

APPENDIX 24

Assessment of Commonwealth Matters





MANGOOLA
OPEN CUT
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GLENORE

**MANGOOLA COAL
CONTINUED OPERATIONS
PROJECT
ASSESSMENT OF
COMMONWEALTH MATTERS**

FINAL

May 2019

MANGOOLA COAL CONTINUED OPERATIONS PROJECT

ASSESSMENT OF COMMONWEALTH MATTERS

FINAL

Prepared by
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on behalf of
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1.0 Introduction

On 21 January 2019, the Department of the Environment and Energy (DoEE) confirmed the Mangoola Coal Continued Operations (MCCO) Project was a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for impacts on threatened species and communities and water related matters of national environmental significance (MNES). Specifically, DoEE considered the MCCO Project is likely to have a significant impact on:

- White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grasslands Critically Endangered Ecological Community (CEEC)
- *Prasophyllum* sp. Wybong
- regent honeyeater (*Anthochaera phrygia*)
- water resources – as the Project is likely to result in changes to groundwater and surface water and impact on surface water quality.

In addition, DoEE also considers the MCCO Project may result in a significant impact on:

- swift parrot (*Lathamus discolor*)
- grey-headed flying fox (*Pteropus poliocephalus*).

Under the bilateral agreement, the Secretary of the NSW Department of Planning and Environment’s Environmental Assessment Requirements (SEARs) for the MCCO Project were reissued to include the assessment requirements from DoEE. These are listed in **Table 1.1** and it is outlined where the requirements have been addressed in the document.

Detailed assessments have been undertaken as part of the Environmental Impact Statement (EIS), to which this report is an appendix, to assess the MCCO Project’s potential impacts on each of the abovementioned MNES. The following section provides a summary of the key MNES assessment findings in relation to Attachment 3 of the SEARs which outlines DoEE’s assessment requirements. The following summary should be read in conjunction with the EIS and specifically the following specialist reports:

- the Biodiversity Assessment Report (BAR) (refer to **Appendix 13**) and **Section 6.9** of this EIS which discusses biodiversity impacts
- the Surface Water Assessment (refer to **Appendix 11**) and **Section 6.8.1** of this EIS which discusses surface water impacts
- the Groundwater Impact Assessment (refer to **Appendix 12**) and **Section 6.8.2** of this EIS which discusses groundwater impacts.

It is noted that DoEE refers to the MCCO Project as the ‘action’. For ease of response to the DoEE assessment requirements this section uses the action and MCCO Project interchangeably.

1.1 Project Overview

Mangoola Coal Mine is an open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW (refer **Figure 1.1**). Mangoola Coal Operations Pty Ltd (Mangoola) has operated the Mangoola Coal Mine under Project Approval (PA) 06_0014 since mining commenced at the site in September 2010.

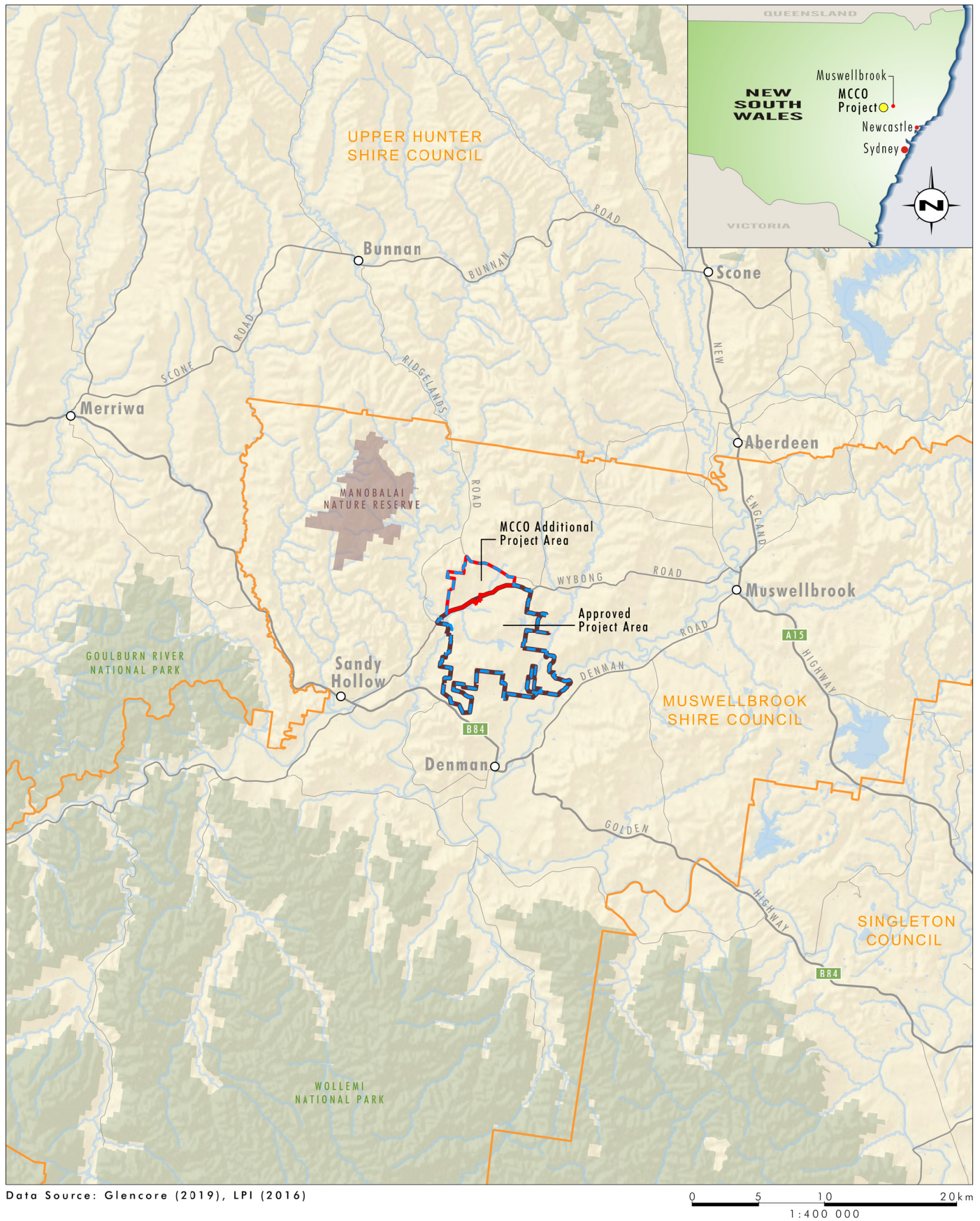
The MCCO Project will allow for the continuation of mining at Mangoola Coal Mine into a new mining area to the immediate north of the existing operations. The MCCO Project will extend the life of the existing operation providing for ongoing employment opportunities for the Mangoola workforce. The MCCO Project Area includes the existing approved Project Area for Mangoola Coal Mine and the MCCO Additional Project Area as shown on **Figure 1.1**.

The MCCO Project generally comprises:

- open cut mining peaking at the same rate as that currently approved (13.5 Million tonnes per annum (Mtpa) of run of mine (ROM) coal) using truck and excavator mining methods
- continued operations within the existing Mangoola Coal Mine
- mining operations in a new mining area located north of the existing Mangoola Coal Mine and Wybong Road, south of Ridglands Road and east of the 500 kilovolt (kV) Electricity Transmission Line (ETL)
- construction of a haul road overpass over Big Flat Creek and Wybong Road to provide access from the existing mine to the proposed Additional Mining Area
- establishment of an out-of-pit overburden emplacement area
- distribution of overburden between the proposed Additional Mining Area and the existing mine in order to optimise the final landform design of the integrated operation
- realignment of a portion of Wybong Post Office Road
- the use of all existing or approved infrastructure and equipment for the Mangoola Coal Mine with some minor additions to the existing mobile equipment fleet
- construction of a water management system to manage sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation of mine water. The water management system will be connected to that of the existing mine
- continued ability to discharge excess water in accordance with the Hunter River Salinity Trading Scheme (HRSTS)
- establishment of a final landform in line with current design standards at Mangoola Coal Mine including use of natural landform design principles consistent with the existing site
- rehabilitation of the proposed Additional Mining Area using the same revegetation techniques as at the existing mine
- a likely construction workforce of approximately 145 persons. No change to the existing approved operational workforce

- continued use of the mine access for the existing operational mine and access to/from Wybong Road, Wybong Post Office Road and Ridgelands Road to the MCCO Project Area for construction, emergency services, ongoing operational environmental monitoring and property maintenance.

The MCCO Project is described in further detail in **Section 1** of the EIS and **Figures 1.1** and **Figure 1.2** illustrates the location and key features of the MCCO Project.



Legend

- MCO Project Area
- Approved Project Area
- MCO Additional Project Area
- Local Government Area

FIGURE 1.1

Regional Locality Plan

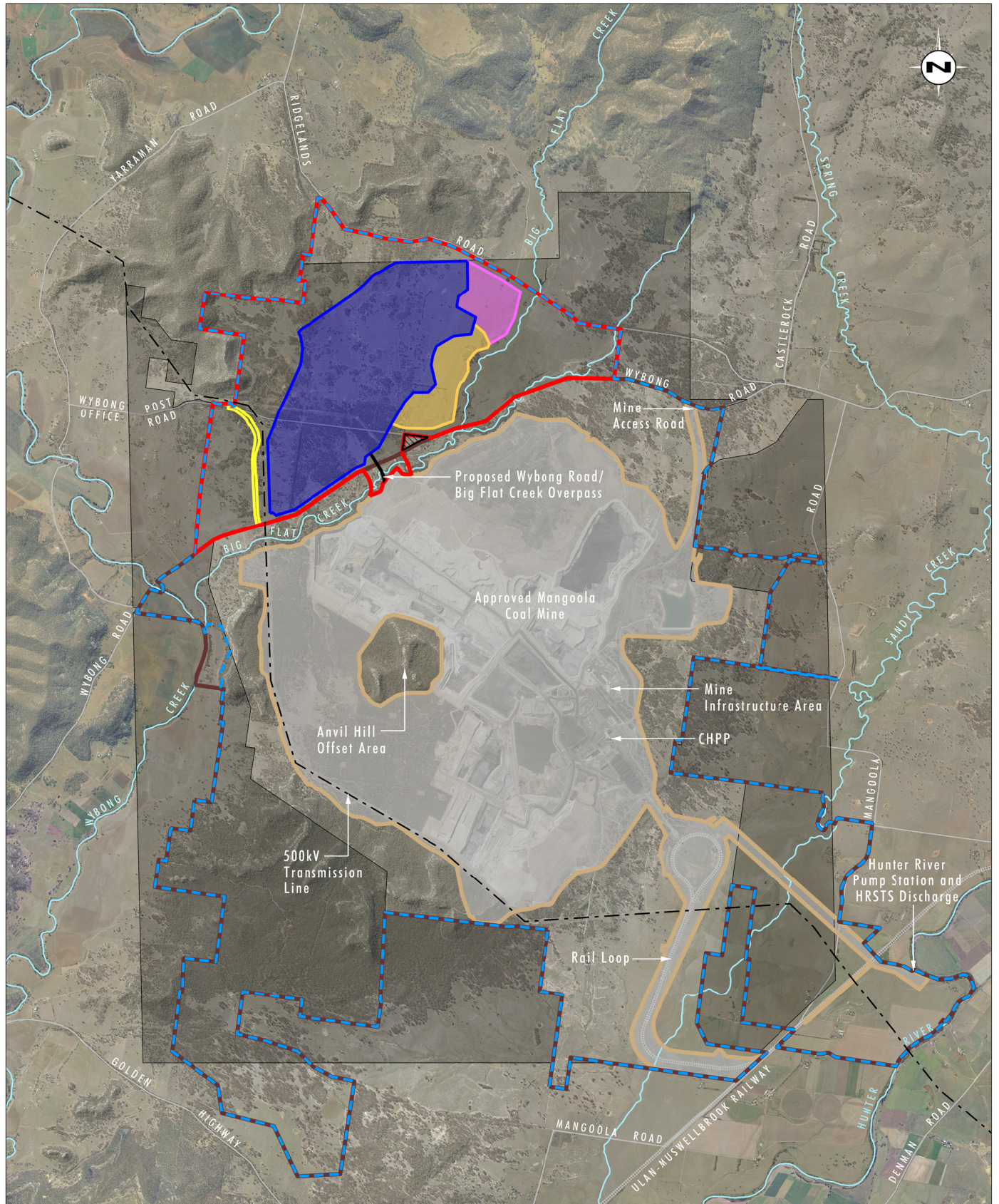


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

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1:65 000

Legend

- MCCO Project Area
- Approved Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Proposed Emplacement Area
- Proposed Topsoil Stockpile Area
- Wybong Post Office Road Realignment
- Crown Land (TSR) Excluded from MCCO Project Area
- Assessment Lease 9

FIGURE 1.2

Key Features of the Mangoola Coal
Continued Operations Project

1.2 DoEE Assessment Requirements

A checklist of DoEEs assessment requirements as outlined in Attachment 3 of the SEARs that relate to biodiversity and where they have been addressed in this document is outlined in **Table 1.1**. The other requirements identified in Attachment 3 of the SEARs (including the general assessment requirements and water) are addressed in Section 7.0 of the EIS. This document relates to the assessment of impacts on biodiversity related MNES and ecohydrology. As discussed above, the following summary should be read in conjunction with the EIS main text (in particular Section 7.0) and specifically the following specialist reports:

- the Biodiversity Assessment Report (BAR) (refer to Appendix 13) and Section 6.9 of the EIS main text which discusses biodiversity impacts
- the Surface Water Assessment (refer to Appendix 11) and Section 6.8.1 of the EIS main text which discusses surface water impacts
- the Groundwater Impact Assessment (refer to Appendix 12) and Section 6.8.2 of the EIS main text which discusses groundwater impacts.

Table 1.1 DoEE Requirements and where they have been addressed in this document

Requirement	Relevant Section
The Applicant must consider each of the protected matters under the triggered controlling provisions that may be impacted by the action. Noting that the above species and communities may not be a complete list, it is the responsibility of the Applicant to undertake an analysis of the relevant impacts and ensure all protected matters that are likely to be impacted are assessed for the Commonwealth Minister's consideration.	Throughout this document
Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.	Section 3.5
Biodiversity (threatened species and communities and migratory species)	
Significant impacts associated with the proposed action on MNES are associated with the removal of native vegetation, in particular the removal of 691 Prasophyllum sp. Wybong individuals and the loss of up to 256 hectares of habitat critical to the survival of the Regent Honeyeater. These impacts must be appropriately offset for EPBC Act purposes.	
For each of the EPBC Act listed species predicted to occur in the project site, and each of the EPBC Act listed ecological communities likely to be significantly impacted, the EIS/biodiversity assessment report (BAR) must provide: <ul style="list-style-type: none"> a. survey results, including details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Commonwealth guidelines and policy statements and/or the NSW Framework for Biodiversity Assessment (FBA); b. a description and quantification of habitat in the study area (including suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advices, conservation advices and recovery plans, threat abatement plans and wildlife conservation plans; and c. maps displaying the above information (specific to each EPBC protected matter) overlaid with the proposed action. It is acceptable, where possible, to use the mapping and assessment of Plant Community Types (PCTs) and the 	<p>Section 2.1</p> <p>Section 3.2</p> <p>Section 3.2</p>

Requirement	Relevant Section
<p>species surveys prescribed by the FBA as the basis for identifying EPBC Act-listed species and communities. The EIS must clearly identify which PCTs are considered to align with habitat for the relevant EPBC Act listed species or community, and provide individual maps for each species or community.</p> <p>d. Description of the nature, geographic extent, magnitude, timing and duration of any likely direct, indirect and consequential impacts on any relevant EPBC Act listed species and communities. It must clearly identify the location and quantify the extent of all impact areas to each relevant EPBC Act listed species or community.</p> <p>e. For each of the EPBC Act listed species and communities likely to be impacted by the development, the EIS must provide information on proposed avoidance and mitigation measures to deal with the impacts of the action, and a description of the predicted effectiveness and outcomes that the avoidance and mitigation measures will achieve.</p> <p>f. Quantification of the offset liability for each species and community significantly impacted, and information on the proposed offset strategy, including discussion of the conservation benefit for each species and community, how offsets will be secured, and the timing of protection. All suitable habitat for MNES significantly impacted must be offset.</p> <p>It is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action i.e. 'like-for-like'. Like-for-like includes protection of native vegetation that is the same EEC or habitat being impacted, or funding to provide a direct benefit to the matter being impacted i.e. threat abatement, breeding and propagation programs or other relevant conservation measures.</p>	<p>Section 3.3</p> <p>Section 3.4</p> <p>Section 3.5</p>
<p><u>Offsetting impacts to the <i>Prasophyllum</i> sp. Wybong:</u> As <i>Prasophyllum</i> sp. Wybong is not a threatened species under the NSW Biodiversity Conservation Act 2016, DoEE will accept the credit liability generated for <i>Prasophyllum petilum</i> as the credit liability for <i>Prasophyllum</i> sp. Wybong, subject to being satisfied that the proposed offsets meet the offset requirements under the EPBC Act.</p>	
<p>Water resource, in relation to coal seam gas development and large coal mining development</p>	
<p>c) Ecological and ecohydrological assessment:</p> <p>i. Conceptualisation of the impacts of water resource regimes and changes on biodiversity.</p> <p>ii. Potential impacts from temporal and spatial changes in terrestrial surface water flows and quality in relation to fine-scale topographic features (e.g. soaks, drainage systems, depressions, soil saturation) for known habitat within the two sub-catchments that currently, or may potentially (future colonization), support <i>Prasophyllum</i> sp. Wybong.</p> <p>iii. Potential impacts from temporal and spatial changes and quality of water resources (terrestrial surface and groundwater) in relation to fine-scale topographic features (riparian and flood zones) within the two sub-catchments that support White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland.</p> <p>iv. In addition to ephemeral creeks, consider potential impacts from temporal and spatial changes and quality of water resources (surface and groundwater) on associated riparian vegetation and aquatic ecosystems (including stream and creek aquatic biota) of the Wybong, Sandy and Alvil* Creeks.</p>	<p>Section 5.3</p>

* "Alvil" Creek stated in the DoEE Requirements. Should be Anvil Creek.

2.0 MNES Biodiversity Assessment

2.1 Biodiversity Surveys for Listed Threatened Species and Communities

Extensive ecological surveys have been completed within the broader Mangoola Mine land holding and specifically within the MCCO Additional Project Area as part of previous assessments including the Mangoola Coal Biodiversity Certification Assessment prepared as part of the Upper Hunter Strategic Assessment (UHSA) (Umwelt 2015) and more recently, surveys as part of the proposed MCCO Project.

Surveys completed within the MCCO Additional Project Area include bird and herpetological searches, terrestrial and arboreal Elliott trapping, cage trapping, pitfall trapping, hair tubes, harp traps, spotlighting, diurnal and nocturnal call playback, targeted threatened species searches, Anabat echolocation surveys, habitat assessment and opportunistic observation. Threatened species, vegetation communities and Threatened Ecological Communities (TECs) considered likely to occur within the local area were targeted as part of these surveys utilising meander transect surveys and semi-quantitative plot based survey in accordance with the NSW Framework for Biodiversity Assessment methodology and relevant NSW and Commonwealth survey guidelines.

A description of the surveys undertaken within the MCCO Additional Project Area as they relate to impacted or potentially impacted MNES are provided in the Sections below.

Field surveys are considered adequate to have identified the extent of MNES species or habitat occurring in the MCCO Additional Project Area and were conducted in accordance or with consideration of the following survey guidelines, policy statements or recovery plans:

- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities –Working Draft (DEC 2004)
- NSW Guide to Surveying Threatened Plants (OEH 2016)
- Draft Survey Guidelines for Australia’s Threatened Orchids (DoE 2013)
- Survey Guidelines for Australia's threatened bats (DEWHA 2010a)
- Survey Guidelines for Australia's threatened birds (DEWHA 2010b)
- Survey guidelines for Australia's threatened mammals (DSEWPC 2011)
- Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. (TSSC 2006)
- National Recovery Plan for White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland. (DECCW 2010)
- National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (Commonwealth of Australia (CoA) 2016)
- Approved Conservation Advice for *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) (a leek-orchid) (DEWHA 2009).
- Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus* (DoEE 2017).

2.1.1 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

A total of 55 floristic plots and 34 rapid assessments were conducted across the MCCO Project Area as part of the biodiversity survey with the survey effort shown on **Figures 2.1** and **2.2**. These surveys were undertaken during four separate survey periods in order to accurately sample the vegetation communities and potentially occurring threatened flora species:

- April 2014 surveys:
 - 1 to 4 April 2014
 - 6 to 11 April 2014
 - 16 to 17 April 2014
- March 2017 surveys:
 - 15 to 17 March 2017
 - 20 to 25 March 2017
- May 2017 surveys:
 - 15 to 17 May 2017
 - 17 to 18 May 2017
- August 2017 surveys:
 - 1 to 3 August 2017.

Vegetation communities identified in the MCCO Additional Project Area were compared to TECs listed under the Commonwealth EPBC Act and an assessment of similarity with the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- full-floristic quadrat assessment, rapid assessments and meandering survey to determine floristic composition and structure of each ecological community (including specific 20 x 50m plot sampling for White box – Yellow box – Blakelys Red Gum Grassy Woodland and Derived Native Grasslands CEEC)
- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the Commonwealth Threatened Species Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the Commonwealth DoEE
- assessment against diagnostic and condition criteria, where relevant, and
- comparison with other assessments of TECs in the region.

Detailed assessment of the vegetation communities described and mapped within the MCCO Additional Project Area was undertaken to determine whether the vegetation present met the condition class thresholds identified in Commonwealth Conservation and/or Listing Advice for White Box – Yellow Box –

Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC (TSSC 2006). These thresholds have been incorporated into an identification flowchart for the CEEC within the EPBC Act Policy Statement (DEH 2006) for the community which was also utilised during the assessment.

The following PCTs in the MCCO Additional Project Area were identified, in part, as having Blakely's red gum (*Eucalyptus blakelyi*) or Blakely's red gum/forest red gum (*Eucalyptus blakelyi* x *Eucalyptus tereticornis*) intergrades as the dominant overstorey species (refer to **Figure 2.1**):

- 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter
- 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – derived native grassland
- 1607 Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter.

These PCTs all exhibited a predominantly native understorey and exceeded the minimum patch size of 0.1 hectare (ha) that is specified in the Listing Advice (TSSC 2006). These PCTs also met the Listing Advice criteria of containing at least 12 or more native understorey species.

The plot/transect surveys undertaken as part of the MCCO Project are considered to be consistent with the relevant published survey guidelines and policy statements.

2.1.2 *Prasophyllum* sp. Wybong

Extensive targeted survey of the MCCO Additional Project Area has been conducted in accordance or with consideration of the NSW Guide to Surveying Threatened Plants (OEH 2016) and the Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013). A summary of the targeted surveys for *Prasophyllum* sp. Wybong is shown in **Table 2.1** and the spatial extent of survey undertaken in suitable habitat is shown on **Figure 2.1**.

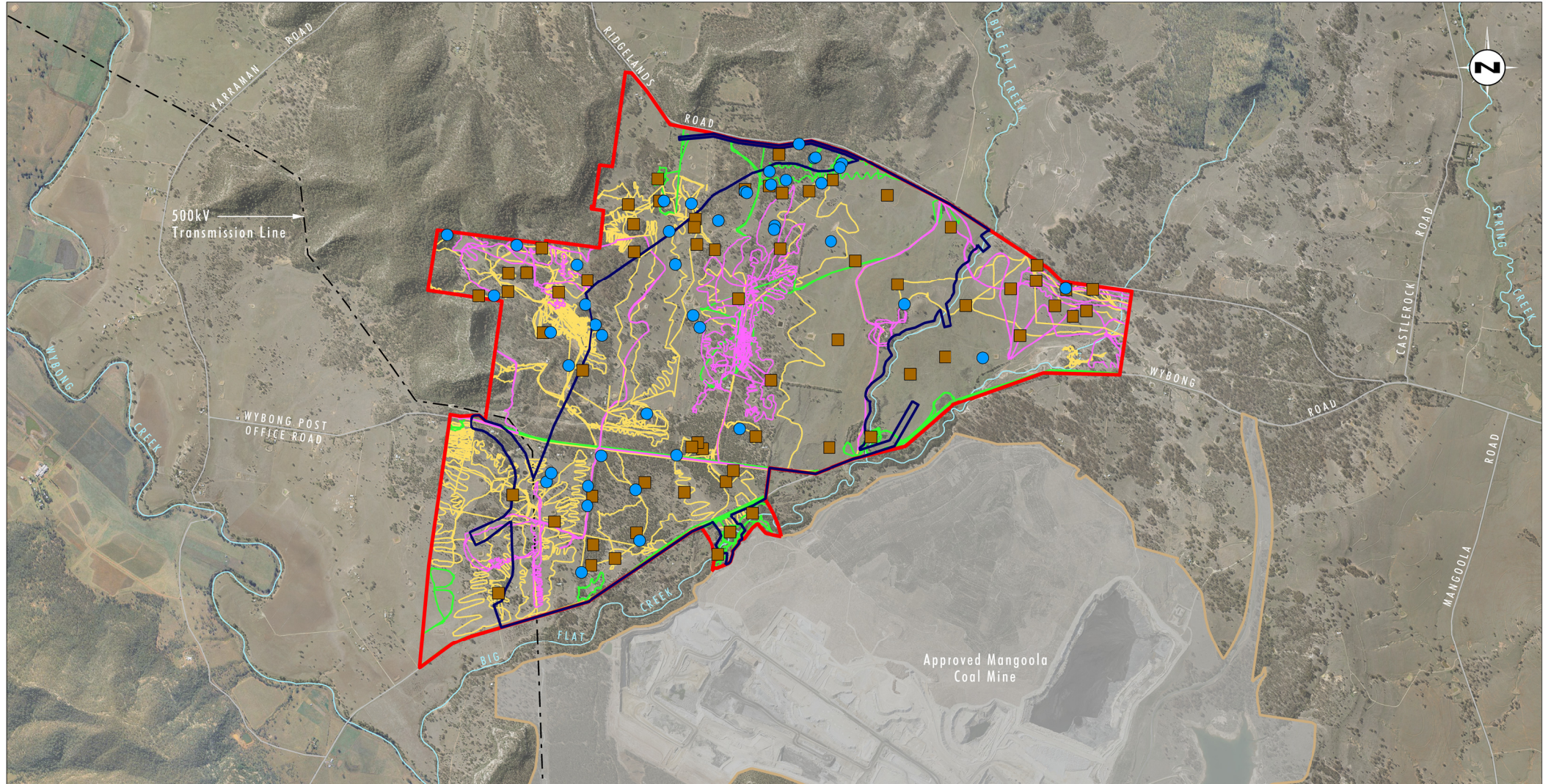


Image Source: Glencore (April 2018)

Data Source: Glencore (2019)

0 0.5 1.0 2.0 km
1:40 000

Legend

- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Flora Plots/Transect 2014-2017
- Semi-quantitative Rapid Sampling Plot 2014-2017
- Spring 2013 Targeted Searches
- Spring 2014 Targeted Searches
- Spring 2016 Targeted Searches

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FIGURE 2.1

Flora Survey Effort in the
MCCO Additional Project Area

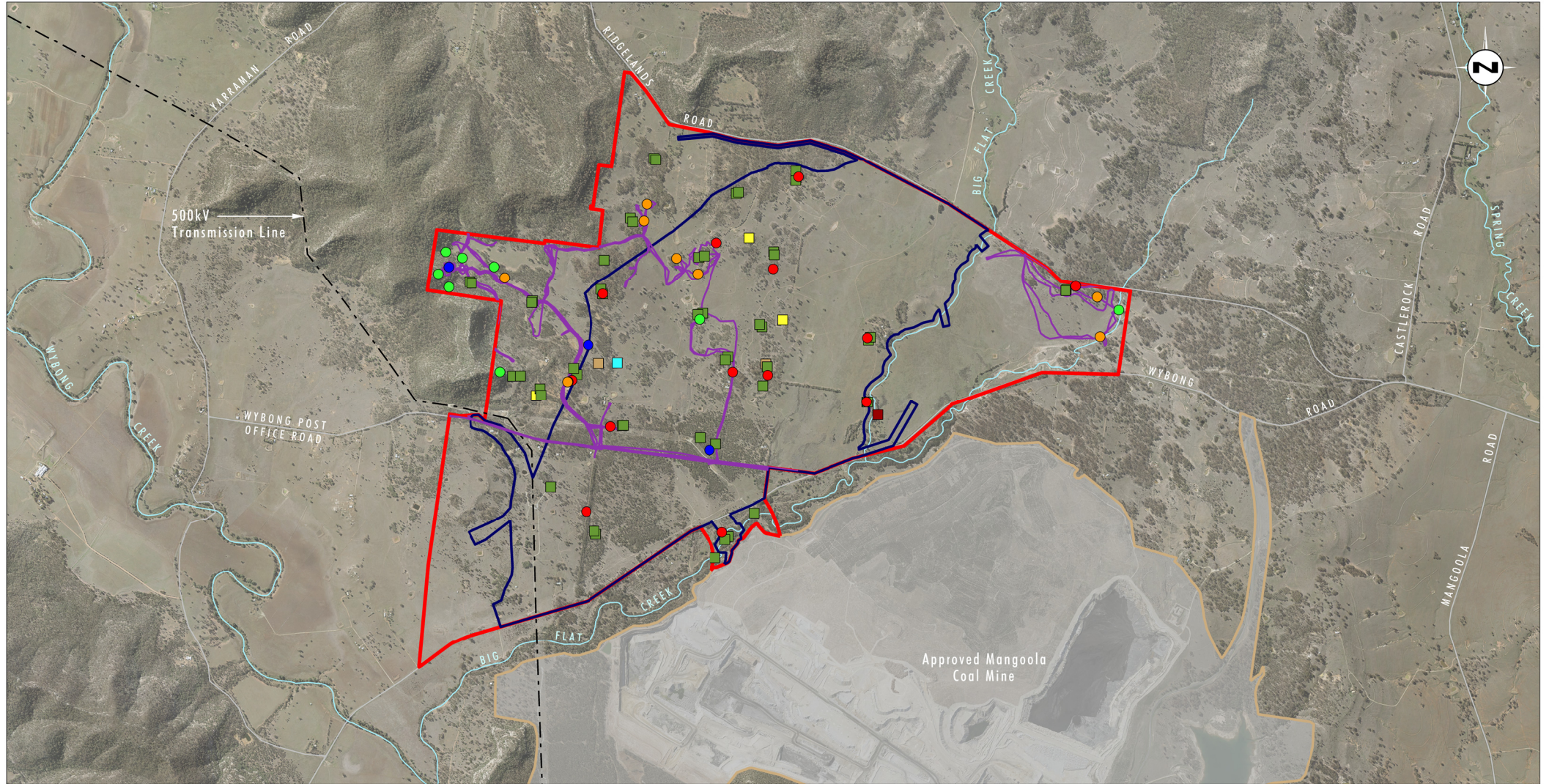


Image Source: Glencore (April 2018)

Data Source: Glencore (2019)

Legend

- Approved Mangoola Coal Mine Disturbance Area
- MCO Additional Project Area
- MCO Additional Disturbance Area
- Driving Spotlight Transects

- Survey (2014-2016):
- Winter Bird Survey
 - Anabat Survey
 - Remote Camera
 - Koala SAT Searches

- Survey (2017-2018):
- Winter Bird Survey
 - Call Playback
 - Herpetological Survey
 - Koala SAT Search
 - Spotlighting Survey

0 0.5 1.0 2.0 km
1:40 000

FIGURE 2.2

Fauna Survey Effort in the
MCO Additional Project Area

Table 2.1 Targeted Surveys for Prasophyllum sp. Wybong in the Mangoola Land Holdings

Survey Timing	Surveys with Consideration of the Following Guidelines	Survey Methodology	Location of Surveys
27 and 28 September 2010	<i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC 2004)</i>	Meander transects in potential habitat. Surveys conducted within known flowering period of the species, based on reference populations. Methodology considered highly suitable to detect flowering orchids.	MCCO Additional Project Area (exploration drilling locations)
4 to 7 October 2011	<i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC 2004)</i>	Meander transects in potential habitat. Surveys conducted within known flowering period of the species, based on reference populations. Methodology considered highly suitable to detect flowering orchids.	Existing Biodiversity Offsets adjacent to MCCO Additional Project Area
10 October 2011	<i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC 2004)</i>	Meander transects in potential habitat. Methodology considered highly suitable to detect flowering orchids. Surveys conducted within known flowering period of the species, based on reference populations.	MCCO Additional Project Area (exploration drilling locations)
17 to 19 September 2013	<i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC 2004)</i> Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)	Meander transects in potential habitat. Surveys conducted within known flowering period of the species, based on reference populations. Methodology considered highly suitable to detect flowering orchids.	MCCO Additional Project Area (Upper Hunter Strategic Assessment)
22 to 25 September 2014	<i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC 2004)</i> Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)	Meander transects in potential habitat. Surveys conducted within known flowering period of the species, based on reference populations. Methodology considered highly suitable to detect flowering orchids.	MCCO Additional Project Area (MCCO Constraints Assessment)

Survey Timing	Surveys with Consideration of the Following Guidelines	Survey Methodology	Location of Surveys
23 September to 9 October 2015	<i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities</i> – Working Draft (DEC 2004) Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)	Meander transects in potential habitat. Methodology considered highly suitable to detect flowering orchids. Surveys conducted within known flowering period of the species, based on reference populations.	Refer to Bell 2016
18 and 19 October 2016	<i>NSW Guide to Surveying Threatened Plants</i> (OEH 2016b) Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)	Parallel transects 20m apart in areas of potential habitat. Methodology considered highly suitable to detect flowering orchids. Surveys conducted within known flowering period of the species, based on reference populations.	MCCO Additional Project Area
18 to 22 September 2017	<i>NSW Guide to Surveying Threatened Plants</i> (OEH 2016b) Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)	Parallel transects 20m apart in areas of potential habitat. Methodology considered highly suitable to detect flowering orchids. Surveys conducted within known flowering period of the species, based on reference populations.	Proposed Biodiversity Offsets Locations
25 to 29 September 2017	<i>NSW Guide to Surveying Threatened Plants</i> (OEH 2016b) Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)	Parallel transects 20m apart in areas of potential habitat. Methodology considered highly suitable to detect flowering orchids. Surveys conducted within known flowering period of the species, based on reference populations.	Proposed Biodiversity Offsets Locations
3 to 6 October 2017	<i>NSW Guide to Surveying Threatened Plants</i> (OEH 2016b) Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)	Parallel transects 20m apart in areas of potential habitat. Surveys conducted within known flowering period of the species, based on reference populations.	Proposed Biodiversity Offsets Locations

Survey Timing	Surveys with Consideration of the Following Guidelines	Survey Methodology	Location of Surveys
20 to 21 September 2018	<i>NSW Guide to Surveying Threatened Plants</i> (OEH 2016b) Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)	Parallel transects 20m apart in areas of potential habitat. Surveys conducted within known flowering period of the species, based on reference populations.	Proposed Biodiversity Offsets Locations
24 to 26 September 2018	<i>NSW Guide to Surveying Threatened Plants</i> (OEH 2016b) Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)	Parallel transects 20m apart in areas of potential habitat. Surveys conducted within known flowering period of the species, based on reference populations.	Proposed Biodiversity Offsets Locations

2.1.2.1 Detectability of *Prasophyllum* sp. Wybong

Local weather conditions are known to be highly influential in determining flowering and therefore detectability, of *Prasophyllum* sp. Wybong. Dr Stephen Bell of East Coast Flora surveys has undertaken an analysis of rainfall and correlations with flowering of *Prasophyllum* sp. Wybong at Mangoola. The following is an excerpt from Dr Stephen Bell's Expert Report (Bell, 2018) prepared as part of the NSW Framework for Biodiversity Assessment (FBA), for which OEHL have accredited Dr Bell as a recognised expert in the ecology of *Prasophyllum* sp. Wybong.

As a rule of thumb, dry winters in the Hunter Valley generally result in below average flowering in terrestrial orchids. Low rainfall in the three months leading up to flowering place individual orchids under stress, meaning that flowering may be postponed for that season for all but the most robust individuals. Because of this trait, terrestrial orchids have been described of as 'time-travellers' (Brundrett 2016), encapsulating the uncertainty in determining their presence in any given area.

*The unpredictability of orchid flowering from year-to-year has been highlighted over the eight year translocation project of *Diuris tricolor* and *Prasophyllum petilum* that has been undertaken at Mangoola Coal (Bell in prep. 1,2; also reported annually in reports to Mangoola Coal). Over the course of eight years of monitoring, the June-to-August pre-flowering rainfall in approximately half of them has been above average, and half has been below average. Dry years have been reflected in low rates of detection within recipient plots, while wetter years have shown an increase in detection (Figure 3). There are of course other factors contributing to the extent of orchid detection observed (expanded upon in Bell in prep 2), but there is a clear trend associated with winter rainfall. Of the nine recipient plots, all displayed lower detection rates in the drought year of 2017, following three seasons of above average winter falls. Results obtained for the 2018 surveys showed a continuing decline in detection despite marginally better rainfall. A similar downward trend was observed for the five recipient plots (n=440) established within mine rehabilitation, monitored over 2-3 years since 2015.*

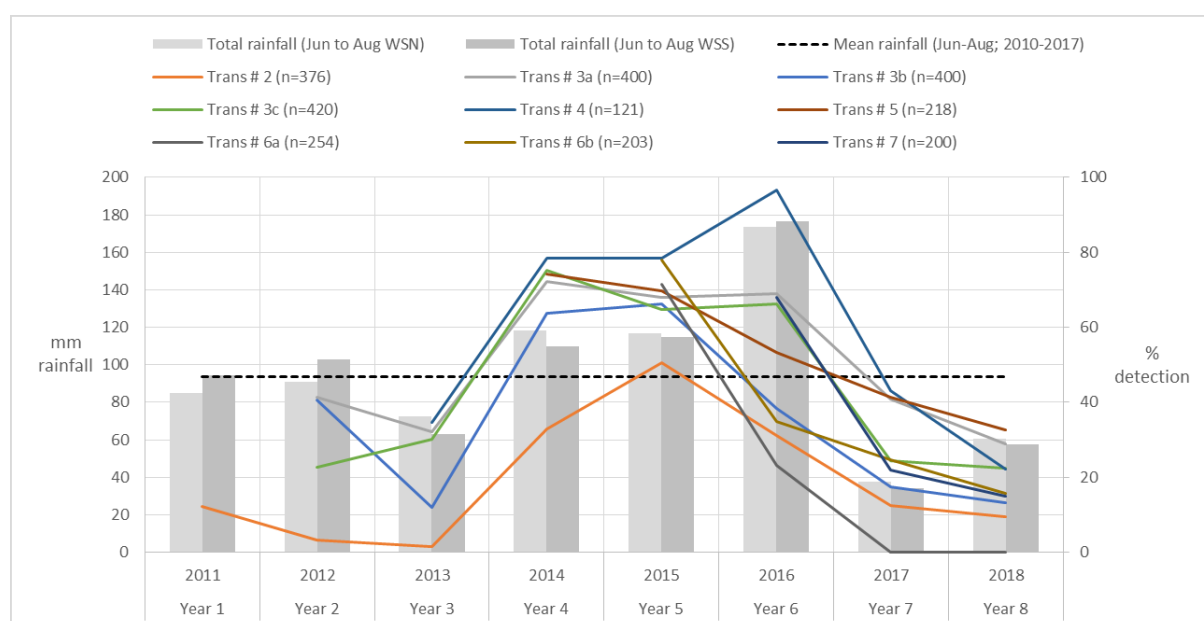


Figure 2.3 Excerpt from Bell (2018) Rainfall received (with 3-month average, June to August) and orchid detection during the course of monitoring across nine recipient plots within derived grassland, over a period of three to eight years (n=2,592 orchids)

The surveys within the MCCO Additional Project Area were primarily undertaken between 2013 and 2016 which represented the best flowering years in the last eight years of monitoring (refer to **Figure 2.3**). In comparison, the surveys of the proposed offset areas were undertaken in 2017 and 2018 which represent the worst years for flowering in the last eight years.

Rainfall data is taken from the Mangoola Coal weather stations north (WSN) and south (WSS) and these stations are shown relative to the MCCO Additional Project Area in **Figure 2.4** (Bell 2019).

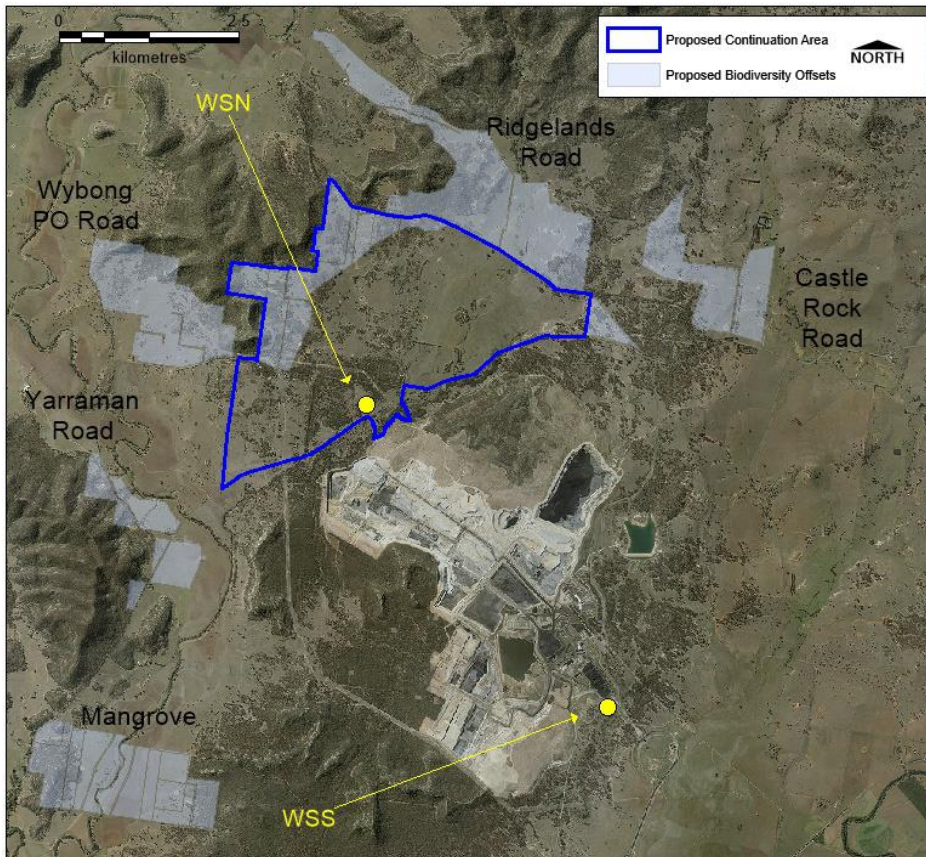


Figure 2.4 Location of Mangoola Coal weather station north (WSN) and south (WSS), relative to the MCCO Project Area

2.1.2.2 Timing of Surveys for *Prasophyllum* sp. Wybong

Targeted threatened orchid surveys were timed with consideration of the flowering status of reference populations in offset and rehabilitation areas within the Mangoola land holding to ensure that the species was detectable during the proposed survey period. In many cases, surveys were delayed when reference populations were not flowering. This process ensures that the maximum extent of the population is detectable during surveys, noting that not all individuals within the population flower annually. The replication of surveys across multiple years allowed for consideration of the ephemeral nature of flowering of these individuals, again maximising the opportunity for the full extent of the population to be identified and considered as part of the assessment.

The plot/transect surveys and meander transect undertaken as part of the MCCO Project are considered to be consistent with the published survey guidelines and policy statements relevant at the time of the surveys.

2.1.3 Regent Honeyeater and Swift Parrot

The regent honeyeater (*Anthochaera phrygia*) and the swift parrot (*Lathamus discolor*), both listed as critically endangered under the EPBC Act, have been recorded in the region but they have not been recorded within the MCCO Additional Project Area despite targeted survey. The regent honeyeater and swift parrot are considered to have potential to occur in areas of appropriate winter-flowering eucalypt habitat, as defined for the national recovery plans for the species.

Targeted winter bird surveys for the regent honeyeater and swift parrot were undertaken on 30 and 31 August 2016 at 13 locations (refer to **Figure 2.2**), 24 and 25 July 2017 at 26 locations and 18 and 19 June 2018 at 24 locations.

Surveys began with a period of quiet listening for approximately 5 minutes. Regent honeyeater and swift parrot calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes between species calls. Following call playback sessions, bird surveys were conducted at each site for a minimum of 30 minutes totalling one person hour of survey per site. This involved walking a meandering transect and recording the number of any bird species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Opportunistic observations were also undertaken throughout the survey.

The winter bird surveys targeted areas of better quality habitat resources for both species and were timed to coincide with the known presence of the species in the Hunter Valley. Surveys were conducted using the targeted search method in accordance with the methods described in the survey guidelines for Australia's threatened birds (DEWHA 2010b) and with consideration of the relevant recovery plans for each species.

Table 2.2 Summary of Swift Parrot and Regent Honeyeater Surveys for the MCCO Project

Common Name <i>Scientific Name</i>	BC Status	EPBC Status	Required Survey Period [^]	Survey Technique and Timing
swift parrot <i>Lathamus discolor</i>	E	CE	March - July	30 and 31 August 2016 – at 13 sites 24 and 25 July 2017 – at 26 sites 18 and 19 June 2018 – at 24 sites Quiet listening for 5 minutes and calls played using 15 watt directional load hailer for four minutes followed by an additional 5 minutes. Bird surveys were then conducted for 30 minutes
regent honeyeater <i>Anthochaera phrygia</i>	CE	CE	All year	30 and 31 August 2016 – at 13 sites 24 and 25 July 2017 – at 26 sites 18 and 19 June 2018 – at 24 sites Quiet listening for 5 minutes and calls played using 15 watt directional load hailer for four minutes followed by an additional 5 minutes. Bird surveys were then conducted for 30 minutes

[^] required survey period as specified by the FBA methodology.

Annual monitoring surveys of the biodiversity offset areas and retained vegetation associated with the existing Mangoola Mine include winter bird surveys that target the regent honeyeater and swift parrot. Review and analysis of monitoring results was used to supplement the targeted surveys undertaken within the MCCO Additional Project Area.

The targeted surveys undertaken as part of the MCCO Project are considered to be consistent with the relevant published survey guidelines and policy statements for the regent honeyeater and swift parrot.

2.1.4 Grey-headed Flying Fox Surveys

Spotlighting surveys targeting the grey-headed flying fox were undertaken in areas of appropriate habitat between the hours of 8 pm and midnight using 30 watt Lightforce hand-held spotlights. The surveys were undertaken over two nights in February 2014, with approximately four person hours completed each night. Areas targeted for spotlighting primarily comprised woodland patches dominated by eucalypt species favoured by the grey-headed flying fox. The locations of spotlighting surveys are shown on **Figure 2.2**.

An assessment for the presence of breeding camps was also undertaken as part of the general biodiversity surveys undertaken across the MCCO Additional Project Area and surrounding habitats since the commencement of surveys in 2013. Particular focus was paid to drainage line communities which the species is known to favour in the Hunter Valley and elsewhere across its range. No breeding camp sites were identified.

The targeted surveys undertaken as part of the MCCO Project are considered to be consistent with the relevant published survey guidelines and policy statements for the grey-headed flying fox.

2.2 Description and Quantification of Habitat for Impacted MNES

2.2.1 *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as a CEEC under the EPBC Act. This community occurs along the western slopes and tablelands of the Great Dividing Range from Southern Queensland through NSW to central Victoria. It is characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of white box, yellow box or Blakely's red gum trees.

Approximately 15.6 hectares of woodland and 8.4 hectares of derived native grassland that conforms to the *White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland* CEEC was identified within the Development Footprint and will be directly impacted as a result of the MCCO Project. The following PCTs in the MCCO Proposed Additional Mining Area were identified as having Blakely's red gum (*Eucalyptus blakelyi*) or Blakely's red gum/forest red gum (*Eucalyptus blakelyi* x *Eucalyptus tereticornis*) intergrades as the dominant overstorey species (refer to **Figure 2.5**):

- HU812/PCT1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter
- HU812/PCT1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – derived native grassland
- HU821/PCT1607 Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter.

Detailed assessment of the vegetation communities described and mapped within the MCCO Additional Project Area was undertaken to determine whether the vegetation present met the condition class thresholds identified in the Commonwealth Listing Advice (TSSC 2006).

The National Recovery Plan for the CEEC identifies habitat critical to its survival as occurring on the moderate to highly fertile soils of the western slopes of NSW and Queensland, the northern slopes of Victoria, and the tablelands of the Great Dividing Range from southern Queensland through NSW and the ACT, or prior dominance, of white box, yellow box or Blakely's red gum trees.

Given the current highly fragmented and degraded state of this ecological community, all areas of Box-Gum Grassy Woodland which meet the minimum condition criteria outlined in the National Recovery plan are critical to the survival of this ecological community.

The approximately 15.6 hectares woodland and 8.4 hectares of derived native grassland which conforms to the *White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland* CEEC within the Development Footprint would be critical to the survival of the CEEC, in accordance with the criteria prescribed in the National Recovery Plan for the CEEC (DECCW 2011). The MCCO Project would result in the removal of habitat critical to the survival of the White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland CEEC, however the extent of proposed clearing represents a small area in the context of the broader range of the community both in NSW and in Australia.

The estimated total current national extent of White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland CEEC is estimated to be approximately 416 000 hectares (TSSC 2006), of which approximately 250 729 hectares is known to occur in NSW. The permanent loss of approximately 15.6 hectares woodland and 8.4 hectares of derived native grassland CEEC as a result of the Proposed Action represents a negligible reduction in the estimated current extent of the community across its national range, estimated to be approximately 0.009 per cent of the current extent of the community in NSW.

The DoEE has assessed the MCCO Project as having a likely significant impact on the CEEC.

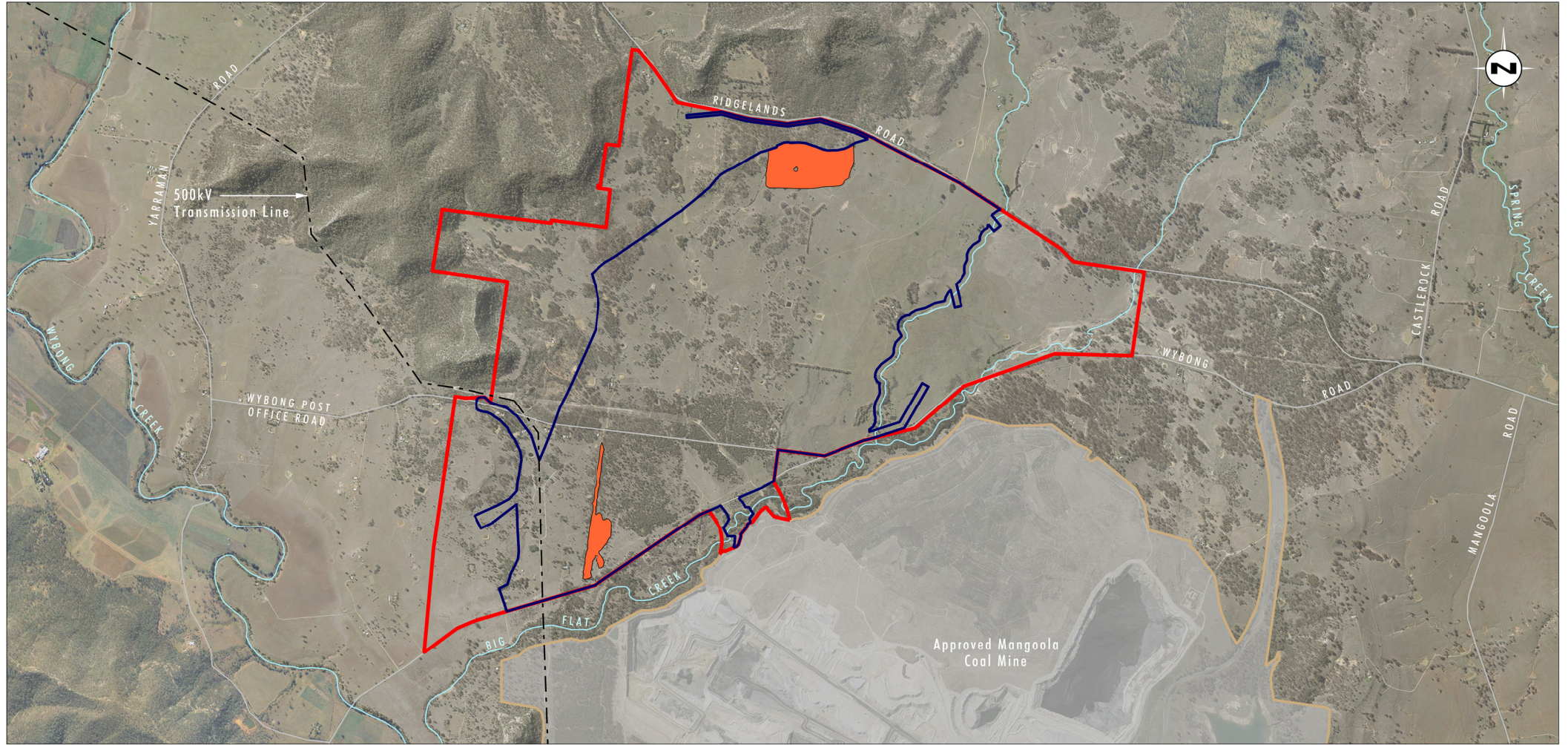


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

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Legend

- Approved Mangooola Coal Mine Disturbance Area
- MCO Additional Project Area
- MCO Additional Disturbance Area
- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC

FIGURE 2.5

EPBC Act Listed CEEC in the
MCO Additional Disturbance Area

2.2.2 *Prasophyllum* sp. Wybong

Prasophyllum sp. Wybong is listed as Critically Endangered under the EPBC Act. There was a change (July 2017) to the listing status of the *Prasophyllum* species occurring at Mangoola under the EPBC Act. DoEE has confirmed that from a Commonwealth Government perspective the plants recorded at Mangoola should be considered as *Prasophyllum* sp. Wybong, rather than *Prasophyllum petilum*, which the orchid records are recognised as, under the NSW BC Act. It is noted that there is considerable taxonomic uncertainty in relation to this species.

The amended SEARs note that the DoEE will accept the credit liability generated for *Prasophyllum petilum* as the credit liability for *Prasophyllum* sp. Wybong, subject to being satisfied that the proposed offsets meet the offset requirements under the EPBC Act.

Populations of the leek orchid (*Prasophyllum* sp. Wybong) are limited in distribution and the species is endemic to NSW. The species is known from seven populations in eastern NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield and Currabubula and the Pilliga area. Populations of this species have been recorded at the Tarengo Travelling Stock Route (TSR) in Boorowa, Captains Flat, Ilford, Steve's TSR in Delegate, Muswellbrook and Wybong (DoE 2019 & DECCW 2010). Habitat for this species is observed to be open grassland or grassy woodland (Bell and Copeland 2010). Most of the significant orchid populations recorded across multiple survey periods tend to have been found within open grassland habitats (Bell and Copeland 2010 & Umwelt 2015).

There is very little research-based literature that allows confident definition of population size or population boundaries of the leek orchid as this species is cryptic in nature and difficult to identify in the field unless in flower as it persists via tuber dormancy when not in flower (Bell and Copeland 2010 & Bell 2016). It is considered that the Wybong population of the species likely represents a regional population of the species, occurring in the Sydney Basin Bioregion.

The MCCO Project will result in the loss of 691 individual orchids (Umwelt 2019, Bell 2019), with the expected population size in the Mangoola Coal land holding estimated to be in excess of 15,000 individuals (Bell 2016). Surveys within Mangoola Coal owned properties to date have identified approximately 5,806 individual orchids.

The 691 individuals of the leek orchid documented above represents 634 individuals that have been recorded in the Development Footprint and 57 individuals extrapolated to occur in an area of habitat approximately 13 hectares in size (see **Figure 2.6**). Survey timing restrictions prevented formal transects being walked across the entirety of the small area of potential habitat. Instead, a single transect was walked in the potential habitat area and individuals were counted from 5m on either side. Using the observed density along the single transect and the results of an Expert Report (Bell 2018), a density of 4 plants per hectare was used to determine the final number of individuals in that area. The density estimate used to extrapolate the number of individuals in this area of potential habitat is the upper limit of density estimates provide by Dr Stephen Bell in his Expert Report for this species.

The loss of 691 individual *Prasophyllum* sp. Wybong may lead to a long-term decrease in the size of the population of the leek orchid in the Hunter Valley. The current extent of occurrence of the leek orchid is estimated to be 48,000 km². There is no data to indicate a decline in extent (DoE 2019).

Current available literature on the biology and ecology of the leek orchid is limited and there is no defined critical habitat for this species. The regional population of the species located in the Wybong area is considered to comprise an important population of the species that is likely to be critical to the survival of the species. The loss of 691 *Prasophyllum* sp. Wybong individuals may adversely affect habitat critical to the survival of the species.

All terrestrial orchids share unique traits which are applicable to the leek orchid. These traits include having specific pollinator requirements, obligate mycorrhizal associations and a dormant phase (Vizer 2013). However, current available literature on life history traits of the leek orchid (*Prasophyllum* sp. Wybong) is limited. The main life history trait known about these orchids that is pertinent to the Proposed Action is that flowering in both orchids occurs in spring, typically from September to October (DoE 2019 & Vizer 2013). It is unknown if the MCCO Project will disrupt the breeding cycle of the regional extent of the *Prasophyllum* sp. Wybong population in the Wybong area.

There is no approved recovery plan or threat abatement plan for *Prasophyllum* sp. Wybong, however, any impacts to known habitat for the species will likely contravene the objectives of the Priority Actions listed in the conservation advice (DEWHA 2009).

The MCCO Project is likely to result in a reduction in the area of occupancy of the species and may adversely affect habitat critical to its survival. It is unknown whether the Proposed Action will disrupt the breeding cycle of the Wybong population of *Prasophyllum* sp. Wybong. In addition, the Proposed Action is in contradiction with the recovery actions listed in the conservation advice for this species. For these reasons the DoEE has assessed the Proposed Action as having a likely significant impact on *Prasophyllum* sp. Wybong, and will be assessed as such through this document.

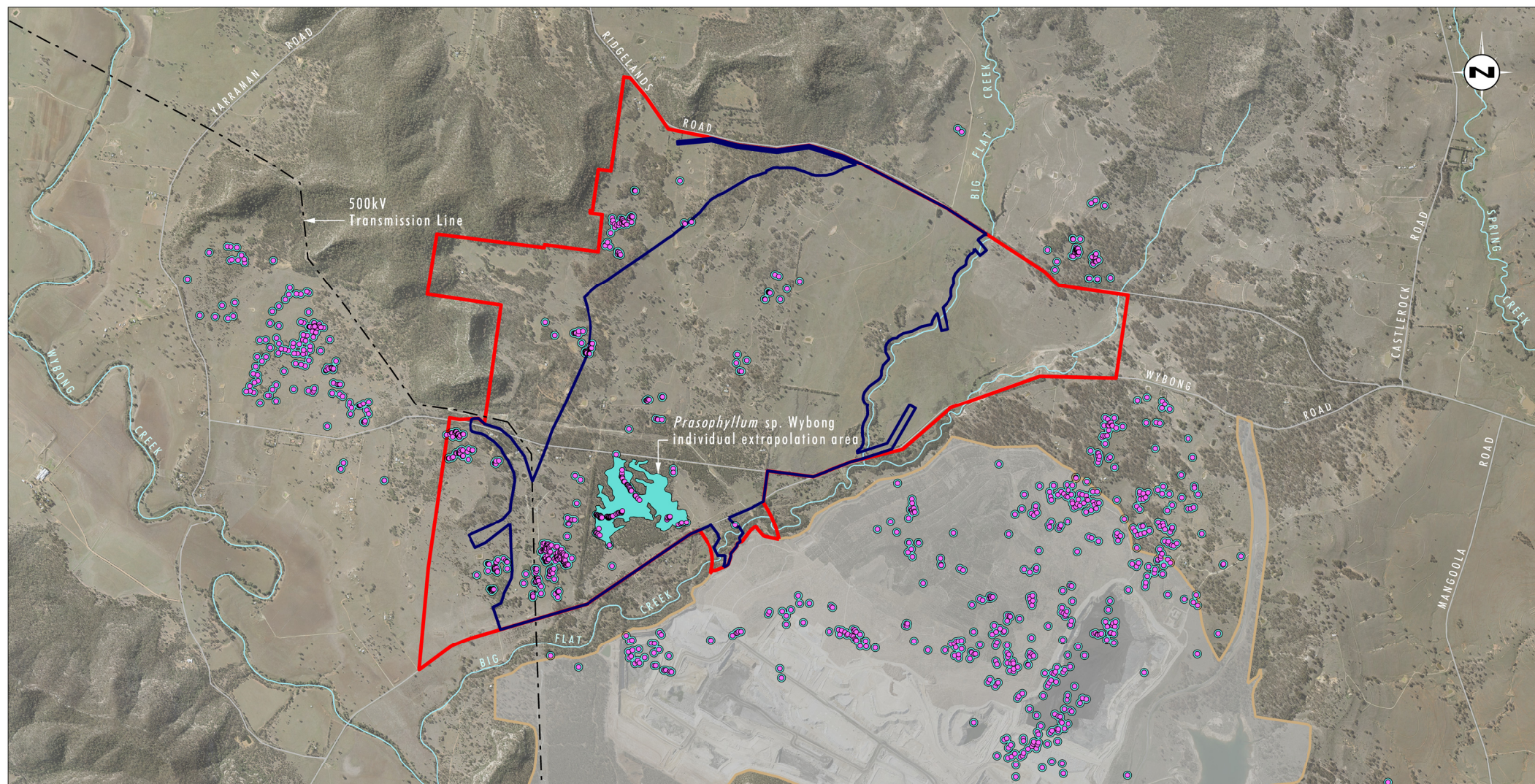


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

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Legend

- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Leek Orchid (*Prasophyllum* sp. Wybong) Locations
- Leek Orchid (*Prasophyllum* sp. Wybong) Species Polygon

File Name (A4): R20/4004_382.dgn
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FIGURE 2.6

Locations of Leek Orchid (*Prasophyllum* sp. Wybong)
Surrounding the MCCO Additional Project Area

2.2.3 Regent honeyeater (*Anthochaera phrygia*)

The regent honeyeater is listed as critically endangered under the EPBC Act and has a patchy distribution extending from south-east Queensland, into NSW and the Australian Capital Territory, to central Victoria (CoA 2016). The species is highly mobile, capable of travelling large distances and occurs only irregularly at most sites in varying numbers. Adding further difficulty to the survey and study of this species is its ability to often go long periods without being observed anywhere (CoA 2016).

The regent honeyeater is endemic to mainland south-eastern Australia and mostly inhabits inland slopes of the Great Dividing Range (TSSC 2015). The regent honeyeater comprises a single population, with some exchange of individuals between regularly used areas (CoA 2016). As at 2010, the total population size is estimated at 350–400 mature individuals (CoA 2016).

As the species occurs as a single population in Australia, any record of the species would constitute part of a population as described above. The population of regent honeyeater has not been recorded within the Development Footprint. It has been recorded approximately 16 km north west of the Development Footprint (between Wybong and Merriwa) however this is a historic record from 1996 (BioNet 2019).

The regent honeyeater's primary habitat is box-ironbark eucalypt woodland and dry sclerophyll forest, however it utilises riparian vegetation and lowland coastal forest. Habitat critical to the survival of the regent honeyeater includes any breeding or foraging areas where the species is likely to occur and any newly discovered breeding or foraging locations (CoA 2016). Ironbark woodland occurs across 147.97 hectares of the Development Footprint, and will be impacted by the Proposed Action. This area represents critical habitat as the Hunter Valley region has been mapped in the recovery plan as 'species likely to occur' despite a lack of recent records in the Project Area.

The controlled action decision (DoEE 2019) states that the MCCO Project is like to have a significant impact on the regent honeyeater due to the loss of 256 hectares of habitat critical to the survival of the species. Consultation with the DoEE assessment officer determined that DoEE had identified all PCTs that contain ironbark as providing critical habitat for the species.

Review of PCTs determined that the MCCO Project area contains 147.9 hectares of woodland and forest communities that contain narrow-leaved ironbark (*Eucalyptus crebra*) and spotted gum (*Corymbia maculata*) as occurring in the canopy, as meeting the broad definition of potential habitat that DoEE has considered as habitat critical to the survival of the species. Derived native grassland communities of these PCTs have not been included in the analysis of potential habitat.

The above assessment is inherently conservative, allowing for the presence of canopy species only and with no consideration of the quality of habitat for the regent honeyeater or swift parrot as defined by the respective recovery plans and knowledge of the species ecology and habitat preferences.

The National recovery plan for the regent honeyeater identifies the following canopy species as key tree and mistletoe species across the species range:

- Mugga (or Red) 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 (*Dendrophoe vitellina*)

Other tree species may be regionally important. For example the 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 (*Eucalyptus eugenioides*) and other stringybark species, and broad-leaved ironbark (*Eucalyptus fibrosa*) can also contribute important nectar flows at times. The recovery plan also identifies that ‘mature, large individual trees tend to be more important as they are more productive, particularly on highly fertile sites and in riparian areas’.

Based on fieldwork that considered the extent of habitat within the MCCO Project area in accordance with the National Recovery Plan and the regional ecology of the species within the Hunter Valley, a total of approximately 8.6 hectares of potential foraging habitat for the species, associated with vegetation community 1602 Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter was identified in the MCCO Project area and the species was considered to have a low likelihood of occurrence within the MCCO Additional Project Area. The assessment also noted that the habitat within the MCCO Additional Project Area is substantially degraded as a result of previous clearing, with few mature spotted gum individuals recorded.

Following the controlled action decision and discussions with DoEE, the following vegetation communities have been determined by DoEE as critical habitat for the regent honeyeater in the MCCO Project Area (refer to **Figure 2.5**):

- HU816/PCT1602 Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter
- HU817/PCT1603 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter
- HU821/PCT1607 Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter (*Eucalyptus tereticornis* x *Eucalyptus blakelyi* intergrades dominant in the canopy).

The combined total area of the above vegetation communities represents 147.97 hectares of habitat with the potential to support regent honeyeater foraging (noting exclusion of derived native grassland communities which do not provide habitat for the species).

The regent honeyeater mainly breeds in three key sites in NSW being the Bundarra-Barraba area, the Capertee Valley, and the Lower Hunter Valley (CoA 2016 & OEH 2019). Other breeding areas are known in the Pilliga woodlands and the Mudgee-Wollar areas of NSW. The regent honeyeater has not been recorded in the MCCO Additional Project Area and it is unlikely to contain breeding or nesting habitat for the species.

Any impacts to known habitat for the regent honeyeater will likely contravene the objectives of the recovery plan. The regent honeyeater has not been recorded within the MCCO Additional Project Area, however 147.97 of critical habitat has been identified by the DoEE in its Controlled Action decision. The MCCO Project is unlikely to result in a significant impact on the *population* of the regent honeyeater. Although the MCCO Additional Project Area provides potential foraging habitat for this species, the area proposed to be disturbed is minimal and the regent honeyeater has not been recorded utilising the potential habitat within the MCCO Additional Project Area or in the immediate surrounds.

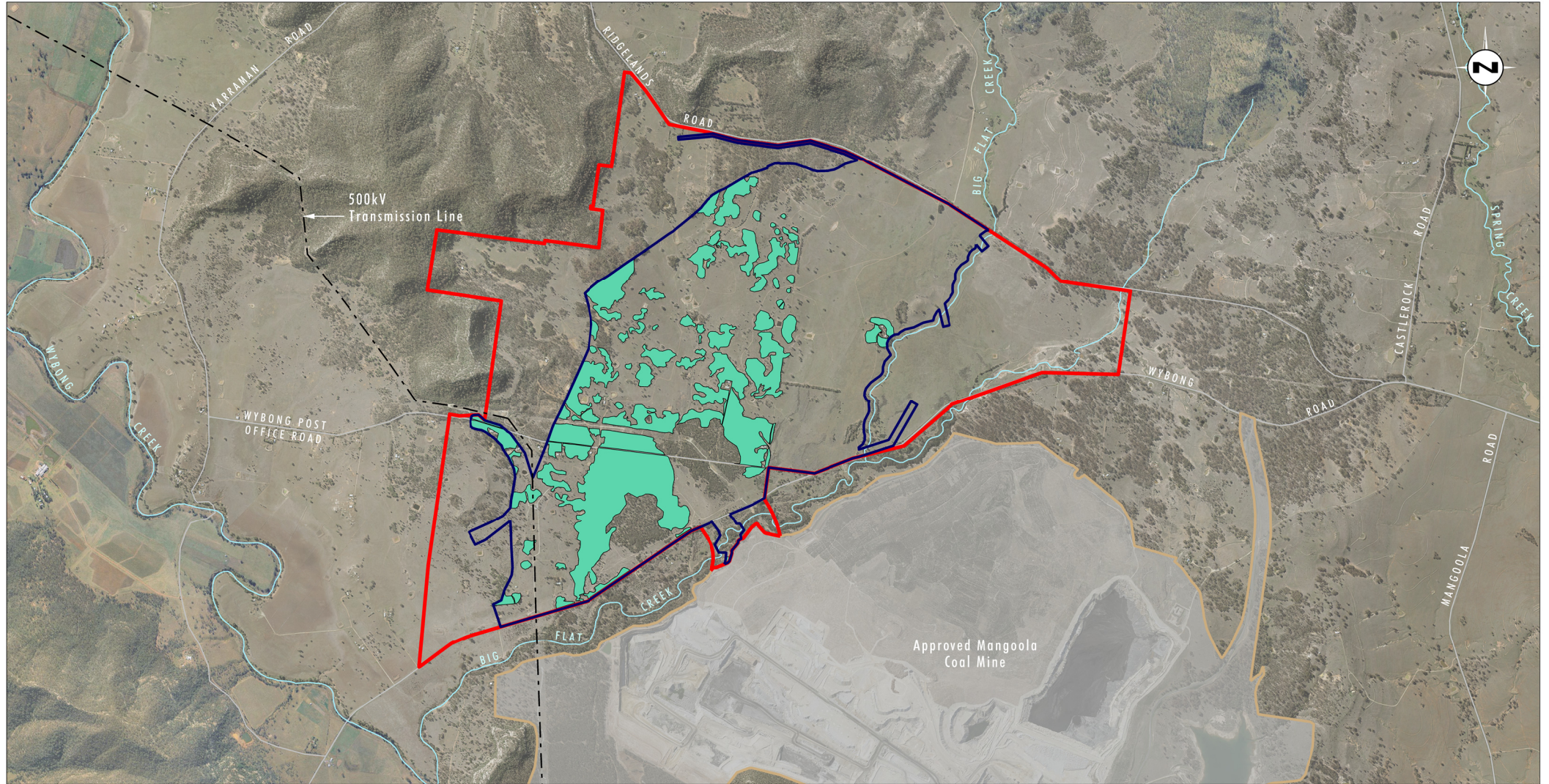


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

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Legend

- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Potential Regent Honeyeater Habitat

FIGURE 2.7

Potential Habitat for Regent
Honeyeater (*Anthochaera phrygia*) in
the MCCO Additional Disturbance Area

2.2.4 Swift Parrot (*Lathamus discolor*)

The swift parrot is listed as critically endangered under the EPBC Act. The species breeds in Tasmania and moves to mainland Australia for the non-breeding season (usually arriving between February and March) (Saunders and Tzaros 2011). Most of the population winters in Victoria and NSW where it disperses across broad landscapes foraging on nectar and lerps in eucalypts. Until recently it was believed that in NSW, swift parrots forage mostly in the coastal and western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region (Saunders and Tzaros 2011). However, evidence is gathering that the forests on the coastal plains from southern to northern NSW are also important. They return to Tasmania in spring (September-October). The movements of this species on the mainland are poorly understood, but it is considered to be nomadic and irruptive, moving in response to food supply.

The swift parrot occurs as a single population that migrates annually from breeding grounds in Tasmania to the winter foraging grounds on the coastal plains and slope woodlands of mainland eastern Australia (Saunders and Tzaros 2011). Approximately 200 mature birds (10 per cent of the total estimated population) are known to over-winter in the Lower Hunter Region of New South Wales (Roderick et al. 2013).

As the species occurs as a single population in Australia, any record of the species would constitute a part of a *population* as described above. There have been few records of the species within the Central Hunter Valley in the past few years, however recent sightings have been recorded in the winter 2017 season in the lower Hunter areas (Birdline NSW 2019). This species has the potential to make use of the open forest and woodland habitats of the Development Footprint, particularly where there are prolific flowering eucalypts and this migratory species is likely to move throughout the area in response to mass flowering events. This species does not breed on mainland Australia, and as such the MCCO Additional Disturbance Area only represents potential foraging habitat for this species.

The MCCO Additional Disturbance Area contains low to moderate quality potential foraging habitat for this species. In accordance with the National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) approximately 27.4 hectares of potential woodland foraging habitat occurs within the Development Footprint, based on the presence of spotted gum (*Corymbia maculata*) and forest red gum (*Eucalyptus tereticornis*) which are identified as key foraging resources for the swift parrot in the Hunter Valley. Analysis of vegetation survey data and habitat assessment results indicates that the additional key foraging species that provide habitat for the species in the Hunter Valley, as per the Recovery Plan, were not recorded in the MCCO Additional Disturbance Area.

The following vegetation communities are identified as potential foraging habitat for the swift parrot in the MCCO Additional Disturbance Area (refer to **Figure 2.8**):

- HU812/PCT1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter (*Eucalyptus tereticornis* dominant in the canopy)
- HU816/PCT1602 Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (*Corymbia maculata* dominant in the canopy)
- HU821/PCT1607 Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter (*Eucalyptus tereticornis* x *Eucalyptus blakelyi* intergrades dominant in the canopy).

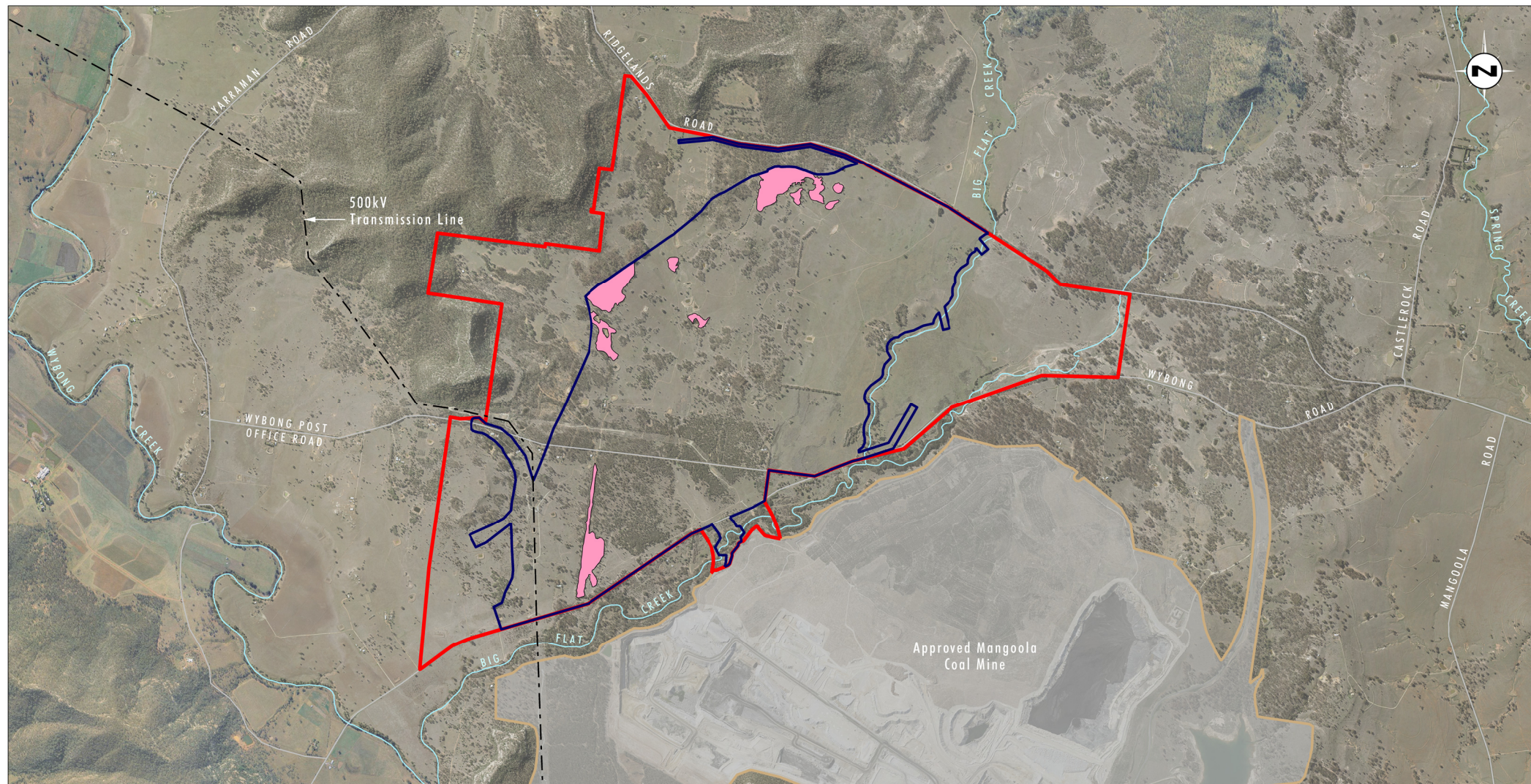


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

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Legend

- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Potential Swift Parrot Foraging Habitat

FIGURE 2.8

Potential Foraging Habitat for
Swift Parrot (*Lathamus discolor*) in
the MCCO Additional Disturbance Area

The original biodiversity impact assessment provided in the Referral (Umwelt 2018) found that the predicted impacts of the MCCO Project were unlikely to result in a significant impact on a population of the swift parrot. The DoEE determined in the controlled action decision that the swift parrot will be potentially significantly impacted by the MCCO Project. In the time since the Referral was lodged, the MCCO Project has been revised and the impacts on biodiversity have been reduced. In addressing the amended SEARs, further review and analysis of the identified direct, indirect and consequential impacts of the revised MCCO Project was undertaken to determine the impact on the population of the swift parrot. A revised assessment of significance for the species is provided in **Appendix A**. The results of the revised assessment have determined that the MCCO Project is unlikely to result in a significant impact on the population of the swift parrot.

Habitat critical to the survival of the swift parrot includes those areas of priority habitat for which the species has a level of site fidelity or possess phenological characteristics likely to be of importance to the swift parrot (Saunders and Tzaros 2011). The swift parrot has not been recorded within the MCCO Additional Project Area or the immediate locality and has not shown site fidelity to the habitats of the MCCO Additional Project Area. The MCCO Additional Project Area includes vegetation containing spotted gum and forest red gum which are key feed tree species for the swift parrot in the Hunter-Central Rivers (Saunders and Tzaros 2011). The MCCO Project will result in the loss of 27.4 hectares of potential habitat that is not important, notable, or of consequence, having regard to its context or intensity.

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

The grey-headed flying-fox is listed as Vulnerable under the EPBC Act. It has not been recorded in the MCCO Additional Disturbance Area. The closest record of the species occurs 10 km to the south of the MCCO Additional Project Area near Denman.

All eucalypt forest and woodland vegetation within the MCCO Additional Project Area may provide potential foraging habitat for this species. Eucalypt-dominated vegetation communities within the MCCO Additional Disturbance Area occur across approximately 162.6 hectares.

Camp sites (breeding habitat) have not been identified within the MCCO Additional Project Area and are not expected to occur. The nearest substantial roost camp site of the grey-headed flying-fox to the MCCO Additional Project Area is in Muswellbrook approximately 17 km to the east of the MCCO Additional Disturbance Area (DoEE 2019). The population estimate for grey-headed flying-foxes in Muswellbrook was estimated to be between 2,500 and 9,999 individuals during the most recent survey in August 2018 (DoEE 2019). The highest estimate of this population is from 2015 with the population estimated to be between 16,000 and 49,999 individuals (DoEE 2019). Potentially occurring foraging individuals in the MCCO Additional Project Area are likely to be from this camp sites located within 50 km of the site.

According to the draft *National Recovery Plan for the Grey-Headed Flying-Fox* (DECCW 2009), foraging habitat that meets one of the following criteria is considered critical to the survival of the species:

- productive during winter and spring, when food bottlenecks have been identified
- known to support populations of >30,000 individuals within an area of 50 km radius (the maximum foraging distance of an adult)
- productive during the final weeks of gestation, and during the weeks of birth, lactation and conception
- productive during the final stages of fruit development and ripening in commercial crops affected by grey-headed flying-foxes and/or

- known to support a continuously occupied camp.

The National Recovery Plan for the grey-headed flying-fox (DECCW 2009) also includes criteria for roosting habitat critical to the survival of the species. Since the MCCO Additional Project Area does not contain a grey-headed flying-fox camp, it will not impact roosting habitat critical to the survival of the species.

The MCCO Additional Disturbance Area is considered to comprise up to 162.6 hectares of potentially suitable eucalypt foraging habitat for this species and may be productive during winter and spring according to the above criteria. However, given that this species has not been recorded in the MCCO Additional Project Area, and given that it only represents a relatively small area of suitable fragmented habitat when compared to the local area, it is considered that the MCCO Project is unlikely to substantially adversely affect foraging habitat critical to the survival of the species.

The original biodiversity impact assessment provided in the Referral (Umwelt 2018) found that the predicted impacts of the MCCO Project were unlikely to result in a significant impact on a population of the grey-headed flying-fox. The DoEE determined in the controlled action decision that the grey-headed flying-fox will be potentially significantly impacted by the MCCO Project. In the time since the Referral was lodged, the MCCO Project has been revised and the impacts on biodiversity have been reduced. In addressing the amended SEARs, further review and analysis of the identified direct, indirect and consequential impacts of the revised MCCO Project was undertaken to determine the impact on the population of the grey-headed flying-fox. A revised assessment of significance for the species is provided in **Appendix A**. The results of the revised assessment have determined that the MCCO Project is unlikely to result in a significant impact on the population of the grey-headed flying fox.

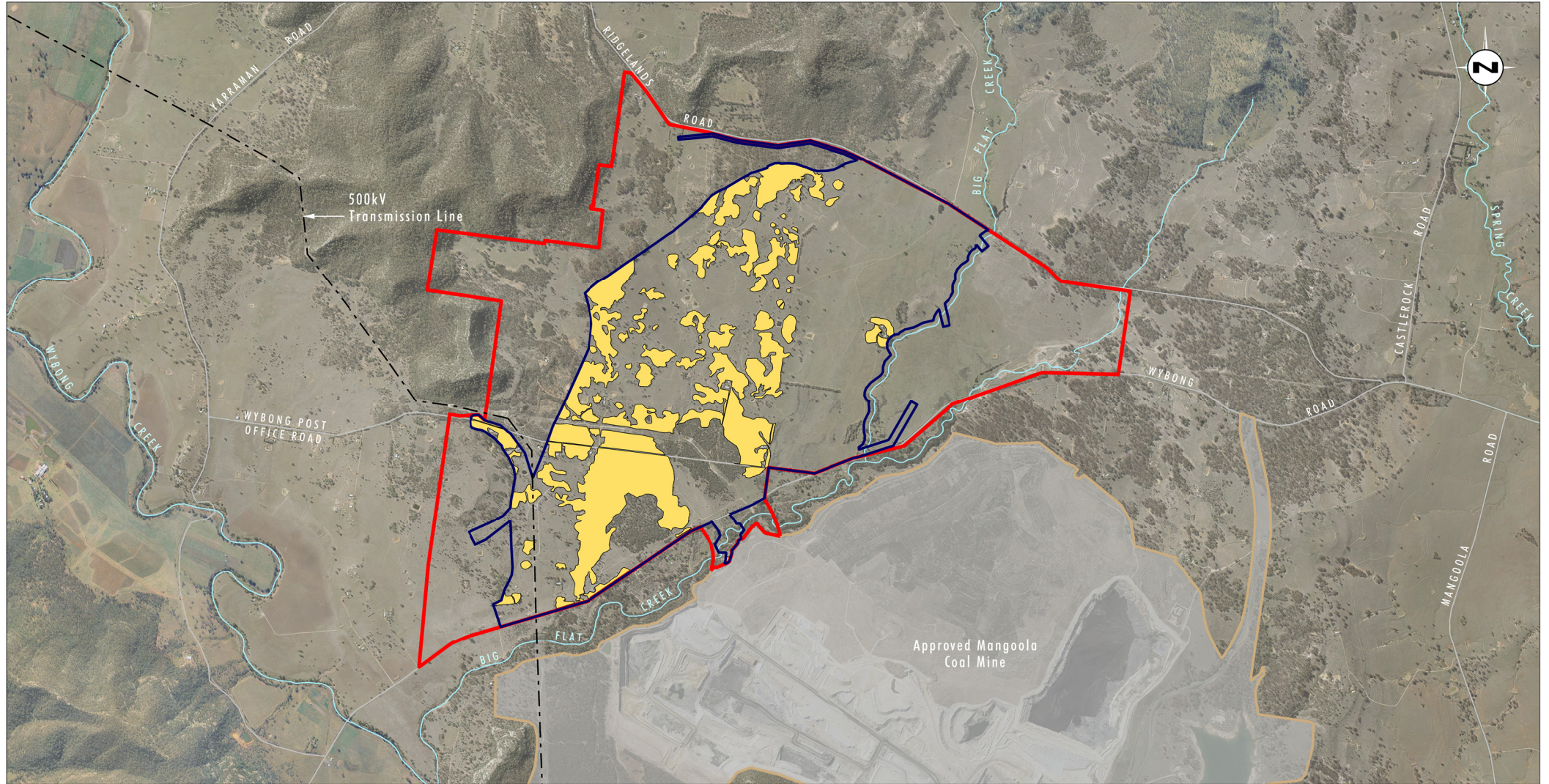


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

0 0.5 1.0 2.0 km
1:40 000

Legend

- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Potential Grey-headed Flying-fox Habitat

FIGURE 2.9

Potential Habitat for Grey-headed
Flying Fox (*Pteropus poliocephalus*) in
the MCCO Additional Disturbance Area

2.3 Assessment of impacts to listed Threatened Species and Communities

The development of the MCCO Project will result in direct, indirect and consequential impacts on biodiversity values within the MCCO Additional Disturbance Area. Direct impacts include the loss of native vegetation and fauna habitats as a result of clearance works and subsequent mining activity. The MCCO Project is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding lands. However, some minor indirect impacts associated with habitat connectivity, fugitive light emissions, dust, noise, groundwater changes, weeds and feral animals may occur during the MCCO Project.

Consequential impacts arise where a project creates a requirement for additional development or where additional development is facilitated to a significant extent by a project. The MCCO Project is not expected to result in substantial consequential biodiversity impacts.

It is recognised that the MCCO Project will remove vegetation and further increase fragmentation and isolation of habitats, and thus contribute to cumulative habitat loss and vegetation clearance in the locality.

These impacts are summarised in **Table 2.3**.

Table 2.3 Predicted Impacts from the MCCO Project on EPBC Act listed threatened species and communities

Impact Type	MNES	Description	Nature of Impact	Direct Impact Area (ha)
Direct	<i>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</i> CEEC	Loss of 15.6 ha of woodland and 8.4 ha of derived native grassland through clearing	Permanent	24
Direct	<i>Prasophyllum</i> sp. Wybong	Clearing of 691 individuals	Permanent	691 individuals
Direct	regent honeyeater (<i>Anthochaera phrygia</i>)	Removal of potential narrow-leaved ironbark dominated habitat determined by DoEE to be critical to the survival of the species	Permanent	147.97
Direct	swift parrot (<i>Lathamus discolor</i>)	Removal of potential foraging habitat	Permanent	27.4
Direct	grey-headed flying-fox (<i>Pteropus poliocephalus</i>)	Removal of potential foraging habitat for	Permanent	162.6

Impact Type	MNES	Description	Nature of Impact	Direct Impact Area (ha)
Indirect	Non-specific Biodiversity related MNES	Removal of 'stepping stone' corridor pathways for fauna movement and gene flow. A potential corridor exists within the MCCO Additional Project Area linking the woodland and forest habitats to the south with those in the east and north.	Medium term	196.4
Indirect	Non-specific Biodiversity related MNES	Fugitive light emissions resulting from the MCCO Project may result in adverse impacts on adjacent habitats and cause behavioural changes in nocturnal birds and bats. The grey-headed flying fox could potentially be affected if present within, or near to, the MCCO Additional Project Area.	Medium term	
Indirect	Non-specific Biodiversity related MNES	Noise and blasting impacts may have a minor indirect impact on fauna species. Potential impacts include noise disturbing the roosting and foraging behaviour of fauna species and/or reducing the occupancy of areas of otherwise suitable habitat. Given that the proposed action is part of, and adjacent to an existing mine operation with existing impacts, any additional impacts resulting from noise emissions are not expected to be substantial for threatened species, populations and communities.	Medium term	
Indirect	Non-specific Biodiversity related MNES	Air quality impacts have the potential to adversely impact native species from dust generating activities during ground disturbing works. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth and increased air pollutants for native species (flora and fauna). Given that the proposed action is part of, and adjacent to an existing mine operation with existing impacts, any additional impacts resulting from air quality not expected to be substantial for threatened species, populations and communities.	Medium term	

Impact Type	MNES	Description	Nature of Impact	Direct Impact Area (ha)
Indirect	Non-specific Biodiversity related MNES	<p>Weed species could be inadvertently brought into the MCCO Additional Disturbance Area with imported materials or could invade naturally through removal of native vegetation. The presence of weed species within the MCCO Additional Disturbance Area has the potential to decrease the value of extant vegetation to native species, particularly threatened species. Populations of feral fauna species such as foxes, rabbits, pigs, deer, dogs and cats can increase and quickly populate new areas as a result of disturbance. 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 and various forms land management currently implemented. Any additional impacts resulting from weeds or feral animals are insignificant in relation to threatened species, populations and communities.</p>	Medium term	
Indirect	<i>Prasophyllum</i> sp Wybong	<p>No groundwater impacts are predicted that are likely to impact on <i>Prasophyllum</i> sp. Wybong due largely to the absence of shallow groundwater impacts predicted in the areas in which this MNES occurs.</p> <p>No surface water impacts are predicted that are likely to impact on <i>Prasophyllum</i> sp. Wybong due to the areas of this community that are near to but outside of the direct impact area for the MCCO Project being upslope of the MCCO Project. That is, no water will drain from the MCCO Project into an area occupied by the species, or otherwise affect the drainage of this species outside the direct impact area, and therefore no impacts are predicted.</p> <p>Changes in flooding along Big Flat Creek are predicted to be relatively minor and do not interact with known records of <i>Prasophyllum</i> sp. Wybong outside the direct impact area.</p>	Short term	

Impact Type	MNES	Description	Nature of Impact	Direct Impact Area (ha)
Cumulative	Non-specific Biodiversity related MNES	The history of land clearing associated with agriculture and approved mining development has resulted in an incremental loss of vegetation and fauna habitat surrounding the MCCO Additional Disturbance Area, and within the upper Hunter Valley more generally. The MCCO Project will result in a loss of approximately 570 hectares of native woodland and forest vegetation. The MCCO Project will remove vegetation and further increase fragmentation and isolation of habitats, and thus contribute to cumulative habitat loss and vegetation clearance in the locality.	Medium – long term	
Consequential	Non-specific Biodiversity related MNES	The MCCO Project is an extension of an existing mining operation which uses existing mining facilities. The extension includes the identified economic mining resources therefore consequential impacts are not predicted.	Medium – long term	

The relevant impacts of the MCCO Project are considered to be well known and predictable based on the extensive knowledge of the ecological values of the MCCO Additional Project Area and a sound understanding of the impacts of the MCCO Project (e.g. clearing of vegetation, earthworks and water management). The direct impacts of the MCCO Project, as they relate to the clearing of EPBC listed CEEC and threatened species habitat is predicted to be permanent; however, a detailed biodiversity offset and rehabilitation program has been proposed as part of the MCCO Project in order to compensate for the residual impacts of habitat loss that cannot be adequately avoided or minimised. The proposed rehabilitation and reinstatement of habitat will mean that, over time, impacts will not be completely irreversible as most key ecological features will be recovered. Rehabilitation and regeneration of the mine site, in addition to an appropriate biodiversity offset strategy will ensure that there is no residual significant impact to the landscape in the medium-long term as a result of the MCCO Project. Further details regarding the proposed biodiversity offset strategy are discussed in Section 7 of the Biodiversity Assessment Report (BAR) (refer to Appendix 13 of the EIS).

2.4 Avoidance and Mitigation of Impacts

2.4.1 Avoidance Strategies

Mangoola has sought and will continue to seek opportunities during the detailed design process to avoid and minimise impacts to biodiversity values, following the established hierarchy of avoid, minimise, mitigate and offset. This has included avoidance and minimisation of disturbance of key vegetation communities and fauna habitats. Where impacts are unavoidable the residual impact of the MCCO Project will be offset following the NSW Biodiversity Offsets Policy for Major Projects which utilises the FBA.

Mangoola undertook a detailed biodiversity constraints study as part of the MCCO Project's pre-feasibility assessment to guide the development and detailed design of the MCCO Project. Through this process, alternative mining options were considered and Mangoola has sought to minimise the biodiversity impacts associated with the MCCO Project whilst maximising the economic resource recovery.

Through the iterative design process and the modifications made to the project design, the potential biodiversity impacts of the MCCO Project have been significantly reduced. In total the changes to the physical components of the MCCO Project have resulted in an overall reduction of 401 hectares to the total MCCO Additional Disturbance Area. In terms of biodiversity values, the avoidance of certain infrastructure locations has resulted in the preservation of 23.7 hectares of threatened ecological communities and 1022 individual threatened species. Specifically, the MCCO Project has been designed to avoid impacts to 34 *Prasophyllum* sp. Wybong through the relocation of infrastructure.

Due to selecting the preferred option and not proceeding with the alternative mining options and infrastructure locations, the MCCO Project was able to avoid key physical impacts through the reduced surface disturbance footprint and extent of proposed operations. In addition to these avoided physical impacts there have also been significant reductions in predicted impacts of noise and dust emissions on the wider locality by deciding not to proceed with some of the alternative mine plan options.

2.4.2 Mitigation Measures

Mangoola has committed to the design and implementation of a comprehensive strategy to mitigate the residual impacts of the Proposed Action. The impact mitigation measures proposed are based on best available practices and are widely used to mitigate the impact of coal mining developments in the Hunter Valley and elsewhere. Residual impacts of the Proposed Action on EPBC listed threatened species and communities include:

- direct habitat loss for threatened species and ecological communities
- dust and air quality impacts
- fugitive light emissions
- noise and blasting impacts
- weed encroachment
- impacts to corridors resulting in reduced connectivity for fauna movement and
- introduction of feral animals.

Table 2.4 provides an outline of the avoidance and minimisation measures to be implemented by Mangoola Coal for the impacts described above to those MNES that are predicted to be significantly impacted by the MCCO Project.

Table 2.4 Avoidance and mitigation methods for residual impacts on EPBC listed threatened species and communities

EPBC Act listed species or community	Impact	Avoidance and mitigation measures
<i>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC</i>	Direct impact – removal of 24 ha of vegetation	<p>An extensive mitigation and offsetting strategy is proposed including the provision of:</p> <ul style="list-style-type: none"> the delineation of clearance areas to avoid unnecessary impacts and clearance of surrounding vegetation habitat enhancement measures such as the installation of nest boxes, salvaged hollows, fallen timber, hollow logs and rocks to supplement mine rehabilitation areas rehabilitation of the MCCO Additional Disturbance Area post mining as described in the EIS, and the implementation of a biodiversity offset strategy in accordance with the FBA, including local biodiversity offsets which include habitat regeneration areas
	Air quality impacts; dust covering vegetation impacting health and growth	<p>The design of the MCCO Project will include inherent measures to minimise the potential for adverse air quality impacts. These include:</p> <ul style="list-style-type: none"> progressive rehabilitation and stabilisation of disturbed land dust suppression on haul roads and other operational areas to reduce vehicle generated dust emissions
	Weed encroachment	<p>Mangoola has an adaptive weed management strategy described within its Mining Operations Plan (MOP). Weed infestations are monitored as part of annual walkover inspections and ecological monitoring programs, and a response is required for significant infestations (>10% undesirable species cover) (Glencore 2018).</p>
	Cumulative impacts of land clearing	<p>Rehabilitation and regeneration of the CEEC will be a key focus of the proposed Biodiversity Offset Strategy that will be prepared for the MCCO Project to ensure that there is no residual significant impact to the community in the medium-long term as a result of the Proposed Action. Mangoola's rehabilitation objectives for the MCCO Additional Disturbance Area include the following:</p> <ul style="list-style-type: none"> Establish similar native vegetation communities to those that will be impacted by the MCCO Project. Establishment of ecological rehabilitation as part of the biodiversity offset for the MCCO Project. Develop native vegetation corridors linking surrounding remnant vegetation areas to the southwest of the MCCO Additional Disturbance Area to existing remnants in the north

EPBC Act listed species or community	Impact	Avoidance and mitigation measures
	Surface water and groundwater indirect impacts	<p>With regard to groundwater impacts, the standoff distance (220m) to the Wybong Creek alluvium avoids direct impact on the alluvium and minimises the indirect impacts.</p> <p>Avoidance of a second crossing of Big Flat Creek.</p> <p>Water take is in accordance with the provisions of the NSW Water Management Act 2000 and Mangoola hold all applicable licences.</p> <p>Water discharges are managed in accordance with Mangoola's EPL and the HRSTS. No changes are proposed to Mangoola's already approved water discharge arrangement.</p> <p>Erosion and sediment controls are designed and operated in accordance with the 'Blue Book' (Landcom, 2004 and DECCW, 2008) which is the relevant guideline for the design of such controls in NSW.</p> <p>Mangoola has also committed to, and will be required by a condition of development consent to prepare a Water Management Plan for the MCCO Project. This plan will build on the existing Water Management Plan in place for the current Mangoola Coal Mine. The Plan will need to be prepared in consultation with relevant NSW Government agencies and approved for implementation by DPE. Compliance with the plan will be assessed by regular independent audits and through periodic compliance assessments by NSW government compliance officers.</p>
<i>Prasophyllum</i> sp. Wybong	Direct impact – loss of 691 individuals	<p>A number of specific design changes were implemented during the early stages of designing the MCCO Project that ameliorated the impacts of the MCCO Project on significant biodiversity features. The reduction to the MCCO Additional Disturbance Area presented in the Preliminary Environmental Assessment (Umwelt 2017) has resulted in the avoidance of impacts upon 34 <i>Prasophyllum</i> sp. Wybong individuals.</p> <p>Mangoola is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project. Two offset sites are proposed, and up to 500 hectares of native vegetation communities will be restored as part of ecological mine rehabilitation. The proposed Biodiversity Offset Strategy completely satisfies the credit requirements of the MCCO Project.</p>
	Air quality impacts; dust covering vegetation impacting health and growth	<p>The design of the MCCO Project will include inherent measures to minimise the potential for adverse air quality impacts. These include:</p> <ul style="list-style-type: none"> • progressive rehabilitation and stabilisation of disturbed land • dust suppression on haul roads and other operational areas to reduce vehicle generated dust emissions

EPBC Act listed species or community	Impact	Avoidance and mitigation measures
	Weed encroachment	Mangoola Coal has an adaptive weed management strategy described within its MOP. Weed infestations are monitored as part of annual walkover inspections and ecological monitoring programs, and a response is required for significant infestations (>10% undesirable species cover) (Glencore 2018).
	Surface water and groundwater indirect impacts	<p>With regard to groundwater impacts, the standoff distance (220m) to the Wybong Creek alluvium avoids direct impact on the alluvium and minimises the indirect impacts.</p> <p>Avoidance of a second crossing of Big Flat Creek.</p> <p>Water take is in accordance with the provisions of the NSW Water Management Act 2000 and Mangoola hold all applicable licenses.</p> <p>Water discharges are managed in accordance with Mangoola's EPL and with the HRSTS. No changes are proposed to Mangoola's already approved water discharge arrangement.</p> <p>Erosion and sediment controls are designed and operated in accordance with the 'Blue Book' (Landcom, 2004 and DECCW, 2008) which is the relevant guideline for the design of such controls in NSW</p> <p>Mangoola has also committed to, and will be required by a condition of consent to prepare a Water Management Plan for the MCCO Project. This plan will build on the existing Water Management Plan in place for the current Mangoola Coal Mine. The Plan will need to be prepared in consultation with relevant NSW Government agencies and approved for implementation by DPE. Compliance with the plan will be assessed by regular independent audits and through periodic compliance assessments by NSW government compliance officers.</p>
Regent honeyeater (<i>Anthochaera phrygia</i>)	Direct impact – loss of 147.97 ha of critical habitat	Mangoola is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the MCCO Project. Two land-based offset sites (approximately 1765 hectares) are proposed (along with credits from two existing offset sites previously established by Glencore), and up to 500 hectares of native vegetation communities will be restored as part of ecological mine rehabilitation. Residual credit requirements (for non MNES entities) will be satisfied by payment into the Biodiversity Conservation Fund. The proposed Biodiversity Offset Strategy completely satisfies the credit requirements of the MCCO Project.

EPBC Act listed species or community	Impact	Avoidance and mitigation measures
	Removal of 'stepping stone' corridor pathways for fauna movement and gene flow. Cumulative habitat loss and vegetation clearance in the locality.	<p>Future mine rehabilitation will aim to re-instate connectivity at a local and regional scale in the medium to long-term. Mangoola's rehabilitation objectives for the MCCO Additional Disturbance Area include the following:</p> <ul style="list-style-type: none"> • Establish similar native vegetation communities to those that will be impacted by the MCCO Project. • Establishment of ecological rehabilitation as part of the biodiversity offset for the MCCO Project. • Develop native vegetation corridors linking surrounding remnant vegetation areas to the southwest of the MCCO Additional Disturbance Area to existing remnants in the north
	Fugitive light emissions may result in behavioural changes in fauna; disruption of seasonal day length, trigger changes in foraging behaviour	As per existing site practice, appropriate lighting controls to minimise impacts will continue to be implemented as part of the MCCO Project including minimisation of fugitive lighting emissions following Australian Standards. There will be no substantial change to fugitive light emission impacts on the surrounding fauna habitat given that the proposed mine operation is already part of, and adjacent to, existing mining operations with existing lighting impacts.
	Noise and blasting impacts may disturb the roosting and foraging behaviour of fauna species and/or reduce the occupancy of areas of otherwise suitable habitat.	Mitigation of noise and blasting impacts are outlined in Mangoola Open Cut Noise Management Plan and Blast Management Plan respectively. Noise and blast control measures include both design and operational controls and adaptive management strategies are in place as part of each plan.
	Air quality impacts; increased air pollutants for native species	<p>The design of the MCCO Project will include inherent measures to minimise the potential for adverse air quality impacts. These include:</p> <ul style="list-style-type: none"> • progressive rehabilitation and stabilisation of disturbed land • dust suppression on haul roads and other operational areas to reduce vehicle generated dust emissions
	Introduction of feral animals	Mangoola Coal has an adaptive feral pest management strategy described within its MOP. Feral animal impacts are monitored as part of annual walkover inspections and ecological monitoring programs, and a response is required for moderate to severe impacts caused by feral animals (Glencore 2018).

2.4.3 Assessment of Outcomes and Effectiveness

The avoidance and mitigation measures proposed are expected to be effective in minimising the impact on the ecological features of the MCCO Additional Project Area during construction and operation of the Proposed Action. As discussed in **Section 2.4.1** above, the changes to the physical components of the MCCO Project have resulted in an overall reduction of 401 hectares to the total MCCO Additional Disturbance Area, and in the preservation of 23.7 hectares of threatened ecological communities and 1022 individual threatened species.

The majority of the MCCO Additional Disturbance Area comprises heavily modified vegetation in the form of grazed derived native grasslands and the MCCO Project largely avoids the highest quality remnant forest and woodland occurring on the slopes within the MCCO Additional Project Area. Furthermore, these higher quality remnant forest and woodland areas avoided by the MCCO Project have been included in the proposed Biodiversity Offset Strategy.

Indirect impacts of the construction and operation of the project (i.e. noise, light, blasting impacts) on surrounding biodiversity values are expected to be minor as the proposed mine operation is already part of, and adjacent to, existing mining operations with existing indirect impacts. Potential impacts on EPBC Act listed threatened species and communities as a result of mine operations will continue to be managed as per existing site practices.

The Biodiversity Offset Strategy proposed as part of the Proposed Action is expected to result in an increase in habitat quality at the proposed Biodiversity Offset Sites for the range of flora and fauna species and Critically Endangered Ecological Community impacted by the Proposed Action. The increase in habitat quality is expected to result from the range of proposed management actions such as passive regeneration, and active planting of overstorey and midstorey species as well as tree hollow and fallen log augmentation for certain zones of the offset sites. Following the implementation of these management measures, the land identified in the proposed Biodiversity Offset Strategy have the potential to support an increased abundance of target species in higher quality habitat.

In addition, the ecological rehabilitation program is conceptual only at this stage and will be refined through the development of the rehabilitation strategy. Mangoola Mine's current rehabilitation program is re-establishing 1100 hectares of woodland and forest vegetation in accordance with its existing Project Approval and this commitment will be maintained for the MCCO Project. In addition, the MCCO Project would result in a further 482 hectares of rehabilitation within the MCCO Additional Disturbance Area. It is expected that the rehabilitation will be effective in establishing self-sustaining areas of native vegetation commensurate with the agreed rehabilitation objectives and post mining land use.

2.5 Proposed Biodiversity Offset Strategy

A Biodiversity Offset Strategy is proposed to compensate for residual impacts on those species, vegetation communities and ecological features that are likely to be, or could potentially be, significantly impacted by the MCCO Project at both the State and Commonwealth level. The Biodiversity Offset Strategy compensates for these residual impacts by using direct land-based offset sites with the inclusion of vegetation regeneration and on-site rehabilitation.

The objectives of the Biodiversity Offset Strategy are to:

- maintain or improve the terrestrial and aquatic biodiversity values of the region in the medium to long term

- identify land-based offsets that contain as many as possible of the threatened species impacted by the Proposed Action
- identify land-based offsets that are strategically located
- identify land-based offsets in which an environmental gain can be made via appropriate management strategies
- provide for the long term conservation of offsets
- to develop a management strategy for the proactive environmental management of the proposed offset sites, but with appropriate consideration of the existing rural nature of the area and
- as a minimum provide a suite of offsets (land-based) that have ecological value similar to the residual impacts of the Proposed Action on threatened flora species and threatened fauna species.

Mangoola is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of these ecological values as a result of the MCCO Project. The following biodiversity offset strategy has been developed in accordance with the FBA and completely satisfies the credit requirements of the MCCO Project and meets the stated aims of the EPBC Act Environmental Offsets Policy, being:

- to ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act
- to provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act
- to deliver improved environmental outcomes by consistently applying the policy
- to outline the appropriate nature and scale of offsets and how they are determined and
- to provide guidance on acceptable delivery mechanisms for offsets.

The policy includes the provision that at least 90 percent of offset points must be earned from direct (i.e. land-based) offsets, while the remainder can be earned through indirect measures (e.g. funding or relevant recovery actions).

As discussed in **Section 2.4**, Mangoola has, where possible, altered the MCCO Project to avoid and minimise ecological impacts in the MCCO 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. It is currently proposed that the biodiversity offset strategy will consist of the following direct offsets (refer to **Figure 2.10**):

- In-perpetuity conservation using the retirement of biodiversity credits through the establishment of Stewardship Agreements for:
 - Mangoola Offset Site, and
 - Wybong Heights Offset Site

- In addition to this, credits from proposed Biobank Sites currently being finalised by Glencore will be used. These credits have been created at existing offset sites using the BioBanking Assessment methodology (BBAM) and are currently unallocated. These credits will be retired for the MCCO Project. These include:
 - 790 credits for HU817/PCT1603 from the proposed Highfields BioBank Site, and
 - *Prasophyllum* sp. Wybong (assessed as *Prasophyllum petilum* under NSW legislation) credits (and *Diuris tricolor* credits) from the proposed Mangrove BioBank Sites
- Restoration of up to 456 hectares of native vegetation communities as part of ecological mine rehabilitation, and
- Payment into the Biodiversity Conservation Fund for the small number of remaining credits (non-MNES).

All offset methods proposed are in accordance with the FBA and are considered 'like for like' in accordance with the NSW *Biodiversity Offset Policy for Major Projects* and the EPBC Act Environmental Offset Policy. Under the 'like for like' rules, impacts on vegetation are to be offset with vegetation that is in the same locality as the impact and is:

- the same plant community type (vegetation in NSW is divided into around 1500 plant community types), or
- a plant community type in the same vegetation class (vegetation in NSW is divided into 99 vegetation classes) that has undergone a similar or greater amount of clearing since European inhabitation.

Both the proposed Mangoola and Wybong Heights Offset Sites have been subject to BioBanking Surveys under the FBA to determine the credit yield for each site, however, it is envisaged that both sites will be secured using a Stewardship Agreement under the BC Act.

The proposed Mangoola and Wybong Heights Offset sites are wholly owned by Glencore (and its subsidiaries). The offset sites are proposed to be secured following approval but before the commencement of work. This is typically within 12 months of development consent. In-perpetuity conservation will be achieved through the retirement of biodiversity credits through the establishment of these Stewardship Sites.

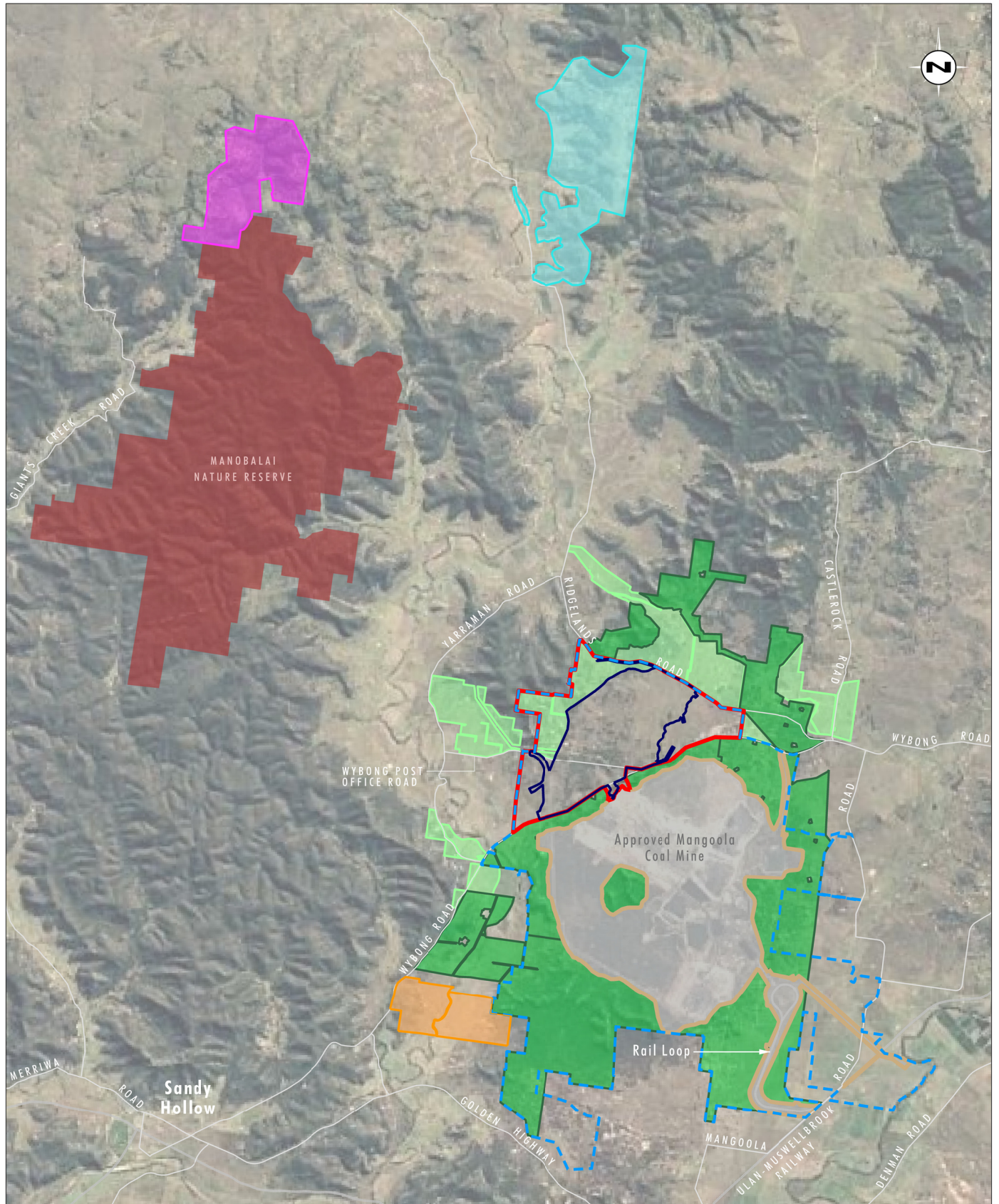


Image Source: Google Earth (Dec 2016)

Data Source: Glencore (2019)

Note: Offset boundaries are based on LPI cadastre

0 2 4 6 km
1:120 000

Legend

- MCOO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCOO Additional Project Area
- MCOO Additional Disturbance Area
- Existing Offsets
- Highfields Offset Site
- Mangrove Offset Site
- Proposed Mangoola Offset Sites
- Proposed Wybong Heights Offset Site

FIGURE 2.10

Proposed Biodiversity Offset Areas

2.5.1 Proposed Offset Site Biodiversity Values

The Proposed Mangoola Offset site surrounds the MCCO Project Additional Project Area to the north and west and includes Glencore-owned properties to the west of the current mining operations. The offset site is 1005 hectares in size, with approximately 30 per cent having been previously cleared for agricultural purposes. The site is positioned on the lower slopes sandstone escarpments with the majority of the site containing Hunter Valley floor woodland vegetation and derived native grassland. The vegetation is reasonably young and as a result the hollow-bearing tree density is generally low, however this is predicted to naturally improve with passive regeneration. 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.

The Mangoola Offset site, in part, directly adjoins large areas of native vegetation already managed by Mangoola for conservation purposes through a (pending) Conservation Agreement with the Minister administering the *National Parks and Wildlife Act 1974*. The preservation of these adjoining sites will provide conservation benefit to the local landscape through re-instating corridors for connectivity.

The Wybong Heights offset site is an 895 hectares agricultural property of which approximately 760 hectares is proposed as offsets. Wybong Heights contains a mix of native woodland and forest communities, derived native grasslands and improved pasture on the alluvial flats associated with Wybong Creek near Manobalai in the Upper Hunter Valley. The site is found on the western edge of a large scale vegetation corridor, known as the Great Eastern Ranges, which runs along the Great Dividing Range. 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.

In addition to the Mangoola and Wybong Heights offset sites, Mangoola will source species and ecosystem credits from two proposed BioBank sites currently being established by Glencore, being the proposed Mangrove Biobank Site and the Highfields BioBank Site. Specifically, the credits relate to *Prasophyllum* sp. Wybong and *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands* CEEC.

2.5.2 Offset Liability and Conservation Benefit

The offset liability for the MCCO Project was determined and described in the BAR with a summary of the overall offset liability shown in **Table 2.1**. Note that DoEE have determined that the credit liability for *Prasophyllum* sp. Wybong will be satisfied by the offsetting of *Prasophyllum petilum*.

Based on advice from DoEE (refer to Attachment 3 of the SEARs) and the description and quantification of habitat for impacted MNES provided in **Section 2.2**, the following listed species and communities are expected to be subject to residual significant impacts as a result of the MCCO Project and therefore require a suitable offset in accordance with the EPBC Act Environmental Offsets Policy:

- *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands* CEEC
- *Prasophyllum* sp. Wybong
- regent honeyeater (*Anthochaera phrygia*).

The grey-headed flying fox and swift parrot are not expected to be significantly impacted and therefore do not require specific offsets. It is noted however, that in accordance with the FBA, both of these species are classified as ecosystem credit species and therefore the loss of potential habitat noted as occurring in the

MCCO Additional Project Area for these species will be offset with a 'like-for-like' offset in accordance with the FBA.

Table 2.5 Credits Required to Offset the MCCO Project

Name	Credits Required
Ecosystem Credits	
HU812 Forest Red Gum grassy open forest on floodplains of the lower Hunter	1,874
HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	369
HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	13,457
HU821 Blakely's red Gum - Narrow-leaved Ironbark - Rough-barked apple shrubby woodland of the Hunter	253
HU906 Bull Oak grassy woodland of the central Hunter Valley	1,597
HU945 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	168
Species Credits	
Flora	
Tarengo leek orchid <i>Prasophyllum petilum</i>	8,963
pine donkey orchid <i>Diuris tricolor</i>	17,238
Fauna	
large-eared pied bat <i>Chalinolobus dwyeri</i>	27
southern myotis <i>Myotis macropus</i>	20

The MNES that were determined by DoEE to be significantly impacted by the MCCO Project are included in the credit liability for ecosystems and relevant species-credits required to be offset.

The Biodiversity Offset Strategy has been developed with consideration of the need to compensate for residual significant impacts to White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC, the regent honeyeater and *Prasophyllum sp.* Wybong, with the aim to maintain or improve the biodiversity values of the surrounding region in the medium to long term. This aim will be delivered through the securing of in-perpetuity 'like-for-like' land-based offsets and in conjunction with the various impact mitigation and offset strategies that are proposed to be employed as part of the MCCO Project.

The proposed conservation benefits are likely to be realised, particularly given that the two land-based offset components are strategically located adjacent to or close to existing conservation reserves and biodiversity offset areas, Glencore is committed to ensure adequate funding for biodiversity conservation and land management associated with approved developments and the establishment of a secure legal mechanism to protect the biodiversity values of the land (Stewardship Agreement). The Biodiversity Offset Strategy also includes substantial commitments to habitat restoration and regeneration resulting in an increase in woodland and forest habitats and key threatened species habitats in the medium to long term which Glencore has a proven track record of delivering in the Hunter Valley.

In relation to MNES, the aspects of the MCCO Project biodiversity offset strategy specifically relate to offsetting residual significant impacts to MNES are summarised in **Table 2.6** and described below.

This includes a total of 297 hectares of HU730 White Box x Grey Box - Red Gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley is proposed to be included in the MCCO Project biodiversity offset strategy. This community conforms to the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC and adequately offsets the direct impact to 24 hectares of the CEEC associated with the MCCO Project.

As discussed in **Section 2.2**, woodland and forest communities containing white box, ironbark and spotted gum provide critical habitat for the regent honeyeater, with a total of greater than 770 hectares of potential habitat proposed for in-perpetuity conservation as a result of the implementation of the MCCO Project offset strategy. PCTs with canopy species including Narrow-leaved Ironbark (*Eucalypts crebra*) and spotted gum (*Corymbia maculata*) include the following:

- HU701 Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion
- HU702 - Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills
- HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter
- HU821 Blakely's red Gum - Narrow-leaved Ironbark - Rough-barked apple shrubby woodland of the Hunter
- HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter
- HU826 - Narrow-leaved Ironbark – Grey Gum – Native Olive Woodland of the Central Hunter
- HU868 Narrow-leaved Ironbark - Grey Gum shrubby open forest on sandstone ranges of the upper Hunter Valley

In addition to these woodland and forest communities, approximately 390 hectares of derived native grassland associated with HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter will be managed for restoration as part of the biodiversity offset strategy at the Mangoola Offset Site which will provide a long-term conservation benefit for the regent honeyeater in the Upper Hunter Valley.

In relation to the *Prasophyllum* sp. Wybong habitat in the offsets areas, Dr Stephen Bell was commissioned to prepare an Expert Report considering a range of habitat features, using the biophysical attributes

documented at locations where the orchids are known to occur, to determine the likelihood of individuals occurring in the offset areas. In addition, Dr Stephen Bell also examined the relative densities of *Prasophyllum* individuals across the entire Mangoola land holding (using information from Bell 2016) to estimate the likely population size within the proposed offset sites. Following field inspections on 31 July and 4 October 2018, Dr Bell used data collected and existing floristic plot data to construct a map of orchid habitat quality across the proposed offsets. The proposed Mangoola biodiversity offset area provides a total of 779 hectares of suitable habitat for *Prasophyllum* sp. Wybong, which is expected to yield a minimum of 2,187 *Prasophyllum* sp. Wybong.. The Expert Report is included in Appendix C of the Biodiversity Assessment Report (BAR) (refer to Appendix 13 of the EIS).

Table 2.6 Biodiversity Offsetting Outcomes for Residual Impacts on MNES

EPBC Act listed species or community	Area of Direct and indirect Impact	Area of MNES identified At Mangoola Offset Site	Area of MNES identified At Wybong Heights Offset Site	Area of MNES identified At Mangrove Offset Site	Area of MNES identified At Highfields Offset Site	Area of MNES proposed as ecological rehabilitation	Total area of MNES identified in the Proposed Offset Areas
<i>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</i> CEEC	24 hectares	Approx. 91 ha	297.6 ha of HU730	-	Approx. 60 ha	-	Approx. 449 ha
Regent honeyeater	147 hectares	60.1 ha of HU702 17.1 ha of HU826 48 ha HU816 206.9ha HU817 54.6 ha HU821	15.3 ha of HU701 105.8 ha of HU868 130.6 ha of HU816 132.8 ha of HU821	-	-	142 ha HU817	Approx. 912 ha
<i>Prasophyllum</i> sp. Wybong	691 individuals	1749 individuals	-	438 Individuals	-	-	2,187 individuals

2.5.3 Conservation Benefit Summary

Impacts to *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC, the regent honeyeater and *Prasophyllum* sp. Wybong have been assessed using the BioBanking Assessment Methodology and offset requirements have been determined in accordance with the FBA. The impacts associated with the MCCO Project are proposed to be offset in accordance with the 'like-for-like' rules established under the FBA. The MCCO Project biodiversity offset strategy is described in the Biodiversity Assessment Report (BAR).

The in-perpetuity conservation of the Mangoola and Wybong Heights Offset Sites represents approximately 1,755 hectares of land to offset 570 hectares land impacted in the MCCO Additional Project Area. The offset lands have similar ecological values and are of a comparable quality to the impacted land in the MCCO Additional Disturbance Area, which will be managed to improve quality and ecological integrity as the offset sites are managed for threats and passively regenerated, where relevant.

It is envisaged that based on the above, the Biodiversity Offset Strategy will deliver net biodiversity gains in the medium and long term for the EPBC Act listed threatened species and communities addressed in this document, as both the size and future ecological value of the offset sites far exceeds those of the Additional Disturbance Area.

3.0 Ecohydrological Assessment of MNES

The EIS includes detailed assessments of the impacts of the MCCO Project on biodiversity and water and considers the interactions between water impacts and the potential for consequential impacts on biodiversity. This includes:

- Biodiversity Assessment Report (BAR) – prepared in accordance with the NSW FBA which considers both direct and indirect impacts due to impacts on water and riparian vegetation
- Aquatic Ecology Assessment – which considers impacts on aquatic ecology due to the MCCO Project and is included as an appendix to the BAR
- Groundwater Dependent Ecosystem Assessment – which identifies potential GDEs and assesses the impact of the MCCO project on these potential GDEs
- Stygofauna Assessment – which included survey of and assessment of impacts on Stygofauna
- Groundwater Impact Assessment – which assessed the impacts of the MCCO Project on groundwater resources and consequential impacts on biodiversity such as impacts on GDEs
- Surface Water Assessment – which assessed the impacts of the MCCO Project on surface water.

The purpose of this ecohydrological assessment is not to repeat all of the above assessments which are provided elsewhere in the EIS but to specifically focus on the matters raised in the DoEE assessment requirements which formed part of the SEARs which were:

- i. conceptualisation of the impacts of water resource regimes and changes on biodiversity
- ii. potential impacts from changes in terrestrial surface water flows and quality that may potentially, support *Prasophyllum* sp. Wybong
- iii. potential impacts from changes and quality of water resources (terrestrial surface and groundwater) on White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- iv. potential impacts on water resources (surface and groundwater) on associated riparian vegetation and aquatic ecosystems of the Wybong, Sandy and Anvil Creeks.

These requirements are addressed in the following sections.

3.1 Conceptualisation of Impacts of Changes to Water Resource Regimes on Biodiversity

3.1.1 Groundwater

A detailed conceptualisation of the potential impacts of the MCCO Project on groundwater resources is provided in the Groundwater Impact Assessment. In summary, this conceptualisation identifies that the mining void would be a sink for groundwater in the surrounding fractured rock aquifers (including the coal seams, regolith/weathered rock zone). This is illustrated in **Figures 3.1 and 3.2** which show the conceptualisation of the pre-mining and during mining groundwater environment.

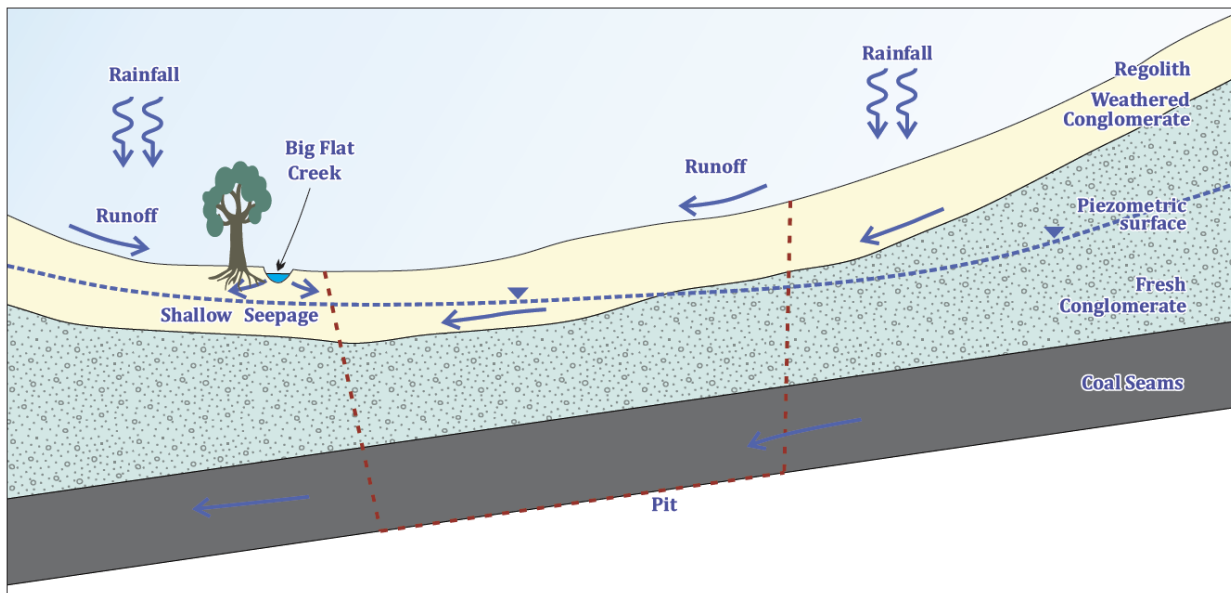


Figure 3.1 Conceptual hydrogeological model – pre mining

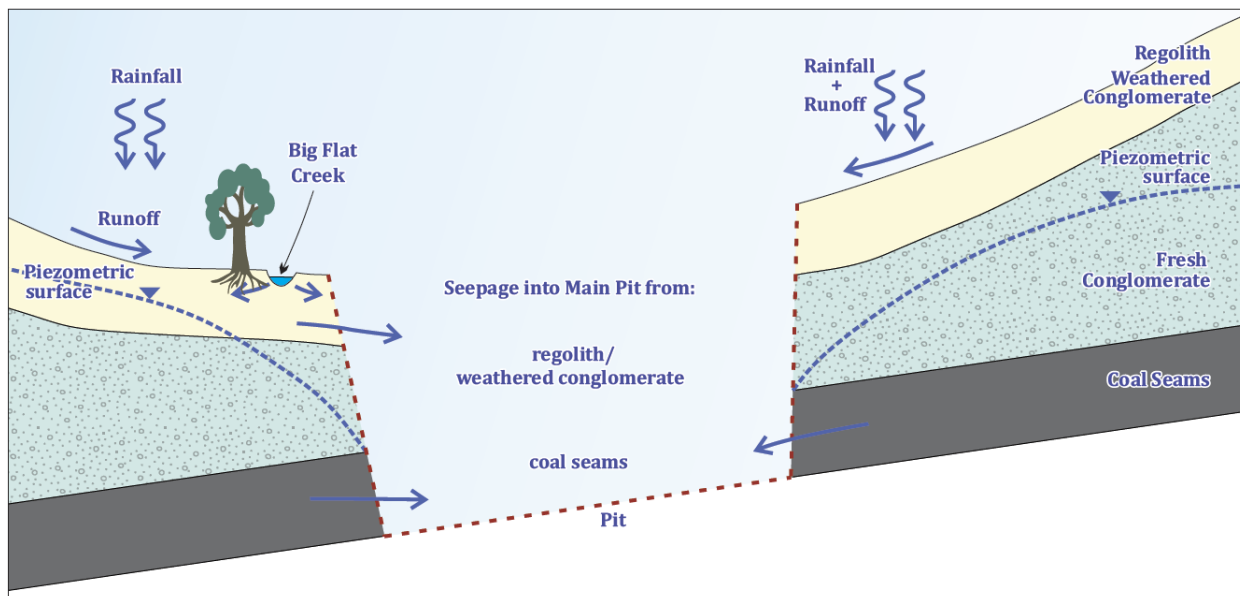


Figure 3.2 Conceptual hydrogeological model – during mining

The groundwater conceptualisation also identifies that the MCCO Project is sufficiently distant from the nearest alluvial aquifers that no direct take or interception of alluvial aquifers is predicted to occur. There is the potential for groundwater fluxes in the fractured rock aquifers to have a consequential effect on fluxes in the alluvial groundwater and this was assessed in detail in the Groundwater Impact Assessment.

Specifically in regard to biodiversity interactions with groundwater impacts, much of the predicted impacts are in water bearing zones at depth and therefore are not predicted to result in any impacts on biodiversity. The theoretical potential exists for impacts in areas where the groundwater is closer to the surface and is being used by flora or fauna and these areas where therefore further considered in this conceptualisation as outlined in **Table 3.1**. It is noted that this table focusses on impacts that could occur on areas outside the MCCO Project Additional Disturbance Area as the impacts on MNES inside the MCCO Project Additional Disturbance Area have been assessed and accounted for elsewhere.

Table 3.1 Conceptualisation of Groundwater / Biodiversity Interactions and Potential for Impact

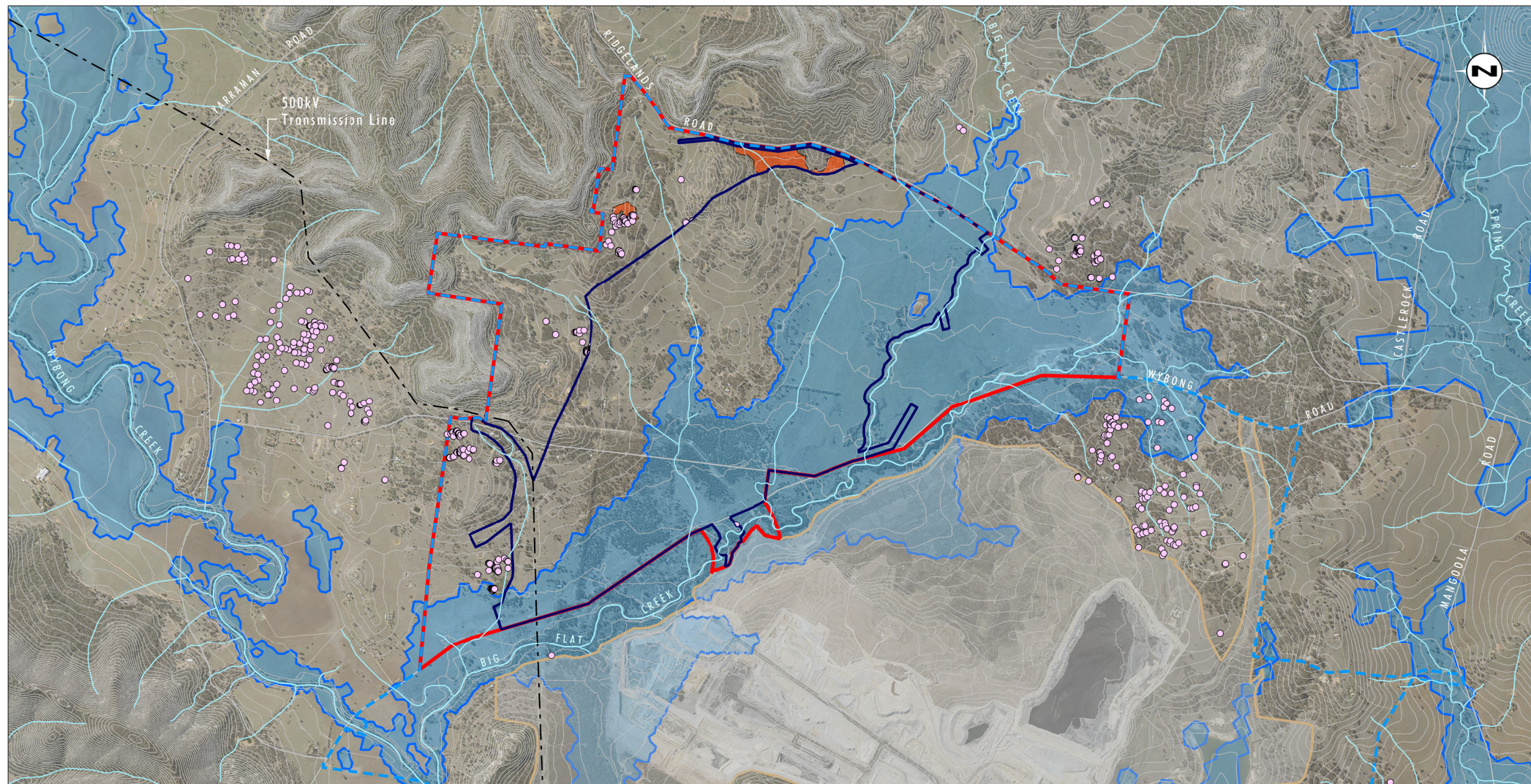
Groundwater Interaction Aspect	Discussion and Potential for Impact
Shallow groundwater (not alluvium)	<p>There is the potential that shallow groundwater (non alluvial) may be being accessed by terrestrial vegetation for at least part of its water requirement and therefore any impact on the shallow groundwater could impact on this vegetation.</p> <p>To assess the potential for impact in this regard, the groundwater assessment investigated the drawdown in the upper layers (layers 1 and 2) of the groundwater model which represent the upper layers. The model was also used to identify the areas in which pre-mining, groundwater would have occurred within 10m of the surface. These areas are shown on Figure 3.3. The groundwater model then assessed the potential for impacts on the groundwater in these areas to determine the potential for impact (refer to Figure 3.3). Should any MNES occur in these areas then the MCCO Project may impact on their water availability and this would require further assessment (refer to Section 3.5).</p>
Alluvial groundwater	<p>As noted above, the MCCO Project will not directly impact on any alluvial areas and there will be no direct take of alluvial water. However, there is the potential that change in fluxes in the fractured rock water bearing zones may result in consequential impacts on fluxes in the alluvial zone. This was tested through the groundwater model which found that there is the potential for minor changes in alluvial groundwater fluxes in the alluvium of Wybong Creek. The groundwater assessment found that the majority of the total change in flux during active mining (maximum 33 ML/year) can be attributed to the continued operations within the approved Mangoolia Coal Mine (maximum 30 ML/year). The incremental change due to mining within the MCCO Proposed Additional Mining Area is a maximum of 3 ML/year.</p> <p>While the impacts of the MCCO Project on alluvial groundwater are minor, should any MNES occur in these areas then the MCCO Project may impact on their water availability and this would require further assessment (refer to Section 3.4).</p>
Stygofauna	<p>Should any stygofauna be present within the groundwaters impacted by the MCCO Project they could be impacted. The stygofauna assessment completed for the EIS found, however, that stygofauna were absent from the MCCO Project area and surrounds and therefore no impacts are predicted.</p>
GDEs	<p>Should GDEs exist and groundwater impacts occur, there is the potential for the MCCO Project to impact on these GDEs. A detailed assessment of GDEs was undertaken in the EIS and found that outside of the MCCO Additional Disturbance Area there are only two potential GDE's located within an area near Big Flat Creek where the predicted drawdowns are 1m to 2 m. The predicted drawdowns affect areas of HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley which as a riparian community is considered likely to have a moderate level of dependence on groundwater; and HU905/PCT1691 - <i>Eucalyptus crebra</i>/<i>Eucalyptus moluccana</i> grassy woodland of the central and upper Hunter which is considered likely to have a low level of dependence on groundwater.</p> <p>None of the potential GDEs identified were MNES.</p>

Groundwater Interaction Aspect	Discussion and Potential for Impact
Changes to baseflow in surface water system due to changes in groundwater fluxes	<p>Change in groundwater can result in consequential changes in baseflow in surface drainage systems. Any such changes could then impact on any MNES dependent on those baseflows.</p> <p>There are no changes to baseflows in Big Flat Creek predicted as the creek will be disconnected from groundwater when the proposed MCCO Proposed Additional Mining Area commences operations.</p> <p>The predicted impact on Wybong Creek is very small and would be indiscernible at 3 ML/year and no impact is predicted on Sandy Creek.</p>

As an outcome of the above conceptualisation, with regard to impacts on MNES, should any woodland vegetation that constitutes a MNES exist in areas of shallow groundwater where impacts are predicted, there is the potential for them to be impacted. This is assessed in further detail in **Section 3.3**.

Hydrology models predict that the total flow volumes in Wybong Creek and Big Flat Creek would be expected to reduce by a minor degree as a result of the catchment area intercepted by the MCCO Additional Disturbance Area. Flow volumes at Wybong Creek may be reduced by up to 1.2 per cent during the life of the project, and the Wybong Creek catchment yield would only reduce at a maximum rate of 1.1 per cent as a result of the final void. The prevalence of a 'zero flow' output at Big Flat Creek may increase by 1.8 per cent over the MCCO Project life, however this is considered a negligible impact given the ephemeral nature of the creek. The reduction in groundwater-derived baseflow at Big Flat Creek is also predicted to be minor (reduction in up to 10ML/year) (HEC 2019).

It is recognised that changes to water resource regimes (both surface and groundwater) are unavoidable, and to a degree, somewhat unpredictable impacts of mining activity. However, based on the information that is available, and the proposed mitigation measures, it is predicted that impacts to biodiversity as a result of altered water regimes will be minor.



Data Source: Glencore (2019)

0 0.5 1.0 2.0 km
1:40 000

Legend

- MCCO Project Area
- Approved Mangooda Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Groundwater Within 10m of Surface
- White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland - EPBC ACT
- *Prasophyllum* sp. Wybong

File Name (A4): R20/4004_386.dgn
20190513 14.59

FIGURE 3.3

Groundwater Within
10m of Surface

3.1.2 Surface Water

The MCCO Additional Project Area occurs almost entirely in Big Flat Creek. During mining when surface runoff occurs after rainfall, water within the mine water management system will be captured and reused within the mine. The capture of runoff within the mine will result in some loss of runoff in the downstream water systems. No minewater will be discharged to Big Flat Creek or Wybong Creek and therefore no downstream minewater impacts will occur in these systems. Erosion and sediment control structures designed in accordance with relevant guidelines will be installed for areas of ground disturbance and treat all sediment laden runoff prior to it leaving the site. The majority of clean water surface runoff from upslope of the mining disturbance area will be directed around the mine via clean water diversion drains. These drains will direct the runoff towards Big Flat Creek but will change the local flows in the areas leading into Big Flat Creek.

The MCCO Project also has the potential to change flooding in Big Flat Creek due to the works proposed in the flood affected area and changes in runoff volumes due to capture of some water in the mining footprint. The potential for changes in downstream water quality also require consideration.

A slope analysis for the MCCO Additional Project Area and surrounds is provided in **Figure 3.4**. Land which is upslope of the MCCO Project Additional Disturbance Area will drain into the disturbance area for the mine. The clean water diversion drains will be within the MCCO Project Additional Disturbance Area as they will require earthworks to construct them. It is noted that there is a 'buffer' around the proposed works that is included in the MCCO Project Additional Disturbance Area to allow for construction room and therefore the area assessed as 'cleared' includes some space upslope of where water will run in the clean water diversion drain. The only potential upslope impacts on surface water are therefore in any areas where water may pond. Given the slope and the design of the diversion drains which will drain water away, and considering the 'construction buffer' included in the MCCO Project Additional Disturbance Area, no significant ponding is expected outside of the MCCO Project Additional Disturbance Area and therefore no impacts on upslope vegetation outside the MCCO Project Additional Disturbance Area are predicted.

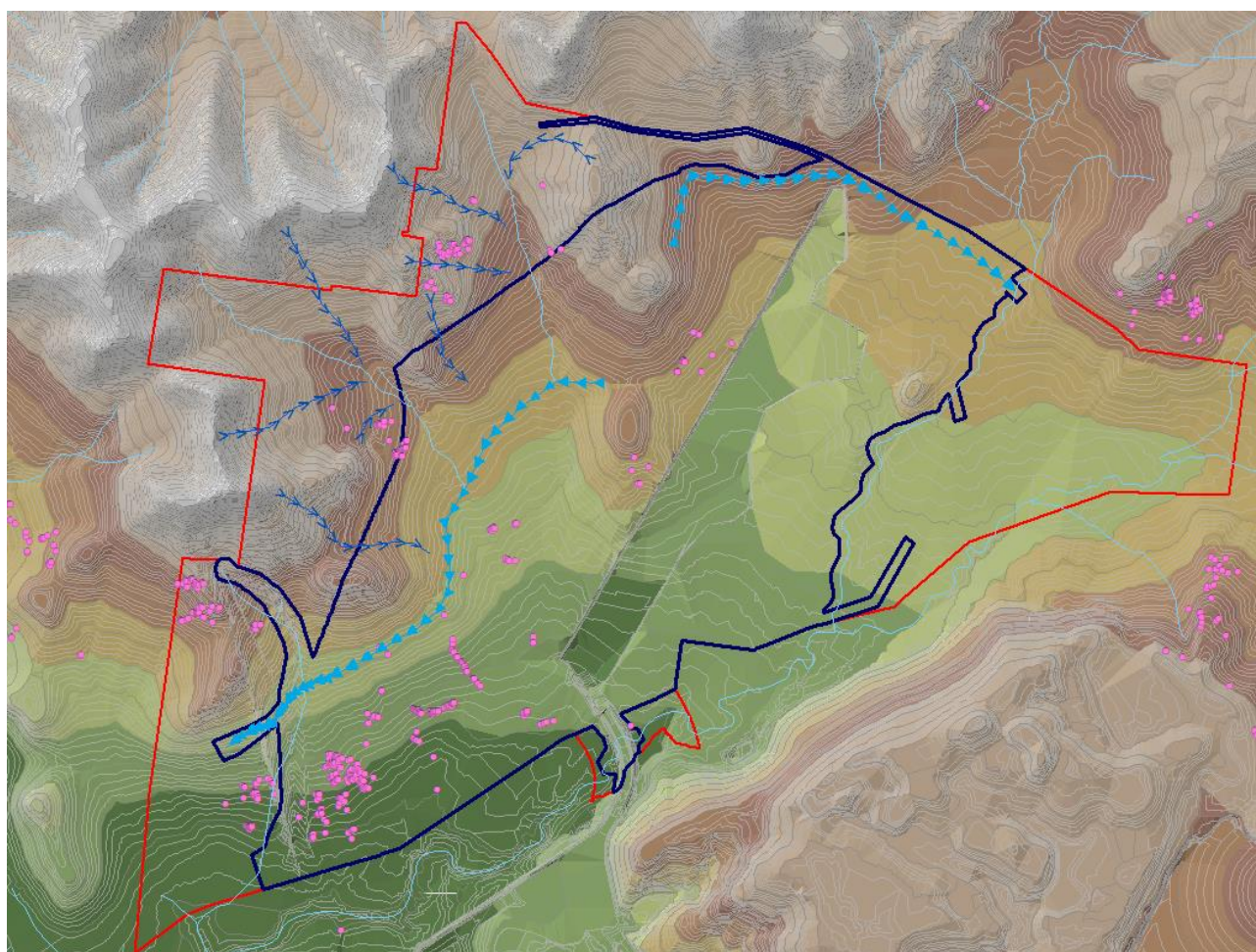


Figure 3.4 Slope Analysis for the MCCO Additional Project Area

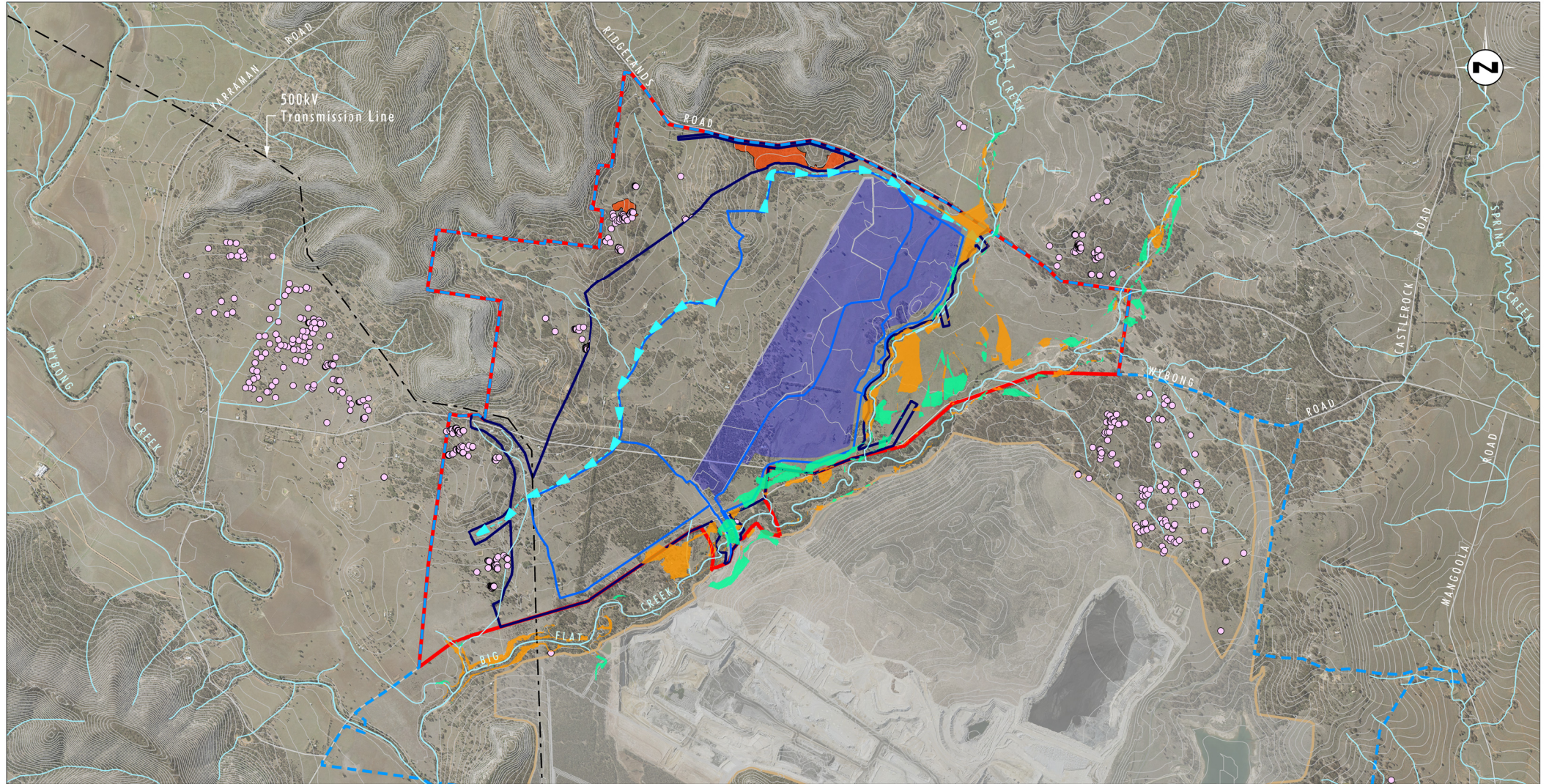
Table 3.2 identifies the aspects of surface water that could potentially interact with biodiversity as a result of the MCCO Project. It is noted that this table focusses on impacts that could occur on areas outside the MCCO Project Additional Disturbance Area as the direct impacts on MNES inside the MCCO Project Additional Disturbance Area have been assessed and accounted for elsewhere.

Table 3.2 Conceptualisation of Surface Water / Biodiversity Interactions and Potential for Impact

Surface Water Interaction Aspect	Discussion and Potential for Impact
Changes to flooding	<p>The MCCO Project will result in some relatively minor changes in flooding in Big Flat Creek due to the construction of a proposed flood levee to prevent ingress of flood flows into parts of the mining area and due to the construction of an overpass over the creek. Culverts will maintain flow along the creek but some impacts will occur. The areas in which flooding changes will occur are shown on Figures 3.5 to 3.8. Should MNES occur in the areas where flooding changes are predicted, assessment of the potential impacts of these changes will be required.</p> <p>No flooding impacts are predicted on Wybong Creek or other streams.</p>

Surface Water Interaction Aspect	Discussion and Potential for Impact
Changes to flows downstream due to capture of runoff in mine water management system	<p>The MCCO Project will capture the runoff of a proportion of the catchment of Big Flat Creek which is ephemeral and does not flow each day of the year. This will reduce flows in Big Flat Creek. The change in flows is predicted to result in a small increase in zero flow days in Big Flat Creek. Should any MNES occur along the areas of Big Flat Creek where flow occurs and changes may occur, these would need further assessment.</p> <p>The changes in flow in Big Flat Creek are predicted to also have a very minor effect on flows in Wybong Creek. As the catchment and hence the flows in Wybong Creek are much larger, the effect on flows is very minor and no adverse impacts on biodiversity (including any MNES) are predicted.</p>
Changes to flows downstream due to clean water diversion drains	<p>The progression of the proposed clean water diversion drains is shown on Figures 3.5 to 3.7. With regard to the drain to the east, this drain will direct water into Big Flat Creek and will stay as part of the final landform. As this drain releases water into Big Flat Creek (at which point the changes in flows are not expected to be significant as the water currently flows to Big Flat Creek) and as the impacts of construction of this drain have been assessed as a direct impact, no further impacts have been identified for this drain that require assessment.</p> <p>With regard to the clean water diversion drains that take water to the west, these drains change over the life of the mining operation and therefore the catchment being captured by these drains and directed to the west of the mine changes over time. Once mining is completed, the post mining catchment reduces but remains larger than the current catchment of this area meaning that long-term, there is the potential for increased moisture in the area downstream of an existing dam. Should any MNES occur in the area where this clean water diversion drain releases water the impacts of this change would require further consideration.</p>
Changes to upslope ponding	<p>Given the slope and the design of the diversion drains which will drain water away, and considering the 'construction buffer' included in the MCCO Project Additional Disturbance Area, no significant ponding is expected outside of the MCCO Project Additional Disturbance Area and therefore no impacts on upslope vegetation outside the MCCO Project Additional Disturbance Area are predicted.</p>
Changes to downstream water quality	<p>The Surface Water Assessment found that no impacts are predicted on downstream water quality and therefore no potential impacts on MNES are predicted due to this aspect.</p>

As an outcome of the above conceptualisation, with regard to impacts on MNES, further consideration of the changes relating to flooding and the clean water diversions directing runoff to the west of the mine is required.



Data Source: Glencore (2019)

0 0.5 1.0 2.0 km
1:40 000

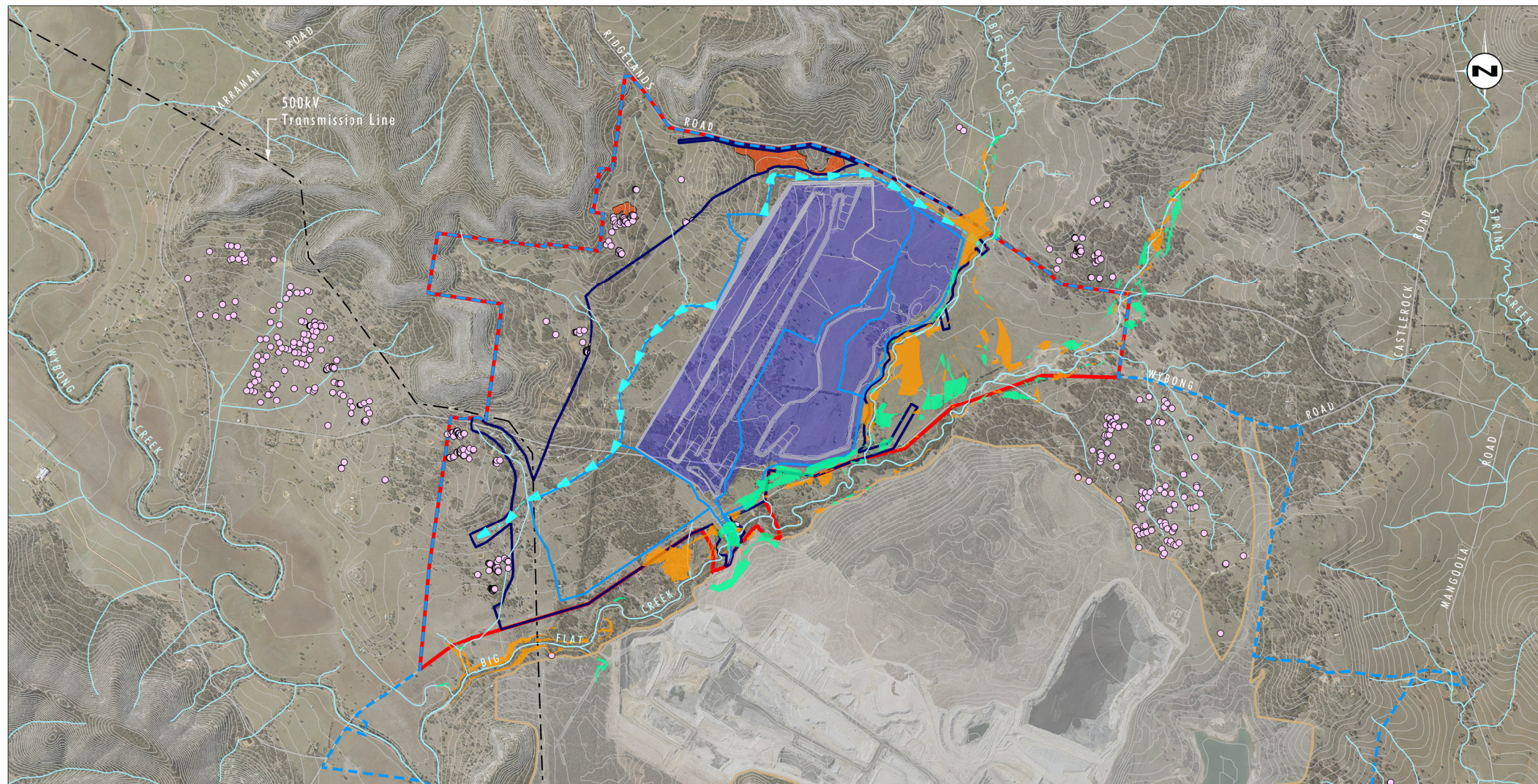
Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Progression of Mining
- Catchment Area
- White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland - EPBC ACT
- 1:100 Year Decrease Inundation Area
- 1:100 Year Increase Inundation Area
- Drainage Flow Arrow
- *Prasophyllum* sp. Wybong

File Name (A4): R20/4004_387.dgn
20190513 15.12

FIGURE 3.5

MNES in Relation to Catchment
Project Year 1



Data Source: Glencore (2019)

0 0.5 1.0 2.0 km
1:40 000

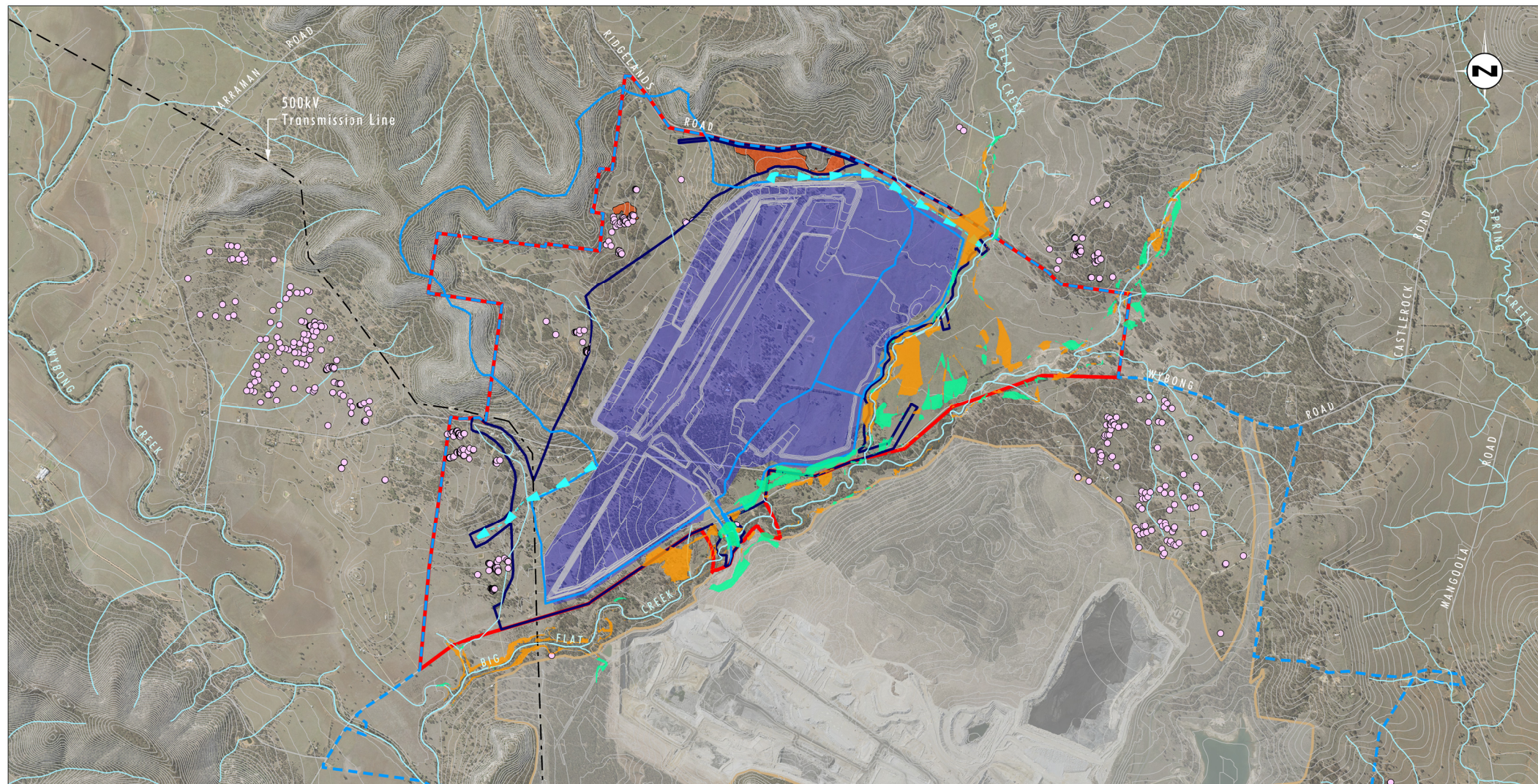
Legend

- MCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCO Additional Project Area
- MCO Additional Disturbance Area
- Progression of Mining
- Catchment Area
- White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland - EPBC ACT
- 1:100 Year Decrease Inundation Area
- 1:100 Year Increase Inundation Area
- Drainage Flow Arrow
- *Prasophyllum* sp. Wybong

File Name (A4): R20/4004_388.dgn
20190513 15.14

FIGURE 3.6

MNES in Relation to Catchment
Project Year 3



Data Source: Glencore (2019)

0 0.5 1.0 2.0 km
1:40 000

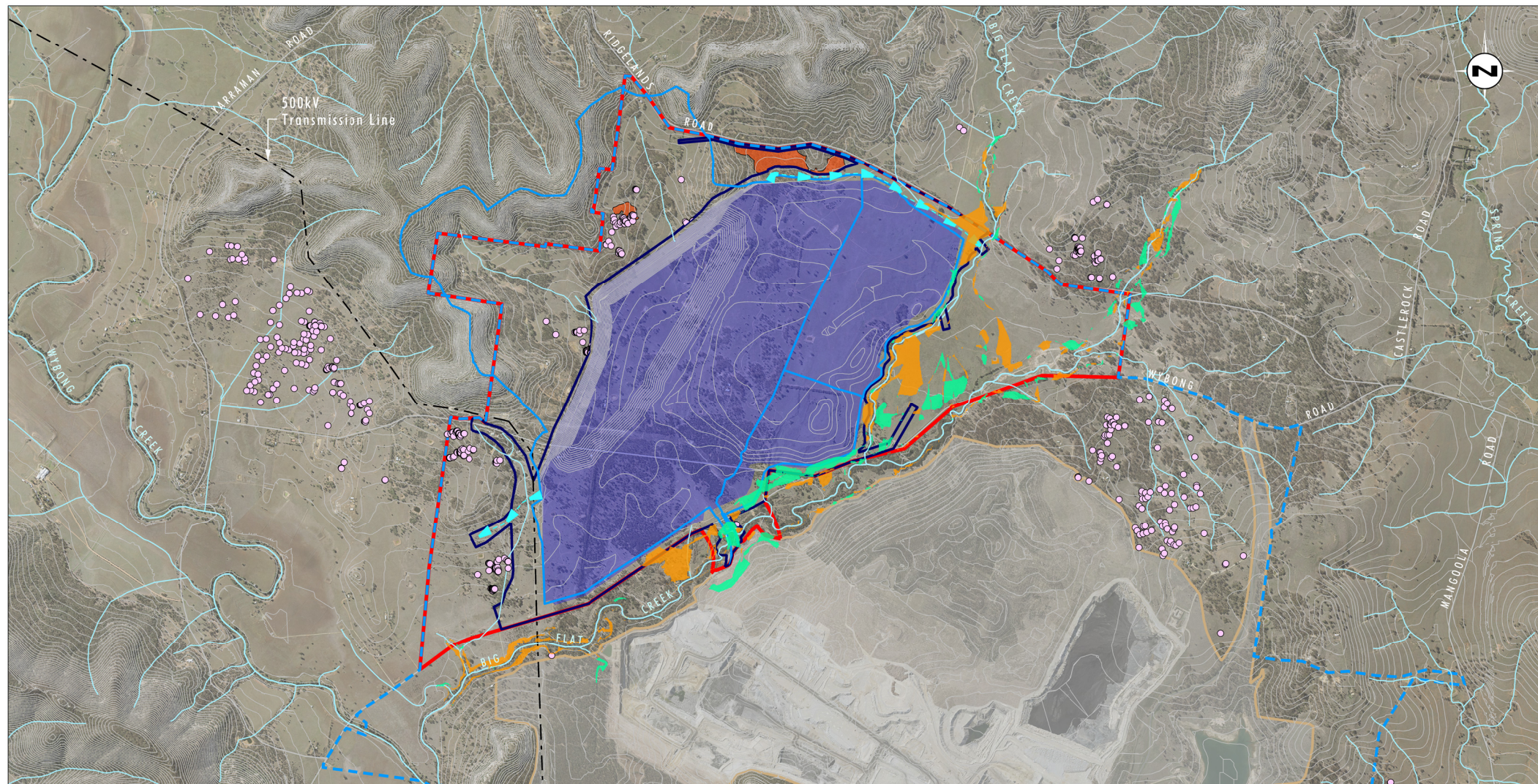
Legend

- MCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCO Additional Project Area
- MCO Additional Disturbance Area
- Progression of Mining
- Catchment Area
- White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland - EPBC ACT
- 1:100 Year Decrease Inundation Area
- 1:100 Year Increase Inundation Area
- Drainage Flow Arrow
- *Prasophyllum* sp. Wybong

File Name (A4): R20/4004_389.dgn
20190513 15.16

FIGURE 3.7

MNES in Relation to Catchment
Project Year 5



Data Source: Glencore (2019)

0 0.5 1.0 2.0 km
1:40 000

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Progression of Mining
- Catchment Area
- White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland - EPBC ACT
- 1:100 Year Decrease Inundation Area
- 1:100 Year Increase Inundation Area
- Drainage Flow Arrow
- *Prasophyllum* sp. Wybong

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20190513 15.23

FIGURE 3.8

MNES in Relation to Catchment
End of Mine

3.2 Impacts of changes to water resource regimes on *Prasophyllum* sp. Wybong

DoEE has requested further information about the potential changes in surface water flows and quality that may affect *Prasophyllum* sp. Wybong. As identified in **Section 3.1.2**, there are two aspects of surface water changes that require consideration. These are changes in flooding and changes due to the diversion of clean water around the proposed mining area to the west of the mine for the life of the mine. These changes and the potential for them to impact on *Prasophyllum* sp. Wybong are provided below.

It is noted that the assessment of flooding changes and flow changes to the west of the mine due to clean water diversion was undertaken using high resolution topographic data sourced from LIDAR. This is consistent with the approach requested by DoEE which requested consideration of impacts in relation to fine-scale topographic features.

With regard to flooding, the changes in flooding at different stages of the MCCO Project are shown on **Figures 3.4 to 3.6**. As also shown on these figures there are no records of *Prasophyllum* sp. Wybong in these areas that are outside of the MCCO Additional Disturbance Footprint. Therefore there are no impacts on known records of *Prasophyllum* sp. Wybong. With regard to impacts on potential habitat, given the relatively small changes predicted to flood flows and the very infrequent occurrence of major flooding events that result in out of channel flow, no significant impacts on potential habitat are predicted.

With regard to clean water diversion to the west a specific surface water flow assessment was undertaken by Hydro Engineering Consulting (HEC) which is included as **Appendix B**. The assessment used fine scale topographic information (LIDAR) data converted into 0.1m contours and did an assessment of flows exiting the clean water diversion drain. The assessment found that the discharge from the clean water diversion drain would flow into an existing farm dam and then when the dam spills, the water would discharge from the dam spillway and be released as overland flow across a paddock. The flow path was mapped using fine scale topographic data and it was found that only one known record of *Prasophyllum* sp. Wybong occurs in the vicinity of (but not directly in) this overland flow path. The assessment also found that in a 50 per cent annual exceedance event (sometimes referred to as a 1 in 2 year event) the flows from the dam would be non-erosive. This means that no erosion effects downstream of the dam are predicted in such rainfall / runoff events. Therefore the key potential change relates to more frequent overflow of the dam following rainfall events and consequential post overflow event changes in downslope soil moisture content.

As noted above, there is one *Prasophyllum* sp. Wybong record in the vicinity but not directly within the overland flow path. The HEC assessment found that it could be affected by overland flow (and therefore increased soil moisture) but this was uncertain as in the absence of a clear gully or channel it was not readily possible to calculate a flow width. Therefore, following the precautionary principle there is the potential that this orchid and the surrounding habitat in the vicinity of the overland flow path may be exposed to more frequent periods of increased soil moisture due to the MCCO Project. As the drain will only flow after rainfall events that are sufficiently large to cause runoff, and as this runoff will then be captured in a dam, it is not expected that frequent overland flow downstream of the dam will occur. When it does occur it will occur after rainfall sufficient to generate surface runoff and when the soil would already be moist. A discharge from the dam spillway would introduce more localised moisture, however, this effect would likely be short term as runoff will only occur after larger rainfall events and would typically cease relatively quickly after the rain ceases.

While it is assessed that there will periodically be increased moisture reporting to the area downslope of the dam and that this may effect an area with one known *Prasophyllum* sp. Wybong record and potential habitat, it is uncertain what effect this may have on the orchid. Bell (2018) suggests that there is a clear trend between winter rainfall and *Prasophyllum* sp. Wybong flowering and detection rates. Lower than

average rainfall in the winter season before flowering (August-September) puts the orchid under stress and impedes the ability of the individual to flower. Wetter years increase detection rates. Vizer (2013) also suggests that recruitment and germination outcomes are likely to be dependent on high moisture conditions (rainfall and moist soil). He also observed that *Prasophyllum* sp. Wybong can occur in clay, clay/loam and loam soils, which have the ability to hold moisture in the soil. It is therefore likely that rainfall and soil moisture are important factors to the flowering and possibly the survival of the species. Increased soil moisture is likely to increase germination, flowering and detection rates for this species, and this is particularly important in drought conditions. Although one individual and the surrounding area of habitat may be subject to increased water flows, based on the current literature, it is considered unlikely that this will have adverse impacts on that individual or the habitat.

On the basis of the above assessment it can be concluded that it is unlikely that the increased periodic moisture that may occur in the vicinity of one record of *Prasophyllum* sp. Wybong and the adjacent area of habitat will adversely impact on the individual or habitat. However, it is also noted that as *Prasophyllum* sp. Wybong is a cryptic species the potential for an adverse impact cannot be conclusively ruled out. Regardless, it can be concluded that in the unlikely event that there was an adverse impact on the one individual and the adjacent habitat, this impact would not be significant to the local population due to the small number (i.e. one) of known records affected and the relatively small area of habitat affected in the context of the local population (estimated at 15,000 (Bell, 2018)) and the area of habitat for the local population.

3.3 Impacts of changes to water resource regimes on CEEC

As identified in **Sections 3.1.1** and **3.1.2**, there are three aspects of the interactions of the MCCO Project on water resources that have the theoretical potential to impact on terrestrial vegetation that forms a MNES. These are:

- Groundwater – impacts on shallow groundwater
- Surface water – changes to flooding along Big Flat Creek
- Surface water – changes to downstream flows including due to clean water diversion drains.

Figure 3.3 shows the area in which drawdown in shallow groundwater is predicted due to the MCCO Project. As shown on **Figure 3.3**, there is no White-Box Yellow-Box Blakely's Red Gum Grassy Open Forest and Derived Native Grassland CEEC within this area and therefore no impacts on this community are predicted due to groundwater impacts.

Impacts to riparian and flood zones in the Wybong and Big Flat Creek sub-catchments as a result of altered surface and groundwater regimes are unlikely to have any substantial impact upon White-Box Yellow-Box Blakely's Red Gum Grassy Open Forest and Derived Native Grassland CEEC. The CEEC occurs outside the extent of the 1;1000 AEP flood impact zone and does not form part of any riparian vegetation. Therefore no impact on the CEEC is predicted due to flooding impacts.

With regard to changes to surface flows, the areas in which flow changes may occur is discussed above and relates to changes in Big Flat Creek and where the clean water diversion drain discharges to the west of the MCCO Additional Mining Area. There are no occurrences of White-Box Yellow-Box Blakely's Red Gum Grassy Open Forest and Derived Native Grassland CEEC in these areas and no impacts on the community are predicted due to changes in flows.

The areas of CEEC within the MCCO Additional Project Area that will be retained (i.e. those areas outside the MCCO Additional Disturbance Area) are upslope of the MCCO Additional Disturbance Area and therefore as outlined in **Section 3.1.2** no changes to surface water flows are predicted in these areas.

Therefore in summary, no impacts on the CEEC are predicted due to water impacts from the MCCO Project.

3.4 Impacts of changes to water resource regimes on riparian vegetation and aquatic ecosystems

DoEE has requested consideration of impacts of changes to water resources associated with riparian vegetation and aquatic ecosystems of the Wybong, Sandy and Anvil Creeks.

Due to the position of the MCCO Additional Project Area in the landscape, there are no predicted impacts to Sandy Creek. Sandy Creek is a tributary of the Hunter River and occurs to the south-east of the existing Mangoola mine. At its closest point, Sandy Creek is 5.3 km away from the MCCO Additional Project Area. Groundwater drawdown is not predicted to have impacts extending this distance from the proposed MCCO Additional Mining Area (AGEC 2019), and surface water will not be impacted as the MCCO Additional Project Area does not form part of the catchment for Sandy Creek, and the creek occurs upstream of any confluence with watercourses affected by the MCCO Project.

With regard to Anvil Creek, no additional impacts due to the MCCO Project are predicted. It is important to note that Anvil Creek has been mined through during 2018 as part of the approved mining operations and the catchment area has been heavily modified, with most of the water now diverted into the mine water management system (HEC 2019). The creek is proposed to be reinstated post-operations, and it will be designed to mimic original flow patterns as much as practical. No impacts are expected to occur to Anvil Creek as a result of the MCCO Project.

With regard to Wybong Creek, minor impacts on flows were predicted but these are very small to negligible in the context of the flows in Wybong Creek and no impacts on riparian vegetation or aquatic ecology were predicted. No impacts on water quality in Wybong Creek were predicted by the Surface Water Assessment. No substantial change to groundwater movement in the Wybong Creek catchment is predicted (AGEC 2019), and no GDEs or stygofauna will be affected as a result of the MCCO Project.

3.5 Summary of Ecohydrological Assessment Outcomes

A summary of the findings of potential ecohydrological impacts as they relate to MNES is provided below. This assessment focusses on the potential indirect effects of changes in water flows (surface and groundwater) in relation to MNES. As discussed above, this is separate to the assessment of direct impact which is associated with the areas proposed to be cleared as part of the MCCO Project.

In summary, the ecohydrological assessment process found:

- no groundwater impacts are predicted that are likely to impact on *Prasophyllum sp.* Wybong or White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC (Box Gum Woodland CEEC). This finding is due largely to the absence of shallow groundwater impacts predicted in the areas in which these MNES occur
- no surface water impacts are predicted that are likely to impact on Box Gum Woodland CEEC. This finding is due to the areas of this community that are near to but outside of the direct impact area for the MCCO Project being upslope of the MCCO Project. That is, no water will drain from the MCCO

Project into an area occupied by the community, or otherwise affect the drainage of this community outside the direct impact area, and therefore no impacts are predicted

- changes in flooding along Big Flat Creek are predicted to be relatively minor and do not interact with any areas of Box Gum Woodland and no known records of *Prasophyllum sp. Wybong* outside the direct impact area
- there is one area where a clean water diversion drain will direct clean water into a catchment area to the west of the direct impact area and release it into an existing dam. When sufficient runoff occurs, the dam will overflow and as per the existing situation, water will travel via overland flow across a largely cleared paddock and eventually enter into Big Flat Creek. There are no records of *Prasophyllum sp. Wybong* in the overland flow path but there is one record in the vicinity and potential habitat is present. A specific hydrological assessment was undertaken to assess the potential changes in flow in the area and used fine scale topographic information to assist with the analysis. The assessment found that while there will be some increased moisture in the area downslope of the dam, it is unlikely that this will adversely impact on *Prasophyllum sp. Wybong*
- the MCCO Project is not predicted to result in any impacts on Sandy Creek or its associated riparian vegetation as it is located to the southeast of and well outside of the impact area of the MCCO Project
- the MCCO Project is not predicted to result in any impacts on Anvil Creek or its associated riparian vegetation. It is noted that Anvil Creek is located within the impact area of the approved Mangoola Coal Mine which was previously referred and found to not constitute a controlled action
- the MCCO Project is not predicted to result in any significant impacts on Wybong Creek. The predicted changes in flow associated with the MCCO Project were found by the Surface Water Assessment to represents a small and likely indiscernible impact to flow in Wybong Creek. No flooding or water quality impacts were predicted in the Surface Water Assessment. Therefore, no adverse impacts on the riparian vegetation or aquatic ecosystems of Wybong Creek are predicted.

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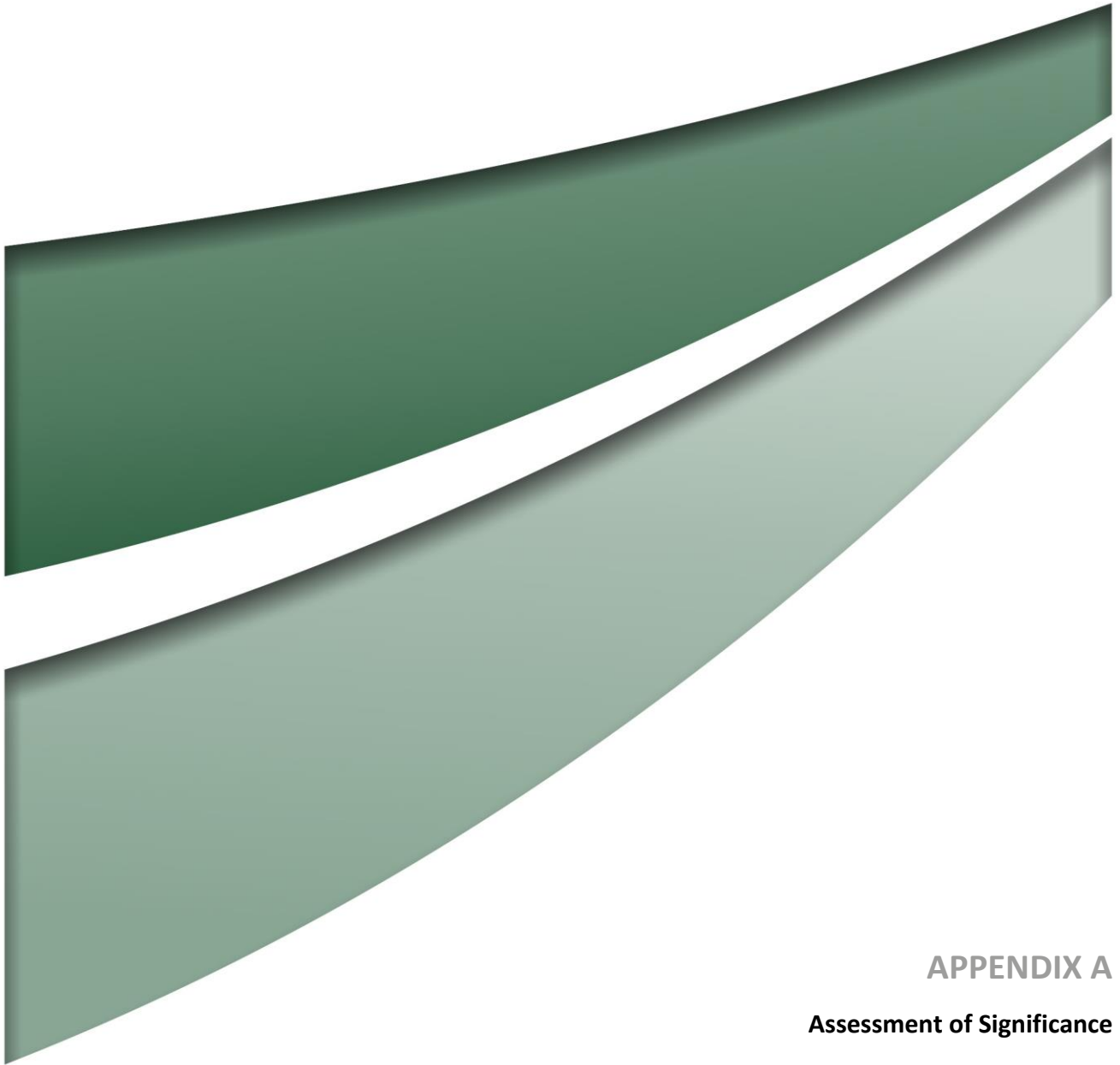
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APPENDIX A

Assessment of Significance

The EPBC Act requires an Assessment of Significance relating to the potential impacts of a proposed action on listed MNES. These assessments have been conducted in accordance with the Significant Impact Guidelines 1.1 (DoE 2013), based on the current mine plan.

As outlined in **Section 2.3**, the following EPBC Act listed species and communities are considered by DoEE to be likely to be or have the potential to be significantly impacted by the Proposed Actions (the MCCO Project):

Critically Endangered or Endangered Ecological Communities

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

Critically Endangered and Endangered Species

- swift parrot (*Lathamus discolor*)
- regent honeyeater (*Anthochaera phrygia*)
- Leek Orchid (*Prasophyllum* sp. Wybong)

Vulnerable Species

- grey-headed flying fox (*Pteropus poliocephalus*)

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

The distribution of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC is from the western slopes and tablelands of the Great Dividing Range from southern Queensland to central Victoria (DECCW, 2011). It occurs in the Brigalow Belt South, Nandewar, New England Tableland, South Eastern Queensland, Sydney Basin, NSW North Coast, South Eastern Highlands, South East Corner, NSW South Western Slopes, Victorian Midlands and Riverina Bioregions (TSSC, 2006).

Detailed assessment of the vegetation communities described and mapped within the MCCO Additional Project Area was undertaken to determine whether the vegetation present met the condition class thresholds identified in the Listing Advice (TSSC 2006). The following PCTs in the MCCO Additional Project Area were identified as having Blakely's red gum (*Eucalyptus blakelyi*) or (potential, based on NSW Herbarium identifications) Blakely's red gum/forest red gum (*Eucalyptus blakelyi* x *Eucalyptus tereticornis*) intergrades as the dominant overstorey species:

- 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter
- 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – derived native grassland
- 1607 Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter.

These PCTs all exhibited a predominantly native understorey and exceeded the minimum patch size of 0.1 hectares that is specified in the Listing Advice (TSSC 2006). These PCTs also met the Listing Advice criteria of containing at least 12 or more native understorey species.

Approximately 15.6 hectares of woodland and 8.4 hectares of derived native grassland that conforms to *White Box – Yellow Box – Blakely’s Red Gum Woodland and Derived Native Grassland* CEEC has been mapped within the MCCO Additional Project 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;**

Approximately 15.6 hectares of woodland and 8.4 hectares of derived native grassland that conforms to the CEEC was identified within the MCCO Additional Project Area and will be directly impacted as a result of the Proposed Action.

The estimated total current national extent of White Box Yellow Box – Blakely’s Red Gum Woodland and Derived Native Grassland is estimated to be approximately 416 000 hectares (TSSC 2006), of which approximately 250 729 hectares is known to occur in NSW. The permanent loss of approximately 15.6 hectares of woodland and 8.4 hectares of derived native grassland CEEC as a result of the proposal represents a negligible reduction in the estimated current extent of the community across its national range, estimated to be approximately 0.009 per cent of the current extent of the community in NSW.

- **fragment or increase fragmentation of an ecological community;**

This ecological community has been heavily cleared across most of its range. The remaining extent of the ecological community is highly fragmented, occurring in small isolated patches within a cleared environment, or within a landscape of other disturbed woodlands (TSSC, 2006).

Vegetation occurring within the MCCO Additional Project Area is currently highly fragmented as a result of historic and current agricultural land practices. The removal of 15.6 hectares of woodland and 8.4 hectares of derived native grassland conforming to White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland CEEC is not likely to result in an increase in the level of fragmentation of this CEEC in the local area or across its range.

- **adversely affect habitat critical to the survival of an ecological community;**

The National Recovery Plan for the CEEC identifies habitat critical to the survival of Box-Gum Grassy Woodland is on the moderate to highly fertile soils of the western slopes of NSW and Queensland, the northern slopes of Victoria, and the tablelands of the Great Dividing Range from southern Queensland through NSW and the ACT. Given the current highly fragmented and degraded state of this ecological community, all areas of Box-Gum Grassy Woodland which meet the minimum condition criteria outlined in the National Recovery plan are critical to the survival of this ecological community.

The approximately 15.6 hectares of woodland and 8.4 hectares of derived native grassland which conforms to the White Box-Yellow Box-Blakely’s Red Gum Woodland and Derived Native Grassland CEEC within the MCCO Additional Project Area would be critical to the survival of the CEEC, in accordance with the criteria prescribed in the National Recovery Plan for the CEEC (DECCW 2011).

The Proposed Action would result in the removal of habitat critical to the survival of the White Box-Yellow Box-Blakely’s Red Gum Woodland and Derived Native Grassland CEEC, however the extent of proposed clearing represents a small area in the context of the broader range of the community both in NSW and in Australia.

- **modify or destroy abiotic factors necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;**

While approximately 15.6 hectares of woodland and 8.4 hectares of derived native grassland that conforms to the CEEC will be removed from the MCCO Additional Project Area, the Proposed Action is not expected to adversely affect retained areas of the CEEC occurring outside the MCCO Additional Project Area as the Proposed Action will be designed to avoid offsite impacts. The Proposed Action will include detailed consideration of the effect of the Proposed Action on groundwater regimes and surface water flows with the minimisation of adverse impacts a key consideration in the design process.

- **cause substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species; or**

It is well documented that the invasion and establishment of exotic species contributes to a reduction in ecological function of this ecological community. Weeds compete with locally indigenous flora for available resources and often limit the diversity and regenerative capacity of a native ecosystem. Although a number of perennial and annual weeds pose a serious threat to the CEEC, amongst the most serious threats are in the Hunter Valley are Coolatai grass and African olive (*Olea europaea* subsp. *cuspidata*) (DECCW 2011).

The Proposed Action will result in the direct removal of approximately 15.6 hectares of woodland and 8.4 hectares of derived native grassland that conforms to the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC. This reduction in the extent of the CEEC is not expected to result in a change in native flora and fauna species in the locality such that the composition of species in adjacent areas of CEEC is affected.

- **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**

The Listing Advice for this community states that there has been an overall reduction in the integrity of this ecological community compared with its pre-1750 state. There are essentially no areas remaining that could be considered fully intact, as most patches have at least some degree of weed invasion.

The majority of the remaining extent has lost its native understorey, lost whole suites of species, been invaded by exotic species or lost structural integrity in terms of the loss of shrub, tree or ground layers. Further invasion by exotic species and landscape-scale effects such as salinity, nutrient enrichment, soil structural decline and altered fire regimes are likely to detrimentally effect the integrity of the remaining ecological community in the future (TSSC 2006).

The Proposed Action will result in the removal of approximately 15.6 hectares of woodland and 8.4 hectares of derived native grassland that conforms to the CEEC. The risk of the Proposed Action resulting in the introduction or spread of invasive species that are harmful to the CEEC becoming established within the adjacent Mangoola land holding or the wider region is considered to be low. Mangoola proactively monitor and manages its buffer land in accordance with an approved Biodiversity Offset Management Plan, of which overall condition and invasive species presence is routinely investigated and remediated if required.

- **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 Proposed Action is not expected to cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the surrounding extent of the CEEC.

- **interfere with the recovery of an ecological community;**

A National Recovery Plan has been prepared for White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland CEEC (DECCW, 2011). The objectives of this plan includes achieving no net loss in the extent and condition of the CEEC, increasing protection of sites with high recovery potential, increasing landscape functionality through management and restoration of degraded sites and increasing transitional areas around remnants and linkages between remnants.

Any impacts to known occurrences of the White Box-Yellow Box-Blakely's Red Gum Woodland and Derived Native Grassland CEEC will likely contravene the objectives of the recovery plan. Recovery recommendations includes avoiding clearance and fragmentation of the CEEC. The Proposed Action includes the removal of approximately 15.6 hectares of woodland and 8.4 hectares of derived native grassland that conforms to the CEEC and would interfere with the recovery of this CEEC. Rehabilitation and regeneration of the CEEC will be a key focus of the proposed Biodiversity Offset Strategy that will be prepared for the MCCO Project to ensure that there is no residual significant impact to the community in the medium-long term as a result of the Proposed Action.

Conclusion

The Proposed Action would include the removal of 15.6 hectares of woodland and 8.4 hectares of derived native grassland that conforms to the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC. The Proposed Action is not considered to result in a significant impact on the CEEC as the Proposed Action will result in the clearing of approximately 0.009 per cent of the current extent the community across its NSW range; will not increase fragmentation, and will not cause the further degradation of adjacent retained examples of the CEEC in proximity to the MCCO Additional Project Area. Rehabilitation and regeneration of the CEEC will be a key focus of the proposed Biodiversity Offset Strategy that will be prepared for the MCCO Project to ensure that there is no residual significant impact to the community in the medium-long term as a result of the Proposed Action.

Swift Parrot

The swift parrot is listed as critically endangered under the EPBC Act. The species breeds in Tasmania and moves to mainland Australia for the non-breeding season (usually arriving between February and March) (Saunders and Tzaros 2011). Most of the population winters in Victoria and NSW where it disperses across broad landscapes foraging on nectar and lerps in eucalypts. Until recently it was believed that in NSW, swift parrots forage mostly in the coastal and western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region (Saunders and Tzaros 2011). However, evidence is gathering that the forests on the coastal plains from southern to northern NSW are also important. They return to Tasmania in spring (September-October). The movements of this species on the mainland are poorly understood, but it is considered to be nomadic and irruptive, moving in response to food supply.

Upon reaching their core non-breeding range there is no known geographical pattern of movement. During the non-breeding season, the home-range varies tremendously between individuals and between years.

Priority sites for this species have been identified within the National Recovery Plan for the species (Saunders and Tzaros 2011). This species is likely to utilise coastal forest and river-flat vegetation associations within the coastal natural resource management region (which includes the Hunter-Central Rivers), in communities dominated by swamp mahogany (*Eucalyptus robusta*), blackbutt (*Eucalyptus pilularis*), forest red gum (*Eucalyptus tereticornis*) and spotted gum (*Corymbia maculata*) (Saunders and Tzaros 2011).

In this case, a *population* means:

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

The swift parrot occurs as a single *population* that migrates annually from breeding grounds in Tasmania to the winter foraging grounds on the coastal plains and slope woodlands of mainland eastern Australia (Saunders et al. 2011). Approximately 200 mature birds (10 per cent of the total estimated population) are known to over-winter in the Lower Hunter Region of New South Wales (Roderick et al. 2013).

As the species occurs as a single population in Australia, any record of the species would constitute a part of a *population* as described above. There have been few records of the species within the Central Hunter Valley in the past few years, however recent sightings have been recorded in the winter 2017 season in the lower Hunter areas (Birdline NSW 2017). This species has the potential to make use of the open forest and woodland habitats of the MCCO Additional Project Area, particularly where there are prolific flowering eucalypts and this migratory species is likely to move throughout the area in response to mass flowering events. This species does not breed on mainland Australia, and as such the MCCO Additional Project Area only represents potential foraging habitat for this species.

The MCCO Additional Project Area contains low to moderate quality potential foraging habitat for this species. In accordance with the National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) approximately 27.4 hectares of potential woodland foraging habitat occurs within the MCCO Additional Project Area, based on the presence of spotted gum (*Corymbia maculata*) and forest red gum (*Eucalyptus tereticornis*) which are identified as key foraging resources for the swift parrot in the Hunter Valley. Analysis of vegetation survey data and habitat assessment results indicates that the additional key foraging species that provide habitat for the species in the Hunter Valley, as per the Recovery Plan, were not recorded in the MCCO Additional Project Area. The following vegetation communities are identified as potential foraging habitat for the swift parrot in the MCCO Additional Project Area:

- 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter (*Eucalyptus tereticornis* dominant in the canopy)
- 1602 Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter (*Corymbia maculata* dominant in the canopy)
- 1607 Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter (*Eucalyptus tereticornis* x *Eucalyptus blakelyi* intergrades dominant in the canopy).

We note that White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEECs is broadly known to provide habitat for this species in the Hunter Valley, where it contains *Eucalyptus melliodora* and *Eucalyptus albens*, as per the National Recovery Plan for the species. Analysis of the constituent canopy species in this CEEC was undertaken to determine the extent of potential foraging habitat for the swift parrot within these vegetation communities and it was found that characteristic species *Eucalyptus melliodora* and *Eucalyptus albens* were absent from the MCCO Additional Project Area

and the areas of White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland CEEC that does not contain key feed species are not considered to comprise likely foraging habitat for the species.

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

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

The swift parrot has not been recorded within the MCCO Additional Project Area or the immediate locality, however a search of the Atlas reveals the nearest sighting of the swift parrot is approximately 28 km east of the MCCO Additional Project Area, in 2012 near Muswellbrook (BioNet, 2017).

The Proposed Action may result in the loss of 27.4 hectares of open forest and woodland containing key feed trees spotted gum (*Corymbia maculata*) and forest red gum (*Eucalyptus tereticornis*) for the swift parrot (Saunders et al. 2011). The MCCO Additional Project Area is not known as a historical or important foraging site for this species.

It is considered unlikely that the Proposed Action will lead to a decrease in the size of the *population* of swift parrot.

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

The swift parrot has not been recorded within the MCCO Additional Project Area or the immediate locality. The Proposed Action may result in the loss of 27.4 hectares of open forest and woodland containing potential feed trees for the swift parrot (spotted gum and forest red gum). While the Proposed Action will remove potential habitat for the swift parrot, it is not likely to lead to a significant reduction in foraging habitat in the local area or region.

The Proposed Action may result in a reduction of the potential area of occupancy for the swift parrot in the MCCO Additional Project Area, however this is unlikely to substantially reduce the area of known occupancy in the wider locality or region for a *population* of the swift parrot.

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

A *population* of the swift parrot has not been recorded within the MCCO Additional Project Area or the immediate locality. The swift parrot is highly dispersive and it is unlikely that the Proposed Action would create a significant change to the species’ dispersal capacity or create a significant barrier the movement of the species.

It is unlikely that the Proposed Action would result in the fragmentation of the existing *population* into two or more populations.

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

Habitat critical to the survival of the swift parrot includes those areas of priority habitat for which the species has a level of site fidelity or possess phenological characteristics likely to be of importance to the swift parrot (Saunders et al. 2011). The swift parrot has not been recorded within the MCCO Additional Project Area or the immediate locality and has not shown site fidelity to the habitats of the MCCO Additional Project Area. The MCCO Additional Project Area includes vegetation containing spotted gum and forest red gum which are key feed tree species for the swift parrot in the Hunter-Central Rivers (Saunders et al. 2011). The Proposed Action will result in the loss of 27.4 hectares of this potential habitat.

Breeding habitat, which is restricted to Tasmania, will not be affected by the Proposed Action.

The Proposed Action is unlikely to adversely affect habitat that is critical to the survival of the species.

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

The swift parrot breeds and nests exclusively in Tasmania and migrates to mainland Australia during the non-breeding season. There is no potential for breeding habitat to occur in the MCCO Additional Project Area.

The Proposed Action will not disrupt the breeding cycle of the *population* of swift parrot.

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

The swift parrot has been recorded in the region, however records are concentrated in the lower Hunter Valley. The closest record is approximately 28km to the east of the MCCO Additional Project Area, however this species has not been recorded within the MCCO Additional Project Area despite targeted survey over multiple years. The swift parrot is considered to have potential to occur in areas of potential habitat dominated or co-dominated by spotted gum and forest red gum which are key foraging tree species for the swift parrot as listed in the National Recovery Plans this species in the Hunter-Central Rivers (Saunders et al. 2011).

The Proposed Action will involve the removal of 27.4 hectares of open forest and woodland that contains some areas of key feed tree species for the swift parrot identified as spotted gum and red forest gum.

It is considered unlikely that the Proposed Action would modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that a *population* of the swift parrot would 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;**

The Proposed Action is not expected to result in invasive species that are harmful to a *population* of the swift parrot becoming established in this species habitat.

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

Psittacine beak and feather disease is a common and potentially deadly disease of parrots caused by a circovirus named beak and feather disease virus. The disease appears to have originated in Australia and is widespread and continuously present in wild populations of Australian parrots. Beak and feather disease affecting endangered psittacine species (parrots and related species) was listed in April 2001 as a key threatening process under the EPBC Act.

It is considered highly unlikely that the Proposed Action will introduce beak and feather disease or any other disease that may cause the swift parrot to decline.

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

The following recovery plan has been prepared:

- National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (Saunders et al. 2011)

Any impacts to known habitat of the swift parrot will likely contravene the objectives of the recovery plan. The swift parrot has not been recorded within 28km of the MCCO Additional Project Area, however potential foraging habitat has been identified. It is considered unlikely that the Proposed Action will interfere with the recovery of a *population* of the swift parrot throughout Australia.

Conclusion

The Proposed Action is unlikely to result in a significant impact on the *population* of the swift parrot. Although the MCCO Additional Project Area provides potential foraging habitat for this species, the swift parrot (*Lathamus discolor*) has not been recorded within the MCCO Additional Project Area despite targeted survey over multiple years.

Regent Honeyeater

The regent honeyeater is listed as critically endangered under the EPBC Act and has a patchy distribution extending from south-east Queensland, into NSW and the Australian Capital Territory, to central Victoria (CoA, 2016). The species is highly mobile, capable of travelling large distances and occurs only irregularly at most sites in varying numbers. Adding further difficulty to the survey and study of this species is its ability to often go long periods without being observed anywhere (CoA 2016). Its primary habitat is box-ironbark eucalypt woodland and dry sclerophyll forest, however it utilises riparian vegetation and lowland coastal forest. Habitat critical to the survival of the regent honeyeater includes any breeding or foraging areas where the species is likely to occur and any newly discovered breeding or foraging locations.

The species is known to undertake a complex series of movements, which are thought to be governed mainly by the flowering of a select number of Eucalyptus species. It is likely the species use different areas within its range in different years depending on food resources (CoA 2016b).

The MCCO Additional Project Area does not occur within the four known breeding areas for the species where it is regularly recorded, namely Bundarra-Barraba area of NSW, the Capertee Valley in NSW, the lower Hunter Valley in NSW and the Chiltern area of north-east Victoria.

The regent honeyeater's primary habitat is box-ironbark eucalypt woodland and dry sclerophyll forest, however it does utilise riparian vegetation and lowland coastal forest. Habitat critical to the survival of the regent honeyeater includes any breeding or foraging areas where the species is likely to occur and any newly discovered breeding or foraging locations (CoA 2016). Ironbark woodland occurs across 147.97 hectares of the MCCO Additional Disturbance Area, and will be impacted by the Proposed Action. This area represents critical habitat as the Hunter Valley region has been mapped in the recovery plan as 'species likely to occur' despite a lack of recent records in the Project Area.

The controlled action decision (DoEE 2019) states that the MCCO Project is likely to have a significant impact on the regent honeyeater due to the loss of 256 hectares of habitat critical to the survival of the species. Consultation with the DoEE assessment officer determined that DoEE had identified all PCTs that contain ironbark as providing critical habitat for the species.

Review of PCTs determined that the MCCO Project area contains 147.9 hectares of woodland and forest communities the contain narrow-leaved ironbark (*Eucalyptus crebra*) and spotted gum (*Corymbia maculata*) as occurring in the canopy as meeting the broad definition of potential habitat that DoEE has considered as habitat critical to the survival of the species. Derived native grassland communities of these PCTs have not been included in the analysis of potential habitat.

The above assessment is inherently conservative as discussed in Section 2.2.3, however for the purposes of this assessment it is considered that 147.97 hectares of habitat for the regent honeyeater will be removed by the Proposed Action.

In this case, a *population* means:

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

The regent honeyeater is endemic to mainland south-eastern Australia and mostly inhabits inland slopes of the Great Dividing Range (TSSC, 2015b). The regent honeyeater comprises a single population, with some exchange of individuals between regularly used areas (CoA, 2016b). As at 2010, the total population size is estimated at 350–400 mature individuals (CoA, 2016b).

As the species occurs as a single population in Australia, any record of the species would constitute part of a *population* as described above. The *population* of regent honeyeater has not been recorded within the MCCO Additional Project Area however it has been recorded approximately 16 km north west of the MCCO Additional Project Area (between Wybong and Merriwa) however this is a historic record from 1996 (BioNet, 2017).

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

The *population* of the regent honeyeater has not been recorded within the MCCO Additional Project Area or the immediate locality. The Proposed Action may result in the loss of 147.97 hectares of vegetation containing foraging habitat for the regent honeyeater as their diet primarily consists of nectar from eucalypts and mistletoe (CoA, 2016b). The MCCO Additional Project Area is not known as a historical or important foraging site for this species.

As per the Atlas of NSW Wildlife, the closest record of the regent honeyeater to the MCCO Additional Project Area is approximately 16 km east of the mine site. The species has been recorded sporadically in the upper Hunter Valley, with most records of the species concentrated in the lower Hunter. There have been no sightings of the regent honeyeater within the MCCO Additional Project Area despite targeted surveys.

It is considered unlikely that the Proposed Action will lead to a decrease in the size of the *population* of regent honeyeater.

- reduce the area of occupancy of the species; or

The regent honeyeater has not been recorded within the MCCO Additional Project Area or the immediate locality. The Proposed Action may result in the loss of 147.97 hectares of foraging habitat. While the Proposed Action will remove potential habitat for this species, it is not likely to lead to a significant reduction in known habitat in the region.

The Proposed Action may result in a reduction of the potential area of occupancy for the regent honeyeater in the MCCO Additional Project Area, however this is unlikely to substantially reduce the area of known occupancy in the wider locality or region.

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

The decline of the population of the regent honeyeater is attributed to clearing, fragmentation and degradation of its habitat (TSSC, 2015b).

The population of regent honeyeater has not been recorded within the MCCO Additional Project Area or the immediate locality. The regent honeyeater is highly dispersive and it is unlikely that the Proposed Action would create a significant change to the species' dispersal capacity or create a significant barrier to the movement of the species.

It is unlikely that the Proposed Action would result in the fragmentation of the existing *population* into two or more populations.

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

Habitat critical to the survival of the regent honeyeater includes any breeding or foraging areas where the species is likely to occur and any newly discovered breeding or foraging locations (CoA, 2016b). The species has not been recorded breeding in the MCCO Additional Project Area. The MCCO Additional Project Area includes vegetation containing spotted gum and ironbark. The Proposed Action may result in the loss of 147.97 hectares of this habitat type.

The Proposed Action is unlikely to adversely affect habitat that is critical to the survival of a *population* of the regent honeyeater.

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

The regent honeyeater mainly breeds in three key sites in NSW being the Bundarra-Barraba area, the Capertee Valley, and the Lower Hunter Valley (CoA, 2016b & OEH, 2017). Other breeding areas are known in the Pilliga woodlands and the Mudgee-Wollar areas of NSW. The regent honeyeater has not been recorded in the MCCO Additional Project Area and it is unlikely to contain breeding or nesting habitat for the species.

The Proposed Action is not expected to disrupt the breeding cycle of the *population* of 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**

The regent honeyeater has been recorded in the region however this species has not been recorded within the MCCO Additional Project Area despite targeted survey over multiple years. The regent honeyeater is considered to have potential to occur in areas of appropriate winter-flowering eucalypt habitat.

The Proposed Action will involve the removal of 147.97 hectares of vegetation that contains spotted gum or narrow-leaved ironbark. The lower Hunter area supports other areas of habitat that contain suitable woodland and forest vegetation that would also provide potential habitat for this species such as the Wollemi National Park and Mt Royal National Park.

It is considered unlikely that the Proposed Action would modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that a *population* of the regent honeyeater would 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;**

The Proposed Action is not expected to result in invasive species that are harmful to the regent honeyeater becoming established in the species habitat.

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

The Proposed Action is not expected to introduce any disease that may cause the regent honeyeater to decline.

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

The following recovery plan has been prepared:

- National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (CoA, 2016b)

Any impacts to known habitat for the regent honeyeater will likely contravene the objectives of the recovery plan. The regent honeyeater has not been recorded within the MCCO Additional Project Area, however approximately 147.97 hectares of potential foraging habitat has been identified. It is considered unlikely that the Proposed Action will interfere with the recovery of the regent honeyeater (*Anthochaera phrygia*) throughout Australia.

Conclusion

The Proposed Action is unlikely to result in a significant impact on the *population* of the regent honeyeater. Although the MCCO Additional Project Area provides potential foraging habitat for this species, the area proposed to be disturbed is minimal and the regent honeyeater has not been recorded utilising the potential habitat within the MCCO Additional Project Area or in the immediate surrounds.

Leek orchid (*Prasophyllum* sp. Wybong)

Prasophyllum sp. Wybong is listed as Critically Endangered under the EPBC Act. There has been a recent change (July 2017) to the listing status of the *Prasophyllum* species occurring at Mangoola under the EPBC Act. DoEE has confirmed that from a Commonwealth Government perspective the plants recorded at Mangoola should be considered as *Prasophyllum* sp. Wybong, rather than *Prasophyllum petilum*, which is listed as an endangered species under the NSW BC Act. It is noted that there is considerable taxonomic uncertainty in relation to this species.

The amended SEARs note that the DoEE will accept the credit liability generated for *Prasophyllum petilum* as the credit liability for *Prasophyllum* sp. Wybong, subject to being satisfied that the proposed offsets meet the offset requirements under the EPBC Act.

In this case, a *population* means:

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

Populations of the leek orchid (*Prasophyllum* sp. Wybong) are limited in distribution and the species is endemic to NSW. The species is known from seven populations in eastern NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield and Currabubula and the Pilliga area. Populations of this species have been recorded at the Tarengo Travelling Stock Route (TSR) in Boorowa, Captains Flat,

Ilford, Steve's TSR in Delegate, Muswellbrook and Wybong (DoE 2019 & DECCW 2010). Habitat for this species is observed to be open grassland or grassy woodland (Bell and Copeland 2010). Most of the significant orchid populations recorded across multiple survey periods tend to have been found within open grassland habitats (Bell and Copeland 2010 & Umwelt 2015).

There is very little research-based literature that allows confident definition of population size or population boundaries of the leek orchid as this species is cryptic in nature and difficult to identify in the field unless in flower as it persists via tuber dormancy when not in flower (Bell and Copeland 2010 & Bell 2016). It is considered that the Wybong population of the species likely represents a regional population of the species, occurring in the Sydney Basin Bioregion.

The MCCO Project will result in the loss of 691 individual orchids (Umwelt 2019 in prep, Bell 2019), with the expected population size in the Mangoola Coal land holding estimated to be in excess of 15,000 individuals (Bell 2016). Surveys within Mangoola Coal owned properties to date have identified approximately 5,806 individual orchids.

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**

The Proposed Action will result in the loss of approximately 691 individual orchids (Umwelt, 2017), with an expected population size in the Mangoola Coal land holding estimated to be in excess of 15,000 individuals (Bell, 2016). Surveys within Mangoola Coal owned properties to date have identified approximately 5,806 orchids.

The loss of 691 individual *Prasophyllum* sp. Wybong may lead to a long-term decrease in the size of the population of the leek orchid in the Hunter Valley.

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

The current extent of occurrence of the leek orchid is estimated to be 48,000 km². There is no data to indicate a decline in extent of the leek orchid (DoE, 2017a). The Proposed Action is likely to result in a reduction in the area of occupancy of the species.

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

While the Proposed Action will result in a decline in the area of occupancy of the species, the location of the Proposed Action in relation to the known occurrence of the species indicates that the existing population is not likely to be fragmented into two or more populations.

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

Current available literature on the biology and ecology of the leek orchid is limited and there is no defined critical habitat for this species. The regional population of the species located in the Wybong area is considered to comprise an important population of the species that is likely critical to the survival of the species.

The loss of 691 *Prasophyllum* sp. Wybong individuals may adversely affect habitat critical to the survival of the species.

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

All terrestrial orchids share unique traits which are applicable to the leek orchid. These traits include having specific pollinator requirements, obligate mycorrhizal associations and a dormant phase (Vizer, 2013). However, current available literature on life history traits of the leek orchid (*Prasophyllum* sp. Wybong) is limited. The main life history trait known about this orchid that is pertinent to the MCCO Project is that flowering occurs in spring, typically from September to October (DoE, 2017a & Vizer 2013).

It is unknown if the Proposed Action will disrupt the breeding cycle of the regional extent of the *Prasophyllum* sp. Wybong population in the Wybong area.

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

The Proposed Action will require the removal of known habitat for 691 *Prasophyllum* sp. Wybong and may modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

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

The Proposed Action is not expected to result in invasive species that are harmful to the *Prasophyllum* sp. Wybong becoming established in the species' habitat.

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

Prasophyllum sp. Wybong is not known to be affected by diseases that are causing the species to decline. Therefore, the Proposed Action is not likely to result in the introduction of disease that may cause the species to decline.

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

A National Recovery Plan for *Prasophyllum* sp Wybong has not been prepared however the Conservation Advice for the species identifies priority recovery and threat abatement actions. The loss of known habitat for the species is likely to contravene the recovery planning objectives of the Conservation Advice.

Conclusion

The loss of known habitat, containing 691 individuals of *Prasophyllum* sp. Wybong is likely to result in a significant impact on this species.

Grey-headed Flying Fox (*Pteropus poliocephalus*)

In the case of a vulnerable species, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations 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 grey-headed flying-fox has not been recorded in the MCCO Additional Project Area. The closest record of the species occurs 10 km to the south of the MCCO Additional Project Area near Denman. All eucalypt forest and woodland vegetation within the MCCO Additional Project Area may provide potential foraging habitat for this species. Camp sites (breeding habitat) have not been identified within the MCCO Additional Project Area and are not expected to occur.

The nearest substantial roost camp site of the grey-headed flying-fox to the MCCO Additional Project Area is in Muswellbrook approximately 17 km to the east of the MCCO Additional Project Area (DoEE 2017c). The population estimate for grey-headed flying-foxes in Muswellbrook was estimated to be between 500 and 2,499 individuals during the most recent survey in February 2017 (DoEE 2017c). The highest estimate of this population is from 2015 with the population estimated to be between 16,000 and 49,999 individuals (DoEE 2017c). Potentially occurring foraging individuals in the MCCO Additional Project Area are likely to be from these camp sites located within 50 km of the site. No nationally important grey-headed flying-fox camps have been identified within 50 km of the MCCO Additional Project Area according to the National Flying-Fox Monitoring Viewer.

The MCCO Additional Project Area is considered to comprise areas of potentially suitable foraging habitat for this species but these are unlikely to contain significant breeding and roosting habitat necessary for maintaining genetic diversity. The MCCO Additional Project Area is also not near the limit of the known range of this species. Therefore, the MCCO Additional Project Area is unlikely to contain an *important population* of the grey-headed flying-fox.

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;

Given that there is not considered to be an *important population* of the grey-headed flying-fox present within the MCCO Additional Project Area, the Proposed Action will not lead to a long-term decrease in the size of an *important population* of this species.

- reduce the area of occupancy of an *important population*, or;

The Proposed Action will result in the loss of approximately 170 hectares of potential foraging habitat for grey-headed flying-fox. However, since the MCCO Additional Project Area does not contain an important population of the grey-headed flying-fox, the Proposed Action will not reduce the area of occupancy of an *important population* of this species.

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

The habitat within the MCCO Additional Project Area is already highly fragmented and does not contain an *important population* of the grey-headed flying-fox. Therefore, the Proposed Action will not result in the fragmentation of an *important population* of this species.

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

According to the draft *National Recovery Plan for the Grey-Headed Flying-Fox* (DoEE 2017), foraging habitat that meets one of the following criteria is considered critical to the survival of the species:

- productive during winter and spring, when food bottlenecks have been identified
- known to support populations of >30,000 individuals within an area of 50 km radius (the maximum foraging distance of an adult)
- productive during the final weeks of gestation, and during the weeks of birth, lactation and conception
- productive during the final stages of fruit development and ripening in commercial crops affected by grey-headed flying-foxes and/or
- known to support a continuously occupied camp.

The MCCO Additional Project Area is considered to comprise up to 162.4 hectares of potentially suitable eucalypt foraging habitat for this species and may be productive during winter and spring according to the above criteria. However given that this species has not been recorded in the MCCO Additional Project Area, the relatively small area of suitable fragmented habitat when compared to the local area, it is considered that the Proposed Action is unlikely to substantially adversely affect foraging habitat critical to the survival of the species.

The National Recovery Plan for the grey-headed flying-fox (DoEE 2017) also includes criteria for roosting habitat critical to the survival of the species. Since the MCCO Additional Project Area does not contain a grey-headed flying-fox camp it will not impact roosting habitat critical to the survival of the species.

Therefore, the Proposed Action is unlikely to substantially adversely affect habitat that is critical to the survival of the species.

- **disrupt the breeding cycle of an *important population*, or;**

No grey-headed flying-fox breeding populations or camps have been identified in the MCCO Additional Project Area. The Proposed Action is not expected to disrupt the breeding cycle of an *important population* of this species.

- **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 Proposed Action will result in the loss of approximately 170 hectares of potential foraging habitat for grey-headed flying-fox. Given the regionally small area of potential foraging habitat to be removed and the substantial area of high quality remnant vegetation in habitats associated with Manobalai Nature Reserve, the MCCO Additional Project Area is unlikely to be depended on by local grey-headed flying-fox colonies.

It is considered unlikely that the Proposed Action will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the grey-headed flying-fox would decline.

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

The Proposed Action is not expected to result in invasive species that are harmful to the grey-headed flying-fox becoming established in the species habitat.

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

No diseases that may cause the grey-headed flying-fox to decline are likely to be introduced as a result of the Proposed Action.

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

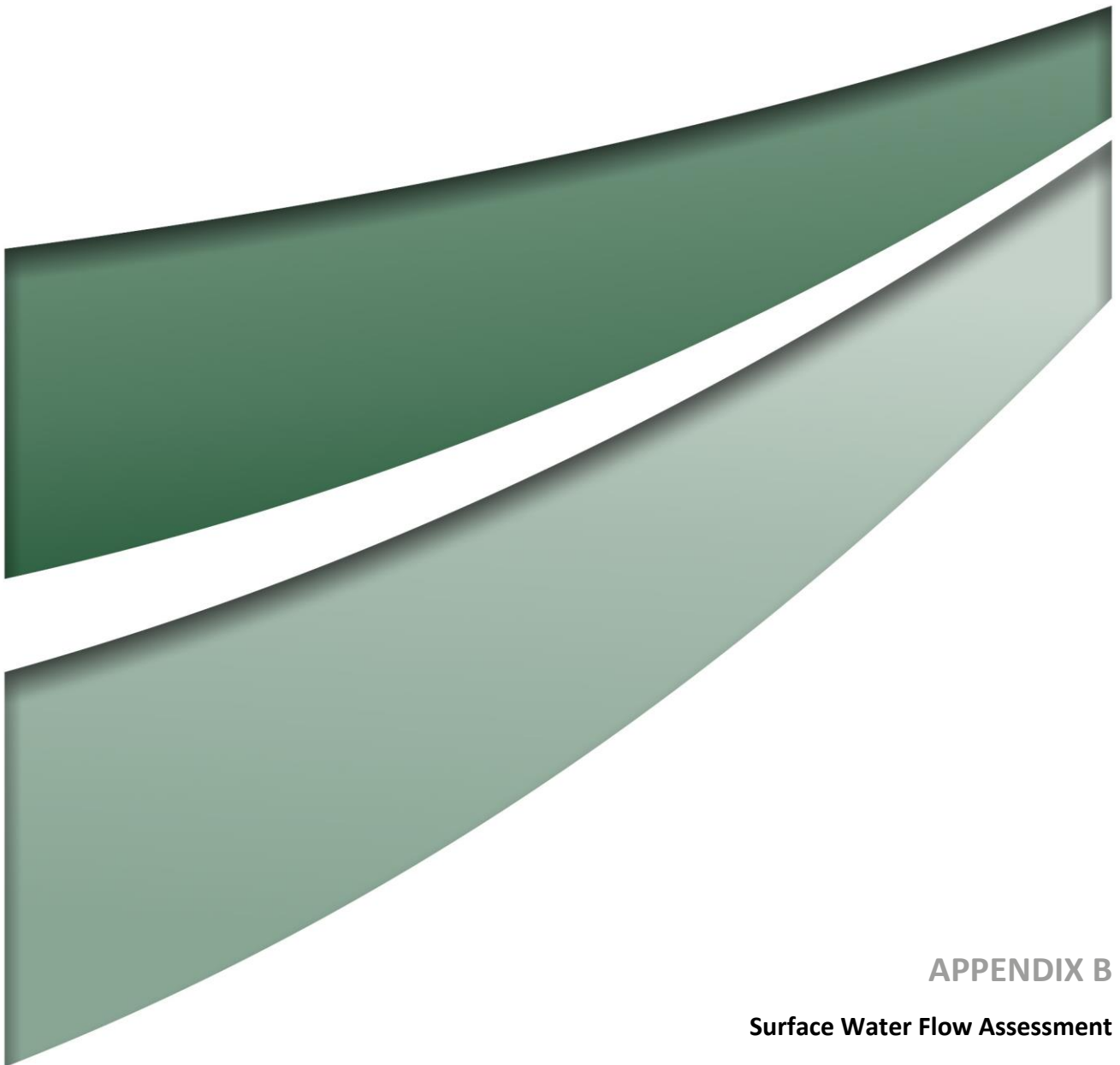
There is currently no approved recovery plan for the grey-headed flying-fox. The overall objectives of the draft *National Recovery Plan for the Grey-headed Flying Fox* (DoEE 2017) are to:

- reduce the impact of threatening processes on grey-headed flying-foxes and arrest decline throughout the species' range
- conserve the functional roles of grey-headed flying-foxes in seed dispersal and pollination and
- improve the standard of information available to guide recovery of the Grey-headed Flying-fox, in order to increase community knowledge of the species and reduce the impact of negative public attitudes on the species.

No significant effect on the recovery of the grey-headed flying-fox is expected to occur as a result of the Proposed Action as the potential areas of foraging habitat that will be impacted as a result of the Project are not expected to impact an *important population* of this species.

Conclusion

The Proposed Action is unlikely to result in a significant impact on an *important population* of grey-headed flying-fox as the MCCO Additional Project Area is not considered to support an *important population* of this species.



APPENDIX B

Surface Water Flow Assessment

16 May 2019

Executive Manager Environment NSW & ACT
Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284
via Email
Attention: John Merrell

John,

**Re: Mangoolia Coal Continued Operations Project - *Prasophyllum* sp. Wybong
Hydrological Assessment**

Further to our discussions and provision of data, we have undertaken an assessment of the potential hydrological effects of the upslope runoff diversion proposed as part of the Mangoolia Coal Continued Operations Project (MCCO Project) on *Prasophyllum* sp. *Wybong* orchids in the area.

The area assessed is shown in Figure 1. This includes topographic contours (0.1 m interval) generated from supplied LiDAR data and mapped location of *Prasophyllum* sp. *Wybong* orchids (shown as coloured circles). The downstream end and outfall of the proposed upslope diversion drain is also shown – it is understood that the outfall will comprise a ‘level spreader’¹ to distribute the flow evenly to downslope areas. Outflow from the level spreader would report to a nearby existing farm dam via upslope contour banks. Spill from the farm dam is via a spillway on its western side. The estimated catchment area reporting to the farm dam is summarised in Table 1 at three different points in time: currently (i.e. without the diversion), at Year 3 of the MCCO Project (i.e. with the maximum catchment reporting to the diversion) and following Project completion (i.e. final landform). Also shown in Table 1 are estimated daily flow rates at the farm dam spillway – derived from a regional catchment-scale daily rainfall runoff model. The method involved simulating catchment runoff using the Australian Water Balance Model (AWBM)². Model parameters were taken from a model calibration for a nearby stream gauging station³. The model was run for a period of 130 years using the full period of available daily local climate data⁴ to simulate daily catchment runoff. Annual maxima runoff values were then calculated and ranked in order to generate daily flow statistics.

¹ As detailed in Landcom (2004). “Managing Urban Stormwater: Soils & Construction Volume 1”, 4th edition, March.

² Boughton, W.C. (2004). “The Australian Water Balance Model”, Environmental Modelling and Software, vol.19, pp. 943-956.

³ GS 210088: Dart Brook at Aberdeen. Parameters obtained from Boughton, W.C. and Chiew, F. (2003). “Calibrations of the AWBM for Use On Ungauged Catchments”. Cooperative Research Centre for Catchment Hydrology Technical report 03/15, December.

⁴ Rainfall and evaporation data obtained from the SILO Data Drill for the MCCO Project Area; refer <https://legacy.longpaddock.qld.gov.au/silo/>

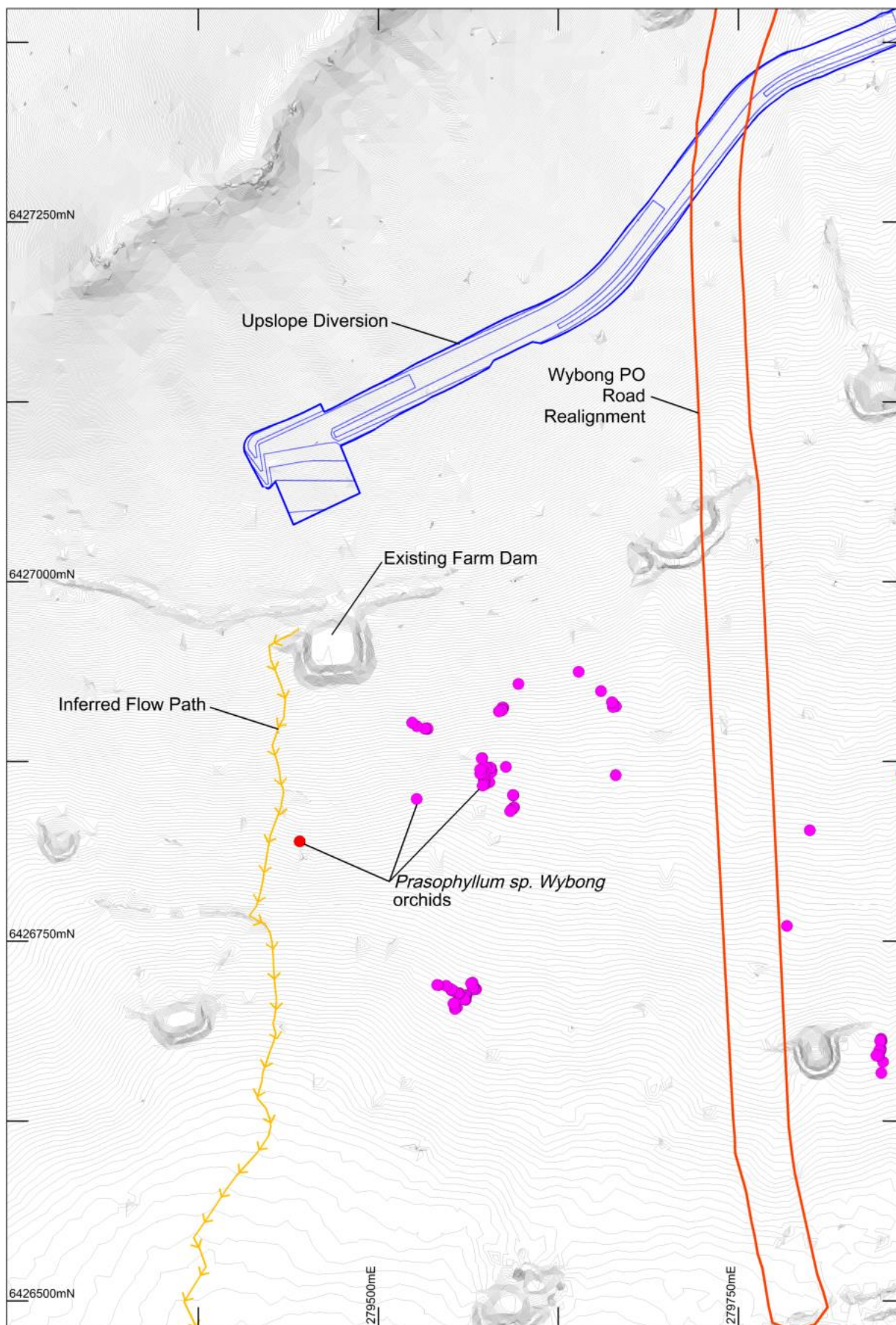


Figure 1 Site Plan

Table 1 Farm Dam Estimated Catchment Area and Flow Rate

Stage	Catchment Area (km ²)	50% (1:2) AEP* Flow Rate (ML/d)	2 EY [†] Flow Rate (ML/d)
Existing	0.073	0.19	0.10
MCCO Project Year 3	4.105	10.8	5.8
Final Landform	0.541	1.4	0.76

* Annual exceedance probability

† Exceedances per year

The 1:2 AEP flow rates have a 50% chance of being exceeded in any year, while the 2 EY flow rates would on average be exceeded twice a year.

The flow rates given in Table 1 were used to estimate spillway flow depth and velocity at steady flow conditions using spillway geometric information derived from supplied LiDAR. For the 50% AEP and with the additional catchment area associated with the MCCO Project at Year 3, a flow velocity of 0.4 m/s was calculated. Such a flow in the farm dam spillway is not likely to generate erosive flow velocities provided that the spillway supports a grass cover⁵.

The main flow path from the farm dam spillway, inferred from the topographic contours, is also indicated on Figure 1. It should be noted however that there is no distinct gully, swale or any other drainage feature evident from the contours downslope of the farm dam spillway. Therefore it is likely that flow from the spillway would spread over a wide area. It is not possible to estimate the width of flow for a given magnitude flow rate by simple analytical flow calculations.

Of the mapped existing *Prasophyllum* sp. *Wybong* orchids in the area, it appears that there is only one individual (coloured red on Figure 1) that could potentially be affected by flow downslope of the farm dam spillway.

Please contact the undersigned if you have any queries.

Yours faithfully,



Tony Marszalek

Director

⁵ Refer USDA & NRCS (1984). "Grassed waterways", National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 7, US Department of Agriculture, Washington D.C.

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