BHP

MT ARTHUR COAL MINE
MODIFICATION 2

Modification Report

Appendix D

Biodiversity Development Assessment Report

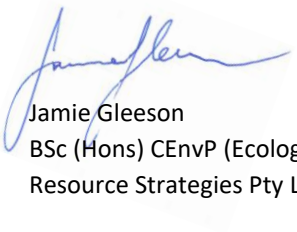
Resource Strategies

MT ARTHUR COAL MINE MODIFICATION 2

BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

September 2023
Project No. HVE-19-09
Document No. 01204554

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 on the basis of the requirements of (and information provided under) the biodiversity assessment method.



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27 September 2023

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DEFINITIONS

BAM: *the Biodiversity Assessment Method.*

BC Act: *the NSW Biodiversity Conservation Act 2016.*

BC Regulation: *the NSW Biodiversity Conservation Regulation 2017.*

Biodiversity Assessment Method Calculator/BAM Credit Calculator: *the online computer program that provides decision support to assessors and proponents by applying the BAM and referred to as the BAM Credit Calculator. The BAM Credit Calculator contains biodiversity data from the BioNet Vegetation Classification and the Threatened Biodiversity Data Collection that the assessor is required to use in a BAM assessment. The BAM Credit Calculator applies the equations used in the BAM, including those to determine the number and class of biodiversity credits required to offset the impacts of a development, or created at a biodiversity stewardship site. It is published by the Department.*

Biodiversity Development Assessment Report (BDAR): *a report prepared by an accredited person in relation to proposed development or activity that would be authorised by a planning approval, or proposed clearing that would be authorised by a vegetation clearing approval, that:*

(a) assesses in accordance with the BAM the biodiversity values of the land subject to the proposed development, activity or clearing;
(b) assesses in accordance with the BAM the impact of proposed development, activity or clearing on the biodiversity values of that land;
(c) sets out the measures that the proponent of the proposed development, activity or clearing proposes to take to avoid or minimise the impact of the proposed development, activity or clearing; and
(d) specifies in accordance with the BAM the number and class of biodiversity credits that are required to be retired to offset the residual impacts on biodiversity values of the actions to which the biodiversity offsets scheme applies.

Biodiversity Offsets: *the gain in biodiversity values achieved from the implementation of management actions on areas of land, to compensate for losses to biodiversity values from the impacts of development.*

Biodiversity Stewardship Site: *means the land that is designated by a biodiversity stewardship agreement to be a biodiversity stewardship site for the purposes of the BC Act.*

Broad Condition State: *areas of the same Plant Community Type that are in relatively homogenous condition. Broad condition is used for stratifying areas of the same Plant Community Type into a vegetation zone for the purpose of determining the vegetation integrity score.*

Class of Biodiversity Credit: *biodiversity credits that share the same attributes (refer to Subsection 10.2 of the BAM 2020).*

Development Footprint: *the area of land that is directly impacted on by a proposed development, including access roads and areas used to store construction materials. The term development footprint is also taken to include clearing footprint, except where the reference is to a small area development or a major project development.*

Ecosystem Credits: *a measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a PCT, and PCTs generally. Ecosystem credits measure the loss in biodiversity values at a development, activity, clearing or biodiversity certification site and the gain in biodiversity values at a biodiversity stewardship site.*

EPBC Act: *the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.*

***High threat weed cover**: plant cover composed of vascular plants that, if not controlled, will invade and outcompete native plant species. Also referred to as high threat weeds or high threat exotic vegetation. Plants considered to be high threat weeds are listed on the high threat weeds list published in the BAM-C.*

***Mapped Important Areas:** for a small number of species for which we have extensive, long-term datasets that indicate the importance of parts of the landscape, the species credit components of their habitat will be mapped as 'important areas'. Mapping these areas seeks to address the criticism that survey rarely detects these highly mobile species, resulting in the ongoing loss of core habitat. Mapping means that if impacted by development, these important areas required for the species to persist in the wild will be offset within a mapped important area.*

***Native Vegetation Cover:** the percentage of native vegetation cover on the subject land and the surrounding buffer area. Cover estimates are based on the cover of native woody and non-woody vegetation. Native vegetation cover includes regrowth, derived native grasslands and plantations that are comprised of plants native to New South Wales.*

***Plant Community Type (PCT):** a NSW plant community type identified using the Plant Community Type classification system.*

***Serious and Irreversible Impacts (SAII):** impacts likely to contribute significantly to the risk of extinction of a threatened species or ecological community in NSW.*

***Species Credit Species:** threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits.*

***Species Credits:** the class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.*

***Subject Land:** is land subject to a development, activity, clearing, biodiversity certification or a biodiversity stewardship proposal. It excludes the assessment area which surrounds the subject land (i.e. the area of land in the 1500 m buffer zone around the subject land or 500 m buffer zone for linear proposals). In the case of a biodiversity certification proposal, subject land includes the biodiversity certification assessment area.*

***Vegetation Class:** a level of classification of vegetation communities, as defined in Keith (2004).*

***Vegetation Formation:** a broad level of vegetation classification as defined in Keith (2004). There are 16 vegetation formations and sub-formations in NSW.*

***Vegetation Integrity (VI):** the condition of native vegetation assessed for each vegetation zone against the benchmark for the Plant Community Type.*

***Vegetation Integrity (VI) Score:** the quantitative measure of vegetation condition calculated in accordance with Equation 23 or Equation 24.*

***Vegetation Zone:** a relatively homogenous area of native vegetation on a development site, land to be biodiversity certified or a biodiversity stewardship site that is the same Plant Community Type and broad condition state.*

EXECUTIVE SUMMARY

The Mt Arthur Coal Mine (MAC) is an open cut coal mining operation situated approximately 5 kilometres (km) south-west of Muswellbrook in the Muswellbrook Local Government Area in the Upper Hunter Valley of New South Wales (NSW). The MAC is owned and operated by Hunter Valley Energy Coal Pty Ltd (HVEC), a wholly owned subsidiary of BHP.

Mining operations at MAC are currently approved until 30 June 2026, in accordance with the Project Approval MP 09_0062 as modified (Project Approval). In June 2022, HVEC announced a decision to cease mining at MAC in 2030, as part of a plan to provide a pathway to closure of the operation. Accordingly, HVEC is seeking a modification of the Project Approval for a four-year extension of mining operations at MAC until 30 June 2030 and other associated changes (the Modification).

This Biodiversity Development Assessment Report (BDAR) was prepared for the Modification in accordance with the NSW *Biodiversity Assessment Method 2020* (BAM) under the NSW *Biodiversity Conservation Act 2016* (BC Act).

Landscape Features

The land subject to the development (the Subject land) is on the edge of the existing/approved surface disturbance area. It is approximately 25 hectares (ha) and has been cleared historically and is mostly former cattle grazing land with derived native grassland with some heavily fragmented scattered and clumped trees. The Subject land is undulating and contains no water sources or rocky habitat. Grazing cattle were removed from the paddocks associated with the Subject land over five years ago.

Native Vegetation

Dr Colin Driscoll (Hunter Eco) undertook contemporary systematic field-based floristic vegetation surveys across the Subject land. Surveys were undertaken in October 2022, November 2022 and July 2023. The surveys included sampling from 13 vegetation integrity (VI) plots, 153 Rapid Data Points and identification of each individual tree within the Subject land and immediate surrounds.

Most of the trees in the Subject land are Bull Oak (*Allocasuarina luehmannii*), with less White Box (*Eucalyptus albens*) and fewer Slaty Box (*Eucalyptus dawsonii*). There is a linear strip of plantings at the northern end of the Subject land. There are three Kurrajong Trees (*Brachychiton populneus*) in the southern end of the Subject land.

Two Plant Community Types (PCTs) were identified within the Subject land:

- PCT 483 *Grey Box x White Box Grassy Open Woodland on Basalt Hills in the Merriwa Region, Upper Hunter Valley*; and
- PCT 1655 *Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin*.

The woodland form of PCT 483 in the Subject land (approximately 0.3 ha of woodland) is equivalent to the *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* Critically Endangered Ecological Community (Box-Gum Woodland Critically Endangered Ecological Community [CEEC]) listed under the BC Act, is approximately 22.5 ha of derived native grassland (a total of approximately 22.8 ha of Box-Gum Woodland CEEC listed under the BC Act). This CEEC is a potential Serious and Irreversible Impact (SAII) entity as described in this BDAR.

The woodland form of PCT 1655 in the Subject land (approximately 0.4 ha) is equivalent to the *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion* Vulnerable Ecological Community listed under the BC Act (Slaty Gum Woodland VEC). The occurrence is mostly Bull Oak (*Allocasuarina luehmannii*) with one single large Slaty Box (*Eucalyptus dawsonii*) tree.

Threatened Species

Bolwarra and Future Ecology undertook targeted surveys for threatened species. Many of the threatened species that can be associated with the PCTs in the Subject land are not likely to occur because the habitat is too degraded. No species credit species were confirmed to be present or likely to use the habitat in the Subject land.

Measures to Avoid and Minimise Impacts

As described above if approved, HVEC will cease mining at the MAC in 2030, as part of a managed plan to provide a pathway to closure of the operation. HVEC is proposing to decrease the total approved disturbance area by approximately 412 ha as the southern out-of-pit emplacement area, as well as the Western Option Edderton Road Realignment, are no longer required to be disturbed. HVEC are not seeking a reduction in biodiversity credit/offset obligations as a result of the reduction in approved disturbance.

The Modification would enable the recovery of additional coal resources while proceeding with a managed process to cease mining in June 2030. The Development Footprint presented in the *Mt Arthur Coal Mine – Modification 2 Scoping Letter* was approximately 35 ha to take the mine disturbance area out to the mining lease boundaries to allow for ancillary infrastructure around the pit shell. Based on feedback from the biodiversity and heritage studies (biodiversity offset liability was considered in making this decision), HVEC has heavily scrutinised the design and optimised the design as per the smaller 25 ha layout, resulting in 10 ha of impact avoidance.

A highwall safety bund, haul road and water management infrastructure would be required (and constrained to) around the outside of the proposed open cut pit. Access tracks would be required to provide access to the infrastructure. A number of topsoil stockpiles would be placed outside of the pit to facilitate rehabilitation of the adjacent final landform. The spatial footprint of the topsoil stockpiles cannot be further minimised without increasing the height of the topsoil stockpiles which can reduce stability and fertility of the soil resource.

The majority of the Development Footprint covers the derived native grassland areas in poorest condition (i.e. areas with the lowest VI scores), noting that most of it is Box-Gum Woodland CEEC (Table 2). The Box-Gum Woodland CEEC in the Development Footprint cannot be avoided due to the need to place the linear infrastructure adjacent to the open cut pit extent.

Potential Impacts

The Modification would require the removal of approximately 24.6 ha of native vegetation, comprising mostly derived grasslands (23.7 ha), woodland (0.7 ha) and planted trees (0.2 ha). The Development Footprint is an extension from the existing/approved surface development area and no habitat would become fragmented or isolated.

The Box-Gum Woodland CEEC in the Development Footprint is not a good example of the community as the woodland has been heavily fragmented by past clearing and as a result it consists of a number of small patches (totalling 0.3 ha) that are isolated. The derived native grassland component of the community (approximately 22.5 ha) is in sub-optimal condition (VI score of 36.6 out of a possible 100) due to the past clearance and long-term use of the paddocks for grazing livestock. Hunter Eco notes that the area studied is weedy and one third of all plant species recorded were weeds (30 weed species including six High Threat Exotic species).

Approximately 0.4 ha of native vegetation in the Development Footprint is equivalent to the Slaty Gum Woodland VEC listed under the BC Act. Again, this woodland has been heavily fragmented by past clearing (Figure 8) and as a result it consists of a number of small patches (totalling 0.4 ha) that are isolated.

There are no prescribed biodiversity impacts relevant to the Modification.

Measures to Mitigate and Manage Impacts

The Modification does not result in any new types of potential impacts on biodiversity, but rather an incremental increase in the surface disturbance area in the location of the Subject land (however, an overall net reduction of 387 ha in the approved disturbance footprint) and continued activities. Given this, there is not a need for approved mitigation, management and monitoring measures in MACs approved *Biodiversity Management Plan* to be changed specifically due to the Modification.

General biodiversity management measures outlined in the approved *Biodiversity Management Plan* that are relevant to the Modification include revegetation of the post-mine landforms, pre-clearance surveys, collecting and propagating seed, salvaging and reusing material from the site for habitat enhancement, controlling weeds, controlling feral pests and bushfire management.

Biodiversity Offset Requirements

As a result of running the BAM Credit Calculator, the Modification requires a total of 566 ecosystem credits for clearance within the Development Footprint (Table ES-1).

Table ES-1
Biodiversity Credit Requirements

Credit Type	Development Footprint Area (ha)	Total Development Footprint Credits
PCT 483 *Grey Box x White Box Grassy Open Woodland on Basalt Hills in the Merriwa Region, Upper Hunter Valley*	23	536
PCT 1655 *Grey Box - Slaty Box shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin*	1.6	30
	Total	**566**

HVEC is cognisant that the new species of legless lizard (*Delma vescolineata*) has only recently been identified as a separate species, and in time, it could also potentially be listed as a threatened species under the BC Act. On this basis, HVEC is prepared to provide biodiversity offsets for *Delma vescolineata* should it be listed under the BC Act in the 12 months following determination of the Modification.

1 INTRODUCTION

This Biodiversity Development Assessment Report (BDAR) forms part of a Modification Report which has been prepared to accompany an application to modify Project Approval MP 09_0062 under section 4.55(2) of the *Environmental Planning & Assessment Act 1979*.

1.1 PROJECT OVERVIEW

The Mt Arthur Coal Mine (MAC) is an open cut coal mining operation situated approximately 5 kilometres (km) south-west of Muswellbrook in the Muswellbrook Local Government Area (LGA) in the Upper Hunter Valley of New South Wales (NSW) (Figure 1). MAC is owned and operated by Hunter Valley Energy Coal Pty Ltd (HVEC), a wholly owned subsidiary of BHP.

Mining operations at MAC are currently approved until 30 June 2026, in accordance with the Project Approval MP 09_0062 as modified (Project Approval). In June 2022, HVEC announced a decision to cease mining at MAC in 2030, as part of a plan to provide a pathway to closure of the operation. Accordingly, HVEC is seeking a modification of the Project Approval for a four-year extension of mining operations at MAC until 30 June 2030 and other associated changes (the Modification).

1.2 MODIFICATION DESCRIPTION

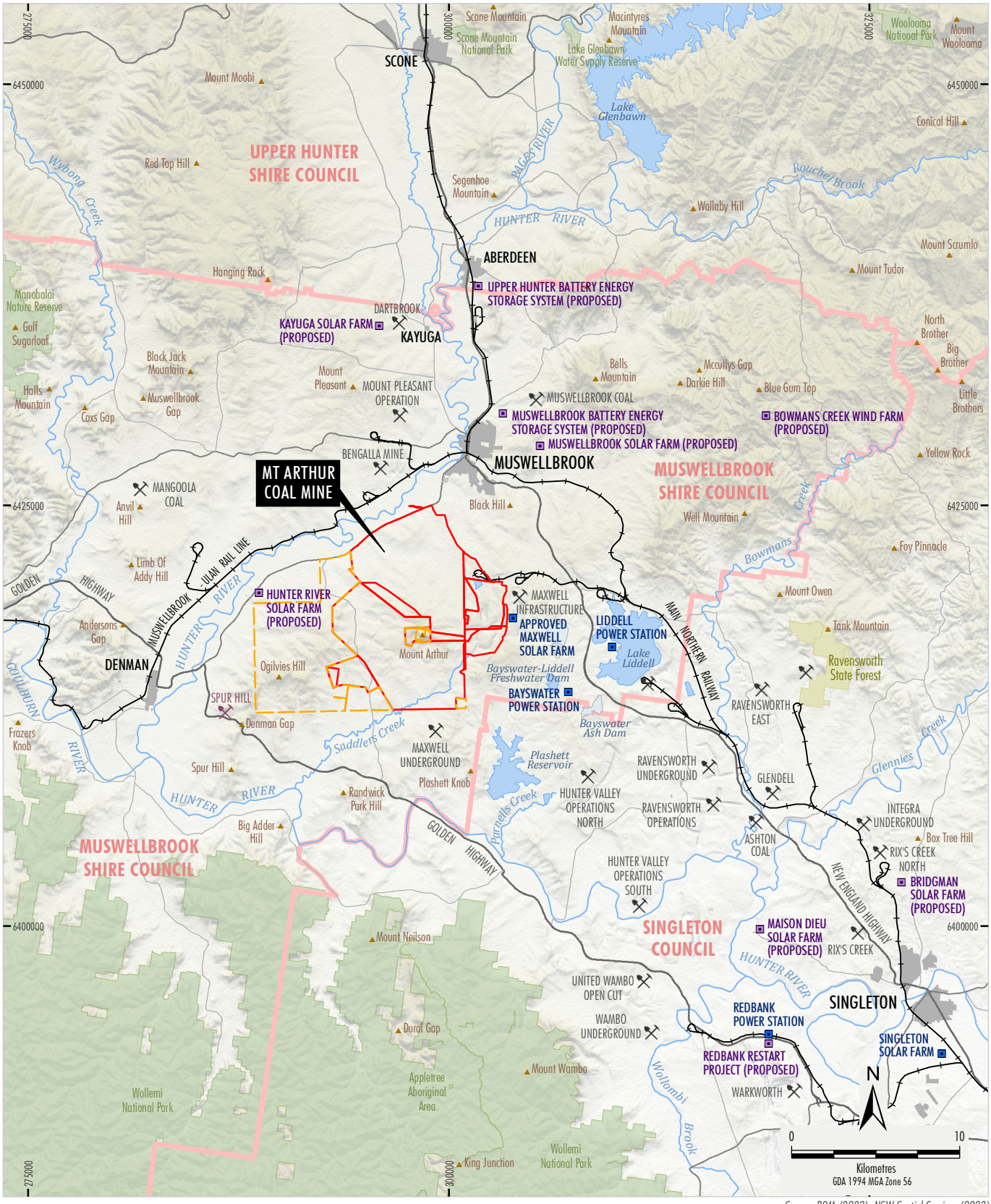
The Modification seeks to modify the Project Approval as follows:

- a four-year extension of mining activities to 30 June 2030;
- a reduction in the approved open cut mining rate from 32 Million tonnes per annum (Mtpa) of run-of-mine (ROM) coal to a maximum of 25 Mtpa ROM coal (similar to current actual ROM coal production);
- a reduction in the cumulative open cut and underground ROM coal handling rate from 36 Mtpa to 29 Mtpa;
- reduction in the maximum total (open cut and underground) coal rail transportation from 27 Mtpa of product coal to 20 Mtpa, and a reduction in train movements from 30 to 20 movements per day;
- a minor extension of the approved disturbance area in the north-west corner of the operation predominantly to allow for access and ancillary infrastructure (refer to Modification New Disturbance Area within Figure 2);
- an overall reduction (387 ha) in approved disturbance, as some previously approved disturbance areas are no longer intended to be disturbed (refer to Impact Minimisation Area within Figure 2); and
- a revised final landform and final void configuration, including an overall reduction in the approved height of the northern overburden emplacement areas and the final landform (to reflect the current actual height).

A general arrangement of the Modification is shown on Figure 2.

The Modification would involve no change to:

- existing mining tenements;
- existing coarse rejects and tailings management;
- existing workforce;
- the existing explosives facility;



Source: BOM (2023); NSW Spatial Services (2023)

LEGEND

- State Forest
- National Parks and Wildlife Estate
- Local Government Area
- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Mining Operation
- Proposed Mining Operations (Application Lodged)
- Existing/Approved Energy Generation Site
- Proposed Energy Generation Site

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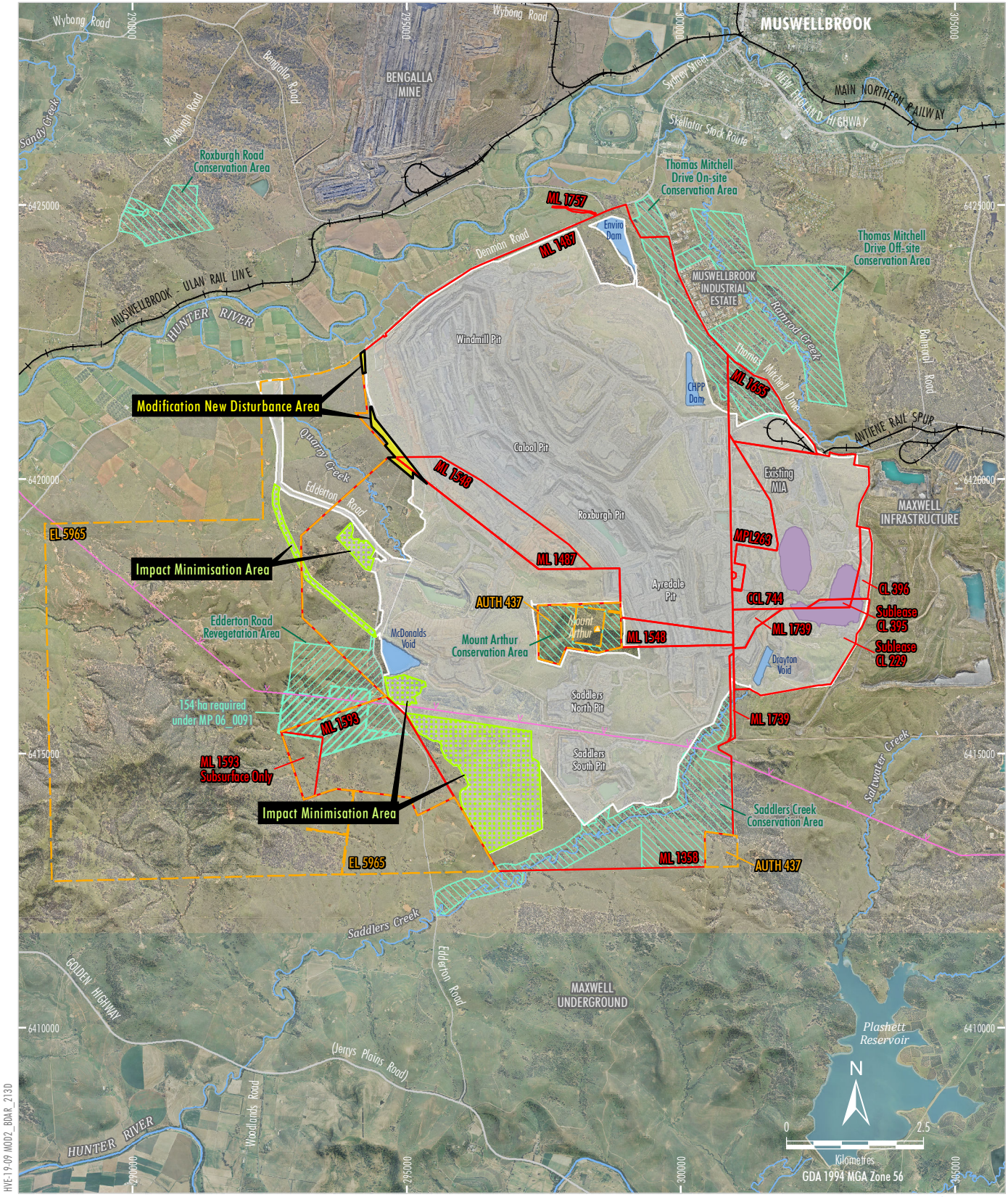
MT ARTHUR COAL MINE MODIFICATION 2

Regional Location

Figure 1

HVE-19-09 MOD2_BDAR_209C



HVE-19-09 MOD2_BBAR_213D

Source: BHP (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: BHP (2022-2020)

LEGEND

- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Existing 500kV Electricity Transmission Line
- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Tailings Storage Facility
- Water Storage
- Modification New Disturbance Area
- Impact Minimisation Area

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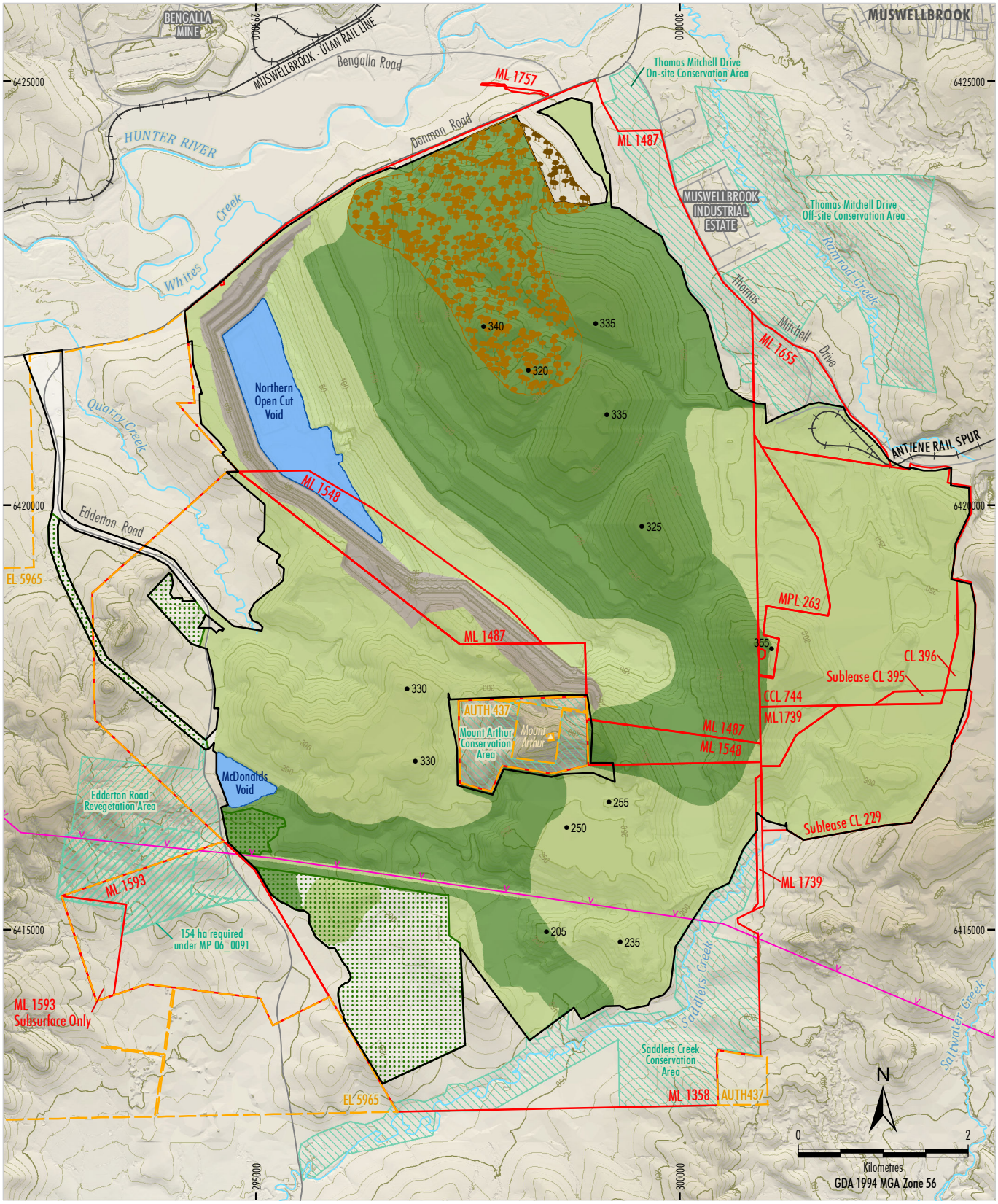
MT ARTHUR COAL MINE MODIFICATION 2

Modification General Arrangement

Figure 2



HVE-19-09 MOD2_BBAR_231H

Source: BHP (2023); NSW Spatial Services (2023)

LEGEND

- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Existing 500kV Electricity Transmission Line
- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Modified Surface Development
- Impact Minimisation Area *
- Existing Remnant Woodland
- Box-Gum Woodland Establishment Area
- Woodland Corridor #
- Pasture Area
- Remnant Highwall
- Water Storage
- •320 Approximate Elevation (m AHD)

* Remnant Woodland within approved disturbance area (including the Impact Minimisation Area) forms part of woodland corridor area obligations under Project Approval MP 09_0062.

\# The conceptual distribution of woodland corridors has been planned to satisy the offset requirements of Project Approval MP 09_0062 that relate to rehabilitation. The final distribution of woodland on the final landform would be subject to detailed design.

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MT ARTHUR COAL MINE MODIFICATION 2

Conceptual Final Landform

Figure 3

- existing site accesses;
- existing electricity supply and distribution;
- existing offset and rehabilitation objectives;
- existing services, plant and equipment; and
- the existing hours of operation and associated activities (undertaken 24 hours per day, seven days a week).

1.3 GENERAL DESCRIPTION OF THE SUBJECT LAND

The land subject to the development (the Subject land) has been cleared historically and is mostly grazing land with derived native grassland with some heavily fragmented scattered and clumped trees. The Subject land is approximately 25 hectares (ha).

The Development Footprint is defined as the area of land that is directly impacted on by a proposed development and is equivalent to the Subject land for this assessment. The Development Footprint encompasses the footprint required for construction and operation.

1.4 ASSESSMENT REQUIREMENTS/APPROACH

This BDAR has been prepared by Jamie Gleeson (Resource Strategies Pty Ltd), who is an accredited assessor (assessor accreditation number BAAS17080) and peer-reviewed by Dr Colin Driscoll (Hunter Eco) (assessor accreditation number BAAS17004). The peer review letter is provided in Attachment A.

The Project is assessed as a State Significant Development. The Modification has been assessed in accordance with the *Biodiversity Assessment Method 2020* (BAM) (Department of Planning, Industry and Environment [DPIE], 2020a) established under Section 6.7 of the NSW *Biodiversity Conservation Act 2016* (BC Act). This BDAR does not provide an assessment of matters under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

No category 1 exempt land occurs in the Subject land. The former Edderton Road alignment passes through the Development Footprint and has been mapped as cleared land.

1.5 INFORMATION SOURCES USED IN THIS ASSESSMENT

This BDAR has been prepared using various data sources as described below. A reference list is provided in Section 10.

1.5.1 Field Surveys

Hunter Eco (2023) (Attachment B), Bolwarra (2023) (Attached to Attachment B) and Future Ecology (2023) (Attachment C) undertook flora and fauna surveys in the Subject land and surrounds.

Hunter Eco (2023) (Attachment B) undertook vegetation sampling and mapping in the Subject land and surrounds. Surveys were undertaken in October 2022, November 2022 and July 2023. Threatened flora species searches were undertaken by Bolwarra (2023) (Attached to Attachment B) in September, October and December 2021, as well as October 2022. The surveys were undertaken across nine study areas surrounding MAC, including the Subject land.

Future Ecology (2023) (Attachment C) undertook fauna surveys in the Subject land and wider area in 2021 and 2022 using a team of up to four ecologists including specialists in amphibians, reptiles, birds and mammals. An additional survey within the Subject land was undertaken in July 2023.

1.5.2 Published Databases

Published databases used in this assessment include:

- *Threatened Biodiversity Data Collection* (Department of Planning and Environment [DPE], 2023a);
- *BioNet Vegetation Classification* (DPE, 2023b);
- *BioNet Atlas* (DPE, 2023c); and
- *Directory of Important Wetlands of Australia* (Department of Climate Change, Energy, the Environment and Water [DCCEEW], 2023a).

1.5.3 Spatial Data

Spatial data used in this assessment include:

- *NSW Landscapes (Mitchell 2002) Release 3.1* (DPE, 2017);
- *Interim Biogeographic Regionalisation for Australia (Subregions) v. 7 (IBRA)* (DCCEEW, 2023b);
- *State Vegetation Type Map: Upper Hunter v1.0. VIS_ID 4894* (DPE, 2023h);
- *NSW State Vegetation Type Map* (DPE, 2022c); and
- *NSW Landuse 2017 v1.2* (DPE, 2023i).

1.5.4 BAM Credit Calculator

The BAM Credit Calculator (App last updated: 13/04/2023 10:00 [Version: 1.4.0.00] BAM data last updated: 22/06/2023 [Version: 61]) was used in this assessment, with exception of the Plant Community Type (PCT) classification.

On 14 April 2023, the BAM Credit Calculator was updated to include the revised PCT classification for Eastern NSW. Transitional arrangements allow assessors with in-progress BAM-Credit Calculator assessments, to maintain the legacy PCT classification. The BAM case for this BDAR was opened in December 2022 prior to the revised PCT classification and therefore the transitional arrangements apply. The vegetation mapping was also completed prior to the revised PCT classification so the legacy PCT classification was retained for the assessment. On 1 February 2023, the BAM-Credit Calculator was updated to include Version 1.2 benchmarks, which have been used in this assessment.

2 LANDSCAPE CONTEXT

This section provides information on the landscape features in accordance with the BAM (DPIE, 2020a).

2.1 BIOREGIONAL SETTING

The Subject land is located in Muswellbrook Shire Council LGA (Figure 1) within the Hunter Interim Biogeographic Regionalisation for Australia (IBRA) as well as subregions of the Sydney IBRA region (DCCEEW, 2023b) (Figures 4 and 5).

2.2 TOPOGRAPHY, HYDROLOGICAL SETTING, GEOLOGY AND SOILS

The Subject land is undulating. Generally, rainfall runoff flows north-west into Quarry Creek and associated tributaries and then into the Hunter River.

The MAC is located in the Hunter Coalfields in the northern part of the Permo-Triassic Sydney Basin, comprising Late Permian aged sediments forming the southern part of the Sydney-Gunnedah-Bowen Basin. GSS Environmental (2012) identified that the north-western extent of the Modification 1 Study Area (immediate east of the Modification 2 Study Area) primarily consisted of sodosols, and smaller portions of chromosols.

2.3 RIVERS, STREAMS, ESTURIES AND WETLANDS

There are no rivers, streams, estuaries or wetlands in the Subject land. There are no State or Commonwealth mapped wetlands on, or adjacent to, the Subject land (after DCCEEW, 2023a; NSW Department of Environment, Climate Change and Water, 2010). The streams and rivers downstream of the Subject land and within the assessment area are mapped on Figures 4 and 5.

2.4 HABITAT CONNECTIVITY

The Subject land is on the edge of the existing/approved surface disturbance area and is mostly derived native grassland with some heavily fragmented scattered and clumped trees. The native vegetation in the Subject land is not part of a larger woodland patch and the scattered and clumped trees provide minimal habitat connectivity and is not part of a movement corridor for threatened species across their range.

2.5 KARST, CAVES, CREVICES, CLIFFS AND ROCKS

No karst, caves, crevices, cliffs or rocks associated with threatened species occur in the Subject land.

2.6 AREAS OF OUTSTANDING BIODIVERSITY VALUE

There are no Areas of Outstanding Biodiversity Value listed under the NSW *Biodiversity Conservation Regulation 2017* (BC Regulation) associated with the Subject land.

2.7 NSW (MITCHELL) LANDSCAPES

The Subject land is within the Central Hunter Foothills Mitchell Landscapes (DPE, 2023d; Mitchell, 2002) (Figure 4).

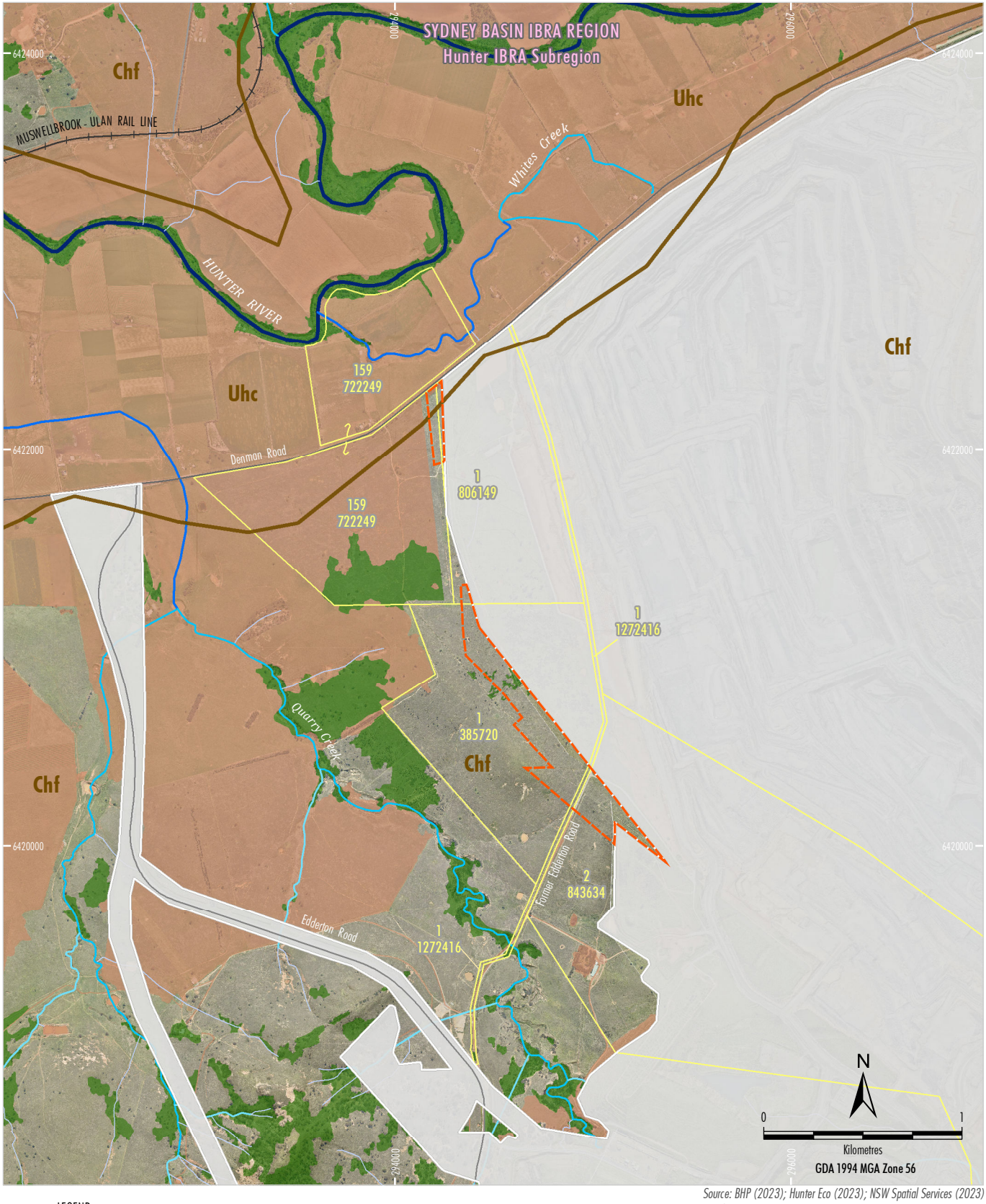
2.8 ADDITIONAL FEATURES

There are no applicable Secretary's Environmental Assessment Requirements.

2.9 NATIVE VEGETATION COVER

Native vegetation cover is assessed on the Subject land and within a 1,500 (metres) buffer area surrounding the outside edge of the boundary of the Development Footprint (Figure 5)[1]. An aerial photo of the Subject land is shown on Figure 5. The extent of native vegetation cover (including areas of planted native vegetation), as mapped by site surveys (Hunter Eco, 2023) (Attachment B) and regional mapping (DPE, 2023e) is shown on Figure 5. There is approximately 18 (percent) native vegetation cover within the 1,500 m buffer area (i.e. the >10-30% cover class is relevant).

[1] A figure scale appropriate for the size of the 1,500 m assessment area has been selected.



HVE-19-09 MOD2_BBAR_203E

Source: BHP (2023); Hunter Eco (2023); NSW Spatial Services (2023) Aerial Mosaic: MAC (2022-2020)

LEGEND

- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)
- Subject Land Cadastral Boundary
- Habitat Connectivity Area
- Non-native Vegetation

Strahler Stream Order

- 1st Order (Riparian Corridor Width 10 m)
- 2nd Order (Riparian Corridor Width 20 m)
- 3rd Order (Riparian Corridor Width 30 m)
- 4th Order (Riparian Corridor Width 40 m)
- 9th Order (Riparian Corridor Width 50 m)

Mitchell Landscapes

- Chf — Central Hunter Foothills
- Uhc — Upper Hunter Channels and Floodplain

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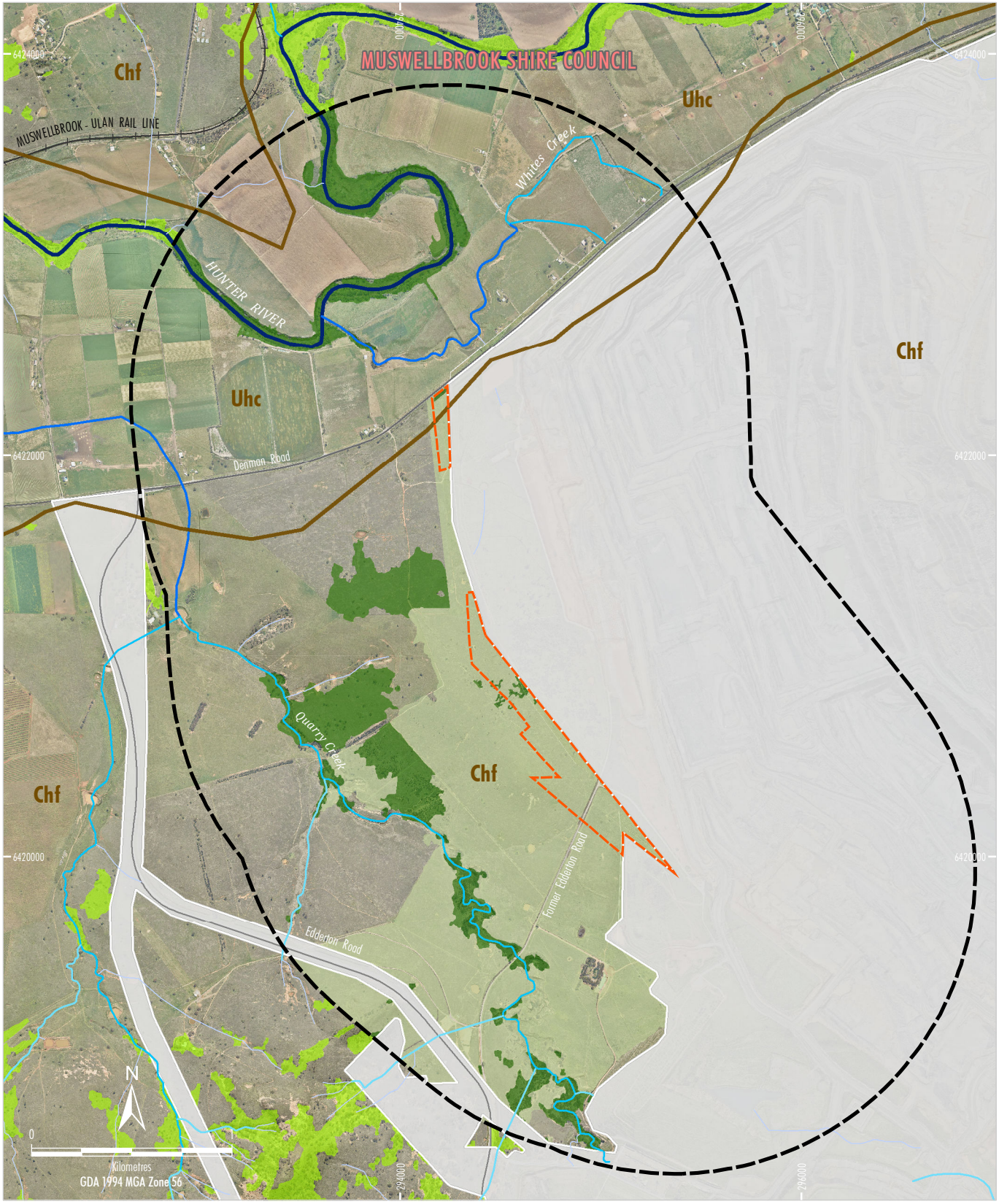
Site Map

Figure 4



LEGEND

- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)
- Assessment Area (Subject Land 1500 m Buffer)
- Woodland within the Buffer
- Derived Native Grassland within the Buffer
- Habitat Connectivity outside the Buffer

Strahler Stream Order

- 1st Order (Riparian Corridor Width 10 m)
- 2nd Order (Riparian Corridor Width 20 m)
- 3rd Order (Riparian Corridor Width 30 m)
- 4th Order (Riparian Corridor Width 40 m)
- 9th Order (Riparian Corridor Width 50 m)

Mitchell Landscapes

- Chf — Central Hunter Foothills
- Uhc — Upper Hunter Channels and Floodplain

Source: BHP (2023); Hunter Eco (2023); NSW Spatial Services (2023) Aerial Mosaic: MAC (2022-2020)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Location Map

Figure 5

3 NATIVE VEGETATION

This section provides a description of the native vegetation relevant to the Subject land.

3.1 NATIVE VEGETATION EXTENT

The Subject land has been cleared historically and is mostly grazing land with derived native grassland with some heavily fragmented scattered and clumped trees. The native vegetation extent of the Subject land is shown on Figure 5. There are no differences between the actual native vegetation extent and that shown in the imagery (dated 2021), except progression of mining within the approved surface development area. The former Edderton Road alignment passes through the Development Footprint.

3.2 EXISTING INFORMATION ON NATIVE VEGETATION

The *State Vegetation Type Map: Upper Hunter v1.0. VIS_ID 4894* (DPE, 2018) was superseded by the *NSW State Vegetation Type Map* (DPE, 2022c) in 2022. Both regional mapping sources show an ironbark vegetation community in the Subject land.

Hunter Eco (2013) undertook flora surveys of the existing/approved surface disturbance area adjacent to the Subject land (inside the assessment area). Mapping of the adjacent area showed that it comprised of derived native grassland with a patch of Box – Ironbark Woodland, with Slaty Box.

3.3 VEGETATION SURVEYS

Hunter Eco (2023) (Attachment B) undertook contemporary systematic field-based floristic vegetation surveys across the Subject land. Surveys were undertaken in October 2022, November 2022 and July 2023. The surveys included sampling from 13 vegetation integrity (VI) plots, 153 Rapid Data Points and identification of each individual tree within the Subject land and immediate surrounds. The intensity of the methods meant that the environmental variation was sampled.

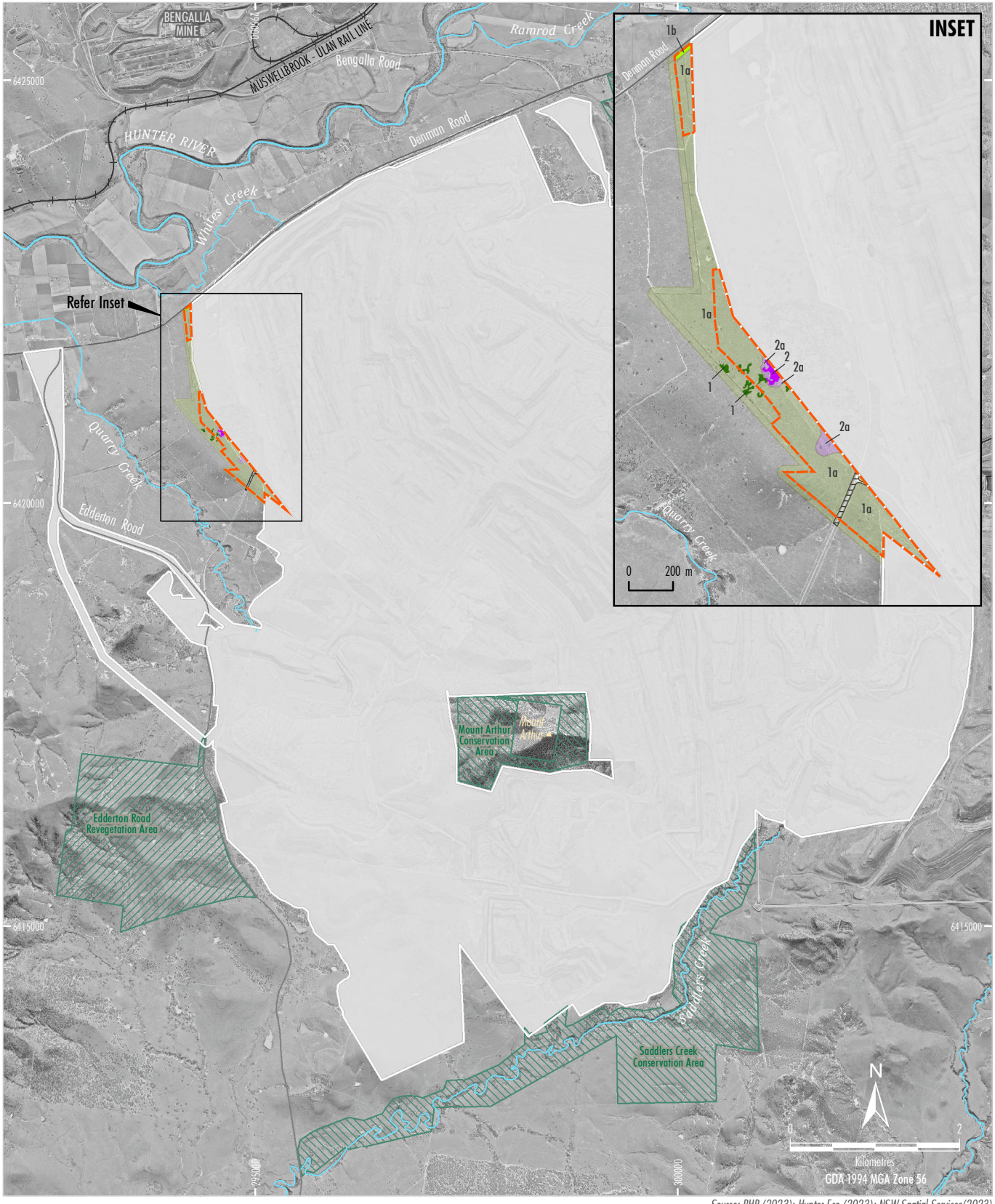
The PCTs and vegetation zones on the Subject land were identified and mapped by Hunter Eco (2023) (Attachment B) in accordance with the BAM (DPIE, 2020a) and the *BioNet Vegetation Classification* (DPE, 2023b) (Figure 6). Detailed methods and results are provided in Attachment B.

As described in Section 1.5.4, the vegetation mapping was also completed prior to the revised PCT classification so the legacy PCT classification was retained for this assessment in accordance with the transitional arrangements.

3.4 PLANT COMMUNITY TYPES AND THREATENED ECOLOGICAL COMMUNITIES

Most of the trees in the Subject land are Bull Oak (*Allocasuarina luehmannii*), with less White Box (*Eucalyptus albens*) and fewer Slaty Box (*Eucalyptus dawsonii*). There is a linear strip of plantings at the northern end of the Subject land. There are three Kurrajong Trees (*Brachychiton populneus*) in the southern end of the Subject land.

Land use in the Subject land and surrounds is shown on Figure 7 from the *NSW Landuse 2017 v1.2* (DPE, 2023i). The area north of the former Edderton Road has had no grazing for up to 20 years. On the southern side of the former Edderton Road, livestock were removed around 2017 to 2018.



HVE-19-09 MOD2_BBAR_215C

Source: BHP (2023); Hunter Eco (2023); NSW Spatial Services(2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Subject Land (Development Footprint)
- Approximate Extent of Existing/Approved Surface Development

Vegetation Communities

- 1. Grey Box x White Box Grassy Woodland (PCT 483) [1]
- 1a. Grey Box x White Box Grassy DNG (PCT 483) [1]
- 1b. Plantation (PCT 483)
- 2. Slaty Box Woodland (PCT 1655) [2]
- 2a. Slaty Box (DNG) (PCT 1655)
- Cleared Land

[1] Equivalent to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the BC Act (and EPBC Act)

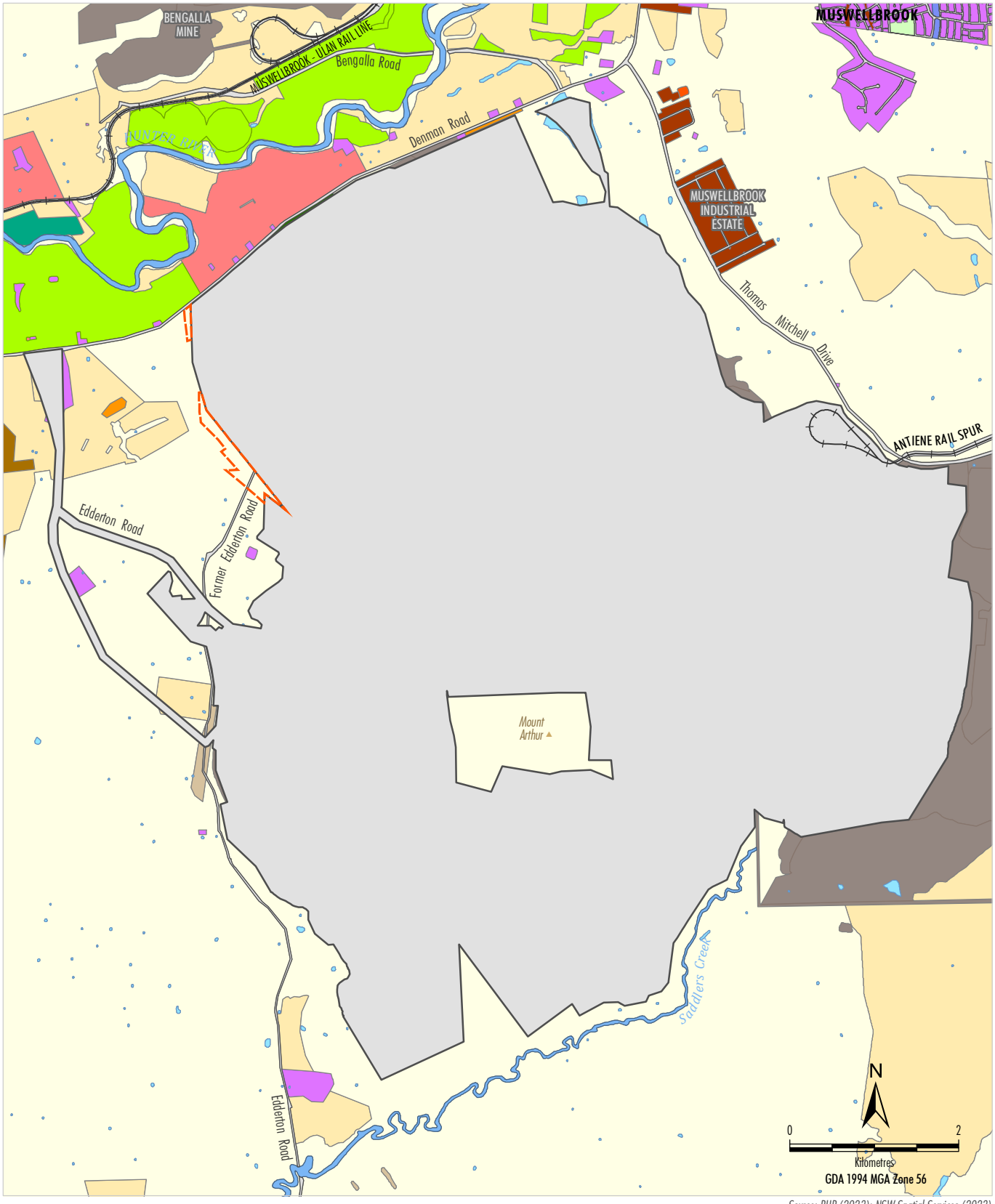
[2] Equivalent to the Hunter Valley Footslopes Slaty Gum Woodland listed under the BC Act and the Central Hunter Valley Eucalypt Forest and Woodland CEEC listed under the EPBC Act

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Vegetation Communities

Figure 6



Source: BHP (2023); NSW Spatial Services (2023)

HVE-19-09 MOD2_BBAR_212D

LEGEND

Approximate Extent of Existing/Approved Surface Development
Subject Land (Development Footprint)

NSW Land Use 2017 v1.2

1.1.0 Nature conservation
1.2.0 Managed resource protection
1.3.0 Other minimal use
2.1.0 Grazing native vegetation
3.1.0 Plantation forests
3.2.0 Grazing modified pastures
3.5.0 Seasonal horticulture
4.2.0 Grazing irrigated modified pastures
4.4.0 Irrigated perennial horticulture
5.2.0 Intensive animal production
5.4.0 Residential and farm infrastructure
5.5.0 Services
5.6.0 Utilities
5.7.0 Transport and communication
5.8.0 Mining
6.2.0 Reservoir/dam
6.3.0 River
6.5.0 Marsh/wetland

BHP

MT ARTHUR COAL MINE MODIFICATION 2

NSW Land Use

Figure 7

Two PCTs were identified within the Subject land. The PCTs (and vegetation zones of broad condition states) are listed in Table 1. Hunter Eco (2023) (Attachment B) assigned the PCTs a site-specific vegetation community name as listed in Table 1. The former Edderton Road alignment passes through the Development Footprint and has been mapped as cleared land.

Table 1
Plant Community Types within the Subject Land

Veg Zone	Vegetation Community (Hunter Eco, 2023) (Attachment B)	PCT ID [C]	Total Area (ha)	Percent Cleared in NSW (%)[C]
Grassy Woodlands Formation - Western Slopes Grassy Woodlands Class				
1	Grey Box x White Box Grassy Woodland [A]	PCT 483 *Grey Box x White Box Grassy Open Woodland on Basalt Hills in the Merriwa Region, Upper Hunter Valley*	0.3	90 +/- 50
1a	Derived Native Grassland [A]		22.5	
1b	Plantation		0.2	
Dry Sclerophyll Forests (Shrubby Sub-formation) Formation - Western Slopes Dry Sclerophyll Forests Class				
2	Slaty Box Woodland [B]	PCT 1655 *Grey Box - Slaty Box Shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin*	0.4	36
2a	Derived Native Grassland		1.2	
		Total Woodland	*0.7*	
		Total Derived Native Grassland	*23.7*	
		Total Plantation	*0.2*	
		Overall Total Native Vegetation	**24.6**	
		Cleared Land	*0.4*	
		Overall Total Subject Land/Development Footprint	**25**	

[A] Equivalent to the Box-Gum Woodland CEEC listed under the BC Act (and EPBC Act).

[B] Equivalent to the Slaty Gum Woodland VEC listed under the BC Act and the Central Hunter Woodland CEEC listed under the EPBC Act.

[C] DPE (2023b).

The PCTs were identified by comparing the floristic composition recorded from the vegetation sampling methods above with PCT descriptions provided in *BioNet Vegetation Classification* (DPE, 2023b).

PCT 483 is the best match for the Vegetation Community 1 because the indicator canopy species is present (*Eucalyptus albens* <-> *moluccana* [Grey Box x White Box]) and the floristic content of the understorey was a better fit than other PCTs with only three low shrub species recorded (Hunter Eco, 2023) (Attachment B). The linear strip of plantings at the northern end of the Subject land was assigned a PCT as required by the BAM (DPIE, 2020a) and PCT 483 was most appropriate. PCT 1655 was selected as the likely match due to the presence of Slaty Box (*Eucalyptus dawsonii*) and absence of Grey Gum (*Eucalyptus punctata*) (Hunter Eco, 2023) (Attachment B).

The BAM (DPIE, 2020a) defines 'Percent Cleared Value' as the percentage of a PCT that has been cleared as a proportion of its pre-1750 extent, as identified in the *BioNet Vegetation Classification* (DPE, 2023b). The 'Percent Cleared Value' for each PCT is listed in Table 1. Photos of each vegetation zone are provided in Plates 1 to 5.

3.5 THREATENED ECOLOGICAL COMMUNITIES

Hunter Eco (2023) (Attachment B) undertook targeted surveys for potentially occurring threatened ecological communities (TECs) listed under the BC Act or the EPBC Act.

Plate 1 Grey Box x White Box Grassy Woodland (PCT 483)

Plate 2 Derived Native Grassland (PCT 483)

Plate 3 Plantation (PCT 483)

Plate 4 Slaty Box Woodland (PCT 1655)

Plate 5 Derived Native Grassland (PCT 1655)

The Grey Box x White Box Grassy Woodland in the Subject land (approximately 0.3 ha of woodland) is equivalent to the *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* Critically Endangered Ecological Community (Box-Gum Woodland Critically Endangered Ecological Community [CEEC]) listed under the BC Act (and EPBC Act) (Plate 1), as well as approximately 22.5 ha of derived native grassland (Plate 2) (a total of approximately 22.8 ha of Box-Gum Woodland CEEC listed under the BC Act [and EPBC Act]) (Figure 8).

The Slaty Box Woodland in the Subject land (approximately 0.4 ha) is equivalent to the *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion* Vulnerable Ecological Community listed under the BC Act (Slaty Gum Woodland VEC) and the Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered Ecological Community (Central Hunter Woodland CEEC) listed under the EPBC Act (Figure 8). The occurrence is mostly Bull Oak (*Allocasuarina luehmannii*) with one single large Slaty Box (*Eucalyptus dawsonii*) tree (Attachment B; Plate 4).

The PCTS are not associated with any other TECs (DPE, 2023b).

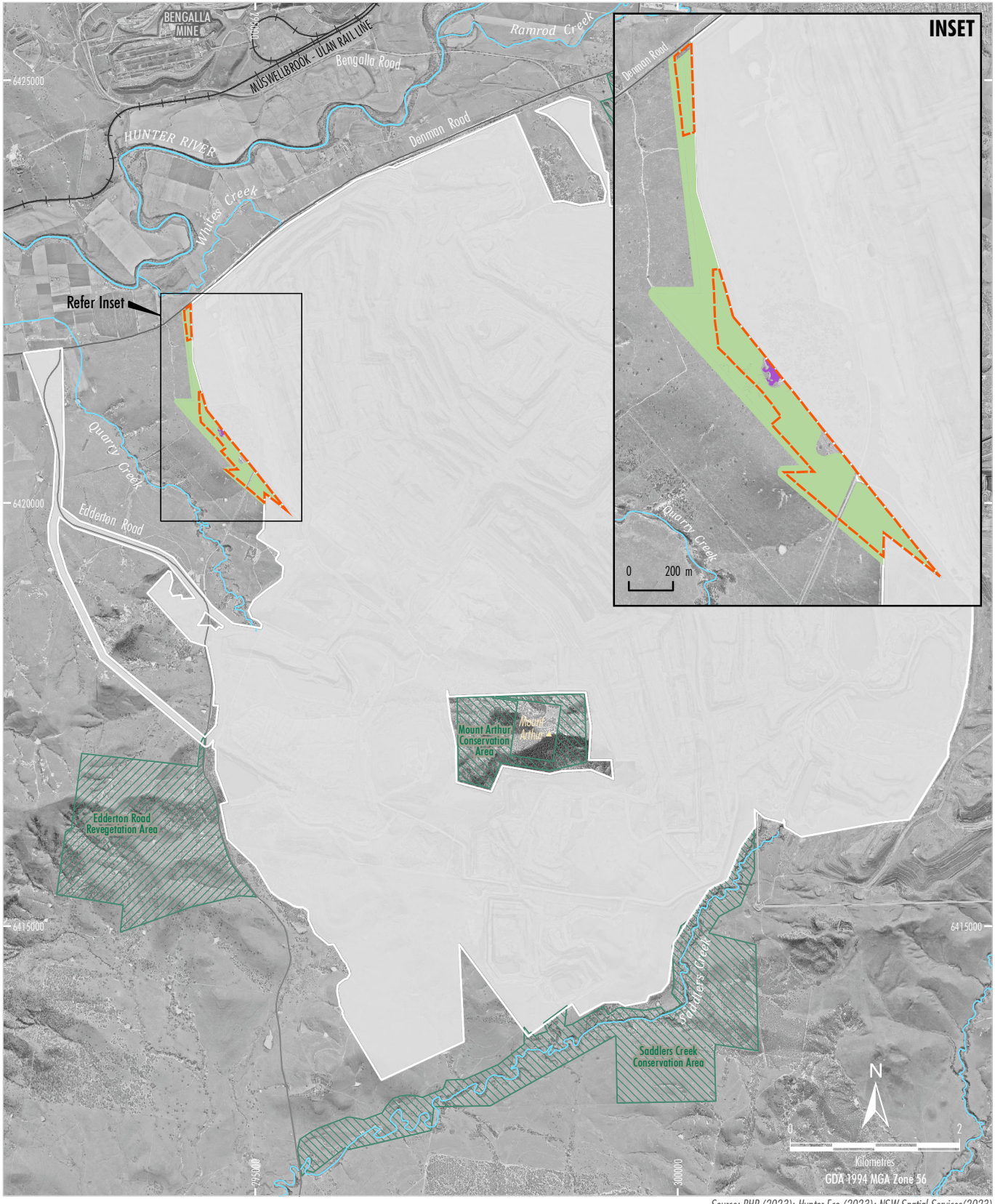
3.6 VEGETATION INTEGRITY ASSESSMENT

Vegetation integrity is a measure of the condition of native vegetation. The VI plot data was independently collected by Hunter Eco (2023) (Attachment B). The VI plots used in the BAM Credit Calculator are shown on Figure 9. A total of eight plots from within the Subject land were used in this assessment (Attachment D), with the number of plots meeting the requirements per area of each zone in the BAM (DPIE, 2020a).

Five vegetation zones (i.e. areas of native vegetation that are the same PCT and similar broad condition states) were mapped in the Subject land (Table 1). Vegetation zones were assigned a condition class value of 'woodland', 'plantation', or 'derived native grassland' (Table 1).

The patch size is greater than 100 ha for each vegetation zone (Table 2). The BAM Credit Calculator calculates the 'composition condition score', 'structure condition score' and 'function condition score' for each vegetation zone using input from the plot data (Table 2). Hollow bearing trees are present in areas of scattered and clumped trees located within Vegetation Zones 1, 2 and 2a (Table 2). An overall score of the VI for each vegetation zone is calculated in the BAM Credit Calculator using input from the plot data. According to the BAM Credit Calculator, all of the vegetation zones have a VI score requiring an offset.

There is one entity recorded on the Subject land that can be a 'potential serious and irreversible impact (SAII) entity', namely the Box-Gum Woodland CEEC listed under the BC Act as described further in Section 8.1.



Source: BHP (2023); Hunter Eco (2023); NSW Spatial Services(2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)

Threatened Ecological Communities

- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the BC Act (and EPBC Act)
- Hunter Valley Footslopes Slaty Gum Woodland listed under the BC Act and the Central Hunter Valley Eucalypt Forest and Woodland CEEC listed under the EPBC Act

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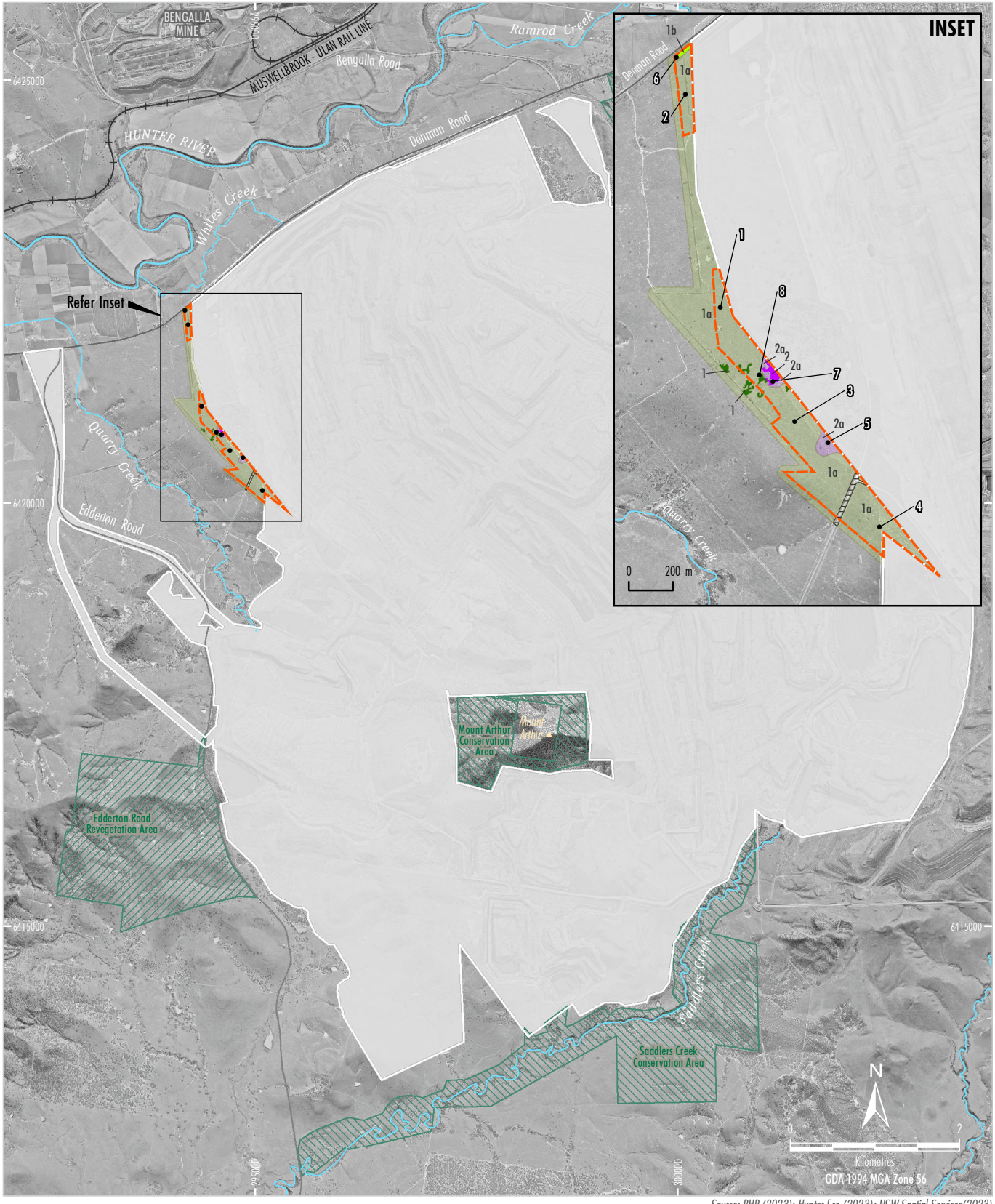
MT ARTHUR COAL MINE MODIFICATION 2

Threatened Ecological Communities

Figure 8



HVE-19-09 MOD2_BBAR_217C

Source: BHP (2023); Hunter Eco (2023); NSW Spatial Services(2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Subject Land (Development Footprint)
- Approximate Extent of Existing/Approved Surface Development
- Vegetation Integrity Plot

Vegetation Communities

- 1. Grey Box x White Box Grassy Woodland (PCT 483) [1]
- 1a. Grey Box x White Box Grassy DNG (PCT 483) [1]
- 1b. Plantation (PCT 483)
- 2. Slaty Box Woodland (PCT 1655) [2]
- 2a. Slaty Box (DNG) (PCT 1655)
- Cleared Land

[1] Equivalent to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the BC Act (and EPBC Act)

[2] Equivalent to the Hunter Valley Footslopes Slaty Gum Woodland listed under the BC Act and the Central Hunter Valley Eucalypt Forest and Woodland CEEC listed under the EPBC Act

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MT ARTHUR COAL MINE MODIFICATION 2

Vegetation Integrity Plots

Figure 9

Table 2
Vegetation Integrity Score Detail

Vegetation Zone	PCT	Vegetation Community (Hunter Eco, 2023) (Attachment B)	Total Area (ha)	Number of Plots Required and Completed	Patch Size (ha)	Sensitivity to Loss*	Biodiversity Risk Weighting*	Composition Condition Score*	Structure Condition Score*	Function Condition Score*	Trees with Hollows	Vegetation Integrity Score*	Offset Required?
1	PCT 483	Grey Box x White Box Grassy Woodland [A]	0.3	1	>100	3	2.5	91.6	82	64.5	Yes	78.5	Yes
1a	PCT 483	Derived Native Grassland [A]	22.5	4	>100	3	2.5	58.4	55.8	15	No	36.6	Yes
1b	PCT 483	Plantation	0.2	1	>100	3	2.5	51.8	82.2	43.8	No	57.1	Yes
2	PCT 1655	Slaty Box Woodland [B]	0.4	1	>100	1.5	1.75	62.5	54.5	91.1	Yes	67.7	Yes
2a	PCT 1655	Derived Native Grassland	1.2	1	>100	1.5	1.75	48.4	14.8	54.5	Yes	33.9	Yes

[A] Equivalent to the Box-Gum Woodland CEEC listed under the BC Act (and EPBC Act).

[B] Equivalent to the Slaty Gum Woodland VEC listed under the BC Act and the Central Hunter Woodland CEEC listed under the EPBC Act.

* BAM Credit Calculator.

4 THREATENED SPECIES

Threatened species that are ecosystem credit species and/or species credit species are pre-determined by the DPE in the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a). The BAM (DPIE, 2020a) states:

> *Threatened species where the likelihood of occurrence of a species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection, are identified in the Threatened Biodiversity Data Collection as ecosystem credit species. Targeted survey is not required for these species.*
>
> …
>
> *Species credit species are threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits*.
>
> …
>
> *In some circumstances, the BioNet Threatened Biodiversity Data Collection may identify a threatened species that requires assessment for ecosystem credits and species credits (referred to as dual credit species).*

4.1 ECOSYSTEM CREDIT SPECIES

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

Step 1: Identify threatened species for assessment.

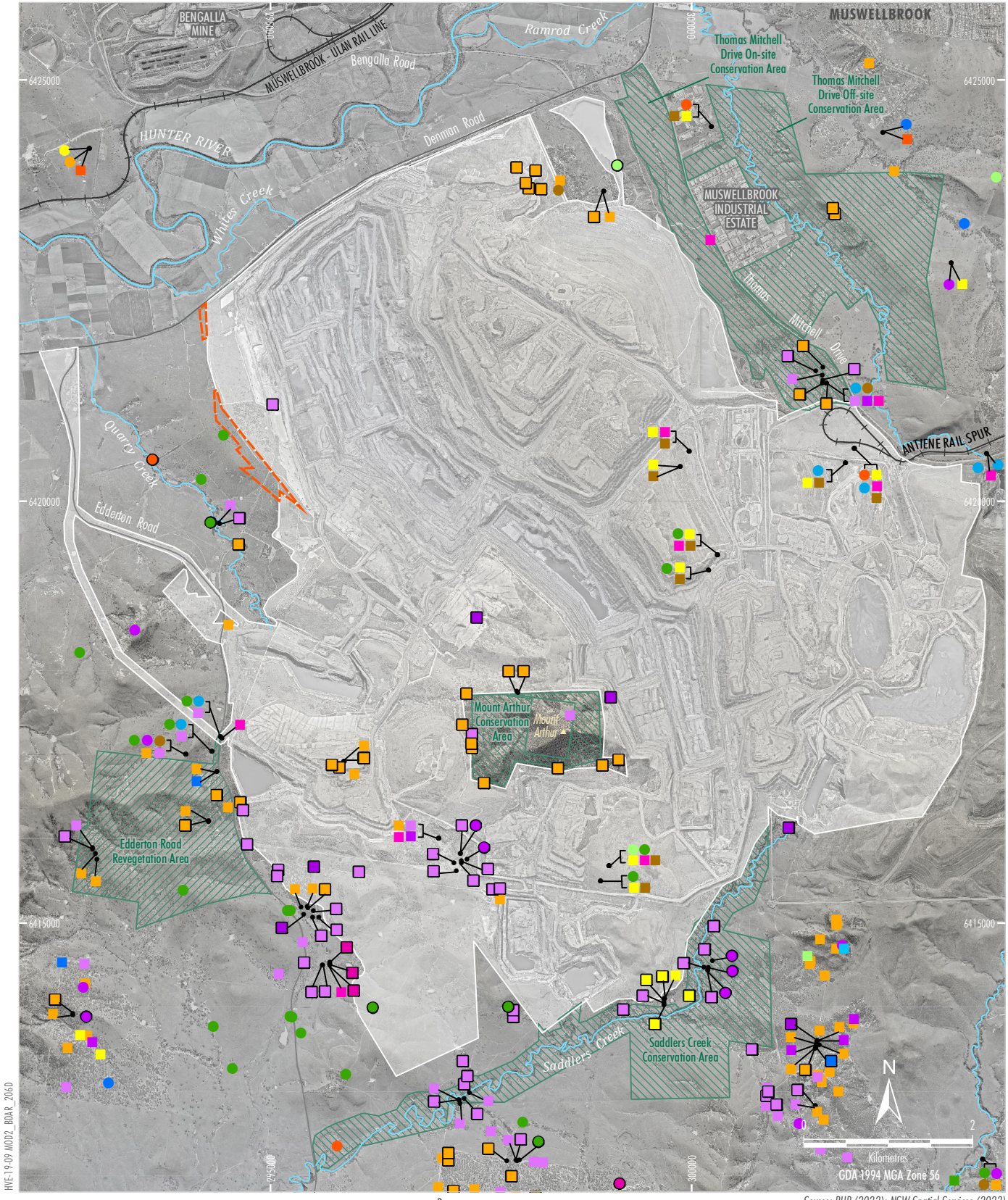
Step 2: Assessment of the habitat constraints and vagrant species on the Subject land.

These steps are applied below.

4.1.1 Step 1: Identify Ecosystem Credit Species for Assessment

A total of 29 ecosystem credit species for assessment are listed in Table 3 from the BAM Credit Calculator. There are a number of ecosystem credit species listed in Table 3 with a maximum of high sensitivity to potential gain (as defined by DPE [2023a]). These ecosystem credit species may potentially use habitat in the Subject land (e.g. woodland birds), but there are also many species listed that are not likely to occur in the Subject land.

The ecosystem credit calculation uses the highest 'sensitivity to potential gain' class in the credit calculation for a vegetation zone. In this case, the species having high 'sensitivity to potential gain' is used in the BAM Credit Calculator to generate the ecosystem credits. No species were removed from the BAM Credit Calculator because at least one species having high 'sensitivity to potential gain' would remain (so removing species from the BAM Credit Calculator would have no effect on the outcome). The 'sensitivity to loss' risk weighting only relates to the Plant Community Type (Table 2). Species shaded in Table 3 are species with records on Figures 10 to 12.



HVE-19-09 MOD2_BBAR_206D

Source: BHP (2022); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)

Survey	Database	Threatened Birds
		Australasian Bittern
		Grey Falcon
		Black Falcon
		White-bellied Sea-Eagle
		Spotted Harrier
		Little Eagle
		Glossy Black-Cockatoo
		Little Lorikeet
		Barking Owl
		White-throated Needletail
		Brown Treecreeper (eastern subspecies)
		Speckled Warbler
		Regent Honeyeater
		Painted Honeyeater
		Hooded Robin (south-eastern form)
		Flame Robin
		Scarlet Robin
		Grey-crowned Babbler (eastern subspecies)
		Varied Sittella
		Dusky Woodswallow
		Diamond Firetail

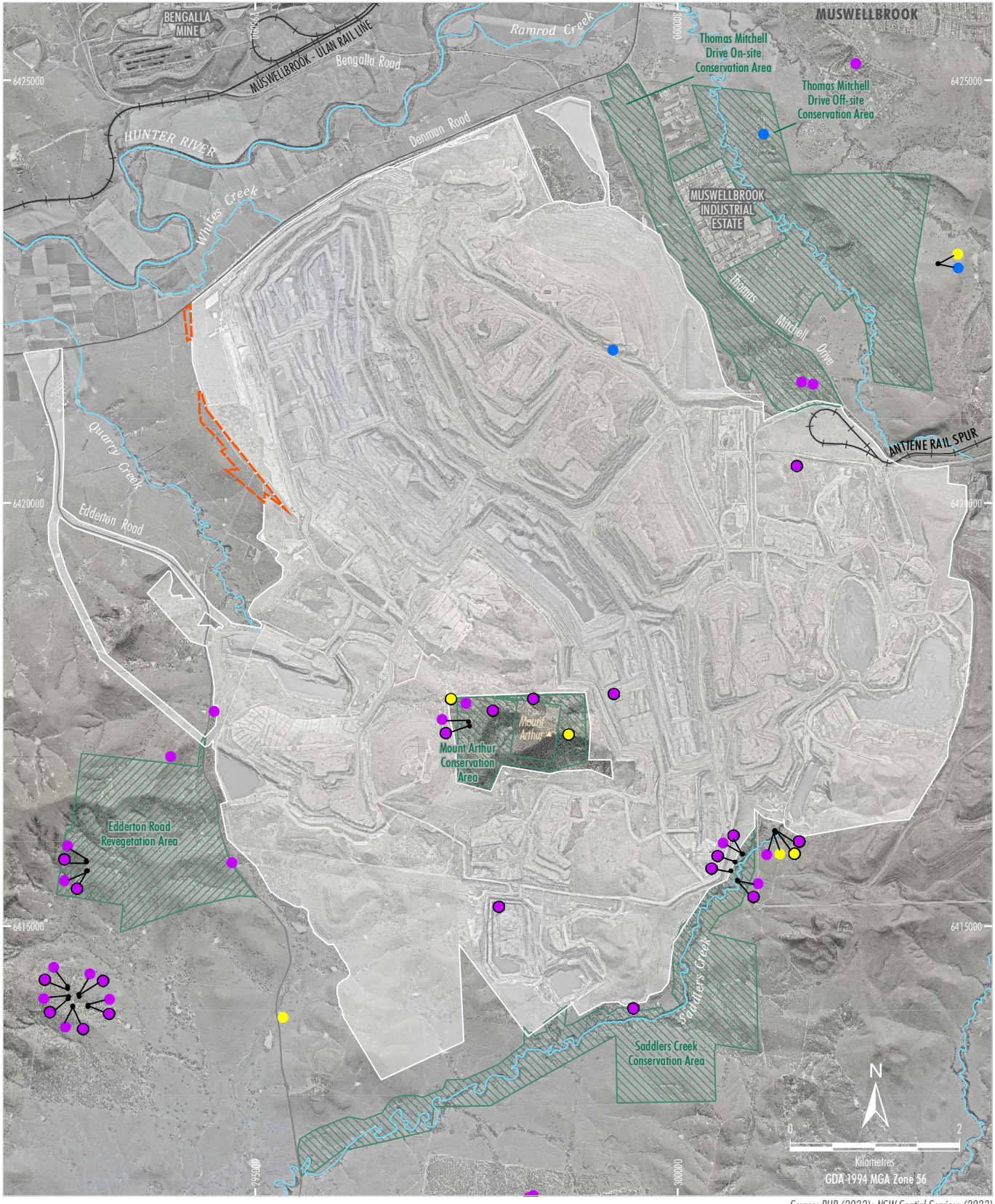
Survey Record Sources: Cumberland Ecology (2009 - 2011, 2016 - 2020); Eco Logical Australia (2014); Ecotone (2000); Future Ecology (2019, 2023); Umwelt (2005, 2006b, 2007b, 2013, 2015)
Database Record Sources: ALA (2022); BirdLife Australia (2022); DPE (2022)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Threatened Birds

Figure 10



HVE-19-09 MOD2_BBAR_207E

Source: BHP (2022); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)

Threatened Mammals

Survey	Database	
○	●	Spotted-tailed Quoll
	●	Koala
●	●	Squirrel Glider

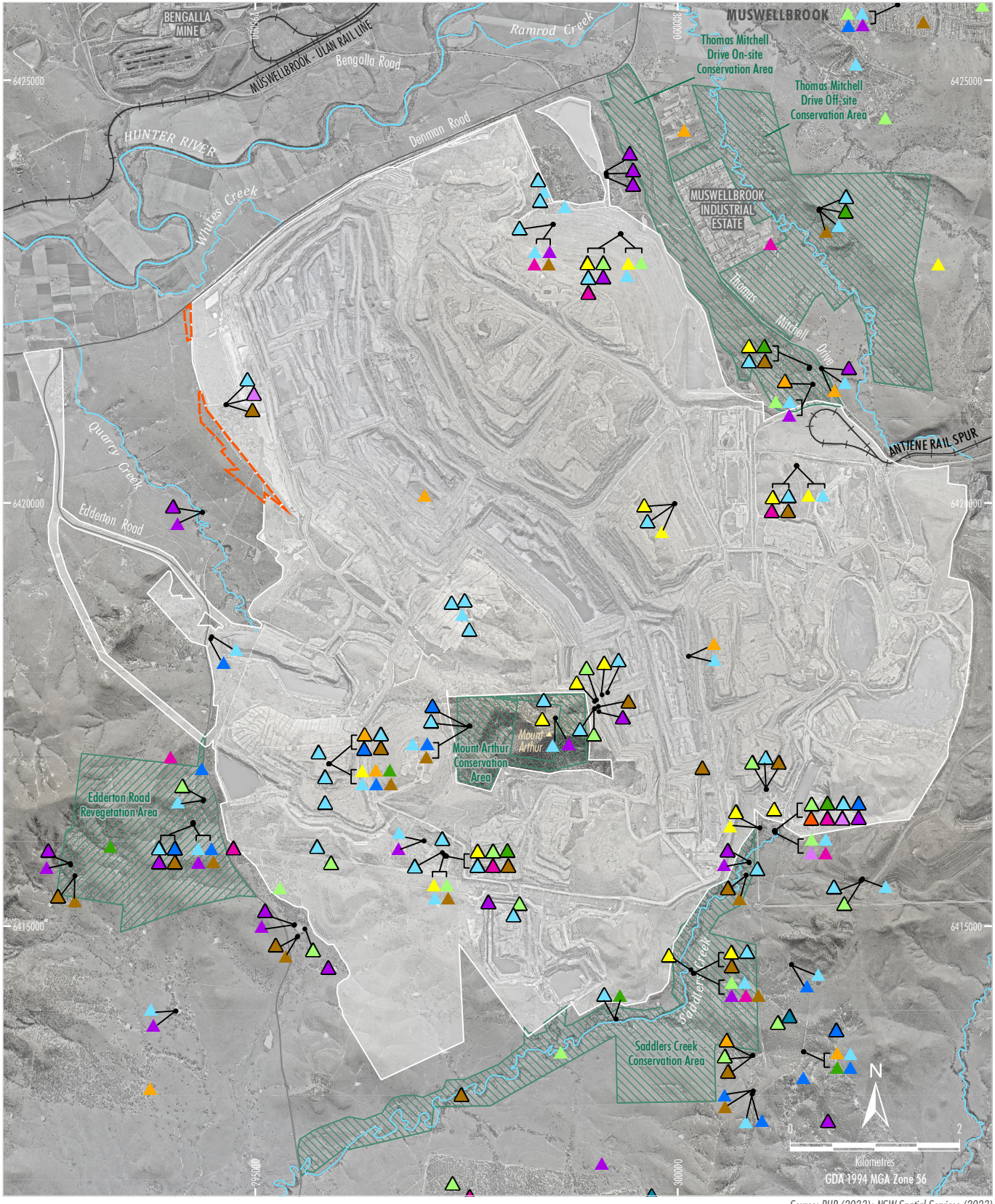
Survey Record Sources: Cumberland Ecology (2009, 2021); Eco Logical Australia (2013, 2015, 2016); Future Ecology (2023); Umwelt (2007b, 2013, 2015)
Database Record Sources: DPE (2022)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Threatened Mammals

Figure 11



HVE-19-09 MOD2_BBAR_208D

Source: BHP (2023); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)

Survey	Database	Threatened Bats
▲	▲	Grey-headed Flying-fox
▲	▲	Yellow-bellied Sheathtail-bat
▲		Northern Freetail Bat
▲	▲	Eastern Coastal Free-tailed Bat
▲	▲	Little Bent-winged Bat
▲	▲	Large Bent-winged Bat
▲		Corben's Long-eared Bat
▲	▲	Large-eared Pied Bat
▲	▲	Eastern False Pipistrelle
▲	▲	Southern Myotis
▲	▲	Greater Broad-nosed Bat
▲	▲	Eastern Cave Bat

Survey Record Sources: Cumberland Ecology (2009, 2011, 2016 - 2022); Eco Logical Australia (2013 - 2017); Ecotone (2000); Future Ecology (2023); Niche (2012); Umwelt (2007a, 2013, 2015)
Database Record Source: DPE (2022)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Threatened Bats

Figure 12

Table 3
Ecosystem Credit Species from the BAM Credit Calculator

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Sensitivity to Potential Gain[3]
		BC Act	EPBC Act		
Birds					
Lophoictinia isura	Square-tailed Kite	V	-	Species/Ecosystem	Moderate
Hieraaetus morphnoides	Little Eagle	V	-	Species/Ecosystem	Moderate
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	V	Species/Ecosystem	High
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	Species/Ecosystem	Moderate (foraging)
Glossopsitta pusilla	Little Lorikeet	V	-	Ecosystem	High
Neophema pulchella	Turquoise Parrot	V	-	Ecosystem	High
Lathamus discolor	Swift Parrot	E	CE	Species/Ecosystem	Moderate
Tyto novaehollandiae	Masked Owl	V	-	Species/Ecosystem	High
Ninox strenua	Powerful Owl	V	-	Species/Ecosystem	High
Ninox connivens	Barking Owl	V	-	Species/Ecosystem	High
Hirundapus caudacutus	White-throated Needletail	-	V	Ecosystem	High
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	V	Ecosystem	High
Chthonicola sagittata	Speckled Warbler	V	-	Ecosystem	High
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Ecosystem	Moderate
Anthochaera phrygia	Regent Honeyeater	CE	CE	Species/Ecosystem	High
Grantiella picta	Painted Honeyeater	V	V	Ecosystem	Moderate
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	E	Ecosystem	Moderate
Petroica phoenicea	Flame Robin	V	-	Ecosystem	Moderate
Petroica boodang	Scarlet Robin	V	-	Ecosystem	Moderate
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	Ecosystem	Moderate
Daphoenositta chrysoptera	Varied Sittella	V	-	Ecosystem	Moderate
Stagonopleura guttata	Diamond Firetail	V	V	Ecosystem	Moderate
Mammals					
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Ecosystem	High
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Species/Ecosystem	High
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Ecosystem	High
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Species/Ecosystem	High (foraging)
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Ecosystem	High
Falsistrellus tasmaniensis	Eastern False Pipestrelle	V	-	Ecosystem	High
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Ecosystem	High

Note Highlighted species are species shown on Figures 10 to 12.

[1] Conservation status listed under the BC Act and EPBC Act (current as at September 2023).
CE Critically Endangered; E Endangered; V Vulnerable.

[2] Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (current as at September 2023).

[3] Sensitivity to potential gain under the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (current as at September 2023).

Flora and fauna studies previously undertaken at MAC (Table 4) were also reviewed for any nearby potentially relevant threatened species records. Attachment E provides a summary of the threatened species records in the locality from database searches and past survey results. Threatened flora species records are shown on Figure 13 (noting these are species credit species discussed in Section 4.2). Threatened fauna species records are shown on Figures 10 to 12.

Table 4
Previous Flora and Fauna Studies

Surveys	Timing	Location	Reference
Baseline surveys for environmental assessments	Between 1998 and 2006	Mt Arthur Mine	Dames and Moore (2000); Umwelt (2006a)
Fauna surveys for the Mt Arthur Coal Modification 1	2012	Modification 1 areas	Niche Environment and Heritage (2012)
Flora surveys for the Mt Arthur Coal Modification 1	2013	Modification 1 areas	Hunter Eco (2013)
Annual Biodiversity Monitoring	Between 2003 and 2022	Mt Arthur Mine	Cumberland Ecology (2009b, 2010a, 2017, 2018, 2019, 2020, 2021, 2022a, 2022b); Umwelt (2003, 2005, 2006b, 2007a and b, 2013, 2014, 2015); Wildthing Environmental Consultants (2008)
Diuris tricolor Monitoring	Between 2007 and 2020	Mt Arthur Mine	Cumberland Ecology (2010b, 2011, 2016); Eco Logical Australia (2020); Umwelt (2008, 2010)

Records for the following additional ecosystem credit species not included in Table 3 are shown on Figures 10 and 12:

- Australasian Bittern (*Botaurus poiciloptilus*) (medium sensitivity to gain);
- Grey Falcon (*Falco hypoleucos*) (medium sensitivity to gain);
- Black Falcon (*Falco subniger*) (medium sensitivity to gain);
- White-bellied Sea Eagle (*Haliaeetus leucogaster*) (high sensitivity to gain);
- Spotted Harrier (*Circus assimilis*) (medium sensitivity to gain);
- Dusky Wood swallow (*Artamus cyanopterus cyanopterus*) (medium sensitivity to gain);
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) (high sensitivity to gain); and
- Little Bent-Winged Bat (*Miniopterus australis*) (medium sensitivity to gain).

None of these species have been recorded within the Subject land. None of these species have a higher 'sensitivity to potential gain' than 'high' so none have been added to the BAM Credit Calculator (because doing so would have no effect on the ecosystem credit outcome).

4.1.2 Step 2: Assessment of the Habitat Constraints and Vagrant Species

The BAM (DPIE, 2020a) states:

> *The assessor may opt to undertake an additional assessment of the habitat constraints on the subject land for the threatened species predicted for assessment.*

No ecosystem credit species were removed from the BAM Credit Calculator as the species with the highest 'sensitivity to potential gain' class (i.e. 'high') are likely to occur and therefore, removal, of any other species would not change the ecosystem credit requirement.

4.2 SPECIES CREDIT SPECIES

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

Step 1: Identify species credit species for assessment.

Step 2: Assessment of the habitat constraints for species credit species on the Subject land.

Step 3: Identify candidate species credit species for further assessment.

Step 4: Determine presence or absence of a candidate species credit species.

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

Step 6: Determine the habitat condition within the habitat (Species Polygon) for species assessed by area.

These steps are discussed below.

4.2.1 Step 1: Identify Species Credit Species for Assessment

A total of 35 species credit species are listed in Table 5 for initial assessment from the BAM Credit Calculator. Species shaded in Table 5 are species with records on Figures 10 to 13. None of the records are within the Subject land.

Table 5
Species Credit Species from the BAM Credit Calculator

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Sensitivity to Potential Gain[2]	Potential Associated PCTs[2]	Paddock Trees Important to Species? [2]
		BC Act	EPBC Act				
Flora							
Acacia pendula	*Acacia pendula* population in the Hunter catchment	EP	-	Species	Very High	-	Yes
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Species	Moderate	1655	No
Cymbidium canaliculatum	*Cymbidium canaliculatum* population in the Hunter Catchment	EP	-	Species	Moderate	-	Yes

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Sensitivity to Potential Gain[2]	Potential Associated PCTs[2]	Paddock Trees Important to Species? [2]
		BC Act	EPBC Act				
Diuris tricolor	Pine Donkey Orchid/ Pine Donkey Orchid population in the Muswellbrook LGA	V/EP	-	Species	Moderate	1655	No
Eucalyptus pumila	Pokolbin Mallee	V	V	Species	High	1655	Yes
Monotaxis macrophylla	Large-leafed Monotaxis	E	-	Species	High	483	No
Ozothamnus tesselatus	-	V	V	Species	Moderate	1655	Yes
Pomaderris queenslandica	Scant Pomaderris	E		Species	High	1655	Yes
Pomaderris reperta	Denman Pomaderris	CE	CE	Species	High	1655	No
Prostanthera cineolifera	Singleton Mint Bush	V	V	Species	High	1655	Yes
Prostanthera cryptandroides subsp. cryptandroides	Wollemi Mint-bush	V	V	Species	High	1655	No
Thesium australe	Austral Toadflax	V	V	Species	Moderate	1655	No
Reptiles							
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	Species	High	483 and 1655	No
Delma impar	Striped Legless Lizard	V	V	Species	Moderate	483 and 1655	No
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	Species	High	1655	Yes, within 500 m of moderate -good patch
Birds							
Lophoictinia isura	Square-tailed Kite	V	-	Species/Ecosystem	Moderate	1655	No
Hieraaetus morphnoides	Little Eagle	V	-	Species/Ecosystem	Moderate	1655	Yes
Burhinus grallarius	Bush Stone-curlew	E	-	Species	High	1655	Yes
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	V	Species/Ecosystem	High	1655	Yes
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	Species/Ecosystem	High (breeding); Moderate (foraging)	1655	No
Lathamus discolor	Swift Parrot	E	CE	Species/Ecosystem	Moderate	1655	Yes
Tyto novaehollandiae	Masked Owl	V	-	Species/Ecosystem	High	1655	Yes
Ninox strenua	Powerful Owl	V	-	Species/Ecosystem	High	1655	No
Ninox connivens	Barking Owl	V	-	Species/Ecosystem	High	483 and 1655	Yes

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Sensitivity to Potential Gain[2]	Potential Associated PCTs[2]	Paddock Trees Important to Species? [2]
		BC Act	EPBC Act				
Anthochaera phrygia	Regent Honeyeater	CE	CE	Species/Ecosystem	High	483 and 1655	Yes
Mammals							
Planigale maculata	Common Planigale	V	-	Species	High	1655	No
Phascolarctos cinereus	Koala	E	E	Species	High	483 and 1655	Yes
Cercartetus nanus	Eastern Pygmy-possum	V	-	Species	High	1655	No
Petaurus norfolcensis	Squirrel Glider	V	-	Species	High	1655	Yes
Petauroides volans	Southern Greater Glider	-	E	Species	High	1655	No
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Species	Very High	1655	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Species/Ecosystem	High	1655	No
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Species/Ecosystem	Very High (breeding); High (foraging)	1655	No
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Species	Very High	1655	No
Vespadelus troughtoni	Eastern Cave Bat	V	-	Species	Very High	1655	No

Note: Highlighted species are species shown on Figures 11 to 13.

[1] Conservation status listed under the BC Act and EPBC Act (current as at September 2023). CE = Critically Endangered; E = Endangered; V = Vulnerable.

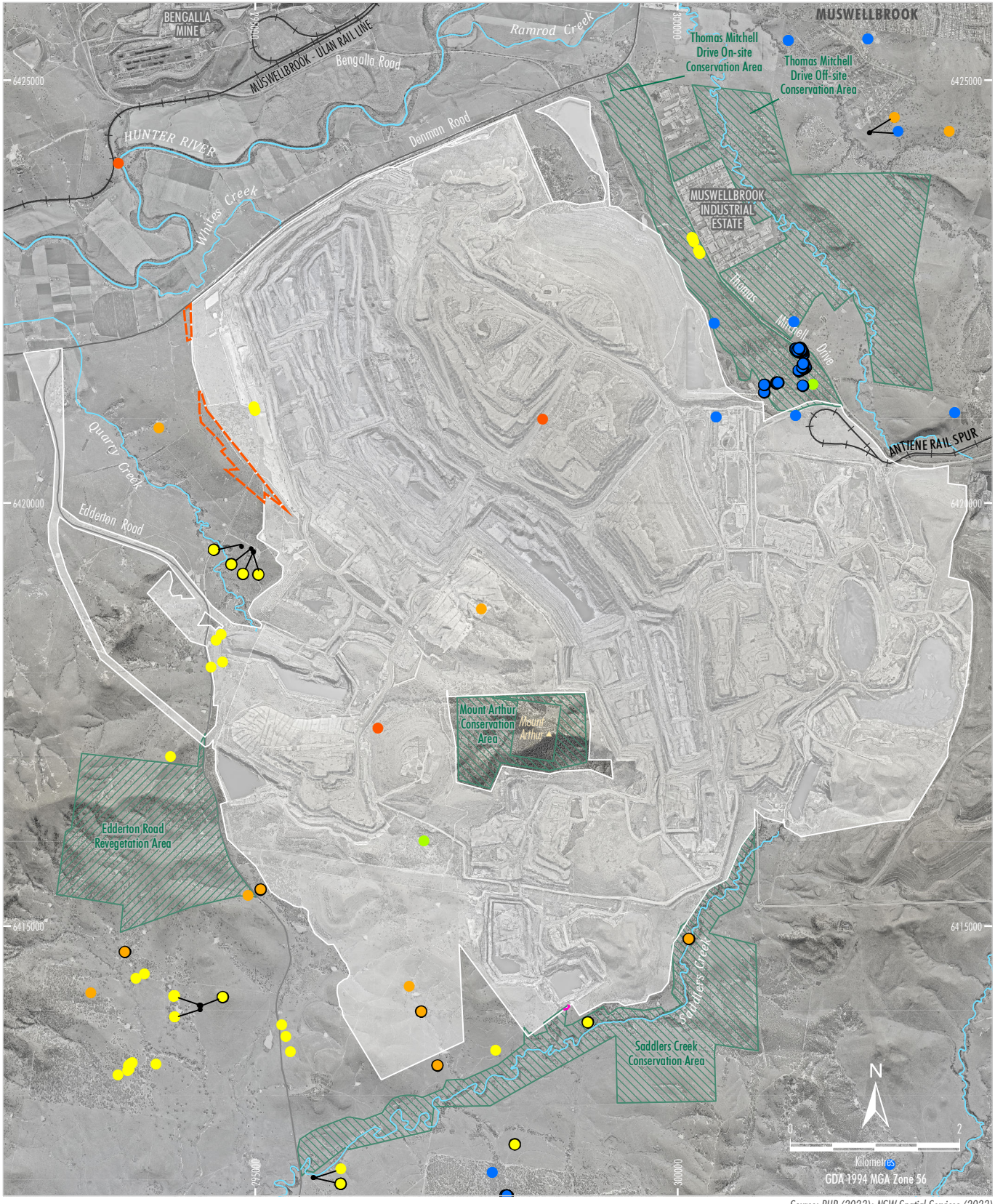
[2] *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (current as at September 2023).

4.2.1.1 Review of Databases and Past Flora and Fauna Surveys

Flora and fauna studies previously undertaken at MAC (Table 4) were also reviewed for any nearby potentially relevant threatened species records (including species credit species) as described in Section 4.1.1. Results of the database review are provided in Attachment E.

There are two BioNet database records of *Eucalyptus camaldulensis* population in the Hunter Catchment in the existing/approved surface disturbance of the mine (DPE, 2023c). However, there is no potential habitat at the location of these records, with the species more likely along the Hunter River.

There is one BioNet database record of Narrow-leaved Black Peppermint (*Eucalyptus nicholii*) in the existing/approved surface disturbance of the mine (DPE, 2023c). However, the record is marked as 'questionable' in the BioNet database (DPE, 2023c) and it is highly unlikely to be a true record as it is well outside the distribution of the species. The record appears in a cleared area so cannot be ground-truthed. In any case, the species does not occur in the Modification area.



HVE-19-09 MOD2_BBAR_2046

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)

Survey / Database

Threatened Flora

- *Acacia pendula* population in the Hunter Catchment
- *Cymbidium canaliculatum* population in the Hunter Catchment
- *Eucalyptus camaldulensis* population in the Hunter Catchment
- Narrow-leaved Black Peppermint
- Pine Donkey Orchid population in the Muswellbrook Local Government Area
- *Thesium australe*

Survey Record Sources: Bolwarra (2023); Cumberland Ecology (2011, 2012); Hunter Eco (2013); Future Ecology (2023)
Database Record Sources: ALA (2022); DPE (2022)

Source: BHP (2023); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Threatened Flora Records

Figure 13

Slaty Red Gum (*Eucalyptus glaucina*), Euphrasia arguta, Tarengo Leek Orchid (*Prasophyllum* sp. Wybong), Illawarra Greenhood (*Pterostylis gibbosa*), Hawkweed (*Picris evae*) and Rufous Pomaderris (*Pomaderris brunnea*) appear in the Commonwealth Protected Matters Search Tool (DCCEEW, 2023c) for the wider locality but there are no nearby records of these species (DPE, 2023c). These species are not associated with PCTs within the Subject land are not likely to occur.

Records for the following three additional fauna species credit species are shown on Figure 13:

- Southern Myotis (*Myotis macropus*); and
- Little Bent-winged Bat (*Miniopterus australis*) (a dual credit species that requires breeding habitat to be present for it to be a species credit species).

None of these species are considered candidate species for this assessment because, there is no potential habitat for the Southern Myotis and no suitable breeding habitat for Little Bent-winged Bat in the Subject land.

The database review also identified some additional fauna species credit species that have no potential habitat in the Subject land, namely the Booroolong Frog (*Litoria booroolongensis*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Red Goshawk (*Erythrotriorchis radiatus*), Eastern Curlew (*Numenius madagascariensis*), Curlew Sandpiper (*Calidris ferruginea*), Little Tern (*Sternula albifrons*), Superb Parrot (*Polytelis swainsonii*) and Brush-tailed Phascogale (*Phascogale tapoatafa*).

4.2.1.2 Geographic Constraints

Geographic constraints are identified in the BAM Credit Calculator for some fauna species credit species, and if the Subject land is outside of the geographic constraints, it precludes the species from further assessment. As shown in Table 6, the Subject land is not outside of the geographic constraints identified in the BAM Credit Calculator.

Table 6
Species Credit Species – Geographic Constraints

Scientific Name	Common Name	Geographic Constraint within the Hunter Sub-zone in the BAM Credit Calculator	Assessment
Acacia pendula – endangered population	Weeping Myall population in the Hunter catchment	Within Hunter River catchment	Not a relevant constraint
Cymbidium canaliculatum – endangered population	Tiger Orchid population in the Hunter Catchment	Must be within Hunter catchment as defined by Australia's River Basins	Not a relevant constraint
Diuris tricolor – endangered population	Pine Donkey Orchid population in the Muswellbrook LGA	Muswellbrook LGA	Not a relevant constraint

Mahony *et. al.* (2022) undertook a genetic and morphological study on legless lizards in the Hunter Valley and concluded that the lizards previously thought to be Striped Legless Lizard (*Delma impar*) were not, but instead were a new species of legless lizard (*Delma vescolineata*). There is no evidence of Striped Legless Lizard (*Delma impar*) occurring in the Hunter Valley, but rather it is located 250 km south (Mahony et. al. 2022). The Striped Legless Lizard (*Delma impar*) is therefore an unlikely candidate species.

A new species of legless lizard (*Delma vescolineata*) was recorded by Future Ecology (2023) (Attachment C) in March 2022 outside of the Subject land as shown on Figure 14. Two individual legless lizards were recorded under roofing sheet in mostly thick derived native grassland (1 m high) comprising Windmill Grass, Bamboo Grass, and *Bothriochloa* sp.. The site where the legless lizards were recorded did not contain surface rock. This species is further discussed in Section 4.2.5.

4.2.2 Step 2: Assessment of the Habitat Constraints and Vagrant Species

Habitat constraints are identified in the BAM Credit Calculator for some fauna species credit species, and the absence of the habitat constraints precludes the species from further assessment. Step 2 is not applicable to a species where no habitat constraints are listed for that species in the BAM Credit Calculator. Table 7 shows that 10 species are removed as candidate species due to the absence of habitat constraints – the highlighted species are retained.

4.2.3 Step 3: Identify Candidate Species Credit Species for Further Assessment

4.2.3.1 Degraded Habitat

The Subject land has been cleared historically and is mostly grazing land with derived native grassland with some heavily fragmented scattered and clumped trees. As such, many of the species that can be associated with the PCTs in the Subject land are not likely to occur because the habitat is too degraded. A total of five species have been removed as candidate species due to degraded habitat as described below.

Despite being removed as candidate species from the BAM Credit Calculator, the surveys by Future Ecology (2023) (Attachment C) would have recorded the fauna species if they were present. The species listed below have not been recorded at the MAC during any past surveys or monitoring (Section 4.1.1) (Figures 10 to 13).

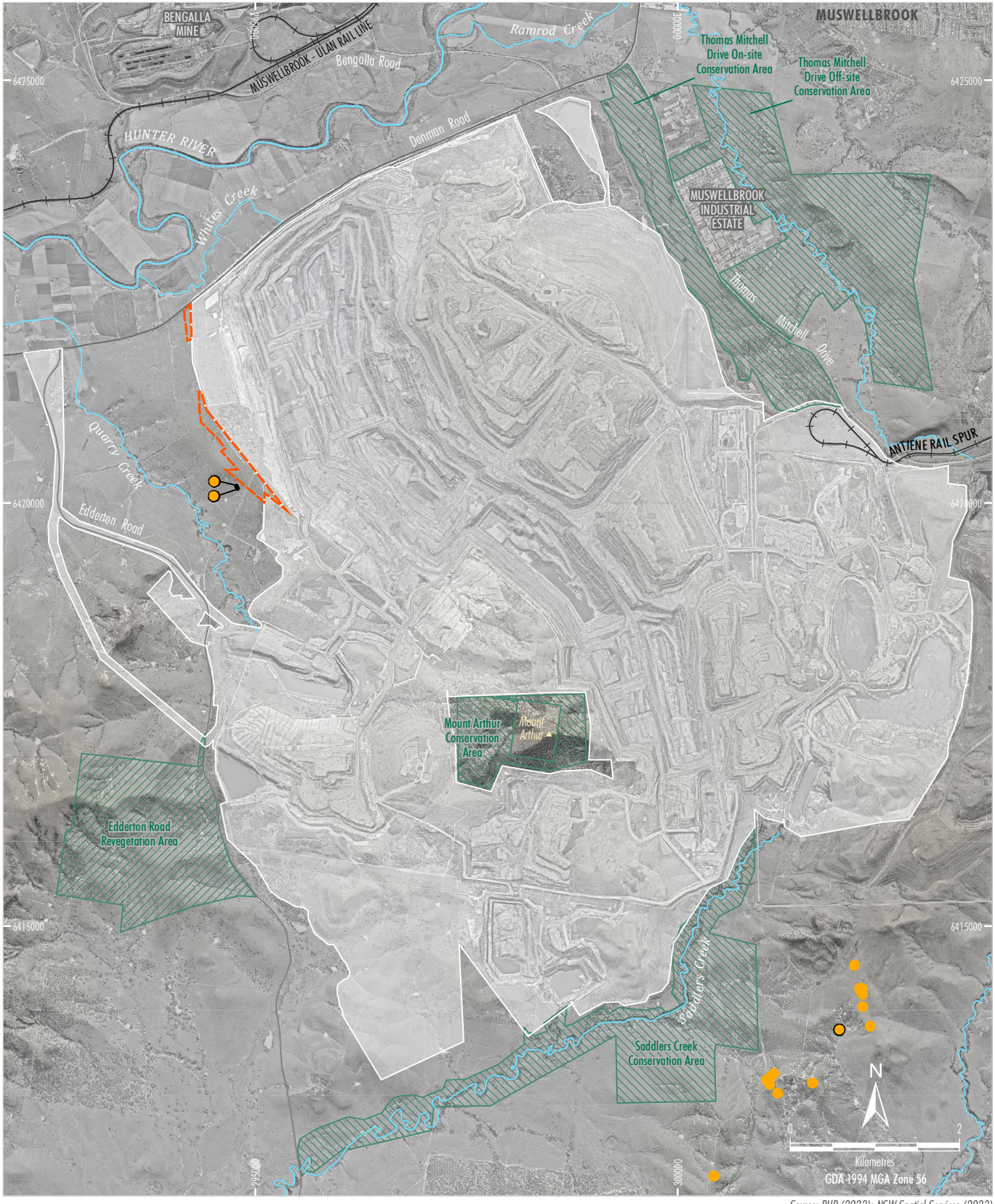
Large-leafed Monotaxis

The Large-leafed Monotaxis (*Monotaxis macrophylla*) is a short-lived annual, and will not be present unless a recent disturbance/fire event has occurred and triggered germination. The Subject land does not represent potential habitat for this species as the Large-leafed Monotaxis (*Monotaxis macrophylla*) grows on rocky ridges and hillsides (DPE, 2023a), which are absent from the Subject land.

Pale-headed Snake

The Pale-headed Snake (*Hoplocephalus bitorquatus*) species has not been recorded at MAC during any past surveys (Section 4.1.1). The closest record of this species is located approximately 75 km east of the Subject land in the Dungog Shire, NSW (DPE, 2023c). It is found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest (DPE, 2023a), which are absent from the Subject land.

It is noted that the Pale-headed Snake (*Hoplocephalus bitorquatus*) will use paddock trees within 500 m of intact habitat (DPE, 2023a), however, the clumped and scattered paddock trees in the Subject land are not within 500 m of intact habitat. The woodland in the Subject land is substantially degraded, therefore, the species is not likely to use it.



HVE-19-09 MOD2_BBAR_205E

Source: BHP (2022); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

LEGEND
- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)

Survey Database

Threatened Reptile
Delma vescolineata

Survey Record Sources: Future Ecology (2019, 2023)
Database Record Source: DPE (2022)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Delma vescolineata sp. Records

Figure 14

Table 7
Species Credit Species – Habitat Constraints Assessment

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Habitat Constraints (DPE, 2023a)	Assessment
		BC Act	EPBC Act			
Reptiles						
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	Species	*Rocky areas or within 50 m of rocky areas.*	The Subject land contains no rocky areas that provide potential habitat for the Pink-tailed Legless Lizard (Future Ecology, 2023; Attachment C).
Birds						
Lophoictinia isura	Square-tailed Kite	V	-	Species/Ecosystem	*Breeding constraint – presence of nest trees.*	The Subject land contains no nest trees (with large stick nests built by raptors) and therefore no potential breeding habitat for this species (Future Ecology, 2023; Attachment C).
Hieraaetus morphnoides	Little Eagle	V	-	Species/Ecosystem	*Breeding constraint – presence of nest trees - live (occasionally dead) large old trees within vegetation.*	The Subject land contains no nest trees (with large stick nests built by raptors) and therefore no potential breeding habitat for this species (Future Ecology, 2023; Attachment C).
Burhinus grallarius	Bush Stone-curlew	E	-	Species	*Fallen/standing dead timber including logs.*	There is some fallen/standing dead timber including logs in the Subject land (Future Ecology, 2023; Attachment C).
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	V	Species/Ecosystem	*Breeding constraint – Hollow bearing trees - Living or dead tree with hollows greater than 15 cm diameter and greater than 8 m above ground.*	There are five trees within the Subject land that have hollows that have a suitable sized diameter and are high enough above ground to be used by this species for breeding, however there was no sign of use (feathers, white wash) and this species was not detected anywhere in the Study area despite several targeted surveys (Future Ecology, 2023; Attachment C).
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	Species/Ecosystem	*Breeding constraint – Eucalypt tree species with hollows at least 3 m above the ground and with hollow diameter of 7 cm or larger*	
Lathamus discolor	Swift Parrot	E	CE	Species/Ecosystem	*Breeding constraint – as per Important Habitat Map*	The Subject land is not within a mapped important habitat area for this species (DPE, 2023f).
Tyto novaehollandiae	Masked Owl	V	-	Species/Ecosystem	*Breeding constraint – Living or dead trees with hollows greater than 20 cm diameter.*	There are five trees within the Subject land that have hollows that have a suitable sized diameter to be used by this species for breeding, however there was no sign of use (feathers, white wash, prey remains) and this

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Habitat Constraints (DPE, 2023a)	Assessment
		BC Act	EPBC Act			
Ninox strenua	Powerful Owl	V	-	Species/Ecosystem	*Breeding constraint – Living or dead trees with hollows greater than 20 cm diameter.*	species was not detected anywhere in the Study area despite several targeted surveys (Future Ecology, 2023; Attachment C).
Ninox connivens	Barking Owl	V	-	Species/Ecosystem	*Breeding constraint – Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.*	
Anthochaera phrygia	Regent Honeyeater	CE	CE	Species/Ecosystem	*Breeding constraint – as per Important Habitat Map*	The Subject land is not within a mapped important habitat area for this species (DPE, 2023f).
Mammals						
Phascolarctos cinereus	Koala	E	E	Species	*Presence of koala use trees - Refer to the* Koala (*Phascolarctos cinereus*): Biodiversity Assessment Method Survey Guide *for information on targeted survey requirements and mapping species polygons.*	The Subject land is mostly derived native grassland with very few remnant and regenerating Eucalypt species. Two large Slaty Box (*Eucalyptus dawsonii*) were observed on the Subject land and there was no indication of use by Koala including scats and deep scratches on trunk. This species was not detected via spotlighting and call-playback in the Study area despite several targeted surveys (Future Ecology, 2023; Attachment C).
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Species	*Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines*	Habitat absent.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Species/Ecosystem	*Breeding camps.*	Habitat constraint absent. The nearest camp is at Singleton (DCCEEW 2022).
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Species/Ecosystem	*Breeding constraint – 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.*	No known potential habitat within 2 km of the Subject land.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Species	*Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.*	No known potential habitat within 2 km of the Subject land.

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Habitat Constraints (DPE, 2023a)	Assessment
		BC Act	EPBC Act			
Vespadelus troughtoni	Eastern Cave Bat	V	-	Species	*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.*	No known potential habitat within 2 km of the Subject land.

[1] Conservation status listed under the BC Act and EPBC Act (current as at September 2023).

CE Critically Endangered

E Endangered

V Vulnerable.

[2] Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (current as at September 2023).

Future Ecology (2023) (Attachment C) undertook spotlighting and funnel traps in riparian vegetation along Quarry Creek (west of the Subject land) and the Pale-headed Snake (*Hoplocephalus bitorquatus*) was not recorded.

Southern Greater Glider

The Southern Greater Glider (*Petauroides volans*) species has not been recorded at MAC during any past surveys (Section 4.1.1). The closest record of this species is located approximately 40 km east near Mount Royal National Park (DPE, 2023c). No records of the Southern Greater Glider (*Petauroides volans*) were found in the database review covering the wider area (Attachment E).

This species occupies a relatively small home range (one-three ha) and requires multiple tree hollows and forage resources (eucalypt leaves, buds, flowers and mistletoe) (DPE, 2023a). It is often recorded along waterways. Paddock trees are not an important component of the species habitat (DPE, 2023a) and fragmentation is a recognised threat to the species.

The woodland in the Subject land is substantially degraded and does not provide suitable habitat resources for the Southern Greater Glider (*Petauroides volans*) Future Ecology (2023) (Attachment C) undertook spotlighting in riparian vegetation along Quarry Creek (west of the Subject land). The Southern Greater Glider (*Petauroides volans*) was not recorded.

Eastern Pygmy-possum

This species has not been recorded at MAC during any past surveys (Section 4.1.1). The closest record of the Eastern Pygmy-possum (*Cercartetus nanus*) is located approximately 40 km east near Mount Royal National Park (DPE, 2023c). No records of the Eastern Pygmy-possum (*Cercartetus nanus*) were found in the database review covering the wider area (Attachment E).

The Eastern Pygmy-possum (*Cercartetus nanus*) inhabits a broad range of habitats such as rainforest, sclerophyll forest, woodland and heath, although the species prefers habitat with a rich shrub understory (DPE, 2023a).

The woodland in the Subject land is substantially degraded and does not provide suitable habitat resources for the Eastern Pygmy-possum (*Cercartetus nanus*). Future Ecology (2023) (Attachment C) undertook a range of survey techniques to detect the species (e.g. nocturnal surveys, pitfall traps, Elliot A traps and funnel traps). The Eastern Pygmy-possum (*Cercartetus nanus*) was not recorded.

Common Planigale

The Subject land is outside of the main distribution of the Common Planigale (*Planigale maculata*), with most records on coastal north-eastern NSW the closest of which is located approximately 90 km east at Barrington Tops National Park (after DPE, 2023c). No records of the Common Planigale (*Planigale maculata*) were found in the database review covering the wider area (Attachment E). This species inhabits rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water (DPE, 2023a).

Future Ecology (2023) (Attachment C) undertook targeted surveys for the Common Planigale (*Planigale maculata*) using pitfall and Elliot A traps. A total of 880 Elliot A trap-nights, 264 pitfall trap-nights and 88 reptile funnel trap nights were achieved around MAC. The Common Planigale was not recorded by Future Ecology (2023) (Attachment C), or during any of the past fauna surveys (Section 4.1.1).

4.2.4 Step 4: Determine Presence or Absence of a Candidate Species Credit Species

4.2.4.1 Species Important Habitat Mapping

No Important Habitat Mapping occurs in the Subject land (DPE, 2023f).

4.2.4.2 Species Assumed to be Present

No species credit species are assumed to be present.

4.2.4.3 Expert Report

No expert reports have been prepared for species credit species.

4.2.4.4 Targeted Surveys

Table 8 contains a list of threatened species and populations that were targeted during surveys.

Threatened Flora Species and Populations

Bolwarra (2023) (Attached to Attachment B) undertook target surveys for the threatened flora species and populations in a number of locations surrounding the MAC, including the Subject land. The threatened species and populations listed in Table 8 were targeted in accordance with *Surveying Threatened Plants and Their Habitats: NSW Survey Guide for the Biodiversity Assessment Method* (DPIE, 2020b).

Bolwarra (2023) (Attached to Attachment B) undertook three rounds of surveys in the study area. Round 1 was undertaken in September 2021 and involved 100 m transects, Round 2 was undertaken in December 2021 and involved 100 m transects, Round 3 was undertaken in October 2022 and involved 5 to 10 m transects. In addition, Dr Colin Driscoll (Hunter Eco, 2023) watched for the target threatened flora species through the flora survey work he completed in the study area (e.g. identification of each tree, floristic plots, vegetation mapping and flora species list compilation).

No threatened flora species or populations were recorded in the Subject land. Threatened flora species and populations were recorded elsewhere outside of the Subject land (Weeping Myall [*Acacia pendula*] population in the Hunter catchment], *Cymbidium canaliculatum* population in the Hunter catchment], and *Thesium australe*), providing confidence that if those species were present, they would have been detected via the targeted surveys.

Bolwarra (2023) (Attached to Attachment B) states that it is likely that decades of cultivation, grazing by cattle and sheep, droughts, exotic species dominance and high rabbit abundance has severely impacted the potential for threatened orchid species to occur in the study area.

Table 8
Candidate Species Credit Species – Survey Timing

Scientific Name	Common Name	Biodiversity Credit Class[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flora														
Acacia pendula	*Acacia pendula* population in the Hunter catchment	Species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cryptostylis hunteriana	Leafless Tongue Orchid	Species	Yes	-	-	-	-	-	-	-	-	-	Yes	Yes
Cymbidium canaliculatum	*Cymbidium canaliculatum* population in the Hunter Catchment	Species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diuris tricolor	Pine Donkey Orchid	Species	-	-	-	-	-	-	-	-	Yes	Yes	-	-
Eucalyptus pumila	Pokolbin Mallee	Species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ozothamnus tesselatus	-	Species	-	-	-	-	-	-	-	-	Yes	Yes	-	-
Pomaderris queenslandica	Scant Pomaderris	Species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pomaderris reperta	Denman Pomaderris	Species	-	-	-	-	-	-	-	-	Yes	Yes	Yes	-
Prostanthera cineolifera	Singleton Mint Bush	Species	-	-	-	-	-	-	-	-	Yes	Yes	-	-
Prostanthera cryptandroides subsp. Cryptandroides	Wollemi Mint-bush	Species	-	-	-	-	-	-	-	-	Yes	Yes	Yes	-
Thesium australe	Austral Toadflax	Species	Yes	Yes	-	-	-	-	-	-	-	*	Yes	Yes
Birds														
Burhinus grallarius	Bush Stone-curlew	Species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Calyptorhynchus lathami	Glossy Black-cockatoo	Species/Ecosystem	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-
Callocephalon fimbriatum	Gang-gang Cockatoo	Species/Ecosystem	Yes	-	-	-	-	-	-	-	-	Yes	Yes	Yes

Scientific Name	Common Name	Biodiversity Credit Class[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tyto novaehollandiae	Masked Owl	Species/Ecosystem	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-	-
Ninox strenua	Powerful Owl	Species/Ecosystem	-	-	-	-	Yes	Yes	Yes	Yes	-	-	-	-
Ninox connivens	Barking Owl	Species/Ecosystem	-	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mammals														
Phascolarctos cinereus	Koala	Species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Petaurus norfolcensis	Squirrel Glider	Species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note Months in which surveys are to be conducted in accordance with the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) are denoted with 'Yes'. The shaded cells are months in which targeted surveys were undertaken by Bolwarra (2023) (Attached to Attachment B) and Future Ecology (2023) (Attachment C) for the relevant species.

[1] Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (current as at September 2023).

* Austral Toadflax was recorded outside of the Subject land in October (Bolwarra [2023] [Attached to Attachment B]).

Threatened Birds

Future Ecology (2023) (Attachment C) undertook targeted surveys for the Bush Stone-curlew (*Burhinus grallarius*) in a study area encompassing the Subject land using call playback and spotlighting. However, no signs of the Bush Stone-curlew (*Burhinus grallarius*) were detected.

Nocturnal surveys (incorporating quiet listening, call-playback and spotlighting) were carried out during August 2021 (with nine call-playback sessions and 48 hours of surveys completed), and diurnal bird surveys were undertaken on various occasions from May to November 2021, March 2022 and in July 2023. However, no signs of the threatened cockatoos or owls were recorded (no birds or nests). There are five trees within the Subject land that have hollows that have a suitable sized diameter and are high enough above ground to be used by threatened cockatoos or owls for breeding, however, there was no sign of use (feathers, white wash) (Future Ecology, 2023).

No threatened cockatoos or owls have been previously detected in the study area despite several targeted surveys. No records of the Powerful Owl (*Ninox strenua*) were found in the database review covering the wider area (Attachment E).

Threatened Mammals

Over 10 years ago, in 2011, a single Koala (*Phascolarctos cinereus*) was recorded within the approved MAC (HVEC, pers. comm., 2012 in Hunter Eco, 2013) (Figure 11). The Koala (*Phascolarctos cinereus*) was a lone male, thought to be most likely moving through looking for a mate. The Koala was taken by wildlife carers who relocated him into a rehabilitated area near where he was originally found.

Future Ecology (2023) (Attachment C) undertook targeted surveys for the Koala (*Phascolarctos cinereus*) and Squirrel Glider (*Petaurus norfolkensis*) in a study area encompassing the Subject land. The surveys involved:

- Nocturnal surveys (incorporating quiet listening, call-playback and spotlighting) were carried out during March 2022 (with 11 call-playback sessions and 34.5 hours of surveys completed).
- A total of 10 passive acoustic monitoring devices (Songmeter Mini from Wildlife Acoustics) were deployed for 2-4 nights in November 2021 (a total of 39 acoustic monitor trap-nights).
- A total of 2,053 camera trap-nights were completed from May 2021 to March 2022.
- Searches for scratchings on tree trunks and scats below Eucalypt trees (particularly published feed tree species) were undertaken as part of general ecological surveys.
- An additional two nights of spotlighting and call-playback together with the use of acoustic monitors was completed in the proposed modification area (Site A) in July 2023.
- Recordings from each Chorus unit for that period of an hour before dawn on 20 July 2023 were listened to in real time for any indication of Koala as well as Large Forest Owl and Squirrel Glider calls.

No signs of Koala or Squirrel Glider were detected in the assessment area encompassing the Subject land. The Subject land is mostly derived native grassland with very few remnants and regenerating Eucalypt species. Two large Slaty Box (*Eucalyptus dawsonii*) were observed on the Subject land and there was no indication of use by Koala (i.e. absence of scats and deep scratches on the trunk). Due to the small size of the Subject land, each tree was able to be searched for the Koala, which exceeded the sampling methods in DPE (2022b).

4.2.5 Step 5: Determine the Area or Count, and Location of Suitable Habitat for a Species Credit Species

No species credit species were confirmed to be present or likely to use the habitat in the Subject land.

The new species of legless lizard (*Delma vescolineata*) (that was previously thought to be *Delma impar*) has only recently been identified as a separate species by Mahony *et. Al.* (2022), and in time, it could also potentially be listed as a threatened species under the BC Act. On this basis, HVEC is prepared to provide biodiversity offsets for the new species of legless lizard (*Delma vescolineata*) should it be listed under the BC Act in the 12 months following determination of the Modification. Also of note, the new species of legless lizard (*Delma vescolineata*) is on the Commonwealth Finalised Priority Assessment List (assessment due April 2024).

The Modification would involve clearance of approximately 24.4 ha of potential Legless Lizard habitat (all native vegetation except the plantation [Vegetation Zone 1b]). Under the NSW Biodiversity Offset Scheme, the Biodiversity Risk Weighting (a score from 0.5 to 3) is used to calculate the number of species credits required for a particular threatened species. The Striped Legless Lizard (*Delma impar*) has a Biodiversity Risk Weighting of 1.5 as it is listed as 'Vulnerable' under the BC Act and has a moderate sensitivity to gain. Given the same habitat requirements, if the new legless lizard species (*Delma vescolineata*) was to be listed under the BC Act and have the same Biodiversity Risk Weighting (1.5), the Project (as modified) would provide 343 credits. However, if the legless lizard (*Delma vescolineata*) was apportioned a higher Biodiversity Risk Weighting of 2 or 3, the credit requirements would be correspondingly higher. To account for the fact that the new species has only recently been identified and there is uncertainty as to whether the new species will be listed under the BC Act (and the Biodiversity Risk Weighting if listed), possible credit values are listed in Table 9.

Table 9
Possible *Delma vescolineata* Credits

Vegetation Zone	Total Area (ha)	Vegetation Integrity Score	Credits		
			Biodiversity Risk Weighting 1.5	Biodiversity Risk Weighting 2	Biodiversity Risk Weighting 3
1	0.3	78.5	343	457	686
1a	22.5	36.6			
2	0.4	67.7			
2a	1.2	33.9			

4.3 PRESCRIBED ADDITIONAL BIODIVERSITY IMPACT ENTITIES

Prescribed additional biodiversity impacts (prescribed impacts) must be assessed as part of the NSW Biodiversity Offsets Scheme, as per Clause 6.1 of the BC Regulation. The BC Regulation states:

(1) The impacts on biodiversity values of the following actions are prescribed (subject to subclause (2) as biodiversity impacts to be assessed under the biodiversity offsets scheme—

(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.

There are no prescribed biodiversity impacts relevant to the Modification as outlined below.

4.3.1 Karst, Caves, Crevices, Cliffs and Other Geological Features of Significance

No karst, caves, crevices, cliffs and other geological features of significance associated with threatened species occur in the Subject land.

4.3.2 Human Made Structures and Non-native Vegetation

No human-made structures or areas of non-native vegetation that provide habitat for relevant threatened species (e.g. bats) occur in the Subject land. The former Edderton Road alignment passes through the Development Footprint and has been mapped as cleared land.

4.3.3 Habitat Connectivity

As described in Section 2.4, the native vegetation in the Subject land is not part of a larger woodland patch and the scattered and clumped trees provide minimal habitat connectivity.

4.3.4 Movement of Threatened Species that Maintains their Lifecycle

The native vegetation in the Subject land is not part of a movement corridor for threatened species across their range. The Modification would not impact the movement of threatened species that maintains their lifecycle.

4.3.5 Water Bodies, Water Quality and Hydrological Processes

As described in Section 2.3, there are no waterways in the Subject land. Generally, rainfall runoff flows north-west into Quarry Creek and associated tributaries and then into the Hunter River. The Modification would not impact water quality, water bodies and hydrological processes that sustain threatened species or threatened ecological communities.

4.3.6 Fauna Vehicle Strike

There would be an increase in the life of the mine from 2026 to 2030, which would result in additional vehicle movements in this period (i.e. relative to the scenario where the Modification is not approved and the mine closes in 2026). However, there would be no material change in the number of vehicles as a result of the Modification and therefore no material change in the potential for fauna-vehicle strike relative to the currently approved operations. The existing roads (and stock fence) inside the perimeter of the approved disturbance would be moved south into the Subject land. There are a number of existing dirt tracks that occur within the Subject land.

5 AVOID AND MINIMISE IMPACTS

This section describes the measures that have been evaluated and adopted to avoid or minimise impacts on biodiversity values (including prescribed impacts). Impacts are avoided when adverse impacts on biodiversity values, or certain areas of biodiversity are completely prevented. Impacts are minimised when impacts on biodiversity values are reduced.

As described in Section 1, HVEC will cease mining at MAC in 2030, proposing a continuation of mining for four years beyond 2026 as part of a managed plan to provide a pathway to closure of the operation. The Modification (25 ha) would result in a net reduction in approved disturbance of 387 ha, as some areas previously approved for disturbance by the Project Approval are no longer intended to be disturbed. HVEC is proposing to decrease the disturbance by approximately 412 ha as the southern out-of-pit emplacement area, as well as the Edderton Road Realignment, are no longer required. The Impact Minimisation Area (412 ha) includes portions of previously mined and rehabilitated land approved to be re-disturbed for the southern out-of-pit emplacement area.

This section has been prepared in consideration of the BAM (DPIE, 2020a) and *Biodiversity Assessment Method Operational Manual* (DPE, 2023g) in regard to the Development Footprint.

5.1 LOCATION OF THE DEVELOPMENT TO AVOID OR MINIMISE DIRECT AND INDIRECT IMPACTS ON BIODIVERSITY VALUES

The BAM (DPIE 2020) states:

> *When selecting a proposal's location, all of the following should be analysed. Justification for the decisions in determining the final location must be based on consideration of:*
>
> - *Alternative modes or technologies that would avoid or minimise impacts on biodiversity values*
> - *Alternative routes that would avoid or minimise impacts on biodiversity values*
> - *Alternative locations that would avoid or minimise impacts on biodiversity values*
> - *Alternative sites within a property on which the proposal is located that would avoid or minimise impacts on biodiversity values*

5.1.1 Alternative Locations that would Avoid or Minimise Impacts on Biodiversity Values

The Subject land was considered the most appropriate location due to the following reasons:

- Mining in the Windmill Pit is currently active and operating towards the western extent of the approved disturbance footprint. Continued mining would occur in the Windmill Pit until closure in 2026 (as approved).
- The Development Footprint is a contiguous extension of the currently approved disturbance boundary adjoining the Windmill Pit (i.e. no new open cut pits are proposed). The Development Footprint has been selected based upon the presence of the existing coal seams being mined in the Windmill Pit, and therefore the Modification would enable the extraction of additional economically viable coal resources.
- The Development Footprint is located within existing mining lease (ML) boundaries.
- Ayredale, Roxburgh, Calool and Saddlers Pits are nearing the end of their respective mine lives as the remaining available resource within these pits is limited. Therefore, there is limited potential for any extension to the Ayredale, Roxburgh, Calool and Saddlers Pits.

5.1.2 Alternative Sites within a Property on which the Proposal is Located that would Avoid or Minimise Impacts on Biodiversity Values

BHP initially undertook a range of initial steps to prepare an application to seek approval to mine until 2045 to recover additional coal resources within EL 5965 (the Continuation Project). The Continuation Project would have involved the extraction of additional coal resources over approximately 4,000 ha of land within EL 5965 (further west of the proposed Development Footprint), which would have resulted in significant surface disturbance and vegetation clearance. However, after further evaluation of economic and financial factors, it was concluded by BHP that Mt Arthur Coal's commercial viability was limited beyond 2030.

BHP also considered commencing the closure process at the end of the current approved mine life (i.e. 30 June 2026), resulting in no additional surface disturbance activities. It was acknowledged by BHP and external stakeholders that should this occur, there would be insufficient time to plan for closure, and that substantial economic benefits (associated with continuing the operation to 2030) would not be realised.

Therefore, the proposal to continue operations to 2030 including associated mining within the Development Footprint was considered the most feasible option in comparison to other alternatives.

5.1.3 Alternative Modes or Technologies that would Avoid or Minimise Impacts on Biodiversity Values

There are no alternative modes or technologies (such as underground mining methods) that could be applied to the Modification that would avoid or minimise impacts on biodiversity values. The most efficient form of coal extraction is for the current mode of mining to be continued since the Modification would involve only a minor increase to the existing pit crest.

5.1.4 Alternative Routes that would Avoid or Minimise Impacts on Biodiversity Values

Alternative routes are not applicable to the Modification.

5.2 DESIGN OF THE DEVELOPMENT TO AVOID OR MINIMISE DIRECT AND INDIRECT IMPACTS ON BIODIVERSITY VALUES

The BAM (DPIE, 2020) states the BDAR must *'document the reasonable measures taken by the proponent to avoid or minimise clearing of native vegetation and threatened species habitat during proposal design, including placement of temporary and permanent ancillary construction and maintenance facilities'.*

The Development Footprint presented in the *Mt Arthur Coal Mine – Modification 2 Scoping Letter* (HVEC, 2022) was approximately 35 ha to take the mine disturbance area out to the ML boundaries to allow for ancillary infrastructure around the pit shell (Figure 15). Based on feedback from the biodiversity and heritage studies (biodiversity offset liability was considered in making this decision), HVEC has heavily scrutinised the design and optimised the design as per the smaller 25 ha layout, resulting in 10 ha of impact avoidance.

Source: BHP (2023); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

LEGEND

- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Approximate Extent of Existing/Approved Surface Development
- Initial Development Footprint Prior to the Final Development Footprint
- Development Footprint
- No Disturbance Proposed
- Existing Flood Levee
- Existing Groundwater Cut-off Wall

Proposed Infrastructure

- Final Highwall
- Light Vehicle Road
- Highwall Safety Bund and Fence
- Haul Road Windrow
- Pipeline
- Clean Water Diversion
- Dirty Water Drain and Bund
- Highwall Corridor including Haul Road (approx 80 m)
- Temporary Topsil Stockpile
- Open Cut Mining
- General Infrastructure Area #

General infrastructure includes access and haul roads, and laydown and other infrastructure areas.

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Impact Avoidance

Figure 15

The Development Footprint (approximately 25 ha) is a contiguous extension of the existing/approved disturbance area and is very minor relative to the approved disturbance extent (6,710 ha). The Development Footprint is required for the purposes of (Figure 15):

- increase in open cut pit extent (Windmill Pit);
- highwall safety bund;
- haul road and access roads;
- topsoil stockpiles; and
- water management infrastructure for pit dewatering including a clean water diversion, dirty water drain and bund, and associated pipelines.

The proposed increase in the Windmill Pit would enable a managed process to cease mining in June 2030. The proposed increase in open cut pit extent is a minor fraction of the overall size of the approved Windmill Pit (Figure 2).

The proposed infrastructure in the Development Footprint would be consistent with the approved MAC, with linear infrastructure aligned parallel to the proposed open cut pit. A highwall safety bund, haul road and water management infrastructure would be required (and constrained to) around the outside of the proposed open cut pit. Access tracks would be required to provide access to the infrastructure. The reasonably streamlined infrastructure has the effect of minimising the Development Footprint.

A number of topsoil stockpiles would be placed outside of the pit to facilitate rehabilitation of the adjacent final landform. The spatial footprint of the topsoil stockpiles cannot be further minimised without increasing the height of the topsoil stockpiles which can reduce stability.

There are no areas in the Subject land or immediate surrounds that have no biodiversity values (except for the former Edderton Road that runs through the Subject land). The area of planted native vegetation (i.e. the Plantation) is considered to have comparatively lower biodiversity values than other vegetation zones (such as the Box-Gum Woodland CEEC) because the young plantings are not representative of the vegetation that once occurred in that location (Plate 3).

The majority of the Development Footprint covers the derived native grassland areas (i.e. areas with the lowest VI scores and poorest condition), noting that most of it is Box-Gum Woodland CEEC (Table 2). The small areas of woodland (approximately 1 ha) in the Development Footprint cannot be avoided due to the need to place the linear infrastructure adjacent to the open cut pit extent.

5.3 CONSTRUCTION AND OPERATION

Surface infrastructure within the Development Footprint would be constructed progressively throughout the mine life (i.e. until 2030). As approved, BHP's Land Management procedure would be implemented for the Modification, and details the control measures to be implemented during vegetation clearing to assist in undertaking activities in an environmentally responsible manner and in accordance with BHP's procedures and commitments. The Land Management procedure covers:

- permit to disturb process;
- pre-clearance survey;
- fauna management;
- topsoil management; and
- biodiversity management.

Further detail regarding the Land Management procedure is detailed in BHP's approved *Biodiversity Management Plan* (BHP, 2019) (which would be updated to include the Modification).

The vegetation clearing protocol includes the following best practice measures to avoid incidental clearance of vegetation. These protocols are as follows:

- clear delineation of the approved disturbance areas on the ground prior to clearing activities (e.g. flagging tape, painted markers, posts) and restriction of clearing to within these areas;
- signposts to alert personnel not to enter vegetation outside of the disturbance areas; and
- mine staff and contractors would be made aware of clearing limits and restricted access areas.

5.4 REHABILITATION

Surface infrastructure would be decommissioned and removed (infrastructure may be retained where an alternate ongoing use is determined) and surface development areas rehabilitated progressively or at the end of the mine life. Progressive mine rehabilitation has the effect of minimising the duration of the impacts.

The overall rehabilitation goal for MAC, encompassing the Development Footprint, is to comprise a combination of native vegetation and agricultural (pasture) land uses (Figure 3). The Development Footprint would be revegetated back to an agricultural land use.

During rehabilitation, adverse impacts on surrounding vegetation and habitat can occur if environmental weeds become established or through sedimentation or erosion of cleared areas. To minimise impacts from environmental weeds, BHP would continue weed prevention measures, control and monitoring. Operational sediment and erosion control works would be maintained during the establishment of revegetation to minimise impacts from sedimentation or erosion.

5.5 ACTIONS AND MEASURES TO AVOID THE DIRECT AND INDIRECT IMPACTS ON THREATENED ECOLOGICAL COMMUNITIES AT RISK OF SAII

There is one entity recorded on the Subject land that can be a 'potential SAII entity', namely the Box-Gum Woodland CEEC listed under the BC Act.

As described above, the Development Footprint presented in the *Mt Arthur Coal Mine – Modification 2 Scoping Letter* (HVEC, 2022) was approximately 35 ha to take the mine disturbance area out to the ML boundaries to allow for ancillary infrastructure around the pit shell (Figure 15), and this would have involved the clearance of approximately 32.8 ha of Box-Gum Woodland CEEC listed under the BC Act (approximately 32.2 ha of derived native grassland and approximately 0.6 ha of woodland).

Based on feedback from the biodiversity and heritage studies, HVEC has optimised the design, as per the smaller 25 ha layout, by condensing and streamlining the ancillary infrastructure around the pit shell (Figure 15). The areas of Box-Gum Woodland CEEC in the Development Footprint (approximately 0.3 ha of woodland and approximately 22.5 ha of derived native grassland (a total of approximately 22.8 ha) cannot be avoided due to the need to place the linear infrastructure adjacent to the open cut pit extent. The impact on the Box-Gum Woodland CEEC has been minimised by preventing approximately 10 ha of Box-Gum Woodland CEEC being cleared.

6 ASSESSMENT OF POTENTIAL IMPACTS

Impacts on vegetation and habitat adjacent to the Development Footprint are assessed below, including those listed in the BAM (DPIE, 2020a), and *Biodiversity Assessment Method Operational Manual* (DPE, 2023g). Relevant key threatening processes listed under the BC Act have been assessed.

6.1 DIRECT IMPACTS ON NATIVE VEGETATION AND HABITAT

6.1.1 Clearing of Native Vegetation

The Modification would require the progressive removal of 24.6 ha of native vegetation as outlined in Table 10 and shown on Figure 6. This comprises mostly derived native grasslands (23.7 ha), woodland (0.7 ha) and plantation (0.2 ha). Most of the trees in the Subject land are Bull Oak (*Allocasuarina luehmannii*), with less White Box (*Eucalyptus albens*) and fewer Slaty Box (*Eucalyptus dawsonii*). There is a linear strip of plantings at the northern end of the Subject land. There are three Kurrajong Trees (*Brachychiton populneus*) in the southern end of the Subject land. The former Edderton Road alignment passes through the Development Footprint and has been mapped as cleared land.

Table 10
Native Vegetation Clearance within the Development Footprint

Veg Zone	Vegetation Community (Hunter Eco, 2023) (Attachment B)	PCT ID	Total Area (ha)	Vegetation Integrity Score (Table 2) [C]
1	Grey Box x White Box Grassy Woodland [A]	PCT 483 *Grey Box x White Box Grassy Open Woodland on Basalt Hills in the Merriwa Region, Upper Hunter Valley*	0.3	78.5
1a	Derived Native Grassland [A]		22.5	36.6
1b	Plantation		0.2	57.1
2	Slaty Box Woodland [B]	PCT 1655 *Grey Box - Slaty Box shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin*	0.4	67.7
2b	Derived Native Grassland		1.2	33.9
		Total Woodland	*0.7*	
		Total Derived Native Grassland	*23.7*	
		Total Plantation	*0.2*	
		Overall Total Native Vegetation	**24.6**	
		Cleared Land	*0.4*	
		Overall Total Subject Land/Development Footprint	**25**	

[A] Equivalent to the Box-Gum Woodland CEEC listed under the BC Act (and EPBC Act).

[B] Equivalent to the Slaty Gum Woodland VEC listed under the BC Act and the Central Hunter Woodland CEEC listed under the EPBC Act.

[C] This score would be zero after clearance and before mine rehabilitation.

The Box-Gum Woodland CEEC in the Development Footprint is not a good example of the community as the woodland has been heavily fragmented by past clearing (Figure 8) and as a result it consists of a number of small patches (totalling 0.3 ha) that are isolated.

The derived native grassland component of the community (approximately 22.5 ha) is in sub-optimal condition (VI score of 36.6 out of a possible 100) due to the past clearance and long-term use of the paddocks for grazing livestock. Hunter Eco (2023) (Attachment B) notes that the area studied is weedy and one third of all plant species recorded were weeds (30 weed species including six High Threat Exotic species).

Approximately 0.4 ha of native vegetation in the Development Footprint is equivalent to the Slaty Gum Woodland VEC listed under the BC Act. Again, this woodland has been heavily fragmented by past clearing (Figure 8) and as a result it consists of a number of small patches (totalling 0.4 ha) that are isolated.

The overall rehabilitation goal for MAC, encompassing the Development Footprint, is to comprise a combination of native vegetation and agricultural (pasture) land uses (Figure 3). The Development Footprint would be revegetated back to an agricultural land use.

6.1.2 Clearing of Fauna Habitat

The land in the Development Footprint has been cleared historically and is mostly grazing land with derived native grassland with some heavily fragmented scattered and clumped trees. The trees that remain or that have regrown since past clearance provide suboptimal habitat for most threatened species that occur in the area. The Development Footprint is an extension from the existing/approved surface development area and no habitat would become fragmented or isolated.

The fauna survey results (Attachment C) indicate that some wide-ranging threatened raptors may forage in the area [e.g. Black Falcon (*Falco subniger*), some threatened woodland birds may use the habitat (Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) eastern subspecies and Specked Warbler (*Chthonicola sagittata*)] and some threatened bats may use tree hollows and/or forage in the area. No species credit species were confirmed to be present or likely to use the habitat in the Subject land.

Dead wood and dead trees are present in the Development Footprint and surrounds. Stags (dead trees) can provide habitat for hollow-dwelling fauna (including some threatened birds and bats). Logs on the ground can provide habitat for fauna such as lizards and snakes), however, no threatened fauna that use logs were recorded.

The Modification would involve clearance of approximately 24.4 ha of potential habitat for the new legless lizard species (*Delma vescolineata*) habitat (all native vegetation except the plantation [Vegetation Zone 1b]). The species was recorded outside of the Development Footprint, under roofing sheet in mostly thick native derived grassland (1 m high) and not associated with rocky areas or cow pats (which are also known to provide shelter) as grazing cattle were removed from the paddocks associated with the Subject land over five years ago.

The habitat in the Subject land is typical of the surrounding landscape and loss of the habitat in the Development Footprint is unlikely to significantly impact any local fauna populations.

6.1.3 Cumulative Impacts

Cumulative impacts are considered to be the total impact on the environment that would result from the incremental impacts of the Project in addition to past, present and reasonably foreseeable planned developments that may interact with the Project impacts. Cumulative impacts include both direct and indirect impacts.

The total MAC disturbance area encompasses approximately 6,710 ha. The extent of the Development Footprint (approximately 25 ha) which is a contiguous extension of an existing open cut pit and is very minor relative to the approved disturbance extent.

As described in Section 5, the Modification involves a net reduction in approved disturbance (387 ha), as some areas previously approved for disturbance by the Project Approval are no longer intended to be disturbed. HVEC is proposing to decrease the disturbance by approximately 412 ha as the southern out-of-pit emplacement area, as well as the Edderton Road Realignment, are no longer required. The Impact Minimisation Area (412 ha) includes portions of previously mined and rehabilitated land approved to be re-disturbed for the southern out-of-pit emplacement area.

6.2 INDIRECT IMPACTS ON NATIVE VEGETATION AND HABITAT

This section assesses the potential for indirect impacts on vegetation and habitat adjacent to the Development Footprint, during construction and operation. Vegetation adjacent to the Development Footprint is shown on Figure 6. Threatened fauna records adjacent to the Development Footprint are shown on Figures 10 to 12.

No threatened flora have been recorded adjacent to the Development Footprint (Figures 13). No threatened mammals have been recorded adjacent to the Development Footprint, and the closet records are of the Southern Myotis (*Myotis macropus*) along Quarry Creek (Figures 11 and 12). Some database records of the Spotted Harrier (*Circus assimilis*) are shown on Figure 13 adjacent to the Development Footprint (DPE, 2023c) but these may have been birds overhead as this is a wide-ranging raptor typically recorded overhead and no potential nests were recorded by Future Ecology (2023) (Attachment C).

6.2.1 Inadvertent Impacts on Adjacent Habitat or Vegetation

Inadvertent impacts on habitat or vegetation adjacent to the Development Footprint has the potential to occur through human error. As approved, BHP's Land Management procedure would be implemented for the Modification, and details the control measures to be implemented during vegetation clearing (Section 7). The vegetation clearing protocol includes the following best practice measures to avoid incidental clearance and vegetation to be retained:

- clear delineation of the approved disturbance areas on the ground prior to clearing activities (e.g. flagging tape, painted markers, posts) and restriction of clearing to within these areas;
- signposts to alert personnel not to enter vegetation outside of the disturbance areas; and
- mine staff and contractors would be made aware of clearing limits and restricted access areas.

6.2.2 Reduced Viability of Adjacent Habitat Due to Edge Effects

Edge effects can occur from a change in physical and/or biological conditions at edges of habitat. The vegetation adjacent to the Development Footprint is mostly open derived native grassland (Vegetation Zone 1a) with some small patches of open and fragmented woodland (Vegetation Zones 1) (Figure 6). As described in Section 6.1.1, the derived native grassland is in poor condition due to the past clearance and long-term use of the paddocks for grazing livestock, and the patches of woodland provide minimal habitat. It is noted that there is more woodland habitat to the west of the Subject land, along Quarry Creek (Figure 4).

The mining activities would be undertaken over a short period (i.e. until 2030), after which the land would be subject to revegetation. Given this, and the current condition of the vegetation, it is unlikely that there would be measurable edge effects from the Modification that would reduce the viability of the adjacent habitat. The potential impact of noise, dust or light spill is discussed further below in Section 6.2.3. The potential impact of weeds is discussed in Section 6.2.4.

6.2.3 Reduced Viability of Adjacent Habitat Due to Noise, Dust or Light Spill

Noise, dust and light spill will occur temporarily during operations but will subside when HVEC cease mining at MAC in 2030. HVEC implement a number of measures to reduce noise, dust and light spill, as described in the Modification Report (HVEC, 2023).

The land adjacent to the Development Footprint comprises limited habitat as described in Section 6.2.2. Any incremental increase in noise, dust and light spill on the adjacent habitat as a result of the Modification is unlikely to significantly impact any local fauna populations, noting that the vegetation adjacent to the Development Footprint is mostly open derived native grassland.

6.2.4 Transport of Weeds and Pathogens from the Site to Adjacent Vegetation

Activities that could spread weeds during construction and operation include soil disturbance, vehicle movements and movement of soil. Disturbed areas (including those undergoing rehabilitation) provide a substrate in which weed species may grow.

The Subject land has been cleared historically and is mostly grazing land with derived native grassland. The area is quite weedy. A third of all plant species recorded by Hunter Eco (2023) (Attachment B) were weeds and six High Threat Exotic species were recorded (Galenia [*Galenia pubescens*], Fireweed [*Senecio madagascariensis*], Saffron Thistle [*Carthamus lanatus*], Common Prickly Pear [*Opuntia stricta*], African Boxthorn [*Lycium ferocissimum*] and Onion Grass (*Romulea rosea*]). Hunter Eco (2023) (Attachment B) describes that the average High Threat Exotic cover was 2.4% (range 0.1% to 20%) with the most abundant weed being Fireweed (*Senecio madagascariensis*).

State level determined priority weed species are set by the NSW DPI. The *Biosecurity Act 2015* and regulations provide specific legal requirements for state level priority weeds and high-risk activities. Regionally determined priority weed species are listed in the *Draft Hunter Regional Strategic Weed Management Plan 2023-2027* (Hunter Local Land Services, 2022) along with regional strategic responses. Galenia (*Galenia pubescens*), African Boxthorn (*Lycium ferocissimum*), Common Prickly Pear (*Opuntia stricta*) and Fireweed (*Senecio madagascariensis*) are priority species recorded by Hunter Eco (2023) (Attachment B).

The Modification is unlikely to increase the risk of weeds transporting from the site to adjacent vegetation given a weed control program is implemented at MAC (Section 7) and the minor nature of the Development Footprint compared to the existing/approved MAC.

The Modification does not involve activities that are likely to spread plant pathogens, and pathogens such as Myrtle Rust (*Austropuccinia psidii*) and *Phytophthora cinnamomi* are more likely to occur in wetter coastal areas.

The Modification would not be likely to increase the risk of disease or exotic pathogen (e.g. *Chlamydi*a spp. in Koalas, Beak and Feather Disease in Psittacine species, or the White-nosed Fungus in microbat species) transfer to native fauna species because animals relevant to the disease/pathogen are not likely to be encountered, the disease/pathogen is not likely to be spread through the activities proposed and/or interactions with potentially susceptible animals would be limited to pre-clearance activities and monitoring conducted by suitability qualitied people.

6.2.5 Increase in Pest Animal or Predatory Species Populations

Pest species recorded by Future Ecology (2023) (Attachment C) in the wider area include: House Mouse (*Mus musculus*), Black Rat (*Rattus rattus*), Dog (*Canis lupus familiaris*), Hybrid Dog (*Canis lupus/familiaris*), Fox (*Vulpes vulpes*), Cat (*Felis catus*), Brown Hare (*Lepus capensis*), Rabbit (*Oryctolagus cuniculus*), Pig (*Sus scrofa*), Common Starling (*Sturnus vulgaris*) and Common Myna (*Sturnus tristis*).

The Modification involves removal of potential habitat. The Modification is unlikely to result in an increase in pest animal populations or increase the populations of predatory species given feral animal control programs are implemented at MAC (Section 7), the minor nature of the Development Footprint compared to the existing/approved MAC and habitats would not become isolated or fragmented. Feral animal control programs would continue during mine rehabilitation.

6.2.6 Increased Risk of Fauna Starvation, Exposure and Loss of Shade or Shelter

Fauna present in the areas proposed to be cleared would be at risk of injury or fatality during clearance activities. The risk to fauna would be determined by the method of clearance, type of fauna present, amount of clearance, the presence of surrounding suitable habitat with the ability to accommodate displaced fauna, and the attendance during the clearance by a fauna handler to cater for injured fauna.

Pre-clearance surveys are conducted within all patches of forest and woodland to be cleared and threatened flora and fauna species detected are relocated into protected habitat. Planned disturbance areas are delineated prior to clearing activities, with restriction of clearing to the minimum area necessary to undertake the approved activities.

6.2.7 Groundwater Dependent Vegetation

SLR Consulting Australia (SLR) (2023) has completed a quantitative groundwater model of MAC, including the Modification. The modelling has been undertaken on a ‘with’ and ‘without’ the Modification basis to allow the incremental impact to be determined.

The main productive aquifer in the area is the Hunter alluvium, however SLR (2023) predicts no incremental drawdown impacts for the alluvium. The extent of maximum predicted incremental drawdown in the lower Permian aquifer extends only approximately 700 m to 1 km west of open cut pit (SLR, 2023).

SLR has also assembled desktop GDE mapping from various sources. The limited extent of predicted maximum incremental drawdown does not show any areas of potential GDEs which are expected to experience drawdowns as a result of the Modification (SLR, 2023).

6.2.8 Other Indirect Impacts

The Modification would not involve:

- indirect impacts that may inhibit nitrogen fixation or increase soil salinity to vegetation in the surrounds;
- potential fertiliser drift to habitat adjacent to the Development Footprint because fertiliser would be used in select areas for revegetation purposes directly applied and not via aerial means;
- rubbish dumping or related indirect impacts;
- the collection of wood from the surrounding native vegetation outside of the Development Footprint;
- the collection of bush rocks from the surrounding native vegetation outside of the Development Footprint;
- indirect impacts to specialist breeding and foraging habitat;
- trampling of threatened flora species as access tracks would be within the Development Footprint;
- adverse changes to hydrology that would impact threatened species;
- changes to the existing fire regime; and
- indirect loss of breeding habitat outside of the Development Footprint.

6.3 PRESCRIBED BIODIVERSITY IMPACTS

The Modification would not involve prescribed biodiversity impacts as described in Section 4.3.

6.4 STATE ENVIRONMENTAL PLANNING POLICY (BIODIVERSITY CONSERVATION)

The *State Environmental Planning Policy* (*Biodiversity and Conservation*) *2021* (Biodiversity and Conservation SEPP) began on 1 March 2022 and consolidates, transfers and repeals provisions of various SEPPs in NSW including the Koala Habitat Protection SEPP (2020 and 2021). The provisions within the repealed SEPPs have been transferred to the new Biodiversity and Conservation SEPP.

The land associated with the Subject Land is zoned RU1 Rural. Chapter 3 of the Biodiversity and Conservation SEPP (Koala Habitat Protection 2020) applies for all RU1, RU2 and RU3 zoned land outside of the Sydney Metropolitan Area and some LGAs of the Central Coast. The Muswellbrook LGA is included in the Central Coast Koala Management Area.

Under the Biodiversity and Conservation SEPP (Koala Habitat Protection 2020), potential koala habitat is defined as:

> *areas of native vegetation where trees of the types listed in Schedule 1 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.*

Under the Biodiversity and Conservation SEPP (Koala Habitat Protection 2020), core koala habitat is defined as:

> *core koala habitat means an area of land with a resident population of koalas, evidenced by attributes such as breeding females, being females with young, and recent sightings of and historical records of a population.*

White Box (*Eucalyptus albens*) and Grey Box (*Eucalyptus moluccana*) are listed as Koala use tree species in Schedule 3 of the Biodiversity and Conservation SEPP (Koala Habitat Protection, 2020), and it is likely that the hybrid White Box x Grey Box would also serve as a food tree (Attachment B). White Box x Grey Box constitutes at least 15% of the total number of trees in the upper or lower strata of the tree component of Vegetation Community 1 (PCT 483) and Vegetation Community 1a (PCT 483) and is therefore considered potential koala habitat, noting however that there are a small number of trees in the Subject land. No core koala habitat occurs in the Development Footprint as the Koala has not been recorded in the Subject land, despite targeted surveys.

Development controls within the Koala Habitat Protection SEPP 2020 do not apply to Part 4 development applications (such as the Modification) which are determined by a consent authority other than a local council. However, even if they were to apply, the Modification is not likely to impact Koalas given the potential habitat is degraded and there are no recent records of the Koala in the locality.

7 MEASURES TO MITIGATE AND MANAGE IMPACTS

The Modification does not represent any new types of potential impacts on biodiversity, but rather an incremental increase in the surface disturbance area in the location of the Subject land (however, an overall net reduction in the approved disturbance footprint) and continued activities. Given this, there is not a need for approved mitigation, management and monitoring measures in the approved *Biodiversity Management Plan* (BHP, 2019) to be changed specifically due to the biodiversity impacts from the Modification. The *Biodiversity Management Plan* (BHP, 2019) was approved by DPE and the Commonwealth Government.

The approved *Biodiversity Management Plan* (BHP, 2019) will be updated to reflect current requirements. For example, *Draft Hunter Regional Strategic Weed Management Plan 2023-2027* (Hunter Local Land Services, 2022) was released in 2022 and aims to prioritise the most important weeds in the region and guide management efforts reflecting the requirements of the NSW *Biosecurity Act 2015*. In addition, the recently published list of High Threat Weeds (weeds that, if not controlled, will invade and outcompete native plant species) would be considered in the revised *Biodiversity Management Plan*.

General biodiversity management measures outlined in the approved *Biodiversity Management Plan* (BHP, 2019) that are relevant to the Modification are described in Table 11. HVEC would continue to be responsible for implementing the measures.

Table 11
Existing Mitigation Measures at the Mt Arthur Coal Mine Relevant to the Modification

Type of Measure/Measure	Method/Technique	Timing	Frequency	Likely Efficacy
Rehabilitation				
Revegetation of the post-mine landforms	The rehabilitation strategy provides for areas for biodiversity outcomes (e.g. woodland corridors) and areas of pasture (the predominant previous site land use). Surface development areas associated with the MAC are progressively rehabilitated and revegetated with species characteristic of native species endemic to the local area. Monitoring is undertaken by suitability qualified people.	Closure	N/A	Moderate-high
Vegetation Clearance				
Pre-clearance surveys	A pre-clearance survey is undertaken by suitability qualified people where there is a significant risk to threatened species, hollow-bearing trees, other habitat trees (such as those containing nests or dreys), vegetation containing significant seed resources, hollow logs/stumps, fallen timber and boulders. The purpose of these inspections are to: • Minimise potential impacts from clearing of habitat trees on threatened fauna species; • Identify fauna within habitat trees and recommend management actions to minimise impact on these species; • Identify safety requirements through the completion of a risk assessment, where applicable; and • Identify habitat attributes for potential salvage (such as sizeable logs and salvaged tree hollows) and where practicable arrange for relocation. Habitat features (such as hollow bearing trees) suitable for salvage will be identified and marked in the field. They may then be reinstated in suitable areas or stockpiled.	During operations	As required	Moderate-high

Type of Measure/Measure	Method/Technique	Timing	Frequency	Likely Efficacy
Collecting and propagating seed	Seed present during land clearance activities are collected for use in plant propagation programmes to provide tube stock for revegetation activities.	During operations	As required	Moderate-high
Salvaging and reusing material from the site for habitat enhancement	Large woody debris deemed suitable for habitat enhancement are identified as part of pre-clearance and post-clearance and would be salvaged and re-used for habitat enhancement.	During operations	As required	Moderate-high
General Management				
Controlling weeds	A weed control program is implemented at MAC and typically includes: • an annual weed assessment across MAC which includes an update to site weed mapping and assesses weed risk setting the basis for weed control for the annual weed control program; • an annual weed control program across MAC targeted on a basis of risk; and • monitoring and inspections of areas to assess the effectiveness of the weed control program and to ascertain the requirement for further work.	During operations and closure	Ongoing	Moderate-high
Controlling feral pests	Feral animal control programs are completed at least annually. These programs typically consist of feral dog and fox baiting and trapping. This will include details of feral animal sightings, control actions and assess the effectiveness of these control strategies.	During operations and closure	Annually	Moderate-high
Bushfire management	A Bushfire Prevention Procedure has been prepared for MAC. The procedure prioritises the protection of life and property, along with the significant ecological features within MAC.	During operations and closure	Ongoing	Moderate-high

Modified source: BHP (2019)

In addition to the above, HVEC implement a number of other general measures to mitigate and manage other potential impacts from MAC, such as measures to manage erosion and sediment, dust, noise and lighting, as described in the Modification Report (HVEC, 2023).

8 IMPACT SUMMARY

8.1 SERIOUS AND IRREVERSIBLE IMPACTS

Under the BC Act, there is a small list of threatened species and communities that are considered by the NSW Government to be at risk of a Serious and Irreversible Impact (SAII). These species/ecological communities are named SAII entities. There are established principles and thresholds for impacts on SAII entities that are considered below, but the onus is on the approval authority to decide if an impact is serious and irreversible. Clause 6.7 of the BC Regulation provides principles for the purposes of determining whether an impact on diversity values is a SAII for the purposes of the Biodiversity Offsets Scheme. It states:

> *(2) An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because:*
>
> *(a) it will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or*
>
> *(b) it will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or*
>
> *(c) it is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or*
>
> *(d) the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.*
>
> *(3) For the purpose of this clause, a* decline *of a species or ecological community is a continuing or projected decline in:*
>
> *(a) an index of abundance appropriate to the taxon, or*
>
> *(b) the geographic distribution and habitat quality of the species or ecological community.*

There is one entity recorded on the Subject land that can be a 'potential SAII entity', namely the Box-Gum Woodland CEEC listed under the BC Act.

The Swift Parrot (*Lathamus discolor*), Regent Honeyeater (*Anthochaera phrygia*) and Large Bent-winged Bat (*Miniopterus orianae oceanensis*) are also recognised as 'potential SAII entities' and are included in Table 3 as these species are dual credit species. However, as described in Table 7, habitat constraints for these species do not occur within the Subject land and so these species would not be impacted by the Modification.

This section provides information regarding the impacts on the Box-Gum Woodland CEEC listed under the BC Act.

Actions and Measures Taken to Avoid the Direct and Indirect Impacts

Actions and measures taken to avoid the direct and indirect impact on the Box-Gum Woodland CEEC listed under the BC Act are described in Section 5.5.

Current Status of the Threatened Ecological Community

The BAM (DPIE, 2020a) requires the following information on the current status of the TEC to be provided:

a. evidence of reduction in geographic distribution (Principle 1, clause 6.7(2)(a) BC Regulation) as the current total geographic extent of the threatened ecological community in NSW AND the estimated reduction in geographic extent of the threatened ecological community since 1970 (not including impacts of the proposal)

b. extent of reduction in ecological function for the threatened ecological community 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

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

c. evidence of restricted geographic distribution (Principle 3, clause 6.7(2)(c) BC Regulation), based on the threatened ecological community's geographic range in NSW according to the:

i. extent of occurrence

ii. area of occupancy, and

iii. number of threat-defined locations

d. evidence that the threatened ecological community is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation).

This information is provided below.

A. Evidence of reduction in geographic distribution (Principle 1, clause 6.7(2)(a) BC Regulation) as the current total geographic extent of the threatened ecological community in NSW AND the estimated reduction in geographic extent of the threatened ecological community since 1970 (not including impacts of the proposal)

The *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) lists the Box-Gum Woodland CEEC listed under the BC Act as an SAII entity based on Principle 1 Population reduction of >=80% in 10 years or three generations.

The *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) does not list the total geographic extent of the TEC in NSW and the estimated reduction in geographic extent of the TEC since 1970. There is no precise information available on the reduction in geographic extent of the TEC since 1970. The Threatened Species Scientific Committee (TSSC) (2020) describes Box-Gum Woodland CEEC as having undergone at least a 90% reduction in geographic distribution as a consequence of extensive clearing throughout its range.

B. extent of reduction in ecological function for the threatened ecological community 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

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

The *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) lists the Box-Gum Woodland CEEC as an SAII entity based on Principle 2 <50 individuals or <250 individuals where threats are known. DPE (pers. comm., August 2023) clarified:

> *'that the information currently in BioNet for Principle 2 is relevant for SAII listed species, not threatened ecological communities. The application of Principle 2 for TECs should specify 'communities with very high levels of either environmental degradation or disruption of biotic processors, and interactions have an increased risk of failure to sustain their characteristic native species assemblages. The criteria for this is ≥90% extent and severity where the disruption or impacts are measured since 1970 or (ii) ≥80% extent and severity where the disruption or impacts are over a 50-year period, either in the past, future, or any part of the past, present and future (as per Bland et al. 2016)'.*

The Box-Gum Woodland CEEC has undergone a reduction as described in TSSC (2020).

C. evidence of restricted geographic distribution (Principle 3, clause 6.7(2)(c) BC Regulation), based on the threatened ecological community's geographic range in NSW according to the:

i. extent of occurrence
ii. area of occupancy, and
iii. number of threat-defined locations

The *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) does not list the Box-Gum Woodland CEEC as an SAII entity based on Principle 3. The Box-Gum Woodland CEEC listed under the BC Act 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 (TSSC, 2020).

i. extent of occurrence

Extent of occurrence is defined as *'the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy'* (IUCN Species Survival Commission, 2012). The *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) does not list the extent of occurrence for the Box-Gum Woodland CEEC. The TSSC (2020) states the extent of occurrence for the community is 702,800 square kilometres.

ii. area of occupancy

Area of occupancy is defined as *'the area within its 'extent of occurrence' which is occupied by a taxon, excluding cases of vagrancy'* (IUCN Species Survival Commission, 2012). The *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) does not list the area of occupancy for the Box-Gum Woodland CEEC. The TSSC (2020) states the area of occupancy for the community is 151,100 km^2.

iii. number of threat-defined locations

The *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) does not list the number of threat-defined locations.

D. evidence that the threatened ecological community is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation).

The *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) does not list the Box-Gum Woodland CEEC as an SAII entity based on Principle 4. There is evidence that the Box-Gum Woodland CEEC will respond to management (e.g. Rawlings, *et al.,* 2010).

Impacts on the Threatened Ecological Community

In relation to the impacts from the Modification on the threatened ecological community, the BAM (DPIE, 2020a) requires the BDAR to include data and information on:

a. the impact on the geographic extent of the threatened ecological community (Principles 1 and 3) by estimating the total area of the threatened ecological community to be impacted by the proposal:

i. in hectares, and

ii. as a percentage of the current geographic extent of the threatened ecological community in NSW.

Data and information should include direct impacts (i.e. from clearing) and indirect impacts where partial loss of the threatened ecological community 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 threatened ecological community

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 threatened ecological community by:

i. estimating the size of any remaining, but now isolated, areas of the threatened ecological community; including areas of the threatened ecological community 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 threatened ecological community, 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 threatened ecological community, and*
- *other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the threatened ecological community as a result of the development*

iii. describing the condition of the threatened ecological community 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.

This information is provided below.

a. the impact on the geographic extent of the threatened ecological community (Principles 1 and 3) by estimating the total area of the threatened ecological community to be impacted by the proposal:

i. in hectares, and

ii. as a percentage of the current geographic extent of the threatened ecological community in NSW.

The Modification would result in the loss of approximately 0.3 ha of woodland and 22.5 ha of derived native grassland equivalent to the Box-Gum Woodland CEEC listed under the BC Act. The Modification would not change the extent of occurrence of the Box-Gum Woodland CEEC and the change in the area of occupancy is 0.00015% based on the area of occupancy in TSSC (2020).

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 threatened ecological community by:

i. estimating the size of any remaining, but now isolated, areas of the threatened ecological community; including areas of the threatened ecological community 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 threatened ecological community, 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 threatened ecological community, and***
- ***other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the threatened ecological community as a result of the development***

iii. describing the condition of the threatened ecological community according to the vegetation integrity score for the relevant vegetation zone(s). The assessor must also include the relevant composition, structure and function condition scores for each vegetation zone.

The Modification would result in the loss of approximately 0.3 ha of woodland and 22.5 ha of derived native grassland equivalent to the Box-Gum Woodland CEEC listed under the BC Act (Figure 8).

There would be no Box-Gum Woodland CEEC listed under the BC Act that would become isolated as a result of the Modification because the Development Footprint is an extension of the existing/approved surface disturbance area.

Hunter Eco (2023) (Attachment B) mapped approximately 138 ha of the derived native grassland form of Box-Gum Woodland CEEC listed under the BC Act within 500 m of the Development Footprint.

The Modification would have no impact on the connectivity and fragmentation of the remaining areas of Box-Gum Woodland CEEC in the local area, as the remaining areas that adjoin to the Development Footprint would remain connected (not isolated). An estimate maximum dispersal distance for native flora species characteristic of the TEC is therefore not relevant. The area to perimeter ratio for remaining areas of the TEC is unknown, as the patch extents past the study extent.

The Box-Gum Woodland CEEC in the Development Footprint is not a good example of the community as the woodland has been heavily fragmented by past clearing (Figure 8) and as a result it consists of a number of small patches (totalling 0.3 ha) that are isolated. The derived native grassland component of the community (approximately 22.5 ha) is in sub-optimal condition (VI score of 36.6 out of a possible 100) due to the past clearance and long-term use of the paddocks for grazing livestock. Hunter Eco (2023) (Attachment B) notes that the area studied is weedy and one third of all plant species recorded were weeds (30 weed species including six High Threat Exotic species). Plates 1 and 2 show the occurrences of the Box-Gum Woodland CEEC listed under the BC Act.

The VI scores (and composition, structure and function condition scores) for the vegetation zones relevant to the Box-Gum Woodland CEEC listed under the BC Act (Vegetation Zones 1 and 1a) are presented in Table 2.

Conclusion

As described above, the onus is on the approval authority to decide if an impact is serious and irreversible. Key points above are:

- The Modification would result in the loss of approximately 0.3 ha of woodland and 22.5 ha of derived native grassland equivalent to the Box-Gum Woodland CEEC listed under the BC Act.
- The Modification would not change the extent of occurrence of the Box-Gum Woodland CEEC (because the extent of occurrence of the Box-Gum Woodland CEEC encompasses the wider occurrence of the community in NSW) and the change in the area of occupancy is 0.00015% based on the area of occupancy in TSSC (2020).
- The Box-Gum Woodland CEEC in the Development Footprint is not a good example of the community as the woodland has been heavily fragmented by past clearing and as a result it consists of a number of small patches (totalling 0.3 ha) that are isolated.
- The derived native grassland component of the community (approximately 22.5 ha) is in sub-optimal condition (VI score of 36.6 out of a possible 100) due to the past clearance and long-term use of the paddocks for grazing livestock.

As a result of running the BAM Credit Calculator, the Modification requires a total of 529 ecosystem credits for clearance of Box-Gum Woodland CEEC listed under the BC Act (Section 8.2).

8.2 RESIDUAL IMPACTS ON NATIVE VEGETATION (ECOSYSTEM CREDITS)

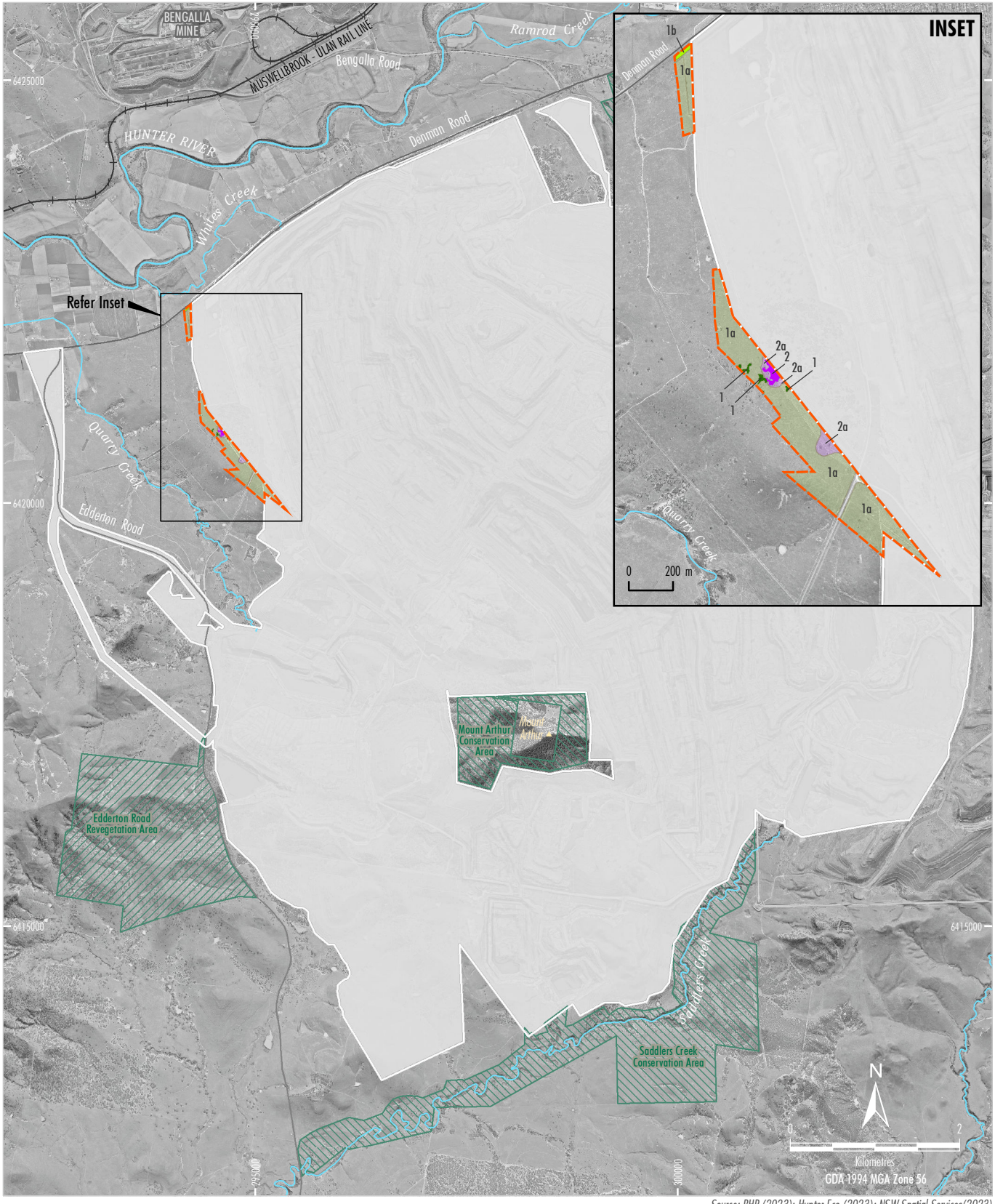
Figure 16 shows areas requiring offset and Figure 17 shows areas not requiring assessment or offset. Table 12 provides the ecosystem credit requirements from the credit report (Attachment F). The like-for-like credits are required to be in the Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong, Yengo or any IBRA subregion that is within 100 km of the outer edge of the impacted site (Attachment G). The variation report is provided in Attachment H.

Table 12
Development Footprint Ecosystem Credit Requirement

Veg Zone	Vegetation Community (Hunter Eco, 2023) (Attachment B)	Credit Requirements (Attachment G)					
		PCT ID	Biodiversity Risk Weighting	Like-for-like PCTs	Trading Group	Hollow-bearing Trees	Ecosystem Credit Requirement
1	Grey Box x White Box Grassy Woodland[A]	PCT 483 *Grey Box x White Box Grassy Open Woodland on Basalt Hills in the Merriwa Region, Upper Hunter Valley*	2.5	74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373, 3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Yes	15
1a	Derived Native Grassland[A]					No	514
1b	Plantation					No	7
2	Slaty Box Woodland[B]	PCT 1655 *Grey Box - Slaty Box shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin*	1.75	1176, 1655, 3490	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	Yes	12
2a	Derived Native Grassland					Yes	18
						Total	**566**

[A] Equivalent to the Box-Gum Woodland CEEC listed under the BC Act

[B] Equivalent to the Slaty Gum Woodland VEC listed under the BC Act



Source: BHP (2023); Hunter Eco (2023); NSW Spatial Services(2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)

Areas Requiring Offset

- 1. Grey Box x White Box Grassy Woodland (PCT 483) [1]
- 1a. Grey Box x White Box Grassy DNG (PCT 483) [1]
- 1b. Plantation (PCT 483)
- 2. Slaty Box Woodland (PCT 1655) [2]
- 2a. Slaty Box (DNG) (PCT 1655)

[1] Equivalent to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the BC Act (and EPBC Act)

[2] Equivalent to the Hunter Valley Footslopes Slaty Gum Woodland listed under the BC Act and the Central Hunter Valley Eucalypt Forest and Woodland CEEC listed under the EPBC Act

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BHP

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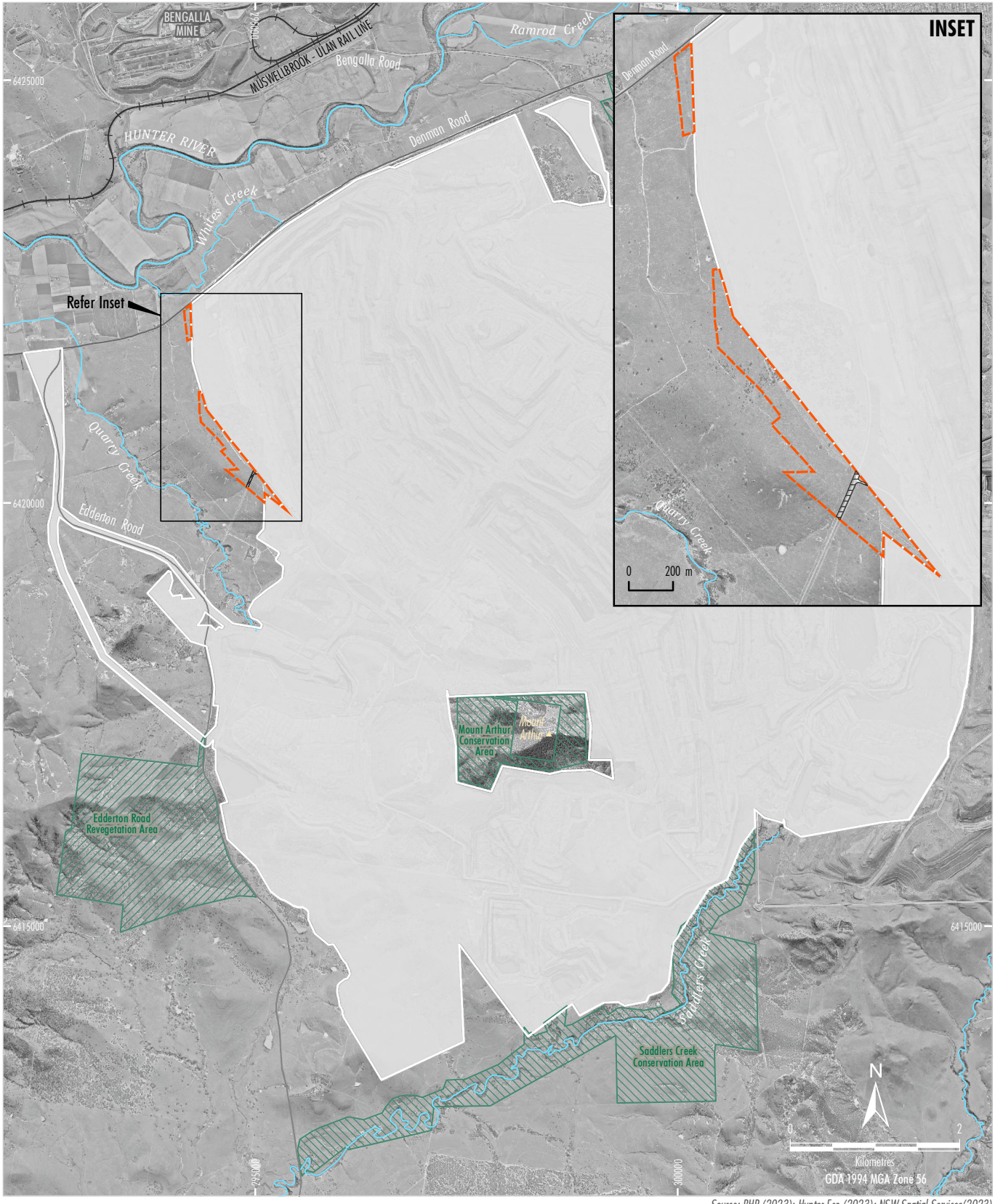
Areas Requiring Offset

Figure 16



HVE-19-09 MOD2_BOAR_219A

Source: BHP (2023); Hunter Eco (2023); NSW Spatial Services(2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND
- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Subject Land (Development Footprint)

Areas Not Requiring Assessment or Offset
- Cleared Land

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Areas Not Requiring Assessment or Offset

Figure 17

8.3 RESIDUAL IMPACTS ON THREATENED SPECIES (SPECIES CREDITS)

No species credit species were confirmed to be present or likely to use the habitat in the Subject land.

As described in Section 4.2.5, *Delma vescolineata* (that was previously thought to be *Delma impar*) has only recently been identified as a separate species by Mahony *et. al.* (2022), and in time, it could also potentially be listed as a threatened species under the BC Act. On this basis, HVEC is prepared to provide biodiversity offsets for *Delma vescolineata* should it be listed under the BC Act in the 12 months following determination of the Modification.

To account for the fact that the new species has only recently been identified and there is uncertainty as to whether the new species will be listed under the BC Act (and the Biodiversity Risk Weighting if listed), possible credit values are listed in Table 9.

9 CONCLUSION

The Subject land is on the edge of the existing/approved surface disturbance area. It has been cleared historically and is mostly former cattle grazing land with derived native grassland with some heavily fragmented scattered and clumped trees. The extant vegetation is recognised as Box-Gum Woodland CEEC listed under the BC Act and Slaty Gum Woodland VEC listed under the BC Act.

The Modification would require the removal of approximately 24.6 ha of native vegetation, comprising mostly derived grasslands (23.7 ha), woodland (0.7 ha) and planted trees (0.2 ha). There are no prescribed biodiversity impacts relevant to the Modification.

Many of the species that can be associated with the PCTs in the Subject land are not likely to occur because the habitat is too degraded. No species credit species were confirmed to be present or likely to use the habitat in the Subject land.

The Modification does not result in any new types of potential impacts on biodiversity, but rather an incremental increase in the surface disturbance area in the location of the Subject land (however, an overall net reduction in the approved disturbance footprint) and continued activities. Given this, there is not a need for approved mitigation, management and monitoring measures in the approved Biodiversity Management Plan to be changed specifically due to the Modification.

General biodiversity management measures outlined in the approved Biodiversity Management Plan that are relevant to the Modification include revegetation of the post-mine landforms, pre-clearance surveys, collecting and propagating seed, salvaging and reusing material from the site for habitat enhancement, controlling weeds, controlling feral pests and bushfire management.

As a result of running the BAM Credit Calculator, the Modification requires a total of 566 ecosystem credits for clearance within the Development Footprint. HVEC is cognisant that the new species of legless lizard (*Delma vescolineata*) has only recently been identified as a separate species, and in time, it could also potentially be listed as a threatened species under the BC Act. On this basis, HVEC is prepared to provide biodiversity offsets for *Delma vescolineata* should it be listed under the BC Act in the 12 months following determination of the Modification.

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ATTACHMENT A

PEER REVIEW LETTER

Manager Approvals, Land, Access and Heritage
NSW Energy Coal
BHP

Attention: Sarah Bailey

21 September 2023

Dear Sarah

Peer Review of Mt Arthur Coal Mine Modification 2
Biodiversity Development Assessment Report

At the request of Resource Strategies Pty Ltd I have conducted a review of the Mt Arthur Coal Mine Modification 2 Biodiversity Development Assessment Report (BDAR).

I hold Biodiversity Assessment Method (BAM) assessor accreditation (BAAS 17004) as provided for under the NSW *Biodiversity Conservation Act 2016* (BC Act). The aim of the review was to ensure that the report provided the relevant information and data as required by the BAM 2020.

In reviewing the BDAR, I aimed to ensure that it met the BAM guidelines for assessing the impact of the Modification on threatened biodiversity. As well as assessing that it accurately reflected the findings of the baseline flora (including attached threatened flora report) and fauna reports.

Corrections and suggestions were made over three drafts, these comments/ corrections have been incorporated to my satisfaction and I consider that the BDAR comprehensively addresses the requirement of the BAM.

Disclosure: I prepared the Flora Baseline Report for the Modification which included providing Vegetation Integrity plot data for input by others into the BAM Calculator. This did not conflict with my role as an independent reviewer as I had no direct involvement in the preparation of the BDAR.

Yours Faithfully
HUNTER ECO

Colin Driscoll

Dr Colin Driscoll
Environmental Biologist

HUNTER ECO · ABN 25 112 984 240
PO Box 59, Wangi Wangi, NSW 2267 **M** 0438 773 029 **E** cd_enviro@bigpond.com

ATTACHMENT B

MT ARTHUR MINE MODIFICATION 2 – FLORA SURVEY REPORT

MT ARTHUR COAL MINE MODIFICATION 2

FLORA SURVEY REPORT

Prepared by
Dr Colin Driscoll

August 2023

HUNTER ECO · ABN 25 112 984 240
PO Box 59, Wangi Wangi, NSW 2267 **M** 0438 773 029 **E** cd_enviro@bigpond.com

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EXECUTIVE SUMMARY

The Mt Arthur Coal Mine is an open cut coal mining operation situated approximately 5 kilometres (km) south-west of Muswellbrook in the Muswellbrook Local Government Area in the Upper Hunter Valley of New South Wales (NSW) (Figure 1). The Mt Arthur Coal Mine is owned and operated by Hunter Valley Energy Coal Pty Ltd (HVEC), a wholly owned subsidiary of BHP.

The Mt Arthur Coal Mine is currently approved to operate until 30 June 2026, in accordance with Project Approval MP 09_0062 (MP 09_0062). In June 2022, HVEC announced a decision to cease mining at the Mt Arthur Coal Mine in 2030, as part of a responsible plan to provide a pathway to closure of the operation. Accordingly, HVEC is seeking a modification of MP 09_0062 for a four-year extension of the Mt Arthur Coal Mine to 30 June 2030.

HVEC is seeking to modify MP 09_0062 under section 4.55(2) of the NSW *Environmental Planning & Assessment Act 1979*, and will include the following activities:

- four-year extension of mining activities to 30 June 2030;
- reduction in the approved open cut mining rate from 32 Million tonnes per annum (Mtpa) Run-of-Mine (ROM) to a maximum of 25 Mtpa ROM (similar to current actual ROM coal production);
- reduction in the cumulative open cut and underground ROM coal handling rate from 36 Mtpa to 29 Mtpa;
- reduction in maximum total (open cut and underground) coal rail transportation from 27 Mtpa of product coal to 20 Mtpa, and a reduction in train movements from 30 to 20 movements per day;
- minor extension of the approved disturbance area in the north-west corner of the operation predominantly to allow for access and ancillary infrastructure (refer to Modification New Disturbance Area within Figure 2);
- an overall reduction in approved disturbance, as some previously approved areas are no longer intended to be disturbed (refer to Impact Minimisation Area within Figure 2); and
- revised final landform and final void configuration, including an overall reduction in the approved height of the northern overburden emplacement areas and the final landform (to reflect the current actual height).

This is a baseline report of the flora and vegetation communities across a Study Area encompassing surface works associated with the Modification.

The objectives of this report were to:

- document plant species growing across the Study Area by drawing on the results of all past surveys and augmenting this information with that from contemporary surveys;
- classify and map the distribution of vegetation communities across the Study Area; and
- target species, communities and populations listed as threatened either in the NSW *Biodiversity Conservation Act, 2016* (BC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act).

The surveys were conducted according to the methods and requirements of all relevant NSW and Commonwealth guidelines.

The land within, and surrounding, the Study Area is predominately used for agricultural and industrial activities, comprising grazing and coal mining. The current dominant land uses within, and adjacent to, the Study Area include open cut coal mining, power generation and industrial activities, agriculture, and residential development. Agriculture has occurred in the area since the Muswellbrook region was first inhabited by European settlers in 1824, creating large areas of grassland interspersed with small woodland remnants.

There are no major drainage lines given that the Study Area is located along a ridge line. Elevation is undulating, falling from 232 metres (m) Australian Height Datum (AHD) at the southern end to 132 m AHD at the northern end.

Two vegetation communities were mapped across the Study Area with both of these communities present in remnant vegetation form and derived native grassland form. For the derived native grassland, scattered paddock tree species indicated the likely community that had been cleared.

For each of the vegetation communities, floristic content was compared with that listed in the various Scientific Committee Determinations and related advice to identify any threatened ecological communities listed under the BC Act and the EPBC Act. The threatened communities found to be present are listed in Table ES-1.

Table ES-1 Threatened Ecological Communities Recorded across the Study Area

Threatened Ecological Community	Conservation Status
Threatened Ecological Communities listed under the BC Act	
White-Box Yellow Box-Blakely's Red Gum Woodland	CE
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	V
Threatened Ecological Communities listed under the EPBC Act	
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE
Central Hunter Valley Eucalypt Forest and Woodland	CE

V = Vulnerable, E = Endangered, CE = Critically Endangered.

The only tree species indicative of threatened Box-Gum woodland was the *Eucalyptus albens* x *Eucalyptus moluccana* (White Box x Grey Box) hybrid. These trees were present in fragmented woodland clusters and scattered paddock trees. The study area is weedy and one third of all plant species recorded were weeds (39 weed species including seven High Threat Exotic (HTE) species). The average HTE cover was 2.4% (range 0.1% to 20%) with the most abundant weed being Fireweed (*Senecio madagascariensis*). The average weed cover excluding HTE was 0.7% (range 0.1% to 25%) with the most abundant weed being Purpletop (*Verbena bonariensis*).

Detailed targeted transect searches did not locate any threatened flora species.

1 INTRODUCTION

This flora survey report forms part of a Modification Report which has been prepared to accompany an application to modify Project Approval MP 09_0062 (MP 09_0062) under section 4.55(2) of the *Environmental Planning & Assessment Act 1979* (EP&A Act). The flora survey was conducted across a wider Study Area surrounding the Disturbance Area.

1.1 PROJECT OVERVIEW

Mt Arthur Coal Mine is an open cut coal mining operation situated approximately 5 kilometres (km) south-west of Muswellbrook in the Muswellbrook Local Government Area (LGA) in the Upper Hunter Valley of New South Wales (NSW) (Figure 1). Mt Arthur Coal Mine is owned and operated by Hunter Valley Energy Coal Pty Ltd (HVEC), a wholly owned subsidiary of BHP.

The Mt Arthur Coal Mine is currently approved to operate until 30 June 2026, in accordance with MP 09_0062. In June 2022, HVEC announced a decision to cease mining activities at the Mt Arthur Coal Mine in 2030, as part of a plan to provide a pathway to closure of the operation. Accordingly, HVEC is seeking a modification of MP 09_0062 for a four-year extension of the Mt Arthur Coal Mine to 30 June 2030.

1.2 MODIFICATION DESCRIPTION

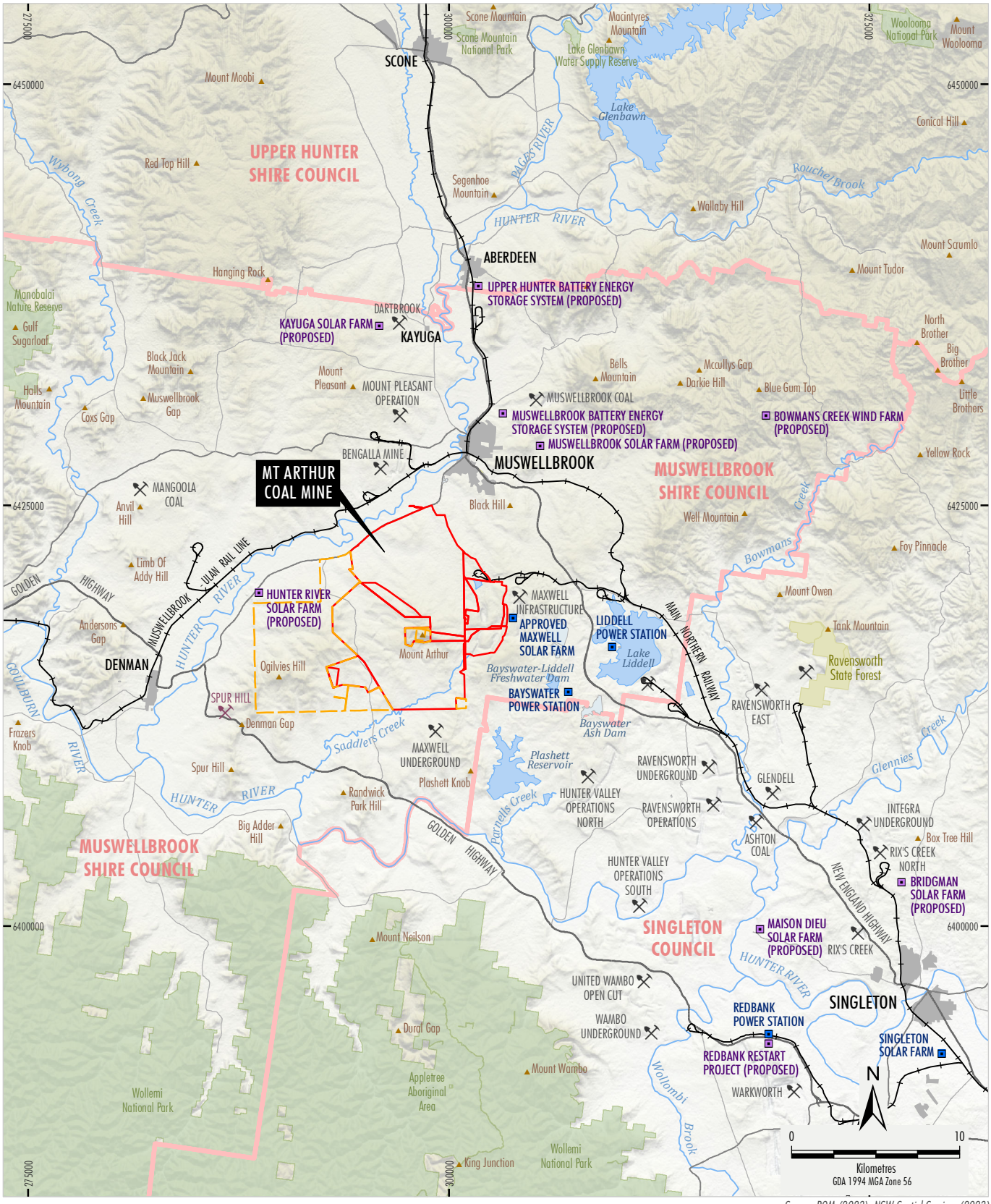
HVEC is seeking to modify MP 09_0062 under section 4.55(2) of the EP&A Act, and will include the following activities:

- four-year extension of mining activities to 30 June 2030;
- reduction in the approved open cut mining rate from 32 Million tonnes per annum (Mtpa) Run-of-Mine (ROM) to a maximum of 25 Mtpa ROM (similar to current actual ROM coal production);
- reduction in the cumulative open cut and underground ROM coal handling rate from 36 Mtpa to 29 Mtpa;
- reduction in maximum total (open cut and underground) coal rail transportation from 27 Mtpa of product coal to 20 Mtpa, and a reduction in train movements from 30 to 20 movements per day;
- minor extension of the approved disturbance area in the north-west corner of the operation predominantly to allow for access and ancillary infrastructure (refer to Modification New Disturbance Area within Figure 2);
- an overall reduction in approved disturbance, as some previously approved areas are no longer intended to be disturbed (refer to Impact Minimisation Area within Figure 2); and
- revised final landform and final void configuration, including an overall reduction in the approved height of the northern overburden emplacement areas and the final landform (to reflect the current actual height).

The Modification General Arrangement is shown on Figure 2.

The Modification would involve no change to:

- existing mining tenements;
- existing coarse rejects and tailings management;
- existing workforce;
- the existing mining method of conventional open cut mining; and
- the existing hours of operation and associated activities (undertaken 24-hours per day, seven days a week).



Source: BOM (2023); NSW Spatial Services (2023)

LEGEND

- State Forest
- National Parks and Wildlife Estate
- Local Government Area
- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Mining Operation
- Proposed Mining Operations (Application Lodged)
- Existing/Approved Energy Generation Site
- Proposed Energy Generation Site

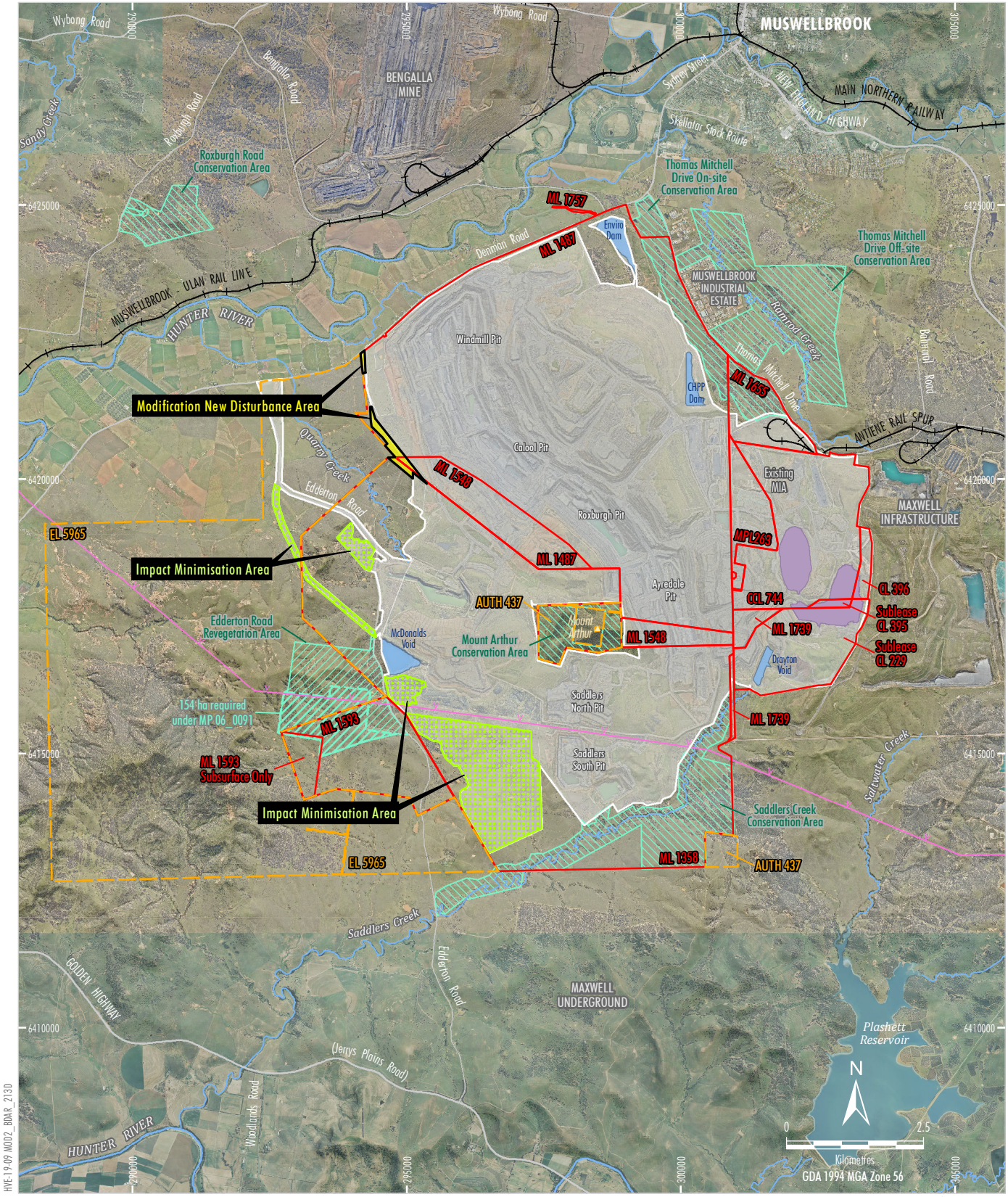
BHP

MT ARTHUR COAL MINE MODIFICATION 2

Regional Location

Figure 1

HVE-19-09 MOD2_BDAR_209C



HVE-19-09 MOD2_BBAR_213D

Source: BHP (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: BHP (2022-2020)

LEGEND

- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Existing 500kV Electricity Transmission Line
- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Tailings Storage Facility
- Water Storage
- Modification New Disturbance Area
- Impact Minimisation Area

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Modification General Arrangement

Figure 2

2 OBJECTIVES, GUIDELINES AND SOURCES

The objectives of this report are to:

- document plant species growing across the Study Area by drawing on the results of all past surveys, augmenting this information with that from current surveys; and
- classify and map the distribution of vegetation communities, Plant Community Types (PCTs) and threatened communities listed under the *NSW Biodiversity Conservation Act*, 2016 (BC Act) and/or the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Matthew Bailey (Bolwarra) undertook target surveys for threatened species and populations listed under the BC Act and EPBC Act (Attachment A).

The following methods, guidelines and policies were consulted in the methodology of this study:

- *Biodiversity Assessment Method 2020* (BAM) (Department of Planning, Industry and Environment [DPIE], 2020);
- *Biodiversity Assessment Method 2020 Operational Manual Stage 1* (DPIE 2022);
- *Biodiversity Assessment Method 2020 Operational Manual Stage 2* (DPIE 2019a);
- *Biodiversity Assessment Method 2020 Operational Manual Stage 3* (DPIE 2020a);
- *Surveying Threatened Plants and their Habitats*: *NSW Survey Guide for the Biodiversity Assessment Method* (DPIE, 2020b); and
- *Koala (Phascolarctos cinereus) Biodiversity Assessment Method Survey Guide* (Department of Planning and Environment [DPE] 2022a).

Threatened species and communities, habitat and distribution data were drawn from:

- BioNet Atlas (DPE 2022b);
- BioNet Threatened Biodiversity Data Collection (DPE 2023a);
- BioNet Vegetation Classification (DPE 2023b);
- Commonwealth Species Profile and Threats Database (SPRAT) (Department of Climate Change, Energy, the Environment and Water [DCCEEW] 2023a);
- Atlas of Living Australia (ALA) (ALA 2022); and
- Probable Vegetation Groundwater Dependent Ecosystems - Hunter / Central Rivers (DPE 2022c).

3 REGIONAL SETTING

The Study Area is located approximately 5 km south east of Muswellbrook in the central Hunter Valley and is located in the:

- Hunter Local Land Services area;
- Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion, Hunter sub-region;
- Central Western Slopes Botanical Division; and
- Muswellbrook LGA.

4 DESCRIPTION OF THE STUDY AREA AND SURROUNDS

4.1 LAND USE HISTORY

The land within, and surrounding, the Study Area is predominately used for agricultural and industrial activities, comprising grazing and coal mining. The current dominant land uses within, and adjacent to, the Study Area include open cut coal mining, power generation and industrial activities, agriculture, and residential development. Agriculture has occurred in the area since the Muswellbrook region was first inhabited by European settlers in 1824, creating large areas of grassland interspersed with small woodland remnants.

4.2 MITCHELL LANDSCAPES

Mitchell Landscapes are mapped regions of NSW that collate areas having common attributes including an estimate of the amount cleared since 1750 (Eco Logical Australia, 2008; DPE, 2017; Mitchell, 2002). Details of the Mitchell Landscapes within the Study Area are provided in Table 1.

Table 1 Mitchell Landscapes in the Study Area

Landscape Name	Percentage Cleared Estimate (%)	Percentage of Study Area Covered by Landscape (%)
Central Hunter Foothills	75	97
Upper Hunter Channels and Floodplains	90	3

4.3 TOPOGRAPHY AND DRAINAGE

Figure 3 shows the Study Area in the local context of topography and drainage. There are no major drainage lines given that the Study Area is located along a ridge line. Elevation is undulating, falling from 232 m Australian Height Datum (AHD) at the southern end to 132 m AHD at the northern end.

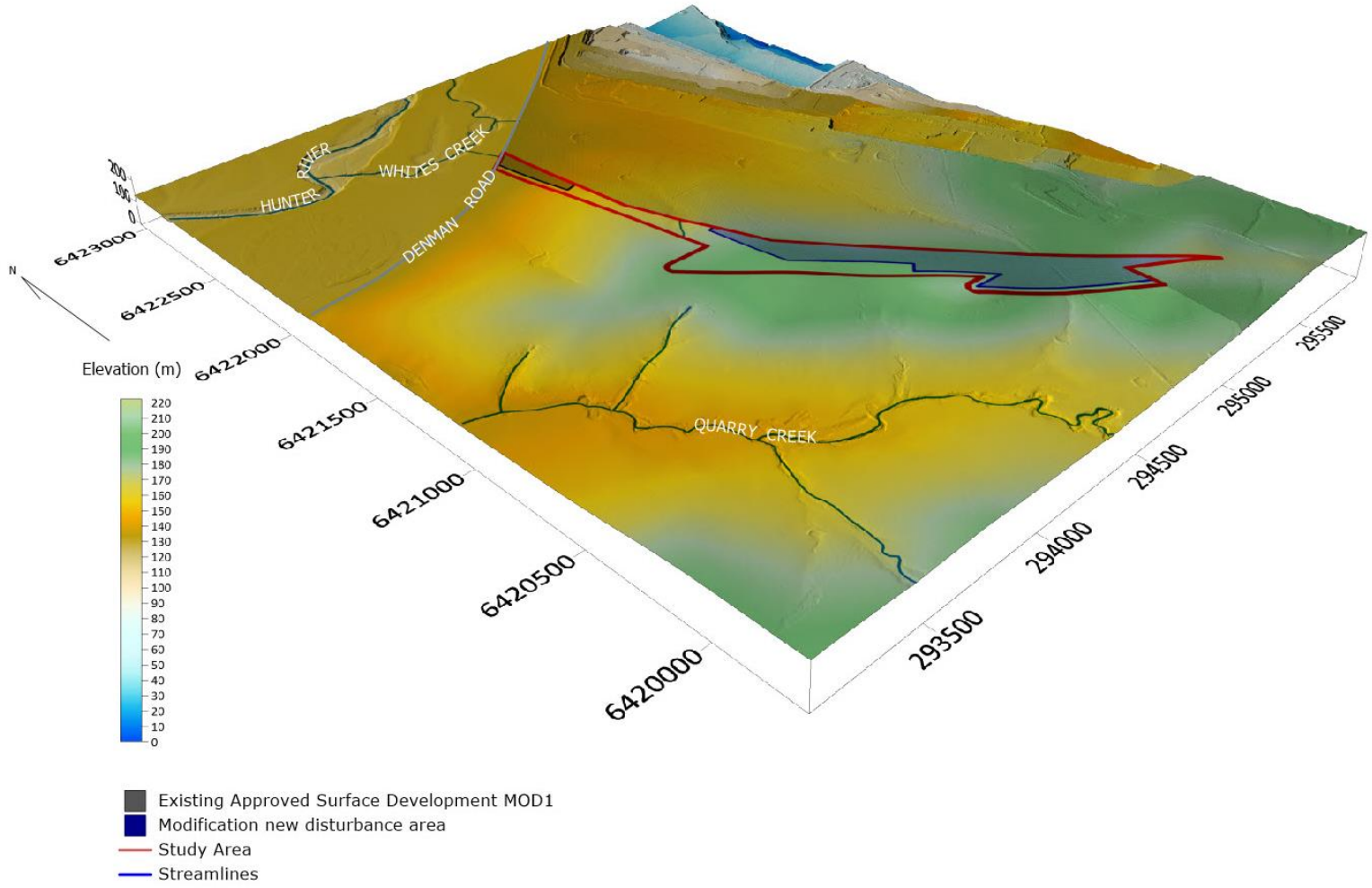


Figure 3 Topography and Drainage across the Study Area and Surrounds

4.4 GEOLOGY AND SOILS

Geology across the Study Area was sourced from the *New South Wales Seamless Geology dataset, single layer, version 2.2* (Colquhoun *et al* 2022). The Study Area lies entirely over Permian sandstone geology.

An Agricultural Impact Statement was undertaken by HVEC (2013) for Modification 1. As part of the Agricultural Impact Statement, a desktop study and soil survey conducted by GSS Environmental (2012) to characterise and assess the soils in the Modification 1 Study Area. GSS Environmental (2012) identified that the north-western extent of the Modification 1 Study Area (immediate east of the Modification 2 Study Area) primarily consisted of sodosols, and smaller portions of chromosols. Soils across the Study Area were also reviewed against the Australian Soil Classification (ASC) Soil Type map of NSW (DPIE 2021), whereby the entire Study Area comprises of Sodosols.

Sodosols generally have low agricultural potential due to high sodicity and low chemical fertility.

4.5 CLIMATE

Long-term rainfall data were sourced from a Bureau of Meteorology (BoM) Muswellbrook (Lindisfarne) Station 61168 (Figure 4). The Muswellbrook area experiences a temperate climate with an average annual rainfall of approximately 604 millimetres (mm) (BoM 2023), with January being the highest rainfall month at 78 mm. The months with the least rainfall are July and August both with 30 mm. Seasonally the highest rainfall months are from late Spring to early Autumn averaging approximately 63 mm per month and the lowest from late Autumn to early Spring averaging approximately 36 mm per month.

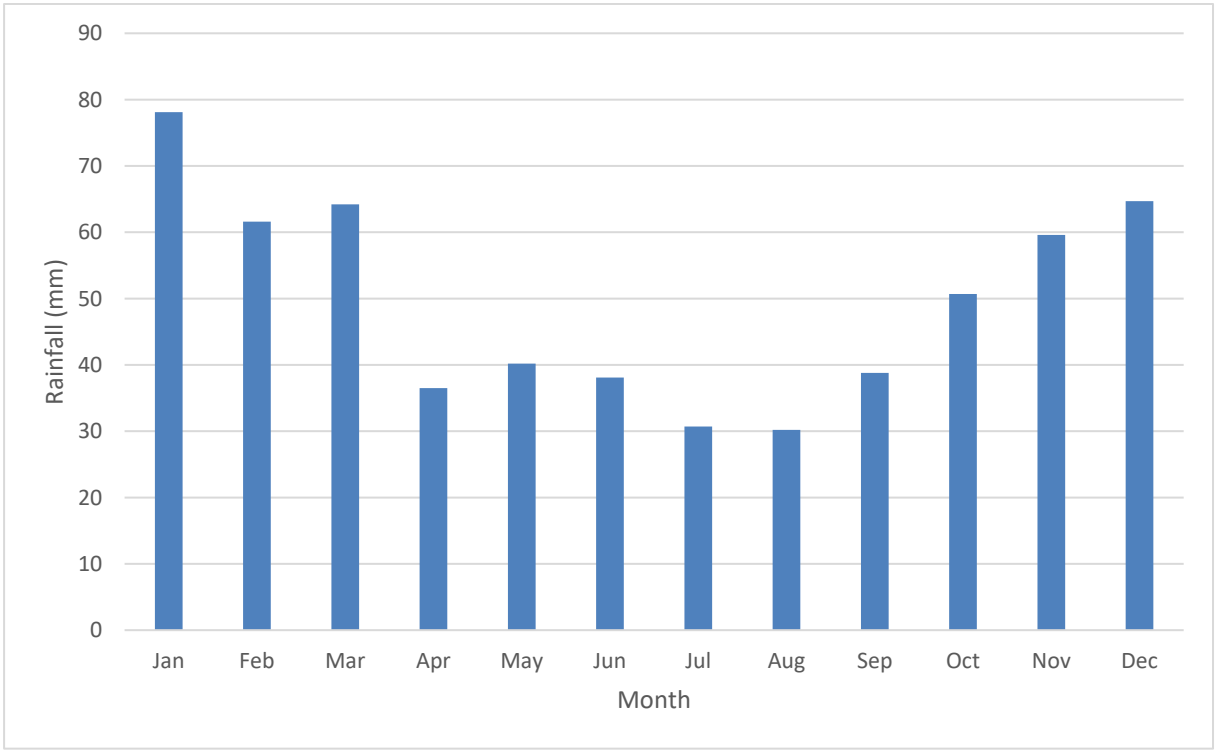


Figure 4 Monthly Average Rainfall Records from Bureau of Meteorology Muswellbrook (Lindisfarne) Station 61168

The nearest available long-term temperature data (Figure 5) were from Scone Airport (Station 61363) indicating that the warmest month is January with a mean maximum of 31.8 degrees Celsius (°C). The coldest month is July with a mean minimum of 3.4 °C.

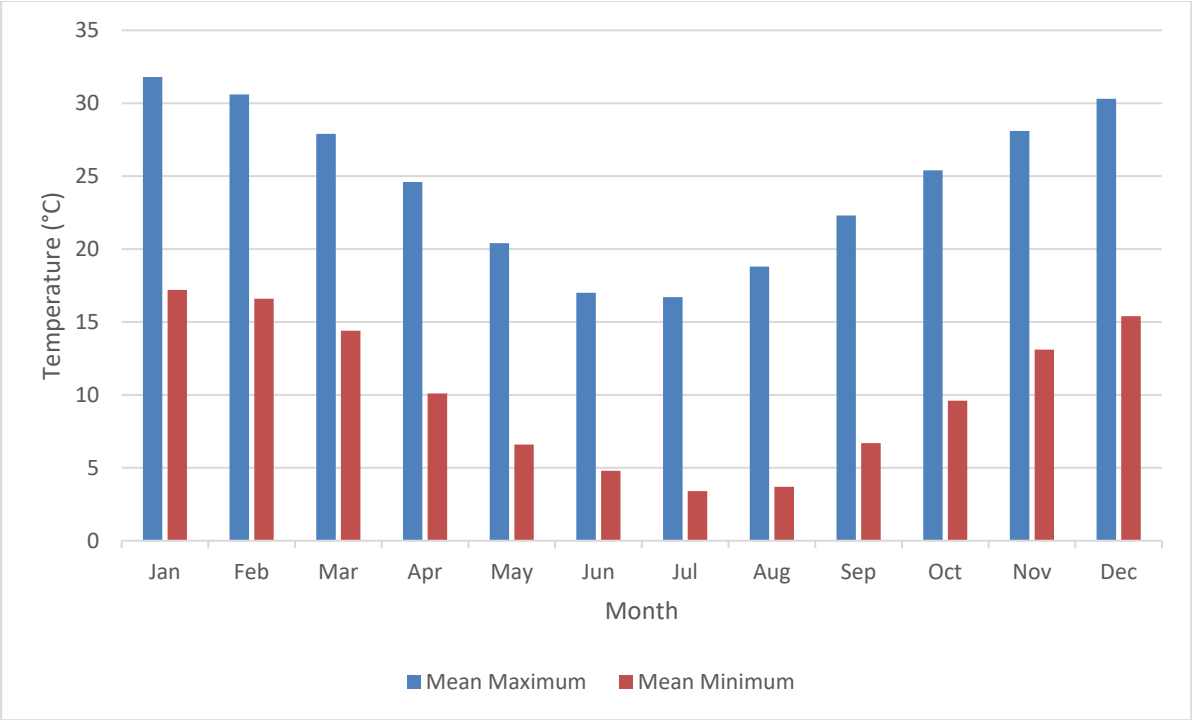


Figure 5 Monthly Average Minimum and Maximum Temperature Records from Scone Airport (Station 61363)

4.6 FIRE HISTORY

Fire data were extracted from *NPWS Fire History – Wildfires and Prescribed Burns* (DPE 2022d) which shows that a wildfire affected the southern end of the Study Area over the period from 29 December 2005 to 4 January 2006.

4.7 VEGETATION

The Study Area is made up of derived native grassland with scattered paddock trees (97%), open woodland (2%) and plantation (1%).

5 BACKGROUND INFORMATION

5.1 REGIONAL SURVEYS

There are two regional vegetation mapping products that include the Study Area and describe PCTs. *Upper Hunter State Vegetation Type Mapping* assigned what are now referred to as legacy PCTs having been replaced by revised PCTs that includes revised Eastern NSW PCT in the *NSW State Vegetation Type Map*[1]. Table 2 provides the details of the mapping and classification across the Study Area from both.

Table 2 Details of Regional Surveys in the Study Area

PCT ID	PCT Name	Area (ha)
Upper Hunter State Vegetation Mapping – legacy		
796	Derived grassland of the NSW South Western Slopes	27
1603	Narrow-leaved Ironbark – Bull Oak – Grey Box shrub – grass open forest of the central and lower Hunter	1
1691	Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter	2
0	Non-native	5
State Vegetation Type mapping – new		
3431	Central Hunter Ironbark Grassy Woodland	4
0	Not native vegetation	32

Note; ha = Hectares

5.2 LOCAL SURVEYS

Flora surveys conducted within and in the vicinity of Mt Arthur Coal Mine are listed in Table 3 with only Cumberland Ecology (2009a) overlapping the Study Area.

[1] https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet/state-vegetation-type-map

Table 3 Details of Local Surveys

Report	Survey	General Location	Survey Type and Time
Dames and Moore (2000)	EIS flora and fauna report	Mt Arthur Coal Mine	Flora – 15-21 November 1998 Fauna – 14-21 November 1998
Umwelt Environmental Consultants (Umwelt) (2003)	Monitoring	Mt Arthur Coal Mine	Flora and Fauna – 1 April 2003; 7-9 May 2003
Umwelt (2005)	Monitoring	Mt Arthur Coal Mine	Flora – December 2004; early January 2005 Fauna – 14-15 December 2004; 20-22 December 2004
Umwelt (2006a)	Flora and Fauna	Mt Arthur Coal Mine	Flora – 16-18 February 2005; 30 November 2005 Fauna – 21-25 February 2005
Umwelt (2006b)	Monitoring	Mt Arthur Coal Mine	Flora – November 2005 Fauna – December 2005
Umwelt (2006c)	Downcast Shaft Facility	Mt Arthur Coal Mine	Flora and Fauna – 7 December 2005
Hansen Bailey (2007)	Drayton Mine Extension	Drayton Mine	Flora and Fauna – 14-17 February 2006; 6 September 2006; 12-16 February 2007
Umwelt (2007a)	Monitoring	Mt Arthur Coal Mine	Flora – November 2006 Fauna – December 2006
Umwelt (2007b)	Mt Arthur Underground Project	Mt Arthur Coal Mine	Flora – 5 to 8 April 2005; 5-7 December 2005 Fauna – 7-11 March 2005; 5-7 December 2005
Cumberland Ecology (2009a)	Mt Arthur Consolidation	Mt Arthur Coal Mine	Flora and Fauna – 28 August 2008; 21-23 September 2008; 30 September – 2 October 2008; 10-12 November 2008; 19-23 January 2009; 4 March 2009; 8-9 April 2009; 9-10 July 2009; and 13-14 July 2009
Cumberland Ecology (2009b)	Monitoring	Mt Arthur Coal Mine	Flora and Fauna – 19-23 January 2009
Cumberland Ecology (2009c)	Ecological Assessment	Drayton Mine	Flora and Fauna - May 2009
Cumberland Ecology (2010a)	EPBC Act referral	Mt Arthur Coal Mine	Flora and Fauna – Drawn from other studies
Cumberland Ecology (2010b)	Monitoring	Mt Arthur Coal Mine	Flora and Fauna – 19-22 January 2010; 27-29 January 2010
Cumberland Ecology (2010c)	Monitoring	Mt Arthur Coal Mine	Flora and Fauna – 20-23 September 2010
Umwelt (2011)	Flora and fauna	Mt Arthur Coal Mine	Vegetation Communities – 29 August 2011 - 2 September 2011
Cumberland Ecology (2011)	Monitoring *Diuris tricolor* (Pine Donkey Orchid)	Mt Arthur Coal Mine	Flora – 29 September 2011

Report	Survey	General Location	Survey Type and Time
Cumberland Ecology (2012)	Ecology Impact Assessment	Drayton Mine	Flora and Fauna 2009 and 2011 (see Table 4.1 in the Cumberland Ecology report for details)
Hunter Eco (2013)	Ecological Assessment	Mt Arthur Coal Mine	Flora – 16 April-9 May; 9-12 September; 19 September 2012
Cumberland Ecology (2015)	Biodiversity Assessment	Drayton Mine	Flora and Fauna – 2009 - 2015
Hunter Eco (2019)	Flora Report	Maxwell Underground Mine	Flora and Vegetation – 2017 - 2019

6 METHODS

All field surveys were conducted by Dr Colin Driscoll of Hunter Eco who has been conducting flora and vegetation surveys at the Mt Arthur Coal Mine since 2012. Table 4 shows the survey days and on all occasions the weather was mild and dry.

Table 4 Floristic Survey Days

Date	Task	Rainfall (mm)
10 October 2022	RDP and VI plots	0
13 October 2022	RDP and VI plots	0
16 November 2022	VI plots	0
10 July 2023	VI Plots	0

6.1 IDENTIFYING NATIVE PLANT COMMUNITY TYPES

PCTs are described in the *BioNet Vegetation Classification* (DPE, 2023c). The PCTs in the Study Area were identified by comparing the floristic composition recorded in the field with PCT descriptions provided in *BioNET Vegetation Classification*. This was an iterative process starting with matching dominant canopy species, followed by shrub and groundcover; any geographic limitations were also considered.

The likely PCTs associated with derived grassland were determined by floristic species composition, identification of each tree in the Study Area and landscape position. Threatened Ecological Communities (TECs) associated with a PCT were also noted and mapped as described in Section 7.4.

Any existing information on native vegetation in the Study Area and surrounding locality was reviewed (Section 5) and the survey was designed to sample the entire Study Area and the expected environmental variation.

Dominant species present in the canopy, shrub and ground structural layers were recorded at numerous locations (a total of 153 Rapid Data Points [RDPs]) were sampled in and around the Study Area [Figure 6]). A plot-based vegetation survey was stratified according to the PCTs, their condition and then targeted to sample the expected environmental variation. The data collected were used to assist with the identification and mapping of PCTs.

6.2 ASSESSING VEGETATION INTEGRITY (SITE CONDITION)

All plot data were collected to meet the requirements of the BAM (DPIE, 2020). The plots/transects were established to provide a representative assessment of the Vegetation Integrity (VI) of the vegetation zone, accounting for the level of variation in the broad condition state of the vegetation zone.

A total of eight VI survey plots were randomly located within stratification units in the Study Area by walking a random distance into the vegetation zone (Figure 6). Plots were not located in or near ecotones that are readily distinguishable from the broad condition state of the vegetation zone. The plots were, however, spread across the separate areas of the vegetation zone. An additional five VI plots adjacent to the Study Area were included in the assessment.

Each plot consisted of a 20 m x 20 m floristic plot nested at one end of a 20 m x 50 m plot. The following data were collected in the 20 m x 20 m plot as per the BAM (DPIE, 2020):

- identification of all flora species, stratum in which each species occurs and growth form;
- a record of the abundance of each species; and
- a record of whether each species is native or exotic, or High Threat Exotic (HTE).

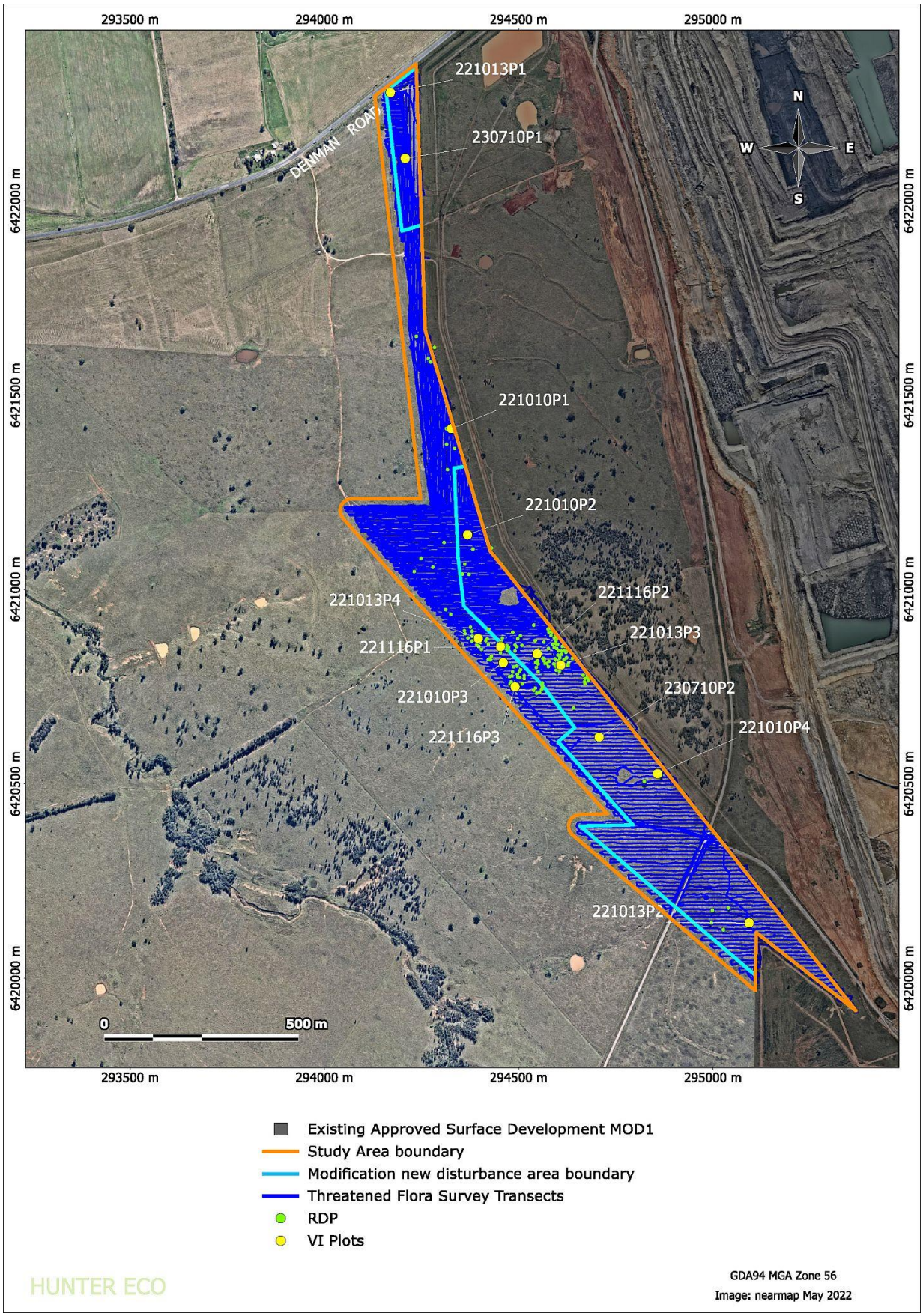


Figure 6 Sample Sites and Threatened Flora Survey Transects

A record of the number of large trees, tree stem size class, tree regeneration, length of fallen logs were collected in the 20 m x 50 m plot. Presence of hollow bearing trees was assessed for the vegetation zone.

The percentage of litter cover at five 1 m x 1 m sub-plots specified locations in the 20 m x 50 m plot was sampled.

These data were tabulated in a format suitable for entry into the BAM Credit Calculator (BAM-C).

6.3 GROUNDWATER DEPENDENT ECOSYSTEMS

The *NSW State Groundwater Dependent Ecosystem Policy* (Department of Land and Water Conservation, 2002) describes three types of Groundwater Dependent Ecosystems (GDEs) relating to flora in NSW:

- terrestrial vegetation that are dependent in whole or in part on water reserves held in the ground;
- streams (and associated vegetation) receiving base flows from groundwater; and
- wetlands (and associated vegetation) dependent on the surface expression of groundwater.

Vegetation making up a GDE, termed phreatophytic and consisting of phreatophytes, can have varying degrees of dependency on the groundwater. Obligate GDEs are made up of species that depend entirely on groundwater and are capable of living with their roots continually wet or at least for seasonal periods of inundation. Facultative GDEs contain species that access the groundwater via the capillary fringe and also take up water from within the soil matrix above this area (Hatton and Evans, 1998). These plants cannot cope with having their roots inundated with water.

Depth to water is an important consideration for identifying potential GDEs and in this context plant rooting depth is relevant. While some plants are capable of sending roots tens of metres into the soil, generally the plants in dry sclerophyll woodland, including trees, would have maximum root depth of approximately 5 m (Canadell *et al*., 1996).

Initially the *National Atlas of Groundwater Dependent Ecosystems, Terrestrial GDE* (BoM 2019), which provides a model of potential GDEs across Australia was consulted along with *Probable Vegetation Groundwater Dependent Ecosystems - Hunter / Central Rivers* (DPE 2022c). These sources showed either no potential GDE (BoM 2019) or low potential GDE (DPE 2022c) which reflects the elevated position of the Study Area. The final determination of GDE presence was based on an assessment of whether species within each mapped vegetation community are known to be typically groundwater dependent.

6.4 THREATENED ECOLOGICAL COMMUNITIES

TEC records from within 20 km of the Study Area were extracted from the BioNet Atlas (DPE 2022b). TECs listed under the EPBC Act predicted to occur were also extracted using the Commonwealth Protected Matters Search Tool (PMST) (DCCEEW 2023b). Following initial field habitat assessment these communities were evaluated for their likelihood of occurring based on dominant canopy species and habitat conditions. Subsequently after plot data analysis the floristic content of communities was compared with descriptions in the listed community determinations (DPE 2023c and DCCEEW 2023a).

Table 5 provides a list of TEC extracted from the BioNet Atlas (DPE 2022b). Table 5 also includes TEC from the Commonwealth PMST (DCCEEW 2023b).

Table 5 Threatened Ecological Communities and Likelihood of Occurrence

Community Name	Status		Likelihood of Occurring Prior to the Survey
	BC Act	EPBC Act	
Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	E	-	Possible, but unlikely*
Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	E	-	Possible, but unlikely*
Central Hunter Valley eucalypt forest and woodland	-	CE	Possible*
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	None, Study Area not coastal
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	-	E	None, Study Area not coastal
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	-	E	None, Study Area in the Sydney Basin Bioregion
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	None, Study Area not coastal
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	-	E	None, Study Area not in South-eastern Australia
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	E	-	None, Study Area not on a floodplain
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	E	-	None, Study Area not positioned on a lowland drainage line
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	V	-	Possible*
Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions	E	-	None, Study Area not on gentle slopes arising from depressions and drainage flats
Hunter Valley Weeping Myall (*Acacia pendula*) Woodland	-	CE	Possible
Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion	CE	-	Possible*
Lowland Rainforest of Subtropical Australia	-	CE	None, no rainforest present
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	-	CE	None, Study Area not on basalt geology
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	-	CE	Non. Study Area not on a river flat
Weeping Myall Woodlands	-	E	Possible*
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	-	CE	Possible*

*Recorded within Mt Arthur Coal Mine leases

6.5 ENDANGERED POPULATIONS

Table 6 shows the endangered populations extracted from the *BioNet Atlas* (DPE 2022b).

Table 6 Endangered Populations

Endangered Population	Status	Likelihood of Occurring
Cymbidium canaliculatum population in the Hunter Catchment	E	Possible*
Acacia pendula population in the Hunter catchment	E	Possible*
Diuris tricolor, the Pine Donkey Orchid population in the Muswellbrook local government area	E	Possible*

*Recorded within Mt Arthur Coal Mine leases

Bolwarra undertook target surveys for threatened species and populations listed under the BC Act and EPBC Act (Attachment A). Field surveys were conducted according to the requirements in the DPIE (2020b) *Surveying Threatened Plants and Their Habitats: NSW Survey Guide for the Biodiversity Assessment Method*. The method requires parallel transects to be surveyed with distance apart assigned by growth form and vegetation density.

6.6 THREATENED FLORA SPECIES

The BAM-C indicated that any of the species listed in Table 7 could possibly occur in the Study Area given associated PCTs. To establish a candidate list of threatened species to target, a number of additional sources were reviewed, including:

- threatened flora species records from *BioNet Atlas* (DPE 2022b);
- threatened flora species predicted to occur in the Commonwealth PMST (DCCEEW, 2023b);
- species from the above two searches were filtered to only include those listed as occurring the Hunter IBRA sub-region;
- threatened flora species records from past reports (Table 3); and
- threatened flora species listed in the *Threatened Biodiversity Data Collection* (DPE, 2023a) as associated with the various PCT likely to occur in the Study Area.

Bolwarra undertook target surveys for threatened species and populations listed under the BC Act and EPBC Act (Attachment A). As described above, field surveys were conducted according to the requirements in the DPIE (2020b) *Surveying Threatened Plants and Their Habitats: NSW Survey Guide for the Biodiversity Assessment Method*.

There are two BioNet database records of *Eucalyptus camaldulensis* population in the Hunter Catchment in the existing/approved surface disturbance of the mine (DPE 2022b). However, there is no potential habitat at the location of these records, with the species is more likely along the Hunter River.

There is one BioNet database record of Narrow-leaved Black Peppermint (*Eucalyptus nicholii*) in the existing/approved surface disturbance of the mine (DPE 2022b). However, the record is marked as 'questionable' in the BioNet database and it is highly unlikely to be a true record.

Picris evae (Hawkweed) (V – BC Act, V – EPBC Act) and *Pomaderris brunnea* (Rufous Pomaderris) (E – BC Act, V – EPBC Act) appear in the Commonwealth PMST (DCCEEW, 2023b) for the wider locality but there are no nearby records of these species (DPE 2022b). These species are not associated with PCTs within the Sydney Basin – Hunter subregion (DPE 2023a) and are not likely to occur in the study area.

Table 7 Threatened Flora Species Potentially Occurring in the Study Area

Scientific Name	Common Name	Source	Status	
			BC Act	EPBC Act
Cryptostylis hunteriana	Leafless Tongue Orchid	BAMC-C	V	V
Cynanchum elegans	White-flowered Wax Plant	PMST	E	E
*Diuris tricolor**	Pine Donkey Orchid*	BAMC-C	V	
Eucalyptus glaucina	Slaty Red Gum	PMST	V	V
Eucalyptus pumila	Pokolbin Mallee	BAMC-C	V	V
Monotaxis macrophylla	Large-leafed Monotaxis	BAMC-C	E	
Ozothamnus tesselatus	-	BAMC-C	V	V
Pomaderris queenslandica	Scant Pomaderris	BAMC-C	E	
Pomaderris reperta	Denman Pomaderris	BAMC-C	CE	CE
Prostanthera cineolifera	Singleton Mint Bush	BAMC-C	V	V
Prostanthera cryptandroides subsp. cryptandroides	Wollemi Mint-bush	BAMC-C	V	V
Pterostylis gibbosa	Illawarra Greenhood	PMST	E	E
*Thesium australe**	Austral Toadflax*	BAMC-C	V	V

Note: PMST = Protected Matters Search Tool (DCCEEW, 2023b)
*Recorded within Mt Arthur Coal Mine leases

6.7 KOALA POTENTIAL HABITAT

The *State Environmental Planning Policy (Biodiversity and Conservation) 2021* (Biodiversity and Conservation SEPP) began on 1 March 2022 and consolidates, transfers and repeals provisions of various SEPPs in NSW including the Koala Habitat Protection SEPP (2020 and 2021). The provisions within the repealed SEPPs have been transferred to the Biodiversity and Conservation SEPP.

The *Koala* (Phascolarctos cinereus) *Biodiversity Assessment Method Survey Guide* (DPE, 2022a) divides NSW into several modelling regions and the Study Area is located in the Central Coast region. Appendix C of DPE (2022a) provides lists of Koala use tree species for each modelling region with each species ranked according to the level of importance as feed or shelter trees.

Zoning of the Study Area is RU1 Primary Production. Chapter 3 *Koala Habitat Protection 2020* of the Biodiversity and Conservation SEPP applies to all RU1 zoned land within the Muswellbrook LGA.

7 RESULTS

Data from the 153 RDPs and 13 floristic plots allowed vegetation communities to be tentatively identified across the Study Area, primarily based on the dominant canopy species. Each community was then given a generic descriptive name and code (Table 8). Areas of derived grassland were assigned a PCT based on paddock tree species and adjoining woodland types. VI plots were randomly placed in these communities. Figure 6 shows the RDP and plot locations.

Table 8 Generic Communities Mapped in the Study and Disturbance Areas

Code	Generic Name	Study Area (ha)	Disturbance Area (ha)
1	Grey Box x White Box Grassy Woodland PCT 483	0.54	0.22
1a	Grey Box x White Box Grassy DNG PCT 483	42.27	22.5
1b	Plantation PCT 483	0.16	0.16
2	Slaty Box Woodland PCT 1655	0.39	0.39
2a	Slaty Box DNG PCT 1655	1.16	1.16
	Totals	**44.52**	**24.43**

7.1 PCT ASSIGNMENT

Table 9 shows the assignment of PCT based on field survey. The indicator canopy species were *Eucalyptus albens* <-> *moluccana* (Grey Box x White Box) for Generic Community 1 and *Eucalyptus dawsonii* (Slaty Box) for Generic Community 2.

7.2 TEC ASSIGNMENT

The *BioNet Vegetation Classification* (DPE 2023b) assigns probable TECs to all PCTs and Table 10 provides details of these assignments for each PCT mapped across the Study Area. Figure 7 shows the TECs under the BC Act and/or EPBC Act.

7.3 VEGETATION COMMUNITY CONDITION

Overall, the Study Area consisted of a grassy landscape divided into patches of grassy woodland within wider derived native grassland with few paddock trees.

Table 9 Plant Community Type Assignment

PCT	PCT Name	Location	Canopy Content	Shrub Content	Assessment
1, 1a, 1b Grey Box x White Box Grassy Woodland, DNG, Plantation					
483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Merriwa District	*Eucalyptus albens <--> moluccana; Eucalyptus moluccana; Eucalyptus albens; Angophora floribunda; Eucalyptus melliodora;*	*Sclerolaena muricata; Sida trichopoda; Pimelea curviflora var. curviflora;*	Neither PCT are a clear match to the floristic content in the Study Area due to the highly disturbed condition. Canopy content is similar for both PCT however PCT 618 has high shrub content not found in the Study Area. Despite being described as occurring in the Merriwa area, **PCT 483 is the better match** to the floristic content in the Study Area with only three low shrub species recorded.
618	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	Upper Hunter Valley	*Eucalyptus albens <--> moluccana; Angophora floribunda; Eucalyptus blakelyi <--> tereticornis; Eucalyptus melliodora; Brachychiton populneus subsp. populneus; Eucalyptus eugenioides; Eucalyptus crebra;*	*Bursaria spinosa subsp. spinosa; Acacia implexa; Solanum stelligerum; Olearia elliptica subsp. elliptica; Pandorea pandorana subsp. pandorana; Breynia oblongifolia; Pittosporum undulatum; Pimelea curviflora var. curviflora; Melicytus dentatus; Notelaea microcarpa var. microcarpa; Clematis glycinoides var. glycinoides;*	
2, 2a Slaty Box Woodland and DNG					
1176	Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	Upper Hunter Valley	*Eucalyptus dawsonii; Eucalyptus punctata; Eucalyptus moluccana; Eucalyptus crebra; Callitris endlicheri; Allocasuarina luehmannii; Eucalyptus fibrosa; Corymbia trachyphloia subsp. amphistomatica; Brachychiton populneus subsp. populneus;*	*Acacia doratoxylon; Acacia linearifolia; Acacia salicina; Dodonaea viscosa; Geijera parviflora; Notelaea microcarpa var. microcarpa; Olearia elliptica; Persoonia linearis;*	PCT 1176 has a potentially wide range of canopy species not found in the immediate Study Area and surrounds, such as *Eucalyptus punctata* and *Corymbia trachyphloia* subsp. *amphistomatica*. Similarly for shrub content, in particular *Acacia doratoxylon; Acacia linearifolia; Acacia salicina*. Furthermore, the classification confidence level is noted as Very Low. Thus, **PCT 1655 is the better match**. PCT 1655 is a match because the canopy contains Slaty Box
1655	Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	Upper Hunter Valley	*Eucalyptus moluccana; Eucalyptus dawsonii; Callitris endlicheri;*	*Notelaea microcarpa; Dodonaea viscosa; Olearia elliptica; Desmodium varians;*	

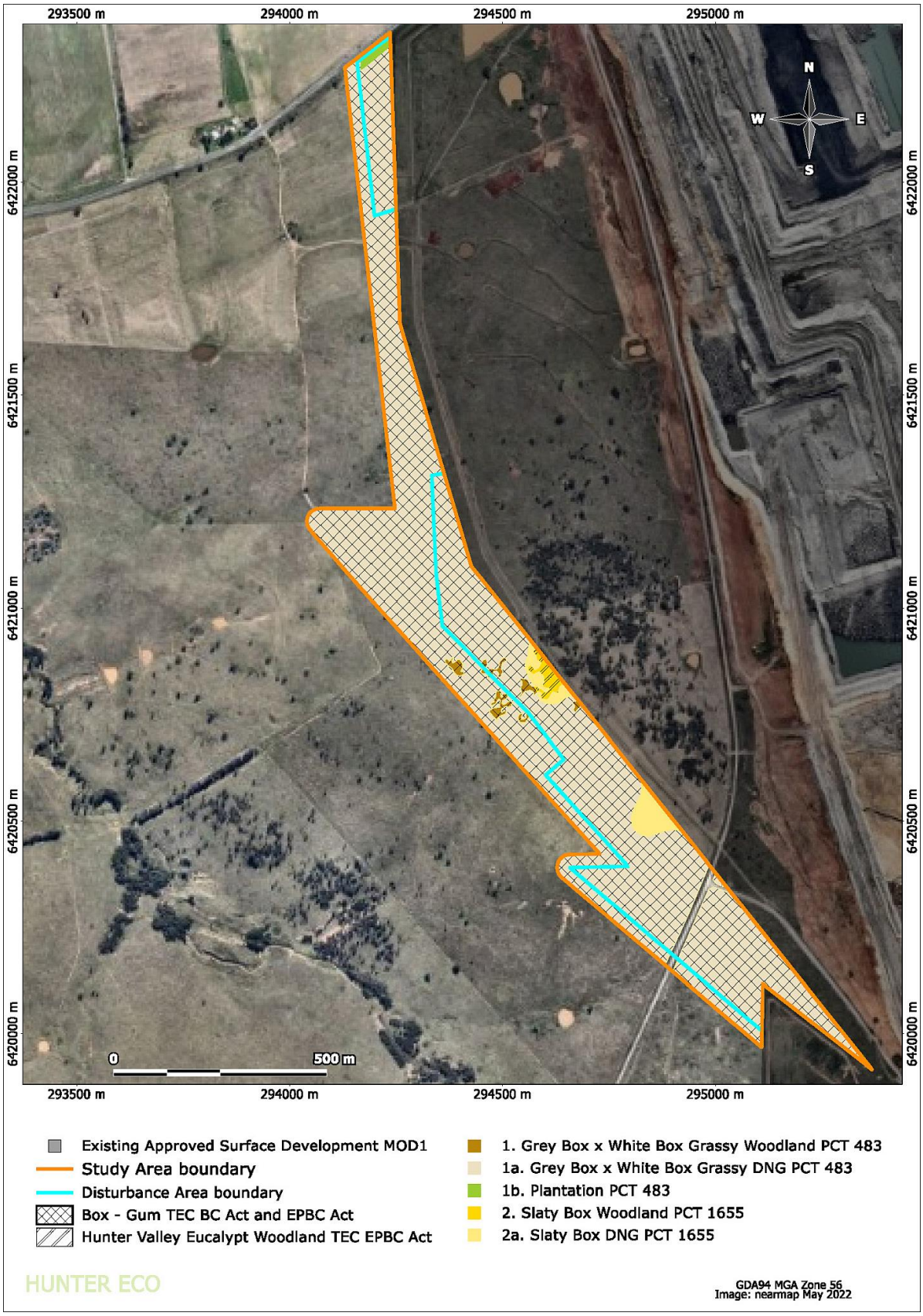


Figure 7 Generic Vegetation Communities and TEC Across the Study Area

Table 10 Threatened Ecological Community Assignment

Code	Generic Name	Associated TEC (DPE 2023b)	Assigned TEC	Rationale
1	Grey Box x White Box Grassy Woodland (PCT 483)	Listed BC Act CE White Box Yellow Box Blakely's Red Gum Woodland	BC Act CE White Box Yellow Box Blakely's Red Gum Woodland	The NSW Scientific Committee Determination (DPE 2023c) includes hybrid Grey Box x White Box
		Listed EPBC Act CE White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	EPBC Act CE White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	This vegetation zone meets the relevant composition and condition criteria (Threatened Species Scientific Committee, 2006) (Section 7.5)
1a	Derived Native Grassland (PCT 483)	Listed BC Act CE White Box Yellow Box Blakely's Red Gum Woodland	BC Act CE White Box Yellow Box Blakely's Red Gum Woodland	Cleared grassland deemed to be derived from Box-Gum woodland is included in the NSW Scientific Committee Determination (DPE 2023c)
		Listed EPBC Act CE White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	EPBC Act CE White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	This vegetation zone meets the relevant composition and condition criteria (Threatened Species Scientific Committee 2006) (Section 7.5)
1b	Plantation (PCT 483)	None	None	Did not contain indicator canopy or ground species ((Section 7.5).
2	Slaty Box Woodland (PCT 1655)	Listed BC Act Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	Indicated by the presence of Slaty Gum
		Listed EPBC Act CE Central Hunter Valley eucalypt forest and woodland	Central Hunter Valley eucalypt forest and woodland	Indicated by the presence of Slaty Gum and Bull Oak
2b	Derived Native Grassland (PCT 1655)	None	None	Derived native grassland is **not** included in both the NSW and Commonwealth Scientific Committee determinations for this community

7.4 THREATENED ECOLOGICAL COMMUNITIES LISTED UNDER THE BC ACT

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

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 is listed as critically endangered under the BC Act (short title Box-Gum Woodland Critically Endangered Ecological Community [CEEC] listed under the BC Act). The *BioNet Vegetation Classification* (DPE 2023b) recognised that PCT 483 could represent this TEC.

Box-Gum Woodland CEEC listed under the BC Act is primarily characterised by a canopy dominated by *Eucalyptus albens* (White Box), *Eucalyptus blakelyi* (Blakely's Red Gum) or *Eucalyptus melliodora* (Yellow Box) with an open canopy and perennial grassy understorey with few shrubs (DPE 2023c). In the Upper Hunter White Box is generally replaced with a putative hybrid of White Box and Grey Box often called 'albemol' and variably identified as 'Grey Box x White Box' or 'White Box x Grey Box' (DPE 2023c). In the Study Area, PCT 483 was an open grassy woodland with the canopy dominated by the hybrid box.

Vegetation Communities 1 and 1a are recognised as Box-Gum Woodland CEEC listed under the BC Act for the reasons outlined in Table 10.

7.5 SERIOUS AND IRREVERSIBLE IMPACTS

Under the BC Act, there is a small list of threatened species and communities that are considered by the NSW Government to be at risk of a Serious and Irreversible Impact (SAII). These species/ecological communities are named SAII entities. There is one entity recorded on the Subject land that can be a 'potential SAII entity', namely the Box-Gum Woodland CEEC listed under the BC Act.

The extent of Box-Gum Woodland CEEC beyond the Study Area was mapped and there was approximately 138 ha of the derived native grassland form only of the CEEC within a 500 m buffer.

Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion

Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion is listed as a vulnerable ecological community under the BC Act, and is described as a low to mid-high woodland. The determination does not include grasslands derived from this community. *Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin* (PCT 1655) was assessed to be a component of the vulnerable ecological community as the primary canopy content was characterised by the presence of *Eucalyptus dawsonii*, consistent with the TEC.

7.6 THREATENED ECOLOGICAL COMMUNITIES LISTED UNDER THE EPBC ACT

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

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as a CEEC under the EPBC Act (short title Box-Gum Woodland CEEC listed under the EPBC Act). *Grey Box x White Box Grassy Open Woodland on Basalt Hills in the Merriwa Region, Upper Hunter Valley* (PCT 483), *was* assessed as components of this TEC, including the derived native grassland variants.

The main identifying characteristic was the presence of White Box x Grey Box in the canopy of PCT 483.

The condition thresholds for Box-Gum Woodland CEEC listed under the EPBC Act (Threatened Species Scientific Committee 2006) are: a predominantly native perennial ground layer (≥50%); at least 12 native understorey species in any patch excluding grasses, with all patches >0.1 ha; and at least one Important Species present.

Table 11 shows the threshold values for each variant of PCT 483. Plantation was sufficiently non-compliant to exclude.

Table 11 PCT 483 Box-Gum Species Compliance Assessment

Generic Community	% Perennial species	Native non-grass species	Important species	Threshold Compliance
1. Grey Box x White Box Grassy Woodland	>50%	13	5	Yes
1a. Derived Native Grassland (PCT 483)	>50%	13	3	Yes
1b. Plantation	>50%	7	1	No

Central Hunter Valley Eucalypt Forest and Woodland

Central Hunter Valley Eucalypt Forest and Woodland is listed as a CEEC under the EPBC Act. *Grey Box - Slaty Box shrub - Grass Woodland on Sandstone Slopes of the Upper Hunter and Sydney Basin* (PCT 1655) was assessed as representing the TEC. The primary canopy species were consistent with that of the TEC given the presence of *Eucalyptus dawsonii* (Slaty Box) and *Allocasuarina luehmannii* (Bull Oak).

The determination for *Central Hunter Valley Eucalypt Forest and Woodland* specifically excludes derived grasslands other than for narrow (30 m or less) strips around woodland areas or connection between woodland areas. *Central Hunter Valley Eucalypt Forest and Woodland* was present in one small patch (Figure 7).

7.7 FLORA SPECIES

Appendix 1 lists a total of 121 flora species that were recorded from 39 families and 93 genera, among which were 39 weed species including seven HTE species. The dominant families were Poaceae (Grasses) with 21 native species and six weed species including one HTE species and Asteraceae (Daisies) represented by seven native species and ten weed species including one HTE species. The HTE species *Senecio madagascariensis* (Fireweed) and *Galenia pubescens* (Galenia) were present in all VI plots. The average HTE cover was 2.4% (range 0.1% to 20%) with the most abundant weed being Fireweed (*Senecio madagascariensis*). The average weed cover excluding HTE was 0.7% (range 0.1% to 25%) with the most abundant weed being Purpletop (*Verbena bonariensis*).

Table 12 shows the count of BAM Growth Form Groups in each generic community.

Table 12 Count of BAM Growth Form Groups in Each Generic Community

Generic Community		Fern	Forb	Grass	Other	Shrub	Tree	Weed	HTE
1.	Grey Box x White Box Grassy Woodland	1	21	18	3	6	2	18	5
1a.	Grey Box x White Box Grassy DNG	1	22	20	4	5	1	24	5
1b.	Grey Box x White Box Grassy Plantation	1	6	5	0	1	3	14	2
2.	Slaty Box Woodland	1	16	8	2	4	3	11	4
2a.	Slaty Box DNG	1	5	6	1	4	2	11	3

7.7.1 Threatened Flora Species

Approximately 76 km of transect survey was conducted across the Study Area and surrounds (Figure 6) and no threatened flora species were recorded. These transects were conducted by Bolwarra with a separate report provided in Attachment A.

7.7.2 Endangered Populations

No endangered populations were recorded.

8 GROUNDWATER DEPENDENT ECOSYSTEMS

The *National Atlas of Groundwater Dependent Ecosystems, Terrestrial GDE* (BoM, 2019) showed no probable GDE in the Study Area. *Probable Vegetation Groundwater Dependent Ecosystems - Hunter/Central Rivers* (DPE 2022c) showed tree patches within the Study Area as Low probability GDE.

There was no evidence of GDE vegetation with the majority of trees being *Allocasuarina luehmannii* (Bull Oak) along with *Eucalyptus albens* x *Eucalyptus moluccana* (White Box x Grey Box hybrid) and *Eucalyptus dawsonii* (Slaty Box) none of which are groundwater dependent.

9 KOALA POTENTIAL HABITAT

For the Central Coast modelling region both *Eucalyptus albens* (White Box) and *Eucalyptus moluccana* (Grey Box) are listed as Koala food trees (DPE 2022a). It is likely that the hybrid White Box x Grey Box would also serve as a food tree. For this reason, Vegetation Community 1 (PCT 483) both in the woodland form and in several scattered paddock trees across the derived native grassland form (Community 1a) would comprise potential koala habitat.

No other Koala food trees listed in the Biodiversity and Conservation SEPP, Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (DPE 2022a) or *Koala Habitat Information Base Technical Guide* (DPIE 2019b) are present in the study area.

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APPENDICIES

APPENDIX 1 COMBINED FLORISTIC LIST

Families and Species		
Aizoaceae		**Lomandraceae**
**Galenia pubescens*		*Lomandra confertifolia* subsp. *rubiginosa*
Apiaceae		*Lomandra filiformis* subsp. *filiformis*
Cyclospermum leptophyllum		*Lomandra glauca*
Apocynaceae		*Lomandra multiflora*
Gomphocarpus fruticosus		**Malvaceae**
Asparagaceae		*Modiola caroliniana*
Arthropodium milleflorum		*Sida rhombifolia*
Asteraceae		*Sida corrugata*
**Carthamus lanatus*		*Sida hackettiana*
**Senecio madagascariensis*		**Myoporaceae**
Cirsium vulgare		*Eremophila debilis*
Conyza sp.		*Myoporum montanum*
Facelis retusa		**Myrtaceae**
Gamochaeta americana		*Eucalyptus albens x moluccana*
Gamochaeta pensylvanica		*Eucalyptus dawsonii*
Hypochaeris radicata		*Eucalyptus sideroxylon*
Lactuca serriola		**Nyctaginaceae**
Soliva sessilis		*Boerhavia dominii*
Calotis lappulacea		**Oxalidaceae**
Chrysocephalum semipapposum		*Oxalis exilis*
Cotula australis		**Plantaginaceae**
Cymbonotus lawsonianus		*Plantago lanceolata*
Senecio quadridentatus		*Plantago debilis*
Vittadinia cuneata		*Plantago drummondii*
Vittadinia pterochaeta		**Poaceae**
Brassicaceae		**Paspalum dilatatum*
Lepidium bonariense		*Avena sativa*
Lepidium pseudohyssopifolium		*Bromus molliformis*
Cactaceae		*Cynodon dactylon*
**Opuntia stricta*		*Lolium perenne*
Campanulaceae		*Setaria pumila*
Wahlenbergia communis		*Anthosachne scabra*
Casuarinaceae		*Aristida ramosa*
Allocasuarina luehmannii		*Austrostipa densiflora*
Chenopodiaceae		*Austrostipa scabra*
Einadia hastata		*Austrostipa scabra* subsp. *falcata*
Einadia nutans		*Austrostipa scabra* subsp. *scabra*
Einadia nutans subsp. *nutans*		*Austrostipa verticillata*
Einadia polygonoides		*Bothriochloa biloba*
Enchylaena tomentosa		*Bothriochloa decipiens*
Maireana microphylla		*Chloris truncata*

Families and Species		
Sclerolaena birchii		*Chloris ventricosa*
Convolvulaceae		*Cymbopogon refractus*
Convolvulus graminetinus		*Cynodon dactylon*
Dichondra repens		*Digitaria ramularis*
Crassulaceae		*Eriochloa pseudoacrotricha*
Crassula sieberiana		*Panicum effusum*
Crassula sieberiana subsp. *sieberiana*		*Panicum queenslandicum*
Cyperaceae		*Paspalidium albovillosum*
Carex inversa		*Paspalidium constrictum*
Cyperus gracilis		*Rytidosperma caespitosum*
Fimbristylis dichotoma		*Sporobolus creber*
Fabaceae (Faboideae)		**Primulaceae**
**Medicago sp.*		**Lysimachia arvensis*
**Trifolium sp.*		**Pteridaceae**
Glycine clandestina		*Cheilanthes sieberi*
Glycine microphylla		**Rubiaceae**
Glycine stenophita		**Galium aparine*
Grona varians		*Asperula conferta*
Oxytes brachypoda		**Solanaceae**
Pullenia gunnii		***Lycium ferocissimum*
Fabaceae (Mimosoideae)		**Solanum nigrum*
Acacia falcata		*Solanum cinereum*
Acacia salicina		**Sterculiaceae**
Gentianaceae		*Brachychiton populneus*
**Centaurium erythraea*		**Verbenaceae**
Geraniaceae		**Verbena bonariensis*
**Erodium cicutarium*		**Verbena quadrangularis*
**Geranium molle*		*Verbena gaudichaudii*
Erodium crinitum		**Phormiaceae**
Iridaceae		*Dianella longifolia*
***Romulea rosea*		**Commelinaceae**
**Sisyrinchium iridifolium*		*Commelina cyanea*
Lamiaceae		**Phyllanthaceae**
**Stachys arvensis*		*Phyllanthus gunnii*
Mentha satureioides		**Polygonaceae**
Linaceae		*Rumex* sp.
**Linum trigynum*		**Thymelaeaceae**
Linum marginale		*Pimelea curviflora* var. *subglabrata*

*Weed species
**High Threat Weed species.

APPENDIX 2 BAM-C INPUT DATA

Plot	PCT	Area	patchsize	conditionclass	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
221010P1	483	33	101	DNG	56	294327	6421414	135	1	2	10	13	1	4	0.1	0.2	60.8	6.3	0.1	0.4	0	0	72	0	0	0	0	0	0	1	5.2
221010P2	483	33	101	DNG	56	294369	6421141	352	0	1	6	14	1	4	0	0.1	45.2	2.4	0.1	0.4	0	0	76	0	0	0	0	0	0	0	10
221010P3	483	33	101	DNG	56	294460	6420812	60	0	3	3	7	1	2	0	0.3	40.2	5.6	0.1	0.2	0	0	72	0	0	0	0	0	0	0	20.2
221010P4	1655	1.2	101	DNG	56	294857	6420526	46	2	4	6	5	1	1	7.1	0.4	30.5	0.5	0.1	0.1	1	1	46	19	0	0	0	0	0	0	5.2
221013P1	483	0.2	101	Plantation	56	294170	6422278	35	3	1	5	6	1	0	80.1	1	40.2	0.6	0.1	0	0	0	70	0	1	1	1	0	0	1	0.2
221013P2	483	33	101	DNG	56	295093	6420142	325	0	1	8	5	0	1	0	0.1	70.6	1.4	0	0.1	0	0	90	0	0	0	0	0	0	0	0.2
221013P3	1655	0.4	101	Woodland	56	294608	6420805	195	3	4	8	15	1	2	100.1	0.4	40.6	1.5	0.1	0.2	1	1	48	30	1	1	1	0	0	1	1.3
221013P4	483	0.5	101	Woodland	56	294396	6420873	105	2	3	8	11	1	2	50	0.3	80.5	1.1	0.1	0.2	0	0	72	0	0	0	1	1	0	0	5.1
221116P1	483	0.5	101	Woodland	56	294453	6420853	70	2	5	13	10	1	2	45	0.5	61	20.9	0.1	0.2	1	2	72	34	1	0	1	1	1	1	6.2
221116P2	483	0.5	101	Woodland	56	294547	6420834	130	1	5	12	11	1	2	70	0.5	36.2	2	0.1	0.2	1	2	56	0	1	1	1	0	1	1	5.3
221116P3	483	0.5	101	Woodland	56	294491	6420750	23	2	4	8	8	1	1	70	0.4	10.7	0.8	0.1	0.1	2	2	62	17	1	1	1	0	0	1	29.2
230710P1	483	22.5	101	DNG	56	294209	6422109	160	0	0	5	1	0	0	0	0	65.2	0.1	0	0	0	0	80	0	0	0	0	0	0	0	0.4
230710P2	483	22.5	101	DNG	56	294707	6420620	126	0	4	12	6	0	0	0	0.4	82.7	1.6	0	0	0	0	90	0	0	0	0	0	0	0	3.3

APPENDIX 3 VEGETATION INTEGRITY PLOT DATA (COVER)

Scientific Name	221010P1	221010P2	221010P3	221010P4	221013P1	221013P2	221013P3	221013P4	221116P1	221116P2	221116P3	230710P1	230710P2		Scientific Name	221010P1	221010P2	221010P3	221010P4	221013P1	221013P2	221013P3	221013P4	221116P1	221116P2	221116P3	230710P1	230710P2
**Carthamus lanatus	0	0	0	0	0	0	0	0	0.1	0	0	0	0															
**Galenia pubescens	0.2	5	0.1	0.1	0.1	0.1	0.1	0.1	5	0.1	9	0.2	3		Commelina cyanea	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0
**Lycium ferocissimum	0	0	0	0.1	0	0	0.1	0	0.1	0.2	20	0	0		Convolvulus graminetinus	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0	0
**Opuntia stricta	0	0	0	0	0	0	0.1	0	0	0	0.1	0	0.2		Cotula australis	0.1	0	0	0	0	0	0.1	0	0	0	0	0	0
**Paspalum dilatatum	0	0	0	0	0	0	0	0	0	0	0	0.1	0		Crassula sieberiana	0	0	0	0	0	0	0	0	0	0.1	0	0	0
**Romulea rosea	0	0	0.1	0	0	0	0	0	0	0	0	0	0		Crassula sieberiana subsp. sieberiana	0	0	0	0	0	0	0.1	0	0	0	0	0	0
**Senecio madagascariensis	5	5	20	5	0.1	0.1	1	5	1	5	0.1	0.1	0.1		Cymbonotus lawsonianus	0.1	0	0	0	0	0	0.1	0	0	0	0	0	0
*Avena sativa	0	0	0	0	0.3	0.1	0	0	0	0	0	0	0		Cymbopogon refractus	0	0	0	0	0	0	0	0	0	0.1	0	0	0
*Bromus molliformis	0	0	0	0	0.1	0.1	0	0	0	0	0	0	0		Cynodon dactylon	0	0	0	0	0	0	0	0	0	0	0	20	5
*Centaurium erythraea	0	0	0	0	0	0	0.1	0	0.1	0.1	0.1	0	0		Cyperus gracilis	0.1	0	0	0	0.1	0	0.1	0	0.1	0.1	0.1	0	0
*Cirsium vulgare	0.1	0	0	0.1	0	0.2	0	0	0	0	0	0.1	0.1		Dianella longifolia	0	0	0	0	0	0	0	0	0.1	0	0	0	0
*Conyza sp.	0.1	0.1	0.1	0	0	0.1	0	0.1	0.1	0.1	0	0	0.1		Dichondra repens	0.2	0.1	0.1	0	0.1	0	0	0.1	0	0.1	0	0	0
*Cyclospermum leptophyllum	0	0.1	0.1	0.1	0	0	0.1	0	0.1	0.1	0.1	0	0		Digitaria ramularis	0	0	0	0	5	10	0	0	0	0	0	0	0
*Cynodon dactylon	0	0	0	0.1	0.1	0	0	0	0	0	0.1	0	0		Einadia hastata	0	0	0	0	0	0	0.1	0	0	0.1	0.1	0	0
*Erodium cicutarium	0	0	0.2	0	0	0	0.1	0.1	0	0.1	0	0	0		Einadia nutans	0	0	0	0	0	0	0	0	0	0	0.1	0	0.1
*Facelis retusa	0	0	0	0	0	0	0.1	0	0	0	0	0	0		Einadia nutans subsp. nutans	5	0.1	0.1	0.1	0.1	0	0.1	0.1	0	0	0	0	0
*Galium aparine	0	0	0	0	0.1	0	0	0	0	0	0	0	0		Einadia polygonoides	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0	0
*Gamochaeta americana	0	0	0	0.1	0	0	0	0	0.1	0.1	0.1	0	0		Enchylaena tomentosa	0	0	0	0.1	0	0	0.1	0.1	0.1	0.1	0.1	0	0.1
*Gamochaeta pensylvanica	0	0.1	0	0	0	0.1	0.1	0	0	0	0	0	0		Eremophila debilis	0.1	0	0.1	0	0	0	0.1	0.1	0.1	0.1	0.1	0	0
*Geranium molle	0	0	0	0	0.1	0	0	0	0	0	0	0	0		Eriochloa pseudoacrotricha	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0	0
*Gomphocarpus fruticosus	0.1	0.1	0	0	0	0	0.1	0	0	0.1	0	0	0.2		Erodium crinitum	0	0	0	0	0	0	0	0	0.1	0	0	0	0
*Hypochaeris radicata	0	0	0	0	0	0	0	0.1	0	0.1	0	0.1	0		Eucalyptus albens x moluccana	0.1	0	0	0	0	0	0	25	5	0	40	0	0
*Lactuca serriola	0.1	5	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1	0	0		Eucalyptus dawsonii	0	0	0	7	0	0	40	0	0	0	0	0	0
*Lepidium bonariense	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0		Eucalyptus sideroxylon	0	0	0	0	10	0	0	0	0	0	0	0	0
*Linum trigynum	0	0	0	0	0	0.1	0	0	0	0	0	0	0		Fimbristylis dichotoma	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0

Scientific Name	221010P1	221010P2	221010P3	221010P4	221013P1	221013P2	221013P3	221013P4	221116P1	221116P2	221116P3	230710P1	230710P2		Scientific Name	221010P1	221010P2	221010P3	221010P4	221013P1	221013P2	221013P3	221013P4	221116P1	221116P2	221116P3	230710P1	230710P2
*Lolium perenne	0.1	0	0.1	0	1	0.1	0	0.1	0	0.1	0.1	0	0		Glycine clandestina	0.1	0.1	0	0.1	0	0	0.1	0.1	0	0.1	0.1	0	0
*Lysimachia arvensis	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0		Glycine microphylla	0	0	0	0	0	0	0	0	0.1	0	0	0	0
*Medicago sp.	0.1	0.1	0.1	0.1	0	0	0	0	0.1	0	0.1	0	0		Glycine stenophita	0.1	0.1	0	0	0	0	0	0	0	0	0	0	0
*Modiola caroliniana	0.1	0	0.1	0.1	0.1	0.1	0	0	0	0	0	0	0		Grona varians	0.1	0.1	0.1	0	0	0.1	0.1	0.1	0.1	0.1	0	0	0
*Plantago lanceolata	0.1	0	0.1	0.1	8	2	0	0.1	0	0.1	0.1	0.1	0.1		Lepidium pseudohyssopifolium	0	0	0	0	0.1	0	0.1	0.1	0	0	0.1	0	0
*Setaria pumila	0	0	0	0	0	0	0	0	0	0	0	0.1	0		Linum marginale	0	0	0	0	0	0	0.1	0	0	0	0	0	0
*Sida rhombifolia	3	0	0.1	0.1	5	1	0.1	0	0.1	0.1	0.2	0.1	3		Lomandra confertifolia subsp. rubiginosa	0	0	0	0	0	0	0	0	0	0	0	0	0.1
*Sisyrinchium iridifolium	0.1	0	0	0	0	0	0	0	0	0	0	0	0		Lomandra filiformis subsp. filiformis	0.3	0.1	0.1	0	0	0.1	0	0.1	0	0	0.1	0	0.1
*Solanum nigrum	0.1	0.1	0	0	0.1	0	0	0	0	0.1	0.1	0	0		Lomandra glauca	0	0	0	0	0	0.1	0.1	0.1	0.1	0	0	0	0
*Soliva sessilis	0	0	0	0	0	0	0	0	0	0	0.1	0	0		Lomandra multiflora	0	0	0	0.1	0	0	0.1	0.1	0.1	0	0	0	0.1
*Stachys arvensis	0	0.1	0	0	0.1	0	0.1	0	0	0	0	0	0		Maireana microphylla	0	0	0.1	0.1	0	0	0.1	0	0.1	0.1	0.1	0	0.1
*Trifolium sp.	0	0	0	0.1	0	0	0	0	0	0	0	0	0		Mentha satureioides	0.1	0	0	0	0	0	0	0	0	0	0	0.1	0
*Verbena bonariensis	0	0	0.1	0.1	0.1	25	0.1	0	0	0.1	0.1	0	0		Myoporum montanum	0	0	0	0	0	0	0	0	0.1	0	0	0	0
*Verbena quadrangularis	0	0	0	0	0	0	0	0	0	0	0	0	3		Oxalis exilis	0.1	0.1	0	0.1	0.1	0	0.1	0	0	0	0.1	0	0
Acacia falcata	0	0	0	0	1	0	0	0	0	0	0	0	0		Oxytes brachypoda	0.1	0.1	0	0	0	0	0	0	0.1	0	0	0	0
Acacia salicina	0	0	0	0.1	70	0	0.1	0	0	0	0	0	0		Panicum effusum	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0
Allocasuarina luehmannii	0	0	0	0	0	0	60	25	40	70	30	0	0		Panicum queenslandicum	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Anthosachne scabra	0	0	0	0	0	0	0	0	0.1	0	0	0	0.1		Paspalidium albovillosum	0.1	0	0	0	0	0	0.1	0	0	0	0	0	0
Aristida ramosa	20	5	0	10	0	0.1	20	5	0.1	0.1	0.1	10	10		Paspalidium constrictum	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0
Arthropodium milleflorum	0.1	0.1	0.1	0	0	0	0.1	0.1	0	0	0	0	0		Phyllanthus gunnii	0	0	0	0	0	0	0	0	0	0.1	0	0	0
Asperula conferta	0	0	0	0	0	0	0	0	0	0	0	0	0.2		Pimelea curviflora var. subglabrata	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Austrostipa densiflora	0	0	0	0.1	0.1	0.1	0	0	0	0	0	0	0		Plantago debilis	0.1	0.1	0	0.1	0	0	0.1	0	0	0	0	0	0
Austrostipa scabra	0.1	0.1	0	0.2	0	0.1	0	5	0	0	0	0.1	0.1		Plantago drummondii	0	0	0	0	0	0	0	0	0	0.1	0	0	0
Austrostipa scabra subsp. falcata	0	0	0	0	0	0	0	0	5	0.2	5	0	0		Pullenia gunnii	0.1	0.1	0	0	0	0	0	0.1	0	0	0	0	0
Austrostipa scabra subsp. scabra	0	0	0	0	0	0	20	0	0	0	0	0	0		Rumex sp.	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Austrostipa verticillata	0.1	10	0	0	0	0	0.1	0	0	5	0	0	0		Rytidosperma caespitosum	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0.1

Scientific Name	221010P1	221010P2	221010P3	221010P4	221013P1	221013P2	221013P3	221013P4	221116P1	221116P2	221116P3	230710P1	230710P2		Scientific Name	221010P1	221010P2	221010P3	221010P4	221013P1	221013P2	221013P3	221013P4	221116P1	221116P2	221116P3	230710P1	230710P2
Boerhavia dominii	0	0	0	0	0	0	0.1	0	0	0	0	0	0		Sclerolaena birchii	0	0	0	0.1	0	0	0	0	0	0	0	0	0
Bothriochloa biloba	5	10	0	0	30	0	0	0	0	0	0	0	10		Senecio quadridentatus	0	0	0	0.1	0	1	0	0	0	0	0	0	0
Bothriochloa decipiens	0	0	0	0	0	0	0	0	0	0	0	5	2		Sida corrugata	0.1	0.1	0	0	0	0	0.1	0.1	0.1	0.1	0	0	0
Brachychiton populneus	0	0	0	0	0.1	0	0	0	0	0	0	0	0		Sida hackettiana	0.1	0.1	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0	0.1
Calotis lappulacea	0	0.2	0.1	0	0	0.1	0.1	0.1	0.1	1	0	0	0.1		Solanum cinereum	0.1	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1	0.1	0	0.1
Carex inversa	0.1	0	0.1	0.1	0	0	0.1	0	0.1	0.1	0.2	0	0		Sporobolus creber	5	0	0	0	0	0.1	0	0.1	5	0.2	0	50	50
Cheilanthes sieberi	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1	0	0		Verbena gaudichaudii	0	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0
Chloris truncata	0	0	0	0	0	0	0	0	0	0	0	0.1	0		Vittadinia cuneata	0	0	0	0	0	0.1	0	0.1	0.1	0	0	0	0
Chloris ventricosa	30	20	40	20	5	60	0	70	50	30	5	0	10		Vittadinia pterochaeta	0	0.1	0	0	0	0	0	0	0	0	0	0	0
Chrysocephalum semipapposum	0	1	5	0	0.1	0.1	0.1	0.1	20	0.1	0.1	0	1		Wahlenbergia communis	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0

*Weed
**High Threat Weed

APPENDIX 4 COMMUNITY PROFILES

1. Grey Box x White Box Grassy Woodland

Plant Community Type

PCT 483 Grey Box x White Box Grassy Open Woodland on Basalt Hills in the Merriwa Region, Upper Hunter Valley.

Status

Listed BC Act, CE: 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
Listed EPBC Act, CE: White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland

General Description

This community covered 2% of the Study Area. The dominant canopy species were hybrid *Eucalyptus moluccana* x *Eucalyptus albens* (Grey Box x White Box) and *Allocasuarina luehmannii* (Bull Oak) with a grassy ground cover with no shrubs. Dominant grasses were *Chloris ventricosa* (Tall Chloris), *Austrostipa verticillata* (Slender Bamboo Grass) and *Austrostipa scabra* (Spear Grass). The most dominant herb was *Calotis lappulacea* (Yellow Burr Daisy).

Species Richness

Native species 27; Weeds 9 including the High Threat Weeds *Galenia pubescens* (Galenia) and *Senecio madagascariensis* (Fire Weed).
Plots: 4

1a. Grey Box x White Box Derived Native Grassland

Plant Community Type

PCT 483 Grey Box x White Box Grassy Open Woodland on Basalt Hills in the Merriwa Region, Upper Hunter Valley

Status

Listed BC Act, CE: 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
Listed EPBC Act, CE: White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland

General Description

This community made up 87% of the Study Area and consisted of cleared grassland with scattered paddock trees. Dominant grasses were *Chloris ventricosa* (Tall Chloris), *Digitaria ramularis* (Digitaria) and *Aristida ramosa* (Spear Grass).

Species Richness

Native species 91; Weeds 43 including High Threat Weeds being *Galenia pubescens* (Galenia) and *Senecio madagascariensis* (Fireweed).
Plots: 4

1b. Grey Box x White Box Plantation

Plant Community Type

PCT 483 Estimated as derived from Grey Box x White Box Grassy Open Woodland on Basalt Hills in the Merriwa Region, Upper Hunter Valley

Status

Not a TEC

General Description

Dominant planted canopy species were *Eucalyptus sideroxylon* (Mugga Ironbark) and *Acacia salicina* (Cooba) along with *Acacia falcata* (Hickory Wattle). The grassy ground cover was dominated by *Bothriochloa biloba* (Red Grass), *Chloris ventricosa* (Tall Chloris) and *Digitaria ramularis* (Digitaria).

Species Richness

Native species 16; Weeds 16 including the High Threat Weeds *Galenia pubescens* (Galenia) and *Senecio madagascariensis* (Fireweed). Plots: 1

2. Slaty Box Woodland

Plant Community Type

PCT 1655 Grey Box – Slaty Box shrub – Grass Woodland on Sandstone Slopes of the Upper Hunter Valley and Sydney Basin

Status

Listed BC Act, V: Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion
Listed EPBC Act, CE: Central Hunter Valley eucalypt forest and woodland.

General Description

This community was characterised by a single large *Eucalyptus dawsonii* (Slaty Box) making up 1% of the Study Area. The mapped Slaty Box area was an extension of a larger Slaty Box area adjoining to the east. The dominant canopy was *Allocasuarina luehmannii* (Bull Oak) with a grassy ground cover and no shrubs. Dominant grasses were *Austrostipa scabra* (Spear Grass) and *Aristida ramosa* (Three-awn Spear Grass).

Species Richness

Native species 34; Weeds 15 including High Threat Weeds *Galenia pubescens* (Galenia), *Opuntia stricta* (Common Prickly Pear), *Lycium ferocissimum* (African Boxthorn) and *Senecio madagascariensis* (Fireweed).
Plots: 1

2a. Slaty Box Derived Native Grassland

Plant Community Type

PCT 1655 Grey Box – Slaty Box shrub – Grass Woodland on Sandstone Slopes of the Upper Hunter Valley and Sydney Basin Derived Native Grassland

Status

Not a TEC.

General Description

Making up 3% of the Study Area this community was open grassland with a single *Eucalyptus dawsonii* (Slaty Box) paddock tree and no shrubs. Dominant grasses were *Chloris ventricosa* (Tall Chloris) and *Aristida ramosa* (Three-awn Speargrass).

Species Richness

Native species 20; Weeds 13 including the High Threat Weeds *Galenia pubescens* (Galenia), *Lycium ferocissimum* (African Boxthorn) and *Senecio madagascariensis* (Fireweed).
Plots: 1

ATTACHMENT A
Threatened Flora Survey Report

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MT ARTHUR COAL MINE MODIFICATION 2

THREATENED FLORA SURVEY REPORT

PREPARED BY
BOLWARRA ENVIRONMENTAL SERVICES

AUGUST 2023

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EXECUTIVE SUMMARY

Hunter Valley Energy Coal Pty Ltd is seeking to modify Project Approval MP 09_0062 for the Mt Arthur Coal Mine under section 4.55(2) of the NSW *Environmental Planning & Assessment Act 1979* to allow for a four-year extension of Mt Arthur Coal Mine to 30 June 2030 (the Modification). The Modification would involve a number of activities, including a minor extension of the approved disturbance area in the north-west corner of the operation (Modification New Disturbance Area).

As part of the baseline flora assessment for the proposed Modification New Disturbance Area, targeted surveys for a number of threatened flora species were undertaken in September, October and December 2021, as well as October 2022. Surveys were originally undertaken across the nine study areas surrounding the existing Mt Arthur Coal Mine, while a third round of surveys was only within the study area associated with the Modification.

The target threatened flora species have been adequately surveyed within the study area for the Modification and the surveys in the wider surrounds provides additional information on the threatened flora species present at the mine site.

Three threatened species were recorded during the surveys: Tiger Orchid (*Cymbidium canaliculatum*), Austral Toadflax (*Thesium australe*) and Weeping Myall (*Acacia pendula*). However, these records are outside the study area associated with the Modification and are not relevant to the Modification.

The typical ground layer condition within the study area associated with the Modification has been modified by cultivation, grazing and exotic species coverage, resulting in habitat that is unlikely to support any of the target threatened species. As no threatened species were recorded within the study area associated with the Modification during surveys, it considered unlikely for these species to be present.

1 INTRODUCTION

This threatened flora survey report forms part of a Modification Report which has been prepared to accompany an application to modify Project Approval MP 09_0062 (MP 09_0062) under section 4.55(2) of the NSW *Environmental Planning & Assessment Act 1979* (EP&A Act).

1.1 PROJECT OVERVIEW

The Mt Arthur Coal Mine is an open cut coal mining operation situated approximately 5 kilometres (km) south-west of Muswellbrook in the Muswellbrook Local Government Area (LGA) in the Upper Hunter Valley of New South Wales (NSW) (Figure 1). The Mt Arthur Coal Mine is owned and operated by Hunter Valley Energy Coal Pty Ltd (HVEC), a wholly owned subsidiary of BHP.

The Mt Arthur Coal Mine is currently approved to operate until 30 June 2026, in accordance with MP 09_0062. In June 2022, HVEC announced a decision to cease mining activities at the Mt Arthur Coal Mine in 2030, as part of a plan to provide a pathway to closure of the operation. Accordingly, HVEC is seeking a modification of MP 09_0062 for a four-year extension of the Mt Arthur Coal Mine to 30 June 2030.

1.2 MODIFICATION DESCRIPTION

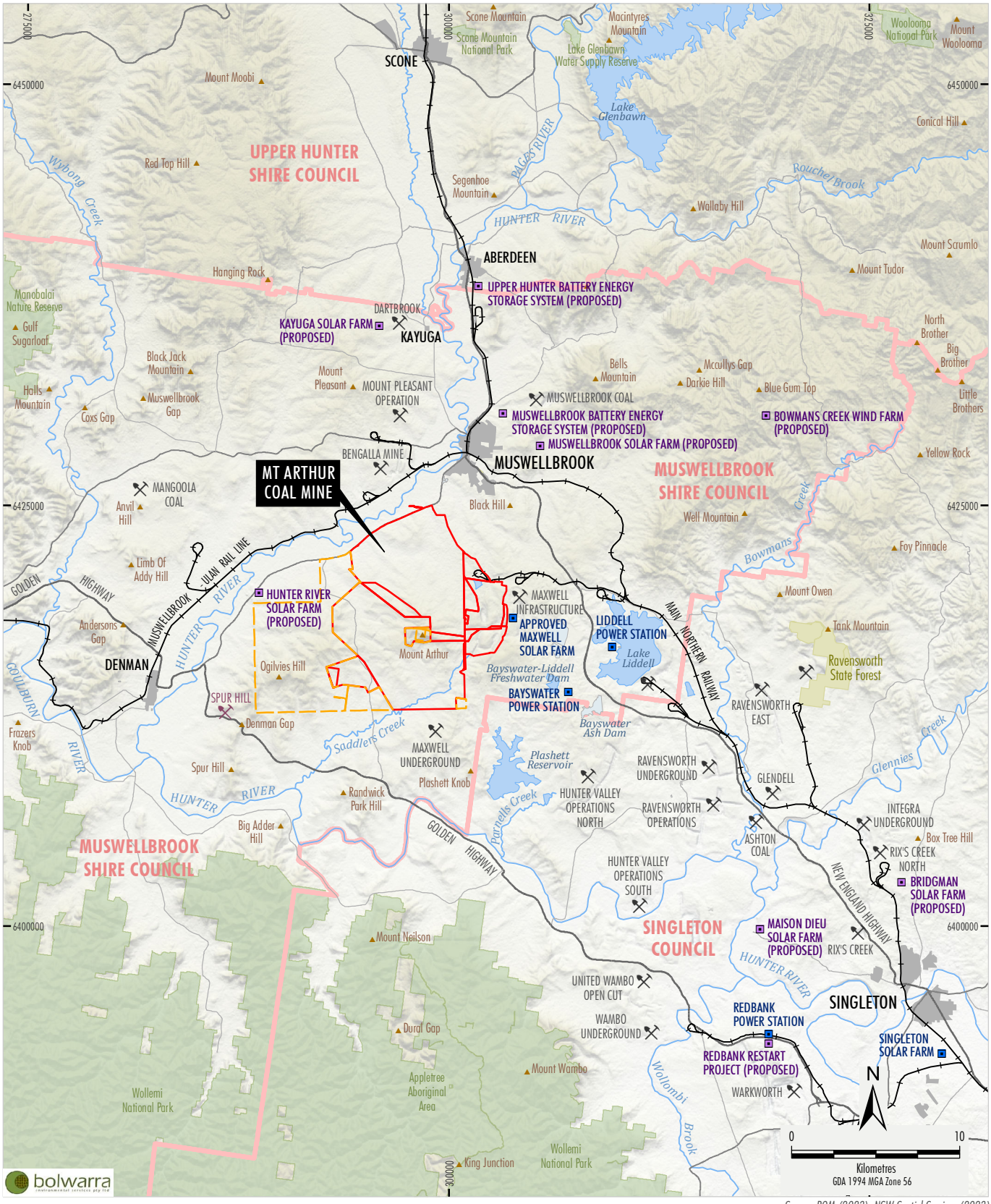
HVEC is seeking to modify MP 09_0062 under section 4.55(2) of the EP&A Act, and will include the following activities:

- four-year extension of mining activities to 30 June 2030;
- reduction in the approved open cut mining rate from 32 Million tonnes per annum (Mtpa) Run-of-Mine (ROM) to a maximum of 25 Mtpa ROM (similar to current actual ROM coal production);
- reduction in the cumulative open cut and underground ROM coal handling rate from 36 Mtpa to 29 Mtpa;
- reduction in maximum total coal (open cut and underground) rail transportation from 27 Mtpa of product coal to 20 Mtpa, and a reduction in train movements from 30 to 20 movements per day;
- minor extension of the approved disturbance area in the north-west corner of the operation predominantly to allow for access and ancillary infrastructure (refer to Modification New Disturbance Area within Figure 2);
- an overall reduction in approved disturbance, as some previously approved areas are no longer intended to be disturbed (refer to Impact Minimisation Area within Figure 2); and
- revised final landform and final void configuration, including an overall reduction in the approved height of the northern overburden emplacement areas and the final landform (to reflect the current actual height).

The Modification General Arrangement is shown on Figure 2.

The Modification would involve no change to:

- existing mining tenements;
- existing coarse rejects and tailings management;
- existing workforce;
- the existing mining method of conventional open cut mining; and
- the existing hours of operation and associated activities (undertaken 24-hours per day, seven days a week).



Source: BOM (2023); NSW Spatial Services (2023)

LEGEND

- State Forest
- National Parks and Wildlife Estate
- Local Government Area
- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Mining Operation
- Proposed Mining Operations (Application Lodged)
- Existing/Approved Energy Generation Site
- Proposed Energy Generation Site

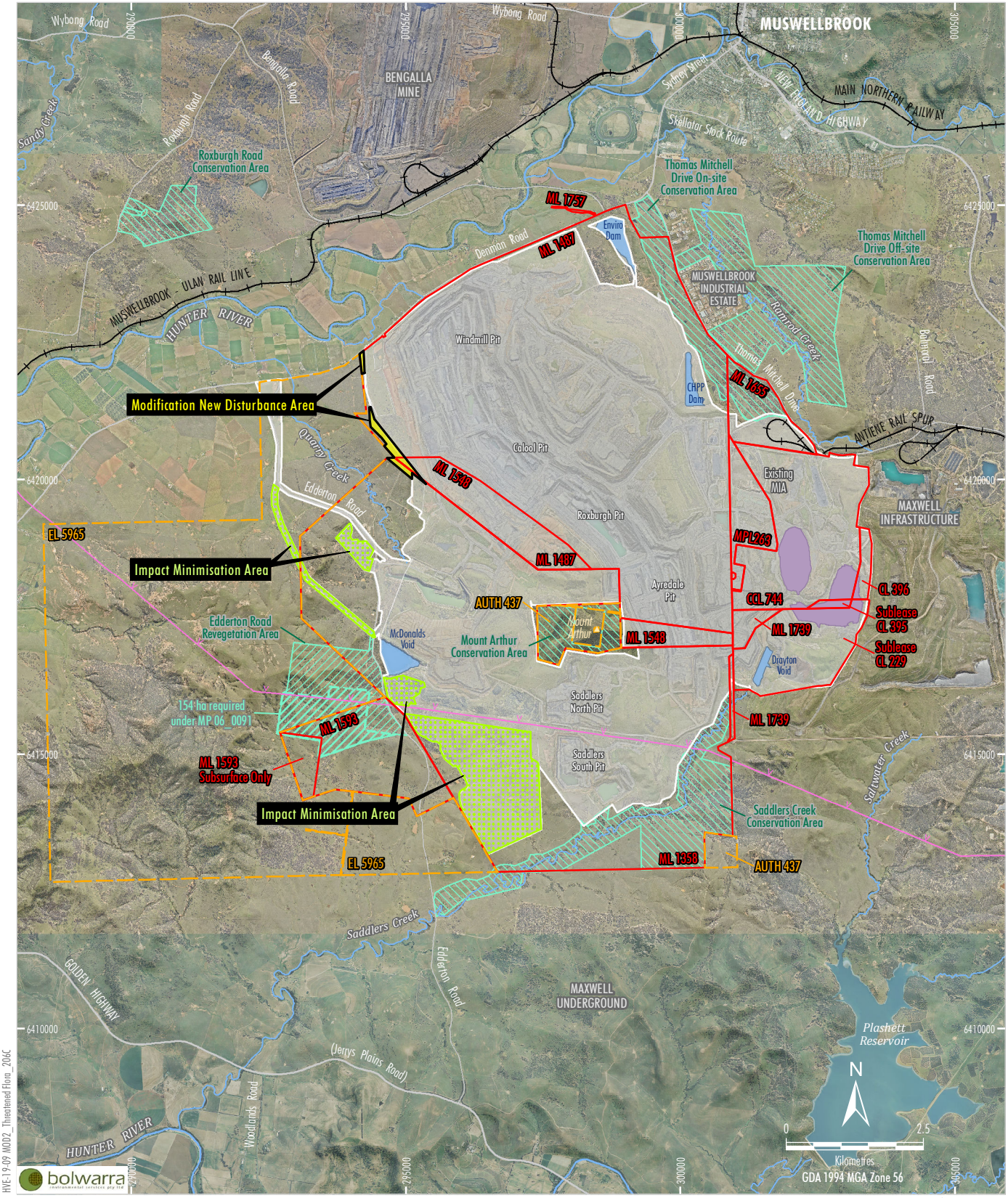
BHP

MT ARTHUR COAL MINE MODIFICATION 2

Regional Location

Figure 1

HVE-19-09 MOD2_Threatened Flora_207C



HVE-19-09 MOD2_Threatened Flora_206C

bolwarra

Source: BHP (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: BHP (2022-2020)

LEGEND

- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Existing 500kV Electricity Transmission Line
- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Tailings Storage Facility
- Water Storage
- Modification New Disturbance Area
- Impact Minimisation Area

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Modification General Arrangement

Figure 2

1.3 OBJECTIVES

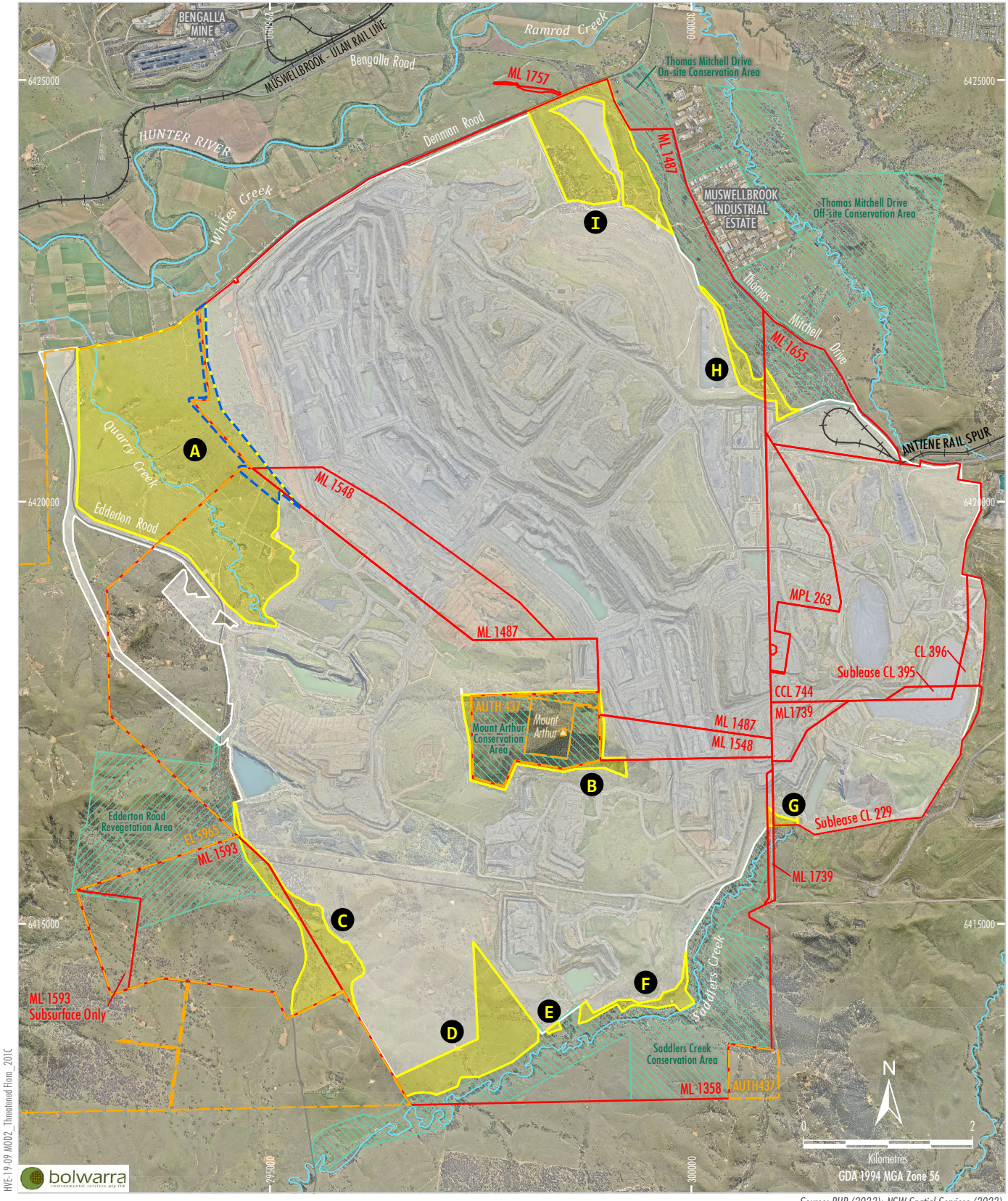
The objectives of this report are to:

- target species and populations listed as threatened under the NSW *Biodiversity Conservation Act, 2016* (BC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act); and
- where threatened species are present, determine the number of individuals or area of habitat.

Threatened flora surveys were undertaken in a series of study areas around the Mt Arthur Coal Mine (designated as Study Areas A to I) as well as within the study area for the Modification (Figure 3).

The study area for the Modification is approximately 35 hectares (ha) in size and is located immediately west of the active Northern Open Cut Pits from the south side of old Edderton Road in the south to Denman Road in the north (Figure 3).

The study area for the Modification is highly disturbed and mostly derived native grassland. The Plant Community Types (PCTs) and vegetation zones in the study area for the Modification were identified by Dr Colin Driscoll (Hunter Eco) and are shown on Figure 4. Target species, locations of suitable habitat requiring survey and transect spacing for the relevant threatened flora species each vegetation zone were provided by Dr Colin Driscoll (Hunter Eco) and used to prepare a survey plan.



HVE-19-09 MOD2_Threatened Flora_201C

Source: BHP (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

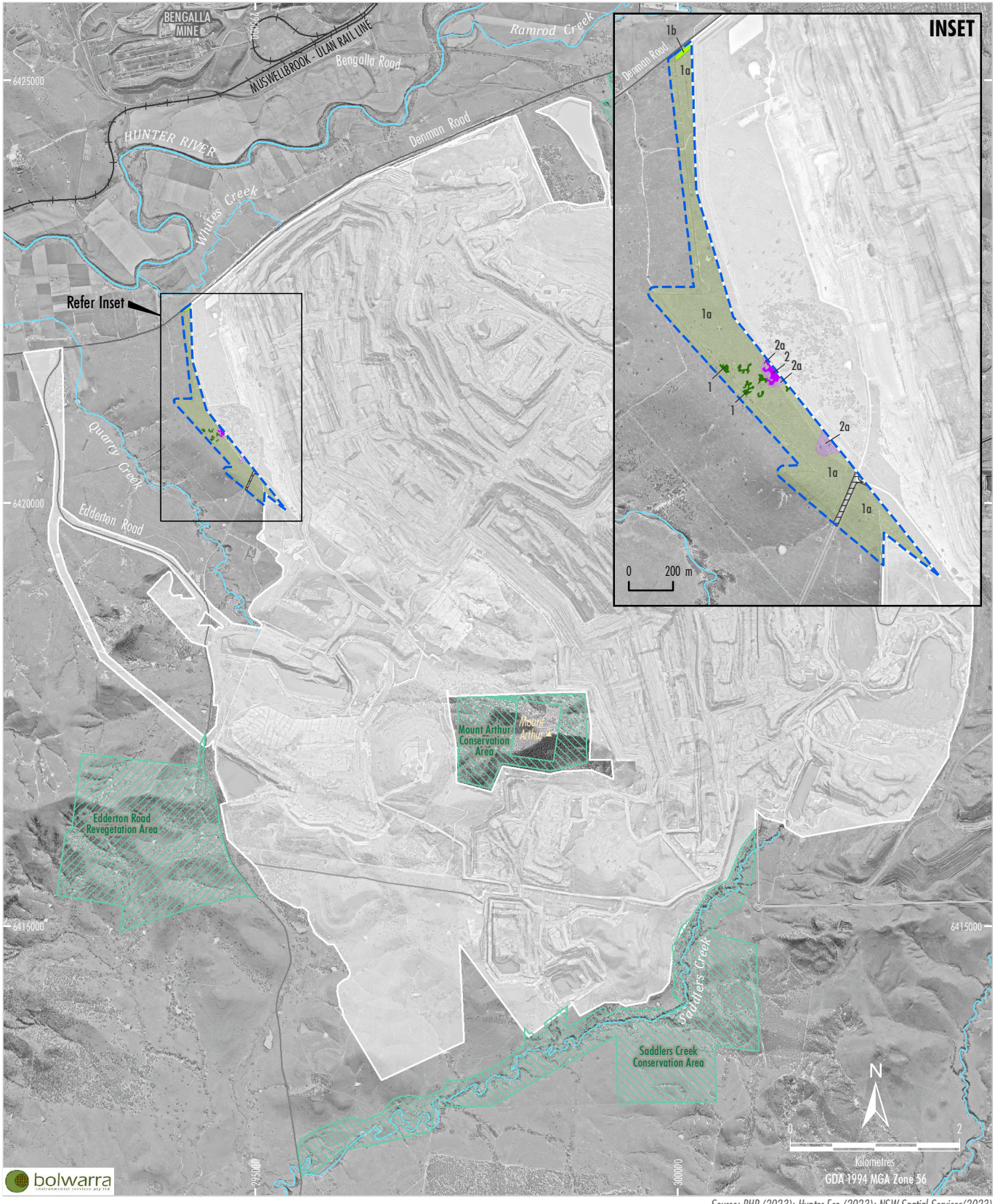
- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Study Area - Mt Arthur Coal Mine
- Study Area - Modification

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Threatened Flora Study Areas

Figure 3



HVE-19-09 MOD2_Threatened Flora_205C

Source: BHP (2023); Hunter Eco (2023); NSW Spatial Services(2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Study Area - Modification

Vegetation Communities

- 1. Grey Box x White Box Grassy Woodland (PCT 483) [1]
- 1a. Grey Box x White Box Grassy DNG (PCT 483) [1]
- 1b. Plantation (PCT 483)
- 2. Slaty Box Woodland (PCT 1655) [2]
- 2a. Slaty Box (DNG) (PCT 1655)
- Cleared Land

[1] Equivalent to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the EPBC Act and BC Act

[2] Equivalent to the Hunter Valley Footslopes Slaty Gum Woodland listed under the BC Act and the Central Hunter Valley Eucalypt Forest and Woodland CEEC Listed under the EPBC Act

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Vegetation Mapping

Figure 4

2 METHODOLOGY

Surveys were undertaken in accordance with the *Surveying Threatened Plants and their Habitats: NSW Survey Guide for the Biodiversity Assessment Method* (2020) (the Guide) (DPIE, 2020b). The survey design was undertaken by Hunter Eco with 5m, 10m and 100m grid based transect point files and PCT mapping for the study area provided to the ecologists, Matthew Bailey and Garon Staines/Alex Dudley undertaking the surveys.

2.1 TARGET SPECIES

Dr Colin Driscoll (Hunter Eco) established a list of potentially occurring threatened species and populations to target considering the likely PCTs in study areas around the Mt Arthur Coal Mine and previous threatened flora species records. The scope of work involved targeted surveys for the threatened species and population listed in Table 1.

Table 1
Target Threatened Flora Species in Study Areas around the Mt Arthur Coal Mine

Scientific Name	Common Name	BC Act Status*	EPBC Act Status*
Acacia pendula population in the Hunter catchment	Weeping Myall	EP	-
Diuris tricolor	Pine Donkey Orchid	V/EP	-
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V
Cymbidium canaliculatum population in the Hunter catchment	Tiger Orchid	EP	-
Cynanchum elegans	White-flowered Wax Plant	E	E
Eucalyptus camaldulensis population in the Hunter catchment	River Red Gum	EP	-
Eucalyptus glaucina	Slaty Red Gum	V	V
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V
Eucalyptus pumila	Pokolbin Mallee	V	V
Monotaxis macrophylla	Large-leafed Monotaxis	E	-
Ozothamnus tesselatus	-	V	V
Persicaria elatior	Tall Knotweed	V	V
Pimelea curviflora var. *curviflora*	-	V	V
Pomaderris bodalla	Bodalla Pomaderris	V	-
Pomaderris queenslandica	Scant Pomaderris	E	-
Pomaderris reperta	Denman Pomaderris	CE	CE
Prasophyllum petilum	Tarengo Leek Orchid	E	E
Prostanthera cineolifera	Singleton Mint Bush	V	V
Prostanthera cryptandroides subsp. *cryptandroides*	Wollemi Mint-bush	V	V
Pterostylis chaetophora	Rustyhood Orchid	V	-
Thesium australe	Austral Toadflax	V	V

*Threatened species status listed under the BC Act and EPBC Act, current as at February 2023; V = Vulnerable, E = Endangered, EP = Endangered Population.

Of the species listed in Table 1, only the Weeping Myall, Pine Donkey Orchid and *Cymbidium canaliculatum* were known to occur near the study area prior to the survey. None of the other species in Table 1 have been previously recorded at the Mt Arthur Coal Mine. Table 2 demonstrates that the survey requirements have been met for the threatened species and populations associated with the PCTs in the study area for the Modification based on the Department of Planning and Environment (DPE) (2023). The likelihood of each species occurring is also included in Table 2.

Table 2
Targeted Survey within the Study Area Associated with the Modification

Scientific Name	Common Name	Growth Form Group	BC Act Status*	EPBC Status*	Likelihood of Occurrence Prior to the Survey	Survey Requirement (Timing, PCTs and Transect Width) (DPE, 2022; DPIE, 2020b)	Survey Effort (Timing, PCTs, Methodology and Transect Width)	Guideline Met
Acacia pendula population in the Hunter catchment	Weeping Myall	Trees	EP	-	Possible	Any month, PCTs 1655 and 483, 40 metres (m) transect	All surveys, all PCTs, 5-10 m transects	Yes
Diuris tricolor	Pine Donkey Orchid	Orchids	V/EP	-	Possible	September and October, PCT 1655, 10 m transect	September 2021, all PCTs, 100 m transect October 2022, all PCTs, 5-10 m transects	Yes
Cryptostylis hunteriana	Leafless Tongue Orchid	Orchids	V	V	Unlikely, the closest records of this species are along the NSW coast (DPE, 2023).	November to January, PCT 1655, 10 m transect		Yes
Cymbidium canaliculatum population in the Hunter catchment	Tiger Orchid	Orchids	EP	-	Possible	Any month, PCT 1655, 10 m transect	All surveys, all PCTs, 5-10 m transects	Yes
Eucalyptus pumila	Pokolbin Mallee	Trees	V	V	Unlikely, potential habitat too degraded and restricted to one area near Pokolbin (DPE, 2023)	Any month, PCT 1655, 40 m transect	All surveys, all PCTs, 5-10 m transects	Yes
Monotaxis macrophylla	Large-leafed Monotaxis	Herbs and Forbs	E	-	Unlikely, no recent fire in the study area and no suitable habitat as grows on rocky ridges and hillsides, coastal heath, arid shrubland, forests	August to Feburary, PCT 483, 10 m transect		No fire

Scientific Name	Common Name	Growth Form Group	BC Act Status*	EPBC Status*	Likelihood of Occurrence Prior to the Survey	Survey Requirement (Timing, PCTs and Transect Width) (DPE, 2022; DPIE, 2020b)	Survey Effort (Timing, PCTs, Methodology and Transect Width)	Guideline Met
					and montane heath (DPE, 2023)			
Ozothamnus tesselatus	-	Shrubs	V	V	Unlikely, potential habitat too degraded	September, October, PCT 1655, 10 m transect	September 2021, all PCTs, 100 m transect October 2022, all PCTs, 5-10 m transects	Yes
Pomaderris queenslandica	Scant Pomaderris	Shrubs	E	-	Unlikely, unsuitable habitat in the study area as it is found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks (DPE, 2023).	Any month, PCT 1655, 10 m transect	All surveys, all PCTs, 5-10 m transects	Yes
Pomaderris reperta	Denman Pomaderris	Shrubs	CE	CE	Unlikely, potential habitat too degraded and restricted to the Denman area (DPE, 2023).	September to November, PCT 1655, 10 m transect	September 2021, all PCTs, 100 m transect October 2022, all PCTs, 5-10 m transects	Yes
Prostanthera cineolifera	Singleton Mint Bush	Shrubs	V	V	Unlikely, unsuitable habitat in the study area as it grows on sandstone ridges and restricted to only a few localities near Scone, Cessnock and St Albans (DPE, 2023).	September to October, PCT 1655, 10 m transect		Yes

Scientific Name	Common Name	Growth Form Group	BC Act Status*	EPBC Status*	Likelihood of Occurrence Prior to the Survey	Survey Requirement (Timing, PCTs and Transect Width) (DPE, 2022; DPIE, 2020b)	Survey Effort (Timing, PCTs, Methodology and Transect Width)	Guideline Met
Prostanthera cryptandroides subsp. *cryptandroides*	Wollemi Mint-bush	Shrubs	V	V	Unlikely, unsuitable habitat in the study area as it occurs on rocky ridgelines on Narrabeen Group Sandstones (DPE, 2023).	September to November, PCT 1655, 10 m transect		Yes
Thesium australe	Austral Toadflax	Herbs and Forbs	V	V	Possible	November to February, PCT 1655, 10 m transect	All surveys, all PCTs, 5-10 m transects (note: Austral Toadflax was recorded outside of the study area in October)	Yes

*Threatened species status listed under the BC Act and EPBC Act, current as at February 2023; V = Vulnerable,
E = Endangered, EP = Endangered Population.
^Months of survey from the BioNet Threatened Species Profile Database (DPE 2023).

2.2 SURVEY DETAILS

Three rounds of surveys were undertaken between September 2021 and October 2022 (Table 3).

Table 3
Survey Timing

Survey Period	Dates	Location	Time (Hours)
Round 1	**20 September 2021 to 8 October 2021**		
	20 September 2021 & 21 September 2021	Study Area C - 10m parallel transects.	28
	22, 23, 24, 27, 28, 29, 30 September 2021	Study Area A - 10 & 100m parallel transects.	121
	30 September 2021, 1 October 2021, 4 October 2021, 5 October 2021	Study Area B - 10m parallel transects.	61
	6 October 2021 & 7 October 2021	Study Area E & F - 10m parallel transects.	35
	8 October 2021	Study Area G - 10m parallel transects.	4
	8 October 2021	Study Area H - 10m parallel transects.	8
Round 2	**1 to 7 December 2021**		
	1, 2, 3, 4, 5 December 2021	Study Area A - 5m parallel transects.	28
	5 December 2021	Study Area A - 5m parallel transects.	121
	6 December 2021	Study Area A via 100m transects	61
Round 3	**4 to 11 October 2022**	**Study area for the Modification**	**52.5**
		Total	**519.5**

In addition to the above, Dr Colin Driscoll (Hunter Eco 2023) watched for the target threatened flora species through the flora survey work he completed in the study area (e.g. identification of each tree, floristic plots, vegetation mapping and flora species list compilation).

The weather conditions preceding the surveys in 2021 consisted of above average yearly rainfall with above average late summer/early autumn rainfall coupled with close to average rainfall across winter (BoM 2021). The weather conditions preceding the surveys in 2022 consisted of above average yearly rainfall including winter and autumn prior to the October 2022 survey period (BoM 2022).

Daily weather conditions during the survey period are reported in Table 4.

Table 4
Weather Conditions – BoM Scone Airport AWS (station 061363)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)
20/09/21	2.8	25	0
21/09/21	5.6	15.1	0.2
22/09/21	-0.1	19.5	0
23/09/21	2.1	23.8	0
24/09/21	4.7	25.9	0
27/09/21	1.7	21.9	0
28/09/21	4.1	24.9	0
29/09/21	11.8	22.7	1.4
30/09/21	8.5	25	13.8
1/10/21	11.1	24.2	10.4
4/10/21	10.1	25	0
5/10/21	9.2	21	0
6/10/21	4.2	24.3	0
7/10/21	5	25.9	0
8/10/21	10.9	25.4	0
1/12/2021	18	27.1	2.8
2/12/2021	17.9	28.2	0.2
3/12/2021	14.5	33.9	0
4/12/2021	18.4	29.2	0
5/12/2021	15.5	23.5	1.4
6/12/2021	11.1	24.4	0
7/12/2021	16.3	29.1	11.4
1/10/22	9.3	19	3.6
2/10/22	4.7	19.3	0
3/10/22	5.7	19.6	0
4/10/22	3.1	23.9	0
5/10/22	9.2	16.5	0
6/10/22	12.1	18.8	7.8
7/10/22	10	19.4	0.2
8/10/22	13	22.4	20.6
9/10/22	12.6	18.6	27.2
10/10/22	7	20.6	2.8
11/10/22	6.1	21.4	0
12/10/22	6.2	22.4	0
13/10/22	8.2	24.0	0

Note: Degrees Celsius = (°C) and millimetres = (mm)
Source: BoM 2022 accessed 14/10/2022

2.2.1 Round 1 – September to October 2021

The initial round of surveys was conducted from 20 September 2021 to 8 October 2021 across Study Areas A to I (including the Modification study area). Study Areas A, B, E, F and G were wholly surveyed while Study Areas C and H were partly surveyed (Figure 5a to 5g).

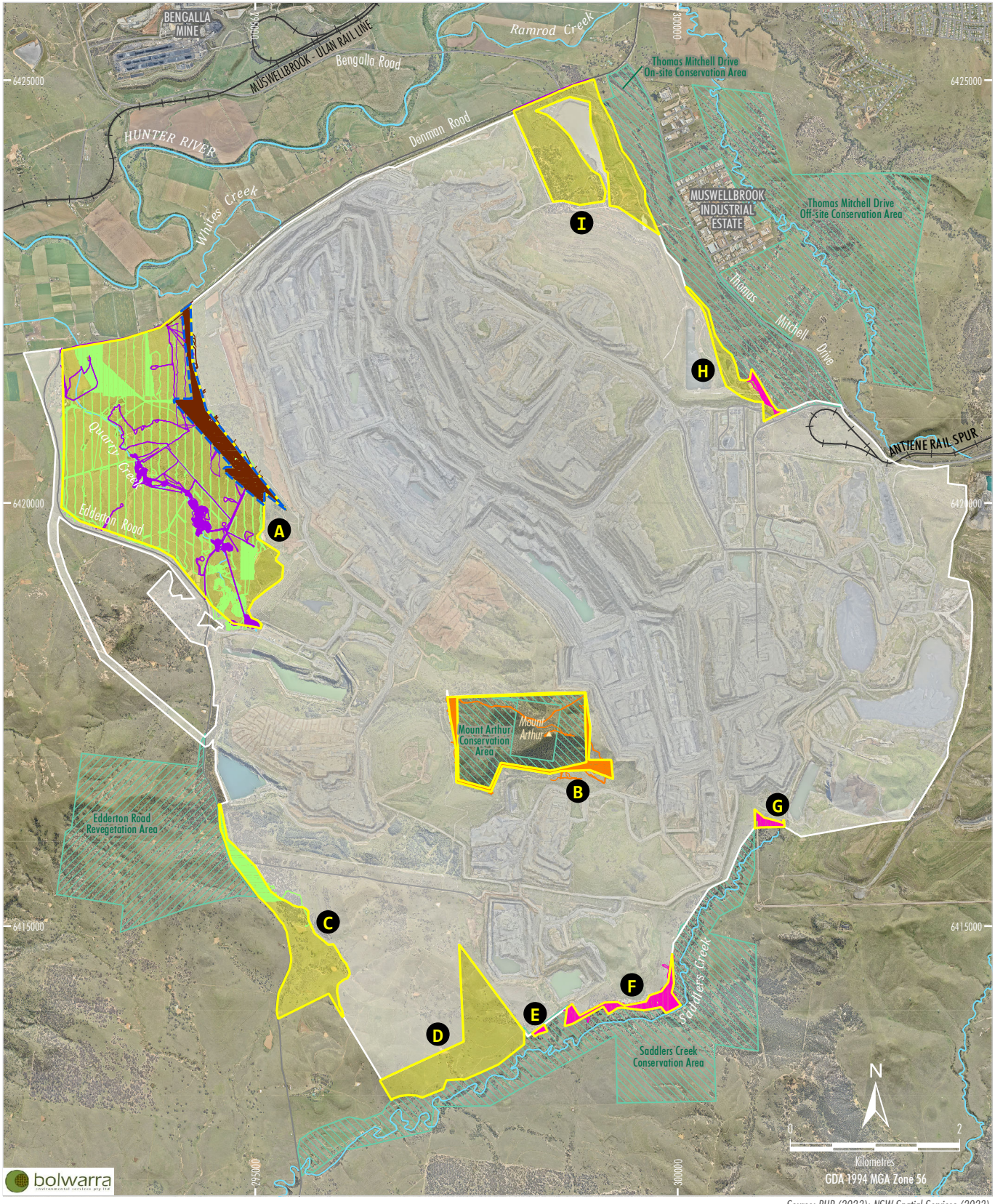
These surveys were undertaken by Matthew Bailey (NSW Scientific Licence 100005, BAM Accreditation BAAS18021) and Garon Staines. Hunter Eco provided 10 m (both 10 m and 100 m transect point files for Study Area A provided) grid based transect point files. These 10 m grid point files were uploaded into Garmin GPSMAP 66s handheld Global Positioning System (GPS) units which were used to navigate and log tracks during the survey.

Northern portions of Study Area A were initially surveyed on 10 m transect. Subsequently Hunter Eco revised the survey plan for the remainder of Study Area A to 100 m transects given the large size of the study area. Survey tracks and detail of each Study Area are shown on Figure 5b to 5g.

The areas surveyed had not been slashed, burnt or logged recently with only minor portions showing evidence of recent grazing by cattle. A dense to moderately dense ground cover consisting of browned off exotic and native grass and herb species together with exotic annuals, including Saffron thistle (*Carthamus lanatus*), was generally present in the derived native grassland areas. Dead Saffron thistle was particularly abundant in Study area A forming dense swathes in part with most of this area dominated by exotics. Groundcover was moderately dense to sparse within woodland and open forest communities. The two yellow flowering species present occasionally; Fireweed (*Senecio madagascariensis)* and Yellow Buttons (*Chrysocephalum apiculatum*) were easily distinguishable from up to 10m. Any yellow flowering species was identified during the survey so that any occurrence of flowering *D. tricolor* would be detected.

Across the original study areas, the presence of fences, steep eroding banks, steep areas, wombat burrows, rabbit warrens, fallen trees, standing trees, dense thickets of African Boxthorn (*Lycium ferocissimum)* and Velvet Mock Olive (*Notelaea macrocarpa)* necessitated minor deviations at times during the field survey from pre-survey grid transect lines. In such instances the grid mapped transect line was visually observed from the adjacent area, with binoculars, if necessary, to ensure adequate coverage as per the Guide.

A reference site of *Diuris tricolor* within a HVEC conservation area adjacent to Thomas Mitchell Drive, approximately 600 m east of Study Site H, was inspected on 20 September 2021 which confirmed that this species was flowering during the survey period. At this location *Diuris tricolor* was flowering abundantly which is attributed to the above average late summer/early autumn rainfall coupled with close to average rainfall across winter (BoM 2021).



Source: BHP (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Study Area - Mt Arthur Coal Mine
- Study Area - Modification

Survey Transects

- 2021 September (Study Area A and C)
- 2021 September-October (Study Area B)
- 2021 October (Study Area E to H)
- 2021 December (Study Area A)
- 2022 October (Modification Study Area)

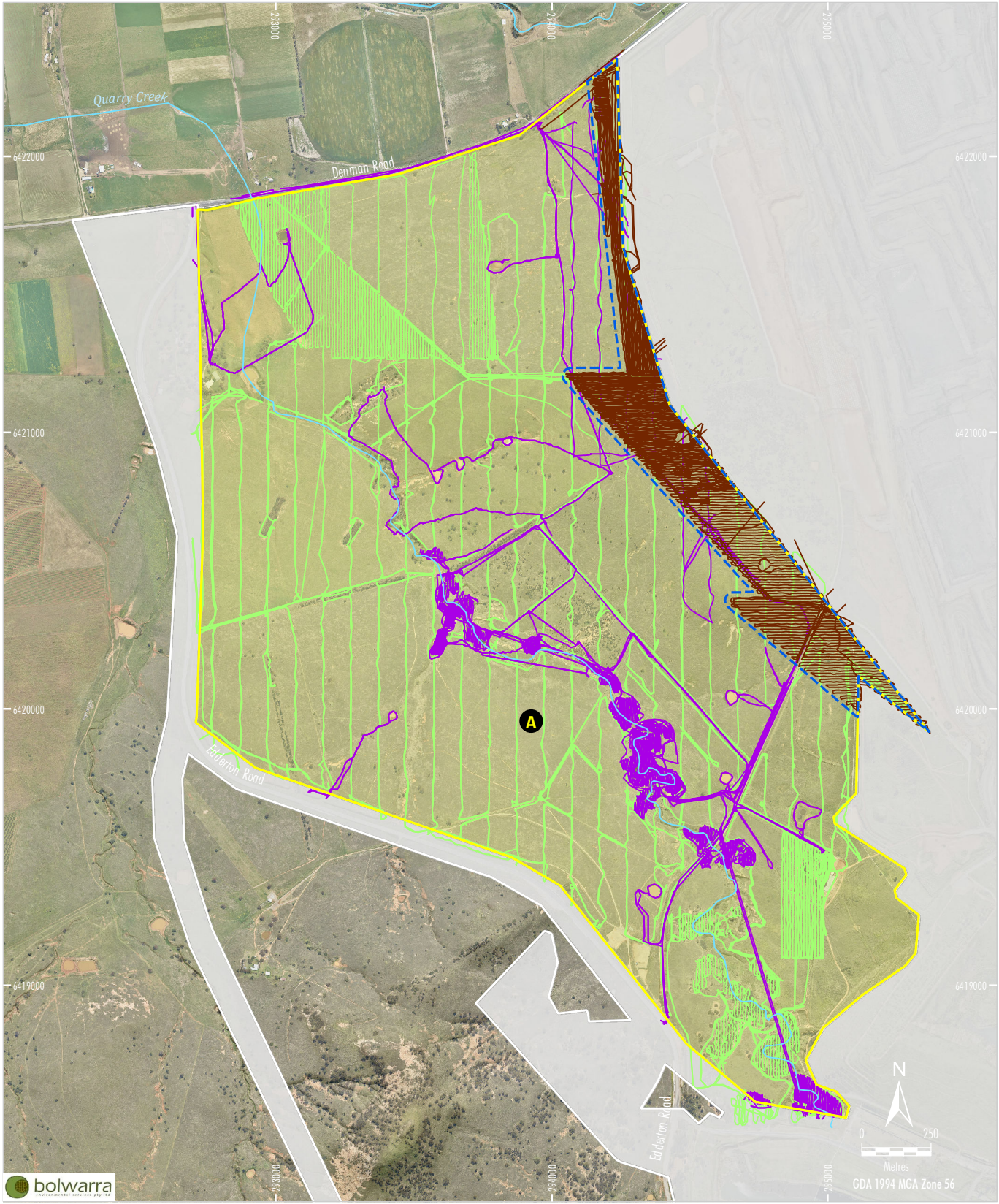
HVE-19-09 MOD2_Threatened Flora_204E

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Survey Transects

Figure 5a



HVE-19-09 MOD2_Threatened Flora_208E

Source: BHP (2023); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

LEGEND

- Approximate Extent of Existing/Approved Surface Development
- Study Area - Mt Arthur Coal Mine
- Study Area - Modification

Survey Transects

- 2021 September-October (Study Area A)
- 2021 December (Study Area A)
- 2022 October (Modification Study Area)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Survey Transects
Mt Arthur Coal Mine - Study Area A

Figure 5b

HVE-19-09 MOD2_Threatened Flora_208E

LEGEND

Existing Conservation/Offset Area

Approximate Extent of Existing/Approved Surface Development

Study Area - Mt Arthur Coal Mine

Survey Transects

2021 September-October (Study Area B)

Source: BHP (2023); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Survey Transects
Mt Arthur Coal Mine - Study Area B

Figure 5c

HVE-19-09 MOD2_Threatened Flora_208E

Source: BHP (2023); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

LEGEND

Edderton Road Revegetation Area

Approximate Extent of Existing/Approved Surface Development

Study Area - Mt Arthur Coal Mine

Survey Transects

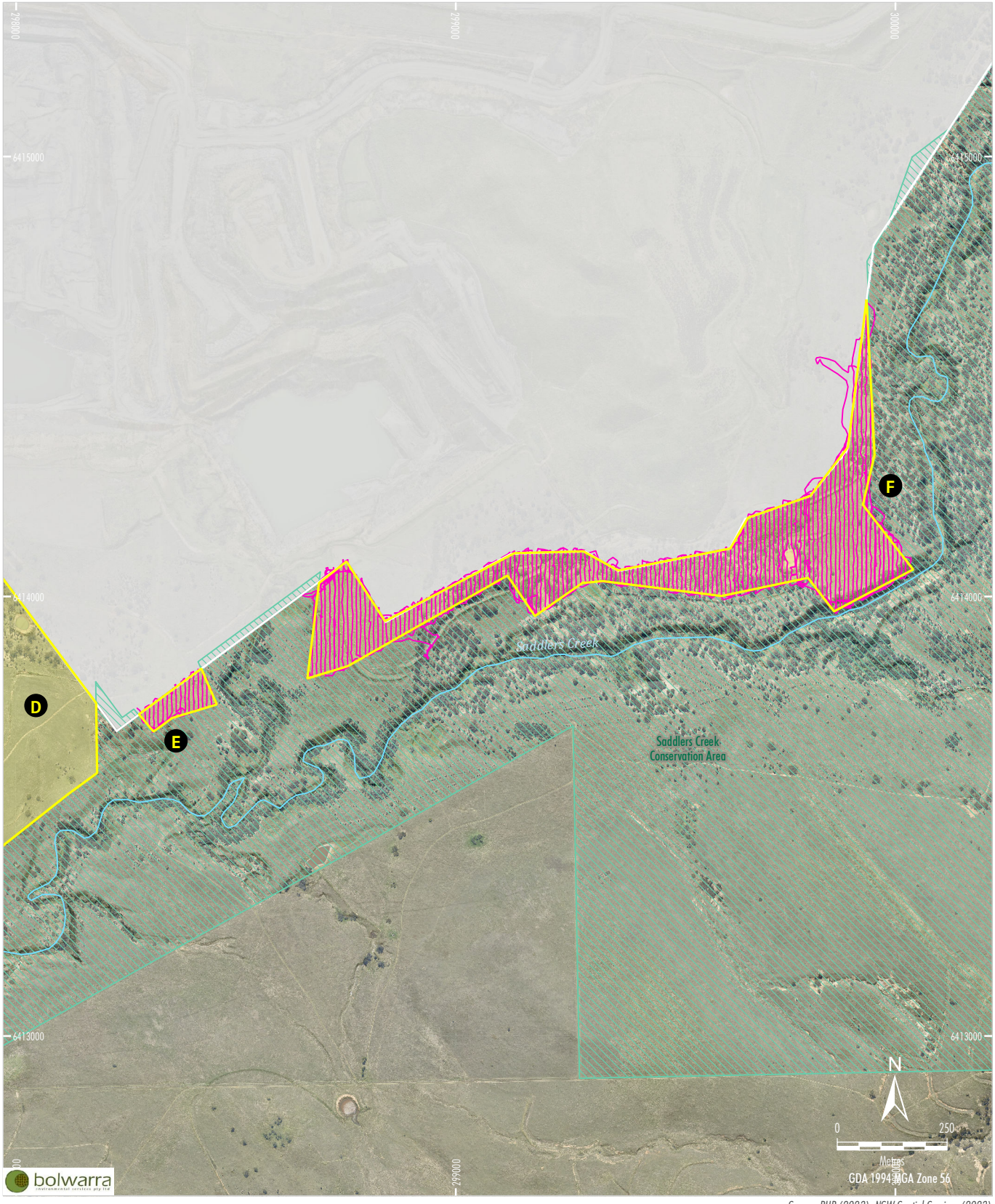
2021 September (Study Area C)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Survey Transects
Mt Arthur Coal Mine - Study Area C

Figure 5d



Source: BHP (2023); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

LEGEND

Existing Conservation/Offset Area

Approximate Extent of Existing/Approved Surface Development

Study Area - Mt Arthur Coal Mine

Survey Transects

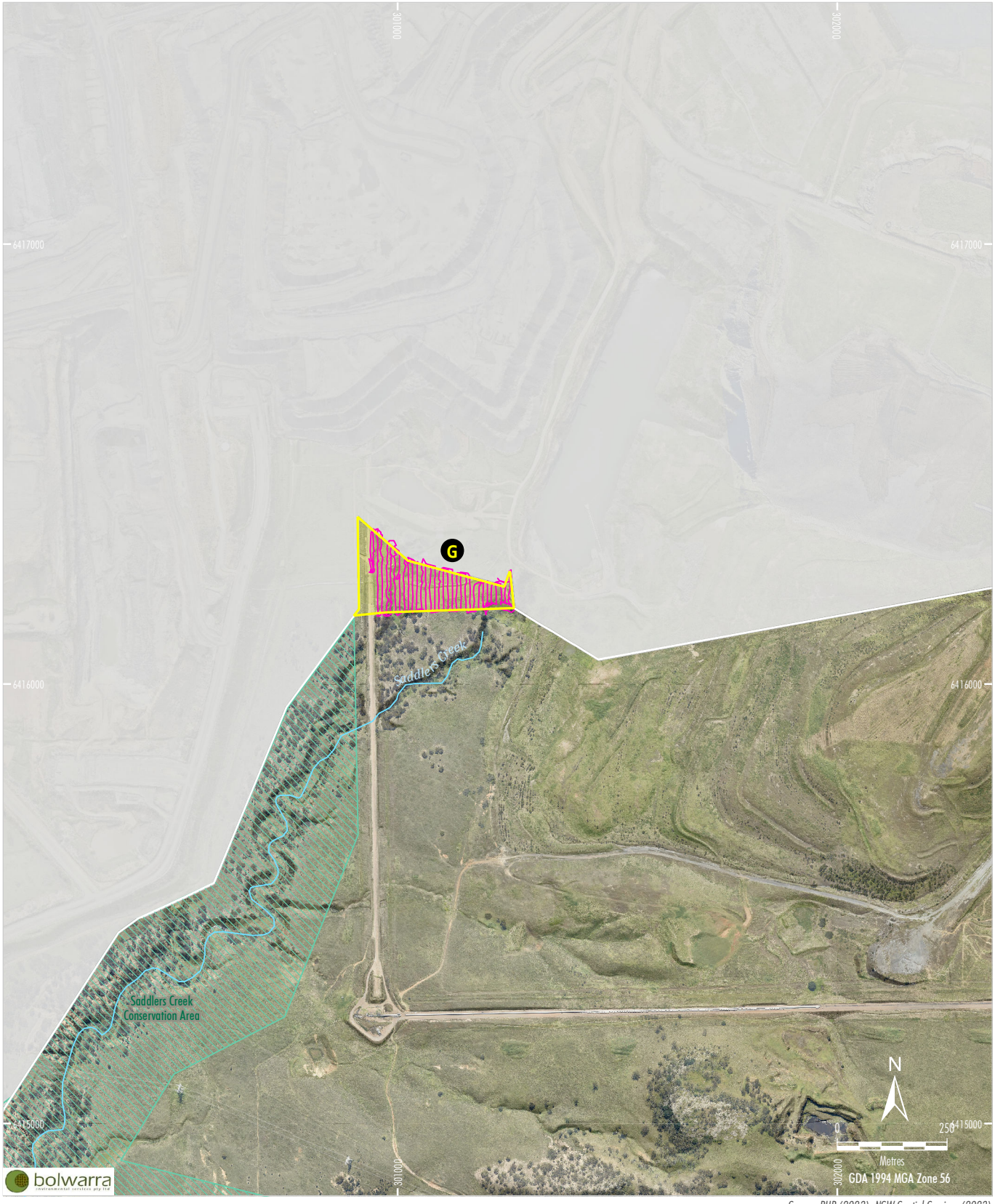
2021 October (Study Area E and F)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Survey Transects
Mt Arthur Coal Mine - Study Area E & F

Figure 5e



HVE-19-09 MOD2_Threatened Flora_208E

LEGEND

Existing Conservation/Offset Area

Approximate Extent of Existing/Approved Surface Development

Study Area - Mt Arthur Coal Mine

Survey Transects

2021 October (Study Area G)

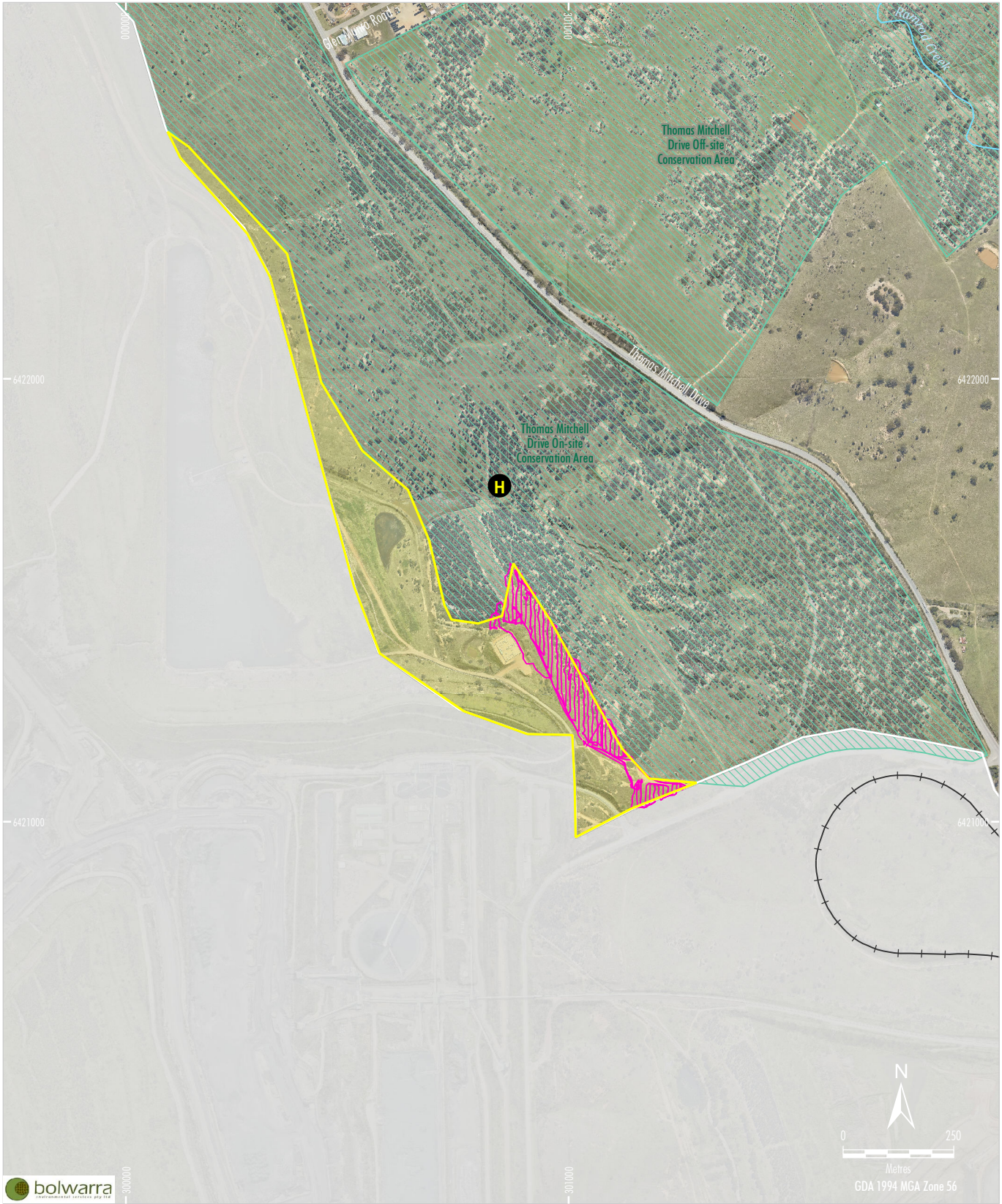
Source: BHP (2023); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Survey Transects
Mt Arthur Coal Mine - Study Area G

Figure 5f



HVE-19-09 MOD2_Threatened Flora_208E

LEGEND

Existing Conservation/Offset Area

Approximate Extent of Existing/Approved Surface Development

Study Area - Mt Arthur Coal Mine

Survey Transects

2021 October (Study Area H)

Source: BHP (2023); NSW Spatial Services (2023)
Aerial Mosaic: MAC (2022-2020)

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Survey Transects
Mt Arthur Coal Mine - Study Area H

Figure 5g

2.2.2 Round 2 – December 2021

The second round of surveys occurred from 1 to 7 December 2021 within the original Study Area A, including the majority of the study area associated with the Modification. These surveys were undertaken by Matthew Bailey and Alex Dudley. Transect point files for 5 m and 100 m transects, dam locations and PCT mapping for the study area were provided by Hunter Eco. The grid point files were uploaded into Garmin GPSMAP 66s handheld GPS units which were used to navigate and log tracks during the survey. Figure 5b shows the Round 2 survey tracks.

Austral Toadflax (*Thesium australe*) was detected in the previous September/October 2021 survey and was considered detectable in that survey period and therefore not requiring survey within this survey. Nevertheless, Austral Toadflax was searched for within the transects targeting Tall Knotweed (*Persicaria elatior*) and Leafless Tongue Orchid (*Cryptostylis hunteriana*) as well as a portion of PCT 483 - Hybrid White/Grey Box Derived Native Grassland of Study Area A via 100 m transects.

As per round 1, the presence of fences, steep eroding banks, steep areas, wombat burrows, rabbit warrens, fallen trees, standing trees, dense thickets of African Boxthorn (*Lycium ferocissimum)* and Velvet Mock Olive (*Notelaea macrocarpa*) necessitated minor deviations at times during the field survey from pre-survey grid transect lines. In such instances the grid mapped transect line was visually observed from the adjacent area, with binoculars, if necessary, to ensure adequate coverage as per the Guide.

The areas surveyed had not been slashed, burnt or logged recently with only minor portions showing evidence of recent grazing by cattle. A dense to moderately dense ground cover consisting of browned off exotic and native grass and herb species together with exotic annuals, including Saffron thistle (*Carthamus lanatus*), was generally present in the derived native grassland areas. Dead Saffron thistle was particularly abundant in Study area A forming dense swathes in part with most of this area dominated by exotics. Groundcover was moderately dense to sparse within woodland and open forest communities.

2.2.3 Round 3 – October 2022

A third round of survey was undertaken from October 4 to 11 in 2022 in the study area associated with the Modification. Targeted surveys were undertaken by Matthew Bailey and consisted of parallel field transect surveys according to the Guide (DPIE, 2020a). Surveys targeted all species listed in Table 1 above, except for those highlighted which were already surveyed in Round 2.

Hunter Eco provided 5 m and 10 m grid based transect point files and PCT mapping for the study area. These 5 m and 10 m grid point files were uploaded into a Garmin GPSMAP 66s handheld GPS unit which was used to navigate and log tracks during the survey. The level of survey effort was considered to be consistent with the Guide (DPIE, 2020b) with approximately 52.5 hours of parallel transect surveying undertaken across the study area.

The areas surveyed had not been burnt or logged recently. An approximate 600m section of the site in the north adjoining Denman Road appeared to have been slashed during winter. Given the Pine Donkey Orchid is deciduous, losing its leaves over winter, with regrowth from a tuber near the end of spring, any occurrences would have been highly detectable in this area also. Across the majority of the site the ground layer consisted of browned off exotic and native grass (mostly laid over and matted) and herb species together with exotic annuals, including Fireweed (*Senecio madagascariensis*), Purpletop (*Verbena bonariensis*) and Saffron thistle (*Carthamus lanatus*). Dead Saffron thistle was particularly abundant in the study site forming dense swathes in part with most of this area dominated by exotics.

The two yellow flowering species present occasionally; Fireweed (*Senecio madagascariensis)* and Yellow Buttons (*Chrysocephalum apiculatum*) were easily distinguishable from up to 10m. Any yellow flowering species was identified during the survey so that any occurrence of flowering *D. tricolor* would be detected.

The presence of fences, rabbit warrens, fallen trees, standing trees, dense thickets of African Boxthorn (*Lycium ferocissimum)* necessitated minor deviations at times during the field survey from pre-survey grid transect lines. In such instances the grid mapped transect line was visually observed from the adjacent area, with binoculars, if necessary, to ensure adequate coverage as per the Guide. Two bare earth patches were not traversed as nil vegetation was present (see Figure 3).

Approximately 1.45 km of transects in the north of the study area from Denman Rd were surveyed on 5 m transect gridlines confirming the open structure of the ground layer, very high exotic species cover, low diversity and lack of any Orchidaceae. Subsequently Hunter Eco revised the survey plan for the remainder of the site so that the derived native grassland communities were surveyed on 10 m transects with the woodland communities surveyed on 5 m transects (Figure 5b).

Prior to conducting this targeted survey, the flowering status of *Diuris tricolor* was verified using a known population within a HVEC offset conservation area adjacent to Thomas Mitchell Drive, at the southern end. This reference site was inspected on 16 September 2022 by Mikael Peck and Bryan Furchert of Cumberland Ecology. At this location, *Diuris tricolor* was at the early flowering stages with some flowers open and others yet to open abundantly.

3 RESULTS

3.1 STUDY AREA FOR THE MODIFICATION

No threatened flora species or populations were recorded in the study area for the Modification.

Transects and meanders undertaken across the study area associated with the Modification in all survey rounds identified that much of it, apart from the minor woodland portions, did not represent potential habitat for the targeted species as this area was heavily modified by agricultural activities (Photos 1 and 2). It is likely that decades of cultivation, grazing by cattle and sheep, droughts, exotic species dominance and high rabbit abundance has severely impacted the potential for threatened orchid species or any members of the family Orchidaceae to occur.

Photo 1. Typical Ground Layer Condition in Modification Study Area (North) – October 2022

Photo 2. Typical Grazed Ground Layer Condition in Modification Study Area (South) – October 2022

Further to the above, Dr Colin Driscoll (Hunter Eco 2023) did not record any of the target threatened flora species through the flora survey work he completed in the study area for the Modification.

3.2 OTHER STUDY AREAS

Three flora species listed as a threatened species or populations were recorded during this survey, but outside of the study area for the Modification (Table 5).

Table 5
Recorded Threatened Flora Species and Populations

Scientific Name	Common Name	BC Act Status*	EPBC Status*	Survey Findings
Acacia pendula population in the Hunter catchment	Weeping Myall	EP	-	Eight Acacia pendula specimens were detected in the southern portion of Study Area A, in and nearby to a former farm building and infrastructure area (Figure 6 and Photos 3 and 4). A voucher specimen was confirmed by the Botanical Information Service of the Royal Botanic Gardens Sydney. Some of these plants held maturing seed pods which together with the small size of some plants indicate that reproduction is occurring in this location. The locations of these and the presence of other native planted trees near the infrastructure raise some questions regarding the origins of these *Acacia pendula* plants.

Scientific Name	Common Name	BC Act Status*	EPBC Status*	Survey Findings
Cymbidium canaliculatum population in the Hunter catchment	Tiger Orchid	EP	-	One large *Cymbidium canaliculatum* specimen was detected incidentally nearby (but outside of) to Study Area E (Figure 6 and Photos 5 and 6).
Thesium australe	Austral Toadflax	V	V	Approximately 150-200 *Thesium australe* plants within an approximate area of 1,490 m^2 were detected in and adjacent to Study Area E (Figure 6 and Photos 7 and 8). In the area of its occurrence there appeared to be greater inter tussock spaces. A voucher specimen was confirmed by the Botanical Information Service of the Royal Botanic Gardens Sydney.

Photo 3. *Acacia pendula* – Study Area A (South)

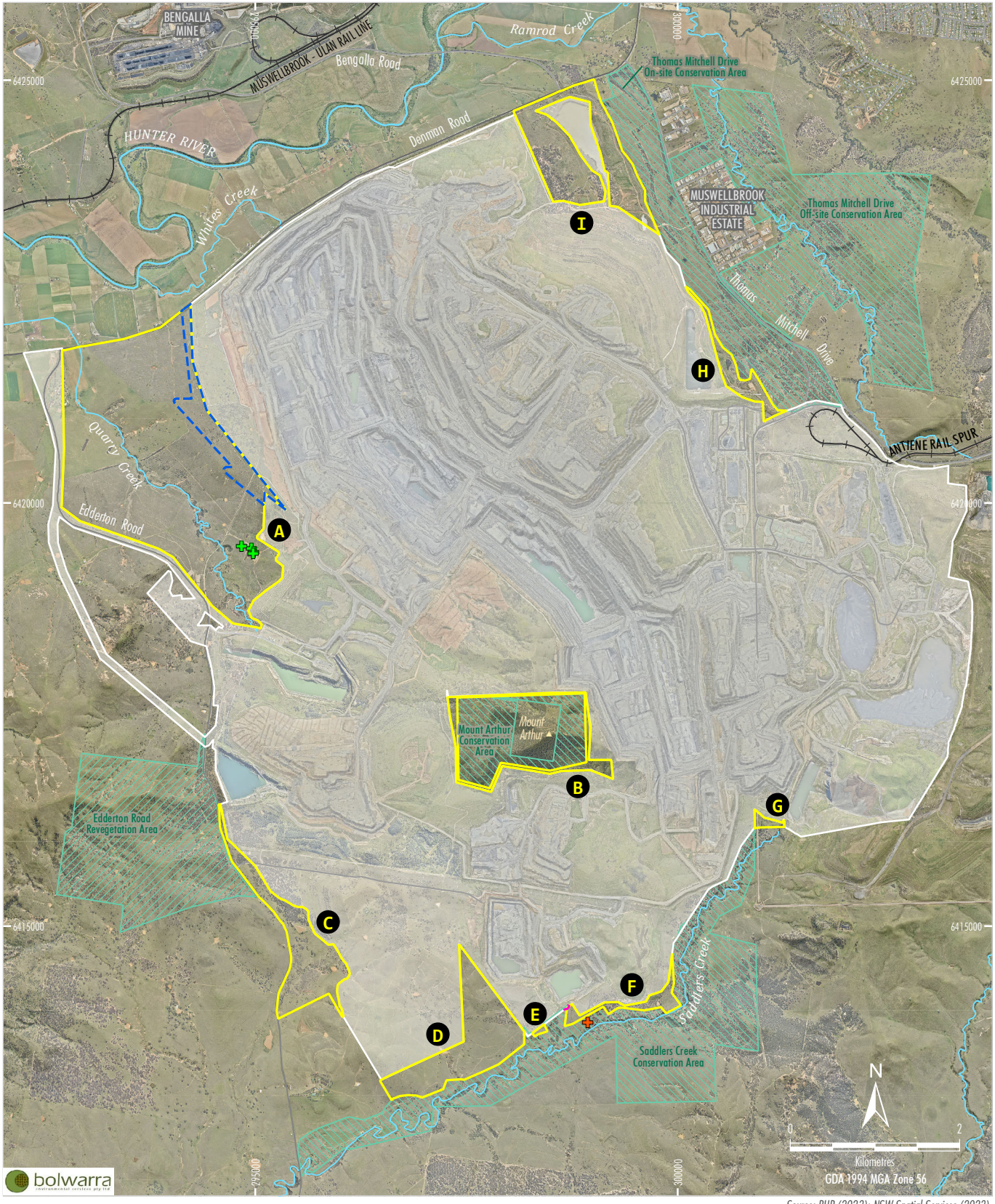
Photo 4. *Acacia pendula* – Farmhouse Grounds

Photo 5. Tiger Orchid Recorded near Study Area E

Photo 6. Tiger Orchid Recorded near Study Area E, Close Up

Photo 7. Austral Toadflax (*Thesium australe*) Plant Recorded in Study Area E

Photo 8. Austral Toadflax Habitat – Study Area E (Foreground)



Source: BHP (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Study Area - Mt Arthur Coal Mine
- Study Area - Modification

Threatened Flora Species

- *Acacia pendula*
- *Cymbidium canaliculatum*
- *Thesium australe*

HVE-19-09 MOD2_Threatened Flora_202C

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MT ARTHUR COAL MINE MODIFICATION 2

Threatened Flora Recorded During the Surveys

Figure 6

4 CONCLUSION

The target threatened flora species have been adequately surveyed within the study area for the Modification and the surveys in the wider surrounds provide additional information on the threatened flora species present at the mine site.

Three threatened species were recorded during the first round of surveys: Tiger Orchid, Austral Toadflax and *Acacia pendula*. However, these records are outside the study area associated with the Modification and not relevant to the Modification.

The typical ground layer condition within the study area associated with the Modification has been modified by cultivation, grazing and exotic species coverage, resulting in habitat that is unlikely to support any of the target threatened species. As no threatened species were recorded within the study area associated with the Modification during surveys, it considered unlikely for these species to be present.

5 REFERENCES

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Hunter Eco (2016) *Mt Arthur Coal Mine Open Cut Modification (2014/7377) – Threatened Orchid Survey*. Letter Report in Mt Arthur Coal Mine Open Cut Modification (EPBC 2014/7377) Preliminary Documentation. Hunter Valley Energy Coal 2016.

Hunter Eco (2023) *Mt Arthur Coal Mine Open Cut Modification 2 – Flora Survey Report*. Hunter Valley Energy Coal 2023.

ATTACHMENT C

MT ARTHUR MINE MODIFICATION 2 – FAUNA SURVEY REPORT

MT ARTHUR COAL MINE MODIFICATION 2
BASELINE FAUNA SURVEY REPORT

Prepared for Hunter Valley Energy Coal Pty Ltd

August 2023

PROJECT NAME	Mt Arthur Coal Mine Modification 2 - Baseline Fauna Survey Report		
PROJECT ADDRESS	Muswellbrook NSW		
PREPARED FOR	Hunter Valley Energy Coal Pty Ltd		
AUTHOR/S	Garon Staines		
VERSION	**Version**	**Draft/Final**	**Date to client**
	1.0	Draft V1	1/03/2023
		Draft V1A	07/08/2023
		Draft V1B	10/08/2023
		Draft V1C	14/08/2023

This report should be cited as: '*Future Ecology (2023) Mt Arthur Coal Mine Modification 2 - Baseline Fauna Survey Report. Prepared for Hunter Valley Energy Coal Pty Ltd (HVEC)*.'

Disclaimer

This report has been prepared by Future Ecology for Hunter Valley Energy Coal Pty Ltd (HVEC) and may only be used for the purpose agreed between these parties, as described in this report. The opinions, conclusions and recommendations set out in this report are limited to those set out in the scope of works and agreed between these parties. Future Ecology accepts no responsibility or obligation for any third party that may use this information or for conclusions drawn from this report that are not provided in the scope of works or following changes occurring subsequent to the date that the report was prepared.

The recommendations provided in this report are based on the results from currently accepted and naturally limited ecological survey techniques. Every effort is made and reasonable care taken to detect all threatened species that may have potential to occur in the locality.

Any representation, statement, opinion or advice expressed or implied in this report is made in good faith on the basis that Future Ecology Pty Ltd, its agents and employees are not liable (whether by reason of negligence, lack of care or otherwise) to any person for any damage or loss whatsoever which has occurred or may occur in relation to that person taking or not taking (as the case may be) action in respect of any representation, statement or advice referred to above.

Contents

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Executive Summary

The Mt Arthur Coal Mine (MAC) is an open cut coal mining operation situated approximately 5 kilometres (km) south-west of Muswellbrook in the Muswellbrook Local Government Area in the Upper Hunter Valley of New South Wales (NSW) (Figure 1). The MAC is owned and operated by Hunter Valley Energy Coal Pty Ltd (HVEC), a wholly owned subsidiary of BHP.

MAC is currently approved to operate until 30 June 2026 in accordance with NSW Project Approval MP 09_0062 (MP 09_0062). In June 2022, HVEC announced a decision to cease mining at MAC in 2030, as a plan to provide a pathway to closure of the operation. Accordingly, HVEC is seeking a modification of MP 09_0062 for a four-year extension of the MAC to 30 June 2030 (the Modification).

HVEC is seeking to modify MP 09_0062 under section 4.55(2) of the NSW *Environmental Planning & Assessment Act 1979*, and will include the following activities:

- four-year extension of mining activities to 30 June 2030;
- reduction in the approved open cut mining rate from 32 Million tonnes per annum (Mtpa) Run-of-Mine (ROM) to a maximum of 25 Mtpa ROM (similar to current actual ROM coal production);
- reduction in the cumulative open cut and underground ROM coal handling rate from 36 Mtpa to 29 Mtpa;
- reduction in maximum total (open cut and underground) coal rail transportation from 27 of product coal to 20 Mtpa, and a reduction in train movements from 30 to 20 movements per day;
- minor extension of the approved disturbance area in the north-west corner of the operation predominantly to allow for access and ancillary infrastructure (refer to Modification New Disturbance Area within Figure 2);
- an overall reduction in approved disturbance, as some previously approved areas are no longer intended to be disturbed (refer to Impact Minimisation Area within Figure 2); and
- revised final landform and final void configuration, including an overall reduction in the approved height of the northern overburden emplacement areas and the final landform (to reflect the current actual height).

This baseline fauna survey report has been prepared by Future Ecology for the Modification. The Modification New Disturbance Area is approximately 24.6 hectares and comprises:

- 0.7 ha of Woodland.
- 23.7 ha of Derived Native Grassland.
- 0.2 ha of Plantation.

Although the Modification New Disturbance Area is relatively small, the fauna surveys were undertaken over a series of study areas, totalling 930 ha, providing a contemporary understanding of threatened species and their habitat around the mine site.

There have been a number of fauna surveys previously undertaken at MAC since the year 2000. These previous reports provide a good background on the fauna likely to be present. Additional fauna surveys were completed by Future Ecology in 2021 and 2022 using a team of up to four ecologists including specialists in amphibians, reptiles, birds and mammals.

A variety of survey techniques were used in accordance with relevant NSW and National guidelines. Threatened fauna species listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and/or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) which are known or likely to occur in the study areas around the MAC were specifically targeted during the surveys.

Several broad fauna habitat types were observed within the study areas around the MAC, comprising aquatic, derived native grassland, disturbed, non-native, planted, wetland and woodland habitats. Most habitats showed evidence of historic and/or ongoing disturbance from grazing as well as mining infrastructure. Most woodland patches were small (<20 ha), fragmented and subject to weed invasion. Connectivity between woodland patches was generally poor across the study areas around the MAC. However, some fauna habitat features such as hollow bearing trees , dead trees, hollow logs and fallen timber, were present at most survey sites.

A total of 177 fauna species were recorded in the study areas around the MAC during the survey period including 14 amphibian, 14 reptile, 108 bird, and 41 mammal species. A total of 13 threatened fauna species currently listed under the BC Act (all listed as vulnerable) were recorded by Future Ecology with a definite confidence level in or immediately adjacent to the study areas around the MAC during the current surveys. Two threatened fauna species listed under the EPBC Act were recorded during the surveys, namely, the Spotted-tailed Quoll and Grey-headed Flying-fox.

Within the study area associated with the Modification New Disturbance Area (Study Area A), the Black Falcon and Speckled Warbler were the only threatened fauna species recorded. These two species are ecosystem species. The Modification New Disturbance Area is not likely to provide habitat for any species credit species. No threatened fauna species listed under the EPBC Act are likely to use the habitat in the Modification New Disturbance Area.

1 Introduction and Project Description

This fauna survey report forms part of a Modification Report which has been prepared to accompany an application to modify Project Approval MP 09_0062 (MP 09_0062) under section 4.55(2) of the *Environmental Planning & Assessment Act 1979* (EP&A Act).

1.1 Project Overview

The Mt Arthur Coal Mine (MAC) is an open cut coal mining operation situated approximately 5 kilometres (km) south-west of Muswellbrook in the Muswellbrook Local Government Area (LGA) in the Upper Hunter Valley of New South Wales (NSW) (Figure 1). The MAC is owned and operated by Hunter Valley Energy Coal Pty Ltd (HVEC), a wholly owned subsidiary of BHP.

MAC is currently approved to operate until 30 June 2026, in accordance with MP 09_0062. In June 2022, HVEC announced a decision to cease mining at the MAC in 2030, as part of a plan to provide a pathway to closure of the operation. Accordingly, HVEC is seeking a modification of MP 09_0062 for a four-year extension of the MAC to 30 June 2030.

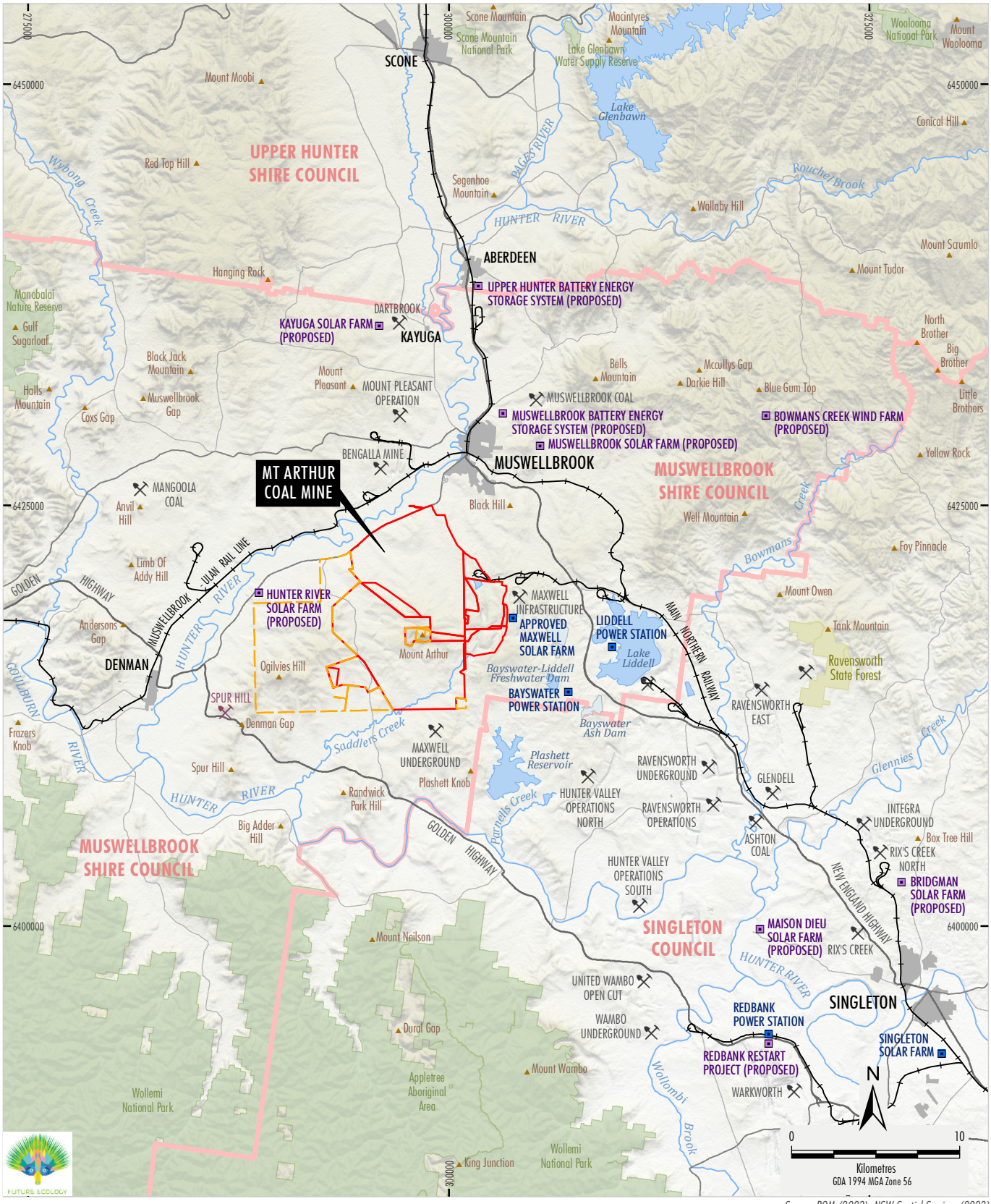
1.2 Modification Description

HVEC is seeking to modify MP 09_0062 under section 4.55(2) of the EP&A Act, and will include the following activities:

- four-year extension of mining activities to 30 June 2030;
- reduction in the approved open cut mining rate from 32 Million tonnes per annum (Mtpa) Run-of-Mine (ROM) to a maximum of 25 Mtpa ROM (similar to current actual ROM coal production);
- reduction in the cumulative open cut and underground ROM coal handling rate from 36 Mtpa to 29 Mtpa;
- reduction in maximum total (open cut and underground) coal rail transportation from 27 Mtpa of product coal to 20 Mtpa, and a reduction in train movements from 30 to 20 movements per day;
- minor extension of the approved disturbance area in the north-west corner of the operation predominantly to allow for access and ancillary infrastructure (refer to Modification New Disturbance Area within Figure 2);
- an overall reduction in approved disturbance, as some previously approved areas are no longer intended to be disturbed (refer to Impact Minimisation Area within Figure 2); and
- revised final landform and final void configuration, including an overall reduction in the approved height of the northern overburden emplacement areas and the final landform (to reflect the current actual height).

The Modification General Arrangement is shown on Figure 2, and would involve no change to:

- existing mining tenements;
- existing coarse rejects and tailings management;
- existing workforce;
- the existing mining method of conventional open cut mining; and
- the existing hours of operation and associated activities (undertaken 24-hours per day, seven days a week).



Source: BOM (2023); NSW Spatial Services (2023)

LEGEND

- State Forest
- National Parks and Wildlife Estate
- Local Government Area
- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Mining Operation
- Proposed Mining Operations (Application Lodged)
- Existing/Approved Energy Generation Site
- Proposed Energy Generation Site

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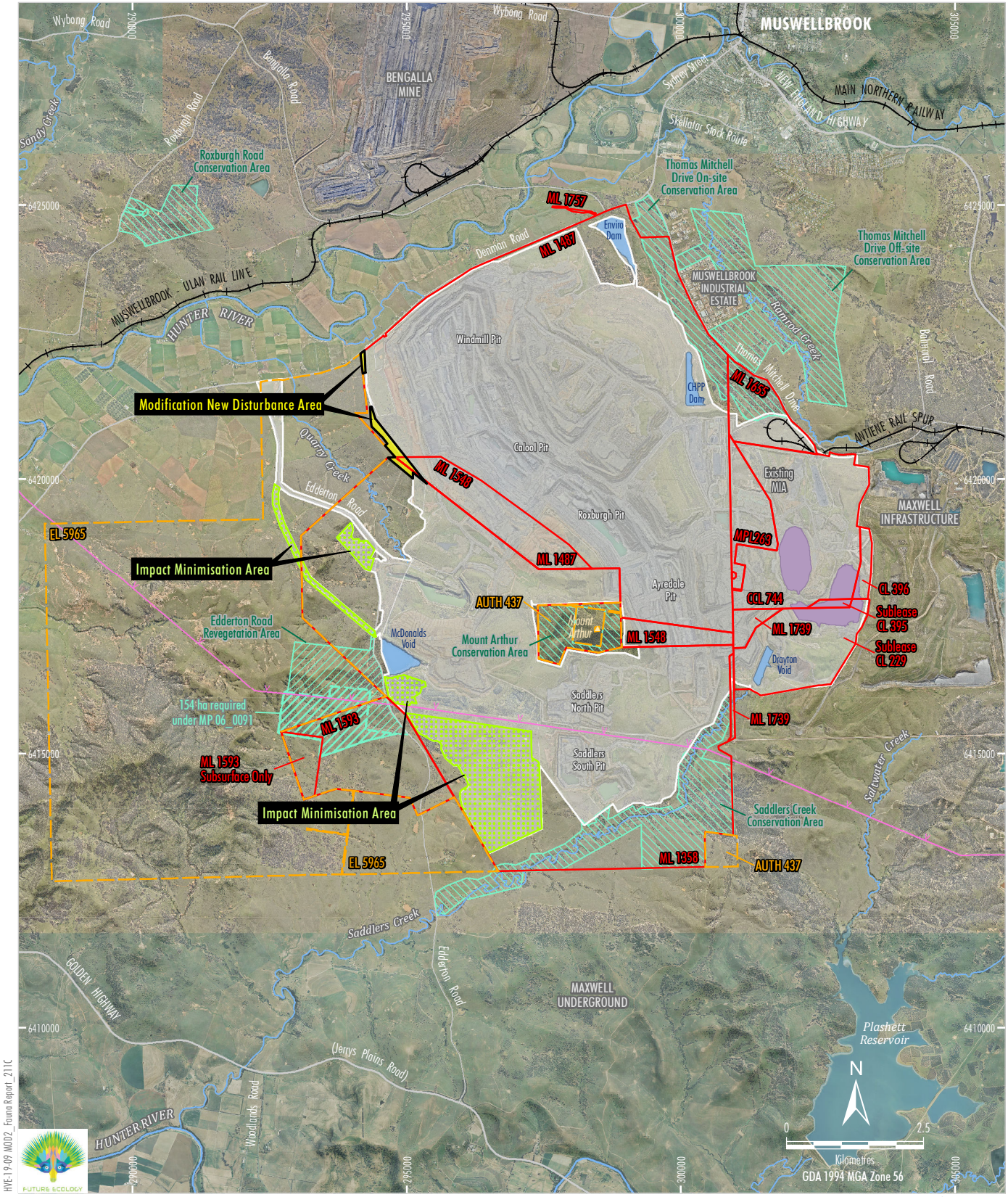
MT ARTHUR COAL MINE MODIFICATION 2

Regional Location

Figure 1

HVE-19-09 MOD2_Fauna Report_210C

FUTURE ECOLOGY



Source: BHP (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: BHP (2022-2020)

LEGEND

- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Existing 500kV Electricity Transmission Line
- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Tailings Storage Facility
- Water Storage
- Modification New Disturbance Area
- Impact Minimisation Area

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MT ARTHUR COAL MINE MODIFICATION 2

Modification General Arrangement

Figure 2

1.3 Purpose of Report

The purpose of the fauna survey and report is to, within the study areas around the MAC:

- survey and document potentially occurring threatened fauna species listed under the NSW *Biodiversity Conservation Act, 2016* (BC Act) in accordance with the relevant survey guidelines;
- survey and document potentially occurring threatened and protected migratory fauna species listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) in accordance with the relevant survey guidelines;
- survey and document threatened fauna species according to the *Biodiversity Assessment Method 2020* (BAM 2020) (Department of Planning, Industry and Environment [DPIE], 2020a); and
- document the broad fauna habitats and the habitat for relevant 'species credit species'.

1.4 Site Description

1.4.1 Study Area

The fauna surveys were undertaken in a series of study areas around the MAC (designated as Study Areas A to I) (Figure 3).

The Modification New Disturbance Area (within Study Area A) is approximately 24.6 hectares (ha) in size and is located immediately west of the active Northern Open Cut Pits from the south side of old Edderton Road in the south to Denman Road in the north (Figure 3).

1.4.2 Land Use

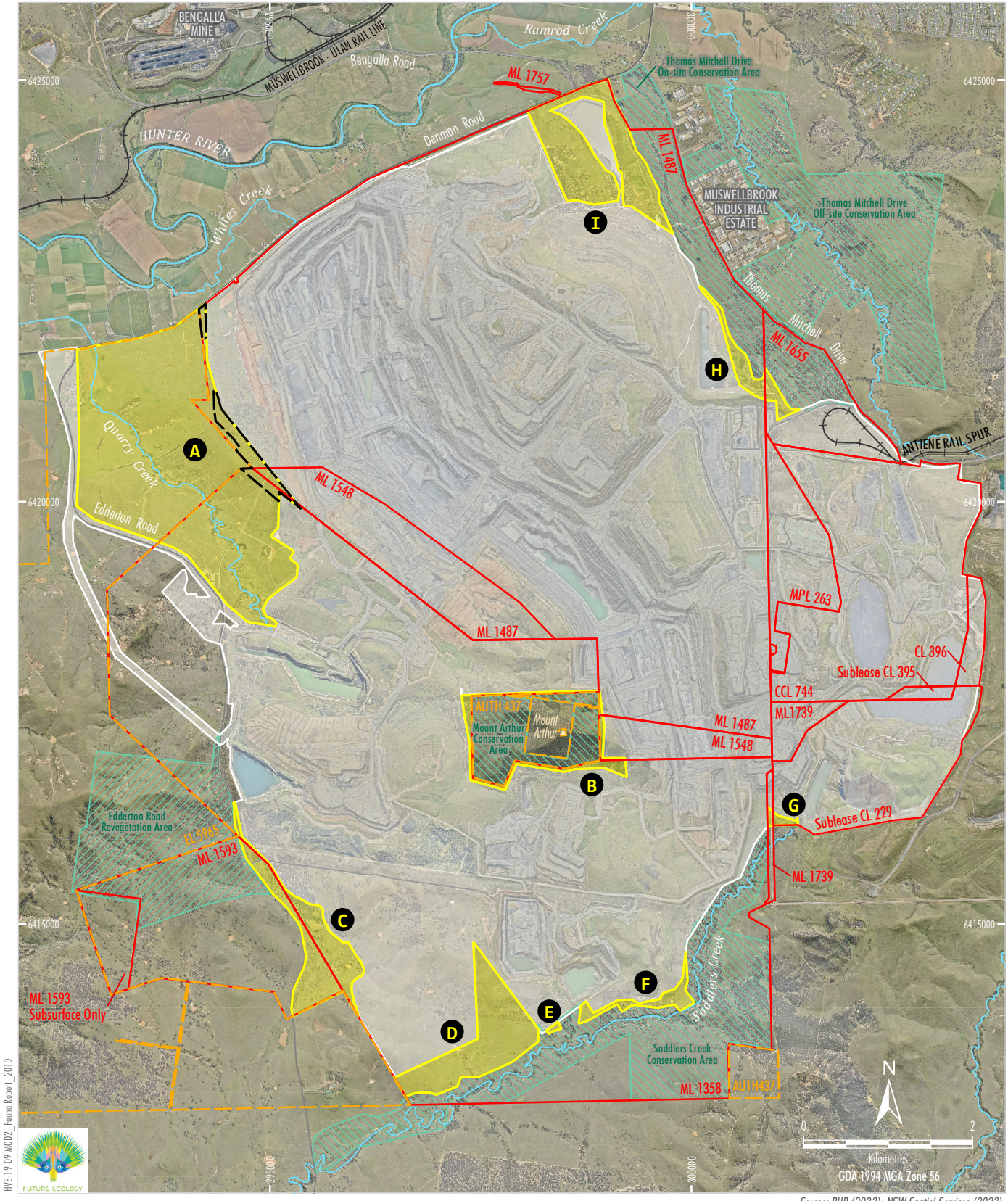
The Modification New Disturbance Area consists of previously cleared grazing land (i.e. grassy paddocks) with some scattered native remnant and regrowth trees particularly in the central section.

The broader locality of MAC is composed of active mining land, mining and other infrastructure, grazing lands and some remnant and regrowth native vegetation including previous biodiversity offset areas.

1.4.3 Regional Setting

The study area is located in the following regional setting:

- Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) bioregion and Hunter IBRA subregion; and
- the Muswellbrook LGA.



Source: BHP (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Exploration Licence Boundary (EL, AUTH)
- Mining and Coal Lease Boundary (ML, MPL, CL, CCL)
- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Modification New Disturbance Area
- Study Area - Mt Arthur Coal Mine

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MT ARTHUR COAL MINE MODIFICATION 2

Fauna Survey Study Areas

Figure 3

1.4.4 Landform and Hydrology

The landform in the Modification New Disturbance Area consists of mostly gentle slopes off a low northwest to southeast orientated broad ridgeline. Elevation is around 170-200 metres (m) Australian Height Datum (AHD) (NSW Spatial Services, 2022). It drains southwest to Quarry Creek, north to Whites Creek and east into the active mining area.

The Modification New Disturbance Area is located in the Hunter River catchment, with the Hunter River approximately 520 m north of the Modification New Disturbance Area, at its closest point.

The following streams (all intermittent) occur in the study areas around the MAC and drain to the Hunter River:

- Quarry Creek drains the western and southern part of the study areas around the MAC and is a 3rd order intermittent stream; and
- two upper branches of Whites Creek drain the northern part of the study areas around the MAC, and they are both 1st order intermittent streams.

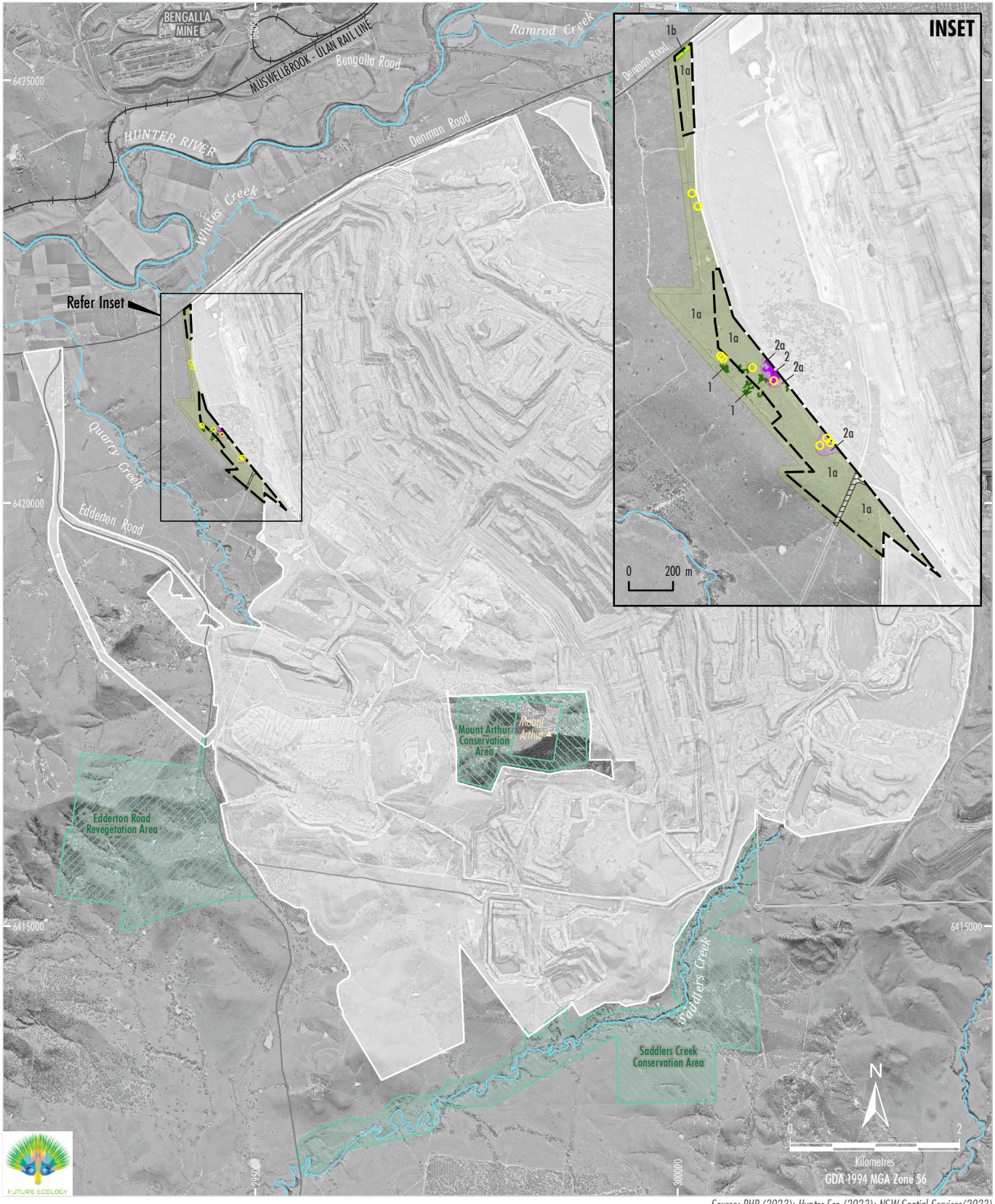
These streams are fed by several small drainage lines and farm dams and commonly only flow after large rain events.

1.4.5 Vegetation

Hunter Eco (2023) has undertaken flora surveys across the Modification New Disturbance Area. The majority of the Modification New Disturbance Area comprises Grey Box White Box Grassy Woodland (Plant Community Type [PCT] 483) in Derived Native Grassland (DNG) form (34 ha; 93%) with some smaller areas of PCT 1655 DNG (1.2 ha), PCT 483 woodland (0.6 ha), PCT 1655 (0.4 ha) and plantation (0.2 ha) (Figure 4).

1.4.6 Summary of Previous Threatened Species Recorded in the Study Area

As detailed in Section 2.2, a literature and database review was undertaken to identify threatened fauna species which are known or likely to occur in the study areas around the MAC. Table 1 lists the threatened fauna species that have previous survey or database records in or close to the study areas around the MAC and/or are predicted to occur in the wider locality.



Source: BHP (2023); Hunter Eco (2023); NSW Spatial Services(2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Modification New Disturbance Area

Vegetation Communities

- 1. Grey Box x White Box Grassy Woodland (PCT 483) [1]
- 1a. Grey Box x White Box Grassy DNG (PCT 483) [1]
- 1b. Plantation (PCT 483)
- 2. Slaty Box Woodland (PCT 1655) [2]
- 2a. Slaty Box (DNG) (PCT 1655)
- Cleared Land
- Hollow Bearing Tree

[1] Equivalent to the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the EPBC Act and BC Act

[2] Equivalent to the Hunter Valley Footslopes Slaty Gum Woodland listed under the BC Act and the Central Hunter Valley Eucalypt Forest and Woodland CEEC listed under the EPBC Act

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MT ARTHUR COAL MINE MODIFICATION 2

Vegetation Communities

Figure 4

Table 1: Threatened Fauna Species Known or Predicted to occur in the Wider Locality

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Database Records				Recorded in Previous Studies and/or Recent Surveys[7]
		BC Act	EPBC Act		EPBC Act Protected Matters Search[3]	BioNet Atlas[4]	ALA[5]	BirdLife[6]	
Amphibians									
Litoria booroolongensis	Booroolong Frog	E	E	S	Predicted	-	-	-	-
Reptiles									
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	S	Predicted	Yes	-	-	-
Delma impar	Striped Legless Lizard	V	V	S	Predicted	Yes	-	-	-
Birds									
Anseranas semipalmata	Magpie Goose	V	-	E	-	Yes	-	-	-
Stictonetta naevosa	Freckled Duck	V	-	E	-	Yes	-	Yes	-
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	E	-	Yes	-	-	-
Botaurus poiciloptilus	Australasian Bittern	E	E	E	Predicted	-	Yes	-	-
Falco hypoleucos	Grey Falcon	E	V	E	Predicted	-	Yes	-	-
Falco subniger	Black Falcon	V	-	E	-	Yes	Yes	Yes	-
Lophoictinia isura	Square-tailed Kite	V	-	S/E	-	Yes	Yes	-	-
Haliaeetus leucogaster	White-bellied Sea-eagle	V	-	S/E	-	Yes	-	Yes	-
Circus assimilis	Spotted Harrier	V	-	E	-	Yes	Yes	Yes	A
Erythrotriorchis radiatus	Red Goshawk	CE	V	S	Predicted	-	-	-	-
Hieraaetus morphnoides	Little Eagle	V	-	S/E	-	Yes	-	Yes	A
Burhinus grallarius	Bush Stone-curlew	E	-	S	-	Yes	-	Yes	-
Rostratula australis	Australian Painted Snipe	E	E	E	Predicted	-	-	-	-
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	-	CE	S/E	Predicted	-	-	-	-
Calidris ferruginea	Curlew Sandpiper	E	CE	S/E	Predicted	-	-	-	-
Sternula albifrons	Little Tern	E	-	S/E	-	-	Yes	-	-
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo	V	V	S/E	Predicted	Yes	Yes	-	-
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	S/E	Predicted	-	Yes	-	-
Glossopsitta pusilla	Little Lorikeet	V	-	E	-	Yes	Yes	-	A, C
Lathamus discolor	Swift Parrot	E	CE	S/E	Predicted	-	-	-	-
Polytelis swainsonii	Superb Parrot	V	V	S/E	Predicted	-	-	-	-
Tyto novaehollandiae	Masked Owl	V	-	S/E	-	-	Yes	-	-

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Database Records				Recorded in Previous Studies and/or Recent Surveys[7]
		BC Act	EPBC Act		EPBC Act Protected Matters Search[3]	BioNet Atlas[4]	ALA[5]	BirdLife[6]	
Ninox connivens	Barking Owl	V	-	S/E	-	Yes	Yes	-	A
Hirundapus caudacutus	White-throated Needletail	-	V	S	Predicted	Yes	Yes	Yes	A
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	E	-	Yes	-	Yes	D, E, F
Chthonicola sagittata	Speckled Warbler	V	-	S/E	-	Yes	Yes	Yes	A, B, C, D, E, F, G, H
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	E	-	Yes	-	-	-
Anthochaera phrygia	Regent Honeyeater	CE	CE	S/E	Predicted	-	Yes	-	-
Grantiella picta	Painted Honeyeater	V	V	E	Predicted	Yes	-	-	-
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	E	-	Yes	-	-	-
Petroica phoenicea	Flame Robin	V	-	E	-	Yes	-	-	-
Petroica boodang	Scarlet Robin	V	-	E	-	Yes	-	Yes	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	E	-	Yes	Yes	Yes	A, C, D
Daphoenositta chrysoptera	Varied Sittella	V	-	E	-	Yes	Yes	Yes	A
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	E	-	Yes	-	-	A, G
Stagonopleura guttata	Diamond Firetail	V	-	E	-	Yes	-	Yes	C, G
Mammals									
Dasyurus maculatus	Spotted-tailed Quoll	V	E	E	Predicted	Yes	-	-	A
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	S	-	Yes	-	-	-
Phascolarctos cinereus	Koala	E	E	S	Predicted	Yes	-	-	-
Petaurus australis	Yellow-bellied Glider	V	-	E	Predicted	-	-	-	-
Petaurus norfolcensis	Squirrel Glider	V	-	S	-	Yes	-	-	A, C, E
Petauroides volans	Southern Greater Glider	E	E	S	Predicted	-	-	-	-
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	S	Predicted	-	-	-	-
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	S/E	Predicted	Yes	Yes	-	A, C, D, K
Saccolaimus flaviventris	Yellow-bellowed Sheathtail-bat	V	-	E	-	Yes	-	-	G
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	E	-	Yes	Yes	-	A, D, E, F, H
Miniopterus australis	Little Bent-winged Bat	V	-	S/E	-	Yes	Yes	-	C, E, G, I

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Database Records				Recorded in Previous Studies and/or Recent Surveys[7]
		BC Act	EPBC Act		EPBC Act Protected Matters Search[3]	BioNet Atlas[4]	ALA[5]	BirdLife[6]	
Miniopterus orianae oceanensis (syn. Miniopterus schreibersii oceanensis)	Eastern Bent-winged Bat, Large Bent-winged Bat	V	-	S/E	-	Yes	Yes	-	A, C, D, E, F, G, H, J, K
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	E	Predicted	Yes	-	-	A
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	S	Predicted	Yes	-	-	F, G, H, I
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	E	-	Yes	Yes	-	A, H
Myotis macropus	Southern Myotis	V	-	S	-	Yes	Yes	-	A, C, E, G, H, K
Scoteanax rueppellii	Greater Broad-nosed Bat, Ruppell's Broad-nosed Bat	V	-	E	-	Yes	-	-	A, E, F, K
Vespadelus troughtoni	Eastern Cave Bat	V	-	S	-	Yes	Yes	-	A, E, F, G, H, K

Note: Shaded species are species with records in the Subject land.

1 Conservation status under the BC Act and/or EPBC Act (current as of March 2023). CE = Critically Endangered; E = Endangered; EP = Endangered Population; V = Vulnerable.

2 Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (Department of Planning and Environment [DPE], 2023a). E = Ecosystem; S = Species.

3 Department of Climate Change, Energy, the Environment and Water (2022b).

4 DPE (2022a).

5 Atlas of Living Australia (ALA) (2022).

6 BirdLife Australia (2022).

7
- A All records prior to 2013: Ecotone (2000); Umwelt Environmental Consultants (2003, 2005, 2006, 2007, 2008, 2010, 2011); Wildthing Environmental Consultants (2008); Cumberland Ecology (2009, 2010, 2011); Niche Environment and Heritage (2012).
- B Umwelt Environmental Consultants (2013)
- C Umwelt Environmental Consultants (2015)
- D Cumberland Ecology Pty Ltd (2016)
- E Cumberland Ecology Pty Ltd (2017)
- F Cumberland Ecology Pty Ltd (2018)
- G Cumberland Ecology Pty Ltd (2019)
- H Cumberland Ecology Pty Ltd (2020)
- I Cumberland Ecology Pty Ltd (2021)
- J BHP (2022)
- K Cumberland Ecology Pty Ltd (2022)

2 Methods

2.1 Nomenclature

Primary sources of literature accessed for nomenclature includes:

- *Commonwealth Scientific and Industrial Research Organisation (CSIRO) List of Australian Vertebrates* (Clayton *et al.,* 2006);
- Amphibians/Reptiles - *Reptiles and Amphibians of Australia, Seventh Edition* (Cogger, 2018);
- Birds - *Systematics and Taxonomy of Australian Birds* (Christidis and Boles, 2008);
- Mammals - *The Mammals of Australia, Third Edition* (Van Dyck and Strahan, 2008); and
- Bats - *Australian Bats, Second Edition* (Churchill, 2009) and *A Current Taxonomic List of Australian Chiropteran* (Reardon *et al.*, 2015).

2.2 Literature and Database Review

A review of relevant literature and databases was undertaken prior to undertaking the field surveys (Section 2.4) to identify known or potentially occurring threatened fauna species or their habitats.

The following databases were reviewed:

- *Birdlife Australia Atlas Database* (Birdlife Australia, 2022);
- *BioNet Atlas* (Department of Planning and Environment [DPE], 2022a);
- *Protected Matters Search Tool* (Department of Climate Change, Energy, the Environment and Water [DCCEEW], 2022b); and
- *Atlas of Living Australia* (ALA, 2022).

The following mapping sources were reviewed:

- *Mt Arthur Coal Mine Modification 2 - Baseline Flora Report* (Hunter Eco, 2023);
- *SIX Maps* (NSW Spatial Services, 2022); and
- *Google Earth Pro* (Google Inc, 2022).

Mt Arthur Coal Open Cut Modification Ecological Assessment (Hunter Eco, 2013)

Hunter Eco (2013) undertook a review of various ecological surveys previously undertaken in the Modification area and surrounding the MAC. These surveys were mainly associated with environmental assessments for various development stages of the MAC. The most recent fauna surveys were undertaken by Niche Environmental and Heritage (Niche) (the Niche report is attached to the Hunter Eco, [2013] ecological assessment). Fauna surveys were undertaken by Niche over six days on 1 May 2012 and 7-11 May 2012. Threatened species that were known to occur or likely to occur were targeted. Fauna survey techniques included arboreal Elliot trapping, wildlife cameras, hair tubes, ultrasonic acoustic recording for bats, diurnal bird surveys, spotlighting, call-playback, dead tree (stag-watching), koala scat searches, herpetological surveys, frog chorus and aquatic habitat surveys. Surveys were carried out in late autumn (cool season) and did not include a warm season component. During the Niche (2012) fauna survey, 77 fauna species comprising three amphibian, five reptile, 44 bird and 25 mammal species were recorded in the Modification area (including six introduced species). Two threatened fauna species were recorded during the Niche (2012) fauna survey, being the Grey-headed Flying-fox (*Pteropus poliocephalus*) and Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*).

Table 5 in the Hunter Eco (2013) report tabulates previous ecological studies, monitoring and reports at MAC and adjacent areas for which background data was compiled for that report. Previous fauna surveys and reports (cited in Hunter Eco, 2013) include:

- 14-21 November 1998 (Dames and Moore, 2000);
- 1 April 2003; 7-9 May 2003 (Umwelt, 2003);
- 14-15 December 2004; 20-22 December 2004 (Umwelt, 2005);
- 21-25 February 2005 (Umwelt, 2006a);
- December 2005 (Umwelt, 2006b);
- 7 December 2005 (Umwelt, 2006c);
- December 2006 (Umwelt, 2007a);
- 7-11 March 2005; 5-7 December 2005 (Umwelt, 2007b);
- 28 August 2008; 21-23 September 2008; 30 September – 2 October 2008; 10-12 November 2008; 19-23 January 2009; 4 March 2009; 8-9 April 2009; 9-10 July 2009; and 13-14 July 2009 (Cumberland Ecology, 2009a);
- 19-23 January 2009 (Cumberland Ecology, 2009b);
- 19-22 January 2010, 27-29 January 2010 (Cumberland Ecology, 2010b);
- 20-23 September 2010 (Cumberland Ecology, 2010c); and
- 1 May 2012 and 7-11 May 2012 (Niche, 2012).

2.3 Relevant Survey Guidelines

Relevant guidelines that were followed during fauna surveys are as follows:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)* (Department of Environment and Conservation [DEC], 2004a);
- *Hygiene Protocol for The Control of Disease in Frogs* (Department of Environment and Climate Change [DECC], 2008a)*;*
- '*Species Credit' Threatened Bats and their Habitats: NSW Survey Guide for the Biodiversity Assessment Method* (Office of Environment and Heritage [OEH], 2018);
- *Koala (Phascolarctos cinereus) Biodiversity Assessment Method Survey Guide* (DPE, 2022c);
- *Threatened Reptiles Biodiversity Assessment Method Survey Guide* (DPE, 2022d);
- *Survey Guidelines for Australia's Threatened Frogs* (Department of Environment, Water, Heritage and Arts [DEWHA], 2010a);
- *Survey Guidelines for Australia's Threatened Bats* (DEWHA, 2010b);
- *Survey Guidelines for Australia's Threatened Birds* (DEWHA, 2010c);
- *Survey Guidelines for Australia's Threatened Mammals* (Department of Sustainability, Environment, Water, Population and Communities [SEWPaC], 2011a);
- *Survey Guidelines for Australia's Threatened Reptiles* (SEWPaC, 2011b);
- *EPBC Act Referral Guidelines for the Vulnerable Striped Legless Lizard, Delma impar* (SEWPaC, 2011c);
- *EPBC Act Referral Guidelines for the Vulnerable Koala* (Department of the Environment [DotE], 2014);
- *Biodiversity Assessment Method* (DPIE, 2020a);
- *NSW Survey Guide for Threatened Frogs - A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method* (DPIE, 2020b);
- *Saving Our Species. Hygiene guidelines. Protocols to Protect Priority Biodiversity Areas in NSW from Phytophthora cinnamomi, Myrtle Rust, Amphibian Chytrid Fungus and Invasive Plants* (2020b);
- *Biodiversity Assessment Method* (DPIE, 2020a);
- *Species Profile and Threats Database* of relevant Commonwealth listed threatened and/or migratory fauna species (DCCEEW, 2022c); and *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a).

2.4 Field Survey

Fauna surveys were completed by Future Ecology in 2021 and 2022 using a team of up to four ecologists including specialists in amphibians, reptiles, birds and mammals.

2.4.1 Weather, Climate and Astronomical Conditions

Fauna surveys took place in the study areas around the MAC over several separate periods:

- 31 May to 2 June 2021;
- 16 to 17 June 2021;
- 5 to 6 July 2021;
- 2 to 4 August 2021;
- 30 August to 1 September 2021;
- 20 to 24 September 2021;
- 27 September to 1 October 2021;
- 4 to 8 October 2021;
- 18 to 24 October 2021;
- 22 to 26 November 2021;
- 21 to 25 March 2022; and
- 19 to 20 July 2023.

Weather records during the surveys were taken from the Scone Airport Automatic Weather Station (AWS), being the closest to the study areas around the MAC (Bureau of Meteorology [BOM], 2022a). Astronomical records were taken from the Geoscience Australia website (2022a; 2022b), and the Museum of Applied Arts and Sciences – Sydney Observatory website (2022).

New South Wales had its 6th wettest year on record, with 2021 rainfall 30% above average recording a yearly rainfall 30% greater than the State's average (BOM, 2022b). This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average (BOM, 2022b).

A summary of these weather records in addition to astronomical records relevant to the survey periods are presented in Table 2.

Table 2: Weather and Astronomical Conditions during Survey Periods

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Sunrise	Sunset	Moonrise	Moonset	Moon phase
May-June 2021								
Monday, 31 May 2021	3.9	19.1	0	6:49	17:00	21:56	11:23	Waning Gibbous (73%)
Tuesday, 1 June 2021	0.5	21.1	0	6:49	16:59	23:00	12:04	Waning Gibbous (63%)
Wednesday, 2 June 2021	3.8	22.4	0	6:50	16:59	0:00	12:38	Last Quarter (52%)
Wednesday, 16 June 2021	0.3	21.3	0	6:56	16:58	11:14	22:13	Waxing Crescent (28%)
Thursday, 17 June 2021	8	17.6	0.8	6:56	16:59	11:49	23:16	Waxing Crescent (38%)
July 2021								
Monday, 5 July 2021	-1.1	15.3	0.2	6:58	17:04	2:29	13:31	Waning Crescent (21%)
Tuesday, 6 July 2021	-1.2	13.8	0	6:58	17:05	3:25	14:04	Waning Crescent (14%)
August 2021								
Monday, 2 August 2021	7.1	20	0.4	6:45	17:20	1:16	12:03	Waning Crescent (36%)
Tuesday, 3 August 2021	6.9	18.7	1	6:44	17:21	2:12	12:38	Waning Crescent (27%)
Wednesday, 4 August 2021	8.9	13.8	0.2	6:43	17:22	3:09	13:19	Waning Crescent (19%)
Monday, 30 August 2021	2.3	20.3	0	6:16	17:38	0:02	10:35	Last Quarter (52%)
Tuesday, 31 August 2021	1.3	23.7	0	6:15	17:39	0:59	11:13	Waning Crescent (43%)
Wednesday, 1 September 2021	2.2	25.1	0	6:14	17:40	1:55	11:57	Waning Crescent (34%)
September 2021								
Monday, 20 September 2021	2.8	25	0	5:49	17:51	17:05	5:34	Waxing Gibbous (99%)
Tuesday, 21 September 2021	5.6	15.1	0.2			18:04	6:04	Full Moon (100%)
Wednesday, 22 September 2021	-0.1	19.5	0					
Thursday, 23 September 2021	2.1	23.8	0					
Friday, 24 September 2021	4.7	25.9	0	5:43	17:54	20:55	7:29	Waning Gibbous (91%)
Monday, 27 September 2021	1.7	21.9	0	5:39	17:56	23:45	9:08	Waning Gibbous (69%)
Tuesday, 28 September 2021	4.1	24.9	0					
Wednesday, 29 September 2021	11.8	22.7	1.4					
Thursday, 30 September 2021	8.5	25	13.8	5:35	17:58	1:32	11:29	Waning Crescent (41%)
October 2021								
Friday, 1 October 2021	11.1	24.2	10.4	5:34	17:58	2:20	12:26	Waning Crescent (31%)
Monday, 4 October 2021	10.1	25	0	5:30	18:00	4:20	15:34	Waning Crescent (7%)
Tuesday, 5 October 2021	9.2	21	0					
Wednesday, 6 October 2021	4.2	24.3	0	5:28	18:02	5:26	17:45	New Moon (0%)
Thursday, 7 October 2021	5	25.9	0					
Friday, 8 October 2021	10.9	25.4	0	5:25	18:03	6:33	20:03	Waxing Crescent (4%)
Monday, 18 October 2021	6.4	25.6	0	5:13	18:10	15:56	4:07	Waxing Gibbous (94%)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Sunrise	Sunset	Moonrise	Moonset	Moonphase
Tuesday, 19 October 2021	5.6	28	0					
Wednesday, 20 October 2021	8.5	20.2	0	5:11	18:12	17:50	5:03	Full Moon (100%)
Thursday, 21 October 2021	5.8	24.3	0					
Friday, 22 October 2021	12.2	26.8	0					
Saturday, 23 October 2021	11.2	33.4	0					
Sunday, 24 October 2021	15.3	24.8	6.4	5:06	18:15	21:36	7:06	Waning Gibbous (89%)
November 2021								
Monday, 22 November 2021	14	20.9	59	4:45	18:40	21:20	6:26	Waning Gibbous (94%)
Tuesday, 23 November 2021	14.9	25.7	0					
Wednesday, 24 November 2021	17.9	28.7	0					
Thursday, 25 November 2021	19.2	26.9	10					
Friday, 26 November 2021	18.3	19.1	45.4	4:43	18:44	N/A	10:02	Waning Gibbous (64%)
March 2022								
Monday, 21 March 2022	11.8	25.6	0	6:00	18:07	20:00	8:40	Waning Gibbous (91%)
Tuesday, 22 March 2022	9.9	31.1	0					
Wednesday, 23 March 2022	13.7	32	0					
Thursday, 24 March 2022	18.4	22	0					
Friday, 25 March 2022	16	23.4	0	6:03	18:02	23:11	13:13	Last Quarter (52%)
July 2023								
Wednesday, 19 July 2023	1.5	17.5	0	06:54	17:11	08:03	18:22	New Moon
Thursday, 20 July 2023	-5.5	20.4	0	06:54	17:12	08:36	19:20	Waxing Crescent

Sources: Geoscience Australia (2022a, 2022b, 2023a, 2023b), Museum of Applied Arts and Sciences - Sydney Observatory (2022), BOM (2022a), BOM (2023), NASA (2023).

Note: all times are in Australian Eastern Standard Time (AEST)

2.4.2 Techniques

Stratification and site selection

The study area consisted of nine separate areas located in mostly cleared agricultural lands as well as some previously disturbed mining, overburden and infrastructure areas. The nine separate areas are generally located around the perimeters of the approved mining areas. General fauna survey sites are listed in Table 3 and shown on Figures 5a to 5h.

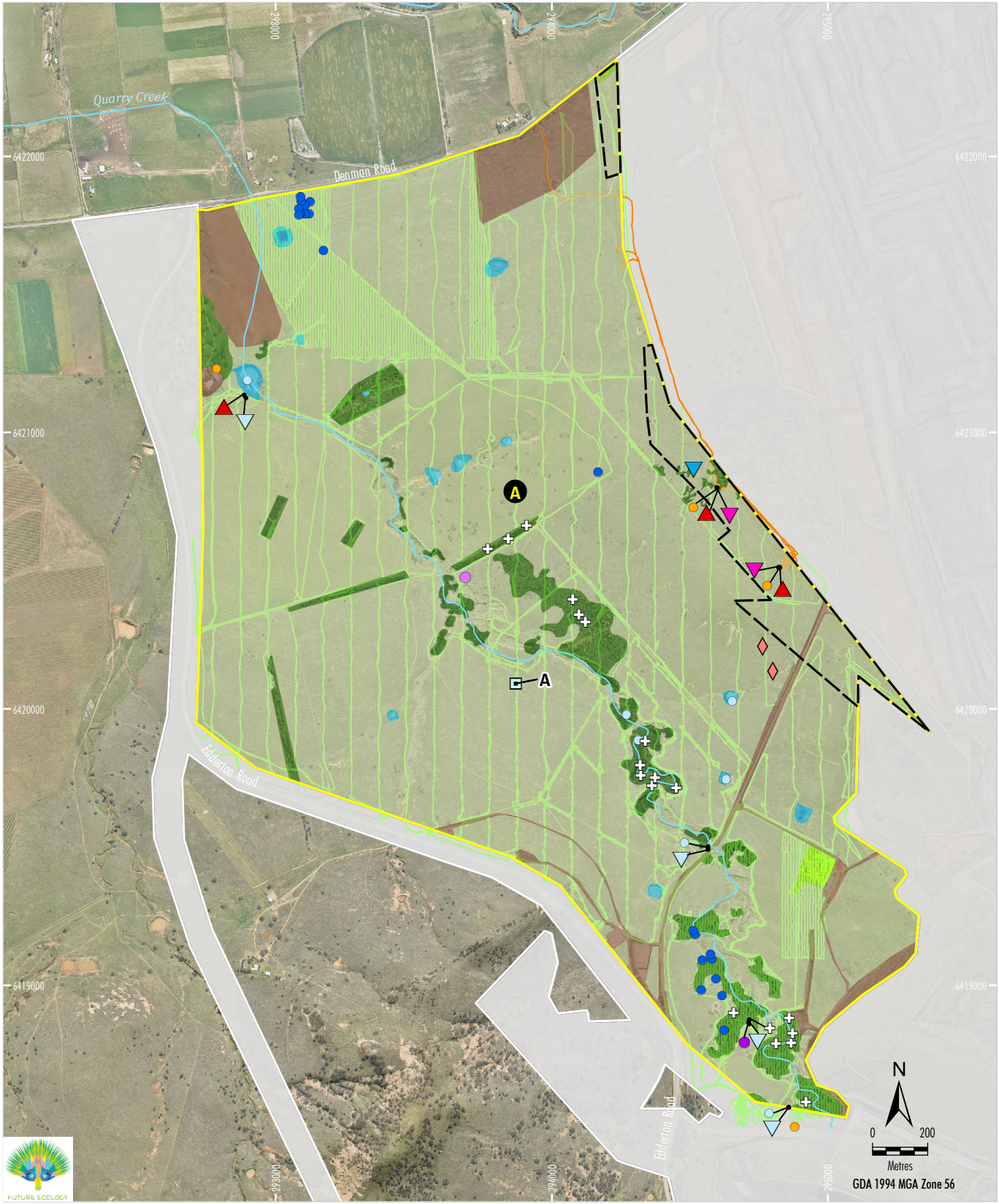
Table 3: General Fauna Survey Sites for the Study Area

Detailed Site	Location (Lat/Long GDA)		Site Type	Figure
A	-32.337107	150.809890	General Fauna	5a
B	-32.360244	150.846177	General Fauna	5b
C	-32.389659	150.828433	General Fauna	5c
D	-32.397499	150.848684	General Fauna	5d
E	-32.394941	150.856359	General Fauna	5d
F	-32.392622	150.868937	General Fauna	5e
G	-32.373514	150.885052	General Fauna	5f
H	-32.325847	150.881925	General Fauna	5g
I	-32.304537	150.861590	General Fauna	5h

The Modification New Disturbance Area is located within Study Area A. The survey sites in Study Area A were located to maximise the chance of locating threatened species.

The following general survey techniques were used during the surveys: habitat assessment, diurnal and nocturnal bird, amphibian and reptile surveys, microbat surveys and mammal surveys via observation, listening, spotlighting, call-playback, trapping, acoustic recording and deployment of artificial shelter habitats. These techniques are described in more detail below.

It should be noted that some surveys were often done concurrently (e.g. spotlighting surveys were carried out at the same time as nocturnal bird and herpetofauna surveys).



LEGEND

- Approximate Extent of Existing/Approved Surface Development
- Modification New Disturbance Area
- Study Area - Mt Arthur Coal Mine

Habitat

- Woodland
- Derived Native Grassland
- Planted
- Aquatic
- Non-native

Survey Sites

- Diurnal Bird Surveys#, Hair Tubes and Scat Searches (Indicative Location Only)
- Acoustic Monitoring
- Active Searches for Amphibians
- Active Searches for Reptiles in Rocky Areas
- Artificial Reptile Habitat
- Cameras
- Pitfall and Elliot A Ground Trap Sites
- Pitfall, Elliot Trap and Reptile Funnel Sites
- Ultrasonic Bat Detectors
- Nocturnal Call-Playback and Spotlight
- Additional Call-Playback and Spotlight (July 2023)
- Additional Call-Playback, Spotlight and Stag Watch (July 2023)
- 2021 September-October Fauna Observations
- 2023 July Fauna Observations

Source: BHP (2023); NSW Spatial Services (2023); Future Ecology (2023); Hunter Eco (2023); Orthophoto Mosaic: MAC (2022)

Note: Diurnal Bird Surveys were undertaken throughout the Study Area.

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Fauna Survey Sites
Mt Arthur Coal Mine - Study Area A

Figure 5a

HVE-19-09 MOD2_Fauna Report_203L

FUTURE ECOLOGY

LEGEND

Existing Conservation/Offset Area

Approximate Extent of Existing/Approved Surface Development

Study Area - Mt Arthur Coal Mine

Habitat

Woodland

Derived Native Grassland

Survey Sites

Diurnal Bird Surveys#, Stag Watch and Scat Searches (Indicative Location Only)

Acoustic Monitoring

Active Searches for Reptiles in Rocky Areas

Cameras

Harp Trap

Harp Trap, Ultrasonic Bat Detectors, Camera and Acoustic Recording

Pitfall, Elliot Trap and Reptile Funnel Sites

Nocturnal Call-Playback and Spotlight

Nocturnal Call-Playback, Spotlight and Stag Watch

Source: BHP (2023); NSW Spatial Services (2023); Future Ecology (2023); Hunter Eco (2023); Orthophoto Mosaic: MAC (2022)

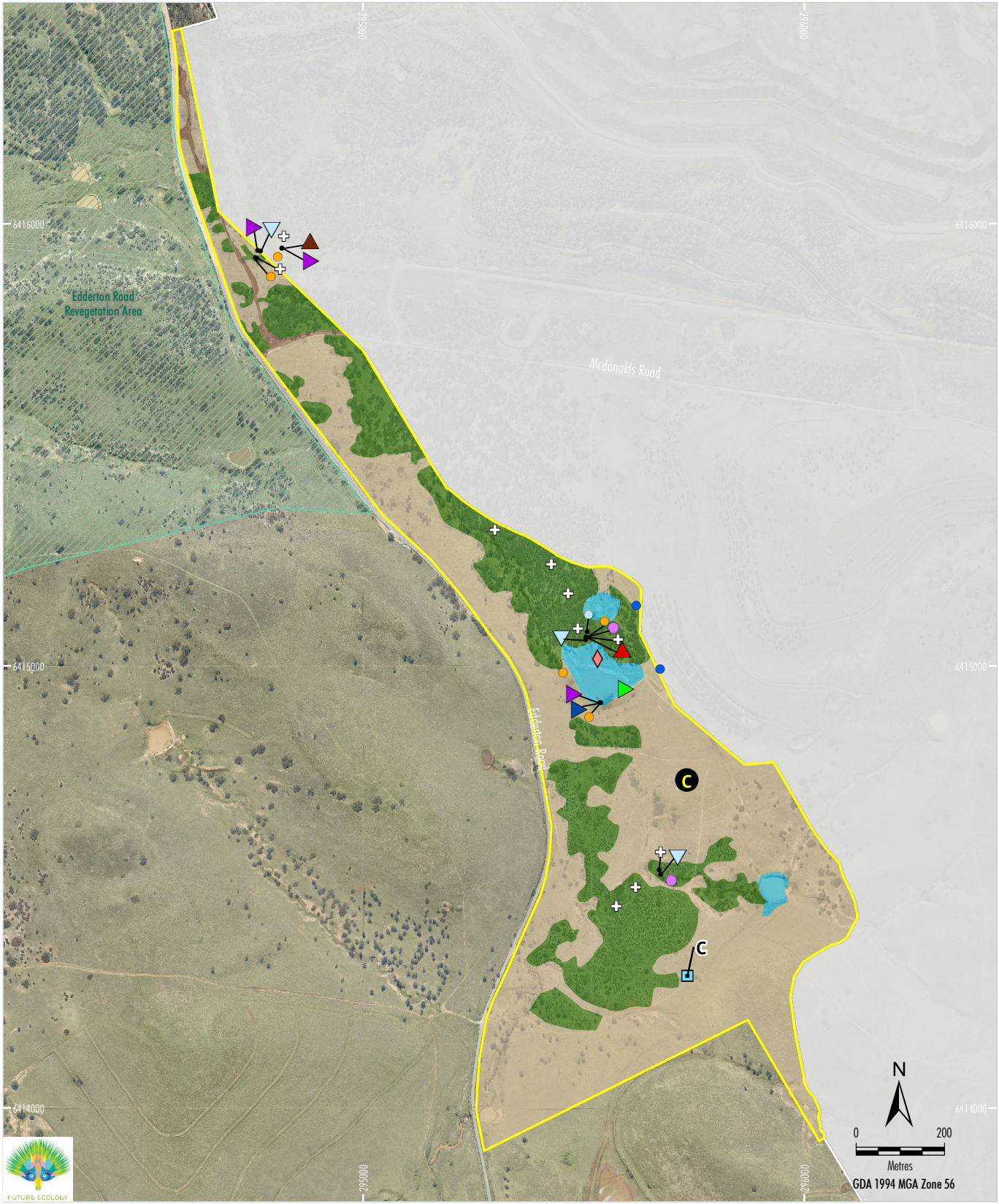
Note: Diurnal Bird Surveys were undertaken throughout the Study Area.

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Fauna Survey Sites
Mt Arthur Coal Mine - Study Area B

Figure 5b



HVE-19-09 MOD2_Fauna Report_203L

FUTURE ECOLOGY

LEGEND

Edderton Road Revegetation Area
Approximate Extent of Existing/Approved Surface Development
Study Area - Mt Arthur Coal Mine

Habitat
Woodland
Aquatic
Non-native
Disturbed

Survey Sites
Diurnal Bird Surveys#, Hair Tubes and Stag Watch (Indicative Location Only)
Acoustic Monitoring
Active Searches for Amphibians
Active Searches for Reptiles in Rocky Areas
Artificial Reptile Habitat
Cameras
Harp Trap
Harp Trap, Ultrasonic Bat Detectors and Acoustic Recording
Harp Trap, Ultrasonic Bat Detectors, Camera and Acoustic Recording
Pitfall and Elliot A Ground Trap Sites
Ultrasonic Bat Detectors
Ultrasonic Bat Detectors and Acoustic Recording
Nocturnal Call-Playback and Spotlight

Source: BHP (2023); NSW Spatial Services (2023); Future Ecology (2023); Hunter Eco (2023); Orthophoto Mosaic: MAC (2022)

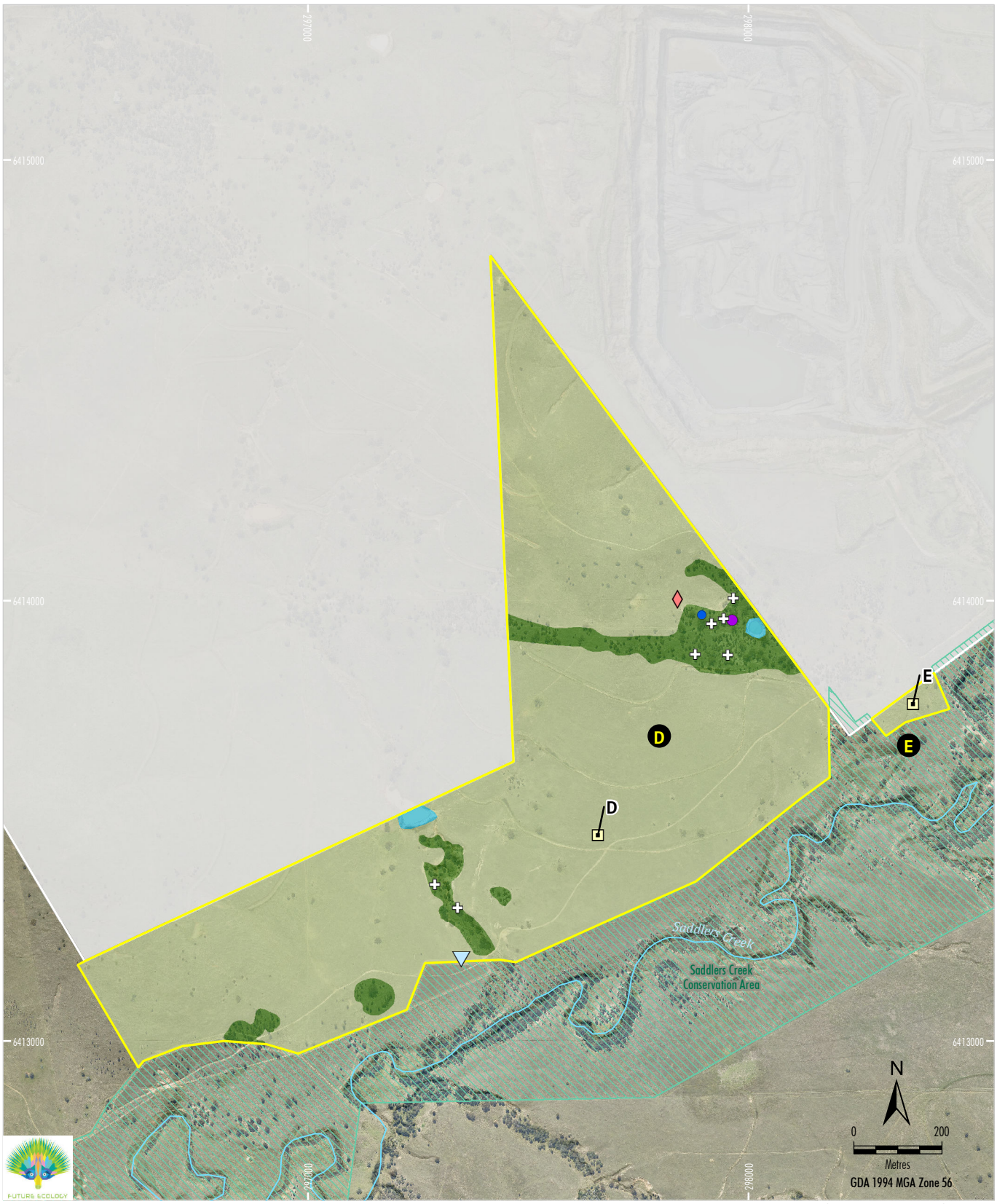
Note: Diurnal Bird Surveys were undertaken throughout the Study Area.

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Fauna Survey Sites
Mt Arthur Coal Mine - Study Area C

Figure 5c



LEGEND

Existing Conservation/Offset Area
Approximate Extent of Existing/Approved Surface Development
Study Area - Mt Arthur Coal Mine

Habitat

Woodland
Derived Native Grassland
Aquatic

Survey Sites

Diurnal Bird Surveys# (Indicative Location Only)
Active Searches for Reptiles in Rocky Areas
Artificial Reptile Habitat
Cameras
Pitfall, Elliot Trap and Reptile Funnel Sites
Nocturnal Call-Playback and Spotlight

Source: BHP (2023); NSW Spatial Services (2023); Future Ecology (2023); Hunter Eco (2023); Orthophoto Mosaic: MAC (2022)

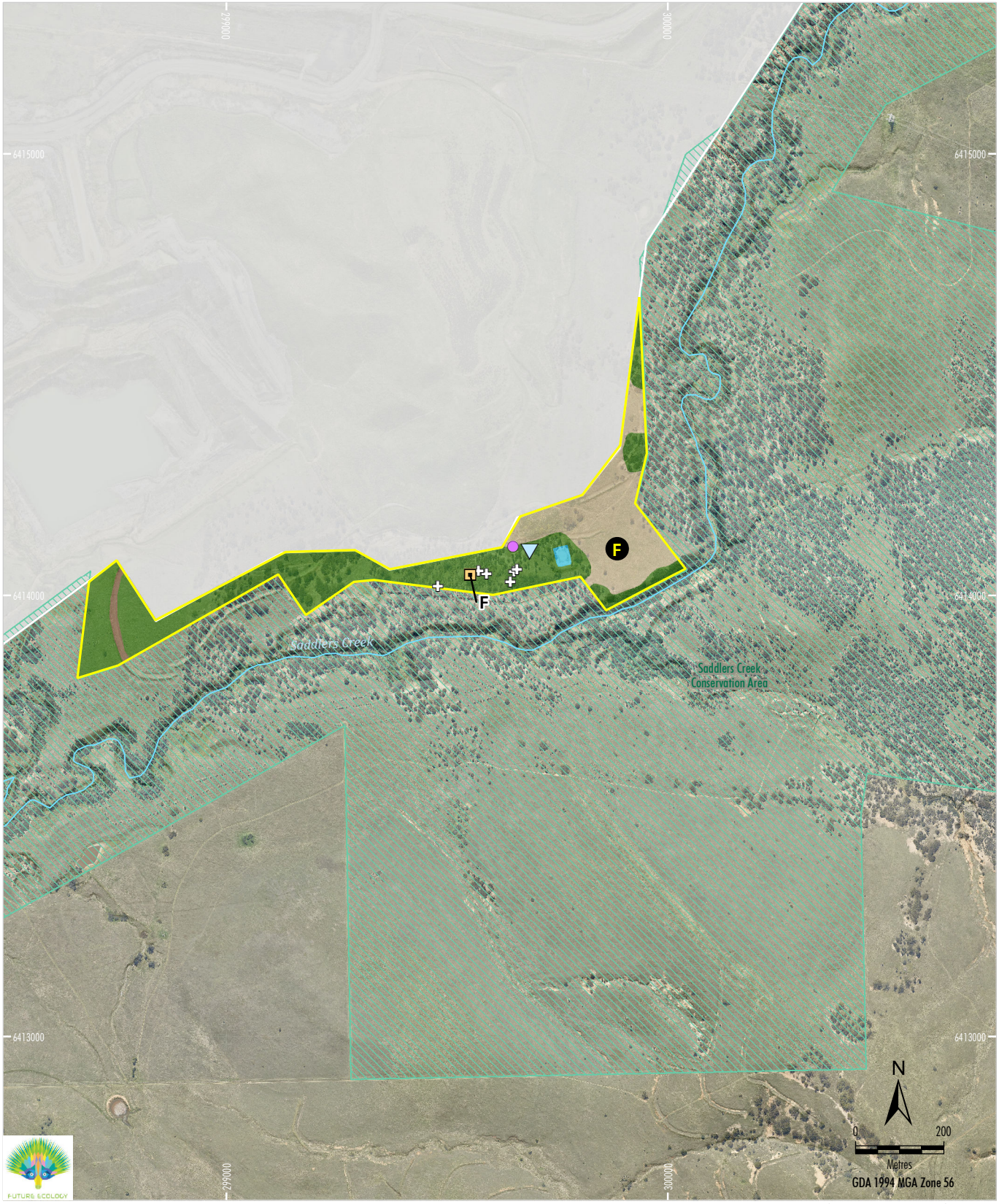
Note: Diurnal Bird Surveys were undertaken throughout the Study Area.

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Fauna Survey Sites
Mt Arthur Coal Mine - Study Area D & E

Figure 5d



HVE-19-09 MOD2_Fauna Report_203L

LEGEND

Existing Conservation/Offset Area
Approximate Extent of Existing/Approved Surface Development
Study Area - Mt Arthur Coal Mine

Habitat

Woodland
Aquatic
Non-native
Disturbed

Survey Sites

Diurnal Bird Surveys# and Stag Watch (Indicative Location Only)
Cameras
Pitfall and Elliot A Ground Trap Sites
Nocturnal Call-Playback and Spotlight

Source: BHP (2023); NSW Spatial Services (2023); Future Ecology (2023); Hunter Eco (2023); Orthophoto Mosaic: MAC (2022)

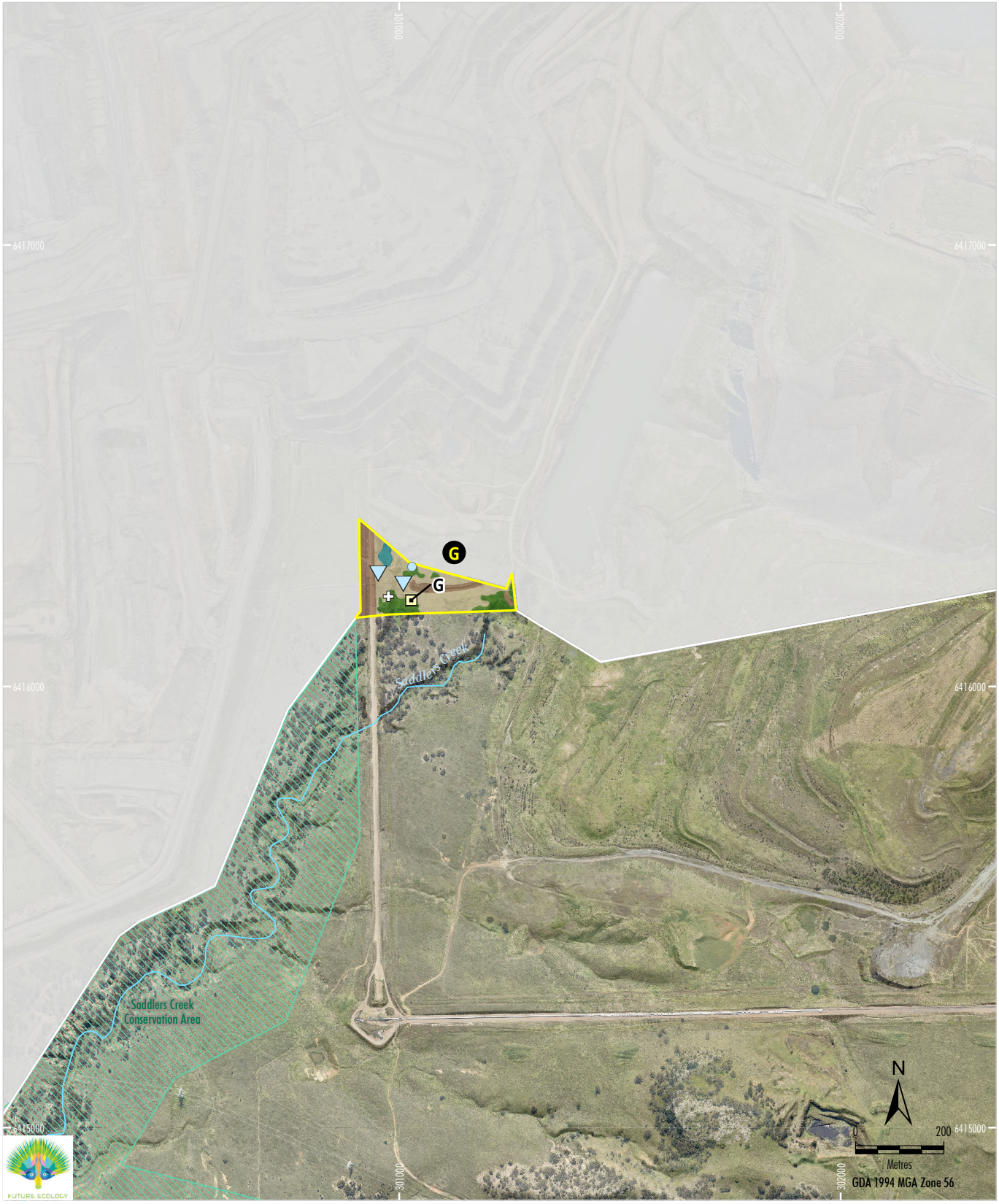
Note: Diurnal Bird Surveys were undertaken throughout the Study Area.

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Fauna Survey Sites
Mt Arthur Coal Mine - Study Area F

Figure 5e



HVE-19-09 MOD2_Fauna Report_203L

LEGEND

Existing Conservation/Offset Area
Approximate Extent of Existing/Approved Surface Development
Study Area - Mt Arthur Coal Mine

Habitat
Woodland
Wetland
Non-native
Disturbed

Survey Sites
Diurnal Bird Surveys# (Indicative Location Only)
Active Searches for Amphibians
Cameras
Nocturnal Call-Playback and Spotlight

Source: BHP (2023); NSW Spatial Services (2023); Future Ecology (2023); Hunter Eco (2023); Orthophoto Mosaic: MAC (2022)

Note: Diurnal Bird Surveys were undertaken throughout the Study Area.

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Fauna Survey Sites
Mt Arthur Coal Mine - Study Area G

Figure 5f

HVE-19-09 MOD2_Fauna Report_203L

FUTURE ECOLOGY

LEGEND

Existing Conservation/Offset Area

Approximate Extent of Existing/Approved Surface Development

Study Area - Mt Arthur Coal Mine

Habitat

Woodland

Aquatic

Non-native

Disturbed

Survey Sites

Diurnal Bird Surveys# (Indicative Location Only)

Active Searches for Amphibians

Cameras

Pitfall and Elliot A Ground Trap Sites

Nocturnal Call-Playback and Spotlight

Source: BHP (2023); NSW Spatial Services (2023); Future Ecology (2023); Hunter Eco (2023); Orthophoto Mosaic: MAC (2022)

Note: Diurnal Bird Surveys were undertaken throughout the Study Area.

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Fauna Survey Sites
Mt Arthur Coal Mine - Study Area H

Figure 5g

HVE-19-09 MOD2_Fauna Report_203L

FUTURE ECOLOGY

LEGEND

Existing Conservation/Offset Area
Approximate Extent of Existing/Approved Surface Development
Study Area - Mt Arthur Coal Mine

Habitat
Woodland
Planted
Aquatic
Non-native
Disturbed

Survey Sites
Diurnal Bird Surveys# and Stag Watch (Indicative Location Only)
Active Searches for Amphibians
Cameras
Pitfall and Elliot A Ground Trap Sites
Nocturnal Call-Playback and Spotlight

Source: BHP (2023); NSW Spatial Services (2023); Future Ecology (2023); Hunter Eco (2023); Orthophoto Mosaic: MAC (2022)

Note: Diurnal Bird Surveys were undertaken throughout the Study Area.

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Fauna Survey Sites
Mt Arthur Coal Mine - Study Area I

Figure 5h

Habitat Surveys

Fauna habitat searches were conducted for potential foraging, roosting, breeding or nesting habitat of nocturnal and diurnal species. This includes inspection for the presence of tree hollows, stags, bird nests, possum dreys, decorticating bark, rock shelters, rock outcrops/crevices, mature/old growth trees, food trees (*Banksia sp*., *Allocasuarina sp*. and winter-flowering eucalypts), culverts, dens, dams, riparian areas and refuge habitats within man-made structures.

Consideration was also given to the occurrence of habitat constraints in the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (Table 4).

Table 4: Habitat Constraints Identified in the *BioNet Threatened Biodiversity Data Collection*

Common Name	Scientific Name	Credit Class[1]	Habitat Constraints identified in the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a)
Reptiles			
Pink-tailed Legless Lizard	*Aprasia parapulchella*	Species	*Rocky areas or within 50 m of rocky areas.*
Birds			
Square-tailed Kite	*Lophoictinia isura*	Species/Ecosystem	*Breeding constraint: Other (Nest trees).*
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Species/Ecosystem	*Breeding constraint: Other (Living or dead mature trees within suitable vegetation within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines).* *Foraging constraint: Waterbodies (Within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines).*
Little Eagle	*Hieraaetus morphnoides*	Species/Ecosystem	*Breeding constraint: Other (Nest trees - live [occasionally dead] large old trees within vegetation).*
Bush Stone-curlew	*Burhinus grallarius*	Species	*Fallen/standing dead timber including logs.*
South-eastern Glossy Black-Cockatoo	*Calyptorhynchus lathami lathami*	Species/Ecosystem	*Breeding constraint: Hollow-bearing trees (Living or dead tree with hollows greater than 15 cm diameter and greater than 8 m above ground).* *Foraging constraint: Other (Presence of Allocasuarina and Casuarina species).*
Gang-gang Cockatoo	*Callocephalon fimbriatum*	Species/Ecosystem	*Breeding constraint: Eucalypt tree species with hollows at least 3 m above the ground and with hollow diameter of 7 cm or larger*
Swift Parrot	*Lathamus discolor*	Species/Ecosystem	*Breeding constraint: Other (As per mapped areas).*
Masked Owl	*Tyto novaehollandiae*	Species/Ecosystem	*Breeding constraint: Hollow-bearing trees (Living or dead trees with hollows greater than 20 cm diameter).*
Powerful Owl	*Ninox strenua*	Species/Ecosystem	*Breeding constraint: Hollow-bearing trees (Living or dead trees with hollows greater than 20 cm diameter).*
Barking Owl	*Ninox connivens*	Species/Ecosystem	*Breeding constraint: Hollow-bearing trees (Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground).*
Regent Honeyeater	*Anthochaera phrygia*	Species/Ecosystem	*Breeding constraint: Other (As per mapped areas).*
Mammals			
Koala	*Phascolarctos cinereus*	Species	*Breeding constraint: Other (Areas identified via survey as important habitat [see comments]).* .
Brush-tailed Rock-wallaby	*Petrogale penicillata*	Species	*Other (Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines).*
Grey-headed Flying-fox	*Pteropus poliocephalus*	Species/Ecosystem	*Breeding constraint: Other (Breeding camps).*
Little Bent-winged Bat	*Miniopterus australis*	Species/Ecosystem	*Breeding constraint: 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).*

Common Name	Scientific Name	Credit Class[1]	Habitat Constraints identified in the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a)
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	Species/Ecosystem	*Breeding constraint: 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;" observation type code "E nest-roost;" with numbers of individuals >500).*
Large-eared Pied Bat	*Chalinolobus dwyeri*	Species	*Cliffs (Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels).*
Southern Myotis	*Myotis macropus*	Species	*Hollow-bearing trees (Within 200 m of riparian zone).* *Other (Bridges, caves or artificial structures within 200 m of riparian zone).*
Eastern Cave Bat	*Vespadelus troughtoni*	Species	*Caves (Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within 2 km of old mines, tunnels, old buildings or sheds).*

[1] Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (current as at August 2023).

Diurnal Bird Surveys

Diurnal bird surveys were carried out by all ecologists during each survey period at each survey site. Surveys were generally done concurrently with other surveys although some dedicated bird-only surveys were also completed.

All observations were recorded within the 'Sightings' App on an iPhone and converted to an Excel file.

When threatened species were detected a count of the number of individuals of that species was also recorded. The time spent on a site was determined by the habitat quality, with the survey effort increased for higher quality sites when compared with lower quality sites. Incidental records of additional or locally significant species were also recorded while travelling around the site and between survey sites.

Some flowering of canopy species occurred during the June to August 2021 surveys with an increased level of bird activity and particularly honeyeaters although general bird activity appeared to be relatively low overall.

Diurnal bird surveys are shown on Figures 5a to 5h at the general fauna survey sites listed in Table 3. The diurnal bird surveys were undertaken across the Study Areas in appropriate habitat.

May – July 2021

All nine sites were visited several times over this period with 80 hours of diurnal surveys completed in total. Each site was visited for a minimum of one hour by one or two ecologists. The survey effort for each site is shown in Table 5:

Table 5: Diurnal Bird Survey Effort for May to July 2021 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Effort (person hours)	**25**	**14**	**7.25**	**7.25**	**2**	**6.5**	**2**	**4**	**12**	**-**	**80**

* Incidental

August 2021

Six of the nine sites were visited several times over this period with 33 hours of diurnal surveys completed in total. Sites A, B, C, D, F and I were visited for a minimum of one hour by one or two ecologists. The survey effort for each site is shown in Table 6:

Table 6: Diurnal Bird Survey Effort for August 2021 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Effort (person hours)	6	11	5	2	-	4	-	-	2.5	2.5	33

* Incidental

20 September – 8 October 2021

From September to early October 2021 one generalist fauna ecologist (who can also do flora surveys) assisted a botanist with threatened plant surveys (transects) within the Study Area (and as part of the flora survey component of the Modification). The ecologist recorded diurnal bird species (and other fauna species) and particularly species not previously recorded during the two previous survey sessions from May to August 2021.

Seven of the nine sites were visited several times over this period with 122.5 hours of diurnal surveys completed in total. The survey effort for each site is shown in Table 7:

Table 7: Diurnal Bird Survey Effort for 20 September – 8 October 2021 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Effort (person hours)	62.5	20.25	18.5	-	0.75	15	2.5	1.75	-	1.25	122.5

* Incidental

18-24 October 2021

Eight of the nine sites were visited at least once over this period with 247 hours of diurnal surveys completed in total. All sites except for Site G were visited for a minimum of one hour by two or four ecologists. The survey effort for each site is shown in Table 8:

Table 8: Diurnal Bird Survey Effort for 18-24 October 2021 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Effort (person hours)	66.5	33	32	46	6	28	-	13.5	18	4	247

* Incidental

November 2021

Three sites (A, B and C) were visited several times from 22 to 26 November 2021 during bat trapping surveys with 53.5 hours of diurnal surveys completed in total. Surveys were mainly done just after dawn and just before dusk during checking or arming of traps. The survey effort for each site is shown in Table 9:

Table 9: Diurnal Bird Survey Effort for November 2021 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Effort (person hours)	8.5	22	23	-	-	-	-	-	-	-	53.5

* Incidental

March 2022

Two sites (A and I) together with incidental (between sites) surveys sessions were visited between 21 and 25 March 2022 during mostly nocturnal surveys with eight hours of diurnal surveys completed in total. Surveys were mainly done late afternoon and before dusk prior to nocturnal activities. The survey effort for each site is shown in Table 10:

Table 10: Diurnal Bird Survey Effort for March 2022 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Effort (person hours)	5.5								1.5	1	8

* Incidental

The overall avifauna survey effort summarised above also included searches for raptor species such as the Square-tailed Kite (*Lophoictinia isura*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*) and Little Eagle (*Hieraaetus morphnoides*). During some surveys on higher ground (particularly at Site B or the nearby Mount Arthur), several high vantage points were selected and scanned for raptors hunting over the canopy and near the edges of remnant woodland, moving between remnants or circling in thermals.

In addition, whenever a raptor nest was observed it was checked for signs of occupation including identification of species if actual birds were observed in nests and/or indication of current use via presence of recent prey items and faecal whitewash below nest or nest tree.

During all survey periods, signs of owl use were searched for under and on some hollow-bearing trees (HBTs) with hollows large enough to accommodate large forest owl species (i.e. owl pellets, remains of meals, faecal whitewash, feathers).

Nocturnal Surveys

Two nocturnal survey sessions were completed during August 2021 and March 2022.

An additional nocturnal survey sessions was completed in July 2023 within the proposed modification area (part of Site A).

Nocturnal surveys consisted of listening for fauna calls from dusk, conducting call-playback of several target species, stag-watching of potential roost/nest trees, spot lighting and active searches for mammals, reptiles and amphibians (including tadpoles).

The playback of pre-recorded calls of threatened nocturnal species were carried out at dusk or after dark using digital MP3 players coupled to a 15-watt Toa megaphone, portable speakers or directly from a smart phone.

After an initial listening period of ten minutes, each call was played for a total of five minutes, followed by a five-minute listening period, with the last listening period followed by at least ten minutes of spotlighting.

Species targeted (in order of call-playback) were the Koala, Squirrel Glider, Powerful Owl, Masked Owl, Barking Owl and Bush Stone-curlew. Any fauna responding were identified either by characteristic call or direct observation using spotlights.

In addition, during frog surveys in March 2022, the calls of the Green and Golden Bell Frog were broadcast at potential habitat sites such as dams, ponds and drainage lines both during the day and at night and are included in the call-playback sessions for this period.

Note that on nights with little to no wind that call-playback sound can travel 2-3 km and therefore cover more than one site (particularly when played through a 15-watt Toa megaphone). During windy nights the opposite is often true, and sound may only cover the site from which the call-playback is being played.

Specific nocturnal owl surveys were completed in August 2021 which is within the breeding periods for Large Forest Owls - being May to August for Masked Owl and Powerful Owl and May to December for Barking Owl (DPE, 2023a).

A potential owl roost tree with a large hollow and a probable owl feeding pellet near its base was initially located at Site B during the day in this period and then was stag-watched from dusk in this same period to help determine if it was still being used.

Additional nocturnal owl surveys were completed over two late afternoons into nights in July 2023 within the proposed Modification New Disturbance Area (Site A). Five HBTs that met the minimum requirements for 'Potential Nest Trees' breeding habitat by the three target Large Forest Owl species as per the Bionet Threatened Biodiversity Data Collection (DPE, 2023) were recorded within the proposed modification area (i.e. Potential Nest Trees are living or dead trees with hollows greater than 20 cm diameter and in the case of Barking Owl such hollows must be greater than 4 m above the ground). A further four HBTs that also met the minimum requirements were also recorded in the proposed potential avoidance area as well as an additional HBT in the adjacent area already approved for development (see Figure 4). Each of these HBTs was initially checked for any signs of owl occupation including whitewash/faecal staining on tree as well as feathers, regurgitated prey remains (pellets) on the ground around each tree and nearby trees. Four of the largest HBTs were then stagwatched from sunset for one hour on two consecutive nights and then call-playback and spotlighting carried out throughout the area for approximately another hour. In addition two acoustic recorders (Chorus by Titley Scientific) and one ultrasonic bat call recorder (Anabat Express by Titley Scientific) were deployed onsite for the duration of the night of 19 July 2023 and for the duration of the nocturnal survey of 20 July 2023. The Chorus units were set to record from 90 minutes before and after sunset and sunrise while the Anabat Express was set to record between sunset and sunrise.

A total of 48 hours of nocturnal survey work which included owls was completed in August 2021. A total of 34.5 hours of nocturnal survey work was completed in March 2022. A total of 14 hours of nocturnal survey work was completed in July 2023.

Figures 5a to 5h show the location of nocturnal surveys in August 2021. Table 11 summarises the survey effort.

Table 11: Nocturnal Surveys for August 2021 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Survey Effort (person-hours)	6	11.25	8.25	4.5	-	5.25	3.75	2.25	6.75	-	48
Call-playback (sessions)	1	2	1	1	-	1	1	1	1	-	9
Stag-watch (sessions)	-	1	1	-	-	1	-	-	-	-	3

* Incidental

Figures 5a to 5h show the location of nocturnal surveys in March 2022. Table 12 summarises survey effort.

Table 12: Nocturnal Surveys for March 2022 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Survey Effort (person-hours)	8	2	6	-	-	-	4.5	-	12	2	34.5
Call-playback (sessions)	4	1	2	-	-	-	1	-	3	-	11
Stag-watch (sessions)	-	-	-	-	-	-	-	-	1	-	1

* Incidental

Figure 5a show the location of nocturnal surveys in July 2023. Table 13 summarises survey effort.

Table 13: Nocturnal Surveys for July 2023 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Survey Effort (person-hours)	14	-	-	-	-	-	-	-	-	-	14
Call-playback (sessions)	2	-	-	-	-	-	-	-	-	-	2
Stag-watch (sessions)	2	-	-	-	-	-	-	-	-	-	2

* Incidental

Ground Elliott Trapping

Ground trap transects consisting of “A” type Elliott traps which target small ground-dwelling mammals (and reptiles) were deployed at several sites in October 2021 as part of pitfall trapping transects, specifically to target for Yellow-footed Antechinus (*Antechinus flavipes*) as part of the survey requirements for Common Planigale (*Planigale maculata*)(DPE, 2023a).

Trap lines typically traversed areas of diverse vegetation or habitat features likely to support the target mammals, including areas of denser groundcovers, fallen timber, hollow logs or shrubs where available. Each trap was baited with a bait mix of peanut butter, honey, molasses, rolled oats, vanilla essence, almond essence and fish sauce.

Dry bedding material (leaves or coconut husk) was placed in each Elliott trap and the traps were covered in plastic bags. Traps were checked early each morning for captures, with any captured animals identified and immediately released. Traps were then left closed for the rest of the day until being opened again in the late afternoon to dusk period.

The “Pitfall”, “Elliot A” and “Funnel Trap Transects” in the Searches for Reptiles and Amphibian subsection below provides more information on configuration and survey effort for Elliot A traps. Figures 5a to 5h show the location of the pitfall trapping transects which includes ground Elliott traps.

Hair Tubes

Approximately eight hair tubes were used as part of the baited camera trapping sessions, which were undertaken from May to July 2021, October to November 2021, and November 2021 to March 2022. However, trapping mostly comprised of sealed bait canisters with some baited tea-bombs and sardine cans, which have no ability to capture hairs.

Hair tubes were single-sided, and five sizes were used: 90 millimetres (mm) diameter (large), 50 mm diameter (medium), 40 mm diameter (small), 30 mm diameter (extra small) and Faunatech funnels. Double-sided tape was placed at the entrance on the upper side of the tube to collect hairs of animals attracted to the bait. All tubes were baited with peanut butter, honey, molasses, rolled oats, vanilla essence, almond essence and fish sauce.

Hairtubes/funnels were generally placed in trees as part of the camera trapping surveys. Baited hair tubes only stay fresh for up to two weeks before needing to be re-baited. The total active hair-tube survey effort was therefore approximately 210 trap-nights.

Figures 5a to 5h show the location of the camera traps which included some hairtubes/funnels.

Any hairs collected were sent to ScatsAbout (Majors Creek, NSW) for analysis.

Camera Trapping

Wildlife cameras were deployed at multiple sites in areas of suitable habitat over several survey periods. Several types of cameras were used including Scout Guard SG550V, Scout Guard SG562C White Flash, Reconyx Hyperfire, Bushnell, Moultrie, Swift Enduro and Swift 3C.

Cameras were pointed at bait stations consisting of hair tubes/hairfunnels/teabombs/perforated pvc pipe baited with peanut butter, honey, molasses, rolled oats, vanilla essence, almond essence and fish sauce and/or a can of sardines pegged through can into ground or nailed to a tree. Most camera bait stations were sprayed with a solution of molasses, honey, vanilla essence, almond essence and fish sauce.

All cameras were set to take still photos, videos or a combination of both. Where the camera model allowed, they were set to activate from dusk to dawn otherwise they were set to be active all day and night.

The use of camera traps is an additional survey technique to those described in DEC (2004a) but is discussed in SEWPaC (2011a) in regard to threatened mammals. Apart from targeting Brush-tailed Phascogale, camera deployment is also suitable for detecting Squirrel Glider, Koala, Spotted-tailed Quoll and Eastern Pygmy-possum.

Figures 5a to 5h show the locations of the camera trapping sites in all survey periods.

Tables 14 to 16 provide more detail on the camera trapping effort at each site during each survey period. Note that the camera trapping survey effort stated in the tables is the ‘effective active trapnights’ which only includes the period in which each camera was assessed as working correctly and still active (i.e. batteries still powering camera, SD card not full, camera recording images/video).

May – July 2021

Camera trapping was carried out over four weeks from 31 May to 6 July 2021 to meet the Brush-tailed Phascogale survey requirements as per the *BioNet Threatened Biodiversity Database Collection* (DPE, 2023a).

50 baited cameras were initially deployed at seven sites in late May/early June 2021 to meet the survey requirements for Brush-tailed Phascogale (DPE, 2023a). The bulk of the cameras were deployed on the larger sites and/or sites with better treed habitat. Cameras were not initially deployed at two sites (E and G) due to lack of trees or poor habitat. Cameras were checked in mid-June after two weeks deployment, batteries and SD cards replaced if required, faulty cameras replaced if required and bait stations refreshed. Four additional cameras were deployed in mid-June 2021 including one camera at Site G in an area of isolated and low-quality treed vegetation. Cameras were retrieved in early July 2021 at least four weeks after initial deployment. The survey effort for each site for this period is shown in Table 14.

Table 14: Camera Trapping Effort for May to July 2021 Survey Period

Site	A	B	C	D	E	F	G	H	I	Total
Cameras	18	6	7	7	-	6	1	2	7	54
Effort (trapnights)	454	162	219	204	-	123	18	62	224	1466

October - November 2021

Additional camera trapping was conducted over three weeks from 22 October to 15 November 2021 on a rock platform area on the top of Mount Arthur after a suspected Spotted-tailed Quoll latrine site was discovered. This is an incidental site adjacent to Site B which would be within the large foraging / breeding territory of this species if present. Four cameras were deployed including two Enduro Swifts and two white flash Scout Guards with a mix of still shots and video selected. One of the camera traps was pointed at a bait station consisting of a can of sardines next to a Faunatech hairfunnel baited as per previous survey. The other cameras were pointed at the potential latrine. The camera trapping survey effort for this survey period is summarised in Table 15.

Table 15: Camera Trapping Effort for October to November 2021 Survey Period

Site	INC*	Total
Cameras	4	4
Effort (trapnights)	84	84

* Incidental site

November – March 2021

Additional baited camera trapping was conducted over several weeks from 22 November 2021 to 23 March 2022 at several locations at three sites (A, B and C). Baits were not renewed nor were cameras checked during the period. The camera trapping effort for this survey period is summarised in Table 16.

Table 16: Camera Trapping Effort for November 2021 – March 2022 Survey Period

Site	A	B	C	D	E	F	G	H	I	Total
Cameras	2	4	4	-	-	-	-	-	-	10
Effort (trapnights)	172	225	278	-	-	-	-	-	-	503

Bat Surveys

Bats were surveyed in accordance with the *'Species Credit' Threatened Bats and their Habitat: NSW Survey Guide for the Biodiversity Assessment Method* (OEH, 2018).

Surveys were undertaken by appropriately experienced bat surveyors, Adam Greenhalgh B.App.Sc., and Garon Staines B.App.Sc. Bat call identification was undertaken by Adam Greenhalgh. These surveyors each have over ten years of experience surveying and identifying bats in NSW.

All bat species in Table 1 were targeted during the surveys, however species in Table 17 were specifically targeted in accordance with the *'Species Credit' Threatened Bats and their Habitats: NSW Survey Guide for the Biodiversity Assessment Method* (OEH, 2018). The survey requirements and survey details are provided in Table 17.

Table 17: Targeted Searches for Conservation Significant Bat Species

Species	Credit Type[1]	Potential Habitat[#]	Survey Method	Survey Period	Required Survey Effort (hours or trap-nights)[#]	Required Minimum Number of Days[#]	Actual Survey Details
Grey-headed Flying-fox *Pteropus poliocephalus*	Species Credit for Breeding Habitat	*The initial search for camps should encompass any recorded camps and roosting habitat likely to occur on the subject land. If a camp is located the survey only needs to take place in the camp (that is the area occupied by the target species) to identify breeding females.*	Daytime camp survey	Oct – Dec	6 (2 per day)	3 (one per month)	No camps are known to occur in the study areas around the MAC (DCCEEW, 2022a). Numerous daytime searches were conducted throughout the study areas around the MAC. No camps were found and therefore the survey effort is not applicable.
Little Bent-winged Bat *Miniopterus australis*	Species Credit for Breeding Habitat	*Caves, tunnels, mines or other structures known or suspected to be used by M. australis including species records in the NSW BioNet Atlas with microhabitat code 'IC –in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.*	Harp trap	Dec – Feb	8	4	There are no *BioNet Atlas* (DPE, 2022a) records of these two species in the study areas around the MAC with *'microhabitat code 'IC –in cave'; observation type code 'E nest-roost'; with numbers of individuals >500'.* No caves, tunnels or disused underground mines occur in the study areas around the MAC, although some redundant undergrounding mining portals do occur outside the study areas around the MAC but within the Mt Arthur Mining Lease and were not inspected. They are located approximately 235 m from the closest point of Site B. The study area does not appear to provide the deep (often limestone) cave habitat required by these species for maternity roosts. Harp trapping was carried out at Sites B and C in late November 2021 using eight harp traps over four nights but was not repeated two weeks later due to lack of any potential maternity roost habitat in the study areas around the MAC. In addition, acoustic recording was also carried out at these same locations in November 2021 during harp-trapping as well as at a dam at Site A.
Large Bent-winged Bat *Miniopterus orianae oceanensis*	Species Credit for Breeding Habitat	*Caves, tunnels, mines or other structures known or suspected to be used by M. schreibersii oceanensis including species records in the NSW BioNet Atlas with microhabitat code 'IC-in cave'; observation type code 'E-nest-roost'; with numbers of individuals >500; or from the scientific literature.*	Harp trap	Dec – Feb	8	4	
Large-eared Pied Bat *Chalinolobus dwyeri*	Species Credit	*The PCTs associated with the species (as per the BioNet Threatened Biodiversity Data Collection [DPE, 2023a]) within 100 m of rocky areas containing caves, or overhangs or*	Harp trap or mist net	Mid Nov – end Jan	16	4	No rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings occur in the study areas around the MAC. Some sandstone cave/overhang habitat does occur around the summit of Mount Arthur

Species	Credit Type[1]	Potential Habitat[#]	Survey Method	Survey Period	Required Survey Effort (hours or trap-nights)[#]	Required Minimum Number of Days[#]	Actual Survey Details
		crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. Traps should be set in woodlands, valley floors, riparian areas and relatively fertile parts of the subject land where possible.	Acoustic detection	Mid Nov – end Jan	16	4	outside the study areas around the MAC. An easily accessible small cave at the summit was inspected for roosting bats in September, October and November 2021 and while no bats were observed some possible bat scats on the floor of the cave were present in September 2021. This cave is located approximately 210 m from the closest point of Site B. Some redundant undergrounding mining portals do occur outside the study areas around the MAC but within the Mt Arthur Mining Lease and were not inspected. They are located approximately 235 m from the closest point of Site B. The study area does not provide the deep sandstone overhang with domed roof habitat required by this species for maternity roosts (the study areas around MAC does not provide any rock escarpment or other potential roosting habitat for this species). Harp trapping was carried out at Sites B and C in late November 2021 using eight harp traps over four nights. In addition, acoustic recording was also carried out at these same locations in November 2021 during harp-trapping as well as at a dam at Site A.
Southern Myotis *Myotis macropus*	Species Credit	*The range of PCTs associated with the species (as per the BioNet Threatened Biodiversity Data Collection [DPE, 2023a]) within 200 m of any medium to large permanent creeks, rivers, lakes or other waterways (i.e. with pools/ stretches 3 m or wider).*	Harp trap or mist net	Oct – Mar	16	4	No bridges, tunnels, culverts or other structures identified as potential breeding habitat occur in the study areas around the MAC apart from numerous hollow-bearing trees and a large twin box culvert on old Edderton Road at Site A which was inspected several times for roosting bats in September 2021 and March 2022. A single bat was observed flying in and out of this culvert in March 2022 and was possibly Southern Myotis. No roosting bats were observed in this culvert although there is some
			Roost search	Oct – Mar	1 per structure	30 min per feature	

Species	Credit Type[1]	Potential Habitat[#]	Survey Method	Survey Period	Required Survey Effort (hours or trap-nights)[#]	Required Minimum Number of Days[#]	Actual Survey Details
			Acoustic detection	Oct – Mar	16	4	potential roosting habitat in the form of old lifting holes in the top sides of the twin box culvert as well as some narrow cracks in the roof between culvert sections. In addition some redundant undergrounding mining portals do occur outside the study areas around the MAC but within the Mt Arthur Mining Lease and were not inspected. They are located approximately 235 m from the closest point of Site B. No permanent creeks, rivers or lakes occur in the study areas around the MAC. Two probable Southern Myotis were observed entering and exiting a dead tree in the large enviro dam at Site I in March 2023 during spotlighting. The Study Area does contain a number of farm dams, mining infrastructure dams and two intermittent creeks (Quarry Creek and Saddlers Creek). Some of these dams are within 200 m of relevant PCTs associated with this species in the study areas around the MAC. Harp trapping was carried out at Sites B and C in late November 2021 using eight harp traps over four nights. At Site C harp traps were located at two dams containing water at least 3m wide. In addition, acoustic recording was also carried out at these same locations in November 2021 during harp-trapping as well as at a dam at Site A.
Eastern Cave Bat *Vespadelus troughtoni*	Species Credit	*The PCTs associated with the species (as per the BioNet Threatened Biodiversity Data Collection [DPE, 2023a]) within 100 m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the*	Harp trap or mist net	Nov – end Jan	16	4	No rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings occur in the study areas around the MAC. Some sandstone cave/overhang habitat does occur around the summit of Mount Arthur outside the study areas around the MAC. An easily accessible small cave at the summit was inspected for
			Roost search	Nov – end Jan	1 per structure	30 min per feature	

Species	Credit Type[1]	Potential Habitat[#]	Survey Method	Survey Period	Required Survey Effort (hours or trap-nights)[#]	Required Minimum Number of Days[#]	Actual Survey Details
		potential habitat. Traps should be set in woodlands, valley floors, riparian areas and relatively fertile parts of the subject land where possible.	Acoustic detection	Nov – end Jan	16	4	roosting bats in September, October and November 2021 and while no bats were observed some possible bat scats on the floor of the cave were present in September 2021. This cave is located approximately 210m from the closest point of Site B. Some redundant undergrounding mining portals do occur outside the study areas around the MAC but within the Mt Arthur Mining Lease and were not inspected. They are located approximately 235m from the closest point of Site B. No old buildings or sheds are located in the study areas around the MAC apart from the Windmill Homestead at Site A which is still being used for accommodation and no bats were observed to be roosting there. There are sheds and demountable buildings associated with the 'core shed' compound at Site A which were not inspected as they have only recently become disused. In addition there is an old metal grain silo adjacent to Site E which was inspected for roosting bats in October 2021 and no bats were observed. Harp trapping was carried out at Sites B and C in late November 2021 using eight harp traps over four nights. In addition, acoustic recording was also carried out at these same locations in November 2021 during harp-trapping as well as at a dam at Site A.

[1] Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (current as at March 2023).

[#] '*Species Credit' Threatened Bats and Their Habitats: NSW Survey Guide for the Biodiversity Assessment Method* (OEH, 2018).

Live trapping surveys using harp traps and mist nets together with acoustic detection were undertaken over four nights in November 2021 during suitable weather conditions (Section 2.4.1), to ensure compliance with *'Species Credit' Threatened Bats and their Habitats: NSW Survey Guide for the Biodiversity Assessment Method* (OEH, 2018) and the species targeted as per Table 18.

The bat surveys for the Grey-headed Flying-fox, Corben's Long-eared Bat (*Nyctophilus corbeni*) and Large-eared Pied Bat (*Chalinolobus dwyeri*) were also undertaken in consideration of the *Survey Guidelines for Australia's Threatened Bats* (DEWHA, 2010b).

The following subsections provide the dates of each survey, details of the methods used and total survey effort for bats.

Harp Trapping

Harp trapping was carried out at Site C at two dams which contained water to a width of at least 3 m to meet Southern Myotis potential foraging habitat requirements (OEH, 2018) as well as at Site B (no dams but located to try and catch any cave dwelling species that could be roosting around the rocky escarpment of nearby Mount Arthur and some redundant underground mining portals).

Harp traps were the standard Faunatech two-bank design.

- Site B: four harp traps placed for four consecutive nights (22-25 November 2021); and
- Site C: four harp traps placed for four consecutive nights (22-25 November 2021).

Harp traps were set and left all night at the above sites within potential flyways wherever possible and/or adjacent to waterbodies. Harp traps were inspected for captures usually once at night and then again at dawn and then disarmed for the day. Any captures were held during the day in cotton bags back at the accommodation, identified to species level, and then released back at the same site that night. Harp traps were moved to a different location within the same site each evening.

Harp traps and mist nets were moved to a different location within the same site each evening. Harp traps were placed at least 20 m apart.

Figures 5b to 5c shows the bat survey sites and Table 18 summarises harp-trap survey effort.

Table 18: Harp trap Effort for 22-25 November 2021 Survey Period

Site	A	B	C	D	E	F	G	H	I	Total
Harp traps	-	4	4	-	-	-	-	-	-	8
Effort (trapnights)	-	16	16	-	-	-	-	-	-	32

Ultrasonic Bat Detection

Electronic ultrasonic acoustic detectors were used to collect ultrasonic calls of microbat species. Detectors used included: Anabat Express and Scout detectors (Titley Scientific, Brisbane QLD), an Echometer and an SMBAT2+ Songmeter (Wildlife Acoustics, Maynard, MA, USA).

Apart from the Echometer, the detectors were used statically (i.e. set and left in one location for several hours or overnight) and were placed at least 50 m apart within each relevant site at ground level or off the ground aiming along potential microbat flyways that microbats could use to forage and navigate.

During harp-trapping from 22-25 November 2021, eight acoustic detectors were placed at each of the eight harp-trap locations while a ninth detector was placed next to a dam near the Windmill Homestead.

In addition, an Echometer attached to an iPhone was used for approximately one hour at the Site I enviro dam in March 2022.

In July 2023 an Anabat Express was left onsite in the proposed modification area (Site A) next to a group of three HBT for a whole night from dusk and then at another very large HBT for part of a second night (approximately two hours from dusk). This was to assist in determining if any of the HBTs were being used as a roost for microbats at this time of year (although this was outside the recommended warm season survey period for many microbat species).

Figures 5a to 5c show the bat survey sites and Table 19 summarises ultrasonic acoustic survey effort.

Table 19: Ultrasonic Acoustic Survey Effort for 22-25 November 2021 and 19-20 July 2023 Survey Period

Site	A	B	C	D	E	F	G	H	I	Total
Acoustic Detectors	2	4	4	-	-	-	-	-	1*	10
Effort (trapnights)	4	16	14	-	-	-	-	-	-	34

*March 2022

Microbat Habitat Searches

Potential microbat roost habitats were visually inspected during the day for roosting bats as follows:

- a natural rock cave at an incidental site on top of Mount Arthur adjacent to Site B for four hours in total in September, October and November 2021; and
- a box culvert bridge on old Edderton Road at Site A for 0.5 hour in September 2021 and 1.5 hours March 2022.

Koala Scat Searches

The Modification New Disturbance Area is mapped as mostly DNG (PCT 483 DNG) with only a few scattered remnant and regenerating native tree species observed during field surveys.

General Koala scat searches were undertaken at several sites in the study areas around the MAC as part of diurnal and nocturnal fauna searches and are included in those times. Any potential Koala scats detected were firstly examined to see if they were composed of finely chewed Eucalyptus leaves and to help differentiate from Brush-tailed Possum (*Trichosurus vulpecula*) scats (which can be superficially similar). Where such scats were detected, they were sent to ScatsAbout for further identification and targeted surveys using the *Spot Assessment Technique for determining localised levels of habitat use by Koalas* (Phillips and Callaghan, 2011) were then carried out.

Acoustic Monitoring for Koala and Squirrel Glider

Ten acoustic monitoring devices (Songmeter Mini from Wildlife Acoustics) were deployed at several locations around the study areas around the MAC for two to four nights in November 2021 (Sites A, B and C), mainly targeting Koala but this technique was employed for Squirrel Glider. One monitor was placed for two nights at Site C and then moved to Site A for two nights. A second monitor was deployed at Site A for three nights. Monitors were set to record for one hour every hour between dusk and dawn. A total of 39 acoustic monitor trap-nights was carried out over the study areas around the MAC. The acoustic data was sent to expert Anna McConville of Echo Ecology who used the Kaleidoscope software package (from Wildlife Acoustics) to search for Koala and Squirrel Glider calls.

In addition two acoustic recorders (Chorus by Titley Scientific) were deployed within the Proposed Modification Area (Site A) for the duration of the night of 19 July 2023 (approximately 12 hours) and for the duration of the nocturnal survey of 20 July 2023 (approximately 2 hours). The Chorus units were set to record from 90 minutes before and after sunset and sunrise. Given that ecologists were onsite from dusk on both survey nights in July 2023 only the recordings from each Chorus unit for that period of an hour before dawn on 20 July 2023 were listened to in real time for any indication of Koala as well as Large Forest Owl and Squirrel Glider calls.

See Figures 5a to 5c for locations and Table 20 for survey effort.

Table 20: Acoustic Monitoring Survey Effort for Koala and Squirrel Glider in November 2021 and July 2023

Site	A	B	C	D	E	F	G	H	I	INC*	Total
No. of Monitors	4	4	5	-	-	-	-	-	-	-	
Trap-nights	7	16	18	-	-	-	-	-	-	-	41

Searches for Reptiles and Amphibians – Active Searches, Pitfall Traps, Reptile Funnels, Artificial Shelter Habitat and Acoustic Monitoring

Active searches were conducted at selected/preferred sites located at representative habitat components across the study areas around the MAC. This included potential shelter, refuge, foraging, over-wintering and breeding habitat for the range of species detected and targeted. Inspected habitat features included ground logs/timber, lightly imbedded surface rock, cow pats, decorticating bark, mature/old growth trees and stags with accessible crevices/fissures/hollows, dams, riparian zones, and man-made refuge habitats, where present, at each survey site and across the study areas around the MAC.

Further opportunistic searches including searches of other suitable microhabitat features encountered whilst traversing between survey plots – this approach targeted species known to have specific habitat/micro-habitat preferences not apparent within the survey plots chosen. Similarly, during road/track traverses, (diurnal and nocturnal) scans were made for species that were active or more active at certain times of the day or night.

Surveys for amphibians were undertaken in accordance with the *Saving Our Species. Hygiene guidelines. Protocols to protect priority biodiversity areas in NSW from Phytophthora cinnamomi, myrtle rust, amphibian chytrid fungus and invasive plants* (DPIE, 2020c).

Initial habitat surveys were carried out for the threatened Green and Golden Bell Frog on at least 20 dams/ponds/drainage lines within the study areas around the MAC searching for habitat features known to be favoured by this species (marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.) (DPE, 2023a), and/or other sedges such as *Phragmites australis*, *Juncus acutus*.

Targeted surveys for Green and Golden Bell Frog were then carried out at a few locations with some habitat features preferred by this species and included dams at Site A, Site C and Site I and a dam and drainage line (tributary of Saddlers Creek) at Site G, and a drainage line at Site A (Quarry Creek).

Diurnal surveys were generally conducted until conditions became too hot or too cold. Nocturnal surveys were generally run between dusk and 10:00 pm to 11:00 pm. The time spent on a site was determined by the habitat quality and the species to be targeted, so that survey effort was increased for higher quality sites compared with lower quality sites.

Specific targeted surveys were conducted for Striped Legless Lizard (*Delma impar*), Pink-tailed Legless Lizard (*Aprasia parapulchella*) and Pale-headed Snake (*Hoplocephalus bitorquatus*).

Lightly imbedded rock areas were identified at Sites A, B, C and D and several searches were undertaken at these locations (see Figures 5a to 5d for locations). Typically, 100-200 rocks (where this number were present) were carefully lifted up and searched under per ecologist per session. In addition, searches were undertaken by looking under cow pats (dung) at several locations given that Striped Legless Lizard is known to use this microhabitat feature (author pers. obs.).

A total of 34.5 hours of nocturnal searches were completed as part of warm season surveys (March 2022) while 48 hours of nocturnal searches were completed in August 2021 (this being outside the optimal survey period for reptiles and many amphibians).

A total of 247 hours of diurnal searches were completed as part of warm season surveys (October 2021) including a total of 87 hours dedicated to active reptile and amphibian searches. Two hours of active reptile searches were also completed in March 2022.

Pitfall, Elliot A and Funnel Trap Transects

From 18-24 October 2021 surveys were carried out using pitfall traps and Elliot A ground-traps as per the specific requirements for Common Planigale (DPE, 2023a). Pitfall trapping is also a suitable technique for Striped Legless Lizard (SEWPaC, 2011c) and Eastern Pygmy-possum as well as amphibians, small reptiles, and small mammals (DEC, 2004).

Pitfall trapping transects consisting of six 150 mm diameter, 600 mm deep end capped PVC pipes and/or 280mm diameter, 410 mm deep plastic buckets placed along a 300 mm high 30 m long drift fencing. Pitfalls were placed 5 m apart in a straight line with a continuous run of drift fence placed along the pitfalls and extending for a few metres beyond the end pitfalls as per DEC (2004). A piece of polystyrene foam together with leaf litter was placed in the bottom of each pit. In the event of inclement weather or when not in use, the top end of the pit was capped.

About 5-10 m off and parallel to the drift fence, 20 Elliot A traps were placed on the ground (10 on either side of drift fence).

In addition, two to four double-ended reptile net funnels were placed along pitfall trap drift fences at some locations.

This configuration was deployed at ten locations over eight sites with Sites A, B and C having two configurations each and Sites D, F, H and I having one configuration each (see Figures 5a to 5h for locations).

All traps were left open for four consecutive nights. Pitfalls and funnels were typically checked within two hours of sunrise and in the afternoon. Elliot traps were checked within two hours of sunrise and then closed for the day. Any animals caught were identified and released.

At least 24 pitfall trap-nights and 80 Elliot A trap-nights were completed at each location, except for sites E and G, while some locations also received between 8 to 32 reptile funnel trap-nights (see Table 21). A total of 264 pitfall trap-nights, 88 funnel trap-nights and 880 Elliot trap-nights were achieved over the study areas around the MAC.

Table 21: Pitfall, Reptile funnel, Elliot A Survey Effort for 18-24 October 2021 Survey Period

Site	A	B	C	D	E	F	G	H	I	INC*	Total
Pitfall (trap-nights)	48	48	48	24	-	24	-	24	24	-	264
Reptile funnel (trap-nights)	-	32	16	16	-	8	-	8	8	-	88
Elliot A (trap-nights)	160	160	160	80	-	80	-	80	80	-	880

* Incidental

Artificial shelter habitat

In August 2021, artificial shelter habitat consisting of grids of second-hand masonry pavers (approximately 40 cm x 30 cm) were deployed at Sites C and D to specifically target Striped Legless Lizard as per SEWPaC (2011c) (see Figures 5a, 5c and 5d for locations) but were also suitable for small mammals such as Common Planigale. Each grid consisted of 50 pavers, at 5 m spacing between pavers, arranged in rows of ten tiles by five pavers. Where possible grids were located on north facing slopes in areas of derived native grassland with denser groundcover. Grids were checked in October 2021 for reptiles and small mammals.

Additional artificial shelter habitat consisting of 12 sheets of old roofing metal (approximately 0.5 m by 0.5 m) were placed on a native grass dominated slope at Site A off old Edderton Road in November 2021. These were laid out in a single transect of around 100 m length with each sheet around 5-10 m apart. They were checked in December 2021 and again in March 2022.

Table 22: Artificial Reptile Habitat

Site	A	B	C	D	E	F	G	H	I	INC*
Pavers (50)	-	-	✓	✓	-	-	-	-	-	-
Roofing Metal Sheets (12)	✓	-	-	-	-	-	-	-	-	-

Acoustic Monitoring

Ten acoustic monitoring devices (Songmeter Mini from Wildlife Acoustics) were deployed at several locations around the study areas around the MAC for two to four nights in November 2021 (Sites A, B and C), mainly targeting Koala but this technique was also used to monitor for threatened amphibians including Green and Golden Bell Frog and Green-thighed Frog where monitors were placed next to a dam, drainage line or flooded area. One monitor was placed for two nights at Site C and then moved to Site A for two nights. A second monitor was deployed at Site A for three nights. Monitors were set to record for one hour every hour between dusk and dawn. A total of 39 acoustic monitor trap-nights were completed over the study areas around the MAC. Relevant monitors placed next to dams and drainage lines (Sites A and C) were then scanned for frog calls on those nights where heaviest rainfall was recorded. Scanning involved listening for frog calls for one minute at the 0, 15, 30, 45 and 59 minute marks for each relevant recording date (See Figures 5a to 5c for locations and Table 23 for survey effort).

Table 23: Acoustic Monitoring for Amphibians

Site	A	B	C	D	E	F	G	H	I	INC*	Total
No. of Monitors	2	4	5	-	-	-	-	-	-	-	
Trap-nights	5	16	18	-	-	-	-	-	-	-	39

Opportunistic Observations

All fauna observed or heard opportunistically during the field surveys (including travelling between sites in the broader area) were recorded. Characteristic signs, tracks, trails and other indirect evidence of fauna species from all fauna groups were also recorded. Any observed predator scats and/or owl pellets containing bone and fur material were collected and sent for analysis to expert Georgeanna Storey of ScatsAbout (Major Creek, NSW).

2.4.3 Survey Effort

Table 24 provides a summary of the survey techniques and effort employed at each of the survey sites.

Table 24: Summary of Survey Techniques and Effort Used at Each Site within the Study Area

Site	Habitat Assessment (hours)	Diurnal Bird Survey (hours)						Nocturnal Surveys (birds, reptiles, frogs, mammals) (hours)			Nocturnal Call-playback (sessions)			Dusk Stagwatch (sessions)			Cameras (trap-nights)# (May-July 2021)	Hair Tubes (trap-nights) (May-July 2021)^	Cameras (trap-nights) (Oct-Nov 2021)	Hair Tubes (trap-nights) (Oct-Nov 2021)	Cameras (trap-nights) (Nov 2021-March 2022)	Hair Tubes (trap-nights) (Nov 2021-March 2022)	Acoustic Monitoring (trap-nights) (Nov 2021)	Acoustic Monitoring (trap-nights) (July 2023	Artificial Reptile Habitat (Aug to Oct 2021)	Artificial Reptile Habitat (Nov 2021 to March 2022)	A Elliott Ground Trapping (trap-nights) (October 2021)	Pitfall Trapping (trap-nights) (October 2021)	Reptile Funnel (trap-nights) (October 2021)	Bat Harp Trapping (trap-nights) (Nov 2021)	Bat Acoustic Recording (trap-nights) (Nov 2021)	Bat Acoustic Recording (trap-nights) (July 2023)	Bat Habitat Searches – Caves/Culverts (hours)
		May-July 2021	Aug 2021	Sept – early Oct 2021	Late Oct 2021	Nov 2021	March 2022	Aug 2021	March 2022	July 2023	Aug 2021	March 2022	July 2023	Aug 2021	March 2022	July 2023																	
A^^	1.5	25	6	62.5	66.5	8.5	5.5	6	8	14	1	4	2	-	-	2	454	28	-	-	172	42	5	2	-	✓	160	48	-	-	3	1	2
B	0.5	14	11	20.25	33	22	-	11.25	2	-	2	1	-	1	-	-	162	-	-	-	225	14	16	-	-	-	160	48	32	16	16	-	-
C	0.5	7.25	5	18.5	32	23	-	8.25	6	-	1	2	-	1	-	-	219	28	-	-	278	-	18	-	✓	-	160	48	16	16	14	-	-
D	0.5	7.25	2	-	46	-	-	4.5	-	-	1	-	-	-	-	-	204	-	-	-	-	-	-	-	✓	-	80	24	16	-	-	-	-
E	0.5	2	-	0.75	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F	0.5	6.5	4	15	28	-	-	5.25	-	-	1	-	-	1	-	-	123	-	-	-	-	-	-	-	-	-	80	24	8	-	-	-	-
G	0.5	2	-	2.5	-	-	-	3.75	4.5	-	1	1	-	-	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	0.5	4	-	1.75	13.5	-	-	2.25	-	-	1	-	-	-	-	-	62	-	-	-	-	-	-	-	-	-	80	24	8	-	-	-	-
I	0.5	12	2.5	-	18	-	1.5	6.75	12	-	1	3	-	-	1	-	224	-	-	-	-	-	-	-	-	-	80	24	8	-	-	-	-
INC*			2.5	1.25	4	-	1	-	2	-	-	-	-	-	-	-	-	-	84	28	-	-	-	-	-	-	-	-	-	-	1	-	4
Totals	**5.5**	**80**	**33**	**122.5**	**247**	**53.5**	**8**	**48**	**34.5**	**14**	**9**	**11**	**2**	**3**	**1**	**2**	**1466**	**56**	**84**	**28**	**503**	**56**	**39**	**2**	✓	✓	**880**	**264**	**88**	**32**	**33**	**1**	**6**

* Incidental

Note that the camera trapping survey effort stated is the 'effective active trapnights' which only includes the period in which each camera was assessed as working correctly and still active (i.e. batteries still powering camera, SD card not full, camera recording images/video).

^ baited hairtubes/stations are assumed to be active for a maximum of 14 nights unless the bait is refreshed.

^^ Note that only diurnal incidental fauna surveys of approximately 12 hours in total (using two ecologists) were completed on 23/9/2021, 24/9/2021, 29/9/2021, 21/10/2021, 22/10/2022, 25/11/2021 as part of threatened flora transect surveys and other fauna survey activities. This was due to the Modification New Disturbance Area being of poorer habitat quality than other parts of the original Site A. However, two additional late afternoon into night nocturnal surveys were completed in the proposed modification area on 19-20 July 2023

2.4.4 Targeted Searches for Threatened Fauna

Threatened fauna species listed under the BC Act and/or EPBC Act which are known or likely to occur in the study areas around the MAC were specifically targeted during the surveys (Table 25). Threatened fauna species were targeted in accordance with the survey timing, techniques and effort described within the relevant survey guidelines listed in Section 2.3.

Table 25 provides a list of threatened fauna species specifically targeted during the surveys (although the surveys were designed to obtain an inventory of all native and introduced fauna species present, not only the threatened species listed).

The following species listed in Table 1 (threatened fauna species predicted to occur in the wider locality) did not have any potential habitat in the study areas around the MAC and are therefore not included in Table 25: Booroolong Frog (*Litoria booroolongensis*), Australasian Bittern (*Botaurus poiciloptilus*), Eastern Curlew (*Numenius madagascariensis*), Curlew Sandpiper (*Calidris ferruginea*) and Little Tern (*Sternula albifrons*).

Table 25: Targeted Searches for Conservation Significant Fauna Species

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
Amphibians							
Green and Golden Bell Frog	*Litoria aurea*	E	V	S	As per NSW Survey Guide for Threatened Frogs (DPIE, 2020b) for this species: Suitable breeding and non-breeding shelter habitat consists of any waterbody with emergent aquatic vegetation and without the plague minnow (*Gambusia holbrooki*). • Aural-visual surveys from Nov. – March, 480 mins per 500m transect and 4 repeat surveys; or • Acoustic recorder surveys from Nov. – March, 154 recorder days, 1 x 14 days; and • Tadpole surveys can be used to replace up to two of the aural-visual surveys and consist of search from Nov. – March for 10 mins/50 square metres (m^2) of surface area for up to 2 repeat surveys. Commonwealth guidelines (DEWHA, 2010a): Similar to NSW but survey period is from September to March.	November to March	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Searches for suitable habitat within the study areas around the MAC were conducted from May 2021 to March 2022 during diurnal and nocturnal surveys. Some marginal habitat was observed (mostly farm dams, mining dams and watercourses with only minor emergent aquatic vegetation). Most surveyed sites had Plague Minnow (*Gambusia holbrooki*). A combination of aural-visual surveys, tadpole surveys and monitoring via acoustic recorders was conducted at the best habitat potential sites in October and November 2021 and March 2022. The November acoustic monitoring event occurred during significant rainfall (>50mm in 24 hours).
Green-thighed Frog	*Litoria brevipalmata*	V	-	S	As per NSW Survey Guide for Threatened Frogs (DPIE, 2020b) for this species: Potential habitat: Suitable breeding habitat is any semi-permanent or ephemeral waterbody of >25 m^2 in surface area located within native vegetation or immediately adjacent to or within 10 m of native vegetation. Surveys should target larger depressions or flooding swamp areas (>5 m X 10 m in diameter), usually identifiable by flood tolerant vegetation. A combination of aural-visual surveys and tadpole searches are completed within or around the edges of potential breeding habitat. An aural-visual survey should be used when the	October to March	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Searches for suitable habitat within the study areas around the MAC were conducted from May 2021 to March 2022 during diurnal and nocturnal surveys. Some marginal habitat was observed (edges of farm dams and riparian areas of intermittent creeks) but the preferred wet sclerophyll habitat for this species in the south of its range (which includes the study areas around the MAC) is absent from the study areas around the MAC. A combination of aural-visual surveys, tadpole surveys and monitoring via acoustic recorders was conducted at the best habitat potential sites in October and November 2021 and

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					frogs are expected to be calling; this is to be followed by a search of the breeding site for tadpoles and metamorphosing froglets approximately 30 to 60 days later. The calling period for this species is very short, usually lasting one or two nights during or immediately after (<24 hours) flooding, but with some ongoing precipitation. Flooding typically occurs as a result of heavy rainfall (>50 mm in 24 hrs), but smaller combined rainfall events may inundate the site. The breeding site must be flooded at the time of the survey. • Aural-visual surveys from Spring-Autumn, 240 mins per 500m transect and 2 repeat surveys; and • Tadpole surveys from Spring – autumn after flooding rains for 10 mins/50 m2 of surface area and 2 repeat surveys.		March 2022. The November acoustic monitoring event occurred during significant rainfall (>50mm in 24 hours).
Reptiles							
Pink-tailed Legless Lizard	*Aprasia parapulchella*	V	V	S	As per NSW Survey Guide for Threatened Reptiles (DPE, 2022) for this species: Habitat surveys consist of diurnal rock searches undertaken by turning over suitably sized rocks in areas of suitable habitat. Turn over a minimum of 200 suitably sized rocks for every 5 ha of suitable habitat. Repeat a minimum of four times per season. Undertake surveys in the 2 hours after sunrise and 2 hours before sunset on sunny days (<50% cloud cover). This ensures a suitable thermal environment is present for the species to be sheltering under rocks at the time of survey. Cease surveys once temperatures exceed 25°C, as the species will move deeper underground where it is not detectable	September, October and November	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Active diurnal reptile searches were undertaken at several sites in October 2021 by two specialist herpetologists (who previously found this species on another project just outside the study areas around the MAC). This also included searching of lightly imbedded rock areas identified at several sites (Reptile Active Search Sites in Figures 5a to 5d). Ten pitfall trapping transects were spread over seven sites in October 2021 achieving 264 trapnights. Artificial reptile habitat was placed at two sites from August to October 2021 and an additional site from October 2021 to March 2022 (Figures 5a to 5d), which could have also detected this species.

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					Suitable habitat is rocky areas (or within 50 m of rocky areas) located within PCTs associated with the species in the Threatened Biodiversity Collection (TBDC). Diurnal habitat searches (which includes overturning of rocks) in spring and early summer (SEWPaC, 2011b). Survey in spring, avoiding hot days in November (DPE, 2023a).		
Striped Legless Lizard	*Delma impar*	V	V	S	As per NSW Survey Guide for Threatened Reptiles (DPE, 2022) for this species: Habitat surveys combined with either pitfall trap surveys or artificial cover are required, as a single method is unlikely to detect this species (DSEWPaC 2011). Undertake habitat surveys in suitable habitat, concentrating the search in and around grass tussocks. Turning over rocks should be done carefully and no more than once per week, as this can adversely impact the species' habitat. Set 25 pitfall traps for 10 days, in vegetated areas of suitable habitat. Use 5 drift fences (30 cm high) with 5 traps per fence set every 4 m along the fence. Appropriate pitfall trap size for this species is ≥ 30 cm deep and ≥ 20 cm wide at the top. Install artificial cover boards at least 3 months prior to the first survey. Place in vegetated areas, ideally positioned on a northerly aspect. Cover boards should consist of 50 roof tiles with 5m spacing between tiles, arranged in a grid of 10 x 5 tiles. For suitable habitat that is: • ≤ 2 ha, use 2 tile grids; • > 2 ha – 30 ha, use one tile grid per 3 ha of suitable habitat; and	September, October, November and December	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Active diurnal reptile searches were undertaken at several sites in October 2021 by two specialist herpetologists (who previously found this species on another project just outside the study areas around the MAC). This also included searching of lightly imbedded rock areas identified at several sites (Reptile Active Search Sites in Figures 5a to 5d). Ten pitfall trapping transects each consisting of 6 pitfalls along a 30m drift fence (60 pitfalls in total) were spread over seven sites in October 2021 achieving 264 trapnights. Artificial reptile habitat was placed at two sites from August to October 2021 and an additional site (Site A adjacent to the Modification Area) from October 2021 to March 2022 (Figures 5a to 5d) (which detected this species)..

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					• > 30–50 ha, use 10 tile grids. Check artificial cover boards once per week, when ambient temperature is ≤28°C. Check shelter sites no more than once per week, as this may cause the species to abandon the site. <u>Replicates</u> Habitat surveys – weekly for 8 weeks or daily for 10 days; pitfall traps – trap for 10 days; artificial cover – check weekly for 8 weeks. Suitable habitat All PCTs on the subject land associated with the species in the TBDC. Commonwealth Guidelines and Referral Guidelines (SEWPaC 2011b; 2011c): Either artificial shelter sites or pitfall trapping as primary technique, but artificial sites are preferred where there is surface rock. Habitat searches are secondary. Artificial shelter: up to 10 grids of 50 tiles on north facing slopes in habitat areas >30 ha as a minimum. Pitfall trapping: at least 50 pitfall configurations should be used for sites >25 ha, using 2-5 pitfalls, 5 m fence per configuration. Survey timing: September to May (SEWPaC, 2011b)		
Pale-headed Snake	*Hoplocephalus bitorquatus*	V	-	S	NSW guidelines (DEC, 2004): Nocturnal spotlighting, 30-minute searches on 2 separate nights should be undertaken per stratification unit. Survey should be undertaken 1-2 days after rainfall and on humid nights (DPE, 2023a).	January, February, March, November and December	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Nocturnal surveys were carried out at various sites in March 2022
Birds							
Magpie Goose	*Anseranas semipalmata*	V	-	E	No species-specific requirement defined (DEC, 2004). Diurnal bird surveys would be appropriate for these species.	None	The survey guideline requirements were met and surveys undertaken at an appropriate time. A total of 544 hours of diurnal bird surveys were undertaken. Surveys were carried out in May-July
Freckled Duck	*Stictonetta naevosa*	V	-	E		None	

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
Black-necked Stork	*Ephippiorhynchus asiaticus*	E	-	E	Habitat constraint: shallow lakes, lake margins and estuaries within 300m of these waterbodies (DPE, 2022b). No species-specific requirement defined (DEC, 2004). Diurnal bird surveys would be appropriate for these species.	None	2021, August 2021, September-early October 2021, late October 2021, November 2021 and March 2022. Surveys exceeded 80 hours over 10 days (for Red Goshawk). Only very marginal habitat for Magpie Goose, Freckled Duck and Black-necked Stork was present in the study areas around the MAC in the form of farm and mining dams with limited fringing and/or emergent macrophytes, sedges and/or rushes. Approximately 15-20 dams were searched over survey periods. Diurnal surveys included surveys from high points in study area searching for raptors. Particular attention was given to searches for and inspection of raptor nests to determine use and what species were using them. In accordance with BAM requirements (DPIE, 2020a), seasonal surveys for Square-tailed Kite were undertaken in September 2021, October 2021 and November 2021, White-bellied Sea-Eagle in July 2021, August 2021, September 2021, October 2021 and November 2021, and Little Eagle in August 2021, September 2021 and October 2021. An additional two late afternoon into night surveys in the proposed modification area (Site A) in July 2023 were also used as an opportunity to check if there were any potential large raptor nest and activity in this area.
Grey Falcon	*Falco hypoleucos*	E	-	E	No species-specific requirement defined (DEC, 2004). Diurnal bird surveys would be appropriate for these species.	None	
Black Falcon	*Falco subniger*	V	-	E		None	
Square-tailed Kite	*Lophoictinia isura*	V	-	S/E	Breeding habitat is live large old trees within suitable vegetation and the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy (DPE, 2023a).	January, September, October, November and December	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	-	S/E	Breeding habitat is live large old trees within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines and the presence of a large stick nest within tree canopy; or an adult with nest material; or adults observed duetting within breeding period. Due to the similarities in nest structure and use of the same nests by White-bellied Sea-Eagles and Wedge-tailed Eagles, where a nest is observed without a bird present, searches for prey remains/feathers below the structure should be undertaken. The differing diets of both species and distinctive adult feathers should provide evidence of nest use, however; where prey items/feathers are absent, repeat visits to the nest until a bird is observed should be undertaken (DPE, 2023a).	July, August, September, October, November and December	
Spotted Harrier	*Circus assimilis*	V	-	E	No species-specific requirement defined (DEC, 2004). Diurnal bird surveys would be appropriate for these species.	None	
Red Goshawk	*Erythrotriorchis radiatus*	CE	V	S	Searches for its distinctive nest and area searches (80 hours over 10 days) is recommended (DEWHA, 2010c).	All year	

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
Little Eagle	*Hieraaetus morphnoides*	V	-	S/E	Breeding habitat is live (occasionally dead) large old trees within suitable vegetation and the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy (DPE, 2023a).	August, September and October	
Bush Stone-curlew	*Burhinus grallarius*	E	-	S	NSW guidelines (DEC, 2004): Call-playback should consist of playing calls for 30 seconds, followed by 4.5 minutes of listening, repeated up to three times. Sites for this species should be 2-4 km apart and conducted during the breeding season. Spotlighting should be done by foot or from a slow-moving vehicle.	All year	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Nocturnal surveys incorporating quiet listening, call-playback and spotlighting were carried out at numerous sites during the survey period. A total of 48 hours of nocturnal survey work including nine call-playback sessions were completed in August 2021 (at the start of the breeding season). A total of 34.5 hours of nocturnal survey work including 11 call-playback sessions was completed in March 2022. Diurnal surveys to flush out this species were also carried out. An additional two late afternoon into night surveys in the proposed modification area (Site A) in July 2023 were also used as an opportunity to do call-playback and spotlighting for this species.
Australian Painted Snipe	*Rostratula australis*	E	E	E	Area searches or transects; targeted stationary observations at dawn and dusk of suitable foraging locations within wetlands (DEWHA, 2010c). This species can only be surveyed for if there is water in the wetland and even then, only when suitable conditions exist (i.e. muddy flats) (DPE, 2023a).	None	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Wetland habitat was not present in study area however some farm and mining dams may have provided potential but marginal habitat. Diurnal and nocturnal surveys undertaken at or near dams in study area would have covered this species. Targeted stationary observations were generally not undertaken due to lack of quality habitat for this species (e.g. wetlands, lakes, swamps and clay pans) within the study areas around the MAC .
South-eastern Glossy Black-Cockatoo	*Calyptorhynchus lathami lathami*	V	-	S/E	The following Bionet survey guidelines for this species within the TBDC (DPE, 2023a) are relevant:	January to September inclusive	**The survey guideline requirements were met and surveys undertaken at an appropriate time.**

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					This is a dual credit species. The identification of breeding habitat will require survey or an expert report. For clearing or development assessments, presence can be assumed. 1. Assessors should look for signs of breeding on site as follows; (a) begging birds of any age or sex; or (b) lone adult males identified during the breeding season (April to August); or (c) an occupied nest. 2. Where signs of breeding on site are present, potential nest trees should be identified. Potential nest trees contain hollows that are; (i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees, and may be near-vertical or vertical. 3. Where potential nest trees are identified on site, monitor for this species during the breeding season (Apr – Aug) to confirm the presence of any actual nest trees on site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements). 4. If actual nest trees are confirmed on site, then the species polygons are to be drawn around those actual nest trees (i.e. trees that birds of the species are known to have used for nesting). The species polygons should be circular in shape and must include a buffer		Numerous diurnal bird surveys were carried out throughout the study areas around the MAC within the required seasonal survey periods for Glossy Black-Cockatoo (May, July, August, September 2021, March 2022) (>150 hrs). Chewed cones were searched for under casuarina trees whenever encountered. Wherever hollows suitable for nesting by Glossy Black-Cockatoo were detected (i.e. very large hollows) they were searched (from the ground) for signs of nesting, feathers etc. An additional two late afternoon into night surveys (including stagwatching) in the proposed modification area (Site A) in July 2023 were also used as an opportunity to check if there were any potential nesting activity in this area. This species was not recorded anywhere within the study area and signs of breeding where therefore also not recorded. The above survey techniques are considered to be in accordance with the methodology specified in the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) as identification of breeding requires bird surveys and searches of breeding habitat constraints.

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					radius of 200 m around each actual nest tree. The purpose of the buffer is to identify the essential area for breeding and minimise disturbance/avoid clearing for a development application, or conserve and improve habitat for a biodiversity stewardship agreement. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, subject land under assessment is linear, and the nest tree is already located near the edge of the wooded area. DEWHA (2010c) has some recommended survey techniques for Glossy Black-Cockatoo (which is listed as nationally endangered in South Australia) and these techniques are also relevant to this species wherever it occurs. Diurnal surveys for all species would be appropriate together with searches for chewed Casuarina cones under trees for signs of Glossy Black-Cockatoo (DEWHA, 2010c). 1. Assessors should look for signs of breeding on site as follows; (a) begging birds of any age or sex; or (b) lone adult males identified during the breeding season (April to August); or (c) an occupied nest. 2. Where signs of breeding on site are present potential nest trees should be identified. Potential nest trees contain hollows that are; (i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees and may be near-vertical or vertical.		

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					3. Where potential nest trees are identified on site, monitor for this species during the breeding season (Apr – Aug) to confirm the presence of any actual nest trees on site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice method that can be replicated for repeat surveys (as per the BAM threatened species survey requirements) (DPE, 2023a).		
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	E	S/E	The following Bionet survey guidelines for this species within the TBDC (DPE, 2023b) are relevant: 1. Assessors should look for signs of breeding on site as follows; (a) lone adult males identified during the breeding season (October to January); or (b) an occupied nest. If breeding is presumed present, progress to Step 3. 2. Where signs of breeding on site are present, potential nest trees should be identified. Potential nest trees are forest and woodland eucalypts containing hollows that are; (i) at least 3 m above the ground and (ii) with hollow diameter of 7 cm or larger. 3. Where potential nest trees are identified on site, monitor for this species during the breeding season (October to January) to confirm the presence of any actual nest trees on site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).	October to January inclusive.	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Numerous diurnal bird surveys were carried out throughout the study areas around the MAC within the required seasonal survey periods for Gang-gang Cockatoo (October 2021, November 2021) (>350 hrs). An additional two late afternoon into night surveys (including stagwatching) in the proposed modification area (Site A) in July 2023 were also used as an opportunity to check if there were any potential nesting activity in this area. This species was not recorded anywhere within the study area and signs of breeding where therefore also not recorded. The above survey techniques are considered to be in accordance with the methodology specified in the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) as identification of breeding requires bird surveys and searches of breeding habitat constraints.

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					4. If actual nest trees are confirmed on site, then the species polygons are to be drawn around those actual nest trees (i.e. trees that birds of the species are known to have used for nesting). The species polygons should be circular in shape and must include a buffer radius of 200 m around each actual nest tree. The purpose of the buffer is to identify the essential area for breeding and minimise disturbance/avoid clearing for a development application, or conserve and improve habitat for a biodiversity stewardship agreement. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear, and the nest tree is already located near the edge of the wooded area.		
Little Lorikeet	*Glossopsitta pusilla*	V	-	E	No species-specific requirement defined (DEC 2004). Diurnal surveys for all species would be appropriate (DEWHA, 2010c).	None	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Numerous diurnal bird surveys were carried out throughout the study areas around the MAC from May 2021 to March 2022.
Turquoise Parrot	*Neophema pulchella*	V	-	E		None	
Swift Parrot	*Lathamus discolor*	E	CE	S/E	DEWHA (2010c) recommends area searches or transect surveys of suitable habitat (20 hours over 8 days), preferably in the early morning and afternoon when birds are most active and vocal. Detection by sighting or call. Slow-moving vehicle transects also effective in expansive areas, detecting loud, distinctive 'clinking' call that can be heard over noise of engine. Targeted surveys of patches of heavily flowering eucalypts may be useful.	None (but only present on mainland from March to September)	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Numerous diurnal bird surveys were carried out throughout the study areas around the MAC from May to September 2021 (>150 hrs) and in March 2022 (8 hrs). Any patches of flowering Eucalypt trees at these times were targeted. Any patches of flowering Eucalypt trees at these times were targeted.

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					Timing: surveys on the mainland should be conducted between March and July (DEWHA, 2010c).		
Superb Parrot	*Polytelis swainsonii*	V	V	S/E	No species-specific requirement defined (DEC, 2004). DEWHA (2010c) recommends area searches or transect surveys of suitable habitat (12 hours over 4 days), preferably in the early morning (sunrise to 10 am) and evening (4 pm to sunset). Also targeted searches for breeding hollows during breeding season (12 hours over 4 days from September to January). Habitat constraint species credit: Living and dead *E. blakelyi, E. melliodora, E. albens, E. camaldulensis, E. microcarpa, E. polyanthemos, E. mannifera, E. intertexta.* Breeding habitat can be identified by the presence of habitat features and observed nest OR two or more birds seen on site (DPE, 2022b).	September, October, November	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Numerous diurnal bird surveys were carried out throughout the study areas around the MAC within the required seasonal survey periods for Superb Parrot (September, October and November 2021) (>400 hrs). Wherever hollows suitable for nesting were detected particularly in any *E. blakelyi* and *E. melliodora* trees they were searched (from the ground) for signs of nesting, feathers etc (i.e. large hollow-bearing trees with high and deep hollows along watercourses. The above survey techniques are considered to be in accordance with the methodology specified in the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) as identification of breeding requires bird surveys and searches of breeding habitat constraints.
Masked Owl	*Tyto novaehollandiae*	V	-	S/E	DEC (2004) requires nocturnal surveys for all species incorporating quiet listening, spotlighting and call-playback. A minimum of five visits per site is suggested for Powerful Owl and Barking Owl and eight visits for Masked Owl. DEC (2004) states that the surveys can occur any time of year. The TBDC (DPE, 2023a) has the following survey requirements: For Powerful Owl and Barking Owl where there are no known nest trees on site, assessors should apply the following process: 1. Look for signs of breeding on site as follows; suitable habitat and (a) presence of male and female OR (b) calling to each other (duetting) OR (c) find nest. Note that	May, June, July and August	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Nocturnal surveys incorporating quiet listening, call-playback and spotlighting were carried out at numerous sites during August 2021 with nine call-playback sessions, three stagwatches and 48 hours of surveys completed. Additional nocturnal surveys were conducted outside the breeding season in March 2022 including 11 call-playback sessions, one stagwatch and 34.5 hours of surveys completed. An additional search for potential nest trees and then two nights of stagwatching, spotlighting and call-playback together with the use of acoustic monitors was completed in the proposed modification area
Eastern Grass Owl	*Tyto longimembris*	V	-	E		None	
Powerful Owl	*Ninox strenua*	V	-	S/E		May, June, July and August	
Barking Owl	*Ninox connivens*	V	-	S/E		May, June, July, August, September, October, November and December	

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					Powerful Owl does not respond as well to call-play-back and could require stagwatching and other evidence of nesting. 2. Where signs of breeding on site are present, potential nest trees should be identified. Potential nest trees are living or dead trees with hollows greater than 20 cm diameter and greater than 4m above ground. 3. Where potential nest trees are identified on site, night monitoring at the identified potential nest locations for a minimum of 2 nights should be undertaken to detect the presence of any owl of this species using a potential nest tree or demonstrating behaviour focussed on a potential nest tree (e.g. investigating the hollow or roosting within 10 m). DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake species surveys using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements) (DPE, 2023a).		(Site A) in July 2023 during the breeding season for Large Forest Owls. Wherever hollows suitable for nesting (very large hollows) were detected they were searched (from the ground) for signs of nesting, feathers, pellets, whitewash, remains of prey, nearby roosting males etc. Any pellets recovered were sent to ScatsAbout for formal identification.

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
White-throated Needletail	*Hirundapus caudacutus*	-	V	S	No species-specific requirement defined. Diurnal bird surveys would be appropriate for these species.	None	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** A total of 544 hours of diurnal bird surveys were undertaken throughout the study areas around the MACfrom May 2021 to March 2022. Surveys were carried out in May-July 2021, August 2021, September-early October 2021, late October 2021, November 2021 and March 2022.
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-	E		None	
Speckled Warbler	*Chthonicola sagittata*	V	-	E		None	
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V	-	E		None	
Regent Honeyeater	*Anthochaera phrygia*	CE	CE	S/E	Diurnal bird surveys undertaken for 20 hours over 10 days in areas of less than 50 ha (DEWHA, 2010c). The species is most conspicuous in the breeding season (primarily between September and November) (DEWHA, 2010c). Targeted searches of woodland patches with heavily flowering trees for 20 hours over five days may be useful as well as call-playback (DEWHA, 2010c).	None	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** A total of 544 hours of diurnal bird surveys were undertaken throughout the study areas around the MACfrom May 2021 to March 2022. Any patches of flowering Eucalypt trees at these times were targeted. Surveys were carried out in May-July 2021, August 2021, September-early October 2021, late October 2021, November 2021 and March 2022. A total of 423 hours of survey were completed just during the September to November breeding season for this species. The study area is not within an important habitat map area for this species (DPE, 2023b).
Painted Honeyeater	*Grantiella picta*	V	V	E	No species-specific requirement defined. Diurnal bird surveys would be appropriate for this species.	None	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** A total of 544 hours of diurnal bird surveys were undertaken throughout the study areas around the MAC from May 2021 to March 2022. Surveys were carried out in May-July 2021, August 2021,
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-	E		None	
Flame Robin	*Petroica phoenicea*	V	-	E		None	

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
Scarlet Robin	*Petroica boodang*	V	-	E		None	September-early October 2021, late October 2021, November 2021 and March 2022.
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V	-	E		None	
Varied Sittella	*Daphoenositta chrysoptera*	V	-	E		None	
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	E		None	
Diamond Firetail	*Stagonopleura guttata*	V	-	E		None	
Mammals							
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	E	Habitat surveys (for potentially suitable habitat resources and signs of activity, scats and latrines), hair tubes and camera trapping (SEWPaC, 2011a). May to August is the optimal survey period for this species (SEWPaC, 2011a). 40 hair tubes (funnels) per 100 ha sampling units spread 100m apart from May to August (SEWPaC, 2011a). Whilst survey is not required for this species if survey is undertaken, cameras can be used throughout the year, however trapping should be limited to Dec to Sept, post breeding months (Sept to Nov) where females have dependent young should be avoided (DPE, 2023a).	None	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** A total of 2,053 camera trap-nights and 140 hairtube trap-nights were completed over the study areas around the MAC from May 2021 to March 2022. Quoll latrines were searched for in suitable habitat. Predator scats were collected and analysed whenever detected. 82.5 hours of nocturnal spotlighting surveys were carried out throughout the study areas around the MAC (in August 2021 and in March 2022). Figures 5a to 5h show the location of baited camera traps.
Brush-tailed Phascogale	*Phascogale tapoatafa*	V	-	S	Survey must be undertaken using baited cameras. The bait type used must remain as an effective attractant until replaced. Cameras must remain in place for a minimum of 4 weeks with cameras checked and baits replaced after 2 weeks. Modified camera approach for sites over 10 ha (DPE, 2023a).	December to June inclusive	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** 50 baited camera traps were deployed throughout the study areas around the MACfrom late May to early July 2021 (i.e. whole of June 2021) with baits replaced and cameras checked after two weeks. At this point a further four baited camera traps were

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
							deployed. The greatest number of cameras were deployed at sites with the most treed vegetation. A total of 1466 'effective active trapnights' was completed which only includes the period in which each camera was assessed as working correctly and still active (i.e. batteries still powering camera, SD card not full, camera recording images/video). Some of the bait chambers were single-ended hairtubes/funnels and 56 trapnights were achieved (this species can also be identified via hair samples). A further 587 camera trap nights and 84 hairtube trap nights were completed from October 2021 to March 2022. Figures 5a to 5h show the location of baited camera traps.
Common Planigale	*Planigale maculata*	V	-	S	Survey must be undertaken using pitfall traps where the substrate allows. Elliott traps should be used to detect whether the Yellow-footed Antechinus (*Antechinus flavipes*) is present (general indicator of Common Planigale presence). Modified survey approach for potential habitat greater than 10 ha (DPE, 2023a). Pitfall trapping guidelines for small mammals and reptiles (DEC, 2004).	All year	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Ten pitfall and Elliot A transects were spread throughout the study areas around the MAC in October 2021 for four days/nights. Each transect consisted of 6 pitfalls, 30m of drift fence and 20 Elliot A ground traps. In addition two to four double-ended reptile net funnels were placed along pitfall trap drift fences at some locations. 880 Elliot A trap-nights, 264 pitfall trap-nights and 88 reptile funnel trapnights were achieved. Figures 5a to 5h show the location of pitfall / Elliot A transects.
Koala	*Phascolarctos cinereus*	E	E	S/E	Federal guidelines (DotE, 2014) discuss direct and indirect methods depending on density of animals and purpose of study. For low density populations indirect methods (signs) are recommended including searches for scratchings, scats etc. For higher density populations call-playback, spotlighting, wildlife	September to December for passive acoustic monitoring March to December for drones.	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (DPE, 2022c) was published in June 2022 once field surveys for the Modification had been completed (in March 2022). The following surveys which have been

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
					cameras and other methods are recommended. Direct observation surveys should be undertaken between August and January (DotE, 2014). Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (DPE, 2022c) require the following: The minimum survey effort to detect koala presence on the subject land requires the total effort for two standard survey methods to be met. A scat detection method, which may indicate past occupancy, must be paired with a non-scat detection method as follows: 1. Spot Assessment Technique or detection dogs, and 2. Spotlighting or passive acoustic or drones. Where areas of suitable habitat are discontinuous, survey effort must be applied to each, independently. The two survey methods may be undertaken in any order, or concurrently where the timing requirements of each method can be met.	All year for other techniques	carried out prior to the introduction of the new survey guidelines only partially meet these new guidelines. Nocturnal surveys incorporating quiet listening, call-playback and spotlighting were carried out at numerous sites during August 2021 with nine call-playback sessions and 48 hours of surveys completed. Additional nocturnal surveys were conducted in March 2022 including 11 call-playback sessions and 34.5 hours of surveys completed. 10 passive acoustic monitoring devices (Songmeter Mini from Wildlife Acoustics) were deployed at several locations around the study areas around the MAC for 2-4 nights in November 2021. A total of 39 acoustic monitor trap-nights was carried out over the study areas around the MAC. The acoustic data was sent to Echo Ecology who used the Kaleidoscope software package (from Wildlife Acoustics) to search for Koala calls. A total of 2,053 camera trap-nights were completed over the study areas around the MAC from May 2021 to March 2022 and this technique can also detect this species (Garon Staines pers. obs.). An additional two nights of spotlighting and call-playback together with the use of acoustic monitors was completed in the proposed modification area (Site A) in July 2023.Searches for scratchings on tree trunks and scats below Eucalypt trees (particularly published feed tree species) were undertaken as part of general ecological surveys. If any koala scats or potential koala scats were found they were sent to ScatsAbout for formal identification. Figures 5a to 5h show the location of nocturnal surveys. Figures 5a to 5c show the location of acoustic monitors.

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
							Figures 5a to 5h show the location of baited camera traps.
Eastern Pygmy-possum	*Cercartetus nanus*	V	-	S	No species-specific requirement defined. Hair tubes, nocturnal spotlighting and call-playback surveys, wildlife cameras, and Elliott trapping would all be appropriate for these species. Pitfall trapping is also appropriate for Eastern Pygmy-possum.	October to March inclusive	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** Nocturnal surveys incorporating quiet listening, call-playback and spotlighting were carried out at numerous sites during August 2021 with nine call-playback sessions and 48 hours of surveys completed. Additional nocturnal surveys were conducted in March 2022 including 11 call-playback sessions and 34.5 hours of surveys completed. 10 passive acoustic monitoring devices (Songmeter Mini from Wildlife Acoustics) were deployed at several locations around the study areas around the MAC for 2-4 nights in November 2021. A total of 39 acoustic monitor trap-nights was carried out over the study areas around the MAC. The acoustic data was sent to Echo Ecology who used the Kaleidoscope software package (from Wildlife Acoustics) to search for Squirrel Glider calls. An additional two nights of spotlighting and call-playback together with the use of acoustic monitors was completed in the proposed modification area (Site A) in July 2023. A total of 2,053 camera trap-nights and 140 hairtube trap-nights were completed over the study areas around the MAC from May 2021 to March 2022 (including 587 camera trap-nights and 84 hair tube trap-nights from October 2021 to March 2022). Ten pitfall and Elliot A transects were spread throughout the study areas around the MAC in October 2021 for four days/nights. Each transect consisted of 6 pitfalls, 30m of drift fence and 20 Elliot A ground traps. In addition two to four double-ended reptile net funnels were placed along pitfall trap drift
Yellow-bellied Glider	*Petaurus australis*	V	-	E		None	
Squirrel Glider	*Petaurus norfolcensis*	V	-	S		All year All year	
Southern Greater Glider	*Petauroides volans*	E	E	S		All year	

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
							fences at some locations. 880 Elliot A trap-nights, 264 pitfall trap-nights and 88 reptile funnel trapnights were achieved and which are relevant for Eastern Pygmy-possum. Figures 5a to 5h show the location of nocturnal surveys. Figures 5a to 5c show the location of acoustic monitors. Figures 5a to 5h show the location of baited camera traps. Figures 5a to 5h show the location of pitfall / Elliot A transects.
Brush-tailed Rock-wallaby	*Petrogale penicillata*	E	V	S	Systematic faecal pellet surveys and time lapse cameras should be considered as appropriate methods of survey (DPE, 2023a).	All year	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** The Mount Arthur summit and upper slopes (which are outside the study areas around the MAC) provide some potential rocky and boulder strewn habitat for this species. Site B which is on the lower and mid slopes of Mount Arthur provides some more marginal habitat. A total of 2,053 camera trap-nights were completed over the study areas around the MAC from May 2021 to March 2022 including 84 trap-nights at an incidental site on the summit of Mount Arthur (outside study area) and 387 trap-nights at Site B which is on the slopes of Mount Arthur.

Common Name	Scientific Name	Conservation Status		Credit Class[3]	Survey Guideline Requirements	Survey Timing (DPE, 2023a)	Survey Techniques and Effort undertaken by Future Ecology
		BC Act[1]	EPBC Act[2]				
Grey-headed Flying-fox, Little Bent-winged Bat, Large Bent-winged Bat, Large-eared Pied Bat, Southern Myotis, Eastern Cave Bat	-	-	-	-	Refer to Table 17.	-	Refer to Table 17.
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	E	Harp trapping / mist netting and ultrasonic bat detection (Anabat) (DEC, 2004; DEWHA, 2010b). October to March (DEC, 2004). October to April (Corben's Long-eared Bat) (DEWHA, 2010b).	None	**The survey guideline requirements were met and surveys undertaken at an appropriate time.** A total of 32 harp trap / mist net nights and 33 Anabat detection nights were undertaken in November 2021 within the recommended October to March (April) survey timing period for these microbat species.
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V	-	E			
Corben's Long-eared Bat	*Nyctophilus corbeni*	V	V	E			
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-	E			
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	E			

1 Threatened species status under the BC Act (current as at March 2023). CE = Critically Endangered, E = Endangered, V = Vulnerable.

2 Threatened species status under the EPBC Act (current as at March 2023). CE = Critically Endangered, E = Endangered, V = Vulnerable.

3 Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (current as at March 2023), E = Ecosystem, S = Species.

3 Survey Results

3.1 Fauna Habitat Types

The majority of the Modification New Disturbance Area comprises derived grassland (23.7 ha; 96.34%) with some smaller areas of heavily fragmented woodland (0.7 ha; 2.84%) and plantation (0.2 ha; 0.81%).

The Modification New Disturbance Area contains no rocky areas that provide potential habitat for the Pink-tailed Legless Lizard, and no large stick nests built by raptors (e.g. White-bellied Sea Eagle, Square-tailed Kite or Little Eagle). There are five hollow-bearing trees within the Modification New Disturbance Area that have hollows that have a suitable sized diameter and are high enough above ground to be suitable potential large forest owl and/or cockatoo nesting tree habitat, however there was no sign of use (feathers, white wash). Two large living Slaty Box (*Eucalyptus dawsonii*) were observed on the Modification New Disturbance Area and there was no indication of use by Koala including scats and deep scratches on trunk.

The following broad fauna habitat types occur in the study areas around the MAC:

- Derived Native Grassland;
- Woodland;
- Non-native;
- Planted;
- Aquatic;
- Disturbed; and
- Wetland.

The broad fauna habitat types are described below.

Derived Native Grassland

This habitat type consists of open grassy areas between patches of dry sclerophyll forest and grassy woodlands. . Cover was moderately dense in most locations unless excessive disturbance, erosion or grazing had recently occurred. Typical species included Bamboo Grass (*Austrostipa* spp.), Three-awned Grass (*Aristida* spp.) and Windmill Grass (*Chloris* spp.).

Fauna habitat features were generally poor within this habitat type as it only provided open areas for some species or grass seed eating species. Generally, fauna habitat features (fallen timber, hollow logs etc.) were absent. This habitat type was probably formed by and subject to ongoing disturbance from grazing and other agricultural practices.

Connectivity in this habitat type was generally moderate to high as it formed large, connected areas across the study areas around the MAC. Scattered or remnant trees were occasionally present in this broad fauna habitat type. It was found adjacent to or interspersed with most sites and was the most abundant habitat type within the study areas around the MAC.

This is the dominant fauna habitat type in the Modification New Disturbance Area.

Woodland

This habitat type consists of remnant and/or regenerating patches of vegetation containing a Eucalypt dominated canopy. Most woodland patches showed evidence of historic and/or ongoing disturbance from grazing as well as from mining infrastructure. Historic clearing, livestock grazing, and other disturbance has effectively removed the predominantly native shrub / small tree layer from large parts of the study areas around the MAC and suppressed the ground-cover layer except where such disturbances had been excluded for some time (e.g. Site B). Most woodland/forest patches were small (<20 ha), fragmented and subject to weed invasion particularly from the introduced shrub species African Boxthorn (*Lycium ferocissimum*). The groundcover layer was typically co-dominated by a variety of native and exotic grass and forb species depending on the site. The largest patch of woodland/forest was at Site B on the footslopes of Mount Arthur. Connectivity between woodland/forest patches was generally poor across the study areas around the MAC. However, fauna habitat features (such as HBTs, dead trees (stags), hollow logs and fallen timber) were present at most survey sites.

Non-native

This broad fauna habitat type is associated with roads, tracks and infrastructure. It generally provides very low fauna habitat value but some structures such as culverts could provide potential roosting habitat for threatened microbats such as Southern Myotis and Bent- wing Bats (*Miniopterus* spp.). There is a small area of non-native fauna habitat in the southern section of the Modification New Disturbance Area associated with Old Edderton Rd.

Planted

This broad fauna habitat type is associated with previously planted vegetation which typically include a mix of native Eucalypt species but not always endemic species (i.e. may not naturally occur within Hunter Valley).

There are a few examples of this broad fauna habitat type mostly in Site I but also a small section in Site A associated with the core shed depot infrastructure area.

Aquatic

There were approximately 28 waterbodies/dams within the study areas around the MAC with most being relatively small farm dams associated with grazing activity although there are larger mining infrastructure dams located in Sites H and I (Figures 5g and 5h). Most dams contained water due to wet La Nina conditions during survey period. The study area did not have any permanent creeks, but some ponded water was observed within intermittent drainage lines during the survey period.

All observed dams lacked aquatic vegetation and a dense fringe of native sedges and rushes possibly due to grazing pressure and other disturbances. Some dams had minor fringing vegetation, but this was mostly grass, exotic herbs or sedges such as *Juncus usitatus*. Some ponded areas in the intermittent creeks (mainly Quarry Creek) had some thicker patches of the introduced Sharp Rush (*Juncus acutus*) as well as the native Bulrush (*Typha* sp.). As such most dams and water bodies provided low quality habitat except for some non-threatened amphibian species, some reptile species such as the Eastern Snake-necked Turtle (*Chelodina longicollis*), eels (*Anguilla* spp.), some aquatic birds, some aquatic invertebrates, as well as potential foraging habitat for the threatened microbat Southern Myotis (*Myotis macropus*).

There was only one mapped small dam within the Modification New Disturbance Area.

Disturbed

Some sections of the study areas around the MAC are classified as disturbed. It appears to be associated with disturbance from mining spoil dumps, infrastructure and more intensive agricultural practices such as cropping. It has very low fauna habitat value.

There is a small area of disturbed fauna habitat in the northern section of the Modification New Disturbance Area.

Wetland

There is a small area of wetland fauna habitat in Site G (0.12 ha), associated with a patch of Typha Rushland in an old farm dam. It provides moderate habitat potential for amphibians, aquatic reptiles, invertebrates, birds etc.

Other fauna habitat features

Some areas of scattered lightly imbedded surface rock were observed in parts of the study areas around the MAC. Specifically, areas of scattered lightly imbedded surface rock were located at Site B on the footslopes of Mount Arthur as well as small outcrops at Sites A, C and D (Figures 5a-5d). Observed surface rock was generally small (<50 cm diameter) and rocks were mostly located directly on soil rather than 'on-rock'. Rock escarpment and 'rock-on-rock' features were absent except for the summit area of Mount Arthur which was outside the study areas around the MAC.

3.2 Fauna Species

A total of 177 fauna species were recorded in the study areas around the MAC during the survey period including 14 amphibian, 14 reptile, 108 bird, and 41 mammal species. A total of 12 of the recorded species were exotics. Appendix A contains the full list of fauna species recorded during the survey periods.

3.2.1 Threatened Fauna Species Listed under the BC Act

Threatened Fauna Species Recorded During the Surveys

A total of 13 threatened fauna species currently listed under the BC Act (all listed as vulnerable) were recorded by Future Ecology with a definite confidence level in or immediately adjacent to the study areas around the MAC during the current surveys (Table 26). Two of the species recorded are listed under the EPBC Act (one listed as vulnerable and the other listed as endangered) (Table 26).

Table 26: Threatened Fauna Species Recorded During this Study.

Common Name	Scientific Name	Conservation Status		Credit Class[3]
		BC Act[1]	EPBC Act[2]	
Birds				
Black Falcon	*Falco subniger*	V	-	E
White-bellied Sea Eagle	*Haliaeetus leucogaster*	V	-	E*
Spotted Harrier	*Circus assimilis*	V	-	E
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-	E
Speckled Warbler	*Chthonicola sagittata*	V	-	E
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V	-	E
Varied Sittella	*Daphoenositta chrysoptera*	V	-	E
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	E
Mammals				
Spotted-tail Quoll	*Dasyurus maculatus*	V	E	E
Squirrel Glider	*Petaurus norfolcensis*	V	-	S
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	E*
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	E
Southern Myotis	*Myotis macropus*	V	-	S

1 Conservation status under the BC Act (current as at March 2023). V = Vulnerable.

2 Conservation status under the EPBC Act (current as at March 2023). V = Vulnerable, E = Endangered.

3 Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a) (current as at March 2023). E = Ecosystem; S = Species.

* These species are a dual credit species; however, no breeding habitat or breeding was recorded and therefore they are considered an 'ecosystem credit species' in the study areas around the MAC.

Figures 6 to 8 show the locations of threatened fauna species records recorded during the surveys.

Within the study area associated with the Modification New Disturbance Area (Study Area A), the Black Falcon and Speckled Warbler were the only threatened fauna species recorded. These two species are ecosystem species. The Modification New Disturbance Area is not likely to currently provide habitat for any species credit species.

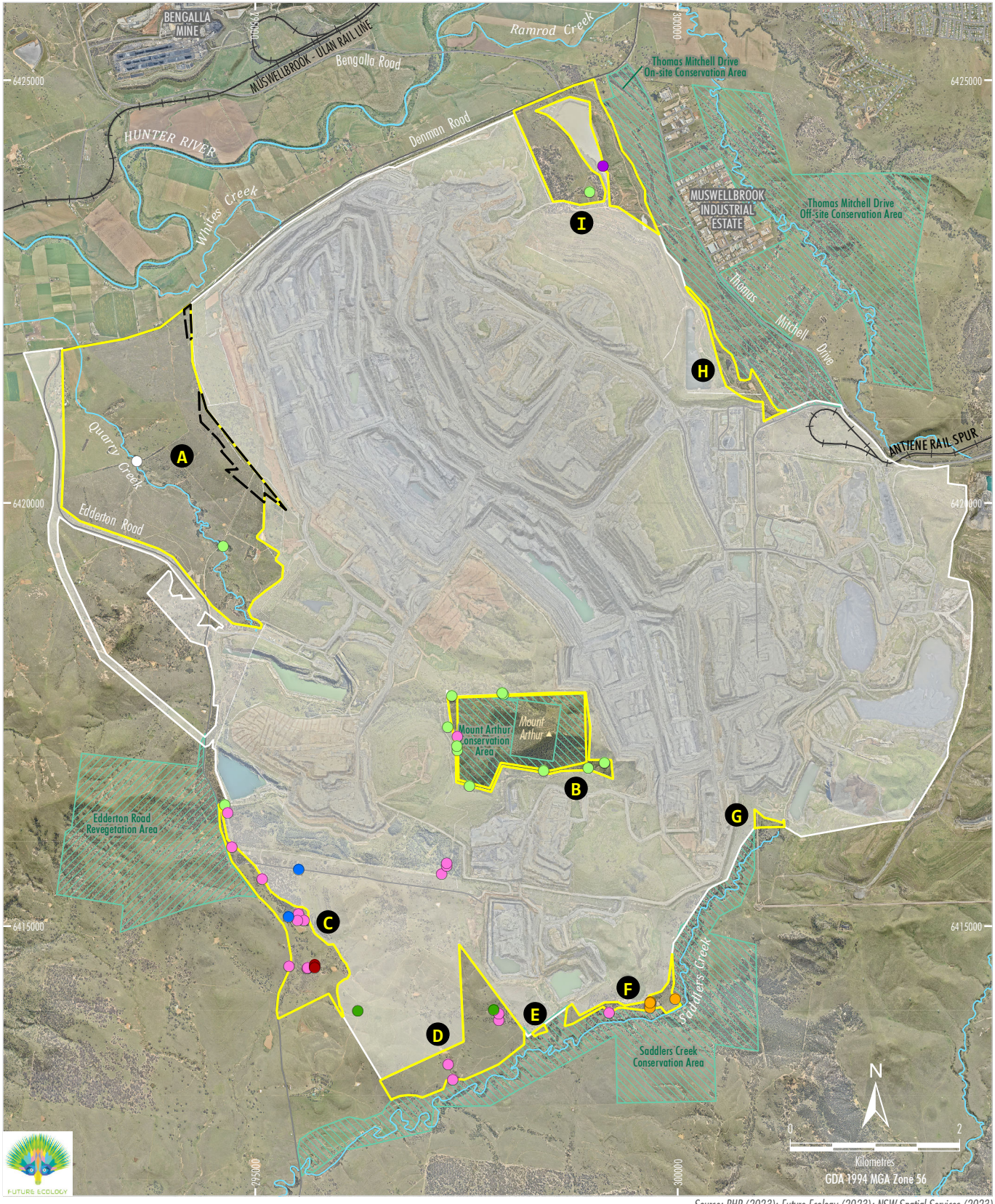
All of the species in Table 26 are discussed below.

Black Falcon (*Falco subniger*)

This species was recorded flying over the study areas around the MAC at Site A (one individual) in August 2021 (Figure 6). The mapped PCTs in which it was observed flying over included PCT 483 DNG, PCT 1692 and PCT 1731.

Black Falcon has been previously observed to nest just outside and to the south of the study areas around the MAC near Saddlers Creek in 2019 (Colin Driscoll pers. obs.), however this nest was not observed to be occupied during the current survey period. Several raptor nests were detected across the study areas around the MAC during current surveys and if occupied the only occupants observed were Wedge-tailed Eagles (*Aquila audax*).

The Modification New Disturbance Area contains no nest trees (large stick nests built by raptors).



HVE-19-09 MOD2_Fauna Report_2040

FUTURE ECOLOGY

Source: BHP (2023); Future Ecology (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Modification New Disturbance Area
- Study Area - Mt Arthur Coal Mine

Threatened Birds

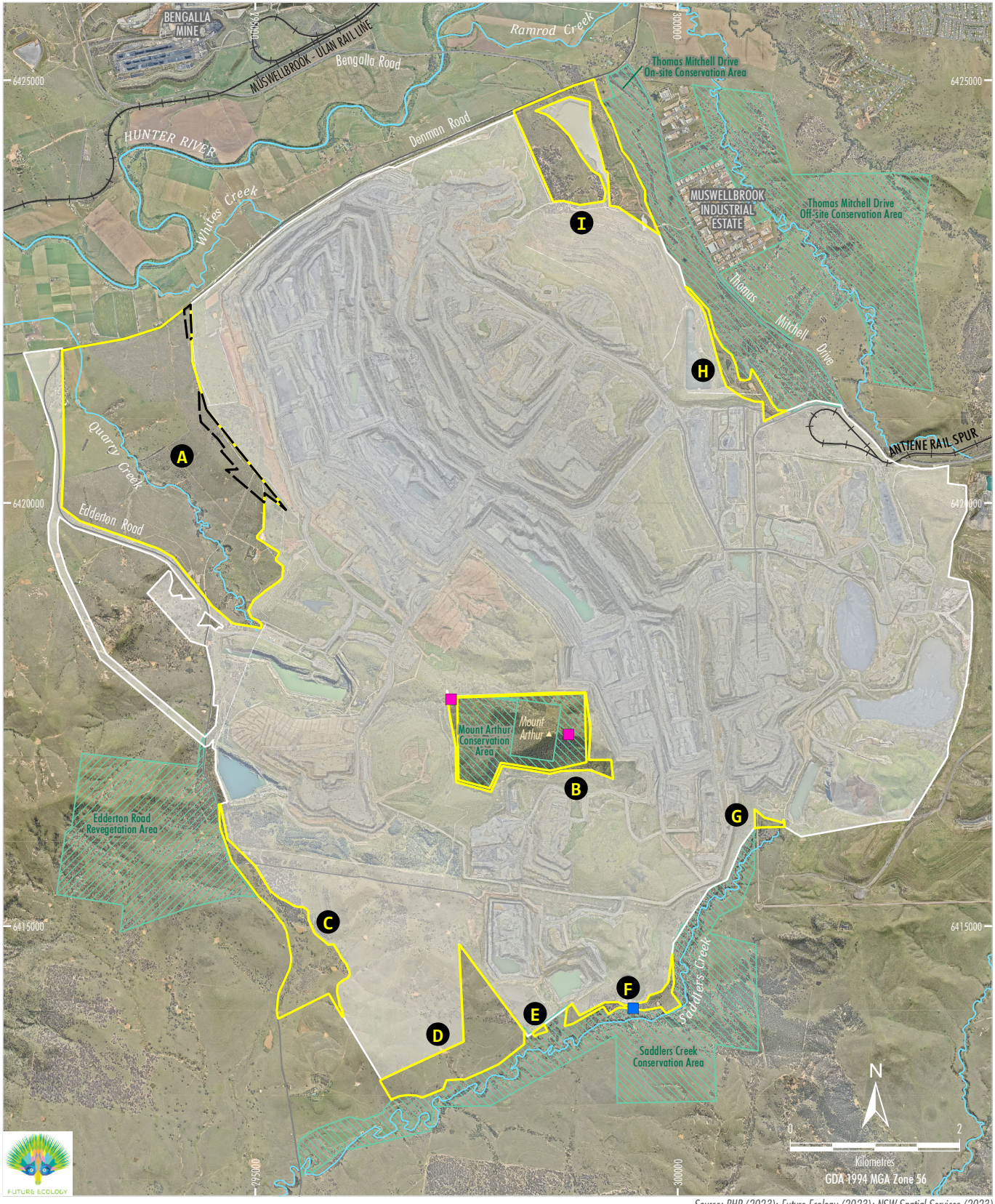
- Black Falcon
- Brown Treecreeper (eastern subspecies)
- Dusky Woodswallow
- Grey-crowned Babbler (eastern subspecies)
- Speckled Warbler
- Spotted Harrier
- Varied Sittella
- White-bellied Sea-Eagle

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Threatened Birds Recorded During the Surveys

Figure 6



Source: BHP (2023); Future Ecology (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: MAC (2022)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Modification New Disturbance Area
- Study Area - Mt Arthur Coal Mine

Threatened Mammals

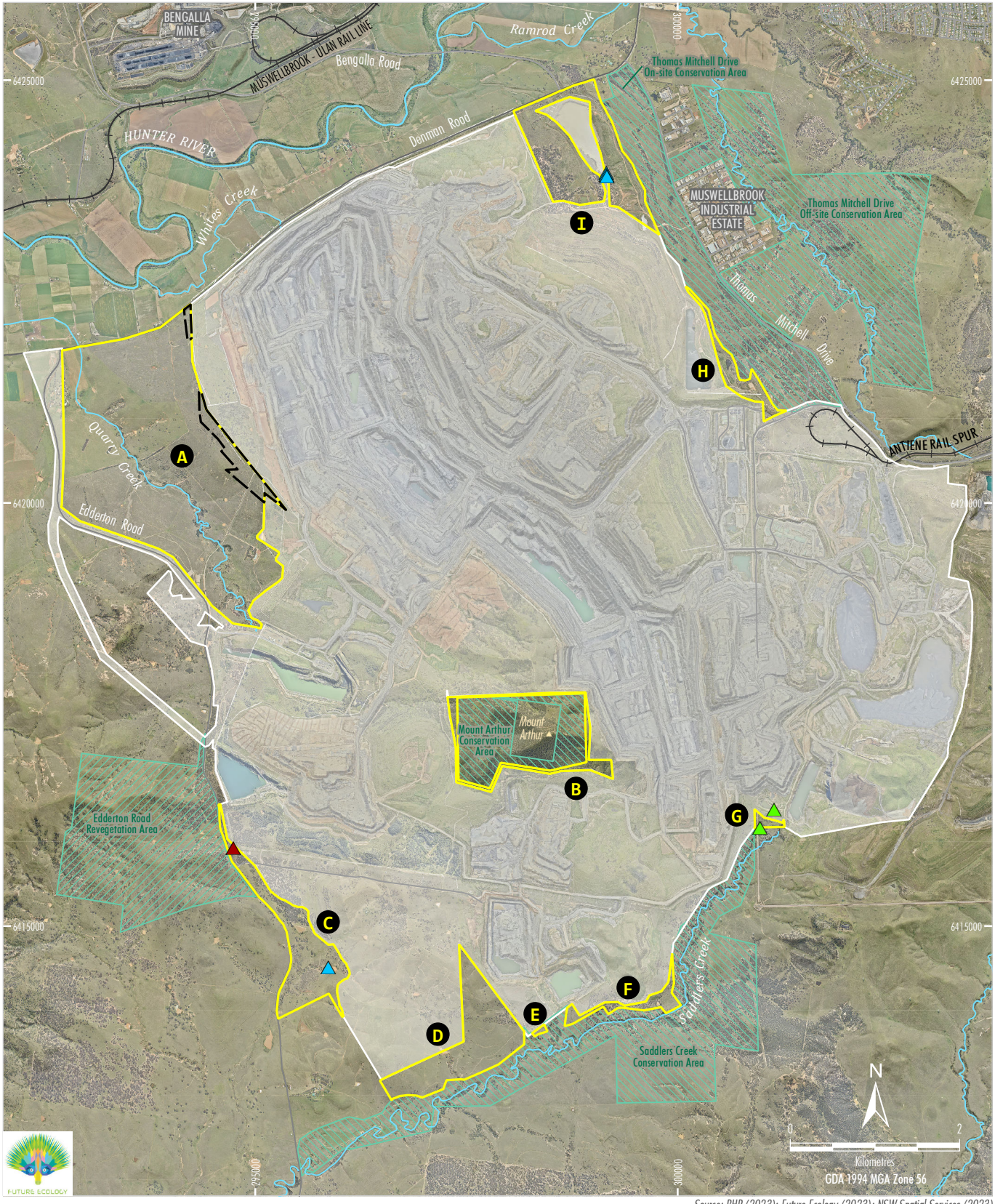
- Spotted-tailed Quoll
- Squirrel Glider

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Threatened Mammals Recorded During the Surveys

Figure 7



HVE-19-09 MOD2_Fauna Report_206E

FUTURE ECOLOGY

Source: BHP (2023); Future Ecology (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: MAC (2022-2020)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Modification New Disturbance Area
- Study Area - Mt Arthur Coal Mine

Threatened Bats

- Greater Broad-nosed Bat
- Grey-headed Flying-fox
- Southern Myotis

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Threatened Bats Recorded During the Surveys

Figure 8

White-bellied Sea-Eagle (*Haliaeetus leucogaster*)

This species was recorded immediately adjacent to Site I in July 2021 (Figure 6). A single individual was observed perching in a dead tree within the environmental dam next to Site I. When the ecologist approached the Sea-Eagle it flew further north and landed on another dead tree within the dam. A second individual or a nest was not observed. It was not observed during subsequent survey periods.

Several raptor nests were detected across the study areas around the MAC but no large raptor nests were observed at Site I. Large raptor nests were observed at other sites and if occupied the only occupants observed were Wedge-tailed Eagles (*Aquila audax*).

The Modification New Disturbance Area contains no nest trees.

Spotted Harrier (*Circus assimilis*)

This species was recorded within the study areas around the MAC during the current survey at Site D (one individual) and adjacent to Site C (one individual) in October 2021 (Figure 6). The mapped PCT in which it was observed at Site D was PCT 483 DNG. The vegetation adjacent to site C where it was also observed has not been mapped but it was within an area of grassland.

Several raptor nests were detected across the study areas around the MAC during current surveys and if occupied the only occupants observed were Wedge-tailed Eagles (*Aquila audax*).

The Modification New Disturbance Area contains no nest trees.

Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)

This species was detected at Site F on several occasions during current surveys (Figure 6).

Speckled Warbler (*Chthonicola sagittata*)

This species was detected at several locations within the study areas around the MAC during the survey period as follows (Figure 6):

- original Site A (one individual) in October 2021
- original Site B at various locations in October 2021(one to three individuals);
- immediately adjacent to Original Site C (two individuals) in September 2021 (two individuals);
- original Site I in August 2021 (two individuals);

Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)

This species was detected at several locations within the study areas around the MAC during the survey period (Figure 6) as follows:

- Site B (number of individuals not recorded) in October 2021;
- Site C (one to four individuals) in June, August, September, October and November 2021;
- Site D (one to nine individuals) in July and August 2021;
- Site F (two to four individuals) in June and October 2021; and
- incidental records (one to seven individuals) outside of study area but within broader MAC area in June, October and November 2021.

Varied Sittella (*Daphoenositta chrysoptera*)

This species was detected at Site C within the study areas around the MAC (one to four individuals) during the survey period in October 2021 (Figure 6).

Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)

This species was detected at Site C within the study areas around the MAC (one to two individuals) during the survey period in October 2021 (Figure 6).

Spotted-tailed Quoll (*Dasyurus maculatus*)

This species was recorded on a camera trap at Site B within the study areas around the MAC (one individual) during the survey period in November 2021 (Figure 7). It was also recorded on a camera trap and a latrine site on the summit of Mount Arthur in October 2021. This area, however, is outside of the study area around the MAC.

Squirrel Glider (*Petaurus norfolcensis*)

This species was recorded on a camera trap at Site F within the study areas around the MAC (one individual) during the survey period in June 2021 (Figure 7).

Despite targeted surveys, this species was not recorded in Study Area A (the study area associated with the Modification New Disturbance Area).

Grey-headed Flying-fox (*Pteropus poliocephalus*)

This species was recorded foraging at Site G and immediately adjacent to Site G within the study areas around the MAC (two to five individuals) during the survey period in August 2021 and March 2022 (Figure 8).

This species was only ever observed to be foraging in the study areas around the MAC (i.e. at night) and not roosting. A known camp of this species has been recorded from the Hunter River in Muswellbrook township (DCCEEW, 2022a).

Greater Broad-nosed Bat (*Scoteanax rueppellii*)

This species was detected at two locations at Site C within the study areas around the MAC during the survey period via acoustic recording with a ‘definite’ confidence level in November 2021 (Figure 8).

Southern Myotis (*Myotis macropus*)

This species was observed foraging at Sites C and I within the study areas around the MAC during the survey period (Figure 8).

Despite targeted surveys, this species was not recorded in Study Area A (the study area associated with the Modification New Disturbance Area).

3.2.2 Other Threatened Fauna Species Previously Recorded at Mt Arthur

Some additional threatened species, which were not detected by Future Ecology with a 'definite' confidence level during current surveys or have been previously detected within or immediately adjacent to the study areas around the MAC, are listed in Table 27.

Despite targeted surveys, these species were not recorded in Study Area A (the study area associated with the Modification New Disturbance Area). No breeding habitat for the Little Bentwing-bat, Large Bent-winged Bat, or Eastern Cave Bat is known to occur within 2 km of the approximate extent of additional surface development.

Table 267: Other Threatened Species Previously Recorded at Mt Arthur

Common Name	Scientific Name	Conservation Status[1]		Credit Class[2]	Previous Studies and Records[3]	Survey Result
		BC Act	EPBC Act			
Mammals						
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V	-	E	A, D, E, F, H	Calls with a 'probable' confidence level were recorded during current surveys via acoustic recording at Site C.
Little Bentwing-bat	*Miniopterus australis*	V	-	S/E*	C, E, G, I	Calls with a 'probable' confidence level were recorded during current surveys via acoustic recording at Site B.
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V	-	S/E*	A, C, D, E, F, G, H, J, K	Calls with a 'probable' confidence level were recorded during current surveys via acoustic recording at Site C.
Eastern Cave Bat	*Vespadelus troughtoni*	V	-	S^	A, E, F, G, H, K	No calls

1 Conservation status under the BC Act and/or EPBC Act (current as of March 2023). CE = Critically Endangered; E = Endangered; EP = Endangered Population; V = Vulnerable.

2 Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (DPE 2023a). E = Ecosystem; S = Species.

3 Sources:

A All records prior to 2013: Ecotone (2000); Umwelt Environmental Consultants (2003, 2005, 2006, 2007, 2008, 2010, 2011); Wildthing Environmental Consultants (2008); Cumberland Ecology (2009, 2010, 2011); Niche Environment and Heritage (2012).
B Umwelt Environmental Consultants (2013)
C Umwelt Environmental Consultants (2015)
D Cumberland Ecology Pty Ltd (2016)
E Cumberland Ecology Pty Ltd (2017)
F Cumberland Ecology Pty Ltd (2018)
G Cumberland Ecology Pty Ltd (2019)
H Cumberland Ecology Pty Ltd (2020)
I Cumberland Ecology Pty Ltd (2021)
J BHP (2022)
K Cumberland Ecology Pty Ltd (2022)

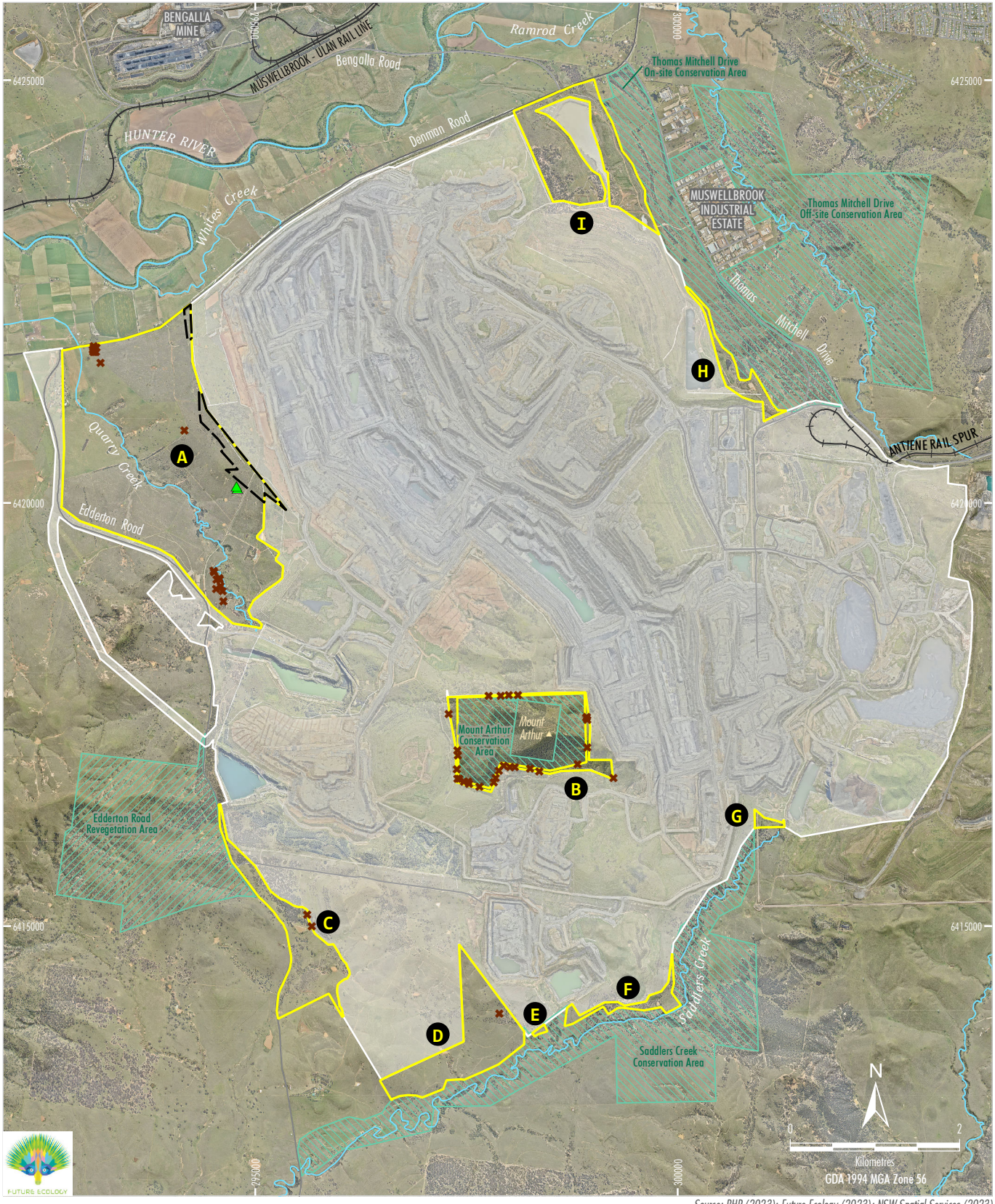
^ This species is a 'species credit species'; however, no breeding habitat was recorded.

* This species is a dual 'species credit / ecosystem credit species'; however no breeding habitat was recorded.

3.2.3 Local Significant Fauna

In July 2022, a genetic and morphological study was published (Mahony et al, 2022) which describes the previously identified occurrences of *Delma impar* from the Hunter Valley and Liverpool Plains of NSW to be a new species, *Delma vescolineata*, which is not listed as threatened under either the BC Act or EPBC Act. However, *Delma vescolineata* is on the Commonwealth Finalised Priority Assessment List (assessment due April 2024).

Delma vescolineata was recorded in 9 March 2022 outside of the Modification New Disturbance Area as shown on Figure 9. Two legless lizards were recorded under roofing sheet in mostly thick native derived grassland (1 m high) comprising Windmill Grass (*Chloris* sp.), Bamboo Grass (*Austrostripa* sp.), and Red Grass (*Bothrichloa* sp). The site where the legless lizards were recorded did not contain surface rock.



HVE-19-09 MOD2_Fauna Report_213C

Source: BHP (2023); Future Ecology (2023); NSW Spatial Services (2023)
Orthophoto Mosaic: MAC (2022)

LEGEND

- Existing Conservation/Offset Area
- Edderton Road Revegetation Area
- Approximate Extent of Existing/Approved Surface Development
- Modification New Disturbance Area
- Study Area - Mt Arthur Coal Mine
- Rocky Area (Lightly Embedded)
- *Delma vescolineata* Observation Site

BHP

MT ARTHUR COAL MINE MODIFICATION 2

Delma vescolineata **sp. Records**

Figure 9

4 Conclusion

The majority of the Modification New Disturbance Area (24.6 ha) comprises derived grassland (23.7 ha; 96.34%) with some smaller areas of heavily fragmented woodland (0.7 ha; 2.84%) and plantation (0.2 ha; 0.81%).

Although the Modification New Disturbance Area is relatively small (24.6 ha), the fauna surveys were undertaken over a series of study areas, totalling 930 ha, providing a contemporary understanding of threatened species and their habitat around the mine site.

Future Ecology has reviewed a number of fauna surveys previously undertaken partly within and/or adjacent to the Modification New Disturbance Area since the year 2000, and then undertook additional comprehensive fauna surveys in 2021 and 2022. An additional survey of the proposed Modification Area was undertaken in August 2023 and included nocturnal surveys.

Several broad fauna habitat types were observed within the study areas around the MAC, comprising aquatic, derived native grassland, disturbed, non-native, planted, wetland and woodland habitats. Most habitats showed evidence of historic and/or ongoing disturbance from grazing as well as from mining infrastructure. Most woodland patches were small (<20 ha), fragmented and subject to weed invasion. Connectivity between woodland patches was generally poor across the study areas around the MAC. However, some fauna habitat features such as HBTs, dead trees (stags), hollow logs and fallen timber, were present at most survey sites.

A total of 177 fauna species were recorded in the study areas around the MAC during the survey periods including 14 amphibian, 14 reptile, 108 bird, and 41 mammal species. A total of 13 threatened fauna species currently listed under the BC Act (all listed as vulnerable) were recorded by Future Ecology with a definite confidence level in or immediately adjacent to the study areas around the MAC during the current surveys.

Two threatened fauna species listed under the EPBC Act were recorded during the surveys, namely, the Spotted-tailed Quoll and Grey-headed Flying-fox.

Within the study area associated with the Modification New Disturbance Area (Study Area A), the Black Falcon and Speckled Warbler were the only threatened fauna species recorded. These two species are ecosystem species. The Modification New Disturbance Area is not likely to currently provide habitat for any species credit species. No threatened fauna species listed under the EPBC Act are likely to use the habitat in the Modification New Disturbance Area.

5 References and Bibliography

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Appendix A Fauna Species Detected

Fauna Group	Common Name	*Scientific Name*	Introduced	NSW Status	Federal Status	Site A	Observation Type	Confidence Level	Site B	Observation Type	Confidence Level	Site C	Observation Type	Confidence Level	Site D	Observation Type	Confidence Level	Site E	Observation Type	Confidence Level	Site F	Observation Type	Confidence Level	Site G	Observation Type	Confidence Level	Site H	Observation Type	Confidence Level	Site I	Observation Type	Confidence Type	Incidental	Observation Type
Amphibians	Eastern Sign-bearing Froglet	*Crinia parinsignifera*				X	O					X	OW																	X	OW			
Amphibians	Common Eastern Froglet	*Crinia signifera*				X	W		X	W		X	W		X	W								X	OW		X	W		X	OW			
Amphibians	Ornate Burrowing Frog	*Limnodynastes ornatus*																			X	T												
Amphibians	Spotted Grass Frog	*Limnodynastes tasmaniensis*				X	W, T		X	W		X	W/T		X	W					X	T		X	OW					X	W			
Amphibians	Red-backed Toadlet	*Pseudophryne coriacea*													X	W																		
Amphibians	Dusky Toadlet	*Uperoleia fusca*							X	W		X	W														X	T						
Amphibians	Smooth Toadlet	*Uperoleia laevigata*				X	W		X	O		X	W		X	T											X	T						
Amphibians	Green Tree Frog	*Litoria caerulea*				X	W		X	W		X	W																					
Amphibians	Eastern Dwarf Tree Frog	*Litoria fallax*										X	W														X	W						
Amphibians	Broad-palmed Frog	*Litoria latopalmata*				X	W		X	W		X	W														X	W/T						
Amphibians	Rocket Frog	*Litoria nasuta*										X	O																	X	O			
Amphibians	Peron's Tree Frog	*Litoria peronii*										X	W																					
Amphibians	Tyler's Tree Frog	*Litoria tyleri*																						X	W									
Amphibians	Verreaux's Tree Frog (subsp)	*Litoria verreauxii verreauxii*																												X	W			
Reptiles	Eastern Snake-necked Turtle	*Chelodina longicollis*				X	O								X	O																		
Reptiles	Eastern Stone Gecko	*Diplodactylus vittatus*							X	O											X	T												
Reptiles	Robust Velvet Gecko	*Nebulifera robusta*				X	O																											
Reptiles	Hunter Valley Delma	*Delma vescolineata* ***sp. nov.***				X	O																											
Reptiles	Two-clawed Worm-skink	*Anomalopus leuckartii*																			X	O												
Reptiles	Southern Rainbow-skink	*Carlia tetradactyla*				X	O		X	O		X	T		X	O/T																		
Reptiles	Elegant Snake-eyed Skink	*Cryptoblepharus pulcher*				X	O								X	O																		
Reptiles	Robust Ctenotus	*Ctenotus robustus*				X	T		X	O		X	O		X	O/T					X	T					X	T		X	T			
Reptiles	Tree Skink	*Egernia striolata*				X	O, T					X	T								X	O												
Reptiles	Eastern Ranges Rock-skink	*Liopholis modesta*							X	O																								
Reptiles	Eastern Bearded Dragon	*Pogona barbata*				X	O					X	O		X	O																		
Reptiles	Lace Monitor	*Varanus varius*				X	O		X	O		X	O		X	O														X	O			
Reptiles	Brown-snouted Blind Snake	*Anilios wiedii*				X	O								X	O																		
Reptiles	Spotted Black Snake	*Pseudechis guttatus*																															X	O
Birds	Stubble Quail	*Coturnix pectoralis*				X	O																											
Birds	Brown Quail	*Coturnix ypsilophora*				X	O		X	O																				X	W			

Fauna Group	Common Name	*Scientific Name*	Introduced	NSW Status	Federal Status	Site A	Observation Type	Confidence Level	Site B	Observation Type	Confidence Level	Site C	Observation Type	Confidence Level	Site D	Observation Type	Confidence Level	Site E	Observation Type	Confidence Level	Site F	Observation Type	Confidence Level	Site G	Observation Type	Confidence Level	Site H	Observation Type	Confidence Level	Site I	Observation Type	Confidence Type	Incidental	Observation Type
Birds	Plumed Whistling Duck	*Dendrocygna eytoni*										X	O																					
Birds	Black Swan	*Cygnus atratus*																									X	O						
Birds	Australian Wood Duck	*Chenonetta jubata*				X	O		X	W		X	OW		X	O														X	OW			
Birds	Pacific Black Duck	*Anas superciliosa*				X	O					X	O											X	O					X	O			
Birds	Grey Teal	*Anas gracilis*										X	O								X	O								X	O			
Birds	Chestnut Teal	*Anas castanea*										X	O																					
Birds	Hardhead Duck	*Aythya australis*																												X	O			
Birds	Australasian Grebe	*Tachybaptus novaehollandiae*				X	OW					X	O																	X	O			
Birds	White-necked Heron	*Ardea pacifica*							X	O		X	O																					
Birds	Intermediate Egret	*Ardea intermedia*				X	O																											
Birds	White-faced Heron	*Egretta novaehollandiae*				X	O					X	O		X	O		X	O					X	O					X	OW			
Birds	Pied Cormorant	*Phalacrocorax varius*				X	O																							X	O			
Birds	Nankeen Kestrel	*Falco cenchroides*				X	O		X	O		X	O		X	O					X	O								X	O			
Birds	Australian Hobby	*Falco longipennis*				X	O								X	O											X	O						
Birds	Brown Falcon	*Falco berigora*				X	O					X	O														X	O						
Birds	**Black Falcon**	***Falco subniger***		**V**		X	O																											
Birds	Peregrine Falcon	*Falco peregrinus*							X	O																								
Birds	Black-shouldered Kite	*Elanus axillaris*				X	O								X	O											X	O						
Birds	Black Kite	*Milvus migrans*																															X	O
Birds	Whistling Kite	*Haliastur sphenurus*																									X	O		X	O			
Birds	**White-bellied Sea Eagle**	***Haliaeetus leucogaster***		**V**	**M**																									**X**	**O**			
Birds	**Spotted Harrier**	***Circus assimilis***		**V**											**X**	**O**																**X**	**O**
Birds	Grey Goshawk	*Accipiter novaehollandiae*																														X	O
Birds	Brown Goshawk	*Accipiter fasciatus*				X	O																											
Birds	Wedge-tailed Eagle	*Aquila audax*				X	O		X	O					X	Q														X	O			
Birds	Purple Swamphen	*Porphyrio porphyrio*				X	W																							X	O			
Birds	Eurasian Coot	*Fulica atra*										X	O																	X	O			
Birds	Painted Button-quail	*Philemon citreogularis*				X	Q																											
Birds	Masked Lapwing	*Vanellus miles*				X	O					X	OW																	X	W			
Birds	Black-fronted Dotterel	*Elseyornis melanops*										X	O																					
Birds	Common Bronzewing	*Phaps chalcoptera*							X	O																								
Birds	Crested Pigeon	*Ocyphaps lophotes*				X	O					X	O		X	O														X	O			
Birds	Bar-shouldered Dove	*Geopelia humeralis*				X	O		X	W																								
Birds	Galah	*Eolophus roseicapillus*				X	O								X	W					X	OW												
Birds	Sulphur-crested Cockatoo	*Cacatua galerita*																			X	OW		X	W									

Fauna Group	Common Name	*Scientific Name*	Introduced	NSW Status	Federal Status	Site A	Observation Type	Confidence Level	Site B	Observation Type	Confidence Level	Site C	Observation Type	Confidence Level	Site D	Observation Type	Confidence Level	Site E	Observation Type	Confidence Level	Site F	Observation Type	Confidence Level	Site G	Observation Type	Confidence Level	Site H	Observation Type	Confidence Level	Site I	Observation Type	Confidence Type	Incidental	Observation Type
Birds	Musk Lorikeet	*Glossopsitta concinna*																						X	W								
Birds	Eastern Rosella	*Platycercus eximius*				X	OW					X	OW		X	O								X	OW					X	O			
Birds	Red-rumped Parrot	*Psephotus haematonotus*				X						X	OW		X	OW																		
Birds	Australian King-Parrot	*Alisterus scapularis*				X	O		X	W								X	OW		X	O												
Birds	Eastern Koel	*Eudynamys orientalis*																														X	O
Birds	Channel-billed Cuckoo	*Scythrops novaehollandiae*				X	W																				X	O						
Birds	Eastern Barn Owl	*Tyto javanica*				X	Q,O								X	W					X	O					X	Q		X	W			
Birds	Tawny Frogmouth	*Podargus strigoides*													X	Q								X	O									
Birds	Australian Owlet-nightjar	*Aegotheles cristatus*				X	W					X	W														X	O		X	W			
Birds	Dollarbird	*Eurystomus orientalis*				X	W														X	W								X	O			
Birds	Laughing Kookaburra	*Dacelo novaeguineae*				X	O					X	O								X	W												
Birds	Sacred Kingfisher	*Todiramphus sanctus*										X	O																					
Birds	White-throated Treecreeper	*Cormobates leucophaea*				X	W					X	W																					
Birds	**Brown Treecreeper**	***Climacteris picumnus***		**V**																	**X**	**OW**												
Birds	Superb Fairy-wren	*Malurus cyaneus*				X	Q		X	O		X	O											X	OW									
Birds	Spotted Pardalote	*Pardalotus punctatus*							X	W		X	W								X	W												
Birds	Striated Pardalote	*Pardalotus striatus*				X	W		X	W		X	W		X	W		X	O		X	W		X	W					X	O			
Birds	**Speckled Warbler**	***Chthonicola sagittata***		**V**		X	O		X	OW		X	OW																	X	OW			
Birds	White-browed Scrubwren	*Sericornis frontalis*							X	W																								
Birds	Weebill	*Smicrornis brevirostris*							X	OW		X	OW		X	OW																		
Birds	Western Gerygone	*Gerygone fusca*							X	OW																								
Birds	White-throated Gerygone	*Gerygone olivacea*				X	OW														X	W												
Birds	Brown Thornbill	*Acanthiza pusilla*							X	OW		X	OW																					
Birds	Buff-rumped Thornbill	*Acanthiza reguloides*				X	W		X	W		X	OW														X	W		X	O			
Birds	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*				X	O		X	O		X	OW																					
Birds	Yellow Thornbill	*Acanthiza nana*				X	O		X	O		X	OW																					
Birds	Yellow-faced Honeyeater	*Caligavis chrysops*				X	OW		X	W		X	W								X	OW		X	W					X	OW			
Birds	White-plumed Honeyeater	*Ptilotula penicillatus*				X	O					X	OW		X	OW					X	OW												
Birds	Noisy Miner	*Manorina melanocephala*				X	OW					X	OW		X	O														X	O			
Birds	Brown-headed Honeyeater	*Melithreptus brevirostris*							X	OW		X	OW																					
Birds	White-naped Honeyeater	*Melithreptus lunatus*				X	O					X	OW								X	OW												
Birds	Noisy Friarbird	*Philemon corniculatus*				X	OW		X	W		X	OW		X	OW					X	W		X	W					X	O			
Birds	Striped Honeyeater	*Plectorhyncha lanceolata*										X	OW																					

Fauna Group	Common Name	*Scientific Name*	Introduced	NSW Status	Federal Status	Site A	Observation Type	Confidence Level	Site B	Observation Type	Confidence Level	Site C	Observation Type	Confidence Level	Site D	Observation Type	Confidence Level	Site E	Observation Type	Confidence Level	Site F	Observation Type	Confidence Level	Site G	Observation Type	Confidence Level	Site H	Observation Type	Confidence Level	Site I	Observation Type	Confidence Type	Incidental	Observation Type
Birds	Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*				X	OW											X	W		X	W		X	W					X	W			
Birds	Eastern Yellow Robin	*Eopsaltria australis*							X	W		X	W																					
Birds	**Grey-crowned Babbler**	***Pomatostomus temporalis temporalis***		**V**					**X**	**W**		**X**	**OW**		**X**	**OW**					**X**	**O**											**X**	**O**
Birds	**Varied Sittella**	***Daphoenositta chrysoptera***		**V**								X	O																					
Birds	Golden Whistler	*Pachycephala pectoralis*																			X	O												
Birds	Rufous Whistler	*Pachycephala rufiventris*				X	OW					X	W		X	OW											X	W						
Birds	Grey Shrike-thrush	*Colluricincla harmonica*										X	O																					
Birds	Grey Fantail	*Rhipidura albiscapa*				X	OW		X	W		X	OW								X	OW								X	OW			
Birds	Willie Wagtail	*Rhipidura leucophrys*				X	O					X	O								X	OW								X	OW			
Birds	Black-faced Monarch	*Monarcha melanopsis*																												X	OW			
Birds	Magpie-lark	*Grallina cyanoleuca*				X	W					X	OW		X	O														X	O			
Birds	**Satin Flycatcher**	***Myiagra cyanoleuca***			**M**							**X**	**OW**																					
Birds	Grey Butcherbird	*Cracticus torquatus*										X	OW		X	OW														X	O			
Birds	Pied Butcherbird	*Cracticus nigrogularis*				X	OW		X	W		X	W		X	W		X	W					X	W		X	W						
Birds	Australian Magpie	*Cracticus tibicen*				X	Q		X	W		X	W		X	OW		X	O		X	O								X	O			
Birds	Pied Currawong	*Strepera graculina*				X	O		X	O		X	OW		X	OW					X	OW												
Birds	**Dusky Woodswallow**	***Artamus cyanopterus***		**V**								X	O																					
Birds	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*				X	O		X	W		X	OW		X	O														X	O			
Birds	White-winged Triller	*Lalage sueurii*				X	OW					X	OW																					
Birds	Olive-backed Oriole	*Oriolus sagittatus*				X	OW		X	W		X	OW								X	W												
Birds	Australian Raven	*Corvus coronoides*				X	Q		X	W		X	W		X	W					X	W					X	W		X	OW			
Birds	White-winged Chough	*Corcorax melanorhamphos*				X	OW		X	W		X	OW								X	Q								X	O			
Birds	Common Starling	*Sturnus vulgaris*	X			X	W																							X	O			
Birds	Common Myna	*Sturnus tristis*	X			X	W																							X	O			
Birds	Welcome Swallow	*Hirundo neoxena*				X	O					X	O														X	O		X	O			
Birds	Fairy Martin	*Petrochelidon ariel*				X	OW																											
Birds	Tree Martin	*Petrochelidon nigricans*				X	O					X	O		X	O														X	O			
Birds	Silvereye	*Zosterops lateralis*				X	O		X	O																								
Birds	Tawny Grassbird	*Megalurus timoriensis*				X	O																											
Birds	Rufous Songlark	*Cincloramphus mathewsi*				X	OW					X	W																					
Birds	Brown Songlark	*Cincloramphus cruralis*				X	OW																											
Birds	Golden-headed Cisticola	*Cisticola exilis*				X	W																	X	W									
Birds	Horsfield's Bushlark	*Mirafra javanica*				X	O					X	O																					

Fauna Group	Common Name	*Scientific Name*	Introduced	NSW Status	Federal Status	Site A	Observation Type	Confidence Level	Site B	Observation Type	Confidence Level	Site C	Observation Type	Confidence Level	Site D	Observation Type	Confidence Level	Site E	Observation Type	Confidence Level	Site F	Observation Type	Confidence Level	Site G	Observation Type	Confidence Level	Site H	Observation Type	Confidence Level	Site I	Observation Type	Confidence Type	Incidental	Observation Type
Birds	Mistletoebird	*Dicaeum hirundinaceum*							X	O																							
Birds	Richard's Pipit	*Anthus novaeseelandiae*				X	O					X	O		X	O																	
Birds	Red-browed Finch	*Neochmia temporalis*				X	O					X	O								X	O		X	OW		X	E					
Birds	Zebra Finch	*Taeniopygia guttata*				X	O																									X	O
Birds	Double-barred Finch	*Taeniopygia bichenovii*				X	O		X	O		X	OW																	X	O		
Mammals	Short-beaked Echidna	*Tachyglossus aculeatus*				X	Q														X	Q											
Mammals	**Spotted-tail Quoll**	***Dasyurus maculatus***		**V**	**E**				X	Q																						X	Q
Mammals	Common Wombat	*Vombatus ursinus*				X	Q		X	O		X	FB											X	FB								
Mammals	**Squirrel Glider**	***Petaurus norfolcensis***		**V**																	**X**	**Q**											
Mammals	Common Ringtail Possum	*Pseudocheirus peregrinus*							X	O																							
Mammals	Common Brushtail Possum	*Trichosurus vulpecula*				X	Q		X	O		X	Q		X	Q					X	O		X	O					X	O		
Mammals	Western Grey Kangaroo	*Macropus fuliginosus*																									X	Q					
Mammals	Eastern Grey Kangaroo	*Macropus giganteus*				X	Q		X	O		X	O		X	Q					X	O		X	O					X	O		
Mammals	Eastern Wallaroo	*Macropus robustus*							X	O					X	O																	
Mammals	Red-necked Wallaby	*Macropus rufogriseus*							X	O											X	O					X	O					
Mammals	Swamp Wallaby	*Wallabia bicolor*				X	Q		X	O																							
Mammals	**Grey-headed Flying-fox**	***Pteropus poliocephalus***		**V**	**V**																			X	O								
Mammals	Little Red Flying-fox	*Pteropus scapulatus*										X	O																				
Mammals	**Eastern Coastal Freetailed Bat**	***Micronomus (Mormopterus) norfolkensis***		**V**								X	U	PR																			
Mammals	South-eastern Free-tailed Bat	*Ozimops planiceps*							X	U	PR																			X	U	PR		
Mammals	Inland Free-tailed Bat	*Ozimops (Mormopterus) petersi*										X	U	PR																			
Mammals	Eastern Free-tailed Bat	*Ozimops (Mormopterus) ridei*										**X**	**U**	**PR**																			
Mammals	White-striped Freetail-bat	*Austronomus australis*							X	U	D	X	U	D							X	W								X	OW		
Mammals	**Little Bentwing-bat**	***Miniopterus australis***		**V**					**X**	**U**	**PR**																						
Mammals	**Large Bentwing-bat**	***Miniopterus orianae oceansis***		**V**								**X**	**U**	**PR**																			
Mammals	Long-eared Bat	*Nyctophilus sp.*							X	U	PR	X	U	D																			
Mammals	Gould's Wattled Bat	*Chalinolobus gouldii*							X	Q	D	X	U	D																X	U	D		
Mammals	Chocolate Wattled Bat	*Chalinolobus morio*							X	Q	D	X	U	D																			
Mammals	**Southern Myotis**	***Myotis macropus***		**V**		X	O					X	O/U	D/PR																X	O/E	D		
Mammals	**Greater Broad-nosed Bat**	***Scoteanax rueppellii***		**V**								**X**	**U**	**D**																			
Mammals	Eastern Broad-nosed Bat	*Scotorepens orion*				X	U	D				X	U	PR																			

Fauna Group	Common Name	*Scientific Name*	Introduced	NSW Status	Federal Status	Site A	Observation Type	Confidence Level	Site B	Observation Type	Confidence Level	Site C	Observation Type	Confidence Level	Site D	Observation Type	Confidence Level	Site E	Observation Type	Confidence Level	Site F	Observation Type	Confidence Level	Site G	Observation Type	Confidence Level	Site H	Observation Type	Confidence Level	Site I	Observation Type	Confidence Type	Incidental	Observation Type
Mammals	Large Forest Bat	*Vespadelus darlingtoni*							X	U	PR	X	U	D																			
Mammals	Southern Forest Bat	*Vespadelus regulus*							X	T		X	U	D																			
Mammals	Little Forest Bat	*Vespadelus vulturnus*							X	U	D	X	U	D															X	U	PR		
Mammals	House Mouse	*Mus musculus*	X			X	H																				X	X	X	X			
Mammals	Bush Rat	*Rattus fuscipes*							X	Q																							
Mammals	Black Rat	*Rattus rattus*	X			X	Q		X	Q		X	Q		X	T											X	Q	X	Q			
Mammals	Dingo	*Canis lupus dingo*				X	Q		X	W		X	Q																X	O			
Mammals	Dog	*Canis lupus familiaris*	X						X	Q																	X	O					
Mammals	Hybrid Dog	*Canis lupus/familiaris*	X																										X	O			
Mammals	Fox	*Vulpes vulpes*	X			X	Q		X	O		X	Q		X	O					X	Q		X	Q		X	Q		X	O			
Mammals	Cat	*Felis catus*	X			X	Q		X	Q					X	Q					X	Q								X	Q			
Mammals	Brown Hare	*Lepus capensis*	X			X	O		X	O		X	Q																				
Mammals	Rabbit	*Oryctolagus cuniculus*	X			X	Q		X	O		X	Q		X	Q											X	Q		X	O			
Mammals	Pig	*Sus scrofa*	X																		X	O		X	P								
Mammals	European Cattle	*Bos taurus*	X			X	Q					X	O		X	O/Q																	
Fish	Eastern Gambusia	*Gambusia holbrooki*	X			X	O																										
Fish	Eel	*Anguilla sp.*				X	O																										
Crustaceans	Dam Yabby	*Cherax destructor*				X	O																						X	O			
Crustaceans	Freshwater Shrimp	*Paratya australiensis*																											X	O			

Key

X: detected
O: observed
W: heard
U: ultrasonic call recorded (microbats)
H: hair sample
Q: captured on camera
T: trapped
XX: in a scat
P: scat
FB: burrow
R: road kill

D: Definite detection (for identification via hair or ultrasonic call)
Pr: Probable detection (for identification via hair or ultrasonic call)
Po: Possible detection (for identification via hair or ultrasonic call)
Bold type: listed threatened and/or protected migratory species
V: listed as vulnerable under the BC and/or EPBC Act
E: listed as endangered under the BC and/or EPBC Act
CE: listed as critically endangered under the BC and/or EPBC Act
M: listed as a migratory and/or marine species under the EPBC Act

ATTACHMENT D

VEGETATION INTEGRITY (SITE CONDITION) DATA

Table D1 Vegetation Integrity (Site Condition) Data

Plot Count	Plot Code (Hunter Eco 2023)	PCT	Area	Patch Size	Condition Class	Zone	Easting	Northing	Bearing	Comp Tree	Comp Shrub	Comp Grass	Comp Forbs	Comp Ferns	Comp Other	Struc Tree	Struc Shrub	Struc Grass	Struc Forbs	Struc Ferns	Struc Other	Fun Large Trees	Fun Hollow tTees	Fun Litter Cover	Fun Len Fallen Logs	Fun Tree Stem 5 to 9	Fun Tree Stem 10 to 19	Fun TreeS tem 20 to 29	Fun Tree Stem 30 to 49	Fun Tree Stem 50 to 79	Fun Tree Regen	Fun High Threat Exotic
1	221010P2	483	22.5	101	DNG	56	294369	6421141	352	0	1	6	14	1	4	0	0.1	45.2	2.4	0.1	0.4	0	0	76	0	0	0	0	0	0	0	10
2	230710P1	483	22.5	101	DNG	56	294209	6422109	160	0	0	5	1	0	0	0	0	65.2	0.1	0	0	0	0	80	0	0	0	0	0	0	0	0.4
3	230710P2	483	22.5	101	DNG	56	294707	6420620	126	0	4	12	6	0	0	0	0.4	82.7	1.6	0	0	0	0	90	0	0	0	0	0	0	0	3.3
4	221013P2	483	22.5	101	DNG	56	295093	6420142	325	0	1	8	5	0	1	0	0.1	70.6	1.4	0	0.1	0	0	90	0	0	0	0	0	0	0	0.2
5	221010P4	1655	1.2	101	DNG	56	294857	6420526	46	2	4	6	5	1	1	7.1	0.4	30.5	0.5	0.1	0.1	1	1	46	19	0	0	0	0	0	0	5.2
6	221013P1	483	0.2	101	Plantation	56	294170	6422278	35	3	1	5	6	1	0	80.1	1	40.2	0.6	0.1	0	0	0	70	0	1	1	1	0	0	1	0.2
7	221013P3	1655	0.4	101	Woodland	56	294608	6420805	195	3	4	8	15	1	2	100.1	0.4	40.6	1.5	0.1	0.2	1	1	48	30	1	1	1	0	0	1	1.3
8	221116P2	483	0.5	101	Woodland	56	294547	6420834	130	1	5	12	11	1	2	70	0.5	36.2	2	0.1	0.2	1	2	56	0	1	1	1	0	1	1	5.3

ATTACHMENT E

THREATENED FLORA AND FAUNA SPECIES KNOWN OR PREDICTED TO OCCUR IN THE WIDER LOCALITY

Table E-1
Threatened Flora and Fauna Species Known or Predicted to Occur in the Wider Locality

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Database Records				Recorded in Previous Studies and/or Recent Surveys[7]
		BC Act	EPBC Act		EPBC Act Protected Matters Search[3]	BioNet Atlas[4]	ALA[5]	BirdLife[6]	
Flora									
Acacia pendula	Weeping Myall (*Acacia pendula* population in the Hunter Catchment)	EP	-	S	-	Yes	Yes	-	A, B, J, N, Q
Cymbidium canaliculatum	Tiger Orchid (*Cymbidium canaliculatum* population in the Hunter Catchment)	EP	-	S	-	Yes	Yes	-	A, D, J, Q
Diuris tricolor	Pine Donkey Orchid (*Diuris tricolor* population in the Muswellbrook local government area)	EP	-	S	-	Yes	-	-	A, O
Diuris tricolor	Pine Donkey Orchid	V	-	S	-	Yes	Yes	-	L
Eucalyptus camaldulensis	Eucalyptus camaldulensis population in the Hunter catchment	EP	-	S	-	Yes	-	-	-
Eucalyptus glaucina	Slaty Red Gum	V	V	S	Predicted	Yes	-	-	-
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	S	-	Yes	Yes	-	-
Euphrasia arguta	-	CE	CE	S	Predicted	-	-	-	-
Ozothamnus tesselatus	-	V	V	S	Predicted	Yes	Yes	-	-
Picris evae	Hawkweed	V	V	S	Predicted	-	-	-	-
Pomaderris brunnea	Rufous Pomaderris; Brown Pomaderris	E	V	S	Predicted	-	-	-	-
Prasophyllum petilum	Tarengo Leek Orchid	E	E	S	-	-	Yes	-	-
Prasophyllum sp. Wybong	a leek-orchid	-	CE	S	Predicted	-	-	-	-
Prostanthera cryptandroides subsp. cryptandroides	Wollemi Mint-bush	V	V	S	-	-	Yes	-	-
Pterostylis gibbosa	Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood	E	E	S	Predicted	-	-	-	-
Thesium australe	Austral Toadflax, Toadflax	V	V	S	Predicted	-	-	-	Q

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Database Records				Recorded in Previous Studies and/or Recent Surveys[7]
		BC Act	EPBC Act		EPBC Act Protected Matters Search[3]	BioNet Atlas[4]	ALA[5]	BirdLife[6]	
Amphibians									
Litoria booroolongensis	Booroolong Frog	E	E	S	Predicted	-	-	-	-
Reptiles									
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	S	Predicted	Yes	-	-	I
Delma impar	Striped Legless Lizard	V	V	S	Predicted	Yes	-	-	-
Birds									
Anseranas semipalmata	Magpie Goose	V	-	E	-	Yes	-	-	-
Stictonetta naevosa	Freckled Duck	V	-	E	-	Yes	-	Yes	-
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	E	-	Yes	-	-	-
Botaurus poiciloptilus	Australasian Bittern	E	E	E	Predicted	-	Yes	-	-
Falco hypoleucos	Grey Falcon	E	V	E	Predicted	-	Yes	-	-
Falco subniger	Black Falcon	V	-	E	-	Yes	Yes	Yes	R
Lophoictinia isura	Square-tailed Kite	V	-	S/E	-	Yes	Yes	-	I
Haliaeetus leucogaster	White-bellied Sea-eagle	V	-	S/E	-	Yes	-	Yes	I, R
Circus assimilis	Spotted Harrier	V	-	E	-	Yes	Yes	Yes	A, I, R
Erythrotriorchis radiatus	Red Goshawk	CE	V	S	Predicted	-	-	-	-
Hieraaetus morphnoides	Little Eagle	V	-	S/E	-	Yes	-	Yes	A, I
Burhinus grallarius	Bush Stone-curlew	E	-	S	-	Yes	-	Yes	-
Rostratula australis	Australian Painted Snipe	E	E	E	Predicted	-	-	-	-
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	-	CE	S/E	Predicted	-	-	-	-
Calidris ferruginea	Curlew Sandpiper	E	CE	S/E	Predicted	-	-	-	-
Sternula albifrons	Little Tern	E	-	S/E	-	-	Yes	-	-
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	V	S/E	Predicted	Yes	Yes	-	I

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Database Records				Recorded in Previous Studies and/or Recent Surveys[7]
		BC Act	EPBC Act		EPBC Act Protected Matters Search[3]	BioNet Atlas[4]	ALA[5]	BirdLife[6]	
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	S/E	Predicted	-	Yes	-	-
Glossopsitta pusilla	Little Lorikeet	V	-	E	-	Yes	Yes	-	A, D, I
Lathamus discolor	Swift Parrot	E	CE	S/E	Predicted	-	-	-	-
Polytelis swainsonii	Superb Parrot	V	V	S/E	Predicted	-	-	-	-
Tyto novaehollandiae	Masked Owl	V	-	S/E	-	-	Yes	-	-
Ninox connivens	Barking Owl	V	-	S/E	-	Yes	Yes	-	A
Hirundapus caudacutus	White-throated Needletail	-	V	S	Predicted	Yes	Yes	Yes	A
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	V	E	Predicted	Yes	-	Yes	E, F, G, I, R
Chthonicola sagittata	Speckled Warbler	V	-	S/E	-	Yes	Yes	Yes	A, C, D, E, F, G, H, I, K, R
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	E	-	Yes	-	-	I
Anthochaera phrygia	Regent Honeyeater	CE	CE	S/E	Predicted	-	Yes	-	-
Grantiella picta	Painted Honeyeater	V	V	E	Predicted	Yes	-	-	I
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	V	E	Predicted	Yes	-	-	-
Petroica phoenicea	Flame Robin	V	-	E	-	Yes	-	-	I
Petroica boodang	Scarlet Robin	V	-	E	-	Yes	-	Yes	I
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	E	-	Yes	Yes	Yes	A, D, E, I, R
Daphoenositta chrysoptera	Varied Sittella	V	-	E	-	Yes	Yes	Yes	A, I, R
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	E	-	Yes	-	-	A, H, I, R
Stagonopleura guttata	Diamond Firetail	V	V	E	Predicted	Yes	-	Yes	D, H
Neophema chrysostoma	Blue -winged Parrot	-	V Ma	-	-	-	-	-	-
Aphelocephala leucopsis	Southern Whiteface	-	V	-	-	-	-	-	-

Scientific Name	Common Name	Conservation Status[1]		Biodiversity Credit Class[2]	Database Records				Recorded in Previous Studies and/or Recent Surveys[7]
		BC Act	EPBC Act		EPBC Act Protected Matters Search[3]	BioNet Atlas[4]	ALA[5]	BirdLife[6]	
Mammals									
Dasyurus maculatus	Spotted-tailed Quoll	V	E	E	Predicted	Yes	-	-	A, R
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	S	-	Yes	-	-	-
Phascolarctos cinereus	Koala	E	E	S/E	Predicted	Yes	-	-	-
Petaurus australis australis	Yellow-bellied Glider	V	-	E	Predicted	-	-	-	-
Petaurus norfolcensis	Squirrel Glider	V	-	S	-	Yes	-	-	A, D, F, I, R
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	S	Predicted	-	-	-	-
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	S/E	Predicted	Yes	Yes	-	A, D, E, I, M, P, R
Saccolaimus flaviventris	Yellow-bellowed Sheathtail-bat	V	-	E	-	Yes	-	-	H, I
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	E	-	Yes	Yes	-	A, E, F, G, I, K
Miniopterus australis	Little Bent-winged Bat	V	-	S/E	-	Yes	Yes	-	D, F, H, I, M
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	S/E	-	Yes	Yes	-	A, D, E, F, G, H, I, K, N, P
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	E	Predicted	Yes	-	-	A
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	S	Predicted	Yes	-	-	G, H, I, K, M
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	E	-	Yes	Yes	-	A, K
Myotis macropus	Southern Myotis	V	-	S	-	Yes	Yes	-	A, D, F, H, I, K, P
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	E	-	Yes	-	-	A, F, G, P, R
Vespadelus troughtoni	Eastern Cave Bat	V	-	S	-	Yes	Yes	-	A, F, G, H, K, P
Pseudomys novaehollandiae	New Holland Mouse	-	V	E	Predicted	-	-	-	-

Note: Shaded species are species with records in the Subject land.

[1] Conservation status under the BC Act and/or EPBC Act (current as of September 2023). CE = Critically Endangered; E = Endangered; EP = Endangered Population; V = Vulnerable.

[2] Biodiversity credit class under the *BioNet Threatened Biodiversity Data Collection* (DPE, 2023a). E = Ecosystem; S = Species.

[3] DCCEEW (2023).

[4] DPE (2023).

[5] Atlas of Living Australia (ALA) (2022).

[6] BirdLife Australia (2022).

[7]

A	All records prior to 2013: Ecotone (2000); Umwelt Environmental Consultants (2003, 2005, 2006, 2007, 2008, 2010, 2011); Wildthing Environmental Consultants (2008); Cumberland Ecology (2009, 2010, 2011); Niche Environment and Heritage (2012).	G	Cumberland Ecology Pty Ltd (2018)	M	Cumberland Ecology Pty Ltd (2021)
B	Hunter Eco (2013)	H	Cumberland Ecology Pty Ltd (2019)	N	BHP (2022)
C	Umwelt Environmental Consultants (2013)	I	Future Ecology (2019)	O	Cumberland Ecology Pty Ltd (2022a)
D	Umwelt Environmental Consultants (2015)	J	Hunter Eco (2019)	P	Cumberland Ecology Pty Ltd (2022b)
E	Cumberland Ecology Pty Ltd (2016)	K	Cumberland Ecology Pty Ltd (2020)	Q	Bolwarra Environmental Services (2023)
F	Cumberland Ecology Pty Ltd (2017)	L	Eco Logical Australia (2020)	R	Future Ecology (2023)

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ATTACHMENT F

BAM BIODIVERSITY CREDIT REPORT

BAM Credit Summary Report

Proposal Details

Assessment Id
00037055/BAAS17080/22/00037056

Proposal Name
Mt Arthur Coal Mod 2

BAM data last updated *
22/06/2023

Assessor Name
Jamie Gleeson

Report Created
27/09/2023

BAM Data version *
61

Assessor Number
BAAS17080

BAM Case Status
Finalised

Date Finalised
27/09/2023

Assessment Revision
0

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin												
2	1655_DNG	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	33.9	33.9	1.2	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Vulnerable Ecological Community	Not Listed	1.75		18

4	1655_Woodland	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	67.7	67.7	0.4	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Vulnerable Ecological Community	Not Listed	1.75		12
											Subtotal	**30**
Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley												
1	483_DNG	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 Highla	36.6	36.6	22.5	Population size	High Sensitivity to Gain	Critically Endangered Ecological Community	Not Listed	2.50	True	514

3	483_Plantation	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 Highla	57.1	57.1	0.2	Population size	High Sensitivity to Gain	Critically Endangered Ecological Community	Not Listed	2.50	True	7

5	483_Woodland	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 Highla	78.5	78.5	0.3	Population size	High Sensitivity to Gain	Critically Endangered Ecological Community	Not Listed	2.50	True	15
											Subtotal	**536**
											Total	**566**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits

ATTACHMENT G

BAM BIODIVERSITY CREDIT REPORT (LIKE FOR LIKE)

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00037055/BAAS17080/22/00037056

Proposal Name
Mt Arthur Coal Mod 2

BAM data last updated *
22/06/2023

Assessor Name
Jamie Gleeson

Assessor Number
BAAS17080

BAM Data version *
61

Proponent Names

Report Created
27/09/2023

BAM Case Status
Finalised

Assessment Revision
0

Assessment Type
Major Projects

Date Finalised
27/09/2023

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
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 Highla	Critically Endangered Ecological Community	483-Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley
Species		

Nil

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

BAM Biodiversity Credit Report (Like for like)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
483-Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	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 Highla	23.0	15	521	536
1655-Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	1.6	30	0	30

483-Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
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 Highla This includes PCT's: 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276,	-	483_DNG	No	514	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373, 3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150					
	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and	-	483_Plantation	No	7	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and

	Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla This includes PCT's: 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383,					Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373, 3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150					
	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 Highla This includes PCT's: 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492,	-	483_Woodland	Yes	15	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373, 3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150					
1655-Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion This includes PCT's: 1176, 1655, 3490	-	1655_DNG	Yes	18	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion This includes PCT's: 1176, 1655, 3490	-	1655_Woodland	Yes	12	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

No Species Credit Data

Credit Retirement Options

Like-for-like credit retirement options

ATTACHMENT H

BAM BIODIVERSITY CREDIT REPORT (VARIATIONS)

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00037055/BAAS17080/22/00037056

Proposal Name
Mt Arthur Coal Mod 2

BAM data last updated *
22/06/2023

Assessor Name
Jamie Gleeson

Assessor Number
BAAS17080

BAM Data version *
61

Proponent Name(s)

Report Created
27/09/2023

BAM Case Status
Finalised

Assessment Revision
0

Assessment Type
Major Projects

Date Finalised
27/09/2023

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
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 Highla	Critically Endangered Ecological Community	483-Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

Species
Nil

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
483-Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	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 Highla	23.0	15	521	536.00
1655-Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	1.6	30	0	30.00

483-Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland,	-	483_DNG	No	514	Hunter,Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the

	Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla This includes PCT's: 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373, 3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150					impacted site.
	White Box - Yellow Box -	-	483_Planta	No	7	Hunter,Ellerston, Karuah Manning,

	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 Highla This includes PCT's: 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373,		tion			Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150					
	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 Highla This includes PCT's: 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324,	-	483_Woodland	Yes	15	Hunter,Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698, 3314, 3359, 3363, 3373, 3376, 3387, 3388, 3394, 3395, 3396, 3397, 3398, 3399, 3406, 3415, 3533, 4147, 4149, 4150					
1655-Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion This includes PCT's: 1176, 1655, 3490	-	1655_DNG	Yes	18	Hunter,Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion This includes PCT's: 1176, 1655, 3490	-	1655_Woodland	Yes	12	Hunter,Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region

	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 5 or higher threat status	1655_DNG	Yes (including artificial)	18	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 5 or higher threat status	1655_Woodland	Yes (including artificial)	12	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

No Species Credit Data

Credit Retirement Options

Like-for-like options