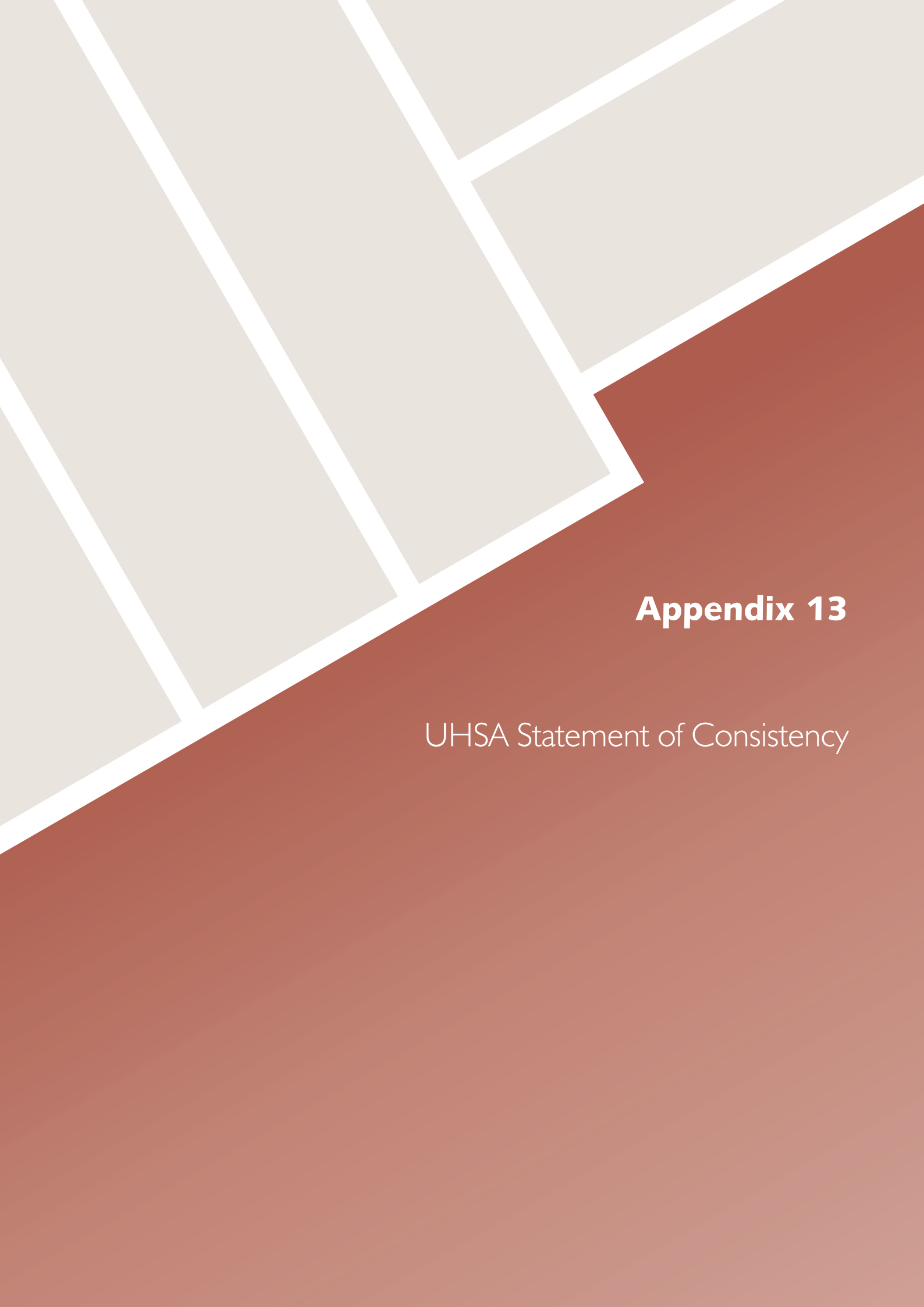
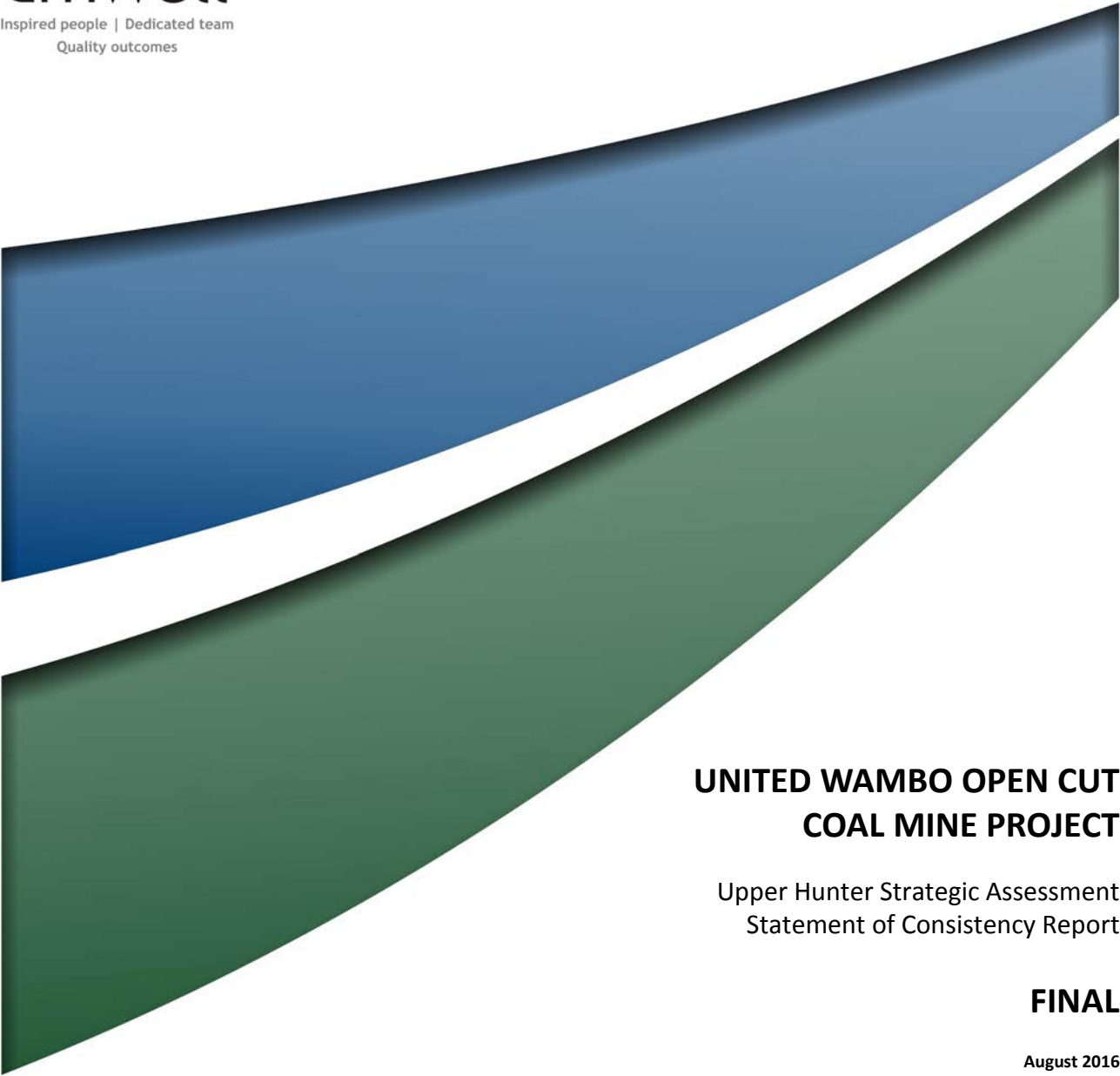




Appendix 13

UHSA Statement of Consistency



UNITED WAMBO OPEN CUT COAL MINE PROJECT

Upper Hunter Strategic Assessment
Statement of Consistency Report

FINAL

August 2016

UNITED WAMBO OPEN CUT COAL MINE PROJECT

Upper Hunter Strategic Assessment Statement
of Consistency Report

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
United Collieries Pty Ltd

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Report No. 3509/R15/FINAL
Date: August 2016



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Quality Management System.

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Appendices

Appendix A	UHSA and United Wambo Open Cut Project Methodology and Biometric Data
Appendix B	Supplementary Information on the Regent Honeyeater and the Non-UHSA Disturbance Area
Appendix C	Assessment of Significance under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)
Appendix D	Offset Sites Species Lists, Plot/Transect Data and Vegetation Community Profiles

1.0 Introduction

The United and Wambo mines are neighbouring mining operations located approximately 16 kilometres (km) west of Singleton in the Hunter Valley region of New South Wales (NSW) (refer to **Figure 1.1**). United Collieries Pty Limited (United) the operator of United mine and Wambo Coal Pty Limited (Wambo) the operator of Wambo mine, have formed a Joint Venture which includes the proposed development of the United Wambo Open Cut Coal Mine Project (the Project).

The Project proposes open cut coal mining for a period of 23 years, with mining in a new open cut mine at United (the United Open Cut) combined with ongoing mining at the existing, approved Wambo Open Cut under a modified mine plan. The Project will optimise future mining operations across these two adjoining open cut mining areas, maximising coal recovery and the efficient use of existing mining infrastructure, while providing the operational flexibility required to actively manage the mine to minimise environmental impacts.

The Project is State Significant Development as defined under State Environmental Planning Policy (State and Regional Development) 2011 and requires development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project will also require a modification to the existing Wambo development consents under section 75W of the EP&A Act to harmonise these consents with the Project. An Environmental Impact Statement (EIS) has been prepared to accompany these applications.

The biodiversity impacts associated with future development of the United and Wambo mines are included in a strategic assessment process being undertaken by the Commonwealth and NSW Governments (refer to **Section 1.1**). This process, known as the Upper Hunter Strategic Assessment (UHSA), will provide the overall biodiversity impact assessment for these sites, with each individual project being assessed under this strategic assessment framework. As a Project fitting under this strategic assessment framework, a UHSA Statement of Consistency report is required to identify how the Project fits within the UHSA process. This report has been prepared by Umwelt (Australia) Pty Limited (Umwelt) as part of the EIS for the Project. The report has been prepared in accordance with the Secretary of the Department of Planning and Environment's Environmental Assessment Requirements (SEARs) and the requirements of the NSW Office of Environment and Heritage (refer to **Section 1.2**).



FIGURE 1.1
Locality Plan

1.1 The Upper Hunter Strategic Assessment

The Australian and New South Wales (NSW) Governments have entered into an agreement to undertake a strategic assessment of a Biodiversity Plan for Coal Mining in the Upper Hunter Valley, NSW. This assessment is referred to as the Upper Hunter Strategic Assessment (UHSA). The UHSA is being undertaken in accordance with the relevant provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the NSW EP&A Act. The NSW Biodiversity Certification Assessment Methodology (BCAM) (DECCW 2011) is being used to assess the impacts.

The Upper Hunter Valley has been identified for a strategic assessment because there are a number of prospective and existing mining and exploration areas for which applications to mine, or to expand existing mines, are expected over the next two decades. There has been extensive historical land clearing in the region for a variety of land uses and the Commonwealth and NSW governments have identified benefit in taking a proactive approach to identify priority biodiversity conservation outcomes in advance of inevitable project-by-project applications for future coal mining.

The Biodiversity Plan, once finalised, will meet both State and Commonwealth biodiversity assessment requirements. Projects that demonstrate compliance with the expected outcomes of the Biodiversity Plan will be approved and conditioned in accordance with the plan requirements in regard to biodiversity.

A UHSA Biodiversity Certification Assessment Report has been prepared for United in consultation with the NSW Office of the Environment and Heritage (OEH) and the final report was submitted to OEH in September 2015 (Umwelt 2015). The United Wambo Project falls within the areas covered by the United Collieries UHSA Report, with the exception of 4 hectares which is referred to as the non-UHSA disturbance area.

The UHSA process was planned to be completed by the date of this report but is currently ongoing. OEH has recently advised that on the current timetable the Biodiversity Plan will be put on public exhibition in the final quarter of 2016. To allow projects to be assessed while the UHSA is being finalised, the NSW and Commonwealth governments developed the UHSA Interim Policy (DP&I 2012). This Project has been assessed in accordance with the Interim Policy.

1.2 Statement of Consistency Report

This 'Statement of Consistency' report has been prepared to demonstrate how the assessment of impacts on biodiversity and the proposed offsetting framework for the Project are consistent with the requirements of the Draft Upper Hunter Strategic Assessment (UHSA) Biodiversity Management Plan in line with the UHSA Interim Policy 2012. To date only selected components of the Draft UHSA Biodiversity Management Plan have been released and comprise:

1. Attachment 1: Cumulative impact and risk assessment methods and results, including detailed instructions for the Central Hunter Valley eucalypt forest and woodland critically endangered ecological community (CEEC) (OEH 2015a)
2. Attachment 3: Managing impacts on biodiversity under the Upper Hunter Strategic Assessment (UHSA) (OEH 2015b)
3. Appendix C – Guidelines for the mitigation of coal mining impacts on biodiversity (OEH 2015c), and
4. Appendix D – Guidelines for the ecological rehabilitation of recognisable and self-sustaining plant community types, guidance for the Upper Hunter Strategic Assessment (OEH 2015d).

The above draft documents were provided to Glencore by OEH on 17 December 2015 (OEH 2015e).

Two further emails/documents provided by OEH were also relied upon, being OEH (2016a), incorporating advice on how to treat an additional area of land added to the additional disturbance area (see **Section 1.3.2** for disturbance area terminology); and OEH (2016b), being the Draft Biodiversity Credit Matching Rules, both dated 26 April 2016.

This report also addresses relevant matters raised in the Secretary of the Department of Planning and Environment's Environmental Assessment Requirements (SEARs) provided initially on 27 July 2015 and revised on 15 December 2015.

The Project is being assessed according to Pathway 1 of the UHSA Interim Policy (DP&I 2012) whereby approval for the Project is being sort prior to the draft UHSA Biodiversity Plan and the proposed UHSA offset fund being released for public exhibition. Pathway 1 of the UHSA Interim Policy specifies that approvals by NSW and the Commonwealth may be issued on a case by case basis and conditioned to cover any uncertainties about expected outcomes of the Biodiversity Plan and the proposed UHSA offset fund.

This report addresses the requirements of the OEH documentation (OEH 2015a, b, c, d and e, and OEH 2016a and b), and the SEARs, both of which specify how Commonwealth Matters of National Environmental Significance (MNES) are to be addressed.

Table 1.1 below summarises the key requirements of these documents.

Table 1.1 Summary of Key Project Biodiversity Requirements

Particular Matter	OEH (2015a,b, c,d,e)	SEARs	Where Addressed in this Report
An assessment of the likely biodiversity impacts of the development, having regard to the NSW Biodiversity Offsets Policy for Major Projects, OEH's requirements (see Attachment 2) and Department of Environment's requirements (see Attachment 3);		✓	As agreed with DPE and OEH, the assessment for this Project was undertaken under the UHSA.
Assessment in accordance with BioCertification Assessment Methodology (BCAM) meeting UHSA requirements		✓	Sections 3, 5 and 12
Reasonable measures to avoid impacts on biodiversity in accordance with OEH (2015b)	✓		Section 4
Details of additional assessments to address new listings	✓		Section 5
Identify MNES likely to be significantly impacted and describe their habitat, describe impacts and consider relevant Commonwealth policy, plans and documents		✓	Section 6
Avoidance or offsetting of MNES in the very high risk category	✓		Section 4 and 13

Particular Matter	OEH (2015a,b, c,d,e)	SEARs	Where Addressed in this Report
Mitigation steps in accordance with OEH (2015c)	✓		Section 10
Details on updating of previous UHSA calculations in accordance with OEH (2015b)	✓		Sections 3 and 5
Calculation of biodiversity credits applicable to proposed disturbance area in accordance with OEH (2015b)	✓		Sections 3, 5 and 12
Targeted conservation actions for entities in the highest risk category in accordance with OEH (2015b)	✓		Section 11
Biodiversity offset strategy	✓	✓	Section 13
Details of how significant residual impacts on MNES have been addressed		✓	Section 13

Notes:

OEH (2015b) Attachment 3: Managing impacts on biodiversity under the Upper Hunter Strategic Assessment (UHSA)

OEH (2015c) Appendix C – Guidelines for the mitigation of coal mining impacts on biodiversity

1.3 Project Overview

Mining has been occurring at Wambo since the late 1960s and at United since 1989, with both mines previously undertaking both open cut and underground mining operations. Over this time the two mines have regularly cooperated, including sharing access to coal resources where appropriate, to provide for more efficient recovery of the State's coal resources. The two mines have also shared some mining infrastructure, including the joint use of the Wambo train loading facility, and share water to minimise external water demand.

Building on this long history of cooperative operations, in November 2014 United and Wambo announced a 50:50 Joint Venture between the two companies. The Joint Venture agreement outlines how the two companies will work together to further develop open cut coal resources held by the two mines.

Whilst open cut coal mining has previously been undertaken at United, over the last two decades the focus has been on underground mining. Underground longwall mining operations were approved to provide up to 2.95 million tonnes per annum (Mtpa) of saleable coal. Mining operations were suspended at United in March 2010 with the mine entering a period of care and maintenance. At that time, exploration and pre-feasibility works were commenced to determine the potential for future mining activities within United's mining lease. Ongoing exploration has identified substantial reserves of coal suitable for open cut mining.

Ongoing open cut and underground mining is occurring at Wambo, with the mine having approval to extract up to 8 million tonnes per annum (Mtpa) of run of mine (ROM) coal by open cut methods. The combined Wambo underground and open cut operations have approval to extract up to 14.7 Mtpa ROM coal, and to transport up to 15 Mtpa of product coal via the train loading facility.

As discussed above, the Project includes open cut mining operations in two areas, the proposed United Open Cut and modified operations in the approved Wambo Open Cut for a period of approximately 23 years. The existing Wambo Open Cut has approval for continued open cut mining until March 2017 (with a modification lodged to extend this to 2020). Due to the progression of mining being slower than originally planned, there will be substantial coal resources remaining in this approved mining area at March 2017 and the Project proposes to continue mining in this approved area. The Project also seeks some minor extensions to the approved Wambo Open Cut surface mining area and will seek approval to mine deeper resources below the approved Wambo Open Cut area.

The Project will produce up to 10 Mtpa of ROM coal. The existing Wambo CHPP and train loading facility will be utilised for the Project. These facilities will also continue to receive coal from the ongoing Wambo underground mine (that is not the subject of this Project).

The Project also requires a number of changes to the layout of existing mining, public and private infrastructure within the Project Area.

The key aspects of the Project are shown on **Figure 1.2** and a summary of the key Project details is provided in **Table 1.2**.

Table 1.2 Summary of Key Project Details

Key Project Components/Aspects	Proposed Operations
Key feature of the Project	The operation of a multi-seam open cut mining operation integrating the existing and approved Wambo Open Cut under a modified mine plan and the proposed United Open Cut.
Total Economically Recoverable Reserve	Approximately 176 Mt of ROM coal recovered from the two open cut mining operations, made up of: • approximately 110 Mt of ROM coal from the United Open Cut • approximately 66 Mt of ROM coal in total from the Wambo Open Cut, including an additional 40 Mt accessed from the increased depth of mining.
Extraction Rates	Up to 10 Mtpa ROM coal.
Life-of- Mine	Approximately 23 years from the date of Project approval.
Operating Hours	24 hours per day, 7 days per week.
Number of Employees	Up to approximately 500 total operational positions (at peak production).
Mining Methods	Open cut mining using a truck and excavator/shovel fleet.
Extent of Mining Areas	Refer to Figure 1.2 for the proposed extent of open cut mining. The Project proposes to modify the Wambo Open Cut boundary to maximise resource recovery. The modification to the approved Wambo Open Cut boundary will result in a minor surface adjustment of approximately 3.8 hectares of additional disturbance. The modification also includes accessing deeper seams within the existing Wambo Open Cut.

Key Project Components/Aspects	Proposed Operations
Infrastructure	Initial use and upgrades of existing United Mine Infrastructure Area prior to its decommissioning and demolition/removal due to the progression of the United Open Cut. Construction of temporary facilities during the construction phase of the Project. Ongoing use, expansion and upgrade of the Wambo Mining Infrastructure Area. Use of existing Wambo CHPP and train loading facility within their currently approved annual capacities of 14.7 Mtpa ROM coal and 15 Mtpa product coal respectively.
Tailings and Rejects Strategy	Decommissioning and capping of existing tailings storage facilities located in areas proposed for overburden emplacement and ongoing use of existing tailings storage facilities and storages established in other mine voids as required. Coarse rejects from coal preparation to be transported by truck to the open cut overburden areas for emplacement and subsequent covering by overburden material. Coarse rejects will continue to be co-disposed within the open cut overburden areas for the life of operations.
External Coal Transport	Product coal will continue to be transported off site via train from the existing Wambo train loading facility. Product coal transport rates proposed to increase from a maximum of six to eight trains per day. No change to total approved 15 Mtpa product coal tonnage transported by train.
Roads	Realignment of a 2 kilometre section of the Golden Highway to accommodate the proposed United Open Cut. The main entrance to the Project will be via the existing entrance to Wambo. The existing United access road will be used in the initial phase of the Project for construction and ancillary services with limited ongoing use as a property access point.
Power Infrastructure	An existing 330 kV transmission line which traverses the proposed United Open Cut mining area is proposed to be relocated as part of the Project (refer to Figure 1.2). Several other 66 kV and 11kV power lines will also require relocation to outside of proposed mining areas. Some existing telecommunications and associated infrastructure are located adjacent to the existing alignment of the Golden Highway and will also require relocation as part of the Project.
Water Management	Construction of mine water management controls including dams. Use of the previously mined United underground voids for water storage.

United is owned 95 per cent by Abelshore Pty Limited, a wholly owned subsidiary of Glencore Coal Pty Limited (Glencore) and 5 per cent by the Construction, Forestry, Mining and Energy Union (CFMEU) and is managed by Glencore. Wambo is a subsidiary of Peabody Energy Australia Pty Limited (Peabody).

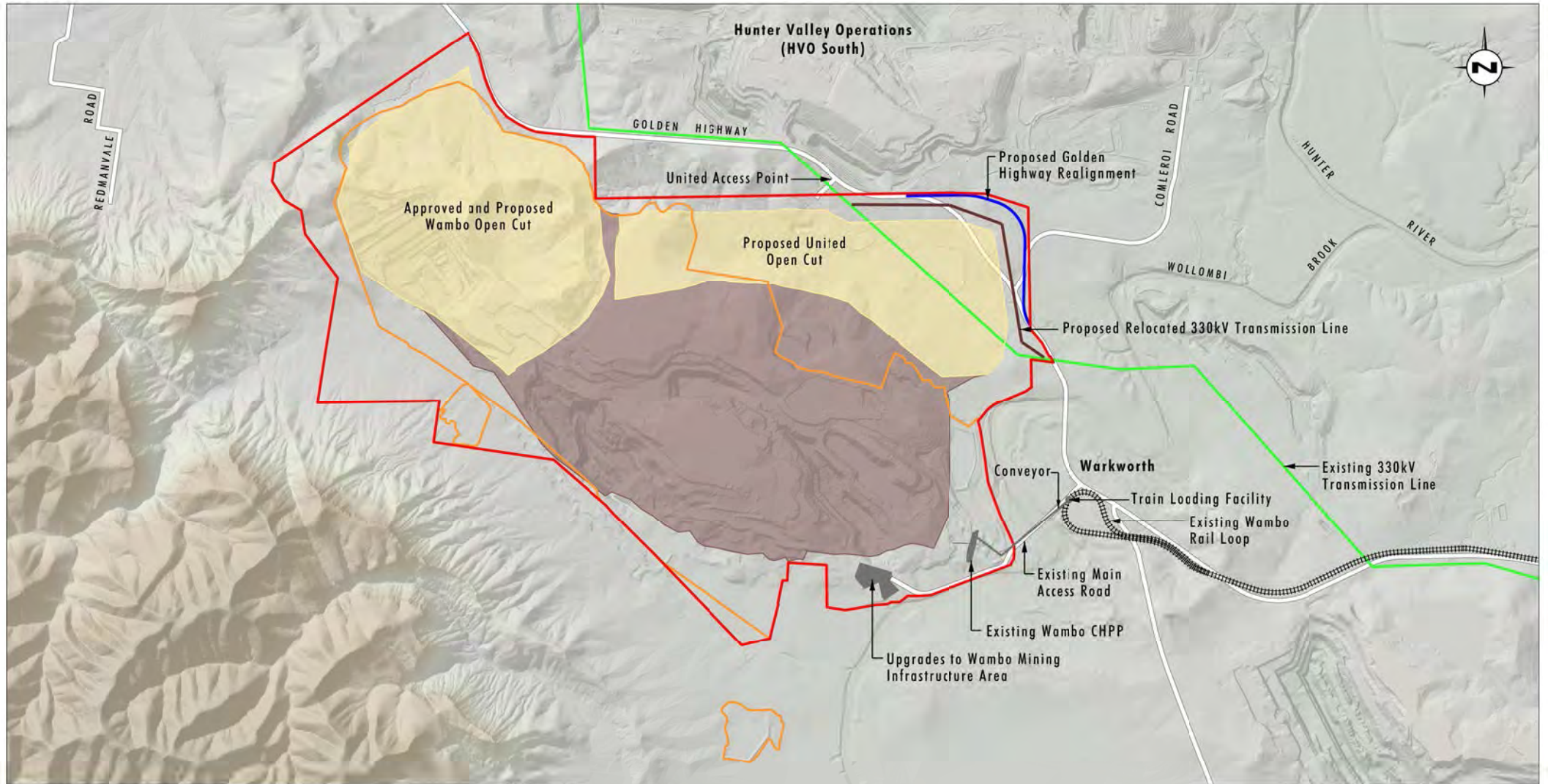


Image Source: United LiDAR (2015)
Data Source: Glencore (2015)

Legend

- Project Area
- Proposed Conceptual Extraction Area
- Active Mining Area
- Approved Wambo Surface Development Area
- Proposed Golden Highway Realignment
- Existing 330kV Transmission Line
- Proposed Relocated 330kV Transmission Line

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FIGURE 1.2

Overview of the Project

1.3.1 Project Area Location

United and Wambo coal mining operations are situated approximately 16 kilometres west of Singleton in the Hunter Valley of NSW (refer to **Figure 1.1**). The village of Warkworth is located approximately 1 kilometre to the southeast of the Project Area (refer to **Figure 1.3**). The village of Jerrys Plains is located approximately 5 kilometres northwest of the Project Area. The village of Bulga is located approximately 7 kilometres to the south of the Project Area. The rural area of Maison Dieu is located approximately 4.5 kilometres to the north east of the Project Area.

1.3.2 Size, Topography and Natural Features

The Project Area is approximately 3015 hectares in size with the majority of the Project Area occurring on the south-western side of the Golden Highway, with a small portion located on the north-eastern side of the highway (refer to **Figure 1.2**). Due to the presence of existing mining operations within the Project Area, much of the Project Area is already disturbed, or is approved for disturbance under relevant State and Commonwealth approvals (refer to **Figure 1.3**). The approximate additional area of ground disturbance required to implement the Project, referred to as the Proposed Conceptual Additional Disturbance Area (hereafter the “additional disturbance area”) is approximately 714 hectares in size and is shown on **Figure 1.3**.

The topography of the Project Area is characterised by an undulating and hilly landscape with lower topographic areas associated with drainage lines (refer to **Figure 1.4**). The foothills of the Wollemi National Park lie to the west of the existing Wambo Open Cut mine (approximately 0.5 kilometres to the west of the Project Area at the closest point) and form the dominant landscape feature surrounding the Project Area (refer to **Figure 1.5**).

An important local topographic feature is a minor ridgeline to the northwest of the Project Area which extends to a height of approximately 200 mAH. This ridgeline provides a topographic barrier between the area proposed for the open cut operations and the private land to the northwest, including the township of Jerrys Plains. The remaining surrounding topography is characterised by gently sloping alluvial plains and undulating hills.

The Project Area is located within the catchments of Redbank Creek, Wollombi Brook, North Wambo Creek, Hunter River and Waterfall Creek, all of which form part of the Hunter River catchment. The Project Area is within the Hunter Catchment Management Authority (CMA) sub-region of the Hunter Valley of NSW.

1.3.3 Land Use and Vegetation History

The Project Area is situated in a landscape that is characterised by mining land, grazing land, more intensive agriculture on the Hunter River alluvial zone (cropping and dairying) and some private and public woodland (see **Figure 1.5**). The land to the north east of the Project Area is occupied by Coal and Allied’s Hunter Valley Operations coal mine (HVO South), and further to the north by agricultural land. The area south of the Project Area is occupied by Wambo owned grazing land. Land to the east of the Project Area is privately owned by the Hunter Valley Gliding Club, surrounded by Coal and Allied owned mining buffer land. To the immediate west of the Project Area is land owned by Wambo which is utilised for grazing. Wollemi National Park is located approximately 0.5 kilometres west of the Project Area at its closest point to the western boundary of the Project Area. Wollemi National Park is also part of the Greater Blue Mountains World Heritage Area.

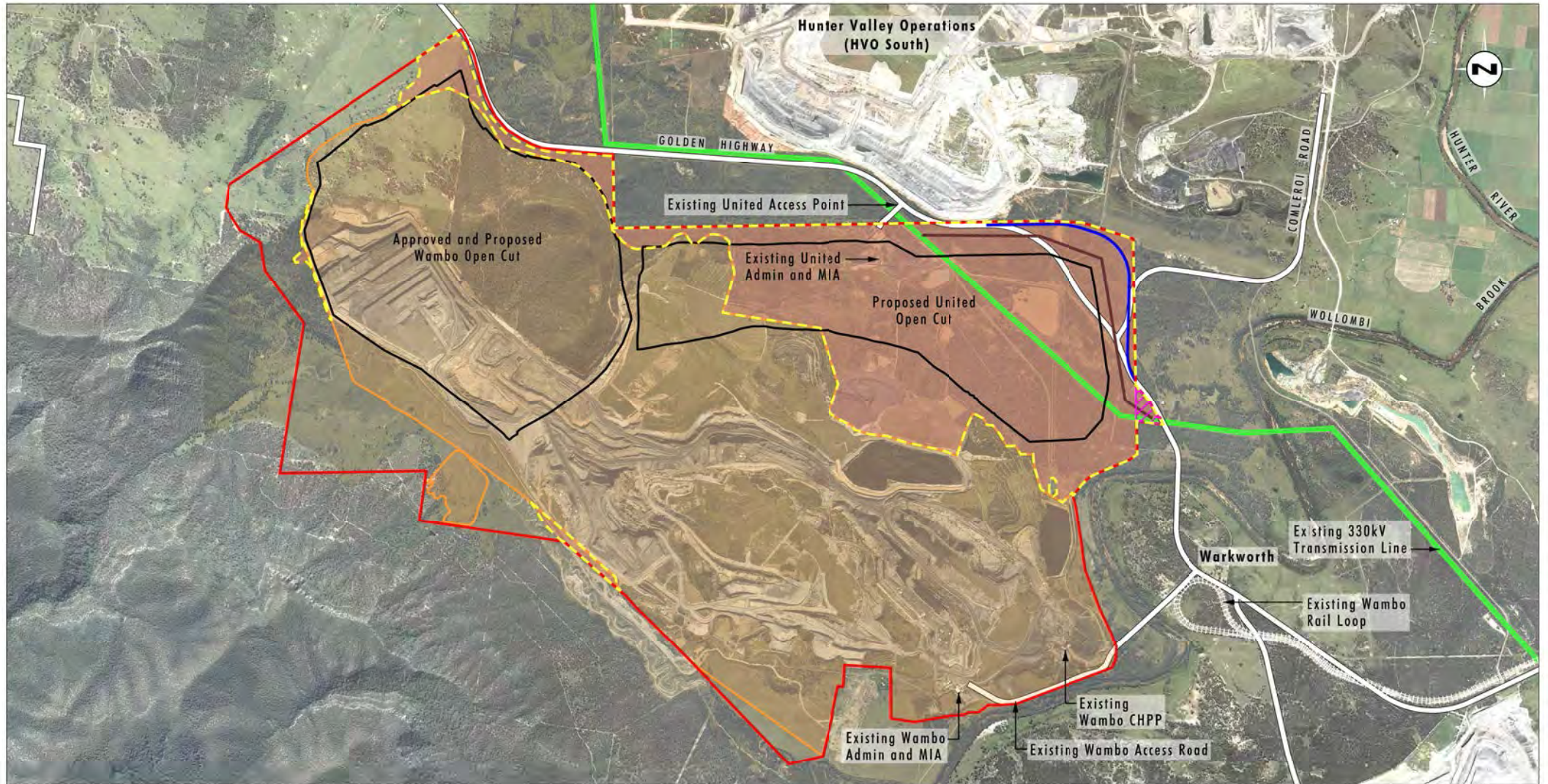


Image Source: AAM (2012), United (2015)
Data Source: Glencore (2014)

Legend

- Project Area
- Conceptual Additional Disturbance Area
- Approved Wambo Surface Development Area
- Proposed Conceptual Extraction Area
- Conceptual Golden Highway Realignment
- Existing 330kV Transmission Line
- Conceptual Relocated 330kV Transmission Line
- Non-UHSA Disturbance Area

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FIGURE 1.3

Conceptual Layout of Project

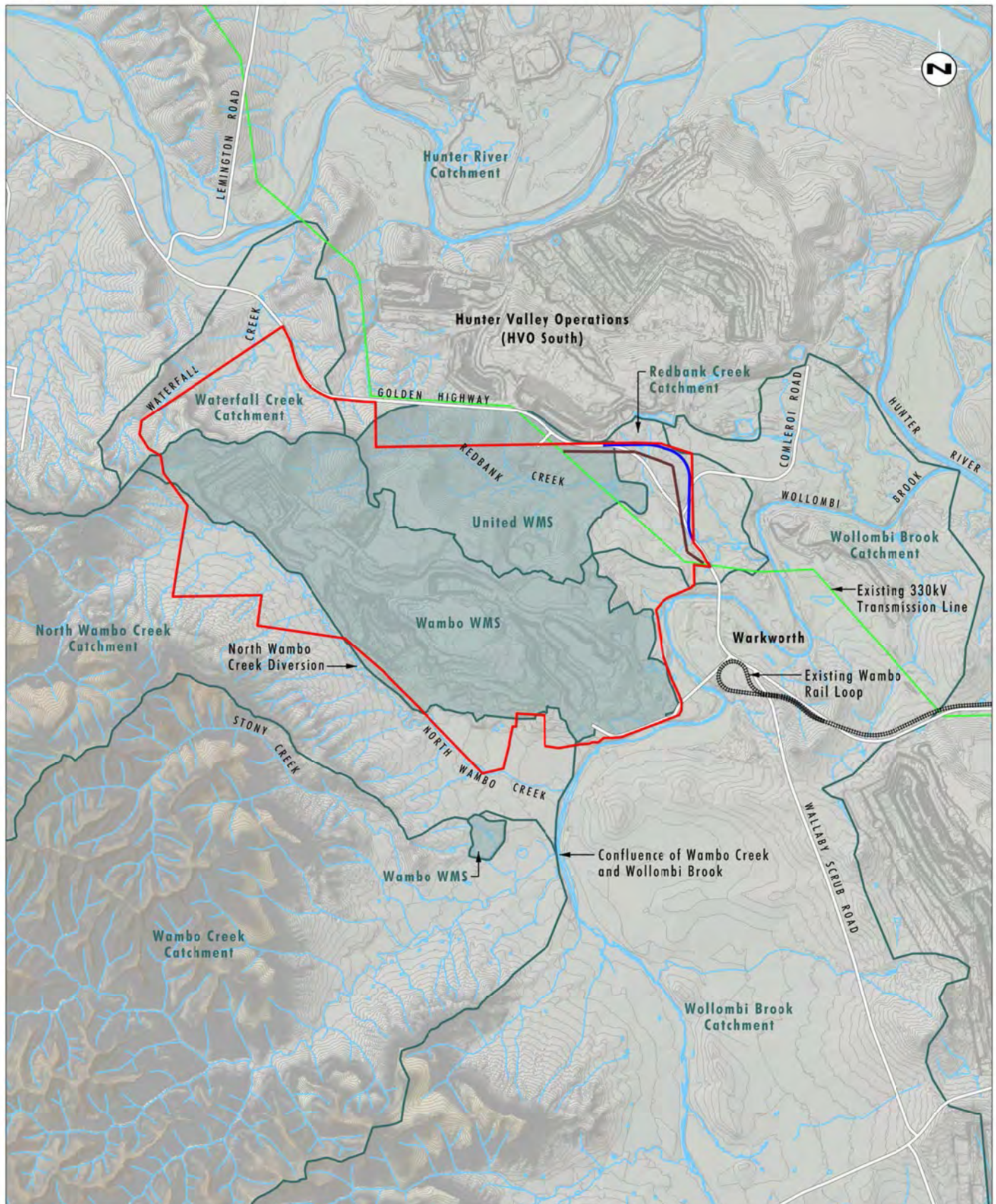


Image Source: United LiDAR (2015)
Data Source: Glencore (2014)
Note: 5m Contour Interval

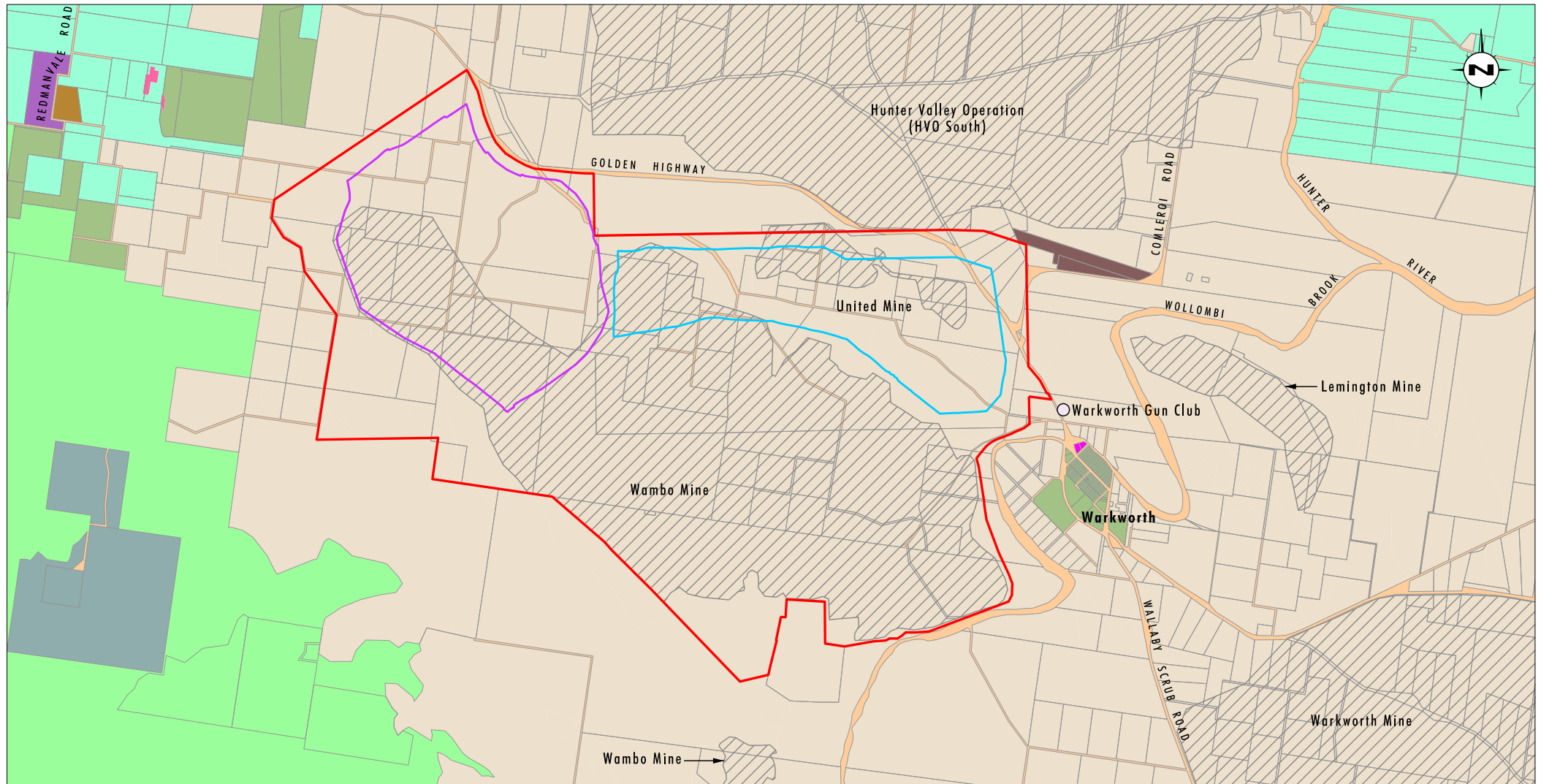
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Legend

- Project Area
- Proposed Golden Highway Realignment
- Existing 330kV Transmission Line
- Proposed Relocated 330kV Transmission Line
- Catchment Area
- Water Management System Catchment

FIGURE 1.4

Topography and Drainage



Data Source: LPMA (2009), Department of Natural Resources (2005)
Note: Refer to Figure 1.7 for Receiver Locations

0 1.0 2.0 3.0 km
1:60 000

Legend

- | | | |
|---|---|--|
| Project Area | Cropping Land | Gliding Club |
| Proposed Conceptual United Open Cut Pit | Mining Operations and Buffer Land | Government Authority (Federal, State or Local) |
| Proposed Conceptual Wambo Open Cut Realignment | National Park | Rural Residential |
| Woodland Area - Private Management | Private Vineyards | Equine Veterinary Facility |
| Mixed Grazing Land | Vineyards on Mine Owned Land | Extent of Existing Surface Mining and Associated Activities (as at 2015) |

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FIGURE 1.5

Land Use

The land use within and surrounding the Project Area is dominated by the existing coal mining activities of Wambo's underground mine, Coal and Allied's HVO South open cut mine and associated mine-owned lands. Prior to the establishment of mining operations, the Project Area had a long history of agricultural land uses, such as grazing. Grazing and dairy operations are still widespread throughout the surrounding area, occurring at a number of properties along the Golden Highway to the north of the Project Area and on the outskirts of Jerrys Plains. Irrigated agriculture is currently being undertaken along the alluvial floodplains of the Hunter River to the north of the Project Area. A small number of olive groves and vineyards are also located in the area around Jerrys Plains.

A large proportion of the Project Area has been impacted by a combination of past mining operations, associated mining infrastructure, existing rehabilitation, infrastructure corridors and past agricultural clearing. Substantial areas of regenerating remnant vegetation are also present within the Project Area. The Project Area contains large areas of cleared and disturbed land, and native vegetation communities providing woodland, riparian, shrubland and grassland habitat and rehabilitated communities. Farm dams and ephemeral watercourses, which are typically dry, provide drinking water for fauna species.

Due to widespread clearing within the local area, the vegetation within the Project Area is fragmented from other stands of vegetation within the landscape. Wollemi National Park is the closest conservation reserve, approximately 0.5 kilometres west of the Project Area at its nearest point and approximately 3 kilometres from the new open cut mining area proposed as part of the Project. As discussed below, widespread past clearing has also resulted in most woodland areas being less than approximately 55 years in age with most woodland areas dominated by regenerating and middle-aged trees of less than 32 years of age.

Figures 1.6 to 1.10 show the change in vegetation in the Project area between 1963 and 2001.

Figure 1.6 depicts the vegetation cover at July 1963. The majority of the additional disturbance area has been previously cleared, except for reasonable tree cover in the north-western (including the "panhandle" area) and south-eastern parts, a number of small remnants in the central part, and dense trees (probably swamp oak *Casuarina glauca*) along a substantial portion of Redbank Creek. Substantial recent clearing can be seen adjoining the western boundary of the large eastern remnant in the southeast of the additional disturbance area. There is reasonable evidence of tree regrowth through much of the additional disturbance area, albeit very scattered in places.

Figure 1.7 depicts the vegetation at 10 June 1971. Key changes from the 1963 photograph include an apparent significant reduction in the tree cover in the north-western "panhandle" area. Most of the central remnants mentioned above still exist, and there has been significant tree regrowth around these and in the south-eastern part of the additional disturbance area. Redbank Creek remains similarly vegetated.

Figure 1.8 depicts the vegetation at 21 December 1983, showing that there has been further clearing in the north-western "panhandle" area with only a treebelt remaining. Most of the vegetation along Redbank Creek remains, but substantial areas of treed regrowth shown on **Figure 1.7** are now removed, along with most of the remnant and regrowth vegetation in the south-western part. Most of the remnant stands in the central part of the additional disturbance area remain.

Figure 1.9 shows the vegetation in 1992 (undated) and depicts significant tree regrowth in the north-western "panhandle" area, apart from the western part of this which has been mostly cleared since 1963. Impacts from mining operations are now obvious, however it can be seen that across much of the remainder of the additional disturbance area there has been significant regrowth of treed vegetation. Some of the aforementioned central remnants are still present, along with vegetation cover in the lower part of Redbank Creek.

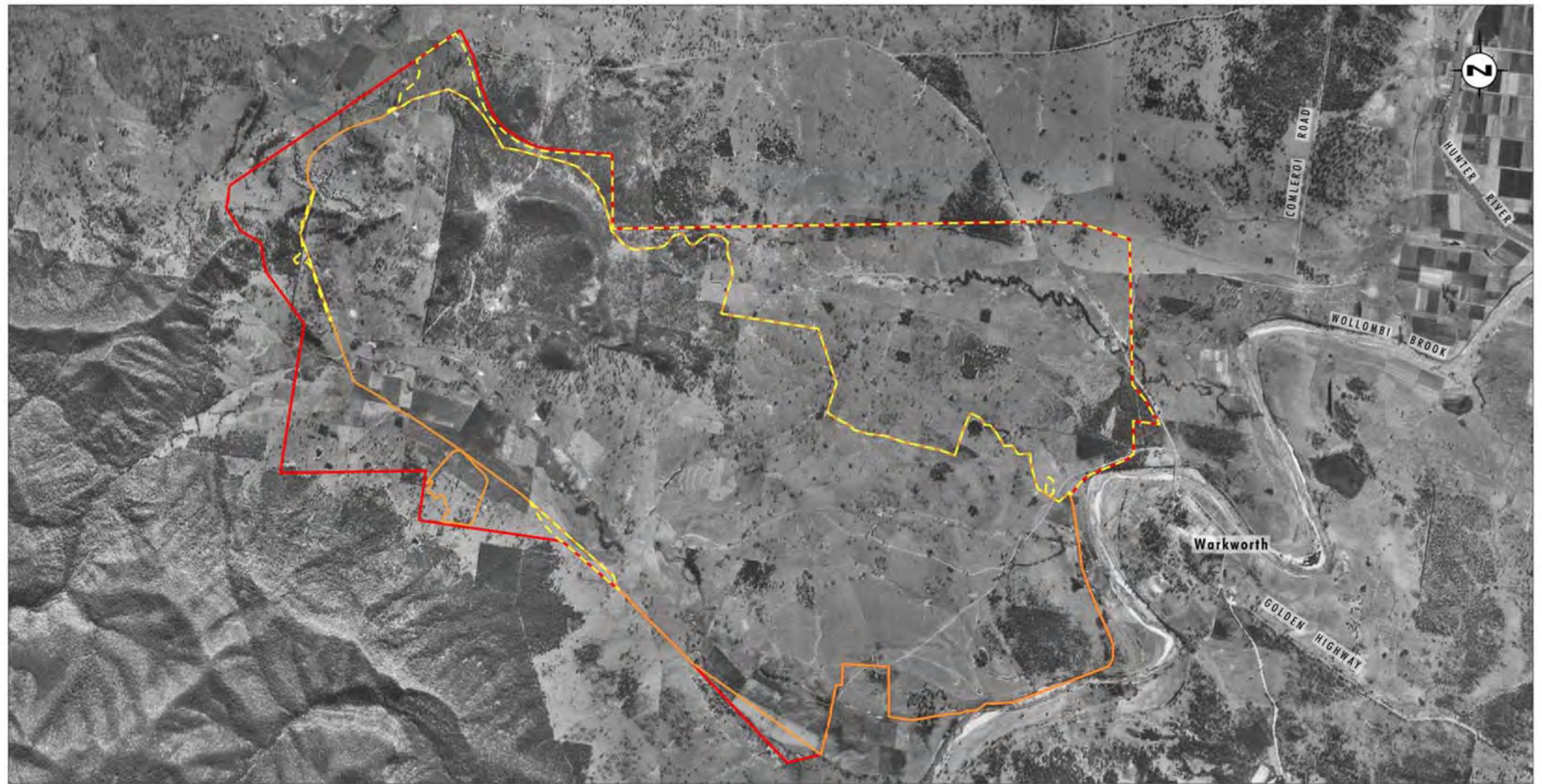


Image Source: Land and Property Management Authority
Base Data Source: Glencore (2015)

0 1.0 2.0 2.5 km
1:50 000

Legend

- Project Area
- Approved Wambo Surface Development Area
- Conceptual Additional Disturbance Area

FIGURE 1.6

Aerial Photograph 1963

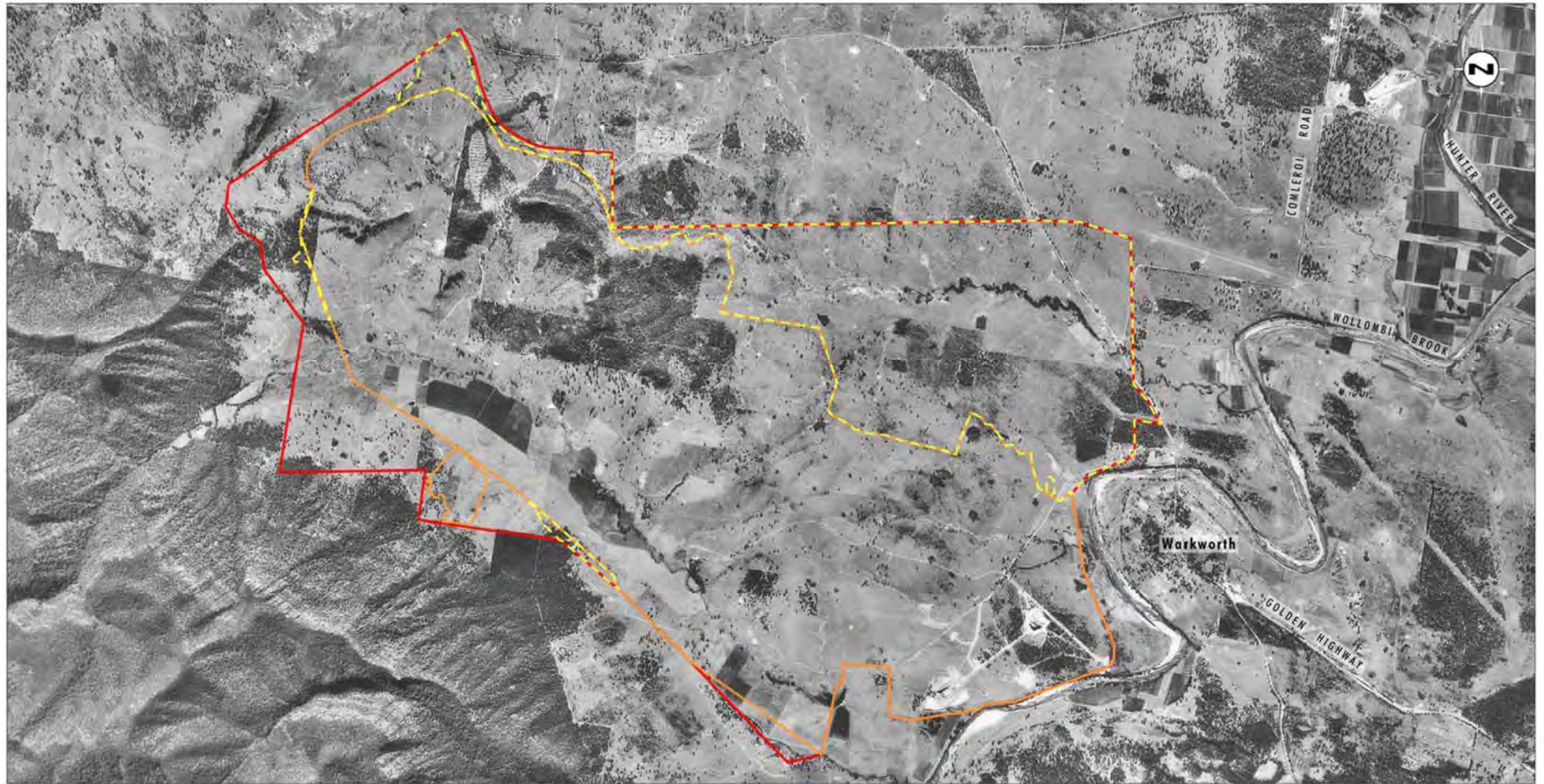


Image Source: Land and Property Management Authority
Base Data Source: Glencore (2015)

0 1.0 2.0 2.5 km
1:50 000

Legend

- Project Area
- Approved Wambo Surface Development Area
- Conceptual Additional Disturbance Area

FIGURE 1.7

Aerial Photograph 1971



Image Source: Land and Property Management Authority
Base Data Source: Glencore (2015)

0 1.0 2.0 2.5 km
1:50 000

Legend

- Project Area
- Approved Wambo Surface Development Area
- Conceptual Additional Disturbance Area

FIGURE 1.8

Aerial Photograph 1983



Image Source: Land and Property Management Authority
Base Data Source: Glencore (2015)

0 1.0 2.0 2.5 km
1:50 000

Legend

- Project Area
- Approved Wambo Surface Development Area
- Conceptual Additional Disturbance Area

FIGURE 1.9

Aerial Photograph
1992



Image Source: Land and Property Management Authority
Base Data Source: Glencore (2015)

0 1.0 2.0 2.5 km
1:50 000

Legend

- Project Area
- Approved Wambo Surface Development Area
- Conceptual Additional Disturbance Area

FIGURE 1.10

Aerial Photograph 2001

Figure 1.10 shows the vegetation during 2001 (undated), in which the vegetation patterns shown in **Figure 1.9** for 1992 remain very similar, with general substantial increases in regrowth tree cover in undisturbed areas.

Figure 1.11 represents the vegetation cover present in 2015, and indicates that the changes seen between the 1983 to 1992 and 2001 photographs have continued. Except for new mining related disturbance there has been a general substantial increase in tree regrowth across the additional disturbance area.

The changing patterns over time that are captured in the above series of photographs reveal that the vast majority of the native vegetation in the additional disturbance area is regrowth vegetation; indeed there is very little tree cover remaining from the 1963 photograph, being mostly limited to small stands of swamp oak of a few hectares in size. Most regrowth is from the period between the December 1983 and 1992 photograph, most likely related to the general land use change from agriculture to mining, with the most substantial increase occurring between 1992 and 2001. Therefore, most of the treed vegetation in the additional disturbance area will be at most 33 years old (regrown since 1983), with a larger proportion of this being younger than 24 years old (regrown since 1992) or 15 years old (regrown since 2001).

1.4 Relationship to United UHSA Study Area

Almost all of the Project Area falls within the areas covered by the United Collieries UHSA Report. A further small area, totalling approximately 4 hectares (refer to **Figure 1.11**), was included within the Project Area and additional disturbance area late in the assessment process. This occurred because of the re-design of a transmission line realignment following comment on the concept design by the asset owner. Due to the redesign to meet the infrastructure owner's design specifications, a further 4 hectares of land (termed the non-UHSA disturbance area) has been included in the additional disturbance area; it should be noted that this area will be used for the transmission line tower location and easement only.

711 hectares of the approximate 714 hectares of the additional disturbance area occurs within the approximate 1,087 hectares of the United UHSA Project Area (Umwelt 2015) as shown in **Figure 1.11**.

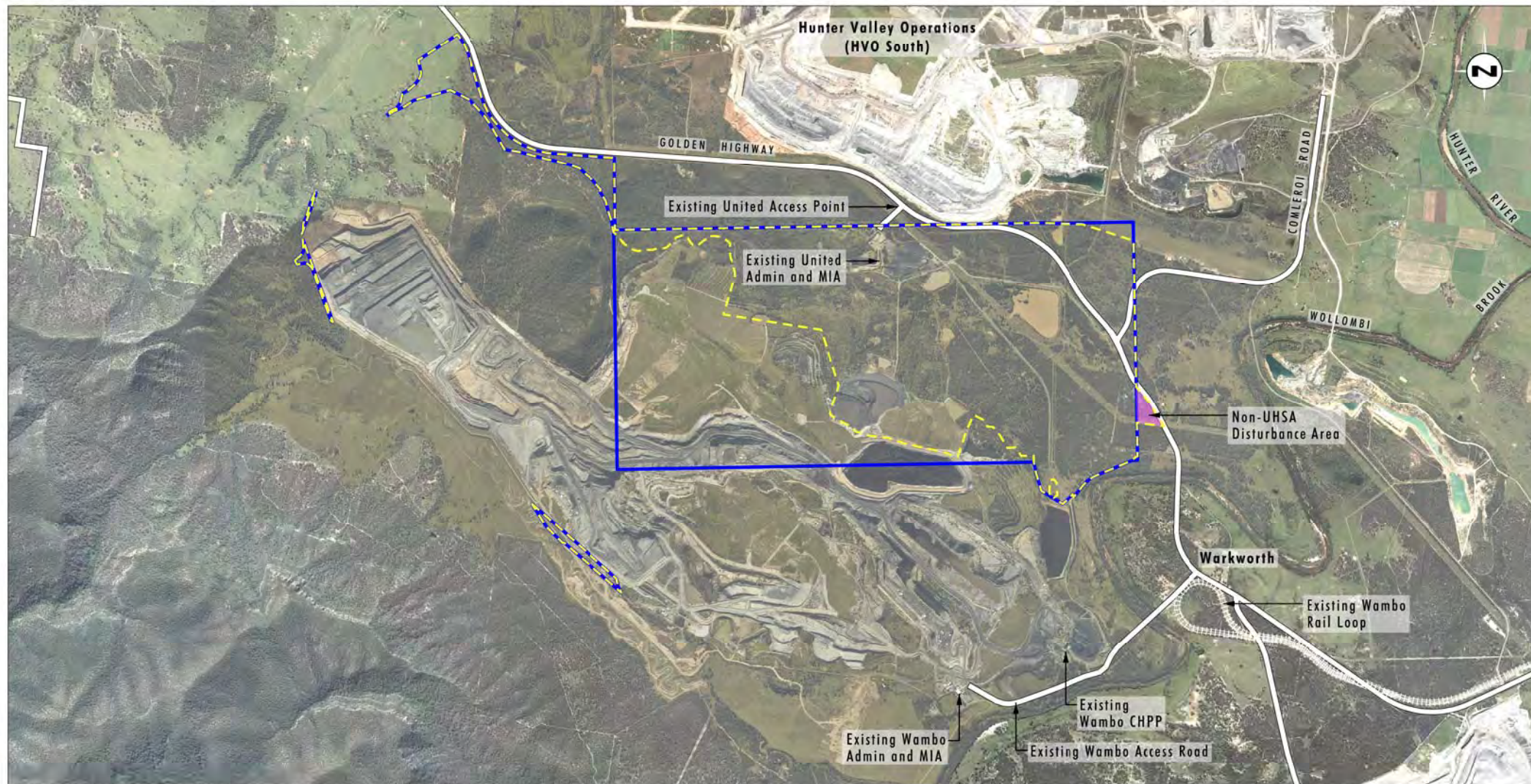


Image Source: AAM (2012), United (2015)
Data Source: Glencore (2014)

0 1.0 2.0 2.5 km
1:50 000

Legend

- UHSA Project Area
- Conceptual Additional Disturbance Area
- Non-UHSA Disturbance Area

FIGURE 1.11

Project Study Area

2.0 United UHSA Biodiversity Certification Assessment Report Summary

The UHSA Biodiversity Certification Assessment report (Umwelt 2015) was prepared for United and the final report was submitted to OEH in September 2015. The United UHSA report was accepted as finalised by OEH on 25 September 2015. The following sections provide summaries of the key components of the United UHSA report.

Almost all of the Project Area falls within the areas covered by the United Collieries UHSA Report. A small additional area, totalling approximately 4 hectares (refer to **Figure 1.11**), was included within the Project Area and additional disturbance area late in the assessment process as outlined in **Section 1.4**. This change occurred after the finalisation of the United Collieries UHSA report and is addressed specifically in **Section 5.0**. While the other sections of this report address the entire additional disturbance area (714 hectares), this section on the UHSA Biodiversity Certification Assessment Report Summary addresses the 711 hectares that was the subject of the Umwelt (2015) report.

2.1 United UHSA Project Area Methods

The methods for undertaking the United BioCertification assessment are detailed in Section 2.0 of the United UHSA report (Umwelt 2015). In summary, these methods included:

- a detailed literature review of relevant reports, technical documents, online ecological databases and regional vegetation mapping in order to gain an understanding of the biodiversity features in the Project Area
- systematic plot/transect vegetation surveys undertaken over multiple years/seasons (in 2013, 2014 and 2015) in accordance with the requirements under the BioCertification Assessment Methodology (BCAM), including reviews of previous flora survey effort on the site undertaken prior to 2013
- qualitative rapid assessments and meandering transects to assist with the delineation and refinement of vegetation mapping
- targeted threatened flora surveys, particularly for potentially occurring threatened orchid species such as Illawarra greenhood (*Pterostylis gibbosa*), pine donkey orchid (*Diuris tricolor*), *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) (now known as *Prasophyllum petilum*) and small snake orchid (*Diuris pedunculata*)
- targeted species-credit fauna surveys including bird surveys, frog surveys, Anabat echolocation recording, remote camera surveys, spotlighting surveys, koala Spot Assessment Technique (SAT) searches and targeted habitat searches undertaken in March 2014
- vegetation and habitat mapping using a high resolution digital aerial photograph (2014) provided by Glencore using the Manifold System 8.0 Enterprise Edition geographic information system (GIS) in a 32 bit mode
- determination of landscape value scores (including per cent native vegetation cover and connectivity value) as defined by the BCAM (DECCW 2011)

- application of the OEH Biodiversity Certification Credit Calculator (Version 1.08 released 18 April 2013 for use on the UHSA BCAM assessments).

Appendix A outlines the methods undertaken as part of the United UHSA (Umwelt 2015) and updated for the United Wambo Open Cut Coal Mine Project.

2.1.1 United UHSA Project Area Survey Biases and Limitations

Few limitations were experienced during the field surveys, however the following should be noted:

- the allocation of derived native grasslands across the Project Area to a former 'parent' community (and subsequent biometric vegetation type (BVT)) was limited by the presence of remnant scattered canopy trees and the proximity to surrounding remnant patches of woodland and forest communities
- for herbaceous and graminoid species, the allocation of some specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material
- seasonal and recent weather conditions were generally moderate for the detection and identification of the flora and fauna during the September 2013 and March 2014 field surveys
- no inaccessible areas occurred across the Project Area.

2.2 United UHSA Project Area Results

Section 3 of the United UHSA report (Umwelt 2015) details the results of the field surveys and application of the Biodiversity Certification Credit Calculator. The sections below provide a summary of the results.

2.2.1 Vegetation Communities

A total of 12 vegetation zones and five threatened ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) were identified across the UHSA Project Area (refer to **Table 2.1**).

Table 2.1 Vegetation Zones of the United UHSA Project Area

Veg Zone No.	Vegetation Zone	Area (ha)	Site Value Score	Threatened Ecological Community ¹
1	HU652 - Moderate to Good Condition Weeping Myall - Coobah - Scrub Wilga Shrubland of the Hunter Valley	0.1	47	Hunter Valley Weeping Myall Woodland CEEC (TSC Act) ²
2	HU812 – Moderate to Good Condition Forest Red Gum grassy open forest on floodplains of the lower Hunter	0.29	81	Hunter Floodplain Red Gum Woodland EEC (TSC Act)

Veg Zone No.	Vegetation Zone	Area (ha)	Site Value Score	Threatened Ecological Community ¹
3	HU816 – Moderate to Good Condition – Plantation/Rehabilitation Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	37	60	Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC (TSC Act)
4	HU869 – Moderate to Good Condition Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	1.6	68	Hunter Valley Footslopes Slaty Gum Woodland VEC (TSC Act)
5	HU905 – Moderate to Good Condition Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	185	72	Central Hunter Grey Box – Ironbark Woodland EEC (TSC Act)
6	HU905 - Moderate to Good Condition - Thinned Canopy	0.08	57	Central Hunter Grey Box – Ironbark Woodland EEC (TSC Act)
7	HU905 – Moderate to Good Condition – Regeneration	27	64	Central Hunter Grey Box – Ironbark Woodland EEC (TSC Act)
8	HU905 – Moderate to Good Condition – Cooba Open Shrubland	101	35	NA
9	HU905 – Low Condition – Derived Native Grassland	105	17	NA
10	HU906 – Moderate to Good Condition Bull Oak grassy woodland of the central Hunter Valley	122	74	3.1 ha conforms to Central Hunter Grey Box – Ironbark Woodland EEC (TSC Act)
11	HU945 – Moderate to Good Condition Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	32	71	NA

Veg Zone No.	Vegetation Zone	Area (ha)	Site Value Score	Threatened Ecological Community ¹
12	Cleared land (including disturbed land, mixed species revegetation plantation and water bodies)	476	NA	NA
Total		1,087		

1 = The Central Hunter Valley Eucalypt Forest and Woodland CEEC was listed after the completion of the United UHSA report and therefore vegetation types conforming to the CEEC are not listed in the Table above. See **Section 5** for updated EPBC CEEC areas of the Project.

2 = Hunter Valley Weeping Myall Woodland CEEC was listed as an EEC for the majority of the period during which this report was prepared, but as of 19 February 2016 is listed as a CEEC under the TSC Act

CEEC = Critically Endangered Ecological Community

EEC = Endangered Ecological Community

EPBC Act = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

ha = hectare

HU#### = Hunter Biometric Vegetation Type Number

NA = not applicable

TSC Act = NSW *Threatened Species Conservation Act 1995*

VEC = Vulnerable Ecological Community

2.2.2 Ecosystem Credit Species

Ecosystem credit species are those species whose general occurrence is satisfactorily represented by the distribution of vegetation communities (biometric vegetation types – BVTs) in which they are predicted to occur. Allocations to vegetation communities are made by OEH and are not subject to public scrutiny.

Six ecosystem credit species were recorded during field surveys of the Project Area, being:

- east coast freetail bat (*Mormopterus norfolkensis*)
- spotted-tailed quoll (*Dasyurus maculatus maculatus*) – see below
- grey-crowned babbler (*Pomatostomus temporalis temporalis*)
- speckled warbler (*Chthonicola sagittata*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) – (ecosystem credits for foraging habitat only)
- eastern cave bat (*Vespadelus troughtoni*) – (ecosystem credits for foraging habitat only).

For the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) and eastern cave bat (*Vespadelus troughtoni*), only foraging habitat is covered by ecosystem credits whilst their breeding habitat is covered by species credits (see **Section 2.2.3**). There is no breeding habitat in the Project Area for these species.

A single spotted-tailed quoll (*Dasyurus maculatus maculatus*) was recorded by a remote camera in 2013 during pest management surveys by United environmental staff outside of the Umwelt surveys, and therefore was not directly communicated in the United UHSA report. Despite targeted surveys undertaken in Feb-March 2013 and March 2014 (see **Section 6.1.3.4**) the species was not re-recorded on the site.

Appendix 6 of the UHSA report (Umwelt 2015) lists the ecosystem credit species which were predicted by the Biodiversity Certification Credit Calculator for each of the vegetation types mapped within the Project Area.

2.2.3 Species Credit Species

Species credit species are those species whose general occurrence is not satisfactorily represented by the distribution of vegetation communities (BVTs) in which they occur. Determinations on whether or not a species is a species credit species are made by OEH and are not subject to public scrutiny.

Four species credit species were recorded during field surveys of the Project Area, being:

- population of weeping myall (*Acacia pendula*)
- eastern osprey (*Pandion cristatus*)
- large-eared pied bat (*Chalinolobus dwyeri*)
- southern myotis (*Myotis macropus*) (breeding habitat).

Due to the absence of potential breeding habitat (sandstone caves) within the additional disturbance area, no credits are required for the large-eared pied bat (Umwelt 2015). The single record of the eastern osprey in the additional disturbance area was considered a vagrant record and no credits are required for the eastern osprey (Umwelt 2015). No breeding habitat of the eastern bentwing-bat or eastern cave bat was recorded in the additional disturbance area and therefore no species credits are required for either species (only the breeding habitat component is a species credit).

Appendices 4 and 5 of the UHSA report (Umwelt 2015) lists the flora and fauna species which were recorded during the surveys of the Project Area for the UHSA.

2.2.4 Red Flags

A red flag is an area regarded as having high biodiversity conservation values as defined in Section 2.3 of the BioCertification methodology (DECCW 2011). Nine vegetation zones across the UHSA Project Area were identified as red flags as they are listed as EECs under the TSC Act and/or they comprise a biometric vegetation type (BVT) that is over 70 per cent cleared in the Hunter/Central Rivers CMA (refer to **Table 2.2**). including a small portion of Zone 10 – Bull Oak Grassy Woodland of the Central Hunter Valley forms part of the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC and is considered a red flag.

Table 2.2 Identified Red Flags for the United UHSA BCAM Area

Vegetation Zone/Species Name	Reason for Red Flag Status¹
Zone 1 – HU652 – Moderate to Good Condition Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley	This vegetation zone is considered to be a red flag as it conforms to the Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion CEEC listed under the TSC Act ² . The corresponding BVT is also 90 per cent cleared.
Zone 2 – HU812 – Moderate to Good Condition Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	This vegetation zone is considered to be a red flag as it conforms to the Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (TSC Act).
Zone 3 – HU816 – Moderate to Good Condition – Plantation Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	This vegetation zone is considered to be a red flag as it conforms to the Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregion EEC (TSC Act).
Zone 5 – HU905 – Moderate to Good Condition Narrow-leaved Ironbark – Grey Box grassy Woodland of the Central and Upper Hunter	This vegetation zone is considered to be a red flag as it conforms to the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the TSC Act. The corresponding BVT is also 79 per cent cleared.
Zone 6 – HU905 - Moderate to Good Condition - Thinned Canopy	This vegetation zone is considered to be a red flag as it conforms to the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the TSC Act. The corresponding BVT is also 79 per cent cleared.
Zone 7 – HU905 – Moderate to Good Condition – Regeneration	This vegetation zone is considered to be a red flag as it conforms to the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the TSC Act. The corresponding BVT is also 79 per cent cleared.
Zone 8 - HU905 – Moderate to Good Condition – Cooba Open Shrubland	The corresponding BVT is 79 per cent cleared.

Vegetation Zone/Species Name	Reason for Red Flag Status ¹
Zone 10 – HU906 – Bull Oak Grassy Woodland of the Central Hunter Valley – Moderate-Good Condition	3.1 ha of the vegetation zone is a red flag as it conforms to Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the TSC Act.
Weeping myall (<i>Acacia pendula</i>)	This species is classified as not being able to withstand further loss. The removal of 137 individuals is higher than the negligible loss of 0 individuals set in the Threatened Species Profile Database (TSPD) (BioNet 2014).
Southern myotis (<i>Myotis macropus</i>)	This species is identified in the Biodiversity Certification Credit Calculator as a red flag. It is noted however that this species is able to withstand further loss in the TSPD (BioNet 2014).
Redbank Creek	Redbank Creek is considered a minor river in the Project Area and a 30 metre buffer either side of a minor river represents a red flag (regional biodiversity link).
Any unnamed drainage lines which meet the definition of a minor creek	These waterways are considered to be minor creeks in the Project Area and a 20 metre buffer either side of a minor creek represents a red flag (local biodiversity link).

1 = The Central Hunter Valley Eucalypt Forest and Woodland CEEC was listed after the completion of the United UHSA report and therefore vegetation types conforming to the CEEC are not listed in the Table above as red flags. See **Section 9** for updated red flag areas for the Project.

2 = Hunter Valley Weeping Myall Woodland CEEC was listed as an EEC for the majority of the period during which this report was prepared, but as of 19 February 2016 is listed as a CEEC under the TSC Act

BVT = Biometric vegetation type

EEC = Endangered Ecological Community

Ha = hectare

HU#### = Hunter Biometric Vegetation Type Number

NA = not applicable

TSC Act = NSW *Threatened Species Conservation Act 1995*

TSPD = Threatened Species Profile Database

2.3 United UHSA Project Area Credit Requirements

The following credit requirements are straight from the Biodiversity Certification Credit Calculator. These relate to the United UHSA BCAM Area and not the additional disturbance area (the latter is addressed in **Sections 3, 5 and 12**).

2.3.1 Species Credits

Table 2.3 details the number of species credits required for all applicable species credit species recorded in the United UHSA Project Area. A total of 3,771 species credits are required for the UHSA United Project Area.

Table 2.3 Number of Species Credits Required for the United UHSA Project Area

Species Name	T _G Value	Number of Individuals/Area of Habitat	Number of Credits Required
Flora Species			
Weeping myall (<i>Acacia pendula</i>) ¹	0.5	137	2,740
Fauna Species			
Southern myotis (<i>Myotis macropus</i>) (breeding habitat)	0.13	13.4 hectares	1,031
Total			3,771

1 = The T_G value of 0.5 for weeping myall (*Acacia pendula*) has been increased from 0.125 following a More Appropriate Local Data (MALD) report accepted by OEH (Umwelt 2014b).

2.3.2 Ecosystem Credits

Table 2.4 details the number of ecosystem credits required for all vegetation zones mapped in the United UHSA Project Area. A total of 20,280 ecosystem credits were generated for the United UHSA Project Area.

Table 2.4 Ecosystem Credits Generated by the United UHSA Project Area.

Veg Zone No.	Vegetation Zone	Area Within the United UHSA Project Area (ha)	No. of Credits Required
1	HU652 - Moderate to Good Condition Weeping Myall - Coobah - Scrub Wilga Shrubland of the Hunter Valley	0.1	2
2	HU812 – Moderate to Good Condition Forest Red Gum grassy open forest on floodplains of the lower Hunter	0.29	14
3	HU816 – Moderate to Good Condition – Plantation/Rehabilitation Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	37 ^A	1,310
4	HU869 – Moderate to Good Condition Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	1.6	60
5	HU905 – Moderate to Good Condition Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	185 ^B	7,482

Veg Zone No.	Vegetation Zone	Area Within the United UHSA Project Area (ha)	No. of Credits Required
6	HU905 - Moderate to Good Condition - Thinned Canopy	0.08	3
7	HU905 – Moderate to Good Condition – Regeneration	27	993
8	HU905 – Moderate to Good Condition – Cooba Open Shrubland	101 ^C	2,414
9	HU905 – Low Condition – Derived Native Grassland	105 ^D	1,689
10	HU906 – Moderate to Good Condition Bull Oak grassy woodland of the central Hunter Valley	122	5,049
11	HU945 – Moderate to Good Condition Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	32 ^E	1,264
12	Cleared Land	476	Nil
Total		1,087	20,280

Notes:

* Hectares have been rounded to the nearest whole number for values over 10 hectares. Values between 1 and 10 hectares have been rounded to the nearest single decimal place. Values less than 1 hectare have been rounded to two decimal places.

A = All of Zone 3 is approved for disturbance and might be cleared under existing approval prior to a future development occurring under the UHSA.

B = 0.17 hectares of Zone 5 are approved for disturbance and might be cleared under existing approval prior to a future development occurring under the UHSA.

C = 8.4 hectares of Zone 8 are approved for disturbance and might be cleared under existing approval prior to a future development occurring under the UHSA.

D = 1.6 hectares of Zone 9 are approved for disturbance and might be cleared under existing approval prior to a future development occurring under the UHSA.

E = 0.29 hectares of Zone 11 are approved for disturbance and might be cleared under existing approval prior to a future development occurring under the UHSA.

ha = hectare

HU#### = Hunter Biometric Vegetation Type Number

T_G = A threatened species multiplier ranging between 0 and 1.0 that is used to calculate the number of credits required. The lower the number the higher the number of credits generated.

3.0 Project Additional Disturbance Area

Section 2 lists the total number of credits generated for the entire UHSA United Project Area. The United UHSA report calculated the credit requirement for areas (nominated by Glencore) that could possibly be identified for mining in the next 25 years. The current Project (which is the subject of this report) identifies proposed mining areas located within the broader United UHSA Project Area.

This section and all subsequent sections identify the credit requirements of the Project (the United Wambo Open Cut Coal Mine Project) which are a subset of the total United UHSA credit requirements. The Project will require the disturbance of an area of approximately 714 hectares, which includes the approximately 4 hectare non-UHSA disturbance area (refer to **Figure 1.11**). **Table 3.1** lists the area of each vegetation type to be impacted by the Project, together with the Site Value Score, which is a measure of the condition of the biodiversity within each vegetation zone (see footnote for explanation).

Table 3.1 Additional Disturbance Area Vegetation Zones

Veg Zone No.	Vegetation Zone	Area (ha)*	Site Value Score [#]	Threatened Ecological Community
2	HU812 – Moderate to Good Condition Forest Red Gum grassy open forest on floodplains of the lower Hunter [^]	0.29	81	Hunter Floodplain Red Gum Woodland EEC (TSC Act)
3	HU816 – Moderate to Good Condition – Plantation/Rehabilitation Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter [^]	29.42	60	Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC (TSC Act) 1.17 ha Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)
4	HU869 – Moderate to Good Condition Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin [^]	1.56	68	Hunter Valley Footslopes Slaty Gum Woodland VEC (TSC Act) 1.13 ha Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)
5	HU905 – Moderate to Good Condition Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	175.06	72	Central Hunter Grey Box – Ironbark Woodland EEC (TSC Act) 169.40 ha Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)

Veg Zone No.	Vegetation Zone	Area (ha)*	Site Value Score [#]	Threatened Ecological Community
6	HU905 - Moderate to Good Condition - Thinned Canopy	0.08	57	Central Hunter Grey Box – Ironbark Woodland EEC (TSC Act) 0.08 ha Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)
7	HU905 – Moderate to Good Condition – Regeneration	26.77	64	Central Hunter Grey Box – Ironbark Woodland EEC (TSC Act) 23.01 ha Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)
8	HU905 – Moderate to Good Condition – Cooba Open Shrubland	80.89	35	NA
9	HU905 – Low Condition – Derived Native Grassland	101.69	17	20.71 ha Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)
10	HU906 – Moderate to Good Condition Bull Oak grassy woodland of the central Hunter Valley	118.62	74	3.1 ha Central Hunter Grey Box – Ironbark Woodland EEC (TSC Act) 8.02 ha Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)
11	HU945 – Moderate to Good Condition Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	31.61	71	NA
12	Cleared land (including disturbed land, mixed species revegetation plantation and water bodies)	147.97	NA	NA
Total		714 (713.96)		

* Hectares have been rounded to the nearest two decimal places in the tables.

[#] Site Value is the condition of each native vegetation zone calculated against the benchmark (determined by OEH for each BVT. The site value score is a quantitative measure of vegetation condition calculated in accordance with BCAM Equation 1 (DECCW 2011).

CEEC = Critically Endangered Ecological Community

EEC = Endangered Ecological Community

EPBC Act = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Ha = hectare

HU#### = Hunter Biometric Vegetation Type Number

NA = not applicable

TSC Act = NSW *Threatened Species Conservation Act 1995*

VEC = Vulnerable Ecological Community

Figure 3.1 shows the vegetation communities mapped within the additional disturbance area.

Table 3.2 details the number of species credits required for all applicable species credit species recorded in the additional disturbance area. A total of 562 species credits are required for the additional disturbance area.

Table 3.2 Number of Species Credits Required for the Additional Disturbance Area

Species Name	T _G Value	Number of Individuals/Area of Habitat	Number of Credits Required
Flora Species			
No credits required as no disturbance (see Table 4.1 in Section 4).	-	0	0
Fauna Species			
Southern myotis (<i>Myotis macropus</i>) (breeding habitat)	0.13	7.3 hectares	562
Total			562

Note: See **Appendix A** regarding the revised assessment approach applied to the southern myotis, in accordance with advice from OEH.

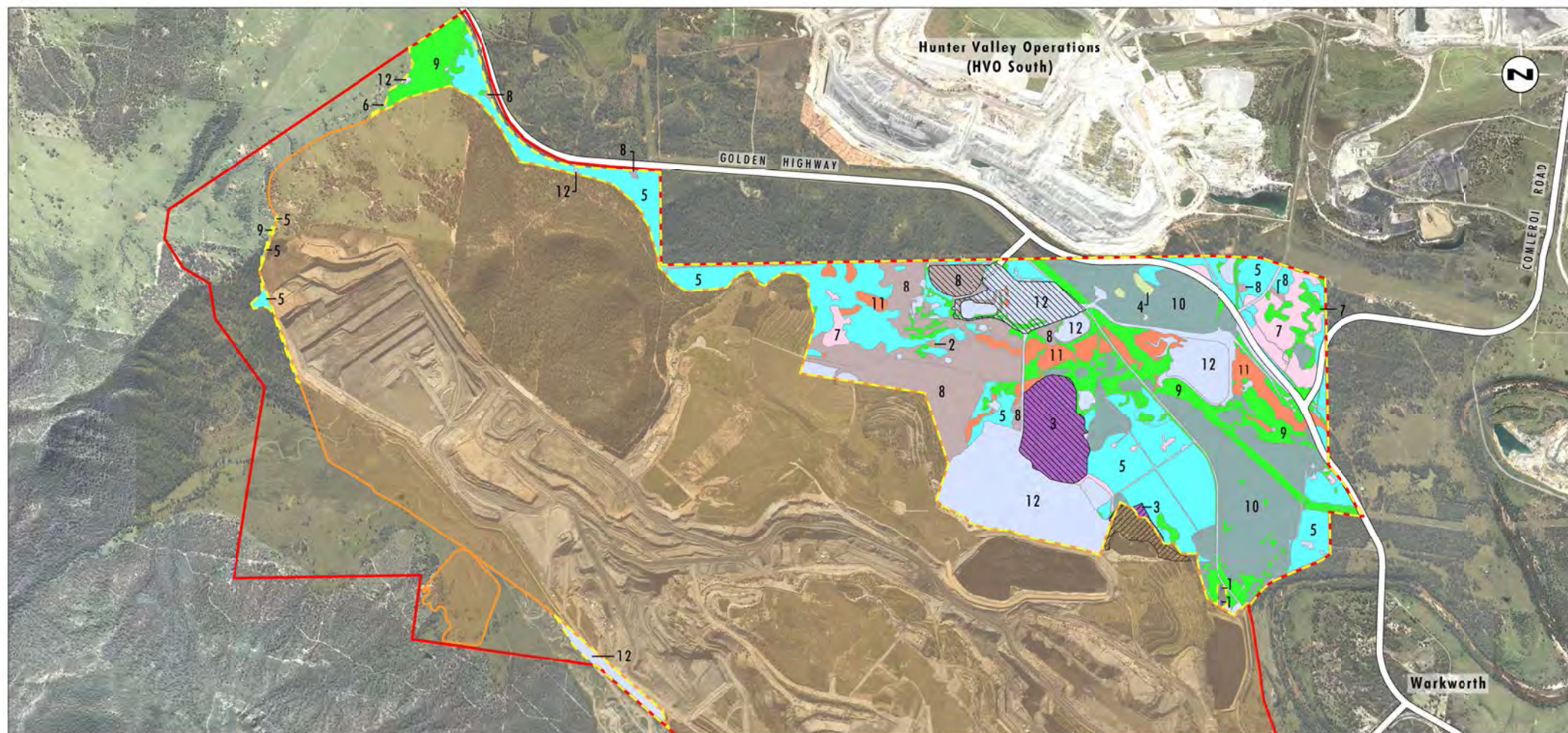


Image Source: AAM (2012), United (2015)

Data Source: Glencore (2014)

Legend

- Project Area
- Conceptual Additional Disturbance Area
- Approved Wambo Surface Development Area
- 1 - HU652 - Weeping Myall - Cooba - Scrub Wilga Shrubland of the Hunter Valley- Moderate to Good Condition
- 2 - HU812 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter - Moderate to Good Condition
- 3 - HU816 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest on Slopes of the Upper Hunter and Sydney Basin - Moderate to Good Condition - Plantation/Rehabilitation (CEEC in part)
- 4 - HU869 - Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin - Moderate to Good Condition (CEEC)
- 5 - HU905 - Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter - Moderate to Good Condition (CEEC)
- 6 - HU905 - Moderate to Good Condition - Thinned Canopy (CEEC)
- 7 - HU905 - Moderate to Good Condition - Regeneration (CEEC in part)
- 8 - HU905 - Moderate to Good Condition - Cooba Open Shrubland
- 9 - HU905 - Low Condition - Derived Native Grassland (CEEC in part)
- 10 - HU906 - Bull Oak Grassy Woodland of the Central Hunter Valley - Moderate to Good Condition (CEEC in part)
- 11 - HU945 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley - Moderate to Good Condition
- 12 - Cleared Land
- Approved for Disturbance
- Wambo Mine Rehabilitation

File Name (A4): R15/3509_203gn
20160506 14.46

FIGURE 3.1

Vegetation Types of the Disturbance Area

4.0 Avoidance and Minimisation Measures

In accordance with the UHSA Appendix C (Draft Guidelines for the Mitigation of Coal Mining Impacts on Biodiversity (OEH 2015)), proponents must avoid impacts on important biodiversity features as the first step of the 'avoid, mitigate, offset' hierarchy. Proponents must undertake all feasible measures to avoid impacts before considering mitigation and offsetting measures to compensate for any remaining impacts.

Avoidance measures can include relocation of the disturbance, alternate designs of the Project and specific construction techniques tailored to avoid impacts. A number of design changes were implemented during the early stages of designing the Project that ameliorated the impacts of the Project on biodiversity entities, including threatened species, endangered ecological communities, and/or their habitats. United has undertaken detailed studies which considered numerous alternative mine and infrastructure plans as discussed in further detail in Section 3.0 of the main text of the EIS.

A key alternative considered was to develop the United Open Cut as a standalone mining operation which would have resulted in approximately 148 hectares of further disturbance to biodiversity than the proposed Project due to the need to develop stand-alone coal processing facilities, mine infrastructure (workshops etc) and transportation infrastructure (rail line, rail loop and train loading facility). This Option 1 Project (as detailed in Section 3.4.1 of the EIS) represented the largest disturbance footprint alternative. This included impacts to the north of the Project Area in areas containing *Central Hunter Valley Eucalypt Forest and Woodland CEEC*. Infrastructure associated with a proposed rail loop option would have impacted areas of potential *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC*, and *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* occurring to the southeast of the Project Area. The revision of these designs reduced the overall impact of the Project on biodiversity.

The avoidance measures proposed for the Project for Very High and High Risk entities (as outlined in the draft *Managing Impacts on Biodiversity under the Upper Hunter Strategic Assessment* document (OEH 2015b)), are outlined in **Table 4.1** below.

Table 4.1 Avoidance Measures for Very High and High Risk Biodiversity Entities of the Project

Entity and Risk Level	Targeted Avoidance Measures
Very High Risk Category <i>Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion EEC</i>	Initial disturbance area boundary included the 0.1 ha stand of Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion (HU652 – Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley). The disturbance area boundary was modified to avoid impacting on the 0.1 ha stand of the community. The stand will be managed for the recovery of the community and will be fenced to exclude grazing stock and unauthorised intrusions (with a 20 metre buffer between the stand and the fence, where practicable, considering the locations of existing infrastructure).

Entity and Risk Level	Targeted Avoidance Measures
High Risk Category <i>Central Hunter Valley Eucalypt Forest And Woodland CEEC</i> <i>Warkworth Sands Woodland in the Sydney Basin Bioregion EEC</i> <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC</i> <i>River Red Gum (Eucalyptus camaldulensis) population in the Hunter Catchment</i>	Impacts for the Option 1 project alternative (refer to Section 3.4.1 of the EIS) would have resulted in a predicted approximate 115 ha of further disturbance to the <i>Central Hunter Valley Eucalypt Forest and Woodland CEEC</i> to the north of the Project Area and south of the Golden Highway associated with a larger pit footprint. Furthermore, infrastructure associated with a proposed rail loop option would have impacted a small area of potential <i>Warkworth Sands Woodland in the Sydney Basin Bioregion EEC</i> occurring to the southeast of the Project Area adjacent to the existing 33kV transmission line easement. Option 1 also included impacts to Wollombi Brook required for a new rail line crossing, and therefore likely to impact a small area of <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC</i> and the stands of river red gum (<i>Eucalyptus camaldulensis</i>) occurring along Wollombi Brook. The disturbance to these biodiversity features was avoided by the revision of the Project design. This has reduced the impacts of the Project on <i>Central Hunter Valley Eucalypt Forest and Woodland CEEC</i> and <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC</i> and avoided completely any impacts on <i>Warkworth Sands Woodland in the Sydney Basin Bioregion EEC</i> and avoided potential clearing impacts on the River Red Gum (<i>Eucalyptus camaldulensis</i>) population in the Hunter Catchment.

5.0 Additional UHSA Requirements

Since the submission of the final United Collieries Biodiversity Certification Assessment Report for the UHSA in September 2015 (United UHSA Report) (Umwelt 2015), OEH has provided additional verbal and written advice (see **Section 1**) regarding how the United Project should be reported, given the delays in the finalisation of the overall UHSA program. In particular, a letter from OEH (2015e) specifies that additional assessments are required in this Statement of Consistency report to address any new listings since the preparation of the United UHSA Report (Umwelt 2015). Furthermore, the document *Managing impacts on biodiversity under the Upper Hunter Strategic Assessment (UHSA)* (OEH 2015b) details how the BCAM assessment is to be updated and tailored to the specific area proposed to be developed, in relation to the broader area assessed in the United UHSA BCAM report (Umwelt 2015). These two elements are addressed in the following **Sections 5.1** and **5.2** respectively.

In addition to the above, a further area of approximately 4 hectares was added to the additional disturbance area outside the United UHSA Project Area, and the technique for assessing potential breeding habitat for the southern myotis was refined by OEH. These are also addressed below and in **Appendix A**.

Finally, an assessment of the potential for the regent honeyeater to occur in the further 4 hectare non-UHSA disturbance area is included in **Section 5.2.2** with targeted survey effort detailed in **Appendix A**. Supplementary information on the regent honeyeater and the non-UHSA disturbance area is included in **Appendix B**.

5.1 Assessment of New Listings

The OEH advised in a letter dated 17 December OEH (2015e) that additional assessments are required in this Statement of Consistency report to address any new listings since the preparation of the United UHSA Report (Umwelt 2015). While the United UHSA Report was submitted in final form in September 2015, it was initially completed and submitted to OEH on 19 March 2015. It was accepted by OEH soon thereafter. However changes to the United Wambo Open Cut Coal Mine Project boundary, together with delays in the finalisation of the overall UHSA program, meant that boundary revisions were required so that this Statement of Consistency report could satisfactorily cover the Project Area. OEH determined that no other changes should be made to the United UHSA Report, despite the changes to listings, and that any changes to listings would be dealt with in this Statement of Consistency report.

The new listings/changes relevant to the Project comprise:

- Central Hunter Valley Eucalypt Forest and Woodland, listed as a critically endangered ecological community (CEEC) under the EPBC Act on 7 May 2015.
- Regent honeyeater (*Anthochaera phrygia*), listed as critically endangered (transferred from endangered) on 8 July 2015. While the regent honeyeater is listed as an ecosystem credit species in the BioCertification Credit Calculator (Version 1.08) and was considered an ecosystem credit species in the United UHSA report, OEH recommends (OEH 2015e) that the species is recognised as a species credit species as per the TSPD.

It is also acknowledged that a proposed listing assessment is currently subject to public consultation to list Warkworth Sands Woodland of the Sydney Basin Bioregion as a CEEC under the EPBC Act. This community does not occur within the Project Area and will not be directly affected by the Project. It is however considered in terms of the potential for it to be indirectly affected by changes to groundwater. This is further discussed in **Section 8.2.6**.

On 5 May 2016 the conservation status of the swift parrot (*Lathamus discolor*) was changed from Endangered to Critically Endangered under the EPBC Act. The swift parrot has not been recorded in the additional disturbance area despite five years of targeted survey effort (refer to **Section 6.1.3.6**). Furthermore it is listed as an ecosystem credit and there have been no changes to its status that have any material effect on the Project's credit requirements.

On 19 February 2016 the NSW Scientific Committee made a Final Determination to change the conservation status of Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion from an Endangered Ecological Community to a Critically Endangered Ecological Community under the TSC Act. All areas of weeping myall woodland will be avoided by the Project (refer to **Section 4**).

5.1.1 Regent Honeyeater Assessment

5.1.1.1 Assessment Summary

The regent honeyeater is a species that typically occurs in the Upper Hunter during the winter months, most often occurring in box-ironbark eucalypt associations. The movement patterns of the regent honeyeater, while in a broad sense are relatively regular (in terms of being an annual movement), also contain a high degree of variability in the specific timing and movement patterns across years, most likely in response to regional eucalypt flowering patterns (DoE 2016).

Targeted winter bird surveys were undertaken across the Project Area during 2010, 2011, 2012, 2013, 2014 and 2016. Targeted winter bird surveys were also undertaken on 11 July 2016 within the 4 hectare non-UHSA disturbance area. Refer to **Appendix A** for detailed survey methodology.

The regent honeyeater was not recorded during the six years of targeted survey. The regent honeyeater was not recorded in the additional disturbance area as a result of these surveys. The survey results indicate that the additional disturbance area is poor quality habitat for the species, or due to the low number of individuals remaining, the chance of the species occurring in the additional disturbance area is very low. Based on the surveys completed, the regent honeyeater is unlikely to utilise habitat in the additional disturbance area.

A discussion on the regent honeyeater in relation to the non-UHSA disturbance area is provided in **Section 5.2.2** with supplementary information provided in **Appendix B**.

5.1.1.2 Credit Requirement

No further assessment is required for the regent honeyeater and no regent honeyeater credits are required for the additional disturbance area.

5.1.2 Central Hunter Valley Eucalypt Forest and Woodland CEEC

5.1.2.1 Assessment Summary

The Central Hunter Valley Eucalypt Forest and Woodland CEEC was listed under the EPBC Act during May 2015. Several vegetation types that occur in the additional disturbance area potentially conform to the CEEC and targeted field surveys were undertaken to determine the potential extent of the CEEC within the additional disturbance area.

A risk assessment by OEH of the potential impacts to the Central Hunter Valley Eucalypt Forest and Woodland CEEC (OEH 2015a) identified that the maximum removal of the CEEC from all UHSA project areas would result in a 12 per cent reduction in the current extent or 5 per cent of the pre-European extent of the

vegetation community. OEH's risk assessment also indicated that the removal of all potential areas of the CEEC from the United UHSA Project Area would break connectivity and isolate patches located to the east of the United UHSA Project Area around the Pokolbin district.

OEH concluded that, with the predicted regional impacts, the community will persist across its range, but that there will be a substantial decrease in its extent across the Central Hunter Valley portion of its distribution. The worst case scenario comprising the removal of all habitat areas from within all the UHSA project areas was estimated by OEH to have a potentially major consequence on the regional population, and the likelihood of this consequence eventuating was estimated to be "likely" (OEH 2015a).

A total of approximately 223.5 hectares of *Central Hunter Valley Eucalypt Forest and Woodland CEEC* was identified within the additional disturbance area (refer to **Figure 5.1**). Components of the following BVTs present in the additional disturbance area conform to the CEEC:

- Zone 3: HU816 Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (1.2 hectares) – note that the area of this vegetation zone excluded from the *Central Hunter Valley Eucalypt Forest and Woodland CEEC* was based on a combination of the understorey having a high proportion of exotic species (greater than 50 per cent perennial exotic understorey), in particular *Acacia saligna*, as well as areas where the introduced sugar gum (*Eucalyptus cladocalyx*) was present. As a result the necessary CEEC condition thresholds were not met in these areas.
- Zone 4: HU869 Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin – (1.1 hectares) – note that the area of this vegetation zone excluded from the *Central Hunter Valley Eucalypt Forest and Woodland CEEC* was based on the patch size being less than the minimum 0.5 hectares and because it was surrounded by dense Bull Oak Forest. As a result the necessary CEEC condition thresholds were not met in these areas.
- Zones 5, 6, 7 and 9: HU905 Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter (213.2 hectares) – note that the areas of vegetation zones 5 – Moderate to Good Condition and Zone 7 – Moderate to Good Condition - Regeneration excluded from the *Central Hunter Valley Eucalypt Forest and Woodland CEEC* were based on a combination of the patch size being less than the minimum 0.5 hectares or the canopy not dominated by one or more of the four characteristic eucalypt species. Zone 9 – Low Condition – Derived Native Grassland areas were excluded where they were greater than 30 metres from a patch of woodland conforming to the *Central Hunter Valley Eucalypt Forest and Woodland CEEC*. Zone 8: 905 Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition – Cooba Open Shrubland was excluded from meeting the *Central Hunter Valley Eucalypt Forest and Woodland CEEC* based on the fact that it does not contain any of the four characteristic eucalypt species. In the context of the dominant canopy species, cooba (*Acacia salicina*), this species is described as being a shrub or tree 3-10 metres high according to Harden (2002). Within this vegetation zone the canopy ranges from 5 to 10 metres and cooba (*Acacia salicina*) is generally a single stemmed plant, meaning that this vegetation zone is classified as a woodland according to Walker and Hopkins (1990). In addition it does not form a naturally-occurring vegetation community according to all other regional mapping and classification work in the Hunter Valley. Based on this, and the fact that it is not a shrubland (rather it is a woodland as it is dominated by low trees, not shrubs), whether derived or not, it does not warrant inclusion in the CEEC delineation for this project.
- Zone 10: HU906 Bull Oak Grassy Woodland of the Central Hunter Valley (8.0 hectares) – note that the area of this vegetation zone excluded from the *Central Hunter Valley Eucalypt Forest and Woodland CEEC* was based on bulloak (*Allocasuarina luehmannii*) dominating the canopy, in which the foliage cover of this species was greater than 75 per cent of the projected canopy cover.

As per the key diagnostic characteristics and condition thresholds outlined in the Approved Conservation Advice (TSSC 2015) areas of vegetation were excluded from the Central Hunter Valley CEEC in the additional disturbance area when:

- patches were less than the minimum 0.5 hectare (woodland component) condition threshold
- the key diagnostic characteristic for the canopy was not met, in which the canopy was not dominated by one or more of the four characteristic species
- bulloak (*Allocasuarina luehmannii*) dominated the canopy, in which the foliage cover of this species was greater than 75 per cent of the projected canopy cover
- the perennial understorey vegetative cover was less than 50 per cent
- the derived native grassland 30 metre buffer from the woodland/forest edge was dissected by a major track, road or woodland/forest vegetation not consistent with the Central Hunter Valley CEEC listing.

The majority of the Central Hunter Valley CEEC in the additional disturbance area was represented by the Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter. The woodland form of this community has a canopy dominated by grey box (*Eucalyptus moluccana*), narrow-leaved ironbark (*Eucalyptus crebra*) and bulloak (*Allocasuarina luehmannii*). In addition, a regenerating form of this community was identified in the north-eastern portion of the additional disturbance area which was dominated by young grey box, narrow-leaved ironbark and bulloak.

A small amount of Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin was included in the Central Hunter Valley CEEC, however this area of woodland was dominated solely by slaty box (*Eucalyptus dawsonii*). A small patch of the Planted/Rehabilitated Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter which was dominated by Spotted Gum (*Corymbia maculata*) was found to conform to the Central Hunter Valley CEEC in the southern portion of the additional disturbance area.

Although the vast majority of the Bull Oak Grassy Woodland of the Central Hunter Valley was excluded from the Central Hunter Valley CEEC listing due to the dominance of bulloak (*Allocasuarina luehmannii*), several small patches in the additional disturbance area were found to contain greater than 25 per cent of the narrow-leaved ironbark (*Eucalyptus crebra*) projected canopy cover and therefore satisfied the key diagnostic characteristic for canopy species dominance. Note that the meaning of “*Allocasuarina luehmannii* (bulloak, buloke) dominates in combination with” in Section 1.5.1 of the Key Diagnostic Characteristics has been interpreted to mean that one or more of the four key eucalypt species should be at least sub- or co-dominant and therefore comprise a minimum of 25 per cent of the canopy cover, in which bulloak could comprise from 25 per cent through to 75 per cent of the canopy cover.

Derived native grasslands within 30 metres of the woodland/forest edges were also included in the Central Hunter Valley CEEC where the perennial understorey vegetative cover was 50 per cent or more, as per the Conservation Advice for the Central Hunter Valley CEEC. The derived native grasslands were dominated by a mixture of native grasses and herbs.

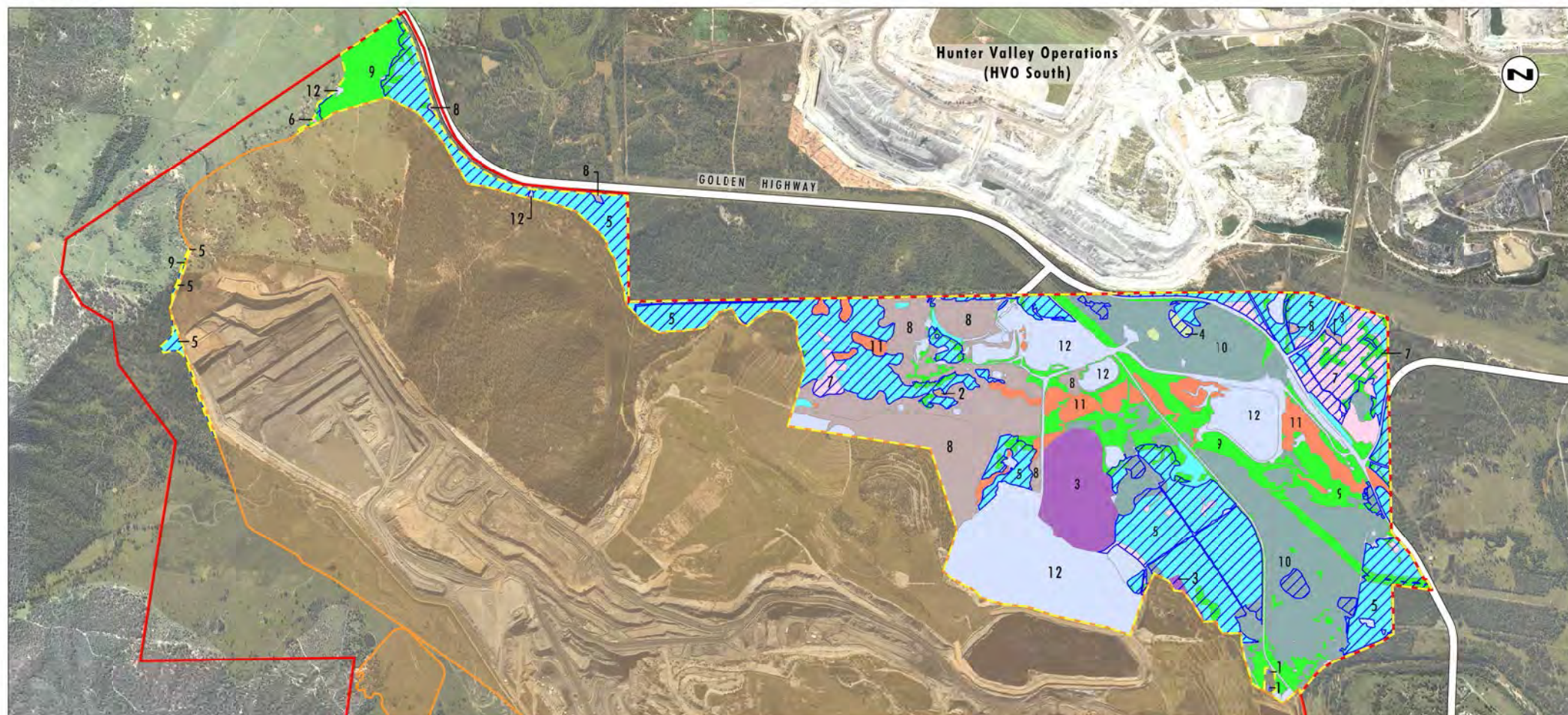


Image Source: AAM (2012), United (2015)
Data Source: Glencore (2014)

Legend

- Project Area
- Conceptual Additional Disturbance Area
- Approved Wambo Surface Development Area
- Central Hunter Valley Eucalypt Forest and Woodland (CEEC)
- 1 - HU652 - Weeping Myall - Cooba - Scrub Wilga Shrubland of the Hunter Valley - Moderate to Good Condition
- 2 - HU812 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter - Moderate to Good Condition
- 3 - HU816 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest on Slopes of the Upper Hunter and Sydney Basin - Moderate to Good Condition - Plantation/Rehabilitation (CEEC in part)
- 4 - HU869 - Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin - Moderate to Good Condition (CEEC)

- 5 - HU905 - Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter - Moderate to Good Condition (CEEC)
- 6 - HU905 - Moderate to Good Condition - Thinned Canopy (CEEC)
- 7 - HU905 - Moderate to Good Condition - Regeneration (CEEC in part)
- 8 - HU905 - Moderate to Good Condition - Cooba Open Shrubland
- 9 - HU905 - Low Condition - Derived Native Grassland (CEEC in part)
- 10 - HU906 - Bull Oak Grassy Woodland of the Central Hunter Valley - Moderate to Good Condition (CEEC in part)
- 11 - HU945 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley - Moderate to Good Condition
- 12 - Cleared Land

0 0.5 1.0 2.0 km
1:35 000

FIGURE 5.1

Central Hunter Valley Eucalypt
Forest and Woodland CEEC

5.1.2.2 Credit Requirement

A total of approximately 223.5 hectares of Central Hunter Valley Eucalypt Forest and Woodland CEEC was identified within the additional disturbance area. The conservation advice for the Central Hunter Valley CEEC identifies areas of moderate quality condition class as being critical to the survival of the community. Areas of moderate quality condition occur within the additional disturbance area and will be removed as a result of the Project.

Under the BioCertification Assessment Methodology the identification of a vegetation community as a threatened ecological community (TEC), either an EEC or CEEC, does not generate additional credit requirements for the community above those of the community itself.

In total 8,403 credits relate to the Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered Ecological Community.

5.2 Inclusion of the Non-UHSA Disturbance Area

5.2.1 Surveys of the Non-UHSA Disturbance Area

Since the United Collieries UHSA report was completed an additional 4.27 hectares was added to the additional disturbance area which was outside of the original United UHSA project area. This area is termed the “non-UHSA disturbance area.” In accordance with advice received from OEH (2016a) Umwelt has investigated this area thoroughly, and has included the findings in this report.

The non-UHSA disturbance area was traversed on foot by an Umwelt ecologist on 14 April 2016. In order to confirm the vegetation type present a total of eight semi-quantitative rapid vegetation assessments and one 20 x 20 metre floristic plot were sampled. Opportunistic surveys were also undertaken for any potential threatened flora and fauna species.

The non-UHSA disturbance area was found to contain the following vegetation zones:

- 5_HU905 – Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition
- 7_HU905 – Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition – Regeneration
- 9_HU905 – Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter – Low Condition – Derived Native Grassland
- Cleared Land.

No threatened flora or fauna species were observed during the field surveys.

Targeted winter bird surveys were undertaken in the non-UHSA disturbance area on 11 July 2016 using both visual searches (using binoculars) and call playback surveys (using a loud hailer) across four survey points. Surveys targeted areas of box-ironbark associates and flowering eucalypts, where available, and noted the occurrence or otherwise of any key tree or mistletoe species as per the National Recovery Plan (DoE 2016) in the non-UHSA disturbance area.

5.2.2 Potential for Regent Honeyeater to Occur in Non-UHSA Disturbance Area

As noted in **Section 2.0** approximately 4 hectares of the additional disturbance area for the Project is outside of the area covered by the United UHSA report (the 'non-UHSA disturbance area'). To assess the potential occurrence of the regent honeyeater in this area, targeted winter bird surveys were undertaken on 11 July 2016 within the 4 hectare non-UHSA additional disturbance area (refer to **Appendix A**) and a detailed habitat suitability assessment was undertaken, building on the extensive previous work undertaken for the Project on the adjoining land.

The winter bird survey did not record the regent honeyeater in the non-UHSA disturbance area and the species has not been recorded in adjoining habitats during the several years of targeted survey. The non-UHSA disturbance area was assessed for suitable habitat for the species as per the information outlined in the National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) released by DoE in April 2016 (DoE 2016). No key tree or mistletoe species for the regent honeyeater and no nesting sites were observed.

Supplementary information has been prepared to specifically provide further detail on the potential occurrence or otherwise of the regent honeyeater within the non-UHSA disturbance area. This is provided in **Appendix B**. The assessment in **Appendix B** concludes that it is unlikely that the regent honeyeater would occur with any frequency or regularity within the non-UHSA disturbance area. The non-UHSA disturbance area was not identified as containing any key tree or mistletoe species for the regent honeyeater as outlined in the National Recovery Plan (DoE 2016) and records in the locality are uncommon and not recent (within the last 10 years). While its occasional, infrequent presence cannot be categorically ruled out, it is very likely that any occurrence in the non-UHSA disturbance area would be rare and of very limited duration, and of no significance to the species as a whole.

The extent of targeted winter bird survey in the non-UHSA disturbance area in 2016 and the surveys undertaken over the wider Project Area in the years 2010, 2011, 2012, 2013, 2014 and 2016 have not recorded the species utilising the habitats of the non-UHSA disturbance area or the similar and contiguous habitats of the wider Project Area. This is consistent with the findings for the regent honeyeater for the United Collieries UHSA report which has been accepted and approved by OEH.

Therefore, species credits for the regent honeyeater have not been calculated for the non-UHSA disturbance area.

5.3 Updated BCAM Assessment

Section 6.1.1 of OEH (2015b) specifies that the proponent must re-calculate the credit requirement reported in their BCAM report for their proposed development area. The purpose of this is to apply the BCAM credit calculation rules to the specific area proposed for development, to ensure that the biodiversity values recorded in the development area are properly accounted for in impact assessment and offsetting. The document specifies the steps that must be addressed to recalculate the credit requirement. These steps then determine the final offset requirement for the Project, which is presented in **Section 12** of this report.

The additional recalculations that were undertaken comprised:

- the re-calculation of the landscape value according to the additional disturbance area
- the re-calculation of the ecosystem credits and species credits according to the revised area calculations for the additional disturbance area, including re-assessment of 'overstorey regeneration' values in derived native grasslands.

No other changes resulted from the change in assessment area (additional disturbance area vs. UHSA BCAM area). The methods employed for the re-calculations and the results are documented in the following sections.

5.3.1 Recalculation of Landscape Value to Additional Disturbance Area

Re-calculation of the landscape value of the additional disturbance area was required as it is smaller than the original UHSA area. Each component of the landscape value was assessed, comprising per cent native vegetation cover in assessment circle, connectivity value and adjacent remnant area. The methods for this are outlined in **Appendix A**.

All components of the landscape value assessment remained the same for the additional disturbance area as they were for the UHSA area. In both the United UHSA BCAM assessment and the United Project Area BCAM assessment the native vegetation cover in the assessment circle was reduced by one vegetation cover category (being a 10 per cent band), reducing from 41-50 per cent native vegetation cover class to 31-40 per cent native vegetation cover class. The native vegetation cover reduced from 2523 hectares (42 per cent) to 2056 hectares (34 per cent).

The highest level of connectivity within the assessment circle is a regional biodiversity link, represented by a 30 metre buffer either side of Redbank Creek which is listed as a minor river on the Major Rivers Database (OEH 2011).

The Project Area is connected to a large area of remnant vegetation to the west where there are extensive areas of moderate to good condition native vegetation which connect to the Wollemi National Park. There is greater than the maximum threshold of 501 hectares of moderate to good condition native vegetation which meets the very large category for adjacent remnant area.

5.3.2 Recalculation of Ecosystem Credits and Species Credits According to the Additional Disturbance Area

Ecosystem credits and species credits have been recalculated for the additional disturbance area, which is smaller than the overall United UHSA area. In particular the re-assessment of 'overstorey regeneration' values in derived native grasslands and shrublands were re-assessed for the additional disturbance area, in accordance with Step 2 in Section 6.1.1 of OEH (2015b).

The re-assessment of 'overstorey regeneration' was undertaken for HU905 – Low Condition – Derived Native Grassland and HU905 – Moderate to Good Condition – Cooba Open Shrubland by interrogating original plot/transect data and vegetation community notes. The re-assessment of 'overstorey regeneration' found that HU905 – Moderate to Good Condition – Cooba Open Shrubland remained at zero, whilst the HU905 – Low Condition – Derived Native Grassland reduced from 0.5 to 0 based on the fact no over-storey trees were recorded as regenerating across the entire zone. The number of overstorey species regenerating was not limited to the floristic plots and accounted for regeneration outside of plots and across the same vegetation zone.

In accordance with Umwelt (2015), the original calculation of 0.5 for HU905 – Low Condition – Derived Native Grassland was calculated by considering the site attribute data from all four Glencore UHSA sites that were surveyed, comprising sites at United, Mangoola, Bulga and Ravensworth. This approach was accepted by OEH. Across these four sites, two overstorey species were recorded within this vegetation zone, comprising grey box (*Eucalyptus moluccana*) and slaty box (*Eucalyptus dawsonii*). Only grey box was recorded as regenerating and as a result the overstorey regeneration was scored as 0.5. A review of the Biometric data collected from the United UHSA site found that neither of these species were recorded as regenerating across the HU905 – Low Condition – Derived Native Grassland vegetation zone and as a result

the amended overstorey regeneration was calculated to be zero. Additionally, further surveys of the Non-UHSA Disturbance Area during 2016 found that none of the overstorey species are regenerating within the HU905 – Low Condition – Derived Native Grasslands. This area however contained substantial hickory wattle (*Acacia falcata*) and some young bullock (*Allocasuarina luehmannii*) regeneration. These species do not constitute ‘overstorey regeneration’ however. Areas of dense regeneration of HU905 were separated out as a unique zone and these received an overstorey regeneration score of 1 across the Project Area. Further detail on this change is outlined in **Appendix A**.

This reduced the site value score for this vegetation zone from 17 to 12.

5.3.3 Southern Myotis Revised Assessment Approach

5.3.3.1 Background

On 22 March 2016 OEH released guidelines relating to the calculation of credits for southern myotis (*Myotis macropus*) breeding habitat (OEH 2016c). Prior to this there was no agreed approach as to how potential breeding habitat should be assessed, rather simple (verbal) advice from OEH had been used as a guide. OEH have since found that in some cases, high credit requirements have been generated because UHSA assessors have used a broad definition of breeding habitat.

To address this, OEH developed guidelines to assist UHSA assessors to refine mapped areas of southern myotis breeding habitat. The guidelines can be applied to both the BCAM to assess a proposed impact and the BBAM to assess a proposed offset. These guidelines help to tailor the identification of southern myotis breeding habitat to riparian vegetation within 200 metres of permanent water sources where potential roosting hollows have been identified.

Detailed information on the assessment approach in accordance with these guidelines is included in **Appendix A**. On 19 and 21 April, and 3 May 2016, United Environmental staff undertook a survey of relevant creeklines previously mapped as southern myotis breeding habitat in the United UHSA BCAM report (Umwelt 2015). The surveys were conducted along Redbank Creek and its tributaries in the previously-mapped area and constituted assessments and measurement of pond dimensions, average streambank width and water flow. Historic analysis of water flow indicates that Redbank Creek is not, in this area, a perpetually flowing stream.

A total of 7.3 hectares of potential breeding habitat was identified in the additional disturbance area using the revised assessment method. This area has been revised from the 13.4 hectares of habitat identified in the UHSA report (Umwelt 2015) as a result of the more detailed site-based surveys that were undertaken for the United Wambo Project, which found that the eastern portion of Redbank Creek does not contain large pooling water bodies or perpetual flow in accordance with the guidelines.

Section 9.0 presents the results of the mapping of potential southern myotis breeding habitat.

5.4 Seven Part Tests of Significance

Threatened species impact assessment is an integral part of environmental impact assessment. The objective of s. 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.

The preparation of the UHSA addresses many of the components of the Seven Part Tests by use of the Biodiversity Certification Credit Calculator. Although it is understood that the preparation of a BioCertification Assessment under the UHSA is intended to supersede the requirement to prepare Seven Part Tests, this is not currently clearly defined in the legislation and therefore the Seven Part Test of Significance in accordance with s. 5A of the EP&A Act is provided in **Table 5.2** below, showing how each aspect of the test has been addressed by this assessment.

Table 5.1 Seven Part Tests of Significance and BCAM

Seven Part Test of Significance	Where Addressed in the BCAM 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 Biodiversity Certification Credit Calculator by the landscape features of the disturbance area (native vegetation cover, IBRA regions, patch sizes, condition and plant community types) and assessed by the impact on these features and credits generated as appropriate. Red flags (Section 2.3 of the BCAM (DECC 2011) identify impacts on areas of high conservation value including threatened species that are very rare, critically endangered, have few populations, have a restricted distribution or poorly known habitat requirements. Red flags are discussed in Section 9.0.
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 Biodiversity Certification Credit Calculator by the landscape features of the disturbance area (native vegetation cover, IBRA regions, patch sizes, condition and plant community types) and assessed by the impact on these features and credits generated as appropriate. Red flags (Section 2.3 of the BCAM (DECC 2011) identify impacts on areas of high conservation value including endangered populations that are very rare, critically endangered, have few populations, have a restricted distribution or poorly known habitat requirements. Red flags are discussed in Section 9.0.

Seven Part Test of Significance	Where Addressed in the BCAM Process
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;	Threatened ecological communities are predicted in the Biodiversity Certification Credit Calculator by the plant community types and biometric community types identified from the field surveys and entered into the BBCC. Credits are generated for impacts on vegetation communities that conform to TECs. Red flags (Section 2.3 of the BCAM (DECC 2011) identify impacts on areas of high conservation value including over cleared vegetation communities and CEECs and EECs listed under the TSC and EPBC Acts. Red flags are discussed in Section 9.0.
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 Biodiversity Certification Credit Calculator through the existing and future Site Value scores 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 Biodiversity Certification Credit Calculator.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);	The Project will not impact any areas of critical habitat as listed under s. 53-55 of the TSC Act.
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 BCAM. Recovery plans have been prepared for Weeping Myall Woodland (OEH 2013), regent honeyeater (<i>Anthochaera phrygia</i>) (DoE 2016), swift parrot (Saunders and Tzaros 2011) and large-eared pied-bat (<i>Chalinolobus dwyeri</i>) (DERM 2011). The Project will not impede the implementation of these recovery plans.

Seven Part Test of Significance	Where Addressed in the BCAM Process
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 BCAM. In the case of this Project, the following key threatening processes will likely be exacerbated in the locality: • Aggressive exclusion of birds by noisy miners (<i>Manorina melanoccephala</i>), • Clearing of native vegetation, • Loss of hollow-bearing trees, and • Removal of dead wood and dead trees.

6.0 Matters of National Environmental Significance

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment 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
- a water resource, in relation to coal seam gas development and large coal mining development.

A Referral (EPBC 2015/7600) to the Commonwealth Environment Minister was submitted in October 2015. The Commonwealth Department of the Environment (DoE) determined that the Project was deemed to comprise a 'Controlled Action' on 7 December 2015, due to the potential for significant impacts on the following matters protected under the EPBC Act:

- listed threatened species and communities
- a water resource, in relation to coal seam gas development and large coal mining development.

The Controlled Action decision was based on the DoE's assessment that the Project is likely to have a significant impact on MNES, including, but not necessarily limited to, the following:

- Central Hunter Valley Eucalypt Forest and Woodland CEEC
- regent honeyeater (*Anthochaera phrygia*)
- swift parrot (*Lathamus discolor*)
- spotted-tailed quoll (*Dasyurus maculatus maculatus*)
- a water resource.

The EPBC assessment of the Project is to occur under the assessment bilateral agreement with the NSW government. In accordance with the SEARs, and as documented in **Table 1.1** in **Section 1.2**, all relevant or potentially-relevant MNES are addressed in this section.

6.1 Threatened Species and Ecological Communities

6.1.1 Threatened Ecological Communities

One TEC, being *Central Hunter Valley Eucalypt Forest and Woodland* critically endangered ecological community (CEEC), has been recorded in the additional disturbance area.

Approximately 223.5 hectares of *Central Hunter Valley Eucalypt Forest and Woodland* CEEC was identified within the additional disturbance area. Components of the following BVTs present conform to the CEEC:

- HU905 Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter
- HU816 Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter
- HU869 Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin
- HU906 Bull Oak Grassy Woodland of the Central Hunter Valley
- derived native grasslands forms of the above-mentioned BVTs.

Section 5.1.2 provides further details on the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC. An Assessment of Significance prepared for the Referral was undertaken to determine the significance of the potential impact on the CEEC. The assessment of significance identified that the loss of 223.5 hectares of the community is likely to have a significant impact on the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC as it will reduce the extent of the community, adversely impact some areas of critical habitat of the ecological community and interfere with the recovery of the ecological community.

6.1.2 Threatened Flora Species

No EPBC Act listed threatened flora species have been identified or are likely to occur in the additional disturbance area and therefore no significant impacts are considered likely.

6.1.3 Threatened Fauna Species

Three threatened fauna species listed as vulnerable under the EPBC Act have been recorded in the additional disturbance area, being:

- large-eared pied bat (*Chalinolobus dwyeri*)
- grey-headed flying-fox (*Pteropus poliocephalus*)
- koala (*Phascolarctos cinereus*) combined populations of Qld, NSW and ACT

One threatened fauna species listed as endangered under the EPBC Act has been recorded in the additional disturbance area, being:

- spotted-tailed quoll (*Dasyurus maculatus maculatus*).

The regent honeyeater (*Anthochaera phrygia*) and the swift parrot (*Lathamus discolor*), both listed as critically endangered, have been recorded in the region but they have not been recorded within the additional disturbance area despite six years of targeted survey. The regent honeyeater and swift parrot are considered unlikely to occur in the additional disturbance area (see **Sections 6.1.3.5** and **6.1.3.6** for further discussion).

An assessment of significance for threatened fauna species which occur, and have the potential to occur, in the additional disturbance area has been undertaken for the preparation of the Referral. The assessment of significance identified that the loss of known and potential habitats for these species was unlikely to result in a significant impact. A summary of the potential impacts of the Project on each species is provided in the following sections.

6.1.3.1 Large-eared pied bat

The large-eared pied bat has been recorded on 15 occasions within the additional disturbance area from the recording of echolocation calls. The large-eared pied bat is a cave roosting species and no cave or escarpment habitat is present within the additional disturbance area. The large-eared pied bat has been recorded widely across the additional disturbance area and is likely to be a resident species within the local area. Approximately 464 hectares of potential foraging habitat occurs in the additional disturbance area, comprising all woodland and regeneration areas (including approximately 29 hectares of mine rehabilitation). Large areas of potential foraging habitat, in the form of woodland and forest areas, occur in the surrounding landscape, particularly to the west and south-west in Wollemi National Park, where large areas of potential roosting and breeding habitat also occurs. An assessment of Significance was undertaken in accordance with Significant Impact Guidelines 1.1 (DoE 2013). The outcome of the assessment (**Appendix C**) is that there is unlikely to be a significant impact on a population of the large-eared pied bat as a result of direct or indirect impacts from the Project.

6.1.3.2 Grey-headed flying-fox

The grey-headed flying-fox has been recorded on several occasions within the additional disturbance area. The additional disturbance area contains suitable foraging habitat for the species, however no camp sites have been identified and they are considered highly unlikely to occur. The nearest known flying fox camp is the Burdekin Park camp in Singleton which is approximately 14 kilometres to the east. The loss of approximately up to 233 hectares of woodland habitat from the additional disturbance area (including 29 hectares of mine rehabilitation) will result in the loss of potential foraging habitat for this species. An assessment of Significance was undertaken in accordance with Significant Impact Guidelines 1.1 (DoE 2013). The outcome of the assessment (**Appendix C**) is that given this species' highly mobile nature and ability to travel tens of kilometres each night, the Project is considered unlikely to significantly impact on a population of the grey-headed flying-fox.

6.1.3.3 Koala

A single 2006 record of the koala is known from the additional disturbance area. The koala was identified from old scats under a single tree by ECOServe in 2006. No other records of the koala have been made since 2006 despite numerous SAT searches and several spotlighting surveys of the additional disturbance area between 2009 and 2014. The koala is considered unlikely to occur in the additional disturbance area and the 2006 record is likely a record of a dispersing individual moving through the landscape. There is not a resident koala population in the additional disturbance area. Approximately 233 hectares of potentially suitable habitat, in the form of eucalypt dominated woodlands (including 29 hectares of mine rehabilitation), occurs across the additional disturbance area. An assessment of Significance was undertaken in accordance with Significant Impact Guidelines 1.1 (DoE 2013). The outcome of the assessment (**Appendix C**) is that given the koala has not been recorded since 2006 despite numerous recent

surveys, and there is not a resident koala population in the additional disturbance area, the Project is considered unlikely to significantly impact on a population of the koala.

6.1.3.4 Spotted-tailed quoll

The Controlled Action decision by the Commonwealth Government assessed that the Project involves clearing of 464 hectares of habitat that DoE considers critical to the survival of the spotted-tailed quoll and that it is therefore likely to result in a significant impact on the species. The spotted-tailed quoll is an ecosystem credit species under the BioCertification Methodology of the UHSA and does not generate credits specifically for the species. The UHSA methodology caters for the impact on this species through generating and offsetting ecosystem credits; that is, the offsetting of suitable vegetation communities and habitat types is considered to appropriately meet the offset needs for the quoll.

The record of the spotted-tailed quoll was made using a baited (i.e. a food source to attract animals) remote camera in an area of swamp oak vegetation during 2013, set at a pig trap by United personnel. This species has not been recorded prior to this event or since this point of time despite subsequent targeted survey. The Survey Guidelines for Australia's Threatened Mammals (DSEWPAC 2011) recommend the use of remote cameras and hair tubes to survey for the spotted-tailed quoll.

Survey during February and March 2013 using 140 terrestrial hair tubes and 120 arboreal hair tubes (targeting terrestrial and arboreal mammals) set for 14 consecutive nights (as per minimum survey night requirement of DSEWPAC (2011)) failed to record the spotted-tailed quoll. The use of 20 remote cameras (set to target the brush-tailed phascogale (*Phascogale tapoatafa*) as part of the UHSA surveys but given that both species' habitat coincides these cameras would have been equally proficient at detecting the spotted-tailed quoll) in March 2014, set for a minimum of three and a maximum of four nights also failed to record the spotted-tailed quoll.

There are relatively few recent records of this species occurring from the floor of the Hunter Valley, with most occurring around the fringes of the valley. It is considered unlikely that the spotted-tailed quoll breeds within the additional disturbance area, however it is likely that the spotted-tailed quoll utilises the habitats available as part of a wider territory.

It is likely that the additional disturbance area forms part of a large home range area for one or a small number of spotted-tailed quolls that forage within in the additional disturbance area on an occasional basis. The spotted-tailed quoll recorded in the additional disturbance area is likely to belong to a local population of the spotted-tailed quoll that predominantly occurs in Wollemi National Park and extends occasionally onto the valley floor. The spotted-tailed quoll has not been recorded in adjacent habitat areas of Wambo and has only once been recorded in the Warkworth Mine associated habitat areas to the south of the Proposed Action, recorded as a 1979 scat record.

Habitat areas of the additional disturbance area and surrounds are likely to provide suboptimal habitat for this species given the level of surrounding disturbance from mining, agriculture and infrastructure. The disturbance caused by the Project may reduce the ability of individuals in Wollemi National Park to disperse or move to suboptimal habitat areas within the additional disturbance area for the period of mining, leaving only a narrow connection of riparian vegetation along Wollombi Brook. In the medium term (i.e. 20 to 30 years) these habitat linkages will be restored through mine rehabilitation. Additional areas of woodland habitat occur to the south and east of Wollombi Brook that may also provide a connection between the areas east of the additional disturbance area and Wollemi National Park.

The Commonwealth Listing Advice for the spotted-tailed quoll (TSSC 2004) identifies the National area of occupancy as less than 2,000 km². The clearing of 464 hectares of potential habitat from the additional disturbance area represents approximately 0.2 per cent of the species' National area of occupancy.

The spotted-tailed quoll is unlikely to be significantly impacted because:

- based on a single record of the species, the additional disturbance area is unlikely to provide resident habitat for the species, and is likely to forage within the additional disturbance area on an occasional basis
- targeted survey effort and several years of non-target monitoring surveys has failed to record the species or any signs of its presence
- it is considered unlikely to breed in the additional disturbance area
- the area of potential impact represents less than 0.2 per cent of the species estimated National area of occupancy.

Appendix C details an assessment of the impacts of the Project on the spotted-tailed quoll according to the *Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013) which identifies that the Project is unlikely to have a significant impact on the spotted-tailed quoll.

6.1.3.5 Regent honeyeater

The Controlled Action decision by the Commonwealth Government assessed that the Project involved clearing of 212 hectares (the correct value at that time, however, due to minor Project changes and revised mapping of the CEEC is now 223.5 hectares) of the Central Hunter Valley Eucalypt Forest and Woodland CEEC that the DoE considers potentially provides high quality foraging habitat for this species.

Of the ten key tree species listed for the regent honeyeater by the National Recovery Plan for the species (DoE 2016) only one (spotted gum (*Corymbia maculata*)) has been recorded in the additional disturbance area. Approximately 29 hectares of Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest occurs in the additional disturbance area in plantation/rehabilitation form. Needle-leaf mistletoe (*Amyema cambagei*), when occurring on river oak (*Casuarina cunninghamiana*) is listed as one of the ten tree species for the regent honeyeater. The mistletoe has been recorded in the additional disturbance area, however river oak itself does not occur in the additional disturbance area.

The National Recovery Plan for the regent honeyeater (DoE 2016) identifies that mature trees tend to be more important as they are more productive, particularly on highly fertile sites and in riparian areas. However, the largest vegetation zone containing a key tree species for the regent honeyeater, the approximate 29 hectares of Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest, does not contain any mature trees. The vegetation zone contains a young canopy with trees between 5 and 11 metres in height.

As discussed in **Section 5.1**, the regent honeyeater is unlikely to occur in the additional disturbance area, as identified by six years of targeted winter bird surveys failing to identify the species and as the preferred habitats of this species are absent. **Appendix C** details an assessment of the impacts of the Project on the regent honeyeater according to the *Significant Impact Guidelines* (DoE 2013) that identifies that the Project is unlikely to have a significant impact on the regent honeyeater.

6.1.3.6 Swift parrot

The Controlled Action decision by the Commonwealth Government assessed that the Project involved clearing of 212 hectares (the correct value at that time, however, due to minor Project changes and revised mapping of the CEEC is now 223.5 hectares) of the Central Hunter Valley Eucalypt Forest and Woodland CEEC that the DoE considers potentially provides high quality foraging habitat for this species. The swift parrot is an ecosystem credit species under the BioCertification Methodology of the UHSA and does not generate credits specifically for the species.

Of the ten key tree species listed for the swift parrot as important foraging habitat in NSW during autumn and winter by the National Recovery Plan for the species (Saunders and Tzaros 2011) only two (spotted gum (*Corymbia maculata*) and forest red gum (*Eucalyptus tereticornis*)) have been recorded in the additional disturbance area. Approximately 29 hectares of Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest occurs in the additional disturbance area in plantation/rehabilitation form. A total of only approximately 0.29 hectares of Forest Red Gum grassy open forest on floodplains of the lower Hunter occurs in the additional disturbance area.

The National Recovery Plan for the swift parrot (Saunders and Tzaros 2011) identifies that during foraging on the mainland swift parrots have been found to preferentially forage in large, mature trees that provide more reliable foraging resources than younger trees. The approximate 29 hectares of Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest that occurs in the additional disturbance area in plantation/rehabilitation form contains a young canopy with trees between 5 and 11 metres in height. No mature spotted gum trees occur in the vegetation zone.

A comparison of the priority habitat areas identified for the swift parrot by Saunders and Tzaros (2011) against the known occurrence of the species in the additional disturbance area is detailed below:

- Habitat used for nesting. Nesting does not occur on the mainland and does not occur in the Project Area.
- Habitat used by large proportions of the swift parrot population. The swift parrot has not been recorded in the additional disturbance area despite five years of targeted monitoring (see **Section 5.1.1** in relation to regent honeyeater and swift parrot surveys). No proportion of the swift parrot population is known to forage in the additional disturbance area.
- Habitat used repeatedly between seasons (site fidelity). The swift parrot has not been recorded in the additional disturbance area despite five years of targeted monitoring (see **Section 5.1.1**). The swift parrot has not repeatedly used any parts of the additional disturbance area.
- Habitats used for prolonged periods of time (site persistence). The swift parrot has not been recorded in the additional disturbance area despite five years of targeted monitoring (see **Section 5.1.1**). The swift parrot has not been recorded in the additional disturbance area on a single occasion.

The potential extent of mainland foraging habitat is not identified in the National Recovery Plan for the swift parrot. However, the potential foraging range is large, comprising most of Victoria (excluding north-west), eastern NSW and parts of south-eastern Queensland. The removal of 212 hectares of potential habitat for the species represents a minute fraction of the species' mainland foraging range.

The swift parrot is unlikely to be significantly impacted as:

- the swift parrot has not been recorded in the additional disturbance area despite six years of targeted monitoring

- there is less than 30 hectares of vegetation zones within the additional disturbance area that contain key foraging tree species (Saunders and Tzaros 2011) for the swift parrot in NSW
- there are no mature trees (favoured for foraging) in the approximately 29 hectares of Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest in the additional disturbance area
- none of the potential habitat areas in the additional disturbance area are consistent with the characteristics of priority habitat areas for the swift parrot.

Appendix C details an assessment of the impacts of the Project on the swift parrot according to the Significant Impact Guidelines (DoE 2013) that identifies that the Project is unlikely to have a significant impact on the swift parrot.

6.2 Migratory Species

A total of 11 species listed as Migratory under the EPBC Act and listed under international conventions were identified as having the potential to occur within 10 kilometres of the Project Area following a review of the DoE Protected Matters Database. **Table 6.1** below lists the species that were identified by the Protected Matters Database and their likelihood of occurrence.

Table 6.1 Migratory Species with the Potential to Occur as Identified by the Protected Matters Database (species in bold have been recorded in the Project Area).

Scientific Name	Common Name	International Convention
Species or Species' Habitat Known to Occur		
<i>Ardea alba</i>	Great egret	JAMBA
<i>Monarcha melanopsis</i>	Black-faced monarch	Bonn
<i>Hirundapus caudacutus</i>	White-throated needletail	CAMBA, JAMBA, ROKAMBA
<i>Myiagra cyanoleuca</i>	Satin flycatcher	Bonn
<i>Rhipidura rufifrons</i>	Rufous fantail	Bonn
Species or Species' Habitat Likely to Occur		
<i>Apus pacificus</i>	Fork-tailed swift	CAMBA, JAMBA, ROKAMBA
<i>Pandion cristatus</i>	Eastern osprey	Bonn
Species or Species' Habitat May Occur		
<i>Gallinago hardwickii</i>	Latham's snipe	Bonn, JAMBA, ROKAMBA
<i>Merops ornatus</i>	Rainbow bee-eater	JAMBA
<i>Ardea ibis</i>	Cattle egret	JAMBA
<i>Motacilla flava</i>	Yellow wagtail	CAMBA, JAMBA, ROKAMBA
<i>Tringa nebularia</i>	Common greenshank	Bonn, CAMBA, JAMBA, ROKAMBA

An assessment of significance for migratory species which occur, or have the potential to occur in the additional disturbance area was undertaken for the preparation of the Referral. The additional disturbance area is not considered to comprise important habitat for any of the occurring or potentially occurring listed migratory species. The additional disturbance area does not support an ecologically significant proportion of a population of any of the migratory species listed in **Table 6.1**. None of the migratory species occur at the limit of their range in the additional disturbance area. There is no evidence to suggest that any of the migratory species listed in **Table 6.1** are declining in the region in which the additional disturbance area occurs. The assessment of significance concluded that the Project is unlikely to result in a significant impact on any EPBC Act migratory species.

6.3 World Heritage Properties

A search of the EPBC Act Protected Matters Database (accessed on 22 December 2015) identified one declared property, the Greater Blue Mountains Area, as occurring within 10 kilometres of the boundary of the Project Area.

The Project Area occurs approximately 0.5 kilometres (at its closest point) from the boundary of Wollemi National Park, part of the Greater Blue Mountains World Heritage Area, and is down slope from the Greater Blue Mountains World Heritage Area. The Project will not result in any direct impact on the National Park as the new open cut mining areas proposed as part of the Project will be approximately 3 kilometres from the National Park.

The closest existing mining area (Wambo Open Cut) to the National Park is approximately 1 kilometre, with the closest section of the new open cut mining areas proposed as part of the Project being approximately 3 kilometres from the National Park. At this distance, the potential for indirect impacts that affect matters of national environmental significance is low and will not be changed as a result of the Project. In terms of the potential for indirect impacts, the Project Area does not occur in the catchment of the Wollemi National Park, and no impacts relating to surface water are predicted on the National Park. The potential groundwater drawdown impacts associated with the Project are not predicted to result in impacts within the National Park. Furthermore, the proposed extent of mining as part of the Project will not move any closer to Wollemi National Park than the currently approved mining. The Project is not considered likely to change the nature or scale of potential indirect impacts related to noise, air quality, vibration or water resources.

The Project is not predicted to result in a significant impact on the Greater Blue Mountains World Heritage Area or any other world heritage properties.

6.4 National Heritage Places

A search of the EPBC Act Protected Matters Database (searched on 22 December 2015) identified one listed place, the Greater Blue Mountains Area, as occurring within 10 kilometres of the boundary of the Project Area. The Project Area occurs approximately 0.5 kilometres (at its closest point) from the Wollemi National Park, part of the Greater Blue Mountains Area National Heritage Property, and is lower in the landscape than the Greater Blue Mountains World Heritage Area. The Project will not result in any direct impact on the National Park.

In terms of the potential for indirect impacts, the Project does not occur in the catchment of the Wollemi National Park, and no impacts relating to surface water are predicted on the National Park. The proposed extent of mining as part of the Project will not move any closer to Wollemi National Park than the currently approved mining and the Project is not considered likely to change the nature or scale of potential indirect impacts related to noise, air quality and vibration. The closest existing mining area (Wambo open cut) to the National Park is approximately 1 kilometre, with the closest proposed new mining area as part of the

Project approximately 3 kilometres from the National Park. At this distance, the potential for indirect impacts that affect matters of national environmental significance is low and will not be changed as a result of the Project.

The Project is not predicted to result in a significant impact on the Greater Blue Mountains National Heritage Area or any other national heritage places.

6.5 Wetlands of National Importance

A search of the EPBC Act Protected Matters Database (searched on 22 December 2015) identified one listed wetland of national importance, the Hunter Estuary Wetlands, as occurring within 50-100 kilometres of the boundary of the Project Area.

The Hunter Estuary Wetlands Ramsar site occurs in the lower estuary of the Hunter River, approximately 70 kilometres south-east (straight line distance) of the Project Area, and a substantially greater distance following the drainage system. The Project will not result in any direct impact on this Ramsar site with the only potential for impact relating to far-field effects on the water regime.

An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:

- areas of the wetland being destroyed or substantially modified.

The Project will not result in any areas of the Hunter Estuary Wetlands being destroyed or substantially modified.

- a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland.

The Project will not result in a substantial or measurable change in the hydrological regime of the Hunter Estuary Wetlands.

- the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected.

The Project will not result in the habitat of native species dependent on the Hunter Estuary Wetlands being seriously affected.

- a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health.

The Project will not result in a substantial or measurable change in the water quality of the Hunter Estuary Wetlands.

- an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.

The Project will not result in an invasive species that is harmful to the ecological character of the Hunter Estuary Wetlands being established (or an existing invasive species being spread) in the wetland.

The Project will not have a significant impact on the Hunter Estuary Wetlands or any other Ramsar sites.

7.0 Assessment of Indirect Impacts on Biodiversity

The Project is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding lands during the construction or operational phases of the Project. 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 construction and operational phases of the Project. This is further discussed in the sections below. Groundwater-dependent ecosystems (GDEs) are discussed in **Section 8**.

7.1 Indirect Impacts on Connectivity and Corridors

The removal of native vegetation from within the additional disturbance area could affect the ability of some local fauna species to move throughout the landscape. A potential corridor of fauna movement (comprising fragmented remnant and woodland rehabilitation patches) exists between an area within the Project Area linking woodland and forest habitats to the north-west with those in the east and south-east. Removal of the vegetation in the additional disturbance area may reduce the dispersal, migration and movement ability of some fauna species within the local area. A significant proportion of the potential indirect impacts noted here are already approved as part of the Approved Wambo Surface Development Area.

In addition to the impacts on potential fauna corridors, the removal of native vegetation from the additional disturbance area 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 a large extent the potential loss of local and regional connectivity is already factored in to the credit calculation in that the Assessment Circle and associate Landscape Value Scores take into account the pre- and post-clearing percentage of native vegetation cover. It is unlikely that any further indirect impact through reduced connectivity and loss of corridors would be of any significant level.

7.2 Fugitive Light Emissions

Fugitive light emissions resulting from the construction and operation of the Project 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
- 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 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 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.

7.3 Noise Impacts

Construction and operational noise impacts have the potential to adversely impact native species. Potential impacts include:

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

Details of the noise controls that will be implemented as part of the Project are outlined in the EIS report.

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.

7.4 Dust Impacts

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

The design of the Project 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
- a range of other dust control measures as discussed in Section 8.0 of the main text of the EIS.

Further details of the dust controls that will be implemented as part of the Project are outlined in the EIS report.

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.

7.5 Weed and Feral Animal Encroachment

Weed species could be inadvertently brought into the Project Area with imported materials, or could invade naturally through removal of native vegetation. The presence of weed species within the Project Area has the potential to decrease the value of extant vegetation to native species, particularly threatened species. Mitigation measures outlined in **Section 10** will be implemented to minimise the potential for weed encroachment into areas surrounding the additional disturbance area.

Populations of feral fauna species such as foxes, rabbits, pigs, 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 10** will minimise the potential for feral animal spread and impacts into surrounding areas around the additional disturbance area.

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.

8.0 Groundwater Dependent Ecosystems (GDEs)

8.1 Potential GDEs within the Additional Disturbance Area

Potential groundwater dependent ecosystems (GDEs) within the additional disturbance area comprise the following vegetation types:

- Swamp Oak – Weeping Grass Grassy Riparian Forest (vegetation zone 11)
- Forest Red Gum Grassy Open Forest on Floodplains (vegetation zone 2).

Both occur along Redbank Creek, an ephemeral creek line. Both communities have a patchy distribution along Redbank Creek (refer to **Figure 8.1**). The remaining vegetation types within the riparian zone (e.g. grassland communities) are unlikely to be GDEs. These vegetation types are not characteristic vegetation types of riparian zones and extend from lower slopes and beyond, down into the riparian zone where riparian communities are absent.

8.2 Potential GDEs outside of the Additional Disturbance Area

The following vegetation types occurring outside the additional disturbance area but in the local area have the potential to be at least partially groundwater-dependent (refer to **Figure 8.1**):

- Central Hunter Swamp Oak Forest
- Hunter Floodplain Red Gum Woodland Complex
- Hunter Valley River Oak Forest
- River Flat Eucalypt Forest
- Stands of individual river red gum trees (*Eucalyptus camaldulensis*)
- Warkworth Sands Woodland.

Each of these is described in greater detail below.

8.2.1 Central Hunter Swamp Oak Forest

This vegetation community is considered likely to be potentially dependent on groundwater reserves in certain circumstances such as during times of drought (refer to **Figure 8.1**). It is dominated by a mid-dense canopy layer of swamp oak (*Casuarina glauca*), a sparse mid-storey, and a dense layer of leaf litter from swamp oak. This vegetation is not consistent with any community listed under the TSC Act or EPBC Act. This vegetation community occurs along Redbank Creek running centrally through the additional disturbance area as well as several patches along Wollombi Brook to the east. It is equivalent to the Swamp Oak – Weeping Grass Grassy Riparian Forest (vegetation zone 11) in the additional disturbance area (see above).

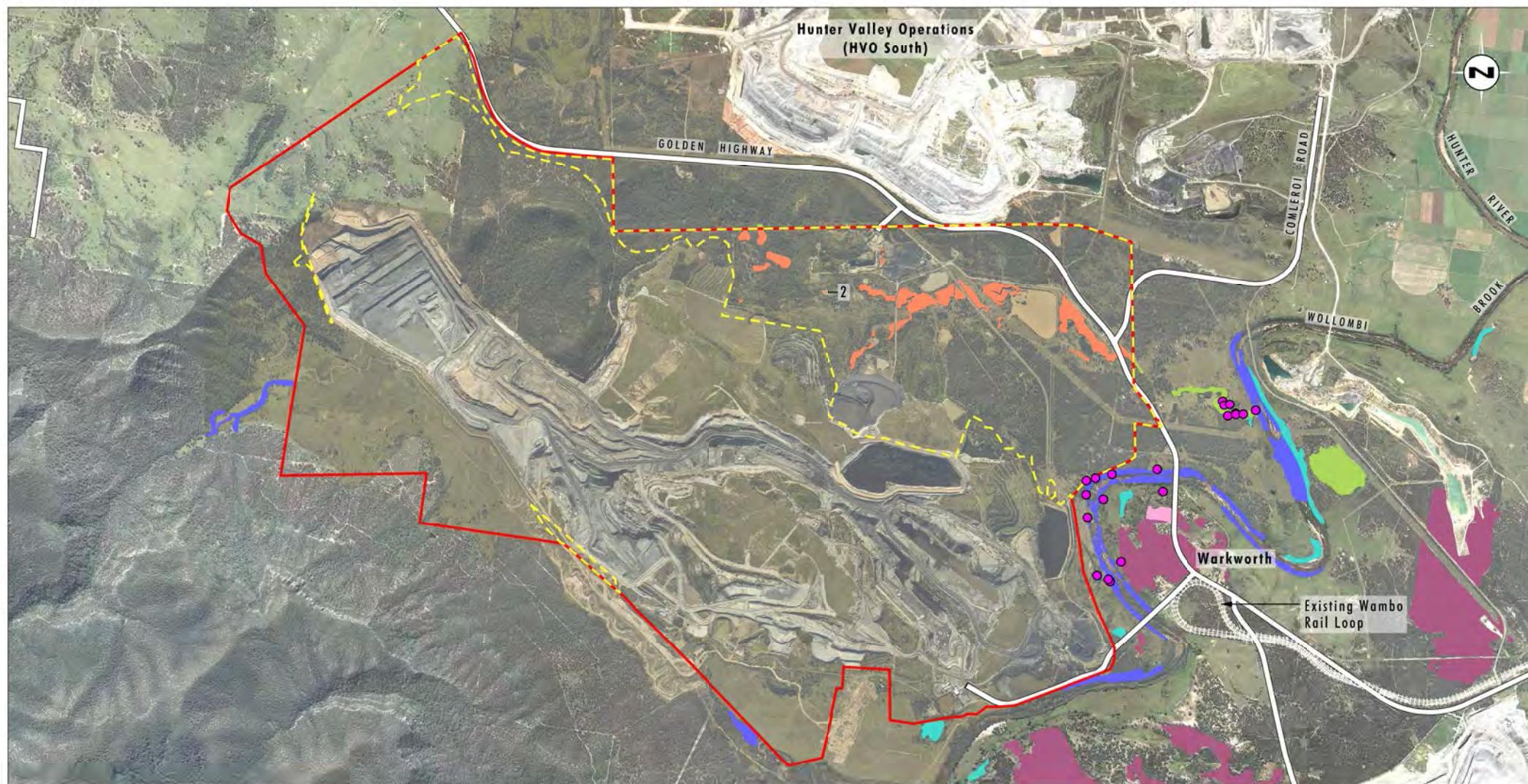


Image Source: AAM (2012), United (2015)

Data Source: Glencore (2014)

Legend

Project Area

Conceptual Additional Disturbance Area

River Red Gum Location

Vegetation Communities Mapped as Part of the UHSA:

2 - HU812 - Forest Red Gum Grassy Open Forest on Floodplains of the lower Hunter - Moderate to Good Condition
11 - HU945 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley - Moderate to Good Condition

Vegetation Communities Mapped as Part of the Hunter Remnant Vegetation Project with Updates by Umwelt:

Hunter Valley River Oak Forest

River Flat Eucalypt Forest

Warkworth Sands Woodland

Hunter Floodplain Red Gum Woodland complex

Central Hunter Swamp Oak Forest

File Name (A4): R15/3509_254.dgn
20160506 14:04

FIGURE 8.1

Potential Groundwater
Dependent Ecosystems

8.2.2 Hunter Floodplain Red Gum Woodland Complex

The Hunter Floodplain Red Gum Woodland Complex in this area is dominated by forest red gum (*Eucalyptus tereticornis*) and rough-barked apple (*Angophora floribunda*) (refer to **Figure 8.1**). This vegetation is consistent with the Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney basin Bioregion Endangered Ecological Community; however it is not consistent with any community listed under the EPBC Act. A small patch (0.29 hectares) Hunter Floodplain Red Gum Woodland Complex occurs along Redbank Creek in the additional disturbance area, along with several patches along Wollombi Brook to the east and south of the additional disturbance area. The closest occurrence outside of the additional disturbance area is approximately 200 metres to the east.

8.2.3 Hunter Valley River Oak Forest

The Hunter Valley River Oak Forest comprises a dense canopy layer of river oak (*Casuarina cunninghamiana*) and occasional emergents of river red gum (*Eucalyptus camaldulensis*) and rough-barked apple (*Angophora floribunda*). Groundcover is typically sparse. In this area, Hunter Valley River Oak Forest primarily occurs along Redbank Creek (refer to **Figure 8.1**). This vegetation is not consistent with any communities listed under the TSC Act and EPBC Act. Hunter Valley River Oak Forest occurs predominately along Wollombi Brook to the east of the additional disturbance area immediately adjacent in some sections. Regional mapping also indicates that two patches occur along a drainage line to the west and the lower slopes to the south.

8.2.4 River-flat Eucalypt Forest

This vegetation is dominated by a canopy of forest red gum (*Eucalyptus tereticornis*) and rough-barked apple (*Angophora floribunda*), occurring in gullies and on lower slopes away from floodplains (refer to **Figure 8.1**). This vegetation is consistent with that of River-flat Eucalypt Forest listed as an EEC under the TSC Act, however it is not consistent with any communities listed under the EPBC Act. A small patch of River-flat Eucalypt Forest occurs along the Wollombi Brook approximately 400 metres to the east of the additional disturbance area.

8.2.5 River Red Gum Stands (*Eucalyptus camaldulensis*)

River red gum (*Eucalyptus camaldulensis*) is listed as an endangered population in the Hunter catchment under the TSC Act. It has been recorded at several locations within the predicted drawdown zone in the riparian zone of Wollombi Brook and Redbank Creek (refer to **Figure 8.1**). These records comprise approximately 20 isolated trees; however more may be present. The River Red Gum Stands occur immediately to the east of the additional disturbance area along Wollombi Brook.

River red gum is a known phreatophyte (deep rooting plant that draws water from the water table) (Ecoscape (Australia) Pty Ltd 2011) and is subsequently considered to be groundwater-dependent.

8.2.6 Warkworth Sands Woodland

Also occurring nearby, but not understood to be in the drawdown affectation zone, is Warkworth Sands Woodland, a highly restricted vegetation community that occupies Aeolian sand deposits in the local area (refer to **Figure 8.1**). It is listed as an EEC under the TSC Act, and is proposed to be listed as a CEEC under the EPBC Act. It is understood to be at least partially dependent on groundwater, particularly where it exists in swales between dune ridges, although this groundwater usually sits as a lens or perched aquifer above semi-permeable argillaceous (clayey) material. Warkworth Sands Woodland occurs to the south-east of the additional disturbance area on the opposite side of the Wollombi Brook. The closest location of this community is approximately 500 metres.

8.2.7 Potential Indirect Impacts on GDEs

The groundwater impact assessment completed for the Project (refer to Appendix 12 of the EIS) identifies two areas within the zone of cumulative drawdown that have been labelled for the purpose of the groundwater impact assessment as GDE1 and GDE2 (refer to Figure 7.12 of Appendix 12 of the EIS). Around 1m in groundwater level decline is predicted at GDE2 due to cumulative impacts from mining (approved mining and the Project) (AGE 2016). The decline in groundwater levels at GDE2 is along the fringes of Wollombi Brook. This drawdown is relatively limited in area and impacts upon only a small portion of possible Hunter Valley River Oak Forest and possibly a small number of River Red Gum trees (refer to Figure 7.10 of AGE (2016)).

At GDE1 groundwater levels are predicted to decline more significantly with mining (approved mining and the Project). Figure 7.13 of AGE (2016) shows the predicted decline in groundwater levels at location of GDE1 for approved mining only (i.e. HVO South, Wambo, MTW) and for approved mining plus the Project. The alluvium near GDE1 becomes largely unsaturated due to cumulative impacts from approved mining (AGE 2016). As discussed below, this desaturation would occur due to the existing approved mining, without the Project.

There is potential for cumulative impacts of the already approved mining (i.e. HVO South, Wambo, MTW) to reduce alluvial groundwater levels below the base of alluvium at GDE1, due to direct take with mining (HVO South) and reduced contributions from the underlying Permian coal measures (AGE 2016). Based on the conceptual timing of the Project, the impact of the Project may result in this effect occurring some 1 year earlier. Therefore, the Project only influences the timing of the impact, not the magnitude of potential impacts on GDEs at GDE1 (AGE 2016). Potential GDEs occurring at GDE1 include areas of Central Hunter Swamp Oak Forest and a small number of River Red Gum trees along Redbank Creek, and areas of Hunter Valley River Oak Forest, some River Red Gum trees and Hunter Floodplain Redgum Woodland Complex along Wollombi Brook (refer to Figure 7.10 of AGE (2016)).

8.3 Stygofauna

An assessment of the presence and potential impacts on stygofauna communities within the aquifers surrounding the Project Area was undertaken by Stygoecologia. The assessment was completed in accordance with the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov et al. 2012). The assessment showed that stygofauna exist in small isolated populations within the shallow alluvial aquifers in the area surrounding the Project Area, including those associated with Wollombi Brook and North Wambo Creek.

The relative consistency of the stygofauna community composition between the bores and aquifers surveyed indicates connectivity within the shallow alluvial aquifers and consistency in the environmental conditions of this aquatic ecosystem. The biodiversity of the stygofauna community across the alluvial aquifers was found to be high with hotspots of biodiversity that potentially have a high degree of endemism.

The risk of the Project to the subterranean ecosystem was considered low based on the potential groundwater drawdown impacts on the alluvium of Wollombi Brook. Due to the consistency of stygofauna composition across the aquifer and the relatively small area of impact in terms of alluvial aquifer drawdown, no adverse impacts on stygofauna are predicted. Ongoing monitoring of groundwater properties and a program of biological surveys were recommended by Stygoecologia.

9.0 Identification of Red Flags

A red flag is an area regarded as having high biodiversity conservation values as defined in Section 2.3 of the BioCertification methodology (DECCW 2011). **Section 2.2.4** of this report identifies the red flags that were determined for the United UHSA BCAM Assessment Report (Umwelt 2015). This section of the report updates the red flag list as it relates specifically to the additional disturbance area.

Nine vegetation zones are identified as red flags in the United UHSA Project Area as they are listed as an EEC under the TSC Act and/or they are listed as an CEEC under the EPBC Act and/or they are over 70 per cent cleared in the Hunter/Central Rivers CMA (refer to **Table 9.1** and **Figure 9.1**), including small areas of Zone 10 – Bull Oak Grassy Woodland of the Central Hunter Valley form part of the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC and/or the Central Hunter Valley Eucalypt Forest and Woodland EEC and are considered a red flag.

The southern myotis is identified in the Biodiversity Certification Credit Calculator as a red flag (refer to **Table 9.1** and **Figure 9.1**). As identified in **Figure 9.1** a total of 7.3 hectares of potential breeding habitat would be affected. It is noted however that this species is able to withstand further loss in the Threatened Species Profile Database (TSPD) (BioNet 2014). In addition, the endangered population of weeping myall (*Acacia pendula*) is identified as a red flag, however, this population has been entirely avoided by the Project and does not occur within the additional disturbance area boundary.

A number of waterways in the Project Area are also considered to be red flags, including Redbank Creek and any un-named drainage lines which meet the definition of a minor creek (refer to **Table 9.1** and **Figure 9.1**).

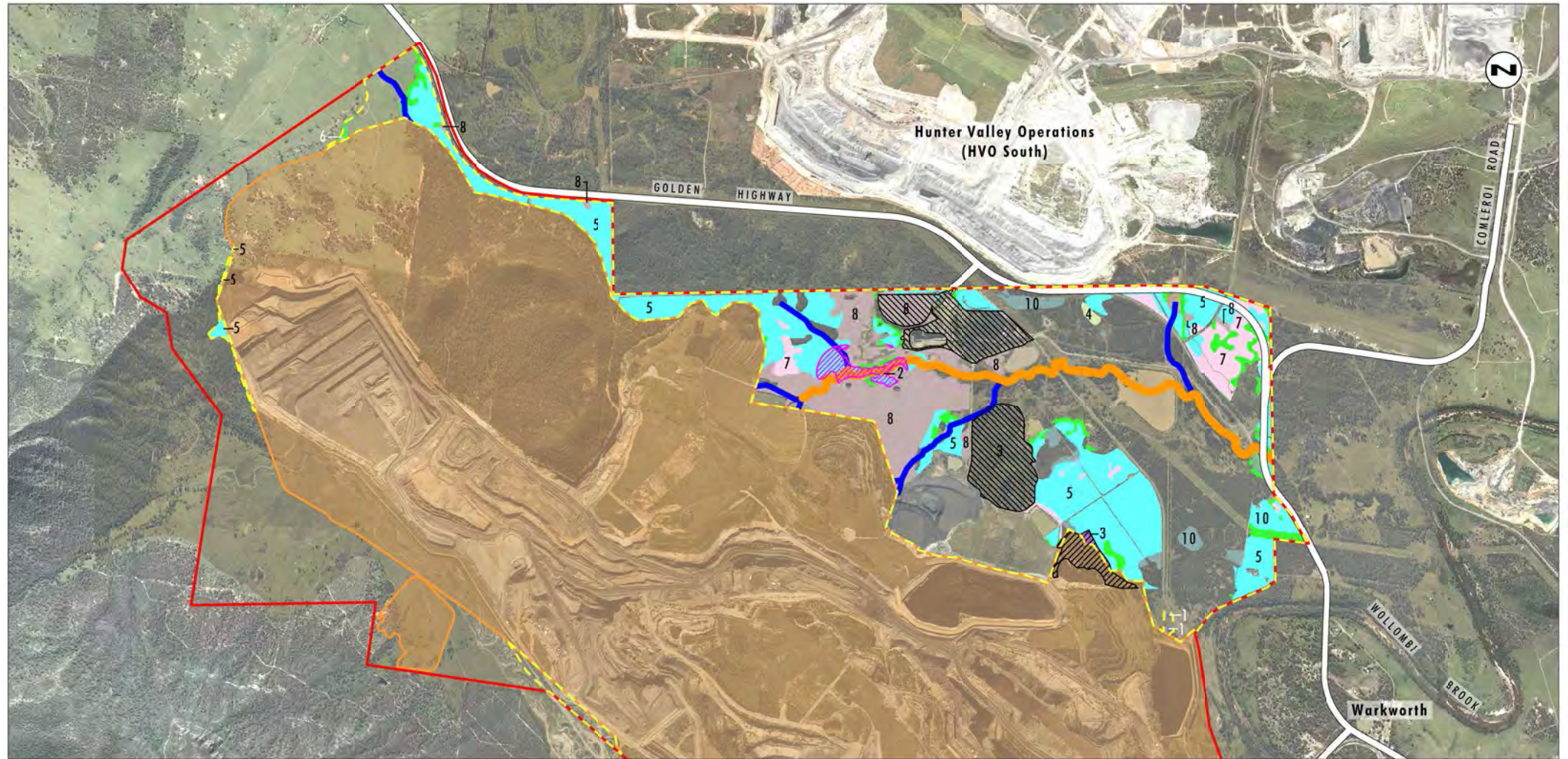


Image Source: AAM (2012), United Collieries (2014)

Data Source: Boundary - Glencore (2014)

Legend

- Project Area
- Conceptual Additional Disturbance Area
- Approved Wambo Surface Development Area
- Southern Myotis Potential Breeding Habitat
- Regional Biodiversity Link
- Local Biodiversity Link
- Approved for Disturbance
- Wambo Mine Rehabilitation

- 1 - HU652 - Weeping Myall - Cooba - Scrub Wilga Shrubland of the Hunter Valley - Moderate to Good Condition
- 2 - HU812 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter - Moderate to Good Condition
- 3 - HU816 - Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest Slopes of the Upper Hunter and Sydney Basin - Moderate to Good Condition - Plantation/Rehabilitation (CEEC in part)
- 4 - HU869 - Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin - Moderate to Good Condition (CEEC)

- 5 - HU905 - Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter - Moderate to Good Condition
- 6 - HU905 - Moderate to Good Condition - Thinned Canopy (CEEC)
- 7 - HU905 - Moderate to Good Condition - Regeneration (CEEC in part)
- 8 - HU905 - Moderate to Good Condition - Cooba Open Shrubland
- 9 - HU905 - Low Condition - Derived Native Grassland (CEEC in part)
- 10 - HU906 - Bull Oak Grassy Woodland of the Central Hunter Valley CEEC - Moderate to Good Condition (CEEC in part)

FIGURE 9.1
Red Flags

Table 9.1 Red Flags within the Additional Disturbance Area

Vegetation Zone/Species Name	Reason For Red Flag Status
Zone 2 – HU812 – Moderate to Good Condition Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	This vegetation zone is considered to be a red flag as it conforms to the Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (TSC Act).
Zone 3 – HU816 – Moderate to Good Condition – Plantation Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	This vegetation zone is considered to be a red flag as it conforms to the Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregion EEC (TSC Act). 1.17 ha of this vegetation zone conforms to the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act).
Zone 4 - HU869 – Moderate to Good Condition Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	1.13 ha of this vegetation zone conforms to the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)
Zone 5 – HU905 – Moderate to Good Condition Narrow-leaved Ironbark – Grey Box grassy Woodland of the Central and Upper Hunter	Forms part of the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the TSC Act. The corresponding BVT is also 79 per cent cleared. Approximately 169.4 ha of this vegetation zone conforms to the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act).
Zone 6 – HU905 - Moderate to Good Condition - Thinned Canopy	Forms part of the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the TSC Act. The corresponding BVT is also 79 per cent cleared. Approximately 0.08 ha of this vegetation zone conforms to the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act).
Zone 7 – HU905 – Moderate to Good Condition – Regeneration	Forms part of the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the TSC Act. The corresponding BVT is also 79 per cent cleared. Approximately 23.01 ha of this vegetation zone conforms to the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act).

Vegetation Zone/Species Name	Reason For Red Flag Status
Zone 8 - HU905 – Moderate to Good Condition – Cooba Open Shrubland	The corresponding BVT is 79 per cent cleared.
Zone 9 - HU905 – Low Condition – Derived Native Grassland	Approximately 20.71 ha of this vegetation zone conforms to the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act).
Zone 10 – HU906 – Bull Oak Grassy Woodland of the Central Hunter Valley – Moderate-Good Condition	Only the small area of this vegetation zone which forms part of the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the TSC Act (see Section 3.1.8). Approximately 8.02 ha of this vegetation zone conforms to the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act).
Southern myotis	This species is identified in the Biodiversity Certification Credit Calculator as a red flag. It is noted however that this species is able to withstand further loss in the TSPD (BioNet 2014).
Redbank Creek	Redbank Creek is considered a minor river in the Project Area and a 30 metre buffer either side of a minor river represents a red flag (regional biodiversity link).
Any unnamed drainage lines which meet the definition of a minor creek	These waterways are considered to be minor creeks in the project area and a 20 metre buffer either side of a minor creek represents a red flag (local biodiversity link).

10.0 Mitigation Strategy

United has sought to avoid and minimise potential impacts on the ecological values of the Project Area throughout the project planning process. This has included avoidance and minimisation of disturbance of key vegetation communities through designing the Project to maximise use of existing mining and transport facilities, and the avoidance of all areas of weeping myall (refer to **Section 4**).

United has committed to the design and implementation of a comprehensive ecological mitigation strategy to mitigate the unavoidable impacts of the Project. During the preparation of the mitigation strategy, the UHSA Guidelines for the Mitigation of Coal Mining Impacts on Biodiversity (OEH 2015c) were consulted. The mitigation guidelines are not mandatory but provide guidance for proponents on how to reduce significant local impacts on biodiversity while undertaking vegetation clearance, mining operations and related activities. The proposed mitigation measures for the Project are described in this section and are generally in accordance with those listed in OEH (2015c).

The following specific control measures are considered to be integral to the mitigation of impacts on the ecological features of the Project Area:

- landform establishment
- implementation of clearing procedures to minimise the impacts of the clearing process and maximise the recovery of any valuable biodiversity resources (e.g. seed collection, re-use of hollow logs and hollows where appropriate)
- feral animal and noxious weed control
- fencing and access control
- management of domestic stock
- pathogen management
- bushfire management
- ensuring appropriate environmental management measures are in place as part of the mining operations to minimise the potential for indirect impacts including:
 - o water management systems that seek to minimise the potential for damage to flora and fauna and their habitats from erosion and unnatural flooding events
 - o noise control systems to minimise noise impacts
 - o dust control measures to minimise dust impacts
 - o lighting controls to minimise night light impacts
 - o blasting controls to minimise blast overpressure and vibration impacts.
- employee education and training.

Each of these control measures will contribute to the maintenance of habitat quality across the Project Area. Specific details on these measures and how they are consistent with the *Mitigation Guidelines* is outlined in the following sections.

United will prepare an appropriate biodiversity management plan in accordance with any relevant Development Consent requirements. The project-specific biodiversity management will guide the implementation of the mitigation steps, which are addressed in the following sections. The outcomes of ecological monitoring (see below) will also be used to provide for the management plan to 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.

The frequency and level of monitoring will be dependent on the environmental features to be assessed. The techniques proposed to be used will be documented in the biodiversity management plan, however it will be targeted, systematic and repeatable.

10.1 Landform Establishment

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 emplacements areas typically results in changes in surface and ground water 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
- Identified areas of moderate to severe erosion will be remediated as soon as practicable.

10.2 Pre-clearance Surveys and Tree Felling Supervision

Pre-clearance surveys and tree-felling supervision recommendations are outlined in Section 5.10 of the *Mitigation Guidelines* (OEH 2015c). These procedures aim to identify significant biodiversity features within areas to be cleared and attempt to minimise the impact of clearing on these features.

A robust tree felling procedure will be implemented to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees. The procedure will detail the necessary pre-clearing activities, requirements during clearing operations, and post-clearing requirements. The procedure will include the following:

- Pre-clearing surveys by a suitably experienced and experienced person prior to felling. This will include marking of hollow-bearing trees, as well as any other notable features such as fallen timber, hollow logs or boulders suitable for salvage; active nests, dreys or dens requiring consideration; and seed-bearing trees for salvage.
- Removal of non hollow-bearing trees/vegetation as close to the hollow-bearing tree felling date as practicable (in order to discourage fauna usage of the area). It is not necessary for the suitably qualified and experienced person to be present to supervise such works.

- Hollow-bearing tree felling procedures, including (but not limited to):
 - o supervision of all hollow-bearing tree felling works by a suitably qualified and experienced person. If an ecological issue is encountered, the suitably qualified person is to advise on the most appropriate measures to ensure minimal impact on fauna species, particularly threatened species
 - o visual canopy inspection on the day of the felling of hollow-bearing trees to check for individual animals in the canopy
 - o shaking of hollow-bearing tree (with heavy machinery where safe to do so) to encourage resident fauna to abandon tree, prior to felling
 - o lowering of hollow-bearing trees as gently as possible (soft-felled) with heavy machinery
 - o inspection of all hollows in felled trees by a suitably qualified and experienced person
 - o capture of any displaced/injured fauna by a suitably qualified and experienced person
 - o if a threatened species is identified in a habitat tree on the day of felling, the supervising person should advise the most appropriate method to minimise potential harm
 - o release of unharmed fauna into nearby secure habitats by a suitably experienced person
 - o injured fauna to be assessed and taken to wildlife carer, if necessary, by a suitably experienced person
 - o felled trees are to be rolled so that the number of hollows blocked against the ground are minimised
 - o all felled trees are to remain in place overnight to allow any unidentified fauna to escape
 - o salvage of suitable hollows for use as compensatory habitat, where practicable.

All personnel who will capture/handle/house and/or transport native fauna species (injured or uninjured) will be appropriately licensed under the relevant field survey and ethics authorities, currently this means licensing under the NSW *National Parks and Wildlife Act 1974* and the NSW Animal Ethics Committee.

The above pre-clearance and tree-felling procedure is generally consistent with the recommendations outlined in Section 5.10 of the UHSA mitigation guidelines (OEH 2015c).

10.2.1 Burrow Clearing Procedure

The common wombat (*Vombatus ursinus*) is known to occur in the additional disturbance area. A burrow clearing procedure will be implemented to minimise the potential for impacts on wombats as a result of the digging up wombat burrows. The procedure will detail the necessary pre-clearing activities, requirements during clearing operations, and post-clearing requirements.

10.3 Weed Control

Weed species could be inadvertently brought into the Project Area 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 at United and Wambo will be incorporated into the Biodiversity Management Plan. 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 Project Area and appropriate weed control methods will be implemented.

10.4 Pest and Feral Animal Control

Introduced fauna species such as foxes, rabbits, pigs, dogs and feral cats could change in distribution and abundance in the Project Area 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 Project Area has the potential to increase impacts on existing native species, particularly via predation and habitat destruction.

Pest and feral animal controls at United and Wambo will be incorporated into the Biodiversity Management Plan. Pest and feral animal control will be undertaken in accordance with current mine practices and in consideration of the UHSA mitigation guidelines (OEH 2015c).

Regular monitoring of revegetation areas and retained areas will be undertaken to assess the level of impact by feral animals, particularly on vegetation establishment. 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.

10.5 Fencing and Access Control

Fencing may be used to demarcate vegetation where required. Any new fencing used within the Project Area 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.

10.6 Domestic Stock

Domestic stock may be strategically grazed in parts of the Project Area to reduce weed species or to manage fuel loads for bushfire risk. The following mitigation measures will be undertaken to manage the impacts of grazing by domestic stock:

- Stock grazing will not be undertaken in areas of high biodiversity values
- Where livestock are being used to remove vegetation by crash grazing, the following principles will be considered:
 - o Allow the stock to feed intensively in a defined area only for short periods
 - o Undertake crash grazing between autumn and mid-spring – ideally before weed species set seed and when these species are more palatable and the nutrient content of the foliage is high
 - o Manage the movement of livestock using fencing (temporary or permanent)
 - o Monitor feed levels so that overgrazing does not occur.
- Where possible ground cover will be maintained towards 100 per cent
- The grazing pressure from other herbivores (e.g. kangaroos, wallabies, rabbits and hares) is to be reviewed in the context of the domestic stocking rate that can be utilised.

10.7 Pathogen Management

The UHSA mitigation guidelines (OEH 2015c) identify that no biological pathogens are known to occur in the United Wambo Project Area. However such pathogens, should they be introduced, have the potential to severely impact biodiversity features by inhibiting vegetation growth and causing disease and death in native flora and fauna species and communities. Pathogen spread can be facilitated by land disturbance, alterations to water flows and transportation and movement of organic material.

The key biological pathogens that have the most risk of impacting biodiversity in the Mine Assessment Area are as follows:

- amphibian chytrid fungus (*Batrachochytrium dendrobatidis*)
- disease-causing rusts to plants of the Myrtaceae family (particularly myrtle rust (*Uredo rangelii*))
- the soil pathogen causing root-rot (*Phytophthora cinnamomi*).

If any of the above pathogens are identified in the Project Area appropriate mitigation actions will be implemented in consultation with relevant authorities, if warranted, to minimise the incidence and spread of the pathogens.

10.8 Bushfire Management

The vegetation that will be retained within the Project Area will require appropriate bushfire management to protect life and property, while supporting appropriate conditions for the significant ecological features identified in the Project Area. Appropriate bushfire management controls will be considered in the development of the Biodiversity Management Plan and where appropriate will include the application of fire research knowledge to generate ecological outcomes through the appropriate use of fire as an ecological management tool.

Bushfire management will consider:

- exclusion of planned bushfire from revegetation and regeneration areas to allow replanted and regenerating communities to mature to a stage where they are able to withstand bushfire and regenerate naturally following such an event
- consideration of the sensitivities of threatened species and threatened ecological communities to bushfire and appropriate bushfire planning and management in relation to known occurrences of these
- the use of ecologically appropriate fire regimes (be they related to burn frequency, duration or intensity), as these have the potential to impact negatively on significant ecological features
- asset protection
- appropriate incorporation of all relevant ecological requirements into bushfire management plans.

10.9 Fauna Habitat Enhancement and Re-instatement

In parallel with revegetation works in mine site rehabilitation areas (refer to **Section 13.4** for further details on mine site rehabilitation), the Project will re-establish ground fauna habitat through the relocation of cleared vegetation to targeted mine site rehabilitation areas, where practicable. This will contribute to the more rapid development of fauna species diversity in the medium to long term as vegetation establishment progresses. The following habitat enhancement and re-instatement mitigation measures may be undertaken:

- Dams could be constructed in the post-mining landform to facilitate the re-colonisation of woodland fauna communities. Dams provide a source of permanent water in the landscape and associated fauna species such as frogs and invertebrates will constitute suitable prey for many additional fauna species such as reptiles. Increasing the habitat complexity and range of micro-habitats occurring in the post-mining landscape will result in the increased utilisation of the rehabilitation by a much wider range of fauna species in the post-mining land form.
- Habitat enhancement of retained vegetation such as provision of nest boxes, salvaged hollows, fallen timber, hollow logs and boulders, as deemed necessary.

10.10 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 ecological issues present in the Project Area 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.

11.0 Conservation Actions

OEH has undertaken a cumulative impact assessment (CIA) and risk assessment on threatened ecological communities, populations and threatened species listed under the EPBC Act and the TSC Act that may be impacted by the implementation of the Draft UHSA Biodiversity Management Plan. The CIA and risk assessment was undertaken on 89 biological entities that are known or are likely to occur, or have potential habitat in the Mine Assessment Area. The risk assessment placed each entity into one of six risk categories. **Table 11.1** lists the entities identified in the United Wambo Project Area as very high or high risk entities.

Table 11.1 Very High and High Risk Categories of OEH (2015).

Risk Category	TSC Act Listing	EPBC Act Listing
Very high	Hunter Valley Weeping Myall Woodland of the Sydney Basin bioregion CEEC	Hunter Valley Weeping Myall (<i>Acacia pendula</i>) Woodland CEEC
High	Not listed on TSC ACT	Central Hunter Valley Eucalypt Forest and Woodland CEEC
	Central Hunter Grey Box- Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	Not listed on EPBC Act
	Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	Not listed on EPBC Act
	Weeping Myall population in the Hunter catchment, <i>Acacia pendula</i> – Endangered Population	Not listed on EPBC Act

Targeted conservation actions are required when a UHSA project impacts on one or more entities in the very high risk category. Targeted conservation actions are undertaken in addition to offset requirements.

As the Project will not impact on any entities in the very high risk category, no targeted conservation actions are required for the Project. As discussed in **Section 4** the identified 0.1 hectare stand of weeping myall (*Acacia pendula*) will be avoided and the stand will be managed for its adequate protection.

12.0 Ecosystem and Species Credits

The following section details the credit requirements for the Project. These are calculated based on the application of the Draft UHSA Biodiversity Management Plan and guidance documents provided by OEH as outlined in **Section 1.2**.

12.1 Offset Credit Requirement

The final offset requirement of the Project is **19,024 credits**, comprising 17,993 ecosystem credits and 1,031 species credits, as outlined in **Table 12.1**.

Table 12.1 Final Offset Requirement of the Project.

Credit Type	Project Impact Area (ha)	Offset Requirement (credits)
Ecosystem Credits		
HU812 – Moderate to Good Condition	0.29	14
HU816 – Moderate to Good Condition – Plantation/Rehabilitation	29.42	1,041
HU869 – Moderate to Good Condition	1.56	59
HU905 – Moderate to Good Condition	175.06	7,080
HU905 - Moderate to Good Condition - Thinned Canopy	0.08	3
HU905 – Moderate to Good Condition – Regeneration	26.77	984
HU905 – Moderate to Good Condition – Cooba Open Shrubland	80.89	1,933
HU905 – Low Condition – Derived Native Grassland	101.69	845
HU906 – Moderate to Good Condition	118.62	4,909
HU945 – Moderate to Good Condition	31.61	1,248
Cleared land (including disturbed land, mixed species revegetation plantation and water bodies)	147.97	Nil
Sub-total	713.96	18,116
Species Credits		
Southern myotis (breeding habitat)	7.3	562
Sub-total	7.3	562
Grand Total		18,678

13.0 Biodiversity Offset Strategy

13.1 Biodiversity Offsetting Options and Approach

United is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project in accordance with the UHSA. United has, where possible, altered the Project to substantially avoid and minimise ecological impacts in the project planning stage, and a range of impact mitigation strategies have been included to mitigate the impact on ecological values prior to the consideration of offsetting requirements (refer to **Sections 4.0** and **10.0**). The biodiversity offset strategy will be developed to meet the offset requirements of the Project identified in **Section 12**. The range of potential offsetting options available to proponents in accordance with the UHSA (OEH 2015b) includes:

- Payment into the Upper Hunter Offsets Scheme
- Retirement of biodiversity credits
- Establishment of proponent-managed offset sites
- Funding of compensatory measures
- Mine site ecological rehabilitation.

The draft UHSA offsetting rules were released by OEH to the UHSA Industry Reference Group on 22 March 2016. Following questions from Umwelt in relation to the Project, OEH provided a revised set of offset rules on 26 April 2016 (OEH 2016b). The key changes related to the clarification of some ambiguous wording. Through the course of the UHSA program OEH has released elements of the possible offsetting rules for consideration or discussion, however it was not until the release of the above documents that a formal offsetting rule-based approach could be applied with any degree of certainty. Notwithstanding the lack of defined UHSA offsetting rules during the course of the Project assessment, United sought to develop an offset strategy which addresses the key fundamentals of the anticipated UHSA Offsetting Rules, together with established practice in biodiversity offsetting where precedent on approach has already been made. Even though draft rules have been released, the biodiversity offset strategy for the Project cannot be formally completed under the UHSA Biodiversity Plan until the rules are finalised. It is therefore proposed that the biodiversity offset strategy outlined in this section is formalised through development consent conditions as per the process outlined in the UHSA Interim Policy (DP&I 2012).

As United's majority shareholder and operator, Glencore has a strong record in preparing and implementing biodiversity offset strategies that firmly address significant biodiversity matters and adequately counterbalance impacts on them. United is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project. The offset strategy will be implemented following the process outlined in the UHSA and the final composition of the offset strategy may evolve as the Project progresses. It is currently proposed that the biodiversity offset strategy will consist of the following:

- Establishment of proponent-managed offset sites, including the following sites:
 - o Highfields Offset Site
 - o Mangrove Offset Site
 - o Wambo Offset Site.

- Mine site ecological rehabilitation contributing 25 per cent of the overall biodiversity offset requirement.
- Payments into the Upper Hunter Biodiversity Offsets Scheme fund and/or establishment of further offset sites for the residual credits that need to be retired.

The proposed offset sites will be established as BioBank sites under BioBanking Agreements, ensuring in-perpetuity conservation and reporting consistent with the BioBanking scheme.

Consistent with discussions with OEH, it is proposed to stage the retirement of credits in accordance with the progressive development of the Project. This staging will be consistent with the staging of the Mining Operations Plans (MOP) for the Project, as governed by the *Mining Act 1992* (refer to **Section 13.2**).

13.2 Staged Credit Requirements

As discussed above, United propose to stage the retirement of ecosystem credits as clearing of the Project Area occurs. This is currently planned to align with the existing MOP process administered by NSW DRE (MOP nominally approved for up to 7 years). However, the final stages may vary from the MOP. **Table 13.1** outlines the staged credit requirements for the Project based on 7 year MOP stages. The credit requirements for each stage are based on extrapolation of the average number of ecosystem credits per hectare for each BVT impacted as part of the Project.

Table 13.1 Staged Ecosystem Credit Requirements

Biometric Vegetation Type	Total Credit Requirement to Offset Impacts	Credits to be Retired during Stage 1	Credits to be Retired during Stage 2	Credits to be Retired during Stage 3
HU812 – Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	14	0	14	0
HU816 – Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest Slopes of the Upper	1,041	1,041	0	0
HU869 – Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin	59	59	0	0
HU905 – Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter	10,845	7,772	2,016	1,057
HU906 – Bull Oak Grassy Woodland of the Central Hunter Valley	4,909	4,519	0	390

Biometric Vegetation Type	Total Credit Requirement to Offset Impacts	Credits to be Retired during Stage 1	Credits to be Retired during Stage 2	Credits to be Retired during Stage 3
HU945 – Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley	1,248	1,174	66	8
Total	18,116	14,565	2,096	1,455
<i>Central Hunter Valley Eucalypt Forest and Woodland CEEC component</i>	8,403	5,637	1,782	984

13.3 Establishment of Proponent-managed Offset Sites

UHSA proponents may establish and manage their own biodiversity offset sites provided that such sites are secured in perpetuity under a BioBanking (or equivalent) agreement. It is intended, once UHSA is in place that the credits generated on the offset site must be matched to the credits required for impacts on the development site. As discussed in **Section 13.1**, the offset strategy will be implemented following the process outlined in the UHSA and the final composition of the offset strategy may evolve as the Project progresses. United currently proposes to establish and manage three offset sites to counterbalance the likely biodiversity impact in the additional disturbance area.

13.3.1 Glencore's Strategic Offset Approach

Glencore's strategic offset approach is centred around establishing offset sites in proximity to key landscape-scale features such as adjoining vegetation remnants, National Parks, Crown Land, government initiatives (such as the Great Eastern Ranges Initiative) and other existing Glencore offset areas. In the Hunter Valley, Glencore currently has two offset clusters: the Manobalai Offset Cluster; and the Greater Ravensworth Area Offset Cluster.

United proposes to establish three offset sites which together form significant biodiversity assets, both in terms of their current biodiversity features as well as their future ecological condition improvement. The location of the offset areas in relation to other Glencore biodiversity offset sites, the Project Area and the Great Eastern Escarpment Corridor are displayed in **Figure 13.1**.

The Highfields Offset Site (Manobalai Offset Cluster) occupies an important position in the landscape, particularly due to its proximity to Manobalai Nature Reserve and location within the corridor proposed as part of the Great Eastern Ranges Initiative. This is of strategic benefit as securing land in this corridor for conservation purposes is a major conservation priority for the NSW Government. The Highfields Offset Site is also located in proximity to the Reedy Valley Offset Site which was established for Glencore's Bulga Optimisation Project. The Highfields Offset Site also adjoins the Esparanga Offset Site which has been proposed for Glencore's Mount Owen Continued Operations Project. These sites provide a total of approximately 2,000 hectares of conservation land.

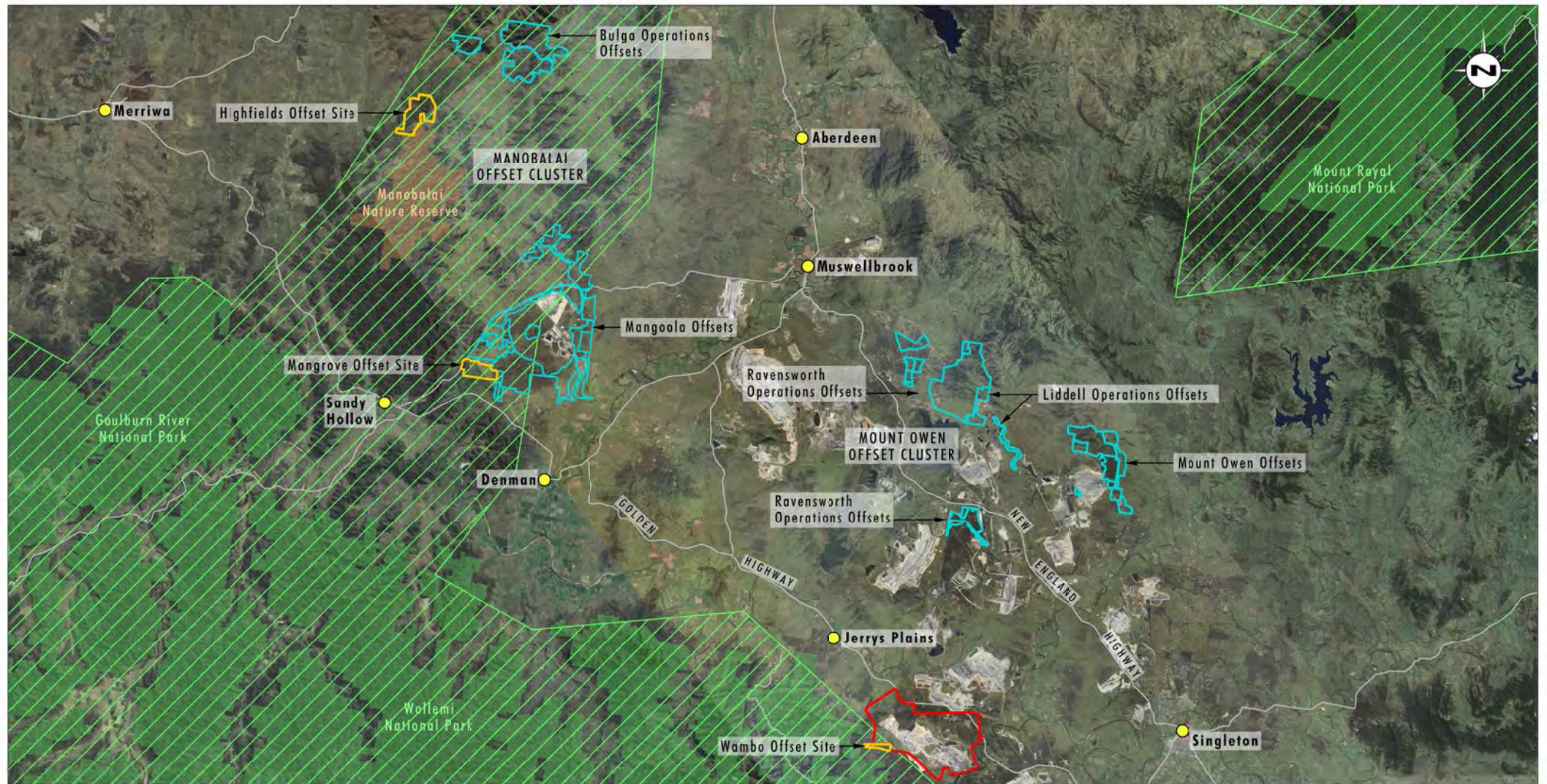


Image Source: Glencore (2008, 2013)
Data Source: Glencore (2016), Department of Lands (2013)

- Legend**
- Project Area
 - Approved Glencore Offsets
 - Proposed Glencore Offsets (United)
 - Great Eastern Ranges Corridor Initiative
 - Nature Reserve
 - National Park

FIGURE 13.1
**Strategic Location of
Glencore Offset Sites**

The Mangrove Offset Site (Manobalai Offset Cluster) adjoins other offset sites that are protected as part of Glencore's Mangoola Mine. It will protect important lowland, river flat and creekline habitats, while also providing a link from the Mangoola offsets to vacant Crown land to the west, and ultimately to Manobalai Nature Reserve and Goulburn River National Park.

The Wambo Offset Site provides locational relevance to the Project, conserving an important area of intact valley floor vegetation and habitats in proximity to the Project Area and connecting to Wollemi National Park to the west.

Further details on these proposed offset sites, including a summary of survey efforts and results, are provided in the following **Sections 13.3.2, 13.3.3 and 13.3.4**. Section 3 of **Appendix D** contains detailed descriptions of all of the vegetation communities mapped at each offset site, while Sections 1 and 2 of **Appendix D** provide species lists for flora and fauna recorded on those sites.

13.3.2 Highfields Offset Site

The Highfields Offset Site is an approximate 428 hectare property containing connected and intact mature vegetation and habitats on fertile Tertiary basalt-derived soils on higher slopes, as well as lowland habitats running off the higher ground. The majority of the hills and escarpments surrounding the central portion of the Highfields Offset Site contain woodland vegetation. A further 575 hectares of the property holding is managed by Glencore for strategic agriculture which is not subject to biodiversity offsetting as part of this Strategy.

The Highfields Offset Site is located within the Wybong Creek catchment, a direct tributary of the Hunter River. Dry Creek is the only major creek line within the site, which is a tributary of Wybong Creek. Dry Creek is an ephemeral creekline that flows in medium to high rainfall events. The landscape features of the site include alluvial flats associated with Dry Creek, steep Narrabeen (Triassic) sandstone slopes and fertile Tertiary basalt-derived soils on the upper slopes.

The historical land use of the Highfields Offset Site has been agricultural, primarily cattle and sheep grazing. The property has been maintained as a landholding for this purpose since the late 1800s. Currently this property is maintained by Glencore and utilised for cattle grazing. Large portions of the property however are under native vegetation cover. Domestic stock may be strategically grazed in parts of the Highfields Offset site to reduce weed species or to manage fuel loads for bushfire risk. Any grazing would be undertaken broadly in accordance with the principles outlined in **Section 10.6**.

Table 13.2 below outlines the landscape features of the site in relation to the data inputs required under BBAM (2014).

Table 13.2 Landscape Features of the Highfields Offset Site

IBRA Bioregion	Brigalow Belt South (partially occurring in the Sydney Basin Bioregion)*
IBRA Subregion	Liverpool Range
Major Catchment Area	Hunter/Central Rivers
Local Government Area	Muswellbrook
Zoning	E3 Environmental Management RU1 Primary Production
Mitchell Landscape	Liverpool Range Valleys and Foothills
Rivers, Streams, Estuaries	Dry Creek
Wetlands	None identified
State or Regional Biodiversity Links	Riparian buffer area on both sides of a 3 rd order stream
Other Features	Connected to Manobalai Nature Reserve Connected to the Esparanga Offset Site Basalt, sandstone and conglomerate outcropping Ridgelines, escarpments and caves Alluvial flats

*Approximately 70 per cent of the Highfields Offset Site occurs within the Brigalow Belt South bioregion with the remaining 30 per cent occurring in the Sydney Basin bioregion.

13.3.2.1 Surveys Undertaken

Surveys of the Highfields Offset Site have been undertaken over many years and seasons and have included the following:

- Detailed flora surveys in May 2011 including systematic plot-based survey and rapid vegetation assessments.
- Detailed fauna surveys in April 2011, including hair funnel surveys, harp trapping, spotlighting, herpetological searches, bird surveys, call playback, micro-bat echolocation recording and habitat assessments.
- Targeted winter bird surveys in August 2011, including bird surveys and call playback targeting the regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*).
- Detailed fauna surveys in April and May 2013, including spotlighting, herpetological searches, bird surveys, call playback and micro-bat echolocation recording.
- Targeted winter bird surveys in July 2013, including bird surveys and call playback targeting the regent honeyeater and swift parrot.

- Detailed flora surveys in May 2013, including systematic plot-based survey and collection of Biometric data in accordance with BBAM (2008).
- Targeted fauna surveys in October 2013, including remote camera surveys targeting the spotted-tailed quoll (*Dasyurus maculatus*).
- Detailed flora surveys in November/December 2015, including systematic plot-based survey and collection of Biometric data in accordance with BBAM (2014).
- Targeted winter bird surveys in August 2016, including bird surveys and call playback targeting the regent honeyeater and swift parrot.

13.3.2.2 Vegetation Zones and Ecosystem Credits

Surveys of the Highfields Offset Site identified five Biometric Vegetation Types (BVTs) which were collated using previous survey effort and refined following the surveys in December 2015 (refer to **Section 13.3.2.1**) in accordance with the requirements under BBAM (2014) (refer to **Figure 13.2**). These communities, their condition classes and the number of credits they generate under BBAM (2014) are outlined in **Table 13.3** and further described in **Appendix D**.

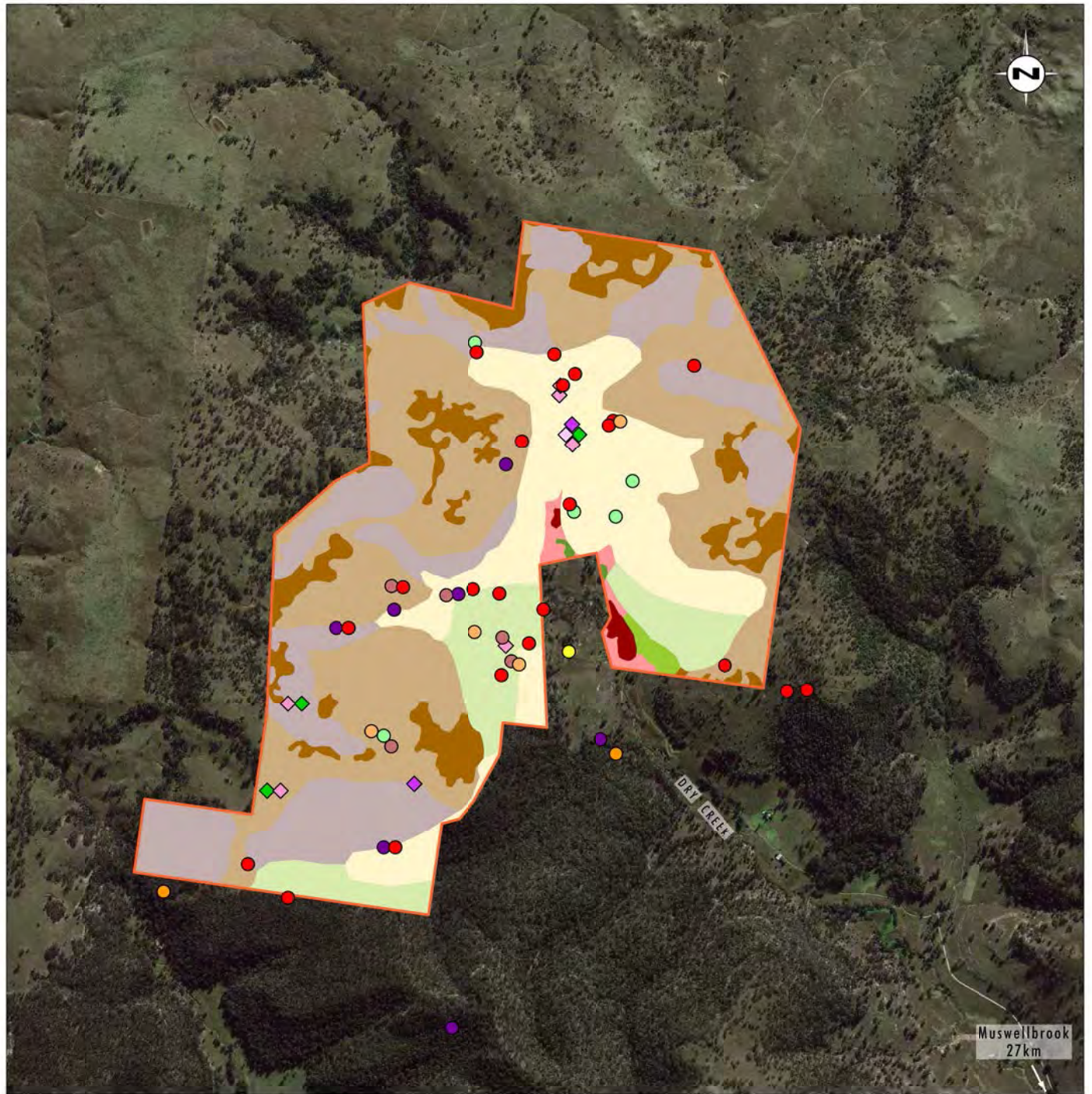


Image Source: Google Earth (2013)
Data Source: ATLAS (2016), Umwelt (2016), United (2015)

0 0.5 1.0 1.5 km
1:25 000

Legend

- | | |
|---|---|
| Highfields Offset Site | <i>Cymbidium canaliculatum</i> |
| 1 - HL701 - Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion - Moderate to Good Condition | Brown Treecreeper (eastern subspecies) |
| 2 - HL701 - Moderate to Good Condition - Derived Native Grassland | Eastern Bentwing-bat |
| 3 - HL714 - Rough-Barked Apple - Red Gum - Yellow Box Woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion - Moderate to Good Condition | Eastern Cave Bat |
| 4 - HL730 - White Box x Grey Box - Red Gum - Rough-barked Apple Grassy Woodland on rich soils on hills in the upper Hunter Valley - Moderate to Good Condition | Grey-crowned Babbler (eastern subspecies) |
| 5 - HL730 - Moderate to Good Condition - Shrubby Variant | Large-eared Pied Bat |
| 6 - HL730 - Moderate to Good Condition - Derived Native Grassland | Little Lorikeet |
| 7 - HL821 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple Shrubby Woodland of the upper Hunter - Moderate to Good Condition | Scarlet Robin |
| 8 - HL868 - Narrow-leaved Ironbark - Grey Gum Shrubby Open Forest on sandstone ranges of the upper Hunter Valley - Moderate to Good Condition | Southern Myotis |
| 9 - HL868 - Low Condition - Derived Native Grassland | Speckled Warbler |
| | Varied Sittella |

FIGURE 13.2

Highfields Offset Site
Biodiversity Features

Table 13.3 BVTs and Ecosystem Credits at the Highfields Offset Site

Veg Zone	Formation	Class	BVT Name	Area within Offset Site (ha)	Credits Generated
1	Grassy Woodlands	Coastal Valley Grassy Woodlands	HU701 - Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion (Moderate to Good)	0.5	6
2	Grassy Woodlands	Coastal Valley Grassy Woodlands	HU701 - Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion (Moderate to Good - DNG)	4.3	56
3	Grassy Woodlands	Western Slopes Grassy Woodlands	HU714 - Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion ^{EPBC/TSC} (Moderate to Good)	2.0	21
4	Grassy Woodlands	Coastal Valley Grassy Woodlands	HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley ^{EPBC/TSC} (Moderate to Good)	158.2	1737
5	Grassy Woodlands	Coastal Valley Grassy Woodlands	HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley ^{EPBC/TSC} (Moderate to Good – Shrubby variant)	97.8	1111

Veg Zone	Formation	Class	BVT Name	Area within Offset Site (ha)	Credits Generated
6	Grassy Woodlands	Coastal Valley Grassy Woodlands	HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley ^{EPBC} (Moderate to Good - DNG)	39.7	516
7	Dry Sclerophyll Forests (Shrub/grass sub-formation)	North-west Slopes Dry Sclerophyll Woodlands	HU821 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter (Moderate to Good)	83.5	902
8	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	HU868 - Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley (Moderate to Good)	39.3	434
9	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	HU868 - Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley (Low DNG)	2.2	31
TOTAL				427.5	4814

Notes:

EPBC – listed as a threatened ecological community under the EPBC Act (refer to **Section 13.3.2.5**)

TSC – listed as a threatened ecological community under the TSC Act (refer to **Section 13.3.2.6**)

Additional Management Actions

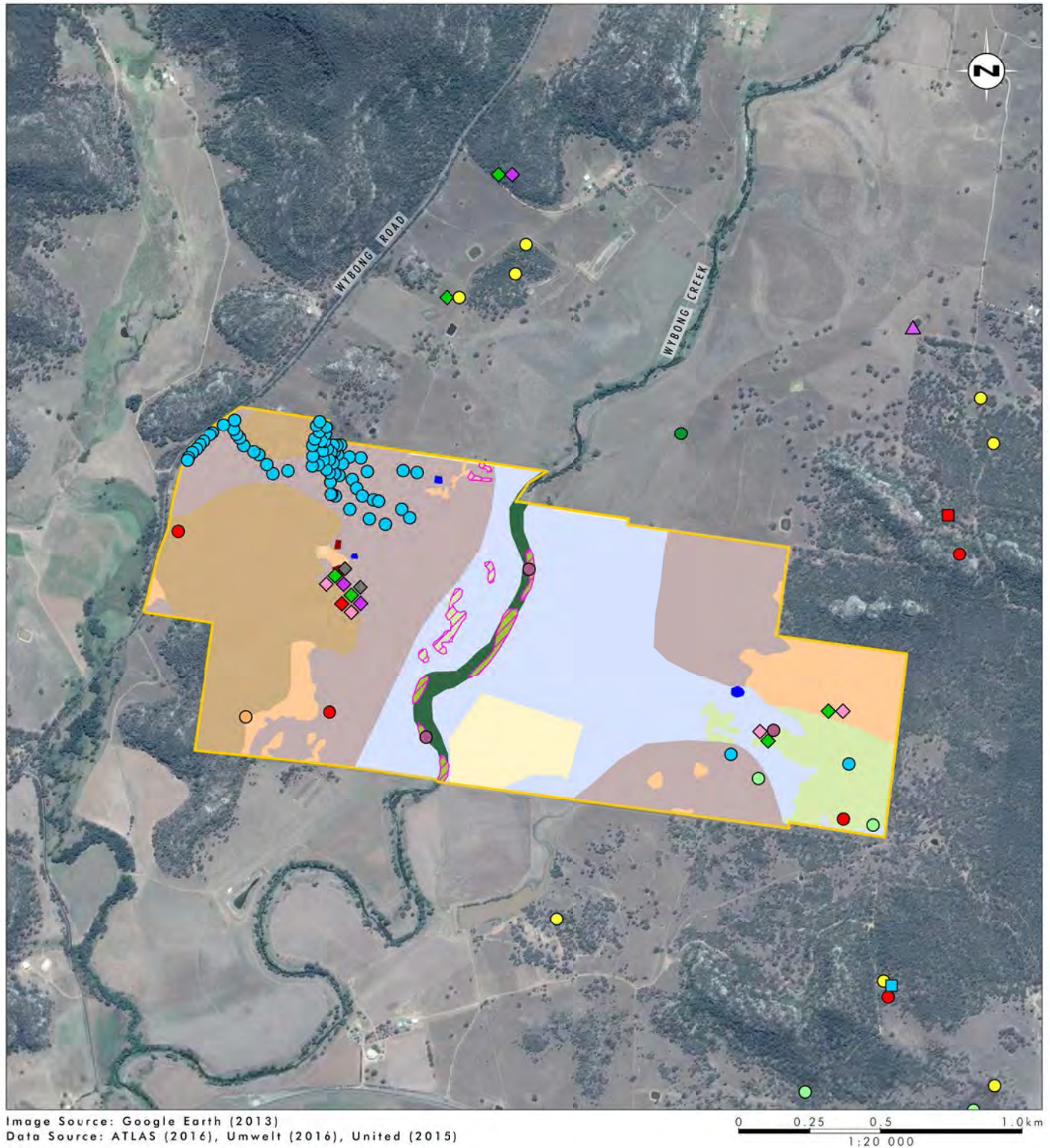
United is committed to actively improving and managing the Highfields Offset Site to maximise the biodiversity values deliver a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project in accordance with the UHSA. Where grassland occurs on the Highfields Offset Site (within Vegetation Zones 2, 6 and 9), additional management actions are proposed to progressively improve parts of these habitats using the following methods:

- Targeted supplementary planting of native canopy and midstorey species to improve the native species richness, native overstorey cover, native midstorey cover and native ground cover (grasses) (where applicable) site attribute scores in accordance with the requirements outlined in Appendix 7 and Table 32 of the BBAM (2014).
- Targeted habitat augmentation including placement of logs and woody debris to improve the total length of fallen logs (where applicable) site attribute score in accordance with the requirements outlined in Appendix 7 and Table 32 of the BBAM (2014).

13.3.2.3 Ecosystem-credit Species

A list of ecosystem-credit species known or with potential to occur in the Highfields Offset Site was generated through previous surveys, literature reviews, completion of database searches, BioBanking survey results and the assessment using the BioBanking Credit Calculator (BBCC). The list of potentially occurring ecosystem-credit species was reviewed to remove species that are not known to occur in the local area or species for which there was a lack of suitable habitat in the Highfields Offset Site. **Table 13.4** identifies the ecosystem-credit species that have been predicted to occur in the Highfields Offset Site by the BBCC.

The location of ecosystem-credit species is shown on **Figure 13.3**.



Legend

- Mangrove Offset Site
- 1 - HL599 - River Red Gum / River Oak Riparian Woodland Wetland in the Hunter Valley - Moderate to Good Condition
- 2 - HL599 - Moderate to Good Condition - Derived Native Grassland
- 3 - HL678 - Black Cypress Pine - Ironbark +/- Narrow-leaved Wattle Low Open Forest Mainly on Narrabeen Sandstone in the Upper Hunter Region of the Sydney Basin Bioregion - Moderate to Good Condition
- 4 - HL812 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter - Moderate to Good Condition
- 5 - HL812 - Low Condition - Derived Native Grassland
- 6 - HL905 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the central and upper Hunter - Moderate to Good Condition
- 7 - HL905 - Moderate to Good Condition - Derived Native Grassland
- 8 - HL812 - Moderate to Good_Poor Condition - Exotic Grassland
- Cleared Land
- Water Body

- Southern Myotis Potential Breeding Habitat
- Acacia pendula*
- Brown Treecreeper (Eastern Subspecies)
- Diuris tricolor*
- Eastern Bentwing-bat
- Eastern Cave Bat
- Eastern False Pipistrelle
- Grey-crowned Babbler (eastern subspecies)
- Koala
- Large-eared Pied Bat
- Southern Myotis
- Speckled Warbler
- Square-tailed Kite
- Squirrel Glider
- Varied Sittella
- Yellow-bellied Sheath-tail-bat

FIGURE 13.3

Mangrove Offset Site
Biodiversity Features

Table 13.4 Ecosystem-credit Species at the Highfields Offset Site

Species Name	TSC Status	EPBC Status	TS Offset Multiplier	Predicted to Occur at the Highfields Offset Site by the BBCC
barking owl <i>Ninox connivens</i>	V	-	3.0	Potential to occur due to suitable habitat and nearby records.
brown treecreeper (eastern subspecies) <i>Climacteris picumnus</i> subsp. <i>victoriae</i>	V	-	2.0	Previously recorded during fauna surveys undertaken in April and May 2013.
flame robin <i>Petroica phoenicea</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.
hooded robin (south-eastern form) <i>Melanodryas cucullata</i> subsp. <i>cucullata</i>	V	-	1.7	Potential to occur due to suitable habitat and nearby records.
grey-crowned babbler (eastern subspecies) <i>Pomatostomus temporalis</i> subsp. <i>temporalis</i>	V	-	1.3	Likely to occur due to suitable habitat and nearby records.
little lorikeet <i>Glossopsitta pusilla</i>	V	-	1.8	Previously recorded during fauna surveys undertaken in April and May 2013.
scarlet robin <i>Petroica boodang</i>	V	-	1.3	Previously recorded during fauna surveys undertaken in May 2013.
speckled warbler <i>Chthonicola sagittata</i>	V	-	2.6	Previously recorded during fauna surveys undertaken in April and May 2013 and August 2015.
spotted-tailed quoll <i>Dasyurus maculatus</i>	V	E	2.6	Likely to occur due to suitable habitat and nearby records.
turquoise parrot <i>Neophema pulchella</i>	V	-	1.8	Likely to occur due to suitable habitat and nearby records.

Species Name	TSC Status	EPBC Status	TS Offset Multiplier	Predicted to Occur at the Highfields Offset Site by the BBCC
varied sittella <i>Glossopsitta pusilla</i>	V	-	1.3	Previously recorded during fauna surveys undertaken in April 2013.

13.3.2.4 Species-credit Species

No species-credit species are known to occur in the Highfields Offset Site. This includes species that are species-credit species for certain habitat components, such as species dependent on caves for breeding. According to the BBCC tool and previous local records of species, the following species-credit species may occur at the Highfields Offset Site:

- Tiger Orchid *Cymbidium canaliculatum* Population in the Hunter Catchment – this species has been recorded immediately adjacent to the offset site boundary.

Furthermore, potential escarpment habitat for large-eared pied bat (*Chalinolobus dwyeri*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) and eastern cave bat (*Vespadelus troughtoni*) occurs within the Highfields Offset Site. These species have been positively identified from echolocation recordings during fauna surveys undertaken in April and May 2013 (Umwelt 2013). Targeted surveys may be required to determine if these habitats are being utilised by these species to gain applicable credits and for inclusion in the final BioBanking Agreement.

13.3.2.5 EPBC Act-listed Threatened Ecological Communities

Four vegetation zones within the Highfields Offset are consistent with a threatened ecological community (TEC) listed under the EPBC Act as discussed below. The area and credits generated by each of these vegetation zones are outlined in **Table 13.3** above.

White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland) CEEC

The following vegetation zones are consistent with the Box Gum Woodland CEEC:

- HU714 - Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion – Moderate to Good Condition
- HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition
- HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition – Shrubby Variant
- HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition Derived Native Grassland.

Overall, each of the identified vegetation communities is consistent with the Box Gum Woodland CEEC for the following reasons:

- occurs within the NSW Sydney Basin and Brigalow Belt South Bioregions as listed in the Commonwealth Listing Advice (TSSC 2006)
- the three HU730 zones occur on relatively fertile Tertiary basalt-derived soils on the upper slopes of the Highfields Offset, whilst HU714 occurs on an alluvial flat associated with main drainage line through the centre of the Highfields Offset
- the overstorey comprises, or prior to clearing would have comprised, one or more of the three characteristic species, including white box (*Eucalyptus albens*), yellow box (*Eucalyptus melliodora*), Blakelys red gum (*Eucalyptus blakelyi*) or their intergrades or hybrids, as the most common overstorey species
- each patch has a predominantly native understorey where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species
- all patches are 0.1 hectares or greater in size
- all patches contain at least one 'important species' (DEH 2006)
- the species composition is consistent with the Commonwealth Listing Advice (TSSC 2006) and associated species list (DEH 2006)
- all patches contained at least 12 native understorey species (excluding grasses).

It is noted that HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition – Shrubby Variant contains a higher density of shrubs. It was separated from HU730 - White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition to reflect this, particularly for fauna habitat reasons. The overall density of shrubs in this zone is less than 30 per cent as required by the Commonwealth Listing Advice (TSSC 2006).

13.3.2.6 TSC Act-listed Threatened Ecological Communities

Four vegetation zones within the Highfields Offset are consistent with a TEC listed under the TSC Act and are addressed below. The area and credits generated by each of these vegetation zones are outlined in **Table 13.3** above.

White Box Yellow Box Blakely's Red Gum Woodland EEC

The following vegetation zones are consistent with the EEC White Box Yellow Box Blakely's Red Gum Woodland (TSC Act):

- HU714 - Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion – Moderate to Good Condition
- HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition and Brigalow Belt South Bioregion – Moderate to Good Condition

- HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley –Moderate to Good Condition – Shrubby Variant
- HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition Derived Native Grassland.

Overall, each of the identified vegetation communities is consistent with the Final Determination of White Box Yellow Box Blakely's Red Gum Woodland EEC (NSW Scientific Committee 2011a) with regard to the following attributes:

- occur within the NSW Sydney Basin and Brigalow Belt South Bioregions
- the canopy of these vegetation zone are dominated by a mixture of white box (*Eucalyptus albens*), yellow box (*Eucalyptus melliodora*), Blakelys red gum (*Eucalyptus blakelyi*) or their intergrades or hybrids
- supports a predominantly native understorey
- supports a reasonable proportion of species that are in the list of characteristic species for the EEC.

13.3.3 Mangrove Offset Site

The Mangrove Offset Site a 259 hectare property containing majority cleared land for agricultural purposes. Steep, rising hills account for approximately 20 per cent of the site ranging from open to moderately dense woodland and containing ridgelines, outcrops and caves. The remainder of the site is characterised by remnant woodland on the slopes and along the Wybong Creek riparian corridor.

The Mangrove Offset Site occurs at the edge of a broad vegetation corridor which extends from the Great Dividing Range (Liverpool Range section) to the rugged sedimentary escarpments to the south. On a broad scale, this corridor connects the Liverpool Ranges to the north with Wollemi and Yengo National Parks to the south and Barrington Tops National Park to the east. Locally the Mangrove Offset Site provides a connection between the Glencore Mangoola Offset Sites to the east, occurring on the Hunter Valley floor, and the more rugged Crown land and conservation reserves to the west.

The historical land use of the Mangrove Offset Site has been agricultural, primarily cattle and sheep grazing and limited crop production. Currently this property is maintained by Glencore and utilised for cattle grazing.

Table 13.5 below outlines the landscape features of the site in relation to the data inputs required under BBAM (2014).

Table 13.5 Landscape Features of the Mangrove Offset Site

IBRA Bioregion	Sydney Basin
IBRA Subregion	Kerrabee
Major Catchment Area	Hunter/Central Rivers
Local Government Area	Muswellbrook
Zoning	RU1 Primary Production E3 Environmental Management
Mitchell Landscape	Upper Hunter Channels and Floodplain
Rivers, Streams, Estuaries	Wybong Creek
Wetlands	None identified
State or Regional Biodiversity Links	Riparian buffer area on both sides of a 6 th order stream or higher
Other Features	Rock outcropping Proximate to Mangoola Mine biodiversity offset areas (Western Corridor and Habitat Enhancement Offset Area) Alluvial flats Farm dams

13.3.3.1 Surveys Undertaken

Surveys of the Mangrove Offset Site have been undertaken over many years and seasons and have included the following methodology:

- Detailed flora surveys in April and May 2012 including systematic plot-based survey and rapid vegetation assessments.
- Detailed fauna surveys in April and May 2012, including hair funnel surveys, spotlighting, herpetological searches, bird surveys, call playback, micro-bat echolocation recording and habitat assessments.
- Targeted flora surveys in September and October 2015, for the terrestrial orchids painted diuris (*Diuris tricolor*) and *Prasophyllum petilum*.
- Detailed flora surveys in November 2015, including systematic plot-based survey and collection of Biometric data in accordance with BBAM (2014).
- Targeted micro-bat echolocation surveys in November 2015 and breeding habitat mapping for southern myotis (*Myotis macropus*).
- Targeted winter bird surveys in August 2016, including bird surveys and call playback targeting the regent honeyeater and swift parrot.

13.3.3.2 Vegetation Zones and Ecosystem Credits

Surveys of the Mangrove Offset Site identified four Biometric Vegetation Types (BVTs) which were collated using previous survey effort and refined following the surveys in November 2015 (refer to **Section 13.3.3.1**) in accordance with the requirements under BBAM (2014) (refer to **Figure 13.3**). These communities, their condition classes and the number of credits they generate under BBAM (2014) are outlined in **Table 13.6** and further described in **Appendix D**.

Table 13.6 BVTs and Ecosystem Credits at the Mangrove Offset Site

Veg Zone	Formation	Class	Biometric Vegetation Type	Area within Offset Site (ha)	Credits Generated
1	Forested Wetlands	Eastern Riverine Forests	HU599 - River Red Gum / River Oak riparian woodland wetland in the Hunter Valley (Moderate to Good)	1.8	28
2	Forested Wetlands	Eastern Riverine Forests	HU599 - River Red Gum / River Oak riparian woodland wetland in the Hunter Valley (Moderate to Good - DNG)	4.2	81
3	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	HU678 - Black Cypress Pine - Ironbark+/-Narrow-leaved Wattle Low Open Forest Mainly on Narrabeen Sandstone in the Upper Hunter Region of the Sydney Basin (Moderate to Good)	44.9	783
4	Forested Wetlands	Coastal Floodplain Wetlands	HU812 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter ^{TSC/EPBC} (Moderate to Good)	15.2	188
5	Forested Wetlands	Coastal Floodplain Wetlands	HU812 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter (Low DNG)	73.8	1080

Veg Zone	Formation	Class	Biometric Vegetation Type	Area within Offset Site (ha)	Credits Generated
6	Grassy Woodlands	Coastal Valley Grassy Woodlands	HU905 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter ^{TSC} (Moderate to Good)	20.0	304
7	Grassy Woodlands	Coastal Valley Grassy Woodlands	HU905 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter (Moderate to Good - DNG)	86.7	1428
8	Forested Wetlands	Coastal Floodplain Wetlands	HU812 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter (Moderate to Good_Poor - Exotic Grassland)	11.9	170
-	N/A	N/A	Cleared Land	0.2	0
-	N/A	N/A	Water Body	0.3	0
Total				258.9	4062

EPBC – listed as a threatened ecological community under the EPBC Act (refer to **Section 13.3.3.5**)

TSC – listed as a threatened ecological community under the TSC Act (refer to **Section 13.3.3.6**)

Additional Management Actions

United is committed to actively improving and managing the Mangrove Offset Site to maximise the biodiversity value deliver a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project in accordance with the UHSA. Where grassland occurs on the Mangrove Offset Site (within Vegetation Zones 2, 5, 7 and 8), additional management actions are proposed to progressively improve parts of these habitats using the following methods:

- Targeted supplementary planting of native canopy and midstorey species to improve the native species richness, native overstorey cover, native midstorey cover and overstorey regeneration (where applicable) site attribute scores in accordance with the requirements outlined in Appendix 7 and Table 32 of the BBAM (2014).
- Targeted habitat augmentation including placement of logs and woody debris to improve the total length of fallen logs (where applicable) site attribute score in accordance with the requirements outlined in Appendix 7 and Table 32 of the BBAM (2014).

13.3.3.3 Ecosystem-credit Species

A list of ecosystem-credit species known or likely to occur in the Mangrove Offset Site was generated from previous surveys, literature reviews, completion of database searches, BioBanking survey results and the assessment using the BBCC. The list of ecosystem-credit species was reviewed to remove species that are not known to occur in the local area or species for which there was a lack of suitable habitat in the Mangrove Offset Site.

Table 13.7 identifies the ecosystem-credit species that have been predicted to occur at the Mangrove Offset Site by the BBCC. The location of ecosystem-credit species is shown on **Figure 13.3**.

Table 13.7 Ecosystem-credit Species at the Mangrove Offset Site

Species Name	TSC Status	EPBC Status	TS Offset Multiplier	Predicted to Occur at the Mangrove Offset Site by the BBCC
barking owl <i>Ninox connivens</i>	V	-	3.0	Potential to occur due to suitable habitat and nearby records.
black-chinned honeyeater (eastern subspecies) <i>Melithreptus gularis subsp. gularis</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.
brown treecreeper (eastern subspecies) <i>Climacteris picumnus subsp. victoriae</i>	V	-	2.0	Recorded during fauna surveys undertaken in April and May 2012 (Umwelt 2012).
bush stone-curlew <i>Burhinus grallarius</i>	E	-	2.6	Historic record occurs approximately 10km to the northwest of the Mangrove Offset Site from 1978 (OEH 2016d). No other records occur in the locality.
diamond firetail <i>Stagonopleura guttata</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.
eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V	-	2.2	Recorded during fauna surveys undertaken in April and May 2012 (Umwelt 2012).
east coast freetail-bat <i>Mormopterus norfolkensis</i>	V	-	2.2	Potential to occur due to suitable habitat and nearby records.

Species Name	TSC Status	EPBC Status	TS Offset Multiplier	Predicted to Occur at the Mangrove Offset Site by the BBCC
flame robin <i>Petroica phoenicea</i>	V	-	1.3	Potential occur due to suitable habitat.
gang-gang cockatoo <i>Callocephalon fimbriatum</i>	V	-	2.0	Potential to occur due to suitable habitat and nearby records.
glossy black-cockatoo <i>Calyptorhynchus lathami</i>	V	-	1.8	Potential to occur due to suitable habitat and nearby records.
greater broad-nosed bat <i>Scoteanax rueppellii</i>	V	-	2.2	Potential to occur due to suitable habitat and nearby records.
grey-crowned babbler (eastern subspecies) <i>Pomatostomus temporalis</i> subsp. <i>temporalis</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.
hooded robin (south-eastern form) <i>Melanodryas cucullata</i> subsp. <i>cucullata</i>	V	-	1.7	Potential to occur due to suitable habitat and nearby records.
little eagle <i>Hieraaetus morphnoides</i>	V	-	1.4	Potential occur due to suitable habitat.
little lorikeet <i>Glossopsitta pusilla</i>	V	-	1.8	Potential to occur due to suitable habitat and nearby records.
masked owl <i>Tyto novaehollandiae</i>	V	-	3.0	Potential to occur due to suitable habitat and nearby records.
painted honeyeater <i>Circus assimilis</i>	V	V	1.3	Potential to occur due to suitable habitat and nearby records.
powerful owl <i>Ninox strenua</i>	V	-	3.0	Potential to occur due to suitable habitat and nearby records.
scarlet robin <i>Petroica boodang</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.

Species Name	TSC Status	EPBC Status	TS Offset Multiplier	Predicted to Occur at the Mangrove Offset Site by the BBCC
speckled warbler <i>Chthonicola sagittata</i>	V	-	2.6	Recorded during fauna surveys undertaken in April and May 2012 (Umwelt 2012).
spotted harrier <i>Circus assimilis</i>	V	-	1.4	Potential to occur due to suitable habitat and nearby records.
spotted-tailed quoll <i>Dasyurus maculatus</i>	V	E	2.6	Potential to occur due to suitable habitat and nearby records.
square-tailed kite <i>Lophoictinia isura</i>	V	-	1.4	Potential to occur due to suitable habitat and nearby records.
squirrel glider <i>Petaurus norfolcensis</i>	V	-	2.2	Potential to occur due to suitable habitat and nearby records.
swift parrot <i>Lathamus discolor</i>	E	CE	1.3	Potential to occur due to suitable habitat.
turquoise parrot <i>Neophema pulchella</i>	V	-	1.8	Potential to occur due to suitable habitat and nearby records.
varied sittella <i>Daphoenositta chrysoptera</i>	V	-	1.3	Recorded during fauna surveys undertaken in April and May 2012 (Umwelt 2012).
yellow-bellied sheath-tail-bat <i>Saccolaimus flaviventris</i>	V	-	2.2	Recorded during fauna surveys undertaken in April and May 2012 (Umwelt 2012).

13.3.3.4 Species-credit Species

A list of species-credit species known to occur in the Mangrove Offset Site was generated during the literature review, completion of database searches, BioBanking survey results and assessment using the BBCC. This includes species that are species-credit species for certain habitat components.

Table 13.8 identifies the credits generated for species-credit species known to occur in the Mangrove Offset Site and the location of species-credit species previously recorded on the site is shown on **Figure 13.3**. The credits generated for the pine donkey orchid are based on individual occurrences of the species, rather than an area of occupation, in accordance with BBAM (2104).

Table 13.8 Species-credit Species at the Mangrove Offset Site

Species Name	TSC Status	EPBC Status	Credits Generated	Further Information on Records
pine donkey orchid <i>Diuris tricolor</i>	V	-	7909 [^]	1114 individuals recorded on the Mangrove Offset Site in 2015 as part of targeted flora surveys (Umwelt 2015).
southern myotis <i>Myotis macropus</i>	V	-	21	Species was recorded from a positively identified echolocation recordings from fauna surveys undertaken in November 2015 as part of this assessment. Hollow-bearing tree habitat occurs within the native forest and woodland within 200m of Wybong Creek (7th order stream) as it runs through the site. 3.0 hectares has been calculated as potential breeding habitat for the species at this site.

[^] Credits are based on estimate counts of the number of individuals during targeted surveys undertaken in September and October 2015.

Furthermore, potential cliff, cave and escarpment habitat for large-eared pied bat (*Chalinolobus dwyeri*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) and eastern cave bat (*Vespadelus troughtoni*) occurs within the Mangrove Offset Site. These species have been positively identified from echolocation recordings during fauna surveys undertaken in April and May 2012 (Umwelt 2012). Targeted surveys may be required to determine if these habitats are being utilised as breeding sites by these species to gain applicable credits and for inclusion in the final BioBanking Agreement.

13.3.3.5 EPBC Act Listed Threatened Ecological Communities

One vegetation zone within the Mangrove Offset is consistent with a TEC listed under the EPBC Act and is described in detail below. The area and credits generated by this vegetation zone are outlined in **Table 13.7** above.

White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland) CEEC

Vegetation zone HU812 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Moderate to Good Condition is consistent with the Box Gum Woodland CEEC for the following reasons:

- occurs within the NSW Sydney Basin Bioregion as listed in the Commonwealth Listing Advice (TSSC 2006)

- the overstorey comprises, Blakelys red gum (*Eucalyptus blakelyi*) and forest red gum (*Eucalyptus tereticornis*) intergrades, as the most common overstorey species
- each patch has a predominantly native understorey where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species
- all patches are 0.1 hectares or greater in size
- all patches contain at least one 'important species' (DEH 2006)
- the species composition is consistent with the Commonwealth Listing Advice (TSSC 2006) and associated species list (DEH 2006)
- all patches contained at least 12 native understorey species (excluding grasses).

13.3.3.6 TSC Act listed Threatened Ecological Communities

Two vegetation zones within the Mangrove Offset are consistent with TECs listed under the TSC Act and are described in detail below. The area and credits generated by each of these vegetation zones are outlined in **Table 13.7** above.

Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC

HU905 – Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good mapped in the Mangrove Offset is consistent with the EEC Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions (TSC Act) (NSW Scientific Committee 2011b). This vegetation zone complies with the Final Determination of the EEC with regard to the following attributes:

- occurs in the NSW Sydney Basin bioregion
- supports a canopy dominated by the characteristic species narrow-leaved ironbark (*Eucalyptus crebra*)
- supports a reasonable proportion of species that are in the list of characteristic species for the EEC
- occurs in the Muswellbrook Local Government Area (LGA) where the EEC has previously been recorded.

Although the Final Determination notes that the EEC Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions generally occurs on Permian sediments, the occurrence of this vegetation zone on Quaternary colluvium soils in the Mangrove Offset does not preclude it from conforming to the Final Determination. This is also consistent with previous work undertaken at the adjoining Mangoola Mine site and accepted by OEH and DPE.

It should also be noted that the derived native grassland, mapped as HU905 – Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter – Low Condition – DNG form of this is community is not covered by the EEC Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions.

Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC

HU812 – Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Moderate to Good Condition mapped within the Mangrove Offset is consistent with the EEC Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions (TSC Act) (NSW Scientific Committee 2011c). This vegetation zone complies with the Final Determination of the EEC with regard to the following attributes:

- dominant canopy species include forest red gum (*Eucalyptus tereticornis*) and forest/Blakely's red gum hybrids (*Eucalyptus tereticornis* x *blakelyi*)
- supports a reasonable proportion of species that are in the list of characteristic species for the EEC given the very small size of the vegetation zone
- occurs on the floodplain rises along a tributary to the Hunter River within the Sydney Basin Bioregion
- occurs in the Muswellbrook Local Government Area (LGA), where it has previously been recorded before.

13.3.4 Wambo Offset Site

The Wambo Offset Site is an approximate 56 hectare property containing mainly intact and connected high quality vegetation adjacent to Wollemi National Park. The site is positioned on the lower slopes of the southern rim of the Hunter Valley at the base of steep slopes and sandstone escarpments to the southwest. The majority of the site contains Hunter Valley floor woodland vegetation, with small pockets of derived native grassland which have previously been cleared. The vegetation is reasonably young and as a result the hollow-bearing tree density is generally low. The woodland vegetation within the site occurs at the interface of land which has been predominantly cleared of trees and converted to grassland for grazing purposes.

Table 13.9 below outlines the landscape features of the site in relation to the data inputs required under BBAM (2014).

Table 13.9 Landscape Features of the Wambo Offset Site

IBRA Bioregion	Sydney Basin
IBRA Subregion	Hunter
Major Catchment Area	Hunter/Central Rivers
Local Government Area	Singleton
Zoning	RU1 Primary Production
Mitchell Landscape	Yengo Plateau
Rivers, Streams, Estuaries	1 st and 2 nd order streams
Wetlands	None identified
State or Regional Biodiversity Links	None identified
Other Features	Outcropping

13.3.4.1 Surveys Undertaken

Surveys of the Wambo Offset Site have included the following methodology:

- Detailed flora surveys in November 2015, including systematic plot-based survey and collection of Biometric data in accordance with BBAM (2014).
- Targeted micro-bat echolocation surveys in November 2015 and breeding habitat mapping for southern myotis (*Myotis macropus*).
- Targeted winter bird surveys in July 2016, including bird surveys and call playback targeting the regent honeyeater and swift parrot.

13.3.4.2 Vegetation Zones and Ecosystem Credits

Surveys of the Wambo Offset Site identified two Biometric Vegetation Types (BVTs) and three vegetation zones in accordance with the requirements under BBAM (2014) (refer to **Figure 13.4**). These communities, their condition classes and the number of credits they generate under BBAM (2014) are outlined in **Table 13.10** and further described in **Appendix D**.

Table 13.10 BVTs and Ecosystem Credits at the Wambo Offset Site

Veg Zone	Formation	Class	BVT Name	Area within Offset Site (ha)	Credits Generated
1	Grassy Woodlands	Coastal Valley Grassy Woodlands	HU817 - Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter ^{EPBC/TSC} (Moderate to Good)	14.7	151
2	Grassy Woodlands	Coastal Valley Grassy Woodlands	HU817 - Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter ^{EPBC} (Moderate to Good - DNG)	1.3	15
3	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	HU869 - Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin ^{EPBC/TSC} (Moderate to Good)	40.0	482
-	N/A	N/A	Cleared Land	0.2	0
TOTAL				56.2	648

EPBC – listed as a threatened ecological community under the EPBC Act (refer to **Section 13.3.4.5**)

TSC – listed as a threatened ecological community under the TSC Act (refer to **Section 13.3.4.6**)

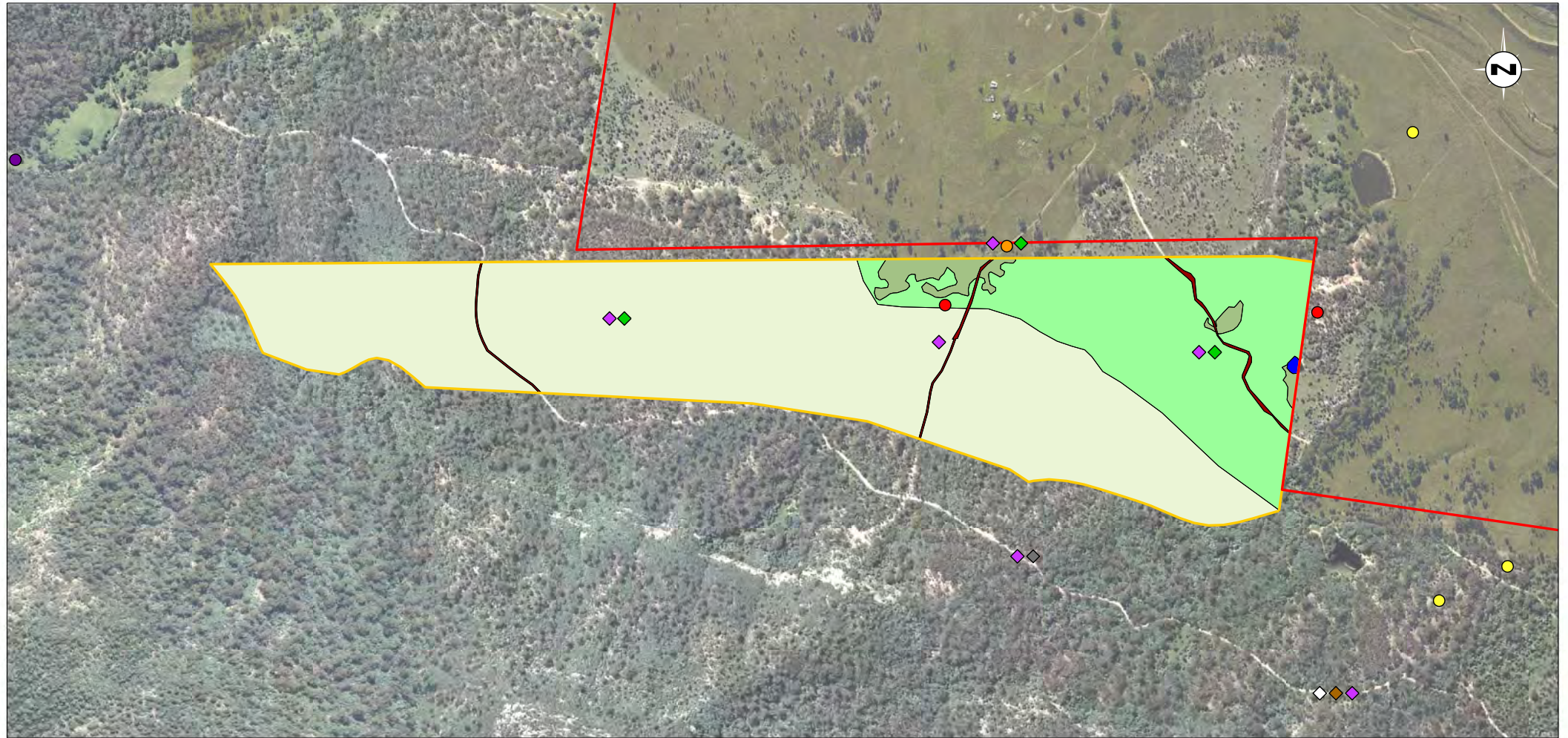


Image Source: Google Earth (2013)
Data Source: ATLAS (2016), Umwelt (2016), United (2015)

Legend

- Project Area
- Wambo Offset Site
- 1 - HU817 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the central and lower Hunter - Moderate to Good Condition
- 2 - HU817 - Moderate to Good Condition - Derived Native Grassland
- 3 - HU869 - Grey Box - Slaty Box Shrub-Grass Woodland on sandstone slopes of the upper Hunter and Sydney Basin - Moderate to Good Condition
- Cleared Land
- Water Body

- ◆ East-coast Freetail-bat
- ◆ Eastern Bentwing-bat
- Grey-crowned Babbler (eastern subspecies)
- Hooded Robin (south-eastern form)
- ◆ Large-eared Pied Bat
- ◇ Little Bentwing-bat
- Little Lorikeet
- Speckled Warbler
- ◆ Yellow-bellied Sheath-tail-bat

0 100 250 500m
1:10 000

FIGURE 13.4

**Wambo Offset Site
Biodiversity Features**

Additional Management Actions

United is committed to actively improving and managing the Wambo Offset Site to maximise the biodiversity value deliver a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project in accordance with the UHSA. Where grassland occurs on the Wambo Offset Site (within Vegetation Zone 2), additional management actions are proposed to progressively improve parts of these habitats using the following methods:

- Targeted supplementary planting of native canopy and midstorey species to improve the native overstorey cover, native midstorey cover and native ground cover (shrubs) site attribute scores in accordance with the requirements outlined in Appendix 7 and Table 32 of the BBAM (2014).
- Targeted habitat augmentation including placement of logs and woody debris to improve the total length of fallen logs site attribute score in accordance with the requirements outlined in Appendix 7 and Table 32 of the BBAM (2014).

13.3.4.3 Ecosystem-credit Species

A list of ecosystem-credit species known or likely to occur in the Wambo Offset Site was generated from literature reviews, completion of database searches, BioBanking survey results and assessment using the BBCC. The list of ecosystem-credit species was reviewed to remove species that are not known to occur in the local area or species for which there was a lack of suitable habitat in the Wambo Offset Site.

Table 13.11 identifies the ecosystem-credit species that have been predicted to occur at the Wambo Offset Site by the BBCC. The location of ecosystem-credit species is shown on **Figure 13.4**.

Table 13.11 Ecosystem-credit Species at the Wambo Offset Site

Species Name	TSC Status	EPBC Status	TS Offset Multiplier	Predicted to Occur at the Wambo Offset Site by the BBCC
barking owl <i>Ninox connivens</i>	V	-	3.0	Potential to occur due to suitable habitat and nearby records.
black-chinned honeyeater (eastern subspecies) <i>Melithreptus gularis subsp. gularis</i>	V	-	1.3	Potential occur due to suitable habitat.
brown treecreeper (eastern subspecies) <i>Climacteris picumnus subsp. victoriae</i>	V	-	2.0	Potential to occur due to suitable habitat and nearby records.
bush stone-curlew <i>Burhinus grallarius</i>	E	-	2.6	No records in the locality and unlikely habitat on site.
Corbens long-eared bat <i>Nyctophilus corbeni</i>	V	V	2.0	Potential occur due to suitable habitat.

Species Name	TSC Status	EPBC Status	TS Offset Multiplier	Predicted to Occur at the Wambo Offset Site by the BBCC
diamond firetail <i>Stagonopleura guttata</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.
eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V	-	2.2	Potential to occur due to suitable habitat and nearby records.
east coast freetail-bat <i>Mormopterus norfolkensis</i>	V	-	2.2	Potential to occur due to suitable habitat and nearby records.
flame robin <i>Petroica phoenicea</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.
gang-gang cockatoo <i>Callocephalon fimbriatum</i>	V	-	2.0	Potential to occur due to suitable habitat and nearby records.
glossy black-cockatoo <i>Calyptorhynchus lathami</i>	V	-	1.8	Potential to occur due to suitable habitat and nearby records.
greater broad-nosed bat <i>Scoteanax rueppellii</i>	V	-	2.2	Potential to occur due to suitable habitat and nearby records.
grey-crowned babbler (eastern subspecies) <i>Pomatostomus temporalis</i> subsp. <i>temporalis</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.
hooded robin (south-eastern form) <i>Melanodryas cucullata</i> subsp. <i>cucullata</i>	V	-	1.7	Potential to occur due to suitable habitat and nearby records.
little eagle <i>Hieraaetus morphnoides</i>	V	-	1.4	Potential to occur due to suitable habitat and nearby records.
little lorikeet <i>Glossopsitta pusilla</i>	V	-	1.8	Potential to occur due to suitable habitat and nearby records.
masked owl <i>Tyto novaehollandiae</i>	V	-	3.0	Potential to occur due to suitable habitat and nearby records.

Species Name	TSC Status	EPBC Status	TS Offset Multiplier	Predicted to Occur at the Wambo Offset Site by the BBCC
painted honeyeater <i>Circus assimilis</i>	V	V	1.3	Potential to occur due to suitable habitat and nearby records.
powerful owl <i>Ninox strenua</i>	V	-	3.0	Potential to occur due to suitable habitat and nearby records.
scarlet robin <i>Petroica boodang</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.
speckled warbler <i>Chthonicola sagittata</i>	V	-	2.6	Recorded on site in 2010 (OEH BioNet 2016d).
spotted-tailed quoll <i>Dasyurus maculatus</i>	V	E	2.6	Potential to occur due to suitable habitat and nearby records.
square-tailed kite <i>Lophoictinia isura</i>	V	-	1.4	Potential to occur due to suitable habitat.
squirrel glider <i>Petaurus norfolcensis</i>	V	-	2.2	Potential to occur due to suitable habitat and nearby records.
swift parrot <i>Lathamus discolor</i>	E	CE	1.3	Potential to occur due to suitable habitat and nearby records.
turquoise parrot <i>Neophema pulchella</i>	V	-	1.8	Potential to occur due to suitable habitat and nearby records.
varied sittella <i>Daphoenositta chrysoptera</i>	V	-	1.3	Potential to occur due to suitable habitat and nearby records.
yellow-bellied glider <i>Petaurus australis</i>	V	-	2.0	Potential to occur due to suitable habitat and nearby records.
yellow-bellied sheath-tail-bat <i>Saccolaimus flaviventris</i>	V	-	2.2	Potential to occur due to suitable habitat and nearby records.

13.3.4.4 Species-credit Species

Furthermore, potential cliff, cave and escarpment habitat for large-eared pied bat (*Chalinolobus dwyeri*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) occurs on Wambo owned land adjacent to the Wambo Offset Site. These species have been positively identified from echolocation recordings during surveys undertaken in 2010 and 2011 (OEH BioNet 2016d). These species are species-credits for breeding habitat only (caves, escarpments, rock outcrops). This habitat may occur at the Wambo Offset Site. Further targeted fauna surveys may be required to confirm the presence of potential species-credit species at the Wambo Offset Site. The location of species-credit species in the locality is shown on **Figure 13.4**.

13.3.4.5 EPBC Act listed Threatened Ecological Communities

Three vegetation zones within the Wambo Offset are consistent with a TEC listed under the EPBC Act and are described in detail below. The area and credits generated by each of these vegetation zones are outlined in **Table 13.10** above.

Central Hunter Valley Eucalypt Forest and Woodland CEEC

The following vegetation zones are consistent with the Approved Conservation Advice Central Hunter Valley Eucalypt Forest and Woodland CEEC (TSSC 2015):

- HU869 – Grey Box – Slaty Box Shrub – Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin
- HU817 – Narrow-leaved Ironbark – Bull Oak – Grey Box shrub – grass open forest of the central and lower Hunter – Moderate to Good Condition
- HU817 – Narrow-leaved Ironbark – Bull Oak – Grey Box shrub – grass open forest of the central and lower Hunter – Moderate to good condition – DNG Condition.

These vegetation zones meet the key diagnostic characteristic and condition thresholds for Central Hunter Valley Eucalypt Forest and Woodland CEEC. In summary the follow criteria are met:

- Occurs in the Hunter River catchment
- Occurs on lower hillslopes on soils derived from Permian sedimentary rocks. This was determined by utilising the boundaries of both the Singleton Soil Landscapes mapping (Kovac and Lawrie 1991) and the Hunter Coalfield Regional Geology mapping (Glen and Beckett 1993), whichever was further downslope. The lower soil landscape was mapped by Kovac and Lawrie (1991) as Bulga (which comprises Permian sandstone, conglomerate, claystone, shale, mudstone and coal seams) and the upper soil landscape mapped as Lees Pinch (comprising Triassic Sandstone). The geology map by Glen and Beckett (1993) indicates that the lower geology is from the Permian period, while the upper geology is from the Triassic period. A precautionary approach was adopted and the lower of the soil landscapes mapping and geology mapping used to identify the occurrence of the CEEC. In addition, the A horizon was sampled in the Wambo Offset Site and was generally consistent with the Bulga soil landscape description.
- Has a projected canopy cover of at least 10 per cent, or for the derived native grasslands occur within 30 metres of the woodland patches
- Where present the canopy is dominated by one of the four characteristic tree species, comprising at this site narrow-leaved ironbark (*Eucalyptus crebra*) and slaty box (*Eucalyptus dawsonii*)

- Contra-indicative species are absent
- The ground layer contains a mixture of native grasses, herbs and shrubs
- The patch of CEEC meets the high quality condition threshold as it is greater than 5 hectares, contains greater than 50 per cent perennial understorey native vegetative cover and at least 12 native understorey species.

13.3.4.6 TSC Act listed Threatened Ecological Communities

Two vegetation zones within the Wambo Offset are consistent with TECs listed under the TSC Act and are described in detail below. The area and credits generated by each of these vegetation zones are outlined in **Table 13.10** above.

Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC

HU817 – Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter – Moderate to Good Condition mapped in the Wambo Offset is consistent with the EEC Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions (TSC Act) (NSW Scientific Committee 2011b). This vegetation zone complies with the Final Determination of the EEC with regard to the following attributes:

- occurs within the NSW Sydney Basin Bioregion
- occurs on Permian aged soils
- occurs on the lower slopes along the southern rim of the Hunter Valley
- supports a canopy dominated by the characteristic species narrow-leaved ironbark (*Eucalyptus crebra*)
- supports a reasonable proportion of species that are in the list of characteristic species for the EEC
- occurs in the Singleton Local Government Area (LGA) where the EEC has previously been recorded.

The derived native grassland, mapped as HU817 – Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter – Moderate to Good Condition – Derived Native Grassland form of this is community is not covered by the EEC Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions.

Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC

HU869 – Grey Box – Slaty Box Shrub – Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin - Moderate to good Condition corresponds with Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC (NSW Scientific Committee 2011d). This vegetation zone complies with the Final Determination of the VEC with regard to the following attributes:

- occurs within the NSW Sydney Basin Bioregion
- occurs on Permian sediments at the lower slopes of the Wambo Offset along the southern rim of the Hunter Valley
- supports a reasonable proportion of species that are in the list of characteristic species for the VEC
- occurs in the Singleton Local Government Area (LGA) where it has previously been recorded.

13.3.5 Proposed Habitat Improvement Initiatives

There are no pre-existing conservation obligations in relation to the proposed offset areas. All three proposed offset areas are currently grazed and have previously been, and could in the future, be developed for agricultural purposes under existing legislative arrangements. The economic viability of any farming on these areas in the future (i.e. if not used for offsetting the impacts from the proposed Project) would almost certainly require an improvement in pasture quality which will significantly lower the ecological value of this land from that which presently exists.

For the purposes of this assessment, the BBCC calculated the conservation management zones across the offset sites using the predicted gain in site value scores based on standard management practices. This includes:

- management of grazing for conservation
- weed control
- ecological fire management
- management of human disturbance
- retention of regrowth and remnant native vegetation
- replanting or supplementary planning where natural regeneration is not sufficient
- retention of dead timber
- erosion control
- retention of rocks.

The biodiversity offset strategy will include specific management measures for each of the proposed offset sites following completion of the UHSA offset rules and finalisation of the strategy.

13.4 Mine Site Ecological Rehabilitation

Rehabilitated woodland areas are proposed to be created within the Project's post-mining landscape to contain flora species assemblages characteristic of the dominant vegetation communities impacted by the Project. The target Plant Community Type (PCT) that will comprise the ecological rehabilitation will be:

- PCT 1691 Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter

A PCT is an identification and classification number for each vegetation community type that occurs in NSW. Each PCT is comprised of one or more Biometric Vegetation Types (BVTs) which identifies the Catchment Management Authority (CMA) region in which the PCT occurs. The target PCT is consistent with BVT HU905 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter which was recorded within the development site. This community conforms to *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* listed under the TSC Act and *Central Hunter Valley Eucalypt Forest and Woodland CEEC* listed under the EPBC Act. This PCT has been recorded on the site in five condition types (refer to **Section 3**) and comprises the largest area of PCT being impacted by the Project.

PCT 1691 Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter occurs naturally in the Hunter Interim Biogeographic Regionalisation for Australia (IBRA) subregion in which the Project occurs. The Vegetation Information System (VIS) administered by OEH does not give a detailed description of the occurrence of this PCT in the Hunter Valley, however it is equivalent to MU 10 - Central Hunter Box – Ironbark Woodland, as mapped by Peake (2006), across 14,800 hectares of the central Hunter Valley. The PCT is known to extend from the Singleton Military Base, west to Denman and Wybong, and north to Castle Rock and Muswellbrook. The PCT mostly occurs south of the New England Highway, and north of the southern Hunter Valley escarpment (Peake 2006).

The *Guidelines for the Ecological Rehabilitation of Recognisable and Self-sustaining Plant Community Types for the UHSA* (Ecological Rehabilitation Guidelines) (OEH 2015d) prescribe the standard required for ecological rehabilitation to contribute to meeting offset requirements under the UHSA. Ecological rehabilitation is defined by the Ecological Rehabilitation Guidelines as a ‘mine site where the rehabilitation will result in recognisable and self-sustaining plant community types (PCTs) as defined through the guidelines’. The Ecological Rehabilitation Guidelines provide objectives and preliminary completion criteria against which ecological rehabilitation can be measured to determine whether it comprises a *recognisable and self-sustaining* PCT. The preliminary completion criteria will continue to be refined during the development and finalisation of the UHSA Biodiversity Plan. The final measurable completion criteria will be published in an updated version of the UHSA Ecological Rehabilitation Guidelines.

The ecological rehabilitation proposed in the Project Area and as part of the biodiversity offset strategy is outlined below, with the general rehabilitation strategy for the Project discussed further in Section 6.13 of the main text of the EIS.

13.4.1 Area of Ecological Rehabilitation

The approximate area of disturbance that will be rehabilitated progressively over the life of the mine comprises 1880 hectares. Of the 1880 hectares of rehabilitation, a minimum of 878 hectares will be rehabilitated to comprise a recognisable and self-sustaining example of PCT 1691 – Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter (refer to **Figure 13.4**).

13.4.2 Objectives, Preliminary Completion Criteria and Performance Indicators

Ecological rehabilitation will be undertaken in accordance with an approved MOP. The MOP will detail performance measures and criteria for specific areas that are to be rehabilitated during the term of the MOP (nominally 7 years), to be used as benchmarks against which performance of the rehabilitation strategy can be measured. The MOP will also specify a suitable timeframe for the delivery of the ecological rehabilitation in accordance with the final completion criteria, which will be developed as part of the MOP process in consideration of the current version of the Ecological Rehabilitation Guidelines. The ecological rehabilitation objectives, preliminary completion criteria and performance indicators that are prescribed by Section 2 of the Ecological Rehabilitation Guidelines (OEH 2015d) are described in **Table 13.12** below and will be included in the MOP to guide the progressive rehabilitation of the ecological rehabilitation areas. The objectives, preliminary completion criteria and performance indicators will be reviewed in accordance with the MOP review timeframe (nominally 7 years) to confirm that progressive rehabilitation of the ecological rehabilitation areas are meeting or trending towards meeting the final completion criteria. Subsequent reviews of the MOP will consider relevant updates to the Ecological Rehabilitation Guidelines in relation to ongoing refinement of the final completion and closure criteria. It is noted, however, the rehabilitation will need to be compared to the completion criteria that is in place at the time it is established.

A detailed rehabilitation monitoring program will be implemented as part of the Project. The monitoring program will consider the outcomes of site-specific rehabilitation risk assessments that will be conducted during the development of an appropriate design and implementation strategy for the ecological rehabilitation and the wider site rehabilitation. The ecological rehabilitation monitoring program will be designed to evaluate the progress of the ecological rehabilitation against the preliminary completion criteria and objectives and will consider the requirements of Section 6 (Rehabilitation Monitoring) of the Ecological Rehabilitation Guidelines (OEH 2015d). The results of the rehabilitation monitoring program will be reported in the Annual Review for the Project. The preliminary completion criteria and performance indicators will be finalised in consultation with OEH as part of the implementation of the Project.

Table 13.12 Ecological Rehabilitation Objectives, Preliminary Completion Criteria and Performance Indicators

Preliminary Completion Criteria	Performance Indicators
Objective 1: Increase in <u>site condition attribute scores</u> are greater than or equal to the increase used to calculate the maximum allowable credit value of the rehabilitation	
Achievement of site condition attribute scores as used to calculate the maximum allowable credit value of rehabilitation.	All proposed site condition attribute scores are achieved as per the maximum allowable credit value of rehabilitation described below: Native Plant Species Richness – 1.0 Over-storey cover – 1.0 Mid-storey cover – 1.0 Native ground cover (grasses) – 1.0 Native ground cover (shrubs) – 1.0 Native ground cover (other) – 1.0 Exotic plant cover – 1.0 Number of trees with hollows – 0.5 Over-storey regeneration – 0.5 Total length of fallen logs – 0.5 Native plant species richness, overstorey cover, overstorey regeneration, midstorey cover, native groundcover (Grasses, shrubs, other) are 'characteristic of'* PCT 1691 as determined through monitoring.
Objective 2: The <u>vegetation composition</u> of the rehabilitation is recognisable as PCT 1691 <i>Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter</i>	
Native plant species are "characteristic of"1 PCT 1691.	Native species richness, assemblage of species, dominance of characteristic or diagnostic species, abundance of weeds is characteristic of the PCT in the Vegetation Information System (VIS) Classification database.

Preliminary Completion Criteria	Performance Indicators
Objective 3: The <u>vegetation structure</u> of the rehabilitation is recognisable as, or is trending towards, PCT 1691 <i>Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter</i>	
Cover, abundance and height range of native plant strata are “characteristic of” 1 or trending towards, PCT 1691.	Minimum measurements for the height, cover and abundance of a representative number of taxa from each relevant strata will be set, in comparison to recognised, published documentation of the typical and acceptable ranges of cover, abundance and height measurements at different stages of restoration, in consultation with OEH.
Objective 4: Levels of <u>ecosystem function</u> have been established that demonstrate the rehabilitation is self-sustainable	
Growing media status is “suitable” 1 for PCT 1691 establishment, and indicators of nutrient cycling are “suitable” for sustaining the PCT 1691.	Suitable measures of growing media status will be set, in comparison to recognised, published documentation of the typical and acceptable attributes at different stages of restoration, in consultation with OEH.
Plant recruitment is “suitable” 1 for sustaining PCT 1691.	Plant recruitment is consistent with control sites.
Plant competition is “suitable” 1 for sustaining PCT 1691.	The exotic plant cover will be <45%. Exotic plant cover must be calculated as a percentage of the total ground and mid-storey cover. Exotic plant cover is measured as total per cent foliage cover of all exotics in all strata.
Plant health is “suitable” 1 for sustaining PCT 1691.	Foliage loss from insect attack or stress and foliage health and/or disease (e.g. myrtle rust) consistent with control sites.
Animal biodiversity (habitat) is “characteristic of” 1 PCT 1691.	Fauna vertebrate and invertebrate species consistent with control sites.
Threats to rehabilitation.	Vertebrate pest species presence and damage consistent with control sites.
Resilience to drought and fire.	Resilience to drought and fire consistent with control sites.

1 = Final completion criteria will be developed in consultation with industry. Through consultation, the terms “characteristic of” and “suitable” will be developed into SMART completion criteria (OEH 2015d).

13.4.3 Ecological Rehabilitation Biodiversity Credits

Ecosystem credits have been calculated for the target PCT in order for ecological rehabilitation to contribute 25 per cent of the overall credit requirement to offset the Project available through the UHSA based on commitments made by OEH. The 25 per cent threshold under the UHSA has been determined by OEH as it is considered that at a regional scale, the appropriate credit load required to offset Hunter Valley floor vegetation communities, particularly those listed under the TSC Act and EPBC Act, are unobtainable in any practical sense. The number of ecosystem credits generated by the proposed ecological rehabilitation is a function of the predicted improvement in vegetation condition at the site (site value) and the improvement in connectivity across the site (landscape value). The methodology and outcomes of the ecosystem credit calculations are provided below, in accordance with the requirements of the Ecological Rehabilitation Guidelines (OEH 2015d).

13.4.3.1 Site Value

The number of credits generated by the site value of the proposed ecological rehabilitation has been calculated in accordance with Figure 2 of the Ecological Rehabilitation Guideline and using the spreadsheet calculator from Section 12.2 of the Framework for Biodiversity Assessment (FBA). The spreadsheet calculator requires the predicted increase in each of the 10 site attribute scores (refer to **Table 12.2** above) and the total area of mine site rehabilitation being used to generate credits.

In order to demonstrate that the completion criteria relating to Objective 1 of the ecological rehabilitation have been met, the maximum increases in site attribute scores identified above in **Table 13.12** need to be achieved in the areas of ecological rehabilitation. United is committed to managing the ecological rehabilitation in a manner that facilitates the improvement of the site so that the relevant site attribute scores increase appropriately and the objectives and completion criteria can be met.

The total number of site value credits calculated by the spreadsheet calculator for the 878 hectares of ecological rehabilitation for the Project, using the maximum allowable increases in site values described in **Table 13.12** is **4,228 credits**.

13.4.3.2 Landscape Value

In accordance with the methodology provided in Section 4.1.2 of the Ecological Rehabilitation Guidelines (OEH 2015d), the total area of the 'ecological rehabilitation and surrounds patch' is 878 hectares and Table 4 of the Ecological Rehabilitation Guidelines assigns 0.6 credits per hectare for patches from 500 hectares to 1,000 hectares in size.

The total number of landscape value credits calculated using Method 2 of the Ecological Rehabilitation Guidelines, is 878 hectares multiplied by 0.6 credits per hectare, which equals **527 credits**.

13.4.3.3 Project Credit Requirement that will be met by Ecological Rehabilitation

Additional areas of up to 1000 hectares of mine site rehabilitation will be created for the Project, however as a supplementary measure, ecological rehabilitation can only contribute up to 25 per cent of the projects total biodiversity offset requirement. The total number of credits required for the Project is 19,020 (refer to **Section 12**). The maximum value mine site rehabilitation can contribute is $19,020 \times 25 \text{ per cent} = 4,755$ credits.

The total number of credit requirements to be retired by ecological rehabilitation is:

- $4,228 \text{ (site value credits)} + 527 \text{ (landscape value credits)} = \mathbf{4,755 \text{ rehabilitation credits}}$.

13.4.4 Justification of Feasibility and Achievability of Ecological Rehabilitation

Glencore is committed to the continual improvement of native ecosystem establishment in mine rehabilitation across all of its mine sites and believes that mine rehabilitation plays an important role in mitigating and offsetting impacts on biodiversity. To this end, Glencore has been a very active participant in contributing to developing the Ecological Rehabilitation Guidelines as part of the UHSA (OEH 2015d). Glencore has had considerable success in establishing high quality mine rehabilitation in the Hunter Valley.

Vegetation community survey and assessment of the Project Area included assessment of both the relevant Wambo and United rehabilitation areas. Zone 3 – HU816 – Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good Condition – Plantation mapped within the Project Area (refer to **Figure 3.1**) is consistent with the Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregion EEC (TSC Act). The vegetation zone mapped within the Project Area occurs on previously mined land and is the result of revegetation efforts.

This vegetation zone complies with the Final Determination of Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregion EEC (NSW Scientific Committee 2011e) with regard to the following species specific attributes:

- this EEC is characterised by a canopy dominated by four key eucalypt species, namely spotted gum (*Corymbia maculata*), broad-leaved ironbark (*Eucalyptus fibrosa*), grey gum (*Eucalyptus punctata*) and narrow-leaved ironbark (*Eucalyptus crebra*). The canopy layer of this community was dominated by spotted gum (*Corymbia maculata*) and hickory wattle (*Acacia implexa*), with some occurrences of sugar gum (*Eucalyptus cladocalyx*)
- this vegetation zone supports a reasonable proportion of species that are in the list of characteristic species for the EEC
 - o 15 out of 44 (34 per cent) native species recorded in this unit are characteristic species in the EEC listing
 - o 15 out of 44 (34 per cent) species in the characteristic species list for the EEC were recorded in this unit. However of the 15 species recorded from the characteristic species list, only one species was a mid-storey or shrub species, the remaining species being either a canopy or ground layer species.
- Natural recruitment of the canopy, midstorey and ground cover layers was occurring.

A total of 1041 ecosystem credits are required to offset the impacts of clearing 29.42 hectares of mine rehabilitation within the Project Area. The vegetation community survey and assessment demonstrates that suitable quality ecological rehabilitation can be established on mined land at United and that ecological rehabilitation can contribute feasible and achievable biodiversity offset outcomes as part of a wider biodiversity offset strategy.

Successful mine ecological rehabilitation has also been undertaken at Glencore's Mt Owen mine site since the mid 1990s. Glencore's Mount Owen operation has worked closely with researchers from the University Of Newcastle since 1995 with the initial goal of the Mount Owen mine research program to re-establish sustainable nutrient acquisition and cycling using natural root-microbe associations. This project soon expanded to include research into the use of available bulk materials and amelioration techniques for mine rehabilitation when forest topsoil would eventually run out. The rehabilitation strategy at Mount Owen has also benefited from the results of research such as a doctorate project through the University of Queensland titled 'Enhancing Eucalypt Forest Re- establishment on Coal Mined Land at Mount Owen'.

Glencore has also participated in several Australian Coal Association Research Program (ACARP) projects on mine site rehabilitation. In collaboration with the University of Newcastle, Glencore has supported a research program that will lead to the most effective methods to establish dry sclerophyll and other native forest communities on rehabilitated overburden dumps. The report *Establishing Native Vegetation – Principles and Interim Guidelines for Spoil Placement Areas and Restoration Lands* (Nussbaumer *et al.* 2012) summarises the outcomes of the University of Newcastle research programs and provides guidance for the ongoing development of ecological rehabilitation on each of Glencore’s Hunter Valley operations.

Mount Owen mine rehabilitation is now listed as a ‘Highly Commended’ site on the Global Restoration Network of the Society for Ecosystem Restoration, International. The key learnings from the research undertaken at Mount Owen has been shared across the range of Glencore sites in the Hunter Valley and elsewhere, in order to improve the biodiversity outcomes of rehabilitation.

In order to demonstrate the biodiversity value of mine rehabilitation, Glencore commissioned an assessment of the ecological outcomes of mine rehabilitation, regeneration and revegetation at Mount Owen mine (Umwelt 2013) to determine the biodiversity value of existing mine rehabilitation and offset site regeneration. The assessment of the biodiversity values of rehabilitated formerly mined land demonstrates that rehabilitated land can create quality vegetation communities and fauna habitats that include threatened fauna species and vegetation that conforms to EEC final determinations. Glencore has established a strong feedback loop that enables the results of annual rehabilitation monitoring to be considered in the ongoing development of rehabilitation techniques.

Glencore has demonstrated that it is both feasible and achievable to create successful ecological rehabilitation that comprises recognisable vegetation communities and important fauna habitats, including for state and Commonwealth listed threatened fauna species. The lessons learned from the United and Mt Owen mine rehabilitation areas (and other Glencore mine sites) will be built into the rehabilitation strategy for the Project to ensure Glencore achieves the overall objective of ecological rehabilitation, that is, the creation of recognisable and self-sustaining PCTs.

13.5 Summary of Biodiversity Offset Strategy

United is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project.

As described above, the offset strategy will be implemented following the process outlined in the UHSA and the final composition of the offset strategy may evolve as the Project progresses. It is currently proposed that the biodiversity offset strategy will consist of the following:

- Establishment of proponent-managed offset sites, including:
 - o Highfields Offset Site
 - o Mangrove Offset Site
 - o Wambo Offset Site.
- Mine site ecological rehabilitation contributing up to 25 per cent of biodiversity offset requirement for PCT 1691 / BVT HU905 - Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter which is consistent with *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* listed under the TSC Act and *Central Hunter Valley Eucalypt Forest and Woodland CEEC* listed under the EPBC Act.

- Payments into the Upper Hunter Biodiversity Offsets Scheme fund and/or establishment of further offset sites for the residual credits that need to be retired.

The three proposed land offsets and ecological rehabilitation generate a total of 22,209 ecosystem and species credits. As outlined in **Section 12**, the Project requires 18,678 credits (ecosystem and species credits), however, as discussed below, not all of the credits generated by the offset site are relevant to the credit needs of the Project following the UHSA offsetting rules.

As noted above, the retirement of credits will be staged as the Project Area is progressively cleared and United may identify further offset sites that will contribute to the meet the biodiversity offset requirements of the Project. It is proposed that the biodiversity offset strategy for the Project is formalised through development consent conditions as per the process outlined in the UHSA Interim Policy (DP&I 2012).

United has developed an offset package that has significant benefits in regard to the strategic location of the proposed offset properties. The offset strategy provides offset sites in proximity to key landscape-scale features such as adjoining vegetation remnants, National Parks, Crown land, the Great Eastern Ranges Initiative, UHSA priority offset areas and other existing Glencore offset areas which provides interconnecting high quality habitats with conservation areas and strategic corridor areas.

Under the UHSA, strategic offsetting areas have been identified as areas having high habitat and connectivity values and the most contribution to long term biodiversity values in the region.

Table 13.13 outlines the key potential offsetting outcomes to be derived through the protection and management of the offset properties outlined in this report and the proposed ecological rehabilitation.

Table 13.13 Summary of Key Potential Offsetting Outcomes

Additional Disturbance Area			Offset Area Protection			Notes
Attribute	Hectares	Credits	Attribute	Hectares	Credits	
Critically Endangered Ecological Communities under the EPBC Act						
Central Hunter Valley Eucalypt Forest and Woodland CEEC	223.5	8,403	Central Hunter Valley Eucalypt Forest and Woodland CEEC	56.0	648	Total EPBC Act CEEC credits in the offset strategy equals 8,976 ecosystem credits.
			Central Hunter Valley Eucalypt Forest and Woodland CEEC (mine rehabilitation)	878	4,755	
			White Box Yellow Box Blakely’s Red Gum Grassy Woodland and Derived Native Grassland CEEC	312.9	3,573	

Additional Disturbance Area			Offset Area Protection			Notes
Attribute	Hectares	Credits	Attribute	Hectares	Credits	
Vegetation Classes						
Coastal Floodplain Wetlands	0.29	14	Coastal Floodplain Wetlands	100.9	1438	
Coastal Swamp Wetlands	31.6	1248	Coastal Swamp Wetlands	0	0	
Eastern Riverine Forests	0	0	Eastern Riverine Forests	6	109	
Hunter-Macleay Dry Sclerophyll Forests	29.4	1041	Hunter-Macleay Dry Sclerophyll Forests	0	0	
Western Slopes Dry Sclerophyll Forests	1.56	59	Western Slopes Dry Sclerophyll Forests	126.4	1730	
North-west Slopes Dry Sclerophyll Woodlands	0	0	North-west Slopes Dry Sclerophyll Woodlands	83.5	902	
Coastal Valley Grassy Woodlands	503.1	15,754	Coastal Valley Grassy Woodlands	1301.2	10,079	Includes 878 hectares and 4755 credits of mine rehabilitation for offsetting.
Western Slopes Grassy Woodlands	0	0	Western Slopes Grassy Woodlands	2	21	
Species-credit Species						
pine donkey orchid (<i>Diuris tricolor</i>)	0	0	pine donkey orchid (<i>Diuris tricolor</i>)	1,141 individuals	7,909	
southern myotis (<i>Myotis macropus</i>)	7.3	562	southern myotis (<i>Myotis macropus</i>)	3.0	21	

As discussed in **Section 13.1** OEH provided revised draft offset rules on 26 April 2016. These rules indicate how credits required for each PCT or species can be offset, initially following a “like-for-like” approach but then, in accordance with OEH requirements, following a set of “variation rules”. **Table 13.14** shows the outcome of the application of the rules. In accordance with the guidance in the updated UHSA offsetting rules, United first sought to offset credits like-for-like and then apply the variation rules as appropriate.

Table 13.14 Final Offset Credit Outcome based on Draft UHSA Offsetting Rules

Impacted Biometric Vegetation Type (BVT)	Credits Required (Impact)	Credits Available (Offset)	Credit Allocation Meets Requirements	Further Information
HU812 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	14	14	✓	14 credits of HU812 at Mangrove Offset Site (like-for-like rules – same PCT).
HU816 - Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	999	0	-999	No offsetting credits available using the updated UHSA offsetting rules.
HU869 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	16	16	✓	16 credits of HU821 at Highfields Offset Site (variation rules - same formation where the per cent cleared is greater or equal to HU869).
HU905 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	2859	1732	-1127	1732 credits of HU905 at Mangrove Offset Site (like-for-like rules – same PCT).

Impacted Biometric Vegetation Type (BVT)	Credits Required (Impact)	Credits Available (Offset)	Credit Allocation Meets Requirements	Further Information
HU906 - Bull Oak grassy woodland of the central Hunter Valley	4577	3447	-1130	62 credits of HU701 at Highfields Offset Site (like-for-like rules – same vegetation class with per cent cleared equal or greater than HU906). 3364 credits of HU730 at Highfields Offset Site (like-for-like rules – same vegetation class with per cent cleared equal or greater than HU906). 21 credits of HU714 at Highfields Offset Site (variation rules - same formation where the per cent cleared is greater or equal to HU906).
HU945 - Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	1248	1248	✓	1248 credits of HU812 at Mangrove Offset Site (variation rules - same formation where the per cent cleared is greater or equal to HU945^).

Impacted Biometric Vegetation Type (BVT)	Credits Required (Impact)	Credits Available (Offset)	Credit Allocation Meets Requirements	Further Information
Central Hunter Valley Eucalypt Forest and Woodland CEEC (comprising portions of HU816, HU869, HU905 and HU906)	8403	5403	-3000	166 credits of HU817 at Wambo Offset Site (like-for-like – conforming CEEC under the EPBC Act). 482 credits of HU869 at Wambo Offset Site (like-for-like – conforming CEEC under the EPBC Act). 4755 credits of mine rehabilitation to restore HU905 (like-for-like – conforming CEEC under the EPBC Act).
Total Ecosystem Credits			-6256	
southern myotis (<i>Myotis macropus</i>)	562	21	-541	21 credits of potential southern myotis roosting habitat at Mangrove Offset Site.
Total Species Credits			-541	

^ VIS database quotes 0% cleared for HU812 across the Hunter/Central Rivers CMA. This is likely due to an error/omission of data in the database. Known per cent cleared for HU812 is quoted as around 98% in Peake (2006) and over 90% in the NSW Scientific Committee's Final Determination for Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (NSWSC 2011c).

United propose that the balance of credits required for the Project will be sourced from either additional offset sites or via payment into the Upper Hunter Biodiversity Offsets Scheme. Ongoing consultation will occur with OEH and DPE regarding the implementation of the offset strategy for the Project.

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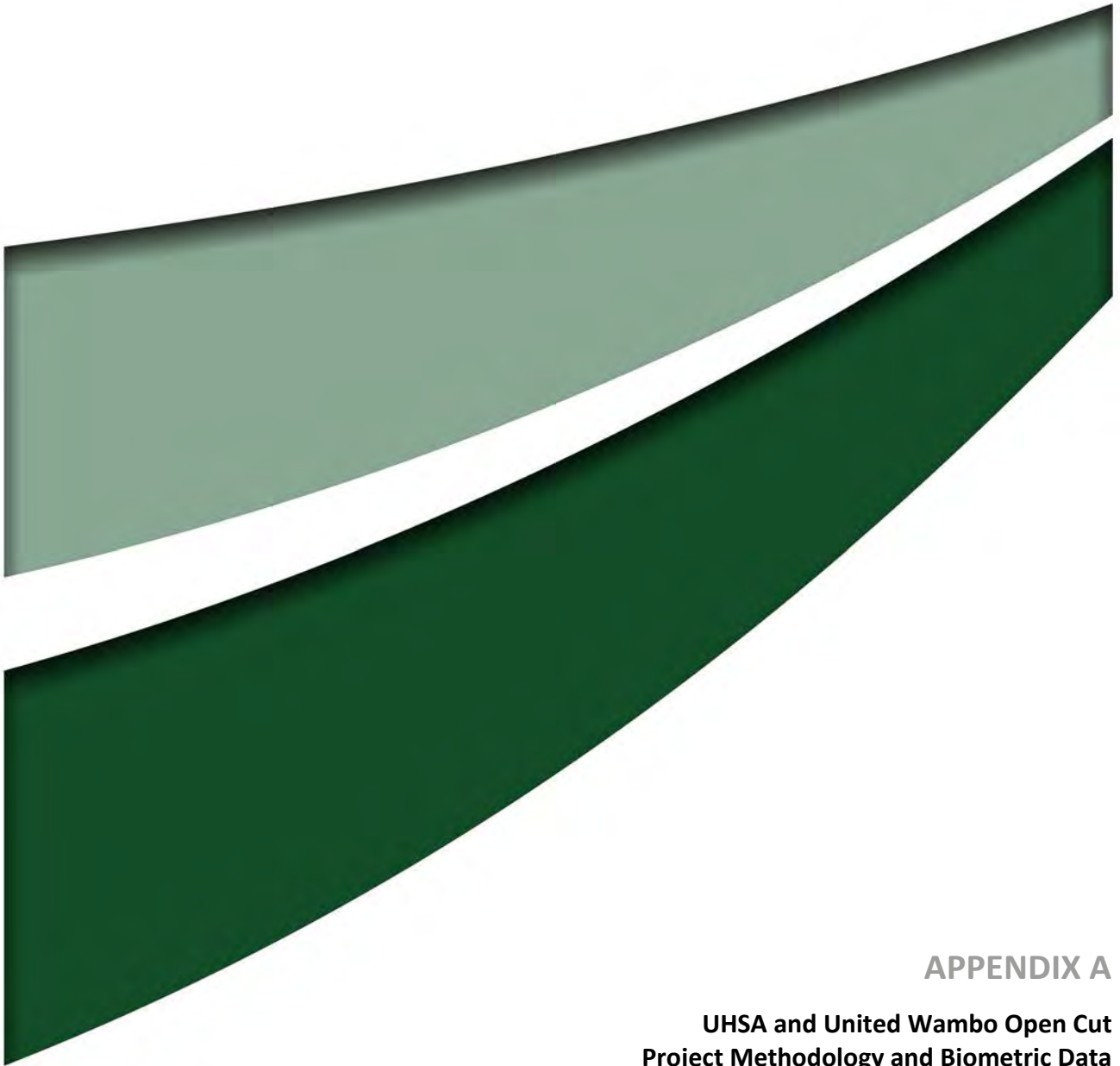
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APPENDIX A

**UHSA and United Wambo Open Cut
Project Methodology and Biometric Data**

1.0 UHSA and United Wambo Open Cut Project Methodology and Biometric Data

This section outlines the methods undertaken as part of the United Collieries UHSA (Umwelt 2015) and the United Wambo Open Cut Coal Mine Project. Broadly, this section has been modified from Section 2.0 of the United Collieries UHSA report (Umwelt 2015) to be relevant for the additional survey and assessment requirements for the Project as outlined in Section 5.0 of the Statement of Consistency Report. The United Collieries UHSA was submitted to OEH in September 2015 and the methods and results accepted as suitable by OEH on 25 September 2015.

1.1 Vegetation Zone Assessment

A vegetation zone is a relatively homogenous area in a biodiversity certification assessment area consisting of a single vegetation type in the same broad condition state. A single zone must not contain a mix of vegetation in low condition and vegetation not in low condition. A zone may comprise one or more discontinuous areas.

1.1.1 Literature Review

Relevant literature was reviewed prior to vegetation survey and mapping in order to gain an understanding of the existing vegetation patterns present in the project area and surrounding areas. Previous studies which were reviewed included:

- The Vegetation of the Central Hunter Valley, NSW (Peake 2006),
- Greater Hunter Native Vegetation Mapping (Sivertsen *et al.* 2011), and
- Draft United Project Preliminary Environmental Assessment (Umwelt 2010).

1.1.2 Systematic Plot/Transect Survey

A total of 49 plots were undertaken across the United UHSA project area during the survey, as shown on **Figure A1**. These surveys were undertaken during ten separate field trips, undertaken over the following periods:

- 11 to 12 February, 24 April and 5 May 2009 (Umwelt 2010),
- 26 to 28 February, 18 to 20 March, 23 to 24 September and 9 to 10 October 2013,
- 5 to 7 March 2014,
- 27 May 2015,
- 9 to 10 July 2015, and
- 14 April 2016 (non-UHSA disturbance area).

Biometric data was not collected during the 2009 surveys. The 2009 sites were revisited during the 2013 field surveys to validate the flora plot data as well as to collect Biometric data. New transect/plot sites were established during October 2013, March 2014 and May 2015 surveys. Floristic and Biometric data were collected at each of these sites.

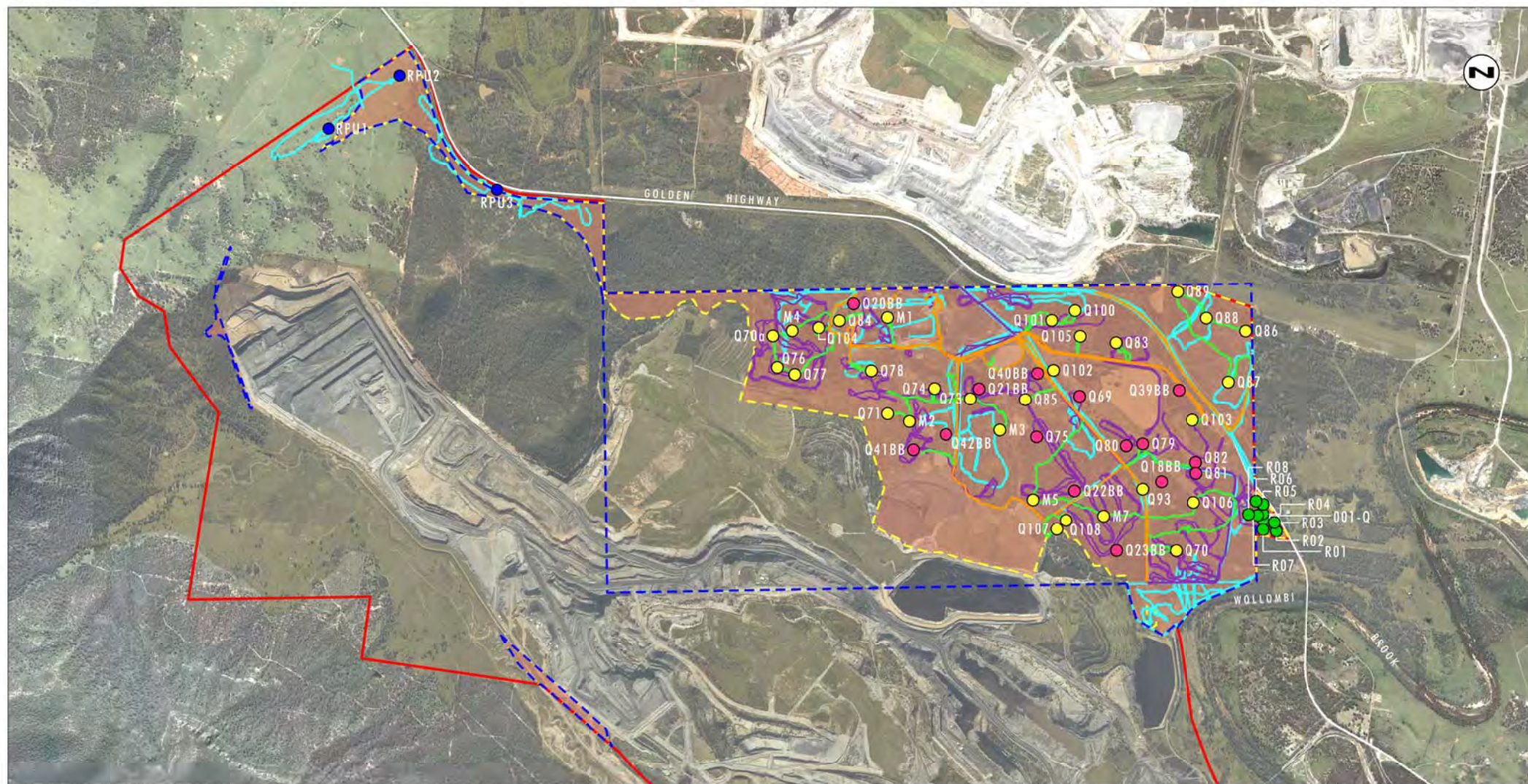


Image Source: AAM (2012), United (2015)
Data Source: Glencore (2014)

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Legend

- Project Area
- Conceptual Additional Disturbance Area
- UHSA Project Area
- Driving Transects
- Meandering Transects (September 2013)
- Meandering Transects (March 2014)
- Meandering Transects (2015)
- 2013 Flora Plots/Transects
- 2014 Flora Plots/Transects
- 2015 Flora Plots/Transects
- 2016 Flora Plots/Rapids

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FIGURE A1

Flora Survey Effort

The non-UHSA disturbance area was traversed on foot by an Umwelt ecologist on 14 April 2016. In order to confirm the vegetation type present a total of eight semi-quantitative rapid vegetation assessments and one 20 x 20 metre floristic plot were sampled.

It should be noted that in addition to the plot/transect data collected from the project area, plot/transect data from the same Biometric vegetation types (BVTs) in the same broad condition states collected from the other three Glencore UHSA sites (Mangoola, Bulga and Greater Ravensworth) were also used in this assessment. Effectively all the Glencore UHSA sites were treated as one large site and applicable plot/transect data was shared across all four sites to provide more accurate site attribute scores for the Biometric Vegetation Types (BVTs) sampled. See **Appendix 1** for further explanation of the 'all sites as one' approach taken to the collection of Biometric site attribute data.

At each plot/transect data were recorded according to Appendix 2 of the BioBanking Assessment Methodology (BBAM) and Credit Calculator Operational Manual (DECC 2009). This involved setting out nested 20 x 50 metre and 20 x 20 metre plots, and a 50 metre transect.

Each plot was positioned at a standardised bearing (north/south and east/west, with the longer side running north/south) and the location marked from the north-east corner with a handheld GPS.

Ten condition attributes were recorded and comprised:

- indigenous plant species richness
- native overstorey foliage cover
- native midstorey foliage cover
- native ground (grasses) foliage cover
- native ground (shrubs) foliage cover
- native ground (other) foliage cover
- exotic plant cover
- number of trees with hollows
- regeneration and
- total length of fallen timber.

At each plot/transect, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 metre plot. Searches of each 20 x 20 metre 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.

In addition to the data collected for each of the ten condition attributes, species within the plot were also assigned a cover-abundance value to reflect their relative cover and abundance in the plot. Species located outside the plot (recorded to assist in vegetation community identifications and mapping) were marked as present but were not assigned a cover-abundance value. A modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with selected modifications sourced from Poore 1955 and Austin *et al.* 2000) was used to estimate cover-abundances of all plant species within each 20 x 20 metre plot. **Table A.1** shows the cover-abundance categories used.

Table A.1 – Modified Braun-Blanquet Crown Cover-abundance Scale

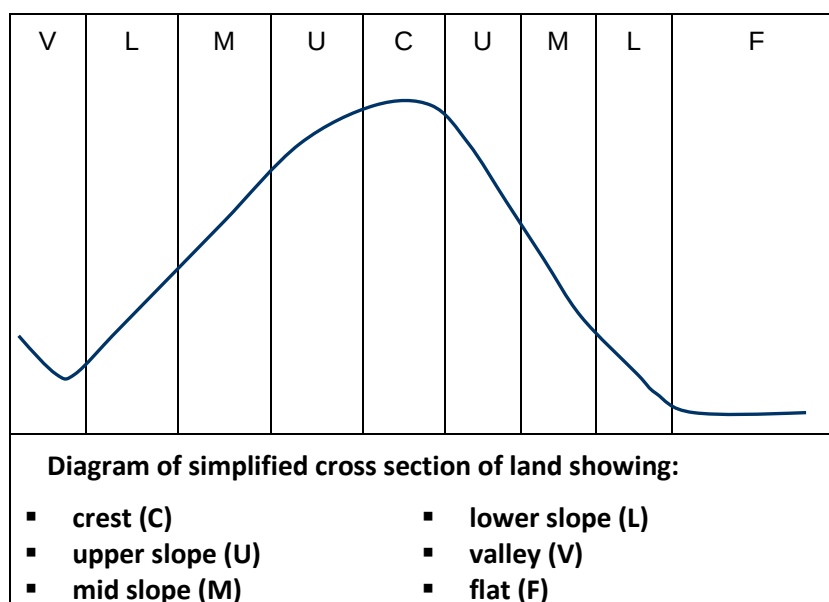
Class	Cover-abundance*	Notes
1	Few individuals (less than 5 per cent cover)	Herbs, sedges and grasses: <5 individuals Shrubs and small trees: <5 individuals
2	Many individuals (less than 5 per cent cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20 per cent cover	–
4	20 – less than 50 per cent cover	–
5	50 – less than 75 per cent cover	–
6	75 – 100 per cent cover	–

Note: * Modified Braun-Blanquet scale (Poore 1955; Austin *et al.* 2000)

All flora species that were readily identified in the field were recorded on pro forma field survey datasheets. All flora species that could not be immediately identified, and samples of all threatened flora species, were collected, dried and identified or sent to the National Herbarium of NSW for identification.

In addition, information was gathered on the condition of the vegetation at each of the survey sites, including fire history and the density of weeds and evidence of disturbance such as feral animals.

Plot/transect sites were selected by considering a range of attributes that were considered to influence or determine the type of vegetation communities present. This stratification was done intuitively, but based on existing topographic, soil, vegetation (as mapped by Peake 2006, Umwelt 2010, Sivertsen *et al.* 2011, Umwelt in prep.) and geological mapping (Mineral Resources NSW 2003). Other factors considered included the spacing of sites across the project area, as well as topographic position (see **Schematic A.1** below) and aspect.



Schematic A.1 – Topographic Positions

Data on topography, soil type and geology were sourced from existing maps. Not all stratification was done *a priori*, as the selection of survey sites in the field was undertaken to ensure that obvious variability in aspect, slope, elevation and micro-terrain was sampled.

Photographic records were taken at each plot from the north-east corner looking along the short side of the plot, diagonally along the plot and then along the long side of the plot.

1.1.3 Qualitative Rapid Assessments

Qualitative rapid assessments were also completed during the 2015 surveys to assist with mapping areas added to the project area after the majority of the project area had been mapped. Each comprised the recording of the dominant canopy and understorey species. The qualitative rapid assessments utilised a qualitative sampling approach, as this method was designed to allow rapid collection of non-quantitative species dominance data across the project area within limited timeframes. The data from the qualitative rapid assessments was primarily used to provide assistance in the delineation and refinement of vegetation mapping.

1.1.4 Meandering Transects

Meandering transects were walked through vegetation units across much of the project area (refer to **Figure A1**). Opportunistic sampling of vegetation was undertaken along these transects, particularly searches for threatened and otherwise significant species, endangered populations and threatened ecological communities (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 targeted specific vegetation units and provided information on spatial patterns of vegetation that fed into vegetation community mapping of the Project Area.

1.1.5 Definition of Ecological Condition

Each of the identified vegetation types recorded in the project area were assigned a broad condition state based on the condition criteria specified in the BCAM (DECCW 2011) and Draft Biodiversity Certification Operation Manual (OEH 2013b). Broad condition states include vegetation in 'moderate to good condition' or 'low condition'. Any vegetation which does not meet the definition of low condition according to Box 1 in the BCAM (DECCW 2011) is considered to be in moderate to good condition. In addition, broad condition states, typically moderate to good condition zones, were further split to reflect the range of variation that sometimes occurred in the broad condition states. For example, areas of woodland vegetation which were regenerating were separated from more mature areas, even though both areas of vegetation met the broad condition class of moderate to good. In this example the regenerating component of the vegetation types is identified as 'moderate to good –regenerating' and the mature component is identified as 'moderate to good – good'.

1.1.6 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within plots and along transects 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 2014), the online plant name database maintained by the National Herbarium of NSW.

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. Where the identity of a specimen was unknown or uncertain, it was sent to the National Herbarium of NSW at the Royal Botanic Gardens Sydney for expert identification.

1.1.7 Vegetation Mapping

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

- review of existing vegetation mapping (Peake 2006, Sivertsen *et al.* 2011, Umwelt 2010) within and surrounding the Project Area
- ground-truthing of existing vegetation maps based on plot and transect survey results
- API on the basis of colour, texture, location in the landscape, soil and vegetation structure (dominant growth form, canopy density and height) and
- revision of vegetation community floristic delineations based on review of plot data.

Vegetation communities in the project area were initially mapped on-screen overlaying a March 2012 high resolution aerial photograph provided by Glencore. Additional areas added to the project area were mapped using a more current 2014 high resolution aerial photograph provided by Glencore. Mapping was done 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 hectare, however mapping was completed at a finer scale in order to map the small stands of weeping myall woodland and narrow bands of disturbed land along access tracks and haul roads.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Communities were then compared to those vegetation communities identified in the *Vegetation of the Central Hunter Valley* (Peake 2006), the *Greater Hunter Native Vegetation Mapping – Geodatabase Guide* (Version 4.0) (Sivertsen *et al.* 2011) and BVT descriptions from the Vegetation Information System (VIS) Classification exported from the online OEH website (OEH 2013e).

The vegetation community profiles provided in Peake (2006), Sivertsen *et al.* (2011) and OEH (2013e) were interrogated to identify communities that contained similar species and structural compositions to ensure that, where possible, the communities identified in the project area were aligned with similar communities/BVTs known to occur in the region.

1.1.8 Adequacy of Flora Field Survey Effort According to the BCAM

The BCAM (DECCW 2011) and Draft Biodiversity Certification Operation Manual (OEH 2013b) predefines the survey effort required for each Biometric vegetation type based on a sliding scale of the number of plots per hectare, as shown in **Table A.2**.

Table A.2 – Minimum Number of Transects/Plots Required per Vegetation Zone Area

Vegetation Zone Area (ha)	Minimum Number of Plots/Transects
0 – 10	1 transect/plot
> 10 – 25	2 transects/plots
> 25 – 50	3 transects/plots or 2 transects/plots if vegetation is in low condition
> 50 – 100	4 transects/plots or 3 transects/plots if vegetation is in low condition
> 100 – 250	5 transects/plots or 4 transects/plots if vegetation is in low condition
> 250 – 1000	6 transects/plots or 5 transects/plots if vegetation is in low condition
>1000 ¹	add 1 additional plot for each 1000 hectares or part thereof. Add the additional plot(s) to both mod-good and low condition zones.

1 = as detailed in an email from OEH on 8 February 2013 in response to Umwelt's identification of poorly defined survey effort requirements above 1000 hectares in the Biodiversity Certification Assessment Methodology.

Table A.3 identifies the adequacy of the plot/transect survey with respect to the BCAM (DECCW 2011) and Draft Biodiversity Certification Operation Manual (OEH 2013b). For each vegetation zone the minimum survey effort was achieved and/or exceeded, except for HU652 - Moderate to Good Condition Weeping Myall - Coobah - Scrub Wilga Shrubland of the Hunter Valley, HU816 – Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good Condition – Plantation/Rehabilitation Condition and HU905 – Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition Regeneration. The additional plot requirements of these three vegetation zones were met using plots completed across the remaining three Glencore UHSA sites (Greater Ravensworth, Mangoola and Bulga). This approach was accepted by OEH.

Table A.3 – Adequacy of Vegetation Survey

Veg. Zone No.	Vegetation Zone	Area Within the UHSA Project Area (ha)*	Area of Impact for United Wambo Project (ha)	No. of Plots Required for United Wambo Project	No. Plots Completed at United Wambo Project	Plots Completed Across all Sites¹	Plot Requirements Met?
1	HU652 - Moderate to Good Condition Weeping Myall - Coobah - Scrub Wilga Shrubland of the Hunter Valley	0.10	0	0	0	3	Yes
2	HU812 – Moderate to Good Condition Forest Red Gum grassy open forest on floodplains of the lower Hunter	0.29	0.29	1	1	8	Yes
3	HU816 – Moderate to Good Condition – Plantation Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	37	29.42	3	2	4	Yes
4	HU869 – Moderate to Good Condition Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	1.6	1.56	1	2	9	Yes
5	HU905 – Moderate to Good Condition Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	185	175.06	5	10	30	Yes
6	HU905 - Moderate to Good Condition - Thinned Canopy	0.08	0.08	1	1	3	Yes
7	HU905 – Moderate to Good Condition – Regeneration	27	26.77	3	2	6	Yes
8	HU905 – Moderate to Good Condition – Cooba Open Shrubland	101	80.89	4	8	9	Yes

Veg. Zone No.	Vegetation Zone	Area Within the UHSA Project Area (ha)*	Area of Impact for United Wambo Project (ha)	No. of Plots Required for United Wambo Project	No. Plots Completed at United Wambo Project	Plots Completed Across all Sites ¹	Plot Requirements Met?
9	HU905 – Low Condition – Derived Native Grassland	105	101.69	4	7	18	Yes
10	HU906 – Moderate to Good Condition Bull Oak grassy woodland of the central Hunter Valley	122	118.62	5	10	16	Yes
11	HU945 – Moderate to Good Condition Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	32	31.61	3	6	11	Yes
12	Cleared Land (including disturbed land, mixed species revegetation plantation and water bodies)	476	147.97	N/A	N/A	N/A	N/A
	TOTAL	1,087	713.96	30	49	117	

1..Greater Ravensworth, Mangoola and Bulga UHSA sites.

In some cases additional plots, above the number required for the site or for all four Glencore UHSA sites, were undertaken to assist in the delineation and refinement of vegetation community mapping, or to sample variation within the communities. Additionally the determination of the number of plots required was a continual process, with the final number of plots required only determined once all field surveys, plant identifications and vegetation zone mapping was completed.

During field surveys any changes to vegetation zones resulted in the need to estimate the subsequent changes in vegetation zone areas and the resulting change in the required plot numbers. As a result some additional plots were completed for some vegetation communities. Similarly, any refinement of vegetation zones after field surveys that reduced the size of a vegetation community may have resulted in less than the required number of plots being completed. Where less than the required number of plots were completed, plots for other Glencore sites that were representative of the vegetation community were used.

1.1.9 Vegetation Zone Biases and Limitations

The allocation of derived native grasslands across the Project Area to a former 'parent' community (and subsequent BVT) was limited by the presence of a suitable density of remnant scattered canopy trees, by the distance to surrounding remnant patches of woodland and forest communities as well as the dominance of remnant patches in similar positions in the landscape. The mapping of derived native grassland communities was based on the location of remnant trees, as well as taking into consideration landscape position, geomorphology and topography.

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. In this case specimens were forwarded to the National Herbarium of NSW if they were considered to be of potential significance or importance.

Seasonal and recent weather conditions were generally moderate for the detection and identification of the above flora families during the September 2013 and March 2014 field surveys. The months leading up to the September 2013 spring surveys experienced above average rainfall during June 2013, well below average rainfall during July and August 2013, and about average rainfall during September 2013. For the March 2014 surveys, well above average rainfall occurred during March 2014, however below average rainfall was recorded in January 2014 and February 2014 (Bureau of Meteorology 2014 – Bulga (South Wambo) weather station).

1.1.10 Determination of Threatened Ecological Communities

Vegetation communities identified in the Project Area were compared to TECs listed under the TSC Act and EPBC Act. The assessment of similarity was made using the following approach:

- comparison with published TEC species lists, including lists of 'important species'
- comparison with TEC habitat descriptions and distributions
- assessment of relevant TEC guidelines published by the Commonwealth Department of the Environment and NSW OEH
- comparison with other assessments of TECs in the region and
- comparison with Final Determinations, guidelines, Listing Advice, recovery plans and conservation advice provided for each TEC, particularly those from the NSW Scientific Committee and the Commonwealth Threatened Species Scientific Committee.

1.1.10.1 Central Hunter Valley Eucalypt Forest and Woodland CEEC

Following the listing of Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered Ecological Community (CEEC) under the EPBC Act in May 2015, targeted surveys for the Central Hunter Valley CEEC were conducted across the additional disturbance area on 27 May, and 9 and 10 July 2015. The detailed vegetation map produced as part of the United UHSA report (Umwelt 2015) (mapped prior to the listing of the Central Hunter Valley CEEC) was used to identify areas of potential Central Hunter Valley CEEC occurrence. A field assessment proforma was developed to capture the key diagnostic features and condition thresholds at each of the sample points, in accordance with the matters prescribed in the Approved Conservation Advice (TSSC 2015). Candidate areas of Central Hunter Valley CEEC identified in the additional disturbance area were compared to the Approved Conservation Advice. The assessment of similarity with the listed community was made determining whether the community in question met:

- the *key diagnostic characteristics* (Section 1.5.1 of the Approved Conservation Advice)
- the minimum *condition thresholds* for moderate quality (Section 1.5.3 of the Approved Conservation Advice).

Known BVTs within the Project Area were also compared against the nine BVTs identified by OEH as corresponding to the Central Hunter Valley CEEC (OEH 2015a), being:

- HU618 Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion
- HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter
- HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter
- HU818 Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter
- HU819 Narrow-leaved Ironbark - Native Olive shrubby open forest of the central and upper Hunter
- HU869 Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin
- HU905 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- HU906 Bull Oak grassy woodland of the central Hunter Valley, and
- HU962 Grey Box grassy open forest of the Central and Lower Hunter Valley.

The non-UHSA disturbance area was traversed on foot by an Umwelt ecologist on 14 April 2016. In order to confirm the vegetation type present and the potential presence of the CEEC, a total of eight semi-quantitative rapid vegetation assessments and one 20 x 20 metre floristic plot were sampled.

1.2 Site Value

As discussed in **Section A.1.2**, a total of 49 plots/transects were completed across the United UHSA Project Area. The values for each of the site attributes were entered into the Biodiversity Certification Credit Calculator in order to determine site value scores.

1.3 Landscape Value

1.3.1 Percent Native Vegetation Cover

The size and configuration of the project area required a single 6000 hectare assessment circle to conduct the BCAM Landscape Value Assessment (refer to **Figure A2**). All native vegetation (excluding grasslands) was mapped in the assessment circle using the Manifold Geographic Information System (GIS) software package. A combination of aerial photographs flown during March 2012 and 2014 was used to digitise all native vegetation within the assessment circle.

1.3.2 Connectivity Value

To determine the connectivity value, the Project Area was assessed for the presence of state, regional or local biodiversity links as defined by the BCAM (DECCW 2011).

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 Director General or are a 40 metre buffer (on the coast and tablelands) either side of a major river as listed in the Major Rivers Database.

Regional biodiversity links are recognised as important links at a regional scale. Regional biodiversity links are identified in a plan approved by the Director General or are a 30 metre buffer (on the coast and tablelands) either side of a minor river or major creek as listed in the Major Rivers Database.

Local biodiversity links comprise:

- a corridor at least 30 metres wide, consisting of patches of native vegetation in moderate to good condition greater than 1 hectare in size and spaced not more than 30 metres apart, which connects two larger areas of native vegetation (each at least 30 hectares) in moderate to good condition; and/or
- a riparian buffer 20 metres either side of a minor creek (as defined by Appendix 1 of the BCAM) or 10 metres either side of a minor watercourse (as defined by Appendix 1 of the BCAM).

1.3.3 Adjacent Remnant Area

The adjacent remnant area is determined by calculating the area of native vegetation cleared in the Mitchell Landscape in which most of the land proposed for biodiversity certification occurs (within an assessment circle). The project area is entirely located in the Central Hunter foothills Mitchell Landscape (refer to **Figure 1.3**).

The assessment of adjacent remnant area has been based on the Central Hunter Foothills Mitchell Landscape, which occurs in the Hunter/Central Rivers CMA region and the Hunter CMA subregion (refer to **Figure 1.1**).

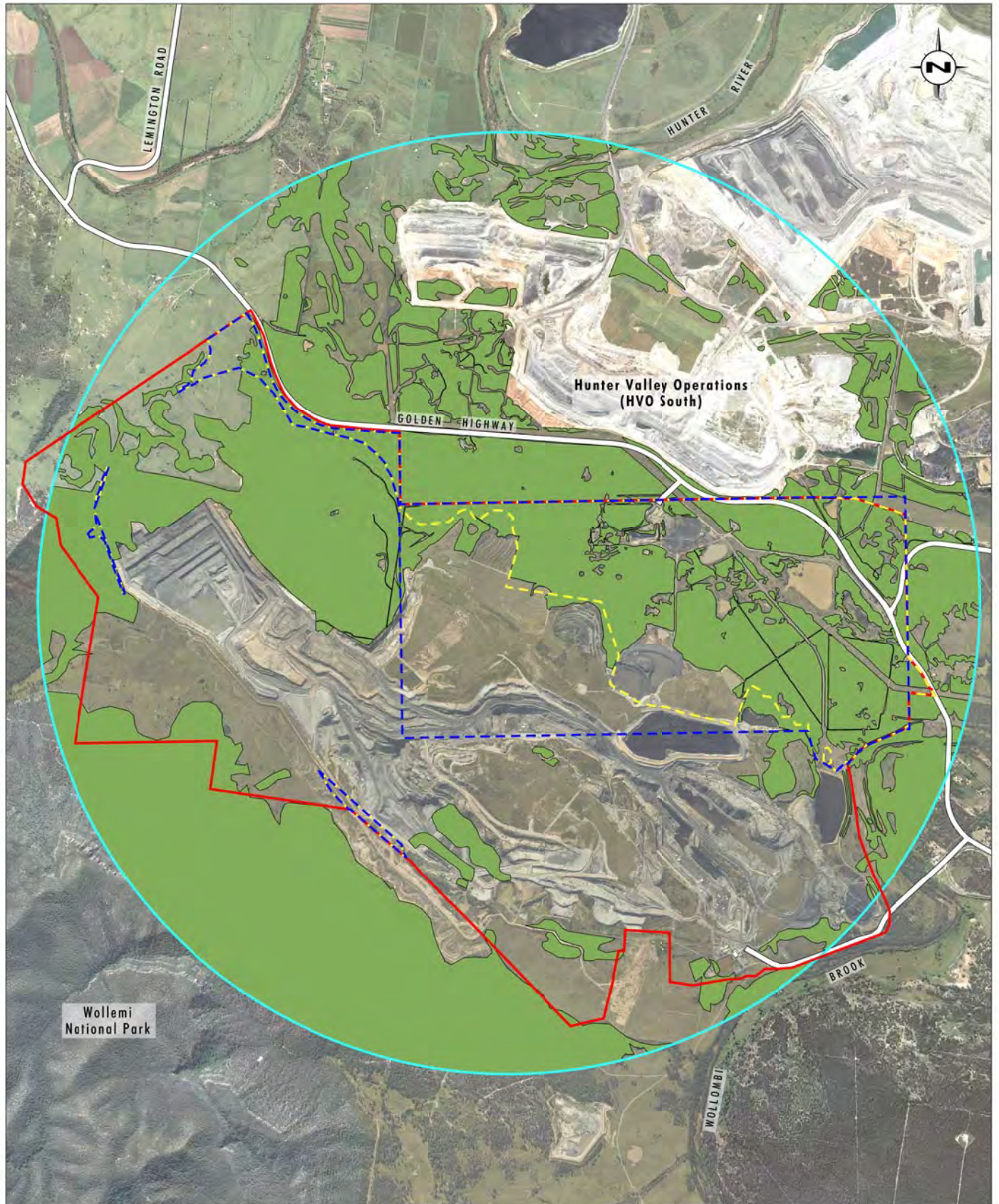


Image Source: AAM (2012), United (2015)
Data Source: Glencore (2014)

0 1.0 2.0 2.5 km
1:50 000

Legend

- Project Area
- Conceptual Additional Disturbance Area
- - - UHSA Project Area
- Native Vegetation
- 6000 ha Assessment Circle

FIGURE A2

Assessment Circle

1.3.4 Recalculation of Landscape Value to the Additional Disturbance Area

All components of the landscape value assessment remained the same for the additional disturbance area as they were for the UHSA area.

Given that the configuration and location of the additional disturbance area remained similar to the UHSA area, the same sized 6,000 hectare assessment circle was used. All native vegetation (excluding grasslands) was mapped in the assessment circle using the Manifold Geographic Information System (GIS) software package (refer to **Figure A2**). A combination of aerial photographs flown during March 2012 and 2014 were used to digitise all native vegetation within the assessment circle.

The connectivity value was assessed for state, regional or local biodiversity links as defined by the BCAM (DECCW 2011). The adjacent remnant area was determined according to the extent to which native vegetation has been cleared in the Mitchell Landscape in which most of the land proposed for biodiversity certification occurs (within an assessment circle). Mitchell Landscapes are areas supporting relatively homogenous geomorphology, soils and broad vegetation types mapped across NSW at a scale of 1:250,000.

1.3.5 Recalculation of Overstorey Regeneration Values

As part of the original UHSA assessment the overstorey regeneration values were calculated by dividing the number of regenerating overstorey species by the total number of overstorey species within each vegetation zone. The number of overstorey species regenerating was not limited to the floristic plots and accounted for regeneration outside of the plots and across the same vegetation zone. This approach was applied across all four Glencore UHSA sites collectively, comprising Greater Ravensworth, Mangoola, Bulga and United (see **Section 1.1.8** for details on this approach). This approach was accepted by OEH. Biometric data within the same vegetation zone was shared across the four UHSA sites (refer to **Section 1.7** for the raw site attribute data).

As per Attachment 3: Managing Impacts on Biodiversity under the Upper Hunter Strategic Assessment (UHSA) (OEH 2015b), the proponent is required to *Recalculate the ecosystem credits and species credits according to the proposed development area. Where a vegetation type being impacted is a derived grassland or shrubland, re-assess the plot data in relation to the 'overstorey regeneration' values. This is necessary because overstorey regeneration relates to the whole zone, not individual plots.* As a result the overstorey regeneration was reviewed for the two vegetation zones HU905 – Low Condition – Derived Native Grassland and HU905 – Moderate to Good Condition – Cooba Open Shrubland. The re-assessment of 'overstorey regeneration' found that HU905 – Moderate to Good Condition – Cooba Open Shrubland remained at zero, whilst the HU905 – Low Condition – Derived Native Grassland reduced from 0.5 to 0 based on the fact no overstorey trees were recorded as regenerating across the entire zone.

The original calculation of 0.5 for HU905 – Low Condition – Derived Native Grassland was arrived at by considering the site attribute data from the four Glencore UHSA sites United, Mangoola, Bulga and Ravensworth. Across these four sites two overstorey species were recorded within this vegetation zone, comprising grey box (*Eucalyptus moluccana*) and slaty box (*Eucalyptus dawsonii*). Only grey box was recorded as regenerating and as a result the overstorey regeneration was scored as 0.5. A review of the UHSA floristic data collected from the United UHSA site found that neither of these species were recorded as regenerating across the HU905 – Low Condition – Derived Native Grassland vegetation zone, and that they were only recorded as regenerating at other Glencore UHSA sites. Additionally, further surveys of the Non-UHSA Disturbance Area during 2016 found that none of the overstorey species are regenerating within the HU905 – Low Condition – Derived Native Grasslands. Areas of dense regeneration of HU905 were separated out as a unique zone and these received an overstorey regeneration score of 1 across the Project Area. As a result the amended overstorey regeneration was calculated to be zero for United.

1.4 Threatened Species

1.4.1 Database Searches and Literature Review

In order to inform field surveys, a preliminary list of threatened species with the potential to occur in the project area was determined by undertaking searches of relevant databases and reviewing applicable literature.

This included:

- a 10 kilometre radius search from the boundary of the project area on the OEH Atlas of NSW Wildlife (BioNet 2014 – accessed January 2013 and June 2014) (refer to **Figures A.3 and A.4**)
- a 10 kilometre radius search from the boundary of the project area on the Commonwealth Department of the Environment Protected Matters Search Tool (Department of the Environment 2014 – accessed January 2013 and June 2014) and
- a review of previous ecological assessments and monitoring undertaken within and surrounding the project area including Umwelt 2010 and Umwelt in prep. (both of which reviewed an extensive number of ecological studies carried within and adjacent to the project area) as well as the Umwelt 2013 ecological monitoring report which includes monitoring results since 2005 (Umwelt 2014a).

In addition, once the initial round of flora surveys were undertaken and when there was a higher degree of confidence in the vegetation communities and habitat features present, a preliminary assessment using the Biodiversity Certification Credit Calculator was undertaken which provided a list of species credit species that might require survey.

The results of the database searches, literature review and preliminary assessment using the Biodiversity Certification Credit Calculator were used to design the survey requirements for species credit species to ensure that appropriate species credit species were surveyed.

The *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* – Working Draft (DEC 2004) were considered when undertaking the threatened species surveys in the project area.

1.4.2 Threatened Flora Surveys

A preliminary list of threatened flora species with potential to occur in the Project Area was generated during the literature review, completion of database searches and preliminary assessment using the Biodiversity Certification Credit Calculator. The preliminary list of potentially occurring species credit species was reviewed to remove species that did not require further assessment in the project area according to Step 3 of Section 4.3 of the BCAM.

Species not requiring further assessment include:

- species for which there is poor quality habitat in the Project Area,
- species only predicted to occur in the CMA subregion
- where an expert report states the species is unlikely to be present
- species which are vagrant species and unlikely to utilise habitat in the Project Area and
- where the records of the species presence are old of have doubtful authenticity.

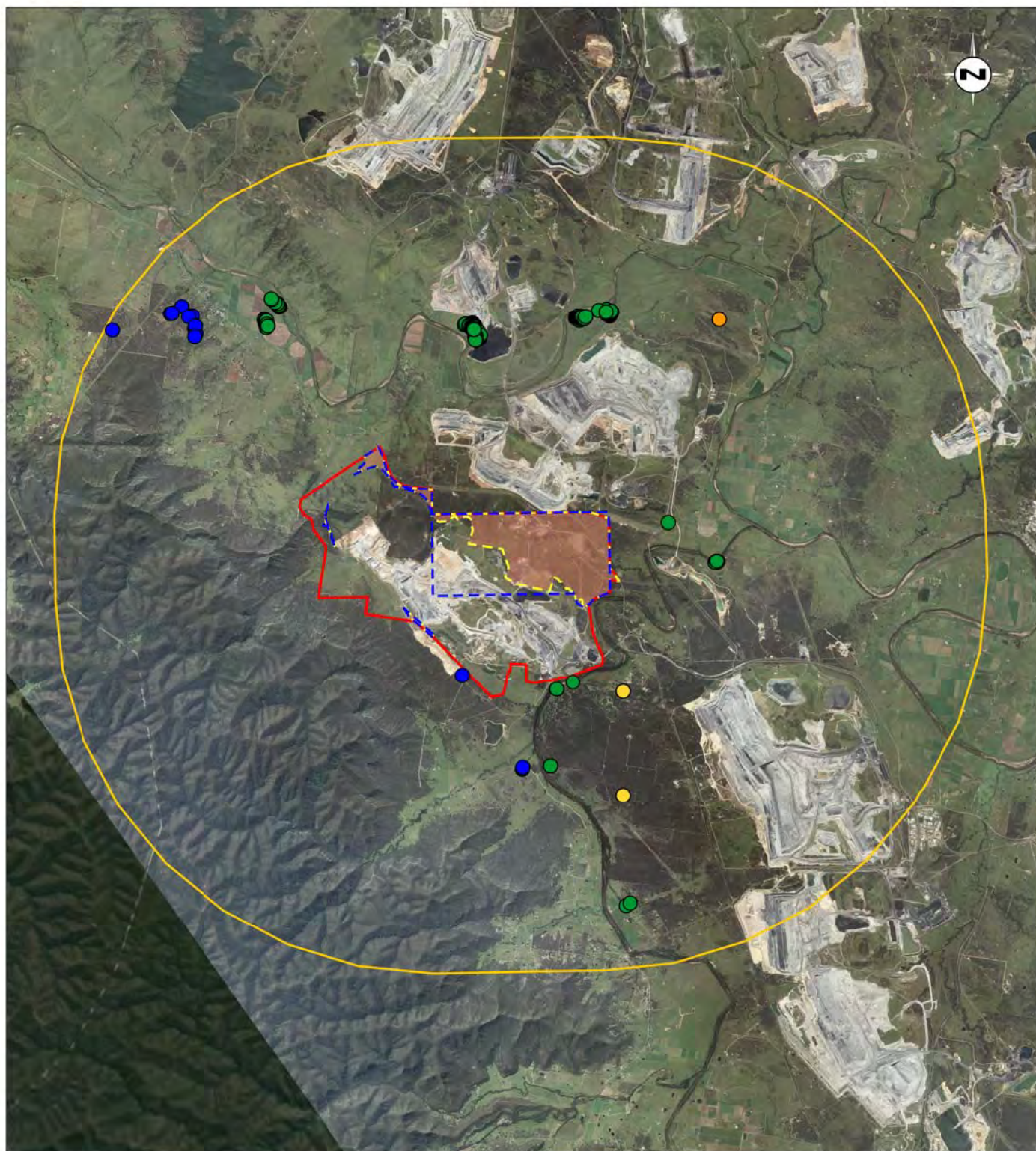


Image Source: Google Earth (2008), Glencore (2012)
Data Source: Boundary - Glencore (2014)

0 2.5 5.0 7.5 km
1:150 000

Legend

- Project Area
- Conceptual Additional Disturbance Area
- - - UHSA Project Area
- 10km Radius
- *Acacia pendula*
- *Eucalyptus camaldulensis*
- *Eucalyptus glaucina*
- *Cymbidium canaliculatum*

FIGURE A3

Threatened Flora Species
(Atlas of NSW Wildlife)

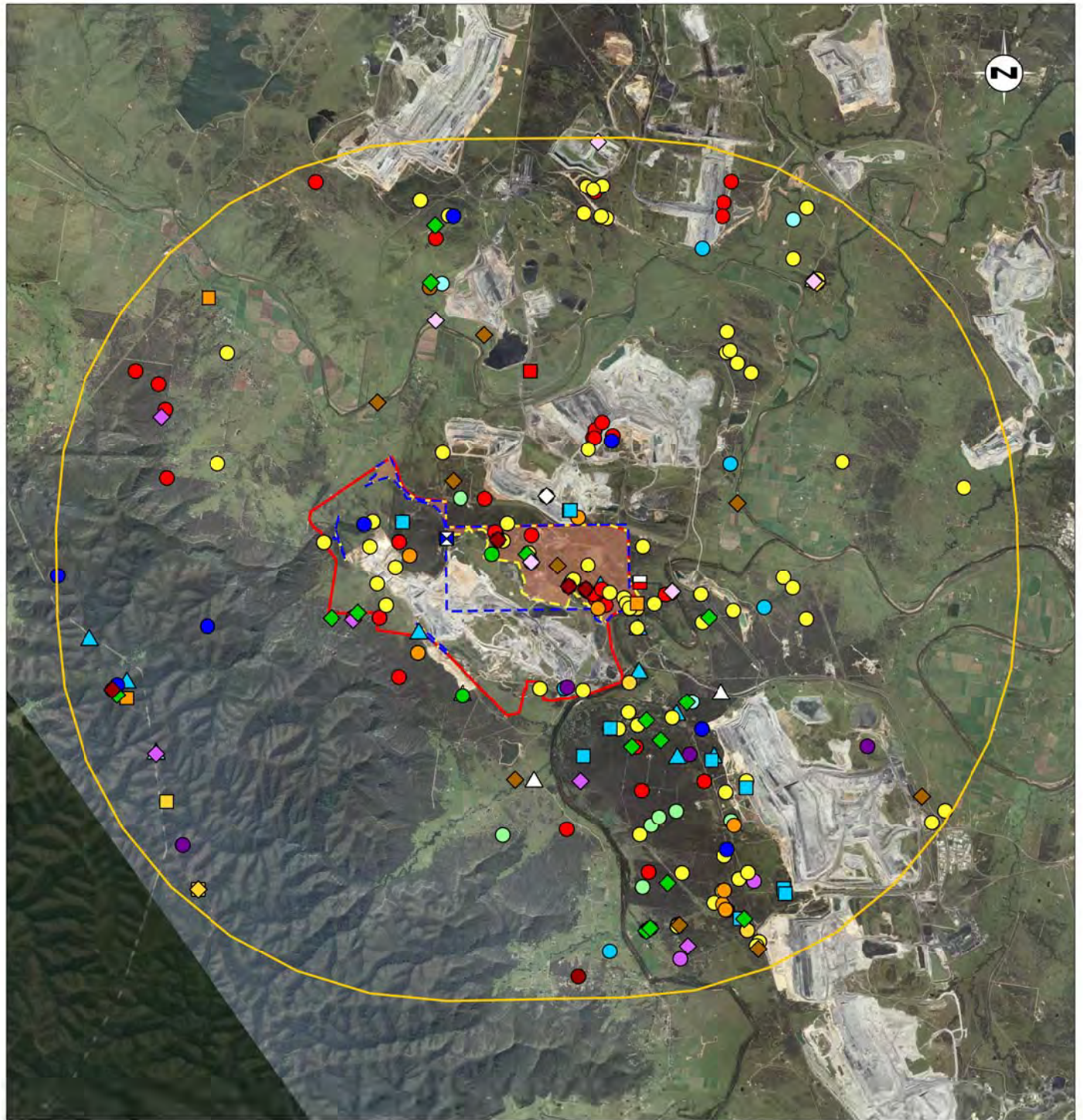


Image Source: Google earth (2008), Glencore (2012)

Data Source: Boundary - Glencore (2014); Species Locations - Atlas of NSW Wildlife Database

Note: Due to the large number of records, some records may be hidden under other records.

Legend

- | | | |
|---|---|---|
| Project Area | ▲ Glossy Black-cockatoo | ◆ Eastern Cave Bat |
| Conceptual Additional Disturbance Area | ▲ Turquoise Parrot | ■ New Holland Mouse |
| UHSA Project Area | ▲ Flame Robin | ● Scarlet Robin |
| 10km Radius | ■ Spotted-tailed Quoll | ● Diamond Firetail |
| ● Spotted Harrier | ■ Brush-tailed Phascogale | |
| ● Little Eagle | ■ Koala | |
| ● Gang-gang Cockatoo | ■ Squirrel Glider | |
| ● Little Lorikeet | ■ Grey-headed Flying-fox | |
| ● Swift Parrot | ■ Yellow-bellied Sheath-tail-bat | |
| ● Powerful Owl | ■ Eastern Freetail-bat | |
| ● Brown Treecreeper (eastern subspecies) | ■ Large-eared Pied Bat | |
| ● Speckled Warbler | ■ Eastern False Pipistrelle | |
| ● Regent Honeyeater | ■ Little Bentwing-bat | |
| ● Grey-crowned Babbler (eastern subspecies) | ■ Eastern Bentwing-bat | |
| ● Varied Sittella | ■ Southern Myotis | |
| ● Hooded Robin (south-eastern form) | ■ Greater Broad-nosed Bat | |

FIGURE A4

Threatened Fauna Species
(Atlas of NSW Wildlife)

Table A.4 identifies the species credit flora species that may occur in the Project Area, the months during which surveys are required by the BCAM (grey and black shading), and the months during which surveys were undertaken (black shading).

Threatened flora species surveys were undertaken during several separate field trips in order to adequately survey during the required seasonal survey periods of all species credit flora species with potential to occur in the Project Area (refer to **Table A.4** and **Figure A1**). In addition historical surveys were also used in this assessment. The surveys were undertaken during:

- 11 to 12 February, 24 April and 5 May 2009 (Umwelt 2010)
- 26 to 28 February, 18 to 20 March, 11, 12, 23 and 24 September and 9 to 10 October 2013
- 5 to 7 March 2014
- 27 May and 9 and 10 July 2015 and
- 14 April 2016 (non-UHSA disturbance area).

The Illawarra greenhood (*Pterostylis gibbosa*) is known to flower during winter and early spring and surveys were undertaken for the Illawarra greenhood during September 2013 and July 2015. The pine donkey orchid (*Diuris tricolor*) and small snake orchid (*Diuris pedunculata*) were also surveyed during September 2013. *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) is listed (refer to **Table A.3**) as requiring survey during October, however as the species was known to be flowering in Mangoola UHSA area during September 2013 it was surveyed during September 2013. All other species were targeted during the March 2014 surveys.

Table A.4 – Species Credit Flora Species Requiring Survey

Scientific Name	Common Name	TSC Act	EPBC Act	J	F	M	A	M	J	J	A	S	O	N	D	Source
<i>Acacia pendula</i>	<i>Acacia pendula</i> population in the Hunter catchment	EP														2
<i>Cymbidium canaliculatum</i>	<i>Cymbidium canaliculatum</i> population in the Hunter Catchment	EP														1, 2, 4
<i>Eucalyptus camaldulensis</i>	<i>Eucalyptus camaldulensis</i> population in the Hunter catchment	EP														2, 4
<i>Eucalyptus glaucina</i>	Slaty red gum	V	V													2, 3
<i>Pomaderris queenslandica</i>	Scant pomaderris	E														1
<i>Pomaderris reperta</i>	Denman pomaderris	CE	CE													1
<i>Prostanthera cineolifera</i>	Singleton mint bush	V	V													1
<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	Wollemi mint bush	V	V													1
<i>Persicaria elatior</i>	Tall knotweed	V	V													1
<i>Thesium australe</i>	austral toadflax	V	V													
<i>Diuris tricolor</i>	pine donkey orchid	V, EP														
<i>Diuris pedunculata</i>	small snake orchid	E	E													
<i>Prasophyllum</i> sp. Wybong (C. Phelps ORG 5269)			CE													
<i>Pterostylis gibbosa</i>	Illawarra greenhood	E	E													3

Grey and black shaded cells = month that survey is required according to the Biodiversity Certification Credit Calculator or a BioBanking report exported for the Hunter-Central Rivers CMA from the online OEH Atlas of NSW Wildlife.

Black shaded cell = month during which surveys were undertaken.

1 = Biodiversity Certification Credit Calculator

2 = NSW Wildlife Atlas

3 = Commonwealth Protected Matters Search Tool (PMST)

4 = Previous nearby ecological surveys including Umwelt 2010, Umwelt in prep. and Umwelt 2014a.

CE = Critically Endangered

E = Endangered

EP = Endangered Population

V = Vulnerable

1.5 Species Credit Fauna Surveys

A preliminary list of threatened fauna species credit species with potential to occur in the Project Area was generated during the literature review, database searches and a preliminary assessment using the Biodiversity Certification Credit Calculator (see **Section A.1.1**).

The preliminary list of potentially occurring species credit species was reviewed to remove species that did not require further assessment in the project area according to Step 3 of Section 4.3 of the BCAM.

Table A.5 identifies the species credit species that may occur in the project area and that required survey.

Threatened fauna species surveys were undertaken from 10 to 14 March 2014 and focussed on surveying for all species credit fauna species with potential to occur in the project area (refer to **Table A.5**). A survey during March allowed all species listed in Table A.5 to be searched for during the appropriate seasons.

Table A.5 – List of Species Credit Fauna Species Determined to Require Surveys

Common Name	Scientific Name	Status		Month												Source Codes
		TSC Act	EPBC Act	J	F	M	A	M	J	J	A	S	O	N	D	
Frogs																
<i>Litoria aurea</i>	green and golden bell frog	E	V													1, 3
Birds																
<i>Hamirostra melanosternon</i>	Black-breasted buzzard	V														4
Mammals																
<i>Phascogale tapoatafa</i>	Brush-tailed phascogale	V														1, 2, 4
<i>Phascolarctos cinereus</i>	Koala	V	V													1, 2, 3, 4
<i>Petrogale penicillata</i>	Brush-tailed rock-wallaby	E	V													1, 3, 4
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox (breeding habitat)	V	V													1, 2, 3, 4
<i>Chalinolobus dwyeri</i>	Large-eared pied bat (breeding habitat)	V	V													2, 3, 4
<i>Miniopterus australis</i>	Little bentwing-bat (breeding habitat)	V														2, 4
<i>Miniopterus schreibersii oceanensis</i>	Eastern bentwing-bat (breeding habitat)	V														2, 4
<i>Vespadelus troughtoni</i>	Eastern cave bat (breeding habitat)	V														2, 4
<i>Myotis macropus</i>	Southern myotis (breeding habitat)	V														1, 2, 4

Grey and black shaded cells = month that survey is required according to the Biodiversity Certification Credit Calculator or a BioBanking report exported for the Hunter-Central Rivers CMA from the online OEH Atlas of NSW Wildlife.
Black shaded cell = month during which surveys were undertaken.

1 = Biodiversity Certification Credit Calculator
 2 = Atlas of NSW Wildlife
 3 = Commonwealth Protected Matters Search Tool (PMST)
 4 = Previous nearby ecological surveys including Umwelt 2010, Umwelt in prep. and Umwelt 2014a.
 E = Endangered
 V = Vulnerable

Targeted surveys for species credit fauna species comprised general bird surveys, targeted winter bird surveys, frog surveys, Anabat echolocation recording, remote camera surveys, spotlighting surveys, koala Spot Assessment Technique (SAT) searches and targeted habitat searches.

1.5.1 General Bird Surveys

General bird surveys, targeting the potential presence of the black-breasted buzzard involved on foot surveys of woodland edge areas around the project area in March 2014. Bird species were identified from characteristic calls and by observation using 10 x 42 binoculars.

A total of four targeted surveys were undertaken across the Project Area with each survey consisting of one person hour of searching. While the bird surveys focused on the presence of the black-breasted buzzard, all bird species encountered were recorded. The location of the black-breasted buzzard surveys are shown on **Figure A5**.

1.5.2 Targeted Winter Bird Surveys

Targeted winter bird surveys were undertaken across the Project Area during 2010, 2011, 2012, 2013, 2014 and 2016 as well as targeted surveys of the non-UHSA disturbance area in 2016. Winter bird surveys targeting the regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*) were undertaken by two ecologists during June, July or August each year, and comprised a total of 106.6 person hours of survey (refer to **Table A.6**). Surveys comprised a combination of predetermined sites and sites positioned during the surveys in areas of eucalypt flowering (refer to **Figure A5**). Surveys included both visual searches (using binoculars) and call play back surveys (using a loud hailer).

Table A.6 - Targeted Winter Bird Survey Effort

Year	Number of Sites	Approximate Time at each Site	Total Person Hours
2010	20	40 person minutes	13.3
2011	20	40 person minutes	13.3
2012	22	1 person hour	22.0
2013	17	1 person hour	17.0
2014	31	1 person hour	31.0
2016 [^]	4	0.5 person hours	2
2016	8	1 person hour	8
Total Person Hours			106.6

[^] Targeted surveys of the non-UHSA disturbance area

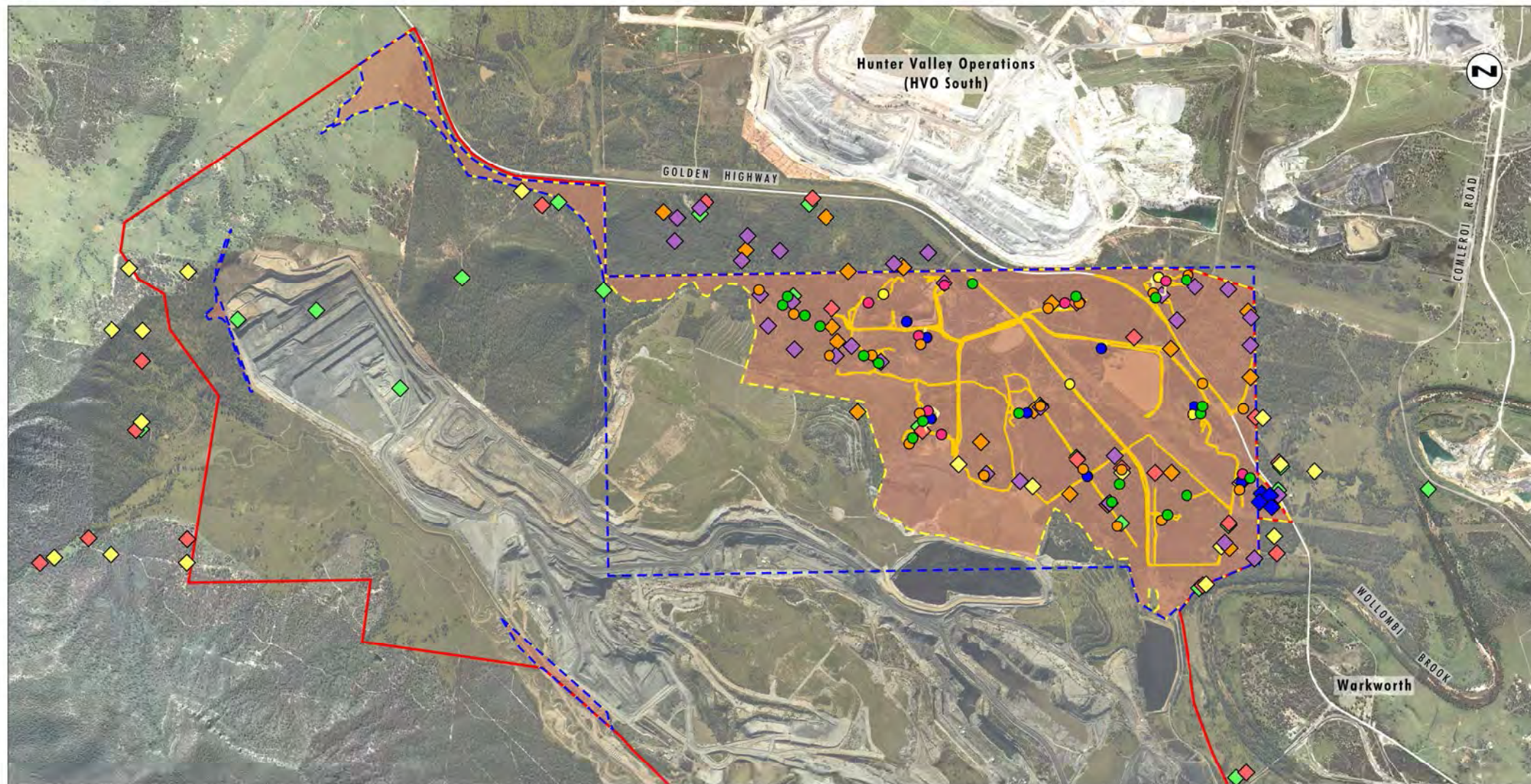


Image Source: AAM (2012), United (2015)
Data Source: Glencore (2014)

0 0.5 1.0 2.0 km
1:40 000

Legend

- | | | | |
|---|---|---|---|
| Project Area | ● Anabat Survey | ◆ 2010 - Winter Bird Survey | ◆ 2016 - Winter Bird Survey |
| Conceptual Additional Disturbance Area | ● Black-breasted Buzzard Survey | ◆ 2011 - Winter Bird Survey | |
| UHSA Project Area | ● Green and Golden Bell Frog Survey | ◆ 2012 - Winter Bird Survey | |
| Spotlighting Transect | ● Koala SAT Searches | ◆ 2013 - Winter Bird Survey | |
| Green and Golden Bell Frog Search | ● Remote Camera | ◆ 2014 - Winter Bird Survey | |

File Name (A4): R15/3509_489.dgn
20160714 16:01

FIGURE A5
Fauna Survey Effort

1.5.3 Frog Surveys

Green and golden bell frog surveys were undertaken at eight targeted dam locations across the project area in March 2014. Each survey commenced with 5 minutes of call playback of the species, followed by 5 minutes of listening for vocalising males. Directly following the call playback, 30 minutes of spotlighting was undertaken by two ecologists (a total of one person hour) at each site. These surveys involved searching along the edge of open water and through fringing vegetation for individuals and listening for vocalisation by males.

The locations of the green and golden bell frog surveys are shown on **Figure A5**.

1.5.4 Anabat Echolocation Recording

Threatened micro-bat surveys were undertaken at eight locations across the project area during March 2014. Calls were recorded using an Anabat SD1 device (hereafter referred to as an 'Anabat'). At each site, the Anabat was positioned at an approximate 30 degree angle and 1 metre above the ground in a waterproof housing. Each detector was positioned towards potential micro-bat flight paths or over water-bodies to increase the likelihood of detecting micro-bat species. The Anabat detector was programmed to start recording from one hour before sunset to one hour after sunrise.

Recordings of bat calls were analysed by Glenn Hoyer of Fly By Night Bat Surveys Pty Ltd (a recognised expert in the identification of micro-bat calls). The echolocation calls of species were identified to one of three confidence levels:

- confident
- probable and
- possible.

All three levels of confidence were treated as positive identifications for the purposes of this ecological assessment. The locations of the micro-bat echolocation surveys are shown on **Figure A5**.

1.5.5 Remote Camera Surveys

The brush-tailed phascogale was targeted using remote camera surveys at 20 locations across the project area in March 2014. Bushnell Trophy Cam HD cameras were used for the remote camera surveys. 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 chicken meat, oats and honey. Cameras were set to take three photos in quick succession when movement was detected. Remote cameras were set at each site for between three and four 24 hour periods. The locations of the remote camera surveys are shown on **Figure A5**.

1.5.6 Spotlighting Surveys

Driving spotlighting surveys for koalas and brush-tailed phascogales was undertaken in targeted areas between the hours of 8.00 pm and midnight using 30 watt Lightforce hand-held spotlights. The surveys were undertaken over two nights with approximately four person hours completed each night. Areas targeted for spotlighting primarily comprised woodland patches dominated by eucalypt species.

The locations of spotlighting surveys are shown on **Figure A5**.

1.5.7 Koala SAT Searches

Searches for signs of the presence of koalas were undertaken at 20 locations across the project area in March 2014 using the Spot Assessment Technique (SAT). 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. The locations of the 20 koala SAT searches are shown on **Figure A5**

1.5.8 Targeted Habitat Searches and Mapping

1.5.8.1 Southern myotis (*Myotis macropus*)

Targeted habitat searches for the southern myotis (*Myotis macropus*) were undertaken adjacent to creek lines with permanent, or close to permanent, water to identify any potential hollow roosting habitat (hollow bearing trees). Areas of woodland within 200 metres of permanent, or close to permanent, water bodies along streams and containing hollow bearing trees were recorded.

Further to this, on 22 March 2016 OEH released guidelines relating to the calculation of credits for southern myotis (*Myotis macropus*) breeding habitat (OEH 2016c). These guidelines help to tailor the identification of southern myotis breeding habitat to riparian vegetation within 200 metres of permanent water sources where potential roosting hollows have been identified.

The following approach, which was adopted for this Project, is quoted from OEH (2016c). Any departure from this approach is noted in square brackets.

Step 1: Identifying resident populations of southern myotis

The identification of southern myotis as a candidate species must be undertaken in accordance with Section 4.3 (Step 1-3) of BCAM (for the development site). Existing data or surveys can be used to indicate that the site is being used by southern myotis for foraging and/or breeding.

Where surveys are used instead of an expert report, these must be conducted in accordance with the draft Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DECC 2004).

The habitat attributes that are described below should be targeted to increase the likelihood of detection.

Step 2: Identifying foraging habitat attributes that indicate breeding sites

The assessor must first identify and map foraging habitat attributes that indicate potential adjacent breeding habitat. Indicators of foraging habitat are as follows:

Inclusions

- Streams of 3rd order or greater, with perpetual flow or large pooling water bodies.
- water bodies (dams, lakes and reservoirs) that have a surface area of 20,000 m² or greater.

Exclusions

- 1st and 2nd order streams with average width less than 3 m
- small isolated farm dams and reservoirs that have a surface area less than 20,000 m².

A description of stream order may be found under Appendix 2 of the BBAM (OEH, 2014).

Step 3: Identifying breeding habitat

Following the identification of foraging habitat (Step 2), the assessor must map adjacent breeding habitat. Mapped breeding habitat must include all native forest and woodland vegetation within 200 m of preferred habitat. Breeding habitat must also incorporate artificial structures such as caves, mines, tunnel, culverts and bridges, any predominately cleared land with scattered trees that have the potential to contain hollows. The 200 m extent must be measured from the top of the bank of the water course or water body.

[Note: this had already been undertaken in Umwelt (2015) and was used here as the initial area within which potential breeding habitat, in accordance with the OEH presented here, was refined.]

Step 4: Further refining breeding habitat

Additional field surveys can be used to refine the area mapped as breeding habitat by identifying areas of vegetation that do not contain hollows or identifying artificial structures such as caves, mines, tunnels, culverts and bridges that do not show signs of breeding. Certain areas of vegetation may not contain hollows due to the age of the vegetation or because the tree species present do not typically form hollows. Before undertaking additional surveys, the proponent should consult with OEH to seek agreement that the survey methods and effort are adequate. The assessor must justify why any excluded areas will not provide potential breeding habitat for southern myotis.

Methods Undertaken

On 19 and 21 April, and 3 May 2016, United Environmental staff undertook a survey of relevant creeklines previously mapped as southern myotis breeding habitat in the United UHSA BCAM report (Umwelt 2015). The surveys were conducted along Redbank Creek and its tributaries in the previously-mapped area and constituted assessments and measurement of pond dimensions, average streambank width and water flow. Historic analysis of water flow indicates that Redbank Creek is not, in this area, a perpetually flowing stream.

1.5.8.2 Grey-headed flying-fox (*Pteropus poliocephalus*)

Habitat searches for grey-headed flying-fox camp sites in woodland and forest habitats were undertaken opportunistically across the project area in March 2014. The surveys were undertaken opportunistically during all other surveys.

1.6 Red Flags

The following steps were followed to identify red flag vegetation type and threatened species in the project area as per the BCAM (DECCW 2011). A red flag area is regarded as having high biodiversity conservation values if it contains one or more of the following criteria:

- a) a vegetation type that is greater than 70 per cent cleared as listed in the Vegetation Types Database (that is, has less than 30 per cent of its estimated distribution remaining in the catchment management authority (CMA) area before the year 1750), and the vegetation is not in low condition;
- b) a critically endangered or endangered ecological community listed under the TSC Act or EPBC Act, and the vegetation is not in low condition;

- c) one or more threatened species identified in the Threatened Species Profile Database that cannot withstand further loss in the CMA area; and/or
- d) areas of vegetation recognised as having regional or state biodiversity conservation significance.

The following steps were carried out to complete the assessment:

- assessment of EECs and CEECs was undertaken;
- the percentage cleared status was obtained from the Biodiversity Certification Credit Calculator (Version 1.08 released 18 April 2013) (OEH 2013c);
- threatened species which could not withstand further loss in the Hunter-Central Rivers CMA were identified from the Threatened Species Profile Database exported during May 2014 from the online OEH Atlas of NSW Wildlife; and
- assessment of vegetation recognised as having regional or state biodiversity conservation significance was undertaken by assessing the project area for major rivers, minor rivers, major creeks, minor creeks and State Environmental Planning Policy (SEPP) 14 Wetlands.

1.7 Transect/Plot Condition Attribute Data

Table A7 below details the condition attribute data collected across the four Glencore UHSA sites for the vegetation zones present at the United UHSA project area. As discussed above, the overstorey regeneration was amended from 0.5 to 0 for HU905 – Low Condition – Derived Native Grassland.

The following abbreviations are used in the below tables:

NPS indigenous plant species richness

NOS native over-storey cover

NMS native mid-storey 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 over-storey regeneration and

FL total length of fallen logs.

Table A7 – Condition Attribute Data Collected for the BVTs within the Project Area

Site	Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
HU652 – Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley – Moderate to Good Condition														
Mangoola	MQ14	36	0	0	100	0	20	18	1	1	0.5	286615	6424348	56
Mangoola	MQ50	35	1	0	94	14	40	26	0	1	0	285723	6423234	56
Bulga	Q22 (Stage 2- Kleinfelder Plots)	17	12	0	50	15	10	30	0	1	16	318424.1	6381781	56
HU812 - Forest Red Gum grassy open forest on floodplains of the lower Hunter – Moderate to Good Condition														
United	78	48	14	8	98	0	24	22	0	1	42	311124	6396718	56
Mangoola	MQ1	46	14	0.4	56	2	30	8	0	1	18	278771	6421535	56
Mangoola	MQ20	32	17.5	2.5	76	2	24	0	0	1	2	280754	6429502	56
Mangoola	MQ8	36	28	8	52	8	40	16	0	1	0	279667	6428981	56
Bulga	P05	45	40	25	16	20	2	8	1	1	17	323323	6377821	56
Bulga	Q07 (Stage 1- Kleinfelder Plots)	42	10.5	7.5	74	12	36	30	0	1	23	323313.9	6377755	56
Ravensworth	RAV P03	36	58	10	44	0	22	4	0	1	12	324415	6410223	56
Ravensworth	RAV P05	28	49	0	50	0	2	18	1	1	19	324410	6413329	56
HU816 - Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter – Moderate to Good Condition Plantation														
United	3	16	8	21	66	4	24	30	0	1	0	312054	6396289	56
United	107	35	17	19	54	14	6	0	0	1	6	312465.1	6395572	56
Ravensworth	Q10	24	52	10	70	10	10	0	0	1	6	323218.2	6412157	56
Ravensworth	Q11	31	27	6	78	6	8	0	0	1	17	322175.6	6411798	56
HU869 - Grey Box – Slaty Box Shrub – Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin – Moderate to Good Condition														
United	100	23	15.5	3	12	4	12	0	1	1	19	312599.8	6397153	56
United	101	36	12	19	38	14	22	2	2	1	27	312428.4	6397082	56
Mangoola	MQ12	32	15.5	0	12	0	2	2	1	1	0	286424	6424501	56
Mangoola	MQ13	27	9.5	0	90	2	38	10	7	1	16	286348	6424760	56
Mangoola	MQ16	40	25	3	52	2	56	26	2	1	32	286554	6425868	56
Mangoola	MQ19	28	24.5	0	16	0	16	2	0	1	0	283928	6429323	56
Mangoola	MQ34	26	18	1	12	0	10	0	1	1	35	279509	6420230	56

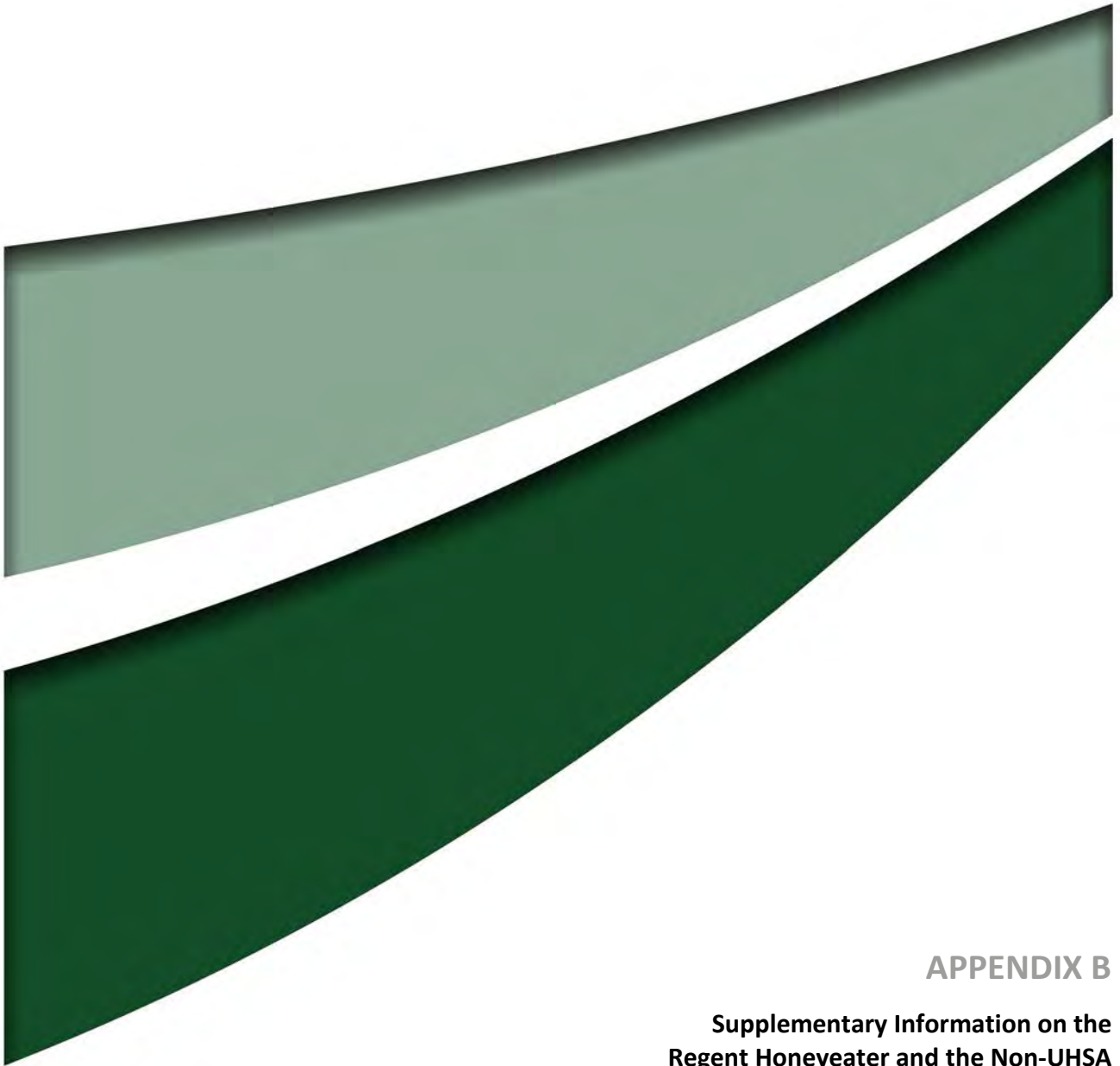
Site	Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Mangoola	MQ36	33	11	0	60	4	12	2	0	1	27	280886	6420447	56
Mangoola	MQ54	31	24	1	28	0	22	0	0	1	0	284245	6428567	56
HU905 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Low Condition Derived Native Grassland														
United	69	20	0	0	86	0	28	36	0	0	0	312633	6396533	56
United	73	18	0	0	100	0	12	30	0	0	0	311841	6396515	56
United	79	31	0	0	92	0	36	22	0	0	0	313088	6396188	56
United	82	28	0	0	88	0	26	36	0	0	0	313472	6396054	56
United	85	22	0	0	90	0	44	18	0	0	0	312237	6396510	56
United	86	20	0	1.5	76	0	2	14	0	0	0	313834	6397005	56
United	RPU2	7	0	0	100	0	0	38	0	0	0	307701	639860	56
Mangoola	MQ25	19	0	0	98	0	52	12	0	0	0	281003	6429312	56
Mangoola	MQ42	18	0	0	100	0	84	0	0	0	0	278493	6422661	56
Mangoola	MQ44	17	0	0	90	0	30	42	0	0	0	282475	6428898	56
Mangoola	MQ7	34	0	0	98	0	78	0	0	0	0	280435	6426921	56
Bulga	P03	12	0	0	96	14	22	8	0	0	0	317194	6382652	56
Bulga	P04	18	0	0	62	0	14	8	0	0	0	319212	6380356	56
Bulga	Q26 (Stage 1- Kleinfelder Plots)	21	0	0	60	1	20	60	0	0	0	320604.8	6378481	56
Ravensworth	RAV P11	21	0	0	88	0	28	36	0	0	0	318491	6411052	56
Ravensworth	RAV P25	18	0	0	92	0	24	34	0	0	6	313796	6404762	56
Ravensworth	RAV P30	18	0	0	64	2	40	34	0	0	0	317136	6412263	56
Ravensworth	RAV P37	17	0	0	98	0	6	26	0	0	0	317825	6415747	56
HU905 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition														
United	4	47	10	23	52	12	22	2	5	1	90	310547	6397007	56
United	5	36	37	0	28	0	26	0	0	1	0	312293	6395783	56
United	7	32	25.5	3.5	40	4	24	0	0	1	12	312806	6395665	56
United	22	20	19	9.5	28	4	10	0	0	1	0	312595.9	6395848	56
United	23	23	22	0	8	2	8	0	0	1	8	312899.8	6395416	56
United	41	38	21.5	7.5	48	8	14	8	0	1	31	311426.8	6396145	56

Site	Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
United	88	33	9.2	0.8	40	8	8	0	1	1	15	313550	6397099	56
United	89	21	11	0.5	26	6	14	0	2	1	4	313340.3	6397290	56
United	108	29	26	17	12	4	22	0	3	1	9	312533.1	6395635	56
United	RPU3	33	12	4	44	10	10	0	0	1	85	308408	6398032	56
Mangoola	MQ17	38	23	2	50	0	24	0	0	1	3	283884	6428860	56
Mangoola	MQ2	57	22.5	1	54	2	40	6	1	1	14	278781	6421839	56
Mangoola	MQ24	39	13	6	78	4	20	0	1	1	2	281154	6429150	56
Mangoola	MQ27	40	45.5	1.5	74	0	40	0	0	1	0	279906	6429162	56
Mangoola	MQ32	34	40.5	0	54	2	32	4	1	1	17	279596	6426672	56
Mangoola	MQ37	34	13.5	10	78	26	10	8	1	1	36	280198	6428279	56
Mangoola	MQ39	43	2	6	56	2	10	2	0	1	3	278416	6428720	56
Mangoola	MQ5	24	12.5	5.5	62	4	34	0	0	1	2	281451	6427800	56
Mangoola	MQ51	41	10	7	78	8	68	8	0	1	9	278796	6428065	56
Mangoola	MQ55	33	24	2	66	4	10	4	0	1	1	279698	6427281	56
Bulga	Q16 (Stage 1- Kleinfelder Plots)	32	40.4	1.3	82	22	74	28	1	1	37	321186.1	6377863	56
Bulga	Q24 (Stage 2- Kleinfelder Plots)	39	19.5	0	80	22	46	24	0	1	4	319167.3	6380855	56
Bulga	Q28 (Stage 1- Kleinfelder Plots)	43	24	19	34	92	24	0	1	1	40	320712	6378842	56
Bulga	Q3 (Stage 2- Kleinfelder Plots)	36	49	22	92	8	38	4	1	1	12	317636.8	6384734	56
Bulga	Q4 (Stage 2- Kleinfelder Plots)	30	19.5	2	96	20	56	36	1	1	28	317488.7	6383318	56
Bulga	Q6 (Stage 2- Kleinfelder Plots)	27	22	3	58	8	38	16	0	1	2	317233.3	6383200	56
Ravensworth	RAV P07	32	50	3	44	0	16	0	0	1	15	321948	6408422	56
Ravensworth	RAV P13	30	40	6	44	2	38	10	0	1	29	318328	6412718	56
Ravensworth	RAV P22	37	30	7	46	2	30	10	0	1	7	316844	6406006	56
Ravensworth	RAV P27	43	31	8	42	8	40	4	1	1	13	312427	6405987	56

Site	Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
HU905 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition – Cooba Open Shrubland														
United	1	16	0	5.2	48	10	4	2	0	0	3	311240	6397103	56
United	2	37	0	5.5	82	0	24	14	0	0	0	311398	6396351	56
United	20	15	0	13.5	86	2	18	8	0	0	0	310995.2	6397203	56
United	42	26	0	2.5	88	2	26	22	0	0	14	311663.3	6396257	56
United	71	38	0	24	92	2	52	16	0	0	0	311241	6396407	56
United	74	46	0	5	82	0	38	16	0	0	0	311579	6396589	56
United	77	31	0	9	78	0	18	20	0	0	21	310566	6396692	56
United	84	34	0	20.5	88	0	44	30	0	0	0	310893	6397080	56
Ravensworth	RAV P26	28	0	9	78	4	50	24	0	0	2	312761	6404860	56
HU905 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition Regeneration														
United	76	42	10.5	7.5	72	0	38	36	0	1	2	310439	6396743	56
United	72	48	6	0	68	0	28	0	0	1	2	310407	6396970	56
Bulga	P01	23	36	7	56	4	24	16	0	1	5	317318	6384902	56
Ravensworth	RAV P12	28	3	33	48	0	6	0	0	1	18	318227	6411391	56
Ravensworth	RAV P31	39	9	28	56	2	28	6	1	1	14	317444	6412369	56
Ravensworth	RAV P36	40	24	0	54	2	18	0	0	1	9	318223	6415133	56
HU905 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition – Thinned Canopy														
Bulga	Q14 (Stage 2-Kleinfelder Plots)	24	8	0	100	0	30	40	2	1	0	317873.7	6382295	56
Bulga	Q18 (Stage 2-Kleinfelder Plots)	17	13	0	100	5	10	40	3	1	26	318116.6	6382050	56
United	RPU1	29	7.5	2	64	0	6	19	1	1	6.5	307185	6398478	56
HU906 - Bull Oak Grassy Woodland of the Central Hunter Valley – Moderate to Good Condition														
United	18	17	18	0	16	0	22	0	0	1	0	313224.9	6395915	56
United	70	40	6.5	8.5	18	2	10	0	0	1	14	313331	6395415	56
United	75	32	17.5	0	8	0	12	0	1	1	0	312319	6396239	56
United	80	29	26	0	18	4	14	0	0	1	2	312969	6396174	56
United	81	32	22	11	6	0	8	0	0	1	2	313475	6395976	56

Site	Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
United	83	33	35.5	0	22	0	24	0	1	1	4	312896	6396921	56
United	87	31	5.8	1.1	36	2	6	0	0	1	5	313709	6396636	56
United	93	19	8	19	32	0	14	0	0	1	2	313088	6395861	56
United	105	28	15	23	60	8	16	4	0	1	5	312637	6396967	56
United	106	27	20	3	18	0	8	2	0	1	2	313456.2	6395765	56
Mangoola	MQ3	25	13.5	8	4	2	4	0	0	1	105	280986	6427725	56
Bulga	Q14 (Stage 1- Kleinfelder Plots)	33	21	4.5	86	46	56	8	0	1	1.8	322606	6377985	56
Ravensworth	Q18	9	22	12	32	4	8	2	0	1	6	322712.4	6410944	56
Bulga	Q18 (Stage 1- Kleinfelder Plots)	24	20	0	44	14	10	0	0	1	0	321117.7	6378048	56
Ravensworth	RAV P18	20	11	33	22	4	50	18	0	1	8	315374	6412568	56
Ravensworth	RAV P23	20	54	0	16	0	14	2	0	1	3	317006	6305743	56
HU945 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley – Moderate to Good Condition														
United	21	17	16	0	70	4	12	4	0	0.5	117	311903.9	6396587	56
United	39	23	31	10	28	2	46	0	0	0.5	75	313351.7	6396578	56
United	40	23	18.5	10	86	2	68	2	7	0.5	19	312325.9	6396699	56
United	102	18	25	20	26	2	4	4	0	0.5	13	312440.6	6396721	56
United	103	16	31	14	30	0	8	6	0	0.5	0	313448.1	6396361	56
United	104	29	14	22	58	6	36	8	2	0.5	33	310740	6397029	56
Mangoola	MQ31	10	45	0	6	4	12	32	2	0.5	42	283179	6429454	56
Bulga	Q25 (Stage 2- Kleinfelder Plots)	9	37.5	0	66	0	4	78	0	0.5	0	317584.5	6383937	56
Ravensworth	RAV P04	29	59	11	74	0	72	4	0	0.5	32	324415	6410667	56
Ravensworth	RAV P14	20	65	0	68	0	48	36	1	0.5	21	317782	6412961	56
Ravensworth	RAV P28	20	18	18	90	2	34	20	1	0.5	17	313288	6404552	56

Note: Grid references use Australian MGA94 (56) projection and Australian Geocentric 1994 (GDA94) datum.



APPENDIX B

**Supplementary Information on the
Regent Honeyeater and the Non-UHSA
Disturbance Area**

1.0 Supplementary Information on the Regent Honeyeater and the Non-UHSA Disturbance Area

This section outlines supplementary information and additional survey effort undertaken in relation to the potential presence of regent honeyeater (*Anthochaera phrygia*) within the 4 hectare non-UHSA disturbance area.

1.1 The Regent Honeyeater (*Anthochaera phrygia*)

The regent honeyeater is currently listed as critically endangered under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The regent honeyeater is endemic to south-east Australia, where it is widespread but with an extremely patchy distribution.

The regent honeyeater comprises a single population, with some exchange of individuals between regularly used areas (DoE 2016). Within its current distribution there are four known key breeding areas where the species is regularly recorded. These are the Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria (DoE 2016). Locally, the species has been recorded breeding in forest habitats around Kurri Kurri, NSW.

As at 2010, the total population size is estimated at 350–400 mature individuals (DoE 2016). Most records of regent honeyeaters come from box-ironbark eucalypt associations, where the species seems to prefer more fertile sites with higher soil water content, including creek flats, broad river valleys and lower slopes (DoE 2016). Other forest types include wet lowland coastal forest dominated by swamp mahogany (*Eucalyptus robusta*), spotted gum-ironbark associations and riverine woodlands (DoE 2016). Seasonal movements outside breeding season in autumn and winter appear to be related to foraging resource availability. Its diet primarily consists of nectar, but also includes invertebrates (mostly insects) and their exudates (e.g. lerps and honeydew), and occasionally fruit (DoE 2016).

The National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) outlines the key tree and mistletoe species for the regent honeyeater, being:

- mugga ironbark (*Eucalyptus sideroxylon*)
- yellow box (*E. melliodora*)
- white box (*E. albens*)
- yellow gum (*E. leucoxylon*)
- spotted gum (*Corymbia maculata*)
- swamp mahogany (*E. robusta*)
- needle-leaf mistletoe (*Amyema cambagei*) on river sheoak (*Casuarina cunninghamiana*)
- box mistletoe (*A. miquelii*)
- long-flower mistletoe (*Dendrophloe vitellina*).

The Recovery Plan also notes that Lower Hunter Spotted Gum forests have recently been demonstrated to support regular breeding events of regent honeyeaters. Flowering of associated species such as thin-leaved stringybark (*E. eugenioides*) and other stringybark species, and broad-leaved ironbark (*E. fibrosa*) can also contribute important nectar flows at times (DoE 2016). Mature, large individual trees tend to be more important as they are more productive, particularly on highly fertile sites and in riparian areas (DoE 2016).

1.2 Methods

To assess the potential occurrence of regent honeyeater in the non-UHSA disturbance area, the following literature review and survey was undertaken:

- flora and habitat surveys on 14 April 2016 in the non-UHSA disturbance area
- targeted winter bird surveys on 11 July 2016 in the non-UHSA disturbance area
- winter bird surveys undertaken in the locality totalling 106.6 person hours over six years (2010, 2011, 2012, 2013, 2014 and 2016)
- review of the National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (DoE 2016) and assessment of the habitat within the non-UHSA disturbance area to compare it to the preferred habitats for the species
- review of the BioNet Atlas of NSW Wildlife, accessed in July 2016.

1.2.1 Targeted Survey Effort across the Non-UHSA Disturbance Area and the Locality

The non-UHSA disturbance area was traversed on foot by an Umwelt ecologist on 14 April 2016, in order to confirm the vegetation type present and habitat types by undertaking eight semi-quantitative rapid vegetation assessments and one 20 x 20 metre floristic plot. This survey also assessed and recorded key canopy species in relation to potential habitat for threatened fauna species.

Targeted winter bird surveys were undertaken on 11 July 2016 using both visual searches (using binoculars) and call playback surveys (using a loud hailer) across four survey points across the non-UHSA disturbance area. The four survey points and associated walking meanders provided thorough coverage of the 4 hectare area (refer to **Table 1** and **Figure 1**). Surveys targeted areas of box-ironbark associates and flowering eucalypts, where available, and noted the occurrence or otherwise of any key tree or mistletoe species (as per the National Recovery Plan) in the non-UHSA disturbance area.

Furthermore, extensive winter bird surveys targeting the regent honeyeater and comprising of up to 104.6 person hours of survey within 118 survey locations in the years 2010, 2011, 2012, 2013, 2014 and 2016, have been undertaken in the wider Project Area and locality (refer to **Table 1** and **Figure 1**) as incorporated in the United UHSA Report (Umwelt 2015) and the United Wambo Open Cut Project Statement of Consistency Report. Winter bird surveys were undertaken by two ecologists during June, July or August of each year. Surveys comprised a combination of predetermined sites and sites positioned during the surveys in areas of eucalypt flowering. Surveys included both visual searches (using binoculars) and call play back surveys (using a loud hailer).

Table 1 - Targeted Winter Bird Survey Effort in the Project Area and Non-UHSA Disturbance Area

Year	Number of Sites	Approximate Time at each Site	Total Person Hours
2010	20	40 person minutes	13.3
2011	20	40 person minutes	13.3
2012	22	1 person hour	22.0
2013	17	1 person hour	17.0
2014	31	1 person hour	31.0
2016^	4	0.5 person hours	2
2016	8	1 person hour	8
Total Person Hours			106.6

^ Targeted surveys of the non-UHSA disturbance area

Up to 30 sites were surveyed within one kilometre of the non-UHSA disturbance area during the six years of targeted survey as well as four sites within the non-UHSA disturbance area in 2016 (refer to **Figure 1**). The vegetation in the wider Project Area is contiguous and connected to the non-UHSA disturbance area and is of a similar age and structure to that of the non-UHSA disturbance area.

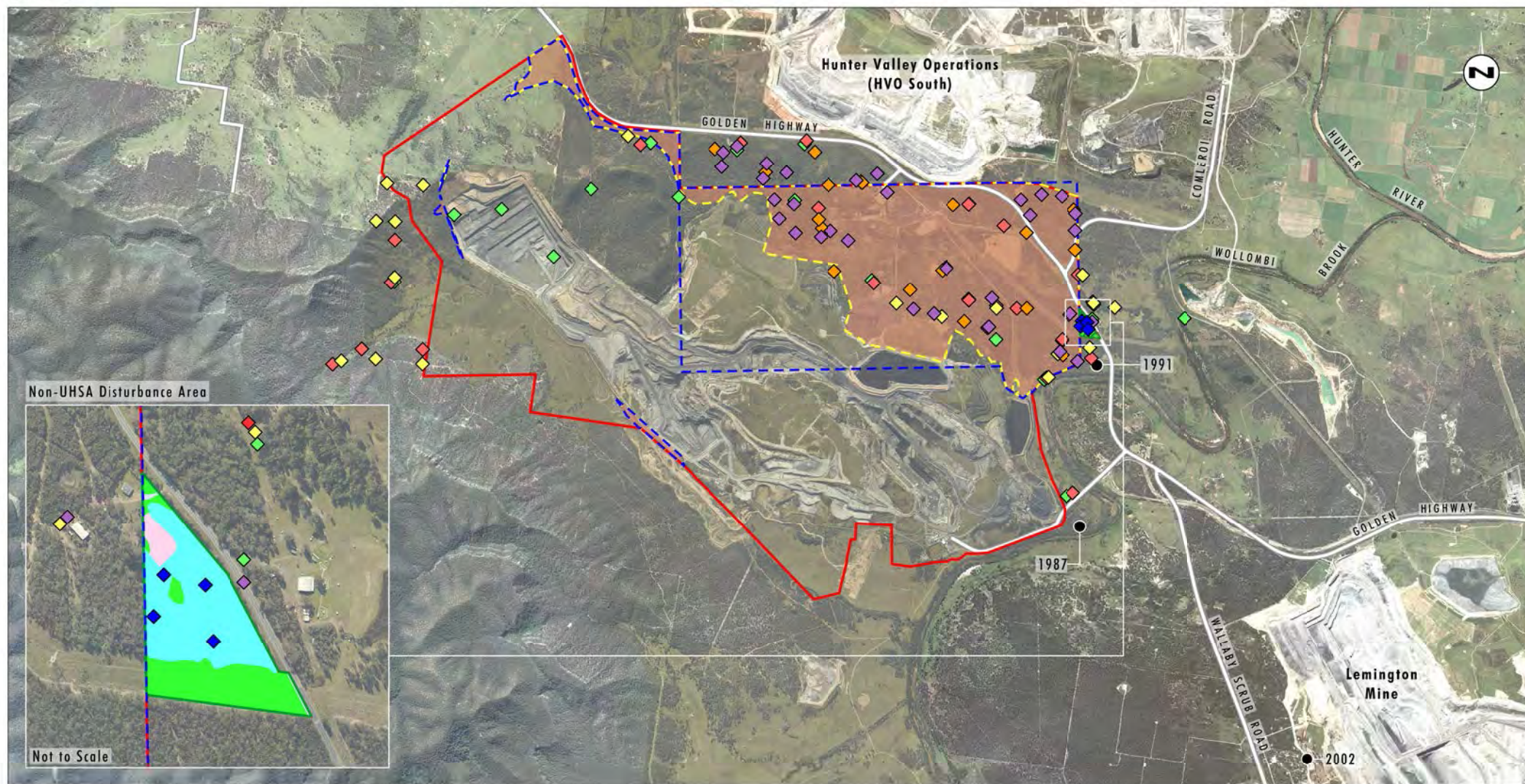


Image Source: AAM (2012), United (2015)
Data Source: Glencore (2014)

0 1 2 3 km
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Legend

- | | | |
|---|---|--|
| Project Area | ◆ 2011 - Winter Bird Survey | HU905 - Narrow-leaved Ironbark - Grey Box grassy Woodland of the Central and Upper Hunter - Moderate to Good Condition (CEEC) |
| Conceptual Additional Disturbance Area | ◆ 2012 - Winter Bird Survey | HU905 - Moderate to Good Condition - Regeneration (CEEC in part) |
| Non-UHSA Disturbance Area | ◆ 2013 - Winter Bird Survey | HU905 - Low Condition - Derived Native Grassland (CEEC in part) |
| ● Regent Honeyeater | ◆ 2014 - Winter Bird Survey | Cleared Land |
| ◆ 2010 - Winter Bird Survey | ◆ 2016 - Winter Bird Survey | |

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FIGURE 1

Regent Honeyeater Surveys and Records
in Relation to the Non-UHSA Disturbance Area

1.3 Description of the Non-UHSA Disturbance Area

The 4 hectare non-UHSA disturbance area consists entirely of Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter (HU905), which is the dominant vegetation type in the Project Area, occurring in three condition types (woodland, derived native grassland and areas of regenerating woodland). The woodland condition type, in this area, has a canopy layer consisting of narrow-leaved ironbark (*Eucalyptus crebra*) and the occasional grey box (*Eucalyptus moluccana*) and a sub-canopy dominated by bullock (Allocasuarina luehmannii) (refer to **Plate 1**). Further areas of this vegetation community within the cleared easement areas are characterised by derived native grasslands. A small area of the non-UHSA disturbance area is in regenerating condition with young and sparse regenerating canopy species (refer to **Plate 2**). **Table 2** below shows the breakdown of vegetation types in the non-UHSA disturbance area.

Table 2 – Vegetation Communities in the Non-UHSA Disturbance Area

Vegetation Type and Condition	Area (ha)
HU905 Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter <i>Moderate to Good</i>	2.56
HU905 Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter <i>Low - Derived Native Grasslands</i>	1.48
HU905 Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter <i>Moderate to Good – Regeneration</i>	0.22
Total	4.26

The habitat in the non-UHSA disturbance area is primarily young with the vegetation likely to be approximately between 20 and 30 years old. Historic aerial photography shows this area to be mostly cleared in 1983, with vegetation regenerating by 1992. Field surveys undertaken in April and July 2016 did not record any key tree or mistletoe species as outlined in the National Recovery Plan for the Regent Honeyeater (DoE 2016).

At the time of the July 2016 survey, few tree canopy species were flowering, however some younger regenerating trees showed signs of bud and emerging flower. Surveys in July 2016, and previous surveys of the wider Project Area, recorded an abundance of noisy miners (*Manorina melanocephala*), a species known to dominate in fragmented landscapes and exclude other bird species from their territories. No regent honeyeaters were recorded during this survey.



Plate 1

Woodland vegetation in the non-UHSA disturbance area.



Plate 2

Regenerating woodland vegetation in the non-UHSA disturbance area.

1.4 Likelihood of Regent Honeyeater Presence

The non-UHSA disturbance area does not contain habitat critical to the survival of the species as outlined in the National Recovery Plan for the Regent Honeyeater. Habitat critical to the survival of the species includes any breeding or foraging habitat in areas where the species is likely to occur (as per Figure 1 of the National Recovery Plan (DoE 2016)) or any newly discovered breeding or foraging locations. While the non-UHSA disturbance area is within the 'species likely to occur' extent in Figure 1 in the National Recovery Plan (DoE 2016), no breeding or foraging habitat associated with any key tree or mistletoe species as outlined in the National Recovery Plan have been recorded in this area.

The vegetation type in the non-UHSA disturbance area is Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter (HU905) which has an open canopy containing narrow-leaved ironbark (*Eucalyptus crebra*) and grey box (*Eucalyptus moluccana*) with a sub-canopy dominated by bullock (*Allocasuarina luehmannii*), which are not important tree species for the regent honeyeater. Furthermore, the vegetation in this area is primarily young (20-30 years old) and mature eucalypt trees that would provide more productive foraging resources are uncommon.

Vegetation in the wider Project Area is known to contain one key tree species, being spotted gum (*Corymbia maculata*) and one applicable key mistletoe species being box mistletoe (*Amyema miquelii*). Spotted gum occurs in the rehabilitation associated with the United mine and box mistletoe occurs sparsely across the Narrow-leaved Ironbark – Grey Box Grassy Woodland of the Central and Upper Hunter (HU905) and Bull Oak Grassy Woodland in the Central and Upper Hunter (HU906) vegetation communities. None of these species have been recorded in the non-UHSA disturbance area.

Previous records of the species in the locality, according to the BioNet Atlas of NSW Wildlife (refer to **Figure 1**), include one record within 500 metres to the south of the non-UHSA disturbance area in riparian vegetation associated with Wollombi Brook (OEH 2016). This record is dated from 1991 with a location accuracy of 10,000 metres (OEH 2016). Another record occurs approximately 2 kilometres to the south of the non-UHSA disturbance area also along Wollombi Brook dated from 1987 with a location accuracy of 1,000 metres (OEH 2016). A more recent record from 2002 occurs approximately 5 kilometres to the southeast of the non-UHSA disturbance area adjacent to Wallaby Scrub Road and Sandy Hollow Creek in box-ironbark woodlands (OEH 2016). One bird was observed foraging in a large narrow-leaved ironbark (*Eucalyptus crebra*) on 24 April 2002 and two birds were recorded foraging in narrow-leaved ironbarks and Blakelys red gum (*Eucalyptus blakelyi*) on 24 April 2002 (OEH 2016).

In recent years the regent honeyeater has been recorded utilising the habitats of the lower Hunter region around particularly at Quorrobolong and Ellalong for breeding and foraging (Birdlife 2013). In November 2007 regent honeyeaters were located breeding in Spotted Gum/Ironbark Forest at nearby Kurri Kurri (Birdlife 2013). A similar number of birds were also present in the Lower Hunter region during 2009 and 2012 (Birdlife 2013). Records of the species are less consistent in the central and upper Hunter and no breeding observations have been recorded in proximity to the non-UHSA disturbance area.

No recent (in the last 10 years) sightings of the species have been recorded in the habitats within or in the locality of the non-UHSA disturbance area, despite targeted surveys undertaken across the wider Project Area during 2010, 2011, 2012, 2013, 2014 and 2016. The extent of targeted winter bird survey in the non-UHSA disturbance area and the wider Project Area have not recorded the species utilising the habitats of the non-UHSA disturbance area or the similar and contiguous habitats of the wider Project Area. The survey results indicate that the additional disturbance area is poor quality habitat for the species, or due to the low number of individuals remaining, the chance of the species occurring in the additional disturbance area is very low.

The dominance of noisy miners (*Manorina melanocephala*) in this area is also likely to reduce the suitability of the habitat in the non-UHSA disturbance area. The aggressive exclusion of birds from woodland and forest habitat by overabundant noisy miners is a key threatening process under the TSC and EPBC Acts and a known threat to the regent honeyeater.

1.5 Conclusion

It is considered unlikely that the regent honeyeater would occur with any frequency or regularity within the non-UHSA disturbance area. The non-UHSA disturbance area was not identified as containing any key tree or mistletoe species for the regent honeyeater as outlined in the National Recovery Plan (DoE 2016) and records in the locality are uncommon and not recent (within the last 10 years) despite targeted surveys undertaken across the wider Project Area during 2010, 2011, 2012, 2013, 2014 and 2016. While its occasional, infrequent presence cannot be categorically ruled out, it is very likely that any occurrence in the non-UHSA disturbance area would be rare and of very limited duration, and of no significance to the species as a whole.

The extent of targeted winter bird survey in the non-UHSA disturbance area in 2016 and the surveys undertaken over the wider Project Area in the years 2010, 2011, 2012, 2013, 2014 and 2016 have not recorded the species utilising the habitats of the non-UHSA disturbance area or the similar and contiguous habitats of the wider Project Area.

This is consistent with the findings for the regent honeyeater for the United Collieries UHSA report which has been accepted and approved by OEH.

1.6 References

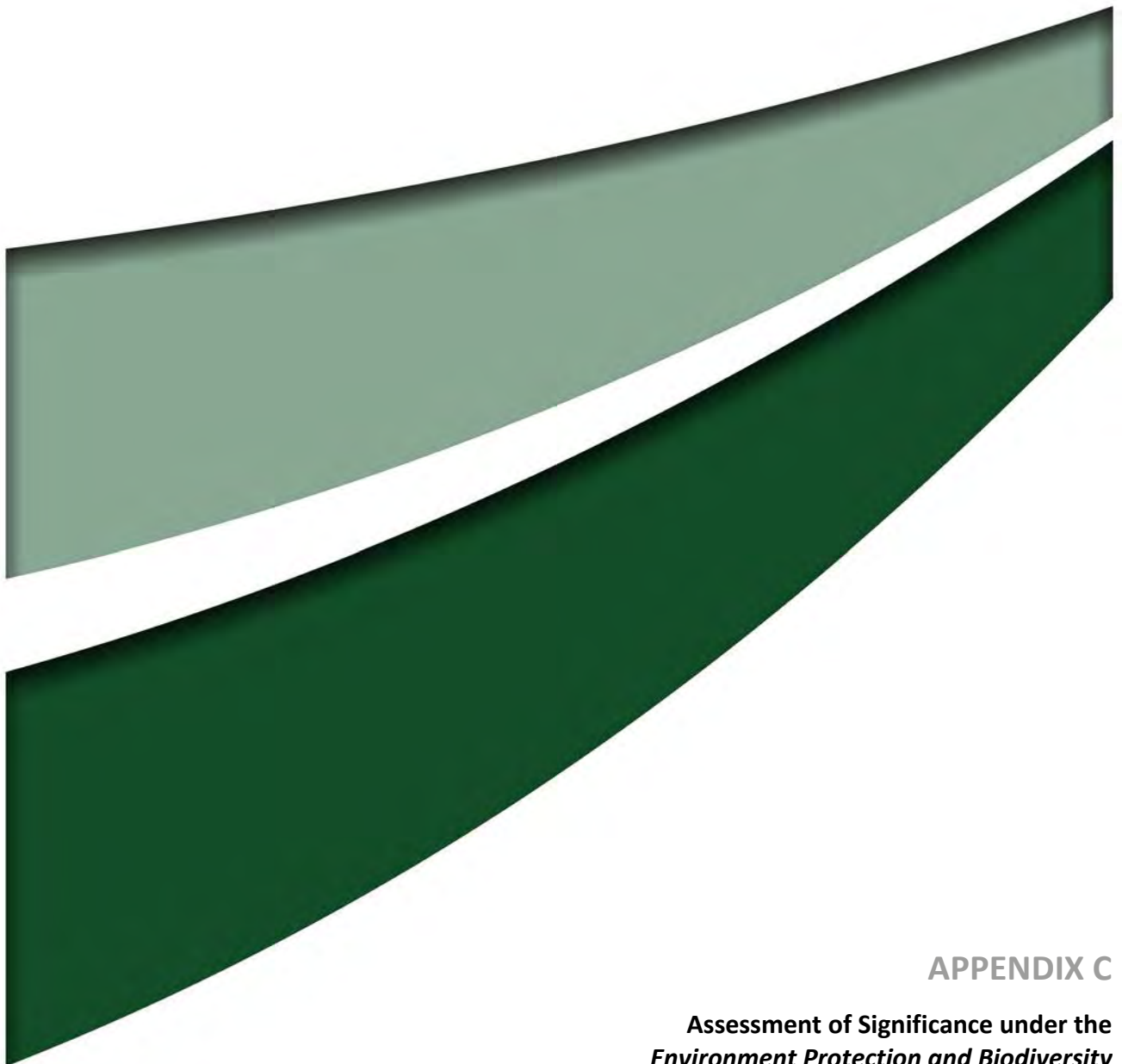
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APPENDIX C

**Assessment of Significance under the
*Environment Protection and Biodiversity
Conservation Act 1999 (EPBC Act)***

Assessment of Significance under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the completion of an Assessment of Significance relating to the potential impacts of a Project on listed Matters of National Environmental Significance (MNES). **Table 1** presents the threatened species and threatened ecological communities (TECs) discussed in Section 6.0 of the Statement of Consistency Report.

Table 1 - Threatened Species and Communities Considered in the Following Assessments

Common Name	Scientific Name
Critically Endangered Species	
Regent honeyeater	<i>Anthochaera phrygia</i>
Swift parrot	<i>Lathamus discolor</i>
Endangered Species	
Spotted-tailed quoll (SE mainland population)	<i>Dasyurus maculatus maculatus</i>
Vulnerable Species	
Large-eared pied bat	<i>Chalinolobus dwyeri</i>
Grey-headed flying-fox	<i>Pteropus poliocephalus</i>
Koala (combined populations of Qld, NSW and the ACT)	<i>Phascolarctos cinereus</i>
Critically Endangered Ecological Communities	
Central Hunter Valley Eucalypt Forest and Woodland	

The tests of significance presented below were prepared for inclusion in the EPBC Act Referral (EPBC 2015/7600) lodged in October 2015, with the Project deemed a 'Controlled Action' in December 2015, due to the potential for significant impacts on the following matters protected under the EPBC Act:

- Central Hunter Valley Eucalypt Forest and Woodland CEEC
- regent honeyeater (*Anthochaera phrygia*)
- swift parrot (*Lathamus discolor*)
- spotted-tailed quoll (*Dasyurus maculatus maculatus*), and
- a water resource.

These tests have been amended since the submission of the Referral to include the most up to date disturbance area and species listing status under the EPBC Act as at 11 May 2016.

Critically Endangered and Endangered Species

The following EPBC Act listed critically endangered species is considered in this assessment:

- Regent honeyeater (*Anthochaera phrygia*);

An assessment in accordance with the Department of the Environment (DoE) (2013) Significant Impact Guidelines 1.1 is provided below for this species.

In this case, a ‘population of a species’ is defined as an occurrence of the species in a particular area. Occurrences include but are not limited to:

- **A geographically distinct regional population, or collection of local populations, or**
- **A population, or collection of local populations, that occurs within a particular bioregion.**

The regent honeyeater was not recorded within the additional disturbance area despite targeted survey and annual winter bird survey monitoring.

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

- **lead to a long-term decrease in the size of a population, or;**

While 233 hectares of potentially suitable foraging habitat exists within the additional disturbance area for the regent honeyeater, this habitat if used at all is likely to only be sporadically used for short periods of time. In most years a small proportion of the eucalypts present in the additional disturbance area will flower and may provide a small short term foraging resource for the species. If utilised by the regent honeyeater in a particular year, the small numbers of flowering trees are likely to be used for between a few days and a few weeks at most. The regent honeyeater has not been recorded in the additional disturbance area despite targeted annual winter bird surveys. Therefore, the Project is unlikely to lead to a long-term decrease in the size of a population of the regent honeyeater.

- **reduce the area of occupancy of the species, or;**

The regent honeyeater has not been recorded in the additional disturbance area despite targeted annual winter bird surveys. Nevertheless, the regent honeyeater could potentially be a rare visitor to the additional disturbance area during winter months when eucalypt tree species flower. The Project will remove 233 hectares of potential habitat for the regent honeyeater. Therefore the Project would reduce the potential area of occupancy for the species.

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

As the regent honeyeater is a highly mobile species that forages over large distances in search of nectar resources, the removal of 233 hectares of potential habitat is considered unlikely to fragment any regent honeyeater population into two or more populations.

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

The habitat within the additional disturbance area is not considered to be critical to the survival of the regent honeyeater and therefore the Project is unlikely to adversely affect habitat critical to the survival of the species.

- **disrupt the breeding cycle of a population, or;**

The regent honeyeater may occur within the additional disturbance area on a rare basis and for short periods of time. It is not known to breed in the Hunter Valley. It is considered unlikely that the Project would disrupt the breeding cycle of any population of the regent honeyeater.

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

Although potential habitat for the regent honeyeater (approximately 233 hectares) would be removed within the additional disturbance area, the Project is considered unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat for these potentially occurring species to the extent that the regent honeyeater would be likely to decline.

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

The Project is not likely to result in invasive species that are harmful to the regent honeyeater becoming established in its habitat.

- **introduce disease which may cause the species to decline, or;**

The Project is not likely to introduce a disease which may cause a decline in the regent honeyeater.

- **interfere with the recovery of the species.**

The Project is unlikely to interfere substantially with the recovery of the regent honeyeater.

Conclusion

The Project is unlikely to result in a significant impact on the regent honeyeater.

Critically Endangered and Endangered Species

The following EPBC Act listed critically endangered species are considered in this assessment:

- Swift parrot (*Lathamus discolor*)

An assessment in accordance with the DoE (2013) Significant Impact Guidelines 1.1 is provided below for this species.

In this case, a ‘population of a species’ is defined as an occurrence of the species in a particular area. Occurrences include but are not limited to:

- **A geographically distinct regional population, or collection of local populations, or**
- **A population, or collection of local populations, that occurs within a particular bioregion.**

The swift parrot has been recorded 3 kilometres from the additional disturbance area based on records from the Atlas of NSW Wildlife (OEH 2015). While it has not been recorded within the additional disturbance area, if it did occur it may form a ‘population’ as defined by the Significant Impact Guidelines 1.1 of the EPBC Act.

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

- **lead to a long-term decrease in the size of a population, or;**

While 233 hectares of potentially suitable foraging habitat exists within the additional disturbance area for the swift parrot, this habitat if used at all is likely to be sporadically used for short periods of time when eucalypt trees flower during winter. In most years a small proportion of the eucalypts present flower and may provide a small short term foraging resource for the species. If utilised by the swift parrot in a particular year, the small numbers of flowering trees are likely to be used for between a few days and a few weeks. Additionally swift parrots may also forage for lerps in eucalypt foliage and typically remain in foraging areas for between a few days and a few weeks, before moving to the next foraging area. The swift parrot has not been recorded in the additional disturbance area despite targeted annual winter bird surveys. Therefore, the Project is unlikely to lead to a long-term decrease of the size of a population of the swift parrot.

- **reduce the area of occupancy of the species, or;**

The swift parrot may be a rare visitor to the additional disturbance area during winter months when eucalypt tree species flower and as a result the Project would reduce the potential area of occupancy. The Project will remove 233 hectares of potential habitat for the swift parrot. The swift parrot has not been recorded in the additional disturbance area despite targeted annual winter bird surveys.

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

As the swift parrot is a highly mobile species that forages over large distances in search of nectar resources, the removal of 233 hectares of potential habitat is considered unlikely to fragment any swift parrot populations into two or more populations.

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

The habitat within the additional disturbance area is not considered to be critical to the survival of the swift parrot and therefore the Project is unlikely to adversely affect habitat critical to the survival of any of this species.

- **disrupt the breeding cycle of a population, or;**

The swift parrot may occur within the additional disturbance area on a rare basis and large areas of potentially suitable habitat occur nearby and well within the mobility range of the species. As the swift parrot breeds in Tasmania and visits the mainland only during the non-breeding season, the potential reduction of up to 233 hectares of potential foraging habitat is considered unlikely to disrupt the breeding cycle of the National swift parrot population.

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

Although potential habitat for the swift parrot (approximately 233 hectares of woodland vegetation) would be removed within the additional disturbance area, the Project is considered unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat for this potentially occurring species to the extent that this species would be likely to decline.

Large potential habitat areas for the swift parrot occur in the nearby Wollemi National Park (approximately 488,620 hectares), providing alternative habitat areas for this highly mobile species.

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

The Project is not likely to result in invasive species that are harmful to the swift parrot becoming established in its habitat.

- **introduce disease which may cause the species to decline, or;**

The Project is not likely to introduce a disease which may cause a decline in the swift parrot.

- **interfere with the recovery of the species.**

The Project is unlikely to interfere substantially with the recovery of the swift parrot.

Conclusion

The Project is unlikely to result in a significant impact on the swift parrot.

Endangered Species

The following EPBC Act listed endangered species is considered in this assessment:

- Spotted-tailed quoll (SE mainland population) (*Dasyurus maculatus maculatus*)

An assessment in accordance with the DoE (2013) Significant Impact Guidelines 1.1 is provided below for this species.

In this case, a ‘population of a species’ is defined as an occurrence of the species in a particular area. Occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

The spotted-tailed quoll (SE mainland population) has been recorded on a single occasion in the east of the additional disturbance area. This record was made by way of baited (i.e. a food source to attract animals) remote camera in an area of swamp oak vegetation during 2013. This species has not been recorded prior to this event or since this point of time despite subsequent targeted survey. There are relatively few recent records of this species occurring from the floor of the Hunter Valley. It is considered unlikely that the spotted-tailed quoll is breeding within the additional disturbance area, however it is likely that the spotted-tailed quoll occasionally utilises the habitats available as part of a wider territory. The spotted-tailed quoll has been recorded once in 2013 by a remote camera set by United personnel. While it has not been recorded within the additional disturbance area since then, if it did occur it may form a ‘population’ as defined by the Significant Impact Guidelines 1.1 of the EPBC Act.

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

- lead to a long-term decrease in the size of a population, or;

While habitat exists within the additional disturbance area for the spotted-tail quoll, the species has been recorded only once, in 2013. It is likely that the additional disturbance area forms part of a large home range area for one or a small number of spotted-tailed quolls that forage within it on occasion. As the additional disturbance area is unlikely to support a significant component of a resident population of the spotted-tailed quoll, the Project is unlikely to lead to a long-term decrease of the size of a population of the spotted-tail quoll.

- reduce the area of occupancy of the species, or;

The spotted-tailed quoll has been recorded once in the additional disturbance area in 2013 and may occur on an occasional or rare basis. If present, the Project would result in a 464 hectare reduction of the potential area of occupancy of the spotted-tailed quoll.

- fragment an existing population into two or more populations, or;

The spotted-tailed quoll has been recorded once within the additional disturbance area. This individual is likely to belong to a local population of the spotted-tailed quoll that predominantly occurs in Wollemi National Park and extends occasionally onto the valley floor. The spotted-tailed quoll has not been recorded in adjacent habitat areas of Wambo Coal Mine and has only once been recorded in the Warkworth Mine associated habitat areas to the south of the additional disturbance area, recorded as a 1979 scat record. Habitat areas of the additional disturbance area and surrounds are likely to provide sub-optimal habitat for the species given the level of surrounding disturbance from mining and agriculture.

Disturbance caused by the Project may reduce the ability of individuals in Wollemi National Park to disperse or move to sub-optimal habitat areas around the additional disturbance area, leaving only a narrow connection of riparian vegetation along Wollombi Brook. Additional areas of woodland habitat occur to the south and east of Wollombi Brook that may also provide a connection between the areas east of the additional disturbance area and Wollemi National Park. The reduction of the ability of the species to disperse or move to the east is considered unlikely to fragment an existing population into two or more populations.

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

The habitat within the additional disturbance area is not considered to be critical to the survival of the spotted-tailed quoll and therefore the Project is unlikely to adversely affect habitat critical to the survival of this species.

- **disrupt the breeding cycle of a population, or;**

While recorded within the additional disturbance area, the spotted-tailed quoll is likely to occur on an occasional or rare basis when dispersing or moving east from high quality habitat areas in Wollemi National Park. As only a very small portion of the spotted-tailed quoll population that occurs in the very large Wollemi National Park is likely to occur on an occasional or rare basis in the additional disturbance area, the Project is unlikely to disrupt the breeding cycle of the species.

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

Although potential habitat for the spotted-tailed quoll (approximately 464 hectares of woodland) would be removed within the additional disturbance area, the Project is considered unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat for this potentially occurring species to the extent that this species would be likely to decline.

Large potential habitat areas for the spotted-tailed quoll occur in the nearby Wollemi National Park (approximately 488,620 hectares), providing alternative habitat areas for this highly mobile species.

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

The Project is not likely to result in invasive species that are harmful to the spotted-tailed quoll becoming established in its habitat.

- **introduce disease which may cause the species to decline, or;**

The Project is not likely to introduce a disease which may cause a decline in the spotted-tailed quoll.

- **interfere with the recovery of the species.**

The Project is unlikely to interfere substantially with the recovery of the spotted-tailed quoll.

Conclusion

The Project is likely to reduce the potential area of occupancy of the spotted-tailed quoll by 464 hectares. However, as there has only been one record of one individual spotted-tailed quoll, and given the likely rare and short (days not weeks) visits to the additional disturbance area by a likely small number of individuals, combined with the occurrence of abundant similar potential habitat areas in the nearby Wollemi National Park, the Project is considered unlikely to result in a significant impact on the spotted-tail quoll.

Vulnerable Species

The following EPBC Act listed vulnerable species is considered in this assessment:

- Large-eared pied bat (*Chalinolobus dwyeri*)
- Grey-headed flying-fox (*Pteropus poliocephalus*), and
- Koala (*Phascolarctos cinereus*) combined populations of Qld, NSW and ACT.

An assessment in accordance with the DoE (2013) Significant Impact Guidelines 1.1 is provided below for these species.

In this case, an important population is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- **key source populations either for breeding or dispersal; or**
- **populations that are necessary for maintaining genetic diversity, and/or**
- **populations that are near the limit of the species range.**

The large-eared pied bat has been recorded within the additional disturbance area; however as this species is a cave-dwelling bat species (and no potential roost sites are present), it is likely that the additional disturbance areas provides only foraging habitat for the species. The presence of this species in the additional disturbance area is not at the known distributional limit for this species and is unlikely to be important for the maintenance of genetic diversity. Consequently, the record of this species within the additional disturbance area is not likely to constitute an important population of this species.

The grey-headed flying-fox has been recorded within the additional disturbance area; however, roosting sites for this species are readily identifiable and have not been identified within the additional disturbance area. As a consequence, it is likely that the grey-headed flying-fox, would only use the habitat of the additional disturbance area as part of a much larger foraging range. Consequently, the presence of the grey-headed flying-fox in the additional disturbance area is not likely to constitute an important population for this species.

The koala has been identified within the additional disturbance area, however, this record was identified from old scats under a single tree in 2006. No other records of the koala have been made since 2006 despite numerous Spot Assessment Technique (SAT) searches and several spotlighting surveys of the additional disturbance area between 2009 and 2015. The koala is considered unlikely to occur in the additional disturbance area and the 2006 record is likely to be a record of a dispersing individual moving through the landscape. There is not an important resident population of the koala in the additional disturbance area.

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

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

The additional disturbance area is unlikely to comprise an important population of large-eared pied bat, grey-headed flying-fox or koala. It is unlikely that the Proposed Action will lead to a long-term decrease to any important populations of large-eared pied bat, grey-headed flying-fox or koala.

- **reduce the area of occupancy of an important population, or;**

The Project will result in the loss of approximately 464 hectares of potential foraging habitat for the large-eared pied bat across woodland, grassland and regenerating habitats within the additional disturbance area. The Project will result in the loss of approximately 233 hectares of eucalypt-dominated woodland potential foraging habitats for the grey-headed flying fox and koala.

The additional disturbance area is unlikely to comprise an important population of large-eared pied bat, grey-headed flying-fox or koala. It is acknowledged that the Project may potentially reduce the availability of foraging habitat available to the large-eared pied bat and grey-headed flying-fox, however the extent of the reduction is not likely to be significant to the populations of these species.

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

The additional disturbance area is unlikely to comprise an important population of large-eared pied bat, grey-headed flying-fox or koala. It is acknowledged that the Project may potentially fragment foraging habitat for the large-eared pied bat and the grey-headed flying-fox; however, these species are highly mobile and unlikely to be significantly impacted by the extent of habitat fragmentation.

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

Potential habitat occurs for the koala in the additional disturbance area, however the loss of this potential habitat is unlikely to affect the survival of the species. While the additional disturbance area provides foraging habitat for both the large-eared pied bat and grey-headed flying-fox the habitat is unlikely to be critical to the survival of either species.

The Project is unlikely to adversely affect habitat critical to the survival of the large-eared pied bat, grey-headed flying-fox and koala.

- **disrupt the breeding cycle of an important population, or;**

The additional disturbance area is unlikely to comprise an important population of large-eared pied bat, grey-headed flying-fox or koala.

The large-eared pied bat is a cave-roosting bat species and there are no appropriate areas in the additional disturbance area for this species to roost. The grey-headed flying-fox roosts in camps; no camps have been identified in the additional disturbance area, and given the level of survey effort in the additional disturbance area, it is unlikely that there are any camp sites for this species present.

The Project is unlikely to disrupt the breeding cycle of an important population of the large-eared pied bat, grey-headed flying-fox or koala.

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

The Project is unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline for the large-eared pied bat, grey-headed flying-fox or koala.

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

The Project is unlikely to result in an invasive species becoming established that is harmful to large-eared pied bat, grey-headed flying-fox or koala.

- **interferes substantially with the recovery of the species.**

It is unlikely that the Project would interfere substantially with the recovery of the large-eared pied bat, grey-headed flying-fox or koala.

Conclusion

The Project is unlikely to result in a significant impact on an important population of the large-eared pied bat, grey-headed flying-fox or koala.

Critically Endangered Ecological Communities

The following EPBC Act listed critically endangered ecological community was considered in this assessment:

- Central Hunter Valley Eucalypt Forest and Woodland;

An assessment in accordance with the DoE (2013) Significant Impact Guidelines 1.1 is provided below for this ecological community.

A total of approximately 223.5 hectares of the Central Hunter Valley Eucalypt Forest and Woodland CEEC (Central Hunter Valley CEEC) has been recorded in the additional disturbance area.

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

- **Reduce the extent of an ecological community**

The removal of approximately 223.5 hectares of the Central Hunter Valley CEEC as a result of the Project will reduce the extent of the community, however the level of the reduction is considered minor given the current extent of 37,000 hectares of the community (i.e. 0.6%).

- **Fragment or increase fragmentation of an ecological community;**

The removal of approximately 223.5 hectares of the Central Hunter Valley CEEC will result in an increase in the fragmentation of the community. The level of fragmentation will increase in the local area with the removal of remnants totalling approximately 223.5 hectares however, given the current occurrence of approximately 37,000 hectares of the community, the level of increase in fragmentation is considered to be negligible.

- **adversely affect habitat critical to the survival of an ecological community;**

The conservation advice for the Central Hunter Valley CEEC identifies area of moderate quality condition class as being areas critical to the survival of the community. Areas of moderate quality condition occur within the additional disturbance area, however given the current approximate 37,000 hectare extent of the community, the removal of the moderate quality condition areas from the additional disturbance area is considered unlikely to affect the survival of the Central Hunter Valley CEEC.

- **modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;**

The clearing of approximately 223.5 hectares of the Central Hunter Valley CEEC result in its complete removal from the additional disturbance area, however, the Project is unlikely to modify or destroy the abiotic factors that affect the survival of the ecological community in surrounding areas.

- **cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;**

The clearing of approximately 223.5 hectares of the Central Hunter Valley CEEC will remove this ecological community from the additional disturbance area although it is unlikely to result in a substantial change in the species composition in the surrounding areas or region.

- **cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**
 - **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
 - **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or;**

The clearing of approximately 223.5 hectares of the Central Hunter Valley CEEC will substantially reduce the quality and integrity of the ecological community in the additional disturbance area. However the removal of approximately 223.5 hectares of the Central Hunter Valley CEEC is unlikely to result in a substantial reduction in the quality or integrity of the surrounding or nearby occurrences of the ecological community.

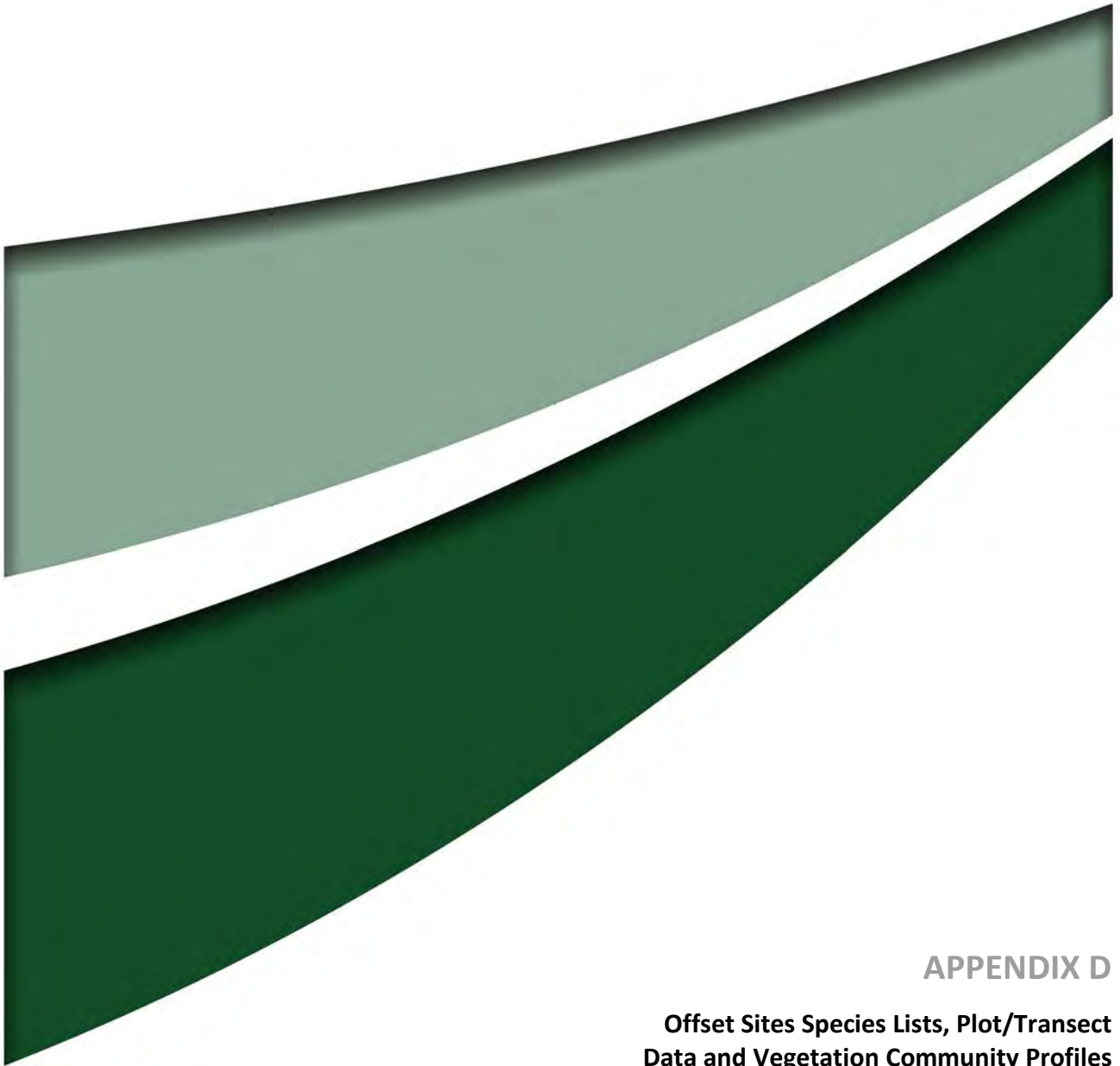
The removal of approximately 223.5 hectares of the Central Hunter Valley CEEC is unlikely to result in assisting an invasive species that is harmful to the Central Hunter Valley CEEC becoming established. It is also unlikely to cause regular mobilisation of fertilizers, herbicides or other chemicals or pollutants into the ecological community which would kill or inhibit the growth of species in the Central Hunter Valley CEEC.

- **interfere with the recovery of an ecological community.**

The removal of 223.5 hectares of the Central Hunter Valley CEEC from the additional disturbance area and will interfere in a minor way with the recovery of the ecological community.

Conclusion

The Project is likely to have a significant impact on the Central Hunter Valley CEEC. The Project will reduce the extent of the community by approximately 223.5 hectares, negligibly increase the level of fragmentation of the ecological community, adversely impact some areas of critical habitat of the ecological community and interfere with the recovery of the ecological community.



APPENDIX D

**Offset Sites Species Lists, Plot/Transect
Data and Vegetation Community Profiles**

Fauna Species Lists

The following fauna list was developed from surveys of the Highfields, Mangrove and Wambo Offset Sites by Umwelt (refer to **Sections 13.3.2.1, 13.3.3.1 and 13.3.4.1**). Detailed fauna surveys of the Wambo Offset Site have not been undertaken by Umwelt, however the Atlas of NSW Wildlife (OEH 2016) contains known threatened species records and these have been included in the table below.

The following abbreviations or symbols are used in the list:

X	Recorded at the relevant Offset Site
asterisk (*)	Denotes species not indigenous to the Offset Sites
subsp.	Subspecies
V	Vulnerable under the TSC and/or EPBC Acts.
PD	Preliminary Determination for listing under the TSC and/or EPBC Acts.

Birds recorded were identified using descriptions in Slater *et al.* (2003) and the scientific and common name nomenclature of BirdLife International Taxonomic Checklist (2015) (formerly Birds Australia). Reptiles recorded were identified using keys and descriptions in Cogger (2000), Swan *et al.* (2004), Weigel (1990) and Wilson and Swan (2008) and the scientific and common name nomenclature of Cogger (2000).

Amphibians recorded were identified using keys and descriptions in Cogger (2000), Robinson (1998), Anstis (2002) and Barker *et al.* (1995) and the scientific and common name nomenclature of Cogger (2000). Mammals recorded were identified using keys and descriptions in Strahan (2002) and Menkhorst and Knight (2004) and the scientific and common name nomenclature of Strahan (2002) for non bat species. Bat species recorded were identified using keys and descriptions in Churchill (1998) with ecological information obtained from Churchill (2008).

Scientific Name	Common Name	Conservation Status		Recorded at Offset Sites		
		TSC Act	EPBC Act	Highfields	Mangrove	Wambo
AMPHIBIANS						
Myobatrachidae						
Crinia signifera	common eastern froglet			X		
Limnodynastes ornatus	ornate burrowing frog				X	
Limnodynastes tasmaniensis	spotted marsh frog				X	
Pseudophryne coriacea	red-backed toadlet			X		
Uperoleia laevisgata	smooth toadlet				X	
Hylidae						
Litoria caerulea	green tree frog				X	
Litoria latopalmata	broad-palmed frog				X	
Litoria peronii	Perons tree frog				X	

Scientific Name	Common Name	Conservation Status		Recorded at Offset Sites		
		TSC Act	EPBC Act	Highfields	Mangrove	Wambo
REPTILES						
Gekkonidae						
<i>Oedura lesueurii</i>	Lesueurs velvet gecko				X	
<i>Underwoodisaurus milii</i>	thick-tailed gecko			X	X	
Varanidae						
<i>Varanus varius</i>	lace monitor			X		
Agamidae						
<i>Amphibolurus muricatus</i>	jacky lizard				X	
<i>Pogona barbata</i>	eastern bearded dragon			X		
Scincidae						
<i>Anomalopus leuckartii</i>	two-clawed worm skink				X	
<i>Carlia foliorum</i>	litter skink			X		
<i>Carlia tetradactyla</i>	southern rainbow skink			X		
<i>Ctenotus robustus</i>	striped skink				X	
<i>Ctenotus taeniolatus</i>	copper-tailed skink			X	X	
<i>Egernia mcphreei</i>	eastern crevice skink			X		
<i>Egernia modesta</i>				X		
<i>Egernia striolata</i>	tree skink				X	
<i>Egernia whitii</i>	Whites skink				X	
<i>Lampropholis delicata</i>	grass skink			X		
Elapidae						
<i>Demansia psammophis</i>	yellow-faced whip snake				X	
BIRDS						
Phasianidae						
<i>Coturnix ypsilophora</i>	brown quail			X	X	
<i>Phaps chalcoptera</i>	common bronzewing			X	X	
Anatidae						
<i>Chenonetta jubata</i>	Australian wood duck			X	X	
<i>Anas gracilis</i>	grey teal			X		
<i>Anas castanea</i>	chestnut teal			X		

Scientific Name	Common Name	Conservation Status		Recorded at Offset Sites		
		TSC Act	EPBC Act	Highfields	Mangrove	Wambo
<i>Anas superciliosa</i>	Pacific black duck			X		
<i>Aythya australis</i>	hardhead			X		
Podicipedidae						
<i>Tachybaptus novaehollandiae</i>	Australasian grebe			X		
Columbidae						
<i>Ocyphaps lophotes</i>	crested pigeon			X	X	
<i>Leucosarcia melanoleuca</i>	wonga pigeon			X		
Podargidae						
<i>Podargus strigoides</i>	tawny frogmouth				X	
Phalacrocoracidae						
<i>Phalacrocorax varius</i>	pied cormorant			X		
Pelecanidae						
<i>Pelecanus conspicillatus</i>	Australian pelican				X	
Ardeidae						
<i>Egretta novaehollandiae</i>	white-faced heron			X		
Accipitridae						
<i>Elanus axillaris</i>	black-shouldered kite				X	
<i>Aquila audax</i>	wedge-tailed eagle			X	X	X
Falconidae						
<i>Falco berigora</i>	brown falcon				X	
<i>Falco cenchroides</i>	nankeen kestrel			X	X	
Cacatuidae						
<i>Cacatua roseicapillus</i>	galah			X	X	
<i>Calyptorhynchus lathami</i>	glossy black-cockatoo	V			X	
<i>Calyptorhynchus funereus</i>	yellow-tailed black-cockatoo			X		X
<i>Cacatua galerita</i>	sulphur-crested cockatoo			X	X	
Psittacidae						
<i>Trichoglossus haematodus</i>	rainbow lorikeet			X		
<i>Glossopsitta concinna</i>	musk lorikeet			X		

Scientific Name	Common Name	Conservation Status		Recorded at Offset Sites		
		TSC Act	EPBC Act	Highfields	Mangrove	Wambo
<i>Glossopsitta pusilla</i>	little lorikeet	V		X	X	
<i>Alisterus scapularis</i>	Australian king-parrot			X	X	
<i>Platycercus eximius</i>	eastern rosella			X	X	
<i>Psephotus haematonotus</i>	red-rumped parrot				X	
<i>Melopsittacus undulatus</i>	budgerigar			X		
Cuculidae						
<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo			X	X	
Strigidae						
<i>Ninox novaeseelandiae</i>	southern boobook			X	X	
Tytonidae						
<i>Tyto javanica</i>	eastern barn owl			X	X	
Halcyonidae						
<i>Dacelo novaeguineae</i>	laughing kookaburra			X	X	
Climacteridae						
<i>Corombates leucophaea</i>	white-throated treecreeper			X	X	X
<i>Climacteris picumnus victoriae</i>	brown treecreeper (eastern subsp.)	V		X	X	
Maluridae						
<i>Malurus cyaneus</i>	superb fairy-wren			X	X	
Acanthizidae						
<i>Origma solitaria</i>	rockwarbler			X	X	
<i>Sericornis frontalis</i>	white-browed scrubwren			X		
<i>Chthonicola sagittata</i>	speckled warbler	V		X	X	X
<i>Smicrornis brevirostris</i>	weebill			X	X	X
<i>Gerygone albogularis</i>	white-throated gerygone			X	X	
<i>Gerygone fusca</i>	western gerygone			X		
<i>Acanthiza lineata</i>	striated thornbill			X	X	X
<i>Acanthiza nana</i>	yellow thornbill			X	X	X
<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill			X	X	X
<i>Acanthiza reguloides</i>	buff-rumped thornbill			X		

Scientific Name	Common Name	Conservation Status		Recorded at Offset Sites		
		TSC Act	EPBC Act	Highfields	Mangrove	Wambo
<i>Acanthiza pusilla</i>	brown thornbill			X	X	
Pardalotidae						
<i>Pardalotus punctatus</i>	spotted pardalote			X	X	X
<i>Pardalotus striatus</i>	striated pardalote			X	X	X
Meliphagidae						
<i>Acanthorhynchus tenuirostris</i>	eastern spinebill			X	X	X
<i>Lichenostomus chrysops</i>	yellow-faced honeyeater			X	X	X
<i>Lichenostomus fuscus</i>	fuscous honeyeater				X	
<i>Lichenostomus leucotis</i>	white-eared honeyeater			X	X	X
<i>Lichenostomus penicillatus</i>	white-plumed honeyeater			X	X	
<i>Manorina melanocephala</i>	noisy miner			X	X	X
<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater			X		
<i>Anthochaera chrysoptera</i>	little wattlebird			X		
<i>Anthochaera carunculata</i>	red wattlebird			X		
<i>Phylidonyris niger</i>	white-cheeked honeyeater			X		X
<i>Myzomela sanguinolenta</i>	scarlet honeyeater			X		
<i>Melithreptus albogularis</i>	white-throated honeyeater			X		
<i>Melithreptus brevirostris</i>	brown-headed honeyeater			X		
<i>Melithreptus lunatus</i>	white-naped honeyeater			X		
<i>Philemon corniculatus</i>	noisy friarbird			X	X	
<i>Plectorhyncha lanceolata</i>	striped honeyeater			X		X
Pomatostomidae						
<i>Pomatostomus temporalis temporalis</i>	grey-crowned babbler (eastern subsp.)	V		X	X	X
<i>Pomatostomus superciliosus</i>	white-browed babbler				X	

Scientific Name	Common Name	Conservation Status		Recorded at Offset Sites		
		TSC Act	EPBC Act	Highfields	Mangrove	Wambo
Eupetidae						
<i>Cinclosoma punctatum</i>	spotted quail-thrush			X		
Neosittidae						
<i>Daphoenositta chrysoptera</i>	varied sittella	V		X	X	
Campephagidae						
<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike			X	X	
Pachycephalidae						
<i>Pachycephala pectoralis</i>	golden whistler			X	X	X
<i>Pachycephala rufiventris</i>	rufous whistler			X	X	
<i>Colluricincla harmonica</i>	grey shrike-thrush			X	X	
Oriolidae						
<i>Oriolus sagittatus</i>	olive-backed oriole			X	X	
Artamidae						
<i>Artamus cyanopterus</i>	dusky woodswallow	PD V			X	
<i>Cracticus torquatus</i>	grey butcherbird			X	X	X
<i>Cracticus nigrogularis</i>	pied butcherbird			X	X	
<i>Cracticus tibicen</i>	Australian magpie			X	X	X
<i>Strepera graculina</i>	pied currawong			X	X	X
Rhipiduridae						
<i>Rhipidura albiscapa</i>	grey fantail			X	X	X
<i>Rhipidura leucophrys</i>	willie wagtail			X	X	
Corvidae						
<i>Corvus coronoides</i>	Australian raven			X	X	X
Monarchidae						
<i>Myiagra rubecula</i>	leaden flycatcher				X	
<i>Grallina cyanoleuca</i>	magpie-lark			X	X	
Corcoracidae						
<i>Corcorax melanorhamphos</i>	white-winged chough			X	X	X
Petroicidae						
<i>Microeca leucophaea</i>	jacky winter			X	X	
<i>Petroica boodang</i>	scarlet robin	V		X		

Scientific Name	Common Name	Conservation Status		Recorded at Offset Sites		
		TSC Act	EPBC Act	Highfields	Mangrove	Wambo
<i>Petroica rosea</i>	rose robin			X		
<i>Eopsaltria australis</i>	eastern yellow robin			X	X	
Timaliidae						
<i>Zosterops lateralis</i>	silveryeye			X	X	
Hirundinidae						
<i>Hirundo neoxena</i>	welcome swallow			X	X	
Sturnidae						
* <i>Sturnus tristis</i>	common myna			X		
* <i>Sturnus vulgaris</i>	common starling				X	
Nectariniidae						
<i>Dicaeum hirundinaceum</i>	mistletoebird			X	X	
Estrildidae						
<i>Taeniopygia guttata</i>	zebra finch				X	
<i>Taeniopygia bichenovii</i>	double-barred finch			X	X	
<i>Neochmia temporalis</i>	red-browed finch			X	X	X
<i>Stagonopleura oculata</i>	red-eared firetail			X		
Motacilidae						
<i>Anthus novaeseelandiae</i>	Australasian pipit			X	X	
MAMMALS						
Dasyuridae						
<i>Antechinus flavipes</i>	yellow-footed antechinus			X		
Vombatidae						
<i>Vombatus ursinus</i>	common wombat			X		
Petauridae						
<i>Petaurus breviceps</i>	sugar glider			X	X	
Pseudocheiridae						
<i>Pseudocheirus peregrinus</i>	common ringtail possum			X		
Phalangeridae						
<i>Trichosurus vulpecula</i>	common brushtail possum			X	X	
Macropodidae						
<i>Macropus giganteus</i>	eastern grey kangaroo			X	X	

Scientific Name	Common Name	Conservation Status		Recorded at Offset Sites		
		TSC Act	EPBC Act	Highfields	Mangrove	Wambo
<i>Macropus rufogriseus</i>	red-necked wallaby			X		
<i>Macropus robustus</i>	common wallaroo			X	X	
<i>Wallabia bicolor</i>	swamp wallaby			X		
Rhinolophidae						
<i>Rhinolophus megaphyllus</i>	eastern horseshoe-bat			X		
Emballonuridae						
<i>Saccolaimus flaviventris</i>	yellow-bellied sheath-tail bat	V		X	X	
Molossidae						
<i>Mormopterus norfolkensis</i>	east coast freetail-bat	V				X
<i>Mormopterus planiceps</i>	southern freetail-bat			X	X	
<i>Tadarida australis</i>	white-striped freetail-bat			X	X	
Vespertilionidae						
<i>Miniopterus schreibersii oceanensis</i>	eastern bentwing-bat	V		X	X	X
<i>Nyctophilus geoffroyi</i>	lesser long-eared bat			X		
<i>Nyctophilus gouldi</i>	Goulds long-eared bat			X		
<i>Chalinolobus dwyeri</i>	large-eared pied bat	V	V	X	X	
<i>Chalinolobus gouldii</i>	Goulds wattled bat			X	X	
<i>Chalinolobus morio</i>	chocolate wattled bat			X		
<i>Falsistrellus tasmaniensis</i>	eastern false pipistrelle	V			X	
<i>Myotis macropus</i>	southern myotis	V		X	X	
<i>Scotorepens balstoni</i>	inland broad-nosed bat			X	X	
<i>Vespadelus regulus</i>	southern forest bat			X		
<i>Vespadelus troughtoni</i>	eastern cave bat	V		X	X	
<i>Vespadelus vulturnus</i>	little forest bat			X	X	
Muridae						
* <i>Mus musculus</i>	house mouse			X		
Canidae						
* <i>Canis lupus familiaris</i>	dog			X		
<i>Vulpes vulpes</i>	fox			X	X	

Scientific Name	Common Name	Conservation Status		Recorded at Offset Sites		
		TSC Act	EPBC Act	Highfields	Mangrove	Wambo
Leporidae						
* <i>Oryctolagus cuniculus</i>	European rabbit				X	
* <i>Lepus capensis</i>	brown hare			X		
Suidae						
* <i>Sus scrofa</i>	pig			X		

Flora Species List

The following list was developed from surveys of the offset sites by Umwelt as outlined in **Section 13.0**. 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:

asterisk (*) denotes species not native to the Marulan area;

subsp. subspecies; and

var. variety.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 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 2016), the on-line plant name database maintained by the National Herbarium of New South Wales.

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

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Cycadopsida		
Zamiaceae	<i>Macrozamia</i> sp.	
Coniferopsida		
Cupressaceae	<i>Callitris endlicheri</i>	black cypress pine
Filicopsida		
Adiantaceae	<i>Asplenium flabellifolium</i>	
Adiantaceae	<i>Cheilanthes distans</i>	bristly cloak fern
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	rock fern
Adiantaceae	<i>Pellaea falcata</i>	
Magnoliopsida (Liliidae)		
Anthericaceae	<i>Arthropodium milleflorum</i>	pale vanilla-lily
Anthericaceae	<i>Arthropodium minus</i>	small vanilla lily
Anthericaceae	<i>Arthropodium</i> sp.	
Anthericaceae	<i>Arthropodium</i> sp. B	

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Anthericaceae	<i>Laxmannia gracilis</i>	slender wire lily
Commelinaceae	<i>Commelina cyanea</i>	native wandering Jew
Cyperaceae	<i>Carex appressa</i>	tall sedge
Cyperaceae	<i>Carex inversa</i>	knob sedge
Cyperaceae	<i>Cyperus enervis</i>	
Cyperaceae	<i>Cyperus gracilis</i>	slender flat-sedge
Cyperaceae	<i>Cyperus</i> sp.	
Cyperaceae	<i>Fimbristylis dichotoma</i>	common fringe-sedge
Cyperaceae	<i>Gahnia aspera</i>	rough saw-sedge
Cyperaceae	<i>Lepidosperma laterale</i>	variable sword-sedge
Cyperaceae	<i>Scleria mackaviensis</i>	
Juncaceae	<i>Juncus homalocaulis</i>	
Juncaceae	<i>Juncus</i> sp.	
Juncaceae	<i>Juncus usitatus</i>	
Juncaceae	<i>Luzula flaccida</i>	woodrush
Lomandraceae	<i>Lomandra filiformis</i>	
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	wattle matt-rush
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	
Lomandraceae	<i>Lomandra longifolia</i>	spiny-headed mat-rush
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	many-flowered mat-rush
Lomandraceae	<i>Lomandra</i> sp.	
Luzuriagaceae	<i>Eustrephus latifolius</i>	wombat berry
Phormiaceae	<i>Dianella caerulea</i>	blue flax-lily
Phormiaceae	<i>Dianella caerulea</i> var. <i>caerulea</i>	
Phormiaceae	<i>Dianella longifolia</i>	blueberry lily
Phormiaceae	<i>Dianella revoluta</i> var. <i>revoluta</i>	
Poaceae	<i>Aristida jerichoensis</i>	
Poaceae	<i>Aristida ramosa</i>	purple wiregrass
Poaceae	<i>Aristida vagans</i>	threeawn speargrass
Poaceae	<i>Austrodanthonia bipartita</i>	wallaby grass
Poaceae	<i>Austrodanthonia fulva</i>	wallaby grass
Poaceae	<i>Austrodanthonia monticola</i>	mountain wallaby grass
Poaceae	<i>Austrodanthonia racemosa</i> var. <i>racemosa</i>	a wallaby grass
Poaceae	<i>Austrostipa aristiglumis</i>	plains grass

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Poaceae	<i>Austrostipa scabra</i>	speargrass
Poaceae	<i>Austrostipa scabra</i> subsp. <i>falcata</i>	
Poaceae	<i>Austrostipa verticillata</i>	
Poaceae	<i>Bothriochloa decipiens</i> var. <i>decipiens</i>	red grass
Poaceae	<i>Bothriochloa macra</i>	red grass
Poaceae	* <i>Briza minor</i>	shivery grass
Poaceae	* <i>Bromus catharticus</i>	prairie grass
Poaceae	* <i>Bromus hordeaceus</i>	soft brome
Poaceae	* <i>Bromus molliformis</i>	soft brome
Poaceae	* <i>Catapodium rigidum</i>	
Poaceae	<i>Cenchrus caliculatus</i>	hillside burrgrass
Poaceae	<i>Chloris truncata</i>	windmill grass
Poaceae	<i>Chloris ventricosa</i>	tall chloris
Poaceae	<i>Cleistochloa rigida</i>	
Poaceae	<i>Cymbopogon refractus</i>	barbed wire grass
Poaceae	<i>Cynodon dactylon</i>	
Poaceae	<i>Dichanthium sericeum</i>	queensland bluegrass
Poaceae	<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	queensland bluegrass
Poaceae	<i>Dichanthium</i> sp.	
Poaceae	<i>Dichelachne micrantha</i>	shorthair plumegrass
Poaceae	<i>Dichopogon strictus</i>	
Poaceae	<i>Digitaria brownii</i>	
Poaceae	<i>Digitaria</i> sp.	a finger grass
Poaceae	<i>Echinopogon caespitosus</i>	bushy hedgehog-grass
Poaceae	<i>Echinopogon ovatus</i>	
Poaceae	<i>Elymus scaber</i>	common wheatgrass
Poaceae	<i>Enteropogon acicularis</i>	curly windmill grass
Poaceae	<i>Eragrostis brownii</i>	brown's lovegrass
Poaceae	<i>Eragrostis leptostachya</i>	paddock lovegrass
Poaceae	<i>Eragrostis setifolia</i>	Neverfail
Poaceae	<i>Eriochloa pseudoacrotricha</i>	early spring grass
Poaceae	<i>Eulalia aurea</i>	
Poaceae	* <i>Lolium perenne</i>	perennial ryegrass
Poaceae	* <i>Lolium rigidum</i>	wimmera ryegrass

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Poaceae	<i>*Lolium sp.</i>	a ryegrass
Poaceae	<i>Microlaena stipoides</i>	weeping grass
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	weeping grass
Poaceae	<i>Panicum effusum</i>	hairy panic
Poaceae	<i>Panicum queenslandicum</i>	yadbila grass
Poaceae	<i>Panicum simile</i>	two-colour panic
Poaceae	<i>Panicum sp.</i>	panicum
Poaceae	<i>Paspalidium distans</i>	
Poaceae	<i>Paspalidium gracile</i>	slender panic
Poaceae	<i>*Paspalum dilatatum</i>	
Poaceae	<i>*Paspalum sp.</i>	
Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>	
Poaceae	<i>Poa sieberiana</i>	snowgrass
Poaceae	<i>Rytidosperma sp.</i>	
Poaceae	<i>Sorghum leiocladum</i>	wild sorghum
Poaceae	<i>Sporobolus creber</i>	slender rat's tail grass
Poaceae	<i>Themeda australis</i>	kangaroo grass
Poaceae	<i>*Vulpia muralis</i>	wall fescue
Magnoliopsida (Magnoliidae)		
Acanthaceae	<i>Brunoniella australis</i>	blue trumpet
Acanthaceae	<i>Rostellularia adscendens</i>	pink tongues
Acanthaceae	<i>Rostellularia sp.</i>	
Amaranthaceae	<i>Alternanthera denticulata</i>	lesser joyweed
Amaranthaceae	<i>Alternanthera sp. A</i>	
Amaranthaceae	<i>*Gomphrena celosioides</i>	
Amaranthaceae	<i>Nyssanthes diffusa</i>	
Apiaceae	<i>*Cyclospermum leptophyllum</i>	slender celery
Apiaceae	<i>*Daucus carota</i>	
Apiaceae	<i>Daucus glochidiatus</i>	native carrot
Apiaceae	<i>Hydrocotyle laxiflora</i>	stinking pennywort
Apocynaceae	<i>*Gomphocarpus fruticosus</i>	narrow-leaved cotton bush
Asteraceae	<i>*Arctotheca calendula</i>	
Asteraceae	<i>*Aster subulatus</i>	
Asteraceae	<i>*Bidens pilosa</i>	cobbler's pegs
Asteraceae	<i>Brachyscome multifida</i> var. <i>multifida</i>	

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Asteraceae	<i>Calotis lappulacea</i>	yellow burr-daisy
Asteraceae	<i>Calotis</i> sp.	
Asteraceae	* <i>Carduus pycnocephalus</i>	slender thistle
Asteraceae	* <i>Carthamus lanatus</i>	saffron thistle
Asteraceae	<i>Cassinia arcuata</i>	sifton bush
Asteraceae	* <i>Centaurea melitensis</i>	maltese cockspur
Asteraceae	* <i>Centaurea</i> sp.	thistle
Asteraceae	<i>Chrysocephalum apiculatum</i>	common everlasting
Asteraceae	* <i>Cirsium vulgare</i>	spear thistle
Asteraceae	* <i>Conyza</i> sp.	a fleabane
Asteraceae	<i>Cymbonotus lawsonianus</i>	
Asteraceae	<i>Euchiton involucratus</i>	star cudweed
Asteraceae	* <i>Euchiton involucratus</i>	
Asteraceae	<i>Euchiton</i> sp.	a cudweed
Asteraceae	<i>Euchiton sphaericus</i>	star cudweed
Asteraceae	<i>Glossocardia bidens</i>	cobbler's tack
Asteraceae	* <i>Hypochaeris glabra</i>	smooth catsear
Asteraceae	* <i>Hypochaeris microcephala</i> var. <i>albiflora</i>	
Asteraceae	* <i>Hypochaeris radicata</i>	catsear
Asteraceae	* <i>Lactuca saligna</i>	willow-leaved lettuce
Asteraceae	<i>Lagenophora gracilis</i>	slender lagenophora
Asteraceae	<i>Olearia ramulosa</i>	
Asteraceae	* <i>Senecio madagascariensis</i>	fireweed
Asteraceae	<i>Senecio quadridentatus</i>	cotton fireweed
Asteraceae	<i>Senecio</i> sp.	
Asteraceae	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>	
Asteraceae	* <i>Silybum marianum</i>	
Asteraceae	* <i>Sonchus oleraceus</i>	common sowthistle
Asteraceae	* <i>Taraxacum officinale</i>	dandelion
Asteraceae	<i>Vernonia cinerea</i>	
Asteraceae	<i>Vittadinia cuneata</i>	a fuzzweed
Asteraceae	<i>Vittadinia dissecta</i>	
Asteraceae	<i>Vittadinia muelleri</i>	a fuzzweed
Asteraceae	<i>Vittadinia pterochaeta</i>	rough fuzzweed

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Asteraceae	<i>Vittadinia pustulata</i>	fuzzweed
Asteraceae	<i>Vittadinia sulcata</i>	
Boraginaceae	<i>Cynoglossum australe</i>	
Boraginaceae	* <i>Echium plantagineum</i>	Paterson's curse
Boraginaceae	* <i>Heliotropium amplexicaule</i>	blue heliotrope
Brassicaceae	* <i>Brassica</i> sp.	brassica
Brassicaceae	* <i>Lepidium africanum</i>	common peppergrass
Cactaceae	* <i>Opuntia aurantiaca</i>	tiger pear
Cactaceae	* <i>Opuntia stricta</i> var. <i>stricta</i>	common prickly pear; smooth pest pear
Campanulaceae	<i>Wahlenbergia communis</i>	tufted bluebell
Campanulaceae	<i>Wahlenbergia gracilis</i>	sprawling bluebell
Campanulaceae	<i>Wahlenbergia</i> sp.	bluebell
Campanulaceae	<i>Wahlenbergia stricta</i>	
Caryophyllaceae	* <i>Paronychia brasiliensis</i>	chilean whitlow wort; brazilian whitlow
Caryophyllaceae	* <i>Petrorhagia dubia</i>	
Caryophyllaceae	* <i>Petrorhagia nanteuilii</i>	proliferous pink
Caryophyllaceae	* <i>Petrorhagia</i> sp.	
Caryophyllaceae	* <i>Polycarpon tetraphyllum</i>	four-leaved allseed
Caryophyllaceae	* <i>Silene gallica</i>	French catchfly
Caryophyllaceae	* <i>Stellaria media</i>	common chickweed
Casuarinaceae	<i>Allocasuarina luehmannii</i>	bullock
Casuarinaceae	<i>Allocasuarina torulosa</i>	forest oak
Chenopodiaceae	<i>Atriplex semibaccata</i>	creeping saltbush
Chenopodiaceae	<i>Chenopodium</i> sp.	goosefoot; crumbweed
Chenopodiaceae	<i>Einadia hastata</i>	berry saltbush
Chenopodiaceae	<i>Einadia nutans</i>	climbing saltbush
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>linifolia</i>	
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>nutans</i>	climbing saltbush
Chenopodiaceae	<i>Einadia</i> sp.	
Chenopodiaceae	<i>Einadia trigonos</i>	fishweed
Chenopodiaceae	<i>Sclerolaena birchii</i>	galvanized burr
Chenopodiaceae	<i>Sclerolaena</i> sp.	copperburr; poverty-bush
Clusiaceae	<i>Hypericum gramineum</i>	small St john's wort
Convolvulaceae	<i>Convolvulus erubescens</i>	pink bindweed

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Convolvulaceae	<i>Dichondra repens</i>	kidney weed
Convolvulaceae	<i>Dichondra</i> sp. A	
Crassulaceae	<i>Crassula sieberiana</i>	Australian stonecrop
Crassulaceae	<i>Crassula</i> sp.	stonecrop
Dilleniaceae	<i>Hibbertia acicularis</i>	
Dilleniaceae	<i>Hibbertia obtusifolia</i>	hoary guinea flower
Ericaceae	<i>Leucopogon muticus</i>	blunt beard-heath
Ericaceae	<i>Melichrus urceolatus</i>	urn heath
Euphorbiaceae	<i>Chamaesyce drummondii</i>	caustic weed
Fabaceae (Caesalpinio)	<i>Senna barclayana</i>	smooth senna
Fabaceae (Caesalpinio)	<i>Senna</i> sp.	
Fabaceae (Faboideae)	<i>Bossiaea prostrata</i>	
Fabaceae (Faboideae)	<i>Daviesia genistifolia</i>	broom bitter pea
Fabaceae (Faboideae)	<i>Desmodium brachypodum</i>	large tick-trefoil
Fabaceae (Faboideae)	<i>Desmodium varians</i>	slender tick-trefoil
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	twining glycine
Fabaceae (Faboideae)	<i>Glycine microphylla</i>	small-leaf glycine
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	variable glycine
Fabaceae (Faboideae)	<i>Hovea apiculata</i>	
Fabaceae (Faboideae)	<i>Indigofera australis</i>	Australian indigo
Fabaceae (Faboideae)	<i>Lotus australis</i>	
Fabaceae (Faboideae)	* <i>Medicago sativa</i>	lucerne
Fabaceae (Faboideae)	* <i>Medicago</i> sp.	
Fabaceae (Faboideae)	* <i>Medicago truncatula</i>	barrel medic
Fabaceae (Faboideae)	<i>Podolobium ilicifolium</i>	
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	
Fabaceae (Faboideae)	<i>Swainsona galegifolia</i>	smooth darling pea
Fabaceae (Faboideae)	<i>Templetonia stenophylla</i>	leafy templetonia
Fabaceae (Faboideae)	* <i>Trifolium arvense</i>	haresfoot clover
Fabaceae (Faboideae)	* <i>Trifolium campestre</i>	hop clover
Fabaceae (Faboideae)	* <i>Trifolium scabrum</i>	rough clover
Fabaceae (Faboideae)	* <i>Trifolium</i> sp.	a clover
Fabaceae (Mimosoide)	<i>Acacia brownii</i>	
Fabaceae (Mimosoide)	<i>Acacia deanei</i> subsp. <i>deanei</i>	Deane's wattle
Fabaceae (Mimosoide)	<i>Acacia doratoxylon</i>	currawang

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Fabaceae (Mimosoide)	<i>Acacia echinula</i>	hedgehog wattle
Fabaceae (Mimosoide)	<i>Acacia falcata</i>	
Fabaceae (Mimosoide)	<i>Acacia piligera</i>	
Fabaceae (Mimosoide)	<i>Acacia salicina</i>	cooba
Fabaceae (Mimosoide)	<i>Acacia salicina</i>	
Fabaceae (Mimosoide)	<i>Acacia</i> sp.	wattle
Fabaceae (Mimosoide)	<i>Acacia stricta</i>	straight wattle
Gentianaceae	* <i>Centaurium</i> sp.	
Gentianaceae	* <i>Centaurium tenuiflorum</i>	branched centaury; slender centaury
Gentianaceae	<i>Erodium</i> sp.	
Geraniaceae	<i>Geranium solanderi</i>	native geranium
Geraniaceae	<i>Geranium solanderi</i> var. <i>solanderi</i>	
Goodeniaceae	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	ivy goodenia
Haloragaceae	<i>Gonocarpus tetragynus</i>	poverty raspwort
Lamiaceae	<i>Ajuga australis</i>	austral bugle
Lamiaceae	* <i>Marrubium vulgare</i>	white horehound
Lamiaceae	<i>Mentha satureioides</i>	native pennyroyal
Lamiaceae	* <i>Salvia verbenaca</i>	
Lamiaceae	<i>Spartothamnella juncea</i>	bead bush
Lamiaceae	* <i>Stachys arvensis</i>	stagger weed
Lobeliaceae	<i>Pratia concolor</i>	
Lobeliaceae	<i>Pratia purpurascens</i>	whiteroot
Loranthaceae	<i>Amyema miquelii</i>	box mistletoe
Loranthaceae	<i>Amyema</i> sp.	mistletoe
Malvaceae	* <i>Modiola caroliniana</i>	red-flowered mallow
Malvaceae	* <i>Pavonia hastata</i>	
Malvaceae	<i>Sida corrugata</i>	corrugated sida
Malvaceae	<i>Sida hackettiana</i>	
Malvaceae	* <i>Sida rhombifolia</i>	paddy's lucerne
Malvaceae	<i>Sida</i> sp.	
Malvaceae	* <i>Sida spinosa</i>	
Moraceae	<i>Ficus rubiginosa</i>	
Myoporaceae	<i>Eremophila debilis</i>	amulla
Myrsinaceae	* <i>Anagallis arvensis</i>	scarlet pimpernel

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Myrsinaceae	<i>Myrsine variabilis</i>	
Myrtaceae	<i>Angophora floribunda</i>	rough-barked apple
Myrtaceae	<i>Eucalyptus albens</i> <--> <i>moluccana</i>	
Myrtaceae	<i>Eucalyptus blakelyi</i>	Blakely's red gum
Myrtaceae	<i>Eucalyptus blakelyi</i> <--> <i>tereticornis</i>	
Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved ironbark
Myrtaceae	<i>Eucalyptus moluccana</i>	grey box
Myrtaceae	<i>Eucalyptus punctata</i>	grey gum
Myrtaceae	<i>Eucalyptus sparsifolia</i>	
Myrtaceae	<i>Kunzea</i> sp.	
Nyctaginaceae	<i>Boerhavia dominii</i>	tarvine
Oleaceae	<i>Notelaea microcarpa</i>	native olive
Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	
Oleaceae	* <i>Olea europaea</i> subsp. <i>cuspidata</i>	
Oxalidaceae	<i>Oxalis exilis</i>	
Oxalidaceae	<i>Oxalis perennans</i>	
Oxalidaceae	* <i>Oxalis pes-caprae</i>	
Oxalidaceae	<i>Oxalis</i> sp.	
Phyllanthaceae	<i>Breynia oblongifolia</i>	coffee bush
Phyllanthaceae	<i>Phyllanthus hirtellus</i>	thyme spurge
Phyllanthaceae	<i>Phyllanthus virgatus</i>	wiry spurge
Phyllanthaceae	<i>Poranthera microphylla</i>	small poranthera
pittosporaceae	<i>Billardiera scandens</i>	
Pittosporaceae	<i>Bursaria spinosa</i>	native blackthorn
Plantaginaceae	<i>Plantago debilis</i>	shade plantain
Plantaginaceae	* <i>Plantago lanceolata</i>	lamb's tongues
Plantaginaceae	<i>Veronica plebeia</i>	trailing speedwell
Polygalaceae	<i>Polygala japonica</i>	dwarf milkwort
Polygonaceae	<i>Rumex brownii</i>	swamp dock
Proteaceae	<i>Pennisetum clandestinum</i>	
Proteaceae	<i>Persoonia linearis</i>	narrow-leaved geebung
Ranunculaceae	<i>Clematis glycinoides</i>	headache vine
Rosaceae	<i>Acaena echinata</i>	sheep's burr
Rosaceae	<i>Acaena</i> sp.	
Rosaceae	<i>Rubus parvifolius</i>	native raspberry

HIGHFIELDS OFFSET SITE		
Family	Scientific Name	Common Name
Rubiaceae	<i>Asperula conferta</i>	common woodruff
Rubiaceae	<i>*Galenia pubescens</i>	
Rubiaceae	<i>Galium leptogonium</i>	
Rubiaceae	<i>Galium</i> sp.	
Rubiaceae	<i>Pomax umbellata</i>	pomax
Rubiaceae	<i>Psydrax odorata</i>	shiny-leaved canthium
Rutaceae	<i>Correa reflexa</i>	native fuschia
Santalaceae	<i>Choretrum</i> sp. Cox's Gap	
Solanaceae	<i>Solanum americanum</i>	glossy nightshade
Solanaceae	<i>Solanum brownii</i>	violet nightshade
Solanaceae	<i>*Solanum nigrum</i>	black-berry nightshade
Stackhousiaceae	<i>Stackhousia viminea</i>	slender stackhousia
Sterculiaceae	<i>Brachychiton populneus</i>	kurrajong
Sterculiaceae	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	
Urticaceae	<i>Urtica incisa</i>	stinging nettle
Verbenaceae	<i>*Verbena bonariensis</i>	
Verbenaceae	<i>*Verbena officinalis</i>	
Verbenaceae	<i>*Verbena rigida</i> var. <i>rigida</i>	veined verbena
Verbenaceae	<i>*Verbena</i> sp.	
Violaceae	<i>Melicytus dentatus</i>	tree violet
Vitaceae	<i>Cayratia clematidea</i>	native grape
Vitaceae	<i>Clematicissus opaca</i>	pepper vine

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Coniferopsida		
Cupressaceae	<i>Callitris endlicheri</i>	black cypress pine
Filicopsida		
Adiantaceae	<i>Cheilanthes distans</i>	bristly cloak fern
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	rock fern
Marsileaceae	<i>Marsilea drummondii</i>	common nardoo
Magnoliopsida (Liliidae)		
Anthericaceae	<i>Arthropodium milleflorum</i>	pale vanilla-lily
Anthericaceae	<i>Arthropodium</i> sp.	
Anthericaceae	<i>Dichopogon fimbriatus</i>	nodding chocolate lily
Anthericaceae	<i>Laxmannia gracilis</i>	slender wire lily
Anthericaceae	<i>Tricoryne elatior</i>	yellow autumn-lily
Asphodelaceae	* <i>Asphodelus fistulosus</i>	onion weed
Commelinaceae	<i>Commelina cyanea</i>	native wandering Jew
Commelinaceae	<i>Murdannia graminea</i>	
Cyperaceae	<i>Carex appressa</i>	tall sedge
Cyperaceae	<i>Carex inversa</i>	knob sedge
Cyperaceae	* <i>Cyperus aggregatus</i>	
Cyperaceae	* <i>Cyperus eragrostis</i>	umbrella sedge
Cyperaceae	<i>Cyperus gracilis</i>	slender flat-sedge
Cyperaceae	<i>Cyperus</i> sp.	
Cyperaceae	<i>Fimbristylis dichotoma</i>	common fringe-sedge
Cyperaceae	<i>Gahnia aspera</i>	rough saw-sedge
Hypoxideae	<i>Hypoxis hygrometrica</i>	
Iridaceae	* <i>Romulea rosea</i> var. <i>australis</i>	onion grass
Juncaceae	* <i>Juncus acutus</i> subsp. <i>acutus</i>	
Juncaceae	<i>Juncus usitatus</i>	
Lomandraceae	<i>Lomandra filiformis</i>	
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	wattle matt-rush
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	
Phormiaceae	<i>Dianella caerulea</i>	blue flax-lily
Phormiaceae	<i>Dianella revoluta</i>	blueberry lily
Poaceae	* <i>Aira</i> sp.	a hairgrass
Poaceae	<i>Aristida calycina</i>	

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Poaceae	<i>Aristida ramosa</i>	purple wiregrass
Poaceae	<i>Aristida vagans</i>	threeawn speargrass
Poaceae	<i>Austrodanthonia bipartita</i>	wallaby grass
Poaceae	<i>Austrodanthonia fulva</i>	wallaby grass
Poaceae	<i>Austrodanthonia monticola</i>	mountain wallaby grass
Poaceae	<i>Austrodanthonia racemosa</i> var. <i>obtusata</i>	a wallaby grass
Poaceae	<i>Austrodanthonia racemosa</i> var. <i>racemosa</i>	a wallaby grass
Poaceae	<i>Austrostipa aristiglumis</i>	plains grass
Poaceae	<i>Austrostipa scabra</i>	speargrass
Poaceae	<i>Austrostipa scabra</i> subsp. <i>scabra</i>	rough speargrass
Poaceae	<i>Austrostipa</i> sp.	a speargrass
Poaceae	<i>Austrostipa verticillata</i>	slender bamboo grass
Poaceae	<i>Bothriochloa decipiens</i> var. <i>decipiens</i>	red grass
Poaceae	<i>Bothriochloa macra</i>	red grass
Poaceae	* <i>Briza minor</i>	shivery grass
Poaceae	* <i>Bromus catharticus</i>	prairie grass
Poaceae	* <i>Bromus diandrus</i>	great brome
Poaceae	* <i>Bromus hordeaceus</i>	soft brome
Poaceae	* <i>Bromus molliformis</i>	soft brome
Poaceae	<i>Chloris truncata</i>	windmill grass
Poaceae	<i>Chloris ventricosa</i>	tall chloris
Poaceae	<i>Cleistochloa rigida</i>	
Poaceae	<i>Cymbopogon refractus</i>	barbed wire grass
Poaceae	<i>Cynodon dactylon</i>	common couch
Poaceae	<i>Dichanthium sericeum</i>	Queensland bluegrass
Poaceae	<i>Dichelachne crinita</i>	
Poaceae	<i>Dichelachne micrantha</i>	shorthair plumegrass
Poaceae	<i>Digitaria brownii</i>	cotton panic grass
Poaceae	<i>Digitaria diffusa</i>	open summer-grass
Poaceae	<i>Digitaria divaricatissima</i>	umbrella grass
Poaceae	<i>Digitaria ramularis</i>	finger panic grass
Poaceae	<i>Digitaria</i> sp.	a finger grass
Poaceae	<i>Echinopogon caespitosus</i>	bushy hedgehog-grass

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Poaceae	<i>Echinopogon ovatus</i>	
Poaceae	* <i>Ehrharta erecta</i>	panic veldtgrass
Poaceae	* <i>Eleusine tristachya</i>	goose grass
Poaceae	<i>Elymus scaber</i>	common wheatgrass
Poaceae	<i>Enneapogon gracilis</i>	slender nineawn
Poaceae	<i>Enteropogon acicularis</i>	curly windmill grass
Poaceae	<i>Eragrostis brownii</i>	brown's lovegrass
Poaceae	<i>Eragrostis elongata</i>	clustered lovegrass
Poaceae	<i>Eragrostis leptostachya</i>	paddock lovegrass
Poaceae	<i>Eragrostis setifolia</i>	neverfail
Poaceae	<i>Eragrostis</i> sp.	a lovegrass
Poaceae	<i>Eriochloa pseudoacrotricha</i>	early spring grass
Poaceae	<i>Eulalia aurea</i>	silky browntop
Poaceae	* <i>Hyparrhenia hirta</i>	coolatai grass
Poaceae	<i>Lachnagrostis filiformis</i>	
Poaceae	* <i>Lolium perenne</i>	perennial ryegrass
Poaceae	* <i>Lolium rigidum</i>	wimmera ryegrass
Poaceae	<i>Microlaena stipoides</i>	weeping grass
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	weeping grass
Poaceae	<i>Notodanthonia longifolia</i>	long-leaved wallaby grass
Poaceae	<i>Panicum effusum</i>	hairy panic
Poaceae	<i>Paspalidium criniforme</i>	
Poaceae	<i>Paspalidium gracile</i>	slender panic
Poaceae	<i>Paspalidium</i> sp.	
Poaceae	* <i>Paspalum dilatatum</i>	paspalum
Poaceae	* <i>Pennisetum clandestinum</i>	kikuyu grass
Poaceae	<i>Rytidosperma</i> sp.	
Poaceae	* <i>Setaria parviflora</i>	
Poaceae	<i>Sporobolus creber</i>	slender rat's tail grass
Poaceae	<i>Urochloa panicoides</i>	
Poaceae	* <i>Vulpia muralis</i>	wall fescue
Poaceae	* <i>Vulpia</i> sp.	rat's-tail fescue
Magnoliopsid (Magnoliidae)		
Acanthaceae	<i>Brunoniella australis</i>	blue trumpet
Aizoaceae	* <i>Galenia pubescens</i>	galenia

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Amaranthaceae	<i>Alternanthera denticulata</i>	
Amaranthaceae	<i>Alternanthera</i> sp. A	
Amaranthaceae	* <i>Gomphrena celosioides</i>	gomphrena weed
Apiaceae	* <i>Cyclospermum leptophyllum</i>	slender celery
Apiaceae	<i>Daucus glochidiatus</i>	native carrot
Apiaceae	* <i>Foeniculum vulgare</i>	fennel
Apiaceae	<i>Hydrocotyle</i> sp.	
Apocynaceae	* <i>Gomphocarpus fruticosus</i>	narrow-leaved cotton bush
Apocynaceae	* <i>Gomphocarpus</i> spp.	
Apocynaceae	<i>Parsonsia</i> sp.	
Asteraceae	* <i>Bidens pilosa</i>	cobbler's pegs
Asteraceae	* <i>Bidens subalternans</i>	greater beggar's ticks
Asteraceae	<i>Brachyscome</i> sp.	
Asteraceae	<i>Calotis lappulacea</i>	yellow burr-daisy
Asteraceae	* <i>Carthamus lanatus</i>	saffron thistle
Asteraceae	<i>Cassinia arcuata</i>	
Asteraceae	<i>Cassinia</i> sp.	
Asteraceae	* <i>Centaurea melitensis</i>	maltese cockspur
Asteraceae	* <i>Centaurea</i> sp.	thistle
Asteraceae	* <i>Chondrilla juncea</i>	skeleton weed
Asteraceae	<i>Chrysocephalum apiculatum</i>	common everlasting
Asteraceae	* <i>Cirsium vulgare</i>	spear thistle
Asteraceae	* <i>Conyza bonariensis</i>	
Asteraceae	<i>Conyza</i> sp.	a fleabane
Asteraceae	* <i>Conyza sumatrensis</i>	tall fleabane
Asteraceae	<i>Epaltes australis</i>	spreading nut-heads
Asteraceae	<i>Euchiton involucratus</i>	star cudweed
Asteraceae	<i>Euchiton</i> sp.	a cudweed
Asteraceae	* <i>Gamochaeta spicata</i>	cudweed
Asteraceae	<i>Glossocardia bidens</i>	cobbler's tack
Asteraceae	* <i>Hypochaeris glabra</i>	smooth catsear
Asteraceae	* <i>Hypochaeris microcephala</i> var. <i>albiflora</i>	
Asteraceae	* <i>Hypochaeris radicata</i>	catsear
Asteraceae	* <i>Lactuca saligna</i>	willow-leaved lettuce

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Asteraceae	<i>*Lactuca serriola</i>	prickly lettuce
Asteraceae	<i>Lagenophora gracilis</i>	slender lagenophora
Asteraceae	<i>Ozothamnus diosmifolius</i>	white dogwood
Asteraceae	<i>*Senecio madagascariensis</i>	fireweed
Asteraceae	<i>*Silybum marianum</i>	variegated thistle
Asteraceae	<i>Solenogyne bellioides</i>	
Asteraceae	<i>*Sonchus oleraceus</i>	common sowthistle
Asteraceae	<i>*Tagetes minuta</i>	stinking roger
Asteraceae	<i>*Tolpis barbata</i>	yellow hawkweed
Asteraceae	<i>Triptilodiscus pygmaeus</i>	common sunray
Asteraceae	<i>Vernonia cinerea</i>	
Asteraceae	<i>Vittadinia cervicularis</i>	
Asteraceae	<i>Vittadinia cuneata</i>	
Asteraceae	<i>Vittadinia dissecta</i>	
Asteraceae	<i>Vittadinia dissecta</i> var. <i>hirta</i>	
Asteraceae	<i>Vittadinia pterochaeta</i>	rough fuzzweed
Asteraceae	<i>*Xanthium occidentale</i>	noogoora burr
Asteraceae	<i>Xerochrysum viscosum</i>	sticky everlasting
Boraginaceae	<i>Cynoglossum australe</i>	
Boraginaceae	<i>Cynoglossum suaveolens</i>	
Boraginaceae	<i>Echium plantagineum</i>	Patterson's curse
Boraginaceae	<i>Heliotropium amplexicaule</i>	blue heliotrope
Brassicaceae	<i>*Brassica</i> sp.	brassica
Brassicaceae	<i>*Hirschfeldia incana</i>	buchan weed
Brassicaceae	<i>*Lepidium africanum</i>	common peppergrass
Brassicaceae	<i>*Lepidium bonariense</i>	argentine peppergrass
Brassicaceae	<i>*Rapistrum rugosum</i>	turnip weed
Cactaceae	<i>*Opuntia aurantiaca</i>	tiger pear
Cactaceae	<i>*Opuntia humifusa</i>	
Cactaceae	<i>*Opuntia stricta</i> var. <i>stricta</i>	common prickly pear; smooth pest pear
Campanulaceae	<i>Wahlenbergia communis</i>	tufted bluebell
Campanulaceae	<i>Wahlenbergia gracilis</i>	sprawling bluebell
Campanulaceae	<i>Wahlenbergia luteola</i>	bluebell
Campanulaceae	<i>Wahlenbergia</i> sp.	bluebell

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Campanulaceae	<i>Wahlenbergia stricta</i>	tall bluebell
Caryophyllaceae	* <i>Paronychia brasiliensis</i>	Chilean whitlow wort; Brazilian whitlow
Caryophyllaceae	* <i>Petrorhagia dubia</i>	
Caryophyllaceae	* <i>Petrorhagia</i> sp.	
Caryophyllaceae	* <i>Polycarpon tetraphyllum</i>	four-leaved allseed
Caryophyllaceae	* <i>Silene gallica</i>	French catchfly
Casuarinaceae	<i>Allocasuarina gymnanthera</i>	
Casuarinaceae	<i>Allocasuarina littoralis</i>	black she-oak
Casuarinaceae	<i>Allocasuarina luehmannii</i>	bulloak
Casuarinaceae	<i>Allocasuarina torulosa</i>	forest oak
Casuarinaceae	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	river oak
Chenopodiaceae	<i>Einadia hastata</i>	berry saltbush
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>linifolia</i>	climbing saltbush
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>nutans</i>	climbing saltbush
Chenopodiaceae	<i>Einadia polygonoides</i>	
Chenopodiaceae	<i>Maireana enchylaenoides</i>	wingless fissure-weed
Chenopodiaceae	<i>Maireana microphylla</i>	small-leaf bluebush
Chenopodiaceae	<i>Sclerolaena birchii</i>	galvanized burr
Clusiaceae	<i>Hypericum gramineum</i>	small St John's wort
Convolvulaceae	<i>Convolvulus erubescens</i>	pink bindweed
Convolvulaceae	<i>Dichondra repens</i>	kidney weed
Convolvulaceae	<i>Dichondra</i> sp. A	kidney weed
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	
Crassulaceae	<i>Crassula sieberiana</i>	Australian stonecrop
Dilleniaceae	<i>Hibbertia obtusifolia</i>	hoary guinea flower
Dilleniaceae	<i>Hibbertia</i> sp.	
Ericaceae	<i>Leucopogon muticus</i>	blunt beard-heath
Ericaceae	<i>Melichrus urceolatus</i>	urn heath
Ericaceae	<i>Styphelia triflora</i>	pink five-corners
Euphorbiaceae	<i>Chamaesyce dallachyana</i>	
Euphorbiaceae	<i>Chamaesyce drummondii</i>	caustic weed
Fabaceae (Faboideae)	<i>Desmodium brachypodum</i>	large tick-trefoil
Fabaceae (Faboideae)	<i>Desmodium rhytidophyllum</i>	
Fabaceae (Faboideae)	<i>Desmodium varians</i>	slender tick-trefoil

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Fabaceae (Faboideae)	<i>Daviesia ulicifolia</i>	
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	twining glycine
Fabaceae (Faboideae)	<i>Glycine microphylla</i>	
Fabaceae (Faboideae)	<i>Glycine</i> sp.	
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	variable glycine
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	sarsaparilla
Fabaceae (Faboideae)	<i>Indigofera australis</i>	australian indigo
Fabaceae (Faboideae)	* <i>Medicago polymorpha</i>	burr medic
Fabaceae (Faboideae)	<i>Pultenaea microphylla</i>	a bush pea
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	
Fabaceae (Faboideae)	<i>Swainsona reticulata</i>	knead swainson-pea
Fabaceae (Faboideae)	* <i>Trifolium angustifolium</i>	narrow-leaved clover
Fabaceae (Faboideae)	* <i>Trifolium arvense</i>	haresfoot clover
Fabaceae (Faboideae)	* <i>Trifolium campestre</i>	hop clover
Fabaceae (Faboideae)	* <i>Trifolium dubium</i>	yellow suckling clover
Fabaceae (Faboideae)	* <i>Trifolium repens</i>	white clover
Fabaceae (Faboideae)	* <i>Trifolium subterraneum</i>	subterranean clover
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i> var. <i>dyctiocarpa</i>	zornia
Fabaceae (Mimosoideae)	<i>Acacia cremiflora</i>	
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	western silver wattle
Fabaceae (Mimosoideae)	<i>Acacia doratoxylon</i>	currawang
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>	
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	hickory wattle
Fabaceae (Mimosoideae)	<i>Acacia</i> sp.	wattle
Fabaceae (Mimosoideae)	<i>Neptunia gracilis</i> f. <i>gracilis</i>	sensitive plant
Gentianaceae	* <i>Centaurium</i> sp.	
Gentianaceae	* <i>Centaurium tenuiflorum</i>	branched centaury; slender centaury
Geraniaceae	<i>Geranium solanderi</i>	native geranium
Goodeniaceae	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	
Goodeniaceae	<i>Goodenia macbarronii</i>	
Goodeniaceae	<i>Goodenia pinnatifida</i>	scrambles eggs
Goodeniaceae	<i>Goodenia</i> sp.	
Haloragaceae	<i>Gonocarpus elatus</i>	a raspwort
Haloragaceae	<i>Gonocarpus tetragynus</i>	poverty raspwort

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Lamiaceae	<i>Ajuga australis</i>	austral bugle
Lamiaceae	<i>Prostanthera prunelloides</i>	
Lamiaceae	* <i>Salvia verbenaca</i>	vervain
Lamiaceae	<i>Scutellaria humilis</i>	dwarf skullcap
Lamiaceae	<i>Spartothamnella juncea</i>	bead bush
Lamiaceae	* <i>Stachys arvensis</i>	stagger weed
Lauraceae	<i>Cassytha glabella</i>	
Linaceae	* <i>Linum trigynum</i>	French flax
Lobeliaceae	<i>Isotoma axillaris</i>	showy isotome
Lobeliaceae	<i>Pratia concolor</i>	poison pratia
Lobeliaceae	<i>Pratia</i> sp.	
Loranthaceae	<i>Amyema gaudichaudii</i>	
Loranthaceae	<i>Amyema miquelii</i>	box mistletoe
Loranthaceae	<i>Amyema</i> sp.	mistletoe
Malvaceae	<i>Hibiscus sturtii</i> var. <i>sturtii</i>	hill hibiscus
Malvaceae	* <i>Modiola caroliniana</i>	red-flowered mallow
Malvaceae	<i>Sida corrugata</i>	corrugated sida
Malvaceae	<i>Sida cunninghamii</i>	ridge sida
Malvaceae	<i>Sida hackettiana</i>	
Malvaceae	* <i>Sida rhombifolia</i>	paddy's lucerne
Malvaceae	* <i>Sida spinosa</i>	
Myoporaceae	<i>Eremophila debilis</i>	amulla
Myrsinaceae	* <i>Anagallis arvensis</i>	scarlet pimpernel
Myrtaceae	<i>Eucalyptus blakelyi</i> <--> <i>tereticornis</i>	
Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved ironbark
Myrtaceae	<i>Eucalyptus fibrosa</i>	red ironbark
Myrtaceae	<i>Eucalyptus moluccana</i>	grey box
Myrtaceae	<i>Eucalyptus punctata</i>	grey gum
Myrtaceae	<i>Eucalyptus tereticornis</i>	
Myrtaceae	<i>Kunzea</i> sp. 'Mt Kaputar'	
Myrtaceae	<i>Melaleuca decora</i>	
Nyctaginaceae	<i>Boerhavia dominii</i>	tarvine
Oleaceae	<i>Notelaea microcarpa</i>	native olive
Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	
Onagraceae	* <i>Ludwigia peruviana</i>	

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Onagraceae	<i>*Oenothera biennis</i>	evening primrose
Onagraceae	<i>*Oenothera mollissima</i>	
Oxalidaceae	<i>Oxalis exilis</i>	
Oxalidaceae	<i>Oxalis perennans</i>	
Oxalidaceae	<i>Oxalis radicata</i>	
Oxalidaceae	<i>Oxalis</i> sp.	
Phyllanthaceae	<i>Phyllanthus virgatus</i>	wiry spurge
Phyllanthaceae	<i>Poranthera microphylla</i>	small poranthera
Phytolaccaceae	<i>*Phytolacca</i> sp.	
Plantaginaceae	<i>Plantago debilis</i>	shade plantain
Plantaginaceae	<i>*Plantago lanceolata</i>	lamb's tongues
Plantaginaceae	<i>*Plantago myosuroides</i> subsp. <i>myosuroides</i>	
Plantaginaceae	<i>Veronica plebeia</i>	trailing speedwell
Polygonaceae	<i>Persicaria lapathifolia</i>	pale knotweed
Polygonaceae	<i>*Polygonaceae indeterminate</i>	docks; knotweeds and lignums
Polygonaceae	<i>*Polygonum aviculare</i>	wireweed
Polygonaceae	<i>Rumex brownii</i>	swamp dock
Polygonaceae	<i>*Rumex conglomeratus</i>	clustered dock
Polygonaceae	<i>*Rumex</i> sp.	dock
Portulacaceae	<i>Portulaca oleracea</i>	pigweed
Proteaceae	<i>Persoonia linearis</i>	narrow-leaved geebung
Rhamnaceae	<i>Alphitonia excelsa</i>	red ash
Rubiaceae	<i>Opercularia diphylla</i>	stinkweed
Rubiaceae	<i>Opercularia</i> sp.	
Rubiaceae	<i>Pomax umbellata</i>	pomax
Rubiaceae	<i>Psydrax odorata</i>	shiny-leaved canthium
Rubiaceae	<i>*Richardia stellaris</i>	
Rutaceae	<i>Boronia anethifolia</i>	
Salicaceae	<i>*Salix babylonica</i>	weeping willow
Sapindaceae	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	wedge-leaf hop-bush
Scrophulariaceae	<i>*Parentucellia latifolia</i>	red bartsia
Scrophulariaceae	<i>*Verbascum virgatum</i>	twiggy mullein
Solanaceae	<i>*Lycium ferocissimum</i>	African boxthorn
Solanaceae	<i>Solanum brownii</i>	violet nightshade
Solanaceae	<i>Solanum campanulatum</i>	

MANGROVE OFFSET SITE		
Family	Scientific Name	Common Name
Solanaceae	* <i>Solanum nigrum</i>	black-berry nightshade
Solanaceae	* <i>Solanum</i> sp.	
Stackhousiaceae	<i>Stackhousia viminea</i>	slender stackhousia
Verbenaceae	* <i>Verbena bonariensis</i>	purpletop
Verbenaceae	* <i>Verbena</i> sp.	
Papaveraceae	* <i>Argemone ochroleuca</i> subsp. <i>ochroleuca</i>	Mexican poppy

WAMBO OFFSET SITE		
Family	Scientific Name	Common Name
Filicopsida		
Adiantaceae	<i>Cheilanthes distans</i>	bristly cloak fern
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	rock fern
Magnoliopsida (Liliidae)		
Anthericaceae	<i>Laxmannia gracilis</i>	slender wire lily
Commelinaceae	<i>Commelina cyanea</i>	native wandering Jew
Cyperaceae	<i>Cyperus gracilis</i>	slender flat-sedge
Cyperaceae	<i>Fimbristylis dichotoma</i>	common fringe-sedge
Cyperaceae	<i>Gahnia aspera</i>	rough saw-sedge
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	wattle matt-rush
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	many-flowered mat-rush
Phormiaceae	<i>Dianella caerulea</i>	blue flax-lily
Phormiaceae	<i>Dianella revoluta</i> var. <i>revoluta</i>	a blue flax lily
Poaceae	<i>Ancistrachne uncinulata</i>	hooked-hairy panic grass
Poaceae	<i>Aristida ramosa</i>	purple wiregrass
Poaceae	<i>Aristida vagans</i>	threeawn speargrass
Poaceae	<i>Austrostipa scabra</i>	speargrass
Poaceae	<i>Bothriochloa decipiens</i> var. <i>decipiens</i>	red grass
Poaceae	<i>Cymbopogon refractus</i>	barbed wire grass
Poaceae	<i>Dichelachne micrantha</i>	shorthair plumegrass
Poaceae	<i>Digitaria diffusa</i>	open summer-grass
Poaceae	<i>Enneapogon gracilis</i>	slender nineawn
Poaceae	<i>Eragrostis leptostachya</i>	paddock lovegrass

WAMBO OFFSET SITE		
Family	Scientific Name	Common Name
Poaceae	<i>Eragrostis setifolia</i>	neverfail
Poaceae	<i>Eriochloa pseudoacrotricha</i>	early spring grass
Poaceae	* <i>Melinis repens</i>	red natal grass
Poaceae	<i>Microlaena stipoides</i>	weeping grass
Poaceae	<i>Panicum effusum</i>	hairy panic
Poaceae	<i>Panicum simile</i>	two-colour panic
Poaceae	<i>Paspalidium distans</i>	
Poaceae	<i>Paspalidium</i> sp.	
Magnoliopsida (Magnoliidae)		
Acanthaceae	<i>Brunoniella australis</i>	blue trumpet
Amaranthaceae	* <i>Gomphrena celosioides</i>	gomphrena weed
Apiaceae	* <i>Cyclospermum leptophyllum</i>	slender celery
Apocynaceae	* <i>Gomphocarpus fruticosus</i>	narrow-leaved cotton bush
Apocynaceae	<i>Parsonsia straminea</i>	common silkpod
Asteraceae	<i>Calotis lappulacea</i>	yellow burr-daisy
Asteraceae	<i>Cassinia cunninghamii</i>	
Asteraceae	<i>Chrysocephalum apiculatum</i>	common everlasting
Asteraceae	* <i>Cirsium vulgare</i>	spear thistle
Asteraceae	* <i>Conyza</i> sp.	a fleabane
Asteraceae	<i>Euchiton involucratus</i>	star cudweed
Asteraceae	* <i>Gamochaeta americana</i>	cudweed
Asteraceae	<i>Glossocardia bidens</i>	cobbler's tack
Asteraceae	* <i>Hypochaeris radicata</i>	catsear
Asteraceae	<i>Olearia elliptica</i>	sticky daisy-bush
Asteraceae	* <i>Senecio madagascariensis</i>	fireweed
Asteraceae	* <i>Sonchus oleraceus</i>	common sowthistle
Asteraceae	<i>Vittadinia dissecta</i>	
Cactaceae	* <i>Opuntia stricta</i> var. <i>stricta</i>	common prickly pear; smooth pest pear
Campanulaceae	<i>Wahlenbergia gracilis</i>	sprawling bluebell
Caryophyllaceae	* <i>Petrorhagia dubia</i>	velvet pink
Casuarinaceae	<i>Allocasuarina luehmannii</i>	bulloak
Chenopodiaceae	<i>Einadia hastata</i>	berry saltbush
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>nutans</i>	climbing saltbush
Chenopodiaceae	<i>Maireana enchylaenoides</i>	wingless fissure-weed

WAMBO OFFSET SITE		
Family	Scientific Name	Common Name
Chenopodiaceae	<i>Maireana microphylla</i>	small-leaf bluebush
Chenopodiaceae	<i>Maireana</i> sp.	cotton bush; bluebush; fissure-weed
Convolvulaceae	<i>Dichondra repens</i>	kidney weed
Convolvulaceae	<i>Evolvulus alsinoides</i>	bindweed
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	
Convolvulaceae	<i>Evolvulus</i> sp.	
Dilleniaceae	<i>Hibbertia diffusa</i>	wedge guinea flower
Euphorbiaceae	<i>Chamaesyce drummondii</i>	caustic weed
Fabaceae (Faboideae)	<i>Desmodium brachypodum</i>	large tick-trefoil
Fabaceae (Faboideae)	<i>Desmodium gunnii</i>	slender tick-trefoil
Fabaceae (Faboideae)	<i>Desmodium varians</i>	slender tick-trefoil
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	twining glycine
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	variable glycine
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i> var. <i>dyctiocarpa</i>	
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	fan wattle
Fabaceae (Mimosoideae)	<i>Acacia binervia</i>	coast myall
Fabaceae (Mimosoideae)	<i>Acacia doratoxylon</i>	currawang
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	hickory wattle
Fabaceae (Mimosoideae)	<i>Acacia salicina</i>	cooba
Gentianaceae	* <i>Centaurium</i> sp.	
Geraniaceae	<i>Geranium solanderi</i>	native geranium
Goodeniaceae	<i>Goodenia rotundifolia</i>	
Lamiaceae	<i>Spartothamnella juncea</i>	bead bush
Linaceae	* <i>Linum trigynum</i>	French flax
Loranthaceae	<i>Amyema gaudichaudii</i>	
Malvaceae	<i>Abutilon oxycarpum</i>	straggly lantern-bush
Malvaceae	<i>Hibiscus sturtii</i>	hill hibiscus
Malvaceae	<i>Sida corrugata</i>	corrugated sida
Malvaceae	<i>Sida cunninghamii</i>	ridge sida
Malvaceae	<i>Sida hacketianna</i>	
Malvaceae	* <i>Sida rhombifolia</i>	paddy's lucerne
Malvaceae	<i>Sida</i> sp.	
Myoporaceae	<i>Eremophila debilis</i>	amulla
Myrsinaceae	* <i>Anagallis arvensis</i>	scarlet pimpernel

WAMBO OFFSET SITE		
Family	Scientific Name	Common Name
Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved ironbark
Myrtaceae	<i>Eucalyptus dawsonii</i>	slaty gum
Myrtaceae	<i>Melaleuca decora</i>	
Myrtaceae	<i>Melaleuca nodosa</i>	
Nyctaginaceae	<i>Boerhavia dominii</i>	tarvine
Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	
Oxalidaceae	<i>Oxalis perennans</i>	
Oxalidaceae	<i>Oxalis radicata</i>	
Phyllanthaceae	<i>Breynia oblongifolia</i>	coffee bush
Phyllanthaceae	<i>Phyllanthus gunnii</i>	
Phyllanthaceae	<i>Phyllanthus virgatus</i>	wiry spurge
Pittosporaceae	<i>Bursaria spinosa</i>	native blackthorn
Proteaceae	<i>Grevillea montana</i>	
Rubiaceae	<i>Psydrax odorata</i>	shiny-leaved canthium
Rutaceae	<i>Philotheca difformis</i>	
Santalaceae	<i>Choretrum</i> sp. <i>Cox's Gap</i>	
Sapindaceae	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	wedge-leaf hop-bush
Solanaceae	<i>Solanum brownii</i>	violet nightshade
Stackhousiaceae	<i>Stackhousia viminea</i>	slender stackhousia
Vitaceae	<i>Cayratia clematidea</i>	native grape

Plot and Transect Data

The following plot and transect data was collected during surveys of the Offset Sites. It includes the ten site attributes that are recorded in each Biometric plot and transect as per Table 2 of the BBAM (OEH 2014). This data is entered into the BioBanking Calculator to assess the site value of each BVT in the Offset Sites.

In order to meet the minimum plot and transect requirements for each vegetation zone in accordance with BBAM (OEH 2014), some plot and transect data entries have been extrapolated by taking the averages of other plot and transects undertaken in that vegetation zone. These extrapolated plots are named “PX1, PX2, PX3” etc, in the tables below.

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.

HIGHFIELDS OFFSET SITE													
Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Veg Zone 1 - HU701 - Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion (Moderate to Good Condition)													
3509 H002	45	22	3.5	58	4	10	8	0	1	0	111111	222222	56
Veg Zone 2 – HU701 - Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion (Moderate to Good - DNG)													
3509 H007	27	0	0	70	0	38	44	0	1	8	111111	222222	56
HQ24	18	0	0	74	0	10	52	0	1	0	111111	222222	56
HQ28	17	0	0	96	0	26	20	0	1	0	111111	222222	56
Veg Zone 3 - HU714 - Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion (Moderate to Good Condition)													
3509 H012	25	19.5	0	80	0	34	22	0	1	8	273707	6440398	56
Veg Zone 4 - HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (Moderate to Good Condition)													
3509 H002	45	22	3.5	58	4	10	8	0	1	0	272958	6441513	56
3509 H005	49	2.7	4.5	64	6	30	4	3	1	53	272763	6440329	56
3509 H006	55	32	11	58	8	24	6	1	1	48	272794	6439869	56
3509 H014	47	29	0.5	42	2	10	2	0	1	15	273285	6441206	56
HQ22	36	24.5	8.5	66	4	34	14	6	1	37	272718	6439967	56
HQ27	27	16	35	40	2	54	36	2	1	88	274205	6440899	56
Veg Zone 5 - HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (Moderate to Good Condition – Shrubby variant)													
3509 H001	44	13	23.2	44	22	50	0	2	1	101	273045	6441672	56
3509 H003	37	22.5	0	64	14	24	10	1	1	14.5	273994	6441429	56
3509 H004	38	13	5	56	6	62	52	0	1	26	273825	6441724	56
HQ23	22	24.5	11	38	2	10	96	1	1	28	272339	6440666	56
HQ26	15	22	7	78	12	48	10	1	1	73	274386	6441095	56

HIGHFIELDS OFFSET SITE													
Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Veg Zone 6 - HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (Moderate to Good Condition - DNG)													
3509 H007	27	0	0	70	0	38	44	0	1	8	272992	6439853	56
HQ24	18	0	0	74	0	10	52	0	1	0	272420	6440566	56
HQ28	17	0	0	96	0	26	20	0	1	0	274224	6441043	56
PX12	21	0	0	80	0	25	38	0	1	3	111111	2222222	56
Veg Zone 7 - HU821 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter (Moderate to Good Condition)													
HQ25	31	23.5	22.5	88	20	46	28	1	0	74	273515	6441126	56
HQ29	40	23	0	70	20	22	2	1	0	106	273842	6440912	56
PX6	39	23.25	11.25	79	20	34	15	1	0	90	111111	2222222	56
PX7	39	23.25	11.25	79	20	34	15	1	0	90	111111	2222222	56
PX8	39	23.25	11.25	79	20	34	15	1	0	90	111111	2222222	56
Veg Zone 8 - HU868 - Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley (Moderate to Good Condition)													
3509 H008	39	20	18.5	38	12	8	0	1	1	51	273206	6440231	56
3509 H009	30	5.5	1.5	58	0	34	0	0	1	70	273345	6440441	56
3509 H010	53	23	11	36	6	18	4	0	1	22	273843	6440433	56
3509 H011	52	4.5	25	66	2	66	2	1	1	53.5	274047	6440460	56
Veg Zone 9 - HU868 - Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley (Low Condition - DNG)													
3509 H013	18	0.25	0	0	0	12	92	0	1	24.5	273841	6440315	56
3509 H015	24	0	0	2	0	6	82	0	1	17.5	273903	6440306	56

MANGROVE OFFSET SITE													
Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Veg Zone 1 – HU599 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley (Moderate to Good Condition)													
3509_13Q	5	0.5	0	36	0	0	14	0	0.5	53	277650	6422357	56
3509_23Q	18	0	0	56	0	0	90	1	0.5	0	277562	6422101	56
Veg Zone 2– HU599 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley (Moderate to Good Condition - DNG)													
3509_12Q	2	0	0	98	0	0	40	0	0.5	0	277444	6421992	56
3509_22Q	6	0	0	74	0	0	26	0	0.5	0	277314	6421745	56
PX1	4	0	0	86	0	0	33	0	0.5	0	111111	2222222	56
Veg Zone 3– HU678 Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion (Moderate to Good Condition)													
3509_05Q	30	4.7	23.7	70	6	20	4	0	1	104	276662	6422539	56
3509_15Q	26	7	5.2	40	4	20	0	0	1	132	276771	6421958	56
3509_16Q	31	7.5	46	16	2	0	0	0	1	15	276932	6422492	56
3509_17Q	32	14	12.2	14	2	2	0	1	1	111	276934	6422207	56
Veg Zone 4– HU812 Forest Red Gum grassy open forest on floodplains of the lower Hunter (Moderate to Good Condition)													
3509_01Q	56	23	0.5	54	4	10	4	0	1	8	278646	6421757	56
3509_03Q	45	15	3.5	64	6	6	0	0	1	79	278834	6421571	56
MQ1	46	14	0.4	56	2	30	8	0	1	18	278771	6421535	56
Veg Zone 5– HU812 Forest Red Gum grassy open forest on floodplains of the lower Hunter (Low Condition - DNG)													
3509_07Q	16	0	0	46	0	22	88	0	0.3	0	277475	6422255	56
3509_09Q	20	0	0	14	0	6	98	0	0.3	0	277166	6421813	56
3509_11Q	17	0	0	32	0	16	66	0	0.3	0	277904	6421874	56
3509_20Q	24	0	0	86	2	14	32	0	0.3	0	278457	6421841	56

MANGROVE OFFSET SITE													
Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Veg Zone 6– HU905 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter (Moderate to Good Condition)													
3509_02Q	40	4.5	4	46	0	48	0	0	1	38	278678	6421907	56
3509_04Q	26	21	0.5	34	6	8	6	1	1	120	278888	6421850	56
3509_14Q	37	14	1.5	66	0	6	8	0	1	30	276889	6421949	56
3509_18Q	45	2.2	3	50	4	26	2	0	1	57	278654	6421948	56
MQ2	57	22.5	1	54	2	40	6	1	1	14	278781	6421839	56
Veg Zone 7– HU905 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter (Moderate to Good Condition - DNG)													
3509_06Q	24	0	0	82	0	22	20	0	1	0	276575	6422785	56
3509_08Q	19	0	0	90	0	2	24	0	1	0	277211	6422549	56
3509_10Q	20	0	0	56	0	14	64	0	1	0	277031	6421920	56
3509_19Q	16	0	0	58	0	18	74	0	1	1	278347	6422297	56
3509_21Q	21	0	0	42	0	10	86	0	1	3	278250	6421617	56
Veg Zone 8– HU812 Forest Red Gum grassy open forest on floodplains of the lower Hunter (Moderate to Good_Poor - Exotic Grassland)													
PX9	0	0	0	0	0	0	90	0	0	0	111111	2222222	56
PX10	0	0	0	0	0	0	90	0	0	0	111111	2222222	56
PX11	0	0	0	0	0	0	90	0	0	0	111111	2222222	56

WAMBO OFFSET SITE													
Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Veg Zone 1 – HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter (Moderate to Good Condition)													
3509_W01	43	13.5	10.5	40	8	20	0	0	1	73	307188	6394976	56
3509_W03	31	6	1	18	0	4	0	0	1	3.5	307423	6394981	56
3509_W04	37	8	4.4	4.6	16	0	0	0	1	56	307352	6394803	56
Veg Zone 2 – HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter (Moderate to Good Condition - DNG)													
3509_W05	22	0	0	94	2	10	20	0	0.5	0	306767	6395035	56
Veg Zone 3 – HU869 Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin (Moderate to Good Condition)													
3509_W02	20	42.5	6.5	34	6	2	0	1	0.5	57	307302	6494516	56
PX3	20	42.5	6.5	34	6	2	0	1	0.5	57	111111	2222222	56
PX4	20	42.5	6.5	34	6	2	0	1	0.5	57	111111	2222222	56
PX5	20	42.5	6.5	34	6	2	0	1	0.5	57	111111	2222222	56

Vegetation Community Profiles

Highfields Offset Site Vegetation Zones

Seven Biometric vegetation zones were identified across the Highfields Offset Site (refer to **Figure 13.3**). The following information is provided for each of the vegetation zones:

- equivalent Biometric Vegetation Type (BVT)
- broad condition class
- total area
- survey effort
- vegetation formation and class
- equivalent Hunter Remnant Vegetation Project (HRVP) map unit (Peake 2006)
- the location of each community in the project area
- a floristic and structural description and
- the conservation status of the community under both NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Veg Zone 1: HU701 – Narrow-leaved Ironbark +/- Grey Box Grassy Woodland of the Upper Hunter Valley, mainly Sydney Basin Bioregion – Moderate to Good Condition

BVT Name	Narrow-leaved Ironbark +/- Grey Box Grassy Woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion	
Condition	Moderate to Good	
BVT Number	HU701	No photo available
Area (ha)	0.5	
Survey Effort	Nil	
Formation	Grassy Woodlands	
Class	Coastal Valley Grassy Woodlands	
HRVP Map Unit	MU10 Central Hunter Box Ironbark Woodland	
General Description	This vegetation zone occurs as small isolated remnant patches on the lower slopes of the offset area.	
Canopy Description	Narrow-leaved ironbark (<i>Eucalyptus crebra</i>) is the dominant species in this community with scattered occurrences of rough-barked apple (<i>Angophora floribunda</i>) and Blakely's red gum (<i>Eucalyptus blakelyi</i>). The canopy is very sparse to sparse and reaches up to 16 metres in height.	
Mid-storey Description	Generally the sub-canopy is absent however a sub-canopy layer can occur in ecotonal areas with adjoining communities. Where this occurs the sub-canopy is very sparse to 8 metres in height, with dominant species including black cypress pine (<i>Callitris endlicheri</i>), red ash (<i>Alphitonia excelsa</i>) and kurrajong (<i>Brachychiton populneus</i> subsp. <i>populneus</i>).	
Shrub Layer Description	A very sparse shrub layer to a height of 4 metres occurs in less disturbed areas; however the shrub layer is typically absent. Commonly occurring species include velvet mock olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>), western boobialla (<i>Myoporum montanum</i>) and blackthorn (<i>Bursaria spinosa</i> subsp. <i>spinosa</i>).	
Ground Cover Description	The ground cover is mid-dense and dominated by a variety of native grasses and forbs. Common species include purple wiregrass (<i>Aristida ramosa</i>), speargrass (<i>Austrostipa scabra</i> var. <i>scabra</i>), tall chloris (<i>Chloris ventricosa</i>), berry saltbush (<i>Einadia hastata</i>), spiked sida (<i>Sida subspicata</i>). In more sheltered locations commonly occurring species include weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), kidney weed (<i>Dichondra repens</i>) and poison rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>).	
Introduced Species	None recorded.	
TSC Act Status	This vegetation zone is not consistent with the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregion EEC, given that the occurrences of this vegetation zone are located in the Brigalow Belt South Bioregion. For further information, refer to Section 13.3.2.6 .	
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.	

Veg Zone 2: HU701 – Narrow-leaved Ironbark +/- Grey Box Grassy Woodland of the Upper Hunter Valley, mainly Sydney Basin Bioregion – Moderate to Good Condition – Derived Native Grassland

BVT Name	Narrow-leaved Ironbark +/- Grey Box Grassy Woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion	
Condition	Moderate to Good – Derived Native Grassland	
BVT Number	HU701	No photo available
Area (ha)	4.3	
Survey Effort	Nil	
Formation	Grassy Woodlands	
Class	Coastal Valley Grassy Woodlands	
HRVP Map Unit	Derived form of MU10 Central Hunter Box Ironbark Woodland	
General Description	This vegetation zone occurs on the lower slopes of the offset area.	
Canopy Description	Nil	
Mid-storey Description	Nil	
Shrub Layer Description	A very sparse shrub layer of cooba (<i>Acacia salicina</i>) occurs in some areas of this vegetation zone.	
Ground Cover Description	Commonly recorded native species include purple wiregrass (<i>Aristida ramosa</i>), red grass (<i>Bothriochloa decipiens</i>), speargrass (<i>Austrostipa scabra</i> subsp. <i>scabra</i>), slender rats tail grass (<i>Sporobolus creber</i>), <i>Glycine tabacina</i> , native geranium (<i>Geranium solanderi</i>), yellow burr-daisy (<i>Calotis lappulacea</i>) and tufted bluebell (<i>Wahlenbergia communis</i>).	
Introduced Species	Common introduced species include paspalum (<i>Paspalum dilatatum</i>), kikuyu (<i>Pennisetum clandestinum</i>), saffron thistle (<i>Carthamus lanatus</i>), white clover (<i>Trifolium repens</i>), spear thistle (<i>Cirsium vulgare</i>) and purpletop (<i>Verbena bonariensis</i>).	
TSC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.	
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.	

Veg Zone 3: HU714 – Rough-Barked Apple - Red Gum - Yellow Box Woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion – Moderate to Good Condition

BVT Name	Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	
Condition	Moderate to Good	
BVT Number	HU714	
Area (ha)	2.0	
Survey Effort	1 biometric plot/transect	
Formation	Grassy Woodlands	
Class	Western Slopes Grassy Woodlands	
HRVP Map Unit	No equivalent	
General Description	This vegetation zone occurs on alluvial flats associated with drainage lines through the centre of the offset area, typically in areas where a gully opens to the alluvium resulting in an increase in water flow. This community has been subject to past disturbances such as logging and grazing.	
Canopy Description	A very sparse canopy between 12 and 15 metres in height dominates the vegetation community, with dominant species including hybridised Blakely's / forest red gum (<i>Eucalyptus blakelyi</i> <--> <i>tereticornis</i>) and rough-barked apple (<i>Angophora floribunda</i>).	
Mid-storey Description	The mid-storey is occasionally absent however when it occurs it is sparse between 6 and 10 metres in height, with dominant species including young canopy species, rusty fig (<i>Ficus rubiginosa</i>) and forest oak (<i>Allocasuarina torulosa</i>).	
Shrub Layer Description	A sparse shrub layer, between 1 and 2 metres in height, occurs with species including velvet mock olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>), narrow-leaved geebung (<i>Persoonia linearis</i>) and coffee bush (<i>Breynia oblongifolia</i>).	
Ground Cover Description	The ground cover vegetation was generally mid-dense to closed and is dominated by native grasses and forbs. Commonly recorded species include weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), spiny-headed mat-rush (<i>Lomandra longifolia</i>), tall sedge (<i>Carex appressa</i>), purple wiregrass (<i>Aristida ramosa</i>), common wheatgrass (<i>Elymus scaber</i>), stinking pennywort (<i>Hydrocotyle laxiflora</i>), kidney weed (<i>Dichondra repens</i>) and hairy panic (<i>Panicum effusum</i>).	
Introduced Species	Introduced flora species are common throughout this vegetation zone as it has been exposed to a long history of stock grazing. Dominant species recorded include <i>Pavonia hastata</i> , soft brome (<i>Bromus molliformis</i>), perennial ryegrass (<i>Lolium perenne</i>), hop clover (<i>Trifolium campestre</i>) and prairie grass (<i>Bromus catharticus</i>)	
TSC Act Status	This vegetation zone is consistent with the <i>White Box Yellow Box Blakely's Red Gum Woodland</i> EEC listed under the TSC Act. For further information, refer to Section 13.3.2.6 .	
EPBC Act Status	This vegetation zone is consistent with the <i>White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland</i> CEEC listed under the EPBC Act. For further information, refer to Section 13.3.2.5 .	

Veg Zone 4: HU730 – White Box x Grey Box - Red Gum - Rough-barked Apple Grassy Woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition

BVT Name	White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	
Condition	Moderate to Good	
BVT Number	HU730	
Area (ha)	158.2	
Survey Effort	6 biometric plots/transects	
Formation	Grassy Woodlands	
Class	Coastal Valley Grassy Woodland	
HRVP Map Unit	MU11 – Upper Hunter White Box – Ironbark Grassy Woodland	
General Description	This vegetation zone occurs on the fertile Tertiary basalt-derived soils on the upper slopes of the Highfields Offset Area, which have been largely cleared for agricultural purposes and have been historically grazed. Specifically, it occurs on undulating hills on the upper slopes in the east and north and lower slopes in the west.	
Canopy Description	The canopy is sparse to mid-dense and dominated by white/grey box intergrades (<i>Eucalyptus albens</i> – <i>moluccana</i>) with occurrences of narrow-leaved ironbark (<i>Eucalyptus crebra</i>), 6 to 20 metres in height. Other canopy species such as grey box (<i>Eucalyptus moluccana</i>), yellow box (<i>Eucalyptus melliodora</i>) and Blakely's red gum (<i>Eucalyptus blakelyi</i>) can occur infrequently.	
Mid-storey Description	The mid-storey is sparse to mid-dense ranging from 1 to 8 metres. Common species include velvet mock olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>), shiny-leaved canthium (<i>Psydrax odoratum</i>), cooba (<i>Acacia salicina</i>), green wattle (<i>Acacia deanei</i> subsp. <i>deanei</i>), <i>Choretrum</i> sp. A and regenerating eucalypts.	
Shrub Layer Description	The shrub layer is typically sparse, ranging from 0.5 to 1 metre, and comprises the above mentioned mid-storey species.	
Ground Cover Description	The ground cover is typically dense with a high diversity of native grasses and forbs. Commonly recorded species include Queensland bluegrass (<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>), purple wiregrass (<i>Aristida ramosa</i>), wallaby grass (<i>Rytidosperma bipartitum</i>), red grass (<i>Bothriochloa decipiens</i>), snowgrass (<i>Poa sieberiana</i> var. <i>sieberiana</i>), speargrass (<i>Austrostipa scabra</i> subsp. <i>scabra</i>), tall chloris (<i>Chloris ventricosa</i>), amulla (<i>Eremophila debilis</i>), kidney weed (<i>Dichondra repens</i>), <i>Glycine tabacina</i> , native geranium (<i>Geranium solanderi</i>), <i>Vittadinia sulcata</i> , yellow burr-daisy (<i>Calotis lappulacea</i>) and tufted bluebell (<i>Wahlenbergia communis</i>).	
Introduced Species	Introduced species are common in this community due to the long history of stock grazing and fertility of the soil. Common species include saffron thistle (<i>Carthamus lanatus</i>), common prickly pear (<i>Opuntia stricta</i> var. <i>stricta</i>), Paddys lucerne (<i>Sida rhombifolia</i>), horehound (<i>Marrubium vulgare</i>) and slender celery (<i>Cyclospermum leptophyllum</i>).	
TSC Act Status	This vegetation zone is consistent with the EEC <i>White Box Yellow Box Blakely's Red Gum Woodland</i> listed under the TSC Act. For further information refer to Section 13.3.2.6 .	
EPBC Act Status	This vegetation zone is consistent with the CEEC <i>White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland</i> listed under the EPBC Act. For further information refer to Section 13.3.2.5 .	

Veg Zone 5: HU730 - White Box x Grey Box - Red Gum - Rough-barked Apple Grassy Woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition - Shrubby Variant

BVT Name	White Box x Grey Box - Red Gum - Rough-barked Apple Grassy Woodland on rich soils on hills in the upper Hunter Valley	
Condition	Moderate to Good – Shrubby Variant	
BVT Number	HU730	
Area (ha)	97.8	
Survey Effort	5 biometric plots/transects	
Formation	Grassy Woodlands	
Class	Coastal Valley Grassy Woodland	
HRVP Map Unit	MU11 – Upper Hunter White Box – Ironbark Grassy Woodland	
General Description	This vegetation zone occurs on the fertile Tertiary basalt-derived soils on the upper slopes of the Highfields Offset Site. It occurs on undulating to steep slopes and sheltered gullies.	
Canopy Description	This community is characterised by a sparse canopy, 8 to 20 metres in height, dominated by white/grey box intergrades (<i>Eucalyptus albens</i> – <i>moluccana</i>) , with occurrences of rough-barked apple (<i>Angophora floribunda</i>) and narrow-leaved ironbark (<i>Eucalyptus crebra</i>).	
Mid-storey Description	A sparse to mid-dense mid-storey is present in this vegetation zone ranging from 1 to 6 metres. Common species included velvet mock olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>), bulloak (<i>Allocasuarina luehmannii</i>), shiny-leaved canthium (<i>Psydrax odoratum</i>) and cooba (<i>Acacia salicina</i>).	
Shrub Layer Description	The shrub layer is typically sparse, ranging from 0.5 to 1 metre, and comprises the above mentioned mid-storey species.	
Ground Cover Description	The ground cover is typically sparse to mid-dense with commonly recorded species including hairy panic (<i>Panicum effusum</i>), snowgrass (<i>Poa sieberiana</i> var. <i>sieberiana</i>), purple wiregrass (<i>Aristida ramosa</i>), threeawn speargrass (<i>Aristida vagans</i>), <i>Glycine tabacina</i> , berry saltbush (<i>Einadia hastata</i>), kidney weed (<i>Dichondra repens</i>), slender bamboo grass (<i>Austrostipa verticillata</i>), weeping grass (<i>Microlaena stipoides</i> subsp. <i>stipoides</i>), blue trumpet (<i>Brunoniella australis</i>) and wallaby grass (<i>Rytidosperma fulvum</i>).	
Introduced Species	Introduced species include African olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>), cobblers pegs (<i>Bidens pilosa</i>), Patersons curse (<i>Echium plantagineum</i>), narrow-leaved cotton bush (<i>Gomphocarpus fruticosus</i>), vervain (<i>Salvia verbenaca</i>), spear thistle (<i>Cirsium vulgare</i>), Cape weed (<i>Arctotheca calendula</i>), and catsear (<i>Hypochaeris radicata</i>).	
TSC Act Status	This vegetation zone is consistent with the EEC <i>White Box Yellow Box Blakely's Red Gum Woodland</i> listed under the TSC Act. For further information refer to Section 13.3.2.6 .	
EPBC Act Status	This vegetation zone is consistent with the CEEC <i>White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland</i> listed under the EPBC Act. For further information refer to Section 13.3.2.5 .	

Veg Zone 6: HU730 – White Box x Grey Box - Red Gum - Rough-barked Apple Grassy Woodland on rich soils on hills in the upper Hunter Valley – Moderate to Good Condition –Derived Native Grassland

BVT Name	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	
Condition	Moderate to Good – Derived Native Grassland	
BVT Number	HU730	
Area (ha)	39.7	
Survey Effort	3 biometric plots/transects	
Formation	Grassy Woodlands	
Class	Coastal Valley Grassy Woodland	
HRVP Map Unit	MU11 – Upper Hunter White Box – Ironbark Grassy Woodland	
General Description	This vegetation zone occurs on relatively fertile Tertiary basalt-derived soils on the upper slopes of the Highfields offset area, in areas that are likely to have once been dominated by white box (<i>Eucalyptus albens</i>), white/grey box intergrades (<i>Eucalyptus albens</i> – <i>moluccana</i>), Blakely’s red gum (<i>Eucalyptus blakelyi</i>), or a combination of these species, based on the current (post-disturbance) distribution of these species. A history of stock grazing throughout this vegetation zone has left it heavily degraded with introduced flora species common and occurring in high numbers.	
Canopy Description	Not present.	
Mid-storey Description	Not present.	
Shrub Layer Description	Not present.	
Ground Cover Description	The dense ground cover is composed of native and introduced grasses and forbs. Commonly recorded native species include Queensland bluegrass (<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>), barbed wiregrass (<i>Cymbopogon refractus</i>), slender rats tail grass (<i>Sporobolus creber</i>), threeawn speargrass (<i>Aristida vagans</i>), purple wiregrass (<i>Aristida ramosa</i>), red grass (<i>Bothriochloa macra</i>), wallaby grass (<i>Rytidosperma bipartitum</i>), wallaby grass (<i>Rytidosperma fulvum</i>), tall chloris (<i>Chloris ventricosa</i>), plains grass (<i>Austrostipa aristiglumis</i>), native pennyroyal (<i>Mentha satureioides</i>), sheeps bur (<i>Acaena echinata</i>) and common woodruff (<i>Asperula conferta</i>).	
Introduced Species	Introduced flora species are common throughout this vegetation zone as it has been exposed to a long history of stock grazing. Dominant species recorded include spear thistle (<i>Cirsium vulgare</i>), narrow-leaved cotton bush (<i>Gomphocarpus fruticosus</i>), catsear (<i>Hypochaeris radicata</i>), fireweed (<i>Senecio madagascariensis</i>), saffron thistle (<i>Carthamus lanatus</i>), hop clover (<i>Trifolium campestre</i>), cobblers pegs (<i>Bidens pilosa</i>) and purpletop (<i>Verbena bonariensis</i>).	
TSC Act Status	This vegetation zone is consistent with the EEC <i>White Box Yellow Box Blakely’s Red Gum Woodland</i> listed under the TSC Act. For further information refer to Section 13.3.2.6.	
EPBC Act Status	This vegetation zone is consistent with the CEEC <i>White Box Yellow Box Blakely’s Red Gum Grassy Woodland and Derived Native Grassland</i> listed under the EPBC Act. For further information refer to Section 13.3.2.5.	

Veg Zone 7: HU821 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple Shrubby Woodland of the upper Hunter – Moderate to Good Condition

BVT Name	Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple Shrubby Woodland of the upper Hunter	
Condition	Moderate to Good	
BVT Number	HU821	
Area (ha)	83.5	
Survey Effort	2 biometric plots/transects	
Formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)	
Class	North-west Slopes Dry Sclerophyll Woodlands	
HRVP Map Unit	MU29: Upper Hunter Hills Sheltered Moist Forest	
General Description	This vegetation zone is a dominant form of open forest in the Highfields Offset Site, occurring on the central steep slopes.	
Canopy Description	This vegetation zone is characterised by a sparse canopy, dominated by grey gum (<i>Eucalyptus punctata</i>) and narrow-leaved ironbark (<i>Eucalyptus crebra</i>), with various associations with rough-barked apple (<i>Angophora floribunda</i>), narrow-leaved stringybark (<i>Eucalyptus sparsifolia</i>) and Blakelys red gum (<i>Eucalyptus blakelyi</i>). This community occurs to 17 to 23 metres in height in sheltered situations.	
Mid-storey Description	The mid-storey layer is very sparse to sparse and ranges from 6 to 10 metres in height. Commonly occurring species include forest oak (<i>Allocasuarina torulosa</i>), Port Jackson fig (<i>Ficus rubiginosa</i>), kurrajong (<i>Brachychiton populneus</i> subsp. <i>populneus</i>), black cypress pine (<i>Callitris endlicheri</i>), velvet mock olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>) and red ash (<i>Alphitonia excelsa</i>).	
Shrub Layer Description	The shrub layer is typically sparse, ranging from 1 to 2.5 metres, and comprises narrow-leaved geebung (<i>Persoonia linearis</i>), prickly shaggy pea (<i>Podolobium ilicifolium</i>), blunt beard-heath (<i>Leucopogon muticus</i>), native blackthorn (<i>Bursaria spinosa</i> subsp. <i>spinosa</i>), coffee bush (<i>Breynia oblongifolia</i>), sweet pittosporum (<i>Pittosporum undulatum</i>), Australian indigo (<i>Indigofera australis</i>) and native cherry (<i>Exocarpos cupressiformis</i>)..	
Ground Cover Description	The groundcover is sparse to mid-dense with species including stinking pennywort (<i>Hydrocotyle laxiflora</i>), pomax (<i>Pomax umbellata</i>), berry saltbush (<i>Einadia hastata</i>), blue flax lily (<i>Dianella revoluta</i> var. <i>revoluta</i>), kidney weed (<i>Dichondra repens</i>), tufted bluebell (<i>Wahlenbergia communis</i>), hairy panic (<i>Panicum effusum</i>), weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), threeawn speargrass (<i>Aristida vagans</i>), rough saw-sedge (<i>Gahnia aspera</i>), variable saw-sedge (<i>Lepidosperma laterale</i>) and poison rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>).	
Introduced Species	Introduced species include wild aster (<i>Aster subulatus</i>), cobblers pegs (<i>Bidens pilosa</i>), African olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>) and fireweed (<i>Senecio madagascariensis</i>).	
TSC Act Status	This vegetation community is not consistent with any listed TEC under the TSC Act.	
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.	

Veg Zone 8: HU868 – Narrow-leaved Ironbark - Grey Gum Shrubby Open Forest on sandstone ranges of the upper Hunter Valley– Moderate to Good Condition

BVT Name	Narrow-leaved Ironbark - Grey Gum Shrubby Open Forest on sandstone ranges of the upper Hunter Valley	
Condition	Moderate to Good	
BVT Number	HU868	
Area (ha)	39.3	
Survey Effort	4 biometric plots/transects	
Formation	Dry Sclerophyll Forests (Shrubby Sub-formation)	
Class	Western Slopes Dry Sclerophyll Forests	
HRVP Map Unit	MU8 – Western Hunter Narrabeen Foothslopes Ironbark – Cypress Pine Woodland	
General Description	This vegetation zone occurs on Narrabeen sandstone and sandy soils on exposed ridges, primarily in the south of the offset area.	
Canopy Description	Typically the vegetation zone is a dry, very-sparse to sparse forest-woodland, with a canopy generally 8 to 20 metres tall. The dominant canopy species is narrow-leaved ironbark (<i>Eucalyptus crebra</i>), however black cypress pine (<i>Callitris endlicheri</i>) and bulloak (<i>Allocasuarina luehmannii</i>) also occur to a lesser extent throughout the community.	
Mid-storey Description	The mid-storey is sparse to mid-dense characterised by young narrow-leaved ironbark (<i>Eucalyptus crebra</i>) as well as narrow-leaved geebung (<i>Persoonia linearis</i>), bulloak (<i>Allocasuarina luehmannii</i>), currawang (<i>Acacia doratoxylon</i>), velvet mock olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>), <i>Choretrum</i> sp. A, blunt beard-heath (<i>Leucopogon muticus</i>), blackthorn (<i>Bursaria spinosa</i> subsp. <i>spinosa</i>) and coffee bush (<i>Breynia oblongifolia</i>). The mid-storey is 1 to 8 metres in height.	
Shrub Layer Description	The shrub layer is typically sparse, ranging from 0.5 to 1 metre, and comprises the above mentioned mid-storey species as well as the low shrubs urn heath (<i>Melichrus urceolatus</i>) and native fuchsia (<i>Correa reflexa</i>).	
Ground Cover Description	The ground cover varies from sparse to mid-dense but is characteristically low, occurring less than 0.5 metres in height. It comprises a range of sub-shrubs, forbs and grasses including <i>Hibbertia acicularis</i> , hoary guinea flower (<i>Hibbertia obtusifolia</i>), kidney weed (<i>Dichondra repens</i>), yellow-burr daisy (<i>Calotis lappulacea</i>), poison rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), slender wire lily (<i>Laxmannia gracilis</i>), rough saw-sedge (<i>Gahnia aspera</i>), threeawn speargrass (<i>Aristida vagans</i>), speargrass (<i>Austrostipa scabra</i>), purple wiregrass (<i>Aristida ramosa</i>), weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), variable sword-sedge (<i>Lepidosperma laterale</i>), wallaby grass (<i>Rytidosperma racemosum</i> var. <i>racemosum</i>) and barbed wire grass (<i>Cymbopogon refractus</i>).	
Introduced Species	Introduced flora species are uncommon in this vegetation zone, and those that did occur are in low abundance. Species include common prickly pear (<i>Opuntia stricta</i> var. <i>stricta</i>), fireweed (<i>Senecio madagascariensis</i>), smooth catsear (<i>Hypochaeris glabra</i>), Paddys lucerne (<i>Sida rhombifolia</i>), wall fescue (<i>Vulpia muralis</i>), scarlet pimpernel (<i>Anagallis arvensis</i>) and <i>Petrorhagia dubia</i> .	
TSC Act Status	This vegetation community is not consistent with any listed TEC under the TSC Act.	
EPBC Act Status	This vegetation community is not consistent with any listed TEC under the EPBC Act.	

Veg Zone 9: HU868 – Narrow-leaved Ironbark - Grey Gum Shrubby Open Forest on sandstone ranges of the upper Hunter Valley– Low Condition – Derived Native Grassland

BVT Name	Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley	
Condition	Low Condition – Derived Native Grassland	
BVT Number	HU868	
Area (ha)	2.2	
Survey Effort	2 biometric plots/transects	
Formation	Dry Sclerophyll Forests (Shrubby Sub-formation)	
Class	Western Slopes Dry Sclerophyll Forests	
HRVP Map Unit	Derived form of MU8 – Western Hunter Narrabeen Foothslopes Ironbark – Cypress Pine Woodland	
General Description	This vegetation zone is restricted to a single patch in the south of the offset area. It occurs on sandy clay soils, down slope of remnant open forests from which it is derived. Its location on the lower slopes of the open valley in the offset area has exposed this vegetation zone to a long history of stock grazing.	
Canopy Description	A canopy layer is absent from this vegetation zone, however narrow-leaved ironbark (<i>Eucalyptus crebra</i>) up to 30 metres occurs scattered throughout the community.	
Mid-storey Description	Not present.	
Shrub Layer Description	Not present.	
Ground Cover Description	This vegetation zone is characterised by a dense ground cover, less than a metre in height. The disturbed state of this vegetation zone has resulted in a high cover of introduced flora species. Native flora species are present but infrequent. Species include weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), early spring grass (<i>Eriochloa pseudoacrotricha</i>), common fringe-sedge (<i>Fimbristylis dichotoma</i>), <i>Juncus usitatus</i> , speargrass (<i>Austrostipa scabra</i>), berry saltbush (<i>Einadia hastata</i>), native wandering Jew (<i>Commelina cyanea</i>), variable glycine (<i>Glycine tabacina</i>), purple wiregrass (<i>Aristida ramosa</i>) and slender rats tail grass (<i>Sporobolus creber</i>).	
Introduced Species	Introduced species dominate the ground cover of this vegetation zone. Dominant species include wall fescue (<i>Vulpia muralis</i>), <i>Petrorhagia dubia</i> , perennial ryegrass (<i>Lolium perenne</i>), soft brome (<i>Bromus hordeaceus</i>), shivery grass (<i>Briza minor</i>), saffron thistle (<i>Carthamus lanatus</i>) and Chilean whitlow wort (<i>Paronychia brasiliiana</i>).	
TSC Act Status	This vegetation community is not consistent with any listed TEC under the TSC Act.	
EPBC Act Status	This vegetation community is not consistent with any listed TEC under the EPBC Act.	

Mangrove Offset Site Vegetation Zones

Seven Biometric vegetation zones were identified within the Mangrove Offset Area (refer to **Figure 13.4**). The following information is provided for each of the vegetation zones:

- equivalent Biometric Vegetation Type (BVT)
- broad condition class
- total area
- survey effort
- vegetation formation and class
- equivalent Hunter Remnant Vegetation Project (HRVP) map unit (Peake 2006)
- the location of each community in the project area
- a floristic and structural description and
- the conservation status of the community under both NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Veg Zone 1: HU599 – River Red Gum / River Oak Riparian Woodland Wetland in the Hunter Valley – Moderate to Good Condition

BVT Name	River Red Gum / River Oak riparian Woodland Wetland in the Hunter Valley	
Condition	Moderate to Good	
BVT Number	HU599	
Area (ha)	1.8	
Survey Effort	2 biometric plots/transects	
Formation	Forested Wetlands	
Class	Eastern Riverine Forests	
HRVP Map Unit	MU13 – Hunter Floodplain Red Gum Woodland Complex	
General Description	This vegetation zone occurs as isolated pockets of remnant woodland along Wybong Creek, with five distinct patches mapped. It is characterised by a very sparse woodland canopy above a dense ground layer.	
Canopy Description	The very sparse canopy comprises river oak (<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>) ranging from 6 to 10 metres in height.	
Mid-storey Description	Not present.	
Shrub Layer Description	Not present.	
Ground Cover Description	This vegetation zone has a dense ground layer less than 1 metre in height. Native grasses are common throughout and are dominated by slender bamboo grass (<i>Austrostipa verticillata</i>), purple wiregrass (<i>Aristida ramosa</i>), common couch (<i>Cynodon dactylon</i>), Queensland bluegrass (<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>) and plains grass (<i>Austrostipa aristiglumis</i>). Native forbs are uncommon, including berry saltbush (<i>Einadia hastata</i>), swamp dock (<i>Rumex brownii</i>) and common everlasting (<i>Chrysocephalum apiculatum</i>).	
Introduced Species	The history of grazing pressure in this vegetation zone has resulted in a high number of introduced species. Dominant species include kikuyu grass (<i>Pennisetum clandestinum</i>), weeping willow (<i>Salix babylonica</i>), prairie grass (<i>Bromus catharticus</i>), galenia (<i>Galenia pubescens</i>), panic veldtgrass (<i>Ehrharta erecta</i>), paspalum (<i>Paspalum dilatatum</i>), turnip weed (<i>Rapistrum rugosum</i>), saffron thistle (<i>Carthamus lanatus</i>), variegated thistle (<i>Silybum marianum</i>), great brome (<i>Bromus diandrus</i>) and soft brome (<i>Bromus hordeaceus</i>).	
TSC Act Status	This vegetation zone is not consistent with any TEC listed under the TSC Act.	
EPBC Act Status	This vegetation is not consistent with any TEC listed under the EPBC Act.	

Veg Zone 2: HU599 – River Red Gum / River Oak Riparian Woodland Wetland in the Hunter Valley – Moderate to Good – Derived Native Grassland

BVT Name	River Red Gum / River Oak riparian woodland wetland in the Hunter Valley		
Condition	Moderate to Good – Derived Native Grassland		
BVT Number	HU599		
Area (ha)	4.2		
Survey Effort	2 biometric plots/transects		
Formation	Forested Wetlands		
Class	Eastern Riverine Forests		
HRVP Map Unit	Derived form of MU13 – Hunter Floodplain Red Gum Woodland Complex		
General Description	This vegetation zone occurs along the banks of Wybong Creek up to approximately 50 metres of the banks Introduced flora species are common in the vegetation zone.		
Canopy Description	Not present.		
Mid-storey Description	Recruiting river oak (<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>) was recorded as the sole native species in the mid-storey, ranging in height from 1 to 4 metres.		
Shrub Layer Description	Not present.		
Ground Cover Description	This vegetation zone is characterised by a mid-dense to dense ground layer with a low native species richness. The native grass common couch (<i>Cynodon dactylon</i>) was the dominant species in the ground layer and sole native grass species recorded. Native forbs were uncommon, including pale knotweed (<i>Persicaria lapathifolia</i>), <i>Chamaesyce dallachyana</i> , tufted bluebell (<i>Wahlenbergia communis</i>) and swamp dock (<i>Rumex brownii</i>). The ground layer was less than 1 metre in height.		
Introduced Species	There has been a history of grazing pressure in this vegetation zone which has resulted in a high number of introduced species. Common species include tall fleabane (<i>Conyza sumatrensis</i>), turnip weed (<i>Rapistrum rugosum</i>), Noogoora burr (<i>Xanthium occidentale</i>), willow-leaved lettuce (<i>Lactuca saligna</i>), spiny rush (<i>Juncus acutus</i> subsp. <i>acutus</i>), weeping willow (<i>Salix babylonica</i>), catsear (<i>Hypochaeris radicata</i>) and kikuyu grass (<i>Pennisetum clandestinum</i>).		
TSC Act Status	This vegetation is not consistent with any TEC listed under the TSC Act.		
EPBC Act Status	This vegetation is not consistent with any TEC listed under the EPBC Act.		

Veg Zone 3: HU678 - Black Cypress Pine - Ironbark+/-Narrow-leaved Wattle Low Open Forest Mainly on Narrabeen Sandstone in the Upper Hunter Region of the Sydney Basin Bioregion – Moderate to Good Condition

BVT Name	Black Cypress Pine - Ironbark+/-Narrow-leaved Wattle Low Open Forest Mainly on Narrabeen Sandstone in the Upper Hunter Region of the Sydney Basin Bioregion	
Condition	Moderate to Good	
BVT Number	HU678	
Area (ha)	44.9	
Surveys Effort	4 biometric plots/transects	
Formation	Dry Sclerophyll Forests (Shrubby Sub-formation)	
Class	Western Slopes Dry Sclerophyll Forests	
HRVP Map Unit	MU 8 – Western Hunter Narrabeen Footslopes Ironbark – Cypress Pine Woodland	
General Description	This vegetation zone is the dominant remnant forest community west of Wybong Creek within the Mangrove Offset Site. It is restricted to the small hills and a small area of the surrounding flats. It is characterised by an intact multi-species canopy, mid-storey and ground layer.	
Canopy Description	This community supports a very sparse to sparse canopy dominated by red ironbark (<i>Eucalyptus fibrosa</i>), currawang (<i>Acacia doratoxylon</i>), grey gum (<i>Eucalyptus punctata</i>) and black cypress pine (<i>Callitris endlicheri</i>). Height of the canopy ranges from 15 to 20 metres. This vegetation zone also comprises very sparse emergent narrow-leaved ironbark (<i>Eucalyptus crebra</i>) trees to a height of 25 metres.	
Mid-storey Description	A very sparse to sparse mid-storey is present with dominant species including velvet mock olive (<i>Notelaea microcarpa</i>), narrow-leaved geebung (<i>Persoonia linearis</i>), <i>Kunzea</i> sp. 'Mt Kaputar', blunt beard-heath (<i>Leucopogon muticus</i>) and <i>Prostanthera prunelloides</i> . The mid-storey varies from 1.5 – 6 metres in height.	
Shrub Layer Description	This vegetation zone lacks a distinct shrub layer, however the abovementioned mid-storey species were also recorded as occurring less than 1 metre in height.	
Ground Cover Description	This vegetation zone is characterised by a sparse to mid-dense ground layer less than 1 metre in height. Common herbs and sub-shrubs included berry saltbush (<i>Einadia hastata</i>), rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), <i>Oxalis perennans</i>, hoary guinea flower (<i>Hibbertia obtusifolia</i>), native wandering Jew (<i>Commelina cyanea</i>), yellow burr-daisy (<i>Calotis lappulacea</i>) and shiny-leaved canthium (<i>Psydrax odorata</i>). Native grasses include <i>Cleistochloa rigida</i>, purple wiregrass (<i>Aristida ramosa</i>), threeawn speargrass (<i>Aristida vagans</i>), speargrass (<i>Austrostipa scabra</i>), barbed wire grass (<i>Cymbopogon refractus</i>), weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), slender panic (<i>Paspalidium gracile</i>) and long-leaved wallaby grass (<i>Notodanthonia longifolia</i>).	
Introduced Species	Introduced species are uncommon in this vegetation zone and include common prickly pear (<i>Opuntia stricta</i> var. <i>stricta</i>), <i>Gomphocarpus</i> sp., tiger pear (<i>Opuntia aurantiaca</i>) and cobblers pegs (<i>Bidens pilosa</i>).	
TSC Act Status	This vegetation zone is not consistent with any TEC listed under the TSC Act.	
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.	

Veg Zone 4: HU812 – Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Moderate to Good Condition

BVT Name	Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	
Condition	Moderate to Good	
BVT Number	HU812	
Area (ha)	15.2	
Survey Effort	3 biometric plots/transects	
Formation	Forested Wetlands	
Class	Coastal Floodplain Wetlands	
HRVP Map Unit	MU13 – Hunter Floodplain Red Gum Woodland Complex	
General Description	This vegetation zone is considered likely to have occurred throughout the lower slopes of the Mangrove Offset Site, including the now derived native grasslands surrounding Wybong Creek. The remnant woodland form is now restricted to the south-west corner of the site, along a small ephemeral drainage line.	
Canopy Description	The very sparse to sparse canopy is between 13 and 18 metres in height, and dominated by forest red gum (<i>Eucalyptus tereticornis</i>), forest/Blakelys red gum hybrids (<i>Eucalyptus tereticornis</i> x <i>blakelyi</i>), grey box (<i>Eucalyptus moluccana</i>) and narrow-leaved ironbark (<i>Eucalyptus crebra</i>).	
Mid-storey Description	The vegetation zone occasionally supported a sparse mid-storey to 9 metres in height, comprising younger forest red gum (<i>Eucalyptus tereticornis</i>), grey box (<i>Eucalyptus moluccana</i>), bulloak (<i>Allocasuarina luehmannii</i>), black she-oak (<i>Allocasuarina littoralis</i>) and <i>Melaleuca decora</i> .	
Shrub Layer Description	A very sparse shrub layer to 1 metre in height, of velvet mock olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>) and bead bush (<i>Spartothamnella juncea</i>) is also present within this vegetation zone.	
Ground Cover Description	This vegetation zone is characterised by a diverse, sparse to mid-dense ground layer less than 1 metre in height. Common herbs include kidney weed (<i>Dichondra repens</i>), yellow burr-daisy (<i>Calotis lappulacea</i>), berry saltbush (<i>Einadia hastata</i>), dwarf skullcap (<i>Scutellaria humilis</i>), slender tick-trefoil (<i>Desmodium varians</i>), native wandering Jew (<i>Commelina cyanea</i>) and <i>Sida hackettiana</i>. Native grasses include barbed wire grass (<i>Cymbopogon refractus</i>), threeawn speargrass (<i>Aristida vagans</i>), purple wiregrass (<i>Aristida ramosa</i>), Browns lovegrass (<i>Eragrostis brownii</i>), hairy panic (<i>Panicum effusum</i>), slender rats tail grass (<i>Sporobolus creber</i>), open summer-grass (<i>Digitaria diffusa</i>) and weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>). Several species of native sedge are also common within the vegetation zone, namely knob sedge (<i>Carex inversa</i>), slender flat-sedge (<i>Cyperus gracilis</i>) and tall sedge (<i>Carex appressa</i>).	
Introduced Species	Perennial ryegrass (<i>Lolium perenne</i>), onion weed (<i>Asphodelus fistulosus</i>), common prickly pear (<i>Opuntia stricta</i> var. <i>stricta</i>), greater beggars ticks (<i>Bidens subalternans</i>), flaxleaf fleabane (<i>Conyza bonariensis</i>), fireweed (<i>Senecio madagascariensis</i>), vervain (<i>Salvia verbenaca</i>), common sowthistle (<i>Sonchus oleraceus</i>), gomphrena weed (<i>Gomphrena celosioides</i>), galenia (<i>Galenia pubescens</i>), narrow-leaved cotton bush (<i>Gomphocarpus fruticosus</i>) and tiger pear (<i>Opuntia aurantiaca</i>) are commonly recorded in this vegetation zone.	
TSC Act Status	This vegetation zone is consistent with the <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions</i> EEC listed under the TSC Act. For further information, refer to Section 13.3.3.6 .	
EPBC Act Status	This vegetation zone is likely to be consistent with the <i>White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland</i> CEEC listed under the EPBC Act. For further information, refer to Section 13.3.3.5 .	

Veg Zone 5: HU812 – Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Low Condition – Derived Native Grassland

BVT Name	Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	
Condition	Moderate to Good – Derived Native Grassland	
BVT Number	HU812	
Area (ha)	73.8	
Survey Effort	4 biometric plots/transects	
Formation	Forested Wetlands	
Class	Coastal Floodplain Wetlands	
HRVP Map Unit	Derived form of MU24 – Hunter Lowlands Red Gum Forest	
General Description	This vegetation zone is one of the two dominant grassland communities mapped within the Mangrove Offset Site. It predominantly occurs east of Wybong Creek There are very few scattered trees within the community. The history of stock grazing on the site has resulted in introduced flora species being common in this grassland community.	
Canopy Description	No canopy is present within this community, but there are a small number of scattered yellow box (<i>Eucalyptus melliodora</i>) and forest/Blakelys red gum hybrids (<i>Eucalyptus blakelyi</i> × <i>tereticornis</i>) recorded throughout this vegetation zone.	
Mid-storey Description	Not present.	
Shrub Layer Description	Not present.	
Ground Cover Description	This vegetation zone is characterised by a diverse, mid-dense to dense ground layer less than 1 metre in height. Common herbs include poison pratia (<i>Pratia concolor</i>), common everlasting (<i>Chrysocephalum apiculatum</i>), rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), galvanised burr (<i>Sclerolaena birchii</i>) and <i>Sida hackettiana</i>. Native grasses include plains grass (<i>Austrostipa aristiglumis</i>), common couch (<i>Cynodon dactylon</i>), windmill grass (<i>Chloris truncata</i>), purple speargrass (<i>Aristida ramosa</i>), silky browntop (<i>Eulalia aurea</i>), wallaby grass (<i>Austrodanthonia bipartita</i>), shorthair plumegrass (<i>Dichelachne micrantha</i>) and <i>Rytidosperma racemosum</i> var. <i>racemosum</i>. Several species of native sedge are also common within the vegetation zone, including common fringe-sedge (<i>Fimbristylis dichotoma</i>) and knob sedge (<i>Carex inversa</i>).	
Introduced Species	The following introduced flora species are commonly recorded throughout this vegetation zone, including perennial ryegrass (<i>Lolium perenne</i>), goose grass (<i>Eleusine tristachya</i>), lambs tounges (<i>Plantago lanceolata</i>), spear thistle (<i>Cirsium vulgare</i>), catsear (<i>Hypochaeris radicata</i>), common couch (<i>Cynodon dactylon</i>), saffron thistle (<i>Carthamus lanatus</i>), <i>Hypochaeris microcephala</i> var. <i>albiflora</i> , haresfoot clover (<i>Trifolium arvense</i>), paspalum (<i>Paspalum dilatatum</i>), fireweed (<i>Senecio madagascariensis</i>), slender celery (<i>Cyclospermum leptophyllum</i>) and <i>Plantago myosuuros</i> subsp. <i>myosuuros</i> .	
TSC Act Status	The derived native grassland form of this BVT is <u>not</u> consistent with the EEC <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions</i> under the TSC Act.	
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act. The dominance of exotic species in the ground layer excludes this vegetation zone from meeting the condition thresholds of the White Box Yellow Box Blakely’s Red Gum Grassy Woodland and Derived Native Grassland CEEC listed under the EPBC Act.	

Veg Zone 6: HU905 – Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good Condition

BVT Name	Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter	
Condition	Moderate to Good	
BVT Number	HU905	
Area (ha)	20.0	
Survey Effort	5 biometric plots/transects	
Formation	Grassy Woodlands	
Class	Coastal Valley Grassy Woodlands	
HRVP Map Unit	MU10 – Central Hunter Box – Ironbark Woodland.	
General Description	This vegetation zone is confined to several moderately sized patches on low rises with shallow soils. These patches occur predominantly in the north east corner of the Mangrove Offset Site, but a number of isolated patches occur in the west.	
Canopy Description	This vegetation zone supports a very sparse to sparse canopy between 10 to 20 metres in height. The dominant canopy species was narrow-leaved ironbark (<i>Eucalyptus crebra</i>), with grey gum (<i>Eucalyptus punctata</i>) and black cypress pine (<i>Callitris endlicheri</i>) occurring less commonly.	
Mid-storey Description	The mid-storey is very sparse and dominated by regenerating narrow-leaved ironbark (<i>Eucalyptus crebra</i>), as well as black she-oak (<i>Allocasuarina littoralis</i>), velvet mock olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>), blunt beard-heath (<i>Leucopogon muticus</i>) and bead bush (<i>Spartothamnella juncea</i>). The mid-storey layer ranges from 2 to 10 metres in height.	
Shrub Layer Description	This vegetation zone lacks a distinct shrub layer, however the abovementioned mid-storey species were also recorded as occurring between 1 and 2 metres in height.	
Ground Cover Description	This community is characterised by a sparse to mid-dense ground layer dominated by a diverse number of native flora species less than 1 metre in height. Common herbs and sub-shrubs include sticky everlasting (<i>Xerochrysum viscosum</i>), sprawling bluebell (<i>Wahlenbergia gracilis</i>), slender wire lily (<i>Laxmannia gracilis</i>), rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>) and common everlasting (<i>Chrysocephalum apiculatum</i>). Native grasses include wallaby grass (<i>Rytidosperma racemosum</i> var. <i>racemosum</i>), shorthair plumegrass (<i>Dichelachne micrantha</i>), barbed wire grass (<i>Cymbopogon refractus</i>), weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), purple wiregrass (<i>Aristida ramosa</i>), mountain wallaby grass (<i>Rytidosperma monticola</i>), speargrass (<i>Austrostipa scabra</i>) and threeawn speargrass (<i>Aristida vagans</i>).	
Introduced Species	The introduced species creeping pear (<i>Opuntia humifusa</i>), common prickly pear (<i>Opuntia stricta</i> var. <i>stricta</i>), common sowthistle (<i>Sonchus oleraceus</i>), perennial ryegrass (<i>Lolium perenne</i>), tiger pear (<i>Opuntia aurantiaca</i>), Argentine peppergrass (<i>Lepidium bonariense</i>), fireweed (<i>Senecio madagascariensis</i>), smooth catsear (<i>Hypochaeris glabra</i>) and scarlet pimpernel (<i>Anagallis arvensis</i>) occur in low abundance in this vegetation zone.	
TSC Act Status	This vegetation zone is consistent with the EEC <i>Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions</i> listed under the TSC Act. For further information refer to Section 13.3.3.6 .	
EPBC Act Status	This vegetation community is not consistent with any listed TEC under the EPBC Act. This vegetation community is excluded from the CEEC <i>Central Hunter Valley Eucalypt Forest and Woodland</i> listed under the EPBC Act as the Mangrove Offset does not occur on Permian aged sediments.	

Veg Zone 7: HU905 – Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter – Moderate to Good – Derived Native Grassland

BVT Name	Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	
Condition	Moderate to Good – Derived Native Grassland	
BVT Number	HU905	
Area (ha)	86.7	
Survey Effort	5 biometric plots/transects	
Formation	Grassy Woodlands	
Class	Coastal Valley Grassy Woodlands	
HRVP Map Unit	Derived form of MU10 – Central Hunter Box – Ironbark Woodland.	
General Description	This vegetation zone is the dominant derived native grassland community of the low foothills within the Mangrove Offset Site. It occurs on the western and eastern sides of Wybong Creek.	
Canopy Description	Not present.	
Mid-storey Description	Not present.	
Shrub Layer Description	Not present.	
Ground Cover Description	This community is characterised by a diverse, dense ground layer between 0.5 to 1 metre in height. Common herbs and sub-shrubs include common everlasting (<i>Chrysocephalum apiculatum</i>), <i>Oxalis radicata</i>, rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), common fringe-sedge (<i>Fimbristylis dichotoma</i>), slender wire lily (<i>Laxmannia gracilis</i>) and swamp dock (<i>Rumex brownii</i>). Native grasses include slender rats tail grass (<i>Sporobolus creber</i>), umbrella grass (<i>Digitaria divaricatissima</i>), weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), hairy panic (<i>Panicum effusum</i>), purple wiregrass (<i>Aristida ramosa</i>), shorthair plumegrass (<i>Dichelachne micrantha</i>), speargrass (<i>Austrostipa scabra</i>), silky browntop (<i>Eulalia aurea</i>), barbed wire grass (<i>Cymbopogon refractus</i>) and common couch (<i>Cynodon dactylon</i>).	
Introduced Species	The introduced species <i>Oenothera mollissima</i> , catsear (<i>Hypochaeris radicata</i>), lambs tongue (<i>Plantago lanceolata</i>), French catchfly (<i>Silene gallica</i>), hop clover (<i>Trifolium campestre</i>), saffron thistle (<i>Carthamus lanatus</i>), fireweed (<i>Senecio madagascariensis</i>), haresfoot clover (<i>Trifolium arvense</i>), wall fescue (<i>Vulpia muralis</i>) and scarlet pimpernel (<i>Anagallis arvensis</i>) are recorded commonly in this vegetation zone.	
TSC Act Status	The derived native grassland form of this vegetation community is <u>not</u> consistent with the EEC <i>Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions</i> listed under the TSC Act. For further information refer to Section 13.3.3.6 .	
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.	

Wambo Offset Site Vegetation Zones

Three Biometric vegetation zones were identified across the Wambo Offset Site (refer to **Figure 13.5**). The following information is provided for each of the vegetation zones:

- equivalent Biometric Vegetation Type (BVT)
- broad condition class
- total area
- survey effort
- vegetation formation and class
- equivalent Hunter Remnant Vegetation Project (HRVP) map unit (Peake 2006)
- the location of each community in the project area;
- a floristic and structural description;and
- the conservation status of the community under both NSW *Threatened Species Conservation Act 1995* (TSC Act) and *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Veg Zone 1: HU817 – Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the central and lower Hunter – Moderate to Good Condition

BVT Name	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	
Condition	Moderate to Good	
BVT Number	HU817	
Area (ha)	14.7	
Survey Effort	Three biometric plots/transects	
Formation	Grassy Woodlands	
Class	Coastal Valley Grassy Woodland	
HRVP Map Unit	MU10 – Central Hunter Box – Ironbark Woodland.	
General Description	Occurs on the lower slopes of the Wambo Offset site.	
Canopy Description	This vegetation zone supports a young, sparse canopy dominated by narrow-leaved ironbark (<i>Eucalyptus crebra</i>), bulloak (<i>Allocasuarina luehmannii</i>) and prickly-leaved paperbark (<i>Melaleuca nodosa</i>). The canopy height ranged from 6 to 15 metres in height.	
Mid-storey Description	A mid-storey is commonly absent from this vegetation zone and when it does occur it is very sparse and comprises immature narrow-leaved ironbark (<i>Eucalyptus crebra</i>) and bulloak (<i>Allocasuarina luehmannii</i>) trees between 4 and 6 metres in height.	
Shrub Layer Description	A very sparse shrub layer is present in the vegetation zone, between 0.5 and 4 metres in height. Dominant species include recruiting bulloak (<i>Allocasuarina luehmannii</i>), <i>Choretrum</i> sp. A, Cunninghams everlasting (<i>Cassinia cunninghamii</i>), shiny-leaved canthium (<i>Psyrax odorata</i>), blackthorn (<i>Bursaria spinosa</i> subsp. <i>spinosa</i>), fan wattle (<i>Acacia amblygona</i>), wedge-leaf hop-bush (<i>Dodonaea viscosa</i> subsp. <i>viscosa</i>), <i>Melaleuca decora</i> , <i>Grevillea montana</i> and prickly-leaved paperbark (<i>Melaleuca nodosa</i>).	
Ground Cover Description	This vegetation zone supports a sparse to mid-dense ground cover less than 0.5 metres in height. Native grasses are dominant while a small number of forbs are also present. Commonly recorded species include, barbed wire grass (<i>Cymbopogon refractus</i>), <i>Eragrostis leptostachya</i> , purple wiregrass (<i>Aristida ramosa</i>), speargrass (<i>Austrostipa scabra</i>), <i>Paspalidium distans</i> , weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), <i>Sida hackettiana</i> , kidney weed (<i>Dichondra repens</i>), native wandering Jew (<i>Commelina cyanea</i>), amulla (<i>Eremophila debilis</i>), berry saltbush (<i>Einadia hastata</i>) and wattle mat-rush (<i>Lomandra filiformis</i> subsp. <i>filiformis</i>).	
Introduced Species	Introduced species included narrow-leaved cotton bush (<i>Gomphocarpus fruticosus</i>) and common prickly pear (<i>Opuntia stricta</i> var. <i>stricta</i>).	
TSC Act Status	This vegetation zone is consistent with the EEC <i>Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions</i> listed under the TSC Act. For further information refer to Section 13.3.4.6 .	
EPBC Act Status	This vegetation community is consistent with the CEEC <i>Central Hunter Valley Eucalypt Forest and Woodland</i> listed under the EPBC Act. For further information refer to Section 13.3.4.5 .	

Veg Zone 2: HU817 – Narrow-leaved Ironbark – Bull Oak – Grey Box Shrub – Grass Open Forest of the central and lower Hunter – Moderate to Good – Derived Native Grassland

BVT Name	Narrow-leaved Ironbark – Bull Oak – Grey Box shrub – grass open forest of the central and lower Hunter	
Condition	Moderate to Good – Derived Native Grassland	
BVT Number	HU817	
Area (ha)	1.3	
Survey Effort	One biometric plot/transect	
Formation	Grassy Woodlands	
Class	Coastal Valley Grassy Woodland	
HRVP Map Unit	Derived form of MU10 – Central Hunter Box – Ironbark Woodland.	
General Description	Small patches of derived native grassland occur throughout the north-east portion of the Wambo Offset Site.	
Canopy Description	Not present.	
Mid-storey Description	Not present.	
Shrub Layer Description	Not present.	
Ground Cover Description	This vegetation zone is almost entirely devoid of shrubs and trees, with only the occasional cooba (<i>Acacia salicina</i>) recorded. It is characterised by a dense ground cover, less than 1 metre in height and dominated by native grasses and forbs. Common species include purple wiregrass (<i>Aristida ramosa</i>), kidney weed (<i>Dichondra repens</i>), shorthair plumegrass (<i>Dichelachne micrantha</i>), red grass (<i>Bothriochloa decipiens</i>), weeping grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), common fringe-sedge (<i>Fimbristylis dichotoma</i>), poison rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), hairy panic (<i>Panicum effusum</i>), common everlasting (<i>Chrysocephalum apiculatum</i>) and wattle mat-rush (<i>Lomandra filiformis</i> subsp. <i>filiformis</i>).	
Introduced Species	The introduced species French flax (<i>Linum trigynum</i>), slender celery (<i>Cyclospermum leptophyllum</i>), are in moderate abundance in this vegetation zone.	
TSC Act Status	The derived native grassland form of this vegetation community is <u>not</u> consistent with the EEC <i>Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions</i> listed under the TSC Act.	
EPBC Act Status	This vegetation community is consistent with the CEEC <i>Central Hunter Valley Eucalypt Forest and Woodland</i> listed under the EPBC Act. For further information refer to Section 13.3.4.5 .	

Veg Zone 3: HU869 – Grey Box – Slaty Box Shrub – Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin – Moderate to Good Condition

BVT Name	Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin	
Condition	Moderate to Good	
BVT Number	HU869	
Area (ha)	40.0	
Survey Effort	One biometric plot/transect located close to the Wambo Offset Site as well as several rapid assessments	
Formation	Dry Sclerophyll Forests (Shrubby Sub-formation)	
Class	Western Slopes Dry Sclerophyll Forests	
HRVP Map Unit	MU7 – Narrabeen Foothills Slaty Box Woodland.	
General Description	Occurs across the Wambo Offset Site on the low slopes at the interface between triassic sandstone and Permian sediments.	
Canopy Description	This vegetation zone supports a sparse to mid-dense canopy typically dominated by slaty box (<i>Eucalyptus dawsonii</i>) and coast myall (<i>Acacia binervia</i>). Height of the canopy ranged from 10 to 15 metres.	
Mid-storey Description	The mid-storey was sparse and comprised coast myall (<i>Acacia binervia</i>) and bullock (<i>Allocasuarina luehmannii</i>). Height of the mid-storey ranged from 5 to 10 metres.	
Shrub Layer Description	The shrub layer is very sparse and included blackthorn (<i>Bursaria spinosa</i> subsp. <i>spinosa</i>), <i>Philotheca difformis</i> , sticky daisy-bush (<i>Olearia elliptica</i>), prickly-leaved paperbark (<i>Melaleuca nodosa</i>), straggly lantern bush (<i>Abutilon oxycarpum</i>), knife-leaf wattle (<i>Acacia cultriformis</i>) and spiny bush-pea (<i>Pultenaea spinosa</i>). The shrub layer ranged from 1 to 3 metres in height.	
Ground Cover Description	This vegetation zone is characterised by a sparse ground layer generally less than 1 metre in height. Common grasses and herbs included barbed wire grass (<i>Cymbopogon refractus</i>), speargrass (<i>Austrostipa scabra</i>), hooked-hairy panic grass (<i>Ancistrachne uncinulata</i>) threeawn speargrass (<i>Aristida vagans</i>), wattle mat-rush (<i>Lomandra filiformis</i> subsp. <i>filiformis</i>), hill hibiscus (<i>Hibiscus sturtii</i> var. <i>sturtii</i>) and berry saltbush (<i>Einadia hastata</i>).	
Introduced Species	No introduced species were recorded in this vegetation community.	
TSC Act Status	This vegetation community is consistent with the VEC <i>Hunter Valley Foothills Slaty Gum Woodland in the Sydney Basin Bioregion</i> listed under the TSC Act. For further information refer to Section 13.3.4.6 .	
EPBC Act Status	This vegetation community is consistent with the CEEC <i>Central Hunter Valley Eucalypt Forest and Woodland</i> listed under the EPBC Act. For further information refer to Section 13.3.4.5 .	

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