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Moolarben Coal Complex UG2 Modification

Biodiversity Development Assessment Report

Prepared for Moolarben Coal Operations Pty Ltd. 24 November 2021

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This Biodiversity Development Assessment Report has been prepared on the basis of the requirements of (and information provided under) the Biodiversity Assessment Method as certified by BAM Accredited Assessor: Nicola Trulock (BAAS # BAAS19058)

Version	Author	Review	Status	Date
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As required by Section 6.15(1) of the NSW *Biodiversity Conservation Act 2016*, I certify that this Biodiversity Development Assessment Report has been prepared by Niche Environment and Heritage, on the basis of the requirements of (and information provided under) the Biodiversity Assessment Method.

Luke Baker

23 November 2021

Executive summary

The Moolarben Coal Complex is located approximately 40 kilometres (km) north of Mudgee, New South Wales (NSW). The Moolarben Coal Complex is operated by Moolarben Coal Operations Pty Ltd (MCO) on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Yancoal Moolarben Pty Ltd [YM] and a consortium of Korean power companies). MCO, MCM and YM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

The Moolarben Coal Complex comprises of four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities) (Figure 1). Stage 1 of the Moolarben Coal Complex comprises open cut operations in OC1, OC2 and OC3, underground operations in UG4 and coal processing and transport facilities. Stage 2 of the Moolarben Coal Complex comprises open cut operations in OC4 and underground operations in UG1 and UG2 (Figure 2).

The Moolarben Coal Project Stage 2 operates in accordance with Project Approval (08_0135) (as modified). MCO is proposing adjustments to the approved UG2 layout as well as extension of longwalls within existing mining tenements (hereafter referred to as 'the Modification'). In summary, the Stage 2 Moolarben Coal Complex Project Approval (08_1035) would include the following changes to the approved Moolarben Coal Complex:

- optimisation of the approved UG2 layout (including the extension of two approved longwall panels);
- increased UG2 extraction height from 3.0 metres (m) to 3.5 m;
- revised UG2 mining sequence;
- increased UG2 ROM coal production from 9.4 million tonnes (Mt) to 13.9 Mt;
- construction and operation of a remote services infrastructure area (including two UG2 service boreholes) within the approved OC4 disturbance footprint to support UG2 operations;
- development of an additional non-subsiding gate road along the southern boundary of the UG1 mining area to assist with ventilation in UG2;
- small reduction in the approved OC4 extent to accommodate the optimised UG2 layout; and
- Other minor adjustments to the mining layout.

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by MCO to prepare a Biodiversity Development Assessment Report (BDAR) for 'the Modification which is to be sought under Section 4.55(2) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

This BDAR has been prepared in accordance with the Biodiversity Assessment Method (BAM) (NSW Department of Planning, Industry and Environment [DPIE] 2020a) to describe and assess indirect and prescribed impacts to the ecological values within the subject land and determine if the Modification is likely to have an impact on threatened biodiversity listed under the NSW *Biodiversity Conservation Act 2016* (BC Act). In regard to Matters of National Environmental Significance listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), this BDAR does not assess the significance of impacts against relevant Commonwealth policies. MCO may separately refer the Modification to the Commonwealth Minister to confirm if the proposed activities are a "Controlled Action" under the EPBC Act.

Native Vegetation

Native vegetation in the subject land was surveyed between 10 February to 25 September 2021 in accordance with the BAM (DPIE 2020a) and the BAM 2020 Operational Manual – Stage 1 (DPIE 2020b). Nine plant community types (PCTs) forming 10 vegetation zones (VZ) were mapped within the subject land:

- PCT 434 - *White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion* – Regenerating woodland
- PCT 472 - *Thyme Honey-myrtle – red gum – Mugga Ironbark shrubland / woodland in impeded drainage flats or depressions in the southern Brigalow Belt South Bioregion* – Remnant shrubby woodland
- PCT 478 - *Red Ironbark – Black Cypress Pine – stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong – Mendooran region, southern Brigalow Belt South Bioregion* – Remnant forest
- PCT 479 - *Narrow-leaved Ironbark- Black Cypress Pine – stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion* – Remnant forest
- PCT 1176 - *Slaty Box – Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion* – in both moderate and low condition states
- PCT 1610 - *White Box – Black Cypress Pine shrubby woodland of the Western Slopes* – Low
- PCT 1614 - *Grey Gum – Grey Myrtle – Narrow-leaved Stringybark – Rusty Fig open forest on ranges of the Upper Hunter* – Remnant forest
- PCT 1629 - *Narrow-leaved Stringybark – Grey Gum shrubby open forest on sandstone ranges of the Sydney Basin* – Remnant forest
- PCT 1767 - *Rough-barked Apple grassy tall woodlands of the Brigalow Belt South* – Remnant woodland.

Four of the PCTs recorded in the subject land and surrounds align to Threatened Ecological Communities (TECs) listed under the BC and EPBC Act:

- PCT 434 mapped within the subject land meets the listing criteria for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the Sydney Basin (Critically Endangered Ecological Community [CEEC], BC Act) and White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CEEC, EPBC Act).
- PCT 472 mapped within the subject land meets the listing criteria for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (CEEC, BC Act).
- PCT 1176 in both moderate and low condition states meets the listing criteria for Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion (Vulnerable Ecological Community [VEC], BC Act and Central Hunter Valley eucalypt forest and woodland (CEEC, EPBC Act).

PCT 1610 mapped outside of the subject land, meets the listing criteria for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (CEEC, BC Act).

Threatened Species

Targeted surveys for threatened flora species were undertaken between 21-25 September 2021 via parallel traverses in accordance with the BAM (DPIE 2020a) and *Surveying Threatened Plants and their Habitats* (DPIE 2020c). No threatened flora species were recorded in the subject land, however two threatened flora species were not able to be surveyed at the time of the surveys:

- Austral Toadflax *Thesium australe* (Vulnerable, BC Act and EPBC Act) – survey period is November - February; and
- *Tylophora linearis* (Vulnerable, BC Act and Endangered, EPBC Act) – survey period is October - May.

Bat habitat assessments were undertaken between 15-18 December 2020, followed by targeted bat surveys (using bat detectors and harp traps) between 11-17 January and 25-31 January 2021, followed by an additional habitat survey on 16 July 2021. These bat surveys were undertaken in accordance with the BAM (DPIE 2020a) and the '*Species Credit' Threatened Bats and Their Habitats Survey Guide* (Office of Environment and Heritage [OEH] 2018a). Other fauna species were opportunistically recorded during these surveys.

A specific fauna habitat assessment survey was undertaken between 24-27 August 2021 in accordance with Section 5.2.2 of the BAM (DPIE 2020a) to determine the presence of habitat constraints and the condition of micro habitats. A range of survey techniques were undertaken including camera trapping, diurnal and nocturnal habitat searches, frog surveys, systematic scat surveys and also opportunistic recordings of non-target threatened species.

Four threatened fauna species recognised as species credit species were recorded in the subject land including:

- Koala *Phascolarctos cinereus* (Vulnerable, BC Act and EPBC Act) – Dual credit species
- Parma Wallaby *Macropus parma* (Vulnerable, BC Act and EPBC Act) – Species credit species
- Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable, BC Act and EPBC Act) – Species credit species
- Eastern Cave Bat *Vespadelus troughtoni* (Vulnerable, BC Act) – Species credit species.

Surveys were not able to be completed for all potentially occurring threatened fauna species recognised as species credit species, and therefore in accordance with the BAM (DPIE 2020a), the following threatened fauna species are assumed to occur in the subject land for the purpose of this assessment:

- Pink-tailed Legless Lizard *Aprasia parapulchella* (Vulnerable, BC Act and EPBC Act) – Species credit species
- Striped Legless Lizard *Delma impar* (Vulnerable, BC Act and EPBC Act) – Species credit species
- Pale-headed Snake *Hoplocephalus bitorquatus* (Vulnerable, BC Act) – Species credit species
- Broad-headed Snake *Hoplocephalus bungaroides* (Endangered, BC Act and Vulnerable, EPBC Act) – Dual credit species (breeding habitat)
- Bush Stone-curlew *Burhinus grallarius* (Endangered, BC Act) – Species credit species
- Gang-gang Cockatoo *Callocephalon fimbriatum* (Vulnerable, BC Act) – Dual credit species
- Superb Parrot *Polytelis swainsonii* (Vulnerable, BC Act and EPBC Act) – Dual credit species
- Masked Owl *Tyto novaehollandiae* (Vulnerable, BC Act) – Dual credit species
- Regent Honeyeater *Anthochaera phrygia* (Critically Endangered, BC Act and EPBC Act) – Dual credit species
- Brush-tailed Phascogale *Phascogale tapoatafa* (Vulnerable, BC Act) – Species credit species
- Eastern Pygmy Possum *Cercartetus nanus* (Vulnerable, BC Act) – Species credit species
- Greater Glider *Petauroides volans* (Vulnerable, EPBC Act) – Species credit species
- Squirrel Glider *Petaurus norfolcensis* (Vulnerable, BC Act) – Species credit species

Avoid and Minimise Impacts

MCO have aimed to avoid and minimise impacts from the Modification where practicable. The layout of the extended longwall panels (LW 201 and LW 202A) has been designed to:

- Ensure the 26.5° angle of draw avoids the Munghorn Gap Nature Reserve.
- Comply with the existing subsidence impact performance measures in the Stage 2 Project Approval (08_0135), including negligible subsidence impacts or environmental consequences on threatened species and communities.
- Setback from Cliff C9 to maintain the subsidence impact performance measure of negligible environmental consequences and avoid impacts to associated threatened species habitat.

As described above, the Modification does not require any new surface disturbance. There would also be a small reduction in the approved OC4 extent to accommodate the extended LW 201 if it is mined as proposed.

Impacts on Native Vegetation and Habitats

No native vegetation or habitat would be cleared for the Modification (i.e. no direct impacts on native vegetation and habitat). However, potential indirect impacts from longwall mining, including consideration of prescribed impacts under section 6.1 of the NSW *Biodiversity Conservation Regulation 2017* (BC Regulation), have been assessed..

The impact on caves, crevices, cliffs and rocks is a prescribed impact under the BC Regulation. The potential impacts on these features as a result of the Modification are summarised as follows:

- Cliff lines – the northern outcrop area (Cliff C9) is predicted to have negligible impact (<20 millimetres [mm] total conventional subsidence) due to avoidance measures in the design phase. As such, fracturing, slabbing and minor rock fall are not expected in this area of the subject land (Mine Subsidence Engineering Consultants [MSEC] 2021).
- Minor cliffs and rock face features – The central-north, central-south and eastern outcrops areas are predicted to have minor impacts (up to 2300 mm Maximum Predicted Incremental Conventional Subsidence) which may result in sandstone fracturing leading to instability, slabbing and potential for small rock falls across a maximum of 5% of total rock face area. This is considered a lowered risk for these particular areas as the shortness of their length and isolation from surrounding geological features results in a lowered risk of impact despite being situated above the longwall panel 202a (MSEC 2021).
- Steep slopes – steep slope features are predicted to have minor impacts (up to 2300 mm total incremental conventional subsidence) which may result in down slope movement resulting in surface tension cracking mainly along top of slopes across a maximum of 5% of their extent (MSEC 2021). These impacts are unlikely to result in destabilization of hollow-bearing trees as evidenced by monitoring of UG1 longwalls 101-103 (ELA 2018, 2019 & 2021a) which has a similar predicted total conventional subsidence parameters and evidence of surface tension cracking but, monitoring to date has not detected any adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence.

The impact on water quality, water bodies and hydrological processes is also a prescribed impact under the BC Regulation. The impacts for hydrological features are similar to the approved layout and include predicted cracking of bedrock, ponding and some diversion of surface water into the strata below during low flow (i.e., light rainfall). These impacts are likely to be temporary in nature as over time the gradients along the drainage lines would approach grades similar to those that existed before mining and any minor cracks will naturally fill with sediment over times.

Impacts on Threatened Biodiversity

As no native vegetation is to be cleared or removed as a result of the Modification, there will be no direct impact to TECs within the subject land.

The Modification will not impact upon potentially occurring threatened flora species, Austral Toadflax or *Tylophora linearis*. If the species were to occur, these species would be on low sedimentary flats which, in the case of the subject land, are not considered likely to be impacted by predicted subsidence impacts.

The following species credit species may use habitat that may be adversely impacted by predicted subsidence impacts:

- Pink-tailed Legless Lizard *Aprasia parapulchella* (Vulnerable, BC Act and EPBC Act)
- Striped Legless Lizard *Delma impar* (Vulnerable, BC Act and EPBC Act)
- Broad-headed Snake *Hoplocephalus bungaroides* (Endangered, BC Act and Vulnerable, EPBC Act)
- Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable, BC Act and EPBC Act)
- Eastern Cave Bat *Vespadelus troughtoni* (Vulnerable, BC Act).

Pink-tailed Legless Lizard and Striped Legless Lizard, which typically shelter under small partially-embedded rocks, the predicted impact may result in mortality to individuals (if they were to occur) and a reduction in habitat availability.

In the case of Broad-headed Snake, which typically shelters under rocks and in crevices, the predicted impacts to minor cliffs and rock face features may result in mortality to individuals (if they were to occur) and a reduction in habitat availability.

Fauna species which use minor cliff lines and rock face features for refuge, breeding and/or foraging habitat may be impacted if the species were to use the impacted portion of the feature (5%). In regard to habitat features for these species occurring in the subject land, the central northern, central southern and eastern outcrop areas are most susceptible; however, as discussed above, there is a lower likelihood of impacts due to size and isolation from surrounding geological features.

Rock features mainly occur in the upper sections of steep slopes within the subject land and, as such, fauna species which use these rock features for refuge, breeding and/or foraging habitat may be impacted if the species were to use the impacted portion of the feature (5%).

In the case of Large-eared Pied Bat and Eastern Cave Bat, if predicted impacts to minor cliffs and rock face features (the 5%) were to occur on habitat used by the species, it may impact the habitat to varying degrees from minor fracturing to cave collapse. These potential impacts on the habitat could result in mortality of individuals in the feature, a reduction in habitat availability and a decline in the bat activity.

It is highly unlikely that the Modification would result in loss of a population of the abovementioned species within the subject land or locality due to the low likelihood of impact and the small area of maximum predicted impact combined with the availability of alternative habitat within and adjacent to the subject land in addition to the habitat available in adjacent Munghorn Gap Nature Reserve and nearby Goulburn River National Park.

This assessment provides relevant information on one threatened ecological community and four threatened fauna species that are recognised as Serious and Irreversible Impact (SAII) entities.

Mitigation and Monitoring Measures

Since the subject land underlies an existing offset area, the subject land would continue to be managed for long term conservation purposes in accordance with the Stage 2 Project approval (08_0135), Biodiversity and Offset Management Plan required under EPBC Act Approval 2008/4444, and the terms of the in-perpetuity conservation mechanism.

The potential subsidence related impacts would be monitored in accordance with a Biodiversity Management Plan and Subsidence Monitoring Plan prepared to support an Extraction Plan for UG2.

Conclusion

Based on a review of the subsidence predictions and associated specialist assessments, coupled with targeted field campaigns and analysis using the BAM (DPIE 2020a), this assessment concludes the following:

- Subsidence is unlikely to result in significant impacts towards native vegetation
- Subsidence is unlikely to result in an impact to threatened flora
- Subsidence may have an impact on rocky outcrop (caves and crevices) habitat likely to be used by threatened bats, Eastern Cave Bat and Large-eared Pied Bat
- Subsidence may have an impact on rocky habitat potentially used by Broad-headed Snake, Pink-tailed Legless Lizard and Striped Legless Lizard

In summary, there is a low likelihood of minor impact on a local population that may use potential habitat in the subsidence extent and also in the wider surrounds. However, the Modification is expected to result in negligible consequence to threatened species and communities in a regional context.

Biodiversity requiring offset under the Biodiversity Offset Scheme

The BAM-C does not require an Assessor to calculate biodiversity offsets for prescribed impacts.

Glossary and list of abbreviations

Term or abbreviation	Definition
°C	Degrees Celsius
AOBVs	Areas of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Methodology
BAM-C	BAM Credit Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BC Regulation	NSW Biodiversity Conservation Regulation 2017
Biosecurity Act	NSW *Biosecurity Act 2015*
BDAR	Biodiversity Development Assessment Report
BMP	Biodiversity Management Plan
BOAMS	Biodiversity Offset Assessment Management System
BoM	Bureau of Meteorology
BOS	NSW Biodiversity Offsets Scheme
CEEC	Critically Endangered Ecological Community
cm	Centimetre
DAWE	Commonwealth Department of Agriculture, Water and Environment
DBH	Diameter at Breast Height
DPIE	NSW Department of Planning, Industry and Environment
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
ELA	Eco Logical Australia
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act 1994*
GDE	Groundwater Dependent Ecosystems
GDE Atlas	Groundwater Dependent Ecosystems Atlas
ha	Hectare/s
HBT	Hollow-bearing Tree
IBRA	Interim Biogeographic Regionalisation for Australia
IPM	Incremental Profile Method
km	Kilometre
km/h	Kilometres per hour
LGA	Local Government Authority
LW	Longwall
M	Metre
MCC	Moolarben Coal Complex
MCM	Moolarben Coal Mines Pty Ltd
MCO	Moolarben Coal Operations Pty Ltd.
ML	Mining Lease

mm	millimetres
MNES	Matters of National Environmental Significance (from the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*).
MSEC	Mine Subsidence Engineering Consultants
Mt	Million tonnes
Niche	Niche Environment and Heritage Pty Ltd
NSW	New South Wales
OC	Open cut mine
OEH	Office of Environment and Heritage
PCT	Plant Community Type
RDP	Rapid Data Point
RMP	Rehabilitation Management Plan
ROM	Run-of-mine
SAII	Serious and Irreversible Impacts
SMP	Subsidence Monitoring Program
TBDC	Threatened Biodiversity Database Collection
TEC	Threatened Ecological Community
The Modification	Stage 2 Moolarben Coal Complex Project Approval (08_1035)
TSSC	Threatened Species Scientific Committee
UG	Underground mine
VEC	Vulnerable Ecological Community
VI	Vegetation Integrity
VZ	Vegetation Zone
Yancoal	Yancoal Australia Limited
YM	Yancoal Moolarben Pty Ltd

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1. Introduction

1.1 Modification description

The Moolarben Coal Complex is located approximately 40 kilometres (km) north of Mudgee, New South Wales (NSW) (Figure 1). The Moolarben Coal Complex is operated by Moolarben Coal Operations Pty Ltd (MCO) on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Yancoal Moolarben Pty Ltd [YM] and a consortium of Korean power companies). MCO, MCM and YM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

The Moolarben Coal Complex comprises of four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities) (Figure 1). Stage 1 of the Moolarben Coal Complex comprises open cut operations in OC1, OC2 and OC3, underground operations in UG4 and coal processing and transport facilities. Stage 2 of the Moolarben Coal Complex comprises open cut operations in OC4 and underground operations in UG1 and UG2 (Figure 2).

The Moolarben Coal Project Stage 2 operates in accordance with Project Approval (08_0135) (as modified). MCO is proposing adjustments to the approved UG2 layout as well as extension of longwalls within existing mining tenements.

Approval for the Modification to Project Approval (08_0135) is being sought under section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). In summary, the Modification would include the following changes to the approved Moolarben Coal Complex:

- optimisation of the approved UG2 layout (including the extension of two approved longwall panels);
- increased UG2 extraction height from 3.0 metres (m) to 3.5 m;
- revised UG2 mining sequence;
- increased UG2 ROM coal production from 9.4 million tonnes (Mt) to 13.9 Mt;
- construction and operation of a remote services infrastructure area (including two UG2 service boreholes) within the approved OC4 disturbance footprint to support UG2 operations;
- development of an additional non-subsiding gate road along the southern boundary of the UG1 mining area to assist with ventilation in UG2; and
- small reduction in the approved OC4 extent to accommodate the optimised UG2 layout.

Figure 3 shows the Modification general arrangement, including the southern extensions to the approved UG2 layout (which is encompassed by the subject land defined by the predicted extent of subsidence impacts). There is no additional native vegetation clearance required for the Modification.

The Modification includes an increase in extraction height across the entire UG2 area. According to MSEC (2021), the increase in extraction height will result in a change in the distribution of predicted subsidence impacts within the approved area, however the overall scale of predicted subsidence impacts remain similar to the approved UG2 layout. Therefore, the impacts resulting from the increased extraction height will not form a part of this assessment (with the exception of consideration of cumulative impacts).

1.2 Description of the subject land

The Modification is located on land in Ulan, NSW, approximately 40 km north-east of the Mudgee central business district (CBD), within the Mid-Western Regional Council local government area (LGA) (Figure 1).

The subject land is associated with the longwall extensions for the Modification and encompasses approximately 34.81 hectares (ha) of land, which is currently zoned RU1 (Primary Production) in the Mid-Western Regional Local Environment Plan (NSW Government 2012).

The subject land is situated to the immediate south of MCO's existing operations (including open cut and underground operations) and comprises land predominately covered in remnant woodland and forest. The subject land is well connected to extensive areas of native vegetation within Munghorn Gap Nature Reserve to the south and is directly connected to Wollemi National Park, located 60 km to the south-east via vegetated hills and ridgelines.

A large proportion of the broader landscape is cleared, and there is evidence of small-scale historical logging and quarrying activities visible in historical aerial imagery. Two unnamed Strahler first stream order waterways (Strahler 1957) run through the subject land, eventually draining into Murragamba Creek located approximately 0.9 km to the east of the subject land (Figure 5).

1.3 Assessment objectives and format

The assessment objectives and format are described in the sections below.

1.3.1 State approval and assessment process – application of the BAM

The proposed modification to the Stage 2 Project Approval (08_0135) will be sought under section 4.55(2) of the EP&A Act. As such, a Biodiversity Development Assessment Report (BDAR) prepared in accordance with the NSW Biodiversity Assessment Method (BAM) (NSW Department of Planning, Industry and Environment [DPIE] 2020a) is required to assess impacts to biodiversity as per the NSW *Biodiversity Conservation Act 2016* (BC Act). As the Modification does not include additional infrastructure beyond what has previously been assessed and approved for the Moolarben Coal Complex, the Modification would not result in any vegetation or habitat clearing. As such, no biodiversity offset prescribed by the BAM Credit Calculator (BAM-C) is required.

In accordance with Section 30A of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*, the BDAR to be submitted with the application for modification must take into account:

- Any measures already taken to avoid, minimise or offset the impact on biodiversity values in connection with the planning approval before the proposed modification; and
- Only the additional impact on biodiversity values resulting from the modification of the development and not those associated with the development as approved.

1.3.2 Commonwealth approval and assessment process

In regard to Matters of National Environmental Significance listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), this BDAR does not assess the significance of impacts against relevant Commonwealth policies. MCO may separately refer the Modification to the Commonwealth Minister to confirm if the proposed activities are a "Controlled Action" under the EPBC Act.

1.3.3 Assessment format

This BDAR addresses the two stages consistent with the BAM (DPIE 2020a):

Stage 1 – Biodiversity Assessment

- Establishing the site context (Section 2.1)
- Assessing native vegetation and threatened ecological communities (TECs) (Section 2.2)
- Assessing the habitat suitability for threatened species (Section 2.3)

- Identifying prescribed additional biodiversity impacts (Section 2.4).

Stage 2 – Impact Assessment

- Avoiding or minimising impacts on biodiversity values (Section 3)
- Assessing the impacts of the proposal on biodiversity values (including prescribed impacts) (Section 4)
- Mitigate and manage impacts on biodiversity values (Section 5)

1.4 Assessment resources and assessor qualifications

This BDAR has been prepared by the accredited personnel and support staff identified in Table 1. Resources and survey guidelines used in the preparation of this BDAR are detailed in Table 2.

Table 1: Assessor and support staff qualifications and resources

Personnel	Role	Qualifications	Tasks carried out
Luke Baker	Discipline Manager, Ecology – Flora Biodiversity Lead; BAM Accredited Assessor	BappSc Accredited Biodiversity Assessor (BAAS17033)	Report preparation.
Sian Griffiths	Senior Associate – Ecology	BEnvSc (Hons) Accredited Biodiversity Assessor (BAAS 17066)	Quality assurance and preparation of Serious and Irreversible Impacts (SAII) assessments.
Nicola Trulock	Senior Consultant - - Ecology	BSc (Hons), CEnvP Accredited Biodiversity Assessor (BAAS19058)	Project Management, Report Preparation, Impact Assessment, Data management, Field survey planning and coordination and quality assurance of SAII assessments.
Dr Jai Green-Barber	Consultant - Ecology	BNatSci (Animal Science), BSc (Honours), PhD Accredited BAM Assessor (BAAS20002)	Report preparation
Yogesh Nair	Consultant - Ecology	MSc, BEnvSci Accredited BAM Assessor (BAAS 18144)	Report preparation
Jessie Bear	Consultant - Ecology	BNatSci(Adv)(EnvMgt)	Report preparation and preparation of SAII assessments.
Jodie Danvers	Consultant- Ecology	BEnvSc	Targeted surveys – fauna
Bart Schiebaan	Ecologist, Co-Director – Hunter Ecology	B.App.Sc., Adv. Dip. Business Mgt., Cert II Conservation & Land Mgt. Accredited BAM Assessor (BAAS18033)	Targeted surveys – flora and fauna
Lizzie Bowman	Ecologist, Co-Director – Hunter Ecology	BSc, Grad Cert. Env Mgt & Sustainability Accredited BAM Assessor (BAAS18112)	Targeted surveys – flora and fauna

Table 2: Assessment resources and guidelines used

Assessment resources/guideline	
Assessment guidelines	• BAM (DPIE 2020a) • BAM Operational Manual – Stage 1 (DPIE 2020b) • BAM Operational Manual – Stage 2 (DPIE 2019a) • BAM-C User Guide (DPIE 2018a)
Survey guidelines	• Surveying Threatened Plants and their Habitats NSW Survey Guide for the Biodiversity Assessment Method (DPIE 2020c). • 'Species Credit' Threatened Bats and their Habitats, NSW Survey Guide for the Biodiversity Assessment Method (Office of Environment and Heritage [OEH] 2018a). • NSW Survey Guide for Threatened Frogs a Guide for the Survey of Threatened Frogs and their Habitats for the Biodiversity Assessment Method (DPIE 2020d) • Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (Department of Environment and Conservation 2004). • Species specific survey requirements in the BioNET Threatened Biodiversity Database Collection (DPIE 2021a). In the absence of specific survey guidelines issued at the state level, Commonwealth survey guidelines were adapted: • Survey Guidelines for Australia's Threatened Mammals (Department of Sustainability, Environment, Water, Population and Communities [DSEWPC] 2011a) • Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011b) • Survey Guidelines for Australia's Threatened Birds (Department of the Environment, Water, Heritage and the Arts 2010) • Draft Survey Guidelines for Australia's Threatened Orchids (Department of the Environment [DOE] 2013)
Previous ecological assessments	• Moolarben Coal Project – Stage 2 – Environmental Assessment Report (MCO 2008) • Ecological Impact Assessment – Stage 2 of the Moolarben Coal Project, Ulan, NSW (Ecovision 2008) • Moolarben Coal Complex UG1 Optimisation Modification Environmental Assessment (MCO 2016) • Moolarben Coal Complex – UG1 Optimisation Modification Flora and Fauna Impact Assessment (Eco Logical Australia [ELA] 2015)
Resources	• This assessment has used the BAM-C (version 1.3.0.00). • Vegetation mapping used for this BDAR has been based on the vegetation validation and BAM plot collection by ELA (2021) • Threatened microbat species polygons have been based on data and reporting undertaken for the Modification by AMBS (2021). • Moolarben Coal Complex UG2 Modification Subsidence Assessment (Mine Subsidence Engineering Consultants [MSEC] 2021). Other publications and guidelines used have been referenced within the text and included in the references section.

Current assessments informing the preparation of this BDAR include:

- *Moolarben Coal Complex UG2 Modification - Baseline Vegetation Assessment* (EcoLogical Australia [ELA] 2021)
- *Moolarben UG2 Modification – Threatened Bat Fauna Surveys* (AMBS 2021).

Both reports can be accessed in Annex 1 and Annex 2 of this BDAR.

2. Biodiversity Assessment

2.1 Landscape context

2.1.1 Landscape assessment

As detailed in section 3 of the BAM (DPIE 2020a), a landscape assessment for the Modification is required. Landscape value is derived from the assessment of a number of factors including:

- Native vegetation cover
- Rivers, streams and estuaries
- Areas of geological significance
- Habitat connectivity.

For each factor the current state of the landscape is assessed then compared with the state of the landscape if the Modification were to proceed.

Table 3 provides details of the landscape settings and scored landscape features for the Modification.

Table 3: Landscape features and scoring under the NSW BAM (DPIE 2020a)

Landscape features	Description	Figure reference
Interim Biogeographic Regionalisation for Australia (IBRA) bioregion/subregion	The Modification is located in the Kerrabee subregion which is within the Sydney Basin IBRA bioregion.	Figure 5
NSW Mitchell Landscapes	The subject land is mapped as occurring within the Gulgong Ranges and the Upper Goulburn Valleys and Escarpment NSW Landscapes (Department of Environment and Climate Change 2002).	Figure 4
Rivers, streams and estuaries and Strahler stream order	Three drainage lines have been identified as occurring in the subject land consisting of two unnamed ephemeral first stream order waterways which merge into one unnamed ephemeral second stream order waterway (Strahler 1957; Spatial Services [SS-SDS] 2021) (Figure 4). All three waterways are minor tributaries of Murragamba Creek, located 0.9 km to the east which is a minor tributary of the Goulburn River. The upper first stream order waterway (Drainage line 1) originates from the western section of the subject land and flows in a west-east direction before joining with the second stream order waterway. The lower first stream order waterway (Drainage line 2) originates to the south of the subject land and flows in a south-north direction before joining with the second stream order waterway. The second stream order waterway (Drainage line 3) flows in a west-east direction before exiting the subject land to the north-east. The unnamed creeks are minor drainage lines within the landscape and are considered intermittent waterways filled solely by overland flows resulting from seasonal rainfall. All drainage lines in the subject land were dry at the time of inspection containing little to no emergent aquatic vegetation.	Figure 4
Wetlands within and adjacent to development	No wetlands or wetland features occur within or in a 1 km vicinity of the subject land. The nearest mapped wetland is located 6.9 km to the north-west of the subject land (DPIE 2010). The nearest important wetland consists of Lake Golan which is located 120 km to the north-east of the subject land (Department of Environment and Energy [DoEE] 2010). The	-

Landscape features	Description	Figure reference
	nearest RAMSAR wetland consists of the Hunter Estuary Wetlands located 187 km to the south-east of the subject land (DPIE 2012). No waterways within the subject land are directly connected with the abovementioned wetland features.	
Connectivity features	Native vegetation within the subject land is directly connected to extensive areas of native vegetation associated with Munghorn Gap Nature Reserve (to the south). Wollemi National Park, 40 km to the south-east, and Goulburn River National Park to north, via a corridor of hills and mountains swathed in remnant native vegetation forming high quality fauna and flora habitat. This wildlife corridor allows for dispersal of native fauna from the eastern seaboard to the western side of the Great Dividing Range allowing for genetic interchange. The subject land forms the northern limits of this wildlife corridor.	Figure 4
Buffer area (percent native vegetation cover)	A 1,500 m buffer was applied to the subject land resulting in an overall buffer area of 799.56 ha. Existing vegetation mapping (ELA 2021) combined with *State Vegetation Type Map: Central Tablelands Region Version 1.0. VIS_ID 4778* (DPIE 2019b) identified 27 Plant Community Types (PCTs) within the buffer area. ***Woody vegetation cover*** The native vegetation extent and cover of woody vegetation was determined via aerial photography interpretation based on canopy cover. For woody vegetation 72 % of the buffer area was determined to support native woody vegetation with benchmark cover (576.09 ha). ***Non-woody vegetation cover*** For non-woody vegetation, experience of the subject land was drawn upon in addition to aerial photography interpretation to estimate cover of native grassland vegetation. For non-woody vegetation 8% of the buffer area was determined to support native grassland with benchmark cover (64.45 ha). ***Total native vegetation cover*** Combining the estimated woody and non-woody vegetation cover resulted in 80% of the buffer area supporting native vegetation.	Figure 5
Karst, caves, crevices, cliffs, rocks and other geological features of significance	There are three rocky outcrops (with caves and crevices) in the subject land towards the south and others rocky outcrops (with caves and crevices) in the wider surrounds. Two main cliff lines are located outside of the subject land (i.e. C9 and C10). Rocky Areas, comprising scattered surface rock, are present throughout the subject land. There are no high hazard soil areas mapped in the subject land.	Figure 4
Areas of Outstanding Biodiversity Value (AOBVs)	The Register of Declared Areas of Outstanding Biodiversity Value (AOBV) has information about declared AOBV in NSW. AOBV declarations in NSW include the following: ▪ Gould's Petrel – critical habitat declaration ▪ Little penguin population in Sydney's North Harbour – critical habitat declaration ▪ Mitchell's Rainforest Snail in Stotts Island Nature Reserve – critical habitat declaration ▪ Wollemi Pine – critical habitat declaration. No registered AOBVs occur within the subject land or surrounds.	

2.2 Native vegetation

This section describes the survey effort, identification and determination of the extent of Plant Community Types (PCTs) occurring across the subject land.

Prior to field survey, ELA completed a desktop-based review of relevant databases and spatial information was undertaken using the following resources (ELA 2021):

- NSW State Vegetation Type Map: Central Tablelands Region Version 1.0 (DPIE 2019b)
- Gulgong 1:100,000 Geological Map (NSW Government Mining, Exploration and Geoscience 2000)
- NSW Landuse 2017 spatial data (DPIE 2017)
- MCO aerial imagery 2020 (MCO 2020b)
- NSW BioNET Vegetation Classification (DPIE 2021c)
- 2 m contours as supplied by MCO
- Water Management (General) Regulation 2018 Hydro Line spatial data (DPIE 2018b)
- NSW Land and Property Information Roads Layer (NSW Government Spatial Services 2021a)
- Historical aerial imagery (NSW Government Spatial Services 2021b).

The results of the desktop-based review were used to produce a draft vegetation map displaying vegetation communities in accordance with PCTs which was used to guide the field survey. Prior to undertaking the field survey, ELA reviewed the PCTs identified within and in close proximity to the subject land to determine whether any had the potential to be aligned with TECs listed under the BC Act or EPBC Act.

2.2.1 Methods – vegetation zone mapping

Field survey to map the PCTs occurring on the subject land was undertaken by ecologists from ELA between 11 February to 27 July 2021 (ELA 2021) using a combination of rapid data points (RDPs) and walking transects. At each RDP, the following data was collected:

- Dominant canopy, mid-storey and groundcover species present
- Vegetation formation and class in accordance with Keith (2004)
- Landform and landscape type
- Weed species
- Soil type
- Evidence of previous disturbance
- A photograph
- Opportunistic observations of threatened flora, TECs, and high threat and / or priority weeds.

2.2.2 Results – vegetation zone mapping

A total of nine PCTs were mapped across the subject land (Figure 6). PCTs recorded across the subject land were stratified into Vegetation Zones (VZ) in accordance with PCT identification and condition using a combination of RDPs and historical and current aerial imagery (Table 4).

Descriptions of PCTs mapped in the subject land are located in Sections 3.1.1 to 3.1.9 in Annex 1 of this report.

Table 4. PCTs present in the subject land and surrounds and corresponding VZs (ELA 2021)

PCT ID	PCT Name[1]	BC Act status	EPBC Act status	Vegetation formation (Keith 2004)	Vegetation class (Keith 2004)	PCT % cleared[1]	Condition	VZ
434	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	Critically Endangered	Critically Endangered	KF_CH3 Grassy Woodlands	Western Slopes Grassy Woodlands	60%	Regenerating woodland	1
472	Thyme Honey-myrtle – red gum – Mugga Ironbark shrubland / woodland in impeded drainage flats or depressions in the southern Brigalow Belt South Bioregion	Critically Endangered (as per ELA 2021)	Not listed	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	70%	Remnant Shrubby woodland	2
478	Red Ironbark – Black Cypress Pine – stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong – Mendooran region, southern Brigalow Belt South Bioregion	Not listed	Not listed	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	29%	Remnant forest	3
479	Narrow-leaved Ironbark- Black Cypress Pine – stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	Not listed	Not listed	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	40%	Remnant forest	4
1176	Slaty Box – Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	Vulnerable	Critically Endangered	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	40%	Moderate	5
							Low	6
1610	White Box – Black Cypress Pine shrubby woodland of the Western Slopes	Critically Endangered (as per ELA 2021)	Not listed	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	67%	Remnant forest	7
1614	Grey Gum – Grey Myrtle – Narrow-leaved Stringybark – Rusty Fig open forest on ranges of the Upper Hunter	Not listed	Not listed	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Hinterland Dry Sclerophyll Forests	27%	Remnant forest	8
1629	Narrow-leaved Stringybark – Grey Gum shrubby open forest on sandstone ranges of the Sydney Basin	Not listed	Not listed	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	1%	Remnant forest	9
1767	Rough-barked Apple grassy tall woodlands of the Brigalow Belt South	Not listed	Not listed	KF_CH3 Grassy Woodlands	Western Slopes Grassy Woodlands	0%	Remnant woodland	10

[1] BioNet Vegetation Classification (DPIE 2021c).

2.2.3 Methods – vegetation integrity

Prior to the field survey, the BAM (DPIE 2020a) was consulted to determine the minimum plot requirements (BAM plots) for assessing vegetation integrity (VI) for each of the VZs. The minimum number of plots required for each VZ is provided in Table 5 below.

Table 5. Area of PCTS within the subject land and surrounds and minimum BAM plot requirement

VZ	PCT ID/name	Condition	Subject Land Area (ha)	Plots required (BAM)
1	434 - White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	Regenerating woodland	1.3	1
2	472 - Thyme Honey-myrtle – red gum – Mugga Ironbark shrubland / woodland in impeded drainage flats or depressions in the southern Brigalow Belt South Bioregion	Remnant shrubby woodland	2.9	2
3	478 - Red Ironbark – Black Cypress Pine – stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong – Mendooran region, southern Brigalow Belt South Bioregion	Remnant forest	8.1	3
4	479 - Narrow-leaved Ironbark- Black Cypress Pine – stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	Remnant forest	2.4	2
5	1176 - Slaty Box – Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	Moderate	2.4	2
6		Low	0.9	1
7	1610 - White Box – Black Cypress Pine shrubby woodland of the Western Slopes	Remnant forest	0	0
8	1614 - Grey Gum – Grey Myrtle – Narrow-leaved Stringybark – Rusty Fig open forest on ranges of the Upper Hunter	Remnant forest	1.1	1
9	1629 - Narrow-leaved Stringybark – Grey Gum shrubby open forest on sandstone ranges of the Sydney Basin	Remnant forest	4.0	2
10	1767 - Rough-barked Apple grassy tall woodlands of the Brigalow Belt South	Remnant woodland	11.7	3
Total			**34.8**	**17**

BAM plot surveys were completed between 30 March to 26 July 2021 by ecologists from ELA (2021). All BAM plots were undertaken in accordance with the BAM (DPIE 2020a) consisting of a 20 m x 50 m plot (centred around a central 50 m transect) for recording of functional attributes and a nested 20 m x 20 m quadrat for recording composition (species richness) and structural (foliage cover) attributes.

Data recorded within each 20 m x 20 m nested quadrat includes:

- A full count of native and exotic species richness
- Projected foliage cover of all species in increments of 0.1-0.9, 1-5 then 5% increments capped at 100%
- Abundance of all species recorded as a relative measure of the number of individuals or shoots of a species within the quadrat using the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000, or specify a number greater than 1000 if required.

Data recorded within the 20 m x 50 m plot includes:

- Diameter at breast height (DBH), measured 1.3 m from the ground, of all canopy trees in the plot
- Presence and number of canopy trees within specific DBH size increments (<5 centimetres [cm], 5-10 cm, 11-20 cm, 21-30 cm, 31-40 cm, 41-50 cm etc.)
- Number of large trees (>50 cm DBH) and presence of regenerating trees (<5 cm DBH)
- Number of hollow-bearing trees (HBTs)
- Length of coarse woody debris measured in metres.

As described in the ELA report (2021), the start point of Plot 13 which targets PCT 479 is positioned outside the boundary of the subject land as a result of subsequent changes in the subject land extent; however, the plot extends into the subject land and the resultant data is considered to be representative of the VZ.

2.2.4 Results - vegetation integrity

A total of 24 BAM plots were collected throughout the subject land. The location of all BAM plots is shown in Figure 6 and the raw data is located in Annex 3.

The VI score was obtained by entering BAM plot data into the BAM-C. The data provides quantitative measures of composition, structure and function for each VZ (Annex 4). The BAM-C compares the values recorded in each VZ on the subject land with the benchmark for the PCT described in the BioNET Vegetation Classification database (DPIE 2021c) to provide the VI score. This score represents the overall condition, health and function of the vegetation compared to the benchmark value (out of 100).

Patch size for all VZs was given the highest score in the BAM-C (>100 ha), as the native vegetation in the subject land is directly connected to other large areas of native vegetation (as can be seen on Figure 5).

The minimum number of plots as per the BAM-C and number of completed plots are detailed in Table 6 and Figure 6.

Table 6: Vegetation zones within the subject land with minimum number of plots required and completed plots

VZ (PCT number)	Condition	Patch size (ha)	Subject Land Area (ha)	Plots required (BAM)	Plots completed
1 (434)	Regenerating woodland	>100	1.3	1	3
2 (472)	Remnant shrubby woodland	>100	2.9	2	2
3 (478)	Remnant forest	>100	8.1	3	3
4 (479)	Remnant forest	>100	2.4	2	2
5 (1176)	Moderate	>100	2.4	2	2
6 (1176)	Low	>100	0.9	1	1
7 (1610)	Remnant forest	>100	0	0	1
8 (1614)	Remnant forest	>100	1.1	1	1
9 (1629)	Remnant forest	>100	4.0	2	3
10 (1767)	Remnant woodland	>100	11.7	3	6
Total			**34.8**	**18**	**24**

Note: VEC = Vulnerable Ecological Community, CEEC = Critically Endangered Ecological Community.

2.2.5 Threatened ecological communities

Of the PCTs mapped within the subject land and surrounds, four (PCTs 434, 472, 1176 and 1610) are consistent with the description and listing criteria for TECs listed under NSW (BC Act) and Commonwealth

(EPBC Act) legislation as outlined in Table 7 below, displayed in Figure 7, and described in Section 3.2 of Annex 1.

Table 7: TECs within the subject land

PCT ID	VZ	Threatened Ecological Community	BC Act Area (ha)	EPBC Act Area (ha)	Area (ha)
PCT 434	1	BC Act listed CEEC *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions* EPBC Act listed CEEC *White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the Sydney Basin*	1.3	1.3	1.3
PCT 472	2	BC Act listed CEEC *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions*	2.9	0	2.9
PCT 1176	5 & 6	BC Act listed VEC *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion* EPBC Act listed CEEC *Central Hunter Valley eucalypt forest and woodlands*	3.3	3.3	3.3
PCT 1610	7	BC Act listed CEEC *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions*	0	0	0

2.3 Threatened species

A review of relevant literature, databases and existing vegetation mapping (ELA 2021) was undertaken to identify potentially occurring threatened biodiversity within the subject land. This process informed initial survey effort and survey design.

The following resources were accessed as part of the data review:

- NSW BioNet Atlas Database (DPIE 2021b) for spatial records of threatened flora listed under the BC Act within a 10 km radius of the subject land – accessed 10 August 2021.
- EPBC Act Protected Matters Search Tool (Department of Agriculture, Water and Environment [DAWE] 2021a) for threatened flora and ecological communities identified as MNES known from or with potential habitat within a 10 km radius of the subject land – accessed 16 August 2021.
- BAM-C tool (using BAM plot data from ELA 2021) to identify candidate species credit species and predicted ecosystem credit species known or predicted to occur within the IBRA subregion – BAM-C output from 9 August 2021.
- NSW Bionet Threatened Biodiversity Database Collection (TBDC) (DPIE 2021a) – accessed August 2021.
- Vegetation mapping: existing vegetation mapping (ELA 2021) was examined prior to the field survey to determine the location of suitable habitats for threatened flora and fauna likely to be present in the subject land.
- Threatened fauna records derived from previous surveys in or adjacent to the subject land (Ecovision 2008, ELA 2015). The survey effort and results for these studies are summarised in Table 8.

Table 8. Summary of previous studies of the subject land

Previous studies	Survey effort	Results summary
Ecological Impact Assessment – Stage 2 of the Moolarben Coal Project, Ulan, NSW (Ecovision 2008)	The survey was undertaken over the entire Stage 2 layout which spanned across 3,382 ha and included the subject land for this Modification. A total of 211 quadrats were undertaken between spring 2004 to winter 2008. Systematic fauna surveys were undertaken between summer 2004 and spring 2005 with targeted surveys undertaken between Summer 2004 through to Winter 2008. Targeted and opportunistic flora and fauna surveys throughout the duration.	The following threatened biodiversity was detected during surveys of the Stage 2 study area which included the subject land for the Modification. TECs: ▪ 295 ha of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (Critically Endangered, BC Act and EPBC Act). Six threatened flora species: ▪ Ausfeld's Wattle *Acacia ausfeldii* (Vulnerable, BC Act) ▪ Capertee Stringybark *Eucalyptus cannonii* (Vulnerable, BC Act) ▪ Hoary Sunray *Leucochrysm albicans* var. *tricolor* (Endangered, EPBC Act) ▪ Pine Donkey Orchid *Diuris tricolor* (Vulnerable, BC Act) ▪ Planted Wallangarra White Gum *Eucalyptus scoparia* (Endangered, BC Act and Vulnerable, EPBC Act). ▪ Scant Pomaderris *Pomaderris queenslandica* (Endangered, BC Act). 18 Threatened fauna species: ▪ Black-chinned Honeyeater *Melithreptus gularis gularis* (Vulnerable, BC Act) ▪ Brown Treecreeper *Climacteris picumnus victoriae* (Vulnerable, BC Act) ▪ Diamond Firetail *Stagonopleura guttata* (Vulnerable, BC Act) ▪ Eastern Long-eared Bat *Nyctophilus bifax* (Vulnerable, BC Act) ▪ Gang-gang cockatoo *Callocephalon fimbriatum* (Vulnerable, BC Act) ▪ Gilbert's Whistler *Pachycephala inornata* (Vulnerable, BC Act) ▪ Glossy Black Cockatoo *Calyptorhynchus lathami* (Vulnerable, BC Act) ▪ Grey-crowned Babbler *Pomatostomus temporalis temporalis* (Vulnerable, BC Act) ▪ Hooded Robin *Melanodryas cucullata cucullata* (Vulnerable, BC Act) ▪ Large Bent-winged Bat *Miniopterus orianae oceanensis* (Vulnerable, BC Act) ▪ Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable, BC Act and EPBC Act) ▪ Little Pied Bat *Nyctophilus picatus* (Vulnerable, BC Act) ▪ Painted Honeyeater *Grantiella picta* (Vulnerable, BC Act and EPBC Act) ▪ Powerful Owl *Ninox strenua* (Vulnerable, BC Act) ▪ Speckled Warbler *Chthonicola sagittata* (Vulnerable, BC Act) ▪ Square-tailed Kite *Lophoictinia isura* (Vulnerable, BC Act) ▪ White-throated Needletail *Hirundapus caudacutus* (Vulnerable, EPBC Act) ▪ Yellow-bellied Sheathtailed-bat *Saccolaimus flaviventris* (Vulnerable, BC Act). Three migratory species: ▪ Rainbow Bee-eater *Merops ornatus* (Migratory, EPBC Act) ▪ Rufous Fantail *Rhipidura rufifrons* (Migratory, EPBC Act) ▪ Satin Flycatcher *Myiagra cyanoleuca* (Migratory, EPBC Act)

Previous studies	Survey effort	Results summary
Moolarben Coal Complex – UG1 Optimisation Modification Flora and Fauna Impact Assessment (ELA 2015)	The survey was undertaken over the UG1 optimisation modification area over 3 days between 17-19 June 2014 consisting of: ▪ Vegetation mapping ▪ Random meanders ▪ RDPs ▪ Habitat assessment ▪ Targeted threatened flora survey ▪ Targeted microbat survey ▪ Targeted diurnal bird survey ▪ Koala habitat assessment ▪ Opportunistic fauna sightings.	The following threatened biodiversity was detected within the UG1 optimisation modification area. TECs: ▪ 295 ha of Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions (Endangered, BC Act). ▪ 295 ha of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (Critically Endangered, BC Act and EPBC Act). Threatened flora species: ▪ Scant Pomaderris *Pomaderris queenslandica* (Endangered, BC Act). Threatened fauna species: ▪ Brown Treecreeper *Climacteris picumnus victoriae* (Vulnerable, BC Act) ▪ Diamond Firetail *Stagonopleura guttata* (Vulnerable, BC Act) ▪ Glossy Black Cockatoo *Calyptorhynchus lathami* (Vulnerable, BC Act) ▪ Large Bent-winged Bat *Miniopterus orianae oceanensis* (Vulnerable, BC Act) ▪ Speckled Warbler *Chthonicola sagittata* (Vulnerable, BC Act) ▪ Varied Sittella *Daphoenositta chrysoptera* (Vulnerable, BC Act).

2.3.1 Assessing the habitat suitability for threatened species

In accordance with the BAM (DPIE 2020a), assessing habitat suitability for an ecosystem credit species involves the following steps:

Step 1: Identify ecosystem credit species for assessment; and

Step 2: Assess the habitat constraints and vagrant species.

The list of predicted species (ecosystem credit species) generated via the BAM-C is displayed in Table 9 below. Predicted species that have been confirmed in the subject land during current surveys (AMBS 2021, ELA 2021) have been categorised as present. For the purpose of this assessment, it is assumed that all predicted species may have potential habitat in the subject land.

Table 9. List of predicted species (ecosystem credit species) for the subject land as determined by BAM-C

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Status (Site)
Barking Owl (foraging)	*Ninox connivens*	V	-	Assumed present
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V	-	Assumed present, previously recorded (Ecovision 2008).
Broad-headed Snake (foraging)*	*Hoplocephalus bungaroides*	E	V	Assumed present
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-	Present. Recorded during surveys (AMBS 2021). Previously recorded (Ecovision 2008; ELA 2015).
Corben's Long-eared Bat	*Nyctophilus corbeni*	V	V	Present. Recorded during surveys (AMBS 2021).
Diamond Firetail	*Stagonopleura guttata*	V	-	Present. Recorded during surveys (AMBS 2021). Previously recorded (Ecovision 2008).
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	Assumed present
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V	-	Assumed present
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-	Assumed present
Flame Robin	*Petroica phoenicea*	V	-	Assumed present
Gang-gang Cockatoo (foraging)	*Callocephalon fimbriatum*	V	-	Assumed present
Glossy Black-Cockatoo (foraging)	*Calyptorhynchus lathami*	V	-	Assumed present, previously recorded (Ecovision 2008; ELA 2015).
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	Assumed present
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*	V	-	Present. Recorded during surveys (AMBS 2021). Previously recorded (Ecovision 2008) and recorded during the current surveys.
Grey-headed Flying-fox (foraging)	*Pteropus poliocephalus*	V	V	Assumed present
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-	Assumed present, previously recorded (Ecovision 2008).
Koala (foraging)	*Phascolarctos cinereus*	V	V	Present. Recorded during surveys (AMBS 2021).
Large Bent-winged Bat (foraging)	*Miniopterus orianae oceanensis*	V	-	Present. Recorded during surveys (AMBS 2021). Previously recorded (Ecovision 2008; ELA 2015).
Little Bent-winged Bat (foraging)	*Miniopterus australis*	V	-	Assumed present
Little Eagle (foraging)	*Hieraaetus morphnoides*	V	-	Assumed present
Little Lorikeet	*Glossopsitta pusilla*	V	-	Assumed present
Masked Owl (foraging)	*Tyto novaehollandiae*	V	-	Assumed present
New Holland Mouse	*Pseudomys novaehollandiae*	-	V	Assumed present

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Status (Site)
Painted Honeyeater	*Grantiella picta*	V	V	Assumed present
Powerful Owl (foraging)	*Ninox strenua*	V	-	Assumed present, previously recorded (Ecovision 2008).
Regent Honeyeater (foraging)*	*Anthochaera phrygia*	CE	CE	Assumed present
Rosenberg's Goanna	*Varanus rosenbergi*	V	-	Assumed present
Scarlet Robin	*Petroica boodang*	V	-	Assumed present
Speckled Warbler	*Chthonicola sagittata*	V	-	Assumed present, previously recorded (Ecovision 2008; ELA 2015).
Spotted Harrier	*Circus assimilis*	V	-	Assumed present
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	Assumed present
Square-tailed Kite (foraging)	*Lophoictinia isura*	V	-	Assumed present, previously recorded (Ecovision 2008).
Swift Parrot (foraging)*	*Lathamus discolor*	E	CE	Assumed present
Turquoise Parrot	*Neophema pulchella*	V	-	Assumed present
Varied Sittella	*Daphoenositta chrysoptera*	V	-	Present. Recorded during surveys (AMBS 2021). Previously recorded (ELA 2015).
White-bellied Sea-Eagle (foraging)	*Haliaeetus leucogaster*	V	-	Assumed present
White-throated Needletail	*Hirundapus caudacutus*	-	V	Assumed present, previously recorded (Ecovision 2008).
Yellow-bellied Glider	*Petaurus australis*	V	-	Assumed present
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	Present. Recorded during surveys (AMBS 2021). Previously recorded (Ecovision 2008).

Table note: CE = Critically Endangered, E = Endangered, V = Vulnerable, * = dual credit species in which the foraging resource component occurs as a predicted species within the BAM-C.

Assessing habitat suitability for a species credit species involves the following steps:

Step 1. Identify species credit species for assessment.

Step 2. Assess the habitat constraints and vagrant species for species credit species on the Biodiversity Assessment Development Footprint.

Step 3: Further assessment of candidate species credit species.

Step 4: Determine the presence of a candidate species credit species.

Step 5: Determine the area or count, and location of suitable habitat for a species credit species (a species polygon).

Step 6: Determine the habitat condition within the species polygon for species assessed by area.

The list of candidate species (species credit species) generated via the BAM-C is provided in Section 2.3.1.1 (flora) and Section 2.3.1.2 (fauna). Threatened flora and fauna species identified as having a moderate or higher likelihood of occurrence in the subject land, which were not in the list generated by BAM-C, were added to the candidate species list for further assessment.

2.3.1.1 Threatened flora (species credit species)

All threatened flora species are regarded as 'species credit' species in the BAM. A total of 32 threatened flora have previously been recorded or have modelled habitat within a 10 km radius of the subject land (Annex 5). The assessment of the likelihood of occurrence of the above species determined that 26 threatened flora species have or may have suitable habitat within the subject land and therefore were relevant species to target during the surveys (Section 2.3.2) (Table 10).

All of the flora species generated via the BAM-C for the PCTs present in the subject land are listed in Table 10. All of the flora species in Table 10 were identified in the BAM-C with exception of Austral Toadflax. Austral Toadflax has been included in Table 10 as Niche Environment and Heritage Pty Ltd (Niche) consider that it may have suitable habitat in the subject land.

A total of nine threatened flora have previously been recorded within a 10 km radius of the subject land (Figure 8), and all of these species are included in Table 10 with exception of *Prasophyllum petilum* and *Pultenaea glabra*, as these species had no associated PCTs in the subject land and were not considered likely to occur.

Table 10. Threatened flora considered likely to occur on subject land

Scientific Name	Common name	Status (BC Act)	Status (EPBC Act)
Acacia ausfeldii	Ausfeld's Wattle	V	
Acacia dangarensis		CE	
Acacia pendula	Acacia pendula population in the Hunter catchment	EP	
Commersonia procumbens		V	V
Commersonia rosea		E	E
Cymbidium canaliculatum		EP	
Cynanchum elegans	White-flowered Wax Plant	E	E
Diuris tricolor	Pine Donkey Orchid	V	

Scientific Name	Common name	Status (BC Act)	Status (EPBC Act)
Eucalyptus cannonii	Capertee Stringybark	V	
Eucalyptus fracta	Broken Back Ironbark	V	
Homoranthus darwinioides	Fairy Bells	V	V
Kennedia retrorsa		V	V
Lasiopetalum longistamineum		V	V
Leionema lamprophyllum subsp. *fractum*		CE	
Monotaxis macrophylla	Large-leafed Monotaxis	E	
Ozothamnus tesselatus		V	V
Pomaderris queenslandica	Scant Pomaderris	E	
Pomaderris reperta	Denman Pomaderris	CE	CE
Pomaderris sericea	Silky Pomaderris	E	V
Prasophyllum sp. Wybong			CE
Prostanthera cryptandroides subsp. *cryptandroides*	Wollemi Mint Bush	V	V
Prostanthera discolor		V	V
Prostanthera stricta	Mount Vincent Mint-bush	V	V
Senecio linearifolius var. *dangarensis*		E	
Thesium australe	Austral Toadflax	V	V
Tylophora linearis		V	E

Table note: CE = Critically Endangered, EP = Endangered Population, E = Endangered, V = Vulnerable.

2.3.1.2 Threatened fauna (species credit species)

A total of 59 threatened fauna species have previously been recorded or have modelled habitat within a 10 km radius of the subject land (Annex 5). A total of 26 threatened fauna species (species credit species) were determined to have suitable habitat within the subject land. These species are listed in Table 11 below.

All of the threatened fauna species (species credit species) generated via the BAM-C for the PCTs present in the subject land are listed in Table 11, with exception of the Giant Burrowing Frog, Grey-headed Flying-fox, Little Bentwing Bat. All of the fauna species in Table 11 were identified in the BAM-C, with exception of the Parma Wallaby and Superb Parrot. The Parma Wallaby has been added to Table 11 as it was recorded during the field survey (Section 2.4.3) and the Superb Parrot added to Table 11 as it had the potential to occur within the subject land based detection of potential habitat identified during the field survey (Section 2.4.3).

A total of eight threatened fauna species (species credit species) have previously been recorded within a 10 km radius of the subject land (Figure 9), and all of these species are included in Table 11.

Table 11: Threatened fauna (species credit species) confirmed or considered likely to occur on the subject land

Scientific Name	Common name	Status (BC Act)	Status (EPBC Act)	Credit type
Anthochaera phrygia	Regent Honeyeater	CE	CE	Ecosystem/Species
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	Species
Burhinus grallarius	Bush Stone-curlew	E	-	Species
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Ecosystem/Species
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Ecosystem/Species
Cercartetus nanus	Eastern Pygmy-possum	V	-	Species
Chalinolobus dwyeri	Large-eared Pied-bat	V	V	Ecosystem/Species
Delma impar	Striped Legless Lizard	V	V	Species
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Ecosystem/Species
Hieraaetus morphnoides	Little Eagle	V	-	Ecosystem/Species
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	Species
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Ecosystem/Species
Lathamus discolor	Swift Parrot	E	CE	Ecosystem/Species
Lophoictinia isura	Square-tailed Kite	V	-	Ecosystem/Species
Miniopterus orianae oceanensis	Large Bent-winged-bat	V	-	Ecosystem/Species
Ninox connivens	Barking Owl	V	-	Ecosystem/Species
Ninox strenua	Powerful Owl	V	-	Ecosystem/Species
Petauroides volans	Greater Glider	-	V	Species
Petaurus norfolcensis	Squirrel Glider	V	-	Species
Petrogale penicillate	Brush-tailed Rock-wallaby	E	V	Species
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	Species
Phascolarctos cinereus	Koala	V	V	Ecosystem/Species
Polytelis swainsonii	Superb Parrot	V	V	Ecosystem/Species
Pseudophryne australis	Red-crowned Toadlet	V	-	Species
Tyto novaehollandiae	Masked Owl	V	-	Ecosystem/Species
Vespadelus troughtoni	Eastern Cave Bat	V	-	Ecosystem/Species
Macropus parma	Parma Wallaby	V		Species

Table note: CE = Critically Endangered, E = Endangered, V = Vulnerable.

2.3.2 Flora assessment

A total of 26 threatened flora species (candidate species) with the potential to occur or have habitat within the subject land are presented in Table 10. The BAM requires the presence of the candidate species in the subject land to be determined through surveys, assuming presence, or expert report.

This section details the survey effort used to detect the presence/absence of threatened flora and their habitats within the subject land. Any threatened flora with potential habitat which is likely to be impacted by the Modification is detailed further in the impact assessment (Section 4).

2.3.2.1 Threatened flora survey

The Stage 2 area to the north of the subject land has been subject to threatened flora surveys over the past 17 years. In particular, the Stage 2 area was subject to threatened flora surveys to support the Stage 2 Environmental Assessment (Ecovision 2008) and the UG1 Optimisation Modification (ELA 2015), the results of which are outlined in Table 8.

Targeted threatened flora surveys were undertaken by Hunter Ecology (on behalf of Niche) between 21-25 September 2021.

The identity, role and experience of all ecologists who have conducted targeted threatened species survey for the Modification are outlined in Table 1.

Threatened flora targeted surveys undertaken by Niche in the subject land were restricted to those species in Table 12 where the required survey period occurs in August or September and are associated with PCTs identified within the subject land.

The field transects completed consisted of 5, 10 and 20 m parallel field traverses throughout all associated PCTs with particular attention to cliff lines including crest and base of slopes, steep slopes and ephemeral waterways and drainage lines, which is consistent with *Surveying Threatened Plants and their Habitats, NSW Survey Guide for the Biodiversity Assessment Method* (DPIE 2020c).

A summary of the survey effort has been provided in Table 12 and displayed on Figure 10.

Table 12: Targeted Flora survey effort

Survey technique	Date	Survey hours	Species targeted
5 m width transect	21-25 September 2021	80	*Commersonia procumbens* *Commersonia rosea* *Cymbidium canaliculatum* *Cynanchum elegans* *Diuris tricolor* *Monotaxis macrophylla* *Tylophora linearis*
10 m width transects	21-25 September 2021	80	*Acacia ausfeldii* *Acacia dangarensis* *Acacia pendula* *Homoranthus darwinioides* *Indigofera efoliata* *Kennedia retrorsa* *Lasiopetalum longistamineum* *Leionema lamprophyllum subsp. fractum* *Ozothamnus tesselatus* *Pomaderris queenslandica* *Pomaderris reperta* *Pomaderris sericea*
20 m width transects	21-25 September 2021	80	*Eucalyptus cannonii* *Eucalyptus fracta*

2.3.2.2 Weather conditions during threatened flora survey

Weather conditions were generally mild during the September flora targeted survey period. Atmospheric conditions during the survey periods are presented in Table 13 below.

Table 13: Climate conditions during targeted flora survey 21-25 September 2021

Conditions	Survey	Wind direction and max. speed (km/h)	Max. temperature (°C)	Min. temperature (°C)	Rain (mm)	Relative humidity at 9am (%)
21 September 2021	Targeted flora survey	SW 30 km/h	12.9	4.4	0.2	65
22 September 2021	Targeted flora survey	WSW 13 km/h	18.9	1,1	0.0	66
23 September 2021	Targeted flora survey	W 7 km/h	21.0	3.5	0.0	73
24 September 2021	Targeted flora survey	NW 11 km/h	22.5	4.4	0.0	72
25 September 2021	Targeted flora survey	W 17 km/h	20.1	3.6	0.0	48

Note: km/h = kilometres per hour, °C = degrees Celsius, mm = millimetres
Data from Ulan Water (62036) (BoM 2021a) and Mudgee Airport AWS (62101) (BoM 2021b); BoM weather stations, www.bom.gov.au

2.3.2.3 Results – targeted threatened flora survey

The field survey entailed sufficient effort (80 hours of traverses) to determine the occurrence of threatened flora within the subject land. No threatened flora were recorded during the field survey.

The results of targeted threatened flora survey are outlined in Table 14 below. Of the candidate species derived from BAM-C, only two species, Austral Toadflax and *Tylophora linearis,* could not be ruled out via targeted survey (as it occurred outside the required survey period), or by absence of habitat constraints within the subject land as follows:

- Austral Toadflax – *Thesium australe* (Vulnerable, BC Act and EPBC Act) – surveys occurred outside of the required survey period (November – February) and potential habitat for this species occurs within the subject land (PCT 434 and 1176). This species is semi-parasitic to root of Kangaroo Grass. Kangaroo Grass was recorded in some of the plots.
- *Tylophora linearis* – (Vulnerable, BC Act and Endangered, EPBC Act) - surveys occurred outside of the required survey period (October – May) and potential habitat for this species occurs within the subject land (PCTs 479 and 1176).

Species polygons have been prepared for these species (Figures 13r and 13s). These species are considered further in Section 4 of this BDAR.

Table 14. Candidate threatened flora targeted survey results and species requiring further consideration

Species name	Common name	BC Act	EPBC Act	PCT association	Months of survey	Geographic constraints (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Targeted survey results and justification	Species requires species polygon?
Acacia ausfeldii	Ausfeld's Wattle	V	-	434, 1610, 1767	Aug-Oct	NA	Footslopes and low rises on sandstone	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Acacia dangarensis	-	CE	-	1176	Jan-Dec	Mount Dangar region, within the Goulburn River National Park and adjacent freehold lands	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey. Further, the species is only known from Mount Dangar which is over 15 km from the subject land.	No
Acacia pendula	Acacia pendula population in the Hunter catchment	EP	-	1176	Jan-Dec	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Commersonia procumbens	-	V	V	434, 472, 478, 479, 1176, 1610	Aug-May	NA	Piliga sandstone	The species was not detected during targeted survey. Survey completed during the required survey period (September). The germination of this species is stimulated by fire and disturbance events and is known to remain dormant underground for long periods as rootstock. The species was detected in high numbers (approx. 200 individuals) recently in nearby UG4 in areas which had not been subject to recent fire or disturbance; therefore, if this species were present in UG2, it would be expected that it would be detected during targeted survey. Therefore, species presence is excluded.	No

Species name	Common name	BC Act	EPBC Act	PCT association	Months of survey	Geographic constraints (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Targeted survey results and justification	Species requires species polygon?
Commersonia rosea	-	E	E	1176	Jan-Dec	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey. Further, the species is only known from Sandy Hollow area which is over 100 km from the subject land.	No
Cymbidium canaliculatum	*Cymbidium canaliculatum* population in the Hunter Catchment	EP	-	1176	Jan-Dec	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey. Samples were taken of Cymbidium spp. detected in the subject land by ELA (2021) which were excluded as this species by the NSW Herbarium.	No
Cynanchum elegans	White-flowered Wax Plant	E	E	1629	Jan-Dec	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Diuris tricolor	Pine Donkey Orchid	V	-	1176	Sep-Oct	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The germination of this species is stimulated by sufficient rain in the lead up to flowering and is known to remain dormant underground for long periods as tubers. As the subject land has been subject to recent rains; it is highly probable that this species would have been detected if it were present. Therefore, species presence is excluded.	No
Eucalyptus cannonii	Capertee Stringybark	V	-	1176, 1610	Jan-Dec	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Eucalyptus fracta	Broken Back Ironbark	V	-	1629	Jan-Dec	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No

Species name	Common name	BC Act	EPBC Act	PCT association	Months of survey	Geographic constraints (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Targeted survey results and justification	Species requires species polygon?
Homoranthus darwinioides	Fairy Bells	V	V	1176	Mar-Dec	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). This species is easily identifiable when in flower. The species is inconspicuous during the non-flowering period; however, surveys were conducted during the appropriate flowering period and it would be expected to be detected if it were present in the subject land. Therefore, this species is excluded.	No
Kennedia retrorsa	-	V	V	1176	Sep-Nov	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Lasiopetalum longistamineum	-	V	V	1176	Sep-Nov	NA	Enriched alluvial gullies or within 200 m	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Leionema lamprophyllum subsp. *fractum*	-	CE	-	1629	Sep-Nov	NA	Cliffs;Sandstone cliffs or ledges or within 100 m, Other; Sandstone footslopes or within 100 m	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Monotaxis macrophylla	Large-leafed Monotaxis	E	-	472, 478, 479, 1176, 1610, 1614	Aug-Feb	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). This species is a short lived annual, living for up to 12 months after germination. The germination of this species is stimulated by fire and disturbance events and is known to remain dormant underground for long periods within the soil seedbank. No evidence of this species was detected within the subject land during recent surveys; therefore, this species is excluded.	No

Species name	Common name	BC Act	EPBC Act	PCT association	Months of survey	Geographic constraints (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Targeted survey results and justification	Species requires species polygon?
Ozothamnus tesselatus	-	V	V	1176	Sept-Oct	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Pomaderris queenslandica	Scant Pomaderris	E	-	472, 1176, 1614	Jan-Dec	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species requires a flowering specimen for confirmation of species identification. Samples from flowering Pomaderris spp. occurring in the subject land were taken and sent to the NSW Herbarium who identified all samples as belonging to *Pomaderris lanigera*. Therefore, this species is excluded from the subject land.	No
Pomaderris reperta	Denman Pomaderris	CE	CE	1176	Sep-Nov	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species requires a flowering specimen for confirmation of species identification. Samples from flowering Pomaderris spp. occurring in the subject land were taken and sent to the NSW Herbarium who identified all samples as belonging to *Pomaderris lanigera*. Therefore, this species is excluded from the subject land.	No
Pomaderris sericea	Silky Pomaderris	E	V	1176, 1629	Sep-Nov	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species requires a flowering specimen for confirmation of species identification. Samples from flowering Pomaderris spp. occurring in the subject land were taken and sent to the NSW Herbarium who identified all samples as belonging to *Pomaderris lanigera*. Therefore, this species is excluded from the subject land.	No

Species name	Common name	BC Act	EPBC Act	PCT association	Months of survey	Geographic constraints (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Targeted survey results and justification	Species requires species polygon?
Prasophyllum sp. *Wybong*	-	-	CE	434	Sep-Oct	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species requires a flowering specimen for confirmation of species identification. No individuals similar to this species were detected within the subject land during the targeted surveys; therefore, this species is excluded.	No
Prostanthera cryptandroides subsp. *cryptandroides*	Wollemi Mint-bush	V	V	1176, 1629	Sep-Nov	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Prostanthera discolor	-	V	V	1176, 1629	Sep-Oct	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). The species is conspicuous and is unlikely to remain undetected during field survey.	No
Prostanthera stricta	Mount Vincent Mint-bush	V	V	1176	Sep-Nov	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September) when the species is flowering or making preparations for flowering and is easily identifiable. The species is conspicuous and is unlikely to remain undetected during field survey.	No
Senecio linearifolius var. *dangarensis*	-	E	-	1614	Jan-Dec	NA	NA	The species was not detected during targeted survey. Survey completed during the required survey period (September). This species requires a rain event for germination and will persist underground as rootstock during dry periods. Recent rains have occurred within the vicinity of the subject land from January to September 2021 with an annual total to September 2021 of 585.1 mm (Bureau of Meteorology [BoM] 2021a). As such, it would be expected that, if the species were present, it would be detected during the targeted surveys. Therefore, this species is excluded.	No

Species name	Common name	BC Act	EPBC Act	PCT association	Months of survey	Geographic constraints (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Targeted survey results and justification	Species requires species polygon?
Thesium australe	Austral Toadflax	V	V	434, 1176	Nov-Feb	NA	NA	The species was not detected during targeted survey. Survey was not completed during the required survey period (Nov-Feb). The species is cryptic and may remain undetected during field survey, therefore potential habitat for this species may occur in the subject land; therefore, species presence is assumed.	Yes – see Table 19.
Tylophora linearis	-	V	E	479, 1176	Oct-May	NA	NA	The species was not detected during targeted survey. Survey was not completed during the required survey period (October-May). The species is conspicuous and is unlikely to remain undetected during field survey. PCTs 479 and 1176 contain the habitat constraints for this species including associated flora species, elevation, canopy assemblage etc. This species is cryptic and flowers/fruits between November – May after sufficient rainfall. The recent prolonged drought and targeted survey not aligning with the required survey period of October result in this species presence being assumed in the subject land.	Yes – see Table 19.

Table note: CE = Critically Endangered, EP = Endangered Population, E = Endangered, V = Vulnerable.

2.4 Threatened fauna and habitat

The following section describes the surveys undertaken to identify threatened fauna species and fauna habitat constraints within the subject land and the subsequent creation of species polygons for threatened species confirmed or assumed present in the subject land.

2.4.1 Habitat assessment survey

A habitat assessment survey focused on identifying the presence/absence of limiting habitat features (habitat constraints) was undertaken by Niche Ecologist Jodie Danvers between 24-27 August 2021 to assist in excluding species or refining potential habitat in accordance with Sections 5.2.1 and 5.2.2 of the BAM (DPIE 2020a). The habitat assessment survey focused on a 100 m radius of minor cliff lines, crests and footslopes in the subject land (Figure 11). AMBS (2021) also undertook a habitat assessment from 15-18 December 2020 and 16 July 2021 to collect data regarding habitat features to assess their type and condition, collecting information on rocky outcrops; the abundance of potential roosting habitat, including rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles; and photos representing the range of potential bat habitats present. Where possible, habitat features (e.g. caves, overhangs, escarpments, outcrops, crevices, boulder piles) were inspected to determine their potential suitability for roosting bats (AMBS 2021).

The habitat assessment survey targeted fauna habitat constraints associated with the candidate species targeted for survey. Fauna habitat constraints and traces targeted during the habitat assessment survey consist of:

- HBTs including tree species, health, DBH, hollow entrance size, hollow height and signs of use
- Caves, crevices, fissures and overhangs
- Rock outcrops and rock shelves
- Coarse woody debris
- Aquatic habitats including wetland/aquatic vegetation, standing pools in ephemeral drainage lines etc.
- Grassland habitats
- Nests and dreys including stick, cup and funnel nests
- Potential denning sites
- Any traces of fauna presence such as sap scars, scratches, feathers, discarded prey items, scat, fur etc.

Data collected during the habitat assessment was recorded as a combination of point and polygon features displaying the location of trace or habitat finds and the creation of preliminary habitat polygons. The resulting field data was collated and analysed and each candidate species was determined to be either excluded, confirmed present or assumed present dependent on the presence of habitat constraints, trace evidence and alignment with the required survey period. Habitat assessment survey results are discussed in Section 2.4.3.

A preliminary species polygon was prepared for all species which were confirmed or assumed present in the subject land. In cases where habitat constraints for a species have not been identified in sections of associated PCTs, the species polygon was refined to only include those sections which contain the identified habitat constraint. The preliminary species polygon was used to guide further targeted survey for relevant species in the event that the survey requirements could be completed within the project timeline.

2.4.2 Threatened fauna targeted survey

All species for which habitat constraints or traces have been identified within the subject land and have targeted survey requirements which are able to be undertaken within the project timeline, were selected for further targeted survey.

Targeted threatened species survey targeting microbat species was undertaken by six AMBS ecologists between 12 and 27 January 2021 (AMBS 2021). Targeted survey for other threatened fauna species was undertaken by Niche ecologist, Jodie Danvers, between 24 to 27 August 2021 and Hunter Ecology ecologists, Bart Schiebaan and Lizzie Bowman between 21 to 25 September 2021.

The identity, role and experience of all ecologists who have conducted targeted threatened fauna species survey for this project are outlined in Table 15 below.

Table 15: Identity, role and experience of ecologists relevant to the targeted threatened species surveys

Consultant name and qualifications	Company	Role	Experience	Survey target	Targeted survey activity
Mark Semeniuk BSc MApSc	AMBS	Director Fauna Ecology	Mark is a BAM accredited assessor with 15 years of experience as an ecologist.	Threatened Bats	Survey planning, field surveys and reporting
Narawan Williams Cert II CALM	AMBS	Ecologist	Narawan has 24 years of experience as an ecologist.	Threatened Bats	Survey planning, field surveys, identification of Anabat sequence files
Chris Jackson BSc MApSc	AMBS	Senior Ecologist	Chris has 15 years of experience in the ecological sector.	Threatened Bats	Survey planning and reporting
David James BSc	AMBS	Senior Ecologist	David has 35 years of experience in the ecological sector.	Threatened Bats	Fauna surveys
Henry Cook BSc MAppSc	AMBS	Ecologist	Henry has 15 years of experience in the ecological sector.	Threatened Bats	Fauna surveys
Dion Hobcroft Cert Zool	AMBS	Ecologist	Dion has over 30 years of experience in the ecological sector.	Threatened Bats	Fauna surveys
Nicola Trulock BEnvSc Cert II, III & IV CALM BAAS 19058	Niche	Senior Ecologist	Nicola is a BAM accredited assessor with over 12 years of experience in the ecological sector	All threatened fauna	Survey planning, data analysis and reporting.
Jodie Danvers BEnvSc	Niche	Ecologist	Jodie has over six years' experience in ecological assessment including targeted survey of threatened species in line with the BAM	All threatened Fauna	Field survey – habitat assessment survey and targeted surveys
Bart Schiebaan BApSc. Cert II CALM BAAS18033	Hunter Ecology	Project Director / Ecologist	Bart is a BAM accredited assessor with over 20 years' experience in ecological assessment and field survey.	Brush-tailed Rock-wallaby	Field survey - targeted surveys

Consultant name and qualifications	Company	Role	Experience	Survey target	Targeted survey activity
Lizzie Bowman BSc G.Cert.Env Mgt & Sus BAAS18112	Hunter Ecology	Senior Ecologist	Lizzie is a BAM accredited assessor with over 20 years' experience in ecological assessment and field survey.	Brush-tailed Rock-wallaby	Field survey - targeted surveys

Species for which targeted surveys were undertaken, were selected on the basis that the minimum survey requirements were able to be completed during the project timeframes. All further species which could not be excluded via habitat assessment or targeted surveys were assumed as present for the purpose of this assessment as per the BAM (DPIE 2020a).

The fauna targeted survey methods and effort consisted of the following tasks (Table 16**,** Figure 11):

- Microbat surveys including daytime surveys of potential roosting habitat, harp traps and bat detectors (Anabat SD2 Bat Detector and Wildlife Acoustics SM2 Songmeters)
- Camera traps
- Frog surveys, including call playback, active searching and active listening.
- Diurnal habitat search for threatened reptiles
- Opportunistic observations made throughout the survey team's time on site.

Table 16. Targeted fauna survey effort

Survey technique	Date	Survey hours	Species targeted
Harp traps	12-14 January 2021 26-28 January 2021	Eight harp traps were deployed for four nights equating to a combined survey effort of 32 harp trap nights.	Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Little Bent-winged Bat (*Miniopterus australis*), Large Bent-winged Bat (*Miniopterus schreibersii* oceanensis), Corben's Long-eared Bat (*Nyctophilus corbeni*), Large- eared Pied Bat (*Chalinolobus* dwyeri), Little Pied Bat (*Chalinolobus picatus*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad- nosed Bat (*Scoteanax* rueppellii) and Eastern Cave Bat (*Vespadelus troughtoni*).
Bat detectors (Anabat SD2 detector and Anabat Express detector)	12-14 January 2021 12-24 January 2021 26-28 January 2021 26-30 January 2021	Four Anabat SD2 detectors were deployed from 12-14 January 2021 for a total of 8 Anabat nights. Two Anabat SD2 detectors were deployed and left in situ for 11 nights between 12- 24 January 2021 for a total of 22 Anabat nights. Two Anabat SD2 detectors were deployed and left in situ for two nights between 26-28 January 2021 for	Yellow-bellied Sheathtail-bat, Eastern Coastal Free-tailed Bat, Little Bent-winged Bat, Large Bent-winged Bat, Corben's Long-eared Bat, Large-eared Pied Bat, Little Pied Bat, Eastern False Pipistrelle, Greater Broad- nosed Bat and Eastern Cave Bat.

Survey technique	Date	Survey hours	Species targeted
		a total of 4 Anabat nights. One Anabat SD2 detector was deployed for four nights from 26-30 January 2021 for a total of four Anabat nights. The combined survey effort equates to 48 Anabat nights.	
Habitat survey (Bats)	15-18 December 2020 16 July 2021	Conducted in conjunction with the bat surveys detailed above.	Identification and mapping of habitat features utilised by bat species including rocky outcrops, caves, overhangs, escarpments, crevices and boulder piles.
Opportunistic survey (Bats)	15-18 December 2020 11-17 January 2021 25-31 January 2021 16 July 2021	Conducted in conjunction with the bat surveys detailed above.	Grey-headed Flying-fox (*Pteropus poliocephalus*).
Opportunistic survey (other fauna)	15-18 December 2020 (AMBS 2021) 11-17 January 2021 (AMBS 2021) 25-31 January 2021 (AMBS 2021) 10-11 February 2021 (ELA 2021) 16-18 February 2021 (ELA 2021) 22 July 2021 (ELA 2021) 27 July 2021 (ELA 2021) 24-27 August 2021 21-25 September 2021	Seven x days for eight hours x two persons = 112 person hours (ELA 2021) Four x days for eight hours x one person = 32 person hours Five x days for eight hours x two persons = 80 person hours Total survey effort is 224 hours.	All fauna species listed in Section 2.4.3 of this report.
Camera traps (non-baited)	25-27 August 2021 until 24-25 September 2021	10 (non-baited) camera traps left out over one survey period of four weeks (as per the survey guidelines (DPIE 2021a)).	Brush-tailed Rock-wallaby (*Petrogale penicillata*)
Frog survey, including call playback, active searching in suitable microhabitats undertaken by torchlight and active listening.	24-27 August 2021 conducted over 4 consecutive nights for 120 minutes per night.	Conducted over four nights during cool conditions with light rainfall (18.4 mm over 48 hours) as per the survey guidelines (DPIE 2020d). No periods of heavy rain in excess of 50 mm in 24 hours were recorded in the two month preceding surveys and no rainfall was recorded during surveys.	Red-crowned Toadlet (*Pseudophryne australis*).

Survey technique	Date	Survey hours	Species targeted
Diurnal habitat search	25 August 2021	Two x 30 minute diurnal habitat searches conducted by one ecologist on 25 August consisting of inspective crevices, fissures and beneath sandstone boulders and rocks on sandstone substrates for traces or individuals.	Broad-headed Snake (*Hoplocephalus bungaroides*)
Systematic Scat survey	21-25 August 2021	Twelve transects conducted by two ecologists over six hours for a total survey effort of 12 hours.	Brush-tailed Rock-wallaby

Weather conditions were generally mild however there were two periods of moderate rainfall exceeding 15 mm in a 24 hour period occurring on the 17 December 2020 and 24 August 2021. Atmospheric conditions during the survey periods are presented in Table 17.

Table 17. Atmospheric conditions during survey period*

Conditions	Survey	Wind direction and max. speed (km/h)	Max. temperature (°C)	Min. temperature (°C)	Rain (mm)	Relative humidity at 9am (%)
15 December 2020	Habitat survey (Bats)	ENE 43 km/h	28.7	16.9	0.0	59
16 December 2020	Habitat survey (Bats)	NNW 31 km/h	28.0	19.3	1.2	98
17 December 2020	Habitat survey (Bats)	NE 35 km/h	33.5	18.9	16.8	54
11 January 2021	1x Bat detector (Anabat)	NE 26 km/h	29.0	13.4	0.0	33
12 January 2021	8 x harp traps, 4 x Bat detector (Anabat SD2), 2 x Bat detector (Anabat SD2)	SSW 30 km/h	31.9	10.3	0.0	34
13 January 2021	8 x harp traps, 4 x Bat detector (Anabat SD2), 2 x Bat detector (Anabat SD2)	WSW 30 km/h	31.8	13.8	0.0	44
14 January 2021	2 x Bat detector (Anabat SD2)	WNW 43 km/h	34.6	15.5	0.0	29
15 January 2021	2 x Bat detector (Anabat SD2)	SW 54 km/h	31.6	12.8	0.0	26
16 January 2021	2 x Bat detector (Anabat SD2)	SW 46 km/h	25.5	11.3	0.0	22
17 January 2021	2 x Bat detector (Anabat SD2)	SW 41 km/h	28.9	6.2	0.0	28
25 January 2021	2 x Bat detector (Anabat SD2)	W 33 km/h	35.4	16.4	0.0	24
26 January 2021	8 x harp traps, 4 x Bat detector (Anabat SD2)	NW 56 km/h	36.4	15.9	0.0	28
27 January 2021	8 x harp traps, 4 x Bat detector (Anabat SD2)	SE 54 km/h	31.5	20.9	0.0	50
28 January 2021	2 x Bat detector (Anabat SD2)	SE 54 km/h	24.4	19.2	0.0	60

Conditions	Survey	Wind direction and max. speed (km/h)	Max. temperature (°C)	Min. temperature (°C)	Rain (mm)	Relative humidity at 9am (%)
29 January 2021	2 x Bat detector (Anabat SD2)	ENE 37 km/h	26.3	18.2	0.0	64
30 January 2021	1 x Bat detector (Anabat SD2)	S 31 km/h	29.8	19.6	0.0	56
31 January 2021	Opportunistic fauna survey	SSE 61 km/h	30.4	16.8	4.2	74
10 February 2021	Opportunistic fauna survey	NNE 33 km/h	26.2	12.3	0.0	44
11 February 2021	Opportunistic fauna survey	ENE 28 km/h	29.3	13.1	0.0	34
16 February 2021	Opportunistic fauna survey	SE 44 km/h	27.6	15.5	0.0	52
17 February 2021	Opportunistic fauna survey	SE 48 km/h	26.3	15.7	0.0	39
18 February 2021	Opportunistic fauna survey	ENE 43 km/h	26.4	14.3	0.0	53
16 July 2021	Opportunistic fauna survey	WNW 72 km/h	14.3	6.2	2.6	93
22 July 2021	Opportunistic fauna survey	W 67 km/h	14.9	-3.1	0.0	69
27 July 2021	Opportunistic fauna survey	NNE 30 km/h	13.7	3.2	5.4	56
24 August 2021	Nocturnal call playback (Frogs)	WSW 50 km/h	9.1	7.0	15.6	88
25 August 2021	Nocturnal call playback (Frogs) 3 x camera traps 2 x habitat search	W 37 km/h	13.7	2.3	2.8	56
26 August 2021	Nocturnal call playback (Frogs) 5 x camera traps	NW 28 km/h	15.7	-1.4	0.0	49
27 August 2021	Nocturnal call playback (Frogs) Diurnal call playback (Bush Stone-curlew) 10 x camera traps	SW 44 km/h	13.4	5.1	0.0	62
28 August 2021	10 x camera traps	WSW 35 km/h	15.4	-2.8	0.0	38
29 August 2021	10 x camera traps	W 48 km/h	18.7	-1.7	0.0	37
30 August 2021	10 x camera traps	NNW 24 km/h	16.0	-0.7	0.0	43
31 August 2021	10 x camera traps	N 22 km/h	21.0	-0.7	0.0	30
1 September 2021	10 x camera traps	SE 26 km/h	24.1	0.2	0.0	25
2 September 2021	10 x camera traps	NNE 35 km/h	24.0	4.9	0.0	49
3 September 2021	10 x camera traps	NNW 31 km/h	22.3	9.8	0.0	39
4 September 2021	10 x camera traps	N 33 km/h	15.4	7.6	0.0	98
5 September 2021	10 x camera traps	WSW 54 km/h	12.8	7.7	8.2	70
6 September 2021	10 x camera traps	S 41 km/h	16.2	4.7	0.0	39
7 September 2021	10 x camera traps	WSW 46 km/h	18.6	-1.3	0.0	29
8 September 2021	10 x camera traps	NNW 20 km/h	20.0	0.4	0.0	45

Conditions	Survey	Wind direction and max. speed (km/h)	Max. temperature (°C)	Min. temperature (°C)	Rain (mm)	Relative humidity at 9am (%)
9 September 2021	10 x camera traps	NW 31 km/h	21.8	0	0.0	33
10 September 2021	10 x camera traps	WSW 35km/h	23.8	1.3	0.0	24
11 September 2021	10 x camera traps	WNW 41km/h	25.1	0.6	0.0	26
12 September 2021	10 x camera traps	NW 59 km/h	25.9	3.7	0.0	26
13 September 2021	10 x camera traps	SW 13 km/h	15.8	2.8	0.0	56
14 September 2021	10 x camera traps	SE 19 km/h	17.9	5.9	6.4	70
15 September 2021	10 x camera traps	E 13 km/h	18.6	1.8	0.0	71
16 September 2021	10 x camera traps	NE 13 km/h	19.2	4.9	0.0	69
17 September 2021	10 x camera traps	NW 19 km/h	21.5	4,2	0.0	75
18 September 2021	10 x camera traps	NW 52 km/h	22.9	8.0	0.2	55
19 September 2021	10 x camera traps	W 33 km/h	23.0	0.9	4.2	88
20 September 2021	10 x camera traps	W 11 km/h	21.8	2.1	0.0	67
21 September 2021	10 x camera traps	SW 30 km/h	12.9	4.4	0.2	65
22 September 2021	10 x camera traps	WSW 13 km/h	18.9	1.1	0.0	66
23 September 2021	10 x camera traps	W 7 km/h	21.0	3.5	0.0	73
24 September 2021	10 x camera traps	NW 11 km/h	22.5	4.4	0.0	72
25 September 2021	10 x camera traps	WNW 44 km/h	20.1	3.6	0.0	48
26 September 2021	1 x camera trap	SE 50 km/h	23.0	5.3	0.0	65
27 September 2021	1 x camera trap	NE 30 km/h	21.0	6.9	0.0	61
28 September 2021	1 x camera trap	NE 13 km/h	22.3	7.5	0.0	70
29 September 2021	1 x camera trap	NE 19 km/h	17.5	13.2	0.0	77
30 September 2021	1 x camera trap	NE 37 km/h	22.7	9.0	15.2	75
1 October 2021	1 x camera trap	NE 13 km/h	22.7	11.5	2.8	96
2 October 2021	1 x camera trap	WNW 44 km/h	18.3	8.2	2.6	85
3 October 2021	1 x camera trap	NNW 28 km/h	20.7	8.7	0.6	89
4 October 2021	1 x camera trap	NW 46 km/h	22.9	6.9	0.0	76
5 October 2021	1 x camera trap	SW 19 km/h	16.8	8.0	0.0	64
6 October 2021	1 x camera trap	WSW 11 km/h	22.7	0.5	0.0	70
7 October 2021	1 x camera trap	W 7 km/h	25.9	4.6	0.0	62
8 October 2021	1 x camera trap	ENE 20 km/h	23.6	5.6	0.0	78
9 October 2021	1 x camera trap	WNW 35 km/h	27.3	2.9	0.0	81
10 October 2021	1 x camera trap	WNW 48 km/h	28.0	8.5	0.0	72
11 October 2021	1 x camera trap	WSW 13 km/h	17.5	2.4	2.2	89
12 October 2021	1 x camera trap	E 13 km/h	13.2	2.0	0.8	84
13 October 2021	1 x camera trap	E 13 km/h	20.2	19.0	12.6	88
14 October 2021	1 x camera trap	NE 19 km/h	25.6	0.0	0.0	82
15 October 2021	1 x camera trap	N 11 km/h	15.2	0.4	0.0	67
16 October 2021	1 x camera trap	W 48 km/h	16.5	11.6	9.0	77
17 October 2021	1 x camera trap	W 33 km/h	21.2	0.2	0.2	86
18 October 2021	1 x camera trap	SW 7 km/h	24.1	0.0	0.0	77
19 October 2021	1 x camera trap	SW 11 km/h	25.0	0.0	0.0	68
20 October 2021	1 x camera trap	SE 19 km/h	21.2	0.0	0.0	71
21 October 2021	1 x camera trap	NE 30 km/h	22.7	0.0	0.0	70

Conditions	Survey	Wind direction and max. speed (km/h)	Max. temperature (°C)	Min. temperature (°C)	Rain (mm)	Relative humidity at 9am (%)
22 October 2021	1 x camera trap	NE 19 km/h	24.8	0.0	0.0	73

Data from Ulan Water (62036) (BoM 2021a) and Mudgee Airport AWS (62101) (BoM 2021b); climate data until 25th of September 2021) BoM weather stations, www.bom.gov.au.

2.4.3 Results – Threatened fauna

The results of habitat assessment surveys and targeted threatened fauna surveys are detailed in the sections below.

Habitat assessment

The habitat assessment survey results allowed for the exclusion of 17 candidate species and the assumed or confirmed presence of 17 candidate species within the subject land (Table 19). The habitat assessment results also allowed for the refinement of seven species polygons in areas where the habitat constraints listed for the species within the TBDC (DPIE 2021a) were not identified in associated PCTs.

The subject land contains intact native vegetation consisting of Eucalypt dominated woodlands and forests of both shrubby and grassy formation, providing a range of habitat for native fauna including potential habitat for a number of threatened species. Key habitat features present within the subject land include, rock outcrops, caves and crevices, HBTs, grassy or shrubby slopes, rocks, coarse woody debris and aquatic habitat. Connectivity is provided by the adjacent Munghorn Gap Nature Reserve and Wollemi National Park, facilitating fauna movement and dispersal along a north-west to south-east densely vegetated corridor.

Eucalypt trees forming the dominant canopy species throughout the PCTs mapped across the subject land provide habitat for the Koala *Phascolarctos cinereus* based on the presence of preferred Koala feed tree species, Blakely's Red Gum *Eucalyptus blakelyi*, Grey Gum *Eucalyptus punctata*, Yellow Box *Eucalyptus melliodora* and White Box *Eucalyptus albens* and high use tree species Narrow-leaved Ironbark *Eucalyptus crebra,* significant use tree species Rough-barked Apple *Angophora floribunda* and low use tree species Red Ironbark *Eucalyptus fibrosa* (DPIE 2019c, OEH 2018b). Multiple observations of Koala scat were found around the north-western section of the subject land by AMBS (2021) and Niche ecologists and an individual Koala was captured on a nearby field camera at 6:28am on October 17 2021.

Eucalypt trees also form foraging habitat for multiple threatened species that may occur in the subject land including Greater Glider *petauroides volans,* Squirrel Glider *Petaurus norfolcensis*, Swift Parrot and Grey-headed Flying-fox. Eucalypt canopy species may form potential foraging habitat for Eastern Pygmy-possum *Cercartetus nanus*. Native vegetation throughout the subject land also forms foraging habitat for hollow and cave-dwelling microbat species such as Corben's Long-eared Bat *Nyctophilus corbeni*, Eastern Cave Bat *Vespadelus troughtoni*, Eastern False Pipistrelle, Large Bent-winged Bat *Miniopterus orianae oceanensis*, Little Bent-winged Bat *Miniopterus australis* and Large-eared Pied Bat *Chalinolobus dwyeri* which feed on invertebrates above and within the canopy.

Mistletoe *Amyema* spp. hosted by Eucalypt trees and *Acacia* spp. throughout the subject land provides potential foraging and nesting habitat for Regent Honeyeater *Anthochaera phrygia*. The subject land occurs on an important mapped area for this species (DPIE 2021d) and therefore, presence of this species is assumed.

A total of 100 HBTs were recorded throughout the subject land, the majority of which contain multiple large and very large hollows, providing important breeding habitat for a number of native mammals and birds (refer to HBT register located in Annex 7). Hollows are present in a range of sizes suitable for use with the majority being small (0-10 cm) and medium sized (10-15 cm), a moderate number of large (15-30 cm) and a few being very large (30+ cm). Small hollows form potential denning and breeding habitat for small arboreal mammals such as Brush-tailed Phascogale *Phascogale tapoatafa*, Squirrel Glider, parrots such as Superb Parrot *Polytelis swainsonii* and reptiles such as Pale-headed Snake *Hoplocephalus bitorquatus* and Broad-headed Snake (summer habitat). Medium sized hollows form potential breeding habitat for Gang-gang Cockatoo and, whilst being of a size that can be utilised by Glossy Black-Cockatoo, it is considered unlikely based on the absence of preferred foraging habitat for this species in the subject land. Large and very large hollows form potential breeding habitat for large forest owls such as Barking Owl, Masked Owl and Powerful Owl. All trees containing large and very large hollows suitable for large forest owls were inspected for breeding activity and traces of these species during the survey, but no evidence of these species was detected.

The shrub and ground layer vegetation throughout the subject land was quite variable, ranging from absent or scattered through to moderate or dense, providing sheltering and grazing habitat for a range of native fauna species. Where ground layer vegetation was present, it was either predominately grass or shrub dominated. Grassy slopes containing rock outcrop or scattered rock within the subject land provide potential habitat for the Pink-tailed Legless Lizard *Aprasia parapulchella* and Striped Legless Lizard *Delma impar*.

Leaf litter also varied throughout the subject land, being either abundant or limited depending on the vegetation community and topography. Coarse woody debris formed from fallen logs was quite abundant, particularly within the gullies or base of slopes providing important shelter for native fauna and potential habitat for the threatened Bush Stone-curlew *Burhinus grallarius*.

Two main ridges occur within the subject land featuring an abundance of rocky outcrops, crevices and caves providing an important shelter and roosting/breeding habitat. Threatened species with the potential to occur that rely on such features include cave-dwelling microbats Large-eared Pied Bat and Eastern Cave Bat which have both been detected in the subject land (AMBS 2021), Brush-tailed Rock Wallaby *Petrogale penicillata* and Broad-headed Snake. Spotted-tail Quoll may utilise the caves and rocky areas in the subject land as potential den sites, in addition to hollow logs, HBTs and other animal burrows.

Surface rocks were abundant on the upper slopes and top of rocky outcrops (Figure 4). Surface rocks provide important habitat for reptiles and frogs, potentially used for shelter for Striped Legless Lizards or the Pink-tailed Legless Lizard in grassy open woodlands. A non-threatened amphibian, Spotted Marsh Frog *Limnodynastes tasmaniensis,* was found sheltering under a rock during field surveys.

Temporary aquatic habitat is present within the subject land with two ephemeral drainage lines running north-east from the base of rocky ridges, providing habitat for frogs. Prior to the field survey, the drainage line running through the north-eastern boundary was determined to be potentially suitable for the Red-crowned Toadlet *Pseudophryne australis*; however, subsequent targeted surveys did not result in detection of this species and determined that the vegetation and leaf litter cover along the drainage line was inadequate for Red-crowned Toadlet which prefer dense vegetation and/or thick piles of leaf litter (DPIE 2021a; Threatened Species Scientific Committee [TSSC] 2002) (Table 19). Approximately 100 metres outside the subject land, the drainage channel contained moist ground, small pools of water and one larger shallow pond; none of which form permanent pools as evidenced by the lack of emergent, semi-emergent and submerged aquatic vegetation. Vegetation in the drainage channel predominantly comprised terrestrial

flora species with a patchy distribution ranging from scattered to moderate cover. The drainage channel also contained scattered woody debris and leaf litter ranging in cover from absent to moderate.

Aquatic habitat within the subject land was not deemed suitable for Booroolong Frog *Litoria booroolongensis* or Giant Burrowing Frog *Heleioporus australiacus* which require permanent pools and a presence of moderate to high densities of emergent aquatic vegetation and the presence of perennial water (DPIE 2021a, TSSC 1998). In addition, Booroolong Frog requires a western flowing waterway whereas the ephemeral waterways and drainage lines, Murragamba Creek and Goulburn River are all eastward flowing (TSSC 1998).

Targeted surveys

The location and identity of all threatened fauna species detected during targeted surveys and opportunistic observations are listed in Annex 6 and displayed in Figure 12.

Up to 12 Large-eared Pied Bat individuals were identified during targeted surveys (harp traps and habitat mapping) conducted by AMBS (2021). Of these 12 Large-eared Pied Bats, seven were confirmed as adults and one was confirmed as a juvenile (AMBS 2021). Based on these results, breeding habitat for this species has been confirmed within the subject land (AMBS 2021) in accordance with the requirements of DPIE (2021a), and the species habitat constraints are considered sensitive to subsidence impacts. Details regarding the preparation of the species polygon for Large-eared Pied Bat are discussed below.

A total of five Eastern Cave Bats were detected during the targeted surveys (AMBS 2021). Of these five Eastern Cave Bat individuals, one was confirmed as an adult and one was confirmed as a juvenile (AMBS 2021). Based on these results, breeding habitat for this species has been confirmed within the subject land (AMBS 2021) in accordance with the requirements of DPIE (2021a), and the species habitat constraints are considered sensitive to subsidence impacts. Details regarding the preparation of the species polygon for Eastern Cave Bat are discussed below.

Caves and deep overhangs were searched during the habitat assessment survey to detect presence or traces (nesting material, feathers, pellets, scat, discarded prey items) of roosting or nesting Masked Owl individuals. No Masked Owl individuals, nests or traces were detected and, as the survey was conducted in August which falls within the required survey period when the species is actively breeding, it is concluded that this species does not utilise these habitat constraints within the subject land. As such, Masked Owl breeding habitat within the subject land is restricted to HBTs containing hollows with an entrance greater than 20 cm diameter.

Potential habitat for Broad-headed Snake was detected within the subject land in rocky areas within PCT 1629. Habitat searches undertaken on 25 August 2021 did not detect this species; however, the species could not be completely excluded from the subject land due to the presence of deep crevices and heavy sandstone boulders in the central and southern section of the minor cliff line in the central southern and eastern outcrop areas in the south-western section of the subject land. Therefore, Broad-headed Snake is assumed present in the aforementioned areas which could not be thoroughly searched, and the species habitat constraints are considered sensitive to subsidence impacts. Details regarding the preparation of the species polygon for Broad-headed Snake are discussed below.

Potential habitat for Brush-tailed Rock Wallaby within the subject land consists of south facing rock overhangs and caves in close proximity to foraging habitats associated with PCTs 434, 1176 and 1629. Camera traps were deployed in the vicinity of rock overhangs and basking sites between 24-27 August 2021 through to 21-25 September 2021 to detect this species utilising the habitat during the winter period.

Analysis of data derived from the camera traps did not result in detection of this species. Systematic scat survey on identified basking habitat (rock platforms) and overhangs was undertaken between 21-25 September 2021. Analysis of the resulting scat samples by Robin Carter Hair ID, did not result in detection of Brush-tailed Rock-wallaby but did detect Parma Wallaby *Macropus parma* (Vulnerable, BC Act). Based on the above results, it has been determined that Brush-tailed Rock-wallaby is unlikely to occur within the subject land and has been excluded whereas Parma Wallaby has been confirmed.

The habitat for Parma Wallaby are not considered sensitive to subsidence impacts as the species preferred habitat is wet sclerophyll forest, of which there is none in the subject land, whereas the dry sclerophyll forest covering the subject land is occasional use only. In addition, Parma Wallaby seeks refuge in dense understorey vegetation during the day, which is not present within subsidence sensitive areas such as cliff lines, rock face features or steep slopes of the subject land. It is likely that Parma Wallaby presence in the subject land is the result of a temporary expansion of its normal foraging range (the northern limits being in the southern section of Munghorn Gap Nature Reserve) due to the recent prolonged drought. Details regarding the preparation of the species polygon for Parma Wallaby are discussed below.

Potential habitat for Pink-tailed Legless Lizard has been detected within the subject land in PCTs 434, 472 and 1176 and additional habitat was detected within sections of PCTs 478, 479, 1614 and 1767 which contain rocks or rock outcrops amongst a grassy groundcover layer. This species could not be excluded via targeted survey due to project timeline constraints; therefore, presence of Pink-tailed Legless Lizard is assumed in the subject land. Details regarding the preparation of the species polygon for Pink-tailed Legless Lizard are discussed below.

Potential habitat for Striped Legless Lizard has been detected within the subject land in PCT 1176 and additional habitat was detected within sections of PCTs 434, 1614 and 1629 which contain rocks or rock outcrops amongst a grassy groundcover layer. This species could not be excluded via targeted survey due to project timeline constraints; therefore, presence of Striped Legless Lizard is assumed in the subject land. Details regarding the preparation of the species polygon for Striped Legless Lizard are discussed below.

The following candidate species have been assumed present in the subject land based on either the presence of habitat constraints, the inability to exclude the potential occurrence of the species via targeted surveys due to inconclusive results or project timeline constraints (Table 18):

- Pink-tailed Legless Lizard
- Striped Legless Lizard
- Pale-headed Snake
- Broad-headed Snake
- Bush Stone-curlew
- Gang-gang Cockatoo
- Superb Parrot*
- Masked Owl
- Brush-tailed Phascogale
- Eastern Pygmy-possum
- Squirrel Glider
- Greater Glider

* = Not predicted by BAM-C

For Regent Honeyeater the habitat constraint information in the TBDC refers to an important habitat map (BAM section 5.1.3). Important habitat maps identify areas that are considered essential to support critical life stages of the species, which for the Regent Honeyeater included:

- Areas identified in The National Recovery Plan (Commonwealth of Australia 2016) as critical to the survival of the species, refined to only include areas of suitable habitat based on expert opinion and PCTs associated with the species
- All woodland vegetation within 200 m of a record
- Records of known breeding events, radial buffers of 1 km were applied to single breeding events (once off breeding at a location) and 5 km buffers applied to multiple breeding events (multiple events in the same year or over multiple years at one location).

Regent Honeyeater is a dual credit species assessed for species (important habitat map) and ecosystem credits (all other areas the species is likely to occur). The subject land is included in the important habitat map for Regent Honeyeater, as identified in Biodiversity Offset Assessment Management System (BOAMs) (DPIE 2021d), therefore no further survey is required. The species is considered present and the part of the subject land that is within the important habitat map forms the species polygon used to generate species credits (BAM section 5.2.5). Any remaining habitat on the subject land, e.g. foraging, unmapped locations used by these species is assessed for ecosystem credits.

The remaining candidate species have either been excluded based on absence of habitat or have been assumed present based on absence of data derived from targeted surveys as outlined in Table 18.

The following species credit species and dual credit species were detected within the vicinity of subject land during targeted surveys (Figure 12):

- Five Eastern Cave Bats (foraging) were captured in harp traps and detected in habitat searches (AMBS 2021)
- Twelve Large-eared Pied Bats (foraging) were captured in harp traps and detected in habitat searches (AMBS 2021)
- Four probable recordings of Large Bent-winged Bat via Anabat detectors; no breeding habitat for this species was detected within or in vicinity of the subject land (AMBS 2021)
- One confirmed observation of Koala (foraging) via field camera and two areas containing scat deposits (AMBS 2021; Niche 2021) and an additional koala record and four scats just outside the subject land boundary.
- Swift Parrot recorded opportunistically within the subject land
- Parma wallaby scat recorded within the subject land*.

* = Not predicted by BAM-C

The following ecosystem credit species were detected within the subject land during targeted surveys (Figure 12):

- One Corben's Long-eared Bat was captured in a harp trap (AMBS 2021)
- One probable recording of Yellow-bellied Sheath-tailed Bat (AMBS 2021)
- Four confirmed observations of Brown Treecreeper via field camera and recorded opportunistically within the subject land (ELA 2021; AMBS 2021)
- Opportunistic recordings within the subject land of (Figure 12):
    - Diamond Firetail (ELA 2021; AMBS 2021)
    - Dusky Woodswallow (ELA 2021)
    - Grey-crowned Babbler (Niche 2021)

- Little Lorikeet (Niche 2021)
- Varied Sittella (AMBS 2021)
- Scarlet Robin (Niche 2021).

Table 18: Candidate species, habitat assessment survey results and species requiring further consideration

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
Amphibians								
Booroolong Frog	*Litoria booroolongensis*	E	E	434, 472	Oct-Dec	N/A	The habitat assessment survey confirmed that no breeding habitat consisting of perennial waterways or ephemeral waterways containing permanent pools occurred within or in the vicinity of the subject land. No non-breeding habitat suitable for the species was detected. Consequently, this species has been excluded based on the lack of breeding and non-breeding habitat in the subject land. The species is determined not likely to occur on the subject land due to the absence of required microhabitats.	No
Giant Burrowing Frog	*Heleioporus australiacus*	V	V	1629	Sep-May	N/A	The habitat assessment survey confirmed that no breeding habitat consisting of perennial waterways or ephemeral waterways containing permanent pools occurred within or in the vicinity of the subject land. No non-breeding habitat suitable for the species was detected. Consequently, this species has been excluded based on the lack of breeding and non-breeding habitat in the subject land. The species is determined not likely to occur on the subject land due to the absence of required microhabitats.	No

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
Red-crowned Toadlet	*Pseudophryne australis*	V	-	1629	Jan-Dec	N/A	The habitat assessment survey detected suboptimal potential habitat suitable for Red-crowned Toadlet along the ephemeral drainage lines of the subject land. This habitat was considered suboptimal due to inadequate cover of leaf litter. Targeted survey undertaken between 24-27 August in accordance with the *NSW survey guide for threatened frogs a guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method* (DPIE 2020d) did not detect this species and, as the surveys occurred during the required survey period, this species has been excluded. The species is determined not likely to occur on the subject land due to non-detection during targeted survey.	No
Reptiles								
Broad-headed Snake (Breeding)*	*Hoplocephalus bungaroides*	E	V	1629	Aug-Sep	Rocky areas: Including escarpments, outcrops and pogodas within the Sydney Sandstone geologies	The habitat assessment survey detected the presence of rock outcrop and rocky areas comprised of Sydney Sandstone geologies. Habitat searches of these areas did not detect the species. The species was unable to be excluded from areas which contained deep crevices or large boulders not able to be sufficiently inspected; therefore, species presence has been assumed and resulting habitat polygon refined to allow for habitat search results. The species is assumed present as suitable microhabitats and habitat constraints are present and the species could not be excluded via survey.	Yes – see Table 19.

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
Pale-headed Snake	*Hoplocephalus bitorquatus*	V	-	434, 472, 1176, 1629	Nov-Mar	N/A	The habitat assessment survey identified multiple HBTs containing hollows suitable for the species. Species presence is assumed due to lack of survey within survey period. The species is assumed present as suitable microhabitats are present and the species could not be excluded via survey.	Yes – see Table 19.
Pink-tailed Legless Lizard	*Aprasia parapulchella*	V	V	434, 472, 1176	Sep-Nov	Rocky areas: Or within 50m of rocky areas	The habitat assessment surveys identified rocky habitats for this species in the associated PCTs 434, 472 and 1176 in addition to two small areas containing suitable habitat outside of this PCT. This species is assumed present due to lack of targeted survey as a result of project timeline constraints. The species is assumed present as suitable microhabitats and habitat constraints are present and the species could not be excluded via survey.	Yes – see Table 19.
Striped Legless Lizard	*Delma impar*	V	V	1176	Sep-Dec	N/A	The habitat assessment survey identified habitat for this species in PCT 1176 in addition to two small areas containing suitable habitat outside of this PCT. The project timeline does not allow for the targeted surveys using tile grids which would allow the appropriate justification to exclude this species. This species is assumed present due to lack of targeted survey as a result of project timeline constraints. The species is assumed present as suitable microhabitats are present and the species could not be excluded via survey.	Yes – see Table 19..

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
Birds								
Barking Owl (Breeding)*	*Ninox connivens*	V	-	434, 472, 478, 479, 1610, 1614, 1629, 1767	May-Dec	Hollow-bearing trees: Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	The survey did not detect any breeding signs as defined in the TBDC; however HBTs suitable for Barking Owl breeding were detected. None of the identified potential breeding trees contained any traces of Barking Owl activity in the vicinity (no individuals, traces (feathers), discarded prey items, pellets or scat). Barking Owl are usually actively mating and nesting during August, and if present, traces would have easily been detected in the vicinity of active breeding trees. Based on this information, Barking Owl has been excluded. The species is determined not likely to occur on the subject land due to non-detection during survey.	No
Bush Stone-curlew	*Burhinus grallarius*	E	-	434, 472, 1176, 1629	Jan-Dec	N/A Fallen/standing dead timber including logs: Null	Habitat assessment surveys have detected habitat for this species consisting of woodland and forest with a grassy groundlayer and coarse woody debris within the lower elevation of the subject land between the northern and western cliff lines. One night of targeted survey (call playback) for this species has been undertaken; however, it does not meet the minimum survey requirements therefore, species presence has been assumed. The species is assumed present as suitable microhabitats and habitat constraints are present and the species could not be excluded via survey.	Yes – see Table 19.

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
Curlew Sandpiper*	*Calidris ferruginea*	E	CE	None	N/A	As per mapped area	No important mapped area on the subject land (DPIE 2021d); therefore, this species is excluded and does not require further assessment.	No
Eastern Curlew*	*Numenius madagascariensis*	-	CE	None	N/A	As per mapped area	No important mapped area on the subject land (DPIE 2021d); therefore, this species is excluded and does not require further assessment.	No
Gang-gang Cockatoo (Breeding)*	*Callocephalon fimbriatum*	V	-	1176, 1629	Oct-Jan	Hollow-bearing trees: Eucalypt tree species with hollows greater than 9 cm diameter	The habitat assessment survey has identified potential breeding trees in PCTs associated with this species within 100 m of cliff lines. The habitat assessment survey was undertaken outside the required survey period and, due to project timeline constraints, targeted survey cannot be completed; therefore, species presence has been assumed. The species is assumed present as suitable microhabitats and habitat constraints are present and the species could not be excluded via survey.	Yes – see Table 19.
Glossy Black-Cockatoo (Breeding)*	*Calyptorhynchus lathami*	V	-	434, 472, 1176, 1629	Jan-Sep	Hollow-bearing trees: Living or dead tree with hollows greater than 15 cm diameter and greater than 8 m above ground. (breeding constraint)	The survey was conducted during the breeding period for this species and, whilst the survey identified 28 HBTs forming potential breeding habitat, no foraging habitat occurs in the subject land and no sign of breeding pairs were detected on or near the HBTs or within the subject land. Therefore, this species has been excluded. The species is determined not likely to occur on the subject land due to non-detection during targeted survey.	No

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
						Presence of Allocasuarina and casuarina species (foraging constraint)		
Little Eagle (Breeding)*	*Hieraaetus morphnoides*	V	-	434, 472, 1176, 1629	Aug-Oct	Other: Nest trees - live (occasionally dead) large old trees within vegetation.	The habitat assessment survey did not detect any large trees or stick nests suitable for Little Eagle in the subject land. The habitat assessment survey occurred during the required survey period; therefore, this species is excluded. The species is determined not likely to occur on the subject land due to the absence of habitat constraints and non-detection during survey.	No
Masked Owl (Breeding)*	*Tyto novaehollandiae*	V	-	434, 472, 1176, 1629	May-Aug	Hollow-bearing trees: Living or dead trees with hollows greater than 20 cm diameter.	The habitat assessment survey did not detect any Masked Owl traces (scat, pellets, feathers, discarded prey items) or nests within caves in the subject land (note: the species has been found to nest in caves in Tasmania but there is no evidence to suggest that this occurs in NSW (DPIE 2021a). Potential breeding trees were identified on site; however, no signs of Masked Owl usage were detected on site, no individuals detected, and no calls were heard during nocturnal surveys. However, given targeted surveys were not undertaken for this species, it has been assumed present.	Yes – see Table 19.
Pink Robin	*Petroica rodinogaster*	V	-	None	Jan-Dec	N/A	No associated PCTs were mapped on the subject land. Potential suboptimal habitat for this species may occur in the low gullies of	No

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
							the subject land which contain non-associated PCT 1176. The habitat assessment survey determined that no suitable habitat for Pink Robin occurred within the subject land. Therefore, this species has been excluded and no further assessment is required. The species is determined not likely to occur on the subject land due to the absence of suitable habitat.	
Powerful Owl (Breeding)*	*Ninox strenua*	V	-	1176, 1629	May-Aug	Hollow-bearing trees: Living or dead trees with hollow greater than 20 cm diameter	The habitat assessment survey did not detect any breeding signs as defined in the TBDC (DPIE 2021a); however HBTs suitable for Powerful Owl breeding were detected. None of the identified potential breeding trees contained any traces of Powerful Owl activity in the vicinity (no individuals, no traces (feathers), no discarded prey items, no pellets, no scat). Powerful Owl juveniles are usually actively mating and nesting during August, and if present, traces would have easily been detected in the vicinity of active breeding trees. Based on this information, Powerful Owl has been excluded. The species is determined not likely to occur on the subject land due to non-detection during survey.	No
Regent Honeyeater (Breeding)*	*Anthochaera phrygia*	CE	CE	434, 472, 479, 1176, 1610	N/A	Other: As per mapped area	An important mapped area (DPIE 2021d) occurs over the entire area forming the subject land and species presence is assumed.	Yes – see Table 19.

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
Square-tailed Kite (Breeding)*	*Lophoictinia isura*	V	-	434, 472, 1176, 1610, 1629	Sep-Jan	Other: Nest trees	No large trees suitable for Square-tailed Kite breeding habitat and no new or aged stick nests were identified in the subject land. No observations of Square-tailed Kite individuals or mated pairs were identified in the subject land during surveys undertaken in September which is within the required survey period; therefore, this species is excluded. The species is determined not likely to occur on the subject land due to the absent of habitat constraints and non-detection during survey.	No
Superb Parrot (Breeding)*	*Polytelis swainsonii*	V	V	434, 472	Sep-Nov	Hollow-bearing trees: Living or dead *E. blakelyi*, *E. melliodora*, *E. albens*, *E. camaldulensis*, *E. microcarpa*, *E. polyanthemos*, *E. mannifera*, *E. intertexta* with hollows greater than 5 cm diameter; greater than 4 m above ground or trees with a DBH of greater than 30 cm	The habitat assessment identified one potential breeding tree in the subject land and, as surveys were conducted outside the required survey period for this species, its presence is assumed. Species presence assumed due to present of habitat constraints and the species could not be excluded via survey.	Yes – see Table 19..
Swift Parrot (Breeding)*	*Lathamus discolor*	E	CE	434, 472	N/A	Other: As per mapped area	No important mapped area on the subject land (DPIE 2021d); therefore, this species is	No

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
							excluded and does not require further assessment.	
White-bellied Sea-Eagle (Breeding)*	*Haliaeetus leucogaster*	V	-	434	July-Dec	Breeding constraint: Other: Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines Foraging constraint: Waterbodies: Within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines	The habitat assessment survey did not detect any large trees suitable for White-bellied Sea-Eagle breeding habitat and no new or aged stick nests were identified in areas vulnerable to subsidence. No observations of White-bellied Sea-Eagle individuals or mated pairs were identified in the subject land during surveys undertaken in August which is within the required survey period; therefore, this species is excluded. The species is determined not likely to occur on the subject land due to the absent of habitat constraints and non-detection during survey.	No
Mammals								
Brush-tailed Phascogale	*Phascogale tapoatafa*	V	-	434, 1629	Dec-June	-	The habitat assessment survey confirmed the presence of suitable habitat for this species (associated PCTs including those which contain hollow-bearing trees with dimensions suitable for Brush-tailed Phascogale) within the subject land. Species presence has been assumed for all associated PCTs with or without suitable hollows as targeted surveys are unable to be conducted within the required survey period due to project timeline.	Yes – see Table 19.

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
							Species presence assumed as habitat present and species could not be excluded via survey.	
Brush-tailed Rock-wallaby	*Petrogale penicillata*	E	V	434, 1176, 1629	Jan-Dec	Other: Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines	The habitat assessment survey identified rocky habitat, overhangs and caves suitable for Brush-tailed Rock-wallaby in multiple areas of the subject land. This species is highly territorial and has high site fidelity (DPIE 2021a). Targeted surveys were undertaken for this species using ten camera traps (nine cameras set from August to September 2021 and one camera set from August to October 2021) focusing on rock platforms, caves, overhangs and crevices likely to be used by the species in addition to a systematic scat survey in vicinity of the habitat at field camera locations. Analysis of field camera visuals and analysis of hair in scat samples did not result in detection of this species. As Brush-tailed Rock-wallaby are highly territorial and have high site fidelity, it would be expected that they would be detected if they were present. Based on this fact, Brush-tailed Rock-wallaby has been excluded from the subject land. The species is determined not likely to occur on the subject land due to non-detection during targeted survey.	No
Eastern Cave Bat	*Vespadelus troughtoni*	V	-	434, 472, 1176, 1629	Nov-Jan	Caves: Within 2 km of rocky areas containing caves, overhangs, escarpments,	Two individuals were detected in the subject land and potential breeding habitat detected in the subject land and surrounds (rocky areas containing caves, overhangs, escarpments, outcrops, or crevices) (AMBS	Yes – see Table 19.

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
						outcrops, crevices or boulder piles, or within 2 km of old mines, tunnels, old buildings or sheds.	2021). Foraging habitat utilised by this species occurs within associated PCTS across the subject land and within 2 km of the breeding habitat identified on the subject land. The species has been recorded in the subject land and is therefore known to be present.	
Eastern Pygmy-possum	*Cercartetus nanus*	V	-	434, 472, 1176, 1629	Oct-Mar	N/A	Habitat assessment surveys have detected habitat for this species consisting of woodland and forest containing foraging resources (Eucalypts) and denning habitat (HBTs possum dreys) suitable for this species. Species presence assumed as surveys unable to be conducted within the required survey period due to project timeline. Species presence assumed as habitat present and species could not be excluded via survey.	Yes – see Table 19.
Greater Glider	*Petauroides volans*	-	V	1176	Jan-Dec	Hollow-bearing trees: Null	The habitat assessment survey identified two potential denning trees in PCT 1176 within the subject land. Species presence is assumed as no targeted surveys have been undertaken for this species. Species presence assumed as habitat present and species could not be excluded via survey.	Yes – see Table 19.
Grey-headed Flying-fox (Breeding)*	*Pteropus poliocephalus*	V	V	434, 472, 1176, 1629	Oct-Dec	Other: Breeding camps	The habitat assessment survey did not detect the presence of a Grey-headed Flying-fox camp or individuals within the subject land during the August and September surveys. The nearest Grey-headed Flying-fox camp is	No

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
							located 35.5 km to the south-west along Cudgegong River near the western outskirts of Mudgee which has not been occupied since February 2019 (DAWE 2021b). In addition, the vegetation along ephemeral waterways within the subject land does not generate the humidity required for occupation of this species as a long-term camp. Based on this fact, the species has been excluded from further assessment. The species is determined not likely to occur on the subject land due to absence of suitable microclimate for a breeding camp and non-detection during targeted survey.	
Koala (Breeding)*	*Phascolarctos cinereus*	V	V	434, 472, 1176, 1629	Jan-Dec	Other: Areas identified via survey as important habitat (see comments)	Habitat assessment survey and opportunistic observation (AMBS 2021) has detected multiple Koala scats throughout the northern and central sections of the subject land in and surrounding associated PCTs and a nearby field camera recorded an observation of Koala in October 2021. The species has been recorded in the subject land and is therefore known to be present.	Yes – see Table 19.
Large Bent-winged Bat* (breeding)	*Miniopterus orianae oceanensis*	V	-	434, 472, 1176, 1629	Dec-Feb	Caves: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;"	Four probable Anabat recordings of this species have been detected within the subject land during targeted surveys; however, no breeding habitat was detected (AMBS 2021). As there is no evidence of breeding habitat within or in the vicinity of the subject land, this species has been excluded and does not require further assessment.	No

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
						observation type code "E nest-roost;" with numbers of individuals >500	The species credit component of this species (breeding habitat) is determined not likely to occur on the subject land, therefore the species has been excluded.	
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	434, 472, 1176, 1629	Nov-Jan	Cliffs: Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels.	Twelve individuals were detected in the vicinity of the subject land and potential breeding habitat detected in the subject land and surrounds (rocky areas containing caves, overhangs, escarpments, outcrops, or crevices) (AMBS 2021). Foraging habitat utilised by this species occurs within associated PCTS across the subject land and within 2 km of the breeding habitat identified on the subject land. The species has been recorded in the subject land and is therefore known to be present.	Yes – see Table 19.
Little Bent-winged Bat (Breeding)*	*Miniopterus australis*	V	-	1176, 1629	Dec-Feb	Caves: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	This species was not detected during passive or active targeted surveys in the subject land (AMBS 2021). Based on the complete absence of this species from targeted survey results combined with the surveys occurring within the required survey period; this species has been excluded and no further assessment is required. The species is determined not likely to occur on the subject land due to non-detection during targeted survey.	No

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	PCT association (DPIE 2021a)	Months of survey (DPIE 2021a)	Habitat Constraints (DPIE 2021a)	Habitat assessment and targeted survey results and justification	Species requires species polygon?
Parma Wallaby	*Macropus parma*	V	-	1176	Jan-Dec	N/A	The systematic scat survey detected pellets which were analysed and attributed to Parma Wallaby (concluding one scat sample as definite and four scat samples as probable for Parma Wallaby). Suboptimal foraging habitat is present within the subject land and dense understorey vegetation forming suboptimal refuge habitat is located in PCT 1176 only. The species has been recorded in the subject land and is therefore known to be present.	Yes – see Table 19.
Squirrel Glider	*Petaurus norfolcensis*	V	-	434, 472, 1176, 1629	Jan-Dec	N/A	Potential denning trees have been identified within the subject land. Species presence is assumed as no targeted surveys have been undertaken for this species. Species presence assumed as habitat present and species could not be excluded via survey.	Yes – see Table 19.

Table note: CE = Critically Endangered, E = Endangered, V = Vulnerable, * = dual credit species.

2.4.4 Threatened Species polygons

As required by section 5.2.5 of the BAM (DPIE 2020a), species polygons were prepared for all candidate species confirmed or assumed present on the subject land.

The list of candidate species requiring species polygons, split by group, is presented in Table 19 below and Figure 13a to Figure 13s.

Table 19: Species polygon requirements

Candidate species	Species polygon requirements	Figure
Austral Toadflax	Polygon formed from the entire extent of associated PCTs 434 and 1176.	13r
Tylophora linearis	Polygon formed from the entire extent of associated PCTs 479 and 1176.	13s
Pink-tailed Legless Lizard	Polygon formed from a 50 m buffer around rocky areas that occur within associated PCTs 434, 472 and 1176, and where the rocky area extends immediately outside the associated PCTs. The polygon also includes a 50 m buffer around suitable rock habitat (ie. rocky areas observed with predominately native grass cover, refer Section 2.4.3) identified during the field survey, which are located within portions of non-associated PCTs 478, 479 and 1629.	13e
Striped Legless Lizard	Polygon formed from the entire area of associated PCT 1176; and areas of suitable habitat that were identified and mapped during the field survey (ie. rocky areas observed with predominately native grass cover, refer Section 2.4.3), which were located partially within non-associated PCTs 434, 1614 and 1629.	13f
Pale-headed Snake	Polygon formed from the entire extent of associated PCTs 434, 472, 1176 and 1629.	13p
Broad-headed Snake	Polygon formed from rocky habitat with deep crevices and large sandstone boulders where species was unable to be excluded during the August 2021 habitat searches (due to the rocky habitat containing deep crevices and large sandstone boulders that made targeted searches challenging) combined with overlying area of associated PCT 1629.	13d
Bush Stone-curlew	Associated PCTs include 434, 472, 1176, 1629; however, habitat polygon has been refined to include PCT 472, 1176, and part of 1629 based on habitat assessment results.	13m
Gang-gang Cockatoo	Polygon formed from a 200 m buffer of all relevant HBTs, within associated PCTs 1176 and 1629, which contain hollows with a diameter of at least 10-15 cm and at least 9 m above ground.	13h
Superb Parrot	The breeding habitat for this species is mapped by a 100 m buffer around living or dead *Eucalyptus blakelyi*, *E. melliodora*, *E. albens*, *E. camaldulensis*, *E. microcarpa*, *E. polyanthemos*, *E. mannifera*, or *E. intertexta* with hollows greater than 5 cm diameter, greater than 4m above ground or trees with a DBH of greater than 30cm, within associated PCTs. Only one HBT identified within the subject land, a stag which may be Blakely's Red Gum *Eucalyptus blakelyi*, met these criteria and formed the breeding habitat polygon for this species.	13k
Masked Owl	Polygon formed from a 100 m buffer of living or dead HBTs, with a hollow greater than 20 cm diameter, within associated PCTs 434, 472, 1176 and 1629.	
Regent Honeyeater	Species polygon is based on the important mapped area (DPIE 2021d) which covers the entire extent of the subject land.	13q
Brush-tailed Phascogale	Polygon formed from associated PCTs 434 and 1629. HBTs that meet the criteria for the species are included (the species nests and shelters in tree hollows with entrances 2.5 - 4 cm wide).	13l
Koala	Polygon formed from the entire extent of associated PCTs 434, 472, 1176, 1629 in addition to non-associated PCT 1614 due to it containing Koala primary feed tree species, Grey Gum *Eucalyptus punctata* as a subdominant species. Part of PCTs 478 and 1767 are also mapped in the polygon as they contained Koala scat samples.	13o

Candidate species	Species polygon requirements	Figure
Eastern Pygmy-possum	Polygon formed from all associated PCTs 434, 472, 1176 and 1629 in the subject land.	13n
Greater Glider	Polygon formed from associated PCTs 1176 and 1629. HBTs relevant to the species are included on the figure (hollow-bearing trees with DBH over 50cm (Smith et al., 2007), hollow cavity entrance >6 cm (estimated minimum entrance diameter) and >14 m height above ground (Department of Environment, Land, Water and Planning [DELWP] 2019).	13i
Squirrel Glider	Polygon formed from all associated PCTs 434, 472, 1176 and 1629. HBTs relevant to the species have been included on the figure (suitable hollow-bearing trees with entrance of 5-10cm).	13j
Parma Wallaby	Polygon formed from entire extent of associated PCT 1176 and parts of non-associated PCTs 478 and 1629 where Parma Wallaby scat was recorded.	13c
Large-eared Pied Bat	Breeding habitat matches the outcrops mapped by AMBS (2021) and the SAII assessment area is formed from a 100m buffer around these breeding habitats. The species polygon maps foraging habitat within associated PCTs 434, 472, 1176 and 1629 as well as non-associated PCTs within 2km of breeding habitat, meaning that this species polygon covers the entire area of the subject land.	13a
Eastern Cave Bat	Breeding habitat matches the outcrops mapped by AMBS (2021) and the SAII assessment area is formed from a 100m buffer around these breeding habitats. The species polygon maps foraging habitat within associated PCTs 434, 472, 1176 and 1629 as well as non-associated PCTs within 2km of the breeding habitat, meaning that this species polygon covers the entire area of the subject land.	13b

2.5 Prescribed biodiversity impact features

Prescribed biodiversity impacts are impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. Prescribed additional biodiversity impacts (prescribed impacts) must be assessed as part of the NSW Biodiversity Offsets Scheme (BOS), as per clause 6.1 of the NSW Biodiversity Conservation Regulation 2017 (BC Regulation). Such prescribed impacts (including direct and indirect impacts) are:

(a) the impacts of development on the following habitat of threatened species or ecological communities—
(i) karst, caves, crevices, cliffs and other geological features of significance,
(ii) rocks,
(iii) human made structures,
(iv) non-native vegetation,
(b) the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range,
(c) the impacts of development on movement of threatened species that maintains their lifecycle,
(d) the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development),
(e) the impacts of wind turbine strikes on protected animals,
(f) the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

Prescribed biodiversity impact features within the subject land and assessment area are:

- caves, crevices and cliffs
- rocks
- habitat connectivity

- waterbodies, water quality and hydrological processes.

These features are shown on Figure 4. An analysis in respect to the prescribed impacts above, has been provided in Table 20 for the threatened species that have been confirmed/assumed to have presence within the subject land (Table 19).

The threatened entities that may use habitat features associated with the prescribed biodiversity impact features within the subject land are listed and discussed in detail below.

Table 20. Analysis of threatened biodiversity assumed/confirmed as present in subject land in relation to prescribed impacts

Species	Status (BC Act)	Status (EPBC Act)	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
Austral Toadflax *Thesium australe*	V	V	Austral Toadflax potential habitat within the subject land is associated with PCTs 1176 and 434. The potential habitat for this species within the subject land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence. If present, this species is therefore not expected to be associated with a prescribed impact.	No
Tylophora linearis	V	E	*Tylophora linearis* potential habitat within the subject land is associated with PCTs 479 and 1176. The potential habitat for this species within the subject land is relatively stable, not considered a GDE and therefore, it is not considered susceptible to subsidence. If present, this species is therefore not expected to be associated with a prescribed impact.	No
Broad-headed Snake (Breeding) *Hoplocephalus bungaroides*	E	V	Broad-headed Snake may utilise rock outcrops and features along minor cliff lines and steep slopes of the subject land which are considered sensitive to subsidence. Broad-headed Snake is a nocturnal reptile which shelters in rock crevices and under flat sandstone rocks during autumn, winter and spring before moving to crevices and HBTs within 500 m of escarpments during the summer months (DPIE 2021a). Broad-headed Snake forages on small reptiles, frogs and small mammals (DPIE 2021a). Habitat assessment identified rocky habitat suitable for the species within the subject land in the vicinity of minor cliff lines. Habitat searches were undertaken for the species which did not result in detection. A section of the subject land in the south-west corner could not be adequately searched due to deep crevices and large sandstone boulders; therefore, species presence is assumed in this area as per the BAM. This species is associated with a prescribed biodiversity impact feature, namely: (i) karst, caves, crevices, cliffs and other geological features of significance,	Yes – see Section 4.4.
Brush-tailed Phascogale *Phascogale tapoatafa*	V	-	If present, Brush-tailed Phascogale may utilise HBTs occurring in PCTs 434 and 1629 on steep slopes. However, this potential habitat which is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes). Brush-tailed Phascogale uses tree hollows for denning and breeding and forages predominantly on arthropods and supplements this diet with invertebrates, nectar and sometimes small mammals (DPIE 2020a). This species is primarily arboreal and the majority of foraging activities occur amongst the mid and upper levels of the canopy. As such, Brush-tailed Phascogale rarely travels along the ground. HBTs and canopy trees are not expected to be impacted by the Modification as	No

Species	Status (BC Act)	Status (EPBC Act)	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
			demonstrated by monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. As this species habitat constraints are not considered sensitive to subsidence, no further assessment is required.	
Bush Stone-curlew *Burhinus grallarius*	E	-	Bush Stone-curlew typically inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber, habitat which is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes). Bush Stone-curlew occurs in open forests and woodlands containing coarse woody debris and a sparse grassy groundlayer (DPIE 2021a). The habitat assessment survey identified habitat constraints for the Bush-Stone-Curlew in the lower elevations of the subject land only. The remainder of the subject land contained PCTs with a dense cover of *Pomax umbellata* or other herbs/shrubs and few to no coarse woody debris. The potential habitat for Bush Stone-curlew is distant from steep slopes and minor cliffs. This species is therefore not expected to be associated with a prescribed impact.	No
Eastern Cave Bat *Vespadelus troughtoni*	V	-	Eastern Cave Bat roosts and breeds in caves and is often found near cliffs or rocky overhangs all of which are located in areas sensitive to subsidence. Eastern Cave Bat roosts in caves, crevices and structures such as mine adits and farm sheds (DPIE 2021a). Sites selected for roosting are usually warm and humid during the day and warm and less humid during the evening (Law and Chidel 2007; Law et al., 2005). Breeding habitat is usually formed from domed caves; however, they have been recorded breeding in a farm shed in northern NSW (Law and Chidel 2007). This species will travel between roosting sites as individuals and as colonies when not in torpor. Two individual Eastern Cave Bat, one of which is a juvenile, and breeding habitat have been detected in the subject land (AMBS 2021). Based on the results of nearby survey findings for this species, it is concluded that the breeding population in the subject land forms a subset of a larger breeding population (AMBS 2021). High quality breeding habitat (high complexity) occurs in the northern (Cliff 9) and western outcrop (Cliff 10) areas (AMBS 2021) which are not expected to be impacted by the Modification (MSEC 2021). Moderate quality breeding habitat (less complex) occurs in the north-central, south-central and eastern outcrop areas (AMBS 2021). This species is therefore associated with a prescribed biodiversity impact feature, namely: (i) karst, caves, crevices, cliffs and other geological features of significance.	Yes – see Section 4.4.
Eastern Pygmy-possum *Cercartetus nanus*	V	-	If present, Eastern Pygmy-possum may utilise HBTs occurring on steep slopes as well as the lower lying areas. However, this potential habitat is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes).	No

Species	Status (BC Act)	Status (EPBC Act)	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
			Eastern Pygmy-possum occurs in dry sclerophyll forest where it forages on nectar from understorey shrubs and supplements its diet with invertebrates (DPIE 2021a). This species dens in a variety of features but displays a preference for tree hollows (DPIE 2021a). The habitat assessment survey identified habitat for Eastern Pygmy-possum throughout the north-west and southern sections of the subject land, some of which coincides with steep slopes. Impacts associated with steep slopes consist of surface tension cracking (MSEC 2021). HBTs and canopy trees are not expected to be impacted by the Modification as demonstrated by monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. As this species habitat constraints are not considered sensitive to subsidence, this species is therefore not expected to be associated with a prescribed impact.	
Gang-gang Cockatoo (Breeding) *Callocephalon fimbriatum*	V	-	If present, Gang-gang Cockatoo may utilise HBTs occurring on steep slopes as well as the lower lying areas. However, this potential habitat is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes). Gang-gang Cockatoo habitat differs according to season, with wet sclerophyll forest preferred during summer and spring and dry sclerophyll forest containing Ironbarks during the autumn winter months (DPIE 2021a). The habitat assessment survey identified nine HBTs suitable for breeding in the north-west and south-west sections of the subject land. No Gang-gang Cockatoo were detected in the subject land during surveys; however, targeted survey for this species was not undertaken. HBTs and canopy trees are not expected to be impacted by the Modification as demonstrated by monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. As this species habitat constraints are not considered sensitive to subsidence, this species is therefore not expected to be associated with a prescribed impact.	No
Greater Glider *Petauroides volans*	-	V	If present, Greater Glider may utilise HBTs occurring on steep slopes as well as the lower lying areas. However, this potential habitat is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes). Greater Glider is an arboreal marsupial restricted to eucalypt forests and woodlands where it forages nocturnally on eucalypt leaves and flowers (TSSC 2016). Greater Glider dens in old growth trees containing large hollows, a resource which is limiting to the species distribution (TSSC 2016). This species typically occurs in tall montane wet sclerophyll forests; however, it is known to use dry sclerophyll forest containing abundant old growth trees with large hollows (TSSC 2016). The habitat assessment survey identified two potential denning trees in PCT 1176 within the subject land. The location of these trees are situated well away from steep slopes and are unlikely to be impacted by subsidence. As this species habitat	No

Species	Status (BC Act)	Status (EPBC Act)	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
			constraints are not considered sensitive to subsidence, this species is therefore not expected to be associated with a prescribed impact.	
Koala (Breeding) *Phascolarctos cinereus*	V	V	Habitat constraints for this species are not considered to be sensitive to subsidence. Koala occur in eucalypt woodlands and forests where they predominantly forage on Eucalypt leaves (DPIE 2021a). This species is arboreal and spends the majority of its time in canopy trees but is known to come to ground when dispersing between trees (DPIE 2021a). Surveys by AMBS (2021) identified a scat in the northern section of the subject land and the habitat assessment survey identified multiple scats throughout the north and north-western section of the subject land in the vicinity of the northern outcrop area (Cliff 9). A field camera set near this location captured an image of a Koala as it traversed the ground between trees. No evidence of Koala was detected in the remainder of the subject land. As this species habitat constraints are not considered sensitive to subsidence, this species is therefore not expected to be associated with a prescribed impact.	No
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	Large-eared Pied Bat roosts and breeds in caves and is often found near cliffs or rocky overhangs all of which are located in areas sensitive to subsidence. Large-eared Pied Bat roosts in caves, crevices, disused Fairy Martin nests and structures such as mine adits (DPIE 2021a). Sites selected for roosting are located close to foraging habitat and are usually cool during the early morning and act as heat sinks during the afternoon, early evening (Williams and Tomson, 2018). Breeding habitat is usually formed from domed caves in which the ambient temperature is insulated from extreme fluctuations (Pennay, 2008). Female Large-eared Pied Bats display high fidelity to their breeding sites (Williams and Tomson, 2018). Twelve individual Large-eared Pied Bat, one of which is a juvenile, and breeding habitat have been detected in the subject land (AMBS 2021). Based on the results of nearby survey findings for this species, it is concluded that the breeding population in the subject land forms a subset of a larger breeding population (AMBS 2021). High quality breeding habitat (high complexity) occurs in the northern (Cliff 9) and western outcrop (Cliff 10) areas (AMBS 2021) which would experience negligible impacts from the Modification (MSEC 2021). Moderate quality breeding habitat (less complex) occurs in the north-central, south-central and eastern outcrop areas (AMBS 2021). This species is therefore associated with a prescribed biodiversity impact feature, namely: (i) karst, caves, crevices, cliffs and other geological features of significance.	Yes – see Section 4.4.
Masked Owl (Breeding) *Tyto novaehollandiae*	V	-	If present, Masked Owl may utilise caves and HBTs occurring on steep slopes as well as the lower lying areas. However, this habitat is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes). Masked Owl occurs in dry eucalypt forest and woodland where it forages along forest edges on preferred prey species, arboreal and terrestrial mammals (DPIE 2021a). Masked Owl breeds and roosts in HBTs containing large hollows and rarely, is known to roost in caves (DPIE 2021a). The habitat assessment survey identified eight HBTs suitable for the species within and in the vicinity of the subject land; however, no signs of use and no traces of the species (feathers, whitewash, discarded prey items, pellets etc.) were detected. Three suitable HBTs are located near steep slopes. All caves and overhangs were	No

Species	Status (BC Act)	Status (EPBC Act)	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
			inspected for presence of Masked Owl; however, no trace of the species was detected. Hollow-bearing trees and canopy trees are not expected to be impacted by the Modification as demonstrated by monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. As this species habitat constraints are not considered sensitive to subsidence, this species is therefore not expected to be associated with a prescribed impact.	
Pale-headed Snake *Hoplocephalus bitorquatus*	V	-	If present, the potential habitat for this species in the subject land is not considered to be sensitive to subsidence and is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes). Pale-headed Snake occurs in dry Eucalypt forests and woodlands where it spends a large amount of time hidden in tree hollows or sheltering under loose bark on tree trunks (DPIE 2021a). This species prefers habitats in or close to riparian corridors in areas with a dry climate (DPIE 2021a). This species preferred prey consists of tree frogs and supplementary prey consists of lizards and small mammals (DPIE 2021a). The habitat assessment survey identified suitable habitat for the species in PCTs 434, 472, 1176 and 1629; some of which occur over steep slopes. HBTs and canopy trees are not expected to be impacted by the Modification as demonstrated by monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. As this species potential habitat is not considered sensitive to subsidence, no further assessment is required.	No
Parma Wallaby *Macropus parma*	V	-	Parma Wallaby habitat within the subject land consists of suboptimal foraging and refuge habitat in the form of dry sclerophyll forest containing pockets of dense understorey, predominantly in the lower elevations of PCT 1176. This habitat is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes). Parma Wallaby preferred habitat consists of wet sclerophyll forest containing a dense shrubby understorey with nearby grassed areas for foraging and the species is known to use suboptimal habitat consisting of dry sclerophyll forest on occasion. The northern limit of the known distribution of this species in the region of Ulan occurs in the southern end of Munghorn Nature Reserve (DPIE 2021d). Parma Wallaby forages nocturnally on grasses and herbs and shelters during daylight in dense understorey vegetation. One scat collected in the subject land contained hairs identified as originating from Parma Wallaby and another three scat samples were identified as possible Parma Wallaby. A possible Parma Wallaby was detected by ecologists during the September systematic scat surveys; retreating after being flushed from nearby vegetation. As the subject land does not contain wet sclerophyll forest and only small pockets of dense understorey vegetation, it is likely that this species utilises the subject land occasionally and their presence is a recent expansion of their normal foraging range as a result of the recent prolonged drought. Whilst the scats are located on or in the vicinity of steep slopes, it is unlikely that Parma Wallaby would remain long in these areas as foraging resources on slopes is sparse to non-	No

Species	Status (BC Act)	Status (EPBC Act)	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
			existent, there is no refuge resources and the scats are likely to have been left whilst the Wallaby traverses between foraging and refuge habitats. As such, this species is not likely to remain for long periods in habitat considered sensitive to subsidence. As this species habitat constraints are not considered sensitive to subsidence, this species is therefore not expected to be associated with a prescribed impact.	
Pink-tailed Legless Lizard *Aprasia parapulchella*	V	V	If present, Pink-tailed Legless Lizard potential habitat in the subject land consists of small, partially embedded rocks in grassy woodland. This potential habitat may be sensitive to subsidence when located directly below cliff lines or on crests. Pink-tailed Legless Lizard occurs in sloping woodland areas covered in native grasses and containing rock outcrops or partially embedded rocks (DPIE 2021a). This species refuge consists of burrows beneath rocks where it forages on the larvae and eggs of ants (DPIE 2021a). Habitat assessment surveys have identified suitable habitat for this species in rocky areas containing a grassy understorey (sparse to moderate cover). No individuals have been detected and no targeted surveys undertaken. The majority of habitat for the species identified within the subject land occurs on steep slopes. This species is therefore associated with a prescribed biodiversity impact feature, namely: (i) karst, caves, crevices, cliffs and other geological features of significance. (ii) rocks	Yes – see Section 4.4.
Regent Honeyeater (Breeding)* *Anthochaera phrygia*	CE	CE	Mistletoe species forming breeding and foraging potential habitat for Regent Honeyeater are not considered sensitive to subsidence or prescribed biodiversity impacts. Regent Honeyeater occurs in dry open sclerophyll forests and woodlands that contain a high abundance of mature trees, high canopy cover and abundance of mistletoes (DPIE 2021a). Regent Honeyeater predominantly forages on the nectar from Mugga Ironbark *Eucalyptus sideroxylon*, Yellow Box *E. melliodora*, White Box *E. albens* and Swamp Mahogany *E. robusta* in addition to the nectar and fruit from mistletoes. The subject land occurs on a mapped important area for the species and as such, species presence (foraging and breeding) is assumed across the entirety of the subject land and coincides with steep slopes. Canopy trees are not expected to be impacted by the Modification as demonstrated by monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. As this species' potential habitat is not considered sensitive to subsidence, this species is therefore not expected to be associated with a prescribed impact.	No
Squirrel Glider *Petaurus norfolcensis*	V	-	If present, Squirrel Glider may utilise HBTs occurring on steep slopes as well as the lower lying areas. However, this habitat is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes). Squirrel Glider occurs in mature dry sclerophyll forest containing mixed species stands with a shrubby understorey and requires abundant HBTs for refuge and denning (DPIE 2021a). Squirrel Glider forages on the sap and nectar of Eucalypts, Acacia gum in addition to honeydew and manna and supplementing this with invertebrates and pollen (DPIE 2021a). The habitat assessment survey identified habitat for this species in PCTs 434, 472, 1176 and 1629 containing suitable HBTs	No

Species	Status (BC Act)	Status (EPBC Act)	Is the species likely to use habitat associated with a prescribed biodiversity impact feature?	Species requires further consideration?
			averaging two HBTs per hectare. Whilst this habitat coincides with steep slopes, HBTs, canopy trees and shrubs are not expected to be impacted by the Modification as demonstrated by monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. As this species habitat constraints are not considered sensitive to subsidence, this species is therefore not expected to be associated with a prescribed impact.	
Striped Legless Lizard *Delma impar*	V	V	If present, Striped Legless Lizard may use rocky areas in relevant PCTs. Rocky features on steep slopes or within proximity to crests are considered sensitive to subsidence. Striped Legless Lizard occurs in Natural Temperate Grassland, secondary grasslands and occasionally in open Box-Gum Woodland containing tussock grasses and sometimes significant amounts of surface rocks (DPIE 2021a). Striped Legless Lizard forages on athropods and invertebrate and will seek refuge in burrows beneath rocks, logs or below the ground (DPIE 2021a). Habitat assessment surveys have identified suitable habitat for this species in rocky areas containing a grassy understorey (sparse to moderate cover). No individuals have been detected, however no targeted surveys undertaken. Approximately half of the habitat for the species identified within the subject land occurs on steep slopes. This species is therefore associated with a prescribed biodiversity impact feature, namely: (i) karst, caves, crevices, cliffs and other geological features of significance. (ii) rocks	Yes – see Section 4.4.
Superb Parrot (Breeding) *Polytelis swainsonii*	V	V	If present, Superb Parrot may utilise HBTs occurring on steep slopes as well as the lower lying areas. However, this habitat is not associated with a prescribed biodiversity impact feature that may be impacted by the Modification (namely, caves, crevices and minor cliffs on steep slopes). Superb Parrot occurs in dry sclerophyll forests and woodland, particularly Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest (DPIE 2021a). This species nests as small colonies in dead or live HBTs, particularly Blakely's Red *Gum E. blakelyi*, Yellow Box, Apple Box *Angophora floribunda* and Red Box *E. polyanthemos* containing hollows with an entrance greater than 5 cm in diameter and at least 4 m or higher off the ground in a tree with a diameter at breast height greater than 35 cm (DPIE 2021a). Superb Parrot will forage within 10 km of their nesting sites on grass seeds and herbaceous plants (DPIE 2021a). One HBT in associated PCT 1176 matching these requirements was detected during the habitat assessment survey. The potential breeding tree identified on the subject land is not in an area considered sensitive to subsidence impacts. As this species habitat constraints are not considered sensitive to subsidence, this species is therefore not expected to be associated with a prescribed impact.	No

a. Habitat of threatened entities including

(i) karst, caves, crevices, cliffs and other geological features of significance,

(ii) rocks,

(iii) human made structures,

(iv) non-native vegetation,

There are approximately 1.6 ha of rocky outcrops (with caves and crevices) in the subject land as well as approximately 6.8 ha of rocky areas (with surface rock) (Figure 4). No human-made structures or non-native vegetation were identified in the subject land that would provide suitable habitat for any threatened species. Since caves, crevices, and rocks are on the subject land, the assessor must:

i. prepare a list of threatened entities that use or are likely to use these habitat features on the subject land and within the surrounding assessment area

Threatened entities that use or are likely to use these habitat features on the subject land and within the surrounding assessment area are listed in Table 20.

The threatened species that may utilise the habitat features and be regarded as prescribed impact entities include:

- Broad-headed Snake (Breeding) *Hoplocephalus bungaroides*
- Eastern Cave Bat *Vespadelus troughtoni*
- Large-eared Pied Bat *Chalinolobus dwyeri*
- Pink-tailed Legless Lizard *Aprasia parapulchella*
- Striped Legless Lizard *Delma impar*

ii. describe how these features provide habitat for, or are used by, each threatened entity (based on published literature and other reliable sources).

The habitat and habitat description associated with each of the threatened species entities has been provided in Table 20.

b. connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range

Native vegetation within the subject land is connected to extensive areas of native vegetation associated with Munghorn Gap Nature Reserve and Goulburn River National Park. Habitat connectivity (native vegetation cover) is shown on Figure 4.

Where corridors or other areas of connectivity link habitat for threatened entities, the assessor must:

i. Prepare a list of threatened entities that are likely to use or are a part of the connectivity or corridor.

All threatened fauna and threatened flora species that are assumed to be present, would likely use the surrounding habitat types for movement and exchange of genetic material. Those threatened species that

have been assumed to be present within the subject land, and thus would use the surrounding landscape for connectivity, are provided in Table 9 and Table 11.

ii. describe the importance of the connectivity to threatened entities, particularly for maintaining movement that is crucial to the species' life cycle (based on published literature and other reliable sources).

Habitat connectivity of the subject land to the surrounding habitat types is important to maintain the movement and exchange of genetic material across the locality for all threatened biodiversity. As connectivity would not be lost as a result of the Project (Section 4) it is highly unlikely that the Project would have any impacts on connectivity that would crucially impact upon movement such that the life cycle of threatened biodiversity would be significantly impacted.

c. Water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

Ephemeral drainage lines occur in the subject land as shown on Figure 4.

Where water bodies or any hydrological processes that sustain threatened entities occur on the subject land, the assessor must:

i. prepare a list of threatened entities that may use or depend on water bodies or hydrological processes for all or part of their life cycle, or prepare a list of threatened entities that will be, or are likely to be impacted by changes to existing water bodies or hydrological processes or the construction of a new water body

No candidate species reliant on hydrological features within the subject land for breeding or foraging were identified during the field surveys and have been excluded from the assessment (surveys occurred during the appropriate survey periods for these species).

TECs that occur within the vicinity of ephemeral drainage lines and waterways in the subject land are PCT 1176 Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion and PCT 434 White Box – Yellow Box –Blakely's Red Gum Grassy Wood land and Derived Native Grass land (Figure 7). Both these TECs occur near Drainage line 8. These TECs are not GDEs, therefore are not likely to be dependent on the hydrological processes of the potentially impacted waterbodies in the subject land.

ii. prepare a list of threatened entities that will be, or are likely to be impacted by changes to existing water bodies or hydrological processes or the construction of a new water body

No threatened entities are likely to be impacted by the potential changes to the ephemeral drainage lines.

iii. describe the habitat provided for each threatened entity by the water body or hydrological process, including consideration of water quality, volume, flow paths and seasonal patterns (based on published literature and other reliable sources).

Not required given the drainage lines are ephemeral.

d. wind turbine strikes on protected animals

Not relevant to this BDAR.

e. vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community

No impacts to threatened species or fauna are considered likely as no supporting infrastructure is proposed for the Modification and vehicle access is not expected to increase as a result of the operational phase of the Modification.

3. Avoid and minimise impacts

3.1 Avoidance and minimisation

In accordance with the BAM, proponents must demonstrate the measures employed to avoid, mitigate and offset impacts of a proposal on biodiversity values. This section of the report outlines the details of the Modification associated with avoidance and planning that MCO has incorporated into the proposal design or would employ during construction or operation of the proposal to reduce impacts on biodiversity values. Mitigation measures have also been detailed in Section 5 to further reduce impacts.

The Modification would result in a minor change to the existing and approved Moolarben Coal Complex that would allow the recovery of an additional 4.5 Mt of ROM coal.

3.2 Locate the proposal to avoid or minimise biodiversity impacts

The location of the Modification has been selected based upon the presence of coal seams able to be economically mined within MCO's existing tenements and the extensive geological and geotechnical data available within the target area in Mining Lease (ML) 1715.

Coal would be mined within the approved Moolarben Coal Complex mine life, Stage 2 Project Approval Boundary and mining tenements and would predominately use the existing and approved surface infrastructure.

The Modification does not require any new surface disturbance. There would also be a small reduction in the approved OC4 extent to accommodate the extended LW 201 if it is mined as proposed.

3.3 Design the proposal to avoid or minimise impacts to biodiversity

Underground mining methods significantly reduce environmental impacts, including vegetation and habitat disturbance, in comparison to open cut mining methods.

MCO have aimed to avoid and minimise impacts from the Modification where practicable. The layout of the extended longwall panels (LW 201 and LW 202A) has been designed to:

- Ensure the 26.5° angle of draw avoids the Munghorn Gap Nature Reserve.
- Comply with the existing subsidence impact performance measures in the Stage 2 Project Approval (08_0135), including negligible subsidence impacts or environmental consequences on threatened species and communities.
- Setback from Cliff C9 to maintain the subsidence impact performance measure of negligible environmental consequences and avoid impacts to associated threatened species habitat.

As described above, the Modification does not require any new surface disturbance. There would also be a small reduction in the approved OC4 extent to accommodate the extended LW 201 if it is mined as proposed.

3.4 Locate the proposal to avoid or minimise prescribed biodiversity impacts

The Modification is set back from Cliff 9 and Cliff 10, which provide more complex and higher quality bat habitat, avoiding prescribed impacts to these important habitat features.

3.5 Design the proposal to avoid or minimise prescribed biodiversity impacts

The Modification may lead to prescribed impacts on rocky outcrops (caves and crevices) providing breeding habitat to threatened bats and reptiles.

Those relevant design measure employed by MCO that are applicable to the Modification that avoid or minimise prescribed biodiversity impacts include set backs from Cliff 9 and Cliff 10, which provide more complex and higher quality bat habitat, avoiding prescribed impacts to these important habitat features.

4. Impact assessment

Stage 2 of the BAM provides the requirements for the Impact Assessment of the BDAR. The Impact Assessment has incorporated the findings from the specialist studies (e.g. MSEC 2021 and WRM 2021) in order to assess the potential direct, indirect and prescribed impacts.

4.1 Direct impacts on native vegetation and habitat

No native vegetation or threatened species habitats would be cleared for the Modification. In other words, no direct impacts on native vegetation or threatened species habitats (as defined by the BAM) would occur as a result of the Modification.

4.2 Indirect impacts on native vegetation and habitat

Indirect impacts that are to be considered in a BDAR are provided in section 8.2 of the BAM. Those indirect impacts that are relevant to the Project are detailed below.

4.2.1 Potential subsidence impacts

The Modification would result in subsidence from longwall mining, in the entire subject land and may result in the prescribed impacts detailed in Section 4.4. The predicted subsidence extent (subject land) is approximately 34.8 ha (Figure 6).

Predictions regarding the likelihood and potential impact of subsidence for the Modification were investigated and reported by MSEC (2021). Natural surface features within the subject land sensitive to subsidence movements as identified by MSEC (2021) and predicted subsidence impacts are outlined in Table 21.

Table 21: Predicted subsidence impact (MSEC 2021) on subsidence sensitive features of the subject land

Feature	Definitions	Performance Criteria (PA 08_0135)	Impact
Cliff C9	A continuous rock face, including overhangs, having a minimum length of 20 m, a minimum height of 10 m and a minimum slope of 2 in 1 (>63.4°)	Negligible environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs or fracturing, that in total do not impact more than 0.5% of the total face of such cliffs within the longwall mining domain)	No cliffs (as defined) are within the predicted subsidence extent (subject land). A total of four cliffs were identified near UG2, identified as C7, C8, C9 and C10 (MSEC 2021). Cliff C9 is the only cliff located within the subject land. Cliff C9 is located above pillars confined by longwalls on all sides and may experience additional 50 mm to 150 mm of vertical subsidence (MSEC 2021) on top of the <20 mm total conventional subsidence. C9 is over 70 m from the end of Longwall 203 (the approved layout included longwall extraction beneath about 50% of the western side of Cliff C9), and over 80 m from the commencement of Longwall 202a in the extended mining area. Proposed non-subsiding secondary workings are located adjacent to the western end of Cliff C9. Impacts to Cliff C9 resulting from the non-

Feature	Definitions	Performance Criteria (PA 08_0135)	Impact
			subsiding secondary workings are considered unlikely (MSEC 2021). The potential for impacts at Cliff C9 based on conventional subsidence movements is considered to be negligible (MSEC 2021). Therefore, no long term indirect impacts on native vegetation or habitat are considered likely.
Steep Slopes	An area of land having a gradient between 1 in 3 (33% or 18.3°) and 2 in 1 (200% or 63.4°)	Minor environmental consequences (that is, occasional rockfalls, displacement of or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 5% of the total rock face area of each such type feature within any longwall mining domain)	Approximately 6.9 ha of steep slopes occur within the predicted subsidence extent (subject land). According to MSEC (2021), up to 5% of the total face area of steep slopes (up to 2300 mm total incremental conventional subsidence) within the subject land are expected to be affected by down slope movements on slopes that are located over or near extracted longwalls. The down-slope movement is expected to result in surface tension cracking occurring mainly near the top of slopes. It is unlikely that mine subsidence would result in large-scale slope failure. The severity of this predicted impact on the feature is considered to be of minor environmental consequence (MSEC 2021). Surface tension cracking to the upper portions of slope faces is unlikely to result in destabilization of HBTs as evidenced by monitoring of UG1 longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. Rock features mainly occur in the upper sections of steep slopes within the subject land and, as such, fauna species which use these rock features for refuge, breeding and/or foraging habitat may be impacted if the species were to use the impacted portion of the feature (5%).

Feature	Definitions	Performance Criteria (PA 08_0135)	Impact
Minor Cliffs and Rock Features	*Minor Cliffs:* A continuous rock face, including overhangs, which has a: • minimum length of 20 m and a height between 5 m and 10 m, or maximum length of 20 m and a minimum height of 10 m; and • minimum slope of 2 to 1 (>63.4°). *Rock Face Features:* • Rock face feature A continuous rock face, including overhangs, which has a: • minimum length of 20 m and a height between 3 m and 5 m, or maximum length of 20 m and a minimum height of 5 m; and • minimum slope of 2 to 1 (>63.4°).	Minor environmental consequences (that is, occasional rockfalls, displacement of or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 5% of the total rock face area of each such type feature within any longwall mining domain)	According to MSEC (2021), up to 5% of the rock face area of minor cliff lines and rock face features (i.e., a sub-component of the steep slopes) (up to 2300 mm total incremental conventional subsidence) are predicted to be impacted resulting in fracturing, rock falls and slabbing. The central-north, central-south and eastern outcrop areas are susceptible to this impact; however, as they are isolated shortened lengths, there is a lower likelihood of impacts despite being situated above the proposed longwall panel (MSEC 2021). The eastern (edge) outcrop area is not expected to be impacted as it is outside of the subsidence extent. The severity of this predicted impact on these features is considered to be of minor environmental consequence (MSEC 2021). Fauna species which use minor cliff lines and rock face features for refuge, breeding and/or foraging habitat may be impacted if the species were to use the impacted portion of the feature (part of the 5% of total face area predicted to be impacted).
Drainage Lines		No greater subsidence impacts or environmental consequences than predicted in the EA.	The potential impacts to the drainage lines in the subject land include: • Additional ponding may develop along the drainage lines for short periods of time after major rain events (in addition to the naturally occurring ponding as a result of heavy rainfall). • Erosion may occur downstream of ponding areas however the gradients along the drainage lines would approach grades similar to those that existed before mining over time. • Cracking of bedrock is expected to result in little change to flows during high flow events although the change would be greater during low flows. No candidate species reliant on hydrological features within the subject land for breeding or foraging were identified during the field

Feature	Definitions	Performance Criteria (PA 08_0135)	Impact
			surveys and have been excluded from the assessment (surveys occurred during the appropriate survey periods for these species).

MSEC (2021) describe that there are four regional structural fault features, none of which intersect the proposed underground mining areas. The four regional structural features are the Spring Gully Fault Zone, Curra and Greenhill's Fault, Flat Dip Domain, and Ulan Hinge Line (MSEC 2021).

The predicted subsidence impacts are unlikely to change vegetation integrity.

4.2.2 Inadvertent impacts on adjacent habitat or vegetation

The predicted subsidence impacts are not likely to extend beyond the subject land, there is not likely to be any inadvertent impacts on adjacent habitat or vegetation.

4.2.3 Reduced viability of adjacent habitat due to edge effects

Edge effects are indirect impacts created as a result of fragmentation of habitats, that may lead to increased light, noise, vibration, weeds or altered temperature and humidity, which often result in changes to the ecosystem that occurs at or near the edge.

Given there is no surface disturbance required for the Modification, the Modification would not result in any fragmentation of habitats.

There is potential for rock falls to result in disturbance to vegetation. However, MSEC (2021) predict this to be of minor environmental consequence, impacting up to a maximum of 5% of the rock face area of minor cliff lines and rock face features and steep slopes. Given no surface works are proposed, weed invasion is not likely to occur as a result of these potentially generated edges.

Considering the above, The Modification is not likely to reduce the viability of adjacent habitat due to edge effects.

4.2.4 Increased risk of starvation or exposure and loss of shade or shelter

Given the Modification would not result in direct removal of any areas of habitat and subsidence impacts to habitat are predicted to be negligible or minor, the Modification is not likely to increase the risk of starvation or exposure and loss of shade or shelter. Even if the low likelihood of subsidence resulting in impacts to the foraging and sheltering habitats present in the subject land eventuates, these impacts would be localised and would not be likely to reduce the availability of habitat to the extent that any local populations would be put at an increased risk of starvation or exposure.

4.2.5 Loss of breeding habitat

Limiting breeding habitat in the subject land includes HBTs, rocky outcrops (caves and crevices) and rocky areas.

Predicted subsidence is unlikely to result in destabilization of HBTs as evidenced by monitoring of UG1 longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation

due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. Therefore, it is highly unlikely that hollow-dependent fauna will be impacted by the Modification.

The Modification would potentially impact on breeding habitat for two threatened bats (Large-eared Pied Bat and Eastern Cave Bat) and Broad-headed Snake. The Modification may result in:

- Potential disturbance of Broad-headed Snake breeding habitat and potential loss of individuals due to occasional rockfalls, dislodgement of boulders or slabs, or fracturing.
- Potential reduction in Eastern Cave Bat and Large-eared Pied Bat breeding habitat and loss of individuals due to occasional rockfalls, dislodgement of boulders or slabs, or fracturing.

The impact of the Modification on breeding habitat for bats and Broad-headed Snake is detailed in Section 4.4.2 and Table 23. MSEC (2021) predict that impacts to minor cliff lines and rock face features, and steep slopes (which is where these breeding habitats occur in the subject land) are likely to be negligible or of minor environmental consequence, in total impacting no more than 5% of the total face of such features.

Long-term impacts that may (but are unlikely) to occur may result in loss of breeding habitat (up to 5% of features within the predicated subsidence extent) for threatened bats, which would constitute a minor impact on the breeding cycle of the local population of the species. The breeding population of Large-eared Pied Bat and Eastern Cave Bat within the subject land forms a subset of a much larger breeding population which spans from the south of Munghorn Gap Nature Reserve. High quality (highly complex) Large-eared Pied Bat and Eastern Cave Bat breeding habitat occurs in the northern (Cliff C9) and western outcrop (Cliff C10) areas which will not be impacted by the Modification whereas moderate quality (less complex) breeding habitat in the north-central, south-central and eastern outcrop areas has a low likelihood of impact due to the short, isolated nature of the features (MSEC 2021). The potential decrease of a small area of breeding habitat (up to 5% of features within the predicated subsidence extent) or mortality of affected individuals in moderate quality breeding habitat is not likely to result in a loss of the breeding population in the subject land or surrounding locality due to the abundance of high quality breeding habitat outside of the predicated subsidence extent and throughout Munghorn Gap Nature Reserve and nearby Goulburn River National Park. Therefore, whilst considered a minor impact, it is of negligible consequence to either species on a regional scale.

Reptiles, such as the Broad-headed Snake, are less likely to be impacted by long-term impacts as they are likely to adjust to and utilise the altered rocky habitat. This impact is further described in Section 4.3.5.

4.2.6 Removal and disturbance of rocks, including bush rock

The Modification would not result in the removal of rocks.

Subsidence impacts may result in the disturbance to rocky outcrops associated with steep slopes, which is potential habitat for the Broad-headed Snake, Pink-tailed Legless Lizard and Striped Legless Lizard. The Modification could potentially result in disturbance of up to a maximum of 5% of steep slopes associated with rocky outcrops and loss of individual Broad-headed Snakes, Pink-tailed Legless Lizards and Striped Legless Lizards. Subsidence impacts on rocky areas (areas with surface rock not associated with steep slopes) is likely to be restricted to surface cracking.

4.2.7 Weeds, pathogens and pest animals

The NSW *Biosecurity Act 2015* (Biosecurity Act) provides for the protection from the threat of exotic animals, plants, pests, diseases and contaminants throughout the state. The Biosecurity Act in relation to the Modification, regulates for the containment or suppression of existing weeds, pest animals and pathogens and the prevention of new incursions. Under the Biosecurity Act, all persons have a general

biosecurity duty to prevent, eliminate or minimise the spread or introduction of identified biosecurity matters.

ELA (2021) completed 24 BAM plots and 38 RDPs during vegetation surveys and confirmed the presence of the following High Threat Exotics in three BAM plots; Common Pear *Opuntia stricta* var. *stricta,* St John's Wort *Hypericum perforatum* and Tree of Heaven *Ailanthus altissima* (ELA 2021). Of these species, Common Pear and St John's Wort are considered priority weeds for the Central Tablelands Local Land Services region. The species and the associated biosecurity duty are displayed in Table 22 below.

Table 22: Priority weeds on the subject land and their associated biosecurity duty

Species name	Common name	Biosecurity duty
Hypericum perforatum	St John's Wort	**Regional Recommended Measure** Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment. Protect grazing land that is free of St. John's wort
Opuntia stricta	Common Pear	**Prohibition on certain dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale.

MCO currently treat priority weeds throughout the MCC as required in accordance with the *Moolarben Coal Complex Biodiversity Management Plan* (MCO 2020a) which would be revised to incorporate the subject land upon Project approval.

The Modification does not involve any vegetation clearing or works aboveground and is therefore not expected to increase the population of or introduce novel weed species or improve access or increase predation of native fauna by pest animal species currently existing in the subject land and the locality.

No evidence of existing plant or soil pathogens such as Myrtle Rust *Puccinia psidii* or Phytophthora *Phytophthora cinnamomi* were identified in the subject land during the field survey. The Modification has a negligible risk of introducing these pathogens to the subject land as there will be no overland works and no increase to vehicular, machinery or pedestrian movements beyond current levels.

Based on the above, the Modification is consistent with provisions of the Biosecurity Act.

4.2.8 Groundwater Dependent Ecosystem

Groundwater Dependant Ecosystems (GDEs) are ecosystems that rely upon groundwater for their continued existence. GDEs may be completely dependent on groundwater, such as aquifer GDEs, or may utilise groundwater intermittently when it is available as a component of its lifecycle water requirements, such as riparian tree species in arid and semi-arid areas (Doody, Hancock and Pritchard, 2018).

The Groundwater Dependent Ecosystem Atlas (GDE Atlas) was developed by the BOM as a national dataset of Australian GDEs to inform groundwater planning and management (BOM 2018). GDEs derived in the GDE Atlas are mapped according to the following classifications:

- high potential for groundwater interaction;
- moderate potential for groundwater interaction; and

- low potential for groundwater interaction.

The GDE Atlas identifies a regionally mapped patch of Central Tableland Ribbon Gum-Apple Gully Forest within the subject land as having moderate potential for groundwater interaction. None of the vegetation communities mapped within the subject land are consistent with the regionally mapped Central Tableland Ribbon Gum-Apple Gully Forest or exhibit groundwater dependent traits. No GDEs are present or likely to be impacted by the Modification.

4.3 Prescribed impacts

Prescribed additional biodiversity impacts (prescribed impacts) are impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. Prescribed impacts must be assessed as part of the BOS, as per clause 6.1 of the BC Regulation. Such prescribed impacts (including direct and indirect impacts) are:

> ***(a) the impacts of development on the following habitat of threatened species or ecological communities—***
>
> ***(i) karst, caves, crevices, cliffs and other geological features of significance,***
>
> ***(ii) rocks,***
>
> *(iii) human made structures,*
>
> *(iv) non-native vegetation,*
>
> *(b) the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range,*
>
> *(c) the impacts of development on movement of threatened species that maintains their lifecycle,*
>
> ***(d) the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development),***
>
> *(e) the impacts of wind turbine strikes on protected animals,*
>
> *(f) the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.*

Those prescribed impacts in bold above are those associated with the Modification. The other listed prescribed impacts are not likely to occur as a result of the Modification and therefore have not been discussed further.

Measures to avoid and minimise prescribed impacts have been discussed in Section 3.

As per the BAM (DPIE 2020a), the assessor must assess the prescribed impacts that the Modification would, or is likely to have, on threatened entities and their habitat, taking into account:

- the TECs, threatened species and their habitat
- ongoing or future impacts that the proposal will have on biodiversity values, considering the measures taken to avoid or minimise impacts,
- the spatial and temporal extent of the impacts likely to result from changes in land use arising from the proposal, in accordance with sections 8.3.1–8.3.6 of the BAM (DPIE 2020a).

The BDAR must include an assessment of any prescribed impacts of the Modification on threatened entities and their habitat, and describe:

- the nature, extent, frequency, duration and timing of prescribed impacts that may occur:
  - during construction

- during operation
- that are uncertain (predictions should be made)

- the consequences of prescribed impacts on biodiversity values
- any limitations to data, assumptions and predictions about impacts on biodiversity.

As detailed in Section 4.2, subsidence as a result of the Modification may result in prescribed impacts.

Predictions regarding the likelihood and potential impact of subsidence for the Modification were investigated and reported by MSEC (2021). Natural surface features within the subject land sensitive to subsidence movements identified by MSEC (2021) are detailed in Section 4.2.

4.3.1 Prescribed impact entities

Prescribed impact entities are identified in Section 2.5.

No TECs or threatened flora species listed under the BC Act are to be adversely affected by prescribed impacts resulting from the Modification.

Five threatened fauna species listed under the BC Act have the potential to be adversely affected by prescribed impacts on rocky outcrops (caves and crevices) and rocky areas. These species are:

- Pink-tailed Legless Lizard
- Striped Legless Lizard
- Broad-headed Snake
- Large-eared Pied Bat
- Eastern Cave Bat.

An assessment for each of the relevant prescribed biodiversity impacts has been completed in the following sections.

4.3.2 Karst, caves, crevices, cliffs, rocks and other geological features of significance

The potential prescribed impacts on rocky outcrops (caves and crevices) and rocky areas are discussed below.

(a) predict the nature, extent and duration of short-term and long-term impacts

According to MSEC (2021), the northern outcrop area (Cliff C9) is predicted to have negligible impact (<20 mm total conventional subsidence) as the longwall panels do not extend beneath the cliff and the longwall panels are set at a sufficient distance to minimize impacts (i.e., the western side of Cliff C9 is located 70 m from LW 203 and the eastern side is located 80 m from the commencement of LW 202a). Impacts from the proposed non-subsiding secondary extraction located adjacent to the western end of Cliff C9 are considered unlikely (MSEC 2021). The revised longwall layout at Cliff C9 has resulted in a predicted subsidence impact which is less than that of the approved layout (MSEC 2021). As such, fauna and their habitats, associated with Cliff C9 are unlikely to be impacted by the Modification.

According to MSEC (2021), up to 5% of the rock face area of minor cliff lines and rock face features (i.e., a feature of the steep slopes) (up to 2300 mm total incremental conventional subsidence) are predicted to be impacted resulting in fracturing, rock falls and slabbing. The severity of this predicted impact on the features is considered minor (MSEC 2021). Fauna species which use minor cliff lines and rock face features for refuge, breeding and/or foraging habitat may be impacted if the species were to use the impacted portion of the feature (5%). In regard to habitat features occurring for these species in the subject land, the central-north, central-south and eastern outcrop areas are most susceptible; however, as they are isolated

shorter lengths (MSEC 2021), there is a lower likelihood of impacts despite being situated above the proposed longwall panel.

Subsidence may cause surface tension cracks to appear at the tops of the slopes, and compression ridges to form at the bottoms of the slopes, which in turn has the potential to cause erosion (MSEC 2021). However, as indicated by MSEC (2021), up to 5% of steep slope (up to 2300 mm total incremental conventional subsidence) within the subject land is expected to be impacted with surface tension cracking occurring mainly near the top of slopes. The severity of these predicted impacts on rock features is considered minor (MSEC 2021). Rock features mainly occur in the upper sections of steep slopes within the subject land and, as such, fauna species which use these rock features for refuge, breeding and/or foraging habitat may be impacted if the species were to use the impacted portion of the feature (5%).

Surface tension cracking to the upper portions of slope faces is unlikely to result in destabilization of HBTs as evidenced by monitoring of UG1 longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. Therefore, it is highly unlikely that hollow-dependent fauna will be impacted by the Modification.

As discussed in relation to native vegetation, MSEC (2021) do not predict large-scale impacts associated with potential rock falls/slipping of rock. As such, no large-scale impacts to TECs or threatened fauna due to earth and rock-face instability would occur.

(b) predict the consequences of impacts on the threatened entities identified in Subsection 6.1.1

As detailed above, short term impacts of subsidence may result in loss or injury to threatened fauna utilising the habitats along cliffs, steep slopes and rocky areas, if the species were to use the impacted portion of the feature (5%). However, these impacts are likely to be localised and temporary and not likely to lead to the loss of an entire sub-population of threatened species.

Long-term impacts may include destruction of breeding habitat for threatened microbats, if the species were to use the impacted portion of the feature (5%). Reptiles are less likely to be impacted by long-term impacts as they are likely to adjust to and utilise the altered rocky habitat.

Based on the MSEC (2021) predictions, there is potential for threatened species habitat to be impacted by the Modification, however impacts are predicted to be minor (up to 5% of the feature impacted) and, as this impact is not expected to lead to the loss of a breeding population in the subject land or locality, the consequence to these species in a regional context are negligible.

Microbat monitoring, targeting cave-dwelling microbats, has been undertaken at Moolarben at UG1 (to the north of the subject land), with post mining surveys undertaken in 2018 and 2020. In order to understand the potential for prescribed impacts of the Modification to impact on threatened bat habitat within the subject land, results of previous monitoring have been reviewed. Microbat monitoring at UG1 has found the following:

- Post mining survey results for monitoring above LW101 (Fly By Night Bat Surveys 2019) were comparable with that obtained during the pre-mining surveys. A similar suite of microbat species were recorded and activity levels of the target species were similar. The Large-eared Pied Bat was recorded at low levels of activity post mining, which was consistent with that recorded during the

pre-mining surveys. The results indicate no discernible change occurred in the activity levels of the three target cave dwelling microbat species recorded during the pre-mining surveys. While there was some collapse and cracking of overhangs above panel LW101, the survey did not find evidence of any adverse impacts to the small number of individuals of the target species utilising the area (Fly By Night Bat Surveys 2019).

- Post mining survey results for monitoring above LW 103 (Fly By Night Bat Surveys 2020) found that bat activity rates recorded during the post-mining survey were less for the Eastern Horseshoe Bat, Large-eared Pied Bat and Large Bent-wing Bat than that recorded during the pre-mining survey. These results may indicate a real decline in activity at the site post mining in these species, but other factors may be partly responsible. A prolonged drought and subsequent reduction in food availability during the period may have contributed to the decrease in activity of these species. While vibration, noise and other impacts may have caused the target microbats to avoid the area, a conclusion is unable to be drawn as to whether the decrease in bat activity has been caused by the effects of mining induced subsidence (Fly By Night Bat Surveys 2020).

Results of the monitoring summarised above, combined with MSEC predictions, would indicate that if a change was to occur it might not be immediate and other factors may result in changes to the local bat populations.

The results of microbat monitoring to date highlight the importance of a monitoring program to enable detection of impacts to cave-dwelling bat species, which may trigger offsetting.

Table 23: Potential impacts to threatened biodiversity confirmed/assumed present associated with caves, crevices, cliffs and rocks

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	SAII	Assessment of potential impact on candidate species	Consequences for local and bioregional persistence
Eastern Cave Bat	*Vespadelus troughtoni*	V	-	Yes – breeding habitat	Eastern Cave Bat roosts and breeds in caves and is often found near cliffs or rocky overhangs all of which are located in areas sensitive to subsidence. Potential impacts of the Modification include minor sandstone fracturing and slabbing leading to instability and potential for small rock falls along minor cliff lines and rock face features. This is predicted for a maximum of 5% of the extent of this feature in the subject land (MSEC 2021).Two individual Eastern Cave Bat, one of which is a juvenile, and breeding habitat have been detected in the vicinity of the subject land (AMBS 2021). Based on the results of nearby survey findings for this species, it is concluded that the breeding population in the subject land forms a subset of a larger breeding population (AMBS 2021). High quality breeding habitat (high complexity) occurs in the northern (Cliff 9) and western outcrop (Cliff 10) areas (AMBS 2021) which are not expected to be impacted by the Modification (MSEC 2021). Moderate quality breeding habitat (less complex) occurs in the north-central, south-central and eastern outcrop areas (AMBS 2021) of which 5% of the steep slopes may potentially be impacted; however, it is considered unlikely due to the short-isolated lengths of the features (MSEC 2021). If these impacts were to occur they may result in mortality of individuals, reduction of breeding habitat and reduced abundance. See Figure 13b for species polygon.	Short term impacts such as rock fall may potentially result in mortality of some individual threatened microbats, decrease in breeding habitat and reduction in abundance; however, it is not likely to lead to the loss of a subpopulation of the species. Long-term impacts that may (but are unlikely) to occur may result in loss of breeding habitat for threatened bats, which would impact on the breeding cycle of the local population of the species; however, abundant high quality breeding habitat occurs in unimpacted areas in the vicinity of the subject land (Cliff C9 and C10) and in the locality (Munghorn Gap Nature Reserve and Goulburn River National Park). As the breeding population in the subject land forms a subset of the larger breeding population in the locality, impacts to the breeding cycle of the species in a regional context are considered negligible.
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	Yes – breeding habitat	Large-eared Pied Bat roosts and breeds in caves and is often found near cliffs or rocky overhangs all of which are located in areas sensitive to subsidence. Potential impacts of the Modification include minor sandstone fracturing and slabbing leading to	

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	SAII	Assessment of potential impact on candidate species	Consequences for local and bioregional persistence
					instability and potential for small rock falls along minor cliff lines and rock face features. This is predicted for a maximum of 5% of the extent of this feature in the subject land (MSEC 2021). Twelve individual Large-eared Pied Bat, one of which is a juvenile, and breeding habitat have been detected in the subject land (AMBS 2021). Based on the results of nearby survey findings for this species, it is concluded that the breeding population in the subject land forms a subset of a larger breeding population (AMBS 2021).. High quality breeding habitat (high complexity) occurs in the northern (Cliff 9) and western outcrop (Cliff 10) areas (AMBS 2021) which would experience negligible impacts from the Modification (MSEC 2021). Moderate quality breeding habitat (less complex) occurs in the north-central, south-central and eastern outcrop areas (AMBS 2021), of which 5% of the steep slopes may potentially be impacted; however, it is considered unlikely due to the short-isolated lengths of the features (MSEC 2021). These impacts may result in mortality of individuals, reduction of breeding habitat and reduced abundance. See Figure 13a for species polygon.	
Pink-tailed Legless Lizard	*Aprasia parapulchella*	V	V	No	Pink-tailed Legless Lizard potential habitat consists of small, partially embedded rocks in grassy woodland. This potential habitat may be sensitive to subsidence when located directly below cliff lines or on crests. Habitat assessment surveys have identified suitable habitat for this species in rocky areas containing a grassy understorey (sparse to moderate cover). No individuals have been detected and no targeted surveys undertaken. The majority of potential habitat for the species identified within the subject land occurs on steep slopes (Figure 13e) which are	

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	SAII	Assessment of potential impact on candidate species	Consequences for local and bioregional persistence
					expected to be impacted by surface tension cracking for up to 5% maximum area of the slope face which may disturb overlying rock features. Subsidence impacts on rocky areas (areas with surface rock not associated with steep slopes) is likely to be restricted to surface cracking. This may result in mortality to individuals or reduction in available habitat.	
Striped Legless Lizard	*Delma impar*	V	V	No	Striped Legless Lizard utilises grasslands with significant amounts of surface rocks, which are used for sheltering over winter. Rocky features on steep slopes or within proximity to crests are considered sensitive to subsidence. Habitat assessment surveys have identified potential habitat for this species in rocky areas containing a grassy understorey (sparse to moderate cover). No individuals have been detected, however no targeted surveys undertaken. Approximately half of the habitat for the species identified within the subject land occurs on steep slopes (Figure 13f) which are expected to be impacted by surface tension cracking for up to 5% maximum area of the slope face which may disturb overlying rock features. Subsidence impacts on rocky areas (areas with surface rock not associated with steep slopes) is likely to be restricted to surface cracking. This may result in mortality to individuals or reduction in available habitat.	
Broad-headed Snake (Breeding)	*Hoplocephalus bungaroides*	E	V	Yes – Breeding habitat	Broad-headed Snake may utilise rock outcrops and features along minor cliff lines and steep slopes of the subject land which are considered sensitive to subsidence. Habitat assessment identified rocky habitat suitable for the species within the subject land in the vicinity of minor cliff lines. Habitat searches were undertaken for the species which did not result in detection. A section of the subject land in the south-west corner could not be adequately	

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	SAII	Assessment of potential impact on candidate species	Consequences for local and bioregional persistence
					searched due to deep crevices and large sandstone boulders; therefore, species presence is assumed in this area. The predicted impacts to minor cliffs and rock face features may result in mortality to individuals (if they were to occur in the impacted area) and a potential reduction in habitat availability up to a maximum of 5%. See Figure 13d for species polygon.	

(c) justify predictions with appropriate modelling, relevant literature and other published sources (if available), or advice from experts.

MSEC (2021) developed the subsidence predictions relied upon to predict likelihood and severity of impacts to threatened species habitats. The predicted conventional subsidence parameters for the longwalls were determined using the Incremental Profile Method (IPM), which was developed by MSEC, and calibrated to local conditions based on the available monitoring data from nearby collieries (MSEC 2021). The adequacy of the prediction model has been confirmed in three annual subsidence monitoring reviews (MSEC 2021).

The IPM is an empirical model based on a large database of observed monitoring data from previous mining within the Southern, Newcastle, Hunter and Western Coalfields of NSW and from mining in the Bowen Basin in Queensland (MSEC 2021).

Subsidence predictions made using the IPM use the database of observed incremental subsidence profiles, the longwall geometries, local surface and seam information and geology. The method has a tendency to over-predict the conventional subsidence parameters (i.e. is slightly conservative) where the mining geometry and geology are within the range of the empirical database (MSEC 2021).

4.3.3 Water quality, water bodies, and hydrological processes

Water bodies within the subject site are ephemeral waterways and drainage lines. The potential prescribed impacted to such features are discussed below.

(a) describe the nature, extent and duration of short-term and long-term impacts.

Impacts to ephemeral drainage lines identified in the subject land resulting from the Modification are similar to the approved layout and include predicted cracking of bedrock, ponding and some diversion of surface water into the strata below (i.e., during periods of light rainfall). These impacts are likely to be temporary in nature as over time the gradients along the drainage lines would approach grades similar to those that existed before mining. Stress fracturing or cracking of bedrock beneath ephemeral waterways is expected to occur; however, overland flow is expected to pass over the cracks during moderate to heavy rainfall with minimal impact to hydrological processes. These cracks and fractures are expected to fill with alluvial and colluvial material over time and the impact will be temporary in nature. The scouring and erosion predicted during heavy rain periods is expected to temporarily increase sediment laden runoff; however, this should cease once the cracks and fractures either fill in naturally or are remediated.

In the case of large cracks and fractures, remediation works may be required as per the requirements of the BMP (MCO 2020a).

(b) predict the consequences to the threatened entities identified in Subsection 6.1.4.

Table 24 details the potential impacts to the threatened biodiversity reliant on drainage features in the subject land.

Table 24: Potential impacts to water quality, water bodies and hydrological processes that sustain threatened species and TECs

Ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences of the impacts on the ecological community
PCT 1176 Hunter Valley Footslopes Slaty Gum Woodland in the	The predicted subsidence may lead to increased ponding and, as a consequence, increased scouring and erosion in ponded areas during rain events. Stress fracturing of	The ephemeral waterway within the subject land may be impacted by

Ecological communities	Nature, extent and duration of short and long-term impacts	Likely Consequences of the impacts on the ecological community
Sydney Basin Bioregion PCT 434 White Box – Yellow Box –Blakely's Red Gum Grassy Wood land and Derived Native Grass land	bedrock beneath ephemeral waterways is expected to occur; however, overland flow is expected to pass over the cracks with only a small percentage of flow to enter fractured surfaces. These cracks and fractures are expected to fill with colluvial material over time and the impact be temporary in nature. Change to flows during high flow events is expected to be minimal, although the change would be greater during low flows. In the case of large cracks and fractures, remediation works may be required.	subsidence and modified hydrology resulting in loss of habitat. The potential impact may occur during or after the operational or decommissioning phase of the Modification, the timing of which is unpredictable. Impacts may also occur due to earth movement during operations. Given the TECs in the subject land are not GDEs, they are not likely to be reliant on the hydrological processes of the waterways in the subject land and are therefore not likely to be impacted by subsidence as a result of the Modification The predicted subsidence impacts on the ephemeral waterway within the subject land are not likely to result in any adverse impacts on the ecological communities, or their vegetation integrity.

(c) where the proposed impact is in relation to longwall mining, calculate the maximum predicted offset liability as per the Addendum to NSW Biodiversity Offsets Policy for Major Projects: upland swamps impacted by longwall mining subsidence, using predictions of impacts on water-dependant plant communities and the threatened species they support

No upland swamps occur in the subject land.

(d) justify predictions of impacts with appropriate modelling (if available), relevant literature and other published sources of information, or consultation with species experts.

Modelling MSEC (2021) used for subsidence predictions is detailed in Section 4.3.2 c) above.

4.3.3.1 State Environmental Planning Policy (Koala Habitat Protection) 2020

The Modification consists of an application for a Modification (section 4.55(2) of the EP&A Act) to the existing Stage 2 Project Approval 08_0135 which was originally assessed as a Major Project under Part 3A of the EP&A Act (now assessed as State Significant Development under Division 4.7 of the EP&A Act). The consent authority in this instance is the NSW Minister for Planning.

The subject land is larger than 1 ha in area and situated on land zoned RU1 – Primary Production within the Mid-Western Regional Local Environmental Plan 2012, which is a Council listed under Schedule 1 of *State Environmental Planning Policy (Koala Habitat Protection) 2020* (Koala Habitat SEPP).

The subject land contains Potential Koala Habitat based on the presence of Schedule 2 listed feed tree species Grey Gum and White Box, which comprise over 15% of the total trees forming the canopy of PCTs 434 and 1629.

The subject land is likely to be considered Core Koala Habitat based on confirmed presence via multiple Koala scat observations during the current survey (AMBS 2021) and nine previous records within the locality over the last 30 years. No evidence of breeding females was observed during the current surveys; however, as no targeted survey was undertaken for this species, a breeding population cannot be ruled out.

In this instance, the preparation of a Koala Plan of Management is not necessary as the provisions of the Koala Habitat SEPP only apply to development under Part 4 of the EP&A Act where Council is the consent authority.

4.4 NSW Fisheries Management Act 1994 (FM Act)

The Fisheries Management Act 1994 (FM Act) provides for the protection of native aquatic fauna (fish, aquatic invertebrates) and their habitats by regulating allowable activities on or near waterways and enacting protections for specific areas (e.g., Marine Protected Areas and Intertidal Protected Areas).

No aquatic flora, fauna or Key Fish Habitats are to be impacted by the Modification, therefore, further assessment under the FM Act is not required.

4.5 Munghorn Gap Nature Reserve

Munghorn Gap Nature Reserve is located outside and to the south of the subject land (i.e. outside of the predicted subsidence extent). MSEC (2021) describe that minor far-field horizontal movements may occur outside of the subject land and extend to Munghorn Gap Nature Reserve. However, MSEC (2021) conclude that impacts to the Munghorn Gap Nature Reserve (landforms or features) resulting from the Modification are considered unlikely.

4.6 Existing Biodiversity Offset Area

The subject land is within an existing offset area held by MCO (i.e. as part of the Onsite Cluster of offset areas) (Figure 14). The offset area was established as part of the NSW Stage 2 Project Approval (08_0135) and EPBC Act Approval 2008/4444. As such, the offset was established and approved in full knowledge that it would partially overlie an approved longwall mining area (i.e. UG2 longwalls), as recognised in the in-perpetuity conservation mechanism.

The offset area has been secured by registering on the title of the land a 'Positive Covenant' instrument and a 'Restriction on the Use of Land by a Prescribed Authority' instrument executed under section 88E(3) of the NSW *Conveyancing Act 1919* and allows for underground mining beneath the offset area:

2. *This instrument does not prevent the following being carried out on the Land as long as the conditions contained in this instrument can be met:*

   a. carrying out environmental studies;

   b. underground mining;

   c. Surface Monitoring Activities;

   d. Rehabilitation required in respect of underground mining; and

e. Exploration Drilling.

The offset area was established for Box-Gum Woodland CEEC, Large-eared Pied Bat, Corben's Long-eared Bat, Regent Honeyeater, Swift Parrot and Spotted-tailed Quoll.

The Modification would not impact the habitat for the Box-Gum Woodland CEEC, Corben's Long-eared Bat, Regent Honeyeater, Swift Parrot or Spotted-tailed Quoll. The risk to the potential habitat for the Large-eared Pied Bat is discussed in section 4.4.2 and Annex 8.

Since the subject land is within an existing offset area, the subject land would be managed for conservation purposes under a Biodiversity and Offset Management Plan.

4.7 Serious and irreversible impacts

The BC Act and the NSW *Local Land Services Act 2013* imposes various obligations on decision-makers in relation to impacts on biodiversity values that are at risk of SAII. These obligations generally require a decision-maker to determine whether the residual impacts of a proposed development on biodiversity values (that is, the impacts that would remain after any proposed avoid or mitigate measures have been taken) are serious and irreversible.

The BC Act and the BC Regulation provide a framework to guide the consent authority in making this determination. The framework consists of a series of principles defined in Section 6.7 of the BC Regulation and supporting guidance, provided for under section 6.5 of the BC Act, to interpret these principles. Criteria to interpret the principles is included in Table 1 of *Guidance to assist a decision-maker to determine a serious and irreversible impact* (DPIE 2019d) and these are addressed below.

Based on the result of the field survey, candidate species assessment (Threatened flora: section 2.3.2; Threatened fauna: section 2.4.3) and analysis against prescribed impacts, the following candidate species are regarded as SAII entities:

- Broad-headed Snake (assumed present)
- Large-eared Pied Bat (confirmed present)
- Eastern Cave Bat (confirmed present), and

The Modification may result in prescribed impacts to potential breeding habitat for Broad-headed Snake, Eastern Cave Bat and Large-eared Pied Bat, all of which are listed as SAII thresholds for these species.

The following entities, although their habitat constraints are not considered sensitive to subsidence, are also SAII entities.

- *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* (confirmed present)
- Regent Honeyeater (assumed present, mapped important areas).

SAII assessments for these species have been completed to assist the determining authority with evaluating the extent and severity of the impact (Annex 8). These are supported by Figure 13a, 13b, 13d, 13e, 13f and 13q which display the species polygon in relation to habitat features covered under the SAII description in the TBDC as per the BAM requirements.

5. Mitigation and Management Measures

Impacts associated with the Modification will be restricted to prescribed impacts resulting from subsidence as detailed in Section 4. The subsidence related impacts have been avoided and minimised as far as practical during the design phase (Section 3). The BAM (DPIE 2020a) requires a BDAR to describe measures to mitigate and manage prescribed impacts.

Management Plans

Since the subject land underlies an existing offset area, the subject land would continue to be managed for long term conservation purposes in accordance with the Stage 2 Project approval (08_0135), Biodiversity and Offset Management Plan required under EPBC Act Approval 2008/4444, and the terms of the in-perpetuity conservation mechanism. As detailed in Section 4.7, the offset is secured in perpetuity, with the terms of the security allowing subsidence and monitoring to occur within the offset.

MCO currently has a number of existing management strategies and plans associated with the Stage 2 Approval (08_0135). Key management strategies and plans include:

- *Environmental Management Strategy* (MCO 2020c)
- *Biodiversity Management Plan* (complex-wide BMP) (MCO 2020a)
- *Rehabilitation Management Plan* (RMP) (MCO 2020d).

In addition to these plans, MCO will be required to prepare and submit an Extraction Plan for UG2 for approval by the DPIE. The Extraction Plan will include:

- a summary of relevant background or baseline data;
- a review of predictions of the potential subsidence effects, subsidence impacts and environmental consequences, incorporating any relevant information (such as monitoring results obtained during mining);
- a monitoring program to provide data to assist with the management of the risks associated with subsidence, validate subsidence predictions and analyse the relationship between subsidence effects and impacts and any ensuing environmental consequences;
- a plan to manage and remediate subsidence impacts and/or environmental consequences (e.g. remediation of observed cracking);
- trigger action response plans to identify risks and outline specific follow up actions to avoid exceedances of agreed performance measures;
- contingency plans that provide for adaptive management where monitoring indicates that there has been an exceedance of agreed performance measures; and
- reporting and review mechanisms.

The UG2 Extraction Plan will include a BMP (additional to the overarching complex-wide BMP [MCO 2020a]) and Subsidence Monitoring Program (SMP). These management plans will be similar to those prepared for the UG1 Extraction Plan.

Subsidence and Biodiversity Monitoring and Mitigation Measures

The UG2 Extraction Plan will include a monitoring programme the purpose of which is to:

- assess the potential environmental consequences of an observed subsidence impact;
- identify appropriate management measures; and
- assess compliance with the relevant subsidence impact performance measures in the Stage 2 Project Approval (08_0135).

The monitoring programme will focus on surface cracking, tree health, ponding along drainage lines and evidence of subsidence impacts to features that provide potential bat roosting sites, compared to baseline condition.

The monitoring programme will generally contain:

- pre mining-impact baseline data prior to secondary extraction on:
    - rocky outcrops (caves and crevices) (e.g. rockfalls, displacement of or dislodgement of boulders or slabs, or fracturing);
    - Eastern Cave Bat and Large-eared Pied Bat activity;
    - presence of surface cracking in native vegetation (including within the TECs);
    - tree health (including within the TECs);
    - presence of ponding along drainage lines.
- annual monitoring of the above for during and for at least two years following longwall extraction;
- best practice monitoring techniques;
- completion and performance criteria, are ecologically-based and act as triggers for management measures;
- information that will be necessary to measure the impact over time; and
- consideration of the results from monitoring at UG1 and/or UG4.

The results from the monitoring programme (or regular inspections by MCO) may trigger the need for remediation/rectification work or contingency measures/controls.

If required, surface cracking will be remediated by infilling with soil or other suitable materials, or by locally regrading and compacting the surface. Remediation of surface cracking will only be undertaken where the works do not create a greater impact than the subsidence impact itself.

Specific measures proposed to manage prescribed impacts, including the methods, timing, frequency, responsibility, risk and consequence of residual impact is displayed in Table 26 below.

In order to determine the presence/absence of Broad-headed Snake, Pink-tailed Legless Lizard and Striped Legless Lizard in the subject land and inform management measures, targeted surveys will be undertaken for these species within potential habitat defined by the species polygons (Figures 13d to 13f) prior to the commencement of secondary extraction in these locations and in consideration of published survey guidelines.

Contingency Measures/Controls

Subsidence impact performance measures in the Stage 2 Project Approval (08_0135) that are relevant to this assessment are presented in Table 25.

Table 25: Moolarben Coal Project Stage 2 Relevant Subsidence Impact Performance Measures

Feature	Subsidence Impact Performance Measure
Drainage Lines (DL1 to DL7)	No greater subsidence impacts or environmental consequences than predicted in the EA.
Cliffs C7, C9 and C10	Negligible environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs or fracturing, that in total do not impact more than 0.5% of the total face of such cliffs within any longwall mining domain).
Other cliffs	No greater subsidence impacts or environmental consequences than predicted in the EA.
Minor cliffs Rock face features Steep Slopes	Minor environmental consequences (that is, occasional rockfalls, displacement of or dislodgment of boulders or slabs, or fracturing, that in total do not impact more than 5% of the total face area of each such type of feature within any longwall mining domain).
Threatened species, threatened populations or endangered ecological communities	Negligible subsidence impacts or environmental consequences.
First workings under an approved Extraction Plan beneath any feature where performance measures in this table require negligible subsidence impacts or negligible environmental consequences	To remain long-term stable and non-subsiding.
Second workings	To be carried out only in accordance with an approved Extraction Plan

In the event a relevant subsidence impact performance measure in the Stage 2 Project Approval (08_0135) is considered to have been exceeded or is likely to be exceeded, MCO will implement contingency measures/controls to address the impact. Examples of contingency measures/controls that will be in the UG2 Extraction Plan are:

- additional monitoring to confirm the performance measure has been exceeded;
- additional remedial works to address the impact (e.g. installation of artificial habitat for cave-dwelling microbats); and/or
- biodiversity offsets (Section 6).

Condition 2, Schedule 4 of PA 08_1035 would continue to apply to the Modified Project. Condition 2, Schedule 4 of PA 08_1035 states:

> *If the Proponent exceeds the performance measures in Table 18* [refer to Table 25 of this report] *and the Secretary determines that:*
>
> *(a) it is not reasonable or feasible to remediate the impact or environmental consequence; or*

(b) remediation measures implemented by the Proponent have failed to satisfactorily remediate the impact or environmental consequence;

then the Proponent shall provide a suitable offset to compensate for the impact or the environmental consequence, to the satisfaction of the Secretary.

Note: Any offset required under this condition must be proportionate with the significance of the impact or environmental consequence.

Table 26: Mitigation and management measures to manage prescribed impacts at UG2

Impact	Mitigation measure	Method	Timing	Frequency	Responsibility	Risk and consequence of residual impact
Threatened microbats – caves and crevices	Biodiversity monitoring program - microbats	Implement annual monitoring program targeting threatened bats. Monitoring to consider including both impact and control sites to enable distinction between mining impacts and wider regional population changes or natural fluctuations caused by events such as drought.	Pre-mining impact baseline data prior to secondary extraction annual as well as annual monitoring during and at least two years following longwall extraction.	Annually	MCO	Low
Native vegetation and habitat	Subsidence remediation	Remediation of surface cracking where practicable. Stabilisation of remediated surface cracking using brush-matting or revegetation. Drainage works and rehabilitation of subsidence troughs where practicable.	As required	Throughout the duration of operations	MCO	Low
	Longwall panel traverses	Any evidence of subsidence impacts compared to baseline condition (e.g. surface cracking, ponding, deterioration in tree health outside natural variation, weed incursion and/or infestation). Nature and extent of any impacts on flora and fauna habitats and evidence of any impacts on terrestrial fauna. The extent and condition of identified threatened flora species or TECs will be recorded and compared to the baseline condition.	Pre-mining impact baseline data for two years prior to secondary extraction annual as well as annual monitoring during and at least two years following longwall extraction.	Annually	MCO	Low

6. Conclusion

This BDAR provides a biodiversity assessment to address the potential impacts associated with the Modification as per the requirement of the BAM (DPIE 2020a) and associated guidelines. The Modification would not result in direct impacts to biodiversity. The potential impacts associated with the Modification are restricted to subsidence related impacts (i.e. prescribed impacts). Subsidence impact predictions detailed in MSEC (2021) identified that minor cliff lines and rock face features (up to a maximum of 5%), steep slopes (up to a maximum of 5%) and ephemeral drainage lines waterways in the subject land may be exposed to subsidence related impacts.

The potential subsidence related impacts would be monitored in accordance with a BMP and SMP, prepared to support an Extraction Plan for UG2.

Based on a review of the subsidence predictions and associated specialist assessments, coupled with targeted field campaigns and analysis using the BAM (DPIE 2020a), this assessment concludes the following:

- Subsidence is unlikely to result in significant impacts towards native vegetation
- Subsidence is unlikely to result in an impact to threatened flora
- Subsidence may have an impact on rocky outcrop (caves and crevices) habitat likely to be used by threatened bats:
  - Eastern Cave Bat (Vulnerable, BC Act)
  - Large-eared Pied Bat (Vulnerable, BC Act and EPBC Act)
- Subsidence may have an impact on rocky habitat potentially used by:
  - Broad-headed Snake (Endangered, BC Act and Vulnerable, EPBC Act)
  - Pink-tailed Legless Lizard (Vulnerable, BC Act and EPBC Act)
  - Striped Legless Lizard (Vulnerable, BC Act and EPBC Act).

Impacts to the breeding habitat of Broad-headed Snake, Eastern Cave Bat and Large-eared Pied Bat are a potential SAII. No impacts to Regent Honeyeater foraging or breeding habitat or *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* CEEC would result from the Modification; however, these SAII entities are assessed. SAII assessments for these species have been completed to assist the determining authority with evaluating the extent and severity of the impact.

The potential subsidence related impacts would be monitored in accordance with a Biodiversity Management Plan (prepared to support an Extraction Plan for UG2). The potential subsidence related impacts to the following candidate species are likely to require a biodiversity offset if monitoring determines that the potential impact has been realized:

- Broad-headed Snake
- Eastern Cave Bat
- Large-eared Pied Bat
- Pink Legless Lizard
- Striped Legless Lizard.

In summary, there is a low likelihood of minor impact on a local population that may use potential habitat in the subsidence extent and also in the wider surrounds. However, the Modification is expected to result in negligible consequence to threatened species and communities in a regional context.

MCO will continue monitoring in accordance with a Biodiversity Management Plan. If the performance measures are exceeded, then biodiversity offsets will apply.

The BAM-C does not currently allow for calculation of biodiversity offsets for prescribed impacts.

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Figures

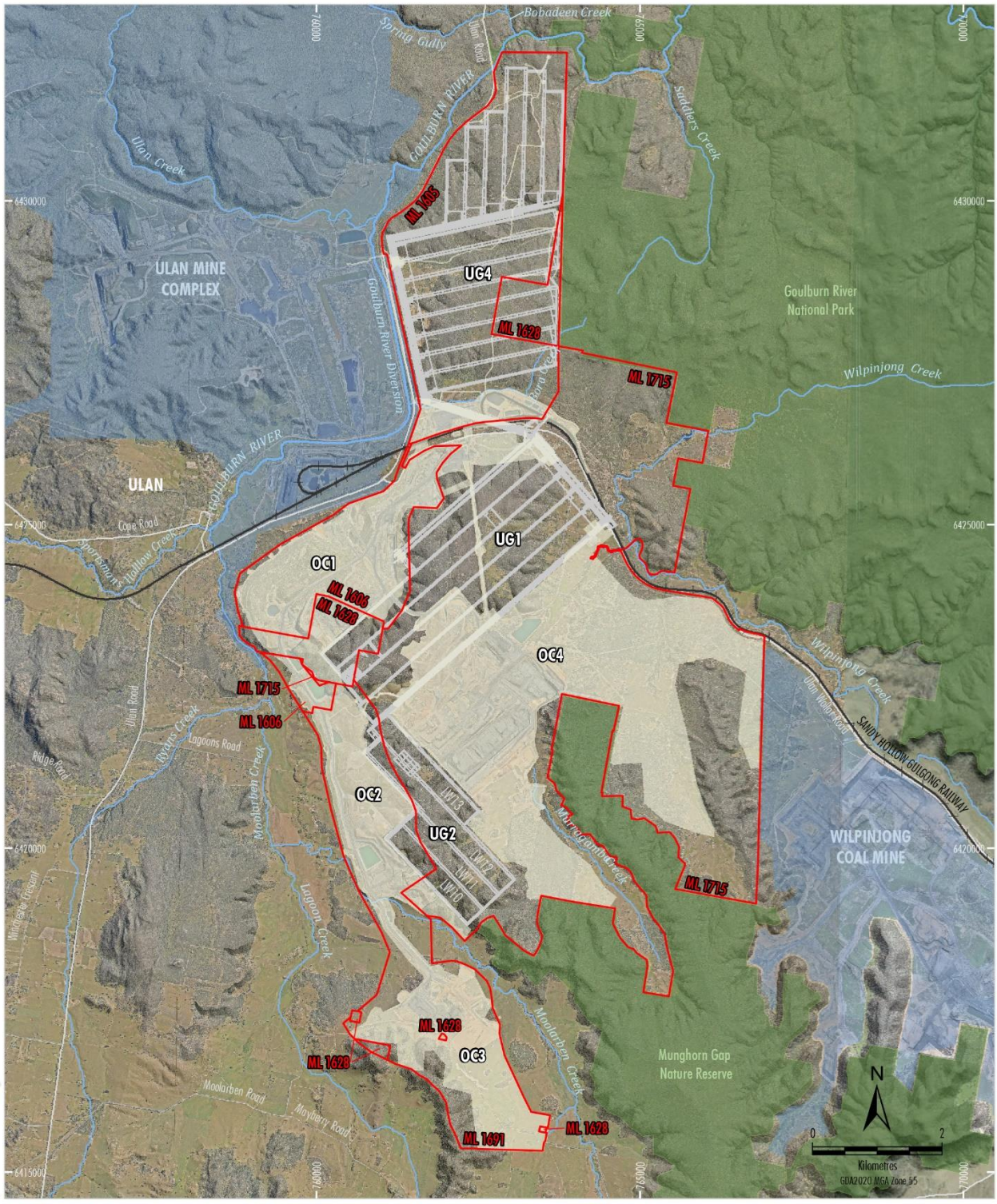
Source: NSW Spatial Services (2021)

YANCOAL
MOOLARBEN COAL

MOOLARBEN COAL COMPLEX

Regional Location

Figure 1



LEGEND
- National Parks/Nature Reserves
- Other Mining Operation
- Mining Lease Boundary

Existing/Approved Development
- Underground Longwall Layout
- Moolarben Coal Complex Disturbance Footprint

Source: MCO (2021); NSW Spatial Services (2021)
Orthophoto: MCO (Jan 2021)

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MOOLARBEN COAL

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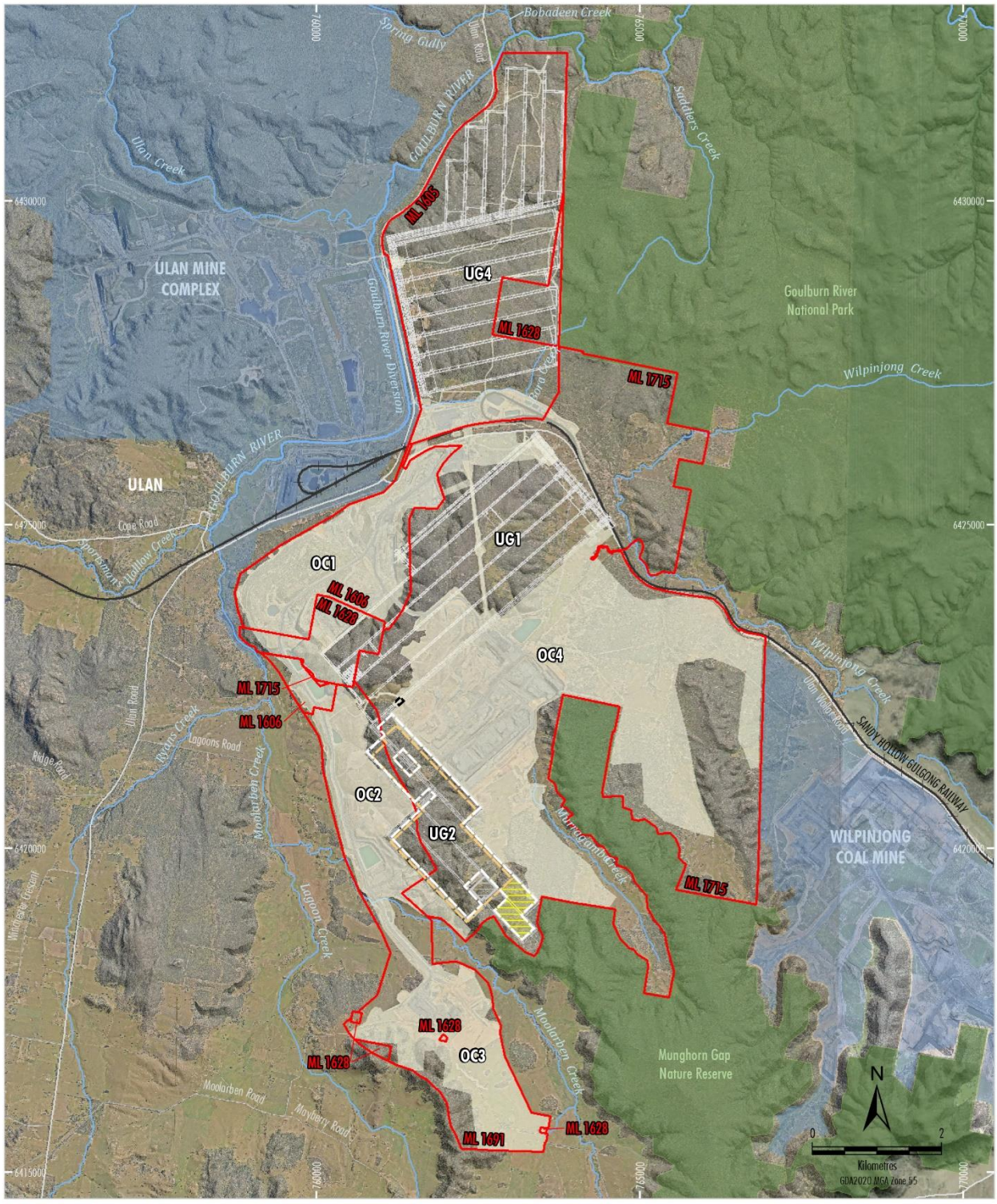
Approved General Arrangement

Figure 2



LEGEND
- National Parks/Nature Reserves
- Other Mining Operation
- Mining Lease Boundary

Existing/Approved Development
- Underground Longwall Layout
- Approximate Extent of UG2 Longwalls
- Moolarben Coal Complex Disturbance Footprint

Proposed UG2 Modification
- Optimised UG2 Longwall Layout
- UG2 Longwall Extension Area
- Non-subsiding UG2 Secondary Workings
- Approximate Extent of Proposed Modified Longwalls
- Proposed Extent of RSIA

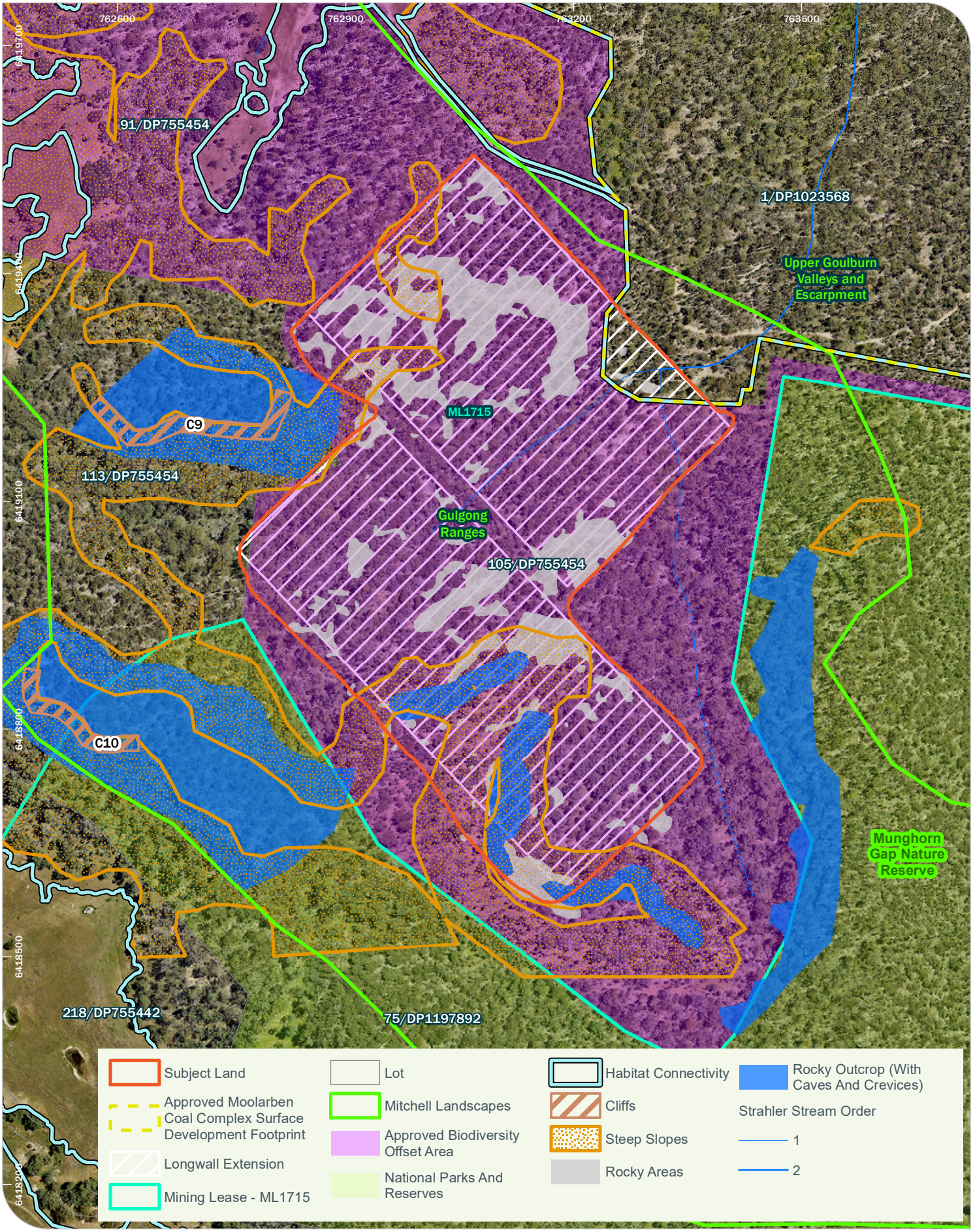
Source: MCO (2021); NSW Spatial Services (2021)
Orthophoto: MCO (Jan 2021)

YANCOAL 兖煤澳大利亚有限公司
MOOLARBEN COAL

MOOLARBEN COAL COMPLEX

Proposed Modified General Arrangement

Figure 3



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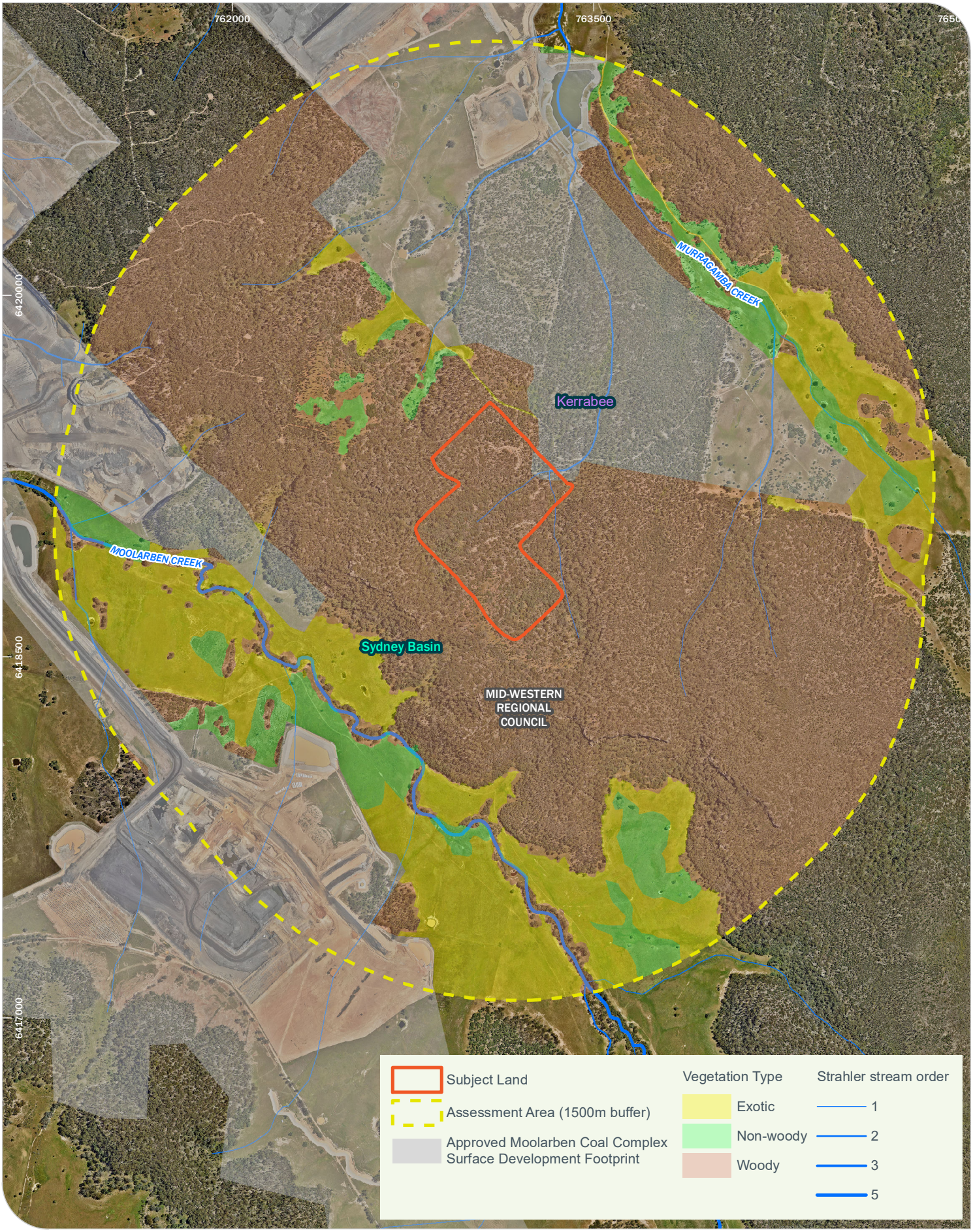
GDA2020 MGA Zone 55

Site Map
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd.

Figure 4



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Subject land in the locality
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 5

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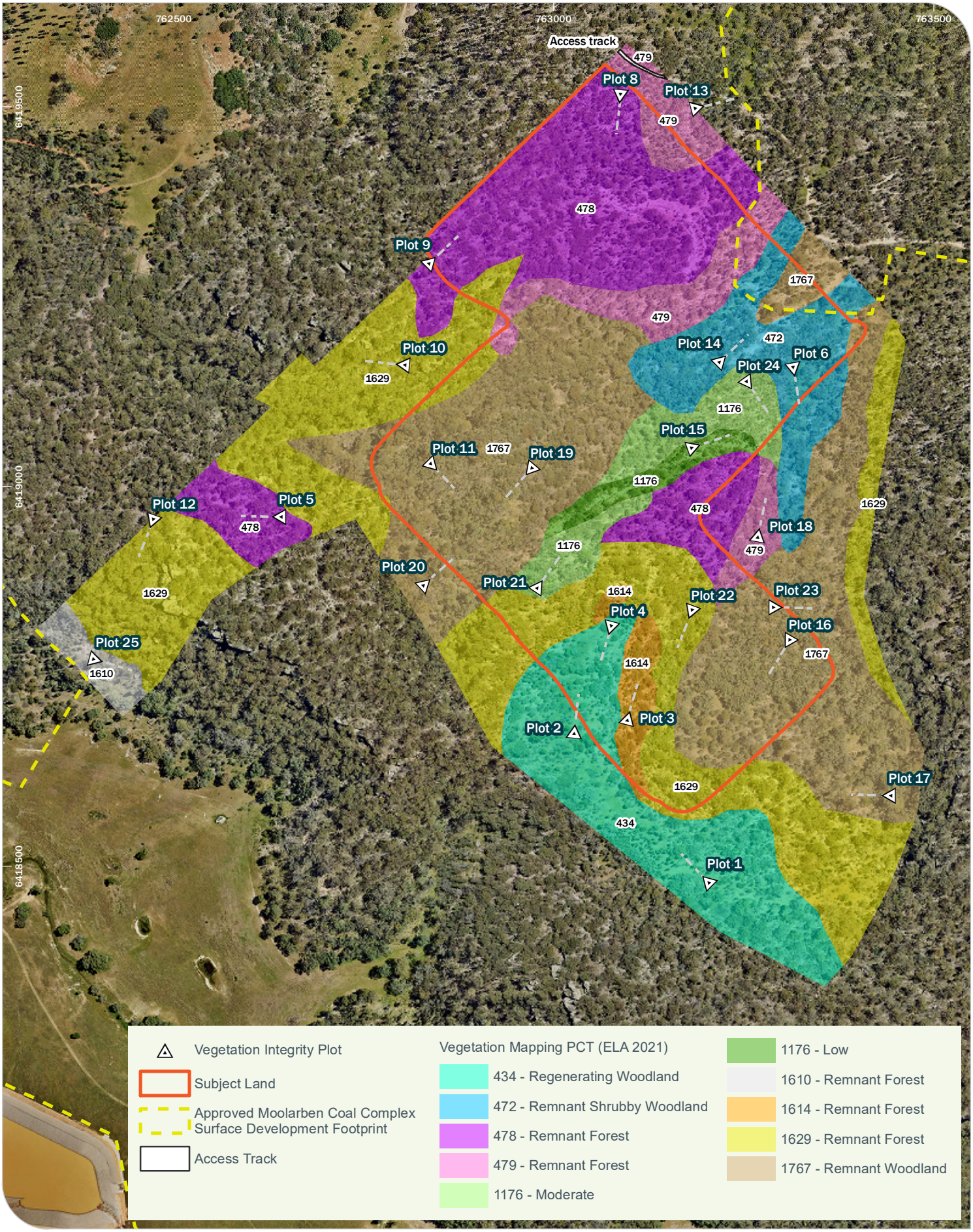

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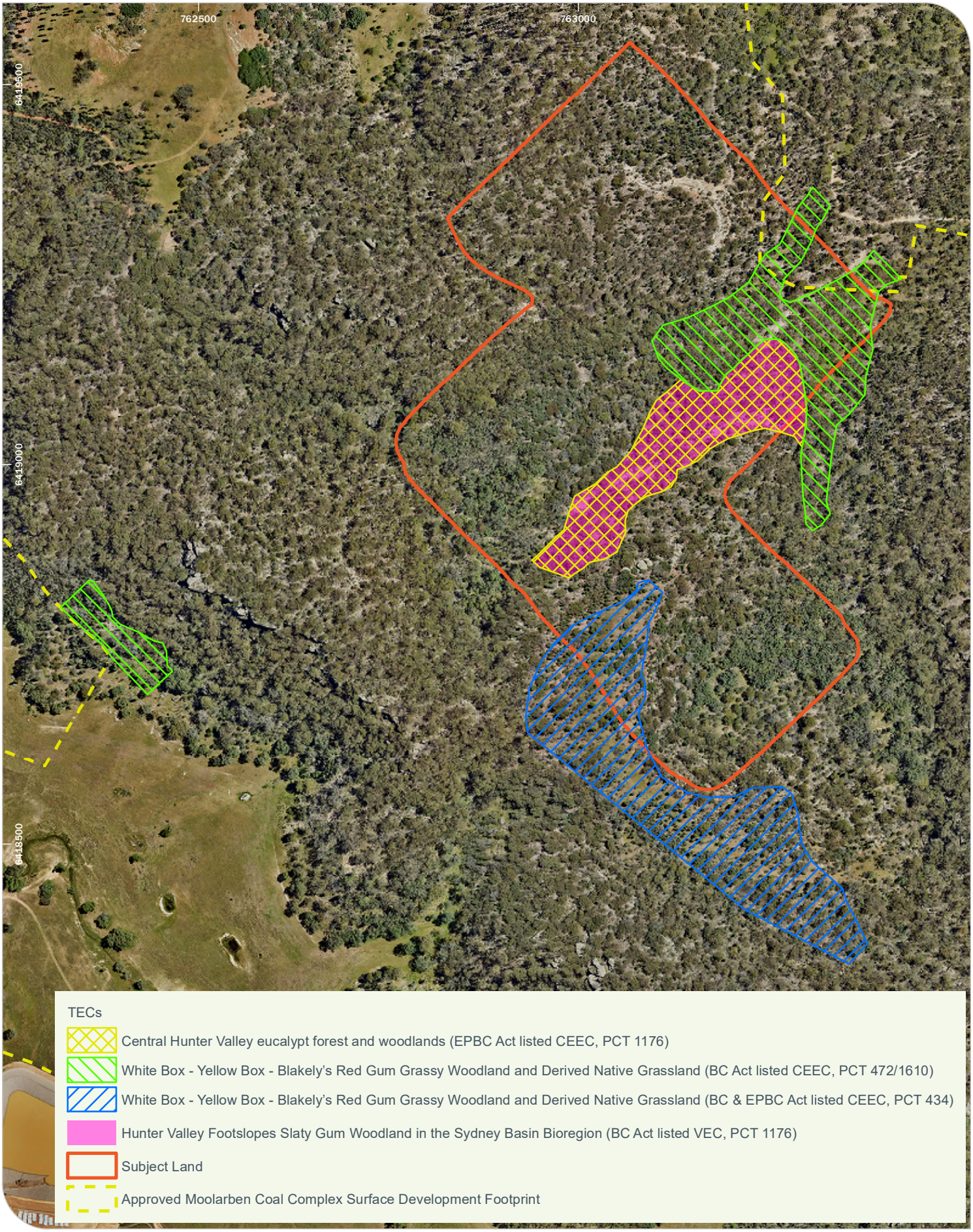
Vegetation zones and plot locations
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 6



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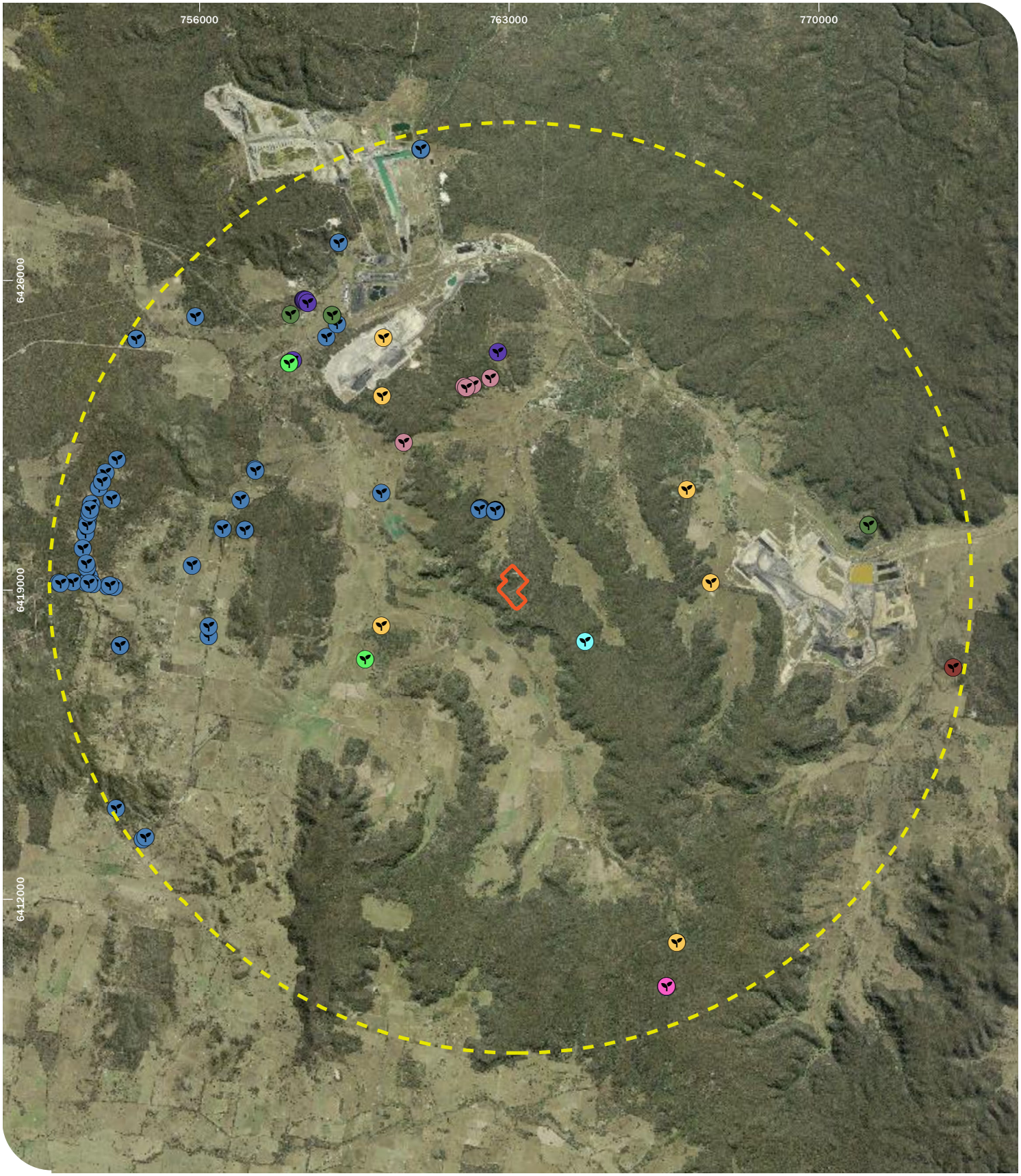
Threatened ecological communities (ELA 2021)

Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 7



Subject Land
10km Search Area

Flora

- *Acacia ausfeldii*
- *Diuris tricolor*
- *Eucalyptus camaldulensis*
- *Eucalyptus cannonii*
- *Leucochrysum albicans var. tricolor*
- *Ozothamnus tesselatus*
- *Pomaderris queenslandica*
- *Prasophyllum petilum*
- *Pultenaea glabra*

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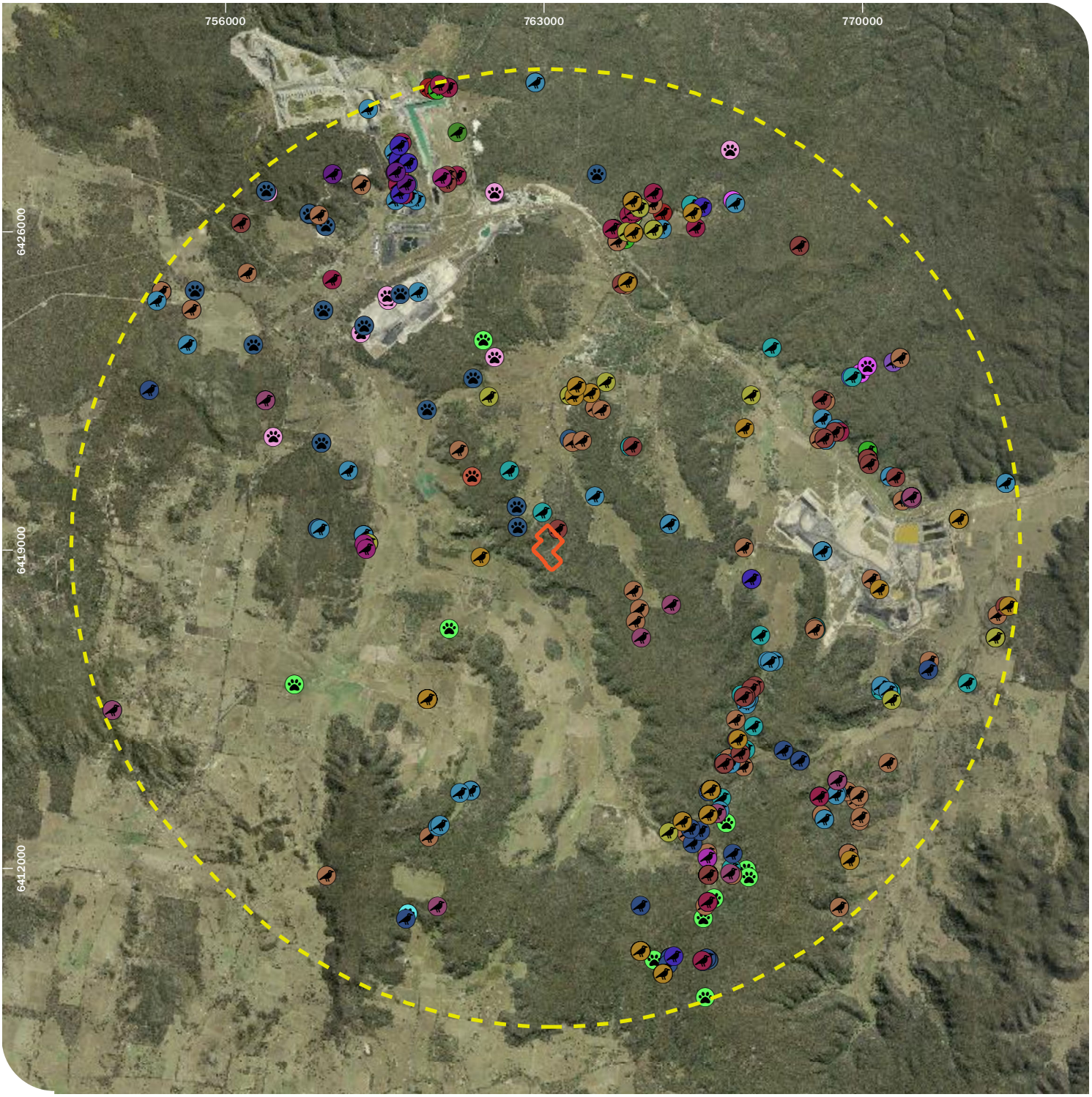
**Species records as per public register prior to survey. Does not include current survey results. Sensitive species not displayed as per license agreement.*

Threatened flora within the locality

Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 8



- Subject Land
- 10km Search Area

Aves

- Black-chinned Honeyeater (eastern subspecies)
- Brown Treecreeper (eastern subspecies)
- Diamond Firetail
- Dusky Woodswallow
- Flame Robin
- Grey-crowned Babbler (eastern subspecies)
- Hooded Robin (south-eastern form)
- Little Eagle
- Little Lorikeet
- Painted Honeyeater
- Pied Honeyeater
- Pink Robin
- Regent Honeyeater
- Scarlet Robin
- Speckled Warbler
- Spotted Harrier
- Varied Sittella
- White-bellied Sea-Eagle
- White-fronted Chat
- White-throated Needletail

Mammalia

- Corben's Long-eared Bat
- Eastern Cave Bat
- Koala
- Large Bent-winged Bat
- Large-eared Pied Bat
- New Holland Mouse
- Spotted-tailed Quoll
- Squirrel Glider
- Yellow-bellied Sheathtail-bat

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GDA2020 MGA Zone 55

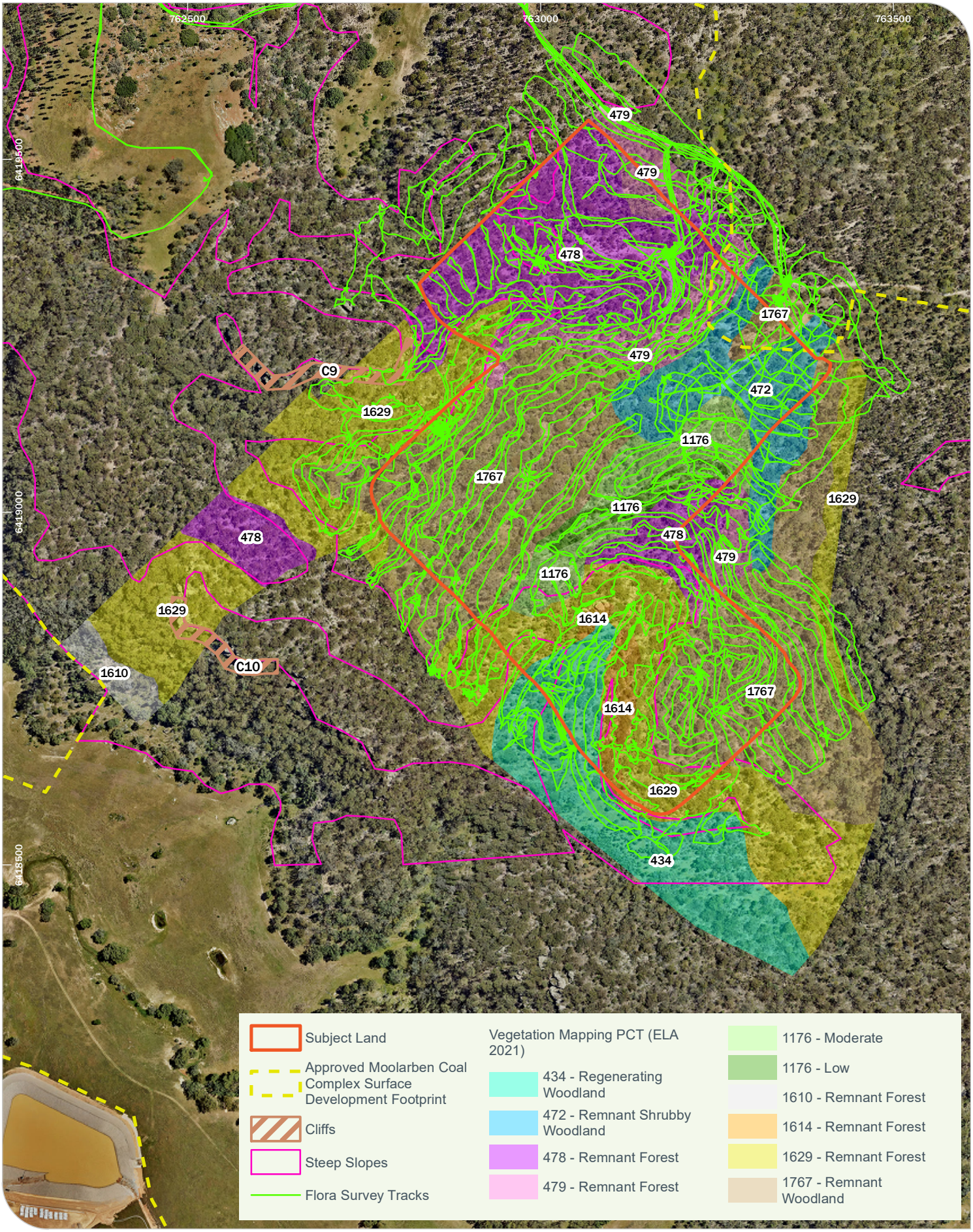
**Species records as per public register prior to survey. Does not include current survey results. Sensitive species not displayed as per license agreement.*

Threatened fauna within the locality

Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 9



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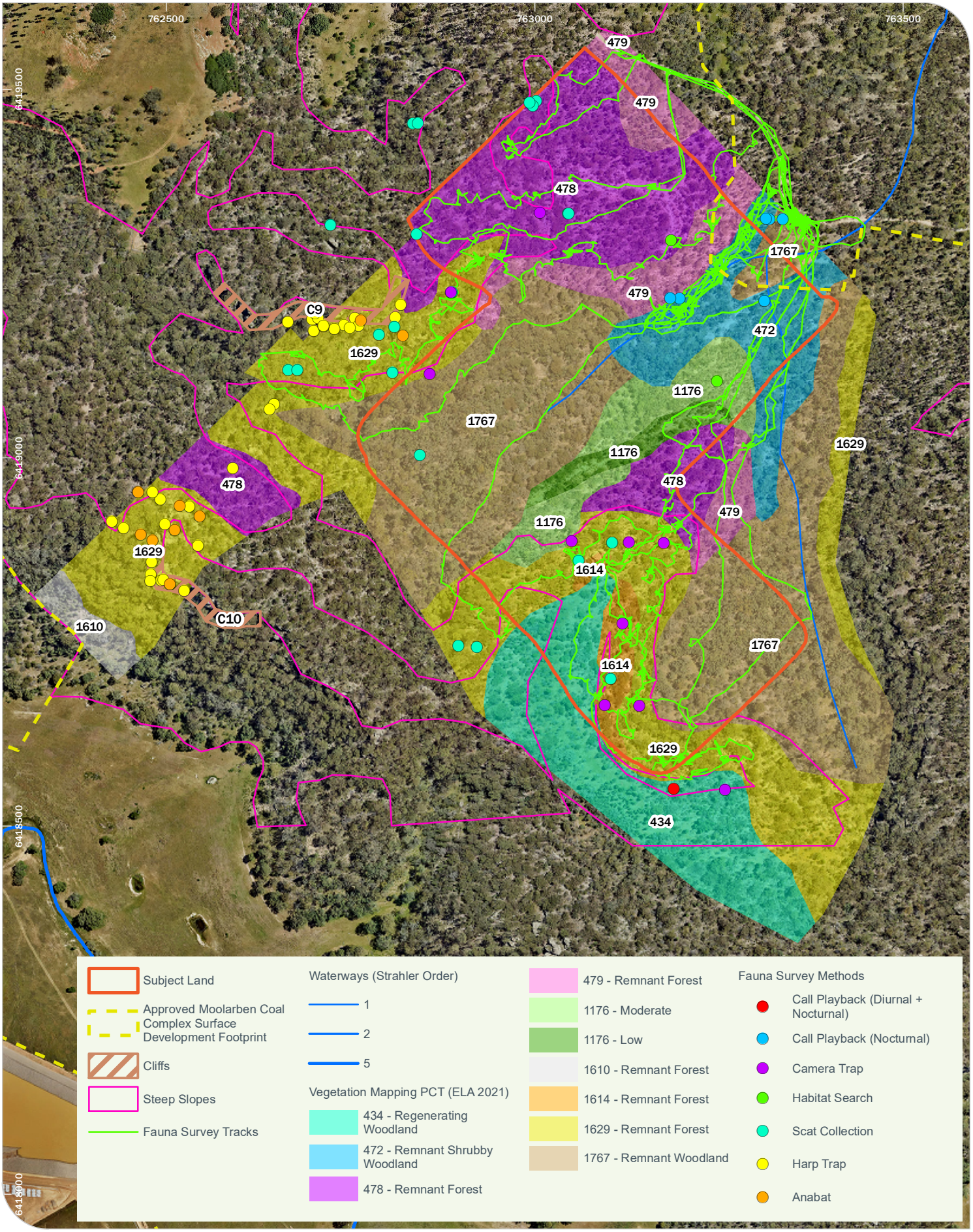
GDA2020 MGA Zone 55

Threatened flora survey methods and effort

Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 10



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Threatened fauna survey methods and effort

Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 11

World Imagery: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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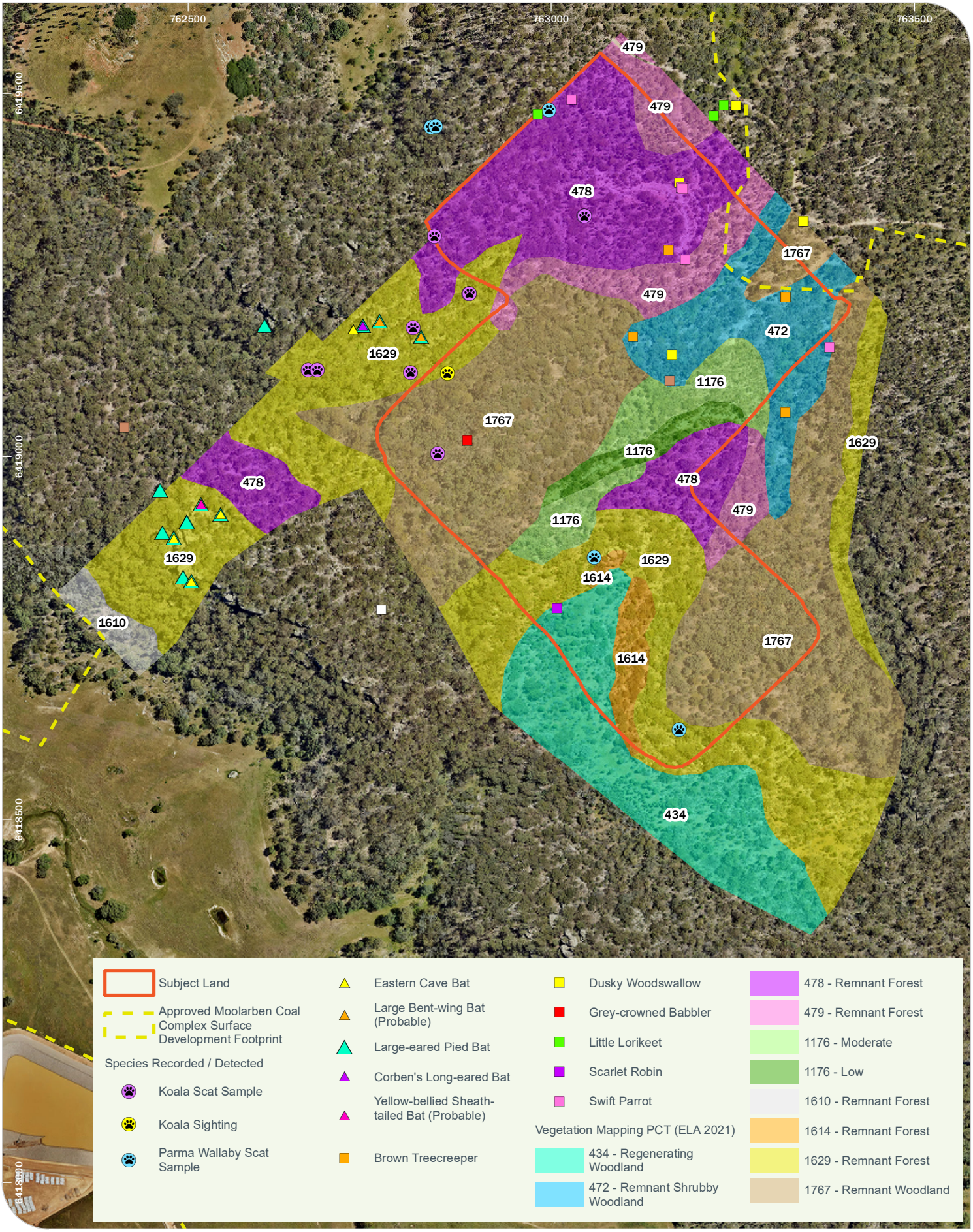

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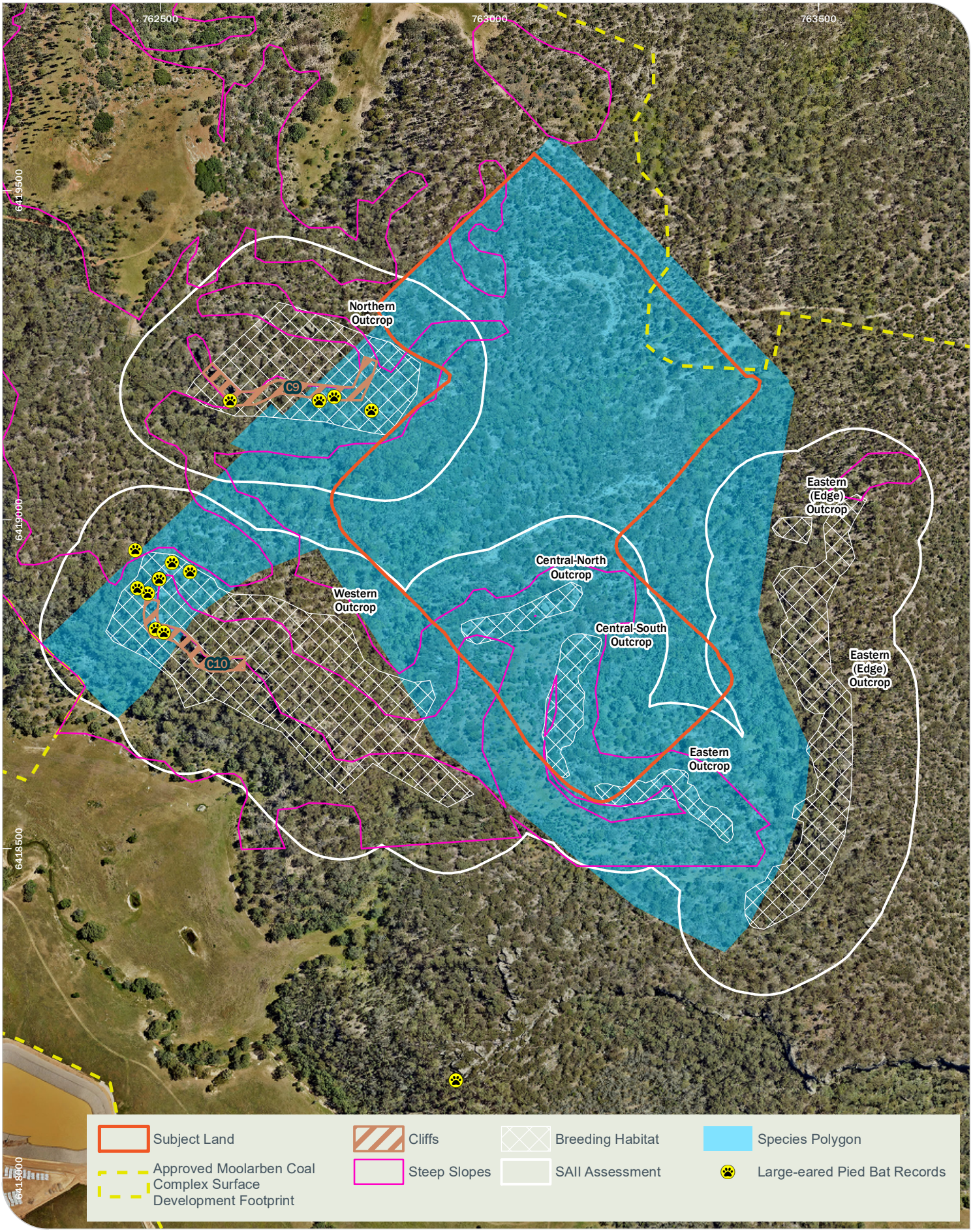
Threatened species detected within subject land and surrounds

Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 12



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Species Polygon
Large-eared Pied Bat (*Chalinolobus dwyeri*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13a

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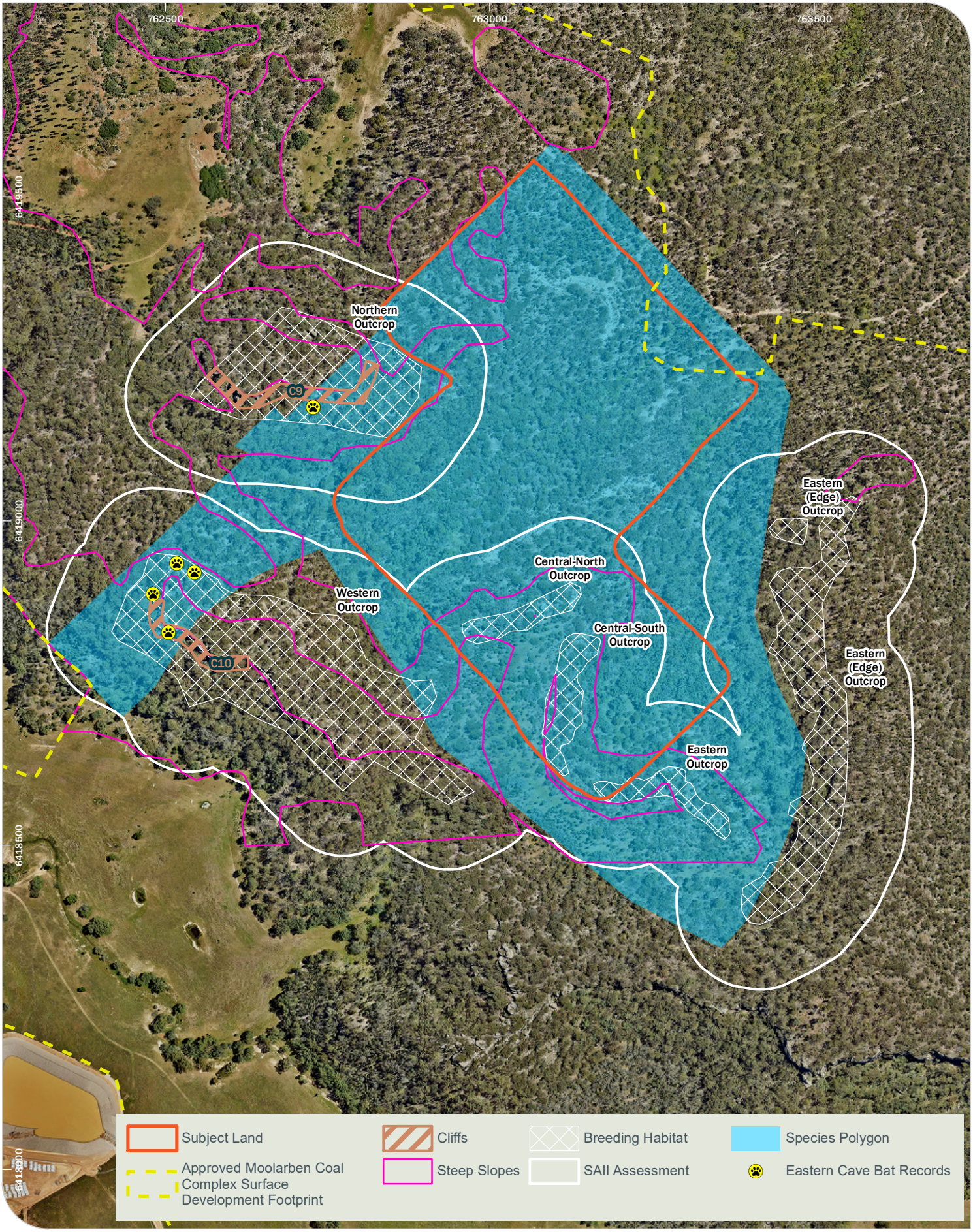

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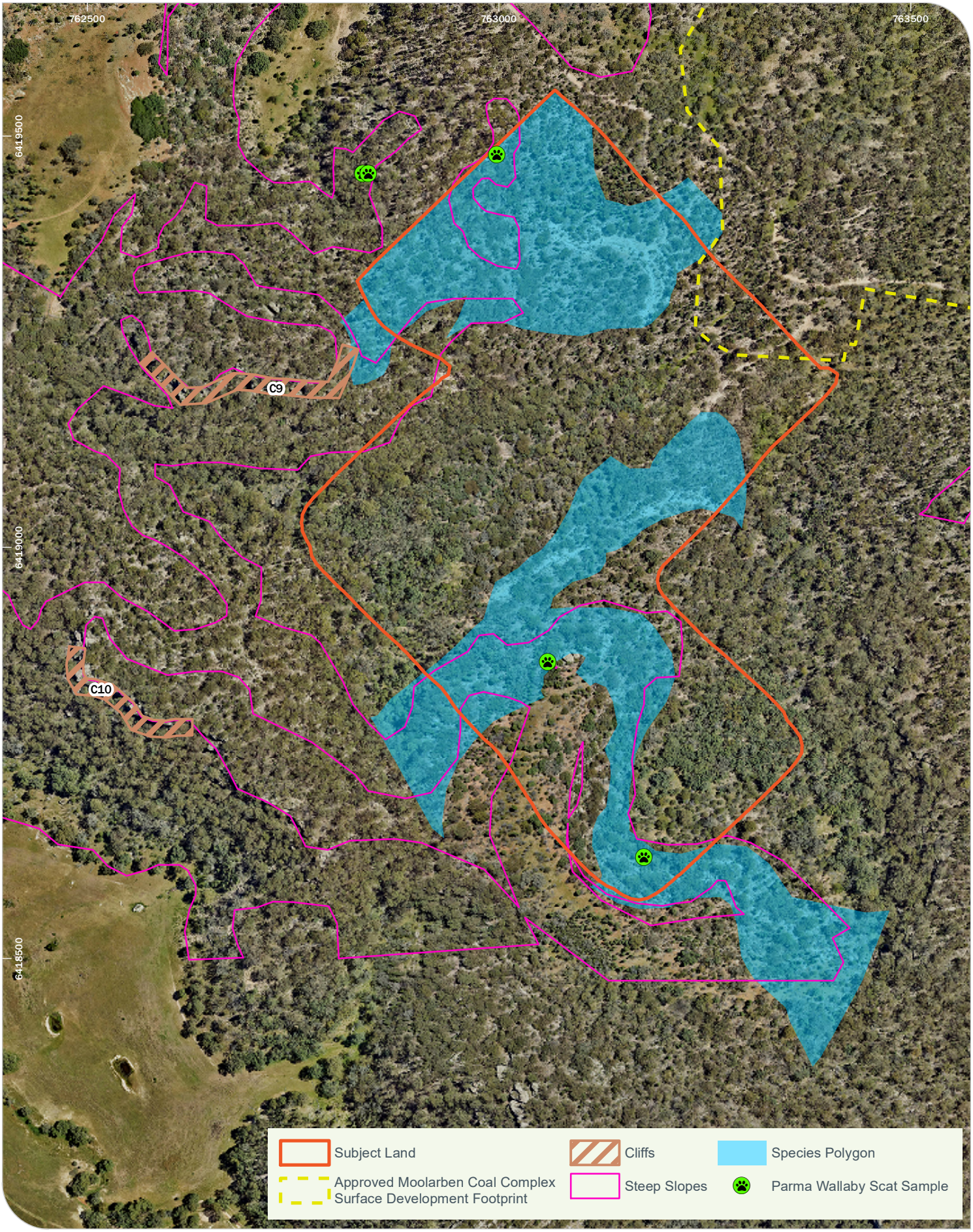
Species Polygon
Eastern Cave Bat (*Vespadelus troughtoni*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13b

v2.0



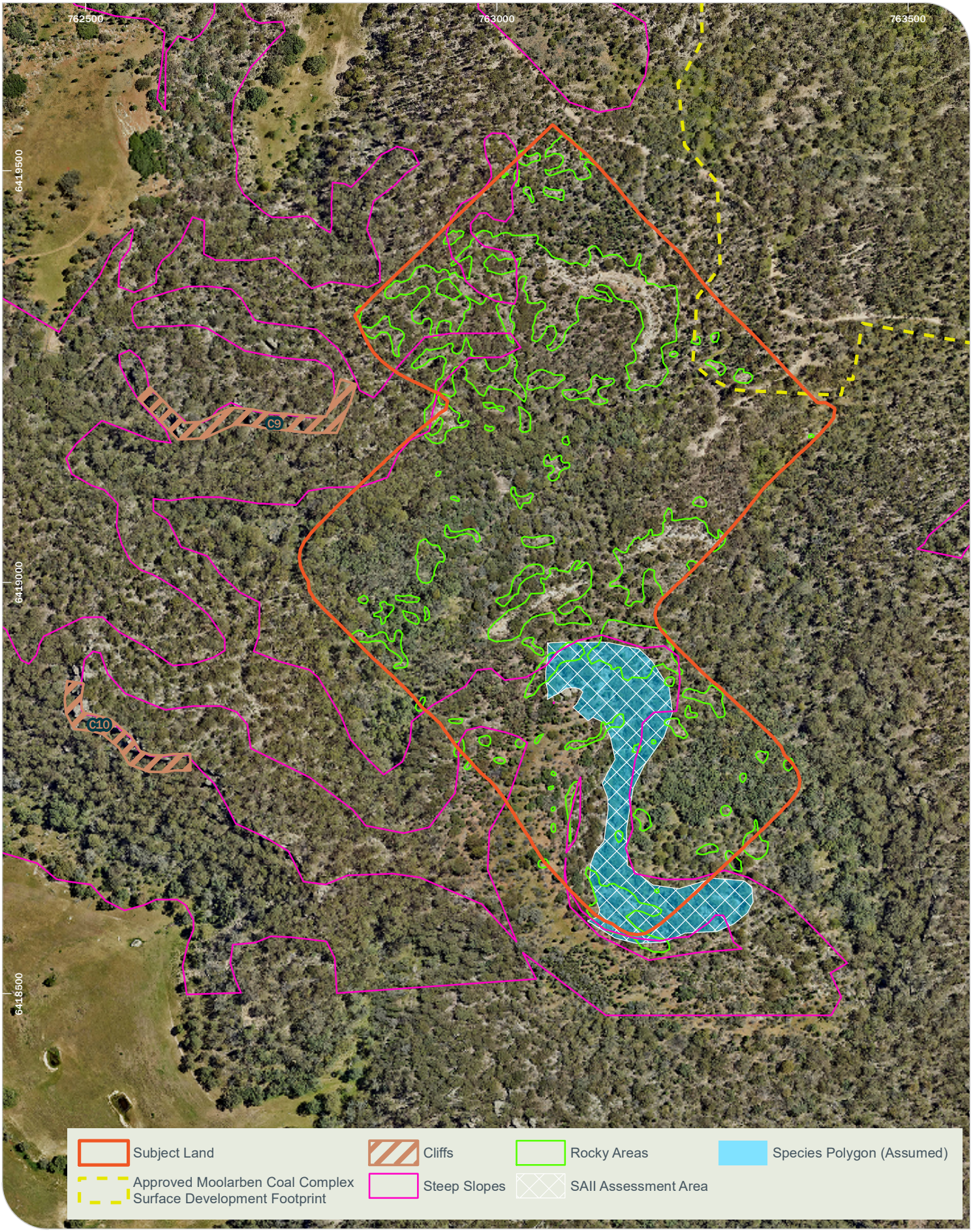
niche Environment and Heritage

0 100
m
GDA2020 MGA Zone 55

Species Polygon
Parma Wallaby (*Macropus parma*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13c



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niche Environment and Heritage

N

0 100

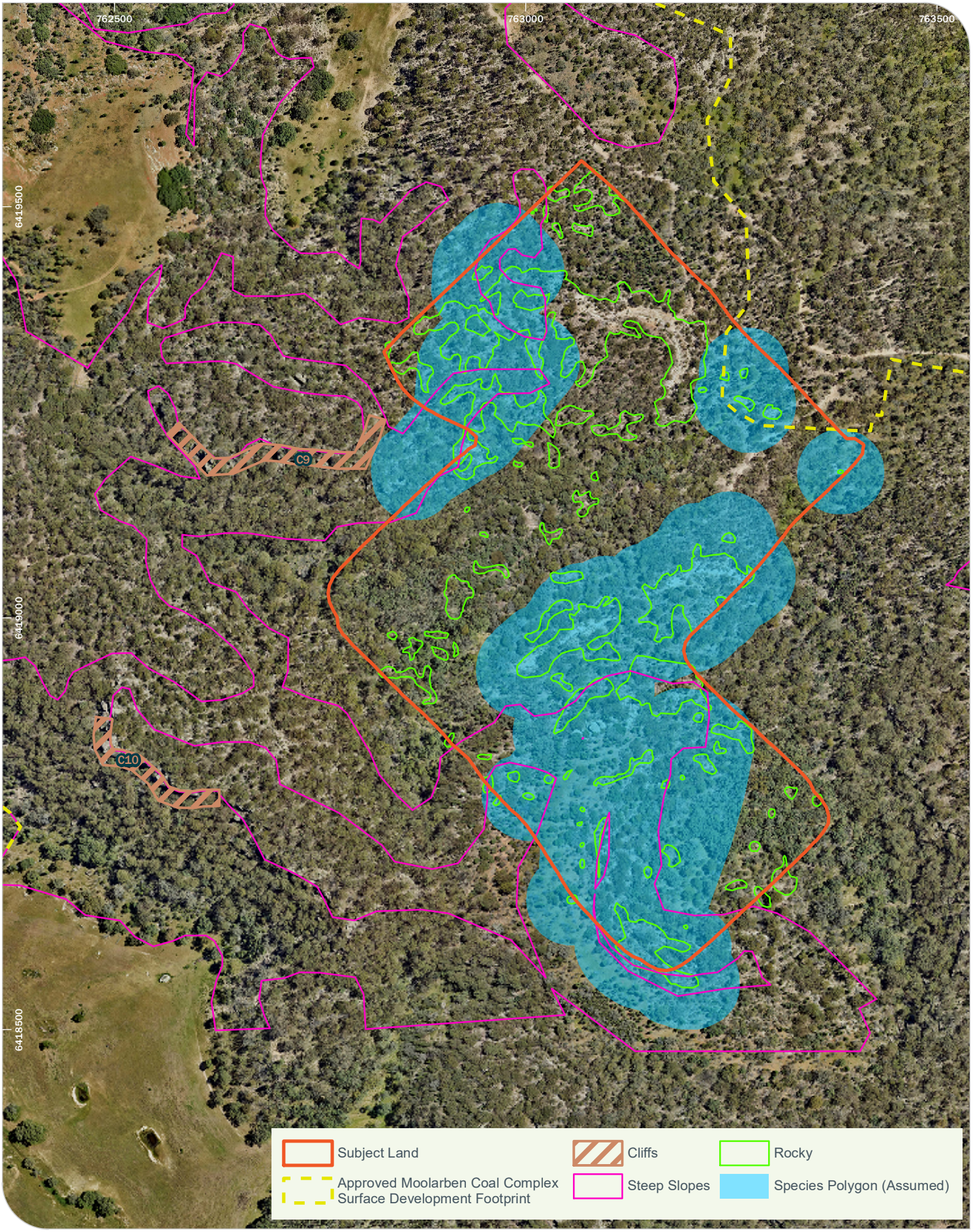
m

GDA2020 MGA Zone 55

Species Polygon
Broad-headed Snake (*Hoplocephalus bungaroides*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13d



niche Environment and Heritage

N

0 100

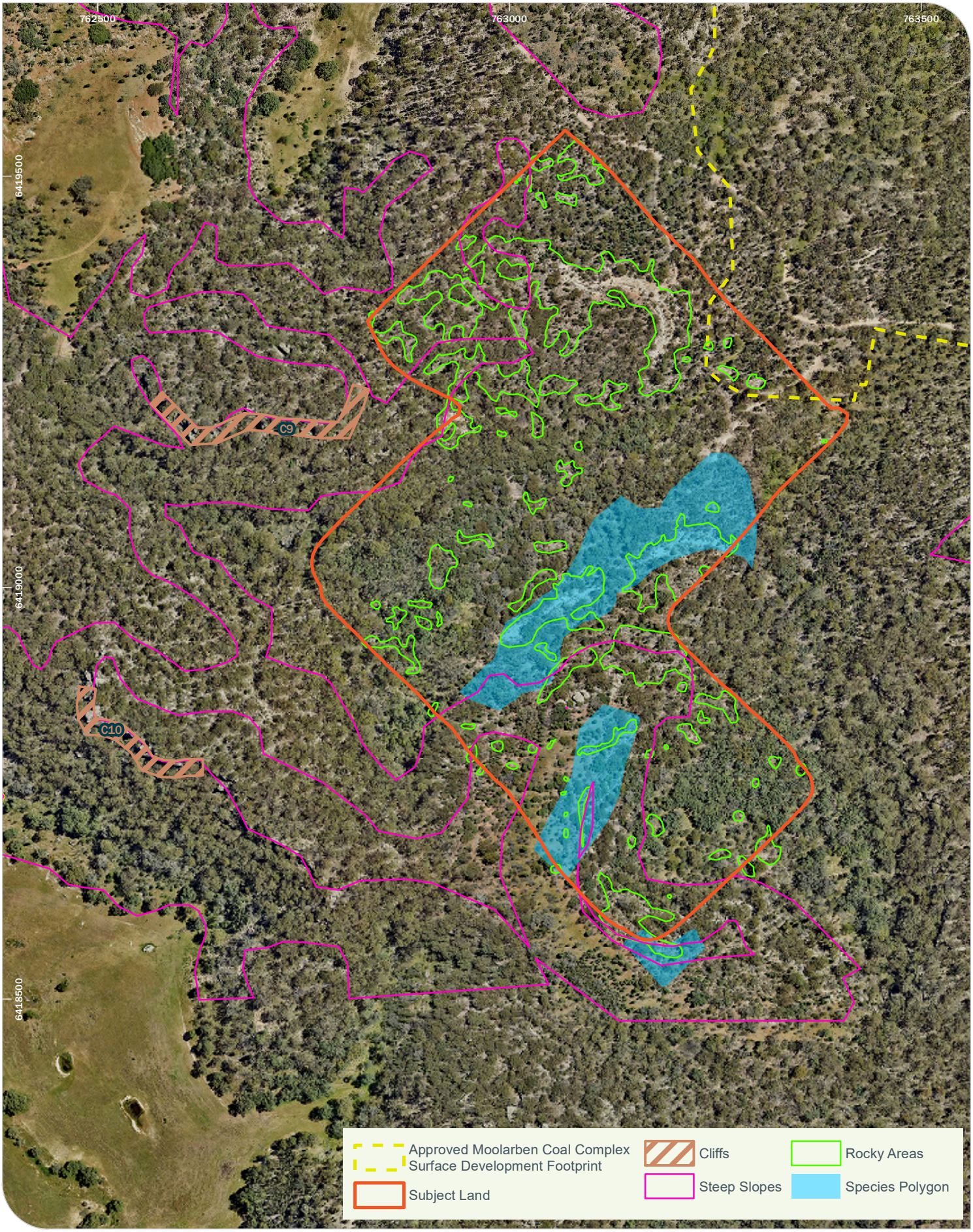
m

GDA2020 MGA Zone 55

Species Polygon
Pink-tailed Legless Lizard (*Aprasia parapulchella*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13e



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niche Environment and Heritage

N

0 100

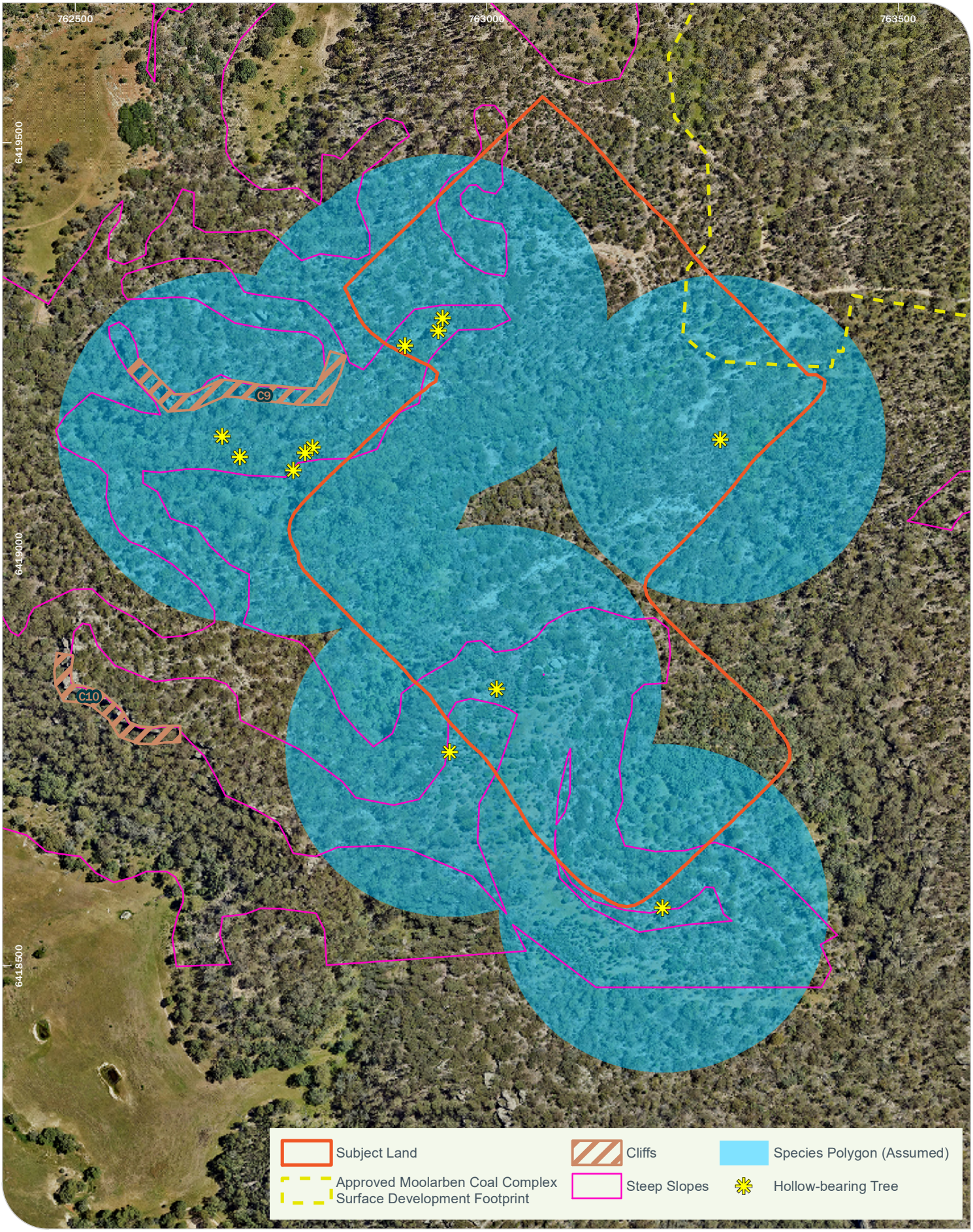
m

GDA2020 MGA Zone 55

Species Polygon
Striped Legless Lizard (*Delma impar*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13f



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niche Environment and Heritage

N

0 100

m

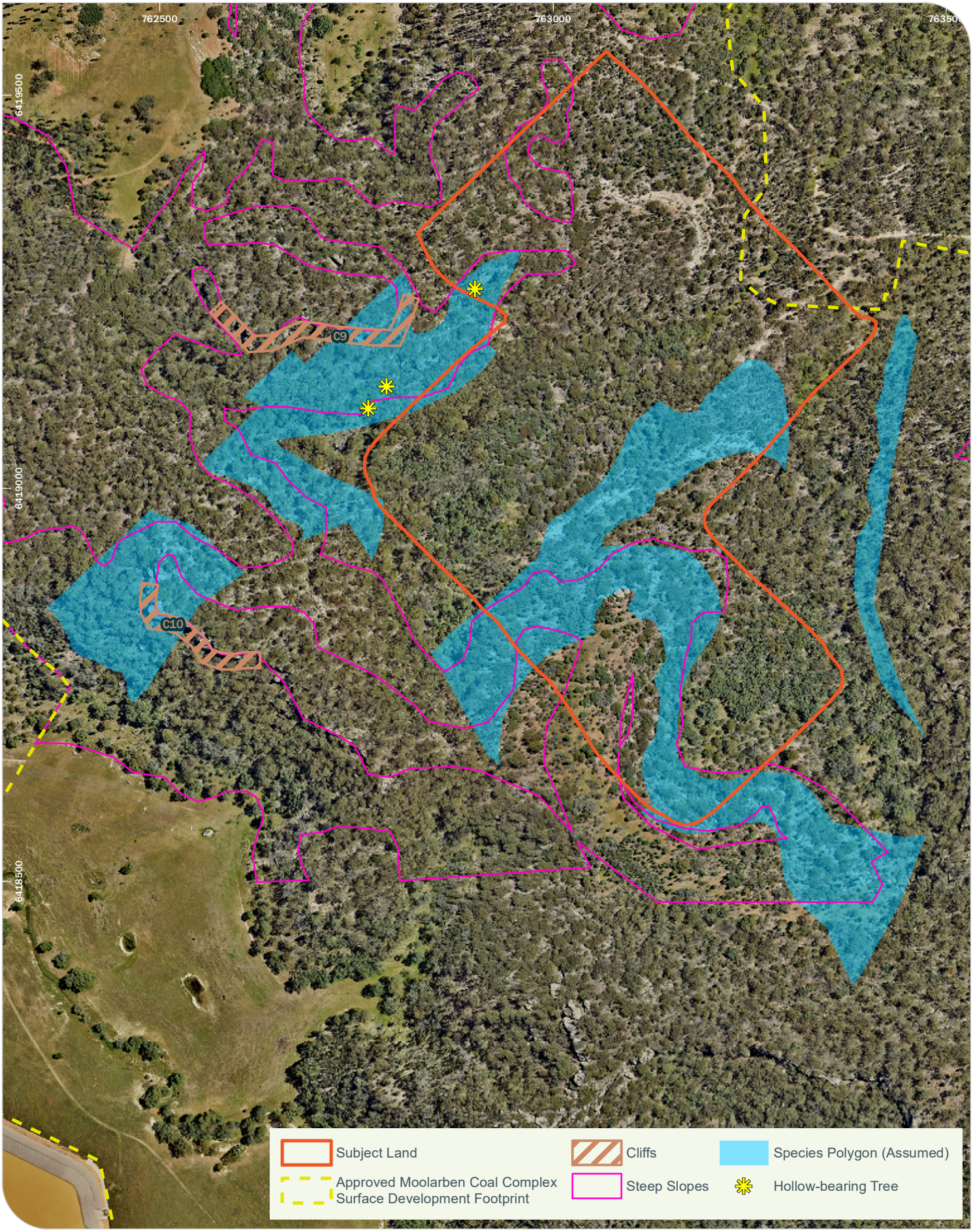
GDA2020 MGA Zone 55

Species Polygon
Gang-gang Cockatoo (*Callocephalon fimbriatum*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13g

v2.0



niche Environment and Heritage

N

0 100

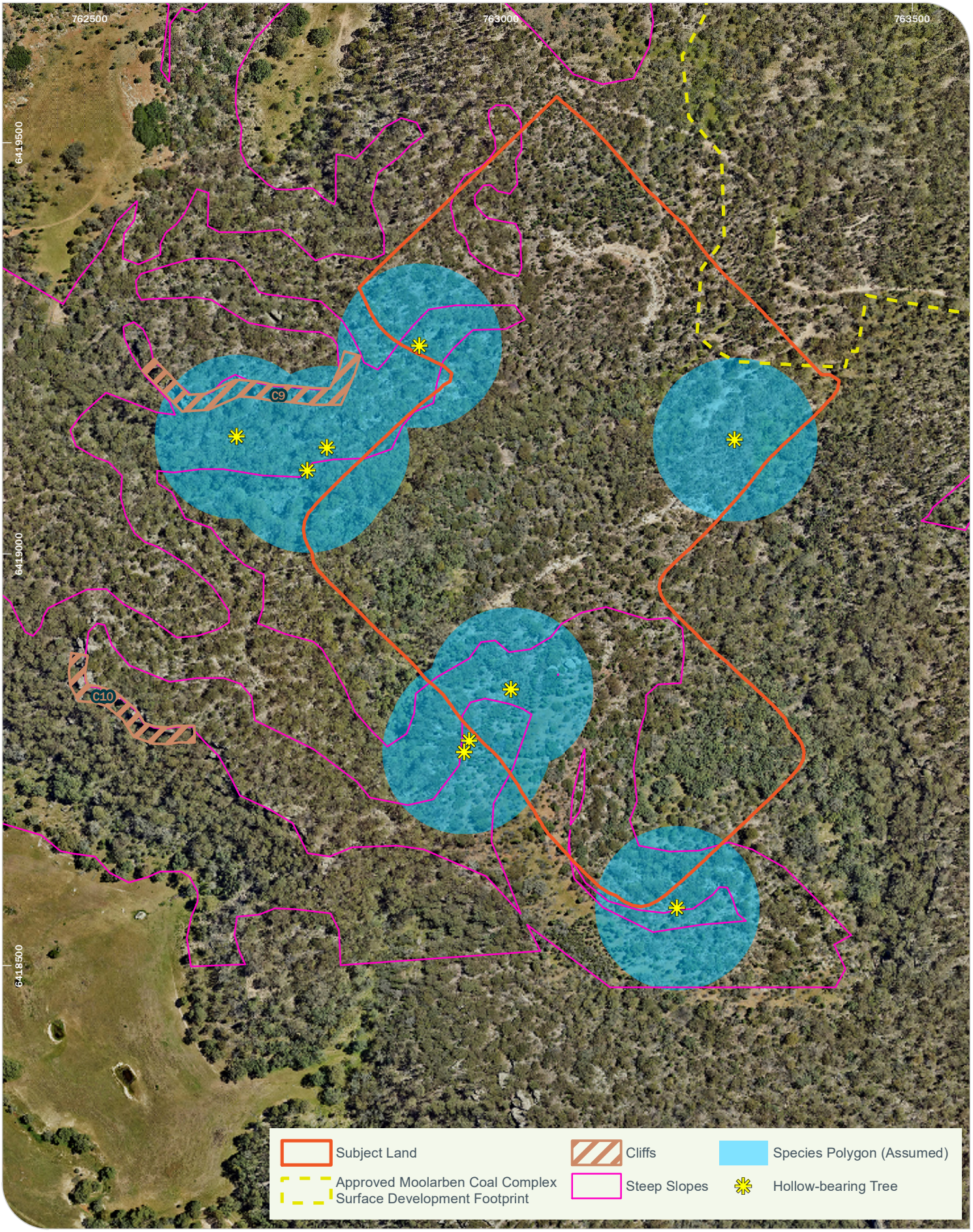
m

GDA2020 MGA Zone 55

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Species Polygon
Greater Glider (*Petauroides volans*)
Moolarben UG2 Modification BDAR

Figure 13h



niche Environment and Heritage

N

0 100

m

GDA2020 MGA Zone 55

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Species Polygon
Masked Owl (*Tyto novaehollandiae*)
Moolarben UG2 Modification BDAR

Figure 13i

Drawn by: Neil Berry File: T:\spatial\projects\a6800\a6853_MCOUG2_BDAR_NSW\Maps\report\BDAR\6853_Figure_13i_MaskedOwl.mxd Last updated: 11/23/2021 10:47:04 AM

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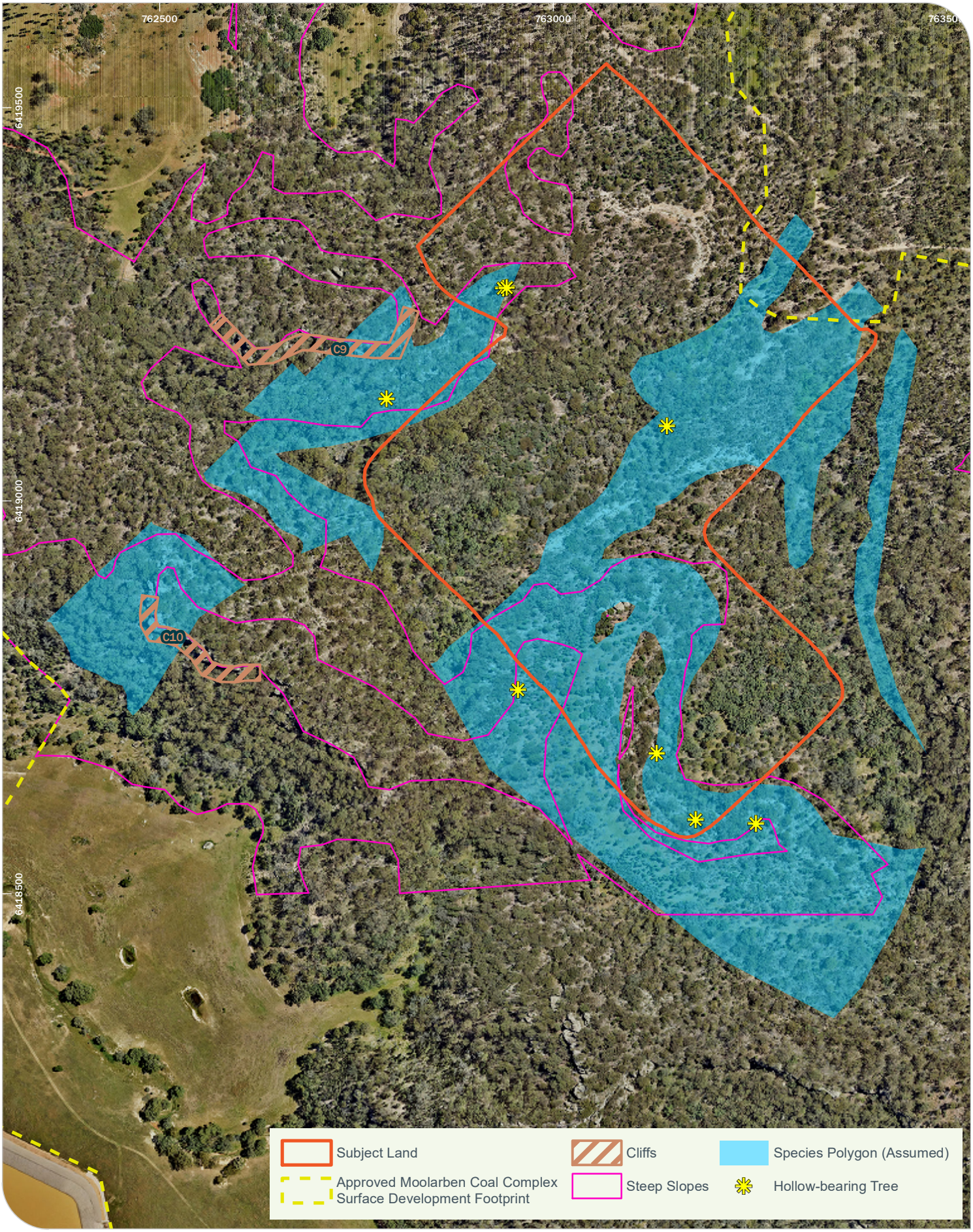


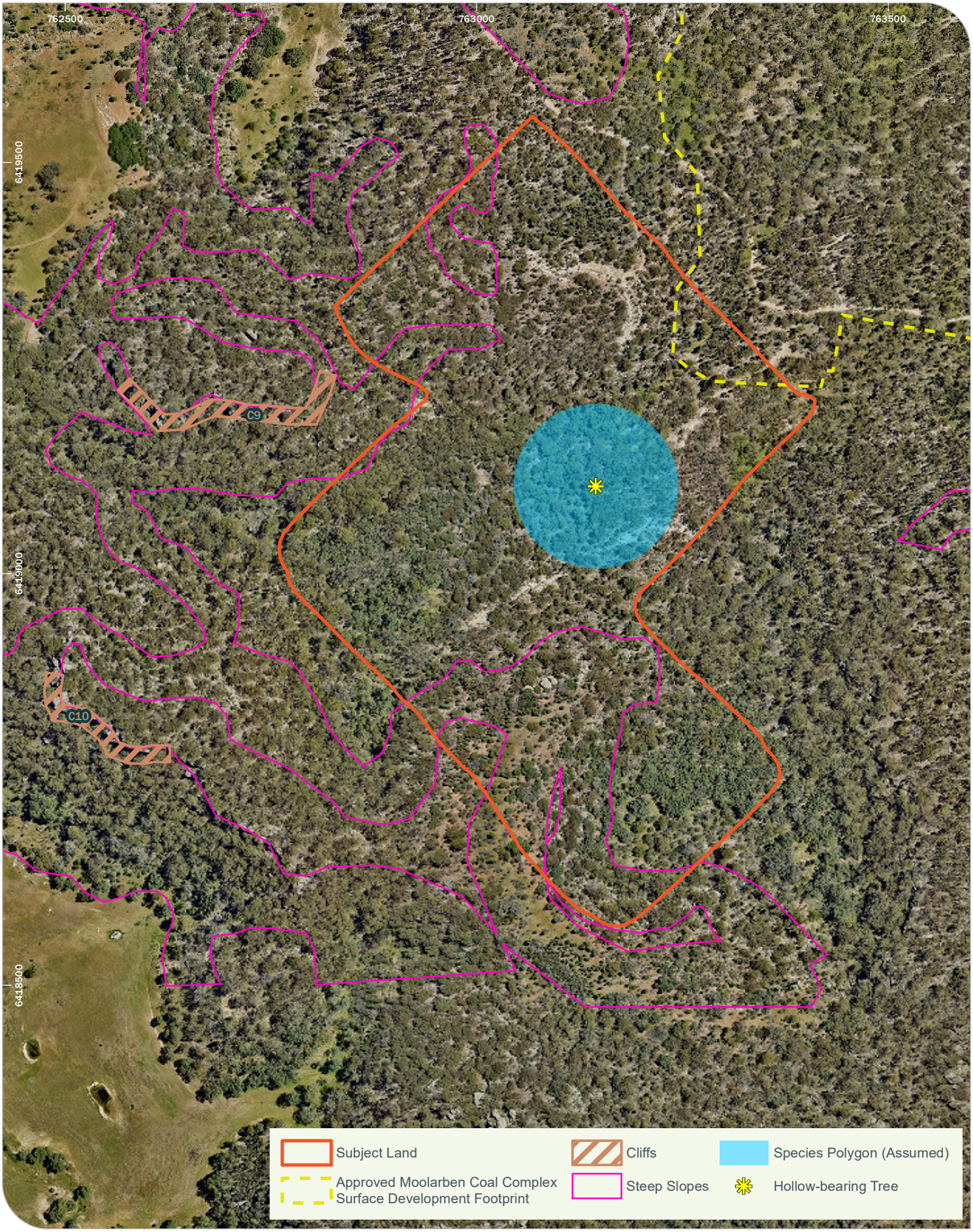
niche Environment and Heritage

0 100
m
GDA2020 MGA Zone 55

Species Polygon
Squirrel Glider (*Petaurus norfolcensis*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13j



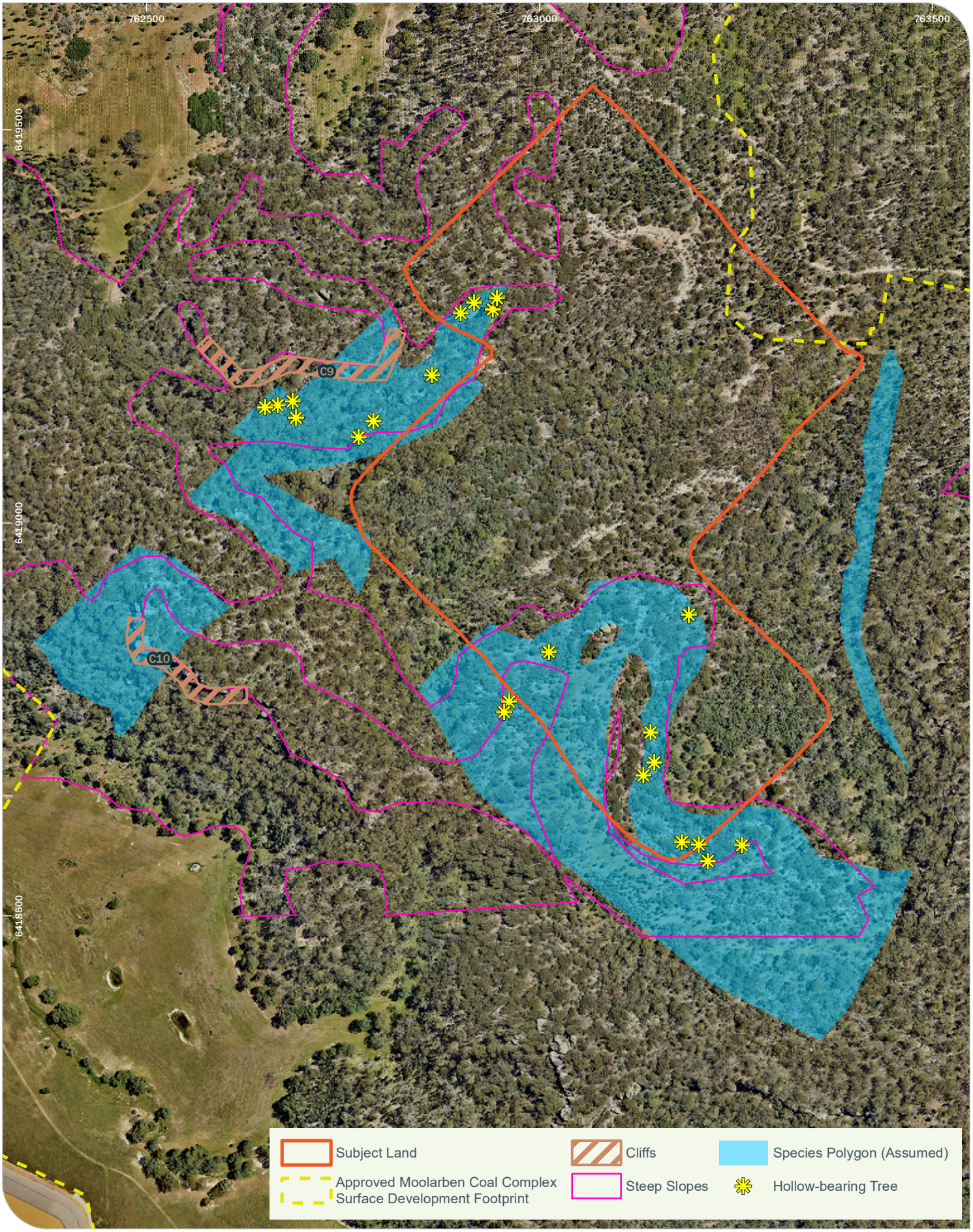
niche Environment and Heritage

0 100
m
GDA2020 MGA Zone 55

Species Polygon
Superb Parrot (*Polytelis swainsonii*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13k



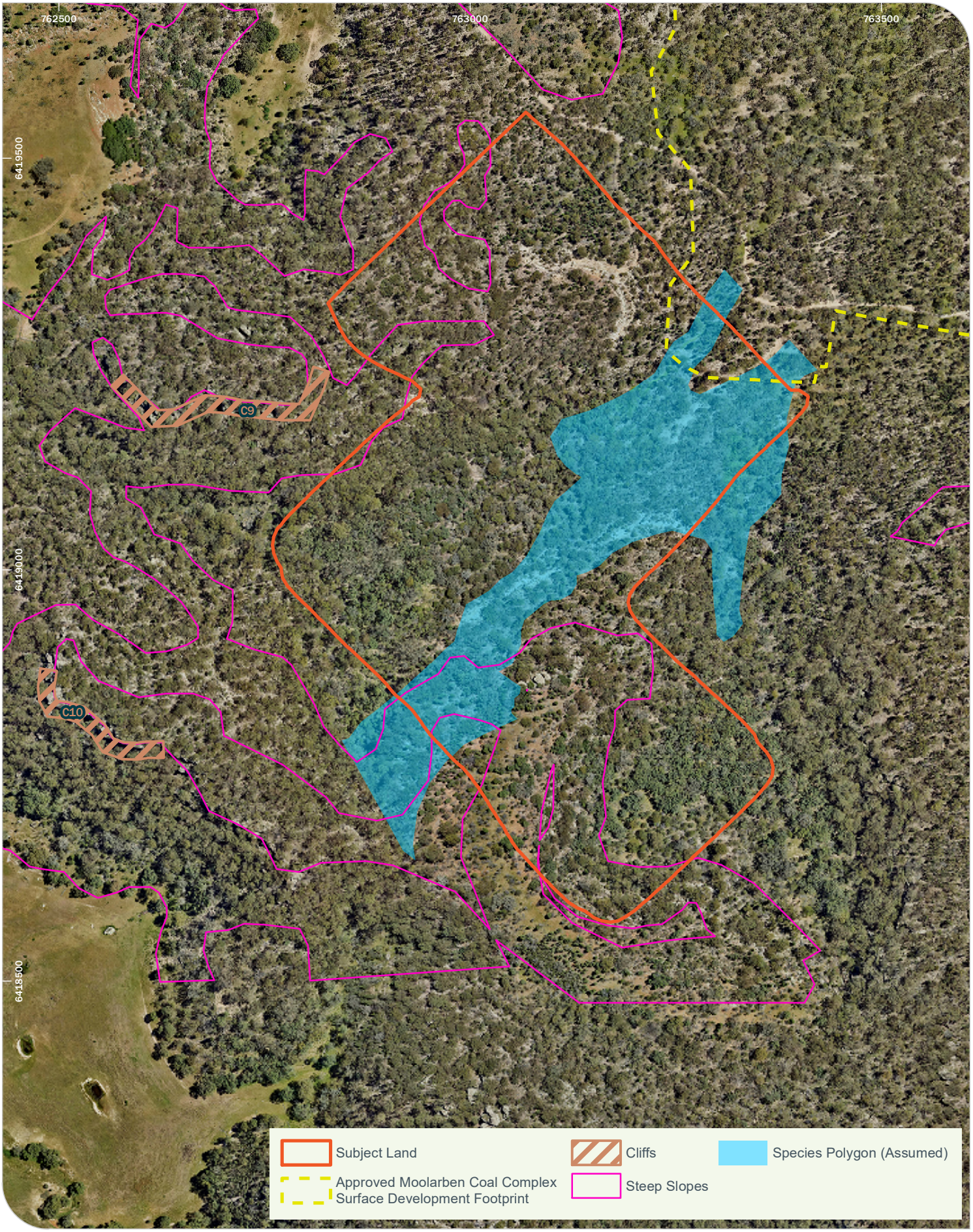
niche Environment and Heritage

0 100
m
GDA2020 MGA Zone 55

Species Polygon
Brush-tailed Phascogale (*Phascogale tapoatafa*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13l



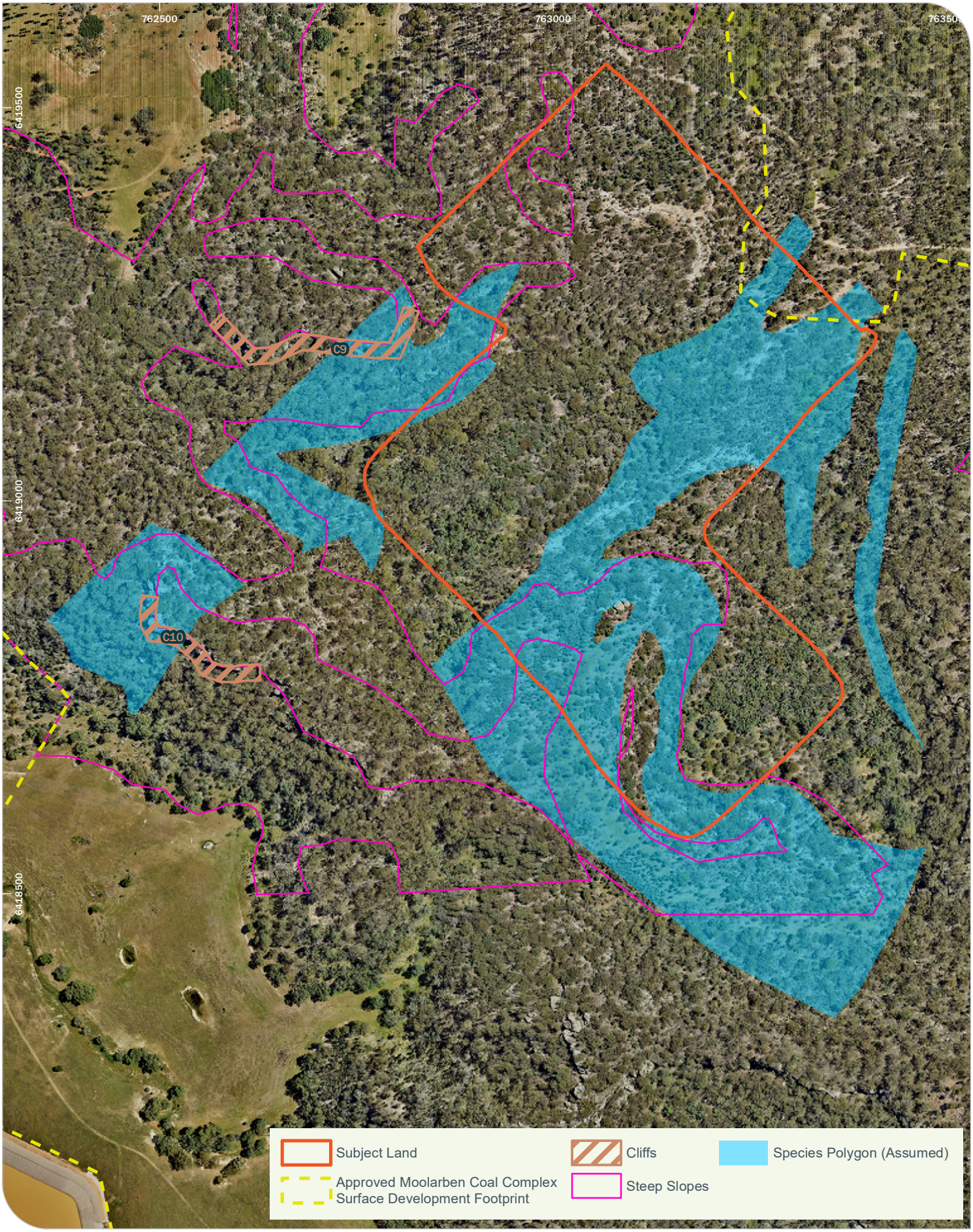
niche Environment and Heritage

0 100
m
GDA2020 MGA Zone 55

Species Polygon
Bush Stone-curlew (*Burhinus grallarius*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13m



niche Environment and Heritage

N

0 100

m

GDA2020 MGA Zone 55

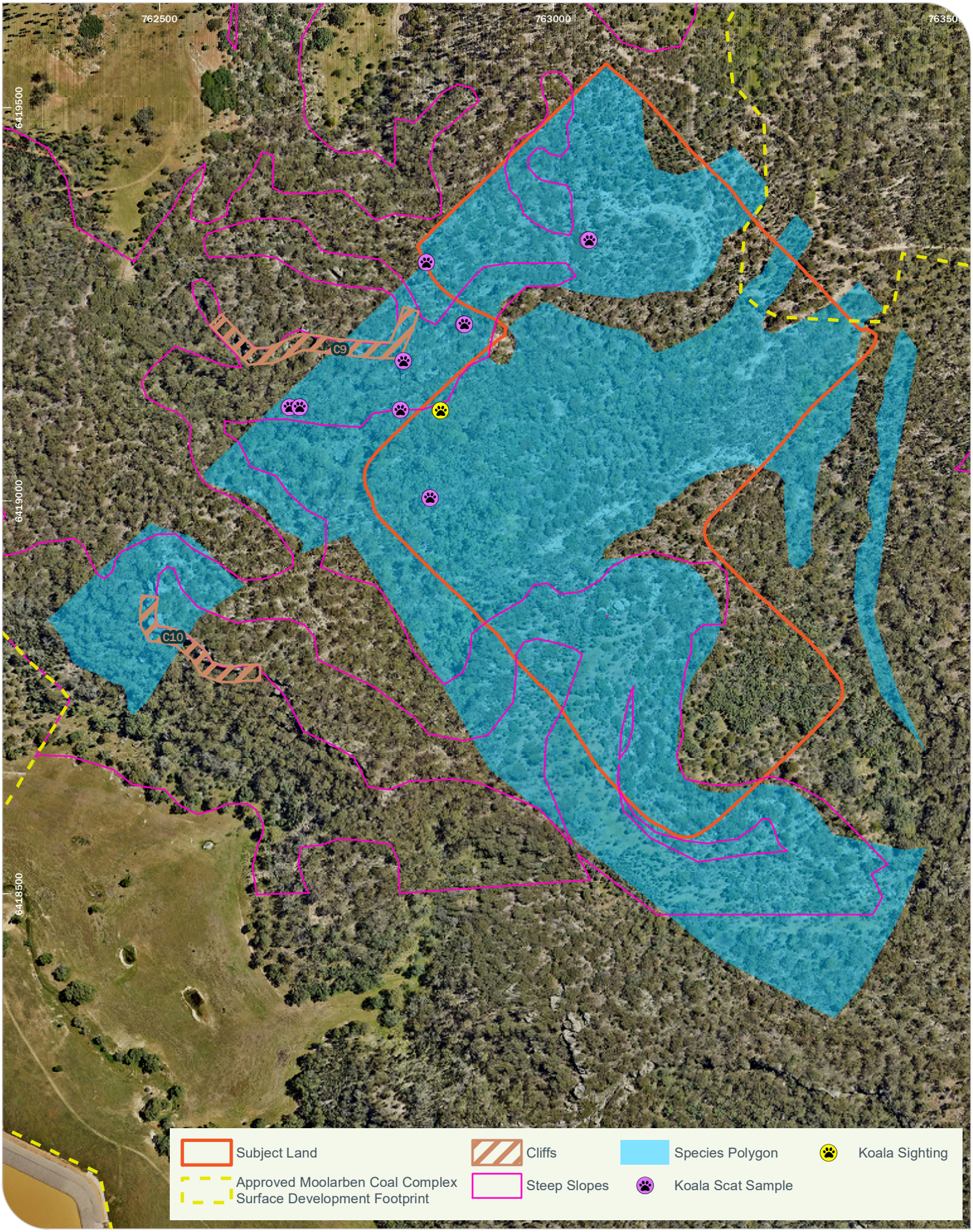
Species Polygon
Eastern Pygmy-possum (*Cercartetus nanus*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13n

Drawn by: Neil Berry File: T:\spatial\projects\a6800\a6853_MCOUG2_BDAR_NSW\Maps\report\BDAR\6853_Figure_13n_EasternPygmyPossum.mxd Last updated: 11/15/2021 11:38:38 AM

v2.0



niche Environment and Heritage

N

0 100

m

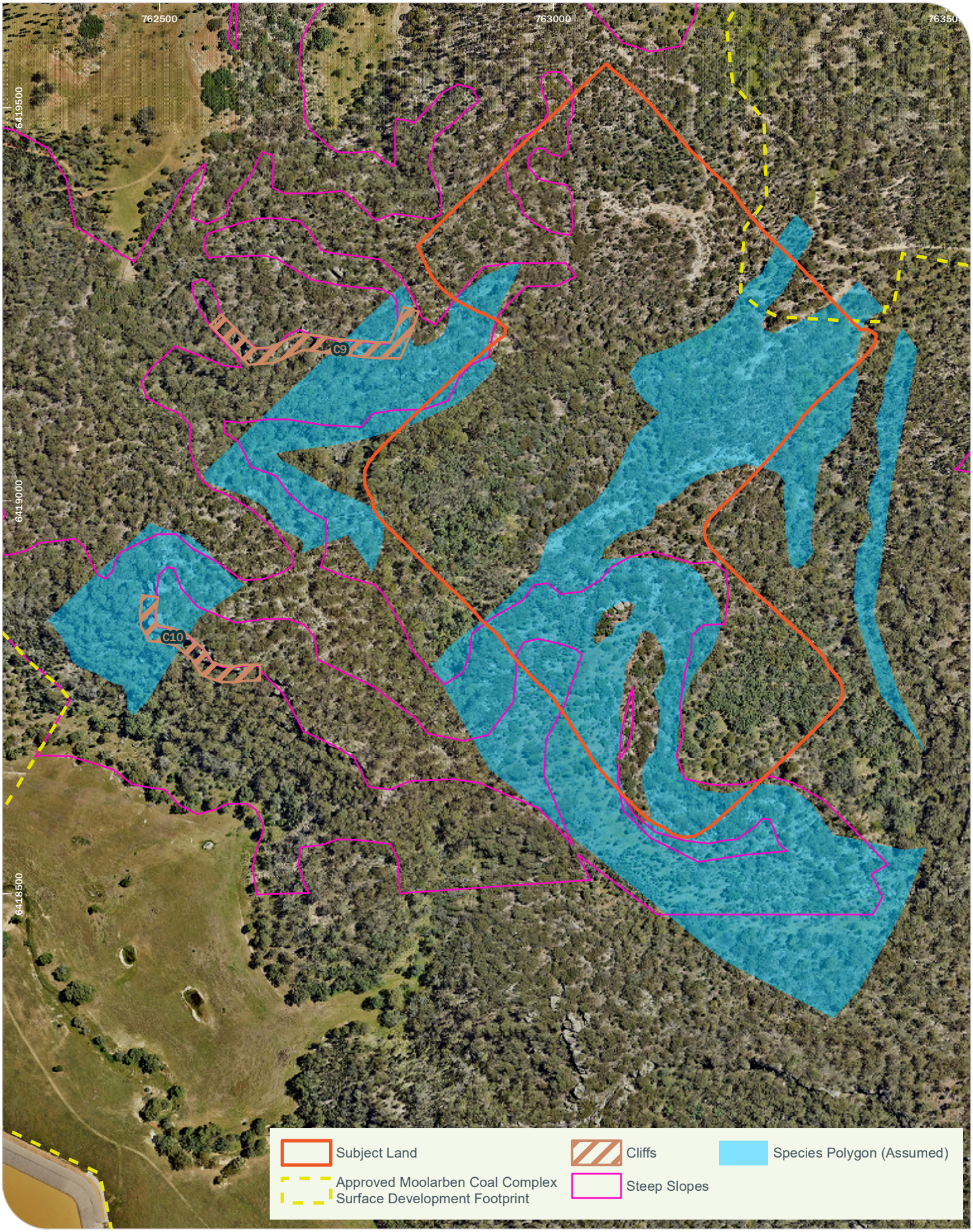
GDA2020 MGA Zone 55

Species Polygon
Koala (*Phascolarctos cinereus*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13o

Drawn by: Neil Berry File: T:\spatial\projects\a6800\a6853_MCOUG2_BDAR_NSW\Maps\report\BDAR\6853_Figure_13o_Koala.mxd Last updated: 11/23/2021 10:57:25 AM



niche Environment and Heritage

N

0 100

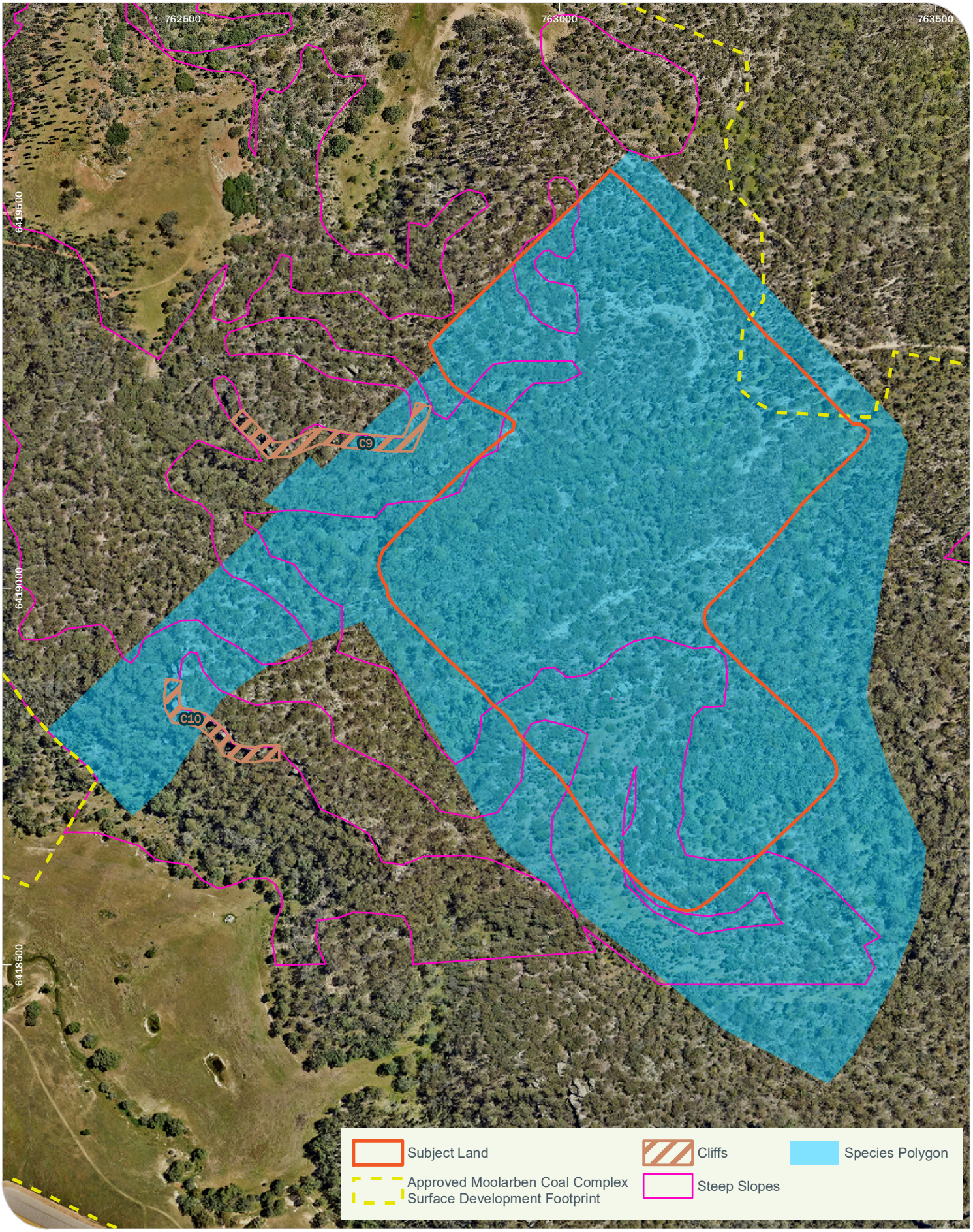
m

GDA2020 MGA Zone 55

Species Polygon
Pale-headed Snake (*Hoplocephalus bitorquatus*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13p



niche Environment and Heritage

N

0 100

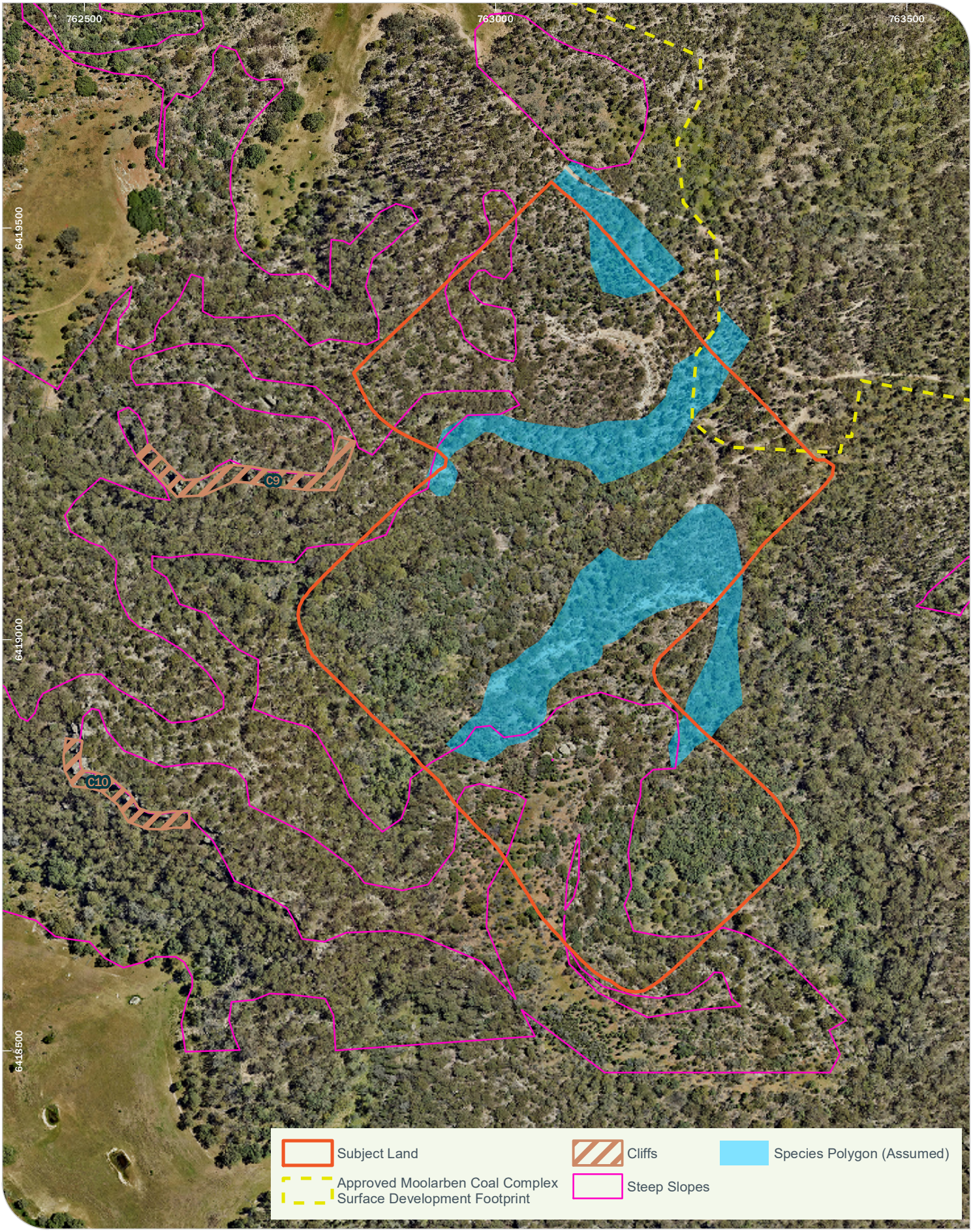
m

GDA2020 MGA Zone 55

Species Polygon
Regent Honeyeater (*Anthochaera phrygia*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13q



niche Environment and Heritage

N

0 100

m

GDA2020 MGA Zone 55

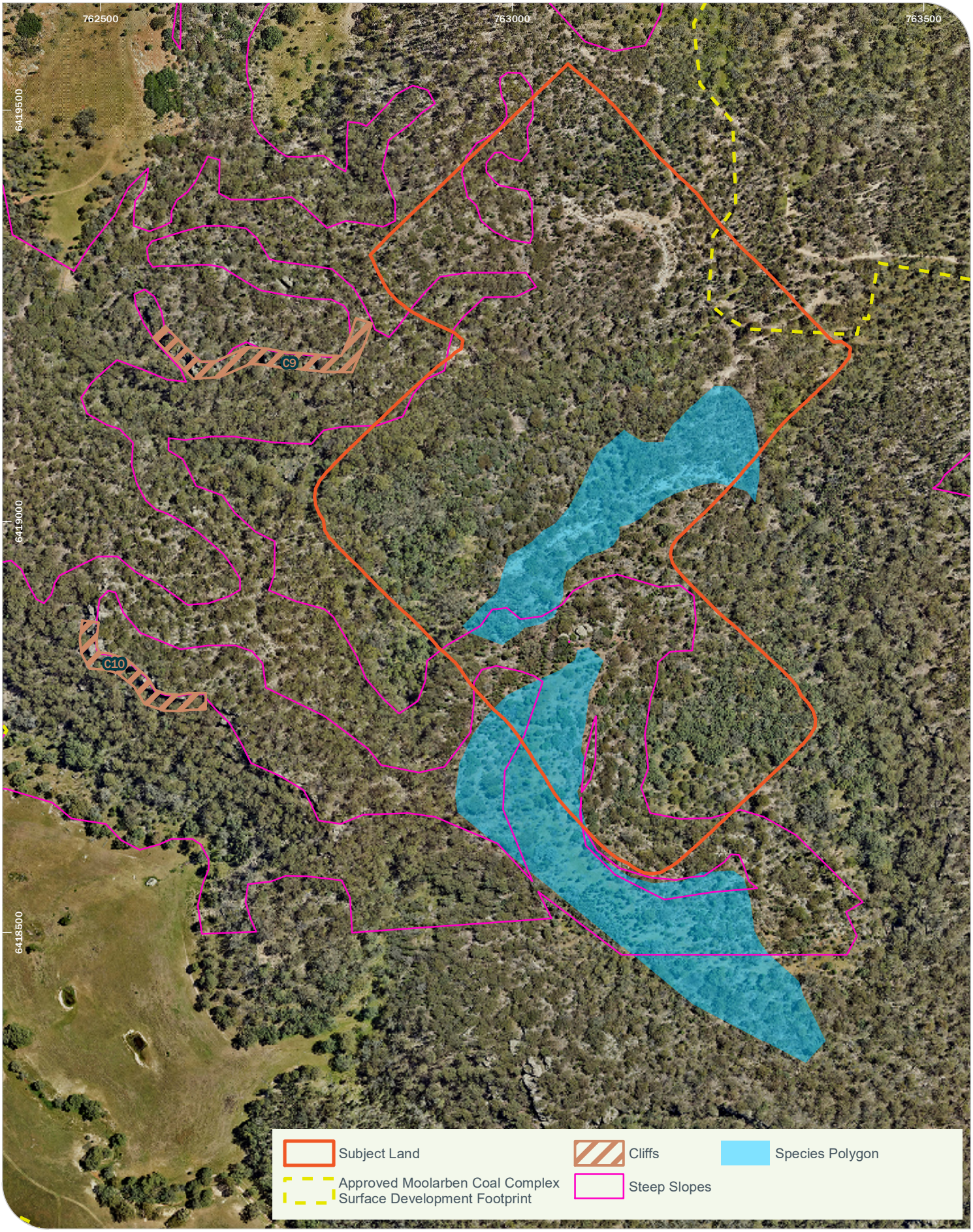
Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Species Polygon
Tylophora linearis
Moolarben UG2 Modification BDAR

Figure 13r

Drawn by: Neil Berry File: T:\spatial\projects\a6800\a6853_MCOUG2_BDAR_NSW\Maps\report\BDAR\6853_Figure_13r_TylophoraLinearis.mxd Last updated: 11/23/2021 11:00:43 AM

v2.0



niche Environment and Heritage

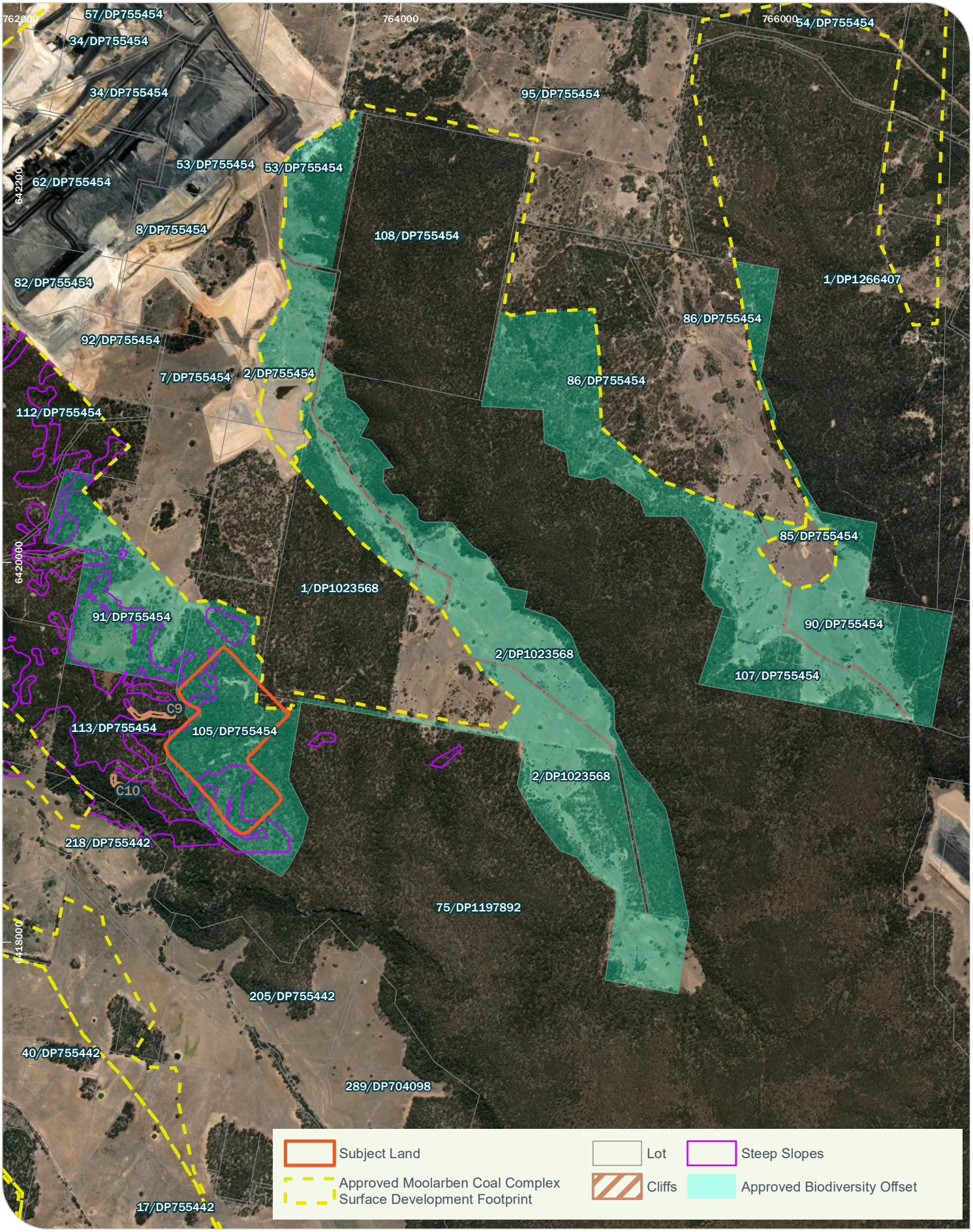
0 100 m

GDA2020 MGA Zone 55

Species Polygon
Austral Toadflax (*Thesium australe*)
Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd

Figure 13s



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niche Environment and Heritage

0 500 m

GDA2020 MGA Zone 55

Approved Biodiversity Offset Area

Moolarben UG2 Modification BDAR

Niche PM: Nicola Trulock
Niche Proj. #: 6853
Client: Moolarben Coal Operations Pty Ltd.

Figure 14

Annex 1. Baseline Vegetation Assessment

Moolarben Coal Complex UG2 Modification - Baseline Vegetation Assessment

Moolarben Coal Operations Pty Ltd

ecological AUSTRALIA
A TETRA TECH COMPANY

1300 646 131
www.ecoaus.com.au

DOCUMENT TRACKING

Project Name	Moolarben Coal Complex UG2 Modification - Baseline Vegetation Assessment
Project Number	18315
Project Manager	Kalya Abbey
Prepared by	Rebecca Croake
Reviewed by	Dr Matthew Dowle
Approved by	Kalya Abbey
Status	**Final**
Version Number	**V1f**
Last saved on	**23 November 2021**

This report should be cited as 'Eco Logical Australia 2021. *Moolarben Coal Complex UG2 Modification - Baseline Vegetation Assessment*. Prepared for Moolarben Coal Operations Pty Ltd.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Moolarben Coal Operations Pty Ltd

Template 2.8.1

Contents

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Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
CEEC	Critically Endangered Ecological Community
DNG	Derived native grassland
ELA	Eco Logical Australia
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection Biodiversity Conservation Act 1999*
HTE	High Threat Exotic
LLS Act	NSW *Local Land Services Act 2013*
LW	Longwall
MCO	Moolarben Coal Operations
ML	Mining Lease
NSW	New South Wales
PA	Project Approval
PCT	Plant Community Type
pfc	Projected foliage cover
RDP	Rapid Data Point
ROM	Run of mine
TEC	Threatened Ecological Community
VEC	Vulnerable Ecological Community
VI	Vegetation integrity
VZ	Vegetation Zone

Executive Summary

Eco Logical Australia (ELA) was engaged by Moolarben Coal Operations Pty Ltd (MCO) to undertake a baseline vegetation assessment for MCO's Modification to Project Approval (PA) 08_0135 for a proposed extension to the approved Underground 2 (UG2) mine domain. The Modification to UG2 (hereafter referred to as the Modification) involves extending the currently approved longwalls to the south-east (the study area). This report details the findings of the baseline vegetation assessment undertaken across the study area and has been prepared to meet the requirements of the '*Native Vegetation*' section of Table 24 of the *Biodiversity Assessment Method* (BAM; DPIE 2020) established under Section 6.7 of the NSW *Biodiversity Conservation Act 2016* (BC Act).

NATIVE VEGETATION

There is 66.5 ha of native vegetation within the study area comprising nine (9) Plant Community Types (PCTs). One (1) PCT is present in two (2) condition classes; therefore, a total of ten (10) vegetation zones (VZs) were identified.

THREATENED ECOLOGICAL COMMUNITIES

One (1) PCT within the study area is associated with the Critically Endangered Ecological Community (CEEC) listed under the BC Act and the Commonwealth *Environment Protection Biodiversity Conservation Act* (EPBC Act) White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (hereafter referred to as Box Gum Woodland) in the BioNet Vegetation Classification (DPIE 2021) and BAM Calculator (BAM-C) (PCT 434); however, three (3) PCTs within the study area were identified as Box Gum Woodland:

- 11.8 ha of BC Act listed Box Gum Woodland, of which 6.7 ha also meets the listing criteria for Box Gum Woodland under the EPBC Act:
    - 6.7 ha of PCT 434 (VZ1) under the BC Act and EPBC Act
    - 4.3 ha of PCT 472 (V2) and 0.8 ha of PCT 1610 (VZ7) under the BC Act.

An additional 3.4 ha of the BC Act listed Vulnerable Ecological Community (VEC) *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion* which also meets the listing criteria for the EPBC Act listed CEEC *Central Hunter Valley eucalypt forest and woodland* is present within the study area (PCT 1176; VZ5 and VZ6).

THREATENED SPECIES

Targeted threatened flora and fauna surveys were not undertaken as part of this assessment.

OFFSET TRADING GROUPS

In accordance with the BAM (DPIE 2020), the VZs identified correspond to six (6) offset trading groups:

- White Box- Yellow Box- Blakely's Red Gum Grassy Woodland & Derived Native Grassland - 6.7 ha
- Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion - 3.4 ha
- Sydney Hinterland Dry Sclerophyll Forests with a percentage cleared value <50% - 1.0 ha
- Western Slopes Dry Sclerophyll Forest with a percentage cleared value <50% - 30.9 ha
- Western Slopes Dry Sclerophyll Forest with a percentage cleared value >50% - 5.1 ha
- Western Slopes Grassy Woodlands with a percentage cleared value <50% -19.4 ha.

1. Introduction

Eco Logical Australia (ELA) was engaged by Moolarben Coal Operations Pty Ltd (MCO) to undertake a baseline vegetation assessment for MCO's Modification to Project Approval (PA) 08_0135 for a proposed extension to the approved Underground 2 (UG2) mine domain. The Modification to UG2 (hereafter referred to as the Modification) involves extending the currently approved longwalls to the south-east (the study area).

This report has been prepared to meet the requirements of the '*Native Vegetation'* section of Table 24 of the *Biodiversity Assessment Method* (BAM; DPIE 2020), established under Section 6.7 of the NSW *Biodiversity Conservation Act 2016* (BC Act).

1.1. Project description

The Moolarben Coal Complex (MCC) is located approximately 40 km north of Mudgee, New South Wales (NSW) (Figure 1 below). The MCC is operated by Moolarben Coal Operations Pty Ltd (MCO) on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Yancoal Moolarben [YM] Pty Ltd and a consortium of Korean power companies). MCO, MCM and YM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

The MCC comprises of four (4) approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure including coal processing and transport facilities (Figure 2 below). Stage 1 of the MCC comprises open cut operations in OC1, OC2 and OC3, underground operations in UG4 and coal processing and transport facilities. Stage 2 of the MCC comprises open cut operations in OC4 and underground operations in UG1 and UG2.

The Moolarben Coal Project Stage 2 operates in accordance with PA 08_0135 (as modified). MCO is proposing changes to optimise the approved UG2 layout as well as extension of longwalls within existing mining tenements.

Approval for the Modification to Project Approval (08_0135)is being sought under section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). In summary, the Modification would include the following changes to the approved Moolarben Coal Complex:

- optimisation of the approved UG2 layout (including the extension of two approved longwall panels);
- increased UG2 extraction height from 3.0 metres (m) to 3.5 m;
- revised UG2 mining sequence;
- increased UG2 ROM coal production from 9.4 million tonnes (Mt) to 13.9 Mt;
- construction and operation of a remote services infrastructure area (including two UG2 service boreholes) within the approved OC4 disturbance footprint to support UG2 operations;
- development of an additional non-subsiding gate road along the southern boundary of the UG1 mining area to assist with ventilation in UG2; and
- small reduction in the approved OC4 extent to accommodate the optimised UG2 layout.

Figure 3 (below) shows the proposed general arrangement of the Modification, including the southern extensions to the approved UG2 layout. The Modification will require no additional disturbance for surface infrastructure; however, biodiversity will be subject to prescribed impacts in accordance with the BAM (DPIE 2020). Associated potential prescribed impacts include damage to habitat and native vegetation as a result of rock fall and cliff damage from mining related subsidence.

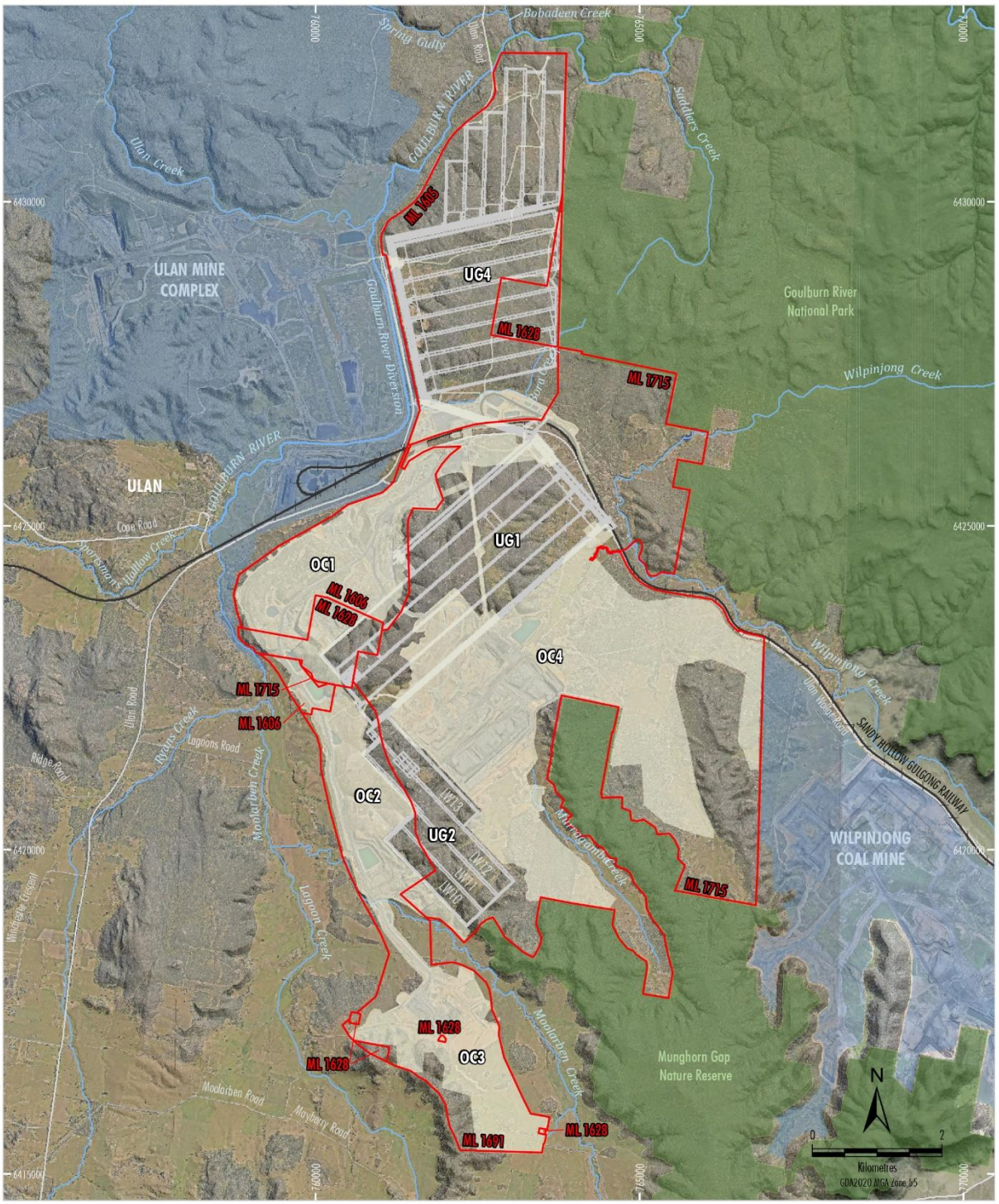
LEGEND
State Forest
National Parks /Nature Reserves
Local Government Boundary
Exploration Licence Boundary
Mining Lease Boundary
Mining Operation

Source: NSW Spatial Services (2021)

YANCOAL
MOOLARBEN COAL
MOOLARBEN COAL COMPLEX
Regional Location

Figure 1

Figure 1: Project location



LEGEND
- National Parks/Nature Reserves
- Other Mining Operation
- Mining Lease Boundary
- Existing/Approved Development
- Underground Longwall Layout
- Moolarben Coal Complex Disturbance Footprint

Source: MCO (2021); NSW Spatial Services (2021)
Orthophoto: MCO (Jan 2021)

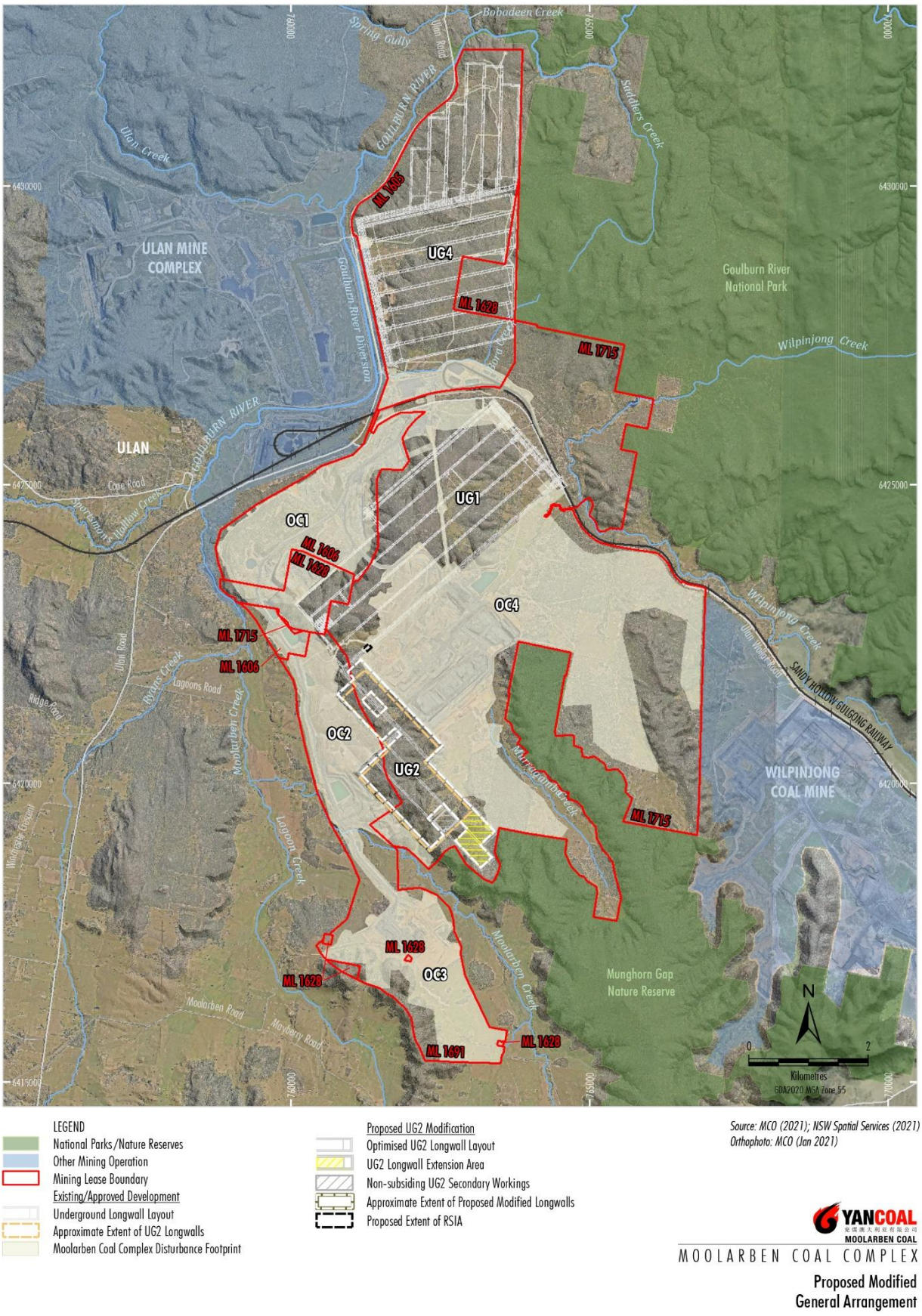
YANCOAL 兖煤澳大利亚有限公司 MOOLARBEN COAL

MOOLARBEN COAL COMPLEX

Approved General Arrangement

Figure 2

Figure 2: Approved General Arrangement



LEGEND
National Parks/Nature Reserves
Other Mining Operation
Mining Lease Boundary
Existing/Approved Development
Underground Longwall Layout
Approximate Extent of UG2 Longwalls
Moolarben Coal Complex Disturbance Footprint

Proposed UG2 Modification
Optimised UG2 Longwall Layout
UG2 Longwall Extension Area
Non-subsiding UG2 Secondary Workings
Approximate Extent of Proposed Modified Longwalls
Proposed Extent of RSIA

Source: MCO (2021); NSW Spatial Services (2021)
Orthophoto: MCO (Jan 2021)

YANCOAL
MOOLARBEN COAL
MOOLARBEN COAL COMPLEX

Proposed Modified General Arrangement

Figure 3

Figure 3: Proposed Modified General Arrangement

1.2. Study area context

The study area is located between the approved OC2 and OC4 operations of the existing MCC and is approximately 66.5 ha in size, comprising of remnant or regenerating woodland / forest. There is evidence of small-scale historical logging and quarrying activities visible in historical aerial imagery (Appendix A); however, there is no Category 1 – exempt land in accordance with the definition provided in the NSW *Local Land Services Act 2013* (LLS Act).

The headwaters of two (2) unnamed Strahler stream order 1 ephemeral streams run through the study area eventually draining into Murragamba Creek, which drains into the approved OC4 pit extent located approximately 1 km to the north of the study area.

The study area is located within the Mid-Western Regional Local Government Area, in the Central Tablelands of NSW and within the Hunter River catchment. It is within the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) Region and Kerrabee IBRA Subregion and within the following NSW (Mitchell) Landscapes (DPIE 2021):

- Upper Goulburn Valleys and Escarpment (57% cleared)
- Gulgong Ranges (0.81% cleared)

The study area is shown in Figure 4.

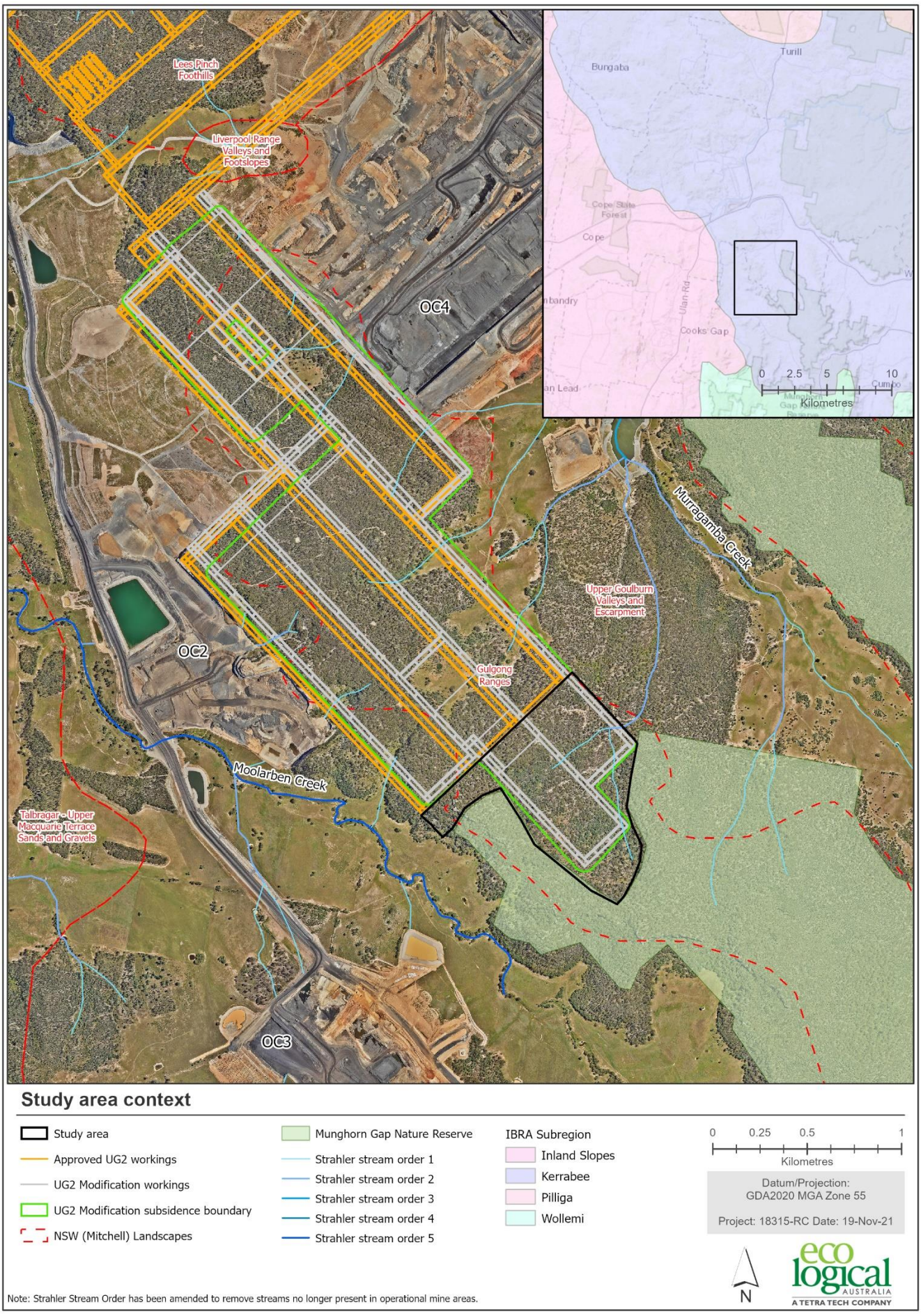


Figure 4: Study area context

2. Methodology

A review of existing information relevant to the study area was undertaken, including:

- NSW State Vegetation Type Map: Central Tablelands Region Version 1.0 (DPIE 2019).
- Gulgong 1:100,000 Geological Map (NSW Government Mining, Exploration and Geoscience 2000).
- NSW Landuse 2017 spatial data (DPIE 2017).
- MCO aerial imagery 2020 (MCO 2020).
- NSW BioNet Vegetation Classification (DPIE 2021).
- 2m contours as supplied by MCO.
- *Water Management (General) Regulation 2018* Hydro Line spatial data (DPIE 2018).
- NSW Land and Property Information (LPI) Roads layer (NSW Government Spatial Services 2021a).
- Historical aerial imagery (NSW Government Spatial Services 2021b).
- *Local Land Services Act 2013* (LLS Act) Category 1 – exempt land definitions and the *Interim Grasslands and other Groundcover Assessment Method* (Office of Environment and Heritage; OEH 2017).

The results of the desktop review were used to produce draft vegetation mapping to Plant Community Type (PCT) and guide the field survey. Topography and geology mapping were used to assist with delineation of PCTs.

A review of each PCT was undertaken to determine if any PCTs had the potential to be associated with a Threatened Ecological Community (TEC) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and / or the BC Act.

A field survey was undertaken to determine the vegetation communities present in the study area, comprising:

- A plot-based vegetation survey
- A vegetation integrity assessment
- A TEC assessment.

The field survey was undertaken on the following dates:

- 10 - 11 February 2021
- 16 - 18 February 2021
- 22 July 2021
- 27 July 2021

2.1. Weather conditions

Weather records for 2021 compared to historical means (Ulan Water weather station; BoM 2021) are provided in Table 1. Weather conditions (Ulan Water weather station; BoM 2021) for the survey period are provided in Table 2 below.

Table 1: Weather conditions for 2021 compared to historical means (BoM 2021)

Month	2021			Historical mean (1970-2021)		
	Min temp (°C)	Max temp (°C)	Total rainfall (mm)	Mean min temp (°C)	Mean max temp (°C)	Total rainfall (mm)
February	11.6	32.9	115.5	16.4	29.9	60.8
March	8.8	32.3	137.2	13.8	27.5	54.4
April	0.5	28.2	2.0	9.8	23.5	40.6
May	-1.2	24.1	14.6	6.2	19.2	44.0
June	-0.3	21.9	73.2	3.7	15.5	45.4
July	-3.4	18.2	56.4	2.6	14.9	48.8

Table 2: Weather conditions for survey period (BoM 2021)

Date	Min temp (°C)	Max temp (°C)	Rainfall (mm)
10 February 2021	12.3	26.2	0
11 February 2021	13.1	29.3	0
16 February 2021	15.5	27.6	0
17 February 2021	15.7	26.3	0
18 February 2021	14.3	26.4	0
22 July 2021	-3.1	14.9	0
27 July 2021	3.2	13.7	5.4

2.2. Plot-based vegetation survey

Plot-based vegetation surveys were conducted by undertaking rapid data points (RDPs) across the study area and were targeted to assess the variations in the landscape identified in the desktop assessment. Data collected, along with historical and current aerial imagery were used to verify PCTs and to stratify PCTs into broad condition states (Vegetation Zones (VZs)). A total of 38 RDPs were collected across the study area. A map depicting the extent of RDPs across the study area is provided in Figure 5 below.

Due to subsequent refinement of the study area, several RDPs were undertaken outside the final study area boundary.

At each RDP the following data was recorded:

- Dominant canopy, midstorey, and groundcover species present
- Vegetation formation and class in accordance with Keith (2004)
- Landform and landscape type
- Soil type
- Evidence of previous disturbance and weeds
- A photograph.

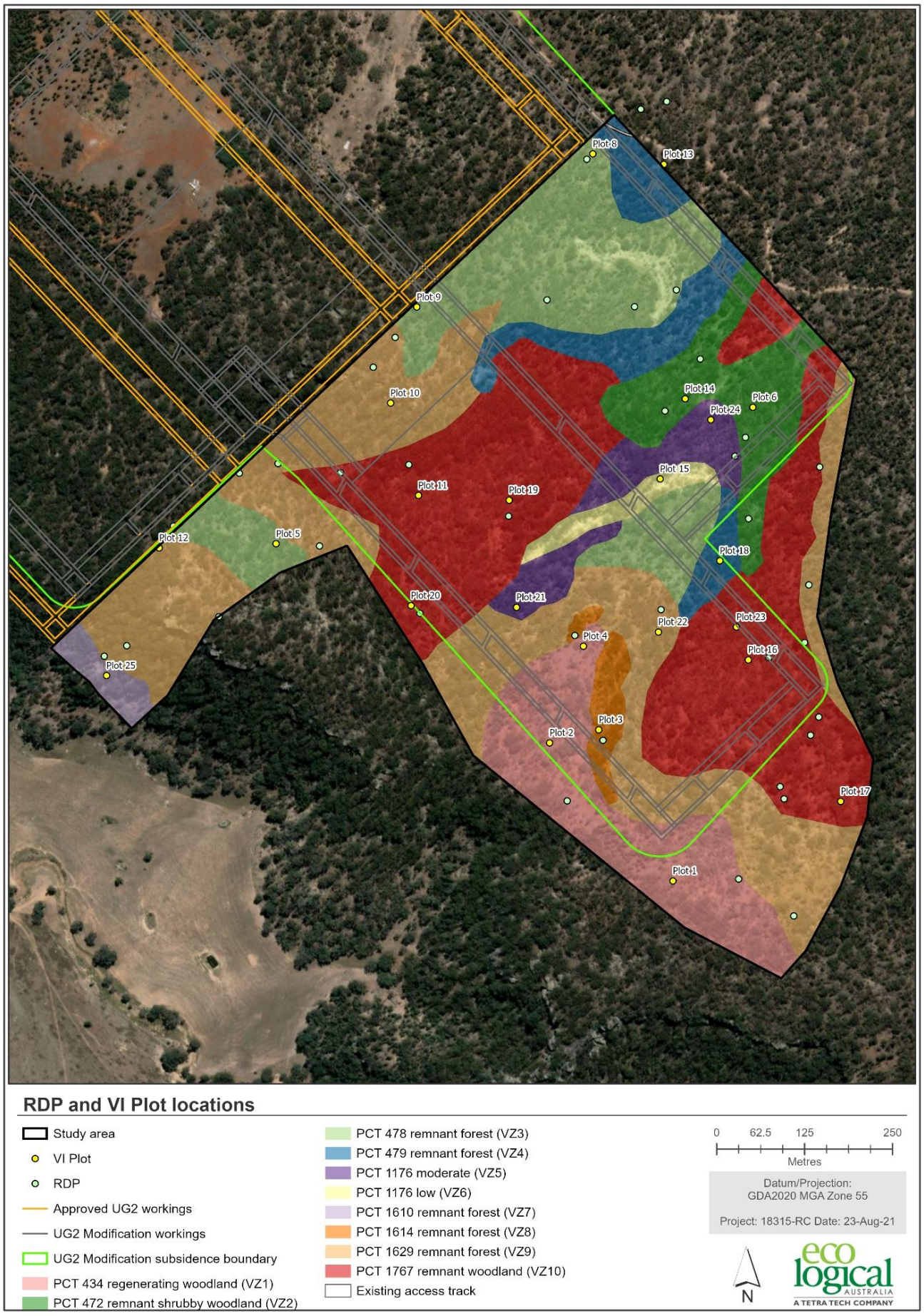


Figure 5: RDP and Vegetation Integrity plot locations

2.3. Vegetation integrity assessment

Vegetation integrity (VI) plots were collected and assessed in accordance with Section 4 of the BAM (DPIE 2020). Twenty-four (24) VI plots were completed between 30 March to 26 July 2021 by ELA ecologists/ BAM Accredited Assessors. Locations of VI plots is provided in Figure 5 above. Complete VI Plot data is provided in Appendix B.

The following data was collected at each VI plot:

- Site name
- Name of recorder(s)
- Date
- Plot orientation, slope, and aspect
- Eastings and Northings
- Site photographs
- Assess composition within the 400 m^2 (20 x 20 m) plot nested within the 1,000 m^2 plot:
    - The full name and number of native plant species.
    - Growth form group for each native species as prescribed by Appendix F *Growth Form Definitions* of the BAM (DPIE 2020) ((T) Tree; (S) Shrub; (G) Grass and grass like (F) Forb; Fern; (O) other).
    - Whether each species is native, exotic, or if the species is a high threat exotic (HTE) or non-high threat weed.
- Assess vegetation structure within the 400 m^2 plot nested within the 1,000 m^2 plot:
    - An estimate of the appropriate cover measure for each recorded species: from 0.1 - 0.9%, 1 - 5% and then to the nearest 5%.
    - A relative measure of the number of individuals or shoots of a species within the plot using the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000, or specify a number greater than 1000 if required.
- Assess vegetation function within the 1,000 m^2 plot (50 x 20 m):
    - Number of large trees, tree regeneration, tree stem size class, total length of fallen logs and number of hollow-bearing trees.
    - Litter cover within five 1m x 1m sub-plots.

Due to changes in study area extent, the start of one VI plot (Plot 13) was positioned approximately 10 m outside the final study area boundary; however, the plot was orientated to the north-west (i.e., into the study area as shown in Appendix A). The positioning of this VI plot was undertaken in accordance with the BAM (DPIE 2020) and data obtained from this plot is deemed to be representative of the surrounding VZ (PCT 479 remnant forest VZ4).

A total of six (6) VI plots were undertaken throughout PCT 1767 remnant woodland (VZ10), which is three (3) more than required for the area of this VZ. Additional plots were undertaken to ensure a representative sample was taken for this VZ, in accordance with BAM Section 4.3.4 (DPIE 2020).

2.4. Threatened Ecological Community assessments

Identification of TECs within the study area was undertaken in accordance with the relevant listings under the BC Act and EPBC Act. PCTs associated with TECs in the BioNet Vegetation Classification (DPIE 2021) were assessed against the relevant listings under the BC Act and EPBC Act (and policy statements) to determine extent of TEC as shown in Table 3.

Table 3: TECs and relevant literature

Legislation	Listing status	TEC name	Literature reference
BC Act	Critically Endangered Ecological Community (CEEC)	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (hereafter referred to as Box Gum Woodland)	Notice and reason for the Final Determination for White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the Sydney Basin (Threatened Species Scientific Committee; TSSC 2020).
EPBC Act	CEEC	White box - Yellow box - Blakely's red gum grassy woodlands and derived native grassland (hereafter also referred to as Box Gum Woodland)	EPBC Act Policy Statement White Box – Yellow Box – Blakely's Red Gum grassy woodlands and derived native grasslands (DEE 2006). Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (TSSC 2006).
BC Act	Vulnerable Ecological Community (VEC)	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion - vulnerable ecological community listing final determination (TSSC 2010).
EPBC Act	CEEC	Central Hunter Valley eucalypt forest and woodland	Central Hunter Valley eucalypt forest and woodland: a nationally protected ecological community (DEE 2016). Approved Conservation Advice (including listing advice) for the Central Hunter Valley eucalypt forest and woodland ecological community (TSSC 2015).

RDPs and VI plots used to inform the presence of TECs were undertaken throughout areas of potential TEC during autumn (March 2021), within optimal seasonal conditions to assess the cover of native perennial species as annual exotic species have generally died off by this time (DEE 2006).

Potential TECs were assessed by identifying continuous areas, or 'patches' for assessment. The description of a 'patch' varies between the descriptions of TECs listed under the EPBC Act. The NSW Scientific Final determinations for Box Gum Woodland and Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion do not provide a definition for 'patch' for TECs listed under the BC Act.

Definitions for 'patch' and to what EPBC Act listed TEC they are applied, is provided in Table 4.

Table 4: Patch definition for the EPBC Act listed TECs

TEC	Source	Definition
The EPBC Act listed CEEC White Box – Yellow Box – Blakely's Red Gum grassy woodlands and derived native grasslands.	*EPBC Act Policy Statement White Box – Yellow Box – Blakely's Red Gum grassy woodlands and derived native grasslands*	Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). In determining patch size it is important to know what is, and what is not, included within any individual patch. The patch is the larger of: • An area that covers five or more trees in which no tree is greater than 75 m from another tree, or, • The area over which the understorey is predominately native. Patches must be assessed at a scale of 0.1 ha (1,000 m^2) or greater (DEH 2006).
The EPBC Act listed CEEC Central Hunter Valley eucalypt forest and woodland.	*Central Hunter Valley eucalypt forest and woodland: a nationally protected ecological community.*	A patch is a discrete and mostly continuous area of the ecological community (e.g., tree canopies within 30 m of each other). A patch of the Central Hunter Valley eucalypt forest and woodland ecological community is the largest area within which the projected canopy cover of trees is at least 10% (on average); or within which the native tree density is at least 10 native tree stems per 0.5 ha [i.e., at least 20 native tree stems/ha] (on average), that are at least one metre in height; or a combination of areas meeting either of these two measures (DEE 2016).

3. Results

3.1. Native vegetation

Five (5) vegetation classes, attributable to five (5) PCTs, are mapped within the study area in the NSW State Vegetation Type Map: Central Tablelands Region (DPIE 2019) as shown in Table 5. Some of these PCTs are not listed in the BioNet Vegetation Classification (DPIE 2021) (i.e., PCT 1860, PCT 1886 and PCT 1906).

Table 5: Vegetation classes and PCTs mapped within the study area on the NSW State Vegetation Type Map: Central Tablelands Region

Vegetation class	PCT name
Southern Tableland Dry Sclerophylly Forests	PCT 1860: Growee Ranges Grey Gum – Scribbly Gum Forest
Southern Tablelands Wet Sclerophyll Forests	PCT 1906: Central Tablelands Ribbon Gum – Apple Gully Forest
South Coast Sands Dry Sclerophyll Forests	PCT 1675: Scribbly Gum - Narrow-leaved Ironbark - Bossiaea rhombifolia heathy open forest on sandstone ranges of the Sydney Basin
Western Slopes Dry Sclerophyll Forests	PCT 1610: White Box - Black Cypress Pine shrubby woodland of the Western Slopes
Western Slopes Grassy Woodlands	PCT 1886: Western Hunter Footslopes Box Woodland

Field validation of vegetation identified a total of 66.5 ha of native vegetation within the study area, which corresponds to two (2) Vegetation Formations, and four (4) Vegetation Classes in accordance with Keith (2004) (Table 6 below). One access track, which does not support any native vegetation (i.e., is a formed track) is present within the northern section of the study area and has been excluded from the PCT mapping. This access track is 0.02 ha.

Native vegetation was attributed to nine (9) PCTs, assigned in accordance with BioNet Vegetation Classification (DPIE 2021) (Table 7 below). A quantitative analysis of floristic plot data was undertaken against the BioNet Vegetation Classification to determine best fit PCTs based on proportion of characteristic species for each VZ. Abiotic factors including soil type and geology, landform pattern and other relevant data was also cross referenced within information contained within the BioNet Vegetation Classification (DPIE 2021). PCT and VZ mapping is provided in Figure 6 below. One (1) PCT was present in two (2) different condition states resulting in ten (10) individual VZs.

Description of each VZ and representative photos for each VZ are provided below. A total of 24 VI plots were completed in accordance with the BAM (DPIE 2020), data from which was used to inform vegetation condition states. Locations of VI Plots are provided in Figure 5 above.

A flora species list is provided in Appendix C.

Table 6: Vegetation Formations and Classes identified within the study area (based on Keith 2004).

Vegetation formation	Vegetation Class
Dry Sclerophyll Forests • Forests or rarely woodlands dominated by an abundance of hard-leaved (sclerophyllous) shrubs in the understorey. • Only rarely dominated by 'box' eucalypts. Groundcover is often sparse and typically dominated by sclerophyllous sedges but may sometimes include reasonably continuous swards of grasses. • Confined to the coast, tablelands, and the western slopes where average rainfall exceeds 500 mm, largely on infertile sandy or loamy soils.	**Western Slopes Dry Sclerophyll Forests:** • Typically dominated by Ironbarks and Cypress Pine 10 to 25 m tall, on shallow, sandy and infertile soils. **Sydney Hinterland Dry Sclerophyll Forests:** • Typically dominated by a range of Bloodwood, Ironbark, Stringybark and Gum Eucalypt species 10 to 25 m tall, on sandstone ridges, slopes and gullies within infertile soils. **North West Slopes Dry Sclerophyll Forests:** • Typically dominated by a range of Box and Ironbark Eucalypt species which form an open canopy up to 25 m tall on a range of geologies and soil types.
Grassy woodlands • Woodlands or rarely forests, typically 15-35 m tall though shorter at subalpine elevations. • Groundcover continuous and dominated by perennial tussock grasses, and interspersed perennial herbs including 'geophytic' orchids and lilies, but few ephemeral herbs and grasses. • Shrubs generally sparse and typically not including chenopods or other drought tolerant species. • Widespread on relatively fertile loams and clay loams of the coastal lowlands, the tablelands, and the western slopes where average annual rainfall exceeds 500 mm. • Western Slopes Grassy Woodlands are typically dominated by Box and Gum Eucalypt species up to 20 m tall, on fertile soils on slopes on the western side of the Great Dividing Range.	**Western Slopes Grassy Woodlands:** • Typically dominated by Box and Gum Eucalypt species up to 20 m tall, on fertile soils on slopes on the western side of the Great Dividing Range.

Table 7: VZs identified within the study area

PCT	PCT Name	Vegetation formation[1]	Vegetation class[1]	% cleared[1]	Condition	VZ	Area (ha)	VI Plots
434	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	KF_CH3 Grassy Woodlands	Western Slopes Grassy Woodlands	73%	Regenerating woodland	1	6.7	3
472	Thyme Honey-myrtle – red gum – Mugga Ironbark shrubland / woodland in impeded drainage flats or depressions in the southern Brigalow Belt South Bioregion	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	70%	Remnant shrubby woodland	2	4.3	2
478	Red Ironbark – Black Cypress Pine – stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong – Mendooran region, southern Brigalow Belt South Bioregion	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	29%	Remnant forest	3	9.8	3
479	Narrow-leaved Ironbark- Black Cypress Pine – stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	65%	Remnant forest	4	3.9	2
1176	Slaty Box – Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	40%	Moderate	5	2.5	2
					Low	6	0.9	1
1610	White Box – Black Cypress Pine shrubby woodland of the Western Slopes	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	29%	Remnant forest	7	0.8	1
1614	Grey Gum – Grey Myrtle – Narrow-leaved Stringybark – Rusty Fig open forest on ranges of the Upper Hunter	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Hinterland Dry Sclerophyll Forests	27%	Remnant forest	8	1.0	1
1629	Narrow-leaved Stringybark – Grey Gum shrubby open forest on sandstone ranges of the Sydney Basin	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	1%	Remnant forest	9	17.2	3
1767	Rough-barked Apple grassy tall woodlands of the Brigalow Belt South	KH_CH3 Grassy Woodlands	Western Slopes Grassy Woodlands	67%	Remnant woodland	10	19.4	6
Total							**66.5**	**24**

[1] BioNet Vegetation Classification (DPIE 2021).

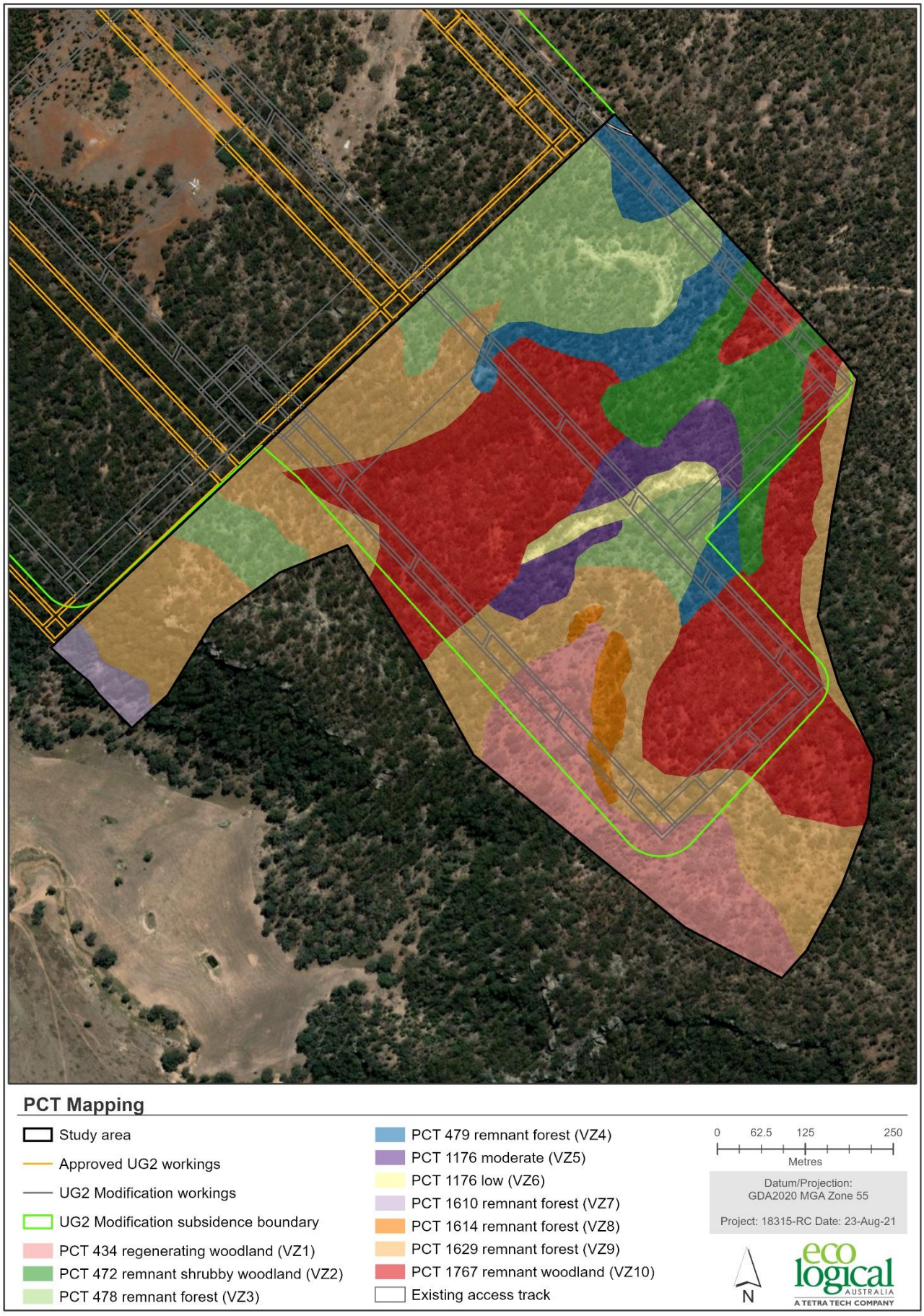


Figure 6: PCT Mapping

3.1.1. PCT 434 – White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion (VZ1)

A full description of PCT 434 is provided in BioNet Vegetation Classification (DPIE 2021) which is summarised in Table 8. A full description of VZ1 is also presented in Table 8. Representative photos of VZ1 are presented in Figure 7 and Figure 8 below.

Table 8: PCT 434 description extracted from BioNet Vegetation Classification (DPIE 2021) and description of VZ1.

Attribute	Description	VZ1 Description
IBRA Region	Sydney Basin	Sydney Basin
IBRA Subregion	Kerrabee	Kerrabee
NSW (Mitchell) Landscape	Not listed	Gulgong Ranges
Soil type	Occurs on red to chocolate clay to loam, often duplex, soils derived from basalt, fine grained metamorphic or sedimentary substrates.	Red to brown clay loams derived from basalt.
Landform position	Hillslopes, hillcrests and footslopes in low and hill landform patterns.	Hillcrests of a basalt intrusion located in the south-west of the study area.
Structure	Tall to mid-high woodland to open woodland.	Open woodland.
Floristic description	Canopy is dominated by *Eucalyptus albens* (White Box) often with *Brachychiton populneus subsp. populneus* (Kurrajong). *Alectryon oleifolius* subsp. *elongatus* (Western Rosewood) and *Callitris endlicheri* (Black Cypress Pine) are also common throughout the upper stratum. The shrub layer is very sparse to sparse and includes *Acacia implexa* (Hickory Wattle), *Notelaea microcarpa* var. *microcarpa* (Native Olive), *Acacia decora* (Western Silver Wattle), *Cassinia quinquefaria* and *Pimelea curviflora.* The ground cover is dense to mid-dense and dominated by grasses and forbs. Grass species include *Poa sieberiana, Aristida personata* (Purple Wiregrass), *Rytidosperma racemosa* var. *racemosa, Bothriochloa macra* (Red Grass), *Austrostipa scabra* subsp. *scabra* (Speargrass), *Dichanthium sericeum* subsp. *sericeum* (Bluegrass), *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Elymus scaber* var. *scaber* (Common Wheat Grass) and *Cymbopogon refractus* (Barbed-wire Grass). Forb species include *Dichondra repens* (Kidney Weed), *Cymbonotus lawsonianus* (Bears-ear), *Boerhavia dominii* (Tar-vine), *Senecio quadridentatus* (Cotton Fireweed), *Sida corrugata* (Corrugated Sida), *Einadia nutans* subsp. *nutans* (Climbing Saltbush), *Swainsona cadellii, Rostellularia adscendens, Oxalis perennans, Wahlenbergia communis* (Australian Bluebell), *Scutellaria humilis* (Dwarf Skullcap), *Hypericum gramineum* (Small St John's Wort), *Mentha satureioides, Veronica plebeia* (Trailing Speedwell) and *Vittadinia muelleri.* Sedges include *Carex inversa* and *Cyperus gracilis* (Slender Flat-sedge).	Selection of this PCT and condition class was based on the dominance of *Eucalyptus albens, Callitris endlicheri* and *Brachychiton populneus* subsp. *populneus* which form an open woodland. Midstorey cover, which was variable throughout the VZ but never exceeded 10% projected foliage cover (pfc), was dominated by *Acrotriche rigida*, *Cassinia quinquefaria* and *Bossiaea obcordata* (Spiny Bossiaea). The ground and shrub composition throughout this VZ varies, with shrub density increasing in steeper areas with shallower soil. Native groundcover was high throughout with an average of 49%. *Bothriochloa macra* and *Microlaena stipoides* var. *stipoides* contributed approximately 20% to the native groundcover. Native herb species *Dichondra repens*, *Ajuga australis* (Australian Bugle) and *Hydrocotyle laxiflora* (Stinking Pennywort) were consistently recorded across all VI plots.

Attribute	Description	VZ1 Description
Additional information for VZ1		
Disturbance	This regenerating form of PCT 434 has undergone significant disturbance. A review of historical (pre - 1990) and current aerial imagery indicates that this VZ may have been selectively thinned. Historical aerial imagery from 1990 and 1982 is provided in Appendix A. One (1) HTE was recorded throughout this VZ, *Opuntia stricta* var. *stricta* (Common Prickly Pear); however, cover was very low (0.2% at Plot 4; average 0.07% cover across VZ2).	
Other PCTs considered	**PCT 483 - Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley** PCT 483 was considered for this VZ due to corresponding landform positions and presence of *Eucalyptus albens*; however, it was excluded from selection based on the assemblage of canopy species. *Callitris endlicheri* (Black Cypress Pine), which contributed to a significant proportion of the canopy, is not listed in the BioNet Vegetation Classification (DPIE 2021) as a characteristic species for PCT 483. Similarly, midstorey species *Acacia implexa* (Hickory Wattle), which was present throughout VZ1 is not listed a characteristic species for PCT 483. **PCT 266 - White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion** PCT 266 was considered for VZ1 due to the presence of *Eucalyptus albens* and *Brachychiton populneus* subsp. *populneus;* however, it was excluded from selection due to *Callitris endlicheri* (Black Cypress Pine) also being a dominant species, and therefore most closely aligned with PCT 434.	
Associated TECs	PCT 434 is associated with the EPBC Act and BC Act listed CEEC White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the Sydney Basin in the BAM-C and BioNet Vegetation Classification (DPIE 2021). VZ1 meets the listing criteria for both the EPBC Act and BC Act listed CEEC due to the grassy woodland structure, location (Sydney Basin), dominance of *Eucalyptus albens,* low shrub cover (<10%) and good grassy and herb diversity in the understorey.	

Figure 7: PCT 434 regenerating woodland (VZ1)

Figure 8: PCT 434 regenerating woodland (VZ1)

3.1.2. PCT 472 – Thyme Honey-myrtle – red gum – Mugga Ironbark shrubland / woodland in impeded drainage flats or depressions in the southern Brigalow Belt South Bioregion (VZ2)

A full description of PCT 472 is provided in BioNet Vegetation Classification (DPIE 2021) which is summarised in Table 7. A full description of VZ2 is also presented in Table 9. Representative photos of VZ2 are presented in Figure 9 and Figure 10 below.

Table 9: PCT 472 description extracted from BioNet Vegetation Classification (DPIE 2021)

Attribute	Description	VZ2
IBRA Region	PCT 472 is not listed as occurring in the Sydney Basin IBRA Region; however, is listed as occurring in the South West Slopes IBRA Region and Inland Slopes IBRA Subregion, which is located approximately 5 km to the west of the study area.	
IBRA Subregion	PCT 472 is also listed as occurring in the Brigalow Belt South IBRA Region and Pilliga IBRA Subregion which are located approximately 20 km to the north of the study area.	
NSW (Mitchell) Landscape	Not listed	Gulgong Ranges
Soil type	Occurs on aeolian or alluvial clayey sand.	Sandy clay derived from sedimentary rock.
Landform position	On flats on drainage depressions where water drainage is impeded in low hill landscapes.	Drainage lines with impeded drainage depressions associated with the headwaters of Strahler stream order 1 streams.
Structure	Mid-high to tall mid-dense shrubland or woodland.	Shrubland to open shrubby woodland.
Floristic description	Over-topping tree species include red gums (*Eucalyptus blakelyi* (Blakely's Red Gum) and *Eucalyptus chloroclada* (Dirty Gum)), *Eucalyptus sideroxylon* (Mugga Ironbark) and *Eucalyptus conica* (Fuzzy Box). The midstorey is dominated by the shrub *Melaleuca thymifolia* (Thyme Honey-myrtle) with other shrubs including *Pultenaea microphylla, Acacia gladiiformis* (Sword-leaved Wattle), *Acacia spectabilis* (Mudgee Wattle), *Leucopogon biflorus, Hovea lanceolata, Exocarpos cupressiformis* (Cherry Balart) and *Pimelea linifolia* (Slender Rice Flower). The groundcover is sparse and low in species diversity and includes sedges such as *Gahnia aspera* (Rough Saw-sedge), *Schoenus ericetorum and Lepidosperma laterale* and the forb *Dampiera lanceolata* (Grooved Dampiera) and orchid *Cyanicula caerulea* (Blue Caladenia).	Selection of PCT 472 was based on the dominance of canopy species *Eucalyptus blakelyi* occurring with shrub species *Melaleuca thymifolia*. Average shrub projected foliage cover (pfc) across VI plots within this VZ was 17% and was dominated by *Melaleuca thymifolia*. Species indicative of water logging and / or poor drainage, in addition to *Melaleuca thymifolia*, were present at variable densities throughout this VZ and included *Arundinella nepalensis* (Reed grass), *Cyperus difformis* (Small Flowered Nut-sedge), *Myriophyllum* sp. and *Isolepis* sp.
Additional information for VZ2		
Disturbance	No HTE species were present within VI Plots within this VZ.	
Other PCTs considered	**PCT 281 – Rough-Barked Apple – red gum – Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion** PCT 281 was considered for VZ2 due to the presence of characteristic canopy species *Eucalyptus blakelyi* and location of VZ within drainage lines consistent with the description for PCT 281 in the BioNet Vegetation Classification (DPIE 2021). PCT 281 was determined to be an inappropriate selection for VZ2 due to relatively high cover of the midstorey, which was dominated by *Melaleuca thymifolia* (Thyme Honey-myrtle). *Melaleuca thymifolia* is not listed as a characteristic species for PCT 281 in the BioNet Vegetation Classification (DPIE 2021). *Angophora floribunda* and *Eucalyptus melliodora* are listed as characteristic canopy species for PCT 281. Despite being the dominant species in the adjacent VZ (VZ10 PCT 1767),	

Attribute	Description	VZ2
	Angophora floribunda is absent from VZ2. This may be due to the impeded drainage and heavier clay substrate present at VZ2. *Eucalyptus melliodora* was also absent from the VZ. Furthermore, PCT 281 is characterised by a grassy woodland structure, whilst VZ2 demonstrated a shrubland to shrubby woodland structure.	
Associated TECs	PCT 472 is not associated with any TECs in the BAM-C or BioNet Vegetation Classification (DPIE 2021) however, assessment against the relevant TEC has been undertaken due to the dominance of *Eucalyptus blakelyi* within the VZ. VZ2 conforms to the definition of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland provided in Part 1 and Part 2 of the Determination; however, does not meet the attributes for the community provided in Part 4 of the Determination due to high shrub cover. VZ2 is not the EPBC Act listed CEEC White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland due to a lack of perennial tussock grass dominance as a result of high shrub cover.	

Figure 9: PCT 472 remnant woodland (VZ2)

Figure 10: PCT 472 remnant woodland (VZ2)

3.1.3. PCT 478 – Red Ironbark – Black Cypress Pine – stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong – Mendooran region, southern Brigalow Belt South Bioregion (VZ3)

A full description of PCT 478 is provided in BioNet Vegetation Classification (DPIE 2021) which is summarised in Table 10. A full description of VZ3 is also shown in Table 10. Representative photos of VZ3 are presented in Figure 11 and Figure 12 below.

Table 10: PCT 478 description extracted from BioNet Vegetation Classification (DPIE 2021)

Attribute	Description	VZ3
IBRA Region	Sydney Basin	
IBRA Subregion	Kerrabee	
NSW (Mitchell) Landscape	Not listed	Gulgong Ranges
Soil type	Occurs sandy loam to clayey soils derived from sandstone, siltstone, shale or slate.	Shallow sand to sandy loams derived from sandstone and conglomerate.
Landform position	Footslopes, hillcrests and hillslopes in hill and low hill landform patters.	Hillslopes and crests associated with the broader escarpment landform pattern present within the study area
Structure	Mid-high to tall open forest.	Open forest.
Floristic description	Co-dominated by *Eucalyptus fibrosa* (Red Ironbark), *Callitris endlicheri* (Black Cypress Pine), *Eucalyptus macrorhyncha (*Red Stringybark), and/or *Eucalyptus punctata* (Narrow-leaved Stringybark) the small tree *Acacia linearifolia* (Narrow-leaved Wattle). The shrub layer is sparse and includes *Phyllanthus hirtellus* (Thyme Spurge)*, Brachyloma daphnoides subsp. daphnoides* (Daphne Heath)*, Hibbertia obtusifolia* (Hoary Guinea Flower)*, Melichrus urceolatus* (Urn Heath)*, Cassinia laevis* (Cough Bush)*, Persoonia linearis* (Geebung)*, Pultenaea microphylla, Dillwynia sieberi, Hibbertia circumdans, Olearia microphylla, Acacia uncinata, Indigofera australis, Lissanthe strigosa* subsp*. strigosa* (Peach Heath)*, Bursaria spinosa* subsp*. spinosa* (Blackthorn) and *Ozothamnus diosmifolius*. The ground cover is mid-dense to sparse. The small shrubs *Platysace ericoides* and *Astroloma humifusa* (Native Cranberry) are often present. Grasses include *Joycea pallida* (syn. *Rytidosperma pallidum*) and *Rytidosperma racemosa*. The mat-rushes include *Lomandra filiformis* (Wattle Mat-rush)*, Lomandra confertifolia* (Mat-rush) and *Lomandra multiflora* (Many-flowered Mat-rush) along with the sedge *Lepidosperma laterale*. Forb species include *Pomax umbellata, Chrysocephalum semipapposum* (Clustered Everlasting)*, Goodenia hederacea* subsp. *hederacea* (Forest Goodenia)*, Veronica plebeia,* and *Stypandra glauca* (Nodding Blue Lily).	Selection of PCT 478 was based on the dominance of canopy species *Eucalyptus fibrosa, Eucalyptus sparsifolia, Eucalyptus punctata* and *Callitris endlicheri*. Midstorey cover was variable, but generally low across vegetation integrity plots ranging from 6% to 11% pfc (average 9% pfc). Midstorey was typically comprised of *Leucopogon muticus* (Blunt Beard-heath), *Persoonia linearis* (Geebung) and *Cassinia cunninghamii* (Cunningham's Everlasting). Midstorey species richness throughout this VZ was relatively high with 11 midstorey species recorded across VI plots. Groundcover was sparse (<6% pfc) and consisted of widely spaced grass and grass-like species including *Cleistochloa rigida, Gahnia aspera* (Rough Saw-sedge) and *Lomandra confertifolia* (Mat-rush). Forb contribution to groundcover was relatively low at time of survey (<1%) but when present, consisted of *Pomax umbellata, Gonocarpus tetragynus* and *Goodenia heterophylla* subsp*. heterophylla.*
Additional information for VZ3		

Attribute	Description	VZ3
Disturbance	This VZ showed signs of small-scale and restricted areas of historical logging of *Eucalyptus fibrosa* and *Eucalyptus sparsifolia* evidenced by presence of stumps. Overall, this PCT is in good condition. No HTEs were recorded across this VZ. There are areas within this VZ which have been subject to higher levels of historical disturbance (i.e., intensive logging); however, at time of survey, condition of growth form groups and extent of exotic species (i.e., projected foliage cover and species richness) across the entire VZ was deemed to be similar and therefore was assigned to the same broad condition state and VZ. Areas which appear to have low vegetation cover in historical aerial imagery (Appendix A) have since regenerated to a standard similar to the entire VZ.	
Other PCTs considered	**PCT 479 – Narrow-leaved Ironbark- Black Cypress Pine – stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion** PCT 479 was excluded from selection for this VZ due to the dominance of *Eucalyptus fibrosa* within this VZ. PCT 479 is also mapped within the study area; however, a distinct boundary between *Eucalyptus fibrosa* dominated forest (VZ3 PCT 478) and a *Eucalyptus crebra* dominated forest (VZ4 PCT 479) was present. Within the study area PCT 479 (VZ4) was dominated by *Eucalyptus crebra, Acacia linearifolia* and *Callitris endlicheri.*	
Associated TECs	PCT 478 is not associated with any TECs in the BAM-C or BioNet Vegetation Classification (DPIE 2021). VZ3 does not conform to any TECs listed under the BC Act and/or the EPBC Act.	

Figure 11: PCT 478 remnant forest (VZ3)

Figure 12: PCT 478 remnant forest (VZ3)

3.1.4. PCT 479 - Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion (VZ4)

A full description of PCT 479 is provided in BioNet Vegetation Classification (DPIE 2021) which is summarised in Table 11. A full description of VZ4 is also shown in Table 11. Representative photos of VZ4 are presented in Figure 13 and Figure 14 below.

Table 11: PCT 479 description extracted from BioNet Vegetation Classification (DPIE 2021) and description of VZ4

Attribute	Description	VZ4
IBRA Region	Sydney Basin	Sydney Basin
IBRA Subregion	Kerrabee	Kerrabee
NSW (Mitchell) Landscape	Not listed	Gulgong Ranges
Soil type	Occurs on red-brown loamy clay to sandy loam soils derived from sandstone, siltstone and shale.	Red to brown sandy loams derived from sandstone and conglomerate.
Landform position	Hill and low hill landforms.	Hillslopes associated with the broader escarpment landform pattern present within the study area.
Structure	Tall open forest.	Open forest.
Floristic description	Dominated by *Eucalyptus crebra* (Narrow-leaved Ironbark), *Callitris endlicheri* often with *Eucalyptus sparsifolia, Eucalyptus punctata* or *Eucalyptus dwyeri* (Dwyer's Red Gum). Other tree species may include *Eucalyptus nubila* (Blue-leaved Ironbark), *Acacia linearifolia, Acacia crassa* (Curracabah), *Eucalyptus macrorhyncha, Eucalyptus fibrosa* and *Corymbia trachyphloia* subsp. *amphistomatica* (Brown Bloodwood). The shrub layer is usually sparse but may be mid-dense in places and is rich in species. Shrub species include *Cassinia arcuata* (Sifton Bush), *Acacia buxifolia* subsp. *buxifolia* (Box Wattle), *Acacia verniciflua* (Varnish Wattle), *Acacia piligera, Cassinia laevis, Dodonaea triangularis, Phyllanthus hirtellus, Sannantha cunninghamii, Macrozamia spiralis, Melichrus urceolatus, Allocasuarina gymnanthera, Melichrus erubescens, Grevillea sericea, Styphelia triflora* (Pink Five-corners), *Acacia sertiformis, Leucopogon muticus, Hibbertia obtusifolia, Kunzea parvifolia* (Violet Kunzea), *Acrotriche rigida, Prostanthera howelliae, Exocarpos cupressiformis* and *Choretrum* sp. A. The ground cover is usually sparse and may contain litter or rock. Grass species include *Joycea pallida, Austrostipa densiflora, Echinopogon caespitosus* var. *caespitosus* (Hedgehog Grass), *Digitaria ramularis, Aristida vagans and Microlaena stipoides* var. *stipoides*. The low shrub *Astroloma humifusum* may be present. Sedges such as *Gahnia aspera* and *Lepidosperma laterale* and mat-rushes such as *Lomandra glauca* and *Lomandra filiformis* subsp. *coriacea* may be present. Forb species include *Pomax umbellata, Goodenia hederacea* subsp.	The canopy in VZ4 was dominated by *Eucalyptus crebra, Acacia linearifolia* and *Callitris endlicheri* with an average canopy cover of 20%. Midstorey cover was relatively low (average 2.5%) but was typically dominated by *Persoonia linearis, Acrotriche rigida, Cassinia sifton* and *Cassinia quinquefaria.* Midstorey species richness was high, with a total of 14 species recorded across VI plots. Groundcover was relatively high (average 40%); however, cover of grass and grass-like and forbs varied across VI plots. Dominant grass and grass-like species included *Digitaria breviglumis* and *Microlaena stipoides* var. *stipoides.* Dominant forb species included *Pomax umbellata* and *Dichondra repens.*

Attribute	Description	VZ4
	hederacea, Gonocarpus elatus, Dianella revoluta var. *revoluta* (Blue Flax-lily)*, Stypandra glauca* and *Xerochrysum viscosa* (Sticky Everlasting).	
Additional information for VZ4		
Disturbance	This VZ showed signs of small-scale historical logging of *Eucalyptus crebra* evidenced by presence of stumps. Overall, this PCT is in good condition. No HTEs were recorded across this VZ.	
Other PCTs considered	**PCT 478 - Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion** PCT 478 was excluded from selection for VZ4 due to the dominance of *Eucalyptus crebra* within VZ4. PCT 478 is also mapped within the study area; however, a distinct boundary between *Eucalyptus fibrosa* dominated forest (VZ3 PCT 478) and a *Eucalyptus crebra* dominated forest (VZ4 PCT 479) was present. Within the study area PCT 478 (VZ3) was typically dominated by *Eucalyptus fibrosa* and *Eucalyptus punctata*. *Eucalyptus crebra* was generally absent from PCT 478 (VZ3) within the study area.	
Associated TECs	PCT 479 is not associated with any TECs in the BAM-C or BioNet Vegetation Classification (DPIE 2021). VZ4 does not conform to any TECs listed under the BC Act and/or the EPBC Act.	

Figure 13: PCT 479 remnant forest (VZ4)

Figure 14: PCT 479 remnant forest (VZ4)

3.1.5. PCT 1176 - Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion (VZ5 and VZ6)

PCT 1176 was identified in two condition states within the study area and as such has been assigned to two separate VZs. A full description of PCT 1176 is provided in BioNet Vegetation Classification (DPIE 2021) which is summarised in Table 12. A full description of VZ5 and VZ6 is also presented in Table 12. Representative photos of VZ5 and VZ6 are presented in Figure 15 to Figure 18 below.

Table 12: PCT 1176 description extracted from the BioNet Vegetation Classification (DPIE 2021) and description of VZ5 and VZ6

Attribute	Description	VZ5 and VZ6
IBRA Region	Sydney Basin	Sydney Basin
IBRA Subregion	Kerrabee	Kerrabee
NSW (Mitchell) Landscape	Not listed	Gulgong Ranges
Soil type	Not assessed.	Sandy loams derived from shale/slate.
Landform position	Gullies and footslopes on Narrabeen Sandstone.	Footslopes and lower hillslopes at the junction of Permian and Triassic sedimentary rock (Narrabeen Sandstone).
Structure	Shrubby woodland.	Woodland to open forest.
Floristic description	Dominant canopy species include *Eucalyptus dawsonii* (Slaty Gum)*; Eucalyptus punctata; Eucalyptus moluccana* (Grey Box)*, Eucalyptus crebra, Callitris endlicheri, Allocasuarina luehmannii, Eucalyptus fibrosa, Corymbia trachyphloia* subsp. *amphistomatica* and *Brachychiton populneus* subsp*. populneus*. *Eucalyptus dawsonii* is often prominent at the interface of Permian and Narrabeen Sediments. Characteristic midstorey species include *Acacia doratoxylon* (Currawang)*; Acacia linearifolia* (Narrow-leaved Wattle)*; Acacia salicina* (Cooba)*; Dodonaea viscosa; Geijera parviflora; Notelaea microcarpa* var. *microcarpa; Olearia elliptica* (Sticky Daisy Bush) and *Persoonia linearis.* Characteristic groundcover species include *Aristida ramosa, Cymbopogon refractus, Oxyetes brachypodum, Dichondra repens, Eremophila debilis* (Winter Apple)*, Lomandra multiflora* subsp. *multiflora* and *Sida corrugata.*	**PCT 1176 moderate condition (VZ5)** Canopy species were present included *Eucalyptus dawsonii, Callitris endlicheri, Eucalyptus albens* and *Acacia linearifolia.* Average canopy cover was 24%. Midstorey cover was variable; however, *Acrotriche rigida* contributed the highest to midstorey cover and was consistently recorded across both VI plots. Several other midstorey species were recorded but did not contribute greatly to midstorey cover (i.e. <0.1%). These included *Cassinia quinquefaria, Persoonia linearis, Daviesia genistifolia, Dodonaea viscosa, Lissanthe strigosa* subsp. *strigosa.* Groundcover was relatively low (average 4%) and was dominated by grasses including *Aristida ramosa, Lomandra filiformis* subsp. *filiformis* and *Rytidosperma pallidum.* Forb contribution to total groundcover was low (average of 1%). **PCT 1176 low condition (VZ6)** Canopy species included *Eucalyptus dawsonii, Eucalyptus fibrosa* and *Acacia linearifolia*. Canopy cover was low (11%) due to historical disturbance. Despite the level of disturbance this VZ supports native vegetation. Midstorey was dominated by *Acrotriche rigida* which contributed 5% to total midstorey cover (6.4%). Groundcover was very sparse (<2%) and was dominated by perennial native grass species such as *Aristida ramosa* and *Austrostipa scabra* subsp. *scabra*
Additional information for VZ5 and VZ6		
Disturbance	**PCT 1176 moderate condition (VZ5)** This VZ showed signs of small-scale historical logging of *Eucalyptus dawsonii* evidenced by presence of stumps and coppiced main trunks. No HTEs were recorded across this VZ.	

Attribute	Description VZ5 and VZ6
	PCT 1176 low condition (VZ6) This VZ showed signs of extensive quarry activities as evidenced by remains of spoil heaps and quarry box cut excised into the hillslope. No HTEs were recorded across this VZ.
Other PCTs considered	**PCT 1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin** *Eucalyptus moluccana* and *Callitris endlicheri*, which are listed as canopy species along with *Eucalyptus dawsonii* within PCT 1655, were not present within VZ5 and VZ6. **PCT 1177 - Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion** PCT 1177 occurs on loamy soils of moderate fertility. Soil present within VZ5 and VZ6 were typically shallow, of low fertility and derived from shale and siltstone (i.e., low loam content). In addition to *Eucalyptus dawsonii,* characteristic canopy species of PCT 1177 include *Eucalyptus macrorhyncha, Angophora floribunda* and *Eucalyptus melliodora* which were not present within VZ5 or VZ6.
Associated TECS	PCT 1176 is associated with the BC Act listed VEC Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion and the EPBC Act listed CEEC Central Hunter Valley eucalypt forest in the BAM-C and BioNet Vegetation Classification (DPIE 2021). VZ5 and VZ6 conform to the NSW Threatened Species Scientific Committee (TSSC) Final Determination for the VEC Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion due to the positioning on the interface of Permian sediments and Narrabeen Sandstone and floristic assemblage. All patches of PCT 1176 which encompasses VZ5 and VZ6 meet the listing criteria for the EPBC Act listed CEEC Central Hunter Valley eucalypt forest and woodland due to floristic assemblage and positioning on the interface of Permian sediments and Narrabeen Sandstone.

Figure 15: PCT 1176 moderate condition (VZ5)

Figure 16: PCT 1176 moderate condition (VZ5)

Figure 17: PCT 1176 low condition (VZ6)

Figure 18: PCT 1176 low condition (VZ6)

3.1.6. PCT 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes (VZ7)

A full description of PCT 1610 is provided in BioNet Vegetation Classification (DPIE 2021) which is summarised in Table 13. A full description of VZ7 is also provided in Table 13. Representative photos of VZ7 are presented in Figure 19 and Figure 20 below.

Table 13: PCT 1610 description extracted from BioNet Vegetation Classification (DPIE 2021) and description of VZ7

Attribute	Description	VZ7
IBRA Region	Sydney Basin	Sydney Basin
IBRA Subregion	Kerrabee	Kerrabee
NSW (Mitchell) Landscape	Not listed	Gulgong Ranges
Soil type	Not assessed.	Clay loam to sandy loams derived from shale/slate.
Landform position	Not assessed	Footslopes and lower hillslopes.
Structure	Woodland.	Open forest.
Floristic description	Characterised by a canopy strongly dominated by *Eucalyptus albens* in association with *Callitris endlicheri.* The mid-storey consists of an open shrub layer typically dominated by *Cassinia sifton*. The ground layer is typically a mix of grasses with various forbs and graminoids including *Rytidosperma racemosa, Austrostipa scabra, Aristida ramosa, Microlaena stipoides, Dichondra repens, Einadia hastata, Einadia nutans, Veronica plebeia, Vittadinia cuneata* (Fuzz Weed)*, Calotis lappulacea* (Yellow Burr-daisy)*, Lomandra filiformis* and *Cheilanthes sieberi* (Rock Fern).	Canopy species present within VZ7 include *Eucalyptus albens* and *Callitris endlicheri.* Canopy cover was 19%. Midstorey cover was 12% and was dominated by *Acrotriche rigida.* Several other shrubs species were recorded; however, did not contribute greatly to midstorey cover, and included *Acacia implexa, Bursaria spinosa* subsp. *spinosa* and *Melichrus erubescens.* Groundcover was relatively high (55%) and was dominated by grasses including *Aristida vagans, Lomandra confertifolia* subsp. *pallida* and *Microlaena stipoides* var. *stipoides.* Forb, fern and other contributed 8% to total groundcover, and included *Cheilanthes sieberi* subsp. *sieberi, Wahlenbergia* spp. and *Clematis glycinoides* (Headache Vine).
Additional information for VZ7		
Disturbance	Several exotic annual species were recorded throughout this VZ; however, cover was <1%. One (1) HTE, *Hypericum perforatum,* was recorded throughout this VZ (cover 0.1%).	
Other PCTs considered	**PCT 1606 - White Box - Narrow-leaved Ironbark - Blakely's Red Gum shrubby open forest of the central and upper Hunter** PCT 1606 was excluded from selection due to VZ7 lacking *Eucalyptus crebra* and *Eucalyptus blakelyi*, which are listed as characteristic canopy species within PCT 1606. PCT 1606 is also categorised as North-west Slopes Dry Sclerophyll Forest and VZ7 is more consistent with Western Slopes Dry Sclerophyll Forests in accordance with Keith (2004). **PCT 266 - White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion** PCT 266 was considered due to the presence of *Eucalyptus albens* and *Brachychiton populneus;* however, was excluded from selection due to the differing vegetation structure. VZ7 is consistent with a Dry Sclerophyll Forest in accordance with Keith (2004). PCT 266 is categorised as a Western Slopes Grassy Woodland in the VIS.	
Associated TECs	PCT 1610 is not associated with any TECs in the BAM-C or BioNet Vegetation Classification (DPIE 2021) however, assessment against the relevant TEC has been undertaken due to the dominance of *Eucalyptus albens* within the VZ.	

Attribute	Description	VZ7
	VZ7 conforms to the definition of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland provided in Part 1 and Part 2 of the Determination; however, does not meet the attributes for the community provided in Part 4 of the Determination due to not conforming to Keith's (2004) grassy woodland as a result of relatively infertile soils. VZ7 is not the EPBC Act listed CEEC White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland due to a lack of moderate to highly fertile soils.	

Figure 19: PCT 1610 remnant open forest (VZ7)

Figure 20: PCT 1610 remnant open forest (VZ7)

3.1.7. PCT 1614 – Grey Gum - Grey Myrtle - Narrow-leaved Stringybark - Rusty Fig open forest on ranges of the Upper Hunter (VZ8)

A full description of PCT 1614 is provided in BioNet Vegetation Classification (DPIE 2021) which is summarised in Table 14. A full description of VZ8 is shown in Table 14. Representative photos of VZ8 are presented in Figure 21 and Figure 22 below.

Table 14: PCT 1614 description extracted from BioNet Vegetation Classification (DPIE 2021) and description of VZ8

Attribute	Description	VZ8
IBRA Region	Sydney Basin	Sydney Basin
IBRA Subregion	Kerrabee	Kerrabee
NSW (Mitchell) Landscape	PCT 1614 is not listed on the BioNet Vegetation Classification (DPIE 2021) as occurring within the Gulgong Ranges; however, it is listed as occurring throughout the Lees Pinch Foothills NSW Landscape which occurs approximately 5 km to the north-east of the occurrence of PCT 1614 within the study area.	
Soil type	Not assessed.	Sandy loam derived from sedimentary rock.
Landform position	Sheltered sites on sandstone ranges.	Sheltered sites amongst sandstone cliffs and boulders, typically at the junction of outcropping basalt and sedimentary rock.
Structure	Open forest.	Open to closed forest.
Floristic description	The canopy is dominated by *Eucalyptus punctata.* Other characteristic canopy species include *Eucalyptus sparsifolia* and *Ficus rubiginosa* (Rusty Fig). The mid-storey consists of small trees, sparse shrubs and scattered climbers. Characteristic midstorey species include *Backhousia myrtifolia* (Grey Myrtle), *Allocasuarina torulosa* (Forest Oak), *Clerodendrum tomentosum* (Hairy Clerodendrum), *Pittosporum undulatum* (Sweet Pittosporum), *Notelaea microcarpa, Maytenus silvestris* (Orange Bush, *Clematis glycinoides* and *Cayratia clematidea* (Native Grape) Epiphytic ferns such as *Platycerium bifurcatum* (Elkhorn Fern) and *Pyrrosia rupestris* (Rock Felt Fern) are also common. The ground layer is typically a mix of grasses and ferns with scattered forbs including *Pellaea falcata* (Sickle Fern), *Doodia aspera* (Prickly Rasp-fern), *Viola hederacea* (Native Violet), *Pratia purpurascens, Microlaena stipoides* and *Oplismenus aemulus* (Basket Grass).	The canopy within VZ8 was dominated by *Ficus rubiginosa*. *Eucalyptus punctata* and *Callitris endlicheri* were also present at much lower abundances. Canopy cover was typically very high (>50%) directly underneath thickets of *Ficus rubiginosa* and sparser (20%) where eucalyptus were the dominant canopy species. Midstorey was very sparse to absent (i.e., <1%) and was comprised of *Acrotriche rigida*, *Correa reflexa* (Native Fuchsia) and *Cassinia quinquefaria.* Groundcover was generally sparse immediately underneath *Ficus rubiginosa* canopy; however, more open areas were more congruous for groundcover. Groundcover was comprised of *Microlaena stipoides, Digitaria breviglumis* and fern species *Cheilanthes sieberi* and *Cheilanthes distans* (Bristly Cloak Fern). *Microlaena stipoides* is listed as a diagnostic species for this PCT in the BioNet Vegetation Classification (DPIE 2021).
Additional information for VZ8		
Disturbance	There was little to no evidence of disturbance throughout PCT 1614. No HTEs were recorded within this VZ.	
Other PCTs considered	No other PCTs were considered for this VZ, as PCT 1614 is the only PCT in which *Ficus rubiginosa* (Rusty Fig) is listed as a characteristic canopy species within the Sydney Basin IBRA Region. Species such as *Backhousia myrtifolia, Clerodendrum tomentosum* and *Pittosporum undulatum* which are listed as midstorey stratum in the BioNet Vegetation Classification (DPIE 2021) were absent from PCT 1614. Based on ELA's professional experience, these species are more commonly recorded in areas of higher rainfall and to the east of the Great Dividing Range. Despite the	

Attribute	Description	VZ8
	absence of these midstorey species, PCT 1614 fits this VZ due to the landscape position, structure, and canopy species present.	
Associated TECs	PCT 1614 is not associated with any TECs in the BAM-C or BioNet Vegetation Classification (DPIE 2021). VZ8 does not conform to any TECs listed under the BC Act and/or the EPBC Act.	

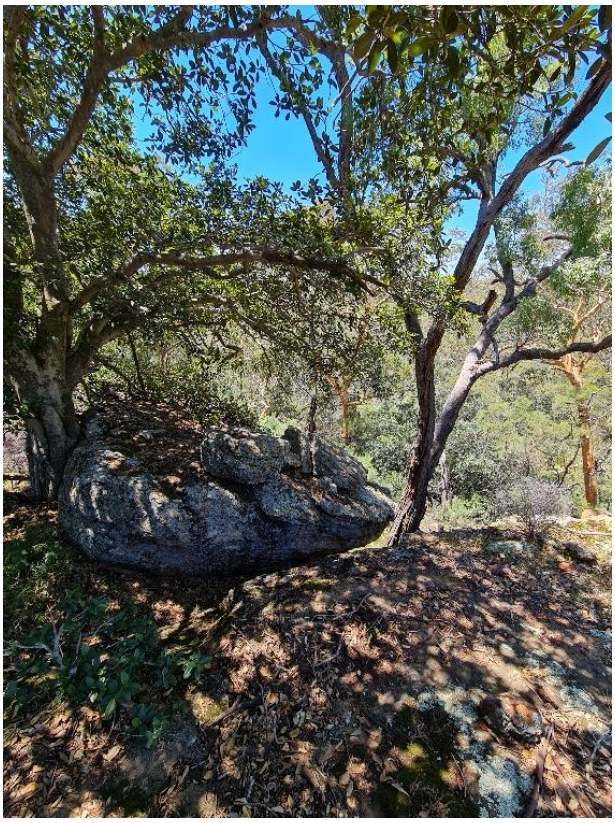


Figure 21: PCT 1614 remnant forest (VZ8)

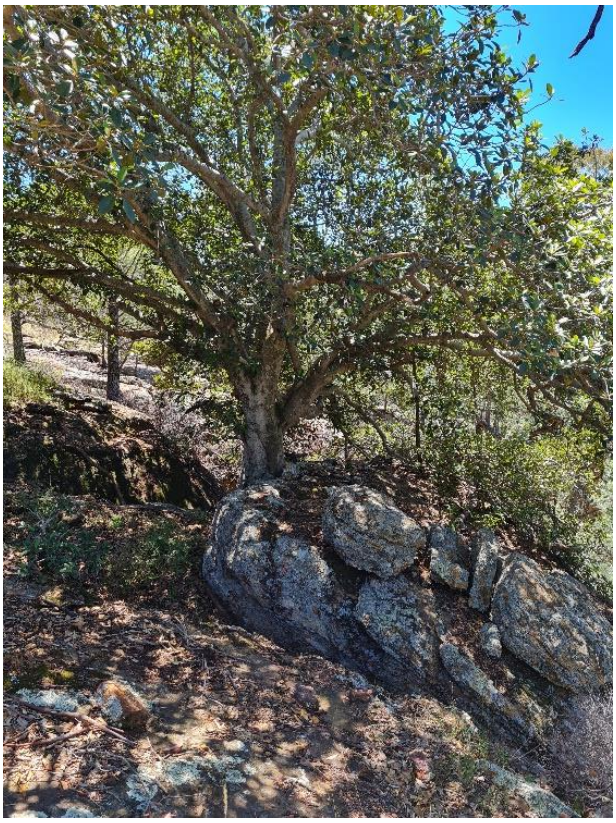


Figure 22: PCT 1614 remnant forest (VZ8)

3.1.8. PCT 1629 - Narrow-leaved Stringybark - Grey Gum shrubby open forest on sandstone ranges of the Sydney Basin (VZ9)

A full description of PCT 1629 is provided in BioNet Vegetation Classification (DPIE 2021) which is summarised in Table 15. A full description of VZ9 is shown in Table 15. Representative photos of VZ9 are presented in Figure 23 and Figure 24 below.

Table 15: PCT 1629 description extracted from BioNet Vegetation Classification (DPIE 2021) and description of VZ9

Attribute	Description	VZ9
IBRA Region	Sydney Basin	Sydney Basin
IBRA Subregion	Kerrabee	Kerrabee
NSW (Mitchell) Landscape	PCT 1614 is not listed on the BioNet Vegetation Classification (DPIE 2021) as occurring within the Gulgong Ranges; however, it is listed as occurring throughout the Upper Goulburn Valleys and Escarpment NSW Landscape which occurs approximately 2 km to the west of the occurrence of PCT 1629 within the study area.	
Soil type	Not assessed.	Sandy loam derived from sedimentary rock.
Landform position	Sandstone ridges and upper slopes.	Sandstone ridges and escarpments.
Structure	Shrubby open forest	Open forest
Floristic description	The canopy is dominated by *Eucalyptus punctata* and *Eucalyptus sparsifolia.* Characteristic midstorey species include *Persoonia linearis, Podolobium ilicifolium* (Prickly Shaggy-Pea) and *Exocarpos strictus* (Dwarf Cherry Balart). Characteristic groundcover species include *Entolasia stricta* (Wiry Panic)*, Lomandra confertifolia, Lomandra filiformis, Dianella caerulea, Dianella revoluta* and *Lepidosperma laterale.*	Selection of PCT 1629 was based on the occurrence of canopy species *Eucalyptus sparsifolia* and *Eucalyptus punctata* on sandstone and conglomerate derived sandy loams on escarpment and associated vegetated scree slopes. Structure was consistent with an open forest. Midstorey was generally sparse (<10% cover) and was dominated by *Phebalium squamulosum* (Scaly Phebalium) and *Persoonia linearis.* Groundcover was generally low (<5%) and was dominated by *Lomandra confertifolia, Cleistochloa rigida* and *Lepidosperma laterale.*
Additional information for VZ9		
Disturbance	This PCT showed signs of small-scale historical logging of *Eucalyptus sparsifolia* as evidenced by stumps. Overall, this PCT is in good condition. No HTEs were recorded throughout this VZ.	
Other PCTs considered	**PCT 1669 - Red Ironbark - Grey Gum - Narrow-leaved Stringybark - Brown Bloodwood shrubby open forest on sandstone ranges of the Sydney Basin** Canopy species *Eucalyptus fibrosa* and *Corymbia trachyphloia*, which are listed as characteristic canopy species throughout PCT 1669, were not present within this VZ.	
Associated TECs	PCT 1629 is not associated with any TECs in the BAM-C or BioNet Vegetation Classification (DPIE 2021). VZ9 does not conform to any TECs listed under the BC Act and/or the EPBC Act.	

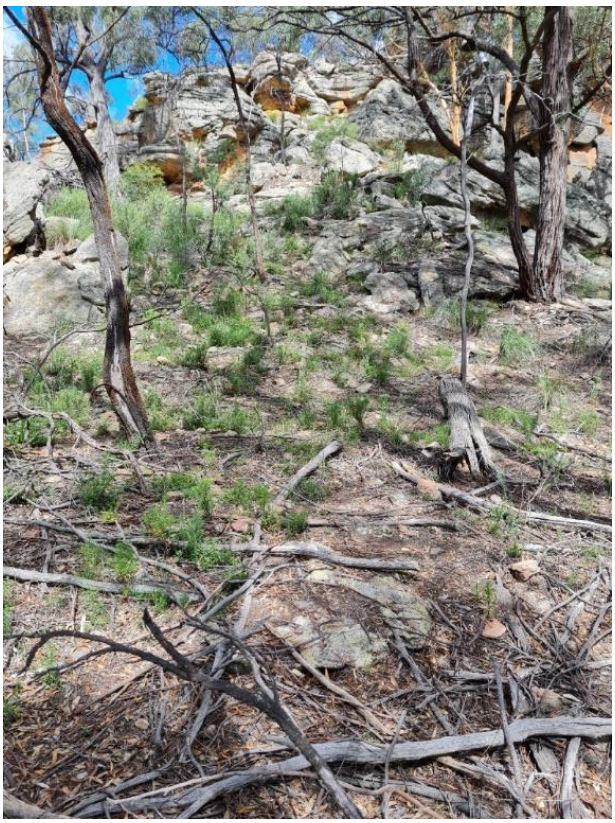


Figure 23: PCT 1629 remnant forest (VZ9)

Figure 24: PCT 1629 remnant forest (VZ9)

3.1.9. PCT 1767 - Rough-barked Apple grassy tall woodlands of the Brigalow Belt South (VZ10)

A full description of PCT 1767 as provided in BioNet Vegetation Classification (DPIE 2021) and a full description of VZ10 is shown in Table 16. Representative photos of VZ10 are presented in Figure 25 and Figure 26 below.

Table 16: PCT 1767 description extracted from BioNet Vegetation Classification (DPIE 2021) and description of VZ10

Attribute	Description	VZ10
IBRA Region	Sydney Basin	Sydney Basin
IBRA Subregion	Kerrabee	Kerrabee
NSW (Mitchell) Landscape	Upper Goulburn Valleys and Escarpment	Upper Goulburn Valleys and Escarpment
Soil type	Sandy substrates.	Sandy loam derived from conglomerate and sandstone.
Landform position	Occurs along minor streamlines and in their headwater areas. 480 – 550 m above sea level (asl).	Occurs in the headwater areas of two (2) Strahler stream order 1 streams at 530 m asl.
Structure	Grassy tall woodland	Grassy woodland to open forest.
Floristic description	Canopy dominated by *Angophora floribunda*. Midstorey is sparse and frequently absent. Groundcover is typically grassy with a mix of associated forbs. Groundcover species include *Dichondra repens, Bothriochloa biloba, Austrostipa aristiglumis* (Plains Grass), *Dichanthium sericeum, Geranium solanderi* (Native Geranium) and *Chloris ventricosa* (Plump Windmill Grass).	The canopy within VZ10 was dominated by *Angophora floribunda.* Canopy species *Acacia linearifolia, Eucalyptus albens, Eucalyptus blakelyi* and *Brachychiton populneus* subsp. *populneus* were also present throughout this VZ; however, did not contribute greatly to canopy cover or canopy stem abundance. The presence of these species was typically proximal to adjacent PCTs (i.e., ecotonal areas). Midstorey cover was variable throughout this VZ; however, was generally less than 5%. When present, midstorey was dominated by *Acrotriche rigida, Cassinia quinquefaria* and *Persoonia linearis.* Groundcover was typically high (>50%) and was dominated by grass and grass-like species including *Microlaena stipoides* var. *stipoides,* Lomandra confertifolia subsp. *pallida* and *Echinopogon caespitosus* var. *caespitosus.* Forb richness was very high (37 species across the VZ), with *Dichondra repens, Hydrocotyle laxiflora, Asperula conferta* and *Cynoglossum australe* contributing significantly to total ground cover.
Additional information		
Disturbance	One (1) HTE was recorded throughout this VZ, *Ailanthus altissima* (Tree of Heaven); however, cover was negligible (0.1%). No other disturbance factors were recorded.	
Other PCTs considered	**PCT 281: Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion** PCT 281 was excluded from selection due to the dominance of *Angophora floribunda* within the VZ. Whilst PCT 281 can be dominated by *Angophora floribunda, Eucalyptus blakelyi* and *Eucalyptus melliodora* are typically also present. *Eucalyptus melliodora* was not present within this VZ. *Eucalyptus blakelyi* was present; however, only within ecotones of the adjacent PCT (PCT 472 Thyme Honey-myrtle - red gum - Mugga Ironbark shrubland / woodland in impeded drainage flats or depressions in the southern	

Attribute	Description	VZ10
	Brigalow Belt South Bioregion). There is no evidence of logging or thinning within this VZ and therefore no evidence of historically higher proportions of *Eucalyptus blakelyi* or presence of *Eucalyptus melliodora.*	
Associated TECs	PCT 1767 is not associated with any TECs in the BAM-C or BioNet Vegetation Classification (DPIE 2021). VZ10 does not conform to any TECs listed under the BC Act and/or the EPBC Act.	

Figure 25: PCT 1767 remnant woodland (VZ10)

Figure 26: PCT 1767 remnant woodland (VZ10)

3.2. Threatened Ecological Communities

A summary of TECs present within the study area is provided in Table 17. Two (2) PCTs mapped are listed as associated with a TEC in the BioNet Vegetation Classification (DPIE 2021) and BAM-C. The extent of these TECs within the study area is provided in Figure 27 and Figure 28 below.

Table 17: TECs present within the study area

BC Act listed TEC	Equivalent EPBC Act listed TEC	PCTs	VZs	Area (ha)
White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the Sydney Basin - CEEC	*White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland* - CEEC	PCT 434	VZ1	BC Act: 6.7 ha EPBC Act: 6.7 ha
		PCT 472	VZ2	BC Act: 4.3 ha
		PCT1610	VZ7	BC Act: 0.8 ha
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion - VEC	*Central Hunter Valley eucalypt forest and woodland* - CEEC	PCT 1176	VZ5 & VZ6	BC Act: 3.4 ha EPBC Act: 3.4 ha

3.2.1. BC Act listed White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC

Definition of the BC Act listed CEEC White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is provided in Part 1 and Part 2 of the *Notice of and reason for the Final Determination for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (TSSC 2020; hereafter referred to as the Determination), and states:

"Section 1.6 of the Act defines an ecological community as "an assemblage of species occupying a particular area". These features of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland are described in Parts 1 and 2 of this Determination, respectively."

Part 3 of the Determination describes the eligibility listing for this community as a CEEC and Part 4 of the determination provides additional field information intended to aid in recognition of this community in the field. Therefore, for VZs within the study area to meet the criteria listed in the Determination, only Part 1 and Part 2 need to be satisfied. As such, VZs containing a PCT listed as associated with the CEEC White Box – Yellow Box – Blakely's Red Gum Woodland and DNG within the BAM-C have been assessed against the descriptive attributes provided in Part 1 and Part 2 of the Determination.

The BC Act listed CEEC Box Gum Woodland is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species include *Eucalyptus albens, Eucalyptus blakelyi* and / or *Eucalyptus melliodora.*

One (1) PCT within the study area is associated with Box Gum Woodland in the BioNet Vegetation Classification (DPIE 2021) and BAM-C (PCT 434). Three (3) PCTs within the study area are dominated by *Eucalyptus albens, Eucalyptus blakelyi* and / or *Eucalyptus melliodora*, and were identified as Box Gum Woodland:

- PCT 434 regenerating woodland (VZ1) conforms to the definition of Box Gum Woodland as the species assemblage and vegetation structure is consistent with the Determination (TSSC 2020).
- PCT 472 shrubby woodland (VZ2) conforms to the definition of Box Gum Woodland provided in Part 1 and Part 2 of the Determination and is therefore Box Gum Woodland; however, does not

meet the attributes for the community provided in Part 4 of the Determination (TSSC 2020) due to high shrub cover.

- PCT 1610 remnant forest (VZ7) conforms to the definition of Box Gum Woodland provided in Part 1 and Part 2 of the Determination (TSSC 2020) and is therefore Box Gum Woodland; however, does not meet the attributes for the community provided in Part 4 of the Determination (TSSC 2020) due to not conforming to Keith's (2004) grassy woodland as a result of relatively infertile soils.

A full assessment of these VZs against the BC Act Final Determination is provided in Appendix E1.

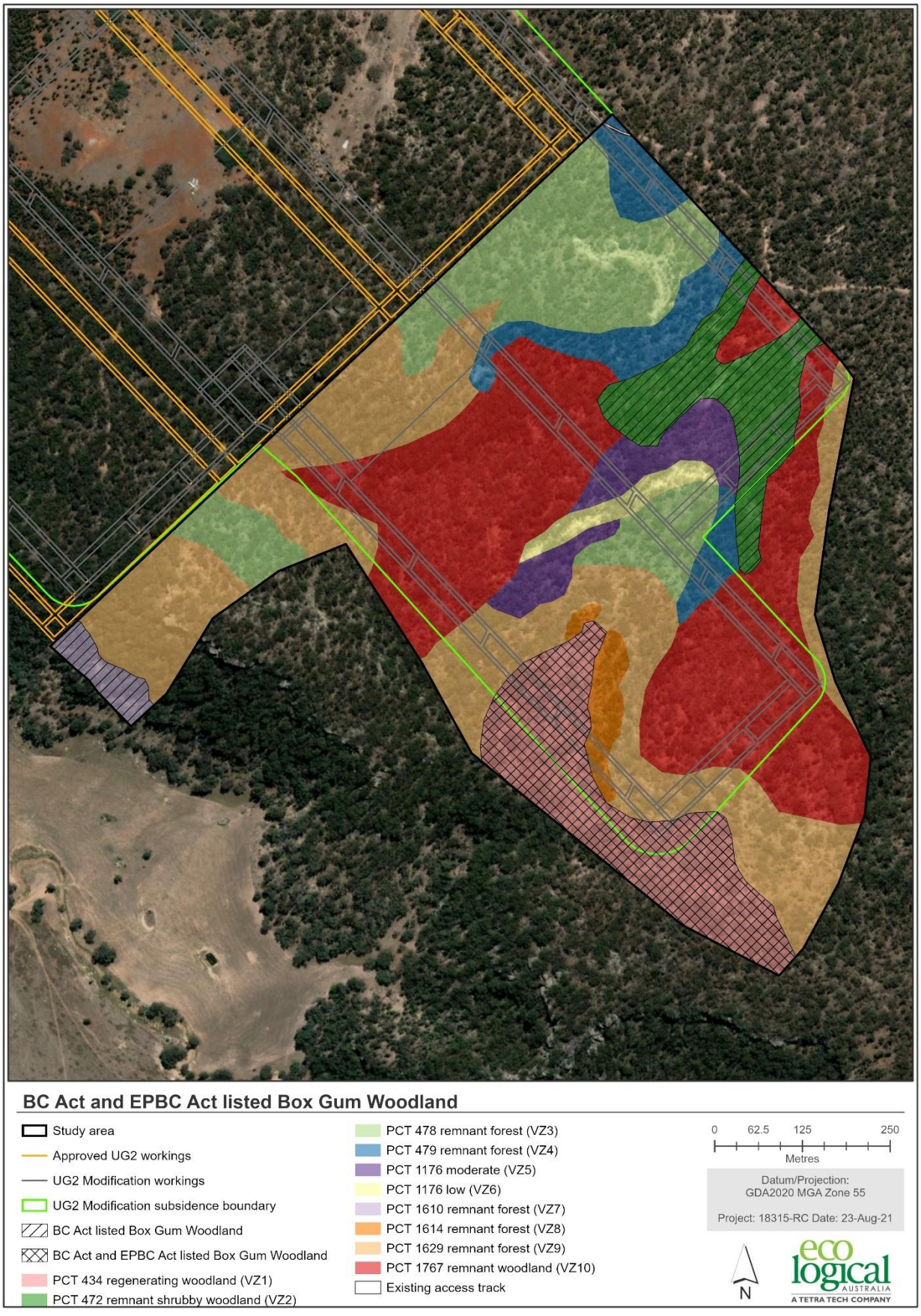


Figure 27: BC Act and EPBC Act listed Box Gum Woodland

3.2.2. EPBC Act listed White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC

One (1) patch of the EPBC Act listed Box Gum Woodland was identified in the study area (PCT 434 regenerating woodland, VZ1) as shown in Figure 27 above in accordance with the associated EPBC Act Policy Statement (DEH 2006) and the listing advice (TSSC 2006) due to the following:

- The most common overstorey species throughout VZ1 (PCT 434 regenerating woodland) is *Eucalyptus albens*.
- The patch has a predominately native understorey and is dominated by native perennial grass species *Bothriochloa macra* and *Microlaena stipoides* subsp*. stipoides*.
- The patch is 6.7 ha in size.
- There are 40 native non-grass species present in the understorey (excluding shrubs), including ten (10) important species.
- Shrub cover was less than 30%.

PCT 472 remnant shrubby woodland (VZ2) does not meet the listing criteria for EPBC Act listed Box Gum Woodland due to a lack of perennial tussock grass dominance as a result of high shrub cover.

PCT 1610 remnant forest (VZ7) does not meet the listing criteria for EPBC Act Box Gum Woodland due to a lack of moderate to highly fertile soils.

A full assessment against the listing criteria for this CEEC under the EPBC Act is provided in Appendix E2.

3.2.3. BC Act listed Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC

Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion is the name given to the ecological community that generally occurs at the interface of Narrabeen Sandstone (Triassic sediments) and Permian sediments in the Hunter Valley and is typically dominated by *Eucalyptus dawsonii* (Slaty Gum) and/or *Eucalyptus moluccana*. The community typically forms a low to mid-high woodland (TSSC 2010).

PCT 1176 is associated with this VEC in the BioNet Vegetation Classification (DPIE 2021) and the BAM-C. PCT 1176 VZ5 and VZ6 meet the criteria for Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion as the occurrence of VZ5 and VZ6 broadly correspond to the interface between Narrabeen Sandstone and Permian Sediments and the species assemblage and vegetation structure is consistent with the Final Determination (TSSC 2010). The distribution of this VEC is shown in Figure 28 below.

A full analysis against the listing criteria as provided in the *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion - vulnerable ecological community listing final determination* (TSSC 2010) is provided in Appendix E3.

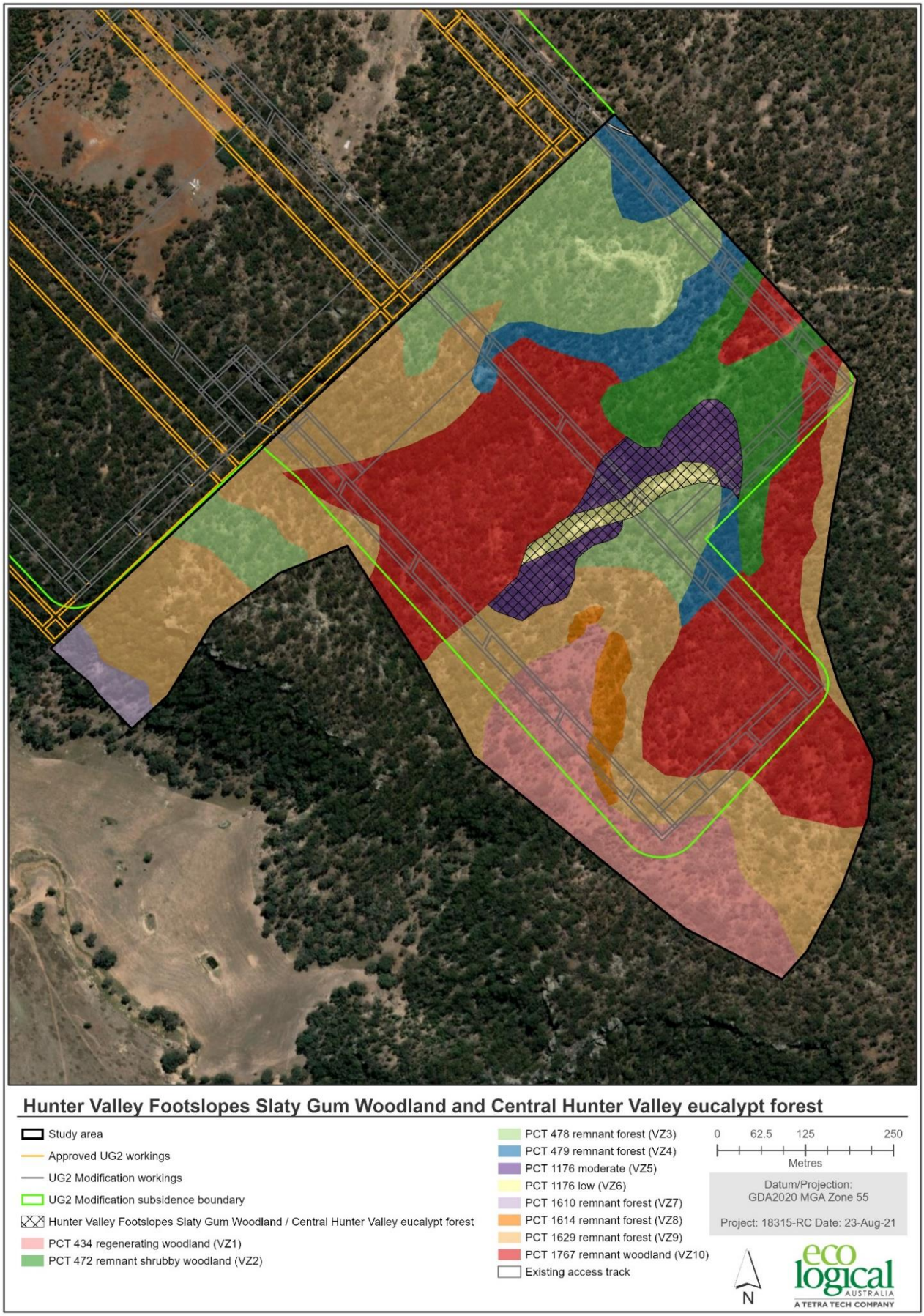


Figure 28: Hunter Valley Footslopes Slaty Gum Woodland and Central Hunter Valley eucalypt forest

3.2.4. EPBC Act listed Central Hunter Valley eucalypt forest and woodland CEEC

Central Hunter Valley eucalypt forest and woodland is typically dominated by one or more of the following four eucalypt species occurring on lower hillslopes and low ridges, or valley floors in undulating country, on soils derived from Permian sedimentary rocks:

- *Eucalyptus crebra*
- *Corymbia maculata* (Spotted Gum)
- *Eucalyptus dawsonii*
- *Eucalyptus moluccana*

PCT 1176 is associated with this CEEC in the BioNet Vegetation Classification (DPIE 2021). The entire extent of PCT 1176 within the study area (VZ5 and VZ6), as shown in Figure 28 above, meets the listing criteria for this CEEC due to the following:

- Within the study area, the occurrence of PCT 1176 (VZ5 and VZ6) occurs on Permian sediment derived clay soil and broadly corresponds to the geological interface between Permian sediments and Narrabeen Sandstone.
- PCT 1176 (VZ5 and VZ6) within the study area occurs on lower hillslopes and low ridges, or valley floors in undulating country.
- It does not occur on occur on alluvial flats, river terraces, eolian sands, Triassic sediments, or escarpments.
- PCT 1176 (VZ5 and VZ6) is a woodland / open forest structure, with a projected canopy cover of trees >10%.
- The canopy of PCT 1176 (VZ5 and VZ6) is dominated by *Eucalyptus dawsonii*.
- *Allocasuarina torulosa* and *Eucalyptus acmenoides* are absent from the patch. *Eucalyptus fibrosa* was recorded at only one (1) out of three (3) VI plots throughout VZ5 and VZ6. Where *Eucalyptus fibrosa* was recorded, it was not the dominant canopy species and is therefore, largely absent from the patch.
- A ground layer is present (although it may vary in development and composition), as a sparse to thick layer of native grasses and other native herbs and/or native shrubs.

A full assessment against the listing criteria for this TEC is provided in Appendix E4.

3.3. Opportunistic threatened species sightings

Three (3) threatened woodland birds listed as vulnerable under the BC Act were recorded opportunistically throughout the study area including:

- Brown Treecreeper (eastern subspecies; *Climacteris picumnus victoriae*).
- Dusky Woodswallow (Artamus cyanopterus cyanopterus).
- Diamond Firetail (Stagonopleura guttata).

The locations of threatened species opportunistically recorded within the study area are provided in Appendix D.

4. Vegetation assessment summary

There is 66.5 ha of native vegetation within the study area representing nine (9) PCTs. One (1) of these PCTs was present in more than one condition state (PCT 1176); resulting in ten (10) VZs.

One (1) PCT within the study area is associated with Box Gum Woodland in the BioNet Vegetation Classification (DPIE 2021) and BAM-C (PCT 434); however, three (3) PCTs within the study area were identified as Box Gum Woodland:

- 11.8 ha of BC Act listed Box Gum Woodland, of which 6.7 ha also meets the listing criteria for the Box Gum Woodland under the EPBC Act:
    - 6.7 ha of PCT 434 regenerating woodland (VZ1) under the BC Act and EPBC Act.
    - 4.3 ha of PCT 472 remnant shrubby woodland (V2) under the BC Act.
    - 0.8 ha of PCT 1610 remnant forest (VZ7) under the BC Act.

An additional 3.4 ha of the BC Act listed VEC *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion* of which also meets the listing criteria for the EPBC Act listed CEEC *Central Hunter Valley eucalypt forest and woodland* is present within the study area (PCT 1176; VZ5 and VZ6).

Three (3) threatened woodland birds listed as vulnerable under the BC Act were recorded opportunistically throughout the study area including:

- Brown Treecreeper (eastern subspecies)
- Dusky Woodswallow
- Diamond Firetail

In accordance with the BAM (DPIE 2020), there are six (6) offset trading groups present within the study area as shown in Table 18 below:

1. White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland – CEEC – 6.7 ha.
2. Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion – VEC - 3.4 ha
3. Sydney Hinterland Dry Sclerophyll Forests with a percentage cleared value <50% - 1.0 ha
4. Western Slopes Dry Sclerophyll Forest with a percentage cleared value <50% - 30.9 ha
5. Western Slopes Dry Sclerophyll Forest with a percentage cleared value >50% - 5.1 ha
6. Western Slopes Grassy Woodlands with a percentage cleared value <50% -19.4 ha

Table 18: Offset trading groups

Trading group number	Offset trading group	VZ	PCT	% cleared	Vegetation formation	Vegetation class	Area (ha)
Trading Group 1	White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland – CEEC	1	PCT 434	65%	KF_CH3 Grassy Woodlands	Western Slopes Grassy Woodlands	6.7
Trading Group 2	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion – VEC	5	PCT 1176	94%	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	0.9
		6	PCT 1176				2.5
	Sub-total (ha)						**3.4**
Trading Group 3	Sydney Hinterland Dry Sclerophyll Forests with a percentage cleared value <50%.	8	PCT 1614	27%	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Hinterland Dry Sclerophyll Forests	1.0
Trading Group 4	Western Slopes Dry Sclerophyll Forest with a percentage cleared value <50%.	3	PCT 478	29%	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	9.8
		4	PCT 479	40%			3.9
		9	PCT 1629	1%			17.2
	Sub-total (ha)						**30.9**
Trading Group 5	Western Slopes Dry Sclerophyll Forest with a percentage cleared value >50%.	7	PCT 1610	67%	KH_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	0.8
		2	PCT 472	70%			4.3
	Sub-total (ha)						**5.1**
Trading Group 6	Western Slopes Grassy Woodlands with a percentage cleared value <50%	10	PCT 1767	27%	KF_CH3 Grassy Woodlands	Western Slopes Grassy Woodlands	19.4
	Total native vegetation (ha)						**66.5**

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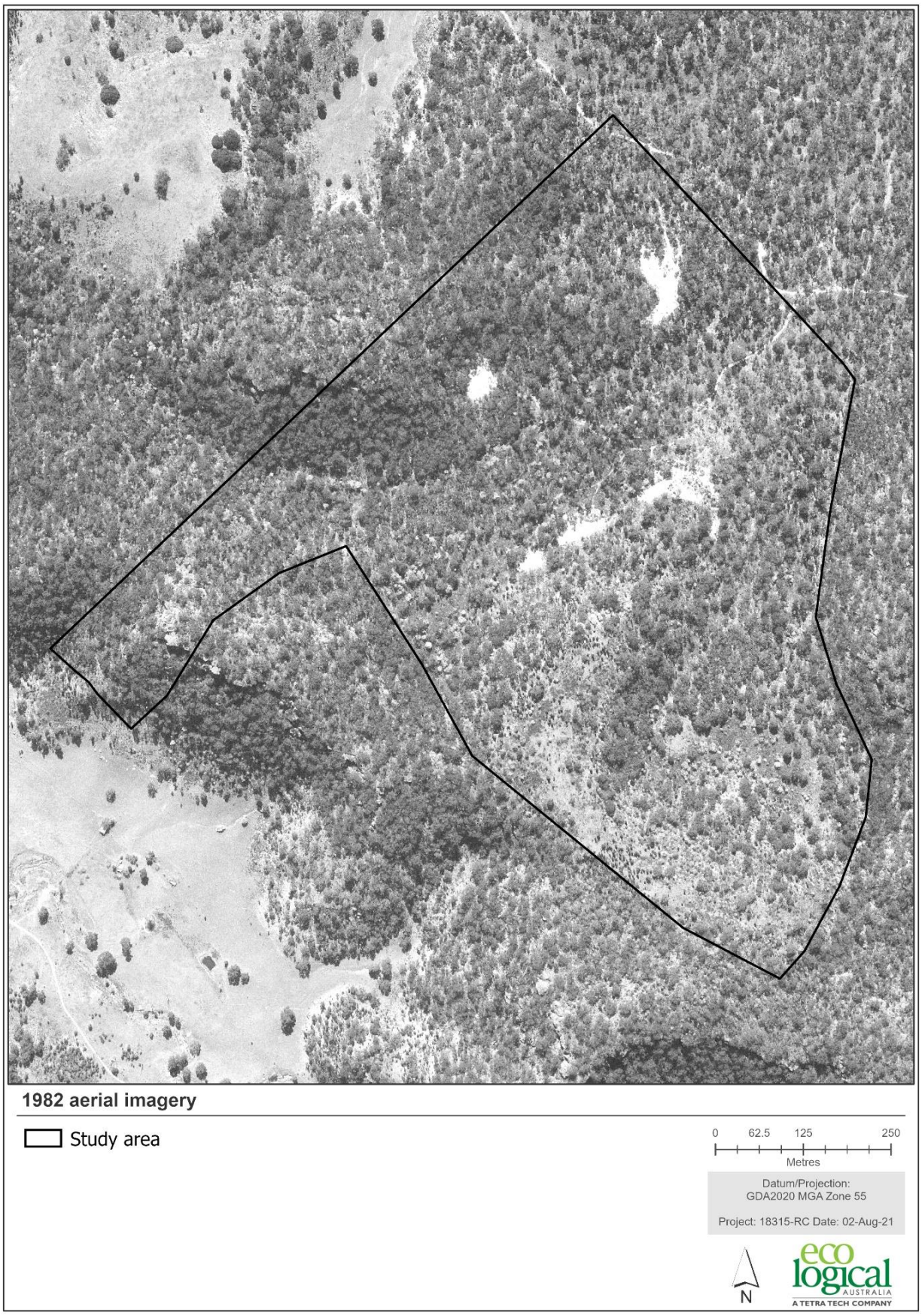
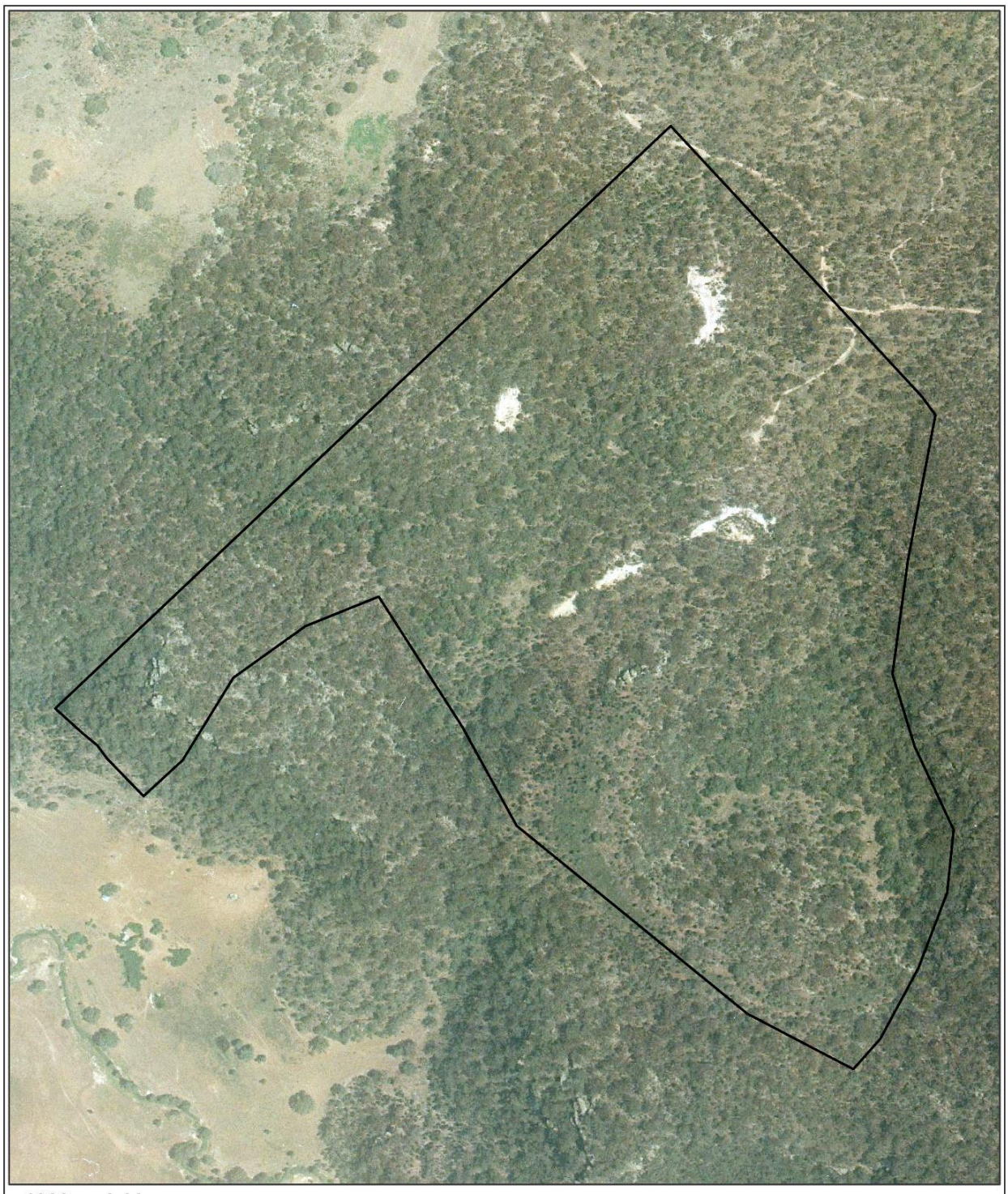
Appendix A Historical aerial imagery





1990 aerial imagery

Study area

0 62.5 125 250

Metres

Datum/Projection:
GDA2020 MGA Zone 55

Project: 18315-RC Date: 02-Aug-21

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Appendix B Complete VI Plot data

Refer to Excel document (18315 UG2 MOD Baseline Veg VI Plot Data V2 dated 23 August 2021).

Appendix C Flora species list

Species	Exotic	Growth form[1]
Acacia buxifolia subsp. *buxifolia*	Native	Shrub
Acacia implexa	Native	Shrub
Acacia linearifolia	Native	Tree
Acacia verniciflua	Native	Shrub
Acaena ovina	Native	Forb
Acianthus fornicatus	Native	Forb
Acrotriche rigida	Native	Shrub
*Ailanthus altissima^*	Exotic	NA
Ajuga australis	Native	Forb
Amyema miquelii	Native	Other
Amyema quandong var. *quandong*	Native	Other
Angophora floribunda	Native	Tree
Aristida ramosa	Native	Grass & grasslike
Aristida spp.	Native	Grass & grasslike
Aristida vagans	Native	Grass & grasslike
Arthropodium minus	Native	Forb
Arundinella nepalensis	Native	Grass & grasslike
Asperula conferta	Native	Forb
Astroloma humifusum	Native	Shrub
Austrostipa bigeniculata	Native	Grass & grasslike
Austrostipa densiflora	Native	Grass & grasslike
Austrostipa scabra subsp. *falcata*	Native	Grass & grasslike
Austrostipa scabra subsp. *scabra*	Native	Grass & grasslike
Austrostipa spp.	Native	Grass & grasslike
Austrostipa verticillata	Native	Grass & grasslike
Billardiera scandens	Native	Other
Bossiaea obcordata	Native	Shrub
Bossiaea prostrata	Native	Forb
Bothriochloa macra	Native	Grass & grasslike
Brachychiton populneus subsp. *populneus*	Native	Tree
Brachyloma daphnoides subsp. *daphnoides*	Native	Shrub
Brunoniella australis	Native	Forb

Species	Exotic	Growth form[1]
Bursaria spinosa subsp. *spinosa*	Native	Shrub
Callitris endlicheri	Native	Tree
Calotis cuneifolia	Native	Forb
Calotis lappulacea	Native	Forb
Carex appressa	Native	Grass & grasslike
Carex inversa	Native	Grass & grasslike
Cassinia cunninghamii	Native	Shrub
Cassinia quinquefaria	Native	Shrub
Cassinia sifton	Native	Shrub
Centaurium tenuiflorum	Exotic	NA
Chamaesyce drummondii	Native	Forb
Cheilanthes austrotenuifolia	Native	Fern
Cheilanthes distans	Native	Fern
Cheilanthes sieberi subsp. sieberi	Native	Fern
Chondrilla juncea	Exotic	NA
Cirsium vulgare	Exotic	NA
Cleistochloa rigida	Native	Grass & grasslike
Clematis spp.	Native	Other
Convolvulus arvensis	Exotic	NA
Convolvulus erubescens	Native	Other
Conyza bonariensis	Exotic	NA
Correa reflexa var. reflexa	Native	Shrub
Crassula spp.	Native	Forb
Cymbonotus lawsonianus	Native	Forb
Cymbopogon refractus	Native	Grass & grasslike
Cynoglossum australe	Native	Forb
Cyperus difformis	Native	Grass & grasslike
Cyperus spp.	Native	Grass & grasslike
Damasonium spp.	Native	Forb
Daviesia genistifolia	Native	Shrub
Daviesia ulicifolia subsp. *ulicifolia*	Native	Shrub
Desmodium varians	Native	Other
Dianella longifolia var. *longifolia*	Native	Forb

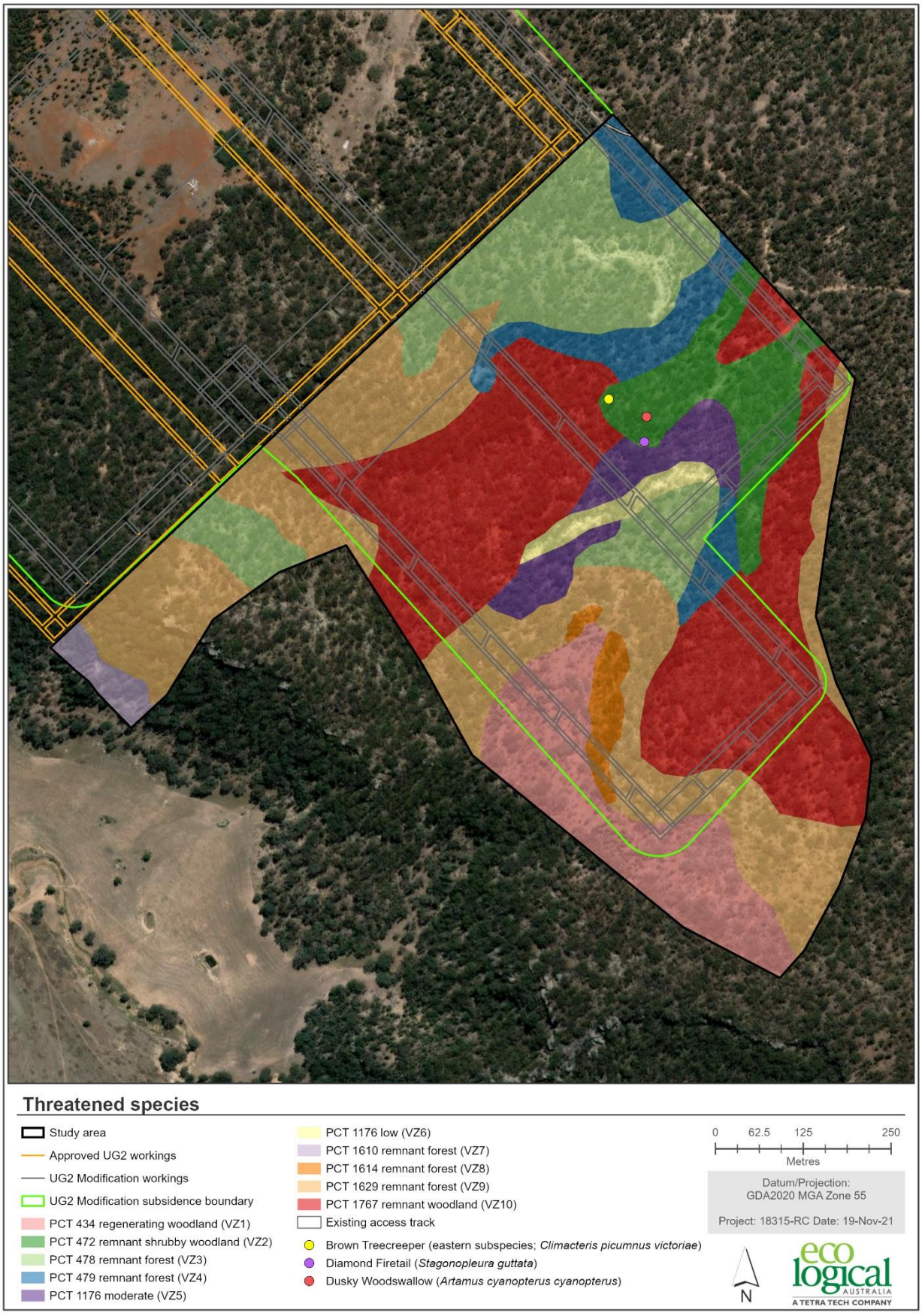
Species	Exotic	Growth form[1]
Dianella revoluta var. *revoluta*	Native	Forb
Dichanthium sericeum subsp. *sericeum*	Native	Grass & grasslike
Dichelachne micrantha	Native	Grass & grasslike
Dichondra repens	Native	Forb
Digitaria breviglumis	Native	Grass & grasslike
Digitaria diffusa	Native	Grass & grasslike
Digitaria spp.	Native	Grass & grasslike
Dodonaea triangularis	Native	Shrub
Dodonaea viscosa subsp. *angustifolia*	Native	Shrub
Dodonaea viscosa subsp. *cuneata*	Native	Shrub
Echinopogon caespitosus var. *caespitosus*	Native	Grass & grasslike
Echinopogon ovatus	Native	Grass & grasslike
Einadia hastata	Native	Forb
Einadia nutans subsp. *nutans*	Native	Forb
Einadia polygonoides	Native	Forb
Einadia trigonos subsp. *stellulata*	Native	Forb
Eragrostis brownii	Native	Grass & grasslike
Erodium cicutarium	Exotic	NA
Eucalyptus albens	Native	Tree
Eucalyptus blakelyi	Native	Tree
Eucalyptus crebra	Native	Tree
Eucalyptus dawsonii	Native	Tree
Eucalyptus dwyeri	Native	Tree
Eucalyptus fibrosa	Native	Tree
Eucalyptus melliodora	Native	Tree
Eucalyptus punctata	Native	Tree
Eucalyptus sparsifolia	Native	Tree
Euchiton sphaericus	Native	Forb
Eulalia aurea	Native	Grass & grasslike
Exocarpos cupressiformis	Native	Shrub
Ficus rubiginosa	Native	Tree
Gahnia aspera	Native	Grass & grasslike
Galium leiocarpa	Native	Forb
Galium spp.	Native	Forb

Species	Exotic	Growth form[1]
Gamochaeta calviceps	Exotic	NA
Geranium homeanum	Native	Forb
Geranium solanderi var. *solanderi*	Native	Forb
Glycine clandestina	Native	Other
Glycine tabacina	Native	Other
Gonocarpus tetragynus	Native	Forb
Goodenia hederacea subsp. *hederacea*	Native	Forb
Goodenia heterophylla subsp. *heterophylla*	Native	Forb
Goodenia paniculata	Native	Forb
Haloragis heterophylla	Native	Forb
Hardenbergia violacea	Native	Other
Hibbertia circumdans	Native	Shrub
Hibbertia obtusifolia	Native	Shrub
Hybanthus monopetalus	Native	Forb
Hydrocotyle laxiflora	Native	Forb
Hypericum gramineum	Native	Forb
Hypericum perforatum^	Exotic	NA
Hypochaeris radicata	Exotic	NA
Indigofera adesmiifolia	Native	Shrub
Indigofera australis	Native	Shrub
Isolepis spp.	Native	Grass & grasslike
Isotoma axillaris	Native	Forb
Isotoma fluviatilis subsp. *australis*	Native	Forb
Lachnagrostis filiformis	Native	Grass & grasslike
Lactuca saligna	Exotic	NA
Lactuca spp.	Exotic	NA
Laxmannia gracilis	Native	Forb
Lepidium africanum	Exotic	NA
Lepidium bonariense	Exotic	NA
Lepidosperma laterale	Native	Grass & grasslike
Leucopogon juniperinus	Native	Shrub
Leucopogon muticus	Native	Shrub
Lissanthe strigosa subsp. *subulata*	Native	Shrub
Lomandra confertifolia subsp. *pallida*	Native	Grass & grasslike

Species	Exotic	Growth form[1]
Lomandra filiformis subsp. *filiformis*	Native	Grass & grasslike
Lomandra glauca	Native	Grass & grasslike
Lomandra longifolia	Native	Grass & grasslike
Lomandra multiflora subsp. *multiflora*	Native	Grass & grasslike
Lysimachia arvensis	Exotic	NA
Macrozamia secunda	Native	Other
Marsdenia viridiflora	Native	Other
Melaleuca thymifolia	Native	Shrub
Melichrus erubescens	Native	Shrub
Microlaena stipoides var. *stipoides*	Native	Grass & grasslike
Modiola caroliniana	Exotic	NA
Myriophyllum spp.	Native	Forb
Opercularia diphylla	Native	Forb
Opercularia hispida	Native	Forb
Opuntia stricta var. *stricta^*	Exotic	NA
Oxalis perennans	Native	Forb
Panicum effusum	Native	Grass & grasslike
Paspalidium spp.	Native	Grass & grasslike
Persoonia linearis	Native	Shrub
Phebalium squamulosum subsp. *lineare*	Native	Shrub
Phyllanthus hirtellus	Native	Shrub
Plantago gaudichaudii	Native	Forb
Platysace ericoides	Native	Shrub
Podolobium ilicifolium	Native	Shrub
Pomax umbellata	Native	Forb
Poranthera corymbosa	Native	Shrub
Poranthera microphylla	Native	Forb
Pseudognaphalium luteoalbum	Native	Forb
Pterostylis spp.	Native	Forb
Pultenaea microphylla	Native	Shrub
Pultenaea spp.	Native	Shrub
Richardia spp.	Exotic	NA
Rytidosperma caespitosum	Native	Grass & grasslike
Rytidosperma pallidum	Native	Grass & grasslike
Rytidosperma spp.	Native	Grass & grasslike
Salvia verbenaca	Exotic	NA
Schoenus apogon	Native	Grass & grasslike
Scutellaria humilis	Native	Forb
Sida spp.	Native	Forb
Sigesbeckia orientalis subsp. *orientalis*	Native	Forb
Solanum campanulatum	Native	Shrub
Solanum cinereum	Native	Shrub
Solanum nigrum	Exotic	NA
Solanum prinophyllum	Native	Forb
Solanum spp.	Native	Forb
Solenogyne bellioides	Native	Forb
Sonchus oleraceus	Exotic	NA
Sporobolus creber	Native	Grass & grasslike
Stellaria pungens	Native	Forb
Stuartina muelleri	Native	Forb
Stylidium laricifolium	Native	Forb
Taraxacum spp.	Native	Forb
Templetonia stenophylla	Native	Forb
Thelymitra spp.	Native	Forb
Themeda triandra	Native	Grass & grasslike
Thysanotus tuberosus subsp. *tuberosus*	Native	Forb
Trifolium repens	Exotic	NA
Verbena bonariensis	Exotic	NA
Veronica plebeia	Native	Forb
Vittadinia muelleri	Native	Forb
Vittadinia spp.	Native	Forb
Wahlenbergia communis	Native	Forb
Wahlenbergia gracilis	Native	Forb
Wahlenbergia spp.	Native	Forb
Xerochrysum bracteatum	Native	Forb

[1] BAM (DPIE 2020)

Appendix D Threatened species



Appendix E TEC assessments

E1 BC Act listed CEEC White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland assessment

NSW BC Act Final Determination	PCT 434 regenerating woodland (VZ1)	PCT 472 remnant shrubby woodland (VZ2)	PCT 1610 remnant woodland (VZ7)
Part 1			
Part 1.1: White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is characterised by the assemblage of species in Part 1.1 of the Determination.	The species assemblage recorded was consistent and included 23 of the species listed in Part 1.1 of the Determination: *Acacia implexa, Ajuga australis, Aristida ramosa, Asperula conferta, Bothriochloa macra, Brunoniella australis, Cheilanthes sieberi* subsp. *sieberi, Cymbonotus lawsonianus, Cymbopogon refractus, Desmodium varians, Eucalyptus albens, Euchiton sphaericus, Glycine tabacina, Hydrocotyle laxiflora, Oxalis perennans, Panicum effusum, Plantago gaudichaudii, Poranthera microphylla, Sporobolus creber, Stellaria pungens, Themeda triandra, Veronica plebeia* and *Wahlenbergia communis.*	The species assemblage recorded was consistent and included seven (7) of the species listed in Part 1.1 of the Determination: *Acacia implexa, Euchiton sphaericus, Eucalyptus blakelyi, Hydrocotyle laxiflora, Hypericum gramineum, Poranthera microphylla* and *Schoenus apogon.*	The species assemblage recorded was consistent and included ten (10) of the species listed in Part 1.1 of the Determination: *Cheilanthes sieberi* subsp. *sieberi, Asperula conferta, Cymbonotus lawsonianus, Gonocarpus tetragynus, Hydrocotyle laxiflora, Plantago debilis, Rumex brownii, Stellaria pungens, Veronica plebeia* and *Eucalyptus albens.*
Part 1.2: The total species list of the community across all occurrences is likely to be considerably larger than that given above.	A further 53 native species were recorded in addition to those listed in Part 1.1 of the Determination.	A further 34 native species were recorded in additional to those listed in Part 1.1 of the Determination.	A further 46 native species were recorded in additional to those listed in Part 1.1 of the Determination.
Part 2			
Part 2.1 The assemblage of species listed in Part 1.1 above which characterises White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland occurs within NSW in the Brigalow Belt South, Nandewar, New England Tableland, Sydney Basin, NSW North Coast, South Eastern Highlands, South East Corner, NSW South Western Slopes and Riverina Bioregions.	The study area is located within the Sydney Basin IBRA region.	The study area is located within the Sydney Basin IBRA region.	The study area is located within the Sydney Basin IBRA region.
Part 2.2 It is the intent of the NSW Threatened Species Scientific Committee that all occurrences of the ecological community (both recorded and as yet unrecorded, and	One (1) condition state was recorded within the study area, regenerating woodland.	One (1) condition state was recorded within the study area, remnant shrubby woodland.	One (1) condition state was recorded within the study area, remnant woodland.

NSW BC Act Final Determination	PCT 434 regenerating woodland (VZ1)	PCT 472 remnant shrubby woodland (VZ2)	PCT 1610 remnant woodland (VZ7)
independent of their condition) that occur within these bioregions be covered by this Determination.			
Outcome against Part 1 and Part 2 of the Determination.	PCT 434 regenerating woodland (VZ1) meets the definitions provided in Part 1 and Part 2 and therefore is the **CEEC *White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the Sydney Basin*.**	PCT 472 remnant shrubby woodland (VZ2) meets the definitions provided in Part 1 and Part 2 and therefore is the **CEEC *White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the Sydney Basin*.**	PCT 1610 remnant woodland (VZ7) meets the definitions provided in Part 1 and Part 2 and therefore is the **CEEC *White Box – Yellow Box –Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the Sydney Basin*.**
Part 4			
Part 4.1. In New South Wales, the community corresponds broadly with Keith's (2004) Western Slopes Grassy Woodlands, Southern Tableland Grassy Woodlands and New England Grassy Woodlands classes	The VZ conforms to Keith's (2004) Western Slopes Grassy Woodlands.	The VZ does not conform to Keith's (2004) Western Slopes Grassy Woodlands due to: • Groundcover is not dominated by perennial tussock grasses. • Shrubs are not sparse.	The VZ does not conform to Keith's (2004) Western Slopes Grassy Woodlands due to: • Soil is not relatively fertile loam or clay loam.
Part 4.2 Characterised by widely spaced trees with canopies not touching and projected foliage cover generally less than 30%[1]	Average canopy projected foliaged cover for this VZ was 7%, and the canopy was not touching. Prior to clearing, the vegetation would have been consistent with a woodland structure.	Average canopy projected foliaged cover for this VZ was 11%, and the canopy was not touching.	Average canopy projected foliaged cover for this VZ was 26%, and the canopy was generally touching (open forest structure).
Part 4.2 Tree height ranges from approximately 15 – 30 m and declines with increasing aridity from east to west	Average tree height was 15m.	Average tree height was 15m.	Average tree height was 12m.
Part 4.2 The groundcover is dominated by perennial tussock grasses interspersed with a diverse range of forb species with the families Asteraceae and Fabaceae, and the orders Liliales and Asparagales well represented	The groundcover is dominated by perennial tussock grasses including *Bothriochloa macra, Dichelachne micrantha, Digitaria breviglumis* and *Panicum effusum.* Asteraceae species C*alotis lappulacea, Cymbonotus lawsonianus, Calotis cuneifolia* and *Sigesbeckia orientalis* subsp. *orientalis* and Fabaceae species *Glycine clandestina, Glycine tabacina* and *Desmodium varians* were interspersed between perennial tussock grasses. Survey was undertaken outside of typical flowering time for many Liliales and Asparagales species, which typically flower	The groundcover is dominated by herb species including *Hydrocotyle laxiflora* and *Myriophyllum* sp. Perennial tussock grasses contributed to less than 5% pfc. Asteraceae species *Calotis cuneifolia,* Fabaceae species *Glycine clandestina* and Liliale species *Arthropodium minus* were present. Survey was undertaken outside of typical flowering time for many Liliales and Asparagales species, which typically flower in spring; however, they are likely to be present.	The groundcover is dominated by perennial tussock grasses including *Austrostipa* species and *Aristida vagans.* Asteraceae species *Cymbonotus lawsonianus* and *Calotis cuneifolia* and Fabaceae species *Glycine clandestina* were interspersed between perennial tussock grasses. Survey was undertaken outside of typical flowering time for many Liliales and Asparagales species, which typically flower in spring; however, they are likely to be present.

NSW BC Act Final Determination	PCT 434 regenerating woodland (VZ1)	PCT 472 remnant shrubby woodland (VZ2)	PCT 1610 remnant woodland (VZ7)
	in spring; however, they are likely to be present.		
Part 4.3 A number of understorey species are typically found throughout almost the entire range of the community (with the exception of the extreme north of its distribution and areas where they have been excluded by grazing). These include: "the dominant tussock grasses *Themeda triandra* and *Poa sieberiana* and a range of other forbs and grasses such as *Chrysocephalum apiculatum, Hypericum gramineum, Geranium solanderi, Glycine clandestina, Dianella revoluta, D. longifolia, Asperula conferta, Leptorhynchos squamatus, Goodenia pinnatifida, Pimelea curviflora, Stackhousia monogyna, Cheilanthes sieberi, Austrostipa scabra, Bulbine bulbosa*, *Lomandra filiformis* and *Oxalis perennans* occupying the inter-tussock spaces"[1]	In addition to those listed above, *Asperula conferta, Geranium solanderi, Oxalis perennans, Lomandra filiformis* and *Cheilanthes sieberi* were also recorded throughout this VZ.	In addition to those species listed above *Hypericum gramineum* was also recorded.	In addition to those species listed above, *Geranium solanderi* var. *solanderi*, *Dianella revoluta* var. *revoluta, Asperula conferta* and *Cheilanthes sieberi* subsp. *sieberi* were also recorded.
Part 4.4 In the western parts of its range, generally the western slopes below 700 m ASL, is typically dominated by *Eucalyptus albens*, although *Eucalyptus melliodora* and *Eucalyptus blakelyi* may be co-dominant or dominant in localised areas such as along non-permanent water courses and in deeper soils associated with valley floors[2]			
Part 4.5 Characteristically dominated by one or more of the species *Eucalyptus albens*, *Eucalyptus. melliodora* and *Eucalyptus blakelyi*.	*Eucalyptus albens* was the dominant canopy species.	*Eucalyptus blakelyi* was the dominant canopy species.	*Eucalyptus albens* was the dominant canopy species.
Part 4.6 Upper Hunter and Goulburn River Valleys typically dominated by *Eucalyptus 'albemol'* (a presumed intergrade between *Eucalyptus albens* and *Eucalyptus moluccana*), although *Eucalyptus melliodora* and *Eucalyptus blakelyi* may be co-dominant or dominant in localised areas along non-permanent creeks			
Part 4.2 Understorey shrubs are typically sparse or absent Part 4.4 Shrub and sub-shrub species such as *Bursaria spinosa* (Blackthorn), *Cassinia sifton* (Sifton Bush), *Eremophila debilis* (Winter Apple), *Notelaea microcarpa* (Native Olive), *Pimelea curviflora* (Curved Rice Flower) and *Templetonia stenophylla*	Shrub cover was variable across this VZ, typically less than 8% cover. Shrub cover was comprised of *Acrotriche rigida, Leucopogon juniperinus* and *Persoonia linearis.*	Shrub cover was variable, but on average was 17% and was dominated by *Melaleuca thymifolia.*	Shrub cover was variable, but on average was 7% and was dominated by *Acrotriche rigida* and *Persoonia linearis.*

NSW BC Act Final Determination	PCT 434 regenerating woodland (VZ1)	PCT 472 remnant shrubby woodland (VZ2)	PCT 1610 remnant woodland (VZ7)
(Leafy Templetonia) may be observed in the western parts of the range although generally with low cover and abundance			
Part 4.6 May occur in the upper Hunter and Goulburn River Valleys where the Great Dividing Range is low, and the climate is suitable for the incursion of species from the west of the divide. Part 4.9 Known to occur on hilly to undulating landscapes in areas with soils of moderate fertility derived from a range of lithologies, including alkaline and acid volcanics, granites, sediments, serpentinites and metamorphic. Part 4.9. The topography on which the community occurs ranges from flat in the west of its range to hilly and undulating in the east	Occurs on clay loam soils on undulating topography derived from basalt. The study area is in the Upper Goulburn Valleys and Escarpment NSW Landscape.	Occurs on sandy clay soils in a broad drainage line derived from sedimentary rock. The study area is in the Upper Goulburn Valleys and Escarpment NSW Landscape.	Occurs on low fertility shallow/skeletal silty loam soils on steep hillslopes comprised of shale. The study area is in the Upper Goulburn Valleys and Escarpment NSW Landscape.

1 Prober SM, Gosper CR, Gilfedder L, Harwood TD, Thiele KR, Williams KJ, Yates CJ 2017. *Temperate Eucalypt Woodlands. In 'Australian Vegetation*', 3rd edn. (Ed. DA Keith) pp. 410–37. (Cambridge University Press: Cambridge)

2 Prober 1996. *Conservation of the grassy white box woodlands: rangewide floristic variation and implications for reserve design*. Australian Journal of Botany 44, 57–77

E2 EPBC Act listed CEEC White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland assessment

Criteria	VZ1 (PCT 434 regenerating woodland)	VZ2 (PCT 472 remnant shrubby woodland)	VZ7 (PCT 1610 remnant open forest)
1. Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum? 2. Does the patch have a predominately[1] native understorey? 3. Is the patch 0.1 ha or greater? 4. There are 12 or more native understorey species present (excluding grasses). There must be at least one 'important species'[2] a. If, not, is the patch 2 ha or greater in size? b. And, does the patch have an average of 20 or more mature trees per hectare, or is there natural regeneration of the dominant overstorey eucalypts?	1. The most common overstorey species throughout VZ1 is *Eucalyptus albens.* 2. The patch has a predominately native understorey and is dominated by native perennial grass species *Bothriochloa macra* and *Microlaena stipoides* var. *stipoides.* 3. The patch is 6.7 ha in size. 4. There are 40 native non-grass species present in the understorey (excluding shrubs). There are ten (10) important species present within the patch.	1. The most common overstorey species throughout VZ2 is *Eucalyptus blakelyi.* 2. The patch has a predominately native understorey. The ground layer is dominated by herb species *Hydrocotyle laxiflora* and *Myriophyllum* sp. Perennial tussock grass cover was low (<5%). 3. The patch is at least 4.3 ha in size. 4. There are 15 native non-grass species present in the understorey (excluding shrubs). There are six (6) important species present within the patch.	1. The most common overstorey species throughout VZ7 is *Eucalyptus albens.* 2. The patch has a predominately native understorey. The ground layer is dominated by perennial tussock grasses *Aristida ramosa* and *Austrostipa* species however cover was relatively low (10%). 3. The patch is at least 0.8 ha in size. 4. There are 33 native non-grass species present in the understorey (excluding shrubs). There are seven (7) important species present within the patch.
'A remnant with a significant ground layer of tussock grasses, and where the distribution of shrubs is scattered or patchy, is part of the ecological community. In shrubby woodlands, the dominance of native tussock grasses in the ground layer of vegetation is lost. Therefore, a remnant with a continuous shrub layer, in which the shrub cover is greater than 30%, is considered to be a shrubby woodland and so is not part of the listed ecological community.' [4, 5]	Shrub cover was assessed within a 20 x 20 m plot (0.04 ha) and ranged from 1.1% to 7.9%, with shrub cover for RDPs consistent with plot data.	Shrub cover was assessed within a 20 x 20 m plot (0.04 ha) and ranged from 8.1% to 25.4%; however, shrub cover values for RDPs located throughout this VZ ranged from 25% to 35%. Review of VZ photos indicates that the shrub layer is relatively continuous throughout the VZ and does not support a dominance of tussock grasses.	Shrub cover was assessed within a 20 x 20 m plot (0.04 ha) and was 7% and shrub cover values for RDPs located throughout this VZ ranged from 5% to 10%. Low shrub cover may also be attributable to the steep slope present within the VZ which was generally greater than 30%.
'Tree cover is generally discontinuous and consists of widely spaced trees of medium	Tree cover is discontinuous and consists of widely spaced trees of medium height in which the canopies are clearly separated.	Tree cover is variable and in some instances the canopies are touching.	Tree cover is variable throughout VZ7; however, canopies are generally touching.

Criteria	VZ1 (PCT 434 regenerating woodland)	VZ2 (PCT 472 remnant shrubby woodland)	VZ7 (PCT 1610 remnant open forest)
height in which the canopies are clearly separated'[4]			Tree cover variability is likely a result of steep slopes.
'This ecological community occurs in areas where rainfall is between 400 and 1200 mm per annum, on moderate to highly fertile soils at altitudes of 170 metres to 1200 metres' [4]	Soil is a fertile clay loam derived from basalt.	Soil is a relatively infertile sandy clay derived from sedimentary rock.	Soil is a relatively infertile silty loam derived from shale.
Outcome	**VZ1 is the EPBC Act listed CEEC *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland.***	**VZ2 is not the EPBC Act listed CEEC *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland* due to a lack of perennial tussock grass dominance as a result of high shrub cover.**	**VZ7 is not the EPBC Act listed CEEC *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland* due to a lack of moderate to highly fertile soils.**

[1] A predominately native ground layer is one where at least 50% of the perennial vegetation cover in the ground layer is made up of native species.

[2] Department of Agriculture, Water and the Environment (2006). *Species list for the EPBC Act policy statement – White Box – Yellow Box – Blakely's Red Gum grassy woodlands and derived native grasslands*.

[3] Threatened Species Scientific Committee (2006). Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

[4] Department of the Environment and Energy (DEE) 2006. EPBC Act Policy Statement White Box – Yellow Box – Blakely's Red Gum grassy woodlands and derived native grasslands.

[5] Remnant attributes, such as shrubbiness, should be measured on a scale of 0.1 hectares or greater

E3 BC Act listed TEC Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion assessment

NSW BC Act Final Determination[1]	PCT 1176 moderate (VZ5) and low (VZ6)
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion is the name given to the ecological community that generally occurs at the interface of Narrabeen Sandstone and Permian sediments in the Hunter Valley and is characterised by the assemblage of species as listed below . The community typically forms a low to mid-high woodland. All sites are within the Sydney Basin Bioregion.	The occurrence of VZ5 and VZ6 broadly corresponds to the geological interface between Permian sediments and Narrabeen Sandstone. The study area is located in the Hunter River catchment.
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion is characterised by the following assemblage of species: *Acacia cultriformis , Acacia decora, Acacia salicina, Allocasuarina luehmannii, Aristida ramosa, Brachychiton populneus* subsp. *populneus, Brunoniella australis, Bursaria spinosa* subsp. *spinosa, Callitris endlicheri , Canthium odoratum, Cheilanthes sieberi* subsp. *sieberi, Cymbopogon refractus, Desmodium brachypodum, Dichondra repens, Dodonaea viscosa* subsp. *cuneata, Eremophila debilis, Eucalyptus crebra, Eucalyptus dawsonii, Eucalyptus moluccana, Eucalyptus punctata, Fimbristylis dichotoma, Geijera salicifolia* var. *salicifolia, Glycine latifolia, Lomandra multiflora subsp. multiflora, Myoporum montanum, Notelaea microcarpa* var. *microcarpa, Olearia elliptica, Sida corrugata, Solanum brownii*	**PCT 1176 moderate (VZ5):** The species assemblage recorded was consistent with the species listed in Part 1.1 of the Determination, and included: *Aristida ramosa, Bursaria spinosa* subsp. *spinosa, Dichondra repens, Dodonaea viscosa* subsp. *cuneata, Eucalyptus crebra, Eucalyptus dawsonii, Eucalyptus punctata*, *Lomandra multiflora* subsp. *multiflora* and *Callitris endlicheri* in accordance with Part 1.2. **PCT 1176 low (VZ6):** The species assemblage recorded was consistent with the species listed in Part 1.1 of the Determination, and included: *Aristida ramosa, Dodonaea viscosa* subsp. *cuneata, Eucalyptus dawsonii and Lomandra multiflora* subsp. *multiflora.*
Hunter Valley Footslopes Slaty Gum Woodland typically forms a woodland, or occasionally forest, comprising a sparse to moderately dense tree stratum, occasional low tree stratum, and moderately dense to dense shrub stratum. The tree canopy is typically dominated by *Eucalyptus dawsonii* (Slaty Gum) and/or *Eucalyptus moluccana* (Grey Box). *Acacia salicina* (Cooba) and *Allocasuarina luehmannii* (Bulloke) may form a low tree stratum or may be part of the upper-most canopy. Other trees which may be present include *Brachychiton populneus* subsp. *populneus* (Kurrajong), *Callitris endlicheri* (Black Cypress Pine), *Eucalyptus crebra* (Narrow-Leaved Ironbark) and *Eucalyptus punctata* (Grey Gum). The shrub layer may include *Olearia elliptica* (Sticky Daisy Bush), *Acacia cultriformis* (Knife-leaved Wattle), *Canthium odoratum* (Shiny-leaved Canthium), *Notelaea microcarpa* var. *microcarpa* (Native Olive), *Dodonaea viscosa* subsp. *cuneata* (Wedge-leaf Hopbush), *Acacia decora* (Western Golden Wattle), *Bursaria*	

[1] NSW Threatened Species Scientific Committee 2010. *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion - vulnerable ecological community listing*.

NSW BC Act Final Determination[1]	PCT 1176 moderate (VZ5) and low (VZ6)
spinosa subsp. *spinosa* (Native Blackthorn), *Myoporum montanum* (Water Bush) and *Solanum brownii* (Violet Nightshade). The groundcover is typically sparse to very sparse and is relatively species poor. It may include *Dichondra repens* (Kidney Weed), *Lomandra multiflora* subsp. *multiflora* (Many-Flowered Mat-rush), *Aristida ramosa* (Wire Grass), *Brunoniella australis* (Blue Trumpet), *Cymbopogon refractus* (Barbed Wire Grass), *Desmodium brachypodum* (Large Tick-trefoil), *Eremophila debilis* (Winter Apple), *Fimbristylis dichotoma* (Common Fringe-rush) and *Sida corrugata* (Corrugated Sida) [2].	
Hunter Valley Footslopes Slaty Gum Woodland typically occurs in colluvial soils on exposed footslopes associated with the interface of Triassic Narrabeen sandstone and Permian sediments.	VZ5 and VZ6 occurs on the Permian period Sydney Basin Illawarra Coal Measures associated with the interface of the Triassic Narrabeen sandstone.
Hunter Valley Footslopes Slaty Gum Woodland has been recorded from the local government areas of Singleton and Muswellbrook but may occur elsewhere within the Sydney Basin Bioregion[3].	The study area is located within the Sydney Basin IBRA Region.
Outcome	**VZ5 and VZ6 within the study area conforms to the NSW TSSC Final Determination for the VEC *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion.***

[2] Peake TC (2006) *The Vegetation of the Central Hunter Valley, New South Wales. A report on the findings of the Hunter Remnant Vegetation Projec*t. Hunter- Central Rivers Catchment Authority, Paterson.

[3] Thackway R, Creswell ID (1995) *'An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserve System Cooperative Program*'. Version 4.0. ANCA, Canberra.

E4 EPBC Act listed CEEC Central Hunter Valley eucalypt forest and woodland assessment

Commonwealth listing criteria	Assessment
In accordance with the EPBC Act *Approved Conservation Advice (including listing advice) for the Central Hunter Valley eucalypt forest and woodland ecological community*[1]*:* 5. It occurs in the Hunter River catchment (typically called the Hunter Valley region); **AND** 6. It typically occurs on lower hillslopes and low ridges, or valley floors in undulating country; on soils derived from Permian sedimentary rocks; **AND** 7. It does not occur on alluvial flats, river terraces, aeolian sands, Triassic sediments, or escarpments; **AND** 8. It is woodland or forest, with a projected canopy cover of trees of 10% or more; or with a native tree density of at least 10 native tree stems per 0.5 ha (at least 20 native tree stems/ha) that are at least one metre in height; **AND** 9. The canopy of the ecological community is dominated by one or more of the following four Eucalypt species: *Eucalyptus crebra*, *Corymbia maculata* (Spotted Gum), *E. dawsonii* and *E. moluccana*; OR a fifth species, *Allocasuarina luehmannii* (Bull Oak) dominates in combination with one or more of the above four Eucalypt species, in sites previously dominated by one or more of the above four Eucalypt species; **AND** 10. *Allocasuarina torulosa* (Forest Oak/ She-oak, Rose She-oak/Oak), *Eucalyptus acmenoides* (White Mahogany) and *E. fibrosa* (Red/Broad-leaved Ironbark) are largely absent from the canopy of a patch; **AND** 11. A ground layer is present (although it may vary in development and composition), as a sparse to thick layer of native grasses and other native herbs and/or native shrubs.	1. Within the study area, the occurrence of PCT 1176 (VZ5 and VZ6) occurs on Permian sediment derived clay soil and broadly corresponds to the geological interface between Permian Sediments and Narrabeen Sandstone. 2. PCT 1176 (VZ5 and VZ6) within the study area occurs on lower hillslopes and low ridges, or valley floors in undulating country. 3. It does not occur on occur on alluvial flats, river terraces, aeolian sands, Triassic sediments, or escarpments. 4. PCT 1176 (VZ5 and VZ6) is a woodland / open forest structure, with a projected canopy cover of trees >10% (25% for VZ5 and 11.1% for VZ6). 5. The canopy of PCT 1176 (VZ5 and VZ6) within the study area is dominated by *Eucalyptus dawsonii.* 6. *Allocasuarina torulosa, Eucalyptus acmenoides* are absent from the patch. *Eucalyptus fibrosa* was recorded at only one (1) out of three (3) VI plots throughout VZ5 and VZ6. Where *Eucalyptus fibrosa* was recorded, it was not the dominant canopy species (i.e., three (3) individuals within VZ6) and is therefore, largely absent from the patch. 7. A ground layer is present (although it may vary in development and composition), as a sparse to thick layer of native grasses and other native herbs and/or native shrubs.
In accordance with the *Central Hunter Valley eucalypt forest and woodland: a nationally protected ecological community:* Is the patch at least 0.5 ha in size? 1. **And** is at least 50% of the perennial understorey vegetative cover of the patch (due to) native plants? 2. Are there at least 12 native understorey species in the whole patch? a. If not, is the patch at least 2 ha in size? b. If not, is the patch continuous with, or near (less than 100m) another area of native woody vegetation that is at least 1 ha in size? c. If not, does the patch have at least on, large, locally indigenous tree (at least 60 cm in diameter at breast height), or at least one tree with hollows?	*1.* VZ5 and VZ6 are greater than 0.5 ha in size (3.4 ha). *2.* VZ5 and VZ6 exhibited a predominately native perennial understorey dominated by *Aristida ramosa, Aristida vagans, Austrostipa scabra, Austrostipa verticillata* and *Microlaena stipoides* var. *stipoides.* VZ5 recorded 14 native understorey species and VZ6 recorded 31 native understorey species.
Outcome	**Outcome: All patches of PCT 1176 which encompasses VZ5 and VZ6 meet the listing criteria for the EPBC Act listed CEEC *Central Hunter Valley eucalypt forest and woodland.***

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Annex 2. Threatened Bat Fauna Surveys

Moolarben Coal Complex UG2 Modification – Threatened Bat Fauna Surveys

Prepared by AMBS Ecology & Heritage
for Moolarben Coal Operations Pty Ltd

Final Report

November 2021

AMBS Reference: 20867

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Recipient:	Trent Cini
Authors:	Mark Semeniuk, Narawan Williams, Corey O'Brien (mapping)

Executive Summary

The Moolarben Coal Complex is located approximately 40 kilometres (km) north of Mudgee, New South Wales (NSW) (Figure 1.1). Moolarben Coal Operations Pty Ltd (MCO) is the operator of the Moolarben Coal Complex on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Yancoal Moolarben [YM] Pty Ltd and a consortium of Korean power companies). MCO, MCM and YM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

AMBS Ecology & Heritage Pty Ltd (AMBS) was commissioned by MCO to undertake fauna surveys in an area potentially subject to an extension (hereafter referred to as 'the Modification') of the currently approved UG2 mine domain. This Threatened Bat Fauna Survey Report provides supporting information to the Biodiversity Development Assessment Report (BDAR) that has been prepared to accompany the development application for the Modification.

The scope of this study involved the survey and documentation of threatened bats and habitat within the Study Area, in accordance with the *Biodiversity Assessment Method* (BAM) as required under the *Biodiversity Conservation Act 2016* (New South Wales) (BC Act).

The field surveys included completing targeted searches for "species credit" bat species in accordance with the BAM during the required survey season. Specifically, this involved deploying harp traps and Anabats in accordance with the survey effort outlined in the '*Species Credit' Threatened Bats and Their Habitats Survey Guide* (Office of Environment and Heritage [OEH] 2018a), and undertaking daytime surveys of potential roosting habitat.

Three of the bat species recorded are listed as threatened on the schedules of the BC Act, and two of these are also listed as threatened on the schedules of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- Large-eared Pied Bat (*Chalinolobus dwyeri*) (BC Act – Vulnerable, EPBC Act – Vulnerable);
- Eastern Cave Bat (*Vespadelus troughtoni*) (BC Act – Vulnerable); and
- Corben's Long-eared Bat (*Nyctophilus corbeni*) (BC Act – Vulnerable, EPBC Act – Vulnerable).

Acoustic calls of two other threatened bats were probably recorded:

- Large Bent-winged Bat (*Miniopterus orianae oceanensis*) (probable) (BC Act – Vulnerable); and
- Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*) (probable) (BC Act – Vulnerable).

Two of the recorded threatened species are classified as species credit species (Large-eared Pied Bat and Eastern Cave Bat), and one which was probably recorded is classified as a dual credit species (Large Bent-winged Bat). These three bats are predominantly cave-dwelling bats, whereas the Corben's Long-eared Bat and Yellow-bellied Sheath-tailed Bat predominantly roost in tree hollows.

The Large Bent-winged Bat is a dual Species/Ecosystem credit species, with breeding habitat assessed for species credits and foraging habitat assessed for ecosystem credits. Only four probable Anabat recordings were attributed to the species, no individuals were captured in harp traps, and there are a small number of BioNet records (Department of Planning, Industry and Environment [DPIE] 2021a) for the species within 20 km of the Study Area. No caves or crevices that would likely be suitable for a maternity/breeding roost were observed in the Study Area. If a breeding structure did occur within the Study Area, it is likely the surveys would have resulted in a greater number of Anabat recordings, and resultant captures of individual bats within harp traps.

On the basis of the above, it is considered unlikely that a Large Bent-winged Bat breeding structure occurs in the Study Area. For this reason, the Large Bent-winged Bat is not considered a Species credit species within the Study Area, due to its dual listing, it will still be consisted an Ecosystem credit species.

The Large-eared Pied Bat and Eastern Cave Bat were regularly recorded on Anabat detectors, captured in harp traps, and one Large-eared Pied Bat was found during a daytime habitat search in a crevice within an overhang. One juvenile for each species was recorded, indicating breeding habitat for both species occurs within the Study Area, while foraging habitat occurs within a 2 km radius according to the '*Species Credit' Threatened Bats and Their Habitats Survey Guide* (OEH 2018a). Breeding habitat for the Large-eared Pied Bat and Eastern Cave Bat are listed under the BC Act as *serious and irreversible impacts* (SAII) candidates.

Other species of threatened fauna recorded opportunistically during the surveys included the Brown Treecreeper (*Climacteris picumnus victoriae*), Varied Sittella (*Daphoenositta chrysoptera*), Diamond Firetail (*Stagonopleura guttata*) and Koala (*Phascolarctos cinereus*) (scats). This information has been incorporated into the BDAR.

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1 Introduction

1.1 Background

The Moolarben Coal Complex is located approximately 40 kilometres (km) north of Mudgee, New South Wales (NSW) (Figure 1.1). The Moolarben Coal Complex is operated by Moolarben Coal Operations Pty Ltd (MCO) on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Yancoal Moolarben Pty Ltd [YM] and a consortium of Korean power companies). MCO, MCM and YM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

The Moolarben Coal Complex comprises of four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities) (Figure 1.2). Stage 1 of the Moolarben Coal Complex comprises open cut operations in OC1, OC2 and OC3, underground operations in UG4 and coal processing and transport facilities. Stage 2 of the Moolarben Coal Complex comprises open cut operations in OC4 and underground operations in UG1 and UG2.

The Moolarben Coal Project Stage 2 operates in accordance with Project Approval (08_0135) (as modified). MCO is proposing adjustments to the approved UG2 layout as well as extension of longwalls within existing mining tenements.

Approval for the Modification to Project Approval (08_0135) is being sought under section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). In summary, the Modification would include the following changes to the approved Moolarben Coal Complex:

- optimisation of the approved UG2 layout (including the extension of two approved longwall panels);
- increased UG2 extraction height from 3.0 metres (m) to 3.5 m;
- revised UG2 mining sequence;
- increased UG2 ROM coal production from 9.4 million tonnes (Mt) to 13.9 Mt;
- construction and operation of a remote services infrastructure area (including two UG2 service boreholes) within the approved OC4 disturbance footprint to support UG2 operations;
- development of an additional non-subsiding gate road along the southern boundary of the UG1 mining area to assist with ventilation in UG2; and
- small reduction in the approved OC4 extent to accommodate the optimised UG2 layout.

Figure 1.3 shows the Modification general arrangement, including the southern extensions to the approved UG2 layout. There is no additional native vegetation removal required for the Modification.

This Threatened Bat Fauna Survey Report provides supporting information to the Biodiversity Development Assessment Report (BDAR) that has been prepared to accompany the Modification.

1.2 Scope and Objectives

The scope of work for this study involves collecting data to determine the presence and identity of bat species and their habitats within the Study Area (Figure 1.3), and providing a report containing the results.

Specifically, the scope of works includes:

- threatened bat species survey(s) according to Section 5 of the NSW *Biodiversity Assessment Method* (BAM) (Department of Planning, Industry and Environment [DPIE] 2020) and the '*Species Credit' Threatened Bats and Their Habitats Survey Guide* (Office of Environment and Heritage [OEH] 2018a);
- description of bat habitat features for target threatened bat species;
- mapping polygons showing suitable habitat for threatened bats classified as species credit species; and
- opportunistic documentation of the presence of other native and introduced fauna species.

1.3 Location of the Study Area

The Study Area is shown on Figure 1.3. It occupies an area of approximately 66.5 hectares (ha) and occurs between the approved open cut 2 (OC2) and open cut 4 (OC4) operations of the existing Moolarben Coal Complex.

1.4 Bioregion and Landscape

The Study Area lies within the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) bioregion, and the Kerrabee IBRA subregion (Thackway & Cresswell 1995, Department of Agriculture, Water and the Environment [DAWE] 2021a).

The landscape surrounding the Study Area is a combination of land that has been cleared for agriculture, particularly on the flats, as well as large areas of native vegetation which mostly occur on the slopes, ridges, and nearby reserves (e.g. Munghorn Gap Nature Reserve).

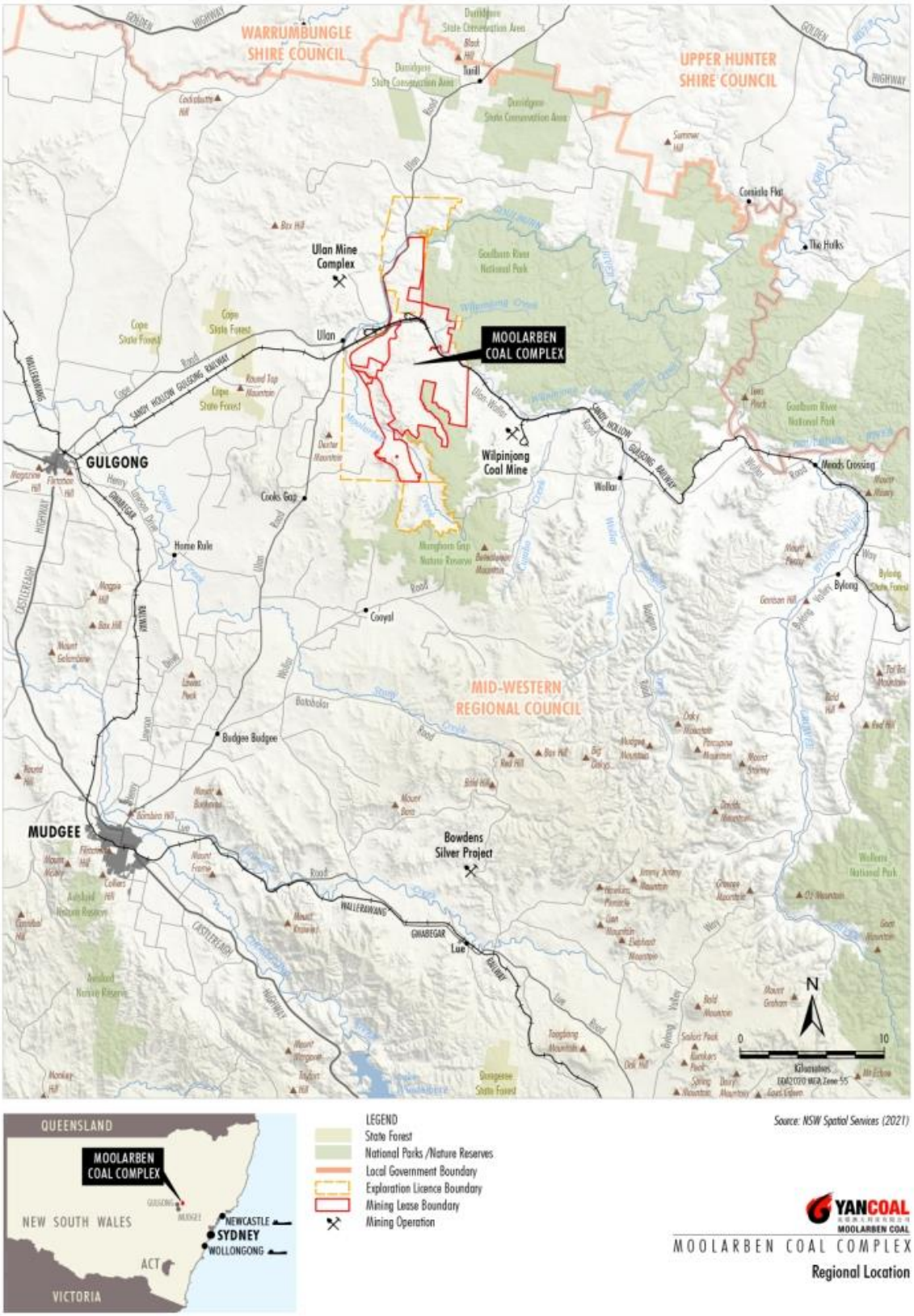

Figure 1.1 Moolarben Coal Complex, New South Wales (NSW)

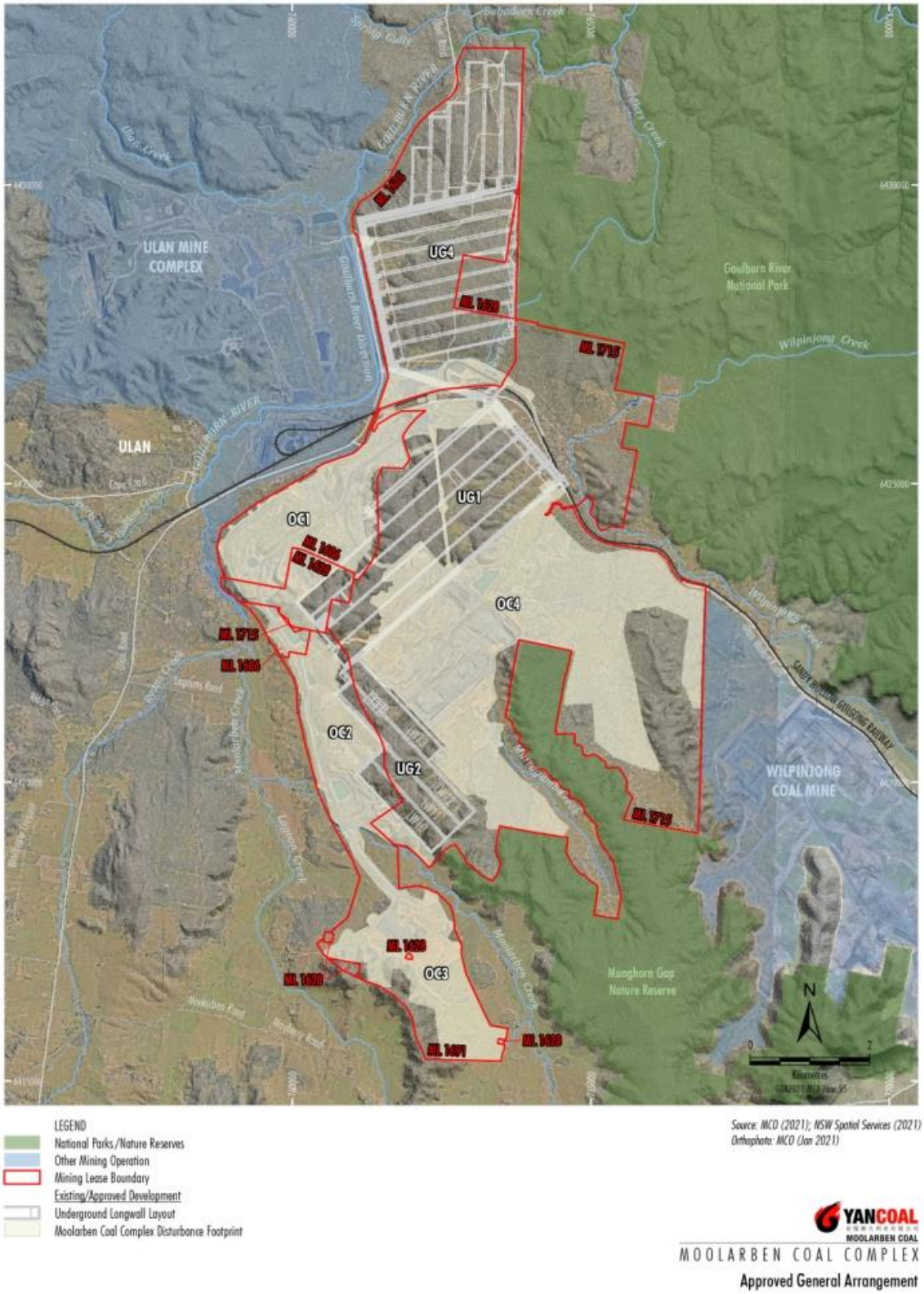

Figure 1.2 Open cut mining and underground mining areas of The Moolarben Coal Complex

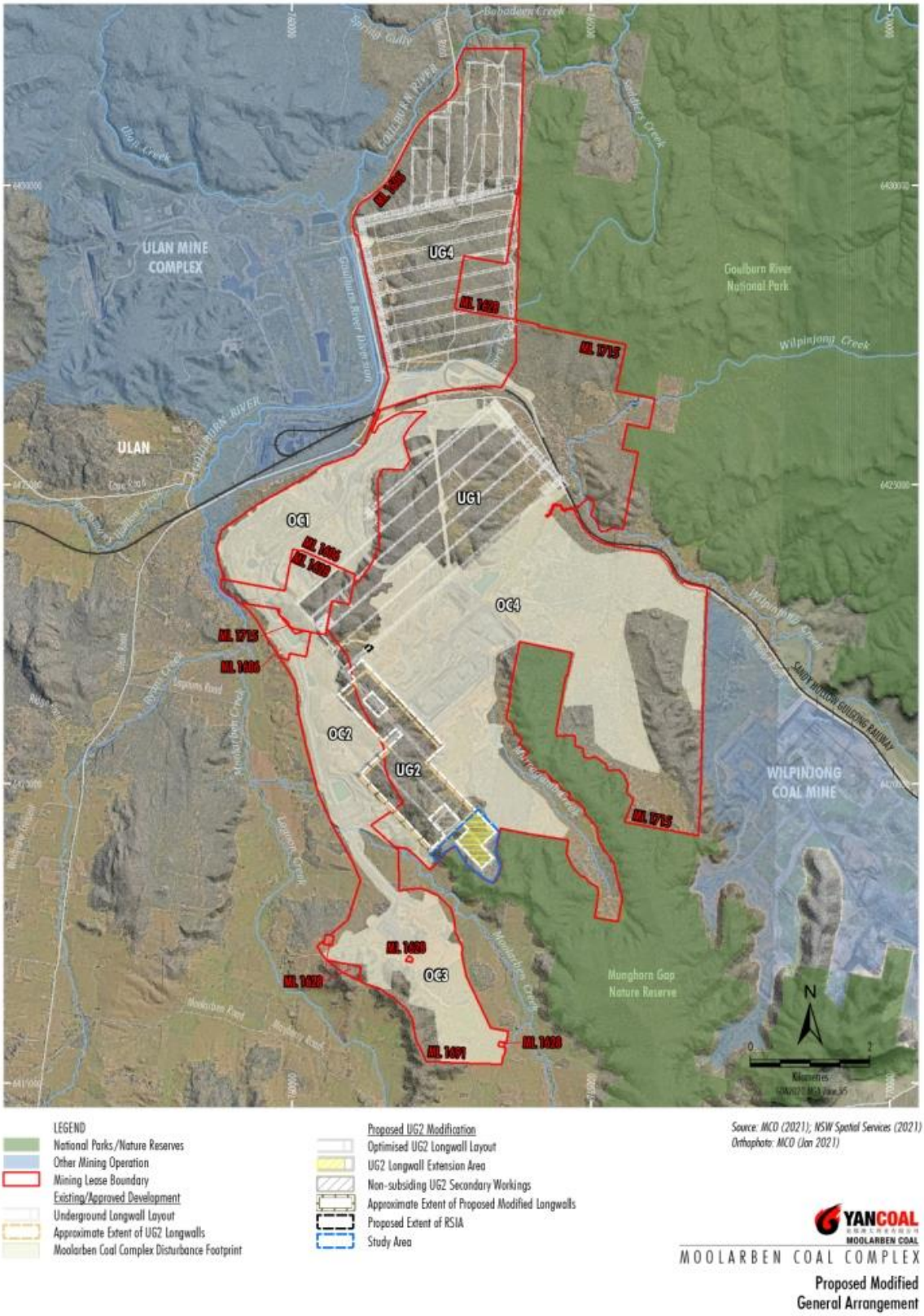

Figure 1.3 The general arrangement of the Modification

1.5 Climate

Weather records were obtained from the nearby Commonwealth Bureau of Meteorology (BoM) weather station at Ulan Water (Station ID 62036), which is located approximately 8 km north-west of the Study Area, and Gulgong Post Office (Station ID 062013) which is located approximately 22 km west of the Study Area. Data displayed in Figure 1.4 below is taken from the Ulan Water Station. Please note data from 2002, 2004, 2005, 2007 and 2014 were incomplete and not included in the graph. Data from 2008 to 2013 was unavailable.

The locality receives an average of about 640.1 millimetres (mm) of rainfall per annum, based on the long-term average between 1906 and 2021 (BoM 2021). Higher rainfall tends to occur in spring and summer, with lower rainfall in winter. Rainfall varies widely from year to year, as shown in Figure 1.4 (complete data from 1953 to 2020), with a lowest recorded total annual rainfall of 325.2 mm (in 2019) and a highest of 1,157.0 mm (in 1973). The three years from 2017-2019 had below average annual rainfall.

Average monthly temperatures range between a minimum of 9.7 degrees Celsius (°C) and a maximum of 23.3°C. The warmest month is usually January (mean monthly maximum 31.3°C, mean minimum 16.9°C) and the coolest is July (mean maximum 14.9°C, mean minimum 2.6°C) (Gulgong Post Office, BoM 2021).

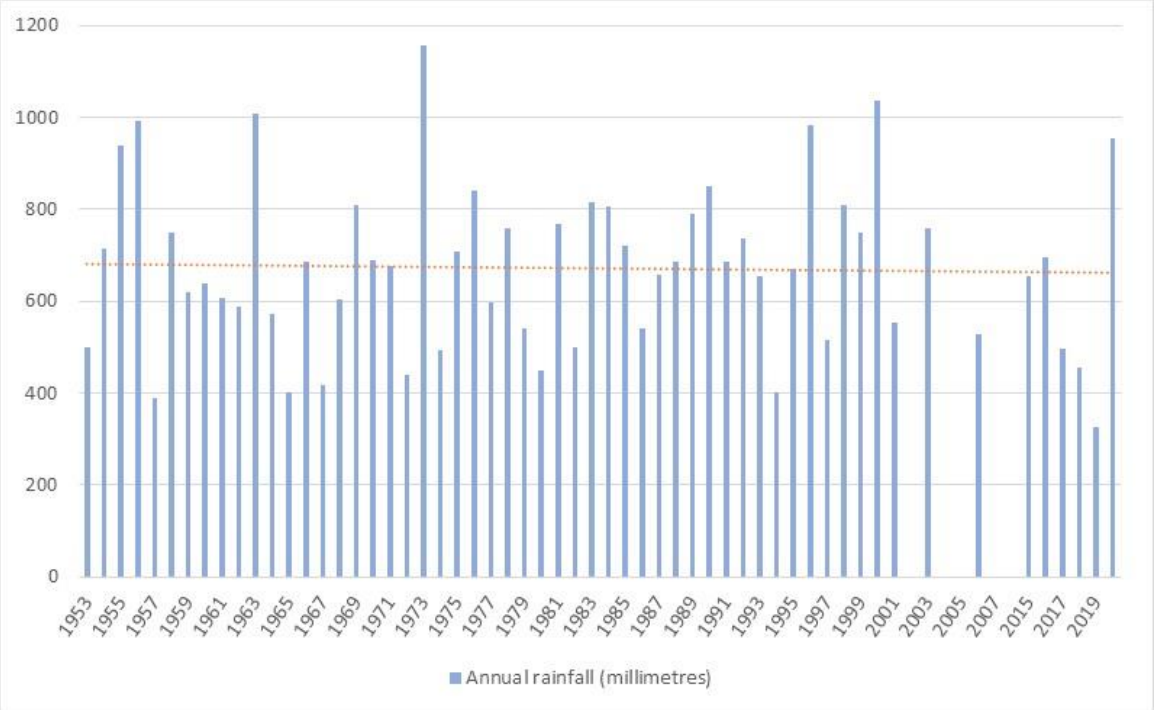

Figure 1.4 Annual average rainfall recorded at Ulan Water (1953-2020) (Source: BoM 2021)

1.6 Topography and Drainage

Natural drainage in the Study Area consists of two first order ephemeral drainage lines, flowing generally to the north. During the survey work, drainage lines in the Study Area were dry. Flow likely occurs only during heavy rainfall events. The drainage lines are distinguished by slight depressions or a minor creek channel, and by a variation in vegetation structure.

1.7 Land Use and Disturbance

The majority of the Study Area is comprised of native forest and woodland. One location in the centre of the Study Area appears to be a former (disused) quarry. Other disturbance in the past is likely to have consisted of logging for timber. Due to the low-nutrient (sandstone-derived) soils and little grass cover, there has probably been minimal use of the Study Area for livestock, with the exception of the small cleared area in the south-west. In general, there are very few to no weeds.

1.8 Plant Community Types and Vegetation Zones

Flora surveys undertaken by Eco Logical Australia (ELA 2021) within the Study Area identified nine plant community types (PCTs):

- PCT 434: White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion;
- PCT 472: Thyme Honey-myrtle - red gum - Mugga Ironbark shrubland / woodland in impeded drainage flats or depressions in the southern Brigalow Belt South Bioregion;
- PCT 478: Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion;
- PCT 479: Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion;
- PCT 1176: Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion;
- PCT 1610: White Box - Black Cypress Pine shrubby woodland of the Western Slopes;
- PCT 1614: Grey Gum - Grey Myrtle - Narrow-leaved Stringybark - Rusty Fig open forest on ranges of the Upper Hunter;
- PCT 1629: Narrow-leaved Stringybark - Grey Gum shrubby open forest on sandstone ranges of the Sydney Basin; and
- PCT 1767: Rough-barked Apple grassy tall woodlands of the Brigalow Belt South.

2 Methods

2.1 Nomenclature

The nomenclature of threatened species follows that used in the *Biodiversity Conservation Act 2016* (NSW) (BC Act) and Commonwealth *Environment Protection & Biodiversity Conservation Act* (EPBC Act) threatened species lists. For non-threatened species the following applies:

- mammal species nomenclature follows *Field Companion to the Mammals of Australia* (Van Dyck *et al.* 2013), with the exception of the free-tail bat genus *Mormopterus*, which follows Reardon *et al.* (2014); and
- bird species nomenclature follows the *BirdLife Australia Working List v2.1* (BirdLife Australia 2017).

2.2 Desktop Review

A desktop study of ecological information and local reports was conducted, which included review of:

- PCT mapping for the Study Area (ELA 2021);
- *Department of Planning, Industry and Environment* (DPIE) *BioNet Atlas* records (DPIE 2021a);
- *EPBC Act Protected Matters Search Tool* (DAWE 2021b); and
- previous records and species profiles for predicted threatened species and Threatened Ecological Communities (TECs) available in the *Threatened Biodiversity Data Collection* (DPIE 2021a) and *Threatened Species Profile Database* (DPIE 2021b) were also reviewed with respect to known and predicted habitat types within the Kerrabee IBRA subregion.

Utilising information from the desktop review, threatened bats known or predicted to occur in the locality are summarised in Table 2.1. The list includes "Species Credit" species or dual-credit "Species/Ecosystem" species, that are required to be surveyed in accordance with the BAM (DPIE 2020). Six other threatened bat species are included in Table 2.1 for completeness. These species are "Ecosystem Credit" species which are not the subject of targeted surveys, and instead will be covered in the main BDAR.

Table 2.1 Threatened bat fauna known or predicted to occur in the locality

Common Name	Scientific Name	Credit Type	Conservation Listing	
			BC Act[1]	EPBC Act[2]
Large-eared Pied Bat	*Chalinolobus dwyeri*	Species	V	V
Eastern Cave Bat	*Vespadelus troughtoni*	Species	V	-
Little Bent-winged Bat	*Miniopterus australis*	Species/Ecosystem	V	-
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	Species/Ecosystem	V	-
Grey-headed Flying Fox	*Pteropus poliocephalus*	Species/Ecosystem	V	V
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	Ecosystem	V	-
Corben's Long-eared Bat	*Nyctophilus corbeni*	Ecosystem	V	V
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	Ecosystem	V	-
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Ecosystem	V	-
Little Pied Bat	*Chalinolobus picatus*	Ecosystem	V	-
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	Ecosystem	V	-

Note:

[1] Conservation status under the BC Act (current as at November 2021). V = Vulnerable.

[2] Conservation status under the EPBC Act (current as at November 2021). V = Vulnerable.

2.3 Field Surveys

2.3.1 Overview

Targeted threatened bat surveys were undertaken for the five "species credit species" known or predicted to occur in the locality. While targeted threatened bat surveys are not required for "ecosystem credit species", the survey techniques and effort carried out have potential to detect these species.

Surveys within the Study Area were undertaken between 15-18 December 2020 to conduct preliminary habitat assessments, site selection, and determine if any Grey-headed Flying-fox camps were likely to be present. Targeted threatened bat surveys were undertaken between 11- 17 January 2021, and 25-31 January 2021, while additional data regarding the potential occurrence of bat habitat was collected on 16 July 2021. Survey timing and duration was designed to target threatened bats that are known or predicted to occur in the Study Area during the timing in the *Threatened Biodiversity Data Collection* (TBDC) (DPIE 2021a). This report includes the methods and results of field surveys for the purposes of informing the BDAR.

The overall survey effort applied was determined by assuming potential habitat for the target threatened bat species occurred throughout the entire Study Area, although targeted survey effort focussed on locations with rocky habitat for cave dwelling bats. The sampling intensity was determined in accordance with the NSW *'Species Credit' Threatened Bats and Their Habitats Survey Guide* (OEH 2018a). Consistent with the guideline, two 50 ha stratification units were applied within the 66.55 ha Study Area. While the majority of the survey effort occurred outside of the proposed underground mine extent, this is considered appropriate because survey locations targeted areas that were most likely to detect potentially occurring threatened bat species. The western sections of the Study Area contain the greatest diversity and complexity of potential microbat roosting habitat, and are closest to the only vehicle access track which leads to the Study Area.

Overall, the survey timing and duration were appropriate on the basis that the surveys were undertaken during the months identified in the TBDC (DPIE 2021a) for each target species, and in accordance with the NSW *'Species Credit' Threatened Bats and Their Habitats Survey Guide* (OEH 2018a).

The survey methods undertaken are described below. Survey locations are shown in Figure 2.1. Site coordinates are documented in Appendix A.

2.3.2 Harp Traps

On 12 and 13 January 2021, eight harp traps were deployed within the Study Area for two nights (16 harp trap-nights). The same survey effort was applied again on 26 and 27 January 2021, providing a total of 32 harp trap-nights for the Study Area (i.e. eight harp traps deployed for four nights). The location of each harp trap was changed each morning after the bats had been collected.

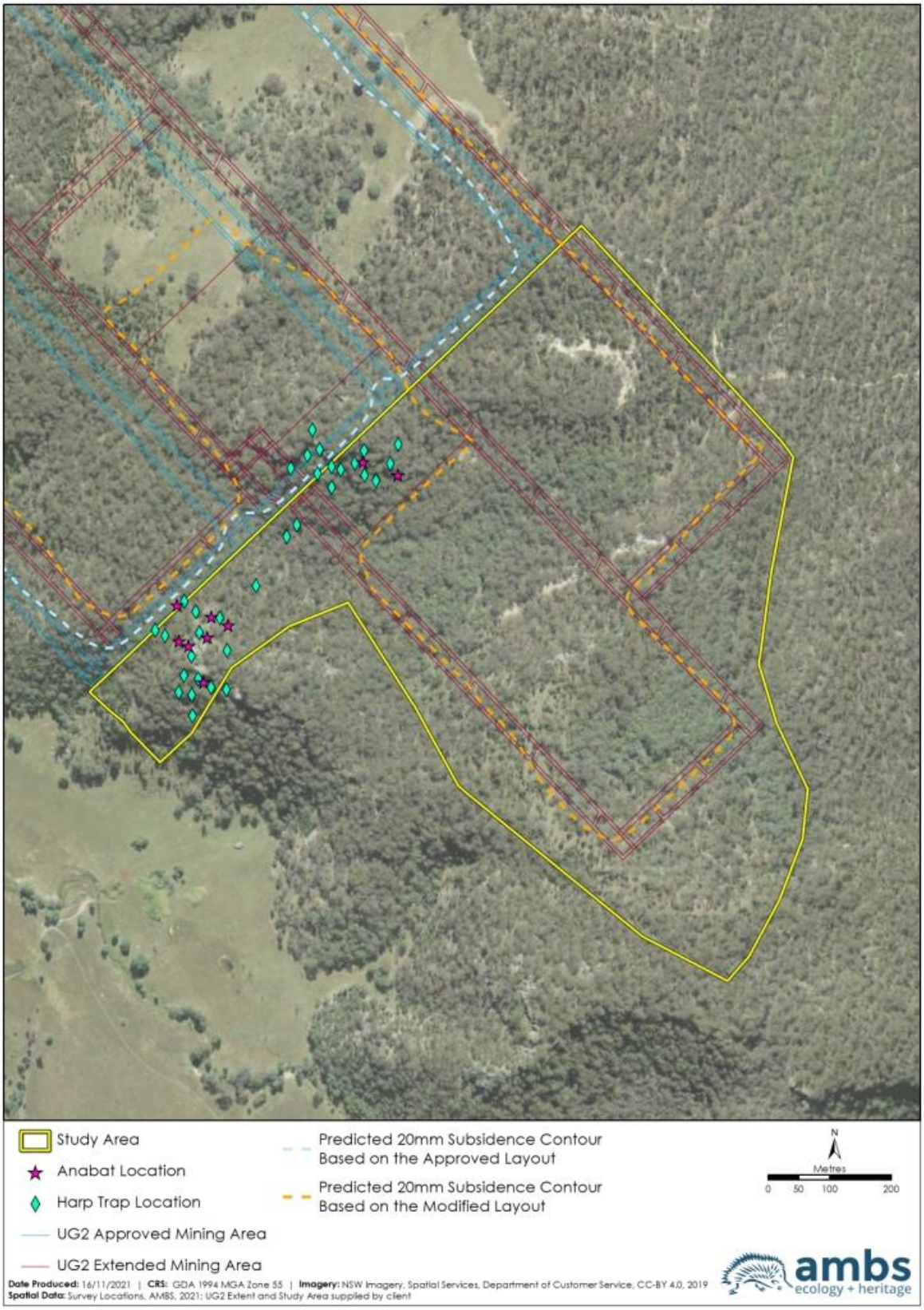

Figure 2.1 Location of targeted survey sites

2.3.3 Anabats

On 12 and 13 January 2021, four detectors were deployed and left in-situ for two nights (eight Anabat-nights), while two detectors were deployed and left in-situ for eleven nights (22 Anabat-nights). On 26 January 2021, one detector was deployed and left in-situ for two nights (two Anabat-nights) and one detector was deployed and left in-situ for four nights (four Anabat-nights; this unit was collected on 30 January 2021). On 28 January 2021, one detector was deployed and left in-situ for two nights (two Anabat-nights). Anabat Express units were set to the automatic "night only" recording mode. Anabat SD Units were programmed to collect data from 19:00 to 06:00. Anabat sequence files were analysed to species level where possible.

2.3.4 Incidental Observations

Incidental observations of non-target fauna were also recorded during 15-18 December 2020, 11-17 January 2021, 25-31 January 2021 and 16 July 2021, where possible.

2.3.5 Habitat Assessment

The study included the collection of data regarding habitat features in the Study Area within the date ranges specified above, to assess their type and condition. Information was collected on:

- rocky outcrops;
- the abundance of potential roosting habitat, including rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles; and
- photos representing the range of potential bat habitats present.

Where possible, habitat features (e.g. caves, overhangs, escarpments, outcrops, crevices, boulder piles) were inspected to determine its potential suitability for roosting bats. The Global Positioning System (GPS) location of the notable habitat features with potential to support roosting bats was recorded when observed.

2.3.6 Species Polygons

Threatened species that are 'ecosystem credit species' and/or 'species credit species' are pre-determined by DPIE in the *Threatened Biodiversity Data Collection* (TBDC) (DPIE 2021a). The BAM (DPIE 2020) section 5.1.1 and 5.1.2 states (emphasis added):

> *Ecosystem credit species are threatened species whose occurrence can generally be predicted by vegetation surrogates and/or landscape features, or that have a low probability of detection using targeted surveys. The TBDC identifies the threatened species assessed for ecosystem credits. A targeted survey is not required to identify or confirm the presence of ecosystem credit species.*
>
> …
>
> *Species credit species are threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence or components of their habitat. These species are identified in the TBDC. A targeted survey or an expert report is required to confirm the presence of these species on the subject land*.

Species polygons were prepared for two threatened bat "Species Credit" species within the Study Area. The BAM (2020) defines a "species polygon" as an area of land identified in Chapter 5 that contains habitat or is occupied by a threatened species. The BAM (2020) also defines "habitat" as an area or areas occupied, or periodically or occasionally occupied, by a species or ecological community, including any biotic or abiotic component.

A variety of information was considered to prepare species polygons for the purpose of quantifying and mapping the species extent (i.e., where the species was present), as well as the potential

habitat (i.e., areas that contain similar habitat which may be utilised by the species despite not being detected in these areas during the current survey). When mapping species polygons for each threatened species, consideration was given to:

- requirements in the BAM (DPIE 2020) and the NSW Survey Guide for *'Species Credit' Threatened Bats and Their Habitat* (OEH 2018a);
- all current and previous records of the species within the Study Area and adjoining habitat;
- the PCTs mapped within the Study Area (ELA 2021);
- PCT associations and habitat constraints for each threatened species, as identified in the *Threatened Biodiversity Data Collection* (DPIE 2021a);
- habitat data collected by AMBS within the Study Area;
- satellite imagery, contour and drainage lines;
- a review of LiDAR to identify any areas within the Study Area that have a slope greater than 63.4 degrees (i.e., the definition of rock face features, minor cliffs, and cliffs in the Stage 2 Project Approval [08_0135]); and
- relevant scientific literature.

A draft species polygon was prepared in February 2021. An additional field survey was undertaken on 16 July 2021 to refine the extent of the mapped habitat to inform the species polygon.

2.3.7 Survey Team

Experience of the survey team personnel and roles for the project, are summarised in Table 2.2.

Table 2.2 Experience of survey team personnel

Name	Company	Qualifications	Experience	Task
Mark Semeniuk	AMBS	Bachelor of Science Master of Applied Science Accredited BAM assessor	15 years' experience with general fauna surveys, including surveys involving harp trapping, Anabat deployment, microbat handling and threatened bat identification.	Survey planning, field surveys and reporting
Narawan Williams	AMBS	Certificate II in Conservation and Land Management	24 years' experience with general fauna surveys, including many which involved habitat searches, harp trapping, Anabat deployment, microbat handling and threatened bat identification.	Survey planning, field surveys, identification of Anabat sequence files
Chris Jackson	AMBS	Bachelor of Science Master of Applied Science	15 years' experience with general fauna surveys, including many which involved habitat searches, harp trapping, Anabat deployment, microbat handling and threatened bat identification.	Survey planning and reporting
David James	AMBS	Bachelor of Science	35 years' experience with general fauna surveys, including many which involved habitat searches, harp trapping, Anabat deployment, microbat handling and threatened bat identification.	Fauna surveys
Henry Cook	AMBS	Bachelor of Science Master of Applied Science	15 years' experience with general fauna surveys, including many which involved habitat searches, harp trapping, Anabat deployment, microbat handling and threatened bat identification.	Fauna surveys
Dion Hobcroft	AMBS	Certificate in Zoology 1998	30+ years' experience with general fauna surveys.	Fauna surveys

2.4 Survey Guidelines and Effort

A reconciliation of survey effort against the NSW Survey Guide for *'Species Credit' Threatened Bats and Their Habitat* (OEH 2018a) is provided in Table 2.3, pertaining to the threatened species that were (prior to the survey) considered to have potential to occur in the Study Area.

A list of threatened bat species required to be surveyed in accordance with the BAM (DPIE 2020) is provided in Table 2.4, including seasonal survey requirements.

Table 2.3 Summary of survey guidelines for threatened bats species potentially found in the Study Area

Species	Method	Suggested Effort	Method Source	Relevant Survey Period (DPIE 2021a)	Applied Effort	Suggested Effort Met
Large Bent-winged Bat, Little Bent-winged Bat Large-eared Pied Bat, Eastern Cave Bat	Harp trapping	Two harp traps for two nights, repeated at least two weeks later. 16 traps over four nights, traps moved each morning.	OEH (2018a)	Summer	Eight harp traps deployed for four nights in January 2021 (32 harp trap nights).	Yes
Large Bent-winged Bat, Little Bent-winged Bat Large-eared Pied Bat, Eastern Cave Bat	Anabats and Song Meters	Two detectors for two nights, repeated at least two weeks later. Four detectors for four nights.	OEH (2018a)	Summer	Four Anabats deployed for two nights, two Anabats deployed for 11 nights in early January 2021, one Anabats deployed for two nights and one Anabat deployed for four nights in late January 2021 (38 Anabat-nights).	Yes

Table 2.4 Threatened bats known or predicted to occur in the locality and associated with PCTs in the Study Area

Common Name	Scientific Name	Biodiversity Credit Class[1]	Nov	Dec	Jan	Feb	Survey Technique
Large-eared Pied Bat	*Chalinolobus dwyeri*	Species	Yes	Yes	Yes	No	HT, AN
Eastern Cave Bat	*Vespadelus troughtoni*	Species	Yes	Yes	Yes	No	HT, AN
Little Bent-winged Bat	*Miniopterus australis*	Species/Ecosystem	No	Yes	Yes	Yes	HT, AN
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	Species/Ecosystem	No	Yes	Yes	Yes	HT, AN
Grey-headed Flying Fox	*Pteropus poliocephalus*	Species/Ecosystem	Yes	Yes	No	No	OPP
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	Ecosystem	n/a	n/a	n/a	n/a	HT, AN
Corben's Long-eared Bat	*Nyctophilus corbeni*	Ecosystem	n/a	n/a	n/a	n/a	HT
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	Ecosystem	n/a	n/a	n/a	n/a	HT, AN
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Ecosystem	n/a	n/a	n/a	n/a	HT, AN
Little Pied Bat	*Chalinolobus picatus*	Ecosystem	n/a	n/a	n/a	n/a	HT, AN
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	Ecosystem	n/a	n/a	n/a	n/a	HT, AN

Note:

[1] Biodiversity credit class under the *Threatened Biodiversity Data Collection* (DPIE 2021a) (current as at November 2021).
Highlighted months are months surveyed by AMBS.
HT = harp trap, AN = Anabat, OPP = opportunistic searches/observation while undertaking other survey techniques.

2.5 Weather Conditions

Rainfall and temperature data were sourced from an MCO weather station (MCO 2021), and are displayed in Table 2.5. Day and night time temperatures during the trapping surveys were generally warm, and little rainfall was observed in the Study Area. The weather conditions were appropriate for detecting the target bat species.

Table 2.5 Weather conditions during the survey period

Date	Temp °C (min)	Temp °C (max)	Rainfall (mm)
15/12/2020	17.6	26.4	0.0
16/12/2020	19.7	27.1	0.6
17/12/2020	17.9	30.2	5.6
11/01/2021	9.4	28.2	0.0
12/01/2021	9.6	30.6	0.0
13/01/2021	11.3	30.0	0.0
14/01/2021	12.8	33.9	0.0
15/01/2021	11.8	30.8	0.0
16/01/2021	6.6	24.7	0.0
17/01/2021	4.5	27.2	0.0
25/01/2021	13.2	34.4	0.0
26/01/2021	14.0	35.1	0.0
27/01/2021	18.2	31.3	0.0
28/01/2021	19.2	25.4	0.0
29/01/2021	18.5	26.1	0.0
30/01/2021	20.0	29.8	1.8
31/01/2021	15.6	30.6	0.2
16/07/2021	3.1	14.1	2.0

3 Results

3.1 Threatened Fauna Species Recorded

Of the five targeted threatened bat species known or predicted to occur in the locality, two were recorded during the surveys and one was probably recorded (Table 3.1). All three species are listed as threatened on the schedules of the BC Act, and one (the Large-eared Pied Bat) is also listed as threatened on the schedules of the EPBC Act (Table 3.1). Two other bat species were recorded (one definite, one probable), as well as four other species of threatened fauna that were recorded opportunistically during the surveys (Table 3.1).

The locations of threatened bats recorded during these surveys are shown on Figure 3.1, while other threatened fauna locations are shown on Figure 3.2. Other species of non-threatened fauna recorded opportunistically during the surveys are listed in Appendix B.

Table 3.1 Threatened fauna recorded in the Study Area

Common Name	Scientific name	Conservation Status		Biodiversity Credit Class[3]	Description
		BC Act[1]	EPBC Act[2]		
TARGETED THREATENED BAT SPECIES					
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	Species	The species was recorded regularly via Anabat detectors, seven individuals were captured in harp traps, and one individual was recorded during a daytime habitat search. One of the captured individuals was a juvenile.
Eastern Cave Bat	*Vespadelus troughtoni*	V	-	Species	The species was recorded regularly via Anabat detectors and two individuals were captured in harp traps. One of the captured individuals was a juvenile.
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V	-	Species/ Ecosystem	Four probable Anabat recordings for the species were identified in the Study Area.
OTHER THREATENED BAT SPECIES					
Corben's Long-eared Bat	*Nyctophilus corbeni*	V	V	Ecosystem	One individual of the species was captured in a harp trap.
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*	V	-	Ecosystem	One probable Anabat recording for the species was identified in the Study Area.
OTHER THREATENED FAUNA					
Brown Treecreeper	*Climacteris picumnus victoriae*	V	-	Ecosystem	Recorded opportunistically on one occasion within the Study Area.
Varied Sittella	*Daphoenositta chrysoptera*	V	-	Ecosystem	Recorded opportunistically on one occasion within the Study Area.
Diamond Firetail	*Stagonopleura guttata*	V	-	Ecosystem	Recorded opportunistically on one occasion, just outside the Study Area.
Koala	*Phascolarctos cinereus*	V	V	Species	Scats were recorded in two general locations, in the north-western section of the Study Area.

Note:

[1] Conservation status under the BC Act (current as at November 2021). E = Endangered, V = Vulnerable.

[2] Conservation status under the EPBC Act (current as at November 2021). V = Vulnerable.

[3] Biodiversity credit class under the *Threatened Biodiversity Data Collection* (DPIE 2021a) (current as at November 2021).

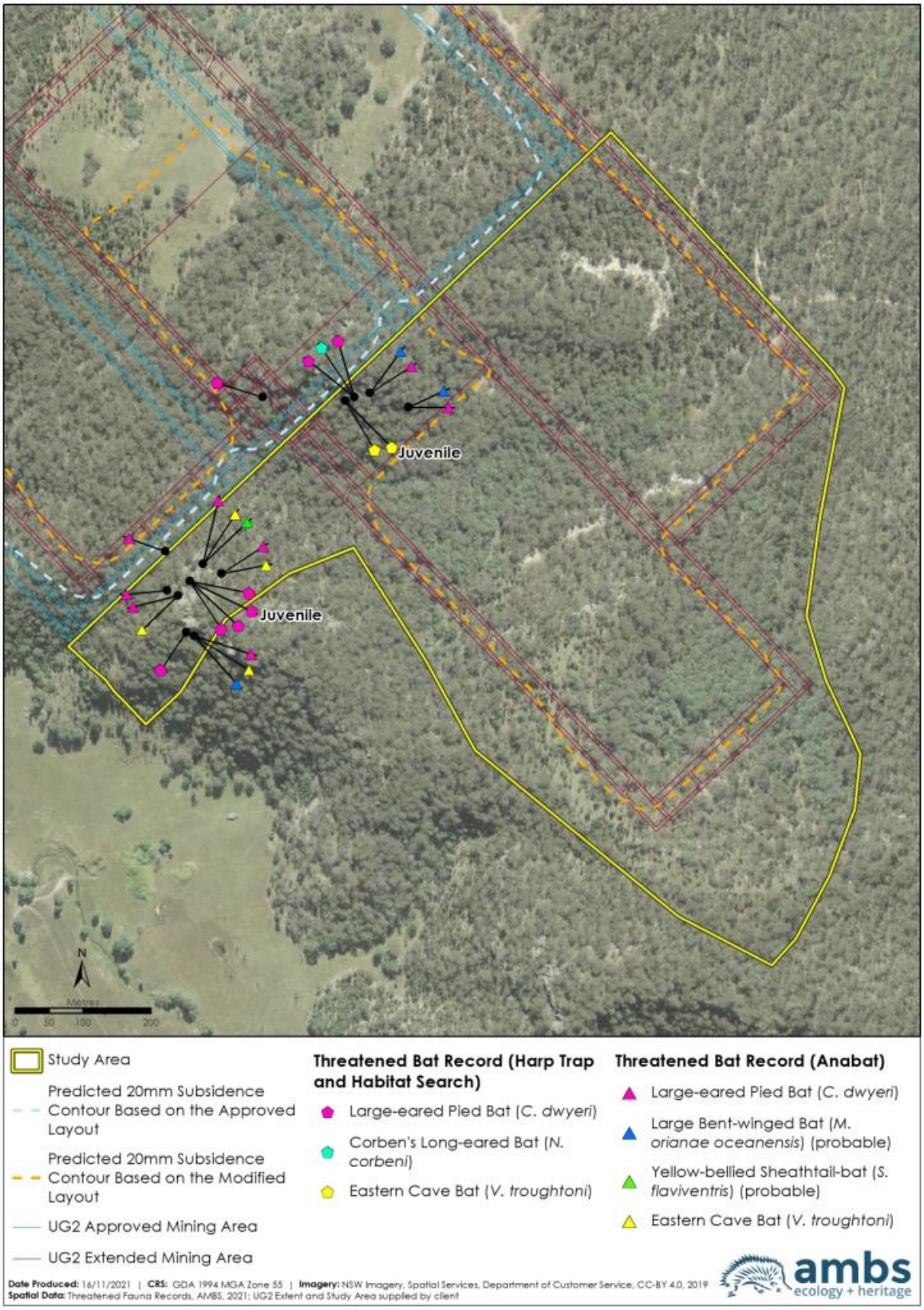

Figure 3.1 Threatened bat records

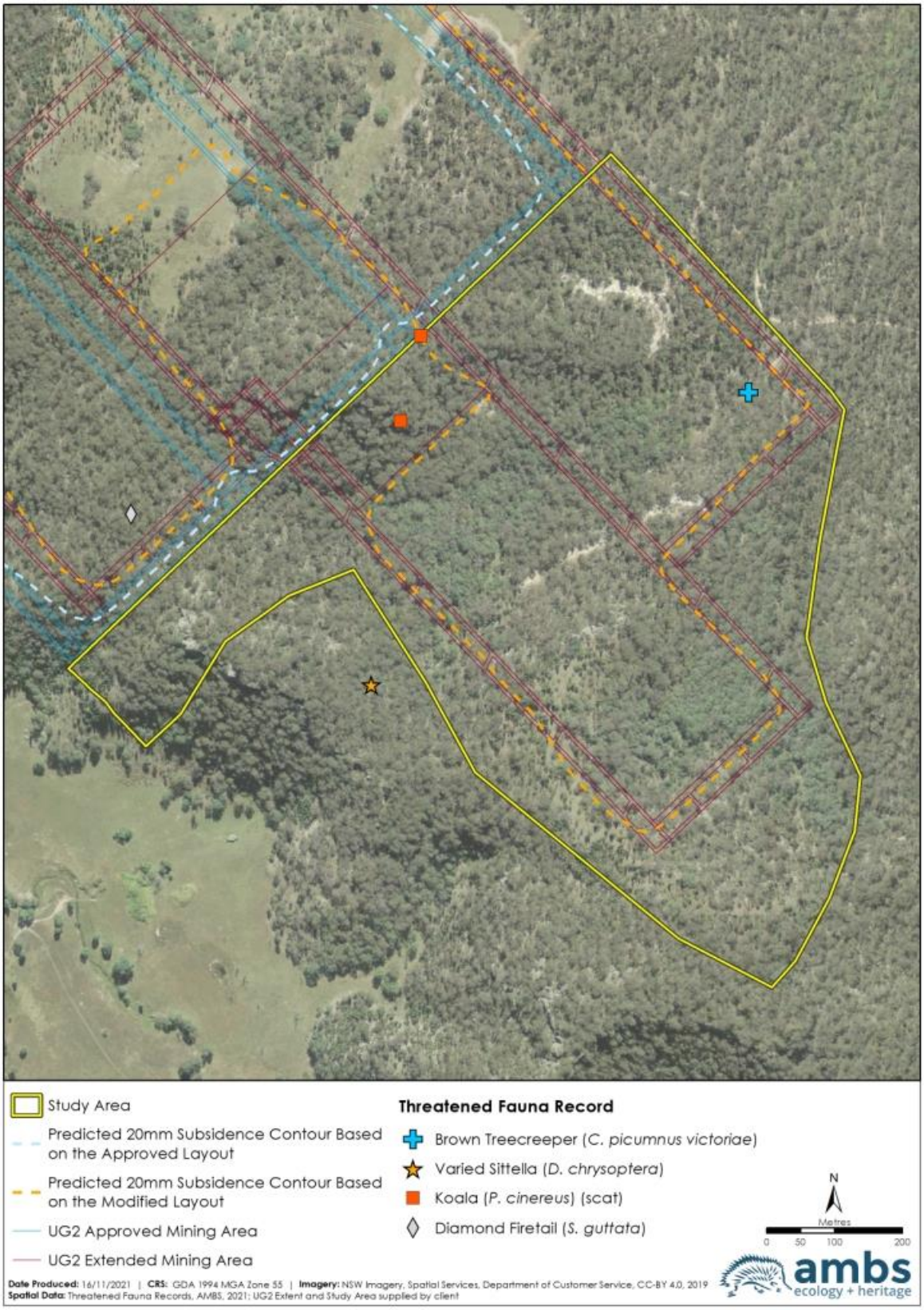

Figure 3.2 Other threatened fauna records

3.2 Threatened Bat Habitat

Habitat for "species credit" bat species in the Study Area included locations with outcropping sandstone and adjacent woodlands and forests. The landforms ranged from small isolated stony hills with limited outcropping rock to larger, steeper sandstone hills and ridgetops with extensive outcropping, caves, crevices, overhangs, cliff faces and boulders.

Six areas contained roosting habitat for "species credit" bat species in the Study Area (Figure 3.3):

- Northern Outcrop;
- Western Outcrop;
- Central-North Outcrop;
- Central-South Outcrop;
- Eastern Outcrop; and
- Eastern (Edge) Outcrop.

Within the Study Area, potential roosting and breeding habitat for the Large-eared Pied Bat and Eastern Cave Bat is extensive and highly variable. The most complex habitat occurs in the Northern and Western Outcrops. In these locations, a variety of habitat features occur including tall sandstone rocks and boulders, small cavities and crevices within rocks, cavities between rocks, low entry caves, small domes, low and high overhangs, and Fairy Martin (*Petrochelidon ariel*) nests (which are known to be used by the Large-eared Pied Bat for roosting). One adult male Large-eared Pied Bat was found during a daytime search at the Northern Outcrop, and microbat scats were observed in the Western, Central-South, and Eastern Outcrops.

Other locations within the Study Area providing roosting and breeding habitat for the Large-eared Pied Bat and Eastern Cave Bat includes the Central-North Outcrop, Central-South Outcrop, Eastern Outcrop and Eastern (Edge) Outcrop. In these locations, a variety of habitat features occur including tall sandstone boulders, overhangs, small cavities and crevices, small domes, low entry caves, and Fairy Martin nests. In comparison to the Northern and Western Outcrops, these locations did not contain the same abundance and variety of habitat features. However, they still provide important roosting and breeding habitat for individuals or small groups, along with providing night roosting habitat for a variety of microbat species. The presence of decaying microbat scats indicates cave roosting species are using this habitat, and this may occur at different times of the year. Further, roosting microbats may not have been recorded in some locations due to the difficulty of viewing the entire inside of all the habitat features, such as Fairy Martin nests.

In summary, any overhangs with Fairy Martin nests, or rock outcrops with small crevices or cavities provide potential habitat for individuals or small groups during the breeding and non-breeding season. Further, Fairy Martins' may build new nests in some overhangs that are currently unoccupied.

A more detailed description of the habitat features recorded at each individual outcrop is provided below.

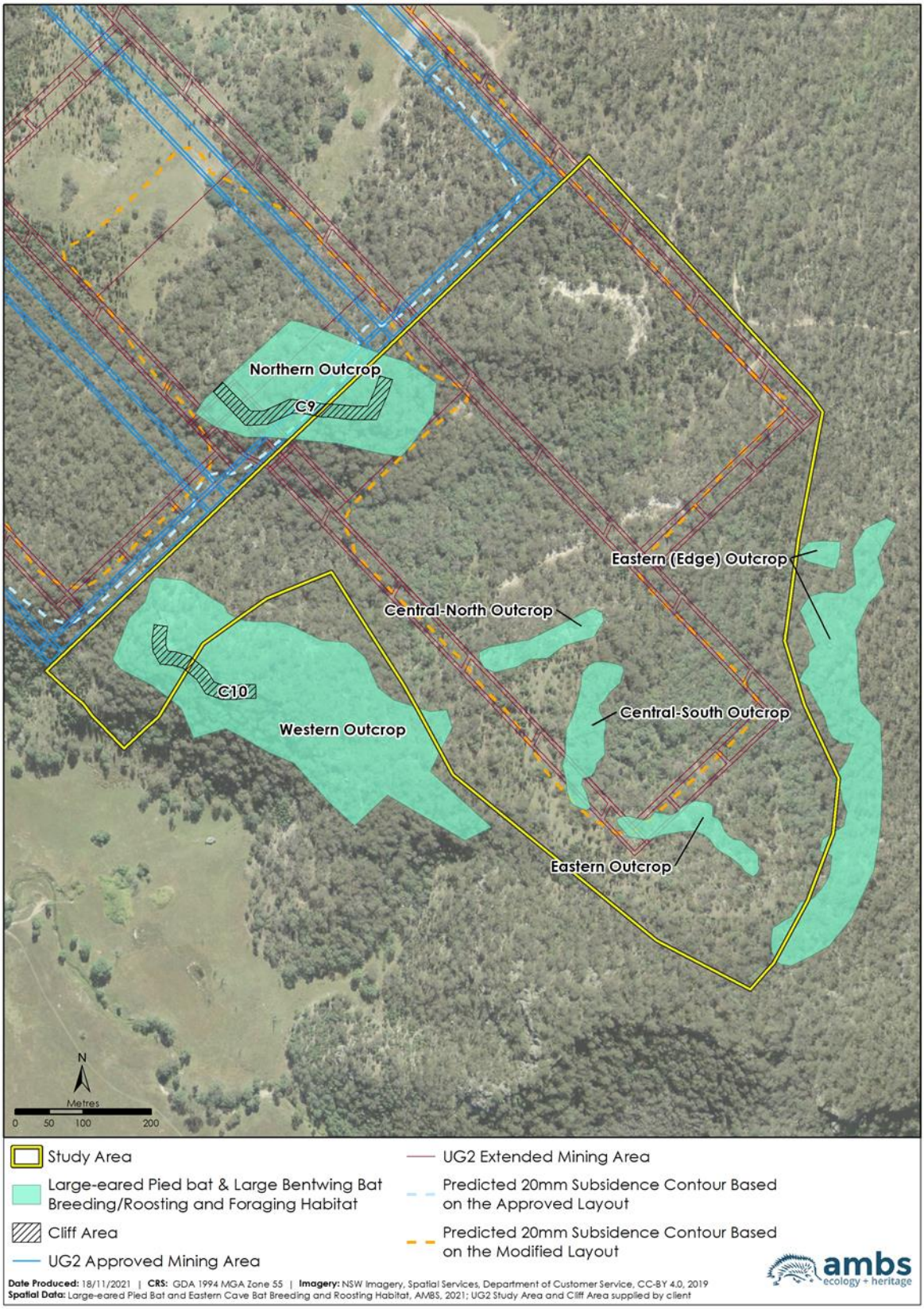

Figure 3.3 Large-eared Pied Bat and Eastern Cave Bat breeding/roosting and foraging habitat

Northern Outcrop (including cliff line [C9])

The Northern Outcrop is a large sandstone outcrop with a roughly east-west alignment and is surrounded by woodland. Potential roosting habitat in this area is extensive and variable.

It contains a variety of bat roosting habitat features including, tall sandstone rocks with small cavities, crevices between boulders, overhangs, a low entry cave, and small domes extending up into some overhangs (Plate 1, Plate 2, Plate 3). For some areas the extent of roosting habitat was difficult to estimate because a definitive end to the cavities could not be seen. Many of these roosting features would provide suitable roosting or breeding habitat for cave roosting species (Large-eared Pied Bat, Eastern Cave Bat).

One adult male Large-eared Pied Bat was found during a daytime habitat search, in a small crevice within an upside down v-shaped overhang/cave. In another location Rock Warblers (*Origma solitaria*) were observed flying into one small entry cave, indicating the area within the cave was large enough to accommodate a nest for these birds.

Plate 1 Large-eared Pied Bat roost (above left); tall overhang (above centre); small dome (above right)

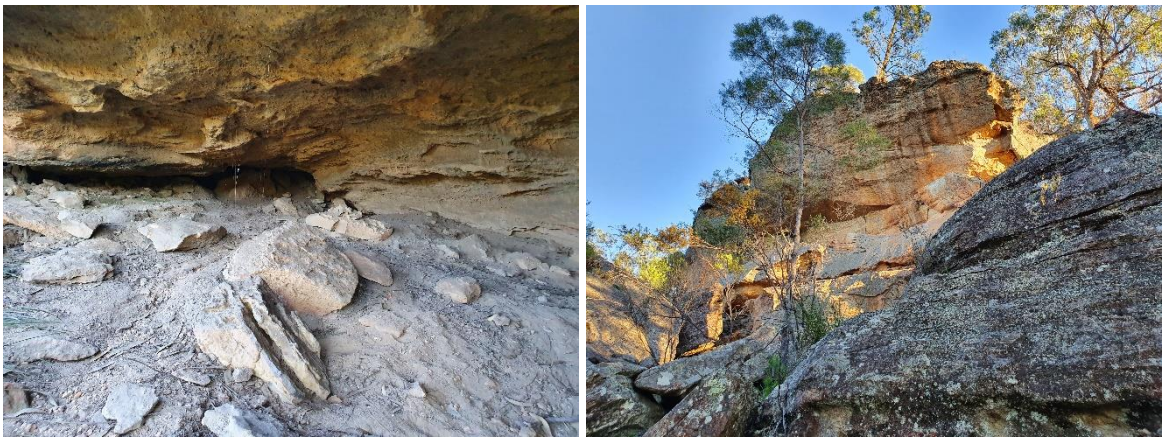

Plate 2 Low entry cave (above left); tall sandstone rock outcrop (above right)

Plate 3 High sandstone rock face and harp trap (above left); overhang with small holes (above right)

Western Outcrop (including cliff line [C10])

The Western Outcrop is a large sandstone outcrop with a roughly east-west alignment and is surrounded by woodland. Potential roosting habitat in this area is extensive and variable. Within the Study Area, the majority of this rock outcrop occurs in the western corner, with a smaller section located in the south of the Study Area.

It contains a variety of bat roosting habitat features including, tall sandstone rock boulders with small cavities, small cavity domes extending up into the ceilings of high overhangs, small holes in rock faces, small and large rock crevices, low entry caves (some of which extend further than can be accessed), overhangs with small holes and crevices, and high cliff faces (Plate 4, Plate 5, Plate 6). For some of the features the extent of roosting habitat was difficult to estimate because a definitive end to the cavities could not be seen. Many of these roosting features could provide suitable roosting or breeding habitat for cave roosting species (Large-eared Pied Bat, Eastern Cave Bat).

Microbat scats were recorded in one location, and Fairy Martin nests were observed in some of the overhangs. Fairy Martin nests are known to be used by the Large-eared Pied Bat for roosting.

Plate 4 High rock face with small holes (above left); small cavity dome within small high overhang (above centre); large crevices into rock face

Plate 5 Small low cave where microbat scats were recorded (above left); overhang with harp trap (above right)

Plate 6 Overhang with Fairy Martin nests (above left); Fairy Martin nests (above right)

Central-North Outcrop

The Central-North Outcrop is a small sandstone outcrop with a roughly east/west alignment and is surrounded by woodland. The outcrop sits at the edge of a small basalt cap. Potential roosting habitat in this area has less complexity compared with the Northern and Western Outcrops.

The area contains tall sandstone boulders with some overhangs, small cavities, crevices, as well as a tall overhang with a dome extending up into the roof (Plate 7, Plate 8). The high overhang also contained Fairy Martin nests and small cavities all of which were not able to be inspected due to access. These roosting features could provide suitable roosting or breeding habitat for cave roosting species (Large-eared Pied Bat, Eastern Cave Bat).

Plate 7 Overhang with small crevices (above left); tall sandstone boulders (above right)

Plate 8 Overhang with small crevices (above left); high overhang with dome and Fairy Martin nests (above right)

Central-South Outcrop

The Central-South Outcrop is a line of sandstone protrusions, rock-faces and boulders with a roughly north-south alignment, and is surrounded by woodland. Potential roosting habitat in this area has less complexity compared with the Northern and Western Outcrops.

There are multiple options of roosting habitat which include multiple low entry caves (one of which decaying microbat scats were observed below suitable roosting positions in the ceiling), multiple overhangs with Fairy Martin nests present, overhangs with roosting potential along with small holes in a limited number of rock faces (Plate 9, Plate 10). These roosting features could provide suitable roosting or breeding habitat for cave roosting species (Large-eared Pied Bat, Eastern Cave Bat).

Plate 9 Low entry cave entrance (above left); inside of cave ceiling (above right)

Plate 10 Overhang with Fairy Martin nests (above left and right)

Eastern Outcrop

The Eastern Outcrop is a line of sandstone protrusions, rock faces and boulders with a roughly east-west alignment following the contour curves. The outcrop is surrounded by woodland and sits just below the basalt cap to the south-east of the of the Central-South Outcrop (the two outcrops almost adjoin). This line of sandstone habitat is lower in height than the Northern and Western Outcrops, and has fewer roosting features by comparison.

The roosting habitat within this section includes small cavities in rock faces, small cavities in overhangs, and overhangs with Fairy Martin nests (Plate 11, Plate 12). Microbat scats were observed in one location. These roosting features provide suitable roosting or breeding habitat for cave roosting species (Large-eared Pied Bat, Eastern Cave Bat).

Plate 11 Overhang where microbat scats were observed (above left); small holes in the rock face (above right)

Plate 12 Overhangs with Fairy Martin nests (above left and right)

Eastern (Edge) Outcrop

The Eastern (Edge) Outcrop is a line of sandstone protrusions, rock faces and boulders with a roughly north-south alignment following the contour curves, and is surrounded by woodland. This rocky habitat runs parallel with the eastern boundary of the Study Area, mostly in Munghorn Gap Nature Reserve, with a narrow rocky gully occurring in the southern extent. The majority of the rocky habitat occurs outside of the Study Area, however there are some habitat features that extend within the Study Area boundary.

The habitat features that occur within the Study Area boundary include a number of overhangs, some with small cavities in their ceiling, as well as a couple of low entry caves under boulders that are sitting separate from the main rocky slope (Plate 13, Plate 14). In comparison to the Northern and Western Outcrops, there is less potential roosting or breeding habitat for individuals or small groups (Large-eared Pied Bat, Eastern Cave Bat), along with potential night roosting habitat.

The rocky habitat up the slope which occurs outside of the Study Area was mostly viewed from the Study Area boundary. Observations from a distance indicate the rocky slope contains a variety of habitat features including overhangs, rock faces with small cavities and potential small caves.

Plate 13 Rock habitat (above left) and low entry small cave (above right) within the Study Area

Plate 14 Rock habitat (above left and right) outside the Study Area

3.3 Summary of Fauna Species Credit Species

Threatened bat surveys were undertaken for the five "species credit species" known or predicted to occur in the locality. Two of these were not recorded during the current surveys, and there are no previous records for either species within the locality of the Study Area (DPIE 2021a):

- Grey-headed Flying-fox; and
- Little Bent-winged Bat.

Two "species credit" species were recorded during the surveys:

- Large-eared Pied Bat; and
- Eastern Cave Bat.

One dual credit bat species, the Large Bent-winged Bat, was probably recorded.

The habitat constraints for each of these recorded species were investigated in accordance with Section 5.2.2 of the BAM (DPIE 2020) (Table 3.2). Table 3.2 provides a discussion as to whether suitable habitat for each species occurs within the Study Area.

Table 3.2 Species credit species recorded or probably recorded in the Study Area

Common Name	Scientific Name	Conservation Status		Biodiversity Credit Class[3]	Potential SAII Entity	Habitat Constraint (DPIE 2021a)	Survey Result
		BC Act[1]	EPBC Act[2]				
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V	-	Species/ Ecosystem	Yes	*Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500.*	Four probable Anabat recordings for the species were identified in the Study Area, and no animals were captured in harp traps. No caves or crevices that would likely be suitable for a maternity/breeding roost were observed in the Study Area. The small number of calls, no animals captured in harp traps, and lack of suitable habitat observed, suggests it is unlikely for there to be breeding caves in the Study Area. As a result, no species polygon is required.
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	Species	Yes	*Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.*	The species was recorded within 100 m of habitat containing rocky areas, caves, overhangs, outcrops and crevices. One juvenile bat of this species was recorded. As a result, a species polygon was prepared for this species.
Eastern Cave Bat	*Vespadelus troughtoni*	V	-	Species	Yes	*Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.*	The species was recorded within 100 m of habitat containing rocky areas, caves, overhangs, escarpments, outcrops or boulder piles. One juvenile bat of this species was recorded. As a result, a species polygon was prepared for this species.

Note:

[1] Conservation status under the BC Act (current as at November 2021). CE = Critically Endangered, E = Endangered, V = Vulnerable.

[2] Conservation status under the EPBC Act (current as at November 2021). CE = Critically Endangered, V = Vulnerable.

[3] Biodiversity credit class under the *Threatened Biodiversity Data Collection* (DPIE 2021a) (current as at November 2021).

3.3.1 Large-eared Pied Bat

The Large-eared Pied Bat occurs from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands (DPIE 2021b). It is generally rare with a very patchy distribution in NSW, occurring mainly in areas with extensive cliffs and caves (DPIE 2021b). There are scattered records from the New England Tablelands and North West Slopes. The species roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (DPIE 2021b). They generally inhabit low to mid-elevation dry open forest and woodland close to roosting features, but also well-timbered areas containing gullies (DPIE 2021b). Females are known to raise young in maternity roosts from November through to January, often in roof domes in sandstone caves and overhangs (DPIE 2021b). The species is known to show site fidelity to the same cave over many years (DPIE 2021b).

The Large-eared Pied Bat was recorded by AMBS during surveys within the Study Area. All records were within 100 m of potential roosting habitat, given that this was the focus of the targeted survey effort. The species was regularly recorded on Anabat detectors, captured in harp traps, and one individual was found during a daytime habitat search in a crevice within an overhang. Seven individuals were caught in harp traps, six of these were adult males. One individual was a juvenile male, on the basis of its elongated wing joints with visible bands of cartilage, and smaller size. Given a juvenile animal has been recorded, roosting habitat within the Study Area should be considered breeding habitat.

On the basis of the information outlined above, breeding and foraging habitat for the Large-eared Pied Bat occurs within the Study Area and nearby surrounds (Figure 3.4). Breeding habitat has been mapped outside the Study Area where it occurs within 100m of the Study Area boundary, because impacts within 100m of breeding habitat have potential to be SAII. In accordance with the NSW survey guide for *'Species Credit' Threatened Bats and Their Habitat* (OEH 2018a), a species polygon is woodland habitat associated with PCTs as per the *Threatened Biodiversity Data Collection* (DPIE 2021a) (i.e. PCTs 434, 472, 1176, 1629) within a 2 km radius of identified roosting habitat. A species polygon for the species has been mapped that occupies an area of 66.49 ha in the Study Area and is shown on Figure 3.4. The species polygon includes PCTs associated with the species, as well as PCTs 478, 479, 1610, 1614 and 1767 because of their proximity to roosting habitat and other areas of suitable habitat (i.e. PCTs associated with the species). It is likely the species would forage or move through all PCTs in the Study Area.

3.3.2 Eastern Cave Bat

The Eastern Cave Bat occurs on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW (DPIE 2021b). The species is very uncommon, and little is known about its biology (DPIE 2021b). Eastern Cave Bats roost in caves, cliffs, and rocky overhangs, which are usually found in dry open forest or woodland, and occasionally wet eucalypt forest and rainforest (DPIE 2021b). They have also been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals (DPIE 2021b). Little is understood of its feeding or breeding requirements or behaviour (DPIE 2021b).

The Eastern Cave Bat was recorded by AMBS during surveys within the Study Area. All records were within 100 m of potential roosting habitat, given that this was the focus of the targeted survey effort. The species was regularly recorded on Anabat detectors, and two individuals were captured in harp traps. One individual was an adult male, and one was a juvenile male, on the basis of its elongated wing joints with visible bands of cartilage, and smaller size. Given a juvenile animal has been recorded, roosting habitat within the Study Area should be considered breeding habitat.

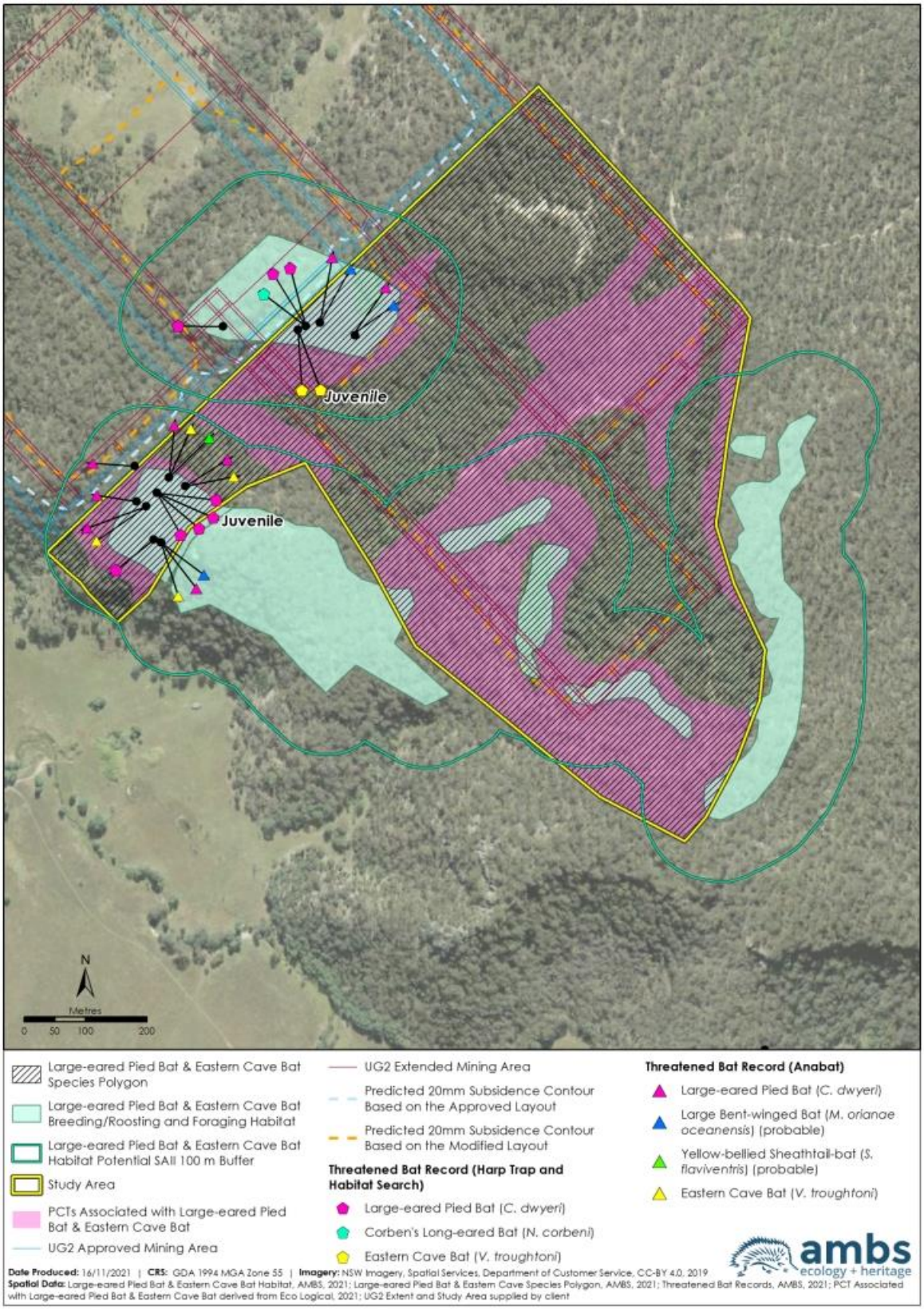

Figure 3.3 Large-eared Pied Bat and Eastern Cave Bat species polygon

On the basis of the information outlined above, breeding and foraging habitat for the Eastern Cave Bat occurs within the Study Area and nearby surrounds (Figure 3.4). Breeding habitat has been mapped outside the Study Area where it occurs within 100m of the Study Area boundary, because impacts within 100m of breeding habitat have potential to be SAII. In accordance with the NSW survey guide for *'Species Credit' Threatened Bats and Their Habitat* (OEH 2018a), a species polygon is woodland habitat associated with PCTs as per the *Threatened Biodiversity Data Collection* (DPIE 2021a) (i.e. PCTs 434, 472, 1176, 1629) within a 2 km radius of identified roosting habitat. A species polygon for the species has been mapped that occupies an area of 66.49 ha in the Study Area and is shown on Figure 3.4. The species polygon includes PCTs associated with the species, as well as PCTs 478, 479, 1610, 1614 and 1767, because of their proximity to roosting habitat and other areas of suitable habitat (i.e. PCTs associated with the species). It is likely the species would forage or move through all PCTs in the Study Area.

4 Conclusion

Two of the recorded threatened species are classified as species credit species (Large-eared Pied Bat and Eastern Cave bat), and one is classified as a dual credit species (Large Bent-winged Bat).

The Large Bent-winged Bat is a dual Species/Ecosystem credit species, with breeding habitat assessed for species credits and foraging habitat assessed for ecosystem credits. Only four probable Anabat recordings were attributed to the species, no individuals were captured in harp traps, and there are a small number of BioNet records (DPIE 2021a) for the species within 20 km of the Study Area. No caves or crevices that would likely be suitable for a maternity/breeding roost were observed in the Study Area. If a breeding structure did occur within the Study Area, it is likely the surveys would have resulted in a greater number of Anabat recordings, and probably captures of individual bats within harp traps. On the basis of the above, it is considered unlikely that a Large Bent-winged Bat breeding structure occurs in the Study Area. For this reason, the Large Bent-winged Bat is not considered a species credit species within the Study Area, however due to its dual listing, it will still be consisted an Ecosystem credit species.

The Large-eared Pied Bat and Eastern Cave Bat were regularly recorded on Anabat detectors, captured in harp traps, and one Large-eared Pied Bat was found during a daytime habitat search in a crevice within an overhang. One juvenile for each species was recorded, indicating breeding habitat occurs within the Study Area, while foraging habitat occurs within a 2 km radius. Breeding habitat for the Large-eared Pied Bat and Eastern Cave Bat are listed under the BC Act as SAII candidates.

Two species of threatened bats classified as “ecosystem credit species” were also recorded during the surveys, including the Corben's Long-eared Bat and Yellow-bellied Sheath-tailed Bat. Four other species of threatened fauna recorded opportunistically, included Brown Treecreeper (*Climacteris picumnus victoriae*), Varied Sittella (*Daphoenositta chrysoptera*), Diamond Firetail (*Stagonopleura guttata*) and Koala (*Phascolarctos cinereus*) (scats). These fauna species will be addressed in the main BDAR.

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Appendix A: Fauna survey locations

Type	Zone	Easting (GDA 94)	Northing (GDA 94)	Number of Nights Deployed
Anabat (Express)	55	762763	6419185	11
Anabat (Express)	55	762820	6419164	11
Anabat (Express)	55	762504	6418827	2
Anabat (Express)	55	762480	6418886	2
Anabat (Express)	55	762464	6418894	2
Anabat (Express)	55	762461	6418952	2
Anabat (SD Unit)	55	762517	6418933	2
Anabat (SD Unit)	55	762544	6418919	4
Anabat (SD Unit)	55	762510	6418900	2
Harp trap	55	762491	6418942	1
Harp trap	55	762441	6418903	1
Harp trap	55	762699	6419171	1
Harp trap	55	762697	6419186	1
Harp trap	55	762810	6419189	1
Harp trap	55	762645	6419071	1
Harp trap	55	762705	6419188	1
Harp trap	55	762740	6419179	1
Harp trap	55	762817	6419206	1
Harp trap	55	762480	6418952	1
Harp trap	55	762425	6418912	1
Harp trap	55	762504	6418827	1
Harp trap	55	762484	6418870	1
Harp trap	55	762755	6419188	1
Harp trap	55	762479	6418857	1
Harp trap	55	762523	6418818	1
Harp trap	55	762530	6418932	1
Harp trap	55	762542	6418879	1
Harp trap	55	762492	6418832	1
Harp trap	55	762495	6418833	1
Harp trap	55	762664	6419183	1
Harp trap	55	762701	6419195	1
Harp trap	55	762727	6419173	1
Harp trap	55	762760	6419178	1
Harp trap	55	762589	6418984	1
Harp trap	55	762478	6418840	1
Harp trap	55	762477	6418831	1
Harp trap	55	762497	6418908	1
Harp trap	55	762712	6419177	1
Harp trap	55	762712	6419178	1
Harp trap	55	762748	6419175	1
Harp trap	55	762639	6419064	1

Appendix B: Fauna species list

Class	Common Name	Scientific Name	Conservation Status	
			BC Act	EPBC Act
Aves	Common Bronzewing	*Phaps chalcoptera*		
	Australian King-Parrot	*Alisterus scapularis*		
	Sulphur-crested Cockatoo	*Cacatua galerita*		
	Australian Owlet-Nightjar	*Aegotheles cristatus*		
	Laughing Kookaburra	*Dacelo novaeguineae*		
	Sacred Kingfisher	*Todiramphus sanctus*		
	Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	
	White-throated Treecreeper	*Cormobates leucophaea*		
	Spotted Pardalote	*Pardalotus punctatus*		
	Striated Thornbill	*Acanthiza lineata*		
	Brown Thornbill	*Acanthiza pusilla*		
	Rockwarbler	*Origma solitaria*		
	White-browed Scrubwren	*Sericornis frontalis*		
	Red Wattlebird	*Anthochaera carunculata*		
	Yellow-faced Honeyeater	*Caligavis chrysops*		
	White-naped Honeyeater	*Melithreptus lunatus*		
	Scarlet Honeyeater	*Myzomela sanguinolenta*		
	White-eared Honeyeater	*Nesoptilotis leucotis*		
	Noisy Friarbird	*Philemon corniculatus*		
	Eastern Yellow Robin	*Eopsaltria australis*		
	Varied Sittella	*Daphoenositta chrysoptera*	V	
	Golden Whistler	*Pachycephala pectoralis*	V	
	Rufous Whistler	*Pachycephala rufiventris*		
	Leaden Flycatcher	*Myiagra rubecula*		
	Grey Fantail	*Rhipidura fuliginosa*		
	Willie Wagtail	*Rhipidura leucophrys*		
	Australian Magpie	*Gymnorhina tibicen*		
	Pied Currawong	*Strepera graculina*		
	Fairy Martin	*Petrochelidon ariel*		
	Mistletoebird	*Dicaeum hirundinaceum*		
	Diamond Firetail	*Stagonopleura guttata*	V	
Mammalia	Common Wombat	*Vombatus ursinus*		
	Eastern Horseshoe Bat	*Rhinolophus megaphyllus*		
	Yellow-bellied Sheathtail-bat (probable)	*Saccolaimus flaviventris*	V	
	White-striped Free-tailed Bat	*Austronomus australis*		
	South-eastern Free-tailed Bat	*Mormopterus (Ozimops) planiceps*		
	Eastern Free-tailed Bat	*Mormopterus (Ozimops) ridei*		
	Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V
	Gould's Wattled Bat	*Chalinolobus gouldii*		
	Chocolate Wattled Bat	*Chalinolobus morio*		
	Large Bent-winged Bat (probable)	*Miniopterus orianae oceanensis*	V	
	Corben's Long-eared Bat	*Nyctophilus corbeni*	V	V
	Lesser Long-eared Bat	*Nyctophilus geoffroyi*		
	Gould's Long-eared Bat	*Nyctophilus gouldi*		
	Inland Broad-nosed Bat	*Scotorepens balstoni*		
	Eastern Broad-nosed Bat	*Scotorepens orion*		
	Southern Forest Bat	*Vespadelus regulus*		
	Eastern Cave Bat	*Vespadelus troughtoni*	V	
	Little Forest Bat	*Vespadelus vulturnus*		
	Koala *	*Phascolarctos cinereus*	V	V

Note:

[1] Conservation status under the BC Act (current as at November 2021). E = Endangered, V = Vulnerable.

[2] Conservation status under the EPBC Act (current as at November 2021). V = Vulnerable.

* Scats were recorded in two general locations

Annex 3. Floristic plot data

Scientific name	Common name	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Trees											
Acacia linearifolia	Narrow-leaved Wattle	0.5	4	0.5	10	0.2	4	0.1	3	1	20
Callitris endlicheri	Black Cypress Pine	2	1	1	1	2	2	-	-	-	-
Eucalyptus albens	White Box	10	5	-	-	-	-	-	-	-	-
Eucalyptus crebra	Narrow-leaved Ironbark	0.1	4	0.1	2	-	-	-	-	-	-
Eucalyptus dwyeri	Dwyer's Red Gum	-	-	-	-	4	3	-	-	-	-
Eucalyptus fibrosa	Red Ironbark	-	-	-	-	-	-	-	-	5	2
Eucalyptus punctata	Grey Gum	-	-	-	-	0.1	4	-	-	5	10
Eucalyptus sparsifolia	Narrow-leaved Stringybark	-	-	-	-	-	-	-	-	3	1
Ficus rubiginosa	Port Jackson Fig	-	-	-	-	10	2	-	-	-	-
Brachychiton populneus subsp. *populneus*	Kurrajong	-	-	-	-	-	-	8	1	-	-
Shrubs											
Acacia implexa	Hickory Wattle	-	-	-	-	-	-	0.1	1	-	-
Acrotriche rigida	-	4	20	0.1	2	0.3	2	-	-	0.7	3
Bossiaea obcordata	Spiny Bossiaea	0.1	10	0.1	20	-	-	0.1	100	-	-
Bursaria spinosa subsp. *spinosa*	Blackthorn	0.1	5								

Scientific name	Common name	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Cassinia cunninghamii	Cunninghams Everlasting	-	-	-	-	-	-	-	-	1	100
Cassinia quinquefaria	-	0.1	5	0.1	10	0.1	5	0.1	5	0.1	20
Cassinia sifton	Sifton Bush	0.1	20	-	-	0.1	5				
Correa reflexa var. *reflexa*	Native Fuchsia	0.1	20	-	-	0.1	6				
Dodonaea triangularis	-	-	-	-	-	-	-	-	-	0.1	50
Dodonaea viscosa subsp. *cuneata*	Wedge-leaf Hop-bush	-	-	-	-	-	-	0.1	5		
Leucopogon juniperinus	Prickly Beard-heath	3	10	0.1	5	-	-	-	-	2	20
Persoonia linearis	Narrow-leaved Geebung	-	-	-	-	0.1	2	1	1	1	10
Phebalium squamulosum subsp. *lineare*	Scaly Phebalium	-	-	-	-	-	-	-	-	0.1	50
Phyllanthus hirtellus	Thyme Spurge	-	-	-	-	-	-	-	-	0.1	10
Poranthera corymbosa	-	-	-	-	-	-	-	-	-	0.3	100
Pultenaea spp.	-	-	-	-	-	-	-	-	-	0.2	20
Solanum campanulatum	-	0.1	2	0.5	9	0.1	5	0.2	5	0.1	10
Solanum cinereum	Narrawa Burr	0.3	10	0.2	5	0.1	2	0.1	3	-	-
Ferns											
Cheilanthes distans	Bristly cloak Fern	-	-	-	-	0.1	2	-	-	-	-
Cheilanthes sieberi subsp. *sieberi*	Mulga Fern	1	100	2	500	1	50	2	100	-	-

Scientific name	Common name	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Forbs											
Ajuga australis	Austral Bugle	1	1000	0.3	500	0.1	10	0.2	100	-	-
Asperula conferta	Common Woodruff	0.1	1	-	-	0.2	50	3	100	-	-
Brunoniella australis	Blue Trumpet	0.2	50	-	-	-	-	-	-	-	-
Calotis cuneifolia	Purple Burr-daisy	0.1	20	0.1	20	-	-	-	-	-	-
Calotis lappulacea	Yellow Burr-daisy	3	1000	2	500	0.1	20	-	-	-	-
Chamaesyce drummondii	Caustic Creeper	0.1	20	-	-	0.1	2	-	-	-	-
Crassula spp.	-	-	-	-	-	0.1	20	-	-	-	-
Cymbonotus lawsonianus	Bears-ear	-	-	0.5	500	-	-	0.1	20	-	-
Cynoglossum australe	-	0.1	10	2	100	0.2	100	-	-	-	-
Dichondra repens	Kidney Weed	3	500	5	1000	0.2	100	1	500	-	-
Einadia nutans subsp. *nutans*	Climbing Saltbush	0.5	50	-	-	0.1	10	0.2	20	-	-
Einadia trigonos subsp. *stellulata*	Fishweed	-	-	-	-	-	-	0.1	5	-	-
Euchiton sphaericus	-	-	-	0.1	1	0.1	10	-	-	-	-
Geranium homeanum	-	-	-	0.1	20	-	-	0.1	20	-	-
Gonocarpus tetragynus	-	-	-	-	-	-	-	-	-	0.3	100
Goodenia hederacea subsp. *hederacea*	Ivy Goodenia	-	-	-	-	-	-	-	-	0.1	50

Scientific name	Common name	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Hydrocotyle laxiflora	Stinking Pennywort	0.1	1	4	500	0.1	10	0.5	100	-	-
Isotoma axillaris	Rock Isotome	-	-	-	-	0.5	100	-	-	-	-
Opercularia hispida	Hairy Stinkweed	0.1	20	-	-	-	-	-	-	-	-
Oxalis perennans	-	0.1	50	0.1	20	0.1	20	-	-	-	-
Plantago gaudichaudii	Narrow Plantain	-	-	0.1	20	0.1	10	-	-	-	-
Pomax umbellata	-	1	500	0.2	20	0.7	100	-	-	0.3	50
Poranthera microphylla	-	0.1	20	-	-	-	-	-	-	-	-
Scutellaria humilis	Dwarf Skullcap	0.1	1	-	-	-	-	-	-	-	-
Sida spp.	-	0.2	20	-	-	-	-	-	-	-	-
Sigesbeckia orientalis subsp. *orientalis*	Indian Weed	2	500	2	100	0.3	50	15	1000	-	-
Solanum spp.	-	-	-	0.1	4	0.1	2	-	-	-	-
Stellaria pungens	Prickly Starwort	0.1	1	-	-	0.3	50	0.1	10	-	-
Veronica plebeia	Trailing Speedwell	0.1	1	-	-	0.1	10	-	-	-	-
Vittadinia muelleri	-	2	500	1	100	0.1	10	0.2	100	-	-
Vittadinia spp.	-	0.1	20	-	-	-	-	-	-	-	-
Wahlenbergia communis	Tufted Bluebell	-	-	0.1	10	0.1	5	0.1	100	-	-
Wahlenbergia gracilis	Sprawling Bluebell	-	-	0.1	20	-	-	-	-	-	-
Grasses and Graminoids											

Scientific name	Common name	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Aristida ramosa	Purple Wiregrass	-	-	0.2	100	-	-	-	-	-	-
Aristida vagans	Threeawn Speargrass	0.2	100	0.4	500	-	-	0.1	20	-	-
Austrostipa densiflora	-	-	-	-	-	0.1	20	-	-	-	-
Austrostipa scabra subsp. *falcata*	-	1	500	0.2	100	0.3	100	0.1	20	-	-
Bothriochloa macra	Red Grass	1	500	15	2000	0.3	100	10	2000	-	-
Carex appressa	Tall Sedge	0.1	1	-	-	-	-	-	-	-	-
Carex inversa	-	-	-	-	-	-	-	0.5	100	-	-
Cleistochloa rigida	-	-	-	-	-	-	-	-	-	2	500
Cymbopogon refractus	Barbed Wire Grass	0.1	1	-	-	-	-	-	-	-	-
Dichanthium sericeum subsp. *sericeum*	Queensland Bluegrass	-	-	-	-	-	-	0.2	50	-	-
Dichelachne micrantha	Shorthair Plumegrass	2	100	1	100	0.3	50	-	-	-	-
Digitaria breviglumis	-	3	500	-	-	-	-	-	-	-	-
Digitaria spp.	-	1	100	-	-	0.5	100	-	-	1	500
Eragrostis brownii	Brown's Lovegrass	-	-	0.2	500	-	-	-	-	-	-
Gahnia aspera	Rough Saw-sedge	-	-	0.1	1	0.1	1	0.1	1	0.1	1
Lepidosperma laterale	Variable Swordsedge	0.1	1	-	-	-	-	-	-	0.1	100

Scientific name	Common name	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Lomandra confertifolia subsp. *pallida*	-	0.5	50	0.1	10	0.3	20	-	-	0.5	20
Lomandra filiformis subsp. *filiformis*	Wattle Mat-rush	-	-	0.1	10	-	-	-	-	-	-
Lomandra longifolia	Spiny-headed Mat-rush	-	-	-	-	-	-	-	-	0.2	10
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	0.2	10	0.1	1	-	-	0.1	2	-	-
Microlaena stipoides var. *stipoides*	Weeping Grass	15	2000	10	1000	0.3	500	10	1000	0.5	100
Panicum effusum	Hairy Panic	1	100	1	100	-	-	1	100	-	-
Paspalidium spp. 1	-	0.5	50	0.5	100	-	-	0.2	100	-	-
Paspalidium spp. 2	-	3	500	1	100	-	-	-	-	-	-
Rytidosperma spp.	-	2	1000	0.3	50	0.5	100	5	500	-	-
Sporobolus creber	Western Rat-tail	-	-	0.2	50	-	-	-	-	-	-
Themeda triandra	Kangaroo Grass	2	100	0.2	50	-	-	-	-	-	-
Other											
Amyema quandang var. *quandang*	-	0.1	1	0.1	1	-	-	-	-	-	-
Clematis spp.	-	0.1	1	0.1	1	0.1	1	-	-	-	-
Convolvulus erubescens	Blushing Bindweed	0.1	5	-	-	-	-	-	-	-	-
Glycine clandestina	-	0.1	20	-	-	-	-	-	-	-	-
Glycine tabacina	-	0.3	50	0.5	100	0.1	10	0.2	100	-	-

Scientific name	Common name	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Grona varians	Slender Tick-trefoil	0.1	10	0.2	50	-	-	0.2	50	-	-
High Threat Weeds											
Opuntia stricta var. *stricta*	Common Pear	-	-	-	-	-	-	0.2	4	-	-

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Trees											
Acacia linearifolia	Narrow-leaved Wattle	0.1	1	0.1	20	1	50	0.5	20	-	-
Angophora floribunda	Rough-barked Apple	-	-	-	-	-	-	-	-	35	20
Callitris endlicheri	Black Cypress Pine	-	-	5	10	1	1	-	-	-	-
Eucalyptus albens	White Box	-	-	-	-	-	-	-	-	4	2
Eucalyptus blakelyi	Blakely's Red Gum	6	3	-	-	-	-	-	-	-	-
Eucalyptus fibrosa	Red Ironbark	-	-	10	9	15	10	-	-	-	-
Eucalyptus punctata	Grey Gum	-	-	-	-	2	3	10	4	-	-
Eucalyptus sparsifolia	Narrow-leaved Stringybark	-	-	-	-	-	-	10	5	-	-
Shrubs											
Acacia implexa	Hickory Wattle	0.1	2	-	-	-	-	-	-	0.1	2
Acacia verniciflua	Varnish Wattle	-	-	0.1	1	-	-	-	-	-	-
Acrotriche rigida	-	-	-	3	50	0.5	20	0.5	5	2	50

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Bursaria spinosa subsp. *spinosa*	Blackthorn	-	-	0.1	1	-	-	-	-	-	-
Cassinia cunninghamii	Cunninghams Everlasting	-	-	-	-	0.1	20	-	-	-	-
Cassinia quinquefaria	-	-	-	-	-	-	-	0.1	2	-	-
Cassinia sifton	Sifton Bush	-	-	0.1	5	-	-	-	-	0.1	10
Daviesia genistifolia	Broom Bitter Pea	-	-	-	-	-	-	0.1	10	-	-
Daviesia ulicifolia subsp. *ulicifolia*	Gorse Bitter Pea	-	-	0.1	5	-	-	-	-	-	-
Dodonaea triangularis	-	-	-	2	100	0.1	100	-	-	0.1	1
Dodonaea viscosa subsp. *cuneata*	Wedge-leaf Hop-bush	-	-	0.5	5	0.1	5	-	-	-	-
Hibbertia obtusifolia	Hoary Guinea Flower	-	-	0.1	10	-	-	-	-	-	-
Leucopogon juniperinus	Prickly Beard-heath	-	-	0.1	2	1	3	-	-	-	-
Lissanthe strigosa subsp. *subulata*	Peach Heath	-	-	-	-	-	-	-	-	-	-
Melaleuca thymifolia	Thyme Honey-myrtle	8	50	-	-	-	-	-	-	-	-
Persoonia linearis	Narrow-leaved Geebung	-	-	-	-	0.8	10	0.2	1	-	-
Phebalium squamulosum subsp. *lineare*	Scaly Phebalium	-	-	0.2	20	1	100	1	50	-	-
Phyllanthus hirtellus	Thyme Spurge	-	-	0.1	5	0.1	1	-	-	-	-

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Poranthera corymbosa	-	-	-	0.2	50	0.2	500	0.2	500	0.1	20
Pultenaea spp.	-	-	-	0.1	20	0.1	5	-	-	-	-
Solanum campanulatum	-	-	-	0.1	4	-	-	-	-	0.3	20
Solanum cinereum	Narrawa Burr	-	-	-	-	-	-	-	-	0.2	10
Ferns											
Cheilanthes sieberi subsp. *sieberi*	Mulga Fern	-	-	0.1	10	-	-	-	-	0.2	50
Forbs											
Arthropodium minus	-	0.1	100	-	-	-	-	-	-	-	-
Asperula conferta	Common Woodruff	-	-	-	-	-	-	-	-	0.4	50
Calotis cuneifolia	Purple Burr-daisy	0.1	10	0.1	1	-	-	-	-	0.1	10
Calotis lappulacea	Yellow Burr-daisy	-	-	-	-	-	-	-	-	0.1	10
Cymbonotus lawsonianus	Bears-ear	-	-	-	-	-	-	-	-	0.1	10
Cynoglossum australe	-	-	-	-	-	-	-	-	-	5	500
Damasonium spp.	-	0.5	100	-	-	-	-	-	-	-	-
Dichondra repens	Kidney Weed	-	-	-	-	-	-	-	-	20	2000
Einadia trigonos subsp. *stellulata*	Fishweed	-	-	0.1	5	-	-	-	-	-	-
Euchiton sphaericus	-	0.2	100	-	-	-	-	-	-	0.1	20
Galium spp.	-	-	-	-	-	-	-	-	-	0.1	2
Geranium homeanum	-	-	-	-	-	-	-	-	-	0.1	50

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Gonocarpus tetragynus	-	-	-	-	-	-	-	0.1	10	0.1	10
Goodenia hederacea subsp. *hederacea*	Ivy Goodenia	-	-	0.2	100	-	-	-	-	-	-
Goodenia heterophylla subsp. *heterophylla*	-	-	-	-	-	0.2	50	0.1	1	-	-
Goodenia paniculata	Branched Goodenia	2	500	-	-	-	-	-	-	-	-
Haloragis heterophylla	Rough Raspwort	1	500	-	-	-	-	-	-	-	-
Hydrocotyle laxiflora	Stinking Pennywort	20	1000	-	-	-	-	-	-	0.5	100
Hypericum gramineum	Small St. John's Wort	0.2	500	-	-	-	-	-	-	-	-
Isotoma fluviatilis subsp. *australis*	-	15	1000	-	-	-	-	-	-	-	-
Myriophyllum spp.	-	30	1000	-	-	-	-	-	-	-	-
Opercularia hispida	Hairy Stinkweed	-	-	0.1	3	-	-	-	-	-	-
Pomax umbellata	-	-	-	-	-	0.2	20	0.1	20	0.1	20
Pseudognaphalium luteoalbum	Jersey Cudweed	-	-	-	-	-	-	-	-	0.1	1
Solenogyne bellioides	-	-	-	-	-	-	-	-	-	0.1	1
Stellaria pungens	Prickly Starwort	-	-	-	-	-	-	0.2	50	-	-
Taraxacum spp.	-	0.1	1	0.1	2	-	-	-	-	-	-
Veronica plebeia	Trailing Speedwell	-	-	-	-	-	-	-	-	0.1	10

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Vittadinia muelleri	-	-	-	0.1	1	-	-	-	-	-	-
Wahlenbergia communis	Tufted Bluebell	-	-	0.1	20	-	-	-	-	0.1	10
Wahlenbergia gracilis	Sprawling Bluebell	-	-	-	-	-	-	-	-	0.1	1
Grasses and Graminoids											
Aristida vagans	Threeawn Speargrass	-	-	0.1	5	-	-	-	-	0.1	20
Arundinella nepalensis	Reedgrass	4	500	-	-	-	-	-	-	-	-
Austrostipa scabra subsp. *falcata*	-	-	-	0.1	20	-	-	-	-	-	-
Cyperus difformis	-	5	1000	-	-	-	-	-	-	-	-
Digitaria breviglumis	-	-	-	0.1	1	-	-	-	-	-	-
Digitaria spp.	-	-	-	-	-	-	-	-	-	5	500
Echinopogon caespitosus var. *caespitosus*	Tufted Hedgehog Grass	0.3	100	-	-	-	-	-	-	0.3	50
Echinopogon ovatus	Forest Hedgehog Grass	-	-	-	-	-	-	-	-	0.2	50
Eragrostis brownii	Brown's Lovegrass	-	-	0.1	5	-	-	-	-	-	-
Eulalia aurea	Silky Browntop	0.1	50	-	-	-	-	-	-	-	-
Gahnia aspera	Rough Saw-sedge	0.5	20	-	-	0.1	1	-	-	0.1	5
Isolepis spp.	-	0.2	100	-	-	-	-	-	-	-	-
Lachnagrostis filiformis	-	0.2	100	-	-	-	-	0.1	3	0.5	100

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Lepidosperma laterale	Variable Swordsedge	-	-	-	-	0.3	20	-	-	-	-
Lomandra confertifolia subsp. *pallida*	-	-	-	0.2	50	0.5	50	4	100	0.2	10
Lomandra glauca	Pale Mat-rush	-	-	-	-	0.2	20	-	-	-	-
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	-	-	-	-	0.1	10	-	-	-	-
Microlaena stipoides var. *stipoides*	Weeping Grass	0.2	100	0.1	10	-	-	-	-	5	1000
Paspalidium spp. 1	-	-	-	-	-	-	-	-	-	0.1	20
Rytidosperma pallidum	Silvertop Wallaby Grass	-	-	0.1	20	-	-	-	-	-	-
Rytidosperma spp.	-	0.1	20	-	-	-	-	-	-	0.5	100
Other											
Billardiera scandens	Hairy Apple Berry	-	-	-	-	-	-	-	-	0.1	1
Clematis spp.	-	-	-	-	-	-	-	-	-	0.1	3
Glycine clandestina	-	0.2	50	-	-	-	-	-	-	0.1	20
Glycine tabacina	-	-	-	-	-	-	-	-	-	0.1	20
Grona varians	Slender Tick-trefoil	-	-	-	-	-	-	-	-	0.1	10
Hardenbergia violacea	False Sarsaparilla	-	-	0.1	1	-	-	-	-	-	-
Macrozamia secunda	-	-	-	0.1	10	-	-	-	-	-	-
High Threat Weeds											
Ailanthus altissima	Tree of Heaven	-	-	-	-	-	-	-	-	0.1	1

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Scientific name	**Common name**	**Plot 12**		**Plot 13**		**Plot 14**		**Plot 15**		**Plot 16**	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Trees											
Acacia linearifolia	Narrow-leaved Wattle	-	-	0.3	5	0.5	4	0.1	3	0.1	3
Angophora floribunda	Rough-barked Apple	-	-	-	-	-	-	-	-	20	20
Brachychiton populneus subsp. *populneus*	Kurrajong	-	-	0.1	1	-	-	-	-	-	-
Callitris endlicheri	Black Cypress Pine	-	-	1	3	-	-	-	-	-	-
Eucalyptus blakelyi	Blakely's Red Gum	-	-	-	-	10	8	4	6	-	-
Eucalyptus crebra	Narrow-leaved Ironbark	-	-	15	10	3	7	-	-	-	-
Eucalyptus dawsonii	Slaty Gum	-	-	-	-	-	-	2	3	-	-
Eucalyptus fibrosa	Red Ironbark	-	-	-	-	-	-	5	4	-	-
Eucalyptus punctata	Grey Gum	2	2	-	-	2	1	-	-	-	-
Eucalyptus sparsifolia	Narrow-leaved Stringybark	15	5	-	-	-	-	-	-	-	-
Shrubs											
Acrotriche rigida	-	-	-	0.3	5	0.2	3	5	20	1	10
Astroloma humifusum	Native Cranberry	-	-	0.1	2	0.1	1	-	-	-	-
Brachyloma daphnoides subsp. *daphnoides*	-	-	-	-	-	-	-	-	-	0.1	1

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Bursaria spinosa subsp. *spinosa*	Blackthorn	-	-	0.1	3	-	-	-	-	-	-
Cassinia cunninghamii	Cunninghams Everlasting	0.3	20	-	-	-	-	0.1	10	-	-
Cassinia quinquefaria	-	-	-	0.1	20	-	-	-	-	0.1	3
Cassinia sifton	Sifton Bush	-	-	0.1	20	-	-	0.1	10	-	-
Daviesia genistifolia	Broom Bitter Pea	-	-	-	-	-	-	0.1	5	-	-
Dodonaea triangularis	-	-	-	0.2	50	-	-	-	-	-	-
Dodonaea viscosa subsp. *angustifolia*	Sticky Hop-bush	-	-	0.1	1	-	-	-	-	-	-
Dodonaea viscosa subsp. *cuneata*	Wedge-leaf Hop-bush	-	-	0.3	5	-	-	0.2	10	-	-
Hibbertia obtusifolia	Hoary Guinea Flower	-	-	-	-	-	-	0.1	4	-	-
Leucopogon juniperinus	Prickly Beard-heath	-	-	-	-	-	-	0.4	4	-	-
Lissanthe strigosa subsp. *subulata*	Peach Heath	-	-	-	-	-	-	-	-	0.1	1
Melaleuca thymifolia	Thyme Honey-myrtle	-	-	-	-	25	100	-	-	-	-
Persoonia linearis	Narrow-leaved Geebung	0.3	2	0.1	20	-	-	0.3	5	0.1	5
Phebalium squamulosum subsp. *lineare*	Scaly Phebalium	0.1	50	-	-	-	-	-	-	-	-
Phyllanthus hirtellus	Thyme Spurge	0.1	1	-	-	-	-	-	-	-	-

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Poranthera corymbosa	-	1	500	-	-	-	-	0.1	3	-	-
Solanum campanulatum	-	0.1	20	2	20	0.1	5	-	-	0.2	10
Solanum cinereum	Narrawa Burr	-	-	0.2	5	-	-	-	-	0.1	2
Ferns											
Cheilanthes sieberi subsp. *sieberi*	Mulga Fern	-	-	0.5	20	-	-	-	-	1	50
Forbs											
Asperula conferta	Common Woodruff	-	-	0.2	50	-	-	-	-	2	100
Calotis cuneifolia	Purple Burr-daisy	-	-	0.2	100	0.1	1	-	-	0.1	10
Cynoglossum australe	-	-	-	0.2	50	-	-	-	-	3	100
Dianella revoluta var. *revoluta*	-	-	-	0.1	5	0.2	50	0.2	50	0.1	1
Dichondra repens	Kidney Weed	-	-	2	500	0.1	50	-	-	2	500
Einadia hastata	Berry Saltbush	-	-	-	-	-	-	-	-	0.1	1
Einadia nutans subsp. *nutans*	Climbing Saltbush	-	-	-	-	-	-	-	-	0.1	1
Einadia trigonos subsp. *stellulata*	Fishweed	-	-	0.1	2	-	-	-	-	-	-
Euchiton sphaericus	-	-	-	0.2	50	-	-	-	-	-	-
Geranium homeanum	-	-	-	-	-	-	-	-	-	0.1	20
Gonocarpus tetragynus	-	0.2	50	-	-	-	-	-	-	-	-

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Goodenia hederacea subsp. *hederacea*	Ivy Goodenia	-	-	0.2	50	-	-	0.1	50	-	-
Goodenia heterophylla subsp. *heterophylla*	-	0.5	100	-	-	-	-	-	-	-	-
Goodenia paniculata	Branched Goodenia	-	-	-	-	0.3	500	-	-	-	-
Haloragis heterophylla	Rough Raspwort	-	-	-	-	0.1	100	0.1	20	-	-
Hybanthus monopetalus	Slender Violet-bush	-	-	-	-	-	-	-	-	0.1	20
Hydrocotyle laxiflora	Stinking Pennywort	-	-	1	100	0.2	50	0.1	1	1	500
Hypericum gramineum	Small St. John's Wort	-	-	0.1	50	0.1	50	-	-	-	-
Laxmannia gracilis	Slender Wire Lily	-	-	0.1	3	-	-	-	-	-	-
Opercularia hispida	Hairy Stinkweed	-	-	0.1	1	-	-	-	-	-	-
Oxalis perennans	-	-	-	0.1	100	-	-	-	-	0.1	50
Pomax umbellata	-	0.1	50	0.2	20	-	-	0.1	10	0.3	50
Poranthera microphylla	-	-	-	0.1	50	0.1	20			0.1	5
Pseudognaphalium luteoalbum	Jersey Cudweed	-	-	0.1	1	-	-	-	-	-	-
Sigesbeckia orientalis subsp. *orientalis*	Indian Weed	-	-	-	-	-	-	-	-	0.1	10
Solenogyne bellioides	-	-	-	0.1	1	-	-	-	-	-	-

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Thysanotus tuberosus subsp. *tuberosus*	Common Fringe-lily	-	-	0.1	1	-	-	-	-	-	-
Veronica plebeia	Trailing Speedwell	-	-	-	-	-	-	-	-	0.5	100
Vittadinia muelleri	-	-	-	-	-	-	-	-	-	0.1	1
Vittadinia spp.	-	-	-	-	-	-	-	-	-	0.2	50
Wahlenbergia communis	Tufted Bluebell	-	-	0.1	20	-	-	-	-	0.1	50
Xerochrysum bracteatum	Golden Everlasting	-	-	0.2	10	-	-	-	-	-	-
Grasses and Graminoids											
Aristida ramosa	Purple Wiregrass	-	-	0.1	20	-	-	0.1	50	-	-
Aristida vagans	Threeawn Speargrass	-	-	0.5	100	0.2	50	0.1	20	-	-
Arundinella nepalensis	Reedgrass	-	-	0.1	2	-	-	-	-	-	-
Austrostipa scabra subsp. *falcata*	-	-	-	0.1	20	-	-	0.1	10	0.1	10
Austrostipa spp.	-	-	-	0.1	1	-	-	-	-	-	-
Cleistochloa rigida	-	0.5	100	-	-	-	-	-	-	-	-
Dichelachne micrantha	Shorthair Plumegrass	-	-	-	-	-	-	0.1	1	-	-
Digitaria breviglumis	-	0.1	20	0.2	50	0.1	10	-	-	-	-
Digitaria spp.	-	0.1	10	7	500	0.2	50	0.1	20	1	100
Echinopogon caespitosus var. *caespitosus*	Tufted Hedgehog Grass	-	-	0.5	100	0.3	100	-	-	5	1000

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Echinopogon ovatus	Forest Hedgehog Grass	-	-	-	-	-	-	-	-	5	1000
Eragrostis brownii	Brown's Lovegrass	-	-	0.1	5	-	-	-	-	-	-
Gahnia aspera	Rough Saw-sedge	-	-	1	10	0.1	2	0.1	3	0.1	1
Lepidosperma laterale	Variable Swordsedge	0.2	20	-	-	0.2	10	-	-	-	-
Lomandra confertifolia subsp. *pallida*	-	0.7	20	0.1	1	1	100	-	-	30	2000
Lomandra glauca	Pale Mat-rush	-	-	-	-	0.1	1	-	-	-	-
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	0.1	1	-	-	-	-	0.1	1	-	-
Microlaena stipoides var. *stipoides*	Weeping Grass	0.1	20	25	2000	0.2	100	0.1	10	5	1000
Paspalidium spp. 1	-	-	-	-	-	-	-	-	-	0.1	2
Rytidosperma spp.	-	-	-	0.2	50	0.1	10	0.1	20	-	-
Schoenus apogon	Fluke Bog-rush	-	-	-	-	5	1000	-	-	-	-
Other											
Amyema miquelii	-	-	-	-	-	0.3	1	-	-	-	-
Clematis spp.	-	-	-	-	-	-	-	-	-	0.1	5
Convolvulus erubescens	Blushing Bindweed	-	-	-	-	-	-	-	-	0.1	1
Glycine clandestina	-	-	-	0.3	100	0.1	20	-	-	0.2	100
Glycine tabacina	-	-	-	-	-	-	-	-	-	0.1	20

Scientific name	Common name	Plot 6		Plot 8		Plot 9		Plot 10		Plot 11	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Grona varians	Slender Tick-trefoil	-	-	-	-	-	-	-	-	0.1	1
Macrozamia secunda	-	-	-	-	-	-	-	-	-	0.1	1

Scientific name	Common name	Plot 17		Plot 18		Plot 19		Plot 20		Plot 21	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Trees											
Acacia linearifolia	Narrow-leaved Wattle	0.1	5	1	10	0.2	10	5	10	0.1	5
Angophora floribunda	Rough-barked Apple	30	20	-	-	20	10	0	0	-	-
Brachychiton populneus subsp. *populneus*	Kurrajong	-	-	-	-	-	-	1	2	-	-
Callitris endlicheri	Black Cypress Pine	-	-	2	1	-	-	-	-	5	10
Eucalyptus albens	White Box	5	1	-	-	10	2	5	5	0.2	1
Eucalyptus crebra	Narrow-leaved Ironbark	-	-	20	1	-	-	-	-	-	-
Eucalyptus punctata	Grey Gum	-	-	-	-	-	-	-	-	20	20
Shrubs											
Acacia implexa	Hickory Wattle	-	-	-	-	0.1	3	1	10	-	-
Acrotriche rigida	-	0.2	1	0.5	10	4	20	2	20	1	10
Cassinia cunninghamii	Cunninghams Everlasting	-	-	-	-	-	-	0.2	10	-	-

Scientific name	Common name	Plot 17		Plot 18		Plot 19		Plot 20		Plot 21	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Cassinia quinquefaria	-	-	-	0.2	50	0.1	10	0.1	20	0.1	20
Cassinia sifton	Sifton Bush	-	-	0.1	10	-	-	-	-	-	-
Daviesia genistifolia	Broom Bitter Pea	-	-	-	-	-	-	-	-	0.1	1
Dodonaea viscosa subsp. *cuneata*	Wedge-leaf Hop-bush	-	-	-	-	-	-	0.2	10	0.1	10
Hibbertia circumdans	-	-	-	-	-	-	-	0.1	10	-	-
Leucopogon juniperinus	Prickly Beard-heath	-	-	0.2	1	-	-	-	-	-	-
Leucopogon muticus	Blunt Beard-heath	-	-	-	-	-	-	0.1	10	-	-
Lissanthe strigosa subsp. *subulata*	Peach Heath	-	-	0.1	1	-	-	-	-	-	-
Persoonia linearis	Narrow-leaved Geebung	0.1	3	0.5	20	-	-	1	10	0.1	10
Phyllanthus hirtellus	Thyme Spurge	-	-	0.1	5	-	-	0.1	20	0.1	5
Poranthera corymbosa	-	-	-	-	-	0.1	20	0.2	10	-	-
Solanum campanulatum	-	25	100	0.1	5	3	20	0.5	10	-	-
Solanum cinereum	Narrawa Burr	0.2	3	-	-	-	-	0.1	10	0.1	1
Ferns											
Cheilanthes austrotenuifolia	Rock Fern	-	-	-	-	-	-	0.1	20	-	-
Cheilanthes sieberi subsp. *sieberi*	Mulga Fern	0.1	5	0.2	20	0.3	20	-	-	-	-
Forbs											

Scientific name	Common name	Plot 17		Plot 18		Plot 19		Plot 20		Plot 21	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Acianthus fornicatus	Pixie Caps	-	-	-	-	-	-	0.1	2	-	-
Asperula conferta	Common Woodruff	5	500	-	-	0.5	50	-	-	-	-
Calotis cuneifolia	Purple Burr-daisy	-	-	0.1	5	0.1	10	0.1	20	0.1	10
Calotis lappulacea	Yellow Burr-daisy	0.1	1	-	-	0.1	10	-	-	-	-
Cymbonotus lawsonianus	Bears-ear	-	-	-	-	0.1	10	-	-	-	-
Cynoglossum australe	-	2	100	0.1	10	0.5	100	0.1	20	-	-
Dichondra repens	Kidney Weed	5	1000	20	1000	5	500	0.1	20	0.1	10
Einadia hastata	Berry Saltbush	-	-	-	-	-	-	0.5	100	0.1	10
Einadia nutans subsp. *nutans*	Climbing Saltbush	-	-	-	-	-	-	0.2	10	-	-
Euchiton sphaericus	-	0.1	10	-	-	0.2	100	-	-	0.1	5
Galium leiocarpum	-			-	-			0.1	10	-	-
Geranium homeanum	-	0.2	50	-	-	-	-	-	-	-	-
Gonocarpus tetragynus	-	-	-	-	-	0.2	20	-	-	-	-
Goodenia hederacea subsp. *hederacea*	Ivy Goodenia	-	-	0.1	50	-	-	-	-	-	-
Haloragis heterophylla	Rough Raspwort	0.1	20	-	-	0.1	10	-	-	-	-
Hydrocotyle laxiflora	Stinking Pennywort	5	1000	-	-	1	100	0.1	20	-	-
Oxalis perennans	-	0.1	5	0.1	20	0.1	20	0.1	20	-	-
Pomax umbellata	-	-	-	20	1000	-	-	1	100	0.1	10

Scientific name	Common name	Plot 17		Plot 18		Plot 19		Plot 20		Plot 21	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Poranthera microphylla	-	-	-	0.1	3	0.1	50	0.1	20	-	-
Pterostylis spp.	Greenhood	-	-	-	-	-	-	0.1	10	0.1	10
Scutellaria humilis	Dwarf Skullcap	-	-	-	-	-	-	-	-	0.1	5
Sigesbeckia orientalis subsp. *orientalis*	Indian Weed	0.3	50	-	-	0.2	50	-	-	0.1	5
Solanum prinophyllum	Forest Nightshade	1	20	0.1	5	0.1	5	-	-	-	-
Stellaria pungens	Prickly Starwort	1	100	-	-	-	-	-	-	-	-
Stuartina muelleri	Spoon Cudweed	-	-	-	-	-	-	0.1	20	-	-
Stylidium laricifolium	Giant Trigger-plant	-	-	-	-	-	-	0.1	10	-	-
Veronica plebeia	Trailing Speedwell	-	-	-	-	0.5	100	0.1	20	-	-
Vittadinia muelleri	-	-	-	-	-	-	-	0.1	20	-	-
Wahlenbergia communis	Tufted Bluebell	0.1	10	-	-	0.1	5	-	-	-	-
Wahlenbergia gracilis	Sprawling Bluebell	-	-	0.1	1	-	-	-	-	-	-
Wahlenbergia spp.	-	-	-	-	-	-	-	-	-	0.1	50
Xerochrysum bracteatum	Golden Everlasting	-	-	0.1	1	0.5	20	-	-	-	-
Grasses and Graminoids											
Aristida ramosa	Purple Wiregrass	-	-	0.1	20	-	-	-	-	-	-
Aristida spp.	-	-	-	-	-	-	-	0.2	10	-	-

Scientific name	Common name	Plot 17		Plot 18		Plot 19		Plot 20		Plot 21	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Aristida vagans	Threeawn Speargrass	-	-	0.1	20	0.2	50	-	-	-	-
Austrostipa densiflora	-	-	-	-	-	-	-	0.1	10	-	-
Austrostipa scabra subsp. *falcata*	-	-	-	0.1	20	0.1	10	-	-	-	-
Austrostipa scabra subsp. *scabra*	Speargrass	-	-	-	-	-	-	0.2	10	-	-
Austrostipa spp.	-	-	-	-	-	-	-	0.1	10	-	-
Cleistochloa rigida	-	-	-	-	-	-	-	5	500	1	10
Dichelachne micrantha	Shorthair Plumegrass	-	-	0.1	10	-	-	-	-	-	-
Digitaria breviglumis	-	-	-	0.1	10	-	-	5	100	0.2	10
Digitaria spp.	-	-	-	0.5	100	5	500	-	-	-	-
Echinopogon caespitosus var. *caespitosus*	Tufted Hedgehog Grass	5	500	0.3	100	-	-	-	-	-	-
Echinopogon ovatus	Forest Hedgehog Grass	-	-	-	-	1	100	0.2	10	-	-
Gahnia aspera	Rough Saw-sedge	-	-	0.2	8	1	20	0.2	10	0.1	10
Lepidosperma laterale	Variable Swordsedge	-	-	-	-	-	-	0.2	10	-	-
Lomandra confertifolia subsp. *pallida*	-	5	100	0.2	20	0.5	20	-	-	-	-
Lomandra filiformis subsp. *filiformis*	Wattle Mat-rush	-	-	-	-	-	-	-	-	0.1	20

Scientific name	Common name	Plot 17		Plot 18		Plot 19		Plot 20		Plot 21	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	-	-	-	-	-	-	-	-	0.1	5
Microlaena stipoides var. *stipoides*	Weeping Grass	25	2000	0.3	100	10	1000	0.5	100	0.2	10
Panicum effusum	Hairy Panic	-	-	-	-	-	-	0.2	10	-	-
Paspalidium spp. 1	-	-	-	-	-	1	100	-	-	-	-
Rytidosperma pallidum	Silvertop Wallaby Grass	-	-	-	-	-	-	3	50	-	-
Rytidosperma spp.	-	-	-	-	-	1	100	-	-	0.1	10
Other											
Amyema miquelii	-	-	-	-	-	-	-	0.2	1	0.2	1
Clematis spp.	-	0.5	20	-	-	0.2	10	0.1	5	-	-
Glycine clandestina	-	0.2	50	0.1	5	0.1	50	0.1	20	0.1	10
Glycine tabacina	-	0.1	20	-	-	0.1	50	0.1	20	0.1	10
Grona varians	Slender Tick-trefoil	0.1	2	-	-	-	-	0.1	20	-	-
Macrozamia secunda	-	-	-	0.1	1	-	-	-	-	-	-

Scientific name	Common name	Plot 22		Plot 23		Plot 24		Plot 25	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Trees									
Acacia linearifolia	Narrow-leaved Wattle	2	20	1	100	0.1	5	-	-
Angophora floribunda	Rough-barked Apple	-	-	20	20	-	-	0.1	1

Scientific name	Common name	Plot 22		Plot 23		Plot 24		Plot 25	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Eucalyptus blakelyi	Blakely's Red Gum	-	-	5	2	-	-	-	-
Eucalyptus crebra	Narrow-leaved Ironbark	-	-	-	-	2	2	-	-
Eucalyptus dawsonii	Slaty Gum	-	-	-	-	20	20	-	-
Eucalyptus melliodora	Yellow Box	-	-	-	-	-	-	15	5
Eucalyptus punctata	Grey Gum	20	10	-	-	-	-	-	-
Shrubs									
Acacia buxifolia subsp. *buxifolia*	Box-leaf Wattle	-	-	-	-	-	-	0.1	1
Acacia implexa	Hickory Wattle	-	-	-	-	-	-	1	100
Acrotriche rigida	-	1	10	0.5	10	7	20	-	-
Astroloma humifusum	Native Cranberry	-	-	-	-	-	-	0.1	1
Brachyloma daphnoides subsp. *daphnoides*	-	-	-	0.1	5	-	-	-	-
Bursaria spinosa subsp. *spinosa*	Blackthorn	0.1	1	-	-	0.1	5	0.2	5
Cassinia cunninghamii	Cunninghams Everlasting	1	10	-	-	-	-	-	-
Cassinia quinquefaria	-	0.5	10	0.1	100	0.2	50	-	-
Correa reflexa var. *reflexa*	Native Fuchsia	0.1	1	-	-	-	-	-	-
Dodonaea viscosa subsp. *cuneata*	Wedge-leaf Hop-bush	0.1	20	-	-	1	20	-	-
Exocarpos cupressiformis	Cherry Ballart	-	-	0.2	2	-	-	-	-
Hibbertia circumdans	-	-	-	0.1	5	-	-	-	-
Hibbertia obtusifolia	Hoary Guinea Flower	-	-	-	-	-	-	0.1	10
Indigofera adesmiifolia	Tick Indigo	-	-	-	-	0.1	10	-	-
Indigofera australis	Australian indigo	0.1	1	-	-	-	-	-	-
Leucopogon muticus	Blunt Beard-heath	-	-	0.2	5	0.1	5	-	-

Scientific name	Common name	Plot 22		Plot 23		Plot 24		Plot 25	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Lissanthe strigosa subsp. *subulata*	Peach Heath	-	-	-	-	0.2	20	0.1	10
Melichrus erubescens	Ruby Urn Heath	-	-	-	-	-	-	0.2	5
Persoonia linearis	Narrow-leaved Geebung	2	10	0.1	10	0.1	5	-	-
Phebalium squamulosum subsp. *lineare*	Scaly Phebalium	0.1	20	-	-	-	-	-	-
Phyllanthus hirtellus	Thyme Spurge	0.1	5	0.1	5	-	-	-	-
Platysace ericoides	-	-	-	-	-	0.1	5	-	-
Podolobium ilicifolium	Prickly Shaggy Pea	0.1	1	-	-	-	-	0.1	1
Poranthera corymbosa	-	0.1	10	-	-	-	-	0.1	5
Pultenaea microphylla	-	-	-	-	-	0.1	5	-	-
Solanum campanulatum	-	0.1	5	0.1	10	0.1	20	-	-
Solanum cinereum	Narrawa Burr	0.5	50	0.2	20	-	-	-	-
Ferns									
Cheilanthes austrotenuifolia	Rock Fern	-	-	0.2	100	-	-	-	-
Cheilanthes sieberi subsp. *sieberi*	Mulga Fern	0.1	10	-	-	-	-	0.1	10
Forbs									
Acaena ovina	-	-	-	-	-	-	-	0.1	20
Bossiaea prostrata	-	-	-	-	-	-	-	0.1	10
Calotis cuneifolia	Purple Burr-daisy	-	-	0.2	100	0.1	20	0.1	10
Cymbonotus lawsonianus	Bears-ear	-	-	0.1	20	-	-	-	-
Cynoglossum australe	-	-	-	0.1	10	-	-	-	-
Dianella longifolia var. *longifolia*	Blueberry Lily	-	-	-	-	-	-	0.1	10
Dianella revoluta var. *revoluta*	Blue Flax-Lily	0.1	5	0.1	10	-	-	0.2	100

Scientific name	Common name	Plot 22		Plot 23		Plot 24		Plot 25	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Dichondra repens	Kidney Weed	0.1	20	1	500	0.1	20	0.1	10
Einadia hastata	Berry Saltbush	-	-	-	-	0.1	20	-	-
Einadia polygonoides	-	0.1	10	-	-	-	-	-	-
Euchiton sphaericus	-	-	-	-	-	-	-	0.1	20
Galium leiocarpum	-	0.1	10	0.2	100	-	-	-	-
Geranium solanderi var. *solanderi*	Native Geranium	-	-	-	-	-	-	0.1	20
Gonocarpus tetragynus	-	-	-	-	-	-	-	0.1	10
Goodenia hederacea subsp. *hederacea*	Ivy Goodenia	-	-	-	-	0.1	50	-	-
Hydrocotyle laxiflora	Stinking Pennywort	-	-	0.1	20	-	-	1	500
Opercularia diphylla	-	-	-	-	-	0.1	10	-	-
Opercularia hispida	Hairy Stinkweed	0.1	20	-	-	-	-	-	-
Pomax umbellata	-	0.1	10	1	100	0.1	50	-	-
Poranthera microphylla	-	-	-	-	-	0.1	20	0.1	20
Pterostylis spp.	Greenhood	-	-	0.1	20	0.1	5	0.1	50
Scutellaria humilis	Dwarf Skullcap	-	-	0.1	20	-	-	-	-
Sigesbeckia orientalis subsp. *orientalis*	Indian Weed	0.1	5	0.1	5	-	-	-	-
Stellaria pungens	Prickly Starwort	0.1	20	-	-	-	-	0.1	20
Thelymitra spp.	-	-	-	-	-	-	-	0.1	5
Templetonia stenophylla	Leafy Templetonia			0.1	5				
Veronica plebeia	Trailing Speedwell	-	-	0.2	10	0.1	20	0.1	10
Vittadinia muelleri	-	-	-	-	-	-	-	0.1	20
Wahlenbergia communis	Tufted Bluebell	-	-	0.1	100	-	-	-	-
Wahlenbergia spp.	-	0.1	10	0.1	100	0.1	50	2	1000
Grasses and Graminoids									
Aristida ramosa	Purple Wiregrass	-	-	0.2	10	0.2	20	-	-

Scientific name	Common name	Plot 22		Plot 23		Plot 24		Plot 25	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Aristida spp.	-	-	-	-	-	1	100	-	-
Aristida vagans	Threeawn Speargrass	-	-	1	100	0.3	50	15	500
Arundinella nepalensis	Reedgrass	-	-	0.5	10	-	-	-	-
Austrostipa bigeniculata	-	-	-	-	-	0.1	2	-	-
Austrostipa scabra subsp. *scabra*	Speargrass	-	-	-	-	0.5	100	1	100
Austrostipa verticillata	Slender Bamboo Grass	-	-	-	-	-	-	0.5	10
Bothriochloa macra	Red Grass	-	-	-	-	-	-	1	100
Cleistochloa rigida	-	1	50	-	-	-	-	-	-
Cyperus spp.	-	-	-	0.1	10	-	-	-	-
Dichelachne micrantha	Shorthair Plumegrass	-	-	-	-	0.1	10	0.5	50
Digitaria breviglumis	-	0.2	10	1	100	0.5	10	-	-
Digitaria diffusa	Open Summer-grass	-	-	1	100	-	-	-	-
Echinopogon ovatus	Forest Hedgehog Grass	-	-	1	100	-	-	1	100
Eragrostis brownii	Brown's Lovegrass	-	-	1	100	-	-	-	-
Gahnia aspera	Rough Saw-sedge	1	100	1	100	0.2	20	1	50
Lepidosperma laterale	Variable Swordsedge	0.2	10	-	-	-	-	1	50
Lomandra confertifolia subsp. *pallida*	-	0.2	10	25	500	-	-	10	100
Lomandra glauca	Pale Mat-rush	0.1	20	-	-	0.1	20	-	-
Lomandra longifolia		-	-	0.1	5	-	-	-	-
Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	0.1	10	-	-	0.1	20	0.1	20

Scientific name	Common name	Plot 22		Plot 23		Plot 24		Plot 25	
		% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Microlaena stipoides var. *stipoides*	Weeping Grass	0.1	20	10	500	0.2	10	10	1000
Panicum effusum	Spiny-headed Mat-rush	-	-	-	-	-	-	0.5	100
Rytidosperma caespitosum	Ringed Wallaby Grass	0.2	10	-	-	-	-	-	-
Rytidosperma pallidum	Silvertop Wallaby Grass	0.5	100	-	-	0.5	10	-	-
Rytidosperma spp.	-	-	-	-	-	-	-	1	100
Themeda triandra	Kangaroo Grass	-	-	-	-	-	-	5	100
Other									
Amyema miquelii		0.2	5	-	-	0.2	2	-	-
Clematis spp.	-	0.1	5	-	-	-	-	1	100
Glycine clandestina	-	0.1	10	0.1	10	0.1	20	-	-
Glycine tabacina	-	0.1	10	-	-	-	-	-	-
Grona varians	Slender Tick-trefoil	-	-	0.1	5	-	-	-	-
Hardenbergia violacea	False Sarsaparilla	0.1	1	-	-	-	-	-	-
Macrozamia secunda	-	0.1	1	-	-	-	-	-	-
Marsdenia viridiflora	Native Pear	-	-	-	-	0.1	5	-	-
High Threat Weeds									
Hypericum perforatum	St. John's Wort	-	-	-	-	-	-	0.1	5

Note: field data was collected in electronic format, therefore raw data sheets have not been provided.

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Annex 4. Vegetation integrity transect scores

Plots	PCT	Composition						Structure						Function						Easting	Northing	50 m transect bearing
		TG	SG	GG	FG	EG	OG	TG	SG	GG	FG	EG	OG	NLT	TSSC	NTH	FL	LL*	HTW			
P1	434	4	8	17	21	1	6	12.6	7.8	32.7	14.1	1	0.8	2	<5, 5-9, 10-29, 20-29, 30-49, 50-79	1	7	50	0	763202	6418480	315
P2	434	3	6	17	17	1	4	1.6	1.1	30.6	17.8	2	0.9	0	<5, 5-9, 10-29, 20-29, 30-49, 50-79	0	5.4	40	0	763027	6418677	5
P3	1614	5	6	9	20	2	2	16.3	0.8	2.7	3.7	1.1	0.2	1	<5	1	32	60	0	763097	6418695	15
P4	434	2	7	11	12	1	2	8.1	1.7	27.3	20.6	2	0.4	0	<5, 5-9, 20-29, 50-79	0	8.4	45	0.2	763075	6418814	5
P5	478	4	11	7	3	0	0	14	5.7	5.3	0.7	0	0	0	5-9,10-19,20-29,30-49,50-79	5	60	50	0	762638	6418960	10
P6	472	2	2	9	11	0	1	6.1	8.1	10.6	69.2	0	0.2	1	<5,10-19,20-29,30-49,50-79	0	4	25	0	763316	6419154	170
P8	478	3	13	7	7	1	2	15.1	6.7	0.8	0.8	0.1	0.2	1	<5,5-9,10-19,20-29,30-49,50-79	1	51	90	0	763088	6419514	185
P9	478	4	10	6	2	0	0	19	4	3.2	0.4	0	0	1	<5,5-9,10-	2	58	220	0	762838	6419296	45

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Plots	PCT	Composition						Structure						Function						Easting	Northing	50 m transect bearing
		TG	SG	GG	FG	EG	OG	TG	SG	GG	FG	EG	OG	NLT	TSSC	NTH	FL	LL*	HTW			
															19,20-29,30-49,50-79							
P10	1629	3	6	2	4	0	0	20.5	2.1	4.1	0.5	0	0	1	10-19,20-29,30-49,50-79	4	54	150	0	762801	6419160	275
P11	1767	2	6	10	18	1	5	39	2.8	12	27.3	0.2	0.5	1	5-9,10-19,20-29,30-49,50-79	0	44	70	0.1	762840	6419028	135
P12	1629	2	6	7	3	0	0	17	1.9	1.8	0.8	0	0	0	10-19,20-29,30-49,50-79	2	62	70	0	762472	6418954	200
P13	479	4	10	13	20	1	1	16.4	3.5	35	5.5	0.5	0.3	1	<5,5-9,10-19,20-29,30-49,50-79	0	19	50	0	763189	6419499	75
P14	472	4	4	11	8	0	2	15.5	25.4	7.5	1.2	0	0.4	2	<5,5-9,10-19,20-29,30-49,50-79	0	63	45	0	763220	6419166	45
P15	1176 - Low	4	8	9	5	0	0	11.1	6.3	0.9	0.6	0	0	0	<5,5-9,10-19,20-29,30-49	0	33	45	0	763184	6419052	70
P16	1767	2	7	8	18	1	6	20.1	1.7	46.3	10.1	1	0.7	0	<5,5-9,10-19,20-29,30-49,50-79	0	26	20	0	763309	6418795	340

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Plots	PCT	Composition						Structure						Function						Easting	Northing	50 m transect bearing
		TG	SG	GG	FG	EG	OG	TG	SG	GG	FG	EG	OG	NLT	TSSC	NTH	FL	LL*	HTW			
P17	1767	3	4	3	13	1	4	35.1	25.5	35	20	0.1	0.9	4	0	1	14	35	0	763441	6418593	270
P18	479	3	7	10	10	1	2	23	1.7	2	40.8	0.2	0.2	0	<5,5-9,10-19,20-29,30-49,50-79	0	74	80	0	763269	6418936	10
P19	1767	3	5	9	17	1	3	30.2	7.3	19.8	9.4	0.3	0.4	2	<5,5-9,10-19,20-29,30-49,50-79	2	54	1	0	762969	6419022	220
P20	1767	3	12	12	15	1	5	11	5.6	14.9	2.9	0.1	0.6	1	<5,5-9,10-19,20-29,30-49,50-79	1	26	220	0	762830	6418872	47
P21	1176 - Moderate	4	7	7	9	0	3	25.3	1.6	1.8	0.9	0	0.4	0	<5,5-9,10-19,20-29,30-49	1	83	55	0	762980	6418869	34
P22	1629	2	14	10	9	1	6	22	5.9	3.6	0.9	0.1	0.7	3	<5,5-9,10-19,20-29,30-49,50-79	1	69	70	0	763181	6418834	200
P23	1767	3	10	12	15	1	2	26	1.7	41.9	3.6	0.2	0.2	2	<5,5-9,10-19,20-29,30-49,50-79	0	57	50	0	763292	6418841	90
P24	1176 - Moderate	3	11	12	10	0	2	22.1	9.1	3.8	1	0	0.3	0	<5,5-9,10-	0	75.6	65	0	763256	6419136	145

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Plots	PCT	Composition						Structure						Function						Easting	Northing	50 m transect bearing
		TG	SG	GG	FG	EG	OG	TG	SG	GG	FG	EG	OG	NLT	TSSC	NTH	FL	LL*	HTW			
															19,20-29,30-49							
P24	1610	2	9	14	17	1	1	15.1	2	47.6	5	2	1	0	<5,5-9,10-19,20-29,30-49	0	36	33	0.1	762397	6418772	95

Key to growth form groups: TG - Tree; SG - Shrub; GG - Grass and Grass-like; FG - Forb; EG - Fern; OG – Other; **Function codes:** NLT - Number of large trees; TSSC - Tree Stem Size Class; NTH - Number of trees with hollows; FL - Course Woody Debris (fallen logs); LL - mean leaf litter cover; HTW - High Threat Weeds

* 1 m^2 litter quadrats were placed at 5 m (left), 15 m (right), 25 m (left), 35 m (right) and 45 m (left) along the central 50 m transect, all positioned 5 m from the transect centreline and alternating to the left and right from the transect centreline (as indicated).

Note: field data was collected in electronic format, therefore raw data sheets have not been provided.

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Annex 5. Threatened species matrix, status and likelihood of occurrence

An assessment of the likelihood for threatened flora to occur within the subject land was undertaken based on the results of the desktop data review. No analysis was undertaken regarding TECs due to this analysis previously having been undertaken by Eco Logical Australia (ELA) prior to conducting the field surveys for the baseline vegetation assessment as detailed in Section 2.4 of the *Moolarben Coal Complex UG2 Modification - Baseline Vegetation Assessment* (ELA 2021). The likelihood of occurrence assessment was subsequently revised upon conclusion of the targeted flora and fauna surveys to reflect the results and increased understanding of habitat potential derived from detailed assessment of the subject land.

The resources listed in Section 2.3 informed the compilation of the likelihood of occurrence table below. Five categories for 'likelihood of occurrence' (detailed below) were attributed to the list of threatened species after consideration of criteria such as known records, presence or absence of important habitat features in the subject land, results of the field surveys and professional judgement. This process was completed on an individual species basis.

Species considered further were those in the 'Confirmed' to 'Moderate' categories, and where **impacts to the species could reasonably occur** from the Modification.

Likelihood of Occurrence Criteria

Likelihood Rating	Criteria
Confirmed	The species was observed within the subject land.
High	It is likely that a species uses potential habitat within the subject land based on nearby known records of the species.
Moderate	Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the subject land.
Low	It is unlikely that the species inhabits the subject land as adequate field surveys have not detected the species within the subject land.
None	The species has not been recorded within the subject land and habitat within the subject land is unsuitable for the species.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Amphibians							
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with more sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis.	Low	Low	No previous records within the locality. No perennial waterways or permanent pools forming breeding habitat in or within 300 m of the subject land. Waterways in the subject land are ephemeral; therefore, likelihood of species habitat being in the subject land is low despite the presence of associated PCT 1629.
Litoria booroolongensis	Booroolong Frog	E	E	The Booroolong Frog is found along permanent western flowing streams of the Great Dividing Range through most of NSW and down into northern Victorua. Streams range from small slow-flowing creeks to large rivers and the adults are found on or near cobble banks and other rock structures within stream margins and shelter under rocks or amongst vegetation near the ground on the stream edge. The species occurs along streams in both forested areas and open pasture, but has been affected by the presence of the introduced willow tree. Booroolong Frogs sometimes basks in the sun on exposed rocks near flowing water during summer.	Low	Low	No previous records within the locality. No perennial waterways or permanent pools forming breeding habitat in or within 300 m of the subject land. Ephemeral waterways and drainage lines in the subject land are all eastward flowing whereas this species requires westward flowing waterways; therefore, likelihood of species habitat being in the subject land is low despite the presence of associated PCTs.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Pseudophryne australis	Red-crowned Toadlet	V	-	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger semi-perennial streams. After rain these creeks are characterised by a series of shallow pools lined by dense grasses, ferns and low shrubs and usually contain leaf litter for shelter. Eggs are terrestrial and laid under litter, vegetation or rocks where the tadpoles inside will reach a relatively late stage of development before waiting for flooding waters before hatching will occur.	Moderate	Low	No previous records within the locality. Associated PCT 1629 occurs within the subject land in close proximity to ephemeral waterway and sandstone rock outcrops. The drainage line running through the north-eastern boundary was determined to be potentially suitable for the Red-crowned Toadlet *Pseudophryne australis*; however, subsequent targeted surveys did not result in detection of this species and determined that the vegetation and leaf litter cover along the drainage line was inadequate for Red-crowned Toadlet which prefer dense vegetation and/or thick piles of leaf litter (DPIE 2021a; TSSC 2002).
Birds							
Anthochaera phrygia	Regent Honeyeater	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. The distribution of the species has contracted	High	High	Species has been previously recorded on 92 occasions with nearest record located 1.6 km to

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.			the south-east of the subject land. This species is reliant on Mistletoe which occurs in high densities in the subject land. The subject land occurs on a mapped important area for this species.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Dusky woodswallows are widespread in eastern, southern and south western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris.	High	Confirmed	Species has been previously recorded on 145 occasions with nearest record located 1.6 km to the south-east of the subject land. Foraging and breeding habitat occurs throughout the subject land in PCTs 434, 472, 478, 479 and 1176. This species has been detected in the subject land during current surveys (ELA 2021)
Burhinus grallarius	Bush Stone-curlew	E	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights.	Moderate	Moderate	Species has been previously recorded on one occasion located 1.6 km to the south-east of the subject land. Foraging and breeding habitat occurs in low lying PCTs 434, 472, 1176 and 1629 across the subject land.
Calidris ferruginea	Curlew Sandpiper	E	CE	The Curlew Sandpiper is distributed around most of the coastline of Australia. It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally	Low	Low	No previous records within the locality and no associated PCTs within the subject land. No wetlands,

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland			swamps, lakes or lagoons forming habitat located in the subject land.
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine snow gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	Moderate	Moderate	Species has been previously recorded on 21 occasions with nearest record located 1.6 km to the south-east of the subject land. Foraging and breeding habitat (HBTs) occurs throughout the subject land in PCTs 1176 and 1629.
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Inhabits forest with low nutrients, characteristically with key Allocasuarina spp. Tends to prefer drier forest types with a middle stratum of Allocasuarina below Eucalyptus or Angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina.	Moderate	Low	Species has been previously recorded on 4 occasions with nearest record located 4.4 km to the north-west of the subject land. No foraging habitat formed from Allocasuarina spp. and Casuarina spp. occurs within the subject land. H The survey was conducted during the breeding period for this species and, whilst the survey identified 28 hollow-bearing trees forming potential breeding habitat, no foraging habitat occurs

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							in the subject land and no sign of breeding pairs were detected on or near the hollow-bearing trees or within the subject land.
Certhionyx variegatus	Pied Honeyeater	V	-	Widespread throughout Acacia, mallee and spinifex scrubs of arid and semi-arid Australia. Occasionally occurs further east, on the slopes and plains and the Hunter Valley, typically during periods of drought. Inhabits mulga shrub, mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering; feeds on nectar, predominantly from various species of emu-bushes; also from mistletoes and various other shrubs; also eats saltbush fruit, berries, seed, flowers and insects.	Low	Low	Species has been previously recorded on one occasion located 5.9 km to the south-east of the subject land. No associated PCTs occur within the subject land; however, the subject land does contain Mistletoe at a high density which may form potential foraging and breeding habitat for this species.
Chthonicola sagittata	Speckled Warbler	V	-	The Speckled Warbler lives in a wide range of eucalypt dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	High	High	Species has been previously recorded on 235 occasions with nearest record located 5.9 km to the south-east of the subject land. Foraging and breeding habitat occurs throughout the subject land in PCTs 434, 472, 1176, 1610, 1614, 1629 and 1767.
Circus assimilis	Spotted Harrier	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densly forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single	Moderate	Moderate	Species has been previously recorded on 1 occasion located 8.8 km to the north of the subject

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				population. Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.			land. Foraging and habitat) occurs throughout the subject land in PCTs 434 and 472. No breeding habitat or traces of stick nests was identified in the subject land during surveys.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	Found in eucalypt woodlands (including box-gum woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and river red gum forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	High	Confirmed	Species has been previously recorded on 285 occasions with nearest record located 1.9 km to the north-east of the subject land. Foraging and breeding habitat occurs throughout the subject land in PCTs 434, 472, 1176, 1610, 1614, 1629 and 1767. This species has been recorded on multiple occasions within the subject land (AMBS 2021, ELA 2021).
Daphoenositta chrysoptera	Varied Sittella	V	-	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.	High	Confirmed	Species has been previously recorded on 38 occasions with nearest record located 2.4 km to the south-west of the subject land. Foraging and breeding habitat occurs throughout the subject land in PCTs 434, 472, 1176, 1610, 1614, 1629 and 1767. This species has

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							been recorded on multiple occasions within the subject land (AMBS 2021).
Epthianura albifrons	White-fronted Chat	V	-	Low vegetation in salty coastal and inland areas and crops. Runs along ground and is found in local flocks in Winter. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas.	Low	Low	One previous record within the locality located 6.3 km to the south-east. No associated PCTs occur within the subject land. No wetlands, swamps, lakes or lagoons forming habitat located in the subject land.
Falco hypoleucos	Grey Falcon	E		Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range.	Low	Low	No previous records for this species within the locality and no associated PCTs mapped within the subject land. Woodlands and forests covering the subject land may harbour prey for this species; however, no suitable breeding habitat or traces of stick nests was detected during surveys. It is considered unlikely to occur due to absence of records and associated PCTs.
Falco subniger	Black Falcon	V	-	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that	Low	Low	Species has been previously recorded on 1 occasion located 7.5 km to the south-east of the subject land. No associated PCTS for this species have been mapped in the

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				falcons are highly mobile, commonly travelling hundreds of kilometres.			subject land. Woodlands and forests covering the subject land may harbour prey for this species; however, no suitable breeding habitat or traces of stick nests was detected during surveys. It is considered unlikely to occur due to low number and distance of record and lack of associated PCTs.
Glossopsitta pusilla	Little Lorikeet	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	High	Confirmed	Species has been previously recorded on 61 occasions with nearest record located 2.7 km to the north of the subject land. Foraging and breeding habitat occurs throughout the subject land in PCTs 434, 472, 478, 479, 1176, 1610, 1614 and 1629 which contain suitable HBTS for the species. Species confirmed present during surveys.
Grantiella picta	Painted Honeyeater	V	V	Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.	High		Species has been previously recorded on 27 occasions with nearest record located 5.9 km to the south-east of the subject land. Foraging and breeding habitat occurs throughout the subject

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							land in PCTs 434, 472, 478, 479, 1176, 1610, 1629 and 1767 which contain Mistletoe at a density suitable for the species.
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways.	Moderate	Moderate	No previous records of this species within the locality. One associated PCT (434) for this species has been mapped in the subject land. Woodlands and forests covering the subject land may harbour supplementary prey for this species; however, no suitable breeding habitat or traces of stick nests were detected during surveys. No perennial waterways which provide primary prey items occur in the subject land.
Hieraaetus morphnoides	Little Eagle	V	-	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.	Moderate	Moderate	Species has been previously recorded on 16 occasions with nearest record located 6.7 km to the north-west of the subject land. Foraging habitat formed from associated PCTs 434, 472, 1176 and 1628 has been mapped in the subject land. No suitable breeding habitat or traces of stick

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							nests was detected during surveys.
Hirundapus caudacutus	White-throated Needletail	-	V	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Migratory and usually seen in eastern Australia from October to April. More common in coastal areas, less so inland.	Moderate	Moderate	No previous records for this species within the locality; however, this species was recorded nearby in surveys undertaken for the Stage 2 EIS (Ecovision 2008). Flyways above PCTs 434, 472, 478, 479, 1176, 1610, 1614, 1629 and 1767 form foraging habitat for this species; however, it is unlikely to roost in the subject land.
Lathamus discolor	Swift Parrot	E	CE	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects . The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW . This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	Moderate	Confirmed	Species has been previously recorded on one occasion located 6.3 km to the north of the subject land. Foraging habitat formed from associated PCTs 434, 472, 1176 and 1629 has been mapped in the subject land. This species does not breed on the Australia mainland and the subject land does not contain a mapped important area. Species recorded during surveys.
Leipoa ocellata	Malleefowl	E	V	Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Utilises mallee	Low	Low	No previous records for this species within the locality and no associated

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				with a spinifex understorey, but usually at lower densities than in areas with a shrub understorey. Less frequently found in other eucalypt woodlands, such as inland grey box, ironbark or bimble box woodlands with thick understorey, or in other woodlands such dominated by mulga or native cypress pine species.			PCTs mapped on the subject land. No signs of breeding habitat (I.e., mounds) were observed during the current survey.
Lophoictinia isura	Square-tailed Kite	V	-	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata or E. smithii. Individuals appear to occupy large hunting ranges of more than 100km2. They require large living trees for breeding, particularly near water with surrounding woodland -forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	Moderate	Moderate	Species has been previously recorded on 8 occasions with nearest record located 5.9 km to the south-east of the subject land. The subject land contains foraging habitat for this species in associated PCTs 434, 472, 1176, 1610 and 1629 which harbour suitable prey species. No suitable breeding habitat or traces of stick nests were detected during surveys.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Occupy a wide range of eucalypt woodlands, Acacia shrublands and open forests. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. The south-eastern form (subspecies cucullata) is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies picata.	Moderate	Moderate	Species has been previously recorded on 58 occasions with nearest record located 2.8 km to the north of the subject land. This species was detected during surveys undertaken for the Stage 2 EIS (Ecovision 2008). Foraging and breeding habitat formed from associated PCTs 434, 472, 1176, 1610, 1614, 1629

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							and 1767 has been mapped in the subject land.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond and Clarence River areas. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions, though it is very rare in the latter.	Moderate	Moderate	Species has been previously recorded on 44 occasions with nearest record located 5.9 km to the south-east of the subject land. This species was detected during surveys undertaken for the Stage 2 EIS (Ecovision 2008). Foraging and breeding habitat formed from associated PCTs 434, 472, 1176 and 1629 has been mapped in the subject land.
Neophema pulchella	Turquoise Parrot	V	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	Moderate	Moderate	Species has been previously recorded on 30 occasions with nearest record located 1 km to the west of the subject land. Foraging and breeding habitat formed from associated PCTs 434, 472, 478, 479, 1176, 1610, 1629 and 1767, containing HBTs suitable for the species which has been mapped in the subject land.
Ninox connivens	Barking Owl	V	-	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country.	Moderate	Moderate	There are no previous records of this species within the locality. The

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							subject land contains foraging habitat for this species in associated PCTs 434, 472, 478, 479, 1610, 1614, 1629 and 1767 which harbour suitable prey species. HBTs forming suitable breeding habitat have been mapped in the subject land; however, no signs of breeding were detected within the subject land and no traces of breeding or other use were detected within a 10 m radius of suitable HBTs.
Ninox strenua	Powerful Owl	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	High	High	Species has been previously recorded on 22 occasions with nearest record located 5.9 km to the south-east of the subject land. The subject land contains foraging habitat for this species in associated PCTs 1176 and 1629 which harbour suitable prey species. HBTs forming suitable breeding habitat have been mapped in the subject land; however, no signs of breeding were detected within the subject land and no traces of breeding or other use were detected

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							within a 10 m radius of suitable HBTs.
Numenius madagascariensis	Eastern Curlew	-	CE	A primarily coastal distribution. Found in all states, particularly the north, east, and south-east regions including Tasmania. Rarely recorded inland. Mainly forages on soft sheltered intertidal sand flats or mudflats, open and without vegetation or cover. Breeds in the northern hemisphere.	Low	Low	No previous records within the locality and no associated PCTs within the subject land. No wetlands, swamps, lakes or lagoons forming habitat and no important mapped areas located in the subject land.
Petroica boodang	Scarlet Robin	V	-	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	Moderate	Confirmed	Species has been previously recorded on 15 occasions with nearest record located 3.9 km to the south-west of the subject land. Foraging and breeding habitat formed from associated PCTs 434, 472, 1176, 1614 and 1629 has been mapped in the subject land. Species recorded during surveys.
Petroica phoenicea	Flame Robin	V	-	Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. The preferred habitat in summer includes eucalyptus forests and woodland, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January.	Low	Low	Species has been previously recorded on 2 occasions with nearest record located 8 km to the south-east of the subject land. Foraging and breeding habitat formed from associated PCTs 434, 1614 and 1629 has been mapped in the subject land.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Petroica rodinogaster	Pink Robin	V	-	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	Low	Low	Species has been previously recorded on 1 occasion located 5.9 km to the south-east of the subject land. No associated PCTs were mapped on the subject land. Potential suboptimal habitat for this species may occur in the low gullies of the subject land which contain non-associated PCT 1176.
Polytelis swainsonii	Superb Parrot	V	V	The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. Inhabits box-gum, box-cypress-pine and boree woodlands and river red gum forest.	Low	Low	There are no previous records of this species within the locality. Foraging and breeding habitat formed from associated PCTs 434 and 472, containing HBTs suitable for the species which has been mapped in the subject land. This species is considered unlikely to occur in the subject land based on lack of records within the locality, the subject land not occurring in the appropriate IBRA subregion for this species and non-detection during Stage 2 EIS surveys (Ecovisino 2008).

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. The eastern subspecies (temporalis occurs from Cape York south through Queensland, NSW and Victoria and formerly to the south east of South Australia. This subspecies also occurs in the Trans-Fly Region in southern New Guinea. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW.	Moderate	Confirmed	Species has been previously recorded on 9 occasions with nearest record located 4.1 km to the south-east of the subject land. Foraging and breeding habitat formed from associated PCTs 472, 1176 and 1629 has been mapped in the subject land. Species recorded during surveys.
Rostratula australis	Australian Painted Snipe	E	E	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	Low	Low	No previous records within the locality and no associated PCTs within the subject land. No wetlands, swamps, lakes or lagoons forming habitat and no important mapped areas located in the subject land.
Stagonopleura guttata	Diamond Firetail	V	-	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities.	High	Confirmed	Species has been previously recorded on 83 occasions with nearest record located 1 km to the west of the subject land. This species has been detected within the subject land during the current surveys (AMBS 2021; ELA 2021). Foraging and breeding habitat formed from associated PCTs 434, 472 and 1176 has been

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							mapped in the subject land.
Tyto novaehollandiae	Masked Owl	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked Owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.	Moderate	Moderate	Species has been previously recorded on 2 occasions with nearest record located 2 km to the north of the subject land. The subject land contains foraging habitat for this species in associated PCTs 434;472, 1176 and 1629 which harbour suitable prey species. HBTs forming suitable breeding habitat have been mapped in the subject land; however, no signs of breeding were detected within the subject land and no traces of breeding or other use were detected within a 10 m radius of suitable HBTs.
Fish							
Galaxias rostratus	Flathead galaxias	CE	CE	Flathead Galaxias, also known as Murray jollytail are a small native fish that are known from the southern part of the Murray Darling Basin. They have been recorded in the Macquarie, Lachlan, Murrumbidgee and Murray Rivers in NSW. Flathead Galaxias are found in still or slow moving water bodies such as wetlands and lowland streams. The species has been recorded forming shoals. They have been associated with a range of habitats including rock and sandy bottoms and aquatic vegetation. Flathead Galaxias spawn in spring and lay slightly adhesive demersal eggs.	None	None	No distribution for this species mapped within the subject land (Department of Primary Industries [DPI] 2021a). No perennial waterways or aquatic habitats suitable for this species detected within the subject land.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Macquaria australasica	Macquarie Perch	E	E	Recent research indicates that there may be at least two distinct forms of Macquarie Perch, one from the western rivers (Murray-Darling Basin form) and one from the eastern rivers (the Shoalhaven and Hawkesbury-Nepean systems) (the coastal form). The species has also been stocked or translocated into a number of reservoirs including Talbingo, Cataract and Khancoban reservoirs and translocated into streams including the Mongarlowe River. Macquarie Perch are found in both river and lake habitats; especially the upper reaches of rivers and their tributaries	None	None	No distribution for this species mapped within the subject land (DPI 2021a). No perennial waterways or aquatic habitats suitable for this species detected within the subject land.
Mammals							
Cercartetus nanus	Eastern Pygmy-possum	V	-	Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows, but can also construct its own nest . Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period .	Moderate	Moderate	No previous records within the locality. Potential foraging and breeding habitat (HBTs) occurs throughout the subject land in PCTs 434, 472, 1176 and 1629.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	High	Confirmed	Species has been detected within the subject land via harp trapping and Anabat detector AMBS 2021. Breeding habitat for this species formed from caves, fissures and deep overhangs has been identified and mapped within the subject land (AMBS 2021). The subject land contains foraging habitat formed from associated PCTs 434, 472, 1176 and 1629.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Moderate	Moderate	Species has been previously recorded on one occasion located 8.1 km to the south-west of the subject land. The subject land contains foraging habitat for this species in associated PCTs 434, 472, 1176, 1610, 1614, 1629 and 1767 which harbour suitable prey species. Rock outcrops, low caves and hollow logs within the subject land may form denning habitat for this species.
Miniopterus australis	Little Bentwing-bat	V	-	Coastal north-eastern NSW and eastern Queensland. Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites. Little Bent-wing Bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	Low	Low	No previous records of this species within the locality. The subject land contains foraging habitat formed from associated PCTs 1176 and 1629. Potential breeding habitat for this species formed from caves, fissures and deep overhangs has been identified and mapped within the subject land; however, no breeding individuals were detected (AMBS 2021). Species was not detected within the subject land during the

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							current survey (AMBS 2021).
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Large Bent-winged Bat occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	High	High	Species has been previously recorded on 2 occasions. Two Anabat returns attributed as possibly being this species have been detected in the subject land via during the current survey (AMBS 2021). The subject land contains foraging habitat formed from associated PCTs 434, 472, 1176 and 1629. Potential breeding habitat for this species formed from caves, fissures and deep overhangs has been identified and mapped within the subject land; however, no breeding individuals were detected (AMBS 2021).
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Corben's Long-eared Bat, also known as the South-eastern Long-eared Bat, has a limited distribution that is restricted around the Murray-Darling Basin in south-eastern Australia. Even in this region its distribution is scattered and it is rarely recorded. It occurs in far eastern South Australia, in areas north of the Murray River, east of Canegrass Station and south of the Barrier Highway. These areas include the Riverland Biosphere Reserve, Danggali Conservation Park and the Birds Australia Gluepot Reserve. It is distributed throughout inland NSW except in the north-west area which is	High	Confirmed	No previous records of this species within the locality. This species has been detected in the subject land via two Anabat returns during the current survey (AMBS 2021). The subject land contains foraging and roosting habitat formed from

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				dominated by treeless plains. It can be found in the Hunter Valley, extending from central NSW to the eastern Hunter Valley coast. Considered Nyctophilus timorensis south eastern form under TSC Act.			associated PCTs 1176 and 1629 containing HBTS suitable for this species.
Petauroides volans	Greater Glider	-	V	The Greater Glider occurs in eucalypt forests and woodlands. The species nests in hollows and are typically found in older forests. Generally the home range for the greater glider is between 0.7-3 hectares and tends to have a population density of 0.01-5 individuals per hectare. The home ranges of females can overlap with males and females however for the males the home ranges never overlap.	Moderate	Moderate	No previous records of this species within the locality. Potential foraging habitat for this species occurs in PCTs 1176 and 1629 containing HBTS suitable for denning mapped on the subject land.
Petaurus norfolcensis	Squirrel Glider	V	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias. There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.	High	High	Species has been previously recorded on three occasions with nearest record located 7.2 km to the east of the subject land. The subject land contains foraging habitat for this species in associated PCTs 434, 472, 1176 and 1629 which also contains HBTs suitable for denning in numbers that meet the minimum requirements of >2 HBTs per Ha.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit.	Moderate	Low	No previous records of this species within the locality. Potential foraging habitat for this species occurs in PCTs 434, 1176 and 1629 containing rock ledges, overhangs, caves and

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							platforms suitable for this species. However, species was not detected during targeted surveys.
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occassional records west ot the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	Moderate	Moderate	No previous records of this species within the locality. Potential foraging habitat for this species occurs in PCTs 434 and 1629 containing HBTS suitable for denning mapped on the subject land.
Phascolarctos cinereus	Koala	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall . In New South Wales, koala populations are found on the central and north coasts, southern highlands, southern and northern tablelands, Blue Mountains, southern coastal forests, with some smaller populations on the plains west of the Great Dividing Range.	High	Confirmed	Species has been previously recorded on nine occasions with nearest record located 2.5 km to the west of the subject land. One confirmed observation via field camera imagery and Koala scats have been detected in the north-western section of the subject land during the current survey (AMBS 2021). Foraging habitat occurs within the subject land in PCTs 434, 472, 1176 and 1629 which contain primary feed tree species Blakely's Red Gum, Grey Gum and White Box.
Pseudomys novaehollandiae	New Holland Mouse	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and	Moderate	Moderate	No previous records of this species within the locality.

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.			Potential foraging, breeding and dispersal habitat for this species occurs in PCT 472 mapped on the subject land.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	Low	Low	No previous records of this species within the locality and no camps detected on the subject land. Potential foraging habitat for this species occurs in PCTs 434, 472, 1176 and 1629 mapped on the subject land. This species is considered unlikely to occur based on lack of nearby records and non-detection during the Stage 2 EIS surveys.
Vespadelus troughtoni	Eastern Cave Bat	V	-	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	High	Confirmed	Species has been detected within the subject land via harp trapping and Anabat detector AMBS 2021. Breeding habitat for this species formed from caves, fissures and deep overhangs has been identified and mapped within the subject land (AMBS 2021). The subject land contains foraging habitat formed from associated PCTs 434, 472, 1176 and 1629.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Migratory Species							
Actitis hypoleucos	Common Sandpiper	-	M, MA, C, J, K	Utilises a wide range of coastal wetlands and some inland wetlands, mostly found around muddy margins or rocky shores. Forages in shallow water and on soft mud, roosts on rocks or vegetation such as mangroves. Northern hemisphere breeding.	None	None	No previous records within the locality. No wetlands, lakes or lagoons forming habitat located in the subject land.
Apus pacificus	Fork-tailed Swift	-	M	The Fork-tailed Swift is almost exclusively aerial, flying from less then one metre to at least 300 metres above ground and probably much higher. In NSW, the Fork-tailed Swift is recorded in all regions. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. These are widespread but scattered further west of the line joining Bourke and Dareton. Sightings have been recorded at Milparinka, the Bulloo River and Thurloo Downs	Low	Low	No previous records within the locality and no associated PCTs within the subject land. Flyways over vegetated areas of the subject land may form foraging habitat for this species. This habitat is likely to be utilised on a transitory basis as the species passes through the region between foraging grounds.
Ardea ibis	Cattle Egret	-	M	The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor.	Low	Low	No previous records within the locality. No wetlands, lakes or lagoons in the subject land; however, it does contain woodlands which may form foraging habitat.
Calidris acuminata	Sharp-tailed Sandpiper	-	M, MA	Prefers muddy edges of shallow or brackish wetlands, with inundated or emergent sedges, saltmarsh or other low vegetation. Also found foraging in sewage ponds and flooded paddocks. Northern hemisphere breeding.	None	None	No previous records within the locality. No wetlands, lakes or lagoons forming habitat located in the subject land.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Calidris melanotos	Pectoral Sandpiper	-	M, MA	Prefers shallow fresh to saline wetlands, found at coastal lagoons, estuaries, bays, swamps, inundated grasslands, saltmarshes and artificial wetlands. Northern hemisphere breeding. n New South Wales (NSW), the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions.	None	None	No previous records within the locality. No wetlands, lakes or lagoons forming habitat located in the subject land.
Chrysococcyx osculans	Black-eared Cuckoo	-	MA	The Black-eared Cuckoo is widespread on mainland Australia, but avoids the wet, heavily forested areas on the east coast and the south-west corner of Western Australia. The Black-eared Cuckoo is found in drier country where species such as mulga and mallee form open woodlands and shrublands. It is often found in vegetation along creek beds.	Low	Low	No previous records within the locality. Open woodlands in the subject land may form suitable habitat for this species.
Gallinago hardwickii	Latham's Snipe	-	M, MA	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration.	None	None	No previous records within the locality. No wetlands, lakes or lagoons forming habitat located in the subject land.
Merops ornatus	Rainbow Bee-eater	-	M	Found throughout mainland Australia most often in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels.	Moderate	Moderate	No previous records within the locality; however, it has been previously detected near the subject land during the Stage 2 EIS surveys. Flyways above the vegetated areas of the subject land may form foraging habitat for this species and the subject land contains suitable roosting habitat.

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Monarcha melanopsis	Black-faced Monarch	-	M	Found along the coast of eastern Australia, becoming less common further south. Inhabits rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Moderate	Moderate	No previous records within the locality. Forests and woodlands in the low gully of the subject land may form foraging habitat for this species.
Motacilla flava	Yellow Wagtail	-	M, MA	Northern hemisphere breeding. This species occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra.	None	None	No previous records within the locality and no suitable habitat detected within the subject land.
Myiagra cyanoleuca	Satin Flycatcher	-	M	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Low	Low	No previous records within the locality. Forests in the low gully of the subject land may form foraging habitat for this species.
Rhipidura rufifrons	Rufous Fantail	-	M	Found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Inhabits tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Low	Low	No previous records within the locality. Forests in the low gully of the subject land may form foraging habitat for this species.
Rostratula benghalensis (sensu lato)	Greater Painted Snipe	E	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys.	None	None	No previous records within the locality. No wetlands, lakes or lagoons forming habitat located in the subject land.
Reptiles							

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by kangaroo grass. Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks.	Moderate	Moderate	No previous records of this species within the locality. Associated PCTs 434; 472 and 1176 mapped in the subject land. Potential foraging and breeding habitat for this species formed of woodland with a grassy groundlayer and surface rock was detected in the subject land.
Delma impar	Striped Legless Lizard	V	V	Found mainly in natural temperate grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near natural temperate grassland and occasionally in open box-gum woodland. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter.	Moderate	Moderate	No previous records of this species within the locality. Associated PCT 1176 mapped in the subject land. Potential foraging and breeding habitat for this species formed of woodland with a grassy groundlayer and surface rock was detected in the subject land.
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	The Pale-Headed Snake has a patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah and out to the western plains. It is found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest where it favours streamside areas, particularly in drier habitats. They shelter during under loose bark or in hollows and have a preference for frogs as prey, although lizards and small mammals are also taken. This species breeds and shelters in hollows in live and dead trees and in and under fallen timber.	Moderate	Moderate	No previous records of this species within the locality. Associated PCT 434, 472, 1176 and 1629 mapped in the subject land. Potential foraging and breeding habitat for this species formed of associated PCTs containing HBTs suitable for the species was detected in the subject land.

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				It is best detected from mid spring to mid autumn and is mostly nocturnal.			
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Occurs almost exclusively in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they spend most of the year sheltering in and under rock crevices and exfoliating rock. However, some individuals will migrate to tree hollows within 500m of escarpment to find shelter during hotter parts of summer.	Moderate	Moderate	No previous records of this species within the locality. Associated PCT 1629 mapped in the subject land. Potential foraging and breeding habitat for this species formed of associated PCTs containing HBTs suitable for the species and rocky areas containing cracks, fissures and sandstone rocks and boulders was detected in the subject land.
Plants							
Acacia ausfeldii	Ausfeld's Wattle	V	-	Found to the east of Dubbo in the Mudgee, Ulan - Gulgong area of the NSW South Western Slopes bioregion, with some records in the adjoining Brigalow Belt South, South Eastern Highlands and the Sydney Basin bioregions. Associated species include Eucalyptus albens, E. blakelyi and Callitris spp., with an understorey dominated by Cassinia spp. and grasses.	Moderate	Low	Species has been previously recorded on 13 occasions with nearest record located 1 km to the west of the subject land. Habitat formed from associated PCTs 434, 1610 and 1767 which contain known associated species Blakely's Red Gum, Cypress Pine, White Box and an understorey containing *Cassinia* spp. and grasses mapped in the subject land. However, species not detected during targeted survey.

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Acacia dangarensis		CE	-	Acacia dangarensis is endemic to NSW and confined to the summit and surrounding slopes of Mount Dangar south of Merriwa, within Goulburn River National Park. The total population size of Acacia dangarensis is estimated to be of the order of 1750 plants extending over an area of about 70 hectares. It is not known to occur in any other location despite considerable survey around the Hunter district in recent years. Acacia dangarensis occurs in pure stands or as a co-dominant tree in sclerophyll woodland on the edge of dry rainforest on basalt and basalt colluvium.	Low	Low	No previous records of this species within the locality. Habitat formed from associated PCTs 1176 mapped in the subject land. Only known from the summit and slopes of Mount Dangar south of Merriwa in GRNP occurring in sclerophyll woodland on the edge of dry rainforest on basalt and basalt colluvium.
Acacia pendula	Weeping Myall population in the Hunter catchment	EP	-	Occurs on the western slopes, western plains and far western plains of NSW, and south into Victoria and north into Queensland. This Hunter population is known to occur naturally as far east as Warkworth, and extends northwest to Muswellbrook and to the west of Muswellbrook at Wybong. Only recorded to date at 6 locations: Jerrys Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. These locations occur within the Muswellbrook and Singleton Local Government Areas, with the population potentially also occurring within the Mid-Western Regional and Upper Hunter LGA's. Within the Hunter catchment the species typically occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations.	Low	Low	No previous records of this species within the locality. Habitat formed from associated PCTs 1176 mapped in the subject land. Occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations. Potential for occurrence in the Mid-Western Regional LGA.
Commersonia procumbens		V	V	Grows in sandy sites, often along roadsides. Endemic to NSW, mainly confined to the Dubbo-Mendooran-Gilgandra region, but also known in the Pilliga, Mount Kaputar National Park, north east of Gulgong and near Denmen. Additional populations have been found in Goonoo SCA in response fires.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCTs 434, 472, 478, 479, 1176 and 1610 mapped in the subject land. Occurs in sandy soils in dry sclerophyll forest

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							and disturbed areas. Has been detected in nearby UG4 previously. However, species not detected during targeted survey.
Commersonia rosea		E	E	Occurs on skeletal sandy soils in scrub or heath vegetation with occasional emergents of Eucalyptus crebra, Callitris endlicheri or E. caleyi subsp. Caleyi. Only known from four localities in the Sandy Hollow district of the upper Hunter Valley, New South Wales, all within an eight kilometre radius of Sandy Hollow.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCTs 1176 mapped in the subject land. Occurs on skeletal sandy soils in scrub or heath vegetation with occasional emergent trees Narrow-leaved Ironbark, Black Cypress Pine or *E. caleyi* subsp. *caleyi.* However, species not detected during targeted survey.
Cymbidium canaliculatum	Cymbidium canaliculatum population in the Hunter Catchment	EP	-	Typically grows in the hollows, fissures, trunks and forks of trees in dry sclerophyll forest or woodland, where its host trees typically occur on Permian Sediments of the Hunter Valley floor. It usually occurs singly or as a single clump, which can form large colonies on trees, between two and six metres from the ground.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCTs 1176 mapped in the subject land. Grows in the hollows, fissures, trunks and forks of trees in dry sclerophyll forest or woodland, where its host trees typically occur on Permian Sediments of the Hunter Valley floor. However,

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							species not detected during targeted survey.
Cynanchum elegans	White-flowered Wax Plant	E	E	Recorded from rainforest gullies scrub and scree slopes from the Gloucester district to the Wollongong area and inland to Mount Dangar. Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region.	Low	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1629 mapped in the subject land. Occurs on the edge of dry rainforest vegetation.
Dichanthium setosum	Bluegrass	V	V	Occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, as well as in Queensland and Western Australia. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture.	Low	Low	No previous records of this species within the locality. Habitat formed from associated PCT 434 mapped in the subject land. Occurs on heavy basaltic black soils and red-brown loams with clay subsoil in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture.
Diuris tricolor	Pine Donkey Orchid	V	-	Sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the far north of NSW. Localities include the Condobolin-Nymagee road, Wattamondara towards Cowra, Cooyal, Adelong, Red Hill north of Narrandera, Coolamon, near Darlington Point, Eugowra, Girilambone, Dubbo, Muswellbrook, and several sites west of Wagga Wagga. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1176 mapped in the subject land. Occurs on sandy soils on flats and small rises in sclerophyll forest among grass, often with native Cypress Pine. Has been detected near the subject land during surveys for the

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							Stage 2 EIS (Ecovision 2008). However, species not detected during targeted survey.
Eucalyptus cannonii	Capertee Stringybark	V	-	Restricted to an area of about 100 by 60 km in the central tablelands of NSW. The western border is approximately marked by a line between Bathurst and Mudgee, while the eastern locations occur approximately on a line between Lithgow and the town of Bylong. Within this area the species is often locally frequent. Recorded from Tablelands Grassy woodland Complex communities and Talus Slope woodland, and in Winburndale Nature Reserve within woodland dominated by Eucalyptus macrorhyncha and Eucalyptus goniocalyx.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCTs 1176 and 1610 mapped in the subject land. Capertee Stringybark is found between 450 m to 1,050 m in altitude in most situations except the valley floors. Has been detected near the subject land during surveys for the Stage 2 EIS (Ecovision 2008). However, species not detected during targeted survey.
Eucalyptus fracta	Broken Back Ironbark	V	-	Locally common but restricted to the northern Broken Back Range near Cessnock, NSW. Occurs in dry eucalypt woodland in shallow soils. Associated species in slightly deeper soils include Eucalyptus sparsifolia, E. punctata, Corymbia maculata and Angophora euryphylla.	Low	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1629 mapped in the subject land. Restricted to the northern Broken Back Range near Cessnock, NSW in a narrow band along the upper edge of a sandstone escarpment. Occurs in dry eucalypt woodland in shallow soils.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Euphrasia arguta		CE	CE	Occur in eucalypt forest with a mixed grass and shrub understorey within Nundle State forest. Sites have either been logged in the last few decades, or appear to have regrown from past clearing.	Low	Low	No previous records of this species within the locality, not known from the IBRA subregion and no associated PCTs mapped within the subject land. Occurs in open forest in sub humid places including meadows near river. Has been previously recorded in eucalypt forest with a mixed grass and shrub understorey.
Homoranthus darwinioides	Fairy Bells	V	V	Grows in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1176 mapped in the subject land. Occurs in woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on loamy sand. However, species not detected during targeted survey.
Indigofera efoliata	Leafless Indigo	E	E	Recorded in Goonoo State forest in Eucalyptus crebra and Callitris glaucophylla dry sclerophyll forest, and in Eucalyptus	Low	Low	One previous record of this species within the locality

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				microcarpa and Callitris glaucophylla tall woodland. Herbarium records note the species as growing on slight rises amongst ironstone formation in stony red-brown sandy loam.			located 6.1 km to the south-east of the subject land. No associated PCTs mapped in the subject land. Occurs in dry sclerophyll forest growing on slight rises amongst ironstone formation in stony red-brown sandy loam.
Kennedia retrorsa		V	V	Found in a variety of habitats from mountainsides to riparian zones, from sheltered forest to steep, exposed rocky ridgelines. Believed to be restricted to the Mount Dangar area and the adjacent Goulburn River catchment, within the Muswellbrook and adjacent Merriwa local government areas.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1176 mapped in the subject land. Occurs in a variety of habitats from mountainsides to riparian zones, from sheltered forest to steep, exposed rocky ridgelines. However, species not detected during targeted survey.
Lasiopetalum longistamineum		V	V	Grows in rich alluvial deposits. Little information is known about the ecology or biology of this species. Occurs in the Mount Dangar - Gungal area within Merriwa and Muswellbrook Local Government Areas. A very small number of plants have been recorded within the Goulburn River National Park.	Low	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1176 mapped in the subject land. Occurs in the Mount Dangar - Gungal area within Merriwa and Muswellbrook LGAs growing on rich alluvial deposits.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
Leionema lamprophyllum subsp. *fractum*		CE	-	Occurs in sparse heathland or very open low woodland in skeletal sandy soils on exposed rocky terrain. Plants have been found on skeletal sandy soils on a rocky northerly to north-westerly facing outcrop at 515 m above sea level. Currently known only from the Broken Back Range near Cessnock, with a historical collection from Munghorn Gap Nature Reserve near Wollar.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1629 mapped in the subject land. Occurs in sparse heathland or very open low woodland in skeletal sandy soils on exposed rocky terrain. However, species not detected during targeted survey.
Monotaxis macrophylla	Large-leafed Monotaxis	E	-	Grows on rocky ridges and hillsides. Displays the properties of a fire ephemeral species in many ways. There is a great diversity in the associated vegetation within NSW, encompassing coastal heath, arid shrubland, forests and montane heath from almost sea level to 1300 m altitude.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCTs 472, 478, 479, 1176, 1610 and 1614 mapped in the subject land. Occurs on rocky ridges and hillsides with a distribution related to the occurrence of fire. However, species not detected during targeted survey.
Ozothamnus tesselatus		V	V	Grows in eucalypt woodland. Upper Hunter from Ravensworth to Bylong and west of Divide at Bunnan. Known to be associated with Dry sclerophyll forests/woodlands and grassy woodlands.	Moderate	Low	One previous record of this species within the locality situated 9.1 km to the south-east of the subject land. Habitat formed from associated PCT 1176 mapped in the subject land. Occurs in Eucalypt woodlands. However,

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							species not detected during targeted survey.
Pomaderris queenslandica	Scant Pomaderris	E	-	Rare in N.S.W. Specimens have been recorded from Mount Danger and Gloucester district. Species more widespread in Queensland. Recorded in moist eucalypt forest or sheltered woodlands with a shrubby understorey.	Moderate	Low	No previous records of this species within the locality. This species has been detected nearby during surveys undertaken for the Stage 2 EIS (Ecovision 2008). Habitat formed from associated PCTs 472, 1176 and 1614 mapped in the subject land. Occurs in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks. However, species not detected during targeted survey.
Pomaderris reperta	Denman Pomaderris	CE	CE	Occupies woodland in association with Eucalyptus crebra , E. blakelyi, Notelaea microcarpa and Allocasuarina littoralis. Associated soil is a sandy loam on sandstone or conglomerate. Recorded from a small number of sites along a single ridgeline near Denman in the upper Hunter Valley.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1176 mapped in the subject land. Occurs in woodland in association with Narrow-leaved Ironbark, Blakely's Red Gum on sandy loam on sandstone or conglomerate. However, species not detected during targeted survey.
Pomaderris sericea	Silky Pomaderris	E	V	There are only two Silky Pomaderris records in NSW that give details of habitat so it is difficult to generalise about the	Moderate	Low	No previous records of this species within the locality.

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				habitat preferences of the species. Both of these records, however, are from open forest on sandstone. The Bundanoon collection was made at the foot of a cliff. In Victoria it grows in low shrubland on rock within the flood level of the river.			Habitat formed from associated PCTs 1176 and 1629 mapped in the subject land. Occurs in open forest on sandstone. However, species not detected during targeted survey.
Prasophyllum petilum	Tarengo Leek Orchid	E	E	Grows in open sites within Natural Temperate Grassland at the Boorowa and Delegate sites. Also grows in grassy woodland in association with River Tussock Poa labillardieri, Black Gum Eucalyptus aggregata and tea-trees Leptospermum spp. near Queanbeyan and within the grassy groundlayer dominated by Kanagroo Grass under Box-Gum Woodland at Ilford (and Hall, ACT)	Low	Low	No associated PCTs mapped in the subject land. Occurs in grassy woodland in association with River Tussock *Poa labillardieri*, Black Gum *Eucalyptus aggregata* and tea-trees *Leptospermum* spp. and within the grassy groundlayer dominated by Kangaroo Grass under Box-Gum Woodland.
Prasophyllum sp. *Wybong*	A leek orchid	-	CE	Endemic to NSW. It is known from seven populations in eastern NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield. Known to occur in open eucalypt woodland and grassland.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCT 434 mapped in the subject land. Occurs in open eucalypt woodland and grassland. However, species not detected during targeted survey.
Prostanthera cryptandroides subsp. *cryptandroides*	Wollemi Mint-bush	V	V	At Glen Davis, occurs in open forest dominated by Eucalyptus fibrosa. Other eucalypt species may be present as sub-dominants. In the Denman-Gungal and Widden-Baerami	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCTs 1176 and

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				Valley areas, occurs on rocky ridgelines on Narrabeen Group Sandstones in association with a range of communities.			1629 mapped in the subject land. Occurs in dry sclerophyll forest in the side gullies of main creeklines, often on rocky or well-drained alluvial substrates. However, species not detected during targeted survey.
Prostanthera discolor		V	V	Grows in dry sclerophyll forest in the side gullies of main creeklines, often on rocky or well-drained alluvial substrates. Does not appear to reproduce vegetatively. Restricted to only a few localities from Bylong to the Baerami Valley within the Rylstone and Muswellbrook local government areas.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCTs 1176 and 1629 mapped in the subject land. Occurs in open forest dominated by Red Ironbark on rocky ridgelines on Narrabeen Group Sandstones in association with a range of communities. However, species was not detected during targeted surveys.
Prostanthera stricta	Mount Vincent Mint-bush	V	V	A locally dominant undershrub in heath or scrub communities along cliff edges, or as an understorey species within a range of open forest or tall open forest types, or in adjacent transitional communities. Grows in areas of both skeletal soil and on deeper, well-drained soil profiles in areas characterised by steep rocky sideslopes, cliff lines, sandstone platforms, or gentle slopes with exposed sandstone outcroppings.	Moderate	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1176 mapped in the subject land. Occurs on skeletal soil and on deeper, well-drained soil profiles in areas characterised by steep rocky sideslopes, cliff lines, sandstone platforms,

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
							or gentle slopes with exposed sandstone outcroppings. However, species was not detected during targeted surveys.
Pultenaea glabra	Smooth Bush-pea	V	V	Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone. Restricted to the higher Blue Mountains.	Low	Low	One previous record of this species within the locality situated 1.5 km to the south-east of the subject land. No associated PCTs mapped in the subject land. Occurs in riparian or swamp habitat areas in the mid to upper altitudes of the central Blue Mountains on sandstone derived soils. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone.
Senecio linearifolius var. *dangarensis*		E	-	Grows on an open scree slope and in woodland and rainforest communities on basalt. Senecio linearifolius var. dangarensis is restricted to a single known population in the Goulburn River National Park.	Low	Low	No previous records of this species within the locality. Habitat formed from associated PCT 1614 mapped in the subject land. Occurs on open scree slopes and in woodland and rainforest communities on basalt.
Swainsona recta	Small Purple-pea	E	E	Before European settlement, this species occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's red gum, yellow box, candlebark gum and long-	Low	Low	No previous records of this species within the locality. Habitat formed from

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Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				leaf box. Grows in association with understorey dominants that include kangaroo grass, poa tussocks and spear-grasses.			associated PCT 434 mapped in the subject land. Occurs in grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum, Yellow Box, Candlebark Gum *E. rubida* and Long-leaf Box *E. goniocalyx*. Grows in association with understorey dominants that include Kangaroo Grass, Poa tussocks *Poa* spp. and Spear-Grasses *Austrostipa* spp.
Thesium australe	Austral Toadflax	V	V	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass.	Moderate	Moderate	No previous records of this species within the locality. Habitat formed from associated PCTs 434 and 1176 mapped in the subject land. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast, usually in association with Kangaroo Grass.
Tylophora linearis		V	E	Tylophora linearis has rarely been collected and is known from eight localities in the Dubbo area and Mt Crow near Barraba in NSW, and 'Myall Park' near Glenmorgan in Queensland. This species is conserved within Goobang National Park, Eura State forest, Goonoo SF, Pilliga West SF and Coolbaggie Nature Reserve. Tylophora linearis grows in	Moderate	Moderate	No previous records of this species within the locality. Habitat formed from associated PCTs 479 and 1176 mapped in the subject land. Occurs in dry

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of Occurrence		Justification
					Prior to survey	Post survey	
				dry scrub, open forest and woodlands associated with *Melaleuca uncinata, Eucalyptus fibrosa, E. sideroxylon, E. albens, Callitris endlicheri, C. glaucophylla, Allocasuarina luehmannii, Acacia hakeoides, A. lineata, Myoporum spp.,* and *Casuarina spp.*			scrub and open forest containing Red Ironbark, Mugga Ironbark *Eucalyptus sideroxylon*, White Box, Black Cypress Pine *Callitris endlich*eri, White Cypress Pine *Callitris glaucophylla* and SheOak *Allocasuarina luehmannii*.
	Key: V – Vulnerable, E - Endangered, EP – Endangered Populations, CE - Critically Endangered, M - Marine, MA - Migratory, C - CAMBA, J - JAMBA, K - ROKAMBA						

Annex 6. Fauna species list

Scientific name	Common name	BC Act	EPBC Act	Observation type
Aves				
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	-	-	O/W
Alisterus scapularis	King Parrot	-	-	O/W
Anthochaera carunculata	Red Wattlebird	-	-	W
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	O/W
Cacatua galerita	Sulphur-crested Cockatoo	-	-	O/W
Cacomantis flabelliformis	Fan-tailed cuckoo	-	Mi	W
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	O/W
Coracina novaehollandiae	Black-faced Cuckooshrike	-	-	O/W
Coracina papuensis	White-bellied Cuckooshrike			
Cormobates leucophaea	White-throated Treecreeper	-	-	O/W
Coturnix ypsilophora	Brown Quail	-	-	O/W
Dacelo novaeguineae	Laughing Kookaburra	-	-	O/W
Daphoenositta chrysoptera	Varied sittella	V	-	O/W
Dromaius novaehollandiae	Emu	-	-	O/W
Eopsaltria australis	Eastern Yellow Robin	-	-	W
Geopelia striata	Peaceful Dove	-	-	O/W
Gerygone olivacea	White-throated gerygone	-	-	O/W
Glossopsitta pusilla	Little Lorikeet	V	-	O/W
Grallina cyanoleuca	Magpie-lark	-	-	O/W
Gymnorhina tibicen	Australian Magpie	-	-	O/W
Lathamus discolor	Swift Parrot	E	CE	O
Lichenostomus melanops	Yellow-tufted honeyeater	-	-	O/W
Lichenostomus virescens	Singing Honeyeater	-	-	O/W
Manorina melanocephala	Noisy miner	-	-	O/W
Melithreptus lunatus	White-naped Honeyeater	-	-	O/W
Menura novaehollandiae	Superb Lyrebird	-	-	O/W
Merops ornatus	Rainbow Bee-eater	-	Mi	W
Origma solitaria	Rockwarbler	-	-	O/W
Oriolus sagittatus	Olive-backed Oriole	-	-	O/W
Pachycephala rufiventris	Rufous Whistler	-	-	O/W
Pardalotus punctatus	Spotted Pardalote	-	-	W
Petroica boodang	Scarlet Robin	V	-	O
Philemon corniculatus	Noisy Friarbird	-	-	O/W
Platycercus elegans	Crimson Rosella	-	-	O/W
Platycercus eximius	Eastern Rosella	-	-	O/W
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	O/W
Ptilonorhynchus violaceus	Satin Bowerbird	-	-	O/W
Pycnoptilus floccosus	Pilotbird	-	-	O
Rhipidura albiscapa	Grey Fantail	-	-	O/W

Rhipidura leucophrys	Willie Wagtail	-	-	O/W
Stagonopleura guttata	Diamond Firetail	V	-	O/W
Strepera graculina	Pied Currawong	-	-	O/W
Todiramphus sanctus	Sacred Kingfisher	-	-	O
Vanellus miles	Masked Lapwing	-	-	O/W
Mammalia				
Felis catus	Domestic Cat	-	-	O
Macropus giganteus	Eastern Grey Kangaroo	-	-	O/P
Macropus parma	Parma Wallaby	V	-	O/P
Macropus robustus	Common Wallaroo	-	-	O
Macropus rufogriseus	Red-necked Wallaby	-	-	O/P
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	A
Phascolarctos cinereus	Koala	V	V	P
Pseudocheirus peregrinus	Common Ringtail Possum	-	-	O
Rattus rattus	Black rat	-	-	O
Tachyglossidae aculeatus	Echidna	-	-	O/T
Trichosurus vulpecula	Brush-tailed possum	-	-	P
Vombatus ursinus	Common Wombat	-	-	O/P
Wallabia bicolor	Swamp Wallaby	-	-	O/P
Reptilia				
Varanus varius	Lace monitor	-	-	O
Amphibia				
Crinia signifera	Eastern Common Froglet	-	-	O/W
Limnodynastes tasmaniensis	Spotted Marsh Frog	-	-	O/W

Key: W – heard; O – observed; P – scat, T – trace, A = Acoustic detector.

Note: field data was collected in electronic format, therefore raw data sheets have not been provided.

Annex 7. Hollow-bearing tree register

Tree number	Scientific name	Common name	DBH	No. of hollows	Hollow size class (cm)	Height above ground (m)
HBT1	*Eucalyptus crebra*	Narrow-leaved Ironbark	200	1	0-5	14
HBT2	*Eucalyptus crebra*	Narrow-leaved Ironbark	70	3	0-5, 5-10	7
HBT3	*Eucalyptus crebra*	Narrow-leaved Ironbark	150	6	0-5, 10-15, 20-30	9
HBT4	-	Stag	90	10	0-5	6
HBT5	*Eucalyptus crebra*	Narrow-leaved Ironbark	150	1	0-5	6
HBT6	*Eucalyptus crebra*	Narrow-leaved Ironbark	90	1	0-5	5
HBT7	*Eucalyptus punctata*	Grey Gum	120	3	0-5, 15-20	8
HBT8	-	Stag	80	1	5-10	7
HBT9	*Eucalyptus dawsonii*	Slaty Gum	85	3	30-40, 40-50, 50+	9
HBT10	-	Stag	65	1	0-5	8
HBT11	*Eucalyptus fibrosa*	Red Ironbark	200	2	0-5, 5-10	15
HBT12	*Eucalyptus fibrosa*	Red Ironbark	150	1	0-5, 10-15	5
HBT13	-	Stag	70	10	5-20	6
HBT14	*Eucalyptus punctata*	Grey Gum	50	5	0-5, 5-10, 15-20	15
HBT15	*Eucalyptus punctata*	Grey Gum	60	3	0-5	6
HBT16	-	Stag	-	1	-	5
HBT17	*Eucalyptus punctata*	Grey Gum	50	5	0-5, 5-10, 10-15	5
HBT18	*Eucalyptus punctata*	Grey Gum	80	3	30-40, 15-20, 0-5	10
HBT19	*Eucalyptus dawsonii*	Slaty Gum	100	6	0-5, 30-40, 40-50	10
HBT20	*Eucalyptus dawsonii*	Slaty Gum	75	3	20-30, 0-5, 5-10	9
HBT21	*Eucalyptus fibrosa*	Red Ironbark	90	3	0-5, 5-10	15
HBT22	*Eucalyptus fibrosa*	Red Ironbark	105	2	0-5,10-15	12
HBT23	*Eucalyptus fibrosa*	Red Ironbark	60	2	0-5,5-10	5
HBT24	-	Stag	-	1	20-30	10
HBT25	-	Stag	-	1	0-5	5
HBT26	*Eucalyptus fibrosa*	Red Ironbark	80	2	0-5	5

Tree number	Scientific name	Common name	DBH	No. of hollows	Hollow size class (cm)	Height above ground (m)
HBT27	*Eucalyptus crebra*	Narrow-leaved Ironbark	95	4	0-5, 20-30	10
HBT28	-	Stag	-	1	0-10	10
HBT29	*Eucalyptus fibrosa*	Red Ironbark	95	3	0-5, 5-10, 10-15	6
HBT30	*Eucalyptus fibrosa*	Red Ironbark	85	5	0-5, 5-10	10
HBT31	-	Stag	-	1	0-5	10
HBT32	*Eucalyptus fibrosa*	Red Ironbark	85	5	0-5, 5-10	10
HBT33	*Eucalyptus punctata*	Grey Gum	40	5	0-5, 5-10	3
HBT34	*Eucalyptus punctata*	Grey Gum	80	2	0-5, 5-10	8
HBT35	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark	45	2	0-5	8
HBT36	*Eucalyptus blakelyi*	Blakely's Red Gum	48	3	0-5, 5-10	8
HBT37	*Eucalyptus blakelyi*	Blakely's Red Gum	36	1	10-15	13
HBT38	*Eucalyptus blakelyi*	Blakely's Red Gum	48	1	0-5	15
HBT39	*Eucalyptus fibrosa*	Red Ironbark	85	4	0-5, 5-10	8
HBT40	*Eucalyptus crebra*	Narrow-leaved Ironbark	120	3	0-5, 5-10	12
HBT41	*Eucalyptus crebra*	Narrow-leaved Ironbark	130	2	0-5	8
HBT42	*Eucalyptus blakelyi*	Blakely's Red Gum	55	1	0-5	2
HBT43	*Eucalyptus punctata*	Grey Gum	95	4	5-10	-
HBT44	*Eucalyptus punctata*	Grey Gum	50	2	0-5	16
HBT45	*Eucalyptus punctata*	Grey Gum	40	1	20-30	2
HBT46	*Eucalyptus punctata*	Grey Gum	60	2	0-5, 20-30	15
HBT47	*Eucalyptus punctata*	Grey Gum	50	3	10-15, 5-10	10
HBT48	*Eucalyptus punctata*	Grey Gum	40	1	0-5	18
HBT49	-	Stag	-	-	-	-
HBT50	-	Stag	-	-	-	-
HBT51	*Eucalyptus crebra*	Narrow-leaved Ironbark	80	3	0-5, 5-10	8
HBT52	*Eucalyptus crebra*	Narrow-leaved Ironbark	50	1	5-10	10

Tree number	Scientific name	Common name	DBH	No. of hollows	Hollow size class (cm)	Height above ground (m)
HBT53	*Eucalyptus crebra*	Narrow-leaved Ironbark	80	3	0-5,15-20	13
HBT54	-	Stag	60	1	0-5	9
HBT55	*Eucalyptus crebra*	Narrow-leaved Ironbark	70	1	0-5	14
HBT56	*Eucalyptus crebra*	Narrow-leaved Ironbark	80	1	50+	10
HBT57	-	Stag	30	5	0-5, 30-40	4
HBT58	-	Stag	40	5	0-5	9
HBT59	*Eucalyptus crebra*	Narrow-leaved Ironbark	80	2	0-5, 5-10	10
HBT60	-	Stag	70	1	0-5, 5-10	10
HBT61	*Eucalyptus fibrosa*	Red Ironbark	120	3	10-15	5
HBT62	-	Stag	70	2	30-40	15
HBT63	*Eucalyptus crebra*	Narrow-leaved Ironbark	75	4	0-5	-
HBT64	*Eucalyptus fibrosa*	Red Ironbark	75	5	10-15, 15-20, 0-5	12
HBT65	-	Stag	50	5	0-5	
HBT66	*Eucalyptus fibrosa*	Red Ironbark	80	2	5-10, 0-5	6
HBT67	*Eucalyptus crebra*	Narrow-leaved Ironbark	80	2	0-5, 5-10	10
HBT68	*Eucalyptus crebra*	Narrow-leaved Ironbark	80	1	0-5	6
HBT69	-	Stag	60	3	0-5, 10-15, 15-20	5
HBT70	*Eucalyptus crebra*	Narrow-leaved Ironbark	70	2	5-10, 0-5	8
HBT71	*Eucalyptus crebra*	Narrow-leaved Ironbark	85	2	0-5, 5-10	10
HBT72	-	Stag	70	2	0-5, 10-15	
HBT73	*Eucalyptus crebra*	Narrow-leaved Ironbark	60	1	15-20	15
HBT74	*Eucalyptus crebra*	Narrow-leaved Ironbark	35	1	20-30	10
HBT75	-	Stag	-	1	-	-
HBT76	*Eucalyptus crebra*	Narrow-leaved Ironbark	-	5	0-5, 5-10	20
HBT77	*Eucalyptus punctata*	Grey Gum	90	6	0-5, 5-10, 10-15	15
HBT78	-	Stag	40	2	0-5, 5-10	-
HBT79	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark	35	2	0-5, 5-10	15
HBT80	*Eucalyptus blakelyi*	Blakely's Red Gum	40	2	0-5, 10-15	10

Tree number	Scientific name	Common name	DBH	No. of hollows	Hollow size class (cm)	Height above ground (m)
HBT81	*Eucalyptus blakelyi*	Blakely's Red Gum	40	2	15-20, 0-5	8
HBT82	*Eucalyptus blakelyi*	Blakely's Red Gum	80	1	50+	18
HBT83	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark	100	2	10-15	9
HBT84	*Eucalyptus punctata*	Grey Gum	80	1	0-5, 5-10, 50+	18
HBT85	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark	100	2	10-15	9
HBT86	*Eucalyptus punctata*	Grey Gum	120	1	50+	20
HBT87	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark	-	-	-	-
HBT88	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark	38	1	10-15	12
HBT89	*Eucalyptus punctata*	Grey Gum	80	3	0-5, 15-20	8
HBT90	*Eucalyptus punctata*	Grey Gum	120	3	50+, 30-40	10
HBT91	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark	75	2	0-5	9
HBT92	*Eucalyptus punctata*	Grey Gum	40	2	0-5	6
HBT93	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark	60	2	0-5	10
HBT94	*Eucalyptus punctata*	Grey Gum	50	3	15-20, 0-5, 5-10	20
HBT95	-	Stag	60	1	40-50	-
HBT96	-	Stag	35	2	0-5	-
HBT97	*Eucalyptus punctata*	Grey Gum	100	3	20-30, 15-20, 0-5	10
HBT98	*Eucalyptus punctata*	Grey Gum	120	3	5-10, 0-5	12
HBT99	*Eucalyptus punctata*	Grey Gum	45	3	5-10, 0-5, 10-15	8
HBT100	*Eucalyptus punctata*	Grey Gum	40	2	0-5	20

Note: field data was collected in electronic format, therefore raw data sheets have not been provided.

Annex 8. Consideration of serious and irreversible impacts

DPIE were contacted to provide an information package for each SAII entity that is a candidate species for the Modification. The information provided by DPIE is included and incorporated into the SAII assessments below.

Additional impact assessment provisions for species at risk of SAII	**Broad-headed Snake (*Hoplocephalus bungaroides*)**
DPIE data package provided	Principle 1 SAII: *species currently in a rapid rate of decline* = No Principle 2 SAII: – *species with a very small population size* = No Population = No information Extreme fluctuations = No Principle 3 SAII: s*pecies with very limited geographic distribution* = No Number of locations = 4 Estimated AOO = 940 km^2 Estimated EOO = 29,404 km^2 Principle 4 SAII: *species that is unlikely to respond to management and is therefore irreplaceable* = Yes Justification = Species dependent on habitat attributes: Rock outcrops including pagodas
1. The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAII, including the action and measures taken to avoid the direct and indirect impact on the species at risk of an SAII. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.	No previous records of this species occur within the locality. Potential habitat for Broad-headed Snake is present within the subject land in rocky areas within PCT 1629 (see Figure 13d). Potential foraging and breeding habitat for this species is associated PCTs containing HBTs suitable for the species and rocky areas containing cracks, fissures and sandstone rocks and boulders was detected in the subject land. Habitat searches undertaken on 25 August 2021 did not detect this species; however, the species could not be completely excluded from the subject land due to the presence of deep crevices and heavy sandstone boulders in the central section of minor cliff line C9. Therefore, Broad-headed Snake is assumed present in the aforementioned areas which could not be thoroughly searched, and the species habitat constraints are considered sensitive to subsidence impacts (Figure 13d).

Additional impact assessment provisions for species at risk of SAII	Broad-headed Snake (*Hoplocephalus bungaroides*)
	The Modification has the potential to disturb Broad-headed Snake breeding habitat and potentially result in loss of individuals due to occasional rockfalls, dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 5% of the total face of such feature within any longwall mining domain or minor environmental consequence (MSEC 2021).
2. The assessor must consult the TBDC and/or other sources to report on the current population of the species including:	
a) evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the: i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites	DPIE have determined that this species is not at risk of SAII due to Principle 1 – rapid rate of decline. i. The decline in population of the species in NSW in the last 10 years cannot be assessed at this time because: • The species information available in Bionet and other reliable/peer reviewed information about the species is limited and does not address this aspect • Bionet record data exhibits a bias toward increased survey effort, resulting in an increase of species records within the last 10 years. However the species is known to be declining, as a result of the threats detailed below. ii. This species shelters under rocks and crevices during the late summer to early spring, as conditions warm up it shifts to using hollows in trees - often in sandstone gully forest just downslope from the outcrops (DPIE 2021a). Key threats to the species, which are likely to have contributed to its decline are: • Land clearing. Prohibiting access and maintaining access gates has been shown to protect habitat from disturbance (Bionet 2021a). • Disturbance of habitat, in particular the removal of large hollow-bearing trees adjacent to sandstone escarpments and bush rock removal (DoE 2014, OEH 2017). • Residential and infrastructure development of ridgetops (DoE 2014). • Pine plantation development and associated tracks that increase accessibility (DoE 2014). • Inappropriate fire regimes, which have reduced tree hollows and, in the absence of fire, thickens canopy and increases shading of winter habitat (DoE 2014). • Illegal collection of individuals by reptile collectors (OEH 2017). • Being hit by vehicles, with increasing human use and vehicular traffic leading to many deaths of adults and youngs (OEH 2017). • Damage to habitat by feral goats (OEH 2017). • Patchy knowledge of the species distribution across some populations (OEH 2017). • Unknown genetic diversity and gene flow between populations/sup-populations within the northern group (OEH 2017). The Modification is not likely to increase any of the above listed threats to the species. However, Broad-headed Snake is also listed as a species of concern in the Key Threatening Process (KTP)

Additional impact assessment provisions for species at risk of SAII	Broad-headed Snake (*Hoplocephalus bungaroides*)
	Alteration of habitat following subsidence due to longwall mining. The Modification would increase the threat of this KTP on the species in the subject land. However, as indicated by MSEC (2021) the potential impacts are considered to be negligible/minor. According to BioNet, there are no nearby records of Broad-headed Snake within 10 km of the subject land, however, the species is highly cryptic. The species is confined to Triassic and Permian sandstones, utilising rock crevices under flat sandstone outcrop during late summer to early spring, then moving to tree hollows downslope from the outcrops. Potential foraging and breeding habitat for this species was detected in the subject land, which is formed from associated PCTs containing HBTs suitable for the species and rocky areas containing cracks, fissures and sandstone rocks and boulders. This accounts for 3.17 ha of the subject land. It is highly likely that within the locality, a large area of habitat would be present, which is currently not affected by subsidence related impacts.
b) evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by: i. an estimate of the species' current population size in NSW, and ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations	DPIE have determined that this species is not at risk of SAII due to Principle 2 – small population size. Responses to b) i and b) ii cannot be provided because: • The species information available in Bionet and other reliable/peer reviewed information about the species is limited and does not address these aspects • Bionet record data does not contain enough records to confidently identify a decline in the population over the last three years. Bionet record data contains 446 records of the species, however this is in no way an indication of the current population size. To assess the distribution of the Broad-headed Snake *Hoplocephalus bungaroides*, Newell and Goldingay (2005) conducted surveys across 236 sites in 10 conservation reserves of the Sydney region, targeting rock outcrops. Despite the apparent suitability of much of the habitat surveyed, few Broad-headed Snakes were detected and in only four of the reserves, confirming the rarity of this species. iii. Studies show that life-history traits and diets of broad-headed snakes contribute to their vulnerability. The specialized diet, reliance upon two distinctive habitats for foraging (including rock outcrops and adjacent woodland), low rate of growth, delayed maturation and low reproductive output may have exacerbated the vulnerability of broad-headed snakes to habitat destruction (Webb and Shine 2006). There is insufficient data to determine whether the species population size would be likely to undergo natural fluctuations, however given its low fecundity rate and highly specific requirements for foraging and breeding, the species does not fit the model for typical boom-bust population dynamics.

Additional impact assessment provisions for species at risk of SAII	Broad-headed Snake (*Hoplocephalus bungaroides*)
c) evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by: i. extent of occurrence ii. area of occupancy iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and iv. whether the species' population is likely to undergo extreme fluctuations	DPIE have determined that this species is not at risk of SAII due to Principle 3 – limited geographic range. i. The Broad-headed Snake occurs in NSW from Wollemi National Park in the north to the Clyde River catchment (south-west of Nowra) in the south, east to Royal National Park and the Illawarra, and west to the upper Blue Mountains at Blackheath and Newnes (DoE 2014). There are four general areas of occurrence: Blue Mountains; southern Sydney; an area north-west of the Cumberland Plain; and the Nowra hinterland (DoE 2014). Populations north of Kiama and south of Kiama are two evolutionary significant units that diverged approximately 800 000 years ago (DoE 2014). The size and area inhabited by the existing population of the Broad-headed Snake is unknown, likely due to a lack of survey and level of difficulty of detection. There are no local records of the species in close proximity to the subject land (within a 10 km radius on BioNet). The species is known from 28 parts of the following IBRA regions: Central West, Hawkesbury Nepean, Hunter-Central Rivers, Southern Rivers and Sydney Metro (DPIE 2015, DoE 2014). ii. This species is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney (Bionet 2021a).Formerly, the Broad-headed Snake occurred along rocky sections of the Sydney coastline from the entrance of Port Jackson south to Botany Bay, and around Middle Harbour, Lane Cove and Parramatta (DoE 2014). Old outlying records were made in the north-west of the Sydney Basin between Bathurst and Mudgee (DoE 2014). Breeding habitat constraints include rocky areas, including escarpments, outcrops and pogodas within the Sydney Sandstone geologies (Bionet 2021a). The species area of occupancy is limited within its known distribution, restricted by availability of suitable breeding habitat. Vegetation associations at known sites are variable, but mainly woodland, open woodland and/or heath and woodland or forest adjacent to the site is essential (DoE 2014). Near Bathurst, it has been found in forest growing on shale or conglomerate slopes and bluffs (DoE 2014). iii. The current distribution of this species is poorly known, further identification of threat-defined locations is unlikely to be possible without detailed knowledge of the current distribution. Therefore, any potentially suitable breeding habitat ought to be considered a threat defined location.

Additional impact assessment provisions for species at risk of SAII	Broad-headed Snake (*Hoplocephalus bungaroides*)
	iv. There is insufficient data to determine whether the species population size would be likely to undergo extreme natural fluctuations, however given its low fecundity rate and highly specific requirements for foraging and breeding, the species does not fit the model for boom-bust population dynamics. Therefore, it's considered that if a sub-population lost a significant number of individuals, the recovery of the sub-population would be slow. Populations where habitat is subject to disturbance, illegal collecting and inappropriate fire regimes, are likely to decline into the future.
d) evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because: i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).	DPIE have determined that this species is at risk of SAII due to Principle 4 – unlikely to respond to management. i. The species averages six offspring but females breed only every second or third year or less frequently (Bionet 2021a). Males reach sexual maturity at about three years, females not until four or five years (Bionet 2021a). The species is known to have a low rate of growth, delayed maturation and low reproductive output (Webb and Shine 2006, DPIE 2021a), which limits the ability to increase an existing population on a biodiversity stewardship site. ii. Bionet states that management has a moderate ability to control threats for the species. The species relies on rocky outcrops for breeding. Goldingay and Newell (2016) found that outcrop restoration can restore habitat quality: lizard prey of the Broad-headed Snake was more abundant in constructed compared to natural outcrops; Broad-headed Snakes were detected equally in constructed and natural outcrops. Therefore, is it likely that the species habitat can be restored post disturbance and could be replaced on a biodiversity stewardship site. iii. The life history traits and ecology of the Broad-headed Snake is not well known. Threats listed in response to 2) a) ii are for the most part controlled within a biodiversity offset site, with the exception of disturbance to breeding habitat by mining operations. The key threatening process *Alteration of habitat following subsidence due to longwall mining* cannot be precluded from a biodiversity stewardship site where it is established within an existing mining lease. This key threatening process may induce cracking, slabbing and rockfalls that may result in the loss of individuals or abandonment of the breeding habitat as a result of the disturbance. However, the species is likely to adjust to and utilise the altered rocky habitat post disturbance from subsidence.
3. Where the TBDC indicates data is 'unknown' or 'data deficient' for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.	Some of the questions in this consideration of SAII cannot be assessed at this time because:

Additional impact assessment provisions for species at risk of SAII	Broad-headed Snake (*Hoplocephalus bungaroides*)
	• The species information available in TBDC, Bionet and other reliable/peer reviewed information about the species is limited • A lot of the information is not covered by scientific papers, and there are significant knowledge gaps. As such, we have noted the knowledge gaps in the TBDC and provided responses using information we have readily available. Items deemed data deficient by DPIE have been detailed at the start of this SAII assessment (DPIE data package).
4. In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
a) the impact on the species' population (Principles 1 and 2) presented by: i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal	i. Habitat for Broad-headed Snake was detected within the subject land in rocky areas within PCT 1629 (Figure 13d). Habitat searches undertaken on 25 August 2021 did not detect this species; however, the species could not be completely excluded from the subject land due to the presence of deep crevices and heavy sandstone boulders in the central section of minor cliff line C9. Therefore, Broad-headed Snake is assumed present in the aforementioned areas which could not be thoroughly searched, and the species habitat constraints are considered sensitive to subsidence impacts (Figure 13d). ii. Given the species is not known to occur on the subject land and surveys could not completely discount this species, it is not known how many individuals may be impacted by the Modification. The Modification has the potential to disturb Broad-headed Snake breeding habitat and potentially result in loss of individuals due to occasional rockfalls, dislodgement of boulders or slabs, or fracturing. However, as indicated by MSEC (2021) the potential impacts to rocky habitat are considered to be minor, with less than 5% of such features being potentially impacted. Further, the species is less likely to be impacted long-term as they are likely to adjust to and utilise the altered rocky habitat post subsidence. iii. The species unit of measure is area. The species polygon was formed from rocky habitat with deep crevices and large sandstone boulders where species was unable to be excluded (August survey) combined with overlying area of PCT 1629 (see Figure 13d). The species polygon covers an area of 3.17 ha. Number of individuals on site is not known as the species was not detected during targeted surveys. As indicated by MSEC (2021) potential impacts to rocky habitat are considered to be of minor environmental consequence (with less than 5% of such features being impacted), therefore likelihood of impact on individuals is also likely to be low.

Additional impact assessment provisions for species at risk of SAII	Broad-headed Snake (*Hoplocephalus bungaroides*)
b) impact on geographic range (Principles 1 and 3) presented by: i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.	i. The subject land comprises 3.17 ha of land that meets the potential area of occupancy for the species, i.e., rocky habitat with deep crevices and large sandstone boulders where species was unable to be excluded via survey (Figure 13d). This land includes potential breeding habitat. Exact areas of occupancy and percentages cannot be provided as there is insufficient data available for this species. As indicated by MSEC (2021) the potential impacts to rocky habitat are considered to be minor. Therefore the Modification is not likely to alter the species geographic range. ii. The impact on the sub-population(s) cannot be quantified, as it is possible and considered likely that they also utilise suitable habitat outside the subject land. Subsidence impacts to habitat (such as rockfalls) may result in the loss of individuals of the sub-population(s), however is unlikely to result in the loss of an entire sub-population. As indicated by MSEC (2021) the potential impacts to rocky habitat as a result of the Modification are considered likely to be minor, therefore impact to individuals of the subpopulation are considered unlikely. Further the habitat may still be utilised by the species following minor disturbances from subsidence. iii. Given the Modification does not result in any direct clearing/removal of habitat for the species, the impacts to rocky habitat is likely to be minor (impacting less than 5% of such features) (MSEC 2021), and the habitat may still be utilised by the species following minor disturbances from subsidence, a population of the species is not likely to be fragmented by the Modification. Therefore the Modification is not likely to reduce the habitat area required to support a population of the species. iv. The Modification is not likely to modify fire regimes. It will modify hydrology of drainage lines within the subject land, however this species is not reliant on drainage lines. A discussion of predicted impacts to prescribed impacts to karst, caves, crevices, cliffs, rocks and other geological features of significance is provided in section 4.3.2.
5. The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate.	Not applicable.

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
DPIE data package	Principle 1 SAII: rapid decline = No

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
	Principle 2 SAII: small population size = No Population = Data deficient Extreme fluctuations = No Principle 3 SAII: limited geographic range = No Number of locations = Data deficient Estimated AOO = Data deficient Estimated EOO = Data deficient Principle 4 SAII: unlikely to respond to management = Yes Justification = Species dependent on habitat attributes: Caves and other similar structures
1. The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAII, including the action and measures taken to avoid the direct and indirect impact on the species at risk of an SAII. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.	Up to 24 Large-eared Pied Bat individuals were identified within the vicinity of the subject land during targeted surveys (harp traps and habitat mapping) conducted by AMBS (2021) (Figure 12). Of these 24 Large-eared Pied Bats, two were immature, one was a juvenile, one was in the latter stages of lactating, and one had possibly lactated in the past based on the colouration of its nipples (AMBS 2021)., No maternity caves were identified during targeted surveys, however breeding habitat is assumed to be present in the subject land by the presence of a juvenile of the species. All roosting habitat in the subject land is assumed to be breeding habitat for the purposes of the assessment. AMBS (2021) found that roosting habitat was extensive and variable in the northern outcrop area (Cliff 9). The extent of roosting habitat was difficult to estimate as a definitive end to the cavities could not always be seen. Based on these results, breeding habitat for this species has been assumed within the subject land in accordance with the requirements of BioNet (DPIE 2021a) and the species habitat constraints are considered sensitive to subsidence impacts (Figure 13a). **Project justification and avoidance measures have been discussed in section 3 of this report.**
2. The assessor must consult the TBDC and/or other sources to report on the current population of the species including:	
a) evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:	DPIE have determined that this species is not at risk of SAII due to Principle 1 – rapid deline. i. The decline in population of the species in NSW in the last 10 years cannot be assessed at this time because:

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites	• The species information available in Bionet and other reliable/peer reviewed information about the species is limited and does not address this aspect • Bionet record data exhibits a bias toward increased survey effort, resulting in an increase of species records within the last 10 years. ii. The species breeding habitat constitutes habitat within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings (DPIE 2021a). Key threats to the species, which are likely to have contributed to its decline are: • Habitat loss, including clearing and isolation of forest and woodland habitats near cliffs, caves and old mine workings for agriculture or development, and damage to roosting and maternity sites from mining operations, and recreational caving activities. • Fire and inappropriate fire regimes: Loss of foraging habitat close to cliffs, caves and old mine workings from forestry activities and too-frequent burning, usually associated with grazing. • Disturbance: Use of pesticides. • Pest animals: Disturbance to roosting areas by goats • Lack of knowledge: Insufficient understanding of habitat requirements (DPIE 2021a). According to BioNet, there are many nearby records of Large-eared Pied Bat within 10 km of the subject land, particularly within and near the existing mining operations. The large number of records within and near existing mining operations is likely a bias caused by increased survey effort in those locations, as the habitat is similar through much of the western slopes, escarpment and foothills of the Great Dividing Range and thus we might expect similar distribution and occurrence throughout the broader area. Note that lack of knowledge about this species is a significant issue. Currently there are only four known maternity caves for this species and two of these are no longer active (DAWE n.d.). Breeding cave dwelling species such as the Large-eared Pied Bat tend to display fidelity to their breeding sites and maternity caves and may breed in large numbers, however the species breeding behaviours are not well studied and only two active maternity caves are known from Coonabarrabran and the Pilliga, and evidence of a maternity cave has been found near Ulan (i.e., capture of lactating females and females with young). The number of breeding females has been observed at one of the known sites to be between 14 and 40 (Pennay 2008). Requirements of maternity roosts are highly specific (discussed in response to c) ii), and given the scarcity of this habitat feature, the loss of a maternity cave would constitute a significant reduction in an important area of occupancy of a population. Further, DERM (2011) state that any maternity roosts must be considered habitat critical to the survival of the species. Given the presence of juveniles, the presence of breeding habitat has been assumed on the subject land.

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
b) evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by: i. an estimate of the species' current population size in NSW, and ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations	DPIE have determined that this species is not at risk of SAII due to Principle 2 – small population size. Responses to b) i and b) ii cannot be provided because: • The species information available in Bionet and other reliable/peer reviewed information about the species is limited and does not address these aspects • Bionet record data does not contain enough records to confidently identify a decline in the population over the last three years • Bionet record data contains 2,022 records of the species, however this is in no way an indication of the current population size. iii. It is estimated that the species occurs in small populations of around 50 individuals (TSSC 2012). There is insufficient data to determine whether the species population size would be likely to undergo natural fluctuations, however given its low fecundity rate and highly specific requirements for breeding, the species does not fit the model for typical boom-bust population dynamics.
c) evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by: i. extent of occurrence ii. area of occupancy iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and iv. whether the species' population is likely to undergo extreme fluctuations	DPIE have determined that this species is not at risk of SAII due to Principle 3 – limited geographic range. i. The current distribution of this species is poorly known, noting that lack of knowledge about this species is a significant issue. Within NSW it is known from 77 parts of eight IBRA bioregions: Border Rivers-Gwydir, Central West, Hawkesbury-Nepean, Hunter-Central Rivers, Namoi, Northern Rivers, Southern Rivers and Sydney Metro (DPIE 2015). ii. This species requires a combination of sandstone cliff/escarpment to provide roosting and breeding habitat that is adjacent to higher fertility sites particularly box gum woodlands or river/rainforest corridors which are used for foraging (TSSC 2012). As such, it is suggested that within its extent of occupancy it is limited to within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels, and breeding habitat is further restricted to within 100m of cliffs and other rock features (DPIE 2021a). The species area of occupancy is limited within its known distribution, restricted by availability of suitable roosting habitat. Requirements of nursery roosts are highly specific, including arched caves with indented dome roofs for heat capture and retention, and deep enough for juveniles to learn to fly inside (TSSC 2012). These physical characteristics are very uncommon in the landscape and therefore a limiting factor to the species area of occupancy. Currently there are only four known maternity caves for this species and two of

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
	these are no longer active (DAWE n.d.). The two known active maternity roosts are located near Coonabarrabran and in the Pilliga (Pennay 2008, DERM 2011). It is suggested that at the breeding stage of the lifecycle, the species distribution becomes highly concentrated into very limited areas (TSSC 2012). iii. The current distribution of this species is poorly known, further identification of threat-defined locations is unlikely to be possible without knowledge of the whereabouts of maternity roosts. DERM (2011) state that any maternity roosts must be considered habitat critical to the survival of the species. Therefore, any potentially suitable roosting and breeding habitat ought to be considered a threat defined location. iv. There is insufficient data to determine whether the species population size would be likely to undergo natural fluctuations, however given its low fecundity rate and highly specific requirements for breeding, the species does not fit the model for boom-bust population dynamics. Therefore, it's considered that if a sub-population lost a significant number of individuals, the recovery of the sub-population would be slow. Given the small size of the species sub-populations (around 50 individuals), a loss of many individuals from a single population may also lead to increased susceptibility to disease and infertility as a result of a drastic genetic bottleneck, which may eventually result in the loss of that sub-population. However, little is known about this species, and it is suggested that at the breeding stage of the lifecycle, the species distribution becomes highly concentrated into very limited areas (TSSC 2012), it's possible that the species maintains genetic diversity through breeding outside their sub-population.
d) evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because: i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).	DPIE have determined that this species is at risk of SAII due to Principle 4 – unlikely to respond to mangement. i. The species has low fecundity, with a mean yearly litter size of 1.8, and the generation length is unknown (TSSC 2012). As discussed previously, the species has a very specific requirement of maternity caves. Additionally, there are many suitable roost caves within the Pilliga that are not used by the species, which indicates the species has a limited capacity to occupy new habitat within a biodiversity stewardship site. A biodiversity stewardship site would need to be established around a known maternity cave for any management actions to have a positive effect on/protect the entire lifecycle of the species.

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
	ii. As previously discussed, the species is reliant on abiotic habitats which cannot be restored or replaced (e.g., caves) on a biodiversity stewardship site. Additionally, relatively low levels of disturbance from macropods is known to have resulted in permanent abandonment of one of the four known maternity roosts, indicating that the species lifecycle may be impacted by very low levels of disturbance which may not necessarily result in the loss or modification of the maternity cave (i.e., while the cave may still be present, the species use of it may not be restored following minor disturbances). iii. The life history traits and ecology of the Large-eared pied bat is not well known. Threats listed in response to 2) a) ii are for the most part controlled within a biodiversity offset site, with the exception of disturbance to roost sites by mining operations. The key threatening process defined as *Alteration of habitat following subsidence due to longwall mining* cannot be precluded from a biodiversity stewardship site where it is established within an existing mining lease. This key threatening process may induce cracking, slabbing and rockfalls that may result in the loss of individuals or abandonment of the roost site as a result of the disturbance.
3. Where the TBDC indicates data is 'unknown' or 'data deficient' for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.	Some of the questions in this consideration of SAII cannot be assessed at this time because: • The species information available in TBDC, Bionet and other reliable/peer reviewed information about the species is limited • A lot of the information is not covered by scientific papers, and there are significant knowledge gaps. As such, we have noted the knowledge gaps in the TBDC and provided responses using information we have been able to source. Items deemed data deficient by DPIE have been detailed at the start of this SAII assessment (DPIE data package).
4. In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
a) the impact on the species' population (Principles 1 and 2) presented by: i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and	i. It is not possible to determine how many individuals comprise the sub-population from the available data. The breeding population of Large-eared Pied Bat within the subject land forms a subset of a much larger breeding population which spans from the south of Munghorn Gap Nature Reserve. The total population in NSW is unknown, as such a percentage to be impacted of the total population cannot be attained. Up to 24 Large-eared Pied Bat individuals were identified during targeted surveys (harp traps and habitat mapping) conducted by AMBS (AMBS 2021) (Figure 12). Of these 24 Large-eared Pied Bats, two were immature, one was a juvenile, one was in the latter stages of lactating, and one had possibly lactated in the past

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal	based on the colouration of its nipples (AMBS 2021). AMBS (2021) found that roosting habitat was extensive and variable in the northern outcrop area (Cliff 9). The extent of roosting habitat was difficult to estimate as a definitive end to the cavities could not always be seen. As such it cannot be established if a crevice/cave occupying the species is located within the subject land. Regardless, breeding habitat for this species has been assumed within the subject land in accordance with the requirements of BioNet (DPIE 2021a) and the species habitat constraints are considered sensitive to subsidence impacts. Breeding habitat as defined by TBDC is associated PCTs within 100 m of identified potential roost habitat features, equating to 47.74 ha of the subject land (Figure 13a). It is not possible to determine how many individuals comprise the sub-population, or to determine whether the subject land is utilised by more than one sub-population as is potentially indicated by the distribution of BioNet (DPIE 2021a) records for the species in the region. ii. As above, the total population in NSW is unknown, as such a percentage to be impacted of the total population cannot be attained. Long-term impacts that may (but are unlikely) to occur may result in loss of breeding habitat (up to a maximum of 5%) for threatened bats, which would constitute a minor impact on the breeding cycle of the local population of the species. The breeding population of Large-eared Pied Bat within the subject land forms a subset of a much larger breeding population which spans from the south of Munghorn Gap Nature Reserve. High quality (highly complex) Large-eared Pied Bat breeding habitat occurs in the northern (Cliff 9) and western outcrop (Cliff 10) areas which will not be impacted by the Modification whereas moderate quality (less complex) breeding habitat in the north-central, south-central and eastern outcrop areas has a low likelihood of impact due to the short, isolated nature of the features (MSEC 2021). Bats which use minor cliff lines and rock face features for refuge, breeding and/or foraging habitat may be impacted if the species were to use the impacted portion of the feature (5%). The potential decrease of a small area of breeding habitat (up to a maximum of 5%) or mortality of affected individuals in moderate quality breeding habitat is not likely to result in a loss of the breeding population in the subject land or surrounding locality due to the abundance of high quality breeding habitat within the vicinity of the subject land and throughout Munghorn Gap Nature Reserve and nearby Goulburn River National Park. Therefore, whilst considered a minor impact, it is of negligible consequence to the species on a regional scale. As previously mentioned, it is suggested that at the breeding stage of the lifecycle, the species distribution becomes highly concentrated into very limited areas (i.e., known maternity caves,

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
	TSSC 2012), and currently only two maternity roosts are known to be currently in use in NSW despite extensive surveys to locate more. DERM (2011) state that any maternity roosts must be considered habitat critical to the survival of the species. Therefore, there is potential that any impact to an undetected maternity cave within the subject land would impact the entire sub-population of the species, potentially more than one sub-population. However, MSEC (2021) predict impacts to bat habitat features to be negligible (for Cliff 9 which supports more complex and higher quality breeding habitat) /minor (for the moderate quality (less complex) breeding habitat in the north-central, south-central and eastern outcrop areas). iii. The species unit of measure is area. The species polygon was formed from PCTs on the subject land to which the species is associated that are within 2km of identified potential roost habitat features (see Figure 13a). The species polygon covers an area of 66 ha, 47.74 ha meets the definition of breeding constraints i.e., within 100m of the aforementioned features and within 100m of the subject land. Impacts are not likely to extend to the entire area of habitat in the subject land, with MSEC (2021) predicting subsidence impacts to be of minor environmental consequence (potentially affecting up to 5% of rocky habitat features). Exact number of bats utilising the subject land and numbers impacted cannot be provided as there is insufficient data available for this species. However, MSEC (2021) predict impacts to bat habitat features to be negligible/minor (i.e. occasional rockfalls, displacement of or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 5% of the total face of such feature).
b) impact on geographic range (Principles 1 and 3) presented by: i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total area of occupancy or extent of occupancy within NSW ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal	i. The subject land comprises 66 ha of land that meets the habitat constraints for the species, i.e., within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels (DPIE 2021a). A total of 47.74 ha meets the definition of breeding constraints i.e., within 100m of the aforementioned features, within 100m of the subject land. This land includes breeding habitat and the assumed presence of a maternity cave. Exact areas of occupancy and percentages cannot be provided as there is insufficient data available for this species. The breeding population of Large-eared Pied Bat within the subject land forms a subset of a much larger breeding population which spans from the south of Munghorn Gap Nature Reserve. Based on MSEC (2021) predictions, impacts to caves, crevices and rock overhangs as a result of the Modification are likely to be negligible (for Cliff 9 which supports more complex and higher quality breeding habitat) /minor (for the moderate quality (less complex) breeding habitat in

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.	the north-central, south-central and eastern outcrop areas). Therefore the Modification is not likely to alter the species geographic range. ii. The impact on the sub-population(s) cannot be quantified, as it is possible and considered likely that they also utilise suitable roosting habitat outside the subject land within Munghorn Gap Nature Reserve and Goulburn River National Park. However, assuming the maternity cave is within the subject land and it experiences subsidence impacts as a result of the Modification, there is potential that a large portion of the sub-population(s) may be lost instantly if the roost collapsed during breeding season while the maternity roost was occupied or gradually as a result of maternity roost abandonment, failure to reproduce, decrease in population size and genetic bottle-necking leading to disease, inbreeding depression and decreased evolutionary potential to adapt to environmental changes. Subsidence impacts to roosting habitat may result in the loss of individuals of the sub-population(s), however the roosting habitat may still be utilised following minor disturbances from subsidence. Based on MSEC (2021) predictions, the impacts to caves, crevice's and rock overhangs as a result of the Modification are likely to be negligible (for Cliff 9 which supports more complex and higher quality breeding habitat) /minor (for the moderate quality (less complex) breeding habitat in the north-central, south-central and eastern outcrop areas). Therefore, the likelihood of the loss of large proportion of the sub-population is minor. iii. The species is suggested to be confined to within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels (DPIE 2021a). However, very little is known about the species and no available resources were found that report on observed dispersal distances within contiguous areas of suitable habitat, such as that found within the Goulburn River National Park/Ulan region. It is not known whether multiple sub-populations utilise the same maternity caves. As such, no conclusion can be drawn regarding viability of fragmented populations that may result from the loss of critical habitat, i.e., a maternity cave. However, MSEC (2021) predict impacts to bat habitat features to be negligible/minor, therefore a population is not considered likely to be fragmented as a result of the Modification. iv. The Modification is not likely to modify fire regimes. It will modify hydrology of drainage lines within the subject land, however this species is not reliant on the drainage lines in the subject land. A discussion of predicted impacts to breeding habitat is detailed in section 4.2.5 and

Additional impact assessment provisions for species at risk of SAII	Large-eared Pied Bat (*Chalinolobus Dwyeri*)
	prescribed impacts to karst, caves, crevices, cliffs, rocks and other geological features of significance is provided in section 4.3.2.
5. The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate.	Not applicable.

Additional impact assessment provisions for species at risk of SAII	Eastern Cave Bat (*Vespadelus troughtoni*)
DPIE data package	Principle 1 SAII: rapid deline = No Principle 2 SAII: small population size = No Population = Data deficient Extreme fluctuations = No Principle 3 SAII: limited geographic range = Number of locations = Data deficient Estimated AOO = Data deficient Estimated EOO = Data deficient Principle 4 SAII: unlikely to respond to mangement = Yes Justification = Species dependent on habitat attributes: Caves and other similar structures
1. The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAII, including the action and measures taken to avoid the direct and indirect impact on the species at risk of an SAII. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.	Eastern Cave Bats were detected during the targeted surveys (AMBS 2021) (Figure 12). Of these records, four were juvenile, one was immature, and one was an adult female which had recently finished lactating (AMBS 2021). Breeding habitat is indicated to be present in the subject land by the presence of a juvenile and lactating females, however no maternity caves were identified during targeted surveys. All roosting habitat in the subject land is therefore considered to be breeding habitat for the purposes of the assessment (Figure 13b). AMBS (2021) found that roosting habitat was extensive and variable in the northern outcrop area (location in the north of the subject land). The extent of roosting habitat was difficult to estimate as

Additional impact assessment provisions for species at risk of SAII	Eastern Cave Bat (*Vespadelus troughtoni*)
	a definitive end to the cavities could not always be seen. Based on these results, breeding habitat for this species has been assumed within the subject land in accordance with the requirements of BioNet (DPIE 2021a) and the species habitat constraints are considered sensitive to subsidence impacts (Figure 13b). **Project justification and avoidance measures have been discussed in section 3.1 of this report.**
2. The assessor must consult the TBDC and/or other sources to report on the current population of the species including:	
a) evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the: i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites	DPIE have determined that this species is not at risk of SAII due to Principle 1 – rapid decline. i. The decline in population of the species in NSW in the last 10 years cannot be assessed at this time because: • The species information available in Bionet and other reliable/peer reviewed information about the species is limited and does not address this aspect • Bionet record data exhibits a bias toward increased survey effort, resulting in an increase of species records within the last 10 years. ii. The species breeding habitat constitutes habitat within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings (DPIE 2021a). Key threats to the species, which are likely to have contributed to its decline are: • Habitat loss, including clearing and isolation of dry eucalypt forest and woodland, particularly about cliffs and other areas containing suitable roosting and maternity sites, mainly as a result of agricultural and residential development • Loss of suitable feeding habitat near roosting and maternity sites as a result of modifications from timber harvesting and inappropriate fire regimes usually associated with grazing • Fire and inappropriate fire regimes: Loss of foraging habitat close to cliffs, caves and old mine workings from forestry activities and too-frequent burning, usually associated with grazing • Disturbance: Damage to roosting and maternity sites from mining operations, and recreational activities such as caving, and pesticides and herbicides may reduce the availability of invertebrates, or result in the accumulation of toxic residues in individuals' fat stores • Pest animals: Probable predation by cats and foxes • Lack of knowledge: There is a strong likelihood that unrecorded populations could be unintentionally affected by land management actions. (DPIE 2021a). According to BioNet, there are many nearby records of Eastern Cave Bat within 10 km of the subject land, particularly within and near the existing mining operations. The large number of records within and near existing mining operations is likely a bias caused by increased survey effort in those locations, as the habitat is similar through much of the western slopes, escarpment and foothills of

Additional impact assessment provisions for species at risk of SAII	Eastern Cave Bat (*Vespadelus troughtoni*)
	the Great Dividing Range and thus we might expect similar distribution and occurrence throughout the broader area. Breeding cave dwelling species such as the Eastern Cave Bat tend to display fidelity to their breeding sites and maternity caves, and Eastern Cave Bats have been observed in congregations of up to 500 females, however, very little is known about the feeding or breeding requirements of this species (DPIE 2021a). Given the presence of juveniles and lactating females, the presence of breeding habitat has been assumed on the subject land.
b) evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by: i. an estimate of the species' current population size in NSW, and ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations	DPIE have determined that this species is not at risk of SAII due to Principle 2 – small population size. Responses to b) i and b) ii cannot be provided because: • The species information available in Bionet and other reliable/peer reviewed information about the species is limited and does not address these aspects • Bionet record data does not contain enough records to confidently identify a decline in the population over the last three years • Bionet record data contains 607 records of the species in NSW, however this is in no way an indication of the current population size. iii. One roosting cluster of the species was estimated to comprise 240 individuals (Law, Chidel & Mong 2005). There is insufficient data to determine whether the species population size would be likely to undergo natural fluctuations, however given its low fecundity rate and highly specific requirements for breeding, the species does not fit the model for typical boom-bust population dynamics.
c) evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by: i. extent of occurrence ii. area of occupancy iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and iv. whether the species' population is likely to undergo extreme fluctuations	DPIE have determined that it is unknown (data deficient) if this species is at risk of SAII due to Principle 3 – limited geographic range. i. The current distribution of this species is poorly known, noting that lack of knowledge about this species is a significant threat. Within NSW it is known from 50 parts of 6 IBRA regions: Border Rivers-Gwydir, Central West, Hawkesbury-Nepean, Hunter-Central Rivers, Namoi, Northern Rivers (DPIE 2015). Additionally, the species has been recorded in Brigalow Belt South bioregion (Ellis 2001). ii. This species requires a combination of sandstone cliff/escarpment to provide roosting and breeding habitat with sheltered, warm, and humid conditions (range from 20°- 25°), however has also been found to preferentially select man-made structures with warmer diurnal temperatures and greater microclimatic variability (range from 18°- 40°) (Law & Chidel 2007).

Additional impact assessment provisions for species at risk of SAII	Eastern Cave Bat (*Vespadelus troughtoni*)
	It is suggested that within its extent of occupancy it is limited to within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds, and breeding habitat is further restricted to associated PCTs within 100m of the aforementioned habitat constraints (DPIE 2021a). iii. The current distribution of this species is poorly known, further identification of threat-defined locations is unlikely to be possible without knowledge of the whereabouts of known maternity roosts. However, any potentially suitable roosting and breeding habitat ought to be considered a threat defined location. iv. The DPIE information package determined that this species is unlikely to undergo extreme fluctuations. The species is thought to have an average offspring value less than 1 as females to not give birth every year (DPIE 2021a), which, given its low fecundity rate, suggests that the species does not fit the model for boom-bust population dynamics. Therefore, it's considered that if a sub-population lost a significant number of individuals, the recovery of the sub-population would be slow. Little is known about this species, and it is suggested that at the breeding stage of the lifecycle, the species distribution becomes highly concentrated into very limited areas (TSSC 2012), it's possible that the species maintains genetic diversity through breeding outside their sub-population during large breeding congregations.
d) evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because: i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).	DPIE have determined that this species is at risk of SAII due to Principle 4 – unlikely to respond to management. i. The species has low fecundity, with a mean yearly litter size of less than 1 (DPIE 2021a), and there has been no information found regarding generation length. Low fecundity indicates the species reproductive characteristics severely limit the ability to increase the existing population size. There is evidence that Eastern cave bats utilise multiple roosts, usually within 1.5 km of one-another and they alternate roosts sometimes daily (Law, Chidel and Mong 2005). However there is no information available that would suggest the species is not capable of colonising a new area of suitable habitat, aside from the fact that population growth is slow due to low fecundity and that the species demonstrates a preference for the safety of large colony size, as suggested by Richards and Martin (2001). For the species to occupy new habitat within a biodiversity stewardship site, the biodiversity stewardship site would need to be established within 1.5 km of known roosts and contain suitable roosting/breeding caves. Considering the species becomes very active in burnt areas, the introduction of an ecologically sensitive burning

Additional impact assessment provisions for species at risk of SAII	Eastern Cave Bat (*Vespadelus troughtoni*)
	regime in a biodiversity stewardship site may encourage more frequent use of the site by the species, even so, there is no evidence to suggest the species will eventually consistently occupy the biodiversity stewardship site. ii. As previously discussed, the species is reliant on abiotic habitats which cannot be restored or replaced (e.g., caves) on a biodiversity stewardship site. iii. The life history traits and ecology of the Eastern cave bats is not well known. Threats listed in response to 2) a) ii are for the most part controlled within a biodiversity offset site, with the exception of disturbance to roost sites by mining operations. The key threatening process defined as *Alteration of habitat following subsidence due to longwall mining* cannot be precluded from a biodiversity stewardship site where it is established within an existing mining lease. This key threatening process may induce cracking, slabbing and rockfalls that may result in the loss of individuals or abandonment of the roost site as a result of the disturbance.
3. Where the TBDC indicates data is 'unknown' or 'data deficient' for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.	Some of the questions in this consideration of SAII cannot be assessed at this time because: • The species information available in TBDC, Bionet and other reliable/peer reviewed information about the species is limited • A lot of the information is not covered by scientific papers, and there are significant knowledge gaps. As such, we have noted the knowledge gaps in the TBDC and provided responses using information we have been able to source. Items deemed data deficient by DPIE have been detailed at the start of this SAII assessment (DPIE data package).
4. In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
c) the impact on the species' population (Principles 1 and 2) presented by: i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be	i. It is not possible to determine how many individuals comprise the sub-population from the available data. The breeding population of Eastern Cave Bat within the subject land forms a subset of a much larger breeding population which spans from the south of Munghorn Gap Nature Reserve. The total population in NSW is unknown, as such a percentage to be impacted of the total population cannot be attained. Assuming one sub-population is currently utilising the subject land and the sub-population may comprise an unknown number of individuals potentially up to or over 500, there is potential that any impact to an undetected maternity cave within the subject land would impact the entire sub-population. Eastern Cave Bats were detected during the targeted surveys (AMBS 2021). Of these records, four were juvenile, one was immature, and one was an adult female which had

Additional impact assessment provisions for species at risk of SAII	Eastern Cave Bat (*Vespadelus troughtoni*)
impacted, along with the area of habitat to be impacted by the proposal	recently finished lactating (AMBS 2021). AMBS (2021) found that roosting habitat was extensive and variable in the northern outcrop area (in the north of the subject land). The extent of roosting habitat was difficult to estimate as a definitive end to the cavities could not always be seen. As such it cannot be established if a crevice/cave occupying the species is located within the subject land. Regardless, breeding habitat for this species has been assumed within the subject land in accordance with the requirements of BioNet (DPIE 2021a) and the species habitat constraints are considered sensitive to subsidence impacts. Breeding habitat as defined by TBDC is associated PCTs within 100 m of identified potential roost habitat features, equating to 47.74 ha of the subject land (Figure 13b). ii. As above, the total population in NSW is unknown, as such a percentage to be impacted of the total population cannot be attained. Long-term impacts that may (but are unlikely) to occur may result in loss of breeding habitat (up to a maximum of 5%) for threatened bats, which would constitute a minor impact on the breeding cycle of the local population of the species. The breeding population of Eastern Cave Bat within the subject land forms a subset of a much larger breeding population which spans from the south of Munghorn Gap Nature Reserve. High quality (highly complex) Eastern Cave Bat breeding habitat occurs in the northern (Cliff 9) and western outcrop (Cliff 10) areas which will not be impacted by the Modification whereas moderate quality (less complex) breeding habitat in the north-central, south-central and eastern outcrop areas has a low likelihood of impact due to the short, isolated nature of the features (MSEC 2021). Bats which use minor cliff lines and rock face features for refuge, breeding and/or foraging habitat may be impacted if the species were to use the impacted portion of the feature (5%). The potential decrease of a small area of breeding habitat (up to a maximum of 5%) or mortality of affected individuals in moderate quality breeding habitat is not likely to result in a loss of the breeding population in the subject land or surrounding locality due to the abundance of high quality breeding habitat within the vicinity of the subject land and throughout Munghorn Gap Nature Reserve and nearby Goulburn River National Park. Therefore, whilst considered a minor impact, it is of negligible consequence to the species on a regional scale. iii. The species unit of measure is area. The species polygon was formed from associated PCTs within 2km of identified breeding/roosting habitat (Figure 13b). The species polygon covers an area of 66 ha, 47.74 ha meets the definition of breeding constraints i.e., within 100m of the aforementioned features and within 100m of the subject land. Impacts are not likely to extend to the entire area of habitat in the subject land, with MSEC (2021) predicting subsidence impacts to be of minor environmental consequence (impacting up to 5% of

Additional impact assessment provisions for species at risk of SAII	Eastern Cave Bat (*Vespadelus troughtoni*)
	habitat features). MSEC (2021) predict impacts to bat habitat features to be negligible (for Cliff 9 which supports more complex and higher quality breeding habitat) /minor (for the moderate quality (less complex) breeding habitat in the north-central, south-central and eastern outcrop areas).
d) impact on geographic range (Principles 1 and 3) presented by: i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total area of occupancy or extent of occupancy within NSW ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.	i. The subject land comprises 66 ha of land that meets the habitat constraints for the species, i.e., within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds (DPIE 2021a). A total of 47.74 ha meets the definition of breeding constraints i.e., within 100m of the aforementioned features and within 100m of the subject land (Figure 13b). This land includes confirmed breeding habitat and the assumed presence of a maternity cave. Exact areas of occupancy and percentages cannot be provided as there is insufficient data available for this species. Based on MSEC (2021) predictions, the impact to caves, crevices and rock overhangs as a result of the Modification is likely to be negligible (for Cliff 9 which supports more complex and higher quality breeding habitat) /minor (for the moderate quality (less complex) breeding habitat in the north-central, south-central and eastern outcrop areas). Therefore the Modification is not likely to reduce the geographic range of the species. ii. The impact on the sub-population(s) cannot be quantified, as it is possible and considered likely (given their tendency to occupy multiple roosts (Law, Chidel & Mong 2005)) that they also utilise suitable roosting habitat outside the subject land. However, assuming the maternity cave is within the subject land and it experiences subsidence impacts as a result of the Modification, there is potential that a large portion of the sub-population(s) may be lost instantly if the roost collapsed during breeding season while the maternity roost was occupied or gradually as a result of maternity roost abandonment, failure to reproduce, decrease in population size and genetic bottle-necking leading to disease, inbreeding depression and decreased evolutionary potential to adapt to environmental changes. Subsidence impacts to roosting habitat may result in the loss of individuals of the sub-population(s), however the roosting habitat may still be utilised following minor disturbances from subsidence. Based on MSEC (2021) predictions, the impact to caves, crevice's and rock overhangs as a result of the Modification is likely to be negligible (for Cliff 9 which supports the more complex and high quality breeding habitat) /minor (for the moderate quality (less complex) breeding habitat in the north-central, south-central and

Additional impact assessment provisions for species at risk of SAII	Eastern Cave Bat (*Vespadelus troughtoni*)
	eastern outcrop areas). Therefore, the likelihood of the loss of large proportion of the sub-population is minor. iii. The species is suggested to be confined to within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds (DPIE 2021a), and is known to utilise multiple roosts (Law, Chidel & Mong 2005). Maximum observed dispersal distance between roosts of one female Eastern cave bat was 3.75 km, but most inter-roost movements were less than 1.5 km (Law, Chidel & Mong 2005). Contiguous areas of suitable habitat found within the Goulburn River National Park/Ulan region may allow for greater dispersal distances, however there is insufficient evidence to support the assertion this may occur. Law, Chidel and Mong (2005) also not that the species was often observed traversing paddocks between areas of preferred foraging habitat, which suggests it may not be confined to vegetated areas within 2 km of roosting habitat. It is not known whether multiple sub-populations utilise the same maternity caves. As such, no conclusion can be drawn regarding viability of fragmented populations that may result from the loss of critical habitat, i.e., a maternity cave. However, MSEC (2021) predict impacts to bat habitat features to be negligible/minor (as discussed above), therefore a population is not considered likely to be fragmented as a result of the Modification. iv. The proposed impact is not likely to modify fire regimes. It will modify hydrology of drainage lines within the subject land, however Eastern Cave Bat is not reliant on the drainage lines in the subject land. A discussion of predicted impacts to breeding habitat is provided in Section 4.2.5 and prescribed impacts to karst, caves, crevices, cliffs, rocks and other geological features of significance is provided in section 4.3.2.
5. The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate.	Not applicable.

Additional impact assessment provisions for species at risk of SAII	*Regent Honeyeater* (*Anthochaera phrygia*)
1. The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAII, including the action and measures taken to avoid the direct and	Regent Honeyeater occurs in dry open sclerophyll forests and woodlands that contain a high abundance of mature trees, high canopy cover and abundance of mistletoes (DPIE 2021a). Regent Honeyeater predominantly forages on the nectar from Mugga Ironbark *Eucalyptus sideroxylon*, Yellow Box *E. melliodora*, White Box *E. albens* and Swamp Mahogany *E. robusta* in addition to the

Additional impact assessment provisions for species at risk of SAII	*Regent Honeyeater* (*Anthochaera phrygia*)
indirect impact on the species at risk of an SAII. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.	nectar and fruit from mistletoes. The subject land occurs on a mapped important area for the species and as such, species presence (foraging and breeding) is assumed across the entirety of the subject land and coincides with steep slopes. Regent Honeyeater has been previously recorded on 92 occasions with nearest record located 1.6 km to the south-east of the subject land (Figure 9). Canopy trees are not expected to be impacted by the Modification as demonstrated by monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no effect on vegetation health or structure greater than that observed at analogue sites. Therefore, this species habitat constraints are not considered sensitive to subsidence.
2. The assessor must consult the TBDC and/or other sources to report on the current population of the species including:	
a) evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the: i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites	i. The species is believed to have undergone a population decline of > 80% within three generations (Garnett et al., 2011, cited in Commonwealth of Australia 2016). ii. Key threats to the species, which are likely to have contributed to its decline are: • Habitat loss, Historical loss, fragmentation and degradation of habitat from clearing for agricultural and residential development, particularly fertile Yellow Box-White Box-Blakely's Red Gum Woodlands. Continuing loss of key habitat tree species and remnant woodlands from major developments (mining and agricultural), timber gathering and residential developments. • Habitat fragmentation: Key habitats continue to degrade from lack of recruitment of key forage species and loss of paddock trees and small remnants increasingly fragmenting the available habitat (DPIE 2021a). • Overgrazing: Suppression of natural regeneration of overstorey tree species and shrub species from overgrazing (DPIE 2021a). • Competition and predation: Competition from larger aggressive honeyeaters, particularly noisy miners, noisy friarbirds and red wattlebirds, and egg and nest predation from native and feral species (DPIE 2021a). • Demographic threats/small population size: The small population size and restricted habitat availability make the species highly vulnerable to extinction via stochastic processes and loss of genetic diversity, and reduced ability to compete, increased predation and reduced fledging rates (DPIE 2021a). • Disturbance: inappropriate forestry management practices and disturbance from recreational land-users (DPIE 2021a). • Fire and inappropriate fire regimes: Loss of key foraging resources as a result of inappropriate fire regimes (DPIE 2021a). According to BioNet, there are many nearby records of Regent Honeyeater within 10 km of the subject land (Figure 9). The majority of records within the locality are to the west of the subject land

Additional impact assessment provisions for species at risk of SAII	*Regent Honeyeater* (*Anthochaera phrygia*)
	within Munghorn Gap Nature Reserve and to the north, within Goulburn River National Park. The Mudgee-Wollar Key Biodiversity Area (KBA) to the north of the subject land has been identified as an area which is critical to the survival of this species (Commonwealth of Australia 2016). The Regent Honeyeater is known to breed sporadically in this KBA (Todd & Maurer 2020). There are no records within the subject land.
b) evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by: i. an estimate of the species' current population size in NSW, and ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations	i. The most recent estimate of the species population size is 350 – 400 individuals (Garnett et al., 2011, cited in Commonwealth of Australia 2016). There is insufficient genetic differentiation between birds captured in different geographic areas, such that the species can be regarded as a single, widely dispersed population (Kvistad et al. 2015). ii. In 1980s the species population was thought to comprise 1500 individuals, however a more recent estimate of 350 – 400 individuals indicates a significant decline (Garnett et al., 2011, cited in Commonwealth of Australia 2016). iii. Data on the age structure composition of the population species is not available. There is insufficient data to determine whether the species population size would be likely to undergo natural fluctuations, however given its low fecundity and fledging success rate and, the species does not fit the model for typical boom-bust population dynamics.
c) evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by: i. extent of occurrence ii. area of occupancy iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and iv. whether the species' population is likely to undergo extreme fluctuations	i. The Regent honeyeater is a highly mobile, semi-nomadic species. Its extent of occupancy temperate woodlands and forests in south-eastern Australia, from the Adelaide region (South Australia) to 100 km north of Brisbane (Queensland). ii. Its area of occupancy has contracted, with the northern extent primarily restricted to the Gore-Karara region south of Brisbane and the species no longer being found in South Australia (Commonwealth of Australia 2016). Within NSW it is known from 127 parts of 11 IBRA regions: Border Rivers-Gwydir, Central West, Hawkesbury-Nepean, Hunter-Central Rivers, Lachlan, Murray, Murrumbidgee, Namoi, Northern Rivers, Southern Rivers, Sydney Metro (DPIE 2015). iii. It is thought that the regent honeyeater comprises a single population, with some exchange of individuals between regularly used areas. The regent honeyeater was formerly more common and widespread, but its distribution and population size have declined markedly due to the loss and degradation of its preferred woodland habitat. Ongoing declines in population size and habitat availability present significant challenges for the recovery of the regent honeyeater and exert strong pressures on survival of the species in the wild (DoE 2016). Given

Additional impact assessment provisions for species at risk of SAII	*Regent Honeyeater* (*Anthochaera phrygia*)
	these challenges, all areas where regent honeyeaters are known or are likely to occur are considered under threat. Habitat critical to the survival of the regent honeyeater is identified in the recovery plan for the species as (DOE 2016): • Any breeding or foraging habitat in areas where the species is likely to occur • Any newly discovered breeding or foraging locations. Key areas include the Bundarra-Barraba, Pilliga Woodlands, Mudgee-Wollar and the Capertee Valley and Hunter Valley areas in New South Wales, and the Chiltern and Lurg-Benalla regions of north-east Victoria (DoE 2016). iv. The Regent Honeyeater is considered a single population over the entirety of its natural range of distribution (DoE 2016). Seasonal patterns of abundance and breeding are related to regional patterns in the flowering of key species (DoE 2016). Females first reproduces at 2 years of age, with an average of 1-3 offspring (DPIE 2021a). There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests (Bionet 2021a).
d) evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because: i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).	i. Given there are only three known key breeding regions remaining (Bionet 2021a), increase in reproductive success is likely to be linked to the location of a biodiversity stewardship site and its proximity to known breeding locations. ii. The species is not reliant on abiotic habitats which cannot be restored or replaced (e.g., caves) on a biodiversity stewardship site. This species is reliant on Mistletoe which occurs in high densities in the subject land and it not likely to be impacted by the Modification. Regardless Mistletoe can be restored on replaced on a biodiversity stewardship site. iii. The species habitat characteristics are not likely to be impacted by subsidence and the species is not listed as a species of concern in the KTP *Alternation of habitat following subsidence due to longwall mining*. Threats listed in response to 2) a) ii are for the most part controlled within a biodiversity offset site.

Additional impact assessment provisions for species at risk of SAII	*Regent Honeyeater* (*Anthochaera phrygia*)
3. Where the TBDC indicates data is 'unknown' or 'data deficient' for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.	Some of the questions in this consideration of SAII cannot be assessed at this time because: • The species information available in TBDC, Bionet and other reliable/peer reviewed information about the species is limited • A lot of the information is not covered by scientific papers, and there are significant knowledge gaps. As such, we have noted the knowledge gaps in the TBDC and provided responses using information we have been able to source.
4. In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
a) the impact on the species' population (Principles 1 and 2) presented by: i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal	i. The Regent Honeyeater is considered a single population throughout its range and is predominantly nomadic, moving through the landscape in response to the availability of foraging resources. The population estimate as of 2018 is 350 mature individuals in the wild. ii. The Modification would not result in the removal of habitat for Regent Honeyeater or result in loss of any individuals. It is unlikely that the Modification would directly or indirectly impact the local population. ii. The species unit of measure is area, with the species polygon made up of the 'Mapped Important Area' for the species (Figure 13q). The subject land comprises 66 ha of land that meets the habitat constraints for the species – i.e. 'Important Mapped Areas'. Surveys are not required for the species, so the number of individuals on the subject land is not known There are no previous records of the species within the subject land (BioNet). However the habitat on the subject land is not likely to be directly or indirectly impacted by the Modification. No individuals are likely to be impacted by the Modification.
b) impact on geographic range (Principles 1 and 3) presented by: i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total area of occupancy or extent of occupancy within NSW ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or	i. The Modification will not impact on habitat for the species, directly or indirectly. Therefore none of the species geographic range or area/extent of occupancy of the species would be impacted by the Modification. ii. The Modification will not impact on Regent Honeyeater population, as no habitat will be impacted and no individuals would be removed. Subsidence is not likely to impact habitat for the species. iii. Given the Modification does not result in any direct clearing/removal of habitat for the species and the habitat will still be utilised by the species following minor disturbances from subsidence, a population of the species is not likely to be fragmented by the Modification. Therefore the

Additional impact assessment provisions for species at risk of SAII	*Regent Honeyeater* (*Anthochaera phrygia*)
documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.	Modification is not likely to reduce the habitat area required to support a population of the species. iv. The Modification is not likely to modify fire regimes. It will modify hydrology of drainage lines within the subject land and may impact on caves, cliffs and rocky features, however this species is not reliant on these habitats. Given the Modification will not impact the species, it will not alter the level of threat that the species faces in the local area.
5. The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate.	Not applicable, the species is at risk of an SAII.

Additional impact assessment provisions for TEC at risk of SAII	*White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* (Critically Endangered)
1. The assessor is required to provide further information in the BDAR or BCAR regarding the impacts on each TEC at risk of an SAII. This must include the action and measures taken to avoid the direct and indirect impact on the TEC at risk of an SAII. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR and BCAR.	Approximately 6.7 ha of the CEEC *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* occurs in the subject land (Figure 7). The Modification does not require the clearing of overlying native vegetation, including areas of *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland*. Short term impacts may result minor loss/changes to the TEC within the subject land, however these would be localised and temporary and are not expected to cause long-term changes to vegetation health or structure as per the findings derived from monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence.
2. The assessor must consult the TBDC and/or other sources to report on the current status of the TEC including:	
a) evidence of reduction in geographic distribution (Principle 1, clause 6.7(2)(a) BC Regulation) as the current total geographic extent of the TEC in NSW AND the	*White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland* has undergone a very large reduction in geographic distribution. The Community has been extensively

Additional impact assessment provisions for TEC at risk of SAII	*White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* (Critically Endangered)
estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal)	cleared throughout its range and remnants are typically small, isolated, highly fragmented and occur in predominantly cleared landscapes and exhibit highly modified understoreys (Tozer and Simpson 2020). The ecological community has been most severely reduced on the Western Slopes of NSW and across Central Victoria. The level of clearance has been least in Northern NSW and Southern Queensland, particularly in the rugged gorge country, and in the ACT. This is largely related to past management history, which is in turn influenced by soil types and topography (Tozer and Simpson 2020). In 2010 it was estimated that only 405,000 ha of the ecological community in various condition states remain (DECCW 2010). Thomas et al. (2000) estimated that approximately 59,468 hectares remained in south-eastern NSW as of the year 2000, which is less than 4% of its original extent. There is circumstantial evidence which suggests that clearing of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is ongoing and has increased in recent years, at least in NSW which accounts for three quarters of the distribution of the Ecological Community (Tozer & Simpson 2020). Thomas *et al.* (2000) estimated that in south-eastern NSW the extent of *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* has been reduced to around 5% of its pre-1750 distribution, existing as remnants that have greater than 20% canopy cover, and are 10 ha in size or larger. Further, it is considered that only 0.05% of *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* in NSW remains in near to original condition (Prober and Thiele 1993; DECCW 2010). The plausible range estimated for the extent of reduction includes values greater than 90% for almost all of the variants of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Furthermore, the plausible ranges for those variants estimated to have been most extensively distributed in NSW suggest that these have almost certainly been reduced to less than 10% of their pre-1750 distribution (Tozer and Simpson 2020).
b) extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes (Principle 2, clause 6.7(2)(b) BC Regulation) indicated by: i) change in community structure	*White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* has a significantly reduced ecological function, evidenced by the following: i) Change in community structure: The White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland that existed prior to European settlement now exists as remnants in three different states. The three states are:

Additional impact assessment provisions for TEC at risk of SAII	*White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* (Critically Endangered)
ii) change in species composition iii) disruption of ecological processes iv) invasion and establishment of exotic species v) degradation of habitat, and vi) fragmentation of habitat	• An overstorey of eucalypt trees exists, but there is no substantial native understorey. • A native understorey exists, but the trees have been cleared. • Both a native understorey and an overstorey of eucalypts exist in conjunction. ii) change in species composition: Grazing, pasture improvement and changed fire regimes has had a significant impact on the species composition of remaining remnants. Grazing has been shown to lead to a reduction in understorey species diversity and richness due to the suppression or loss of native species that are both highly palatable and intolerant of grazing by domestic stock. Areas of Derived Native Grassland subject to grazing usually retain some native species and functioning ecological processes, and it is possible that the habitat value of these grasslands can be at least partially restored following a cessation of grazing and with the regeneration of tree species (Tozer and Simpson 2020). iii) disruption of ecological processes: the disruption of biotic processes and interactions caused by the implementation of management for agricultural production is very severe and the impacts are estimated to apply over more than 90% of the pre-1750 distribution of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Tozer and Simpson 2020). The ecological community continues to be degraded at both the patch and landscape scale. This ongoing modification, while not necessarily leading to the total destruction of all elements of the ecological community, threatens it with extinction. The reduction in the integrity of this ecological community across most of its range has been very severe. The changes have been such that reestablishment of the ecological processes, species composition and community structure of the original ecological community is not likely to be possible, even with immediate positive human intervention (Tozer and Simpson 2020). iv) invasion and establishment of exotic species - The reduction of native plant cover by grazing presents opportunities for the invasion by exotic plant species. Of the remaining area, a large proportion of it has been modified and occurs as trees over a predominantly exotic understorey (Tozer and Simpson 2020). v) degradation of habitat, and vi) fragmentation of habitat - This ecological community is subject to ongoing threats across its range, including further clearing, deterioration of remnant condition and degradation of the landscape in which remnants occur. Degradation and fragmentation of this ecological community involves the loss of suites of species, such as woodland birds, understorey plant species and soil crusts. These can sometimes be replaced, functionally, by more common or exotic species, but more often the species, and their function within the ecological community, simply disappear. It is known that these woodlands and grasslands are

Additional impact assessment provisions for TEC at risk of SAII	*White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* (Critically Endangered)
	losing suites of functionally important species, and that these losses are detrimentally impacting upon the ecological community (Tozer and Simpson 2020).
c) evidence of restricted geographic distribution (Principle 3, clause 6.7(2)(c) BC Regulation), based on the TEC's geographic range in NSW according to the: i) extent of occurrence ii) area of occupancy, and iii) number of threat-defined locations	*White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (DPIE 2021). The geographic distribution of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is not restricted. The extent of occurrence of this ecological community is very large, notwithstanding that it has undergone a severe decline in area of occupancy due to both clearing and degradation. The best estimate of the extent of occurrence is 702,800 km2. The best estimate of the area of occupancy is 151,100 km2 (Tozer and Simpson 2020). This ecological community is subject to ongoing threats across its range. These include further clearing, deterioration of remnant condition and degradation of the landscape in which remnants occur (Tozer and Simpson 2020). Of particular concern is the threat posed to some of the highest quality remnants, on Travelling Stock Routes and Reserves, through the increasing trend of converting intermittent grazing regimes to more intensive or set stocking regimes (Tozer and Simpson 2020). While this ecological community is subject to demonstrable, ongoing threats, there are insufficient data to determine the current degree of these threats across the dispersed remnants of this ecological community. There are also insufficient data to accurately determine its current area (Tozer and Simpson 2020).
d) evidence that the TEC is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation).	The ecological community continues to be degraded at both the patch and landscape scale. This ongoing modification, while not necessarily leading to the total destruction of all elements of the ecological community, threatens it with extinction. The reduction in the integrity of this ecological community across most of its range has been very severe. The changes have been such that reestablishment of the ecological processes, species composition and community structure of the original ecological community is not likely to be possible, even with immediate positive human intervention (Tozer and Simpson 2020). Given the above, degraded stands of the TEC, are unlikely to respond to management. However, potential disturbance to this TEC as a result of the Modification are not expected to cause long-term changes to vegetation health or structure as per the findings derived from monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local

Additional impact assessment provisions for TEC at risk of SAII	***White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland*** **(Critically Endangered)**
	seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. Therefore, these areas are not likely to require management intervention.
3. Where the TBDC indicates data is 'unknown' or 'data deficient' for a TEC for a criterion listed in Subsection 9.1.1(2.), the assessor must record this in the BDAR or BCAR.	Tozer and Simpson (2020) note that the following data components for *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* are data deficient: • Environmental degradation in the last 50 years, in the next 50 years and since 1750. • Quantitative analysis - No quantitative analysis of ecosystem collapse has been carried out for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. • An unknown area of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland has been subjected to clearing of understorey species, probably in addition to the sowing of exotic pasture, or the clearing of Eucalyptus regrowth in derived grassland. The rates of clearing or modification of areas of derived grassland are also unknown and difficult to measure.
4. In relation to the impacts from the proposal on the TEC at risk of an SAII, the assessor must include data and information on:	
a) the impact on the geographic extent of the TEC (Principles 1 and 3) by estimating the total area of the TEC to be impacted by the proposal: i) in hectares, and ii) as a percentage of the current geographic extent of the TEC in NSW. Data and information should include direct impacts (i.e. from clearing) and indirect impacts where partial loss of the TEC is likely as a result of the proposal. The assessor should consider for example, changes to fire regime (frequency, severity), hydrology, pollutants, species interactions (increased competition, changes to pollinators or dispersal), fragmentation, increased edge effects and disease, pathogens and parasites, which are likely to contribute to the loss of flora and/or fauna species characteristic of the TEC	Approximately 6.7 ha of the CEEC *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* occurs in the subject land (Figure 7). The Modification does not require the clearing of overlying native vegetation, including areas of *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland*. Short term impacts may result minor loss/changes to TECs within the subject land, however these would be localised and temporary and are not expected to cause long-term changes to vegetation health or structure as per the findings derived from monitoring of UG1 Longwalls 101-103 (ELA 2017, 2018, 2019, 2021a), which detected surface tension cracking with no adverse impacts to the health of native vegetation that can be definitively attributed to subsidence (decline in canopy health recorded in post-mining sites no greater than that associated with local seasonal variation due to drought conditions experienced prior to 2020) or alteration of structural layers due to subsidence. The Modification is not likely to result in changes to the fire regime, hydrology (the CEEC is not a GDE), pollutants, species interactions, fragmentation, increased edge effects and disease, pathogens and parasites.
b) the extent that the proposed impacts are likely to contribute to further environmental degradation or the disruption of biotic processes (Principle 2) of the TEC by:	b) PCT 434 *White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion* equates to CEEC *White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland* in the subject land.

<table>
<tr><th>Additional impact assessment provisions for TEC at risk of SAII</th><th>White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland (Critically Endangered)</th></tr>
<tr><td>i) estimating the size of any remaining, but now isolated, areas of the TEC; including areas of the TEC within 500 m of the development footprint or equivalent area for other types of proposals
ii) describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by:
• distance between isolated areas of the TEC, presented as the average distance if the remnant is retained AND the average distance if the remnant is removed as proposed, and
• estimated maximum dispersal distance for native flora species characteristic of the TEC, and
• other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development
iii) describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s) (Section 4.3). The assessor must also include the relevant composition, structure and function condition scores for each vegetation zone.</td><td>i) The Modification will not alter the current extent of the CEEC in the subject land or surrounding areas, as no clearing is required and indirect impacts are not considered likely to occur.
ii) The Modification will not alter the current connectivity or increase fragmentation of the remaining areas of the TEC, as no clearing is required and no long term impacts to vegetation condition are likely.
iii) The extent of impacts for via relevant condition zones is tabled below. It should be noted, as detailed above, no area of White Box-Yellow Box-Blakely's Red Gum Grassy Box Woodland and Derived Native Grassland is likely to be directly or indirectly impacted by the Modification.
<table><tr><th>Vegetation zone</th><th>Area (ha)</th><th>Patch size (ha)</th></tr><tr><td>1_434_Regenerating Woodland</td><td>6.7</td><td><100</td></tr></table>
See Section 2.2 for more detail. Given the Modification will not impact (directly or indirectly) on the CEEC, the future VI scores are not predicted to change as a result of the Modification.</td></tr>
<tr><td>5. The assessor may also provide new information that demonstrates that the principle identifying that the TEC is at risk of an SAII is not accurate.</td><td>NA</td></tr>
</table>

Annex 9. Digital files created for the BDAR

Subject land

Approved Mine layout

Cliffs

Steep slopes

Rocky areas

Caves

Existing biodiversity offset

Longwall extension area

Subject area buffer

Vegetation buffer

BAM plots

BAM line

PCT mapping

Access track from veg mapping dataset

Threatened flora records

Threatened fauna records

Flora survey tracks

Fauna survey sites

Scat collection

AMBS Anabat trap locations

Harp trap location

Fauna survey tracks

UG2 threatened species

AMBS bat records

AMBS threatened fauna records

September threatened species records

Threatened fauna records 20211021

6853_AugThreatenedSpeciesRecords_20211115

Eastern Cave Bat species polygon

Large-eared Pied Bat species polygon

Parma Wallaby species polygon

Broad-headed Snake species polygon

Eastern Pygmy Possum species polygon

Pink-tailed Legless Lizard species polygon

Striped Legless Lizard species polygon

Gang-gang Cockatoo species polygon

Greater Glider species polygon

Masked Owl species polygon

Squirrel Glider species polygon

Superb Parrot species polygon

Brush-tailed Phascogale species polygon

Bush Stone Curlew species polygon

Koala species polygon

Pale Snake species polygon

Regent Honeyeater species polygon

Tylophora linearis species polygon

Austral Toadflax species polygon

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Terrestrial
Freshwater
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Research and monitoring
Wildlife Schools and training

Heritage management
Aboriginal heritage
Historical heritage
Conservation management
Community consultation
Archaeological, built and landscape values

Environmental management and approvals
Impact assessments
Development and activity approvals
Rehabilitation
Stakeholder consultation and facilitation
Project management

Environmental offsetting
Offset strategy and assessment (NSW, QLD, Commonwealth)
Accredited BAM assessors (NSW)
Biodiversity Stewardship Site Agreements (NSW)
Offset site establishment and management
Offset brokerage
Advanced Offset establishment (QLD)