storey Description	Not present.	
Shrub Layer Description	The shrub layer is very sparse to absent, limited to small-leaf bluebush (*Maireana microphylla*) and peach heath (*Lissanthe strigosa*).	
Ground Cover Description	This vegetation zone is characterised by a diverse, dense ground layer less than 1.5 metres in height. Dominant grasses include red grass (*Bothriochloa macra*), barbed wire-grass (*Cymbopogon refractus*), purple wiregrass (*Aristida ramosa*) and slender rats tail grass (*Sporobolus creber*). Less common grasses include *Enteropogon acicularis*, couch (*Cynodon dactylon*), tall chloris (*Chloris ventricosa*), paddock lovegrass (*Eragrostis leptostachya*), Browns lovegrass (*Eragrostis brownii*) and hairy panic (*Panicum effusum).* Commonly recorded herbs include many-flowered mat-rush (*Lomandra multiflora*), common everlasting (*Chrysocephalum apiculatum*), whiteroot (*Pratia purpurascens*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*) and common fringe-sedge (*Fimbristylis dichotoma*).	
Introduced Species	Common introduced species include annual trampweed (*Facelis retusa*), onion grass (*Romulea rosea*), french flax (*Linum trigynum*), scarlet pimpernel (*Lysimachia arvensis*), catsear (*Hypochaeris radicata*) and bindyi (*Soliva sessilis*).	

PCT Name	Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter
Condition	Moderate to Good -Derived Native Grassland
PCT Allocation	Vegetation Zone 3 was aligned with HU815 as it supports a high proportion of the characteristic species listed in the PCT description according to the VIS Classification Database (OEH 2017c). Of the 17 flora species listed on the database as characteristic for HU815, this vegetation Zone supports 10 of these species (59 per cent). Historically, this vegetation zone would have had a woodland structure characteristic of the adjacent HU815.
BC Act Status	This vegetation zone is not consistent with any TEC listed under the BC Act.
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.

3.2.1.4 Zone 4 - HU815 – Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter - Derived Native Grassland - Moderate to Good Condition - Olive Plantation

PCT Name	Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter
Condition	Moderate to Good - Derived Native Grassland Olive Plantation
PCT Number	1601
BVT Number	HU815
Area (ha)	6.81
Plots/Transects	Three (P12, P13 and P14)
GHNVM Map Unit (Sivertsen *et. al* 2011)	MU083 - Spotted Gum; Narrow-leaved Ironbark; Red Ironbark shrub; grass open forest of the central and lower Hunter.
HRVP Map Unit (Peake 2006)	MU 27 – Central Hunter Ironbark – Spotted Gum – Grey Box Forest
General Description	This vegetation zone is confined to a square portion in the south-east of the Development Footprint. This vegetation zone represents an olive grove with a predominantly native understorey consistent with adjoining derived native grasslands. Historically, this vegetation zone would have had a woodland structure characteristic of HU815.
Canopy Description	This vegetation zone is characterised by a canopy of planted rows of the exotic African olive (*Olea europaea* subsp. *cuspidata*).
Mid-storey Description	Not present.
Shrub Layer Description	Not present.
Ground Cover Description	This vegetation zone is characterised by a diverse, predominantly native ground layer less than 1.5 metres in height. Dominant grasses include weeping grass (*Microlaena stipoides*), slender rats tail grass (*Sporobolus creber*), barbed wire-grass (*Cymbopogon refractus*), purple wiregrass (*Aristida ramosa*) and couch (*Cynodon dactylon*). Other less common grasses include slender nineawn (*Enneapogon gracilis*), *Enteropogon acicularis,* windmill grass (*Chloris truncata*), speargrass (*Austrostipa scabra*) and hairy panic (*Panicum effusum*). Commonly recorded herbs include poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), native geranium (*Geranium solanderi*) and common fringe-sedge (*Fimbristylis dichotoma*).
Introduced Species	Common introduced species include grasses such as carpet grass (*Axonopus fissifolius*), shivery grass (*Briza minor*), red natal grass (*Melinis repens*), *Setaria parviflora* and paspalum (*Paspalum dilatatum*), as well as herbs such as annual trampweed (*Facelis retusa*), onion grass (*Romulea rosea*), fireweed (*Senecio madagascariensis*), Paddys Lucerne (*Sida rhombifolia*), scarlet pimpernel (*Lysimachia arvensis*), plantain (*Plantago lanceolata*), catsear (*Hypochaeris radicata*) and hop clover (*Trifolium campestre*).

PCT Name	Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter
Condition	Moderate to Good - Derived Native Grassland Olive Plantation
PCT Allocation	Vegetation Zone 4 was aligned with HU815 as it supports some of characteristic species listed in the PCT description according to the VIS Classification Database (OEH 2017c) and occurs in the same landscape position as surrounding intact woodland areas of this PCT. Of the 17 flora species listed on the database as characteristic for HU815, Vegetation Zone 4 supports 4 of them (24 per cent). Management regimes associated with this vegetation zone being an olive plantation have influenced the number of native groundcover species present.
BC Act Status	This vegetation zone is not consistent with any TEC listed under the BC Act.
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.

3.2.1.5 Zone 5 - HU906 – Bull Oak grassy woodland of the central Hunter Valley– Moderate to Good Condition

PCT Name	Bull Oak grassy woodland of the central Hunter Valley	
Condition	Moderate to Good	
PCT Number	1692	
BVT Number	HU906	
Area (ha)	1.45	
Plots/Transects	One (P05)	
GHNVM Map Unit (Sivertsen *et. al* 2011)	MU174 - Bulloak Grassy Woodland of the Central Hunter Valley.	
HRVP Map Unit (Peake 2006)	MU32 – Central Hunter Bulloak Forest Regeneration.	
General Description	This vegetation zone is confined to two small patches in the southern portion of the Development Footprint. This vegetation zone is characterised by dense bull oak (*Allocasuarina luehmannii*) regrowth with a reasonably depauperate understorey.	
Canopy Description	This vegetation zone supported a sparse to mid-dense canopy dominated by regrowth bull oak (*Allocasuarina luehmannii*) between 10 to 12 metres high.	
Mid-storey Description	The mid-storey is largely absent with the exception of sporadic young bulloak (*Allocasuarina luehmannii*) 3-8 metres high.	
Shrub Layer Description	The shrub layer is very sparse, limited to sporadically occurring blackthorn (*Bursaria spinosa*), fan wattle (*Acacia amblygona*), gorse bitter pea (*Daviesia ulicifolia*) and peach heath (*Lissanthe strigosa*).	
Ground Cover Description	This vegetation zone is characterised by a sparse ground layer up to 1 metre in height. Dominant grasses include red grass (*Bothriochloa macra),* barbed wire-grass (*Cymbopogon refractus*) and purple wiregrass (*Aristida ramosa*). Commonly recorded herbs include many-flowered mat-rush (*Lomandra multiflora*), wattle mat-rush (*Lomandra filiformis*), common fringe-sedge (*Fimbristylis dichotoma*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), common everlasting (*Chrysocephalum apiculatum*), slender wire lily (*Laxmannia gracilis*) and yellow burr-daisy (*Calotis lappulacea*).	
Introduced Species	The introduced species, fireweed (*Senecio madagascariensis*), common sowthistle (*Sonchus oleraceus*), Cobblers pegs (*Bidens pilosa*) and French flax (*Linum trigynum*) were recorded in low abundance in this vegetation zone.	
PCT Allocation	Vegetation Zone 5 was aligned with HU906 as it supports a high proportion of the characteristic species listed in the PCT description according to the VIS Classification Database (OEH 2017c). Of the 9 flora species listed on the database as characteristic for HU906, Vegetation Zone 5 supports 6 of them (67 per cent).	
BC Act Status	Not consistent with any listed TEC under the BC Act.	

PCT Name	Bull Oak grassy woodland of the central Hunter Valley
Condition	Moderate to Good
EPBC Act Status	Not consistent with any listed TEC under the EPBC Act. This vegetation zone is not consistent with *Central Hunter Valley Eucalypt Forest and Woodland* CEEC under the EPBC Act given that it is dominated by dense bull oak (*Allocasuarina luehmannii*) regrowth with the contra-indicative species red ironbark (*Eucalyptus fibrosa*) present at greater than 2 individuals per hectare as part of the same patch.

3.2.1.6 Zone 6 - HU945 – Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley – Moderate to Good Condition

PCT Name	Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley
Condition	Moderate to Good
PCT Number	1731
Area (ha)	0.20
Plots/Transects	One (P10)
GHNVM Map Unit (Sivertsen *et. al* 2011)	MU213 Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley.
HRVP Map Unit (Peake 2006)	MU28 – Central Hunter Swamp Oak Forest.
General Description	This vegetation zone occurs as a small patch adjoining a patch of HU906 in the southern portion of the Development Footprint. It occupies the lower slopes along a minor drainage channel.
Tree Canopy Description	This vegetation zone supports a mid-dense canopy dominated by swamp oak (*Casuarina glauca*), with scattered occurrences of bulloak (*Allocasuarina luehmannii*). Height of the canopy ranges from 12 to 25 metres.
Mid-storey Description	Sparse midstorey is dominated by young swamp oak (*Casuarina glauca*) 3 to 10 metres high.
Shrub Layer Description	The shrub layer is very sparse, limited to sporadic occurrences of fan wattle (*Acacia amblygona*), gorse bitter pea (*Daviesia ulicifolia*) and peach heath (*Lissanthe strigosa*).
Ground Cover Description	This vegetation zone is characterised by a dense ground layer less than 1 metre in height. Dominant grass species include weeping grass (*Microlaena stipoides*), barbed wire grass (*Cymbopogon refractus*), red grass (*Bothriochloa macra*), hairy panic (*Panicum effusum*) and purple wiregrass (*Aristida ramosa*). Common herbs in the ground layer include many-flowered mat-rush (*Lomandra multiflora*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), whiteroot (*Pratia purpurascens*) and slender wire lily (*Laxmannia gracilis*).
Introduced Species	The following introduced species occur at low abundance in this vegetation zone, including Cobblers pegs (*Bidens pilosa*), common sowthistle (*Sonchus oleraceus*), French flax (*Linum trigynum*) and fireweed (*Senecio madagascariensis*).
PCT Allocation	Vegetation Zone 6 was aligned with HU945 given the dominance of swamp oak (*Casuarina glauca*) and several characteristic understorey species associated with the PCT (OEH 2017c). Of the 9 flora species listed on the database as characteristic for HU945, Vegetation Zone 6 supports 3 of them (33 per cent).
BC Act Status	This community was compared to the *Swamp Oak Floodplain Forest of the NSW North Coast Sydney Basin and South East Corner Bioregions* EEC listed under the BC Act, however it was found not to conform to the scientific determination. For further information refer to **Section 3.2.3**.

PCT Name	Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley
Condition	Moderate to Good
EPBC Act Status	The single small patch of Swamp Oak Forest was compared to the Conservation Advice for *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland*, proposed EEC under the EPBC Act. This patch is below the minimum patch size detailed in the Conservation Advice (TSSC 2018) and therefore does not meet the condition thresholds of this proposed EEC.

3.2.1.7 Disturbed Land and Dams

All other areas not mapped as part of a vegetation zone satisfied the definition of 'cleared land'. Cleared Land does not meet the definition of 'native vegetation' under the *Native Vegetation Act 2003* and therefore could not be aligned with a PCT or vegetation zone and is excluded from further assessment as per Section 9.5 of the FBA (OEH 2014b). Cleared land is land on which the native overstorey has been completely removed and there is no native mid-storey, and less than 50 per cent of the ground cover vegetation is indigenous species, or less than 10 per cent of the ground cover is present (whether dead or alive).

3.2.2 Current Site Value

Table 3.5 below details the current site value scores for each of the vegetation zones in the Development Footprint. The raw site condition attribute data for each of the vegetation zones is provided in **Appendix C**.

Table 3.5 Vegetation Zone Site Value Scores

Veg Zone	PCT Name	Current Site Value Score
1	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good*	75.17
2	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good - Plantation*	49.48
3	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good - Derived Native Grassland*	19.27
4	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good - Derived Native Grassland Olive Plantation*	8.33
5	PCT1692/HU906 Bull Oak Grassy Woodland of the Central Hunter Valley *Moderate to Good*	53.47
6	PCT1731/HU945 Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley *Moderate to Good*	71.78

3.2.3 Threatened Ecological Communities

One threatened ecological community was recorded in the Development Footprint (refer to **Figure 3.3**), being:

- *Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC listed under the BC Act

The following threatened ecological communities had the potential to occur in the Development Footprint, however were ruled out based on a lack of diagnostic features and conformance to descriptions outlined in NSW Scientific Committee and/or the Commonwealth Threatened Species Scientific Committee guidelines for interpreting listings for species, populations and ecological communities under the BC Act and EPBC Act:

- *Swamp Oak Floodplain Forest of the NSW North Coast Sydney Basin and South East Corner Bioregions EEC* listed under the BC Act

- *Central Hunter Valley Eucalypt Forest and Woodland CEEC* listed under the EPBC Act

Detailed analysis of the vegetation zones with respect to the NSW Scientific Committee and/or the Commonwealth Threatened Species Scientific Committee determinations is provided in below in **Section 3.2.3.1** and **3.2.3.2**.

3.2.3.1 *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregion EEC* under the BC Act

Zone 1 HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good Condition and Zone 2 HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good Condition – Plantation are considered to conform to the *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC*. These two vegetation zones conform with the Final Determination of *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC (NSW Scientific Committee 2011a) with regard to the following attributes:

<u>Zone 1 HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good Condition</u>

- this vegetation zone occurs on Permian sediments within the NSW Sydney Basin Bioregion

- this vegetation zone occurs in the Singleton Local Government Areas (LGA) where this EEC has previously been recorded

- this vegetation zone supports a canopy dominated by the characteristic species spotted gum (*Corymbia maculata*), red ironbark (*Eucalyptus fibrosa*), grey box (*Eucalyptus moluccana*) and narrow-leaved ironbark (*Eucalyptus crebra*)

- this vegetation zone supports a reasonable proportion of species that are in the list of characteristic species for the EEC:

    - 25 out of 57 (44 per cent) native species recorded in this unit are characteristic species in the EEC listing and
    - 25 out of 44 (57 per cent) species in the characteristic species list for the EEC were recorded in this unit.

Zone 2 HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good Condition – Plantation

- this vegetation zone occurs on Permian sediments within the NSW Sydney Basin Bioregion
- this vegetation zone occurs in the Singleton Local Government Areas (LGA) where this EEC has previously been recorded
- this vegetation zone supports a canopy dominated by the characteristic species spotted gum (*Corymbia maculata*), grey box (*Eucalyptus moluccana*), narrow-leaved ironbark (*Eucalyptus crebra*) and red ironbark (*Eucalyptus fibrosa*)
- this vegetation zone supports a reasonable proportion of species that are in the list of characteristic species for the EEC in each structural layer:
    - 20 out of 56 (36 per cent) native species recorded in this unit are characteristic species in the EEC listing and
    - 20 out of 44 (45 per cent) species in the characteristic species list for the EEC were recorded in this unit.

3.2.3.2 Analysis of Occurrence of Other Threatened Ecological Communities

***Central Hunter Valley Eucalypt Forest and Woodland CEEC* under the EPBC Act**

Central Hunter Valley Eucalypt Forest and Woodland CEEC occurs in the Hunter Valley region on soils derived from Permian sedimentary bedrock (TSSC 2015). Typically it is characterised as a eucalypt woodland and open forest, with a shrub layer of variable density and/or a grassy ground layer. Across its range, one or more of a complex of four eucalypt tree species, namely spotted gum (*Corymbia maculata*), narrow-leaved ironbark (*Eucalyptus crebra*), slaty gum (*Eucalyptus dawsonii*) or grey box (*Eucalyptus moluccana*) dominate the canopy (TSSC 2015).

Targeted surveys to map *Central Hunter Valley Eucalypt Forest and Woodland CEEC* were undertaken in July and October 2017 in accordance with the sampling protocols and with consideration to the key diagnostic characteristics and condition thresholds provided within the Approved Conservation Advice (TSSC 2015). These 'key diagnostic characteristics' and 'condition thresholds' provided by the Approved Conservation Advice formed the basis for delineating and identifying patches of native vegetation as being the threatened ecological community and distinguishing between patches of different quality.

The results of the assessment for vegetation patches within the Development Footprint against the key diagnostic characteristics according to the Approved Conservation Advice are detailed in **Table 3.6** below.

Table 3.6 Assessment of Vegetation Patches within the Development Footprint against the Key Diagnostic Features according to the Approved Conservation Advice (TSSC 2015)

Key Diagnostic Characteristic as per Approved Conservation Advice (TSSC 2015)	Vegetation patches within the Proposed Modification Disturbance Area
It occurs in the Hunter River catchment (typically called the Hunter Valley region)	Yes – the Development Footprint occurs within the Hunter River catchment.
It typically occurs on lower hillslopes and low ridges, or valley floors in undulating country; on soils derived from Permian sedimentary rocks	Yes – the Development Footprint is underlain by Permian derived soils on low hills of the valley floor.
It does not occur on alluvial flats, river terraces, Aeolian sands, Triassic sediments or escarpments	Yes – the Development Footprint does not occur on alluvial flats, river terraces, Aeolian sands, Triassic sediments or escarpments.
It is woodland or forest, with a projected canopy cover of trees of 10 per cent or more; or with a native tree density of at least 10 native tree stems per 0.5 ha (at least 20 native tree stems/ha) that are at least one metre in height	Yes – vegetation patches within the Development Footprint comprise a projected canopy of cover at least 10 per cent with a native tree density of at least 10 native tree stems per 0.5 ha that are at least one metre in height.
The canopy of the ecological community is dominated by one or more of the following four eucalypt species: *Eucalyptus crebra* (narrow-leaved ironbark), *Corymbia maculata* (syn. *E. maculata*) (spotted gum), *E. dawsonii* (slaty gum) and *E. moluccana* (grey box); OR a fifth species, *Allocasuarina luehmannii* (bulloak, buloke) dominates in combination with one or more of the above four eucalypt species, in sites previously dominated by one or more of the above four eucalypt species	Yes – Most vegetation patches of forest/woodland within the Development Footprint comprise a canopy dominated by spotted gum (*Corymbia maculata*), narrow-leaved ironbark (*Eucalyptus crebra*), and grey box (*Eucalyptus moluccana)* in combination with a sparse small tree layer of bull oak (*Allocasuarina luehmannii*). However, there are three areas within the Development Footprint that do not contain any of the four characteristic eucalypt species and hence do not align with the CEEC. Specifically, two of these areas are solely dominated by bulloak (*Allocasuarina luehmannii*) and the other is dominated solely by swamp oak (*Casuarina glauca*). The two areas dominated by bulloak are not consistent with *Central Hunter Valley Eucalypt Forest and Woodland* CEEC given that they are dominated by dense bull oak (*Allocasuarina luehmannii*) regrowth with the contra-indicative species red ironbark (*Eucalyptus fibrosa*) present at greater than 2 individuals per hectare within the same patch.
Allocasuarina torulosa (forest oak/ she-oak, rose she-oak/oak), *Eucalyptus acmenoides* (white mahogany) and *Eucalyptus fibrosa* (red/broad-leaved ironbark) are largely absent from the canopy of a patch. Largely absent: meaning no more than two trees per hectare on average across a patch.	**No** – Vegetation patches within the Development Footprint (except one small patch) contain a high abundance of red ironbark (*Eucalyptus fibrosa*). Specifically, there were more than two red ironbark (*Eucalyptus fibrosa)* trees per hectare on average across each patch. The exception is for one patch, dominated by spotted gum (*Corymbia maculata*), in which red ironbark (*Eucalyptus fibrosa*) is absent. However, this patch was not found to align with the CEEC as it was less than the minimum patch size of 0.5 ha, as per the condition thresholds from the Approved Conservation Advice (TSSC 2015).
A ground layer is present (although it may vary in development and composition), as a sparse to thick layer of native grasses and other native herbs and/or native shrubs	Yes – All vegetation patches within the Development Footprint have a sparse to dense ground layer dominated by native grasses and other native herbs and/or native shrubs.

For the single patch where red ironbark (*Eucalyptus fibrosa*) was absent and all other key diagnostic characteristics were met, the patch was then assessed against the condition thresholds from the Approved Conservation Advice (TSSC 2015). This patch was determined not to meet the condition thresholds as it is less than the minimum 0.5 ha patch size.

The two areas dominated by bulloak are not consistent with Central *Hunter Valley Eucalypt Forest and Woodland* CEEC given that they are dominated by dense bull oak (*Allocasuarina luehmannii*) regrowth with the contra-indicative species red ironbark (*Eucalyptus fibrosa*) present at greater than 2 individuals per hectare within the same patch.

***Swamp Oak Floodplain Forest of the NSW North Coast Sydney Basin and South East Corner Bioregions EEC* under the BC Act**

Vegetation Zone 6 HU945 – Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley present in the Development Footprint does not conform to the *Swamp Oak Floodplain Forest of the NSW North Coast Sydney Basin and South East Corner Bioregions* EEC. Although the particular area of the EEC, and some of the supplementary descriptors, presented in the Final Determination are inclusive of the EEC's presence (NSW Scientific Committee 2011b), the EEC can be ruled out on the following points:

a) partly based on the clear intent of the Scientific Committee in limiting the EEC's occurrence to 'rarely above 10 metres elevation'. Vegetation Zone 6 HU945 – Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley occurs at an approximate elevation of 100 metres in the development footprint; and

b) firmly based on the very restricted number of species listed in the Final Determination that are present in the Development Footprint. The only species recorded from the Final Determination is swamp oak (*Casuarina glauca*).

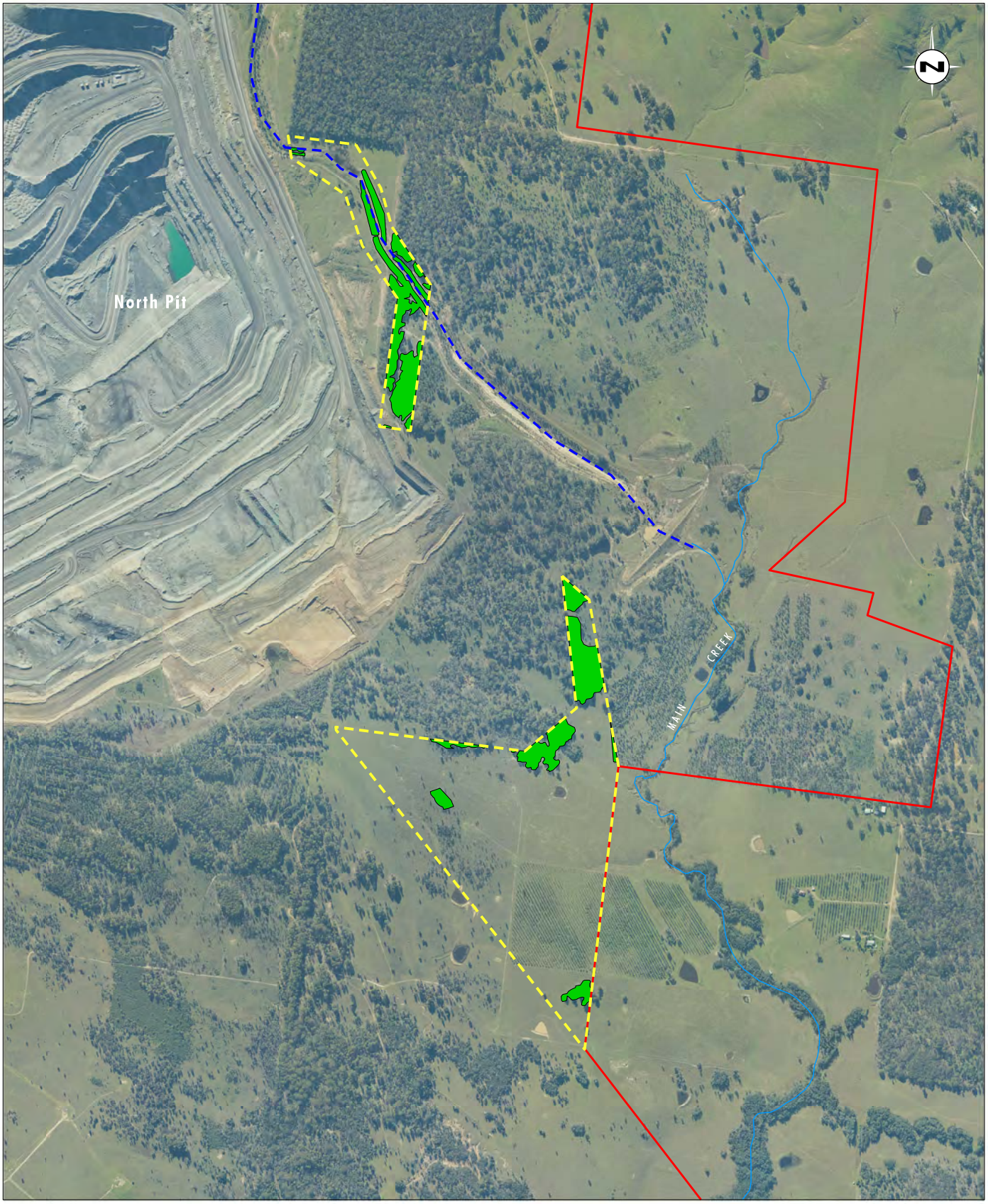

Image Source: Glencore (July 2017)
Data Source: Glencore (2017), BioNet (2017)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- *Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC* listed under the BC Act
- Existing Bettys Creek Diversion

FIGURE 3.3

Threatened Ecological Communities in the Development Footprint

3.3 Threatened Species within the Development Footprint

3.3.1 Ecosystem-credit Species

3.3.1.1 Predicted Species

Table 3.7 below outlines the predicted ecosystem-credit species predicted to occur by the BioBanking Credit Calculator and whether they were recorded within the Development Footprint during the surveys undertaken for this assessment, Atlas of NSW Wildlife records or previous surveys (as shown on **Figure 3.4**).

Table 3.7 Predicted Ecosystem-credit Species

Species Name	BC Act	EPBC Act	Threatened Species Offset Multiplier	Previously Recorded	
				Development Footprint	Mount Owen Complex
barking owl *Ninox connivens*	V	-	3.0	No	No
black-chinned honeyeater *Melithreptus gularis* subsp. *gularis*	V	-	1.3	No	Yes
brown treecreeper *Climacteris picumnus* subsp. *victoriae*	V	-	2.0	No	Yes
bush stone curlew *Burhinus grallarius*	E	-	2.6	No	No
diamond firetail *Stagonopleura guttata*	V	-	1.3	No	Yes
eastern false pipistrelle *Falsistrellus tasmaniensis*	V	-	2.2	No	No
east coast freetail-bat *Mormopterus norfolkensis*	V	-	2.2	Yes	Yes
eastern grass owl *Tyto longimembris*	V	-	1.3	No	No
flame robin *Petroica phoenicea*	V	-	1.3	No	Yes
gang-gang cockatoo *Callocephalon fimbriatum*	V	-	2.0	No	No
glossy black-cockatoo *Calyptorhynchus lathami*	V	-	1.8	No	No
greater broad-nosed bat *Scoteanax rueppellii*	V	-	2.2	No	Yes
grey-crowned babbler *Pomatostomus temporalis* subsp. *temporalis*	V	-	1.3	Yes	Yes
hooded robin *Melanodryas cucullata* subsp. *cucullata*	V	-	1.7	No	Yes
little eagle *Hieraaetus morphnoides*	V	-	1.4	No	Yes

Species Name	BC Act	EPBC Act	Threatened Species Offset Multiplier	Previously Recorded	
				Development Footprint	Mount Owen Complex
little lorikeet *Glossopsitta pusilla*	V	-	1.8	No	Yes
masked owl *Tyto novaehollandiae*	V	-	3.0	No	Yes
painted honeyeater *Grantiella picta*	V	V	1.3	No	No
powerful owl Ninox strenua	V	-	3.0	No	Yes
scarlet robin *Petroica boodang*	V	-	1.3	No	Yes
speckled warbler *Chthonicola sagittata*	V	-	2.6	No	Yes
spotted harrier *Circus assimilis*	V	-	1.4	No	Yes
spotted-tailed quoll *Dasyurus maculatus*	V	E	2.6	No	Yes
square-tailed kite *Lophoictinia isura*	V	-	1.4	No	No
swift parrot *Lathamus discolor*	E	CE	1.3	No	Yes
turquoise parrot *Neophema pulchella*	V	-	1.8	No	No
varied sittella *Daphoenositta chrysoptera*	V	-	1.3	No	Yes
yellow-bellied glider *Petaurus australis*	V	-	2.3	No	No
yellow-bellied sheathtail-bat *Saccolaimus flaviventris*	V	-	2.2	No	Yes

Other ecosystem-credits species that have been recorded in the Development Footprint (that were not predicted by the BBCC) include:

- squirrel glider (*Petaurus norfolcensis*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

Other ecosystem-credits species that have been recorded in the wider Mount Owen Complex (that were not predicted by the BBCC) include:

- dusky woodswallow (*Artamus cyanopterus*)
- New Holland mouse (*Pseudomys novaehollandiae*)
- little bentwing-bat (*Miniopterus australis*).

3.3.1.2 Survey Results

Four ecosystem-credit species were recorded in the Development Footprint during the surveys undertaken for this assessment (refer to **Figure 3.4**). These include:

- grey-crowned babbler (*Pomatostomus temporalis temporalis*)
- squirrel glider (*Petaurus norfolcensis*)
- east coast freetail bat (*Mormopterus norfolkensis*) – foraging habitat only
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) – foraging habitat only.

Other ecosystem-credit species records that have been previously recorded within the Mount Owen Complex are outlined in **Table 3.7** and shown in **Figure 3.4**.

A full fauna species list from the surveys undertaken is included in **Appendix D**.

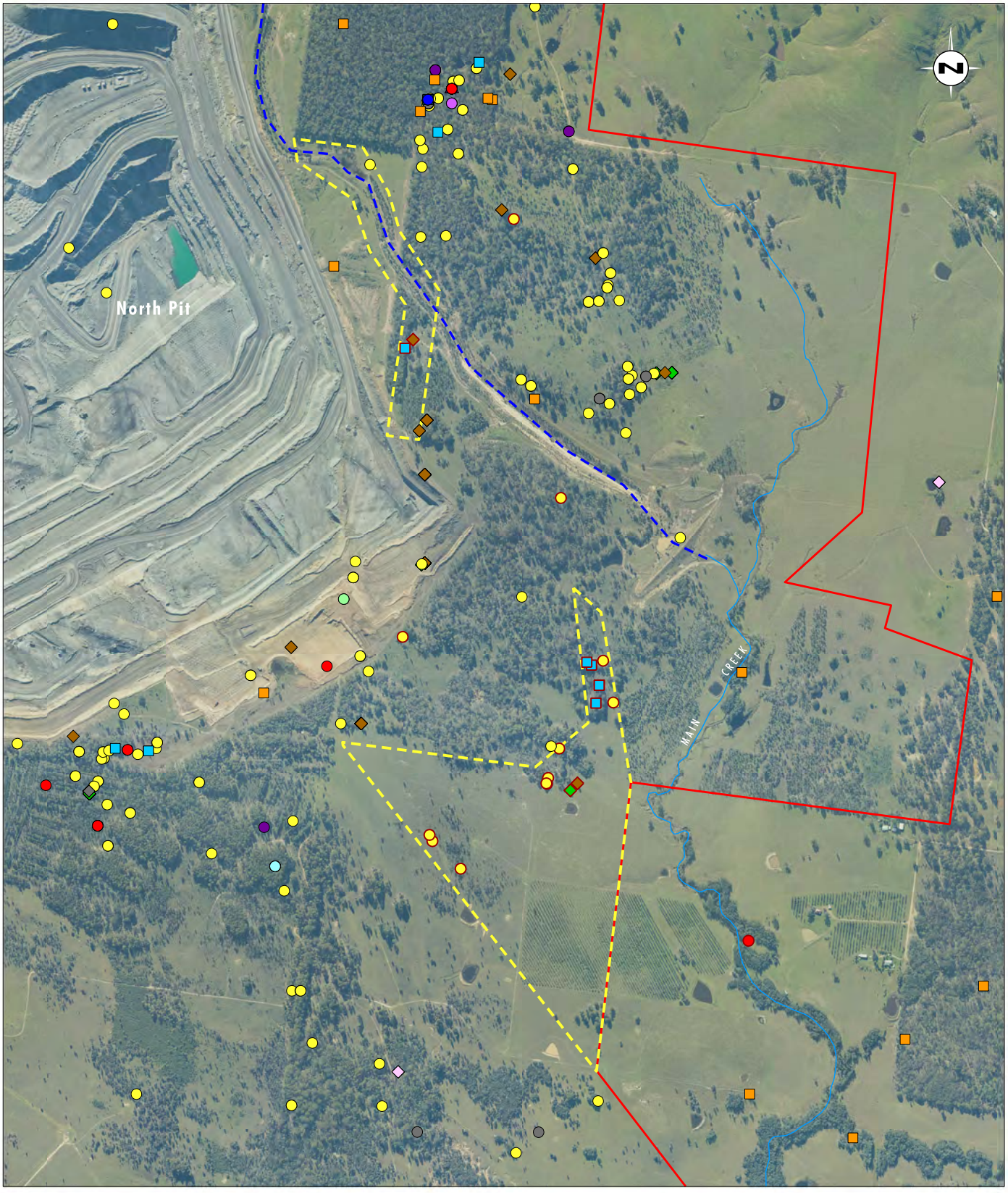

Image Source: Glencore (July 2017)
Data Source: Glencore (2017), BioNet (2017)

0 250 500 750m
1:15 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- Existing Bettys Creek Diversion
- Drainage Line

Recorded as Part of Current Assessment:

- East-coast Freetail-bat
- Eastern Bentwing-bat
- Grey-crowned Babbler
- Speckled Warbler
- Squirrel Glider

Previous Records (including NSW Wildlife Atlas):

- Black-chinned Honeyeater
- Brown Treecreeper
- Diamond Firetail
- East-coast Freetail-bat
- Eastern Bentwing-bat (Foraging Record)
- Grey-crowned Babbler
- Hooded Robin
- Large-eared Pied bat (Foraging Record)
- Little Lorikeet
- Masked Owl
- Southern Myotis (Foraging Record)
- Speckled Warbler
- Spotted-tailed Quoll
- Spotted Harrier
- Squirrel Glider
- Swift Parrot
- Varied Sittella
- Yellow-bellied Sheathtail-bat

FIGURE 3.4

Fauna Ecosystem Credit Species

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20180416 11.33

3.3.2 Species-credit Species

3.3.2.1 Predicted Species-Credit Species

Table 3.8 below outlines the species-credit species predicted to occur by the BBCC or identified from database searches/literature reviews and whether they are considered to occur in the Development Footprint. Record information is derived from the BioNet Atlas of NSW Wildlife (OEH 2017a), unless otherwise noted.

Table 3.8 Predicted Species-credit Species

Species Name	Impacted by the Proposed Modification^	Justification for Impact
Austral toadflax *Thesium australe*	No	This species was not recorded within the Development Footprint despite extensive flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. The closest records of this species occur over 35km to the west of the Development Footprint near Denman. It is highly unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
netted bottle brush *Callistemon linearifolius*	No	This species was not recorded within the Development Footprint despite extensive flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. The closest record of this species occurs over 30km to the south of the Development Footprint near Broke. This species will not be impacted by the Proposed Modification and no species credits have been generated for this species.
Illawarra greenhood *Pterostylis gibbosa*	No	This species was not recorded within the Development Footprint despite extensive flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. This is species is known from a small number of populations in the Hunter region in open forest or woodland, on flat or gently sloping land. The closest record occurs approximately 30km south of the Development Footprint near Milbrodale. It is highly unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
Ozothamnus tesselatus	No	This species was not recorded within the Development Footprint despite extensive flora transects in the known detection period for the species (refer to **Table 2.2**). The species has been previously recorded during surveys undertaken within Ravensworth State Forest immediately north of the Development Footprint (Cole 2004), however this relatively detectable species has not been found in the Development Footprint. It is unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.

Species Name	Impacted by the Proposed Modification^	Justification for Impact
pine donkey orchid *Diuris tricolor*	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). It is noted that 2017 was a dry year and according to reference populations near Wybong this species had a poor flowering season. However, this species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. The closest record occurs approximately 15 km northwest of the Development Footprint near Muscle Creek. It is unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
Pterostylis chaetophora	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. It is understood that the most westerly records of this species occur near North Rothbury approximately 30 km southeast of the Development Footprint. It is unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
scant pomaderris *Pomaderris queenslandica*	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. The closest records of this species occur approximately 40 km west of the Development Footprint around Denman. It is highly unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
Singleton mint bush *Prostanthera cineolifera*	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. The species is restricted to a few localities around Walcha, Scone, Cessnock and St Albans. The closest record of this species occurs approximately 30 km to the south near Pokolbin State Forest and the Singleton Military Area. This species will not be impacted by the Proposed Modification and no species credits have been generated for this species.

Species Name	Impacted by the Proposed Modification^	Justification for Impact
slaty red gum *Eucalyptus glaucina*	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). One specimen was recorded in 1998 in the current mining area, which has subsequently been removed. During surveys in 2016 a possible record of this species was made over a kilometre to the east of the Development Footprint. The NSW herbarium could not make a definitive identification in the absence of budding material. Despite this, no other potential specimens were found to occur in the Development Footprint. It is unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
small snake orchid *Diuris pedunculata*	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. The closest record occurs approximately 35 km north of the Development Footprint near Scone. It is unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
small-flower grevillea *Grevillea parviflora* subsp. *parviflora*	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. The closest record occurs approximately 40 km south of the Development Footprint near Cessnock. This species will not be impacted by the Proposed Modification and no species credits have been generated for this species.
tall knotweed *Persicaria elatior*	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. The closest record occurs approximately 60 km southeast of the Development Footprint near Seaham. This species will not be impacted by the Proposed Modification and no species credits have been generated for this species.
Weeping Myall population in the Hunter catchment	No	This population was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). Weeping myall individuals are known to occur in rehabilitation areas to the west of the Development Footprint on Glencore-owned land. Despite this, no individuals have been recorded in the Development Footprint. This species will not be impacted by the Proposed Modification and no species credits have been generated for this species.

Species Name	Impacted by the Proposed Modification^	Justification for Impact
white-flowered wax plant ***Cynanchum elegans***	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). Furthermore, the species has not been recorded in the wider locality despite extensive survey effort across multiple seasons and years. The closest record occurs approximately 30 km south of the Development Footprint near Broke. This species will not be impacted by the Proposed Modification and no species credits have been generated for this species.
Cymbidium canaliculatum **population in the Hunter Catchment**	No	This population was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer **to Table 2.2**). *Cymbidium canaliculatum* is known to occur to the south-west of the Development Footprint on Glencore-owned land. Despite this, no individuals have been recorded in the Development Footprint. This species will not be impacted by the Proposed Modification and no species credits have been generated for this species.
Eucalyptus camaldulensis **population in the Hunter catchment**	No	This population was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). *Eucalyptus camaldulensis* is known to occur to the west of the Development Footprint along Swamp Creek on Glencore-owned land along. Despite this, no individuals have been recorded in the Development Footprint. This species will not be impacted by the Proposed Modification and no species credits have been generated for this species.
Prasophyllum **sp. Wybong**	No	This species was not recorded within the Development Footprint despite extensive and repeated flora transects in the known detection period for the species (refer to **Table 2.2**). It is noted that 2017 was a dry year and according to reference populations near Wybong this species had a poor flowering season. *Prasophyllum* sp. Wybong is found further to the west of the Development Footprint with the closest known records occurring near Muswellbrook. According to the NSW Atlas of Wildlife the closest record of *Prasophyllum* sp. Wybong is approximately 40 kilometres to the west of the Development Footprint. This species will not be impacted by the Proposed Modification and no species credits have been generated for this species.
brush-tailed phascogale ***Phascogale tapoatafa***	**Yes**	This species was recorded on remote cameras utilising the woodland habitats of the Development Footprint. Furthermore, this species was also recorded during the surveys undertaken for the UHSA through the use of remote cameras west of the Mount Owen mine near Hebden Road and Lake Liddell. The species has also been previously recorded in Ravensworth State Forest (Forest Fauna Surveys 2017). It is likely that all of the eucalypt woodland and forest communities in the Development Footprint provide suitable habitat for the species. Species credits have been generated for this species in relation to 8.8 hectares of suitable eucalypt woodland and forest habitat in the Development Footprint.

Species Name	Impacted by the Proposed Modification^	Justification for Impact
eastern pygmy-possum ***Cercartetus nanus***	No	This species has been recorded in intact habitats in Wollemi National Park and historically near Mount Royal National Park. The closest record occurs approximately 15 km northeast of the Development Footprint in Mount Royal National Park. While suitable habitat for the species occurs within the Development Footprint, this species was not recorded within this area despite extensive and repeated surveys in suitable habitat and in the known detection period for the species (refer to **Table 2.3**). There is no potential that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
green and golden bell frog ***Litoria aurea***	No	This species was previously recorded around Bettys Creek in 1994, 1996, 1997 and 1999 (refer to **Figure 3.5**). This species was not recorded within the Development Footprint despite extensive and repeated targeted surveys undertaken in the known detection period for the species (refer to **Table 2.3**). The Upper Hunter green and golden bell frog key population consists of one main diffuse population at, or in the vicinity of, the Ravensworth and Liddell area and bordering areas of the Singleton and Muswellbrook LGA. No records of the population in the Upper Hunter have been found since 2009. Although the water bodies within the Development Footprint provide potential habitat for the species the absence of individuals in the locality following annual monitoring surveys indicates that the Development Footprint is unlikely to provide habitat for the species. It is unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
green-thighed frog ***Litoria brevipalmata***	No	This species has been recorded on the central coast of NSW and prefers wetter rainforest habitats. The closest record occurs approximately 40 km southeast of the Development Footprint near Kurri Kurri. This species was not recorded within this area despite extensive and repeated surveys in suitable habitat and in the known detection period for the species (refer to **Table 2.3**). There is no potential that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
koala ***Phascolarctos cinereus***	No	The koala (or signs of the koala) was not recorded within the Development Footprint during the targeted SAT or spotlighting surveys undertaken for this assessment. This species has been previously recorded within 1 km of the Development Footprint in the woodland habitats adjacent to Main Creek (refer to **Figure 3.5**). The closest two records are reasonably old, having been recorded in 1997 and 2006. Preferred feed trees were recorded in low abundance the Development Footprint. The koala has not been recorded in any frequency in the wider locality as part of the targeted surveys for the UHSA or the annual monitoring surveys. It is unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.

Species Name	Impacted by the Proposed Modification^	Justification for Impact
pale-headed snake *Hoplocephalus bitorquatus*	No	This species is not generally known to occur in the Hunter Valley. A historical record (from 1992) occurs approximately 35 km to the east of the Development Footprint near Paterson. While suitable habitat for the species occurs within the Development Footprint in the form of tree hollows, this species was not recorded within this area despite extensive and repeated surveys in suitable habitat and in the known detection period for the species (refer to **Table 2.3**). There is no potential that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
regent honeyeater *Anthochaera phrygia*	No	This species has not been recorded within the Development Footprint or the locality despite targeted winter bird surveys undertaken in 2016 and 2017 as well as monitoring surveys undertaken annually in the Mount Owen Complex. This species has not been recorded in the wider locality, with the closest record occurring 20 km to the south of the Development Footprint in near Warkworth in 1991. While the Development Footprint contains in potential foraging habitat for the species, it has not been recorded utilising the habitats of the Development Footprint. This is likely to be due to low frequency of key feed trees (DoE 2016) and the small number of individuals remaining in the population utilising other higher quality habitats in NSW. It is unlikely that this species would be impacted by the Proposed Modification and no species credits have been generated for this species.
southern myotis *Myotis macropus* (breeding habitat only)	No	The species has been occasionally recorded throughout the Mount Owen Complex during annual fauna monitoring surveys in the years 1999, 2000, 2005, 2007, 2009, 2011 and 2015 using call echolocation recording and capture methods (Forest Fauna Surveys 2017). The Development Footprint is considered to comprise potential foraging habitat for this species as part of a wider foraging range in surrounding habitats. To generate species credits for this species, the Development Footprint needs to contain roosting habitat in the form of hollow-bearing trees, bridges, caves or artificial structures within 200 mof a riparian zone. The closest riparian zone is Main Creek, located to the east of the Development Footprint. Mapping of hollow-bearing trees in the Development Footprint did not record any suitable roosting habitat for the southern myotis within 200 m of Main Creek. As a result, no species credits have been generated for this species.

^ As entered into the 'Threatened Species Survey Results' tab in the BBCC.

3.3.2.2 Species Habitat Polygons

Species habitat polygons have been prepared for the brush-tailed phascogale (*Phascogale tapoatafa*) which was recorded on multiple occasions on remote cameras within the Development Footprint. No other species-credit species were recorded or assumed present within the Development Footprint.

The species polygons and records for the brush-tailed phascogale are shown on **Figure 3.5**. Historical records of the koala and green and golden bell frog outside the Development Footprint are also shown on **Figure 3.5**.

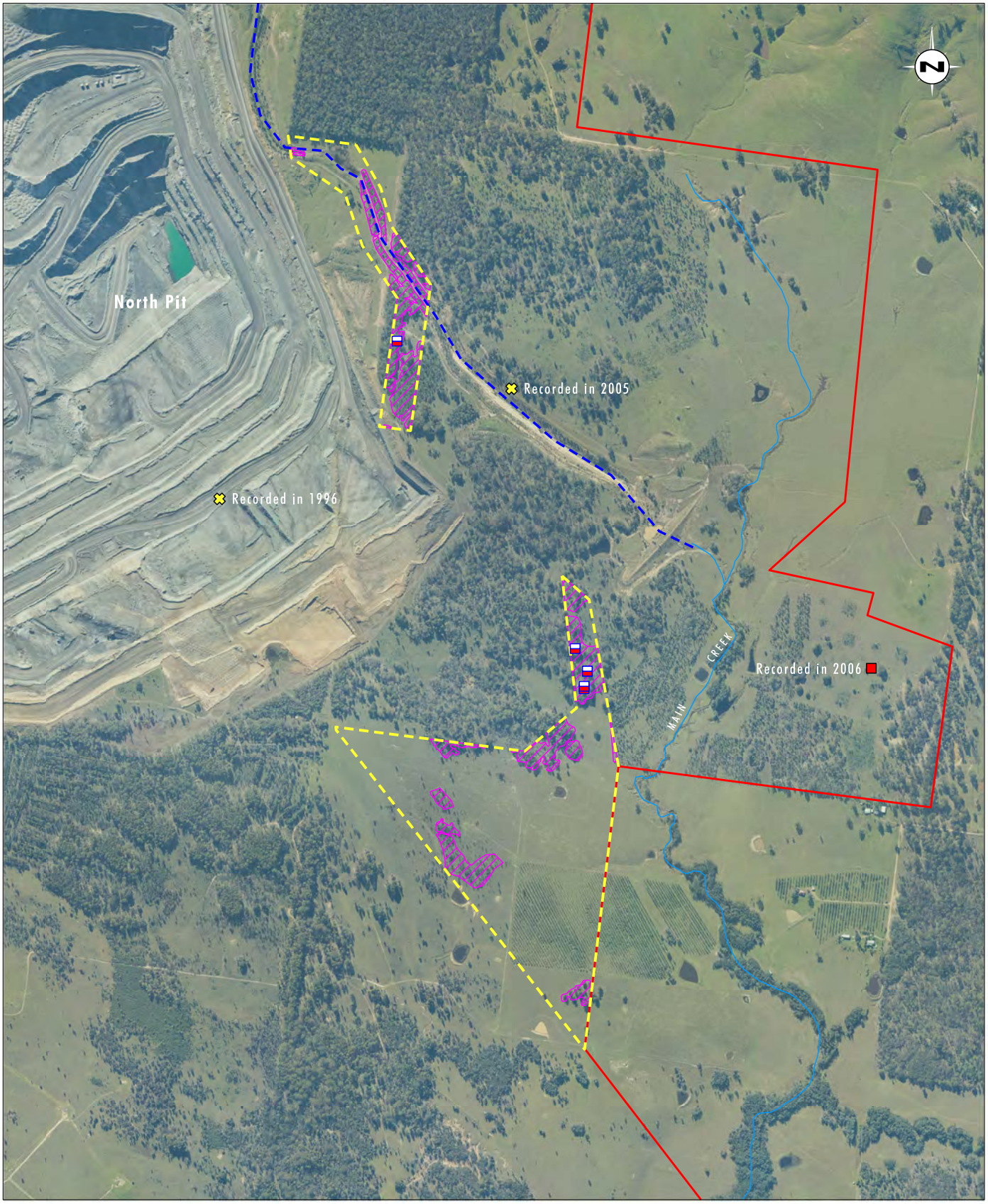

Image Source: Glencore (July 2017)
Data Source: Glencore (2017), BioNet (2017)

0 250 500 750m
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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area (Development Footprint)
- Existing Bettys Creek Diversion
- Drainage Line

Recorded as Part of Current Assessment:
- Brush-tailed Phascogale
- Brush-tailed Phascogale Polygon

Previous Records (including NSW Wildlife Atlas):
- Green and Golden Bell Frog
- Koala

FIGURE 3.5

Species Credit Fauna Species Locations and Species Polygons

4 Avoidance and Minimisation of Impacts

4.1 Avoidance

4.1.1 Site Selection and Planning

Mount Owen has sought to avoid and minimise potential impacts on the ecological values of the Development Footprint throughout the Project planning process. This included targeted avoidance and minimisation of disturbance of key vegetation communities through designing the Proposed Modification to maximise use of existing mining facilities, and the avoidance of all areas of the *Central Hunter Valley Eucalypt Forest and Woodland CEEC* recorded in the wider Mount Owen Complex. The majority of the Development Footprint comprises disturbed and low quality vegetation in the form of derived native grasslands. The derived native grasslands represent lower quality habitat for a range of threatened species. Native forest, woodland and plantation areas comprise less than 20 per cent of the Proposed Disturbance Area and the larger and higher quality remnant patches of native forest and woodland have been avoided. The Development Footprint is set back from Main Creek which provides riparian habitat linking the large areas of remnant woodland and forest to the north as part of the Ravensworth State Forest and existing offset areas to the areas of remnant woodland and forest in the south.

4.2 Construction and Operational Phase Minimisation/Mitigation Measures

Mount Owen has committed to the design and implementation of a comprehensive biodiversity mitigation strategy to mitigate the unavoidable impacts of the Proposed Modification. The following specific control measures, as detailed in the existing approved Mount Owen Complex Biodiversity and Offset Management Plan (prepared under SSD-5850 and DA80/952 and Commonwealth EPBC Act Approval EPBC 2013/6978), are considered to be integral to the mitigation of impacts on the biodiversity features of the Proposed Disturbance Area. The proposed mitigation measures for the Proposed Modification where relevant consider the UHSA Guidelines for the Mitigation of Coal Mining Impacts on Biodiversity (OEH 2016c). The following specific control measures are considered to be integral to the mitigation of impacts on the biodiversity features of the Development Footprint and surrounds:

- landform and rehabilitation establishment
- salvage of biodiversity features, including habitat resources (e.g. hollow logs, tree hollows, fallen timber and rocks/boulders), threatened flora species and material for rehabilitation (e.g. seed collection, and topsoil) for mine rehabilitation
- a pre-clearing procedure will be implemented to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of hollow-bearing trees. The pre-clearing procedure is designed to minimise impacts to hollow-dependent and ground-dwelling fauna. In addition to this, a Ground Disturbance Permit (CAA HSEC PER 0004) will identify any specific ecology requirements, such as wildlife spotter/catcher requirements prior to clearing being permitted to commence on-site
- weed management
- pest animal control
- fencing and access control

- bushfire management
- riparian zone management
- erosion and sedimentation control
- providing appropriate environmental management measures as part of the mining operations to minimise the potential for indirect impacts, and
- employee education and training.

Each of these control measures will contribute to the maintenance of habitat quality adjacent to the Development Footprint outside existing approved disturbance.

Should the Proposed Modification be approved, Mount Owen will review and revise the existing approved Mount Owen Complex Biodiversity and Offset Management Plan in accordance with any additional Development Consent requirements. The revised Biodiversity Management Plan will guide the implementation of the mitigation steps and will be reviewed and adapted in response to new information.

Monitoring is a tool that can be used to assess and inform the ongoing improvement of management actions. The effectiveness and long-term success of mitigation actions will be evaluated against key outcomes, which necessitate regular and appropriately targeted monitoring. This will be achieved by using formal monitoring programs and due diligence assessments that periodically examine measurable changes over time and provide information on impacts and the success or otherwise of mitigation actions.

4.2.1 Landform Establishment and Rehabilitation

Changes to landform, geology and drainage regimes associated with mining have the potential to impact adjacent and nearby habitat areas. For example the creation of overburden emplacement areas typically results in changes in surface water and groundwater movement, availability and quality. The following mitigation controls will be undertaken to mitigate such potential impacts:

- appropriate drainage will be integrated in the design of rehabilitation areas to effectively manage drainage of the final landform without resulting in adverse impacts
- utilisation of natural landform design principles in the establishment of the final landform (as discussed in the SEE) to provide micro-relief in the landform and improved habitat outcomes
- identified areas of moderate to severe erosion will be remediated as soon as practicable

4.2.2 Salvage of Biodiversity Features

Salvaged habitat resources including tree hollows, fallen timber and rocks/boulders provide foraging and refuge habitat for a number of key threatened species, particularly insectivorous woodland birds and terrestrial mammal species. The microclimates provided around fallen timber and rocks/boulders can assist in the establishment of flora species and the decomposing woody material from fallen timber can assist in soil conditioning.

The relocation of salvaged habitat resources are proposed for rehabilitation areas according to the Mount Owen Complex Biodiversity and Offset Management Plan. This will increase habitat complexity for fauna species sooner than when they would naturally develop.

Where salvaged resources are to be installed:

- they are to be of structurally good condition for habitat use
- sizes should be variable to capture for the range of threatened species known to occur in the Mount Owen Complex such as woodland birds, arboreal mammals and micro-bats
- hollow resource density should be consistent with densities in unaffected vegetation on the site (i.e. reference sites); and
- fallen timber resource density should be consistent with densities in unaffected vegetation on the site (i.e. reference sites).

When re-instating habitat features, care must be taken not to damage existing native vegetation and where possible should take place prior to rehabilitation work commencing. Habitat features can be stockpiled in unused areas, if necessary, in a manner that minimises damage and deterioration, until able to be reinstated.

4.2.3 Pre-clearance and Tree-felling

Pre-clearance surveys and tree-felling supervision recommendations are outlined in Section 5.10 of the Mitigation Guidelines (OEH 2016c) and will be implemented according to the Mount Owen Complex Biodiversity and Offset Management Plan. Tree felling processes are implemented at Mount Owen Complex to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees.

4.2.3.1 Pre-clearance Surveys

Pre-clearance surveys are to be undertaken prior to tree felling works, be undertaken by suitably qualified and experienced person and include:

- the demarcation of areas approved for clearing to reduce risk of accidental clearing
- habitat resources and habitat trees should be identified and marked (Note: habitat trees are those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows and boulder piles)
- the potential presence of threatened flora and fauna species, endangered populations and TECs should be identified
- the identification of threatened species or habitat features that are suitable for translocation or salvage. This includes native plant species containing seed for collection and propagation purposes and habitat features to be used in habitat augmentation, and
- disturbance activities should be targeted to specific times of the year to minimise impacts to threatened species usage of habitat features for breeding and roosting, where practicable.

4.2.3.2 Tree-felling Supervision

Tree felling will be completed as close to the completion of pre-clearance surveys as practicable to limit the potential for new issues to arise (such as new active nests being built). Tree felling supervision will be undertaken by an appropriately qualified and experienced person after pre-clearance surveys have identified potential threatened species habitat.

The tree-felling process will include the following:

Prior to Felling Habitat Trees

- Completion of actions recommended from the pre-clearing surveys, including (but not limited to) salvage of identified habitat features, additional surveys to determine threatened fauna usage of the area (if required), identification of active dens or burrows, any actions required to discourage fauna occupation and weed or feral fauna management requirements

- Removal of non-habitat trees/vegetation as close to the habitat tree felling date as possible in order to create disturbance to discourage fauna usage of the habitat trees and

- Shaking of habitat trees (with heavy machinery) as appropriate to encourage fauna to abandon trees.

On the Day of Felling Habitat Trees

- All habitat trees will be subject to a visual inspection to survey for threatened species

- Trees previously identified as containing fauna will be shaken and then felled, providing no threatened species are identified

- The lowering of hollow-bearing trees will be done as gently as possible with heavy machinery

- If a threatened species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include leaving the tree overnight, further shaking to encourage the animal to vacate the tree, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitats

- Uninjured animals should be released on the day of capture into nearby suitable secure habitat and should not be held for extended periods of time

- Injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment

- Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised

- All felled habitat trees should remain in place for a least one night to allow any remaining fauna to escape, and

- Habitat features identified for translocation or salvage operations should be extracted and stored appropriately.

4.2.4 Weed Management

Weed species could be inadvertently brought into the Development Footprint with imported materials, or could invade naturally through removal of native vegetation. The presence of weed species has the potential to be an impediment to revegetation and regeneration activities. In addition, the presence of weed species has the potential to decrease the value of vegetation for native species, particularly threatened species.

Existing weed management controls as specified in the Mount Owen Complex Biodiversity and Offset Management Plan will be applied to the Proposed Modification. Weed control will be undertaken in accordance with current mine practices and, for noxious weed species, with NSW control guidelines.

Regular weed inspections will be undertaken across the Development Footprint and appropriate weed control methods will be implemented.

4.2.5 Pest Animal Control

Introduced fauna species such as deer, foxes, rabbits, pigs, wild dogs and feral cats could change in distribution and abundance in the Development Footprint and adjoining areas as future areas are cleared, mined and then rehabilitated. Clearing, thinning of vegetation and the creation of tracks through existing dense vegetation could assist the penetration of introduced fauna species such as pigs, cats and foxes, and allow them to establish in new areas. An increase in feral species within the Development Footprint and adjoining areas has the potential to increase impacts on existing native species, particularly via predation and habitat destruction.

Existing weed management controls as specified in the Mount Owen Complex Biodiversity and Offset Management Plan will be applied to the Proposed Modification. Pest and feral animal control will be undertaken in accordance with current mine practices and as outlined in the Mount Owen Complex Biodiversity and Offset Management Plan.

Feral animal control works will be undertaken periodically to provide for the suppression of feral animals, and this will be undertaken in a manner that is sympathetic to ecological outcomes.

4.2.6 Fencing and Access Control

Fencing may be used to demarcate vegetation where required. Any new fencing used within the Development Footprint adjacent to native vegetation areas will where possible remove the use of barbed wire especially in the top two strands and replace with plain wire. This type of fencing will minimise potential injury to, or death of, fauna species, particularly macropods and gliding or flying mammals, such as the grey-headed flying-fox (*Pteropus poliocephalus*) and threatened micro-bats. The use of as few wire strands as practical will be considered to reduce potential for fauna entanglement, particularly by macropods.

Access control is an important feature in protecting and demarcating areas outside disturbance footprints from vehicle access, human access and accidental disturbance. Measures include:

- appropriate fencing and signposting of areas to prevent the uncontrolled entry of people, accidental disturbance and to minimise vehicular and human traffic
- clear and visible signage is to be appropriately located to inform employees and others of the restricted access or otherwise of areas of outside the disturbance footprint and
- locking of gates to prevent unwanted vehicle, person access and disturbance.

4.2.7 Bushfire Management

The vegetation that will be retained within areas adjoining of the Development Footprint in the Mount Owen Complex will require appropriate bushfire management to protect life and property, while supporting appropriate conditions for the significant ecological features identified.

The objectives of the Mount Owen Complex Biodiversity and Offset Management Plan will be achieved through the implementation of a range of measures, including;

- maintaining a suitably equipped response to any fires on site and assisting the Rural Fire Service and emergency services on site in the event of a fire at the Mount Owen Complex

- control burning and/or where permitted, appropriate grazing management regimes to reduce ground fuel loads whilst minimising impacts on biodiversity and
- maintaining strategically positioned fire breaks and access roads.

4.2.8 Erosion and Sediment Control

Erosion and sediment control is critical to the long term stability of the land surface and downstream water quality. Mount Owen Complex has developed an Erosion and Sediment Control Plan with the main objective being to protect soil resources and maintain local water course quality. The Mount Owen Complex Erosion and Sediment Control Plan outlines the requirements for erosion and sediment control across the Mount Owen Complex.

Measures outlined in the Erosion and Sediment Control Plan includes:

- minimising the area of disturbance
- diverting run-off water around disturbed areas
- maintaining flow velocity at less than the erosive velocity
- avoiding disturbance in areas of concentrated flows and
- maximising ground cover.

4.2.9 Environmental Management Measures

Appropriate environmental management measures will be used as part of the mining operations to minimise the potential for indirect impacts through currently approved management plans, including:

- water management systems that seek to minimise the potential for damage to flora and fauna and their habitats from erosion and unnatural flooding events
- noise control systems to minimise noise impacts
- dust control measures to minimise dust impacts
- lighting controls to minimise night light impacts and
- blasting controls to minimise blast overpressure and vibration impacts.

4.2.10 Employee Education and Training

The development of education packages and the facilitation of mine site awareness training can help to mitigate anthropogenic impacts on biodiversity. The ability of non-ecological personnel to identify key threatened species or key ecological threats can help to mitigate impacts on threatened species. Improved awareness and stewardship of mine site employees and contractors can potentially benefit all flora and fauna species and vegetation communities. The following mitigation actions will be undertaken to develop a greater understanding and awareness of biodiversity issues in non-ecological trained personnel:

- Inductions for staff, contractors and visitors will be undertaken to make them aware of the key ecological issues present in the Development Footprint and so that they know their role and responsibilities in the protection and/or minimisation of impacts to all native biodiversity.

Inductions will identify the location of sensitive flora and fauna and the policies being implemented to protect the biodiversity values of such areas.

4.3 Direct Impacts Unable to be Avoided

The development of the Proposed Modification will result in direct impacts on biodiversity values within the Development Footprint. Direct impacts include the loss of native vegetation and fauna habitats as a result of clearance works and subsequent mining activity.

Table 4.1 below outlines these impacts as they were entered into the BBCC, which totals approximately 45 hectares of direct impacts to native vegetation communities.

Avoidance and mitigation measures associated with minimising the impacts of these direct impacts are discussed in **Sections 4.1** and **4.2** above.

Table 4.1 Direct Impacts of the Proposed Modification on Native Biodiversity Features

Ecological Feature	Area within the Development Footprint (ha)
Biometric Vegetation Type	
PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower [1] *Moderate to Good*	5.00
PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter [1] *Moderate to Good - Plantation*	2.19
PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good - Derived Native Grassland*	29.30
PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good - Derived Native Grassland Olive Plantation*	6.81
PCT1692/HU906 Bull Oak Grassy Woodland of the Central Hunter Valley *Moderate to Good*	1.45
PCT1731/HU945 Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley *Moderate to Good*	0.20
Total	**44.95***
Species-credit Species Habitats	
brush-tailed phascogale *Phascogale tapoatafa*	8.84

1. Conforms to *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregion* EEC (BC Act)

*Total area of native vegetation (i.e. this excludes 1.42 hectares of Disturbed Land and Dams).

4.4 Assessment of Indirect Impacts on Biodiversity

The Proposed Modification is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding lands. However, some minor indirect impacts associated with habitat connectivity, fugitive light emissions, dust, noise, surface water flow changes, groundwater changes, weeds and feral animals may occur during the Proposed Modification. This is further discussed in the sections below in accordance with Section 8.4 of the FBA (OEH 2014b).

4.4.1 Indirect Impacts on Connectivity and Corridors

The removal of native vegetation from within the Development Footprint could affect the ability of some local fauna species to move throughout the landscape. A potential corridor of fauna movement (comprising fragmented remnant woodland rehabilitation patches) exists between an area within the Development Footprint linking woodland and forest habitats to the north with those in the south. Removal of the vegetation in the Development Footprint may reduce the dispersal, migration and movement ability of some fauna species within the local area. Noting that the riparian habitat associated with the adjacent Main Creek to the east has been avoided and minimised to the extent practicable which will allow continued fauna movement in the landscape.

In addition to the impacts on potential fauna corridors, the removal of native vegetation from the Development Footprint could result in a reduced ability for many fauna species to move throughout the landscape through a reduction in 'stepping stone' habitat areas. Isolated or fragmented areas of suitable habitat for species provide short to medium term refuges (or 'stepping stones' for species as they move from one area of habitat to another, travelling across unsuitable habitat areas between the 'stepping stones') for species as they disperse, migrate or move throughout the landscape. The loss of 'stepping stone' habitat areas for some species could result in an increased level of isolation of populations where species are unable or unwilling to travel across the increased distance between habitat areas.

To an extent, the potential loss of local and regional connectivity is already factored in to the credit calculation in that the Assessment Circle and associated Landscape Value Scores take into account the pre- and post-clearing percentage of native vegetation cover (excluding the proposed post-mine rehabilitation). It is unlikely that any further indirect impact through reduced connectivity and loss of corridors would be of any significant level.

4.4.2 Fugitive Light Emissions

Fugitive light emissions resulting from the Proposed Modification may result in adverse impacts on adjacent habitats and fauna species such as nocturnal fauna species, particularly birds and bats. Potential impacts may include:

- a reduction in the navigational signal ability for some nocturnal animals and
- delaying bats from emerging from roost access points and shortening the amount of time available to them for foraging.

Appropriate lighting controls to minimise impacts will be implemented as part of the Proposed Modification as necessary (providing that these actions do not compromise site safety issues). There will be no substantial change to fugitive light emissions given that the proposed mine operation is already is part of and adjacent to an operation with existing impacts.

Any additional impacts resulting from fugitive light emissions are not expected to be of any level of significance in relation to threatened species, populations and communities.

4.4.3 Noise Impacts

Noise impacts have the potential to adversely impact native species. Potential impacts include:

- noise disturbing the roosting and foraging behaviour of fauna species and
- noise reducing the occupancy of areas of suitable habitat.

Details of the noise controls that will be implemented as part of the Proposed Modification are outlined in the SEE.

In regard to potential impacts on biodiversity, there will be no substantial change to noise impacts given that the proposed mine operation is part of, and adjacent to, an already existing operation with existing impacts.

Any additional impacts resulting from noise emissions are not expected to be of any level of significance in relation to threatened species, populations and communities.

4.4.4 Dust Impacts

Dust impacts have the potential to adversely impact native species during ground disturbing works, including blasting. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth.

The design of the Proposed Modification will include inherent measures to minimise the potential for adverse dust impacts. These include:

- progressive rehabilitation and stabilisation of disturbed land
- dust suppression on haul roads and other operational areas to reduce vehicle generated dust emissions and
- a range of other dust control measures as discussed in the main text of the SEE.

In regard to potential impacts on biodiversity, there will be no substantial change to dust impacts given that the proposed mine is part of and adjacent to an already existing operation with existing impacts.

Any additional impacts resulting from dust are not expected to be of any level of significance in relation to threatened species, populations and communities.

4.4.5 Weed and Feral Animal Encroachment

Weed species could be inadvertently brought into the Development Footprint with imported materials, or could invade naturally through removal of native vegetation. The presence of weed species within the Development Footprint has the potential to decrease the value of extant vegetation to native species, particularly threatened species. Mitigation measures outlined in **Section 4.2** will be implemented to minimise the potential for weed encroachment into areas surrounding the Development Footprint.

Populations of feral fauna species such as foxes, rabbits, pigs, deer, dogs and cats can increase and quickly populate new areas as a result of disturbance. Clearing, thinning of vegetation and the creation of tracks have the ability to assist the establishment and spread of feral fauna species. Mitigation measures outlined in **Section 4.2** will minimise the potential for feral animal spread and impacts into surrounding areas around the Development Footprint.

There will be no substantial change to impacts from weeds or feral animals, given that the proposed mine is part of, and adjacent to, an existing operation with existing impacts.

Any additional impacts resulting from weeds or feral animals are not expected to be of any level of significance in relation to threatened species, populations and communities.

4.4.6 Cumulative habitat loss and vegetation clearance impacts on agricultural and mining areas of the Hunter Valley

The Development Footprint is situated in a landscape that is characterised by mining land, grazing land and some private and public woodland, including Ravensworth State Forest to the north. The history of land clearing, agriculture and mining development has resulted in an incremental loss of vegetation and fauna habitat surrounding the Development Footprint, and within the central Hunter Valley more generally. The Proposed Modification will result in a relatively small loss of approximately 9 hectares of native woodland and forest vegetation (including approximately 2 hectares of native forest plantation).

It is recognised that the Proposed Modification will remove vegetation and further increase fragmentation and isolation of habitats, and thus contribute to cumulative habitat loss and vegetation clearance in the locality. To address these impacts, an extensive mitigation and offsetting strategy is proposed including the provision of:

- the delineation of clearance areas to avoid unnecessary impacts and clearance of surrounding vegetation
- habitat enhancement measures such as the installation of nest boxes, salvaged hollows, fallen timber, hollow logs and rocks to supplement mine rehabilitation areas
- rehabilitation of the Development Footprint post mining and
- the implementation of a biodiversity offset strategy in accordance with the FBA.

4.4.7 Increase in fragmentation

Habitat fragmentation is a common impact arising from development and can result in barriers to movement and dispersal of local flora and fauna species. Habitat corridors may include large expanses of intact native landscapes, river systems and floodplains, networks of habitat patches or scattered paddock trees. The retention of habitat connectivity may help to reduce some of the adverse effects of habitat fragmentation by facilitating dispersal of individuals between patches of remaining habitat. Broadly, the habitats of the locality are already fragmented in a largely agricultural and mining landscape.

The removal of native vegetation from within the Development Footprint could affect the ability of some local fauna species to move throughout the landscape as discussed in **Section 4.4.1**. The fragmentation resulting from the Proposed Modification is expected to be a short to medium term impact, with the re-establishment of native vegetation communities proposed to be rehabilitated on the post-mining landscape.

It is also noted that the potential loss of local and regional connectivity is factored in to the FBA credit calculations for the Proposed Modification in that the Assessment Circle and associated Landscape Value Scores take into account the pre- and post-clearing percentage of native vegetation cover (excluding the proposed post-mine rehabilitation).

4.4.8 Changes in fauna behaviour

Behavioural changes in animals can occur in response to the physical presence of a development and include changes in foraging locations and mating behaviour (Gleeson and Gleeson 2012). This may lead to changes in species composition in the landscape, with these impacts resulting from impacts such as fugitive lighting, noise and vibration impacts. Noise impacts can affect fauna physiology and behaviour, particularly by causing disruption to communication including mating calls, territorial calls and alarm calls (OEH 2016c). Research into the impacts of altered lighting indicates that it can trigger behavioural and physiological

responses including changes in foraging behaviour, disruptions of seasonal day length trigger cues for critical behaviour, disorientation and temporary blindness and interference with predator prey relationships (OEH 2016c). Blasting overpressure and vibration has the potential to disturb routine activities of fauna, particularly birds and bats, including disrupting breeding cycles and behaviour patterns (OEH 2016c).

Appropriate lighting controls to minimise impacts will be implemented as part of the Proposed Modification including minimisation of fugitive lighting emissions following Australian Standards. There will be no substantial change to fugitive light emission impacts on the surrounding fauna habitat given that the Proposed Modification is already is part of, and adjacent to, existing mining operations with existing lighting impacts.

There will be no substantial change to noise impacts on fauna given that the proposed mine operation is part of, and adjacent to, an already existing operation with existing impacts. The same applies to vibration with the vibration impacts broadly consistent with the blasting impacts from the existing mining operations.

4.4.9 The interruption of ecosystem processes

Ecosystem processes refer to the processes that sustain a functioning ecosystem. These can include climatic processes, resource productivity, hydrological processes, nutrient cycling, species interactions and fire regimes. The Proposed Modification has the potential to result in indirect impacts associated with ecosystem processes. While these processes and impacts on them are complex and difficult to quantify, an extensive mitigation strategy is proposed for the Proposed Modification as discussed in **Section 4.1** and **Section 4.2**.

5 Impact Summary

5.1 Impacts Not Requiring Further Assessment

Impacts not requiring further assessment under the FBA include areas of land without native vegetation. The Development Footprint contains approximately 1.4 hectares of cleared land/non-native vegetation that will be removed as a result of the Proposed Modification (containing disturbed land and dams) that does not meet the definition of 'native vegetation' under the *Native Vegetation Act 2003*. This impact does not require further assessment under the FBA.

5.2 Impacts Not Requiring Offset

Impacts on native vegetation not requiring offsets under the FBA include native vegetation that has a site value score of less than 17 and are not identified as an endangered or critically endangered ecological community, and/or associated with threatened species habitat (as represented by ecosystem credits).

A total of 6.8 hectares of Vegetation Zone 4 - HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter_Moderate to Good - Derived Native Grassland Olive Plantation has a current site value of less than 17, and therefore does not require offsetting under the FBA.

5.3 PCTs and Threatened Species Requiring Offset

A range of PCTs, ecosystem-credit species and species-credit species were found to require offsetting for the Proposed Modification as discussed in the sections below.

5.3.1 Ecosystem Credits

Table 5.1 outlines the ecosystem-credit species requiring offset as a result of the Proposed Modification through the use of ecosystem credits linked to vegetation zones. The highest threatened species offset multiplier determines the credit requirements for the vegetation zones these species are predicted to occur in.

Table 5.1 Ecosystem-credit species requiring offset as a result of the Proposed Modification

Common Name	Species Name	Threatened Species Offset Multiplier
barking owl	*Ninox connivens*	3.0
black-chinned honeyeater (eastern subspecies)	*Melithreptus gularis* subsp. *gularis*	1.3
brown treecreeper (eastern subspecies)	*Climacteris picumnus* subsp. *victoriae*	2.0
bush stone-curlew	*Burhinus grallarius*	2.6
diamond firetail	*Stagonopleura guttata*	1.3
eastern false pipistrelle	*Falsistrellus tasmaniensis*	2.2
eastern freetail-bat	*Mormopterus norfolkensis*	2.2
eastern grass owl	*Tyto longimembris*	1.3
flame robin	*Petroica phoenicea*	1.3
gang-gang cockatoo	*Callocephalon fimbriatum*	2.0

Common Name	Species Name	Threatened Species Offset Multiplier
glossy black-cockatoo	*Calyptorhynchus lathami*	1.8
greater broad-nosed bat	*Scoteanax rueppellii*	2.2
grey-crowned babbler (eastern subspecies)	*Pomatostomus temporalis* subsp. *temporalis*	1.3
hooded robin (south-eastern form)	*Melanodryas cucullata* subsp. *cucullata*	1.7
little eagle	*Hieraaetus morphnoides*	1.4
little lorikeet	*Glossopsitta pusilla*	1.8
masked owl	*Tyto novaehollandiae*	3.0
painted honeyeater	*Grantiella picta*	1.3
powerful owl	*Ninox strenua*	3.0
scarlet robin	*Petroica boodang*	1.3
speckled warbler	*Chthonicola sagittata*	2.6
spotted harrier	*Circus assimilis*	1.4
spotted-tailed quoll	*Dasyurus maculatus*	2.6
square-tailed kite	*Lophoictinia isura*	1.4
swift parrot	*Lathamus discolor*	1.3
turquoise parrot	*Neophema pulchella*	1.8
varied sittella	*Daphoenositta chrysoptera*	1.3
yellow-bellied glider	*Petaurus australis*	2.3
yellow-bellied sheathtail-bat	*Saccolaimus flaviventris*	2.2

Table 5.2 outlines the PCTs to be impacted as a result of the Proposed Modification and the ecosystem credits required to offset those impacts. The full Credit Calculator report is included in **Appendix C**.

Table 5.2 Plant Community Types Requiring Offset and the Total Ecosystem Credits Required

Vegetation Zone	Plant Community Type	Total Area to be Impacted (ha)	Highest Threatened Species or EEC Offset Multiplier	Total Ecosystem Credits Required
1	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good*	5.00	3.0	309
2	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good - Plantation*	2.19	3.0	93
3	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good - Derived Native Grassland*	29.30	3.0	582
5	PCT1692/HU906 Bull Oak Grassy Woodland of the Central Hunter Valley *Moderate to Good*	1.45	3.0	66
6	PCT1731/HU945 Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley *Moderate to Good*	0.20	3.0	12
	TOTAL	**38.14**	-	**1,062**

5.3.2 Species Credits

Table 5.3 below outlines the species-credit species to be impacted as a result of the Proposed Modification and the species credits required to offset those impacts. A full Credit Calculator report is included in **Appendix C**.

Table 5.3 Species-credit Species Requiring Offset and the Species Credits Required

Common Name *Scientific Name*	Habitat to be Impacted (ha)	Threatened Species Offset Multiplier	Species Credits Required
brush-tailed phascogale *Phascogale tapoatafa*	8.84	2.0	177

5.4 Impacts on Biodiversity that Require Further Consideration

Under the FBA, certain impacts on biodiversity values may require further consideration by the consent authority. These are impacts that are considered to be complicated or severe and include:

- impacts on landscape features, being:
    - impacts that will reduce the width of vegetation in the riparian buffer zone bordering significant streams and rivers, important wetlands or estuarine areas (in accordance with Section 9.2.3 of the FBA) or
    - impacts that will prevent species movement along corridors that have been identified as providing significant biodiversity linkages across the state (in accordance with Section 9.2.3 of the FBA) and
- impacts on native vegetation that are likely to cause the extinction of an EEC/CEEC from an IBRA subregion or significantly reduce its viability (in accordance with Section 9.2.4 of the FBA) and
- impacts on critical habitat or on threatened species or populations that are likely to cause the extinction of a species or population from an IBRA subregion or significantly reduce its viability (in accordance with Section 9.2.5 of the FBA).

In accordance with Sections 9.2.3, 9.2.4 and 9.2.5 of the FBA (OEH 2014b), impacts on the following biodiversity values require further consideration in the BAR. This information is provided in **Sections 5.4.1** and **5.4.2** below.

- Riparian buffer of the Bettys Creek diversion and
- Swift parrot (*Lathamus discolor*).

5.4.1 Impacts on Vegetation in a Riparian Buffer Zone that Require Further Consideration

As per Section 9.2.3.2 of the FBA (OEH 2014b), impacts on vegetation in a riparian buffer zone that require further consideration include impacts on areas of native vegetation within:

(a) 20 m either side of a 4th and 5th order stream

(b) 50 m either side of a 6th order stream or higher, or

(c) 50 m around an estuarine area

Table 5.4 below provides further information for Bettys Creek diversion in accordance with Section 9.2.3.3 of the FBA (OEH 2014b).

Table 5.4 Impacts on Riparian Buffers that Require Further Consideration

Details Required	Bettys Creek Diversion
(a) the name and stream order of the riparian buffer being impacted	Bettys Creek diversion is a fourth order watercourse and flows in an south-easterly direction through the northern portion of the Development Footprint before joining Main Creek which ultimately flows into the Hunter River. Bettys Creek diversion is an ephemeral watercourse with flows only occurring in the creek during storm events or after prolonged rainfall. Prior to the diversion works Bettys Creek was a third order stream, however diversion works means that it is now classified as 4th order in the Development Footprint. The Bettys Creek diversion which runs through the Development Footprint is artificial and comprises native plantation along the banks. The Bettys Creek diversions drainage channel will not be altered as part of the Proposed Modification, however water management activities will be undertaken which may result in clearing of adjacent vegetation.
(b) the total area of the riparian buffer that is impacted by the Major Project, the extent to which the width of the link will be reduced and over what length, and the size of gaps being created or expanded	In accordance with Section 9.2.3.2 of the FBA (OEH 2014b), impacts that require further consideration on a fourth order stream are those within 20 m either side of the stream. The Proposed Modification will impact 1.9 ha of vegetation that occurs up to 20 m either side of the Bettys Creek diversion (4th order section) in the Development Footprint. This impact will occur across a 474 m length of the Bettys Creek diversion.
(c) the PCT and condition of the vegetation in the riparian buffer	Bettys Creek diversion is primarily dominated by Vegetation Zone 2 - HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter - Moderate to Good Plantation. This vegetation community is artificial and was constructed as part of the diversion works with a mix of locally native flora species. Overall the plantation includes a mid-dense shrub and low tree layer with a reasonable diversity of native species. The ground layer is reasonably sparse with a mixture of native and exotic species. Several weeds occur in moderate densities, including Rhodes grass (*Chloris gayana*), scarlet pimpernel (*Lysimachia arvensis*) and narrow-leafed carpet grass (*Axonopus fissifolius*). The main drainage channel is dominated by the exotic species, including Rhodes grass (*Chloris gayana*) and sharp rush (*Juncus acutus* subsp. *acutus*). Within 20 metres of the main channel there are also occurrences of Vegetation Zone 3 – HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good – Derived Native Grassland and a small patch of remnant Vegetation Zone 1 - HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter - Moderate to Good.

Details Required	Bettys Creek Diversion
(d) any indirect impacts on wetlands or watercourses downstream of the Development Site	The Proposed Modification will result in minor changes to the catchment areas for the Bettys Creek diversion compared to the catchment areas of the current approved final landform at Mount Owen Complex. Due to the large catchment area and highly regulated nature of the Hunter River the assessment indicates that the Proposed Modification will have no impact on flows on the surrounding creek system including the Hunter River.
(e) the mitigation measures proposed to minimise the impact on the biodiversity values of the riparian or downstream area	Erosion and sediment control measures to be implemented as part of the Proposed Modification will be described in the Erosion and Sediment Control Plan (ESCP). These measures will be undertaken in accordance with the Blue Book (Volumes 1 and 2) (DECC 2008). The ESCP will provide a framework for the management of erosion and sedimentation for the Proposed Modification.

5.4.2 Impacts on Threatened Species that Require Further Consideration

As per Section 9.2.5.1 of the FBA (OEH 2014b), impacts on threatened species that require further consideration include impacts on:

(a) any critically endangered species, unless the critically endangered species is specifically excluded in the SEARs

(b) a threatened species or population that is specifically nominated in the SEARS as a species or population that is likely to become extinct or have its viability significantly reduced in the IBRA subregion if it is impacted on by the development, or

(c) where the survey or expert report undertaken in Section 6.6 confirms that a threatened species is present on the proposed development site, and the threatened species has not previously been recorded in the IBRA subregion according to records in the NSW Wildlife Atlas.

Table 5.5 below provides further information for the swift parrot, which is listed as critically endangered under the EPBC Act, in accordance with Section 9.2.5.2 of the FBA (OEH 2014b).

Table 5.5 Impacts on Threatened Species that Require Further Consideration

Details Required	Swift parrot *Lathamus discolor*
(a) the size of the local population directly and indirectly impacted by the development	The swift parrot has not been recorded within the Development Footprint despite targeted winter bird surveys undertaken in July 2016 and July 2017 in accordance with the seasonal requirements for this species. The Proposed Modification will remove approximately 6.8 hectares of vegetation that contains key tree species listed for the swift parrot as per the National Recovery Plan for the species (Saunders and Tzaros 2011). The majority of this habitat is relatively young (less than 30 years old) according to aerial photography interrogation (Umwelt 2014). It is expected that the total population size for the swift parrot is less than 2,000 individuals (Saunders and Tzaros 2011).

Details Required	Swift parrot *Lathamus discolor*
	The closest record of the species occur approximately 275 m from the Development Footprint, where two individuals were recorded in 2014 as part of the annual monitoring of the Southeast Offset Area in June 2014 (Forest Fauna Surveys 2017). This species was also recorded in May 2005 (flock of +20 individuals) and September 2007 (flock of +5 individuals) within the northern section of Ravensworth State Forest (Forest Fauna Surveys 2017). No known populations of the swift parrot occur within the Development Footprint and this is infrequently recorded in the better quality and more mature habitats present within the Ravensworth State Forest which will not be impacted by the Proposed Modification.
(b) the likely impact (including direct and indirect impacts) that the development will have on the habitat of the local population, including but not limited to: **i. an estimate of the change in habitat available to the local population as a result of the proposed development**	The swift parrot breeds in Tasmania and moves to mainland Australia for the non-breeding season (usually arriving between February and March). Most of the population winters in Victoria and NSW. While in NSW, the species occurs in areas of box-gum woodlands and areas of suitable winter-flowering foraging habitat. The Development Footprint contains largely young and fragmented potential foraging habitat for the species. The Proposed Modification will remove approximately 6.8 hectares of majority reasonably young and fragmented habitat which is less than 30 years old that contains key tree species listed for the swift parrot as per the National Recovery Plan for the species (Saunders and Tzaros 2011). No known populations of the swift parrot occur within the Development Footprint and no change in known habitat will occur as a result of the Proposed Modification.
ii. the proposed loss, modification, destruction or isolation of the available habitat used by the local population, and	The Proposed Modification will remove a several native vegetation communities within the Development Footprint including fragmented eucalypt forest and woodland. None of the habitats in the Development Footprint have been recorded as being used by the swift parrot. No known habitat for the swift parrot occurs within the Development Footprint, however the Proposed Modification may result in the loss, modification, destruction or isolation of 6.8 ha of potential habitat for the species.
iii. modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.	The swift parrot breeds exclusively in Tasmania and migrates to mainland Australia during the non-breeding season. There is no potential for breeding habitat to occur in the Development Footprint. No breeding or nesting habitat for swift parrot occurs within the Development Footprint and the Proposed Modification will not result in the modification of habitat important to the species' life cycle.

Details Required	Swift parrot *Lathamus discolor*
(c) the likely impact on the ecology of the local population. At a minimum, address the following: - **breeding** - **foraging** - **roosting, and** - **dispersal or movement pathways**	No breeding or nesting habitat for the swift parrot occurs within the Development Footprint as this occurs exclusively in Tasmania. Roosting habitat may be available in the eucalypt forest and woodlands within the Development Footprint and native woodland vegetation containing key feed trees may provide some winter foraging habitat for the species, although this has not been recorded. The Proposed Modification is unlikely to affect dispersal or movement pathways for this highly mobile species. The Proposed Modification is unlikely to affect the ecology and biology of any population of the swift parrot in the locality.
(d) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development	The swift parrot has not been recorded within the Development Footprint. This species is highly dispersive and it is unlikely that the Proposed Modification will create a significant change to the species dispersal capacity or create a significant barrier to the movement of the species.
(e) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range	The swift parrot occurs as a single population in Australia. The species is known to occur regularly in the winter months in the lower Hunter Valley, having only been infrequently recorded in the adjacent Ravensworth State Forest. The Development Footprint is not at the limit of extent of the species known range. It is unlikely that the Proposed Modification will impede the ability of the swift parrot population to interact for dispersal and genetic viability or diversity.
(f) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population	Key threats for the swift parrot include habitat loss and alteration, climate change, collision mortality and psittacine beak and feather disease (PBFD). The Proposed Modification will exacerbate habitat loss and alteration for the species in potential winter foraging habitat in the central Hunter Valley. The species has not been recorded utilising the habitats of the Development Footprint, showing preference for the larger and more mature adjacent vegetation in the Ravensworth State Forest. The Proposed Modification will not result in an increase of threats related to collision mortality or PBFD.
(g) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion	As part of the Proposed Modification, a Biodiversity Offset Strategy will be prepared in accordance with the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014a). This will require the identification of suitable land-based or non-land based offsets as outlined in this Policy. As the swift parrot is an ecosystem-credit species, the offsets will be matched as per the offsetting rules for like-for-like PCTs that will contain suitable habitat for the species. Land-based offsets will be located in the same or any adjoining IBRA subregion in which the development occurs. The establishment of a Stewardship site, as per the Biodiversity Assessment Methodology (BAM), will include specific management actions that must be carried out to maintain and improve these communities at the BioBank Site. The proposed offset strategy for the proposal is discussed in **Section 7.0**.

5.5 Seven Part Tests of Significance

Threatened species impact assessment is an integral part of environmental impact assessment. The objective of Section 5A of the EP&A Act, the *assessment of significance*, is to improve the standard of consideration afforded to threatened species, populations and ecological communities, and their habitats through the planning and assessment process, and to ensure that the consideration is transparent.

Although it is understood that the preparation of a BioBanking Assessment under the FBA was intended to supersede the requirement to prepare Seven Part Tests, the Department of Planning and Environment (DPE) has advised that the requirements of Section 5A of the EP&A Act are to be considered in the BAR. The preparation of a BAR under the FBA addresses the components of the Seven Part Tests by use of the BBCC. A summary of the requirements of the Seven Part Tests of Significance and where they are addressed in the FBA Assessment is outlined in **Table 5.6** below.

Table 5.6 Seven Part Tests of Significance and the FBA

Seven Part Test of Significance	Where Addressed in the FBA Process
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;	Threatened species (ecosystem-credit and species-credit) are predicted in the BBCC by the landscape features of the Development Footprint (native vegetation cover, IBRA regions, patch sizes, condition and plant community types) and assessed by the impact on these features. Impacts requiring further consideration (Section 9.2 of the FBA (OEH 2014b) identify impacts on critically endangered threatened species, impacts that may cause the extinction of a species in a IBRA subregion and impacts that significantly reduce the viability of a species.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	Endangered populations are predicted in the BBCC by the landscape features of the Development Footprint (native vegetation cover, IBRA regions, patch sizes, condition and plant community types) and assessed by the impact on these features. Impacts requiring further consideration (Section 9.2 of the FBA (OEH 2014b)) identify impacts that may cause the extinction of an endangered population in an IBRA subregion and impacts that significantly reduce the viability of a population.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed; **i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; and** **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;**	Endangered ecological communities are predicted in the BBCC by the plant community types and biometric community types identified from the field surveys and entered into the BBCC. Impacts requiring further consideration (Section 9.2 of the FBA (OEH 2014b) are identified as impacts on any critically endangered or endangered ecological community that may cause the extinction of the EEC/CEEC in a IBRA subregion or significantly reduce the viability of an EEC/CEEC.
d) in relation to the habitat of a threatened species, population or ecological community; **i. the extent to which habitat is likely to be removed or modified as a result of the action proposed;** **ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and** **iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;**	Habitat loss is assessed in the BBCC via the 'Site Values' tab and the loss in site value score entered for each vegetation zone. Fragmentation of habitat is addressed as part of the 'Landscape Value' score including consideration of features before and after the development including per cent native vegetation cover, connectivity value and vegetation condition. The per cent cleared scores for the dominant Mitchell Landscape is also calculated in the 'Landscape Value' score. Important habitat features are identified through determining geographic and habitat features relevant for particular species-credit species and the assessment of landscape features (such as riparian buffers, important wetlands and state or regionally significant biodiversity links). The extent of habitat loss is ultimately determined by the measure of ecosystem credits and species credits calculated in the BBCC.

Seven Part Test of Significance	Where Addressed in the FBA Process
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);	Critical habitat is addressed under impacts that require further consideration by the consent authority (refer to Section 9.2 of the FBA (OEH 2014b)).
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and	Recovery plans are not directly addressed in the FBA. Recovery plans (including drafts) have been prepared for koala (*Phascolarctos cinereus*) (DECC 2008), the regent honeyeater (*Anthochaera phrygia*) (DoE 2016) and the swift parrot (Saunders and Tzaros 2011). It is likely that the Proposed Modification would be inconsistent with any recovery plans prepared for the threatened species impacted by the Proposed Modification as it relates to impacts on habitat for the species. However the Proposed Modification will not impede the implementation of these recovery plans. If supplementary offsetting measures are used (as per Appendix B of the NSW Biodiversity Offset Policy for Major Projects) to offset species or communities impacted by projects, reference can be made to the key objectives and actions in the relevant recovery plans.
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.	Key threatening processes are not directly assessed under the FBA. In this case, the Proposed Modification is likely to contribute to the following key threatening processes through the clearing of vegetation: • Clearing of native vegetation (TSC Act and EPBC Acts) • Loss of hollow-bearing trees (TSC Act) • Removal of dead wood and dead trees (TSC Act). The Proposed Modification may to contribute to the following key threatening processes through clearing of vegetation, edge effects and the operation of the Proposed Modification: • Aggressive exclusion of birds by noisy miners (*Manorina melanocephala*) (TSC and EPBC Acts) • Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*) (TSC and EPBC Acts) • Predation by the European red fox (*Vulpes vulpes*) (TSC and EPBC Acts) • Invasion of native plant communities by exotic perennial grasses (TSC Act). While the Proposed Modification is considered likely to contribute to the function of the above key threatening processes, the Proposed Modification as a whole, or any component of the Proposed Modification would not be classified as a key threatening process.

5.6 Environmental Values not Assessed under the FBA

As per Section 2.3 of the FBA (OEH 2014b), biodiversity values not considered under the FBA include marine mammals, wandering sea birds and biodiversity that are endemic to Lord Howe Island. None of these biodiversity values occur or have the potential to occur within the Development Footprint and as such have not been specifically assessed as part of this assessment.

In addition, the FBA does not assess the direct impacts of a Proposed Modification that are not associated with clearing of vegetation. Examples of these impacts include, but are not limited to:

- bird and bat strike associated with wind farm developments
- vehicle strike
- subsidence and cliff falls associated with mining developments
- downstream impacts on hydrology and environmental flows on surface vegetation and groundwater dependent ecosystems and
- impacts on karst ecosystems.

The Proposed Modification will not involve impacts related to wind farms, substantial changes to vehicle strike risk, or on karst ecosystems. The Proposed Modification will not lead to subsidence associated impacts as it is an open cut mine. Cliff falls can be a risk associated with the high-wall within the mining activity, however, no natural cliff areas will be impacted by the Proposed Modification.

The potential impacts on groundwater dependent ecosystems and downstream impacts on hydrology and environmental flows on vegetation are outlined in the main text of the SEE (Umwelt 2018). It was concluded that the Proposed Modification would not result in significant downstream impacts on surface vegetation. The SEE also contained a detailed assessment of impacts on GDEs, with drawdowns determined to be within levels previously assessed as not being significant as part of the Mount Owen Continued Operations Project (Umwelt 2015b).

6 Biodiversity Credit Report

A full Biodiversity Credit Report is included in **Appendix C**. A summary of the key outcomes in provided in the following sections.

6.1 Credits Required to Offset the Proposed Modification

Table 6.1 below provides a summary of the ecosystem and species credits that require offsetting as a result of the Proposed Modification.

Table 6.1 Credits Required to Offset the Proposed Modification

Name	Credits Required
Ecosystem Credits	
HU815 – Spotted Gum - Narrow-leaved Ironbark - Red Ironbark Shrub - Grass Open Forest Slopes of the Central and Lower Hunter	984
HU906 – Bull Oak Grassy Woodland of the Central Hunter Valley	66
HU945 – Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley	12
Total	**1,062**
Species Credits	
brush-tailed phascogale (*Phascogale tapoatafa*)	177
Total	**177**

7 Biodiversity Offset Strategy

Mount Owen is committed to delivering a biodiversity offset strategy that appropriately addresses the relevant requirements in accordance with the FBA and NSW Biodiversity Offests Policy for Major Projects.

The final biodiversity offset strategy to be delivered for the Proposed Modification will meet the offset requirements identified in **Section 6.0** and will include one or a combination of the following offsetting options under the FBA:

- In-perpetuity conservation through the establishment of proponent-managed Stewardship Site established in accordance with Part 5 of the BC Act, achieved through the retirement of credits. Whilst Mount Owen has identified land within its portfolio that is suitable for meeting the offsetting requirments for the Proposed Modification, it is considering the following alternatives for this Proposed Modification to support regional strategic conservation outcomes sought by Government.

- Securing required credits through the open credit market, and/or

- Payments to the Biodiversity Conservation Fund (established under the BC Act). One of the key functions of the NSW Biodiversity Conservation Trust (BCT) is to secure land-based offsets on behalf of developers who pay into the Biodiversity Conservation Fund (BCT 2018). Through this process the BCT is able to combine offset obligations and funds to establish strategic, larger and more viable offset sites in NSW (NSW Government 2018).

Mount Owen will finalise the biodiversity offset strategy following further discussion with OEH on the above offsetting options.

8 Matters of National Environmental Significance

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment and Energy is required for any action that may have a significant impact on matters of national environmental significance (MNES). These matters are:

- listed threatened species and communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- the Great Barrier Reef Marine Park
- World Heritage properties
- National Heritage places
- nuclear actions and
- a water resource, in relation to coal seam gas development and large coal mining development.

Those aspects of the Proposed Modification requiring approval under the EPBC Act were referred to DoEE in October 2017 to determine whether or not it was a controlled action, thereby requiring approval of the Commonwealth Minister for the Environment and Energy. Detailed assessments of significance were prepared for the following ecological MNES considered to have the potential to occur or be impacted by the Proposed Modification:

Critically Endangered or Endangered Ecological Communities

- *Central Hunter Valley Eucalypt Forest and Woodland CEEC*.

Critically Endangered and Endangered Species

- swift parrot (*Lathamus discolor*)
- regent honeyeater (*Anthochaera phrygia*)
- Australian painted snipe (*Rostratula australis*) and
- spotted-tailed quoll (*Dasyurus maculatus maculatus*) (SE mainland population).

Vulnerable Species

- green and golden bell frog (*Litoria aurea*)
- koala (*Phascolarctos cinereus*) (combined populations of Qld, NSW and the ACT)

- New Holland mouse (*Pseudomys novaehollandiae*)
- large-eared pied bat (*Chalinolobus dwyeri*) and
- grey-headed flying-fox (*Pteropus poliocephalus*).

Migratory Species Listed under International Conventions

- Latham's snipe (*Gallinago hardwickii*)
- white-throated needletail (*Hirundapus caudacutus*) and
- rufous fantail (*Rhipidura rufifrons*).

On 15 December 2017, the Proposed Modification was determined not to be a Controlled Action and does not require approval under the EPBC Act. As such, no further assessment of MNES is included in this report.

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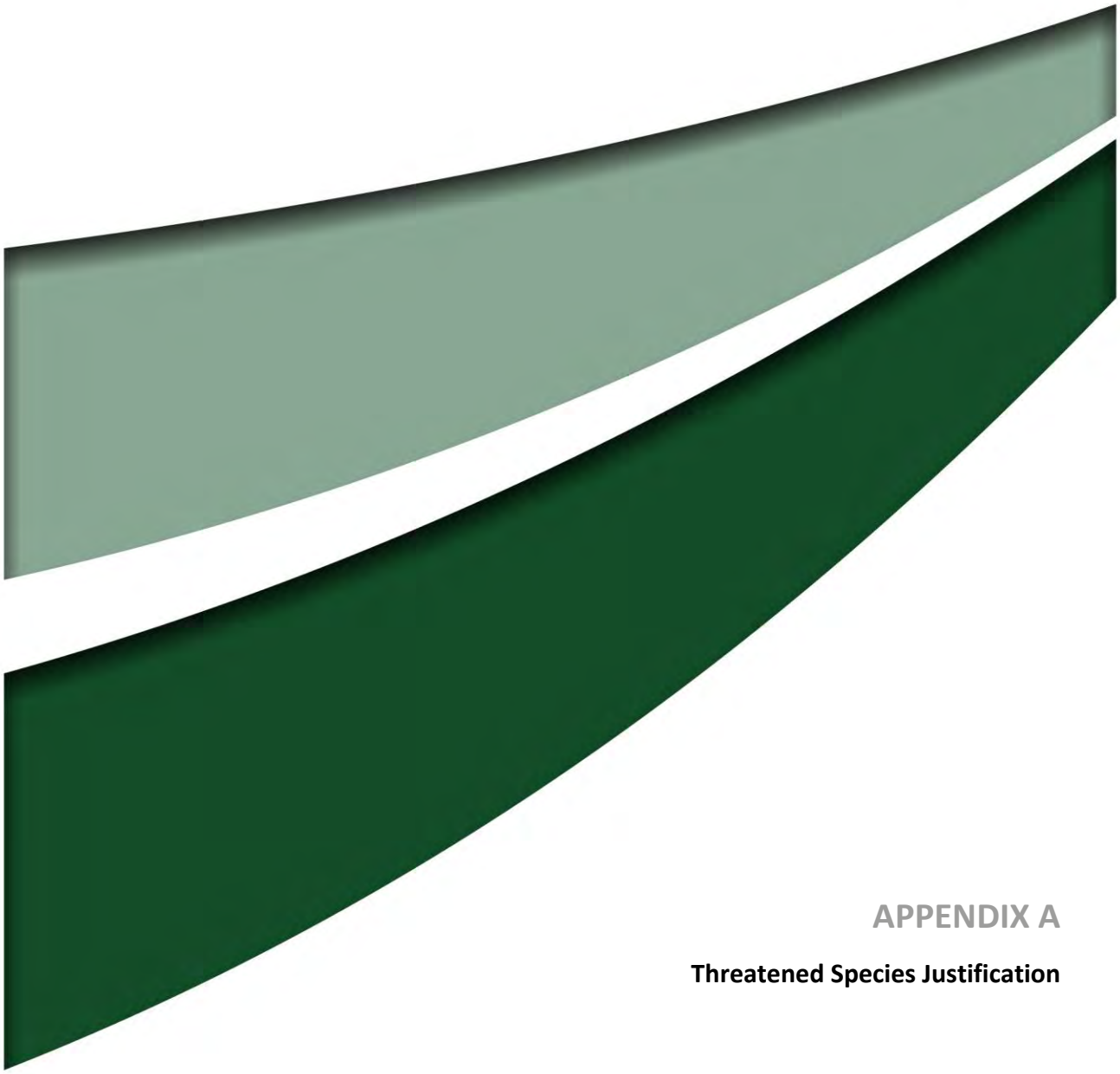


APPENDIX A

Threatened Species Justification

Threatened Species Assessment Justification

Table A1 below lists the flora and fauna species-credit species that were identified during database searches, a literature review and an assessment using the BioBanking Credit Calculator that are considered unlikely to occur due to lack of suitable habitat and absence of local records. **Table A1** provides an individual description of why each of the species was excluded from further assessment within the Development Footprint as per Section 6.5.1.6 of the FBA (OEH 2014b). In many cases, the seasonal survey requirements for these species were adequately covered during the species-credit flora and fauna species surveys outlined in **Section 2.3**.

Habitat and record information is derived from the BioNet Atlas of NSW Wildlife (OEH 2017a), OEH threatened species profiles (OEH 2017b), and DoEE (SPRAT) profiles (DoEE 2017b), unless otherwise noted.

1 BioBanking Credit Calculator
2 BioNet Atlas of NSW Wildlife
3 Protected Matters Search Tool
CE Critically Endangered
E Endangered
V Vulnerable

Table A1 – Threatened Species Assessment Justification

Common Name *Scientific Name*	BC Act	EPBC Act	Source	Reason Targeted Surveys and Further Assessment Were Not Required
Flora Species				
Bynoe's wattle *Acacia bynoeana*	E	V	1	This species is not known from the central Hunter Valley area. This species is known to occur from Morisset in Lake Macquarie, south to the Southern Highlands and west to the Blue Mountains and is associated with heath or dry sclerophyll forest on sandy soils. The nearest record of this species is over 35 kilometres to the southeast of the Development Footprint near Branxton. Floristic surveys and targeted threatened flora walking transects undertaken during the detection period of this species (September-March) did not record this species in the Development Footprint. Furthermore, the species has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.

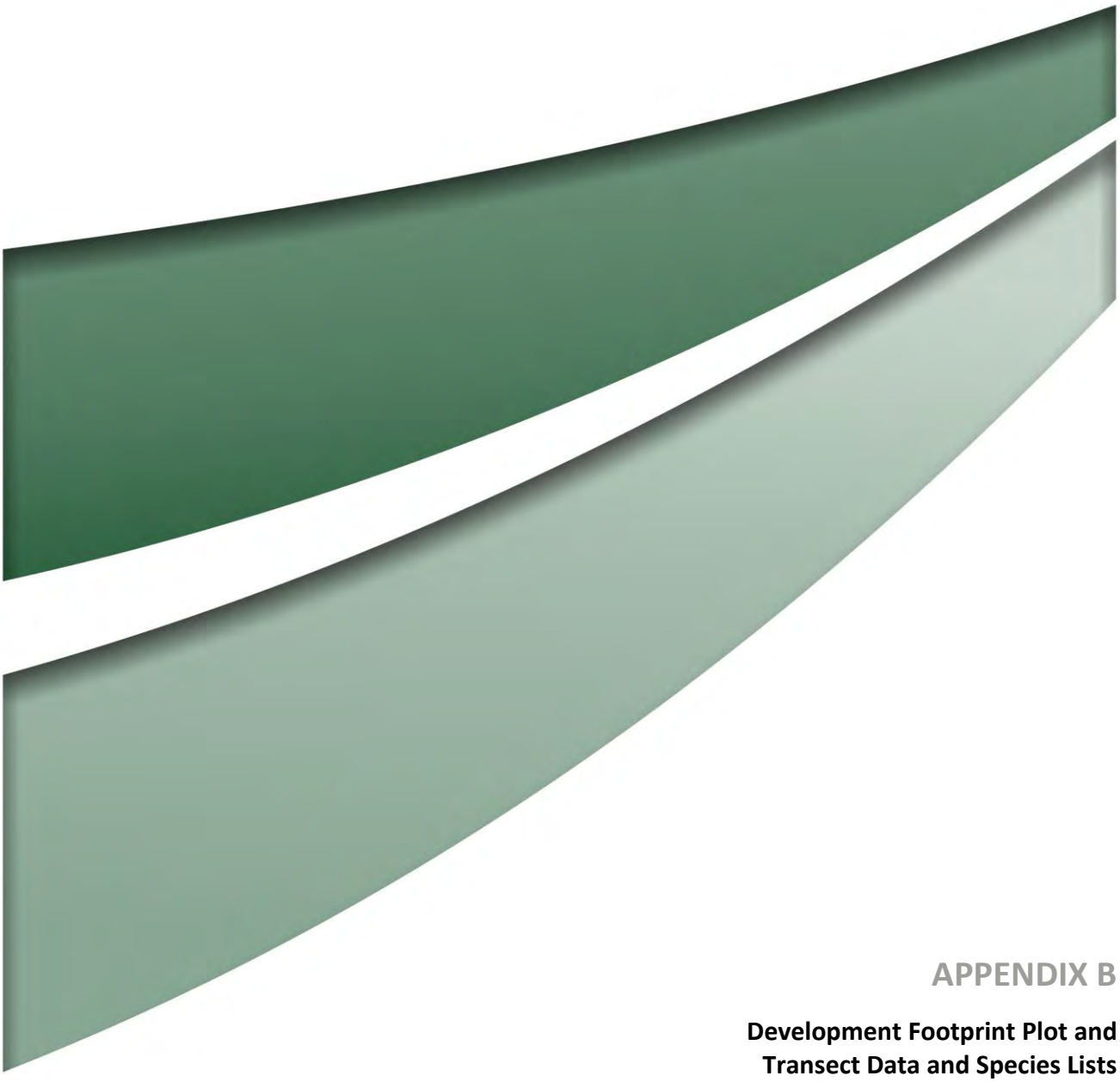
Common Name *Scientific Name*	BC Act	EPBC Act	Source	Reason Targeted Surveys and Further Assessment Were Not Required
leafless tongue orchid *Cryptostylis hunteriana*	V	V	1	This species is not known from the central Hunter Valley area. This species occurs in a wide variety of habitats however is generally restricted to the coastal areas of NSW. The nearest record of this species is over 70 kilometres to the west of the Development Footprint in Heaton State Forest. Targeted floristic surveys and opportunistic observations undertaken during the detection period of this species (Nov-Feb) did not record this species in the Development Footprint. Furthermore, the species has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.
bluegrass *Dichanthium setosum*	V	V	3	This species is not known from the central Hunter Valley area. This species is known to occur on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW and is associated with heavy basaltic black soils and red-brown loams with clay subsoil. The nearest record of this species is over 60 kilometres to the northwest of the Development Footprint near Kars Springs. Targeted floristic surveys and opportunistic observations undertaken during the detection period of this species (Dec-May) did not record this species in the Development Footprint. Furthermore, the species has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.
rough doubletail *Diuris praecox*	V	V	1	This species is not known from the central Hunter Valley area. This species is restricted to the coastal districts of NSW on hills and slopes. The nearest record of this species is over 80 kilometres to the southeast of the Development Footprint in Glenrock State Conservation Area. Opportunistic observations undertaken during the detection period of this species (July-Aug) did not record this species in the Development Footprint. Furthermore, the Development Footprint does not contain suitable habitat for this species and it has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.

Common Name *Scientific Name*	BC Act	EPBC Act	Source	Reason Targeted Surveys and Further Assessment Were Not Required
Euphrasia arguta	CE	CE	3	This species is not known from the central Hunter Valley area. This species was rediscovered in 2008 in the Nundle area and has since been recorded in the Barrington Tops. The nearest of these records is over 75 kilometres to the north of the Development Footprint in the Barrington Tops. Targeted floristic surveys and opportunistic observations undertaken during the detection period of this species (January-April) did not record this species in the Development Footprint. Furthermore, the species has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.
large-leafed monotaxis *Monotaxis macrophylla*	E	-	1	This species is not known from the central Hunter Valley area. This species only appears to be detectable following fire events and is known to grow on rocky ridges and hillsides. The nearest record of this species is over 50 kilometres to the west of the Development Footprint in Wollemi National Park. Floristic surveys and targeted threatened flora walking transects undertaken during the detection period of this species (June-Nov) did not record this species in the Development Footprint. Furthermore, the Development Footprint does not contain suitable rocky habitat for this species. This species does not require further assessment.
North Rothbury persoonia *Persoonia pauciflora*	CE	CE	1	This species has a highly restricted distribution and is found only in the south of the North Rothbury township approximately 35 km to the southeast of the Development Footprint. The extent of occurrence for this species is approximately 4.5 square kilometres in the North Rothbury area. This species does not require further assessment.
Magenta Lilly Pilly *Syzygium paniculatum*	E	V	3	This species is not known from the central Hunter Valley area. The nearest record of this species is close to 50 km to the east of the Development Footprint. Floristic surveys and targeted threatened flora walking transects undertaken during the detection period of this species (all year) did not record this species in the Development Footprint. Furthermore, the Development Footprint does not contain suitable rainforest communities for this species. This species does not require further assessment.

Common Name *Scientific Name*	BC Act	EPBC Act	Source	Reason Targeted Surveys and Further Assessment Were Not Required
Fauna Species (Species-credit)				
booroolong frog *Litoria booroolongensis*	E	E	3	This species occurs predominantly along the western-flowing streams of the Great Dividing Range. Primary habitat requirements for the species include extensive rock bank structures along permanent rivers. The closest record of the species occurs approximately 25 km to the northeast of the Development Footprint in Mount Royal National Park and was recorded in 1979. Targeted nocturnal and diurnal amphibian surveys in February, March, April and October 2017 did not record this species in the Development Footprint. Furthermore, the Development Footprint does not contain suitable rock bank or permanent river habitat for this species and it has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.
giant burrowing frog *Heleioporus australiacus*	V	V	3	This species occurs in southeastern NSW and is not known to occur north of the extent of Wollemi National Park. In this area, the species occurs in hanging swamps on sandstone shelves and beside perennial creeks. The closest record of the species occurs approximately 30 km to the southwest of the Development Footprint in Wollemi National Park. Targeted nocturnal and diurnal amphibian surveys in February, March, April and October 2017 did not record this species in the Development Footprint. Furthermore, the Development Footprint does not contain suitable hanging swamp or sandstone habitat for this species and it has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.
stuttering frog *Mixophyes balbus*	E	V	3	This species is found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. The species appears to be restricted to undisturbed and conserved locations in NSW. The closest record of the species occurs approximately 25 km to the northeast of the Development Footprint in Mount Royal National Park. Targeted nocturnal and diurnal amphibian surveys in February, March, April and October 2017 did not record this species in the Development Footprint. Furthermore, the Development Footprint does not contain tall rainforest, escarpment habitat for this species and it has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.

Common Name *Scientific Name*	BC Act	EPBC Act	Source	Reason Targeted Surveys and Further Assessment Were Not Required
Australasian bittern *Botaurus poiciloptilus*	E	E	3	This species is typically confined to more coastal regions where the species is found in swamps and water bodies with dense tall stands of reeds. The closest record of the species occurs approximately 40 km to the south of the Development Footprint near Cessnock. Diurnal and nocturnal surveys undertaken for this assessment did not record this species in the Development Footprint. Furthermore, the wetland habitat in the Development Footprint does not contain dense tall stands of reeds suitable for this species and it has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.
red goshawk *Erythrotriorchis radiatus*	CE	V	2, 3	This species is very rare in NSW and is generally known from areas north of Coffs Harbour. Few sporadic historic records (over 30 years old) occur in the Hunter. One record from Falbrook (within 3 km of the Development Footprint) from 1982 has an accuracy of 10km. Diurnal surveys undertaken for this assessment did not record this species in the Development Footprint. Furthermore, targeted surveys undertaken as part of the Greater Ravensworth UHSA did not record the species in the wider locality. It has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.
common planigale *Planigale maculata*	V	-	1	This species has rarely been recorded in the Hunter Valley and all records occur north of Dungog and east of the Barrington Tops over 60 km from the Development Footprint. Extensive remote camera surveys undertaken for this assessment did not record this species in the Development Footprint. Furthermore, trapping undertaken as part of annual monitoring in the Mount Owen Complex has not recorded this species in the wider locality in over 20 years of survey. This species does not require further assessment.

Common Name *Scientific Name*	BC Act	EPBC Act	Source	Reason Targeted Surveys and Further Assessment Were Not Required
brush-tailed rock-wallaby *Petrogale penicillata*	E	V	3	This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges. The closest record of the species occurs approximately 15 km to the west of the Development Footprint near Howick from 1996, but is more commonly known from Wollemi National Park approximately 30 km from the Development Footprint. Diurnal surveys undertaken for this assessment did not record this species in the Development Footprint. Furthermore, the Development Footprint does not contain suitable rocky escarpment habitat suitable for this species and it has not been detected following many years of ecological surveys in the locality. This species does not require further assessment.
large-eared pied bat *Chalinolobus dwyeri* (breeding habitat only)	V	V	2, 3	This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges. This species has been tentatively recorded in the Mount Owen Complex during annual fauna monitoring surveys in 1999, 2001, 2006, 2008, 2014 and 2015 using call echolocation recording however no individuals have been captured to confirm its presence (Forest Fauna Surveys 2017). The species-credit component of this species includes roosting and breeding habitat that contains land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels. The Development Footprint does not contain this roosting and breeding habitat suitable for this species. While it is acknowledged that suitable foraging habitat may occur within the Development Footprint for this species, this is not required to be targeted as a candidate species-credit species. Therefore, this species does not require further assessment.



APPENDIX B

Development Footprint Plot and Transect Data and Species Lists

Plot and Transect Data

The following plot and transect data was collected from surveys of the Development Footprint. It includes the ten site attributes that are recorded in each Biometric plot and transect as per Table 2 of the FBA (OEH 2014b). This data is assessed against benchmark data for PCTs and then entered into the BioBanking Credit Calculator (Major Project type) to assess the site value of each PCT in the Development Footprint.

The following abbreviations or symbols are used in the list:

NPS	native plant species
NOC	native overstorey cover
NMC	native midstorey cover
NGCG	native ground cover (grasses)
NGCS	native ground cover (shrubs)
NGCO	native ground cover (other)
EPC	exotic plant cover
NTH	number of trees with hollows
OR	overstorey regeneration, and
FL	total length of fallen logs.

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Zone 1: HU815 - Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good													
3810F-P01-Q	41	31	2.5	52	4	18	2	0	1	10	323438	6413113	56
3810F-P06-Q	38	32.5	0	48	18	26	2	1	1	0	323926	6412151	56
3810F-P07-Q	30	39	2	48	24	28	0	2	1	9.5	323884	6411927	56
Zone 2: HU815 - Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good - Plantation													
3810F-P02-Q	33	20.5	7.5	0	10	0	8	0	0	0	323383	6413357	56
3810F-P04-Q	36	11.1	5.1	78	8	42	30	0	0	34.5	323459	6412911	56
Zone 3: HU815 - Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Derived Native Grassland													
3810F-P03-Q	13	0	0	100	0	14	30	0	0.25	0	323949	6411763	56
3810F-P08-Q	23	0	0	96	0	50	22	0	0.25	0	323837	6411252	56
3810F-P09-Q	21	0	0	96	0	32	28	0	0.25	0	323379	6411878	56
3810F-P11-Q	14	0	2	100	12	54	14	0	0.25	0	323661	6411782	56
Zone 4: HU815 - Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter - Derived Native Grassland - Olive Plantation													
3810F-P12-Q	11	0	0	90	0	24	56	0	0	0	323941	6411402	56
3810F-P13-Q	15	0	0	88	0	8	34	0	0	0	323874	6411330	56
3810F_P14-Q	16	0	0	70	0	16	72	0	0	0	323795	6411444	56
Zone 5: HU906 -Bull Oak Grassy Woodland of the Central Hunter Valley– Moderate to Good													
3810F-P05-Q	23	16.5	3	70	24	28	0	0	1	0	323575	6411651	56
Zone 6: HU945 - Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley – Moderate to Good													
3810F-P10-Q	25	14.1	5	66	10	32	8	0	1	0	323919	6411888	56

Flora Species List

The following list was developed from the systematic plot and transect surveys of the Development Footprint by Umwelt as outlined in **Section 2.2.3**. It includes all species of vascular plants observed during these surveys. It is acknowledged that the list is not comprehensive, as not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

sp.	specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

AR	denotes abundance rating according to BBAM 2014
C	cover measure according to BBAM 2014
asterisk (*)	denotes species non-native species
subsp.	subspecies and
var.	variety.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2017), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Family	Scientific Name	Common Name	P01		P02		P03		P04		P05		P06		P07		P08		P09		P10		P11		P12		P13		P14		Opportunistic Record
			AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	
Filicopsida (Ferns)																															
Adiantaceae	*Cheilanthes distans*	bristly cloak fern	5	0.1															20	0.1											
Adiantaceae	*Cheilanthes sieberi* subsp. *sieberi*	rock fern	20	0.1			50	0.1	10	0.1	5	0.1	50	0.1	10	0.1	50	0.2	20	0.1	1000	0.5	100	0.5	50	0.2	20	0.1	50	0.1	
Magnoliopsida – Liliidae (monocots)																															
Anthericaceae	*Dichopogon fimbriatus*								2	0.1											1	0.1									
Anthericaceae	*Laxmannia gracilis*	slender wire lily	5	0.1							50	0.2	10	0.1							5	0.1	3	0.1							
Cyperaceae	*Cyperus gracilis*	slender flat-sedge	3	0.1									4	0.1	5	0.1															
Cyperaceae	*Fimbristylis dichotoma*	common fringe-sedge					5	0.1			3	0.1					5	0.1	1	0.1			2	0.1	2	0.1	5	0.1	5	0.1	
Cyperaceae	*Lepidosperma laterale*	variable sword-sedge							1	0.1																					
Iridaceae	*Romulea rosea var. australis**						1000	0.5									100	0.2	50	0.1	50	0.1	500	0.1	100	1	1000	5	1000	0.2	
Juncaceae	*Juncus acutus* subsp. *acutus**																										1	0.1			
Juncaceae	*Juncus usitatus*												1	0.1	2	0.2															
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	wattle matt-rush	1	0.1							20	0.1	1000	1	100	0.2					5	0.1	5	0.1			1	0.1			
Lomandraceae	*Lomandra longifolia*	spiny-headed mat-rush			20	0.5																									
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	many-flowered mat-rush	3	0.1					7	0.5	20	0.5	20	2	10	0.2	5	0.3			2	0.2	20	0.5							
Phormiaceae	*Dianella caerulea*	blue flax-lily																													x
Phormiaceae	*Dianella longifolia*	blueberry lily	3	0.1											1	0.1															
Phormiaceae	*Dianella revoluta*	blueberry lily	20	0.2					2	0.1			3	0.1	10	0.5					1	0.1									
Poaceae	*Aristida ramosa*	purple wiregrass	50	5			100	4.5	100	18	50	5	100	10	100	15	100	25	100	25	50	15	100	2.5	50	10	100	30	100	35	
Poaceae	*Austrostipa scabra*	speargrass	20	0.5							1	0.1					2	0.1									1	0.1	1	0.1	
Poaceae	*Austrostipa verticillata*	slender bamboo grass							1	0.1			10	0.5																	
Poaceae	*Axonopus fissifolius**	narrow-leafed carpet grass			50	2																	50	2	100	2	1	0.1	20	0.5	
Poaceae	*Bothriochloa macra*	red grass	3	0.1	50	2	100	1	50	5	50	5	50	3	100	2	50	3	100	20	50	2	50	1	50	1			20	0.5	
Poaceae	*Briza minor**	shivery grass															1	0.1	50	0.5			50	0.2			5	0.1	50	0.1	
Poaceae	*Chloris gayana**	Rhodes grass			50	5																									x
Poaceae	*Chloris truncata*	windmill grass					1	0.1									1	0.1									1	0.1	1	0.1	

Family	Scientific Name	Common Name	P01		P02		P03		P04		P05		P06		P07		P08		P09		P10		P11		P12		P13		P14		Opportunistic Record
			AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	
Poaceae	*Chloris ventricosa*	tall chloris	10	0.2					50	10			5	0.1	5	0.1	4	0.1													
Poaceae	*Cortaderia selloana**	pampas grass																													x
Poaceae	*Cymbopogon refractus*	barbed wire grass	50	5	5	0.1		2	20	0.5	20	0.2	50	1	50	5	100	20	100	25	50	15	100	2.5	10	0.1	50	15	20	5	
Poaceae	*Cynodon dactylon*	common couch			100	2.5	50	2									100	10	50	5					100	25	50	2	10	0.5	
Poaceae	*Digitaria brownii*	cotton panic grass			3	0.1																									
Poaceae	*Digitaria diffusa*	open summer-grass	2	0.1																											
Poaceae	*Echinopogon caespitosus*	bushy hedgehog-grass							1	0.1	2	0.1			3	0.1															
Poaceae	*Enneapogon gracilis*	slender nineawn																											4	0.1	
Poaceae	*Enteropogon acicularis*	curly windmill grass	10	0.1	10	0.1	50	0.2	2	0.1							3	0.1			1	0.1					1	0.1			
Poaceae	*Eragrostis brownii*	Browns lovegrass									10	0.1					100	0.5			10	0.1									
Poaceae	*Eragrostis leptostachya*	paddock lovegrass	50	0.5			100	5					5	0.1	1	0.1															
Poaceae	*Eragrostis* sp.*	lovegrass			20	0.2					1	0.1							100	1			100	0.5	20	0.2	5	0.1	20	1	
Poaceae	*Hyparrhenia hirta**	Coolatai grass																													x
Poaceae	*Lolium rigidum**	Wimmera ryegrass															4	0.1													
Poaceae	*Melinis repens**	red natal grass			3	0.1																					10	0.2	3	0.1	
Poaceae	*Microlaena stipoides*	weeping grass	2	0.1					500	30	1	0.1	5	0.1	3	0.1					50	15			100	25	100	2	50	5	
Poaceae	*Panicum effusum*	hairy panic	3	0.1	2	0.1	50	0.3	3	0.1	1	0.1					20	0.5	50	0.2	20	0.2	100	0.5	1	0.1	50	15	50	5	
Poaceae	*Paspalidium distans*														2	0.1															
Poaceae	*Paspalidium* sp.																				1	0.1									
Poaceae	*Paspalum dilatatum**	paspalum							1	0.1					1	0.1	5	0.2					1	0.1			50	0.2	1	0.1	
Poaceae	*Rytidosperma fulvum*	wallaby grass	1	0.1	3	0.1					2	0.1					3	0.1													
Poaceae	*Rytidosperma* sp.								5	0.1					2	0.1			1	0.1											
Poaceae	*Setaria parviflora**						1	0.1									10	0.1	5	0.1					50	0.2	20	0.5	20	0.5	
Poaceae	*Setaria sphacelata**	south african pigeon grass																													x
Poaceae	*Sporobolus creber*	slender rat's tail grass			50	2	100	40	6	0.1	1	0.1	1	0.1			100	30	100	25	1	0.1	100	2.5	50	5	5	0.1	50	5	
Magnoliopsida – Magnoliidae (dicots)																															
Acanthaceae	*Brunoniella australis*	blue trumpet							20	0.1			3	0.1	50	0.1															
Aizoaceae	*Galenia pubescens**	galenia																													x
Amaranthaceae	*Gomphrena celosioides**	gomphrena weed																													x
Apiaceae	*Centella asiatica*	Indian pennywort																	1	0.1											

Family	Scientific Name	Common Name	P01		P02		P03		P04		P05		P06		P07		P08		P09		P10		P11		P12		P13		P14		Opportunistic Record
			AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	
Apocynaceae	*Gomphocarpus fruticosus**	narrow-leaved cotton bush			1	0.1			1	0.1			1	0.1					3	0.1							3	0.1			
Asteraceae	*Bidens pilosa**	Cobblers pegs	10	0.1					50	0.5	1	0.1	10	0.1	3	0.1					3	0.1			20	0.2	100	1	5	0.1	
Asteraceae	*Calotis lappulacea*	yellow burr-daisy	5	0.1					100	1	1	0.1	4	0.1																	
Asteraceae	*Chrysocephalum apiculatum*	common everlasting			20	0.1	100	1			50	0.5	1	0.1			50	0.3	10	0.1	20	0.1	10	0.1							
Asteraceae	*Cirsium vulgare**	spear thistle	3	0.1					1	0.1					1	0.1															
Asteraceae	*Conyza bonariensis**	flaxleaf fleabane																							20	0.2	3	0.1			
Asteraceae	*Conyza* sp.*	fleabane					3	0.1																							
Asteraceae	*Facelis retusa**	annual trampweed					10	0.1									1	0.1	3	0.1			5	0.1	5	0.1	5	0.1	50	0.1	
Asteraceae	*Hypochaeris radicata**	catsear			3	0.1	50	0.1					3	0.1	1	0.1	100	0.2	20	0.1	5	0.1	20	0.1	100	1	50	0.2	20	0.1	
Asteraceae	*Senecio madagascariensis**	fireweed			5	0.1	10	0.1	10	0.1	20	0.1	3	0.1	3	0.1	50	0.2	10	0.1	10	0.1	3	0.1	1000	1	5	0.1	10	0.1	
Asteraceae	*Sigesbeckia orientalis* subsp. *orientalis*	indian Weed	5	0.1																											
Asteraceae	*Soliva sessilis**	bindyi					50	0.1									50	0.1	20	0.1			50	0.1	20	0.1					
Asteraceae	*Sonchus oleraceus**	common sowthistle					1	0.1	2	0.1	1	0.1			1	0.1													1	0.1	
Asteraceae	*Tagetes minuta**	stinking Roger																													x
Asteraceae	*Tolpis barbata**	yellow hawkweed																											50	0.1	
Asteraceae	*Vernonia cinerea*		20	0.1									10	0.1											1	0.1					
Asteraceae	*Vittadinia sulcata*		1	0.1	3	0.1			3	0.1			1	0.1																	
Boraginaceae	*Cynoglossum australe*																														
Brassicaceae	*Lepidium africanum**	common peppercress																							1	0.1					
Cactaceae	*Opuntia stricta* var. *stricta**	common prickly pear	3	0.1					1	0.1															3	0.1					
Campanulaceae	*Wahlenbergia gracilis*	sprawling bluebell					1	0.1											1	0.1											
Campanulaceae	*Wahlenbergia* sp.	bluebell									1	0.1																			
Casuarinaceae	*Allocasuarina littoralis*	black she-oak			10	2																									
Casuarinaceae	*Allocasuarina luehmannii*	bulloak									100	25	6	2	20	5	6	0.1			5	2									
Casuarinaceae	*Casuarina glauca*	swamp oak			10	3															500	30									
Chenopodiaceae	*Einadia hastata*	berry saltbush											2	0.1																	
Chenopodiaceae	*Einadia nutans*	climbing saltbush	3	0.1																											
Chenopodiaceae	*Maireana microphylla*	small-leaf bluebush	2	0.1	2	0.1			1000	0.2																					
Convolvulaceae	*Dichondra repens*	kidney weed	50	0.1	50	0.1			100	0.5			1000	0.5	100	0.2	10	0.1	10	0.1							50	0.1	20	0.1	

Family	Scientific Name	Common Name	P01		P02		P03		P04		P05		P06		P07		P08		P09		P10		P11		P12		P13		P14		Opportunistic Record
			AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	
Dilleniaceae	*Hibbertia obtusifolia*	hoary guinea flower											2	0.1																	
Ericaceae	*Lissanthe strigosa*	peach heath	20	3	3	0.1					20	1	20	3	1	0.1	3	0.1			1	0.1	4	0.2							
Euphorbiaceae	*Chamaesyce drummondii*												5	0.1																	
Fabaceae (Faboideae)	*Daviesia ulicifolia*	gorse bitter pea									3	0.1	1	0.1	2	0.1	3	0.1			4	0.3									x
Fabaceae (Faboideae)	*Desmodium brachypodum*	large tick-trefoil	20	0.2	20	0.1			20	0.1			20	0.1					1	0.1	2	0.1									
Fabaceae (Faboideae)	*Glycine clandestina*	twining glycine							5	0.1					5	0.1															
Fabaceae (Faboideae)	*Glycine tabacina*	variable glycine			20	0.1			20	0.5	20	0.1	50	0.1					1	0.1	50	0.2					3	0.1			
Fabaceae (Faboideae)	*Indigofera australis*	Australian indigo							1	0.1																					
Fabaceae (Faboideae)	*Medicago minima**	woolly burr medic																	50	0.1					1000	1					
Fabaceae (Faboideae)	*Medicago* sp.*	medic					100	0.1																							
Fabaceae (Faboideae)	*Pultenaea retusa*				1	0.1																									
Fabaceae (Faboideae)	*Pultenaea spinosa*	spiny bush-pea			1	0.1																									
Fabaceae (Faboideae)	*Trifolium campestre**	hop clover																									100	0.2	1000	0.3	
Fabaceae (Faboideae)	*Trifolium repens**	white clover																											500	0.2	
Fabaceae (Mimosoideae)	*Acacia amblygona*	fan wattle			20	2							4	0.5	10	1					2	0.3									
Fabaceae (Mimosoideae)	*Acacia decora*	western silver wattle							8	1																					
Fabaceae (Mimosoideae)	*Acacia falcata*				2	0.1			10	0.2																					
Fabaceae (Mimosoideae)	*Acacia implexa*	hickory wattle	3	0.2	3	0.5			50	25			4	0.5	5	0.5															
Fabaceae (Mimosoideae)	*Acacia irrorata*	green wattle			3	0.3																									
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	prickly moses																													x
Gentianaceae	*Centaurium* sp.*																				1	0.1					2	0.1	1	0.1	
Geraniaceae	*Geranium solanderi*	native geranium																	50	0.5					50	0.1			20	0.1	
Haloragaceae	*Haloragis heterophylla*	variable raspwort							3	0.1							5	0.1					1	0.1			3	0.1			
Lamiaceae	*Ajuga australis*	austral bugle	20	0.2																											
Lamiaceae	*Ballota nigra* subsp. *foetida**																														x
Linaceae	*Linum trigynum**	French flax			50	0.1	1000	0.2			50	0.1					50	0.1	50	0.5	20	0.1	50	0.1			50	0.1			
Lobeliaceae	*Pratia concolor*	poison pratia																													
Lobeliaceae	*Pratia purpurascens*	whiteroot	5	0.1					100	0.2			20	0.1	50	0.2			50	0.2	20	0.1									

Family	Scientific Name	Common Name	P01		P02		P03		P04		P05		P06		P07		P08		P09		P10		P11		P12		P13		P14		Opportunistic Record
			AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	AR	C	
Malvaceae	*Modiola caroliniana**	red-flowered mallow							1	0.1																					
Malvaceae	*Sida rhombifolia**	Paddys lucerne	10	0.2	10	0.1			20	0.2									1	0.1	20	0.5			50	1					
Myoporaceae	*Eremophila debilis*	amulla	20	1																											
Myrsinaceae	*Anagallis arvensis**	scarlet pimpernel			20	0.1	1000	0.5	50	0.2			1	0.1	1	0.1	1000	0.5	1000	1	50	0.1	50	0.1	1000	1	500	2	1000	1	
Myrtaceae	*Angophora floribunda*	rough-barked apple			1	0.2																									
Myrtaceae	*Callistemon* sp.				2	0.2																									
Myrtaceae	*Corymbia maculata*	spotted gum	5	4	4	2			2	0.5					20	20					1	0.3									
Myrtaceae	*Eucalyptus crebra*	narrow-leaved ironbark	3	2	5	2							1	0.1																	
Myrtaceae	*Eucalyptus fibrosa*	red ironbark	5	5	3	1							6	20	5	0.1															
Myrtaceae	*Eucalyptus moluccana*	grey box	8	7	5	3																									
Myrtaceae	*Eucalyptus punctata*	grey gum			1	1																									
Myrtaceae	*Melaleuca styphelioides*	prickly-leaved tea tree			10	2																									
Oleaceae	*Olea europaea* subsp. *cuspidata**	african olive	10	3									3	0.1	2	0.1									20	15	20	25	20	25	
Oxalidaceae	*Oxalis perennans*		3	0.1					5	0.1			1	0.1			3	0.1	10	0.1											
Phyllanthaceae	*Breynia oblongifolia*	coffee bush																													x
Pittosporaceae	*Bursaria spinosa*	native blackthorn	2	0.5							10	1	5	0.2	10	1															
Plantaginaceae	*Plantago debilis*	shade plantain							6	0.1							5	0.1	10	0.1			3	0.1							
Plantaginaceae	*Plantago lanceolata**	lambs tongues					5	0.1									20	0.1	5	0.1					100	1	100	1	50	0.2	
Plantaginaceae	*Plantago* sp.	plantain			3	0.1																									
Plantaginaceae	*Veronica plebeia*	trailing speedwell	20	0.1					2	0.1									3	0.1											
Polygonaceae	*Persicaria lapathifolia*	pale knotweed																													x
Proteaceae	*Grevillea robusta*	silky oak																											2	0.1	x
Rubiaceae	*Asperula conferta*	common woodruff	10	0.1									3	0.1	10	0.1															
Rubiaceae	*Richardia* sp.*				20	0.1															500	0.3									
Solanaceae	*Solanum nigrum**	black-berry nightshade	1	0.1					1	0.1			5	0.3	2	0.1															
Solanaceae	*Solanum prinophyllum*	forest nightshade	5	0.1					1	0.1			3	0.1	5	0.2															
Stackhousiaceae	*Stackhousia muricata*	stackhousia																											1	0.1	
Verbenaceae	*Lantana camara**	lantana																													x
Verbenaceae	*Verbena bonariensis**	purpletop																	1	0.1											
Verbenaceae	*Verbena incompta**	purpletop																													x
Verbenaceae	*Verbena rigida* var. *rigida**	veined verbena			5	0.1	5	0.1	2	0.1									50	1									3	0.1	

Fauna Species List

The following list was developed from surveys of the Development Footprint, as well as from historical surveys of the Mount Owen Complex. This species list was compiled from data from the OEH Atlas of NSW Wildlife, species recorded during field surveys undertaken by Umwelt from 2011 to 2017, as well as records from the 18 years of biodiversity monitoring of the Mount Owen Complex by the University of Newcastle (TUNRA and Newcastle Innovation), Forest Fauna Surveys Pty Ltd and Fly By Night Pty Ltd.

The following abbreviations or symbols are used in the list:

asterisk (*)	Denotes species not indigenous to Mount Owen Complex
carat (^)	Denotes a tentative species record
subsp.	Subspecies
MIG	Listed migratory species under the EPBC Act
V	Vulnerable under Schedule 2 of the Biodiversity Conservation Act 2016 (BC Act);
E	Endangered under Schedule 1 of the BC Act.

Birds recorded were identified using descriptions in Slater *et al.* (2009) and the scientific and common name nomenclature of BirdLife International Taxonomic Checklist (2017) (formerly Birds Australia). Reptiles recorded were identified using keys and descriptions in Cogger (2014), Swan *et al.* (2004), Weigel (1990) and Wilson and Swan (2003) and the scientific and common name nomenclature of Cogger (2014).

Amphibians recorded were identified using keys and descriptions in Cogger (2014), Robinson (1998), Anstis (2013) and Barker *et al.* (1995) and the scientific and common name nomenclature of Cogger (2014). Mammals recorded were identified using keys and descriptions in Strahan (2002), Van Dyck, D. and Strahan, R. (2008) and Menkhorst and Knight (2010) and the scientific and common name nomenclature of Strahan (2002) and Van Dyck, D. and Strahan, R. (2008) for non-bat species. Bat species recorded were identified using keys and descriptions in Churchill (1998) and ecological information was obtained from Churchill (2008).

Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
BIRDS					
Phasianidae					
Coturnix pectoralis	stubble quail	-	-	x	
Coturnix ypsilophora	brown quail	-	-	x	x
Anatidae					
Anas castanea	chestnut teal	-	-	x	
Anas gracilis	grey teal	-	-	x	
Anas rhynchotis	Australasian shoveler	-	-	x	
Anas superciliosa	Pacific black duck	-	-	x	x
Aythya australis	hardhead	-	-	x	x
Chenonetta jubata	Australian wood duck	-	-	x	x

Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
Cygnus atratus	black swan	-	-	x	
Malacorhynchus membranaceus	pink-eared duck	-	-	x	
Podicipedidae					
Podiceps cristatus	great crested grebe	-	-	x	
Tachybaptus novaehollandiae	Australasian grebe	-	-	x	x
Anhingidae					
Anhinga melanogaster	darter	-	-	x	
Phalacrocoracidae					
Phalacrocorax carbo	great cormorant	-	-	x	
Phalacrocorax melanoleucos	little pied cormorant	-	-	x	
Phalacrocorax sulcirostris	little black cormorant	-	-	x	
Pelecanidae					
Pelecanus conspicillatus	Australian pelican	-	-	x	
Ardeidae					
Ardea alba	eastern great egret	-	-	x	
Ardea ibis	cattle egret	-	-	x	
Ardea pacifica	white-necked heron	-	-	x	x
Egretta novaehollandiae	white-faced heron	-	-	x	x
Nycticorax caledonicus	nankeen night heron	-	-	x	
Threskiornithidae					
Platalea flavipes	yellow-billed spoonbill	-	-	x	
Threskiornis spinicollis	straw-necked ibis	-	-	x	
Accipitridae					
Accipiter cirrhocephalus	collared sparrowhawk	-	-	x	
Accipiter fasciatus	brown goshawk	-	-	x	
Aquila audax	wedge-tailed eagle	-	-	x	x
Aviceda subcristata	Pacific baza	-	-	x	
Circus assimilis	spotted harrier	V	-	x	
Elanus notatus	black-shouldered kite	-	-	x	
Haliaeetus leucogaster	white-bellied sea-eagle	V	-	x	
Haliastur sphenurus	whistling kite	-	-	x	
Hieraaetus morphnoides	little eagle	V	-	x	
Falconidae					
Falco berigora	brown falcon	-	-	x	x
Falco cenchroides	nankeen kestrel	-	-	x	x
Falco longipennis	Australian hobby	-	-	x	
Falco peregrinus	peregrine falcon	-	-	x	

Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
Rallidae					
Fulica atra	Eurasian coot	-	-	x	
Gallinula tenebrosa	dusky moorhen	-	-	x	
Gallirallus philippensis	buff-banded rail	-	-	x	
Recurvirostridae					
Himantopus himantopus	black-winged stilt	-	-	x	
Charadriidae					
Elseyornis melanops	black-fronted dotterel	-	-	x	
Vanellus miles	masked lapwing	-	-	x	x
Scolopacidae					
Gallinago hardwickii	Lathams snipe	-	MIG	x	
Turnicidae					
Turnix varia	painted button-quail	-	-	x	
Columbidae					
**Columba livia*	rock dove	-	-	x	
Geopelia cuneata	diamond dove	-	-	x	
Geopelia humeralis	bar-shouldered dove	-	-	x	
Geopelia placida	peaceful dove	-	-	x	
Lopholaimus antarcticus	topknot pigeon	-	-	x	
Macrophygia amboinenses	brown cuckoo-dove	-	-	x	
Ocyphaps lophotes	crested pigeon	-	-	x	x
Phaps chalcoptera	common bronzewing	-	-	x	
**Streptopelia chinensis*	spotted turtle-dove	-	-	x	
Podargidae					
Podargus strigoides	tawny frogmouth	-	-	x	x
Caprimulgidae					
Eurostopodus mystacalis	white-throated nightjar	-	-	x	
Cacatuidae					
Calyptorhynchus funereus	yellow-tailed black cockatoo	-	-	x	
Cacatua galerita	sulphur-crested cockatoo	-	-	x	x
Cacatua roseicapilla	galah	-	-	x	x
Cacatua sanguinea	little corella	-	-	x	
Psittacidae					
Alisterus scapularis	Australian king-parrot	-	-	x	
Glossopsitta concinna	musk lorikeet	-	-	x	
Glossopsitta pusilla	little lorikeet	V	-	x	
Lathamus discolor	swift parrot	E	E	x	
Platycercus elegans	crimson rosella	-	-	x	x
Platycercus eximius	eastern rosella	-	-	x	x
Psephotus haematodus	red-rumped parrot	-	-	x	
Trichoglossus haematodus	rainbow lorikeet	-	-	x	

Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
Cuculidae					
Cacomantis flabelliformis	fan-tailed cuckoo	-	-	x	x
Chalcites basalis	Horsfields bronze-cuckoo	-	-	x	
Chalcites lucidus	shining bronze-cuckoo	-	-	x	
Cuculus pallidus	pallid cuckoo	-	-	x	
Scythrops novaehollandiae	channel-billed cuckoo	-	-	x	x
Centropodidae					
Centropus phasianinus	pheasant coucal	-	-	x	
Strigidae					
Ninox novaeseelandiae	southern boobook	-	-	x	
Ninox strenua	powerful owl	V	-	x	
Tytonidae					
Tyto alba	barn owl	-	-	x	
Tyto novaehollandiae	masked owl	V	-	x	
Aegothelidae					
Aegotheles cristatus	Australian owlet-nightjar	-	-	x	
Apodidae					
Hirundapus caudacutus	white-throated needletail	-	MIG	x	
Halcyonidae					
Alcedo azurea	azure kingfisher	-	-	x	
Dacelo novaeguineae	laughing kookaburra	-	-	x	x
Todiramphus sanctus	sacred kingfisher	-	-	x	x
Meropidae					
Merops ornatus	rainbow bee-eater	-	-	x	
Coraciidae					
Eurystomus orientalis	dollarbird	-	-	x	
Climacteridae					
Climacteris picumnus victoriae	brown treecreeper (eastern subsp.)	V	-	x	
Corombates leucophaeus	white-throated treecreeper	-	-	x	
Ptilonorhynchidae					
Ptilonorhynchus violaceus	satin bowerbird	-	-	x	
Maluridae					
Malurus cyaneus	superb fairy-wren	-	-	x	x
Malurus lamberti	variegated fairy-wren	-	-	x	
Pardalotidae					
Pardalotus punctatus	spotted pardalote	-	-	x	x
Pardalotus striatus	striated pardalote	-	-	x	x

Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
Acanthizidae					
Acanthiza chrysorrhoa	yellow-rumped thornbill	-	-	x	x
Acanthiza lineata	striated thornbill	-	-	x	
Acanthiza nana	yellow thornbill	-	-	x	
Acanthiza pusilla	brown thornbill	-	-	x	
Acanthiza reguloides	buff-rumped thornbill	-	-	x	
Chthonicola sagittata	speckled warbler	V	-	x	x
Gerygone fusca	western gerygone	-	-	x	
Gerygone mouki	brown gerygone	-	-	x	
Gerygone olivacea	white-throated gerygone	-	-	x	x
Sericornis citreogularis	yellow-throated scrubwren	-	-	x	
Sericornis frontalis	white-browed scrubwren	-	-	x	
Smicrornis brevirostris	weebill	-	-	x	x
Meliphagidae					
Acanthagenys reufogularis	spiny-cheeked honeyeater	-	-	x	x
Acanthorhynchus tenuirostris	eastern spinebill	-	-	x	
Anthochaera carunculata	red wattlebird	-	-	x	
Lichenostomus chrysops	yellow-faced honeyeater	-	-	x	x
Lichenostomus fuscus	fuscous honeyeater	-	-	x	
Lichenostomus leucotis	white-eared honeyeater	-	-	x	
Lichenostomus penicillatus	white-plumed honeyeater	-	-	x	x
Manorina melanocephala	noisy miner	-	-	x	x
Manorina melanophrys	bell miner	-	-	x	
Meliphaga lewinii	Lewins honeyeater	-	-	x	x
Melithreptus brevirostris	brown-headed honeyeater	-	-	x	
Melithreptus gularis gularis	black-chinned honeyeater (eastern subsp.)	V	-	x	
Melithreptus lunatus	white-naped honeyeater	-	-	x	
Myzomela sanguinolenta	scarlet honeyeater	-	-	x	
Philemon corniculatus	noisy friarbird	-	-	x	x
Phylidonyris nigra	white-cheeked honeyeater	-	-	x	
Plectorhyncha lanceolata	striped honeyeater	-	-	x	
Petroicidae					
Eopsaltria australis	eastern yellow robin	-	-	x	x
Melanodryas cucullata cucullata	hooded robin (south-eastern form)	V	-	x	
Microeca leucophaea	jacky winter	-	-	x	
Petroica boodang	scarlet robin	V	-	x	
Petroica goodenovii	red-capped robin	-	-	x	x
Petroica phoenicea	flame robin	V	-	x	
Petroica rosea	rose robin	-	-	x	

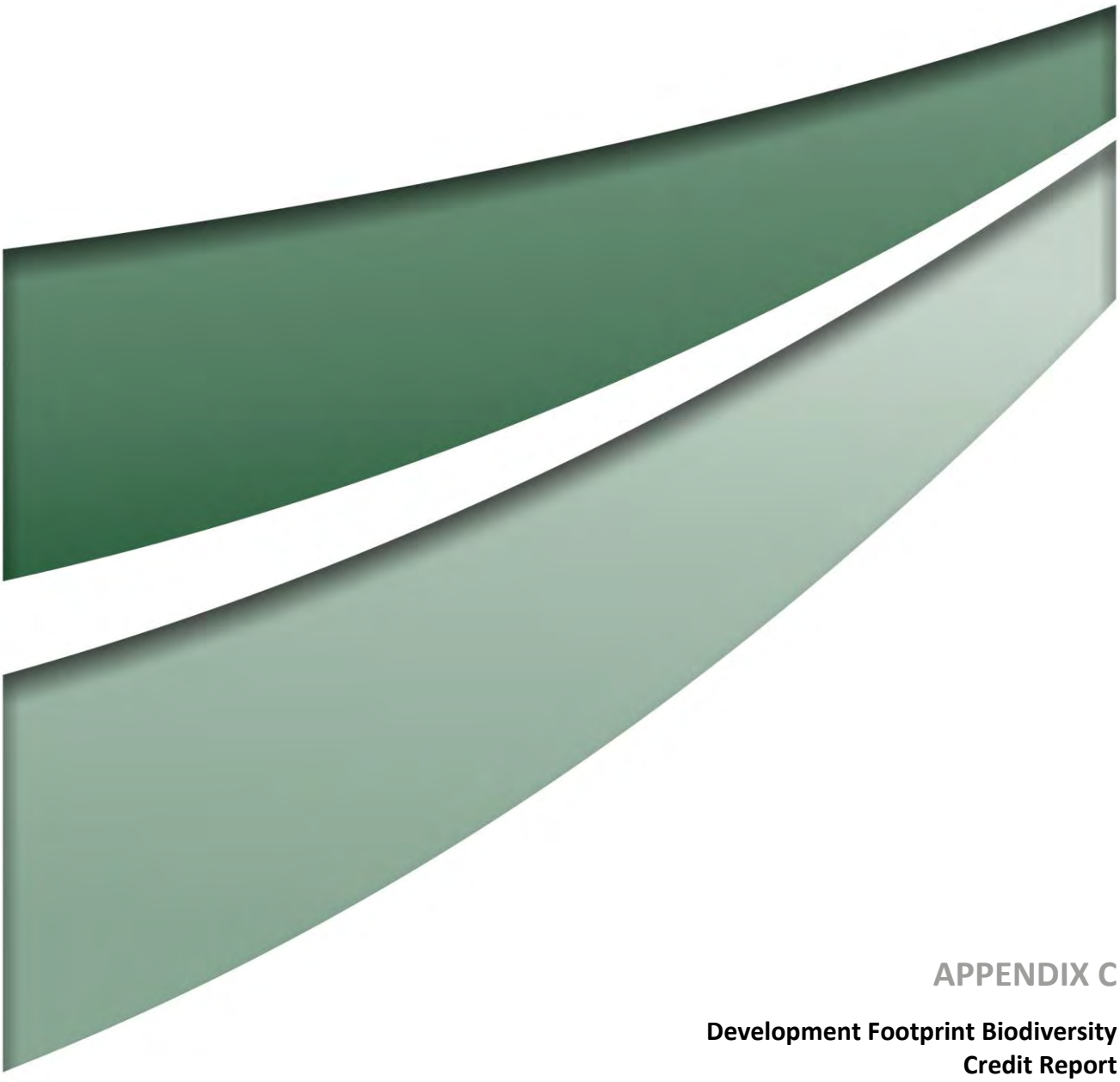
Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
Eupetidae					
Cinclosoma punctatum	spotted quail-thrush	-	-	x	
Psophodes olivaceus	eastern whipbird	-	-	x	
Pomatostomidae					
Pomatostomus temporalis temporalis	grey-crowned babbler (eastern subsp.)	V	-	x	x
Neosittidae					
Daphoenositta chrysoptera	varied sittella	V	-	x	x
Pachycephalidae					
Colluricincla harmonica	grey shrike-thrush	-	-	x	
Falcunculus frontatus	eastern shrike-tit	-	-	x	
Pachycephala pectoralis	golden whistler	-	-	x	x
Pachycephala rufiventris	rufous whistler	-	-	x	x
Dicruridae					
Grallina cyanoleuca	magpie-lark	-	-	x	x
Myiagra inquieta	restless flycatcher	-	-	x	
Myiagra rubecula	leaden flycatcher	-	-	x	
Rhipidura fuliginosa	grey fantail	-	-	x	x
Rhipidura leucophrys	willie wagtail	-	-	x	x
Rhipidura rufifrons	rufous fantail	-	MIG	x	
Campephagidae					
Coracina novaehollandiae	black-faced cuckoo-shrike	-	-	x	x
Coracina papuensis	white-bellied cuckoo-shrike	-	-	x	
Lalage tricolor	white-winged triller	-	-	x	
Oriolidae					
Oriolus sagittatus	olive-backed oriole	-	-	x	
Artamidae					
Artamus cyanopterus	dusky woodswallow	-	-	x	
Cracticus nigrogularis	pied butcherbird	-	-	x	x
Cracticus torquatus	grey butcherbird	-	-	x	x
Gymnorhina tibicen	Australian magpie	-	-	x	x
Strepera graculina	pied currawong	-	-	x	x
Corvidae					
Corvus coronoides	Australian raven	-	-	x	x
Corcoracidae					
Corcorax melanorhamphos	white-winged chough	-	-	x	x
Motacilidae					
Anthus novaeseelandiae	Australasian pipit	-	-	x	x
Passeridae					
**Passer domesticus*	house sparrow	-	-	x	

Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
Estrildidae					
Neochmia temporalis	red-browed finch	-	-	x	
Stagonopleura guttata	diamond firetail	V	-	x	
Taeniopygia bichenovii	double-barred finch	-	-	x	x
Taeniopygia guttata	zebra finch	-	-	x	
Dicaeidae					
Dicaeum hirundinaceum	mistletoebird	-	-	x	x
Hirundinidae					
Hirundo neoxena	welcome swallow	-	-	x	x
Petrochelidon ariel	fairy martin	-	-	x	
Petrochelidon nigricans	tree martin	-	-	x	
Sylviidae					
Acrocephalus australis	Australian reed-warbler	-	-	x	x
Cincloramphus mathewsi	rufous songlark	-	-	x	
Cisticolidae					
Cisticola exilis	golden-headed cisticola	-	-	x	
Zosteropidae					
Zosterops lateralis	silvereye	-	-	x	
Sturnidae					
**Acridotheres tristis*	common myna	-	-	x	
**Sturnus vulgaris*	common starling	-	-	x	
REPTILES					
Cheloniidae					
Chelodina longicollis	snake-necked turtle	-	-	x	x
Gekkonidae					
Diplodactylus vittatus	stone gecko	-	-	x	
Oedura robusta	robust velvet gecko	-	-	x	
Underwoodisaurus milii	thick-tailed gecko	-	-	x	
Varanidae					
Varanus varius	lace monitor	-	-	x	x
Agamidae					
Amphibolurus muricatus	jacky lizard	-	-	x	
Physignathus lesueurii	eastern water dragon	-	-	x	
Pogona barbata	eastern bearded dragon	-	-	x	
Scincidae					
Carlia tetradactyla	southern rainbow skink	-	-	x	
Cryptoblepharus virgatus	cream-striped shinning-skink	-	-	x	
Ctenotus robustus	striped skink, robust ctenotus	-	-	x	x
Egernia modesta	skink	-	-	x	
Egernia striolata	tree skink	-	-	x	
Eulamprus tenuis	barred-sided skink	-	-	x	

Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
Lampropholis delicata	grass skink	-	-	x	x
Lampropholis guichenoti	garden skink	-	-	x	
Lygisaurus foliorum	tree-base litter-skink	-	-	x	
Morethia boulengeri		-	-	x	
Tiliqua scincoides	eastern blue-tongue	-	-	x	
Pygopodidae					
Delma plebeia	leaden delma	-	-	x	
Typhlopidae					
Ramphotyphlops proximus	blind or worm snake	-	-	x	
Elapidae					
Demansia psammophis	yellow-faced whip snake	-	-	x	
Furina diadema	red-naped snake	-	-	x	
Pseudechis guttatus	blue-bellied black snake	-	-	x	
Pseudechis porphyriacus	red-bellied black snake	-	-	x	
Pseudonaja textilis	eastern brown snake	-	-	x	x
Vermicella annulata	bandy bandy	-	-	x	
AMPHIBIANS					
Myobatrachidae					
Crinia signifera	common eastern froglet	-	-	x	x
Limnodynastes dumerilii	banjo frog, eastern pobblebonk	-	-	x	
Limnodynastes ornatus	ornate burrowing frog	-	-	x	
Limnodynastes peronii	striped marsh frog	-	-	x	x
Limnodynastes tasmaniensis	spotted marsh frog	-	-	x	x
Uperoleia fusca	dusky toadlet	-	-	x	
Uperoleia laevigata	smooth toadlet	-	-	x	x
Uperoleia rugosa	rugose toadlet	-	-	x	
Hylidae					
Litoria aurea	green and golden bell frog	E	V	x	
Litoria caerulea	green tree frog	-	-	x	
Litoria dentata	bleating tree frog	-	-	x	
Litoria fallax	green reed frog, dwarf tree frog	-	-	x	x
Litoria latopalmata	broad-palmed frog	-	-	x	x
Litoria lesueuri	Lesueurs frog	-	-		
Litoria peronii	Peron's tree frog	-	-	x	x
Litoria verreauxii	Verreauxs tree frog	-	-	x	
Litoria wilcoxi	Stoney Creek frog	-	-	x	x

Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
MAMMALS					
Tachyglossidae					
Tachyglossus aculeatus	short-beaked echidna	-	-	x	
Dasyuridae					
Antechinus flavipes	yellow-footed antechinus	-	-	x	
Antechinus stuartii	brown antechinus	-	-	x ^	
Dasyurus maculatus	spotted-tailed quoll	V	E	x	
Phascogale tapoatafa	brush-tailed phascogale	V	-	x	x
Planigale tenuirostris	narrow-nosed planigale	-	-	x	
Sminthopsis murina	common dunnart	-	-	x	
Peramelidae					
Isodon macrourus	northern brown bandicoot	-	-	x	
Phascolarctidae					
Phascolarctos cinereus	koala	V	V	x ^	
Vombatidae					
Vombatus ursinus	common wombat	-	-	x	
Petauridae					
Petaurus breviceps	sugar glider	-	-	x^	
Petaurus norfolcensis	squirrel glider	V	-	x	x
Phalangeridae					
Trichosurus vulpecula	common brushtail possum	-	-	x	x
Pseudocheiridae					
Pseudocheirus peregrinus	common ringtail possum	-	-	x	
Macropodidae					
Macropus giganteus	eastern grey kangaroo	-	-	x	x
Macropus robustus	common wallaroo	-	-	x	
Macropus rufogriseus	red-necked wallaby	-	-	x	x
Wallabia bicolor	swamp wallaby	-	-	x	
Pteropodidae					
Pteropus poliocephalus	grey-headed flying-fox	V	V	x	
Pteropus scapulatus	little red flying-fox	-	-	x	
Emballonuridae					
Saccolaimus flaviventris	yellow-bellied sheathtail-bat	V	-	x	
Rhinolophidae					
Rhinolophus megaphyllus	eastern horseshoe-bat	-	-	x	
Molossidae					
Mormopterus norfolkensis	east coast freetail-bat	V	-	x	x
Mormopterus ridei	Ride's Free-tailed Bat	-	-		x
Mormopterus planiceps	southern freetail-bat	-	-	x	x
Nyctinomus australis	white-striped freetail-bat	-	-	x	x

Scientific Name	Common Name	Conservation Status		Mount Owen Complex	Ecological Constraints Assessment Area for the Proposed Modification
		BC Act	EPBC Act		
Vespertilionidae					
Chalinolobus dwyeri	large-eared pied bat	V	V	x	
Chalinolobus gouldii	Gould's wattled bat	-	-	x	x
Chalinolobus morio	chocolate wattled bat	--		x	x
Miniopterus australis	little bentwing-bat	V	-	x	
Miniopterus schreibersii oceanensis	eastern bentwing-bat	V	-	x	x
Myotis macropus	southern myotis	V	-	x	
Nyctophilus geoffroyi	lesser long-eared bat	-	-	x	
Nyctophilus gouldi	Gould's long-eared bat	-	-	x	
Scoteanax rueppellii	greater broad-nosed bat	V	-	x	
Scotorepens balstoni	inland broad-nosed bat	-	-	x	
Scotorepens orion	eastern broad-nosed bat	-	-		
Vespadelus darlingtoni	large forest bat	-	-	x	
Vespadelus pumilus	eastern forest bat	-	-	x	
Vespadelus regulus	southern forest bat	-	-	x	
Vespadelus vulturnus	little forest bat	-	-	x	
Muridae					
**Mus musculus*	house mouse	-	-	x	
Pseudomys novaehollandiae	New Holland mouse	-	V	x	
Rattus lutreolus	swamp rat	-	-	x	
**Rattus rattus*	black rat	-	-	x	x
Canidae					
Canis lupus dingo	dingo	-	-	x	
**Canis familiaris*	dog	-	-	x	x
**Vulpes vulpes*	fox	-	-	x	
Cervidae					
**Dama dama*	fallow deer	-	-	x	
Equidae					
**Equus caballus*	horse	-		x	
Felidae			-		
**Felis catus*	cat	-	-	x	
Leporidae					
**Lepus capensis*	brown hare	-	-	x	
**Oryctolagus cuniculus*	rabbit	-	-	x	
Cervidae					
**Bos taurus*	cattle	-	-	x	x
Invertebrates					
Gastropoda sp.	Unidentifed snail	-	-		x



APPENDIX C

Development Footprint Biodiversity Credit Report

Biodiversity credit report

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

Date of report: 7/12/2017 Time: 9:43:05AM Calculator version: v4.0

Major Project details

Proposal ID:	0113/2017/4583MP
Proposal name:	Mount Owen Continued Operations Project - Modification 2
Proposal address:	n/a Camberwell NSW 2330
Proponent name:	Mount Owen Pty Ltd
Proponent address:	na na NSW na
Proponent phone:	0438646286
Assessor name:	Ryan Parsons
Assessor address:	75 York Street TERALBA NSW 2284
Assessor phone:	02 4950 5322
Assessor accreditation:	0113

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Bull Oak grassy woodland of the central Hunter Valley	1.45	66.00
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter	43.29	984.10
Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	0.20	12.00
Total	44.94	1,062

Credit profiles

1. Bull Oak grassy woodland of the central Hunter Valley, (HU906)

Number of ecosystem credits created	66
IBRA sub-region	Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Bull Oak grassy woodland of the central Hunter Valley, (HU906) Weeping Myall - Coobah - Scrub Wilga shrubland of the Hunter Valley, (HU652) White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley, (HU730) Grey Gum - Forest Red Gum - Yellow Box grassy tall open forest on mid-slopes of the Hunter Valley - North Coast escarpment, (HU691) Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion, (HU701) Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter, (HU817) Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter, (HU818) Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter, (HU905) Blakely's Red Gum - Rough-barked Apple shrubby woodland of central and upper Hunter, (HU910)	Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815)

Number of ecosystem credits created	984
IBRA sub-region	Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815)	Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

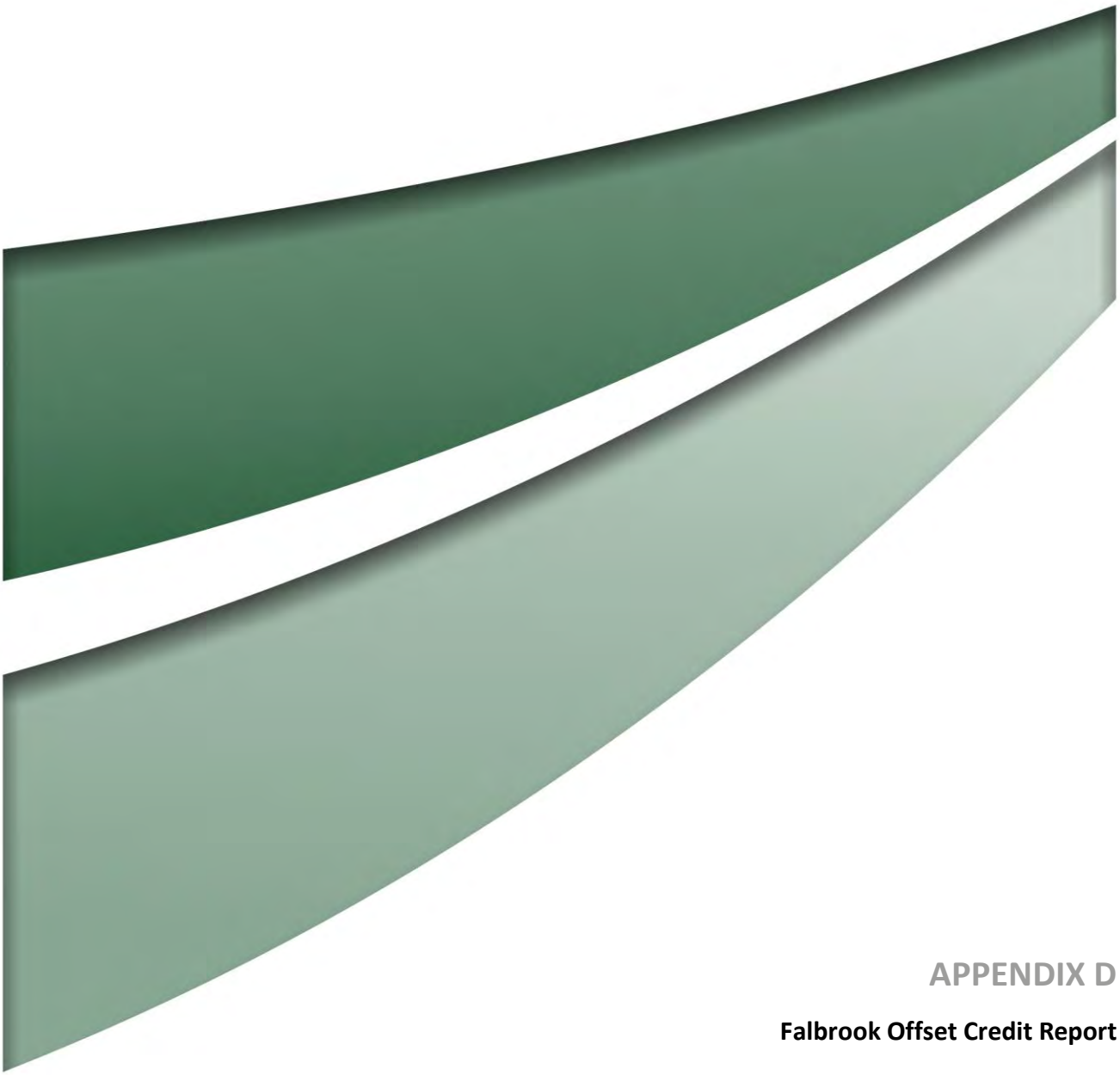
3. Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley, (HU945)

Number of ecosystem credits created	12
IBRA sub-region	Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley, (HU945) Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (HU633) Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast, (HU930) Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast, (HU931) Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast, (HU932) Paperbarks - Woollybutt swamp forest on coastal lowlands of the Central Coast, (HU933) Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast, (HU937) Swamp paperbark - Baumea juncea swamp shrubland on coastal lowlands of the Central Coast and Lower North Coast, (HU944)	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
Brush-tailed Phascogale	Phascogale tapoatafa	8.84	177



APPENDIX D

Falbrook Offset Credit Report

BioBanking credit report

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

Date of report: 2/05/2018 Time: 9:17:00AM Calculator version: v4.0

Biobank details

Proposal ID:	0113/2018/4709B
Proposal name:	Proposed Falbrook Offset Site
Proposal address:	na Falbrook NSW
Proponent name:	Mount Owen Pty Ltd
Proponent address:	
Proponent phone:	+61 2 6520 2686
Assessor name:	Ryan Parsons
Assessor address:	75 York Street TERALBA NSW 2284
Assessor phone:	02 4950 5322
Assessor accreditation:	0113

Additional information required for approval:

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

Ecosystem credits summary

Plant Community type	Area (ha)	Credits created
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	21.55	292.00
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter	88.04	987.00
Total	109.59	1,279

Credit profiles

1. Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter, (HU905)

Number of ecosystem credits created	292
IBRA sub-region	Upper Hunter

2. Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815)

Number of ecosystem credits created	987
IBRA sub-region	Upper Hunter

Species credits summary

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Brush-tailed Phascogale	Phascogale tapoatafa	30.73	218

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Brush-tailed Phascogale	Exclude commercial apiaries
Brush-tailed Phascogale	Exclude miscellaneous feral species
Brush-tailed Phascogale	Fox control
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Exclude commercial apiaries
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Exclude miscellaneous feral species
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Feral and/or over-abundant native herbivore control
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Fox control
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Slashing
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter	Exclude commercial apiaries
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter	Exclude miscellaneous feral species
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter	Feral and/or over-abundant native herbivore control
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter	Fox control
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter	Slashing

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