Mt Arthur Coal

bhpbilliton
resourcing the future

Appendix D – Ecological Assessment

Mt Arthur Coal Open Cut Modification

Ecological Assessment

By Hunter Eco

January 2013

CONTENTS

TABLES

FIGURES

FIGURES (Continued)

APPENDICES

Executive Summary

Hunter Valley Energy Coal (HVEC) seeks to modify the existing Project Approval (PA 09_0062) for the extension of open cut coal mining at the Mt Arthur Coal Complex. The Mt Arthur Coal Mine is located in the Hunter Valley, New South Wales (NSW). The Mt Arthur Coal Open Cut Modification (herein referred to as the Modification), is a proposed continuation of open cut mining operations at the Mt Arthur Coal Mine for an additional operational life of approximately four years. The continuation of mining would include an extension to the west and south-west of approximately 400 metres.

HVEC is seeking environmental approval for the Modification under section 75W of the NSW *Environmental Planning and Assessment Act, 1979*. The purpose of this report is to provide an assessment of the potential ecological impacts associated with the Modification. The assessment has been prepared in accordance with the relevant legislation, policies and guidelines.

This report describes ecology within the proposed disturbance area and immediate surrounds. Floristic and fauna data was collected and vegetation communities were mapped across the Modification areas. Species, populations and communities listed as threatened in the schedules of the NSW *Threatened Species Conservation Act, 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) were the main focus of this assessment.

Assessment Methods

The assessment methodology used in this document was developed in accordance with the NSW Department of Environment and Conservation and NSW Department of Primary Industries 2005 *Draft Guidelines for Threatened Species Assessment*. This terrestrial flora and fauna assessment utilised relevant database sources, a review of past and recent surveys conducted in the Modification areas and surrounds, combined with a supplementary flora and fauna habitat field assessment.

Various flora and fauna surveys have been undertaken in the Modification area, and the area within and surrounding the Mt Arthur Coal Mine. These surveys were mainly associated with environmental assessments for various developmental stages of the Mt Arthur Coal Mine. The most recent flora and fauna surveys were undertaken in 2012 by Hunter Eco and Niche Environment and Heritage (Niche). The 2012 Niche fauna survey report is provided as an attachment to this flora and fauna assessment.

The survey methodology utilised by Hunter Eco and Niche generally conformed with the NSW Department of Environment and Conservation 2004 *Threatened Biodiversity Survey and Assessment Guidelines*. Flora surveys were conducted over seven days from 16 April 2012 to 9 May 2012, September 9 -12 and September 19 while fauna surveys were undertaken over six days on 1 May 2012 and from 7 to 11 May 2012. Threatened species that are known to occur or likely to occur were targeted during the surveys.

The survey techniques for flora included:

- targeted searches for threatened flora species;
- flora plots;
- random meanders; and
- linear transects.

The survey techniques for vertebrate fauna included:

- arboreal Elliot trapping;
- infra-red camera traps;
- hair tubes;
- ultrasonic call recording for bats;
- diurnal bird surveys;
- spotlighting;
- call playback;
- stag watching;
- koala scat searches;
- herpetological surveys; and
- frog chorus survey and aquatic habitat surveys.

Flora

The Modification area is situated within a mining and agricultural landscape. The natural vegetation in and around the Mt Arthur Coal Mine had been predominantly cleared for a variety of agricultural purposes prior to mining.

During the current survey, 239 flora species, comprising 172 native and 67 exotic species, were recorded within the Modification area. These species belong to 58 families, dominated by Poaceae (Grasses) (57 flora species), Asteraceae (Daisies) (36 flora species) and Fabaceae (Faboideae) (Legumes) (17 flora species).

One threatened flora species listed under the EPBC Act, Lobed Blue-grass (*Bothriochloa biloba*), was recorded during the current surveys in Modification Area A and surrounds. Also, one threatened population listed under the TSC Act, *Acacia pendula* (Weeping Myall) population in the Hunter catchment, was recorded in Modification Area A and surrounds.

Eleven vegetation communities were identified and mapped in the Modification area. Six of the vegetation communities identified in the Modification area represent five threatened ecological communities (TECs) listed under the TSC Act and one TEC listed under the EPBC Act. These communities included:

- *White Box Yellow Box Blakely's Red Gum Woodland* (listed under the EPBC Act as the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*);
- *Hunter Lowland Redgum Forest* in the Sydney Basin and NSW North Coast Bioregions;
- *Central Hunter Ironbark—Spotted Gum—Grey Box Forest* in the NSW North Coast and Sydney Basin Bioregions;
- *Central Hunter Grey Box – Ironbark Woodland* in the NSW North Coast and Sydney Basin Bioregions; and
- *Hunter Valley Weeping Myall Woodland* of the Sydney Basin Bioregion.

This document assesses the potential impacts on each threatened flora species, population and TEC present, or likely to occur, in the Modification area.

Fauna

Habitat within the Modification area is mixed, consisting of derived grassland, forest and woodland. Eight broad fauna habitat types are recognised in the Modification area: Forest, disturbed Forest, Grassy Woodland, Disturbed Grassy Woodland, Grassland, Disturbed, Reeds and Rushes and Plantation. Derived grassland supports a mixture of native and exotic grass species and occurs within the Modification area due to historic clearing of woodland or forest habitats for agricultural purposes. Due to historic clearing, habitat features and complexity within the existing grassland habitat is limited.

Aquatic habitat features within the Modification area are limited to small ephemeral streams within Modification Areas B and C and a first/second order ephemeral stream within Modification Area D. The ephemeral creeks within Modification Areas B and C are situated at the top of the Saddlers Creek catchment and consist of first to second order watercourses with irregular, limited flow regimes. Although creek beds are in moderate to good condition, the limited flow regime restricts potential aquatic habitat features along the watercourses.

During the current survey, 77 fauna species, comprising three amphibians, five reptiles, 44 birds and 25 mammals were recorded within the Modification area. Of these, six were introduced species.

Historically, 22 threatened fauna species listed under the TSC Act and/or EPBC Act have been recorded in the Modification area or surrounds. Most of these species have been recorded in the wider area at the Mt Arthur Coal Mine. Two threatened bird species and three threatened mammal species have been recorded in the Modification area: Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*), Varied Sittella (*Daphoenositta chrysoptera*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Eastern Freetail-bat (*Mormopterus norfolkensis*) and Southern Myotis (*Myotis macropus*).

The Grey-headed Flying-fox and Eastern Freetail-bat were recorded during the surveys conducted by Niche. The Grey-headed Flying-fox was recorded at five locations within the study area, while the Eastern Freetail-bat was recorded once during the survey.

No threatened species or TECs listed under the NSW *Fisheries Management Act, 1994* (FM Act) have been identified or are likely to occur with the Modification area, or surrounds, and are therefore not considered relevant to this flora and fauna assessment.

This document assesses the potential impacts on each threatened fauna species present, or likely to occur, in the Modification area.

Evaluation of Potential Impacts on Flora and Fauna

The significance of potential project impacts on threatened species, populations and their habitats, as well as TECs, have been identified and described in this assessment. This includes consideration of key threatening processes listed under the TSC Act, FM Act and EPBC Act. The potential ecological impacts resulting from the Modification include the:

- clearing of 228.9 hectares (ha) of native vegetation, comprised mostly of derived grasslands/reeds (175.5 ha) and Box-Gum woodland (26.6 ha), some of which is known habitat for threatened fauna species listed under the TSC Act;
- removal of approximately 90.3 ha of TECs (within the total 228.9 ha of native vegetation to be cleared);
- clearing of approximately 0.1 ha of the endangered population, *Acacia pendula* in the Hunter Catchment (within the total 228.9 ha of native vegetation to be cleared);
- removal of potential habitat for the threatened *Diuris tricolor;*

- reduction in the connectivity of habitat resources for some flora and fauna species; and
- displacement and/or loss of native vertebrate fauna associated with native vegetation clearing.

Impact assessments have been conducted on all potentially occurring threatened populations, TECs and species listed under the TSC Act. It is concluded that the Modification would not result in a significant impact on any endangered populations, TECs, threatened flora or threatened fauna species.

Impact Avoidance, Mitigation and Offset Measures

A number of management measures have already been implemented to limit ecological impacts from the approved Mt Arthur Coal Mine operations. These measures would be revised to include the actions associated with the Modification. As part of the Modification, the Mt Arthur Coal Mine Biodiversity and Rehabilitation Management Plan would be amended to include biodiversity offsets that would result in an overall gain in biodiversity.

Offset areas have been proposed along Saddlers Creek immediately south of the existing Mt Arthur Coal Mine operations area, and Middle Deep Creek in the Timor district located approximately 70 km north of Muswellbrook. These areas provide similar habitat to that which would be lost as a result of the Modification. In the case of the Middle Deep Creek Offset area, the habitat is superior as demonstrated by confirmation of seven threatened woodland bird species, two mammals and members of one endangered population.

The Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions endangered ecological community is not present in the proposed offset areas. HVEC would, however, provide an additional offset for this community in a location to be determined.

Habitat values of the proposed offset areas would increase through management actions that involve reduction or exclusion of grazing, land remediation and active rehabilitation. It is important to note that the offsets would be established, and their management plans implemented, immediately upon approval of the Modification. In addition, the Modification area would be rehabilitated upon completion of mining and a substantial net gain in biodiversity would result from the combined Modification and proposed offsets.

1 Introduction

1.1 Background

The Mt Arthur Coal Mine is located approximately 5 kilometres (km) south-west of Muswellbrook in the Upper Hunter Valley of New South Wales (NSW) (**Figures 1** and **2**). The Mt Arthur Coal Mine is owned and operated by Hunter Valley Energy Coal (HVEC), a wholly owned subsidiary of BHP Billiton.

HVEC propose a modification to the existing Project Approval (09_0062) under section 75W of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) (herein referred to as the Modification).

The Modification includes a continuation of open cut mining operations at the Mt Arthur Coal Mine for an additional operational life of approximately four years. The Modification includes the following key components:

- a four year continuation of the open cut mine life from 2022 to 2026 at the currently approved maximum rate of 32 million tonnes per annum;
- an increase in open cut disturbance areas;
- use of the conveyor corridor for overburden emplacement;
- duplication of the existing rail loop;
- an increase in the maximum number of train movements per day from 24 to 38;
- the relocation of the load point for the overland conveyor which delivers coal to Macquarie Generation's Bayswater Power Station;
- the relocation and upgrade of the explosives storage, magazine and associated facilities; and
- the construction of additional offices and a control room and a small extension to the run-of-mine coal stockpile footprint.

Not all of the proposed changes would involve habitat disturbance and those that would are shown on **Figure 3** and can be summarised as follows:

- Areas A, B and C are proposed extensions to the open cut;
- Area D is a proposed overburden emplacement area; and
- Area E takes in the proposed duplication of the rail loop.

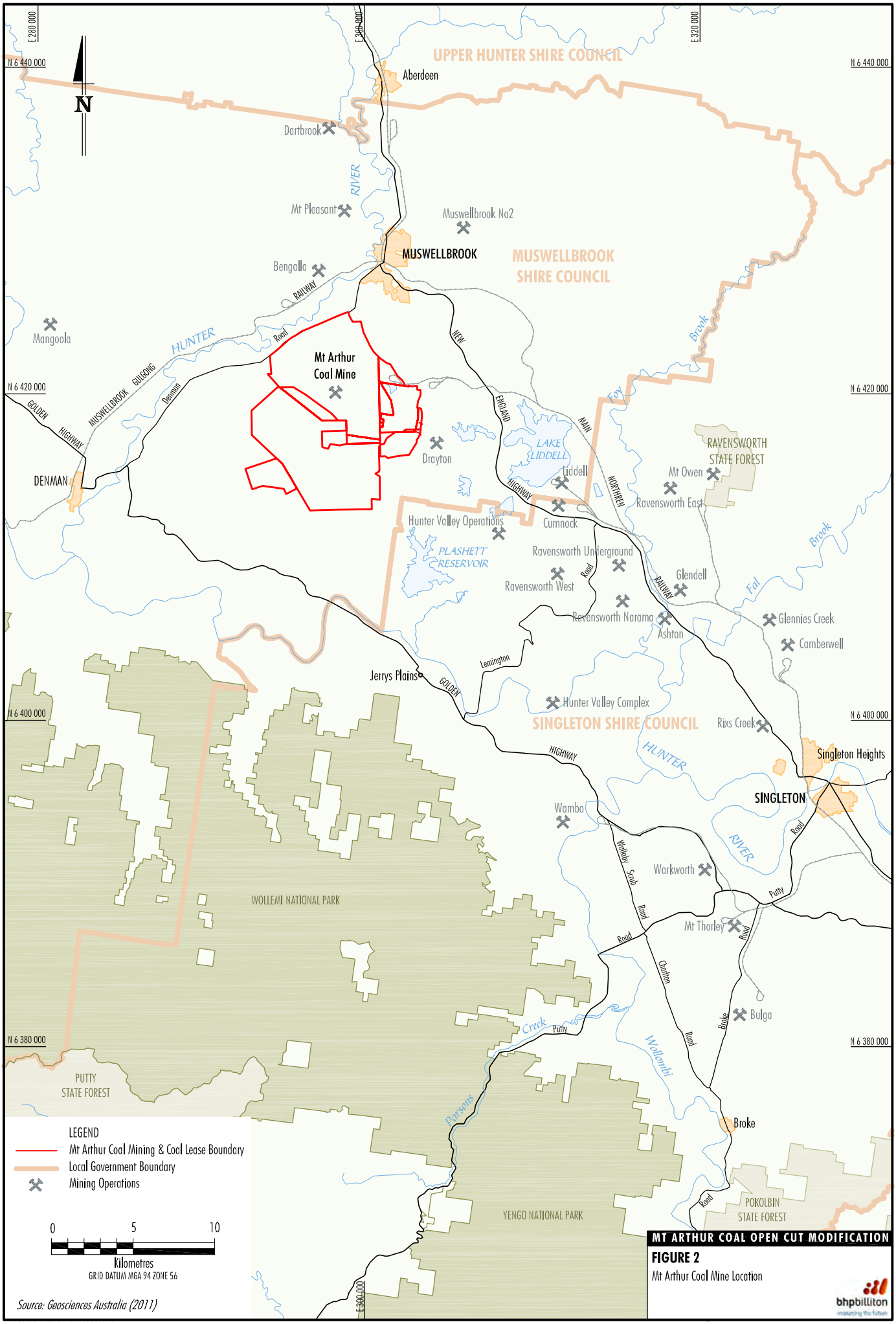
MT ARTHUR COAL OPEN CUT MODIFICATION

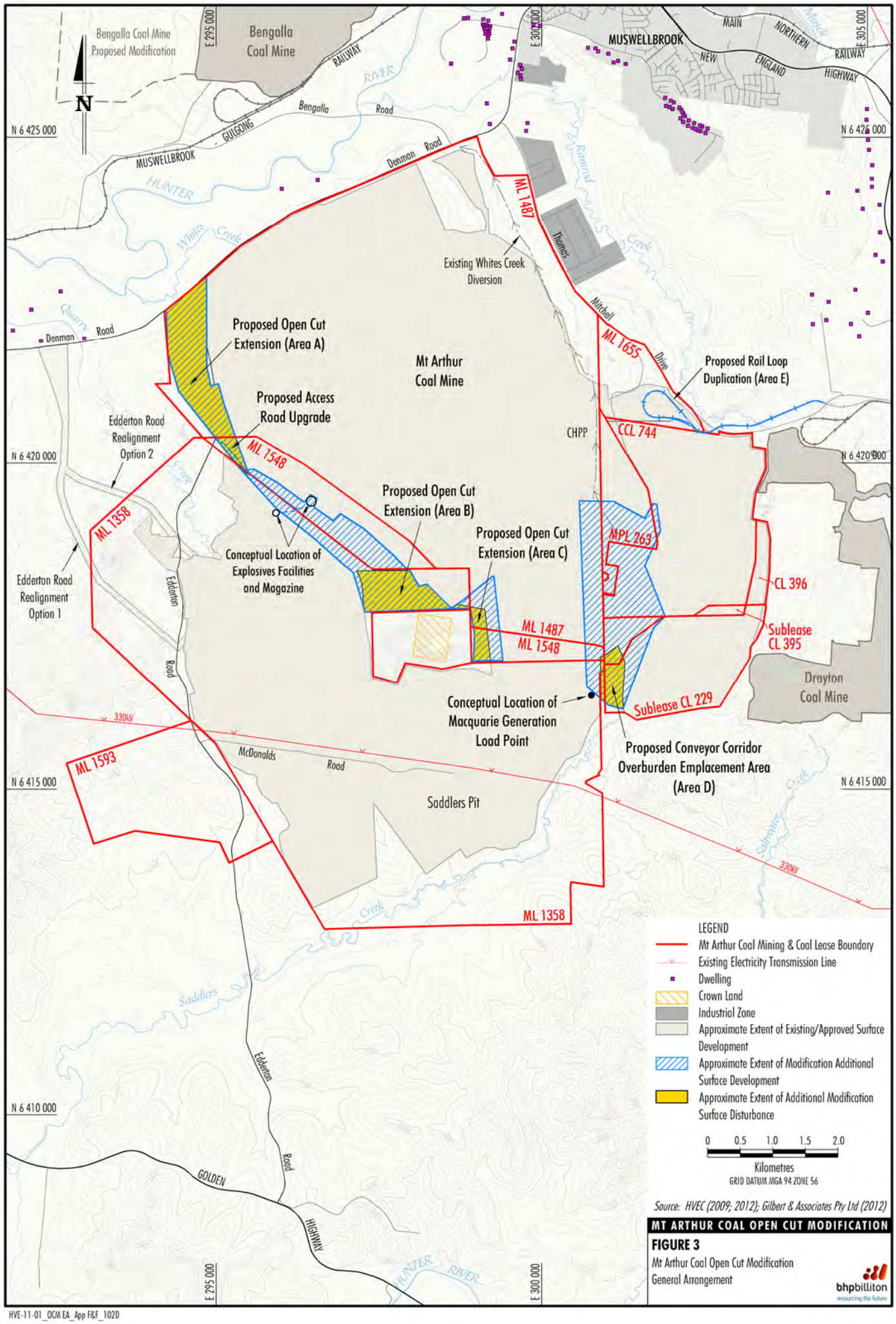
FIGURE 1

Regional Location

bhpbilliton
resourcing the future

HVE-11-01 OCM EA_App F&F_001D


E 280 000
E 300 000
E 320 000
N 6 440 000
N 6 420 000
N 6 400 000
N 6 380 000
N
UPPER HUNTER SHIRE COUNCIL
Aberdeen
Dartbrook
RIVER
Mt Pleasant
Muswellbrook No2
MUSWELLBROOK
MUSWELLBROOK SHIRE COUNCIL
Bengalla
RAILWAY
Mangoola
HUNTER
Road
Mt Arthur Coal Mine
NEW
ENGLAND
MAIN
Foy Brook
LAKE LIDDELL
Liddell
Drayton
RAVENSWORTH STATE FOREST
Mt Owen
Ravensworth East
NORTHERN
HIGHWAY
DENMAN
GOLDEN HIGHWAY
MUSWELLBROOK
GULGONG
Denman
Hunter Valley Operations
Cumnock
PLASHETT RESERVOIR
Ravensworth Underground
Ravensworth West
Road
RAILWAY
Glendell
Fal Brook
Ravensworth Narama
Ashton
Glennies Creek
Camberwell
Jerrys Plains
Lemington
GOLDEN
Hunter Valley Complex
SINGLETON SHIRE COUNCIL
Rixs Creek
HIGHWAY
HUNTER
Singleton Heights
SINGLETON
Wambo
Wollaby Scrub Road
RIVER
Warkworth
Putty Road
Mt Thorley
Road
Road
Chiltern Road
Bulga
Broke Road
WOLLEMI NATIONAL PARK
PUTTY STATE FOREST
Putty Creek
Wollombi Brook
Parsons
Broke
YENGO NATIONAL PARK
POKOLBIN STATE FOREST
LEGEND
Mt Arthur Coal Mining & Coal Lease Boundary
Local Government Boundary
Mining Operations
0
5
10
Kilometres
GRID DATUM MGA 94 ZONE 56
Source: Geosciences Australia (2011)
MT ARTHUR COAL OPEN CUT MODIFICATION
FIGURE 2
Mt Arthur Coal Mine Location
bhpbilliton
HVE-11-01_OCM EA_App F&F_101B



HVE-11-01_OCM EA_App F&F_102D

1.2 Scope of this Report

This report describes the methods and results of an investigation into the ecological impact of mining activities in the Modification area. The primary focus of the investigation was on occurring and potentially occurring species, populations and communities listed as threatened under the NSW *Threatened Species Conservation Act, 1995* (TSC Act), NSW *Fisheries Management Act, 1999* and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act).

As the Modification is to be assessed under section 75W Part 3A of the EP&A Act, the investigation and impact assessment was conducted in accordance with the *Draft Guidelines for Threatened Species Assessment* (NSW Department of Environment and Conservation [DEC] and NSW Department of Primary Industries [DPI], 2005).

The aim of this investigation was to conduct a thorough assessment of the environment in and around the Modification area to maximise the opportunity for detecting threatened species, populations and communities. The assessment did not rely only on survey field results, but also took historical and regional data into account. Where survey timing was not optimal for a particular threatened species, but suitable habitat was present or previous surveys had observed the species that species was considered to be present for the purposes of the impact assessment.

2 Existing Environment

2.1 Regional Location

The Modification area is situated in a mining and agricultural landscape. **Figure 3** shows the extent of the currently approved mining area. Modification Area D is already surrounded by mined land, as is Modification Area E (**Figure 3**). The natural vegetation in and around the Mt Arthur Coal Mine had been predominantly cleared for a variety of agricultural purposes prior to mining.

The Mt Arthur Coal Mine is located in the Hunter Central Rivers Catchment Management Area, the Sydney Basin Bioregion and is at the eastern edge of the Central Western Slopes botanical division.

2.2 Climate

Temperature data for Jerry's Plains, which was the nearest station with long-term records, were obtained from the Australian Bureau of Meteorology (BoM) (2012) (**Figure 4**). Mean minimum temperatures range from approximately 4 degrees Celsius (°C) to 17°C and mean maximum temperatures from approximately 17°C to 32°C (BoM, 2012).

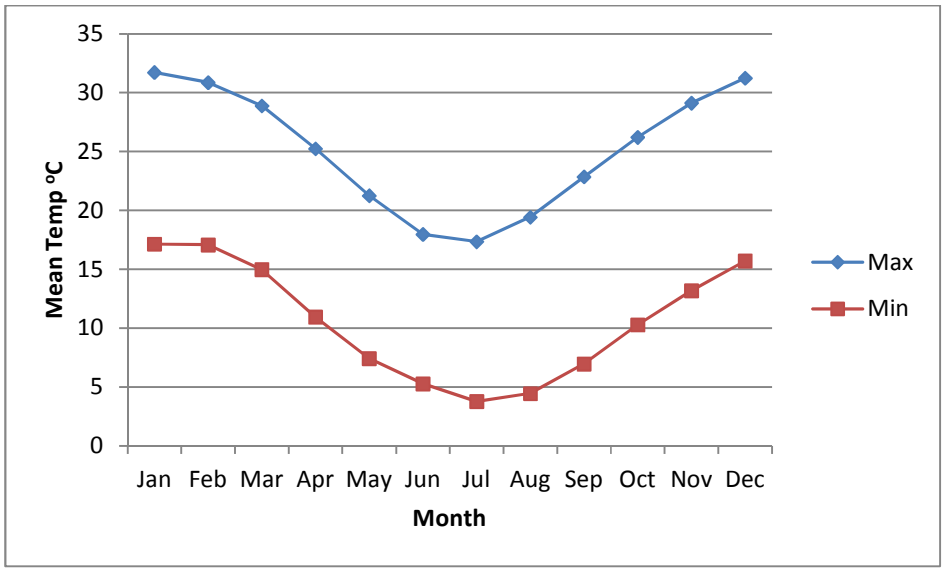


Figure 4: Mean Monthly Temperatures for Jerry's Plains 1907-2012

Rainfall data was obtained for Muswellbrook, which was the nearest station with long-term records (BoM, 2012) (**Figure 5**). The long-term mean annual rainfall is reported as 622 millimetres (mm) (BoM, 2012).

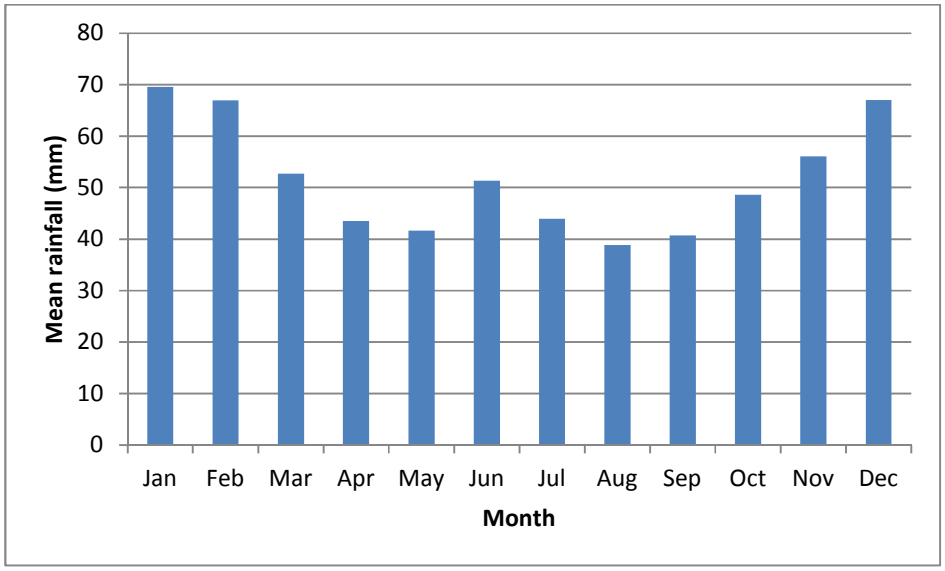


Figure 5: Mean monthly rainfall for Muswellbrook 1870-2012

2.3 Geology

The geological sequences represented in the Modification area are shown in **Table 1** (NSW Department of Mineral Resources, 1999).

Table 1: Geology of the Modification area

Geology	Age	Lithology	Modification Area
Singleton Supergroup, Whittingham Coal Measures	Permian	Coal seams, claystone tuff, siltstone, sandstone	A, B and C
Maitland Group, Mulbring Siltstone	Permian	Siltstone, claystone	D (western third)
Maitland Group, Branxton Formation	Permian	Conglomerate, sandstone, siltstone	D (eastern two thirds)
Greta Coal Measures, Rowan Formation	Permian	Coal seams, siltstone, sandstone	E

2.4 Soils

Three soil landscapes have been mapped across the Modification area (Kovak and Lawrie, 1991) as shown in **Table 2**.

Table 2: Soil types in the Modification area

Soil Landscape	Description	Modification Area
Bayswater	Covering undulating low hills. Main soil types are yellow Solodic Soils on the slopes and Alluvial Soils in drainage lines.	Area A (north) Area D (south) Area E
Liddell	Covering undulating low hills. Main soil types are Yellow Soloths and Yellow Solodic Soils on the slopes. Silaceous Sands can occur on the lower slopes.	Area A (south) Area B (north) Area C (part) Area D (north)
Ogilvie	Covering steep areas. Main soil types are shallow loams and sands.	Area B (south) Area C (centre)

2.5 Landform and Hydrology

Figure 6 shows the landforms in the Modification area, according to slope classes of McDonald *et al.,* (1998). This information is summarised in **Table 3**.

Table 3: Slope classes within the Modification area

Slope Class	Modification Area
Very gently to gently inclined	Area A
Moderately inclined with some steep areas	Area B
Steep with some moderately inclined areas	Area C
Gently to moderately inclined	Area D
Gently to moderately inclined	Area E

The hydrology around the Modification area has been substantially altered by mining. **Figure 6** also shows the creeks and flow directions through the Modification area.

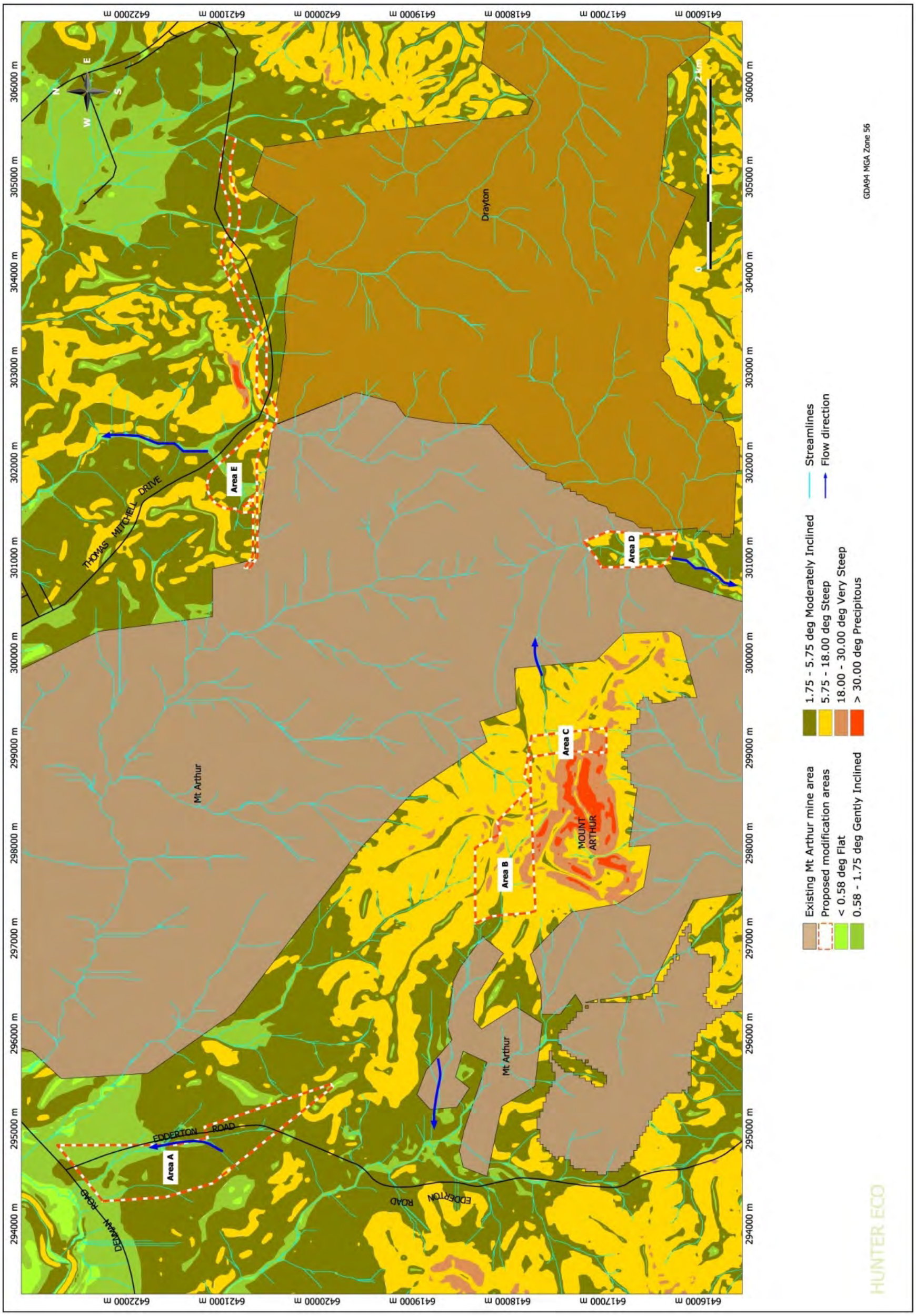


Figure 6: Landform and Hydrology in and around the Modification Area

Surface drainage generally comprises ephemeral creeks with their headwaters flowing north and south-westwards through the Modification area, and ultimately draining into the Hunter River (Gilbert and Associates, 2012). Quarry Creek, Ramrod Creek, Fairford Creek, Whites Creek and several small unnamed creeks flow northwards into the Hunter River on the northern side of the existing mining operations (Gilbert and Associates, 2012). The headwaters of Saddlers Creek flow through the south of the Study area. Saddlers Creek flows generally to the south-west (**Figure 3**) and joins the Hunter River downstream of Denman. The Hunter Valley is one of the largest coastal catchments in NSW, with a catchment area of some 22,000 square kilometres (km^2) (Gilbert and Associates, 2012).

2.6 Land Use

The land within, and surrounding, the Modification is predominately used for agricultural and industrial activities, comprising grazing and coal mining. The current dominant land uses within, and adjacent to, the Modification 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 (Cumberland Ecology, 2009a).

Coal mining is a common land use in the area, with Bengalla Mine located approximately 2 km to the north of the Mt Arthur Coal Complex. The two mines are separated by the Hunter River alluvial floodplain. Several other mining projects (including Drayton Mine), the Saddlers Creek Project exploration leases, Spur Hill Project exploration leases, Macquarie Generation's Bayswater Power Station Liddell Power Station and the Muswellbrook Industrial Estate, are all located in the vicinity of the Modification (Cumberland Ecology, 2009a).

2.7 Vegetation

Table 4 shows the communities mapped by the Hunter Remnant Vegetation Project (HRVP) (Peake, 2006) as being present within the Modification area. Each of the proposed development areas within the Modification area also contain a substantial amount of grassland cleared of canopy trees. These grasslands were not mapped as a vegetation type in the HRVP classification and mapping.

Table 4: HRVP Vegetation communities within the Modification area

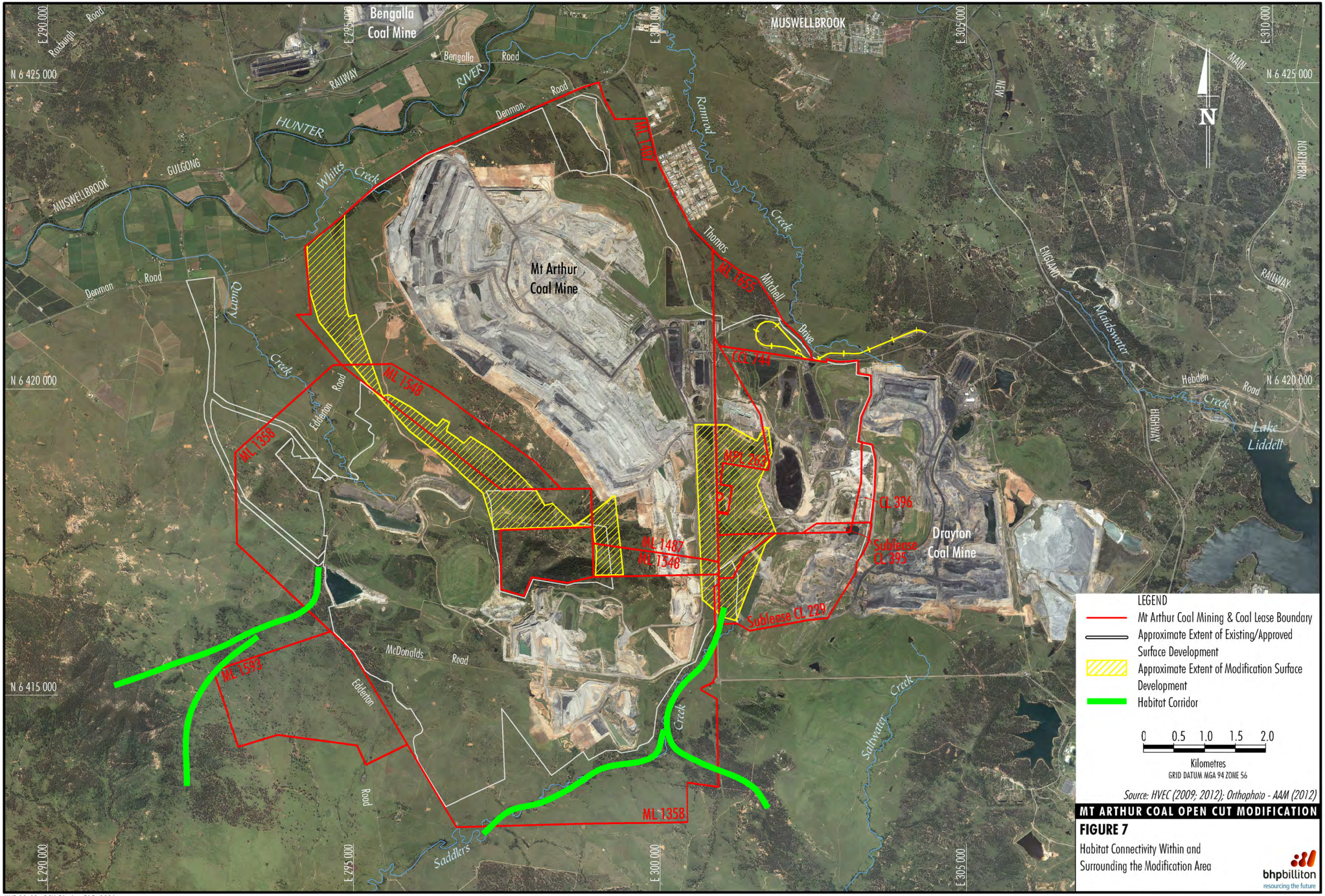
Modification Area	Vegetation Community
Area A	MU32 Central Hunter Bulloak Forest Regeneration
Areas B and C	MU27 Central Hunter Ironbark – Spotted Gum - Grey Box Forest (EEC) MU31 Mount Arthur Forest Complex (EEC)
Area D	No data
Area E	No data

EEC = Endangered Ecological Community.

2.8 Habitat Connectivity

Figure 7 shows the Modification area in relation to the existing approved mining extent including main habitat corridors. As the landscape is substantially cleared, connectivity is not strong, and the Modification area is not connected to the wider habitat areas.

The proposed Areas B and C are located on the footslopes of Mount Arthur and consist of habitat that is contiguous with that over Mount Arthur. Although **Figure 7** suggests that the habitat over Mount Arthur would be isolated until completion of mining, in reality both mining and rehabilitation would be progressive such that there would always be some overland connectivity.



MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 7

Habitat Connectivity Within and Surrounding the Modification Area

bhpbilliton resourcing the future

HVE-11-01_OCM EA_App F&F_109A

3 Overview of the Previous Surveys

This section summarises ecological information collected from the Mt Arthur Coal Mine during previous surveys and monitoring. This ecological information is presented in **Table 5.**

Previous surveys were used to obtain background data on flora and fauna species likely to occur in the Modification area.

Table 5: Previous ecological studies and reports from which background data were compiled

Report	Survey	Location	Survey Type and Time
Dames and Moore (2000)	EIS flora and fauna report	Mt Arthur North	Flora – 15-21 November 1998 Fauna – 14-21 November 1998
Umwelt Environmental Consultants (Umwelt) (2003)	Monitoring	McLeans Hill, Saddlers Creek, Mount Arthur, MD2, A171, MACT	Flora and Fauna – 1 April 2003; 7-9 May 2003
Umwelt (2005)	Monitoring	McLeans Hill, Saddlers Creek, Mount Arthur, A171, MD2, MACT	Flora – December 2004; early January 2005 Fauna – 14-15 December 2004; 20-22 December 2004
Umwelt (2006a)	Flora and Fauna	Mount Arthur, Saddlers Creek	Flora – 16-18 February 2005; 30 November 2005 Fauna – 21-25 February 2005
Umwelt (2006b)	Monitoring	McLeans Hill, Saddlers Creek, Mount Arthur, A171, MD2, MACT	Flora – November 2005 Fauna – December 2005
Umwelt (2006c)	Downcast Shaft Facility	Downcast Ventilation Shaft Facility	Flora and Fauna – 7 December 2005
Umwelt (2007a)	Monitoring	McLeans, Mount Arthur	Flora – November 2006 Fauna – December 2006
Umwelt (2007b)	Mt Arthur Underground Project	Mount Arthur Underground area	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 Project	Within Mount Arthur Consolidation boundary	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	A171, Mount Arthur, McLeans Hill, Saddlers Creek	Flora and Fauna – 19-23 January 2009
Cumberland Ecology (2010a)	EPBC Act referral	Areas within the active operations area	Flora and Fauna – Drawn from other studies

Table 5 (continued): Previous studies and reports from which background data were compiled

Report	Survey Type	Location	Survey Type and Time
Cumberland Ecology (2010b)	Monitoring	A171, McLeans Hill, Mt Arthur, CD1	Flora and Fauna – 19-22 January 2010; 27-29 January 2010
Cumberland Ecology (2010c)	Monitoring	A171, CD1, MACT	Flora and Fauna – 20-23 September 2010
Umwelt (2011)	Flora and fauna	Mt Arthur Consolidation Action Areas	Vegetation Communities – 29 August 2011 - 2 September 2011
Cumberland Ecology (2011)	Monitoring *Diuris tricolor* (Pine Donkey Orchid)	A171	Flora – 29 September 2011
Niche (2012) - **Appendix 1**	Current Modification	Modification areas	Fauna – 1 May 2012; 7-10 May 2012

EIS = Environmental Impact Statement.

Niche = Niche Environmental Consultants.

3.1 Flora and Fauna Species

Although the landscape has been mostly cleared, a diverse native biota (summarised in **Table 6** and detailed in **Appendix 2**) has been recorded. This is despite 32 percent (%) of the recorded flora species being introduced.

Table 6: Summary of flora and fauna species reported previously

Class	Families	Species	Introduced	Threatened
Flora	84	473	150	1
Amphibia	2	11	-	-
Reptilia	6	20	-	-
Mammalia	16	44	10	8
Aves	44	106	1	-

Several flora species previously recorded are listed by the NSW DPI (Agriculture) as noxious weeds for the Upper Hunter County Council. Previously recorded species listed as Class 3 noxious weeds include the Mother of Millions (*Bryophyllum delagoense*). Class 4 noxious weeds included Nodding Thistle (*Carduus nutans*), Bathurst Burr (*Xanthium spinosum*), Tiger Pear (*Opuntia aurantiaca*), Creeping Pear (*Opuntia humifusa*), Common Prickly Pear (*Opuntia stricta* and *Opuntia stricta* var. *stricta*), St. Johns Wort (*Hypericum perforatum*), Johnson Grass (*Sorghum halepense*), Blackberry Bramble (*Rubus fruticosus* sp. agg.), African Boxthorn (*Lycium ferocissimum*) and the Trailing Lantana (*Lantana montevidensis*). Class 5 noxious weeds included Annual Ragweed (*Ambrosia artemisiifolia*) (see **Appendix 2** for a complete list of weed species).

3.2 Vegetation Communities

The following threatened ecological communities (TECs) have been recorded within 10 km of the Modification area:

Endangered Ecological Communities (TSC Act)

- Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions.
- White Box Yellow Box Blakely's Red Gum Woodland.
- Central Hunter Grey Box - Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions.
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions.
- Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion.
- Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion.
- Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions.

Vulnerable Ecological Communities (TSC Act)

- Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion.

Critically Endangered Ecological Community (EPBC Act)

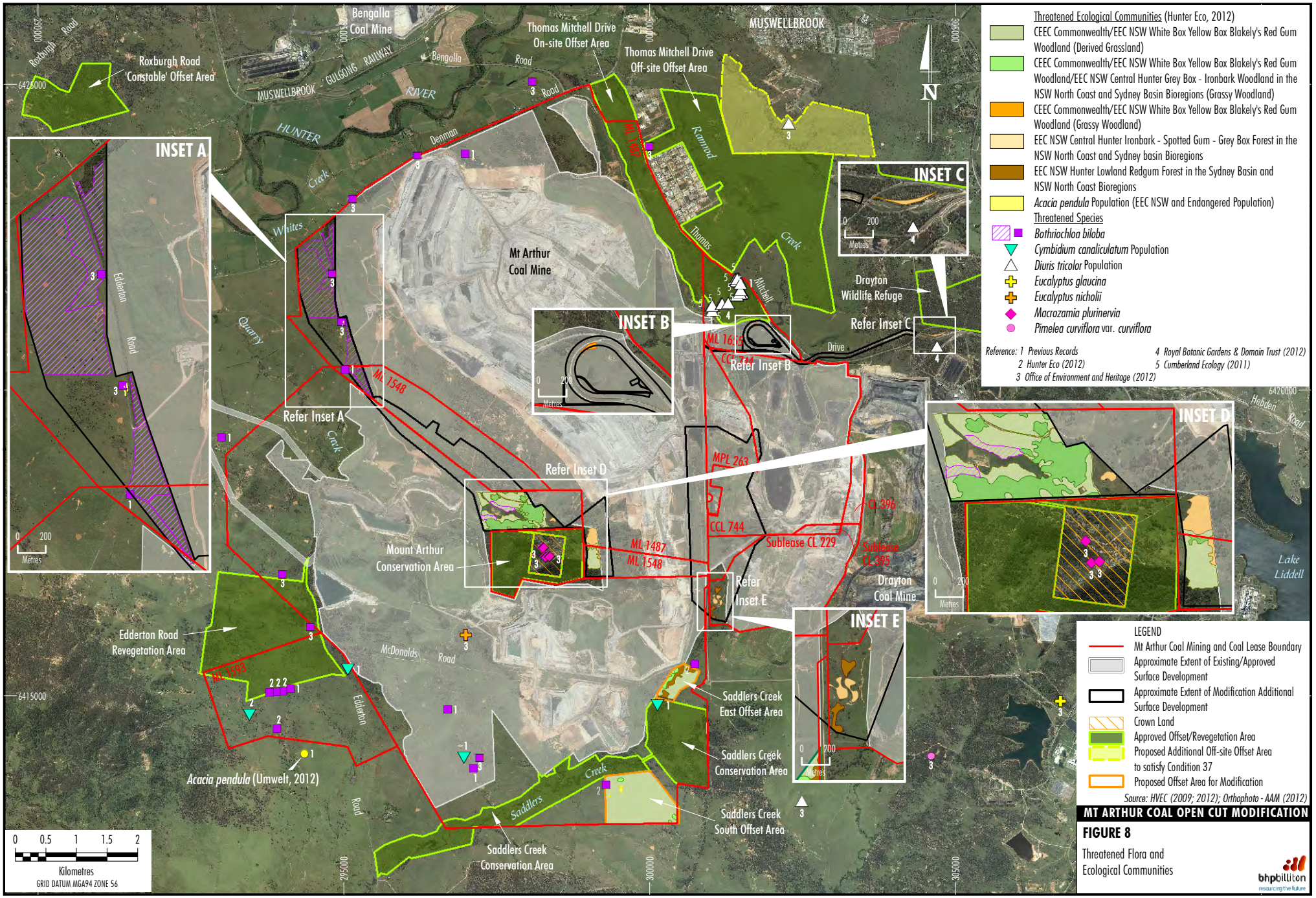
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

The EPBC Act critically endangered ecological community (CEEC) mapping reported in Umwelt (2011) shows the surveyed limits of the derived grassland at the boundaries of Modification Areas A, B, C and D. It would be reasonable to conclude that the protected grasslands continue into these areas.

Table 7 shows the vegetation communities mapped by the HRVP (Peake, 2006) that lie within the Mt Arthur Coal Mine. Also shown are the equivalent threatened communities, as listed under the TSC Act and EPBC Act.

For convenience the following two EECs: the *White Box Yellow Box Blakely's Red Gum Woodland* (NSW) and *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (Commonwealth), will herein be referred to as Box-Gum Woodland EEC/CEEC.

The location of TECs within the Modification area is shown on **Figure 8**.



HVE-11-01_OCM EA_App F&F_201L

Table 7: Vegetation communities and their equivalent threatened community mapped within the Mt Arthur Coal Mine

HRVP Community	Equivalent threatened community	Status[1]
MU8 Western Hunter Narrabeen Footslopes Ironbark – Cypress Pine Woodland	Not threatened	-
MU9 Upper Hunter Hills Box – Ironbark – Red Gum Woodland	Not threatened	-
MU10 Central Hunter Box - Ironbark Woodland	Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	E (TSC Act)
	White Box Yellow Box Blakely's Red Gum Woodland	E (TSC Act)
	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC (TSC Act)
MU11 Upper Hunter White Box - Ironbark Grassy Woodland	White Box Yellow Box Blakely's Red Gum Woodland	E (TSC Act)
	White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE (EPBC Act)
MU19 Hunter Valley Weeping Myall Woodland	Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion	E (TSC Act)
MU24 Hunter Lowlands Red Gum Forest	Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	E (TSC Act)
MU27 Central Hunter Ironbark - Spotted Gum - Grey Box Forest	Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions	E (TSC Act)
MU29 Upper Hunter Hills Sheltered Moist Forest	Not threatened	-
MU32 Central Hunter Bulloak Forest Regeneration	Not threatened	-
MU36 Plantation	Not threatened	-

[1] Threatened species status under the TSC Act and/or EPBC Act (current at 24 January 2013). V=vulnerable, E=endangered, CE=critically endangered.

3.3 Threatened Populations and Flora and Fauna Species

Records were extracted from the NSW Wildlife Atlas (NSW Office of Environment and Heritage [OEH], 2013), Birds Australia (2012), Australian Museum (2012), Royal Botanic Gardens Sydney and the Domain (2012) and the EPBC Act protected matters search tool (Commonwealth Department of Sustainability, Environment, Water, Population and Communities [SEWPaC], 2012a) for threatened flora species, fauna species and populations recorded within a 40 km^2 search area surrounding the Modification area. The results of these database searches are presented in **Appendix 3**.

The database results were used as a guide to determine which threatened populations or species might be present within the Modification area and surrounds. Threatened populations and species previously recorded within and near the Modification area (determined from database results and/or surveys) are listed in **Table 8**. The locations of threatened populations and species recorded within and surrounding the Modification are shown in **Figures 8** to **11**.

A total of three endangered populations, five threatened flora species and 22 threatened fauna species have previously been recorded within the Modification area or surrounds (**Table 8**). No threatened aquatic species were recorded within the Modification area. The likelihood of these species occurring within the Modification area are assessed in **Section 5**. Threatened species that have the potential to occur within the Modification area are further assessed in **Section 7**.

Part of the Muswellbrook Local Government Area (LGA) *Diuris tricolor* endangered population is monitored annually (Cumberland Ecology, 2011) in a conservation reserve located immediately north of Modification Area E.

3.4 Migratory Species

Migratory species listed in database records from the NSW Wildlife Atlas (OEH, 2013), Birds Australia (2012), Australian Museum (2012) and the EPBC Act protected matters search tool (SEWPaC, 2012a) for a 40 km^2 search area surrounding the Modification area are presented in **Appendix 3c**.

Database results indicate that 14 migratory species have been recorded within or surrounding the Modification area or have the potential to occur within or surrounding the Modification area. Three of the 14 migratory species (the White-bellied Sea-Eagle [*Haliaeetus leucogaster*], White-throated Needletail [*Hirundapus caudacutus*] and Rainbow Bee-eater [*Merops ornatus*]) have been previously recorded within or surrounding the Modification area. An assessment on whether the species is likely to occur within the Modification area or surrounds is also presented in **Appendix 3c**.

No migratory species were recorded during recent surveys conducted by Niche (**Appendix 1**). One migratory species, the White-bellied Sea-eagle (*Haliaeetus leucogaster*), was recorded near Modification Area E during recent flora surveys.

Table 8: Threatened populations and flora and fauna species previously recorded within a search area surrounding the Modification area

Scientific Name	Common Name	Conservation Status[1]		Notes
		TSC Act	EPBC Act	
POPULATIONS				
Acacia pendula	*Acacia pendula* population in the Hunter Catchment	E	-	This population was identified in Modification Area A during the recent surveys conducted by Hunter Eco. This species has also been previously recorded surrounding the Modification area (Umwelt, 2007b, 2007c; Cumberland Ecology, 2009a).
Diuris tricolor	*Diuris tricolor*, the Pine Donkey Orchid population in the Muswellbrook LGA	E population, V plant	-	This species has not been recorded in the Modification area[2]. The population has been previously recorded within the Thomas Mitchell Drive Offset area from 2007 to the present (Cumberland Ecology, 2009a, 2011). This species has also been recorded surrounding the Modification area in the OEH (2013) and Royal Botanic Gardens Sydney and the Domain (2012) databases.
Cymbidium canaliculatum	*Cymbidium canaliculatum* population in the Hunter Catchment	E	-	This species has not been recorded in the Modification area, but has been recorded to the west of the Modification area by Umwelt (2006c) and within the Saddlers Creek Conservation area (Umwelt, 2007b).
FLORA				
Bothriochloa biloba	Bluegrass	-	V	This species has been recorded in Modification Area A during the recent surveys conducted by Hunter Eco. This species has previously been recorded to the south and west of the Modification area (Cumberland Ecology, 2010a); south of the Modification area (Umwelt, 2006c); and surrounding the Modification area (Umwelt, 2007b; Cumberland Ecology, 2009a). This species has also been recorded in the OEH (2013) database as present within Modification Area A and surrounds, and is recorded as "predicted to occur" in the EPBC Act Protected Matters Search (SEWPaC, 2012a).
Eucalyptus glaucina	Slaty Red Gum	V	V	This species has not been recorded in the Modification area, but has been recorded 10 km south-west and 5 km south-east of the Modification area in the OEH (2013) database results, and is recorded as "predicted to occur" in the EPBC Act protected matters search (SEWPaC, 2012a).

Table 8 (continued): Threatened populations and flora and fauna species previously recorded within a search area surrounding the Modification area

Scientific Name	Common Name	Conservation Status[1]		Notes
		TSC Act	EPBC Act	
FLORA (Continued)				
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	This species has not been recorded in the Modification area, but has been recorded to the south of Modification Areas B and C in the OEH (2013) database results.
Macrozamia plurinervia	-	-	V	This species has been recorded at Mount Arthur surrounding the Modification area in the OEH (2013) database results.
Pimelea curviflora var. *curviflora*	Rice Flower	V	V	This species has not been recorded in the Modification area, but has been recorded to the far west of the Modification area in the OEH (2013) database results and is predicted to occur in the EPBC Act protected matters search (SEWPaC, 2012a).
FAUNA				
Birds				
Circus assimilis	Spotted Harrier	V	-	This species has not been recorded in the Modification area, but has been recorded to the west of the Modification (Umwelt, 2007b) as well as surrounding the Modification area in the OEH (2013) and Birds Australia (2012) database results.
Hieraaetus morphnoides	Little Eagle	V	-	This species has not been recorded in the Modification area and has been recorded by Umwelt (2007b) surrounding the Modification area. However, the exact location of the species was not reported. This species has also been recorded surrounding the Modification area in the Thomas Mitchell Drive Offset area and to the east and west of the Modification area in the OEH (2013) and Birds Australia (2012) database results.
Burhinus grallarius	Bush Stone-curlew	E	-	This species has not been recorded in the Modification area, but has been recorded to the south of Modification Area E in the Birds Australia (2012) database results.
Glossopsitta pusilla	Little Lorikeet	V	-	This species has not been recorded in the Modification area, but has been recorded to the south-west by Umwelt (2007b). This species has also been recorded to the east and west surrounding the Modification area in the OEH (2013) and Birds Australia (2012) database results.

Table 8 (continued): Threatened populations and flora and fauna species previously recorded within a search area surrounding the Modification area

Scientific Name	Common Name	Conservation Status[1]		Notes
		TSC Act	EPBC Act	
Birds (Continued)				
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	This species has not been recorded in the Modification area, but has been recorded to the east and south surrounding the Modification area in the OEH (2013) and Birds Australia (2012) database results.
Chthonicola sagittata	Speckled Warbler	V	-	This species has not been recorded in the Modification area, but has been recorded in the Thomas Mitchell Drive Offset area and multiple times surrounding the Modification (Umwelt, 2005, 2006a, 2006b, 2007a, 2007b; Cumberland Ecology, 2009a, 2009b, 2010b, 2010c). This species has also been recorded in the Thomas Mitchell Drive Offset area and the Modification area surrounds in the OEH (2013) and Birds Australia (2012) database results.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	This species has not been recorded in the Modification area, but was recorded by Dames and Moore (2000) surrounding the Modification area. However, the exact location of the species was not reported. This species has also been recorded to the east of the Modification area in the Birds Australia (2012) database results. This species was also recorded in the OEH (2013) database results, however the record falls outside of the extent shown on **Figure 9**.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	This species has been recorded in the Modification area, within Modification Area A (Cumberland Ecology, 2009a). This species was recorded within a plantation stand within the Modification area, which would be removed as part of the Modification. This species has also been recorded surrounding the Modification area as well as within the Thomas Mitchell Drive Offset area, Saddlers Creek Conservation area and Edderton Road Revegetation area (Umwelt, 2003, 2006b, 2007b). Grey-crowned Babbler nests have been recorded in the Saddlers Creek Conservation area (Cumberland Ecology, 2009a). This species has also been recorded in the Thomas Mitchell Drive Offset area, Mount Arthur Conservation area and Saddlers Creek Conservation area and the Modification area surrounds in the OEH (2013) and Birds Australia (2012) database results.

Table 8 (continued): Threatened populations and flora and fauna species previously recorded within a search area surrounding the Modification area

Scientific Name	Common Name	Conservation Status[1]		Notes
		TSC Act	EPBC Act	
Birds (Continued)				
Daphoenositta chrysoptera	Varied Sittella	V	-	This species has been recorded within Modification Area C (Umwelt, 2005). This species was recorded during the 2004 monitoring period near the base of Mount Arthur within the Modification area in tall open forest dominated by mature Spotted Gum (*Corymbia maculata*) (Umwelt, 2005). This species has also been recorded to the north of Modification Area B by Umwelt (2006b). This species has also been recorded in the Thomas Mitchell Drive Offset area and the Modification area surrounds in the OEH (2013) and Birds Australia (2012) database results.
Stagonopleura guttata	Diamond Firetail	V	-	This species has not been recorded in the Modification area, but has been recorded by Dames and Moore (2000) surrounding the Modification area. However, the exact location of the species was not reported. This species has also been recorded surrounding the Modification area in the OEH (2013) and Birds Australia (2012) database results.
Mammals				
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	This species has not been recorded in the Modification area, but was tentatively recorded during the first half of 2006 by a HVEC staff member on the main access road to the Mt Arthur Coal offices close to the intersection with Thomas Mitchell Drive (Umwelt, 2007b). An earlier possible sighting of the Spotted-tailed Quoll was also made on a haul road in the Bayswater mining area (Umwelt, 2007b). This species has been recorded to the south-west of the Modification area in the OEH (2013) database results and is predicted to occur in the EPBC Act protected matters search (SEWPaC, 2012a).

Table 8 (continued): Threatened populations and flora and fauna species previously recorded within a search area surrounding the Modification area

Scientific Name	Common Name	Conservation Status[1]		Notes
		TSC Act	EPBC Act	
Mammals (Continued)				
Phascolarctos cinereus	Koala	V	V	This species has not been recorded in the Modification area, but has been recorded within the approved Mt Arthur Coal Mine to the south-west of the Thomas Mitchell Drive Offset area. The Koala recorded within the approved Mt Arthur Coal Mine was a lone male looking for a mate (HVEC, pers. comm., 2012). The Koala was taken by wildlife carers who relocated him into a rehabilitated area near where he was originally found (HVEC, pers. comm., 2012). This species was recorded within the Thomas Mitchell Drive Offset area in the OEH (2013) database results.
Petaurus norfolcensis	Squirrel Glider	V	-	This species has not been recorded in the Modification area, and has been recorded in the general locality surrounding the Modification area on several occasions between 2003 and 2010 (Umwelt, 2003, 2006a, 2006b, 2007b; Cumberland Ecology, 2010c). This species was recorded in a nest box to the immediate north of Modification Area E (Cumberland Ecology, 2010c) and has been recorded surrounding the Modification area and within the Thomas Mitchell Drive Offset area in the OEH (2013) database results.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	This species was recorded by Niche (**Appendix 1**) in the Modification area within the proposed C. The species was seen foraging for nectar and pollen on blossoming Spotted Gum. No breeding or roosting colonies were present. This species has also been recorded to the north of the Modification area in the OEH (2013) database results and is predicted to occur in the EPBC Act protected matters search (SEWPaC, 2012a).
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	This species has not been recorded in the Modification area, but has been recorded by Dames and Moore (2000) surrounding the Modification area. However, the exact location of the species was not reported. This species has been recorded in the Thomas Mitchell Drive Offset area and the Modification area surrounds in the OEH (2013) database results
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	The Eastern Freetail-bat was recently recorded by Niche (**Appendix 1**) within the Modification area in Modification Areas C and D. This species has also been recorded during previous surveys (Umwelt, 2006b, 2007a, 2007b) and recorded in the OEH (2013) database surrounding the Modification.

Table 8 (continued): Threatened populations and flora and fauna species previously recorded within a search area surrounding the Modification area

Scientific Name	Common Name	Conservation Status[1]		Notes
		TSC Act	EPBC Act	
Mammals (Continued)				
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	This species has not been recorded in the Modification area, but has been recorded to the north of Modification Area B by Umwelt (2007a). This species has also been recorded to the north of the Modification area at Muswellbrook in the OEH (2013) database results and is predicted to occur in the EPBC Act Protected Matters Search (SEWPaC, 2012a).
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	This species was possibly recorded by Niche (**Appendix 1**) during the current surveys within the Modification area in the proposed Northern Open Cut Extension area. This species was also recorded in the OEH (2013) database results, however the record falls outside of the extent shown on **Figure 11**.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	This species was possibly recorded by Niche (**Appendix 1**) in the proposed Northern Open Cut Extension area, proposed Southern Open Cut Extension area (eastern flank) and the proposed Overburden Emplacement Extension area. This species has also been recorded on several occasions surrounding the Modification area (Umwelt, 2003, 2005, 2006a, 2006b, 2007a, 2007b; Cumberland Ecology, 2010b, 2010c; Dames and Moore, 2000). This species has also been recorded surrounding the Modification area in the OEH (2013) database results.
Myotis macropus	Southern Myotis	V	-	The Southern Myotis has been previously recorded within the Modification area within Modification Area C by Umwelt (2003) during the 2003 monitoring undertaken annually at the Mt Arthur Coal Mine. This species has been recorded within the Thomas Mitchell Drive Offset area and Edderton Creek Revegetation area as well as surrounding the Modification area in the OEH (2013) database results as well as by Umwelt (2006a, 2006b, 2007b).

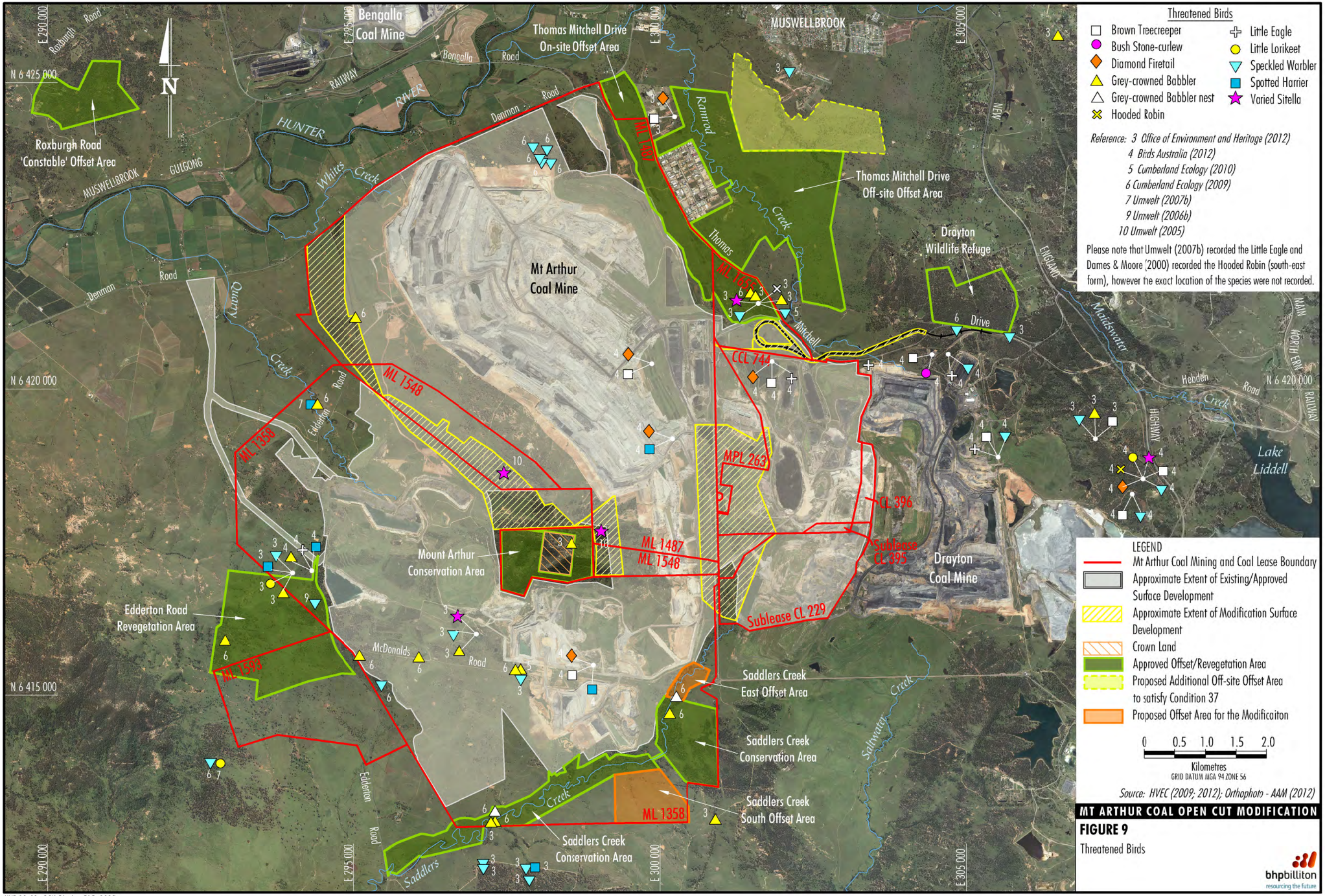
Table 8 (continued): Threatened populations and flora and fauna species previously recorded within a search area surrounding the Modification area

Scientific Name	Common Name	Conservation Status[1]		Notes
		TSC Act	EPBC Act	
Mammals (Continued)				
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	This species has not been recorded in the Modification area, but has been recorded to the west of the Modification area by Umwelt (2007a) and has been recorded to the west in the OEH (2013) database results.
Vespadelus troughtoni	Eastern Cave Bat	V	-	This species was possibly recorded by Niche (**Appendix 1**) in the proposed Northern Open Cut Extension area, proposed Southern Open Cut Extension area (eastern flank) and the proposed Overburden Emplacement Extension area. This species has been recorded within the Saddlers Creek Conservation area and Edderton Road Revegetation area and within the Modification area surrounds (Umwelt, 2006a, 2007a, 2007b). This species has also been recorded surrounding the Modification area in the OEH (2013) database results

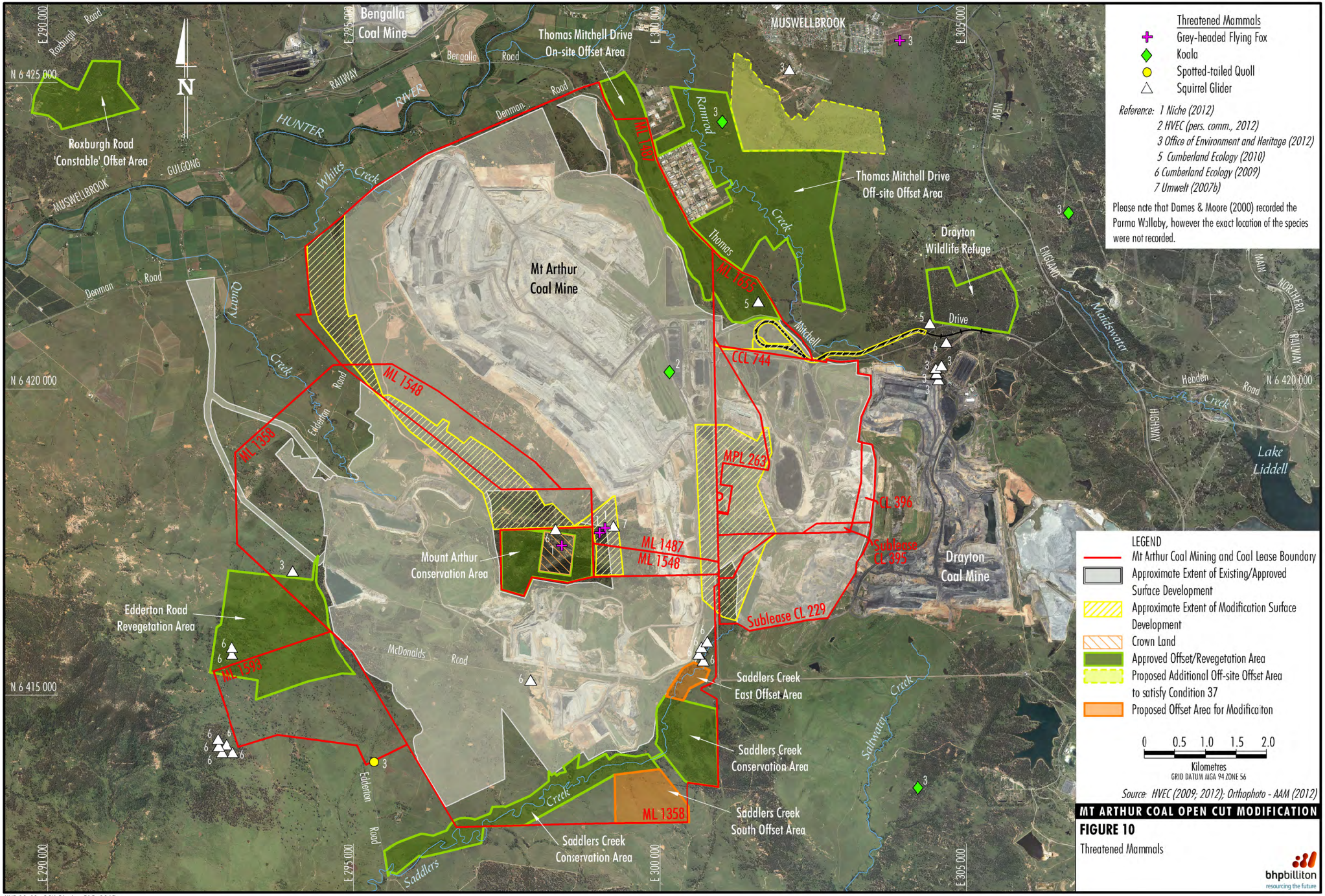
Note: Threatened population and species locations are shown on **Figures 8** to **11**.

[1] Threatened population and threatened flora and fauna species status under the TSC Act and/or EPBC Act (current at 24 January 2013).

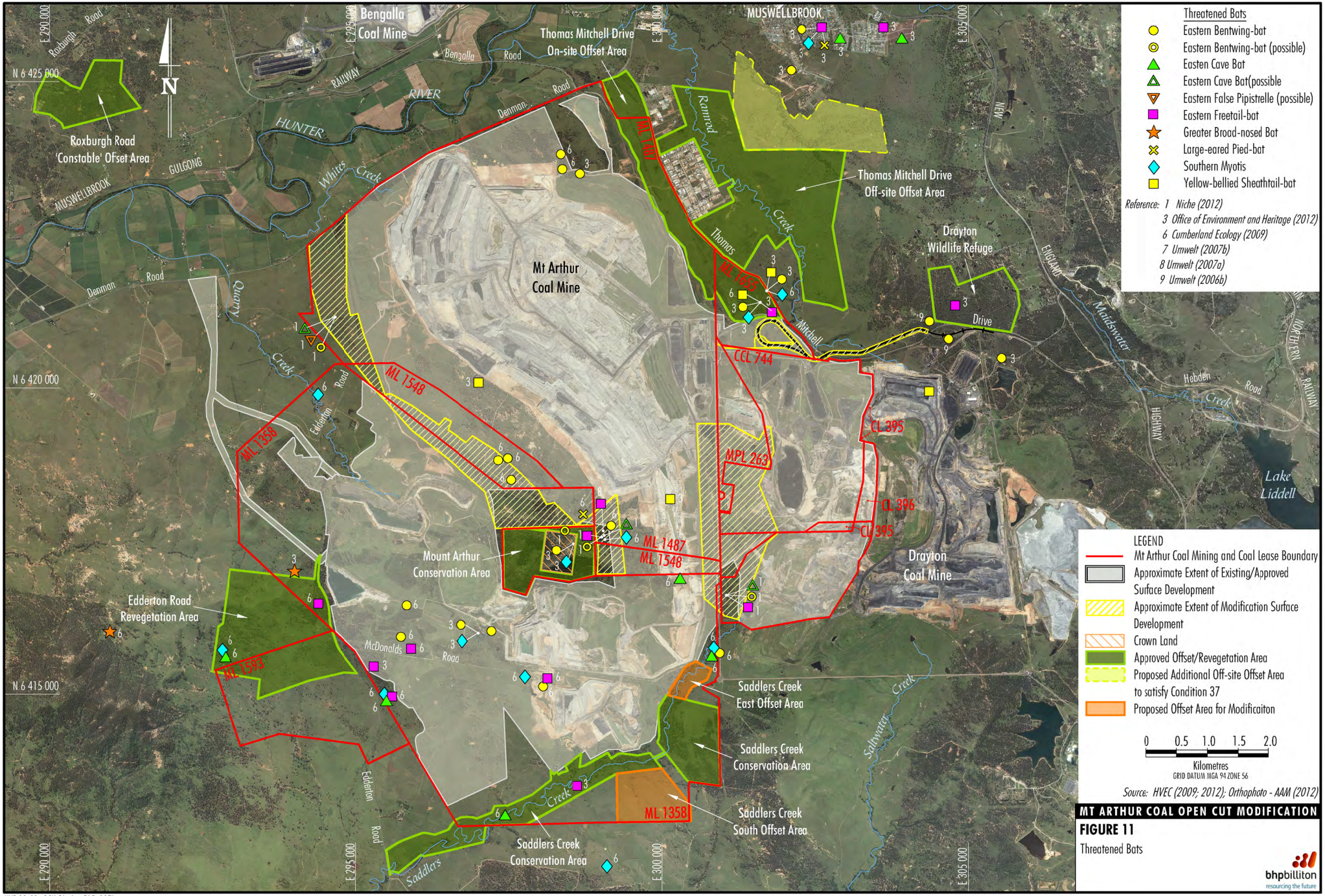
[2] The species can only be found during a narrow flowering period of late September to early October, meaning that its actual presence in the suitable habitat has not yet been determined.



HVE-11-01_OCM EA_App F&F_103G



HVE-11-01_OCM EA_App F&F_106E



HVE-11-01_OCM EA_App F&F_1071

4 Supplementary Field Survey Methods

Flora species, populations and ecological communities listed as threatened in the TSC Act and the EPBC Act were the primary focus of the current survey.

Collection of floristic and vegetation data, and plotting of habitat tree locations, was conducted over seven days from 16 April 2012 to 9 May 2012. The weather was fine, clear and mild, with cold mornings. The only exception being rain on 23 April 2012. **Figure 12** shows the location of 40 floristic sample plots and the floristic meanders that were used to augment the plot data species lists.

4.1 Flora

4.1.1 *Flora Species*

Floristic content in the Modification area was determined through the use of standard 20 x 20 metre (m) sample plots, linear transects and random meanders. All species present were recorded within the bounds of each sample plot along with a score for abundance. Abundance was scored using the modified Braun-Blanquet 1-6 scale (**Table 9**).

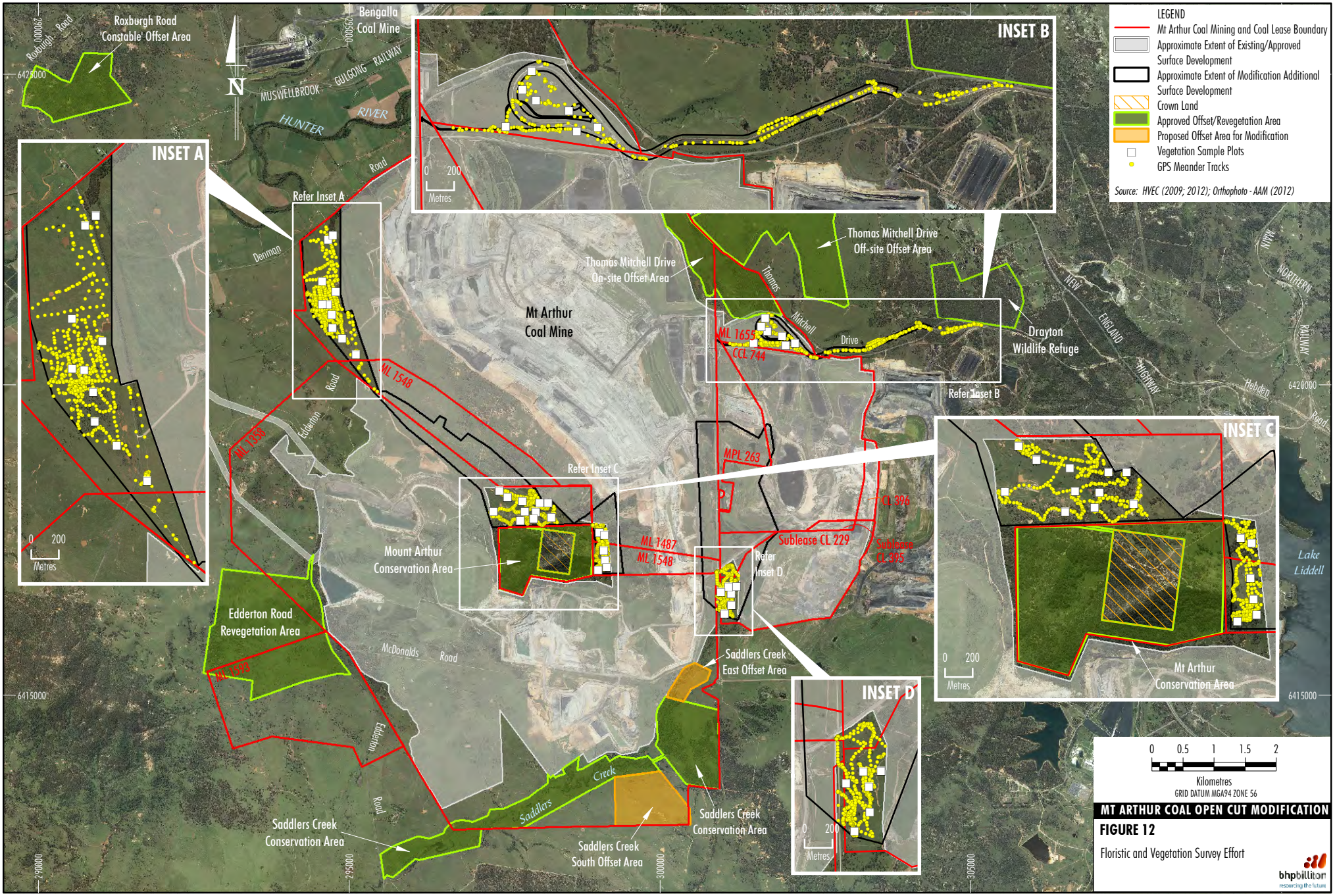
Table 9: Braun-Blanquet cover-abundance scores

Cover range	Score
<5% few individuals	1
<5% many individuals	2
5% - <25%	3
25% - <50%	4
50% - <75%	5
75% - 100%	6

Transects and meanders were used to search for species that had not been recorded in the sample plots.

4.1.2 *Vegetation Communities*

A vegetation map was prepared from ground-truthed point data, floristic plot data and ground-truthed community boundary determination. The applied methods were developed in part by the author and published in NSW Department of Environment and Climate Change (DECC) (2008a). Ground-truthed vegetation data were collected during meanders through the Modification area. Vegetation community types were determined by matching floristic content to data from the Peake (2006) classification presented in the HRVP report.



MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 12

Floristic and Vegetation Survey Effort

bhpbilliton
resourcing the future

HVE-11-01_OCM EA_App F&F_208A

Floristic plot data were analysed using ordination in Primer 6 (Clark and Gorley, 2001), which groups plots of most similar diversity and biomass. Vegetation community boundaries were determined using a 2011 aerial photograph (0.5 m per pixel resolution).

The Vegetation on Mount Arthur and Footslopes

The HRVP report (Peake, 2006) classifies the vegetation across the Mount Arthur peak and footslopes as MU31 Mount Arthur Forest Complex. It is described as a mid-high to tall forest with the canopy dominated by Grey Gum (*Eucalyptus punctata*), Grey Box (*Eucalyptus moluccana*), Kurrajong (*Brachychiton populnea*) and Forest Oak (*Allocasuarina torulosa*). The understorey, described as mid-dense to dense, was reported as being dominated by Velvet Mock Olive (*Notelaea microcarpa var. microcarpa*), Western Boobialla (*Myoporum montanum*), Shiny-leaved Canthium (*Psydrax odorata*) and Sticky Daisy-bush (*Olearia elliptica*).

Peake (2006) notes that the Mount Arthur vegetation was described as a complex because there was insufficient field data to break this area into its component communities; only six data points were available for the HRVP analysis.

Because the Modification area includes part of MU31 Mount Arthur Forest Complex, further data were collected to deconstruct the 'complex'. A vegetation community map was prepared using ground-truthed data and aerial photo interpretation. This was supported by recording boundaries between selected communities using a hand-held Global Positioning System (GPS). Community classification was achieved by comparing the floristic content of the field data with the vegetation community profiles reported in Peake (2006).

Threatened Ecological Communities

In general terms, TECs were determined by comparing species recorded in the sample floristic plots against the NSW or Commonwealth Scientific Committee determinations, with the assistance of published supplementary material. The Scientific Committee determinations for Central Hunter NSW threatened communities refer to communities reported in the HRVP report (Peake, 2006) consistent with the determination. The community profiles in the HRVP report were also used to assist with this classification.

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

This community has been recorded over a wide geographic area, from central Victoria to south-eastern Queensland. Typical tree species include White Box (*Eucalyptus albens*), Yellow Box (*Eucalyptus melliodora*) or Blakely's Red Gum (*Eucalyptus blakelyi*). As determined by the Commonwealth Scientific Committee, this community can exist in a variety of conditions including shrubby woodland, grassy woodland with scattered trees and open grassland devoid of trees. In some areas of the Hunter Valley a hybrid of *Eucalyptus albens* and *Eucalyptus moluccana* (*E. albens x E. moluccana*) has been identified. The Commonwealth Threatened Species Scientific Committee (TSSC) has provided supplementary advice to the effect that this hybrid box is included in the typical species list for the CEEC (http://www.environment.gov.au/epbc/publications/advice-hybrids.html). Of 28 box specimens sent for identification by the National Herbarium of NSW from areas adjoining the Modification, 27 were determined to be hybrids (*E. albens* x *E. moluccana*) (Umwelt, 2011).

HVEC have received legal opinion from two sources as to whether a community dominated by *E. albens* x *E. moluccana* hybrids would be equivalent to the listed CEEC. Both opinions concluded that the CEEC determination, by not specifically including hybrids in the community description (as happens in some more recent determinations), does not allow for the inclusion of hybrids. Thus any community dominated by such hybrids would not meet the definition of the box-gum CEEC. Also, one opinion noted that the supplementary advice provided by the TSSC regarding the unwritten assumption that the original determination included hybrids does not alter the original determination.

However, these opinions have not been tested, therefore the precautionary approach was adapted to assume that the hybrid-dominated vegetation might be the CEEC and the tests should be applied accordingly.

The Commonwealth Department of the Environment and Heritage (DEH) (2006a) *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland* guidelines assist with determining the presence of this community, and these guidelines were applied to the vegetation communities mapped for the Modification. The following is a summary from the guidelines, which was used to determine whether any mapped vegetation unit represented this community (DEH, 2006a):

- Is the area 0.1 hectare (ha) or greater in size with at least one of White Box, Yellow Box or Blakely's Red Gum present, or likely to have been present, prior to clearing?
- Does the ground cover contain at least 50% perennial native species?

- Are there 12 or more native understorey species (other than grasses), and is there at least one important native species? (Important species are listed in either box-gum-species.pdf or box-gum-species.xls available at http://www.environment.gov.au/epbc/publications/box-gum.html).
- If the previous condition is not met, and the patch is equal to or greater than 2 ha in size, are there 20 or more mature trees per hectare, or natural regeneration of the main canopy species?

Sample vegetation plots 20 x 20 m in size were replicated within vegetation units determined through ground inspection and aerial photography interpretation. The plot data from within each vegetation unit were averaged, and averaged data used to determine whether the vegetation unit represented this endangered community.

NSW EEC *White Box Yellow Box Blakely's Red Gum Woodland*

This community occurs over the same range, and is essentially the same as the similarly named Commonwealth community.

For the purposes of this report, wherever the Commonwealth community was identified, the NSW community was also considered to be present.

NSW EEC Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions

The canopy species typical of this community are Grey Ironbark (*Eucalyptus crebra*), Spotted Gum (*Corymbia maculata*), and Grey Box (*Eucalyptus moluccana*). The equivalent HRVP (Peake, 2006) community, MU27 Central Hunter Ironbark – Spotted Gum – Grey Box Forest, has been recorded in the vicinity of the Modification area.

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

The canopy species typical of this community are Grey Box (*Eucalyptus moluccana*) and Grey Ironbark (*Eucalyptus crebra*). The equivalent HRVP (Peake, 2006) community, MU10 Central Hunter Box – Ironbark Woodland, has been recorded within the Modification area. The description of this community also includes hybrid White Box/Grey Box.

NSW EEC Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions

The canopy species typical of this community are Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus moluccana*), Grey Ironbark (*Eucalyptus crebra*) and Grey Gum (*Eucalyptus punctata*). This EEC was gazetted prior to the HRVP (Peake, 2006) report, however, the equivalent community in that report is MU24 Hunter Lowlands Red Gum Forest.

NSW EEC Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion

The NSW Scientific Committee determination of Hunter Valley Weeping Myall Woodland as an EEC (NSW Scientific Committee, 2010a) states that "The most common tree is *Acacia pendula* (Weeping Myall), which may occur with *Eucalyptus crebra* (Narrow-leaved Ironbark), *A. salicina* (Cooba) and/or trees within the *A. homalophylla* - *A. melvillei* complex." This appears to imply that the community must always contain *Acacia pendula* that may be associated with the other species listed.

The determination was solely based on the community MU19 Hunter Valley Weeping Myall Woodland of Peake (2006). In turn, the Peake (2006) community was "...based on non-quantitative assessment, as no survey sites were conducted within it" and is described as "A mid-high to tall woodland or open forest clearly dominated by weeping myall (*Acacia pendula*)."

The foregoing indicates that the Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion EEC is only present when *Acacia pendula* is present and may or may not have other associated species.

4.2 Fauna

4.2.1 *Fauna Species*

Niche (**Appendix 1**) undertook fauna surveys within the Modification areas on 1 May 2012, and from 7 May 2012 to 11 May 2012. Field surveys were targeted and used established survey techniques based upon:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft,* DEC 2004;
- *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna Amphibians for Development and Activities* (NSW Department of Environment, Climate Change and Water [DECCW], 2009a);
- survey guidelines for Australia's threatened bats, birds and frogs (Commonwealth Department of the Environment, Water, Heritage and the Arts, 2010a, 2010b, 2010c); and
- survey guidelines for Australia's threatened mammals and reptiles (SEWPaC, 2011a, 2011b).

Opportunistic observations and broad habitat assessments were also performed throughout the study area.

Targeted survey procedures included the use of arboreal Elliot trapping, infra-red camera traps, hair tubes, ultrasonic call recording for bats, diurnal bird surveys, spotlighting, call playback, stag watching, Koala scat searches, herpetological surveys, frog chorus survey and aquatic habitat surveys (**Appendix 1**). Targeted surveys were undertaken, and incidental searches and observations of fauna use of the study areas were made within each habitat type by examining scats, scratches and other indirect evidence (**Appendix 1**).

4.2.2 *Fauna Habitat Assessment*

Fauna habitat within the Modification area was also mapped, and is described in **Appendix 1**.

Hollow-bearing trees are an important but limited resource that provides denning places for arboreal fauna and insectivorous bats, and nesting sites for a range of birds such as owls, parrots and cockatoos and small diurnal raptors. It can take up to 80 years before a tree is sufficiently senescent to start to develop hollows, and 120-200 years to develop a range of hollow sizes suitable for fauna (reviewed in DECC, 2007a). Consequently, the loss of this habitat over a wide area can have a significant negative impact on the faunal diversity of that area and surrounds.

All trees in the Modification area were inspected for the presence of hollows. The species and location co-ordinates of hollow-bearing trees was recorded.

4.2.3 *SEPP 44 Koala Habitat*

In accordance with *State Environmental Planning Policy 44 – Koala Habitat Protection* (SEPP 44), the impact of the Modification on core and potential Koala habitat was assessed. SEPP 44 aims to encourage the conservation and proper management of areas of natural vegetation that provide habitat for Koalas, to ensure permanent free-living populations over their present range, and to reverse a long trend of population decline. Core and potential Koala habitat are defined by SEPP 44 as:

- core Koala habitat means an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population); and
- potential Koala habitat means areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

The accepted indirect method (other than direct observation of the animal) for detecting Koala activity is the Spot Assessment Technique (SAT) (Phillips and Callaghan, 2011. This method was applied in appropriate habitat within the Modification area. A one hour search was conducted within identified Koala habitat as judged by the presence of favoured feed trees (*Eucalyptus tereticornis*). Each of the 30 *E. tereticornis* trees was examined for scratches, and a one minute search for scats was performed in a 1 m radius around the base of each tree. This was then repeated for a minute whilst combing through the leaf litter. Koala call playback was also used in an attempt to elicit a response.

5 Supplementary Field Survey Results

5.1 Flora

A total of 239 flora species, comprising 172 native species and 67 exotic species, from 58 families were recorded during the current surveys within the Modification area. The most represented families were the Poaceae with 57 species, including 14 exotic species, followed by the Asteraceae with 36 species, including 15 exotic species and the Fabaceae (Faboideae) with 17 species, including seven exotic species.

Details of flora species recorded in the Modification area are provided in **Appendix 4**.

5.1.1 *Threatened Flora Species*

An evaluation of database records of threatened flora species occurring within or surrounding the Modification area, against the known habitat requirements of those species provides an assessment of likelihood of occurrence in the Modification area (**Table 10**). Habitat preference information was drawn from the following online resources:

- http://www.bionet.nsw.gov.au/
- http://plantnet.rbgsyd.nsw.gov.au/

Flora species that were determined to be potentially impacted by the Modification are assessed in **Section 7.3**.

Table 10: Threatened flora species habitat preferences and likelihood of occurrence within the Modification area

Scientific Name	Common Name	Status[1]		Habitat Preferences	Likelihood of Occurrence
		TSC Act	EPBC Act		
Bothriochloa biloba	Bluegrass	-	V	Native grasslands in the central Hunter. Has previously been recorded within the Mt Arthur Coal Mine and in the locality.	Found
Cynanchum elegans	White-flowered Wax Plant	E	E	A rainforest species.	No suitable habitat
Digitaria porrecta	Finger Panic Grass	E	E	Recorded from grasslands of the north west slopes botanical area.	Unlikely
Diuris tricolor	Pine Donkey Orchid	V	-	Known occurrences on the north-eastern side of the Mt Arthur Coal Mine. Grows in natural grassland and grassy woodland in the Muswellbrook LGA.	Possible but not found

Table 10 (continued): Threatened flora species habitat preferences and likelihood of occurrence within the Modification area

Scientific Name	Common Name	Status[1]		Habitat Preferences	Likelihood of Occurrence
		TSC Act	EPBC Act		
Eucalyptus glaucina	Slaty Red Gum	V	V	A coastal species from the north coast botanical area.	Unlikely
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	The one record in the data extraction area is a long way from the species range and is probably a misidentification.	Unlikely
Euphrasia arguta	-	CE	CE	Only recorded from grassy areas near rivers in the Bathurst to Walcha areas. Possibly extinct.	Unlikely
Macrozamia plurinervia	-	-	V	The BioNet database shows records of this plant from the top of Mount Arthur itself. PlantNet however describes it as being restricted to granite-based soils in far northern NSW. The species is very similar to *Macrozamia flexuosa* so the two could be confused.	Possible based on BioNet records. Unlikely based on PlantNet data
Pimelea curviflora var. *curviflora*	Rice Flower	V	V	The majority of records are from coastal sandstone habitat. However, there is a confirmed NSW Wildlife Atlas record from about 2.5 km south of the Modification area.	Possible, but not found
Pomaderris reperta	Denman Pomaderris	CE	CE	Grows in dry sclerophyll woodland and the only known occurrences are restricted to the Denman area, about 7 km west of the Modification area.	Unlikely
Prasophyllum sp. Wybong (C.Phelps ORG 5269)	a leek-orchid	-	CE	A grassland and grassy woodland terrestrial orchid found in Box-Gum habitat.	Possible, but not found
Pterostylis gibbosa	Illawarra Greenhood	E	E	Mainly found in the Central Coast and North Coast botanical areas with a disjunct occurrence at Milbrodale.	Unlikely
Thesium australe	Austral Toadflax	V	V	Grows in grassland and woodland and is a hemi parasite of *Themeda australis*.	Possible but very little *Themeda australis* was recorded.
Tylophora linearis	-	V	E	A dry scrub species.	Unlikely

[1] Threatened flora species status under the TSC Act and/or EPBC Act (current at 24 January 2013).

Of the threatened flora listed in **Table 10**, only *Bothriochloa biloba* was recorded within the Modification area during the May survey. Suitable habitat for *Diuris tricolor* was present in Modification Areas B and C. However, no orchids were found in these areas during a survey in mid September 2012 when *Diuris tricolor* was known to be flowering in the A171 conservation area.

5.1.2 *Vegetation Communities*

The first step in determining which vegetation communities were present in the Modification areas was to analyse the sample plot data by grouping the plots that are most similar to each other. To achieve this, the plot data (**Appendix 5**) were run through Primer 6 (Clarke and Gorley 2001). A dendrogram (**Figure 13**) shows the significantly different groupings (95% confidence) below each solid black line. To assist with interpretation each plot was given a generic classification as shown in the dendrogram key. The degree of difference between each group is then presented by multi-dimensional scaling, a process that positions the plots according to their relative similarity to each other (**Figure 14**). Overall, this analysis verified the following generic groups: grassland, box-gum shrubby, box-gum grassy, Slaty Box, Spotted Gum shrubby, Spotted Gum grassy, Red Gum Grassy and Sharp Rush.

The next step was to compare the floristic content of the plots from each of the generic groups with the community profiles of the Peake (2006) regional classification. The finally selected communities were then compared with determinations for TEC considered likely to occur in the region.

The dendrogram (**Figure 13**) showed five plots as special cases and examination of the data provided an explanation:

- Plots A2, B9 and E6 were dominated by weeds;
- Plot E2 was also dominated by weeds, particularly large areas of Sharp Rush (*Juncus acutus)*; and
- Plot E3 contained a large isolated patch of *Acacia melvillei*.

This information was used in the final vegetation community mapping to separate weedy grassland areas from native grassland areas.

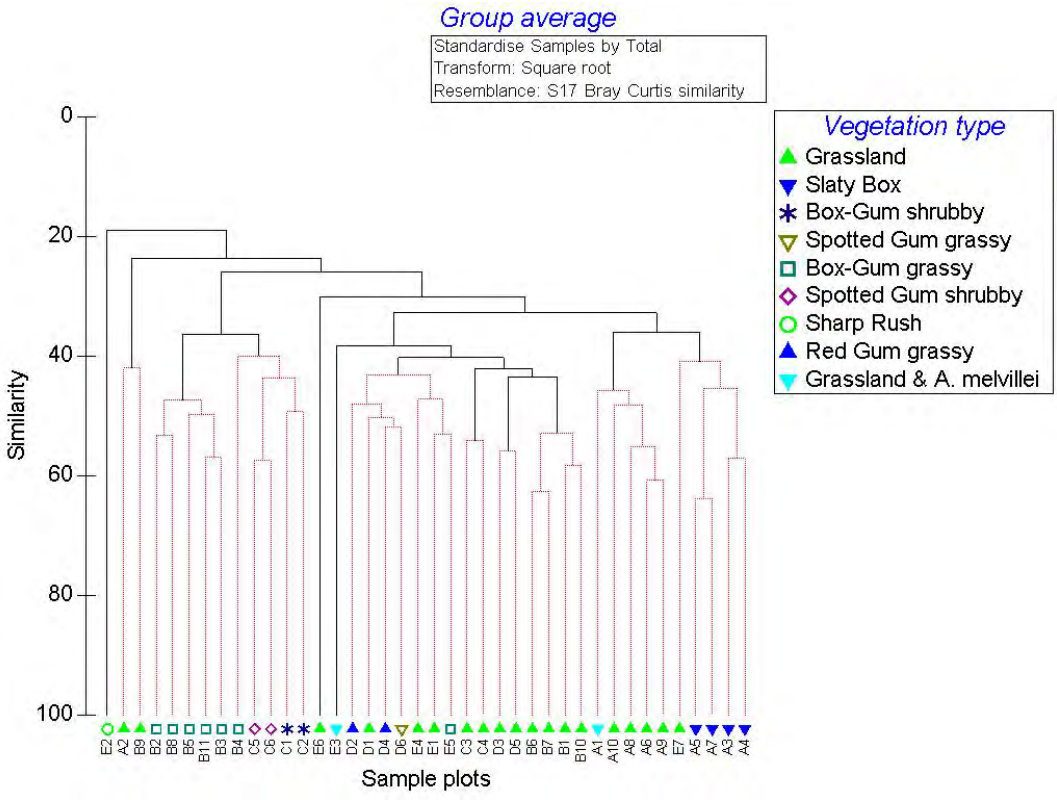


Figure 13: Dendrogram of the 40 Sample Vegetation Plots

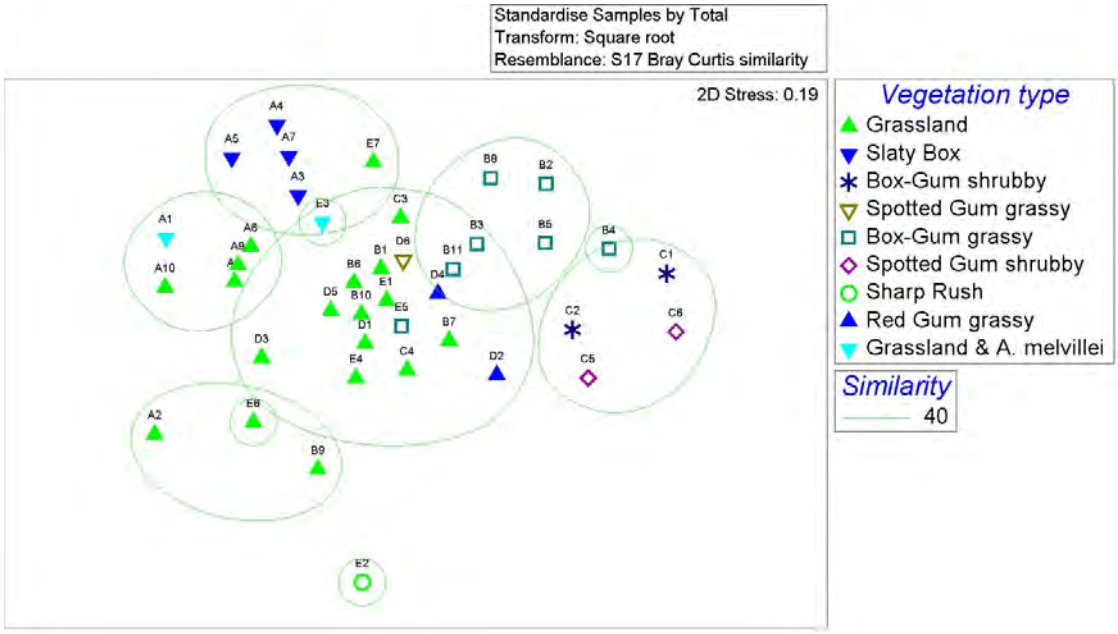


Figure 14: Non-metric Multidimensional Scaling Plot showing the Similarity Relationship between the Sample Vegetation Plots

To determine whether areas of open grassland matched the description of the Box-Gum Woodland EEC/CEEC, they were first assessed for the likelihood that they once supported the required canopy trees. Based on surrounding vegetation, it was determined that one or more of these canopy tree species were present in the open grassland of Modification Areas B, C and E. These two areas were then tested against the conditions outlined in **Section 4.1.2** with each of the criteria required to be met (results shown in **Table 11**). The open grassland in Modification Areas B and C met the condition for classification as the CEEC, whereas the open grassland in Modification Area E did not.

Table 11: Open grassland vegetation attributes

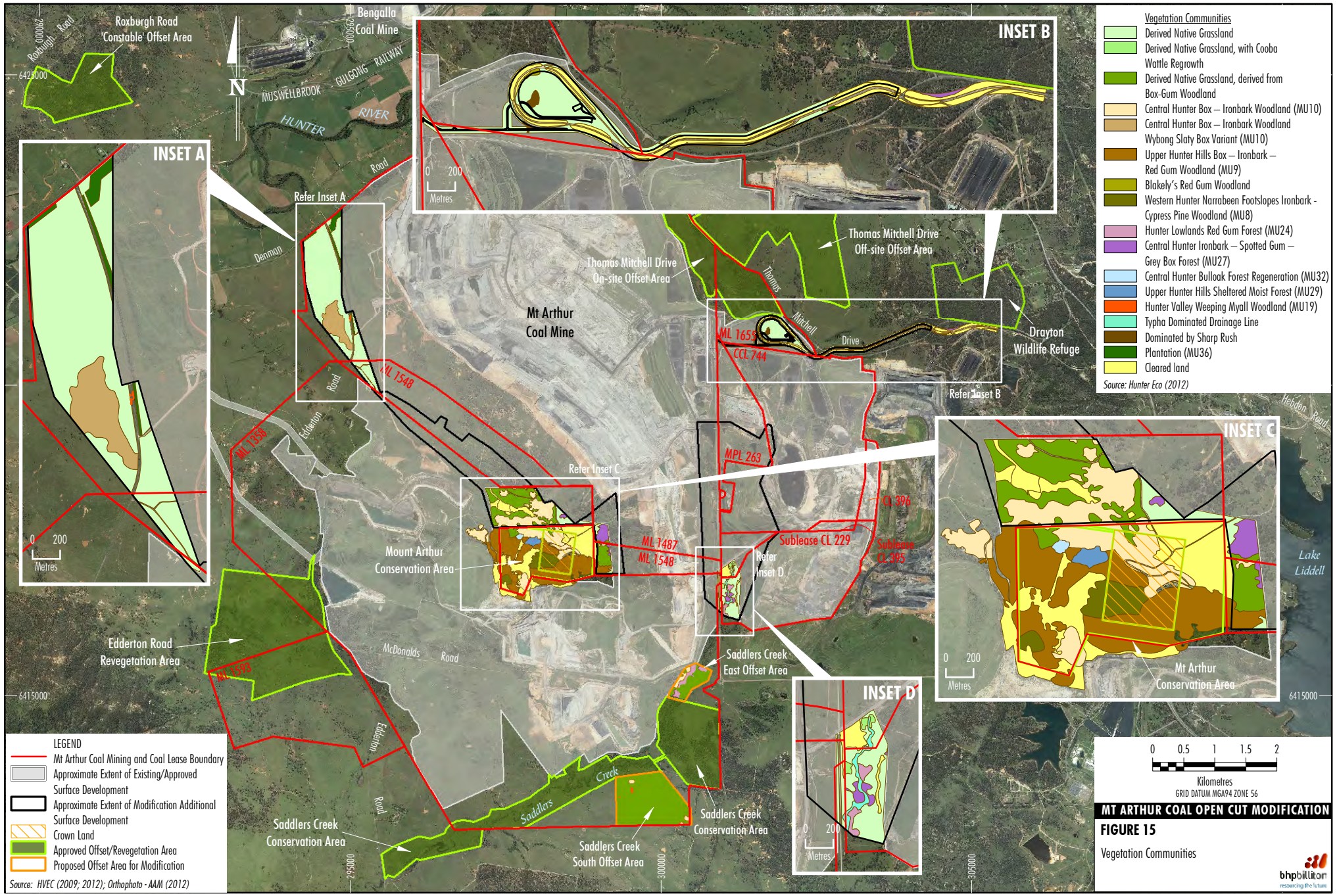
	Positive Indicator Level	Modification Area		
		Area B	Area C	Area E
Number of plots	-	5	2	4
% native cover	50	61	68	57
Native grass species	-	8	9	9
Native other species	12	15	12	9
Important Species	1	3	4	3

Mount Arthur and Footslopes Vegetation

The vegetation within Mount Arthur was mapped and is shown on **Figure 15** and described in detail below. Data from 75 ground-truth points, along with selected vegetation community boundary recording by hand-held GPS, were used to deconstruct the Mt Arthur Coal Mine vegetation. This investigation was not exhaustive, being intended only to provide an indication of the communities present. To complete this task, floristic plot data from within the different communities would need to be collected and analysed. The following HRVP (Peake, 2006) communities were considered to be present:

Central Hunter Box – Ironbark Woodland (MU10)

The dominant canopy species was *Eucalyptus albens x E. moluccana* (Hybrid White Box). This community extended into the Modification area, was representative of Box-Gum Woodland EEC/CEEC, and has been described in further detail in **Appendix 6**.



MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 15

Vegetation Communities

bhpbilliton
resourcing the future

HVE-11-01_OCM EA_App F&F_204E

Upper Hunter Hills Box – Ironbark – Red Gum Woodland (MU9)
This community was located on moist sheltered ridges and slopes. It was characterised by a canopy of Blakely's Red Gum (*Eucalyptus blakelyi*), along with *Eucalyptus albens x E. moluccana* (Hybrid White Box), Rough-barked Apple (*Angophora floribunda*) and *Brachychiton populneus*. There was a dense mid to tall shrub layer consisting primarily of Native Olive (*Notelaea microcarpa*), Western Boobialla (*Myoporum montanum*) and Sticky Daisy-bush (*Olearia elliptica*). Peake (2006) reported >60 ha of this community extant within the bounds of that study. However, this would have resulted from the study being primarily aimed at remnant vegetation of the valley floor.

This community extended into the Modification area and is described in further detail in **Appendix 6**. While the presence of Blakely's Red Gum suggests that the community might be a Box-Gum Woodland TEC, the persistent and dense shrub layer rules that out.

Western Hunter Narrabeen Footslopes Ironbark – Cypress Pine Woodland (MU8)
Found in two locations on exposed western slopes, this community was dominated by Grey Ironbark (*Eucalyptus crebra*) and Black Cypress (*Callitris endlicheri*). While the geology was Permian rather than Narrabeen, the position in the landscape and the floristic content closely matched the description of Peake's (2006) Vegetation Community MU8. Peake (2006) reports 3,107 ha of this community extant within the bounds of that study. This community was not recorded within the Modification area.

Central Hunter Bulloak Forest Regeneration (MU32)
By far the dominant species was Bulloak (*Allocasuarina luehmannii*), almost as a monoculture. This community was not recorded within the Modification area.

Upper Hunter Hills Sheltered Moist Forest (MU29)
The canopy of this community was dominated by Grey Gum (*Eucalyptus punctata*), along with some Rough-barked Apple (*Angophora floribunda*) and Forest Oak (*Allocasuarina torulosa*). A dense mid to tall shrub layer was present dominated by Native Olive (*Notelaea microcarpa*) and Hairy Clerodendrum (*Clerodendrum tomentosum*). Peake (2006) reported >145 ha of this community (mapped by Peake [2006] as MU29) extant within the bounds of that study. Again, this will have resulted from the study primarily being aimed at remnant vegetation of the valley floor.

The following sections provide an overview of the vegetation communities mapped within the Modification area. **Appendix 6** provides full vegetation community profiles.

Modification Area A

The dominant vegetation within Modification Area A was open grassland with widely scattered trees (**Figure 15**). The grassland was dominated by native grasses with a large area containing the Commonwealth listed vulnerable species, *Bothriochloa biloba.* Within the *Bothriochloa biloba* distribution was a 13 ha area in which the species was the dominant grass. Elsewhere it appeared as scattered patches of about 10 or 20 square metres (~74 patches in 49 ha) or was only sporadically present (22 ha).

In the approximate centre of the area is vegetation containing mixed old growth and re-growth Bulloak (*Allocasuarina luehmannii*) along with scattered large Slaty Gum (*Eucalyptus dawsonii*). The dendrogram in **Figure 13** shows the four sample plots from this habitat grouping together, even though some plots had either no Slaty Box or no Bulloak. Based on floristic content, this community was determined to be Central Hunter Box – Ironbark Woodland Wybong Slaty Box Variant (MU10) (Peake, 2006). The floristic content and structure (particularly absent shrub layer) did not match Peake's (2006) Vegetation Community MU7 Narrabeen Footslopes Slaty Box Woodland, indicating that it was also not the NSW vulnerable ecological community *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion.*

At the northern end of this area were several Fuzzy Box (*Eucalyptus conica*). and these trees are likely remnants of what was once a larger population in the locality.

A dense group of *Acacia pendula* were present on both sides of a section of Edderton Road. These plants comprise part of the NSW listed endangered population of this species in the Hunter Catchment as well as an instance of the NSW listed EEC *Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion*. They were growing almost entirely in the road reserve and the ground species were dominated by weeds.

Along the eastern edge of Edderton Road and along the north-eastern edge of Denman Road there is a strip of planted vegetation comprising species that are not locally endemic (mapped as Plantation [MU36]).

Modification Area B

A mixture of open grassland and woodland characterised Modification Area B (**Figure 15**). It is reasonable to assume that the surrounding box woodland would have once been continuous across what is now cleared grassland. The majority of the open grassland was, therefore, determined to form part of the Commonwealth CEEC White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland, taking into account the diagnostic conditions met in **Table 11**. Consistent with this analysis, this grassland would also represent the NSW listed EEC White Box Yellow Box Blakely's Red Gum Woodland.

On the eastern side of this area there was a small patch of Spotted Gum (*Corymbia maculata*) classified as Central Hunter Ironbark – Spotted Gum – Grey Box Forest (MU27). This would also represent the NSW listed EEC *Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions*. The grassland surrounding this Spotted Gum patch and up to the road on the ridge has been determined as being of unknown origin because there was insufficient information available to determine the original dominant canopy.

The woodland habitat (other than the Spotted Gum) was determined to fit Peake's (2006) description of Vegetation Community MU10 Central Hunter Box – Ironbark Woodland. The box species appeared to be what has been classed as a hybrid of White Box (*Eucalyptus albens*) and Grey Box (*Eucalyptus moluccana*). Umwelt (2011) reported having submitted a number of specimens from the vicinity to the Sydney herbarium for identification with almost all being identified as the hybrid. The large and sessile fruit sampled from box trees in Modification Area B during the current investigation were consistent with the hybrid. Combined with the predominantly grassy understorey, the community would form part of the Commonwealth CEEC White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Being consistent with MU10 of Peake (2006), it would be the NSW EEC Central Hunter Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions with MU10 being described as containing the hybrid box, and MU10 being referenced in that NSW Scientific Committee EEC determination. However, this community also represents the NSW EEC White Box Yellow Box Blakely's Red Gum Woodland because that determination specifically includes intergrades of *Eucalyptus moluccana* with *Eucalyptus albens*. Thus, there is an anomaly where the same area of vegetation is representative of two different NSW listed EEC.

A large dam had been constructed in the valley floor that no longer held water. The ground surface in the vicinity of the dam, and a wide diversion contour leading into the dam, was disturbed and covered mostly with exotic grasses. Areas above and below the dam were heavily weed-infested. This area was mapped as Cleared land.

Modification Area C

The two main communities in Modification Area C were dominated by Spotted Gum (*Corymbia maculata)* and Blakely's Red Gum (*Eucalyptus blakelyi*) (**Figure 15**). The remainder of the area was open grassland.

The Spotted Gum community would represent Peake's (2006) MU27 Central Hunter Ironbark - Spotted Gum - Grey Box Forest, although the only canopy species was Spotted Gum. This represents the NSW EEC Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions the determination of which references Peake's (2006) Vegetation Community MU27.

On the southern slopes of Mount Arthur, the habitat was dominated by Blakely's Red Gum (*Eucalyptus blakelyi*) along with Grey Gum (*Eucalyptus punctata*), Rough-barked Apple (*Angophora floribunda*) and hybrid box (*E. albens x E. moluccana*). There was a dense mid to tall shrub layer consisting primarily of *Notelaea microcarpa, Myoporum montanum* and *Olearia elliptica*. Peake (2006) mapped this area as part of the MU31 Mount Arthur Forest Complex. The detailed investigation into the Mt Arthur Coal Mine community concluded that this habitat was consistent with MU9 Upper Hunter Hills Box – Ironbark – Red Gum Woodland, not a threatened community.

Most of the grassland met the requirements (**Section 4.1.2** and **Table 11**) of having been derived from Box-Gum Woodland and, therefore, was classified as part of the Box-Gum Woodland EEC/CEEC.

An area of grassland at the northern end of the area was determined as being of unknown origin because there was insufficient information available to determine the original dominant canopy.

Modification Area D

Figure 15 shows the vegetation mapped across the Modification Area D. A central feature of the area was a drainage line, being the upper reaches of Saddlers Creek, that was dominated by Broadleaf Cumbungi (*Typha orientalis*) reeds. Remnant vegetation gave some indication of the pattern before clearing. At the edges of the central creekline were patches of Forest Red Gum (*Eucalyptus tereticornis*), Spotted Gum (*Corymbia maculata*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). The Red Gum community also contained Grey Gum (*Eucalyptus punctata*), some Grey Box (*Eucalyptus moluccana*) and the box hybrid *Eucalyptus albens x E. moluccana*. The overall combination of species best matched Hunter Lowlands Red Gum Forest (MU24).

Composition of the Spotted Gum and Ironbark communities together was consistent with Central Hunter Ironbark – Spotted Gum – Grey Box Forest (MU27). These two communities were representative of the similarly named NSW EEC Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions and Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions.

The surrounding grassland was deemed to be of undetermined origin although it contained mostly native species, particularly grasses. There were some localised areas where Cooba (*Acacia salicina*) was a dominant regrowth element in the grassland.

A large area at the north-western end had been either filled with spoil or used as a stockpile area as indicated by the stony ground. This area was dominated by exotic species, in particular Coolatai Grass (*Hyparrhenia hirta*) (mapped as Cleared Land).

Modification Area E

This area consisted of the rail loop and main access corridor (**Figure 3**). The primary area of interest was inside the rail loop and outside the southern side of the loop. **Figure 15** shows the vegetation mapped for the overall area. The majority of the area was open grassland. Disturbed areas along the rail line, resulting either from excavation or bunding required to create a level track, had been planted with a variety of exotic grasses such as Rhodes Grass (*Chloris gayana*), Red Natal Grass (*Melinis repens*) and Reed Canary Grass (*Phalaris arundinacea*).

Scattered box trees were observed to the south of the investigation area, but the species could not be determined as they did not carry any fertile material. An area inside the rail loop containing Blakely's Red Gum (*Eucalyptus blakelyi*) was deemed to be part of the Box-Gum Woodland EEC/CEEC. Therefore, the surrounding grassland could have been derived from Box-Gum woodland. However, as **Table 11** shows, there were, on average, insufficient native species other than grasses, for the grassland to be classified as the Commonwealth CEEC White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Meanders and sample vegetation plots through these grasslands revealed large areas that were dominated by exotics such as Coolatai Grass (*Hyparrhenia hirta*), Paspalum (*Paspalum dilatatum*) and Sharp Rush (*Juncus acutus*). It was also concluded that weed content meant that the grassland was not part of the NSW EEC *White Box Yellow Box Blakely's Red Gum Woodland.*

Table 12 provides a summary of all communities mapped across the Modification area. These vegetation communities are mapped on **Figure 15.**

Table 12: Vegetation communities and their corresponding endangered community mapped within the Modification area

Vegetation Type	Vegetation Community	HRVP Equivalent
Grassland	Derived Native Grassland	No HRVP equivalent
Grassland (Cooba Wattle Regrowth)	Derived Native Grassland, with Cooba Wattle Regrowth	No HRVP equivalent
Grassland	Derived Native Grassland, derived from Box-Gum Woodland[1, 2]	No HRVP equivalent
Reed Drainage Line	*Typha* Dominated Drainage Line	No HRVP equivalent
Sharp Rush	Dominated by Sharp Rush	No HRVP equivalent
Box-Gum (grassy)	Central Hunter Box – Ironbark Woodland[1, 2, 3]	MU10
Box-Gum (grassy)	Blakely's Red Gum Woodland[1, 2]	No HRVP equivalent
Box-Gum (shrubby)	Upper Hunter Hills Box – Ironbark – Red Gum Woodland	MU9
Slaty Box	Central Hunter Box – Ironbark Woodland Wybong Slaty Box Variant	MU10
Red Gum	Hunter Lowlands Red Gum Forest[4]	MU24
Spotted Gum	Central Hunter Ironbark – Spotted Gum – Grey Box Forest[5]	MU27
Weeping Myall	Hunter Valley Weeping Myall Woodland[6]	MU19

1 White Box Yellow Box Blakely's Red Gum Woodland EEC.

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

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

4 Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC.

5 Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC.

6 Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion EEC.

5.1.3 *Threatened Flora Populations*

Table 13 lists the likelihood of threatened flora populations occurring in the Modification area.

Table 13: Threatened flora populations

Population	Likelihood of Occurrence
Acacia pendula population in the Hunter Catchment	*Acacia pendula* has been recorded within the Mt Arthur Coal Mine boundary.
Cymbidium canaliculatum population in the Hunter Catchment	This tree orchid is commonly found in Grey or White Box eucalypts, but can also occur in other tree species. There were suitable host trees present in some areas within the Modification area.
Diuris tricolor population in the Muswellbrook LGA	This terrestrial orchid grows in open native grassland as well as grassy woodland. It has only been recorded in the Muswellbrook region. Suitable habitat was present in some areas within the Modification area.
Eucalyptus camaldulensis population in the Hunter Catchment	These are River Red Gums and are generally found on stream and river banks. There was no suitable habitat in the Modification area.

Acacia pendula occurs in Modification Area A and would be impacted by the Modification.

While Modification Area B contained suitable host tree species for *Cymbidium canaliculatum* (Tiger Orchid), none were found. Suitable habitat for this orchid (in established trees) would be impacted by the Modification.

Diuris tricolor has been recorded in and near the Mt Arthur Coal Mine. Suitable habitat was present in Modification Areas B and C. The species can only be found during a narrow flowering period of late September to early October. After confirming that these orchids were flowering in the A171 conservation area (19 September 2012), Modification Areas B and C were carefully searched with no orchids found. Despite no orchids being found, it is possible that some potential habitat for this orchid would be impacted by the Modification.

5.2 Fauna

A total of 77 fauna species, comprising three amphibians, five reptiles, 44 birds and 25 mammals were recorded within the Modification area by Niche (**Appendix 1**). Of these, six were introduced species. A full list of fauna species recorded within the Modification is provided in **Appendix 1**.

5.2.1 *Threatened Fauna Species*

An evaluation of database records for threatened fauna species occurring within or surrounding the Modification area, against their known habitat requirements, provides an assessment of likelihood of occurrence in the Modification area (**Table 14**). Species potentially impacted by the Modification are assessed in **Section 7.4**.

Table 14: Threatened fauna likelihood of occurrence

Scientific Name	Common Name	Status[1]		Habitat Preferences	Habitat Suitability
		TSC Act	EPBC Act		
Amphibians					
Litoria aurea	Green and Golden Bell Frog	E	V	Swamps and wetlands with deep water and reeds.	Unlikely, no suitable habitat present.
Litoria booroolongensis	Booroolong Frog	E	E	Permanent streams with some fringing vegetation cover.	Unlikely, no suitable habitat present.
Birds					
Leipoa ocellata	Malleefowl	E	V	Semi-arid to arid shrublands and low woodlands (SEWPaC, 2012b).	Unlikely, no suitable habitat present.
Oxyura australis	Blue-billed Duck	V	-	Deep water swamps and dams.	No suitable habitat present.
Stictonetta naevosa	Freckled Duck	V	-	Permanent fresh water swamps and creeks (Birdlife Australia, 2012).	No suitable habitat present.
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Wetlands.	No suitable habitat present.
Botaurus poiciloptilus	Australasian Bittern	E	E	Permanent freshwater wetlands.	No suitable habitat present.
Circus assimilis	Spotted Harrier	V	-	Woodland, grassland and shrub steppe.	Suitable habitat present. Species assessed in **Section 7.4.2**.
Hieraaetus morphnoides	Little Eagle	V	-	Woodland, forest, farmland, grasslands, crops, treeless dune fields, and recently logged areas.	Suitable habitat present. Species assessed in **Section 7.4.2**.
Burhinus grallarius	Bush Stone-curlew	E	-	Woodland and forest (Birdlife Australia, 2012).	Lack of records suggest that species is not present and would not be impacted by the Modification.
Rostratula australis	Australian Painted Snipe	E	V	Inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains.	No suitable habitat present.
Glossopsitta pusilla	Little Lorikeet	V	-	Open eucalypt forests and woodlands.	Suitable habitat present. Species assessed in **Section 7.4.4**.
Lathamus discolor	Swift Parrot	E	E	Dry sclerophyll eucalypt forests and woodlands (SEWPaC, 2012b).	Suitable habitat present. Species assessed in **Section 7.4.4**.
Neophema pulchella	Turquoise Parrot	V	-	Open woodlands and eucalypt forests with a ground cover of grasses and under storey of low shrubs.	Suitable habitat present. Species assessed in **Section 7.4.4**.

Table 14 (continued): Threatened fauna likelihood of occurrence

Scientific Name	Common Name	Status[1]		Habitat Preferences	Habitat Suitability
		TSC Act	EPBC Act		
Birds (Continued)					
Tyto novaehollandiae	Masked Owl	V	-	Diverse range of wooded habitat.	Lack of records suggest that species is not present and would not be impacted by the Modification.
Tyto tenebricosa	Sooty Owl	V	-	Moist eucalypt forests and rainforests (DEC, 2006).	Lack of records suggest that species is not present and would not be impacted by the Modification.
Ninox connivens	Barking Owl	V	-	Forests, woodlands, swamp woodlands and dense scrub.	Suitable habitat present. Species assessed in **Section 7.4.1**.
Ninox strenua	Powerful Owl	V	-	Forests and woodlands (DEC, 2006).	Lack of records suggest that species is not present and would not be impacted by the Modification.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	Eucalypt woodlands (including Box-Gum Woodland) and dry open forest.	Suitable habitat present. Species assessed in **Section 7.4.1**.
Chthonicola sagittata	Speckled Warbler	V	-	Eucalyptus dominated communities that have a grassy understorey.	Suitable habitat present. Species assessed in **Section 7.4.1**.
Anthochaera phrygia	Regent Honeyeater	CE	E	Temperate eucalypt woodlands and open forests.	Suitable habitat present. Species assessed in **Section 7.4.1**.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Drier open forests or woodlands dominated by box and ironbark eucalypts. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	Suitable habitat present. Species assessed in **Section 7.4.1**.
Epthianura albifrons	White-fronted Chat	V	-	Salt marsh and other damp areas with low vegetation (Birdlife Australia, 2012).	No suitable habitat present.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee.	Suitable habitat present. Species assessed in **Section 7.4.3**.
Petroica boodang	Scarlet Robin	V	-	Forests, woodlands; and heavier vegetation when breeding.	Suitable habitat present. Species assessed in **Section 7.4.3**.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	Open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands.	Species recorded in Modification area. Species assessed in **Section 7.4.1**.

Table 14 (continued): Threatened fauna likelihood of occurrence

Scientific Name	Common Name	Status[1]		Habitat Preferences	Habitat Suitability
		TSC Act	EPBC Act		
Birds (Continued)					
Daphoenositta chrysoptera	Varied Sittella	V	-	Eucalypt forests and woodlands.	Species recorded in Modification area. Species assessed in **Section 7.4.1**.
Stagonopleura guttata	Diamond Firetail	V	-	Grassy eucalypt woodlands, open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.	Suitable habitat present. Species assessed in **Section 7.4.1**.
Mammals					
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Sclerophyll forests and woodlands, coastal heathlands and rainforests.	Suitable habitat present. Species assessed in **Section 7.4.5**.
Phascolarctos cinereus	Koala	V	V	Eucalypt forests and woodlands.	Suitable habitat present. Species assessed in **Section 7.4.6**.
Petaurus norfolcensis	Squirrel Glider	V	-	Forest and woodland with habitat hollows and nectar resources.	Suitable habitat present. Species assessed in **Section 7.4.7**.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Rocky escarpments.	No suitable habitat present.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Blossoming eucalypts or fruiting trees.	Species recorded in Modification area. Species assessed in **Section 7.4.8**.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Wet and dry forests, grasslands, shrublands, Mallee and open woodlands (Churchill, 2008).	Suitable habitat present. Species assessed in **Section 7.4.9**.
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Rainforest, Melaleuca forest, monsoon forest, tall open forest, River Red Gum and Yellow Box woodlands, riparian open forest and dry sclerophyll forest (Churchill, 2008).	Species recorded in Modification area. Species assessed in **Section 7.4.9**.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Dry sclerophyll forests and woodlands, sub-alpine woodland, edges of rainforest, wet sclerophyll forest, *Callitris* spp. dominated forests and sandstone outcrop country (Churchill, 2008).	Suitable habitat present. Species assessed in **Section 7.4.10**.

Table 14 (continued): Threatened fauna likelihood of occurrence

Scientific Name	Common Name	Status[1]		Habitat Preferences	Habitat Suitability
		TSC Act	EPBC Act		
Mammals(Continued)					
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Wet sclerophyll and coastal Mallee.	Suitable habitat present. Species assessed in **Section 7.4.9**.
Miniopterus australis	Little Bentwing-bat	V	-	Moist eucalypt forest, rainforest or dense coastal Banksia scrub.	No suitable habitat present.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forests and open grasslands (Churchill, 2008).	Species recorded in Modification area. Species assessed in **Section 7.4.10**.
Myotis macropus	Southern Myotis	V	-	Streams and permanent waterways and usually in areas that are vegetated rather than cleared (Churchill, 2008).	Species recorded in Modification area. Species assessed in **Section 7.4.9**.
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands.	Lack of records suggest that species is not present and would not be impacted by the Modification.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Moist gullies in mature coastal forest, rainforest, open woodland, Melaleuca swamp woodland, wet and dry sclerophyll forests, cleared paddocks with remnant trees and tree-lined creeks in open areas (Churchill, 2008).	Suitable habitat present. Species assessed in **Section 7.4.9**.
Vespadelus troughtoni	Eastern Cave Bat	V	-	Tropical mixed woodland, wet and dry sclerophyll forest (Churchill, 2008).	Suitable habitat present. Species assessed in **Section 7.4.10**.
Pseudomys novaehollandiae	New Holland Mouse	-	V	Coastal heath and dry sclerophyll forest and woodland.	Lack of records suggest that species is not present and would not be impacted by the Modification.

After: **Appendix 1**.

[1] Threatened fauna species status listed under the TSC Act and/or EPBC Act (current at 24 January 2013).
V = Vulnerable; E = Endangered; CE = Critically Endangered

5.2.2 *Habitat Assessment*

Niche (**Appendix 1**) undertook a habitat assessment within the Modification area. A total of eight habitat types were recorded within the Modification area, *viz.:* Forest, Disturbed Forest, Grassy Woodland, Disturbed Grassy Woodland, Grassland, Disturbed, Reeds and Rushes and Plantation. A detailed description of these habitat types is provided in **Appendix 1** and **Section 6.1.2.**

Niche (**Appendix 1**) concluded that the habitat within the study area was mixed, constituting derived grassland, forest and woodland. Derived grassland supported a mixture of native and exotic grass species and occurred within the study area due to historic clearing of woodland or forest habitats for agriculture. Habitat features and complexity within the existing grassland habitat was limited and generally favoured a suite of common native fauna species rather than fauna of conservation significance. A sparse covering of scattered large trees throughout the grassland habitat added some complexity in the form of canopy features, hollows, stags and logs, although such features are somewhat isolated (**Appendix 1**).

Woodland and forest vegetation patches covered approximately half of the study area and were variable in condition, structure and habitat features as a result of different disturbance regimes, topography and environmental factors (**Appendix 1**). Habitat assessments were performed throughout six patches along or adjacent to fauna transects (**Appendix 1**).

5.2.3 *SEPP 44 Koala Habitat*

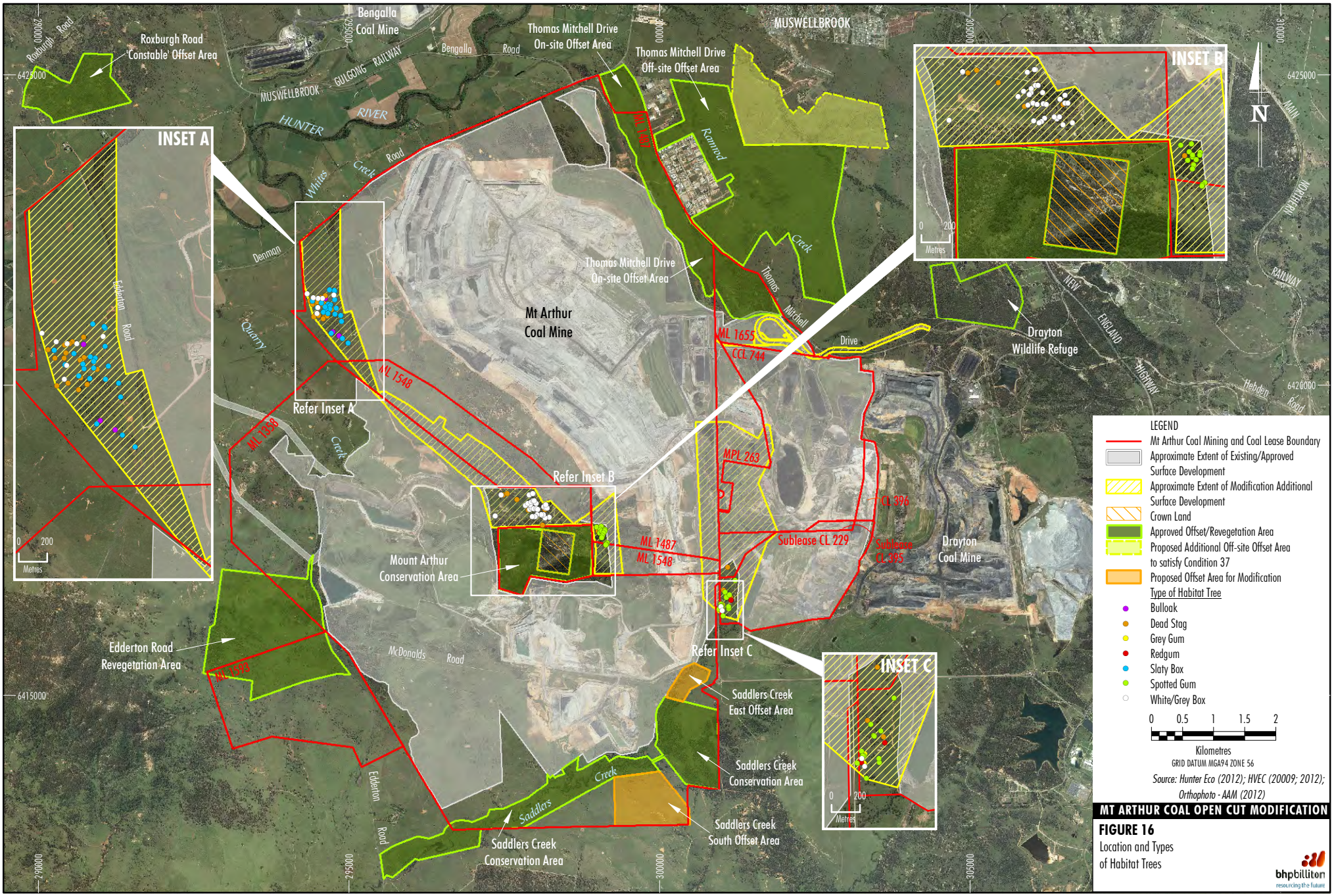
A thorough search by Niche using the Spot Assessment Technique (**Section 4.2.3**) and call playback did not result in the discovery of any Koala in the Modification area.

5.2.4 *Habitat Trees*

A total of 161 habitat trees were recorded (**Figure 16**) and the location coordinates and species details are provided in **Appendix 7**. The numbers of habitat trees in the Modification areas were as follows:

- Area A - 48;
- Area B - 58;
- Area C - 32; and
- Area D - 23.

There were no habitat trees in the proposed Modification Area E.


INSET A
INSET B
INSET C
Roxburgh Road 'Constable' Offset Area
Bengalla Coal Mine
Thomas Mitchell Drive On-site Offset Area
Thomas Mitchell Drive Off-site Offset Area
MUSWELLBROOK
Mt Arthur Coal Mine
Refer Inset A
Refer Inset B
Refer Inset C
Mount Arthur Conservation Area
Edderton Road Revegetation Area
Saddlers Creek East Offset Area
Saddlers Creek Conservation Area
Saddlers Creek South Offset Area
Drayton Wildlife Refuge
Drayton Coal Mine
ML 1655
CCL 744
ML 1548
ML 1358
ML 1487
MPL 263
CL 396
Sublease CL 229
Sublease CL 395
ML 1515
LEGEND
Mt Arthur Coal Mining and Coal Lease Boundary
Approximate Extent of Existing/Approved Surface Development
Approximate Extent of Modification Additional Surface Development
Crown Land
Approved Offset/Revegetation Area
Proposed Additional Off-site Offset Area to satisfy Condition 37
Proposed Offset Area for Modification
Type of Habitat Tree
Bulloak
Dead Stag
Grey Gum
Redgum
Slaty Box
Spotted Gum
White/Grey Box
0 0.5 1 1.5 2
Kilometres
GRID DATUM MGA94 ZONE 56
Source: Hunter Eco (2012); HVEC (20009; 2012); Orthophoto - AAM (2012)
MT ARTHUR COAL OPEN CUT MODIFICATION
FIGURE 16
Location and Types of Habitat Trees
bhpbilliton
resourcing the future

6 Impact Evaluation

The Modification would result in the same types of potential impacts on biodiversity as the existing approved mine (e.g. land clearance and indirect impacts). This section describes the magnitude, extent and significance of potential impacts from the Modification in accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005).

Section 7 provides an assessment of the potential impacts on threatened species. There are some threatened species and ecological communities which would be impacted by the Modification (e.g. *Acacia pendula*) that were not impacted by the existing approved mine.

6.1 Land Clearance

Clearing of native vegetation is listed as a key threatening process on Schedule 3 of the TSC Act. This is relevant to the Modification as land clearance would cause impacts to a range of TECs (**Section 6.1.1**) and fauna (including a number of threatened fauna species) (**Section 6.1.2**) that are known to occur in the Modification area, and potentially to other species that may occur.

Land clearance may also result in the loss of hollow-bearing trees, removal of dead wood and dead trees; bushrock removal; loss of individual animals; impacts to habitat connectivity; changes to hydrology; and removal of Koala habitat. These potential impacts are described in **Sections 6.1.3** to **6.1.8**.

6.1.1 *Loss of Native Vegetation*

The Modification would require the removal of 228.9 ha of native vegetation as outlined in **Table 15**. This comprises mostly derived grasslands (173 ha) and woodland (44.6 ha). The total land clearance area is slightly larger (259.9 ha) as it includes some introduced (such as the vegetation community dominated by Sharp Rush) or cleared map units (**Section 6.1.2**).

Table 15: Vegetation Clearance

Vegetation Type	Vegetation Community	HRVP Equivalent	Area (ha)
Grassland	Derived Native Grassland	no HRVP equivalent	136.8
Grassland (Cooba Wattle Regrowth)	Derived Native Grassland, with Cooba Wattle Regrowth	no HRVP equivalent	1
Grassland	Derived Native Grassland, derived from Box-Gum Woodland[1, 2]	no HRVP equivalent	35.2
Reed Drainage Line	*Typha* Dominated Drainage Line	no HRVP equivalent	2.5
		subtotal	175.5
Box-Gum (grassy)	Central Hunter Box – Ironbark Woodland[1, 2, 3]	MU10	23
Box-Gum (grassy)	Blakely's Red Gum Woodland[1, 2]	no HRVP equivalent	0.2
Box-Gum (shrubby)	Upper Hunter Hills Box – Ironbark – Red Gum Woodland	MU9	3.4
		subtotal	26.6
Slaty Box	Central Hunter Box – Ironbark Woodland Wybong Slaty Box Variant	MU10	17.9
Red Gum	Hunter Lowlands Red Gum Forest[4]	MU24	1.7
Spotted Gum	Central Hunter Ironbark – Spotted Gum – Grey Box Forest[5]	MU27	7.1
Weeping Myall	Weeping Myall Woodland[6]	MU19	0.1
		Total	**228.9**

1 White Box Yellow Box Blakely's Red Gum Woodland EEC.

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

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

4 Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC.

5 Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC.

6 Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion EEC.

The Modification area is mostly comprised of grassland. Weeping Myall Woodland and Blakely's Red Gum Woodland both comprise the smallest areas to be cleared for the Modification (approximately 0.1 ha and 0.2 ha to be cleared for each vegetation community, respectively).

Regionally Significant Vegetation

Six of the vegetation communities identified in the Modification area represent five TECs listed under the TSC Act and one TEC listed under the EPBC Act (**Table 16**).

The Modification would require the removal of approximately 90.3 ha of TECs as outlined in **Table 16**.

Table 16: Vegetation Clearance of TECs within the Modification Area

Community	Conservation Status[1]		Disturbance Area (ha)
	TSC Act	EPBC Act	
Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion	E	-	0.1
White Box Yellow Box Blakely's Red Gum Woodland[2]	E	CE	58.4 comprising: • 35.2 ha of Derived Native Grassland, derived from Box-Gum Woodland; • 23 ha of Central Hunter Box-Ironbark Woodland; and • 0.2 ha of Blakely's Red Gum Woodland.
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	E	-	23
Central Hunter Ironbark – Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions	E	-	7.1
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	E	-	1.7

[1] Threatened population, vegetation community, flora species or fauna species status listed under the TSC Act and/or EPBC Act (current at 24 January 2013).
E = Endangered; CE = Critically Endangered

[2] Listed as the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC under the EPBC Act.

These communities are further assessed in **Section 7.2**.

No regionally significant vegetation corridors are located within the Modification area and none would be impacted by the Modification.

6.1.2 *Loss of Fauna Habitat*

Clearing of native vegetation is recognised as a major factor contributing to loss of biological diversity (NSW Scientific Committee, 2001a). Clearing of vegetation results in the loss of habitat for species that utilise the vegetation, and may also result in the loss of habitat resources. Habitat resources lost may be comprised of hollow-bearing trees, dead wood and dead trees, rocks and fallen timber, and food trees. The loss of these resources may negatively impact on the lifecycle and survival of fauna species that use these resources in the short and long-term.

The impacts of clearing of native and other vegetation and associated habitat loss are considered for threatened fauna species predicted or known to occur within the Modification area in **Section 7.4**. Results from past and recent fauna studies indicate that habitats within the proposed disturbance areas have limited capacity to maintain moderate fauna species diversity or viable populations of any species. Fauna breeding within the proposed disturbance areas would be limited or completely suppressed due to limited resources. Hence removal of fauna habitat within the proposed disturbance areas is unlikely to significantly impact any extant fauna species, or other species that are located across the wider landscape.

As outlined in **Section 6.1.1**, approximately 228.9 ha of native vegetation would be cleared for the Modification. The total land clearance area is slightly larger (259.9 ha) as it includes some introduced or cleared map units. The type of fauna habitat that would be removed and the location is described in **Table 17** and shown on **Figures 3** to **5** of **Appendix 1**.

Table 17: Loss of Each Habitat Type within the Modification Area

Fauna Habitat Type	Approximate Area to be cleared (ha)	Location and Description
Forest	9	This habitat type occurs as Spotted Gum - Grey Box forest within Modification Areas B and C. It comprises a moderate-sized patch of mixed age forest with Spotted Gum to 1 m in diameter and 25 m height. This habitat type has a mid-storey of regenerating Eucalyptus with a good pulse of flowering and a patchy understorey with multiple shrub species present. Mistletoe is also abundant. Hollows are common in a range of sizes with occasional large fallen logs. This habitat type is also present in small patches in Modification Area E. This habitat type is generally good condition with good habitat complexity with some apparent disturbance (extent unknown) due to previous clearing.
Disturbed Forest	3.3	This habitat type occurs as lowland forest within Modification Area D. It comprises a moderately dense cover of large older growth trees to 25 m with recent patchy regrowth of mid-storey and understorey vegetation with native and exotic grasses. Small and medium-sized hollows are frequent in older trees, with at least two large Spotted Gum and Ironbarks with large hollows (i.e. >30 centimetres [cm]). Occasional logs are present below larger trees and some weed infestations in some patches of previous disturbance are present. This habitat type is in moderate condition with some recovery of understorey and mid-storey components occurring.
Grassy Woodland	23.2	This habitat type occurs within Modification Areas A, B, C and E. It comprises a few very old trees with limited hollows. There is some regeneration of canopy species with lower strata components having limited cover and diversity. This habitat type has limited floristic diversity or feeding resources as it is predominantly native grass cover. This habitat type is in moderate condition with good recovery potential.

Table 17 (continued): Loss of Each Habitat Type within the Modification Area

Fauna Habitat Type	Approximate Area to be cleared (ha)	Location and Description
Disturbed Grassy Woodland	17.9	This habitat type occurs as disturbed grassy woodland within Modification Area A. It comprises large scattered trees to 20 m over mixed native/exotic ground cover with limited structural complexity/diversity of vegetation with understorey and mid-storey components largely absent expect for some patches of regenerating Bulloak. Hollows are present in most large mature trees ranging from small to large and logs are present beneath larger trees. This habitat type is in generally poor/moderate condition with some apparent resilience with patches of regenerating shrubs.
Grassland	173	These areas constituted a mix of native and exotic grasses with occasional herbs or forbs. Cover of other vegetative layers such as understorey or canopy was absent or very sparse. These areas were generally highly disturbed and modified due to clearing and grazing. Condition was poor – with moderate or low recovery potential.
Reeds and Rushes	2.6	This habitat type occurs as thick *Typha* along a drainage line within Modification Area D. Small patches are also present within Modification Area E. This habitat type is a potential watering point for a range of terrestrial fauna species and has limited aquatic habitat complexity/features. The drainage line component of this habitat type is generally disturbed, while the surrounding vegetation has moderate recovery potential in most areas.
Disturbed	25.1	Disturbed areas were generally roads or other infrastructure, or places where significant soil disruption including fill had occurred leading to weed domination.
Plantation	5.8	Limited fauna habitat.
Total	**259.9**	

Source: After **Appendix 1**.

6.1.3 *Loss of Hollow-bearing Trees, Removal of Dead Wood and Dead Trees*

The *loss of hollow-bearing* trees and the *removal of dead wood and dead trees* are key threatening processes listed under **Schedule 3** of the TSC Act.

There are 127 hollow-bearing trees within the Modification area. There are scattered Slaty Box trees in Modification Area A that contain hollows. These scattered trees occur within predominantly cleared farmland, but would nonetheless, provide habitat for a variety of animals.

The habitat trees in Modification Areas B and C are mainly White/Grey Box trees and are situated on the lower slopes of Mount Arthur.

The hollow-bearing trees in the Modification area provide potential habitat for a range of bird and hollow-dwelling bat species. The lack of threatened fauna species records from within and surrounding the Modification area indicate that it is it is unlikely that the removal of hollow-bearing trees within the Modification would impact threatened species. However, dead wood and dead trees may provide habitat for the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (possibly recorded), Southern Myotis (*Myotis macropus*) and Eastern Freetail-bat (*Mormopterus norfolkensis*). These species are assessed in detail in **Section 7.4.9**.

The Modification would remove dead wood and dead trees on the ground as part of clearing the habitat. The removal of these habitat components could result in impacts to a number of threatened fauna species (refer to **Section 7.4**) as well as some ground dwelling mammals and birds. The lack of threatened fauna species records from within and surrounding the Modification area indicate that it is it is unlikely that the removal of dead wood and dead trees within the Modification would impact threatened ground dwelling mammals and birds. However, the removal of dead wood and dead trees may provide habitat and may potentially impact the Eastern False Pipistrelle (possibly recorded) and Eastern Freetail-bat. These species are assessed in detail in **Section 7.4.9**.

6.1.4 *Bushrock*

Bushrock removal is a key threatening process listed under Schedule 3 of the TSC Act and is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation. No major rock formations or continuous rock formations are present in the Modification area. While bushrock generally provides a fauna habitat resource, they are unlikely to be critical to threatened species recorded within the Modification area or those which possibly occur. Any bushrock in the proposed clearance areas would be removed, and potential impacts on fauna species within or surrounding the Modification are considered minor.

6.1.5 *Loss of Individual Animals*

Incidents of fauna mortality may result from land clearance activities as a result of direct encounters with construction works/vehicles or through the removal of habitat during clearing. HVEC currently implements a pre-clearance survey programme to minimise harm to fauna species during clearance works. The pre-clearance survey programme would continue for the Modification and is described in **Section 8.1**.

6.1.6 *Impacts on Habitat Connectivity*

Habitat fragmentation can result in a loss of habitat connectivity and an increase in edge effects which can reduce the availability and quality habitat for native flora and fauna. This may increase the numbers of introduced species, which may increase the risk of predation and competition for resources for native flora and fauna species.

The Modification would involve expansion of the existing and approved mine areas. The Modification is not likely to significantly increase the fragmentation of habitats above that already approved, due to the already highly fragmented nature of the landscape. In addition, the Modification is also unlikely to lead to an increase in edge habitat due to the already fragmented landscape.

6.1.7 *Changes to Hydrology – Ecological Value of Watercourses*

The *Alteration to the Natural Flow Regimes of Rivers and Streams and their Floodplains and Wetlands* is a key threatening process listed under Schedule 3 of the TSC Act and *Degradation of Native Riparian Vegetation along New South Wales Water Courses* is a similar Key Threatening Process under Schedule 6 of the NSW *Fisheries Management Act, 199*9.

The Modification would involve the removal of a drainage line that leads into Saddlers Creek (**Figure 3**). The drainage line that runs through to Saddlers Creek consists of a permanent shallow watercourse. Its catchment has been partly impacted by previous mining works to the east and north and is largely cleared and used for agriculture (**Appendix 1**). Habitat in this drainage line consists predominantly of thick *Typha* reed beds, with other aquatic macrophytes also present. There are no pools free of thick *Typha* growth (**Appendix 1**).

The drainage line that leads to Saddlers Creek would be removed for Modification Area D. Toe drains would be constructed around the perimeter of Modification Area D, to divert rainwater runoff from Saddlers Creek to minimise the chances of contamination from Modification Area D, that may negatively impact flora and fauna species. Diversion drains would also be established to direct uncontaminated surface water away from the mine area, and into existing creeks, rivers, or other forms of drainage. This is further described in **Section 6.2.2**.

Aquatic habitat features within the Modification area are limited to small ephemeral creeks within Modification Areas B and C and a first/second order ephemeral stream within Modification Area D. (**Appendix 1**). The ephemeral creeks within Modification Areas B and C are situated at the top of the Saddlers Creek catchment and consist of first to second order watercourses with irregular, limited flow regimes (**Appendix 1**). Although creek beds are in moderate to good condition, the limited flow regime restricts potential aquatic habitat features along the water courses (**Appendix 1**).

6.1.8 *SEPP 44 Koala Habitat*

As previously discussed (**Section 4.2.3**), based on SEPP 44, some potential habitat for Koalas would be cleared by the Modification. However, the potential habitat is not likely to be used by Koalas given the isolated nature of the habitat in the Modification area and lack of any evidence of Koala inhabitation during surveys undertaken within the Modification area (**Section 3.3**).

6.2 Indirect Impacts

Various indirect impacts on flora and fauna have been previously identified as potentially occurring from the existing Mt Arthur Coal Mine (Cumberland Ecology, 2009a). These are described below in relation to the Modification.

6.2.1 *Introduced Flora and Fauna*

The recent flora surveys conducted within the Modification area recorded a total of 67 introduced flora species. These species are listed in **Appendix 2**.

During the recent fauna surveys within the Modification area, Niche (**Appendix 1**) recorded the following six introduced mammal species: Black Rat (*Rattus rattus*), Dog (*Canis lupus familiaris*), Fox (*Vulpes vulpes*), Cat (*Felis catus*), Rabbit (*Oryctolagus cuniculus*) and European Cattle (*Bos taurus*). The risk of impact from introduced fauna to surrounding habitat or wildlife nature is not likely to change as a result of the Modification.

Measures to manage and control weeds and pests within the Mt Arthur Coal Mine are currently implemented and would continue to be implemented for the Modification. These measures are described in detail in **Section 8.1**.

6.2.2 *Runoff Water Quality*

As described in **Section 6.1.7**, the Modification would involve the placement of Modification Area D in the northern catchment of Saddlers Creek. Without controls, there is a potential for mine area runoff water to impact Saddlers Creek. Therefore, toe drains would be constructed around the perimeter of Modification Area D to collect and convey drainage from these areas to containment storages, thereby isolating mine drainage from undisturbed area runoff (Gilbert and Associates, 2012). It is unlikely that surface runoff associated with the Modification would impact flora and fauna in the surrounds, due to the mitigation measures described above. These mitigating measures are consistent with the NSW Fisheries' (1999) *Policy and Guidelines – Aquatic Habitat Management and Fish Conservation.*

6.2.3 *Groundwater Dependent Vegetation*

No groundwater dependent vegetation comprising groundwater dependent ecosystems occurs within the Modification area or immediate surrounds (after Australasian Groundwater and Environmental Consultants Pty Ltd, 2012). An area near Mt Arthur Coal Mine is mapped in the Atlas of Groundwater Dependent Ecosystems as having a moderate potential for groundwater interaction, however, the groundwater level is approximately 70 to 100 m below the ground level.

The *NSW State Groundwater Dependent Ecosystems Policy* (NSW Department of Land and Water Conservation [DLWC], 2002a) was consulted during this assessment.

6.2.4 *Noise*

The impacts of noise on fauna have shown varying levels of impact. Noise can potentially impact certain fauna species, although studies on the effect of noise on wildlife have shown potential impacts are varied. A number of studies have demonstrated that fauna are well adapted to human activities and noise (i.e. habituation), while other studies have shown that noise can mask vocalisation, and cause physiological stress and changes in movement/patterns and behaviour (Radle, 2007; Kaseloo, 2005; Institute for Environmental Monitoring and Research, 2001; Brumm and Slabbekoorn, 2005; Slabbekoorn and Peet, 2003; Hoskin and Goosem, 2010; Parris *et al*., 2009; Herrera-Montes and Aide, 2011; Chan and Blumstein, 2011).

There is a potential for increased disruption to fauna surrounding the Modification due to an increase in noise. Works undertaken in areas closer to fauna habitat (e.g. Mount Arthur) would result in greater impacts from noise on fauna species than works undertaken in areas surrounded by less or no fauna habitat. Most of the habitats within the Modification area are already subject to noise associated with the existing and approved mine. Noise emissions would increase as a result of the Modification (Wilkinson Murray, 2012).

Given the size of the operating mine, any noise impacts would have already occurred with recent fauna surveys recording those species that are tolerant of the current noise regime. It is not likely that the increased noise emissions would have a significant adverse impact to local fauna populations.

6.2.5 *Artificial Lighting*

Artificial lighting has the potential to affect the behavioural patterns of some fauna species. Some bird and bat species, for example, are attracted to insects around lights. As a consequence of this, they could become prey for larger predators (e.g. owls) which may lead to changes in population structure and community composition.

Potential artificial lighting impacts from the approved mine are unlikely to significantly increase as a result of the Modification. Works undertaken in areas closer to fauna habitat (e.g. Mount Arthur) would result in greater impacts from artificial lighting on fauna species than works undertaken in areas surrounded by less or no fauna habitat. It is considered unlikely that artificial lighting required for the Modification would significantly impact fauna.

6.2.6 *Dust*

The atmospheric dust emissions produced by the approved mine would increase slightly as a result of the Modification (PAEHolmes, 2012). This increase is primarily associated with ongoing construction activities, mining activities and overburden handling and stockpiling activities.

The approved mine currently operates with a dust monitoring programme. This programme would continue for the Modification. It is unlikely that any flora species or vertebrate species would be adversely impacted either directly or indirectly by any dust increase generated as a result of the Modification.

6.2.7 *Phytophthora cinnamomi*

Infection of native plants by Phytophthora cinnamomi is listed as a key threatening process under Schedule 3 of the TSC Act and dieback caused by the *root-rot fungus (phytophthora cinnamomi)* is listed under the EPBC Act. *Phytophthora cinnamomi* is a soil borne pathogen that is associated with plant deaths in native vegetation in NSW.

The Modification would not increase the susceptibility of plants to *Phytophthora cinnamomi*. *Phytophthora cinnamomi* spreads in water, soil or plant material, generally in moist, wet conditions (DEH, 2006b). The Modification would not increase the spread of soils or plant material at the Mt Arthur Coal Mine. In addition, HVEC currently implement control measures to stop and reduce the spread of weeds which would be continued for the Modification as discussed in **Section 8**.

6.3 Cumulative Impacts on Biodiversity

Cumulative impacts on biodiversity consist of the net effect of all activities that have occurred across a landscape since European settlement. Clearing of habitat in the Hunter Valley commenced in the early 1800s, primarily for agricultural purposes. The Mt Arthur Coal Mine was originally established in a widely cleared landscape, other than for Mount Arthur itself, and cumulative impacts by the mine on biodiversity cannot be considered in isolation from earlier impacts. This can be illustrated by habitat loss data included in the Peake (2006) HRVP. Considering the two dominant woodland communities reported for the Mt Arthur Coal Mine area, Central Hunter Box-Ironbark Woodland is estimated as 68.4% cleared, and Central Hunter Ironbark - Spotted Gum - Grey Box Forest as 60.9% cleared.

In the context of the overall mine, the Modification would result in the loss of 259.9 ha of mixed habitat, approximately 4% of the already active and approved mine operation area. However, the proposed offset comprises of approximately 427 ha of mostly cleared grassland with the net result being a cumulative gain in potential habitat as natural regeneration and active management proceeds. The offset includes conservation of a comparatively large area of *Acacia pendula*, part of the *Acacia pendula* endangered population in the Hunter Catchment and the Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion (approximately 0.4 ha).

6.4 Aquatic Threatened Species

No aquatic threatened species have been recorded within the Modification area during the current surveys conducted by Niche (**Appendix 1**) or previous surveys undertaken at the existing Mt Arthur Coal Mine (**Section 3.3**). As described in **Section 6.1.7**, aquatic habitat features within the Modification area are limited to small ephemeral streams and small farm dams and are unlikely to support threatened aquatic species.

7 Threatened Species Assessment

In the OEH's Recommended Environmental Assessment Requirements for the Modification, the OEH requested an assessment of the significance of impacts in accordance with section 5A of the EP&A Act and the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC, 2007b). However, as the Modification is to be assessed under section 75W Part 3A of the EP&A Act, the investigation and impact assessment was conducted according to the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005).

The following subsections assess the impact of the Modification on NSW State listed endangered populations (**Section 7.1**), TECs (**Section 7.2**), flora species (**Section 7.3**) and fauna species (**Section 7.4**).

7.1 Endangered Populations

7.1.1 *Acacia pendula* in the Hunter Catchment

Background on Acacia pendula in the Hunter Catchment

Acacia pendula A.Cunn. and G.Don (Fabaceae: Mimosoideae) is of the subgenus Phyllodineae having phyllodes as leaves. It is a widely distributed species ranging from Victoria, through NSW into Queensland. In NSW, the species is commonly found on the western slopes, plains and far-western plains. Outside of this range, there are sporadic occurrences of the species in the Hunter Catchment extending from Singleton to Muswellbrook and Wybong. Two disjunct locations have been confirmed at Bylong, still in the Hunter Catchment, but about 50 km from the next known location.

As the name implies, *Acacia pendula* has a weeping pendulous form when mature. However, most of the occurrences in the Hunter Catchment that are clearly not recently planted have an erect, non-pendulous form.

In the Hunter Catchment, the habitat requirements of *Acacia pendula* appear to be relatively general. It is found across Permian, Quaternary and Triassic geology and across 11 soil landscapes. At most of the sites, the acacia plants exhibit a considerable degree of clonal growth often characterised by one dominant tree surrounded by a number of suckers. This characteristic means that these plants are very persistent. Outside of the Hunter Valley the species is described as growing on major river floodplains, on heavy clay soils (Kodela and Harden, 2002) which contrasts with the range of soils and geology that characterise the Hunter occurrences.

Background on the Acacia pendula Listings under the NSW TSC Act

The NSW Scientific Committee has determined that the Hunter Catchment occurrences of the *Acacia pendula* individuals comprise an endangered population. *Acacia pendula* in the Hunter Catchment is also part of the Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion EEC. This EEC is identified by the presence of *Acacia pendula* along with several other species that are also common to other vegetation communities within the Hunter Valley.

Despite the listings under the TSC Act, there is some uncertainty regarding the conservation status of *Acacia pendula* in the Hunter Catchment (Bell *et al.,* 2007). Bell *et al.* (2007) raised the possibility that the occurrences in the Hunter Catchment were of introduced species rather than a disjunct natural occurrence. There is considerable circumstantial evidence that supports this proposition, such as:

- *Acacia pendula* is an attractive tree with pendulous smoky-grey foliage after which the species was named. Because it is attractive, the species has been planted in domestic gardens and other landscaping throughout the Hunter Valley; several have been planted along the entrance to the Mt Arthur Coal Mine.
- Spatial analysis shows that *Acacia pendula* are located at a median distance of 24 m (range 0 – 421 m) from the centreline of the nearest road, also often being beside farm dwellings, infrastructure or near internal tracks. By contrast, records of the often associated *Acacia salicina*, are located at a median distance of 130 m from road centreline (range 2 m to 2 km). *Acacia pendula* has not been recorded in habitat well away from evidence of human activity.
- Geology and soil data point to a species having generalist habitat requirements, an attribute not normally associated with a naturally rare plant species. This would infer that the *Acacia pendula* population in the Hunter Catchment was formerly common and is now rare as a consequence of habitat clearing. However, in the early 1800's botanist Allan Cunningham travelled through the Hunter, across the ranges to the Liverpool Plains making notes on the various plant species encountered. There is no mention of *Acacia pendula* until he reached the Liverpool Plains (National Library of Australia, 2012).
- It is incongruous that a plant that exhibits such persistence, with generalist habitat requirements, would occur so sporadically across the Hunter Catchment. Spatial analysis shows that the median separation of disjunct occurrences is 3 km (range 200 m to 10 km).

In addition to the above, Bell *et al.* (2007) questioned the taxonomic certainty of the acacia plants at the various locations that have been classified as containing *Acacia pendula*. There are two different growth forms, pendulous and non-pendulous. Some of the occurrences of non-pendulous acacia with smoky-grey foliage have been identified as either *Acacia homalophylla* or *Acacia melvillei*.

Notwithstanding the above, this assessment conservatively assumes that the *Acacia pendula* in the Hunter Catchment are a single 'natural' population. It is worthwhile noting that the listing for the endangered population was based on six occurrences (**Figure 17**). Further work since the listing of the species in 2004, has revealed that there are at least 50 sites of *Acacia pendula* in the Hunter Catchment, excluding all garden and landscaping occurrences.

Description of the Occurrence in the Modification Areas

Acacia pendula is located in Modification Area A. It is situated on each side of a portion of Edderton Road, entirely within the existing road reserve, other than for a few suckers extending past the adjoining property fence (**Figure 17**). Not only are they within the road reserve, but they are growing in a dish drain and berm formed at the road edge; thus they are not growing on the original landform. Enquiries with the roads engineer at Muswellbrook Council revealed that the road was formed well over 25 years ago making these plants at least as old, and most likely much older. These patches of *Acacia pendula* are isolated in the landscape surrounded by predominantly cleared paddocks, and have been for decades. The occurrences are also within metres of the approved Mt Arthur Coal Mine (**Figure 17**).

The patch on the eastern side of the road is approximately 0.06 ha while on the western side of the road there are two patches (approximately 0.05 ha and 0.01 ha) about 15 m apart. Both patches combined cover approximately 0.1 ha. On the eastern side of the road, there is one large tree, approximately 8 – 10 m tall surrounded by more juvenile regrowth (ranging from 1 – 3 m tall). The plants on the western side of the road appear to all be young regrowth ranging from 1 – 3 m tall.

There were some flowers on the more mature trees but there were no seed pods on the plants and there was no evidence on the ground that the plants had recently borne seed. The dense nature of the regrowth was more typical of vegetative spread through suckering than through seed germination. This is consistent with observations at other sites with no reports of seed being produced (Bell *et al.,* 2007).

As described in **Section 5.1.2**, a number of *Acacia melvillei* are regrowing on the eastern side of Edderton Road, scattered over about 0.5 ha, and probably appearing as a result of cattle having been removed. This wattle is listed as a component of the NSW EEC *Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion*. The *Acacia pendula* and *Acacia melvillei* patches are about 500 m apart and there is no indication in the surrounding vegetation that these two occurrences were once part of a single community. Thus, they have been left as separate entities.

Acacia pendula also occurs away from the Modification areas. **Figure 17** shows these locations with Site AP1 being in Modification Area A These sites range from 3 – 9 km distant from the Edderton Road Site AP1.

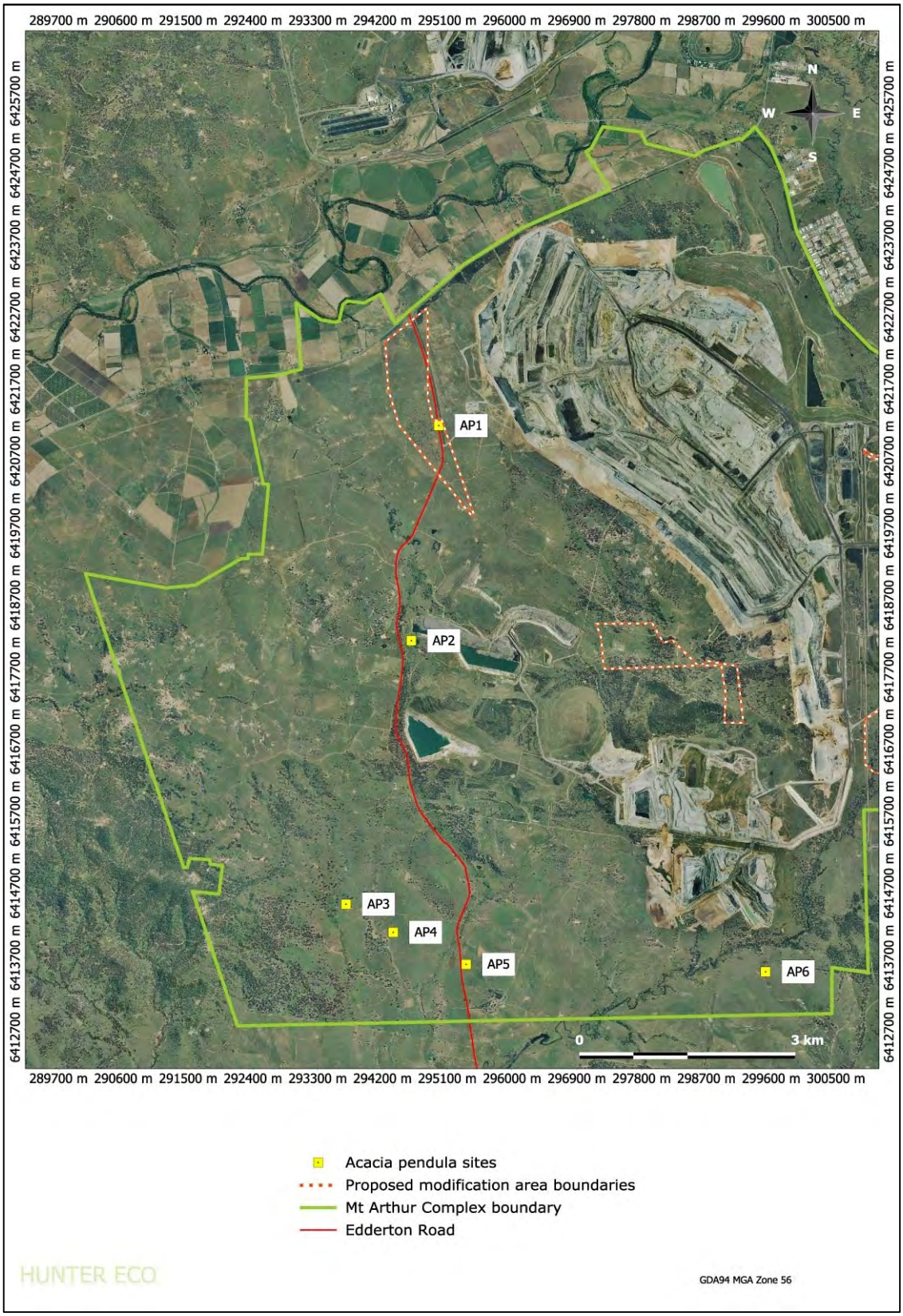


Figure 17: *Acacia pendula* sites

Details of the other sites include:

Site AP2: Located near an old farm house is a large patch of typical pendulous plants covering approximately 0.25 ha. About eight mature trees around 12 m tall were in a neat row indicating that they were planted. These trees have flowered and fruited prolifically with pods carried on the foliage and abundant shed pods on the ground. The plants appeared to have spread through both seed germination and vegetative suckering forming a large dense patch. Seeds have been collected from these plants for the purpose of introducing the species into mine rehabilitation vegetation as required by a current consent condition.

Site AP3: A small patch of regenerating suckering plants about 1 m tall covering an area of about 50 square metres. These plants appear to be responding to reduced grazing pressure.

Site AP4: A group of mature (approximately 12 m tall) trees of the non-pendulous form previously recorded by Umwelt (2007b). These trees were growing in a section of a large erosion contour berm and dish drain and occupied an area of about 0.015 ha.

Site AP5: Three small patches (non-pendulous) were located in close proximity to each other about 1.5 km east of Edderton Road.

Site AP6: A very large patch about 4 km east of Edderton Road growing in a cleared paddock. This group consisted of about 40 trees ranging from 8 – 15 m tall with a number of smaller suckers present. There was also a separate group of low suckering plants about 200 m south-east of the larger population. The area of the large patch was about 0.2 ha and the smaller patch about 0.05 ha. This site is located in an area proposed as an offset to the habitat losses that would be incurred through implementation of the Modification.

Preliminary Genetic Investigation

Recently Hunter Eco and Dr Joe Miller, Commonwealth Scientific and Industrial Research Organisation Acacia geneticist, collected samples of the Acacia *pendula-melvillei-homalophylla* group from the Hunter Valley for a preliminary investigation into the genetics of the group. Included were samples from the Edderton Road *Acacia pendula* and *Acacia melvillei* located within Modification Area A. Also included was a sample of obviously planted *Acacia pendula* from the Mangoola area. Both chloroplast (plastid) DNA and nuclear RNA were compared with known reference data for *Acacia pendula*, *Acacia melvillei*, *Acacia homalophylla* and 12 other western acacia species.

The outcome from eight different locations was:

- The planted sample matched *Acacia pendula* from outside of the Hunter Valley.
- The Edderton Road *Acacia pendula* had the plastid of *Acacia pendula* and the nucleus of *Acacia melvillei*, thus likely a hybrid of the two.
- The Edderton Road *Acacia melvillei* was in fact that species with both plastid and nucleus of *Acacia melvillei*.
- Two other samples were putative *Acacia melvillei* and three were likely hybrids.

These results serve to add caution to plans to propagate these plants until their true identity and origins have been determined through a more comprehensive genetic investigation. The results also highlight the uncertainty associated with identification on morphology alone.

Impact of the Modification on Acacia pendula in the Hunter catchment

How is it likely to affect the lifecycle of the population?

As described above, the Modification would involve removal of approximately 0.1 ha of *Acacia pendula* within the three patches along Edderton Road. It represents loss of one site out of the 50 sites that comprise the endangered population.

Other than the loss of one site, the removal of these plants would have no impact on the *Acacia pendula* population in the Hunter Valley. Genetic exchange between any of the widely separate occurrences would not occur for two reasons: the plants rarely flower, and because the flowers do not carry nectar the only likely pollinators would be native bees collecting pollen. The majority of acacia are self-incompatible meaning that seed can only be produced by pollen being transferred by way of a pollinator to a genetically different plant (Stone *et al.,* 2003). The implication from small native bee pollinators is that pollen will only be transported over short distances, commonly up to 60 m (Krauss, 2000).

As described above, the *Acacia pendula* in the Modification area is located only 30 m from the edge of the approved pit and, as mining progresses, it is likely to be impacted by changes in surface water hydrology, dust and other disturbance.

How is it likely to affect the habitat of the population and community?

The Modification would result in the complete loss of habitat at the specific location where the *Acacia pendula* population and community was recorded (approximately 0.1 ha of the *Acacia pendula* population and community). As described above, the habitat requirements of *Acacia pendula* in the Hunter Catchment appear to be relatively general. It is found across Permian, Quaternary and Triassic geology and across 11 soil landscapes. Thus, the habitat in which the subject population and community are growing is not unique.

Is the population at the limit of its known distribution?

The *Acacia pendula* at Edderton Road are not at the limit of the distribution of the endangered population.

7.1.2 *Diuris tricolor,* the Pine Donkey Orchid Population in the Muswellbrook Local Government Area

This ground orchid is known to occur in a reserve (A171) immediately north of Modification Area E. Nothing is known about its habitat requirements other than that it is generally found in grassy woodland on sandy soil. Potentially, there was suitable habitat for the species in the grassy woodland and derived grassland in Modification Areas B and C.

On 19 September 2012 the orchid was confirmed to be flowering in the A171 reserve so a search was conducted through Modification Areas B and C. No orchids were found.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Modification would not impact the lifecycle of the threatened *Diuris tricolor* as a survey of probable suitable habitat showed that the species was not present.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Modification would not affect known habitat or occurrences of the *Diuris tricolor*.

No critical habitat has been declared in the locality.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The endangered population *Pine Donkey orchid in the Muswellbrook Local Government Area* is at the eastern extent of its overall distribution. However the Modification would not affect any of this endangered population.

7.1.3 *Cymbidium canaliculatum* in the Hunter Catchment

Cymbidium canaliculatum is an arboreal orchid with broad grass-like leaves and is generally found growing in Box eucalypts, although it can also be found in other tree species. There are several records of the species within the Mt Arthur Coal Mine boundary. However, despite a thorough search, none were found in the Modification area. The *E. albens x E. moluccana* hybrid woodland in Modification Area B provided the most suitable habitat.

Two new offset areas are proposed as part of the Modification (**Figure 9**). These offsets would have similar habitat to that found within the Modification area. Thirteen occurrences of *Cymbidium canaliculatum* were recorded in the proposed Middle Deep Creek Offset (**Appendix 8**).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Modification would have no direct effect on the lifecycle of this orchid because none were found in the disturbance areas. The only indirect effect would be the loss of suitable trees in which seed could germinate. The very fine seed of *Cymbidium* are wind dispersed and the nearest *Cymbidium canaliculatum* are approximately 4 km south and south-west of Modification Area B. There is a large amount of suitable habitat within 4 km of these occurrences.

The Modification is not likely to have a negative impact on the endangered population of *Cymbidium canaliculatum.*

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The population is widespread in the Hunter Catchment and the Mt Arthur Coal Mine occurrences are not at the limits of distribution.

The proposal would result in the loss of all the potential habitat in Modification Area B but not in the loss of any individuals. In keeping with the 'improve or maintain' principle the habitat in Modification Area B would be offset at a level that would result in no net habitat loss for this endangered population.

No critical habitat has been declared in the locality.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The species is recorded as far east as the Cessnock-Kurri area in the lower Hunter and up to the foothills of the Liverpool Range in the upper Hunter. The Modification does not affect any part of this endangered population that is at the limits of its distribution.

7.1.4 *Eucalyptus camaldulensis* Population in the Hunter Catchment

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Eucalyptus camaldulensis has been recorded at several locations along the Hunter River to the north and north-west of the Modification. There are no records from within the Mt Arthur Coal Mine, an area that includes the Modification. The proposed Modification would not affect this endangered population.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

There was no suitable habitat for *Eucalyptus camaldulensis* within the Modification.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Eucalyptus camaldulensis is not at the limit of its range in the area containing the Modification.

7.2 Threatened Ecological Communities

7.2.1 Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not relevant in consideration of an EEC.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Section 7.1.1 provides background information on *Acacia pendula*, the key component of Weeping Myall Woodland. The proposal would result in loss of the Edderton Road group of *Acacia pendula,* there being no other species typical of this EEC at that site. However, included in the overall offset strategy for the proposal is a much larger group of *Acacia pendula* (**Section 8.4**) resulting in a net gain in the amount of conserved Weeping Myall Woodland.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Edderton Road *Acacia pendula* plants are not at the limit of the range of Weeping Myall Woodland. The community extends as far south as the Singleton area.

7.2.2 White Box Yellow Box Blakely's Red Gum Woodland

This EEC was mapped in Modification Areas B and C and included both grassy woodland and open grassland that would have once supported one or more of the dominant indicator canopy species (**Figure 8**). A total of 35.2 ha of the open grassland variant and 23.2 ha of the woodland variant was mapped in this area (**Table 15**). This contrasts with 14,818 ha of the woodland habitat mapped for the central Hunter by Peake (2006). Derived grasslands were not included in the Peake (2006) mapping.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not relevant in consideration of an EEC.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Part of the proposal would result in the loss of this EEC in Modification Area B. However, in keeping with 'improve or maintain' principles, appropriate offsets would be provided so that the final outcome of the proposal would be no net loss.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The community is not at the limits of its distribution at this location.

7.2.3 Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions

A total of about 7.1 ha of this EEC was mapped between Modification Areas B, C and D (**Table 15**). The majority of nearly 5 ha was located in the Modification Area C (**Figure 15**). This contrasts with 18,306 ha of this community mapped for the central Hunter by Peake (2006).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not relevant in consideration of an EEC.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Part of the proposal would result in the loss of this EEC in Modification Areas B, C and D. Approximately 7.1 ha of Central Hunter Ironbark – Spotted Gum – Grey Box Forest (MU27) would be removed. The Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC is not present in the proposed offset areas. HVEC would, however, provide an additional offset for this community in a location to be determined.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The community is not at the limits of its distribution at this location.

7.2.4 Hunter Lowlands Redgum Forest in the Sydney Basin and NSW North Coast Bioregions

A total of about 1.7 ha of this EEC was mapped in Modification Area D (**Table 15**; **Figure 15**). This contrasts with 18,300 ha of this community mapped for the central Hunter by Peake (2006).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not relevant in consideration of an EEC.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Part of the proposal would result in the loss of this EEC in Modification Area D. However, in keeping with 'improve or maintain' principles, appropriate offsets would be provided so that the final outcome of the proposal would be no net loss.

No critical habitat has been declared in the locality.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The community is not at the limits of its distribution at this location.

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

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not relevant in consideration of an EEC.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 23 ha of Central Hunter Box – Ironbark Woodland (MU10) would be removed for the Modification. There is an anomaly where the same area of vegetation is representative of two different NSW listed EECs. Being consistent with MU10 of Peake (2006), it would be the NSW EEC *Central Hunter Grey Box – Ironbark Woodland* in the NSW North Coast and Sydney Basin Bioregions with MU10 being described as containing the hybrid box, and MU10 being referenced in that NSW Scientific Committee EEC determination. However, this community will also represent the NSW EEC *White Box Yellow Box Blakely's Red Gum Woodland* because that determination specifically includes intergrades of *Eucalyptus moluccana* with *Eucalyptus albens*.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The community is not at the limits of its distribution at this location.

7.3 Flora

7.3.1 *Diuris tricolor,* the Pine Donkey Orchid

Background

Diuris tricolor is a small terrestrial orchid (NSW Scientific Committee, 2007). It has one to three erect green linear leaves to 30 cm long and a single flower stem arising from the base of the plant with one to six yellow flowers with maroon, purple and white markings (NSW Scientific Committee, 2007). The plant has no physical presence above-ground for most of the year. It shoots its leaves after the first soaking autumn-winter rains and flowers from September to November. This means that surveys for the orchid can only be successful at times when the plants are known to be flowering at least in the vicinity of the site of interest. *Diuris tricolor* is reported to occur in Box/Pine woodlands, usually in habitats with White Cypress Pine (*Callitris glaucophylla*) as one of the dominant species (Burrows, 1999; Bishop, 2000; DLWC, 2002b). However, the majority of records from the Muswellbrook LGA endangered population occur in derived native grassland with little or no canopy cover.

The *Diuris tricolor* occurs at site A171 within the Thomas Mitchell Drive Offset area (**Figure 8**) In 2007, Umwelt undertook a baseline study of the orchid population at monitoring site A171 within the Thomas Mitchell Drive Offset area and developed a Plan of Management for the *Diuris tricolor* (Umwelt, 2008a). The aim of the Plan of Management is to facilitate the appropriate conservation of the population by identifying the current and potential threats to the population and recommending actions for management, including the implementation of an appropriate monitoring programme. The species has since been monitored annually (Umwelt, 2008b, 2010; Cumberland Ecology, 2010d, 2011).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

This ground orchid is known to occur in the Thomas Mitchell Drive Offset area (site A171) immediately north of Modification Area E. Nothing is known about its habitat requirements other than that it is generally found in grassy woodland on sandy soil. Potentially, there was suitable habitat for the species in the grassy woodland and derived grassland in Modification Areas B and C.

On 19 September 2012 the orchid was confirmed to be flowering at site A171 so a thorough search was conducted through Modification Areas B and C. No orchids were found.

The Modification would not affect the lifecycle of this orchid.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

This terrestrial orchid grows in open native grassland as well as grassy woodland. While the species occurs elsewhere in NSW and Queensland, the only records east of the Great Dividing Range are from the Muswellbrook region (NSW Scientific Committee, 2007). Potential habitat was present in Modification Areas B and C.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

In NSW, populations of the species occur on the northern tablelands, central tablelands, north-western slopes and Central Western Slopes (Jones, 1993). *Diuris tricolor* is at the eastern limit of its distribution in the Muswellbrook LGA, and well separated from the main distribution. However, the Modification would not affect any local populations of this orchid.

7.4 Fauna

Table 14 in **Section 5.2.1** provides a list of threatened fauna species which have been recorded within the wider region. This list of threatened fauna species was refined to a list of threatened fauna species with records within or near the Modification area (**Table 18**).

Table 18: Threatened populations, vegetation communities, flora and fauna species that could potentially be impacted by the Modification

Scientific Name	Common Name	Conservation Status[1]	
		TSC Act	EPBC Act
Birds			
Chthonicola sagittata	Speckled Warbler	V	-
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-
Stagonopleura guttata	Diamond Firetail	V	-
Daphoenositta chrysoptera	Varied Sittella	V	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-
Anthochaera phrygia	Regent Honeyeater	CE	E
Tyto novaehollandiae	Masked Owl	V	-
Circus assimilis	Spotted Harrier	V	-
Hieraaetus morphnoides	Little Eagle	V	-
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-
Petroica boodang	Scarlet Robin	V	-
Glossopsitta pusilla	Little Lorikeet	V	-
Neophema pulchella	Turquoise Parrot	V	-
Lathamus discolor	Swift Parrot	E	E
Mammals			
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E
Phascolarctos cinereus	Koala	V	V
Petaurus norfolcensis	Squirrel Glider	V	-
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-
Mormopterus norfolkensis	Eastern Freetail-bat	V	-
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-
Myotis macropus	Southern Myotis	V	-
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-
Vespadelus troughtoni	Eastern Cave Bat	V	-

[1] Threatened population, vegetation community, flora species or fauna species status listed under the TSC Act and/or EPBC Act (current at 24 January 2013).

V = Vulnerable; E = Endangered; CE = Critically Endangered

These threatened fauna species are described in detail in **Sections 7.4.1** to **7.4.10**.

The following threatened waterbird species listed in **Table 14** are unlikely to be affected by the Modification, namely the: Blue-billed Duck (*Oxyura australis*), Freckled Duck (*Stictonetta naevosa*), Black-necked Stork (*Ephippiorhynchus asiaticus*), Australasian Bittern (*Botaurus poiciloptilus*) and Australian Painted Snipe (*Rostratula australis*) due to the absence of ideal habitat. These species may be potential visitors to areas within the Modification, however, it is considered unlikely that these species would occur within the Modification area, given the occurrence of only marginal habitat resources. On this basis, it is considered unlikely that these species would be affected by the Modification. These species are not considered further.

7.4.1 Woodland Bird Species

Introduction

There are a number of threatened woodland birds that may potentially occur within the Modification area based on their known distribution (listed in **Table 14** and discussed in **Section 5.2.1**). However, several woodland birds listed in **Table 14** and discussed in **Section 5.2.1** are not likely to occur in the Modification area or close surrounds and are therefore not listed in **Table 18**.

The following woodland species listed in **Table 14** and discussed in **Section 5.2.1** do not have records within the Modification or close surrounds (**Section 5.2.1**): Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and the Malleefowl (*Leipoa ocellata*). In addition, there is an old record from 1999 in the Birds Australia (2012) database for the Bush Stone-curlew occurring outside of the Modification area to the south of Modification Area E (**Figure 9**). It is considered that this species and habitat for this species does not occur within the Modification area.

The three above-mentioned owls are known to have home ranges of up to 1,000 ha, so at best the Modification area would form a small part of a home range for any of these owls. These owls prey upon small to large arboreal mammals such as gliders, Common Ring-tailed Possums (*Pseudocheirus peregrinus*) and Brush-tailed Possums (*Trichosurus vulpecula*). Historical fauna records, supported by the recent Niche study, show that there is not likely to be sufficient prey species in or around the Modification area to support these birds. Furthermore, the likelihood of these species occurring within the Modification area has considerably decreased as a result of on-going approvals for clearing of potential habitats in adjoining areas. Since these threatened woodland bird species are unlikely to occur within the Modification area, they are unlikely to be affected by the Modification. These species are not considered further.

Threatened Woodland Bird Species Likely to be Affected

Eight threatened woodland birds may be potentially impacted by the Modification, namely the: Speckled Warbler (*Chthonicola sagittata*), Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), Diamond Firetail (*Stagonopleura guttata*), Varied Sittella (*Daphoenositta chrysoptera*), Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*), Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*), Regent Honeyeater (*Anthochaera phrygia*) and Masked Owl (*Ninox novaehollandiae*). All species, except the Black-chinned Honeyeater (eastern subspecies), have been recorded immediately surrounding the Modification area, while the Varied Sittella and Grey-crowned Babbler (eastern subspecies) have been recorded within the Modification area.

None of these woodland bird species were recorded during the current survey within the Modification area conducted by Niche (**Appendix 1**). An assessment on the potential impacts to these species as a result of the Modification is provided below.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The various forms of woodland that occur within the Modification area provide habitat resources for a limited number of threatened woodland species, including the eight threatened woodland bird species listed above. The potential impacts associated with the Modification on the lifecycle of these birds are listed below.

Speckled Warbler (Chthonicola sagittata)

The Speckled Warbler has been recorded in the OEH (2013) and Birds Australia (2012) databases surrounding the Modification area (**Figure 9**). This species has not been previously recorded within the Modification area (**Figure 9**).

The Speckled Warbler nests on the ground in grass tussocks, dense litter and fallen branches (NSW Scientific Committee, 2001b). This species is sedentary and lives in pairs or trios (NSW Scientific Committee, 2001b). The home range of this species varies from 6 to 12 ha (NSW Scientific Committee, 2001b).

The Modification would remove and modify habitat resources potentially used by this species. However, the lack of records from within and surrounding the Modification area indicate that it is unlikely that the Modification would affect the lifecycle of the Speckled Warbler.

Brown Treecreeper (eastern subspecies) (Climacteris picumnus victoriae)

The Brown Treecreeper (eastern subspecies) has been recorded in the OEH (2013) and Birds Australia (2012) databases surrounding the Modification area (**Figure 9**). This species has not been previously recorded within the Modification area (**Figure 9**).

The Brown Treecreeper (eastern subspecies) lays two to three eggs generally in tree hollows and has the highest breeding success in areas with lower shrub densities, moderate levels of ground cover, greater amounts of foraging substrate and greater invertebrate biomass (Garnett *et al.,* 2011).

This species is gregarious and is often seen in family groups of four to five, but a territory may only be defended by one or two birds (Morcombe, 2004).

Fragmentation of habitat disrupts dispersal and recruitment, especially of immature females (Garnett *et al.,* 2011). Connectivity with scattered trees is more important than fragment size for reducing local extinctions and this species is not found in patches less than 700 m from the nearest patch >10 ha unless there are scattered trees <100 m apart (Garnett *et al.,* 2011).

The Modification would remove and modify habitat resources potentially used by this species. However, the lack of records from within and surrounding the Modification area indicate that it is unlikely that the Modification would affect the lifecycle of the Brown Treecreeper (eastern subspecies).

Diamond Firetail (Stagonopleura guttata)

The Diamond Firetail has been recorded surrounding the Modification area by Dames and Moore (2000). Cumberland Ecology (2009a) report that Dames and Moore (2000) recorded this species in dense shrub layers fringing White's Creek in central portions of what is now the Northern Open Cut. In addition, this species has been recorded in the OEH (2013) and Birds Australia (2012) databases surrounding the Modification area (**Figure 9**).

The Diamond Firetail generally nests in loosely scattered colonies, after which in autumn and through winter, large flocks may form (Morcombe, 2004). The nests are bottle-shaped and are built in trees and bushes (NSW Scientific Committee, 2001c).

This species usually occurs in small flocks of 20 to 30 birds (Morcombe, 2004).

The Modification would remove and modify habitat resources potentially used by this species. However, the lack of records from within and surrounding the Modification area indicate that it is unlikely that the Modification would affect the lifecycle of the Diamond Firetail.

Varied Sittella (Daphoenositta chrysoptera)

The Varied Sittella has been recorded surrounding the Modification area and has been recorded once within the Modification area within Modification Area C (Umwelt, 2005) (**Figure 9**). This species was recorded during the 2004 monitoring period near the base of Mount Arthur within the Modification area in tall open forest dominated by mature Spotted Gum (*Corymbia maculata*) (Umwelt, 2005). This species was recorded within Central Hunter Ironbark – Spotted Gum – Grey Box Forest (MU27) within the Modification area (**Figure 15**), which would be removed as part of the Modification.

The Varied Sittella lives in smaller breeding flocks through spring and summer (Morcombe, 2004). This species builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often reuses the same fork or tree in successive years (NSW Scientific Committee, 2010b).

The Modification would remove and modify habitat resources potentially used by this species.

Grey-crowned Babbler (eastern subspecies) (Pomatostomus temporalis temporalis)

The Grey-crowned Babbler (eastern subspecies) has been recorded from areas surrounding the Modification area on several occasions between 2003 and 2009 (**Figure 9**). This species has also been recorded once within the Modification area within Modification Area A (Cumberland Ecology, 2009a) (**Figure 9**). This species was recorded within a plantation stand within the Modification area, which would be removed as part of the Modification.

The Grey-crowned Babbler (eastern subspecies), a sedentary species, is highly gregarious and is typically found in family flocks of about 15 (Morcombe, 2004). This species builds conspicuous dome-shaped nests and breed co-operatively in sedentary family groups of 2 to 13 (NSW Scientific Committee, 2001d).

The Modification would remove and modify habitat resources potentially used by this species.

Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)

The Black-chinned Honeyeater has not been recorded within the Modification area or immediate surrounds. However, potential roosting and foraging resources for this species are present within the Modification area.

The Black-chinned Honeyeater (eastern subspecies) is sedentary, migratory and locally nomadic (Morcombe, 2004). This species build suspended, cup-shaped nests in which two eggs are usually laid (Garnett *et al*., 2011; NSW Scientific Committee, 2001e).

The Modification would remove and modify habitat resources potentially used by this species. However, the lack of records from within and surrounding the Modification area indicate that it is unlikely that the Modification would affect the lifecycle of the Black-chinned Honeyeater (eastern subspecies).

Regent Honeyeater (Anthochaera phrygia)

The Regent Honeyeater has not been recorded within the Modification area or immediate surrounds. However, potential foraging habitat, due to the high nectar resources associated with Eucalyptus-dominated communities found within the Modification area, and shelter resources for this species are present. There is a national recovery plan for this species (Menkhorst *et al.*, 1999).

The Regent Honeyeater builds a cup-shaped nest of fibres located in forks in live eucalypt (including *Angophora*) or she-oak canopy (NSW Scientific Committee, 2010c). A clutch of two or three eggs is laid from late winter to early summer, with multiple attempts per season (NSW Scientific Committee, 2010c).

Breeding sub-populations mainly occur around Capertee Valley in central-eastern NSW and the Bundarra-Barraba region in northern inland NSW (NSW Scientific Committee, 2010c).

The Modification would remove and modify foraging and shelter habitat resources potentially used by this species. However, the lack of records from within and surrounding the Modification area indicate that it is unlikely that the Modification would affect the lifecycle of the Regent Honeyeater.

Masked Owl (Ninox novaehollandiae)

The Masked Owl has not been recorded within the Modification area or immediate surrounds. However, potential roosting and foraging habitat is found within the Modification area. There is a state recovery plan for the Masked Owl (DEC, 2006).

The Masked Owl roosts and nests in heavy woodland areas (Morcombe, 2004). This species roosts during the day in tree hollows, caves and dense foliage including exotic trees (DEC, 2006).

This species has a clutch of one to four eggs in the wild and a single clutch is laid per year or sometimes there is no breeding within a year (DEC, 2006).

The Masked Owl lives as monogamous, sedentary life-long pairs in large permanent home ranges (DEC, 2006).

The Modification would remove and modify habitat resources potentially used by this species. However, the lack of records from within and surrounding the Modification area indicate that it is unlikely that the Modification would affect the lifecycle of the Masked Owl.

A number of existing measures were developed to avoid and mitigate potential impacts on these species as they occur in the surrounds. These measures would continue to be implemented for the Modification:

- Control of weeds to minimise their potential to degrade the species potential habitat on Company-owned land.
- Pest control to minimise the potential for pests to impact these species or their habitats.
- Nest box monitoring and maintenance to ensure that nest boxes located outside of the Modification area are maintained and suitable for bird species.
- Vegetation clearance procedures, such as pre-clearance surveys of forests and woodland areas to be removed, would be undertaken to identify the presence of any threatened bird species. Clearing activities would avoid (where possible), the breading season of threatened birds known to occur within the area.
- Creation of habitat corridors to link isolated remnant vegetation stands.
- Control of dust emissions to minimise the potential for dust to impact these species.
- Implement noise control measures to minimise the potential for noise to impact these species.

In addition, two new offset areas are proposed as part of the Modification (**Figure 9**). These offsets would have similar habitat to that found within the Modification area. The habitat within the proposed offsets would also provide potential habitat for the threatened woodland bird species listed above. The following woodland birds have been confirmed as occurring in the proposed Middle Deep Creek Offset: Brown Treecreeper, Diamond Firetail, Grey-crowned Babbler, Speckled Warbler, Hooded Robin, Little Lorikeet and Varied Sitella (**Appendix 8**).

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Modification would remove and modify approximately 53.4 ha of potential/actual habitat resources potentially used by the above eight woodland species. In the case of the Brown Treecreeper (eastern subspecies), Diamond Firetail, Black-chinned Honeyeater (eastern subspecies), Regent Honeyeater and Masked Owl, these resources are limited and have not been previously widely used. The habitat within the Modification area is also highly fragmented due to the previous works undertaken at the Mt Arthur Coal Mine. Mitigation measures, such as the creation of habitat corridors, would provide links to other areas of potential habitat for these species outside of the Modification area. In addition, none of these species were recorded utilising habitat within the Modification area during the recent survey conducted by Niche (**Appendix 1**).

It is unlikely that the Modification would significantly affect, if at all, the above woodland birds.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

None of the eight woodland bird species are at the limits of their ranges in the study area. In NSW, the Speckled Warbler, Brown Treecreeper (eastern subspecies), Diamond Firetail and Grey-crowned Babbler (eastern subspecies) are found west of the Great Dividing Range (NSW Scientific Committee, 2001b, 2001c, 2001d, 2001f; Blakers *et al.,* 1984; Schodde and Mason, 1999). Speckled Warbler, Brown Treecreeper (eastern subspecies), Diamond Firetail and Black-chinned Honeyeater (eastern subspecies) populations also occur in drier coastal areas such as the Cumberland Plain, Western Sydney and the Hunter and Snowy River valleys (Blakers *et al.,* 1984; Schodde and Mason, 1999; NSW Scientific Committee, 2001b, 2001c, 2001e, 2001f).

The Grey-crowned Babbler (eastern subspecies) is less common at higher altitudes of the tablelands (NSW Scientific Committee, 2001d) and isolated populations are known from coastal woodlands on the North Coast, in the Hunter Valley and from the South Coast near Nowra (Blakers *et al.,* 1984; Schodde and Mason, 1999).

The Varied Sittella has a nearly continuous distribution in NSW from the coast to the far west (Higgins and Peter, 2002; Barrett *et al.,* 2003).

Within NSW, breeding sub-populations of the Regent Honeyeater are fragmented and occur mainly around the Capertee Valley in central-eastern NSW and the Bundarra-Barraba region in northern inland NSW (NSW Scientific Committee, 2010c). Minor and sporadic breeding occurs in other areas such as Warrumbungle National Park, Pilliga forests, Mudgee-Wollar region, and the Hunter and Clarence Valleys (NSW Scientific Committee, 2010c).

7.4.2 Birds of Prey

Introduction

Two birds of prey, the Spotted Harrier (*Circus assimilis*) and Little Eagle (*Hieraaetus morphnoides*), have been previously recorded in the general locality surrounding the Modification. None of these birds of prey were recorded during the current survey within the Modification area conducted by Niche (**Appendix 1**). An assessment on the potential impacts to these species as a result of the Modification is provided below.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Spotted Harrier was recorded by Umwelt (2007b) to the immediate west of proposed Modification Area A and was recorded to the west and south of the Modification in the OEH (2013) and Birds Australia (2012) databases (**Figure 9**).

The Spotted Harrier is nomadic, part migratory or dispersive, its movements linked to abundance of prey species (Morcombe, 2004). This species builds a stick nest in a tree and lays eggs in spring or autumn, with young remaining in the nest for several months (NSW Scientific Committee, 2010d).

The Little Eagle was recorded by Umwelt (2007b), however, the exact location of the species record is unknown. In addition, this species was recorded in the OEH (2013) and Birds Australia (2012) databases immediately north and south of Modification Area E and to the west of the Modification (**Figure 9**).

The Little Eagle is sedentary in adulthood and dispersive when young (Morcombe, 2004). For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring (NSW Scientific Committee, 2010e).

The results of past and current Mt Arthur Coal Mine fauna surveys show that prey species for these raptors would most likely be introduced rodents and rabbits, along with native birds. The Modification area is located at the edge of thousands of hectares of woodland/grassland mosaic across which these species could forage.

It is unlikely that the Modification would affect the lifecycle of the Spotted Harrier or Little Eagle, as indicated by the lack of records within and immediately surrounding the Modification area. The Modification would remove and modify minor habitat resources potentially used by these species.

A number of existing measures were developed to avoid and mitigate potential impacts on these species as they occur in the surrounds. These measures would continue to be implemented for the Modification:

- Vegetation clearance procedures, such as pre-clearance surveys of forests and woodland areas to be removed, would be undertaken to identify the presence of any threatened bird species. The critical time for birds of prey is when they are nesting. If any active nests of threatened birds of prey are found during pre-clearance surveys clearing should be delayed until the young have left the nest. To avoid long delays, it would be preferable that woodland and forest clearing be conducted outside of the known breeding season of these birds.
- Creation of habitat corridors to link isolated remnant vegetation stands.
- Control of dust emissions to minimise the potential for dust to impact these species.
- Implement noise control measures to minimise the potential for noise to impact these species.

In addition, two new offset areas are proposed as part of the Modification (**Figure 9**). These offsets would have similar habitat to that found within the Modification area. The habitat within the proposed offsets would also provide potential habitat for the threatened birds of prey listed above.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Modification would remove and modify approximately 226.4 ha of potential/actual habitat resources potentially used by the above two bird of prey species. These resources are limited for the Spotted Harrier and Little Eagle and have not been previously widely used. The habitat within the Modification area is also highly fragmented due to the previous works undertaken at the Mt Arthur Coal Mine. Mitigation measures, such as the creation of habitat corridors, would provide links to other areas of potential habitat for these species outside of the Modification area. In addition, none of these species were recorded as utilising habitat within the Modification area during the recent survey conducted by Niche (**Appendix 1**).

It is unlikely that the Modification would significantly affect, if at all, the above bird of prey species.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The two bird of prey species are not at the limits of their ranges in the study area. Spotted Harrier and Little Eagle individuals disperse widely in NSW and comprise a single population (NSW Scientific Committee, 2010d, 2010e). The Little Eagle occurs in most parts of NSW except the densely forested areas of the Dividing Range escarpment (NSW Scientific Committee, 2010e).

7.4.3 Robins

Introduction

Two robin species, the Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*) and Scarlet Robin (*Petroica boodang*), have been previously recorded in the general locality surrounding the Modification. None of these robins were recorded during the current survey within the Modification area conducted by Niche (**Appendix 1**). An assessment on the potential impacts to these species as a result of the Modification is provided below.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Hooded Robin (south-eastern form) was recorded by Dames and Moore (2000), however, the exact location of the species record is unknown. In addition, this species was recorded in the Birds Australia (2012) database approximately 6 km from Modification Area D (**Figure 9**).

The Hooded Robin (south-eastern form) is sedentary in adulthood and dispersive when young (Morcombe, 2004). Hooded Robins live in small family groups of pairs or trios with an average home range of 18 ha (NSW Scientific Committee, 2001g). This species is highly mobile and builds a cup nest and usually lays two eggs (NSW Scientific Committee, 2001g; Garnett *et al*., 2011). The Hooded Robin has a nesting territory of approximately 6-50 ha which it defends in breeding pairs or groups (Garnett *et al*., 2011).

The Scarlet Robin has not been recorded within the Modification area or immediate surrounds. However, potential foraging resources for this species are present within the Modification area.

The Scarlet Robin is locally migratory or dispersive (Morcombe, 2004). This species appears to mostly breed in rainforest with nests usually placed near the top of the sub-canopy at a mean height of 5.5 m (Garnett *et al*., 2011). The open cup nest is often placed in the fork of a tree, constructed from fibres and cobwebs (NSW Scientific Committee, 2010f).

It is unlikely that the Modification would affect the lifecycle of the Hooded Robin (south-eastern form) or Scarlet Robin, due to the lack of records within and surrounding the Modification area. The Modification would remove and modify minor habitat resources potentially used by these species.

A number of existing measures were developed to avoid and mitigate potential impacts on these species as they occur in the surrounds. These measures would continue to be implemented for the Modification:

- Vegetation clearance procedures, such as pre-clearance surveys of forests and woodland areas to be removed, would be undertaken to identify the presence of any threatened bird species.
- Creation of habitat corridors to link isolated remnant vegetation stands.
- Control of dust emissions to minimise the potential for dust to impact these species.
- Implement noise control measures to minimise the potential for noise to impact these species.

In addition, two new offset areas are proposed as part of the Modification (**Figure 9**). These offsets would have similar habitat to that found within the Modification area. The habitat within the proposed offsets would also provide potential habitat for the threatened robin species listed above. The Hooded Robin was confirmed to occur within the proposed Middle Deep Creek Offset area (**Appendix 8**).

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Modification would remove and modify approximately 53.4 ha of potential/actual habitat resources potentially used by the above two robin species. These resources are limited for the Hooded Robin (south-eastern form) and Scarlet Robin and have not been previously widely used. The habitat within the Modification area is also highly fragmented due to the previous works undertaken at the Mt Arthur Coal Mine. Mitigation measures, such as the creation of habitat corridors, would provide links to other areas of potential habitat for these species outside of the Modification area. In addition, none of these species were recorded as utilising habitat within the Modification area during the recent survey conducted by Niche (**Appendix 1**).

It is unlikely that the Modification would significantly affect, if at all, the above robin species.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The two robin species are not at the limits of their ranges in the study area. The Hooded Robin (south-eastern form) occurs throughout NSW except for the north-west of the state (Schodde and Mason, 1999). In NSW, the Scarlet Robin occupies open forests and woodlands from the coast to the inland slopes (Higgins and Peter, 2002).

7.4.4 *Parrots*

Introduction

Three parrot species, the Little Lorikeet (*Glossopsitta pusilla*), Turquoise Parrot (*Neophema pulchella*) and Swift Parrot (*Lathamus discolor*), have been previously recorded or tentatively recorded in the general locality surrounding the Modification, or the Modification area is considered to represent potential habitat for the species. None of these parrot species were recorded during the current survey within the Modification area conducted by Niche (**Appendix 1**). An assessment on the potential impacts to these species as a result of the Modification is provided below.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Little Lorikeet (Glossopsitta pusilla)

The Little Lorikeet was recorded by Umwelt (2007b) to the south-west of the Modification (**Figure 9**). In addition, this species has been recorded to the east and west of the Modification in the Birds Australia (2012) and OEH (2013) databases (**Figure 9**).

The Little Lorikeet is a nomadic species and is gregarious, usually foraging in small flocks, often with other species of lorikeet (NSW Scientific Committee, 2009a). This species nests in small hollows, approximately 3 cm in diameter that are located at heights of between 2 and 15 m, mostly in Blakely's Red Gum (*Eucalyptus blakelyi*), Manna Gum (*E. viminalis*) and Tumbledown Gum (*E. dealbata*) (NSW Scientific Committee, 2009a).

Turquoise Parrot (Neophema pulchella)

The Turquoise Parrot was tentatively recorded during surveys for the Bayswater No. 3, but exact locations were not recorded (Cumberland Ecology, 2009a).

The Turquoise Parrot is semi-nomadic and seldom forms large flocks and is commonly encountered in pairs of six to eight birds (Morcombe, 2004; NSW National Parks and Wildlife Service [NPWS], 1999a). The Turquoise Parrot usually nests less than 2 m above the ground in hollows of small trees, dead eucalyptus or in holes or stumps, fence posts or even logs lying on the ground (NPWS, 1999a).

Swift Parrot (Lathamus discolor)

The Swift Parrot has not been recorded within the Modification area or immediate surrounds. However, potential foraging habitat, due to the high nectar resources associated with Eucalyptus-dominated communities found within the Modification area and shelter resources for this species are present. There is a national recovery plan for the Swift Parrot (Birds Australia, 2011).

The Swift Parrot breeds in Tasmania and migrates to overwinter on the mainland in flowering woodlands and forests (Garnett *et al*., 2011). This species distribution fluctuates with food availability as they feed on psyllid lerps, seeds and fruit (Garnett *et al*., 2011).

It is unlikely that the Modification would affect the lifecycle of the Little Lorikeet, Turquoise Parrot or Swift Parrot, as indicated by the lack of records within and surrounding the Modification area. The Modification would remove and modify minor habitat resources potentially used by these species.

A number of existing measures were developed to avoid and mitigate potential impacts on these species as they occur in the surrounds. These measures would continue to be implemented for the Modification:

- Nest box monitoring and maintenance to ensure that nest boxes located outside of the Modification area are maintained and suitable for bird species.
- Vegetation clearance procedures, such as pre-clearance surveys of forests and woodland areas to be removed, would be undertaken to identify the presence of any threatened bird species.
- Creation of habitat corridors to link isolated remnant vegetation stands.
- Control of dust emissions to minimise the potential for dust to impact these species.
- Implement noise control measures to minimise the potential for noise to impact these species.

In addition, two new offset areas are proposed as part of the Modification (**Figure 9**). These offsets would have similar habitat to that found within the Modification area. The habitat within the proposed offsets would also provide potential habitat for the threatened parrot species listed above. The Little Lorikeet has been confirmed to occur in the proposed Middle Deep Creek Offset (**Appendix 8**).

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Modification would remove and modify approximately 53.4 ha of potential/actual habitat resources potentially used by the above three parrot species. These resources are limited for the Little Lorikeet, Turquoise Parrot and Swift Parrot and have not been previously widely used. The habitat within the Modification area is also highly fragmented due to the previous works undertaken at the Mt Arthur Coal Mine. Mitigation measures, such as the creation of habitat corridors, would provide links to other areas of potential habitat for these species outside of the Modification area. In addition, none of these species were recorded utilising habitat within the Modification area during the recent survey conducted by Niche (**Appendix 1**).

It is unlikely that the Modification would significantly affect, if at all, the above parrot species.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The three parrot species are not at the limits of their ranges in the study area. In NSW, the Little Lorikeet is distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri (Barrett *et al.,* 2003). The Turquoise Parrot occurs mainly on the western side of the tablelands, inland slopes and adjoining plains in the eastern half of NSW, and in some dry coastal valleys (especially in the Sydney Basin) (NSW Scientific Committee, 2009b). The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds (NSW Scientific Committee, 2000). This species is found in Tasmania the remaining months where it breeds (NSW Scientific Committee, 2000).

7.4.5 Spotted-tailed Quoll

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) was tentatively recorded during the first half of 2006 by a HVEC staff member on the main access road to the Mt Arthur Coal offices close to the intersection with Thomas Mitchell Drive (Umwelt, 2007a). An earlier possible sighting of the Spotted-tailed Quoll was also made on a haul road in the Bayswater mining area (Umwelt, 2007a). This species was not recorded during the current survey within the Modification area conducted by Niche (**Appendix 1**). There is draft national recovery plan for the Spotted-tail Quoll (Long and Nelson, 2004).

Spotted-tail Quolls are solitary and occupy a very large home range that for females can range from 180 - 1,000 ha and for males can range from 2,000 - 5, 000 ha (Van Dyck and Strahan, 2008). This means that the Modification area would, at best, be a small part of a home range for this species.

Suitable den sites for this species includes hollow logs, tree hollows, rocky outcrops and caves (SEWPaC, 2012b).

It is unlikely that the Modification would affect the lifecycle of the Spotted-tail Quoll, due to the low abundance of potential den sites within the Modification area caused by the long history of disturbance at the Mt Arthur Coal Mine site. In addition, there have been no confirmed records of this species in close proximity to the Modification with the closest record from the OEH (2013) database approximately 4.5 km south-west of the Modification (**Figure 10**).

A number of existing measures were developed to avoid and mitigate potential impacts on these species as they occur in the surrounds. These measures would continue to be implemented for the Modification:

- Control of weeds to minimise their potential to degrade the species potential habitat on Company-owned land.
- Pest control to minimise the potential for pests to impact this species or its habitats.
- Vegetation clearance procedures, such as pre-clearance surveys of forests and woodland areas to be removed, would be undertaken to identify the presence of any Spotted-tailed Quolls. Should any Spotted-tailed Quolls be recorded, they would be captured and translocated to potential habitat outside of the Modification area into one of the conservation, offset or revegetation areas.
- Creation of habitat corridors to link isolated remnant vegetation stands.

- Control of dust emissions to minimise the potential for dust to impact this species.
- Implement noise control measures to minimise the potential for noise to impact this species.

In addition, two new offset areas are proposed as part of the Modification (**Figure 10**). These offsets would have similar habitat to that found within the Modification area. The habitat within the proposed offsets would also provide potential habitat for the Spotted-tailed Quoll.

These on-going measures would continue to benefit wildlife following the implementation of the Modification as discussed further in **Section 8**.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Spotted-tail Quoll is recorded in a wide range of treed habitats including tropical, subtropical and temperate rainforests, vine thickets, wet and dry sclerophyll forest, woodland and coastal scrub (Van Dyck and Strahan, 2008).

The Modification would remove and modify approximately 226.4 ha potential/actual foraging habitat resources in the form of woodland, forest and grassland used by the Spotted-tailed Quoll. However, these resources are limited given that it is highly fragmented and has not been previously widely used. As described previously, there is a low abundance of potential den sites within the Modification area. In addition, this species was not recorded as utilising habitat within the Modification area during the recent survey conducted by Niche (**Appendix 1**).

It is unlikely that the Modification would significantly affect, if at all, the Spotted-tailed Quoll.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Spotted-tailed Quoll is not at the limit of its range in the study area. Spotted-tailed Quoll records are generally confined to within 200 km of the coast and range from the Queensland border to Kosciuszko National Park (SEWPaC, 2012b).

7.4.6 Koala

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Koala (*Phascolarctos cinereus*) has been recorded once in the OEH (2013) database in the Thomas Mitchell Drive Off-site Offset area, approximately 3.2 km north of Modification Area E and within the approved Mt Arthur Coal Mine to the south-west of the Thomas Mitchell Drive Offset area (HVEC, pers. comm., 2012) (**Figure 10**). The Koala recorded within the approved Mt Arthur Coal Mine was a lone male most likely looking for a mate (HVEC, pers. comm., 2012). The Koala was taken by wildlife carers who relocated him into a rehabilitated area near where he was originally found (HVEC, pers. comm., 2012). This species was not recorded during the current survey within the Modification area conducted by Niche (**Appendix 1**). There is state recovery plan for the Koala (DECC, 2008b).

Koalas spend most of their time with a home range which varies according to the local abundance of preferred food trees (Van Dyck and Strahan, 2008). In high quality habitat, this home range may be as small as 1-2 ha while in less favourable habitat, such as semiarid country, home range may be as large as 100 ha, with males occupying a larger home range than females (Van Dyck and Strahan, 2008).

The Modification would remove and modify minor habitat resources potentially used by this species.

A number of existing measures were developed to avoid and mitigate potential impacts on these species as they occur in the surrounds. These measures would continue to be implemented for the Modification:

- Control of weeds to minimise their potential to degrade the species potential habitat on Company-owned land.
- Pest control to minimise the potential for pests to impact this species or its habitats.
- Vegetation clearance procedures, such as pre-clearance surveys of forests and woodland areas to be removed, would be undertaken to identify the presence of any Koalas. Should any Koalas be recorded, they would be captured and translocated to potential habitat outside of the Modification area into one of the conservation, offset or revegetation areas.
- Creation of habitat corridors to link isolated remnant vegetation stands.

- Control of dust emissions to minimise the potential for dust to impact this species.
- Implement noise control measures to minimise the potential for noise to impact this species.

In addition, two new offset areas are proposed as part of the Modification (**Figure 10**). These offsets would have similar habitat to that found within the Modification area. The habitat within the proposed offsets would also provide potential habitat for the Koala.

These on-going measures would continue to benefit wildlife following the implementation of the Modification as discussed further in **Section 8**.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Koalas occur in a fragmented range in eastern Australia, in foothills and coastal plains, as well as in coastal forests further north along watercourses where River Red Gums (*Eucalyptus camaldulensis*) occurs (Van Dyck and Strahan, 2008). This species inhabits a range of eucalypt forest and woodland communities (Van Dyck and Strahan, 2008).

The Modification would remove and modify approximately 53.4 ha of potential/actual habitat resources in the form of woodland and forest used by the Koala. However, these resources are limited given that the habitat is highly fragmented and has not been previously widely used. In addition, this species was not recorded as utilising habitat within the Modification area during the recent survey conducted by Niche (**Appendix 1**).

It is unlikely that the Modification would significantly affect, if at all, the Koala.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Koala is not at the limit of its range in the study area. The Koala mainly occurs on the Central and North Coasts, although significant populations also exist on the Western Slopes and Plains, such as in the Pilliga region and Gunnedah and Walgett LGAs (SEWPaC, 2012b). Koalas are known from a number of sites on the Central and Southern Tablelands and there are also records from the Northern Tablelands (SEWPaC, 2012b).

7.4.7 Squirrel Glider

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Squirrel Glider (*Petaurus norfolcensis*) has been recorded in the general locality surrounding the Modification area on several occasions between 2003 and 2010 (**Figure 10**). This species was recorded in a nest box to the immediate north of Modification Area E (Cumberland Ecology, 2010c) (**Figure 10**). This species has also been recorded in close proximity to Modification Areas B and C (**Figure 10**). This species was not recorded during the current survey within the Modification area conducted by Niche (**Appendix 1**).

Home ranges of the Squirrel Glider have been estimated between 0.65-8.55 ha (NPWS, 1999b). Movements tend to be greater for males than females and the range of a family group is likely to vary according to habitat quality and availability of resources (NPWS, 1999b).

The Modification area is situated in a highly modified landscape and may not contain habitat components critical to the lifecycle of this species.

It is unlikely that the Modification would affect the lifecycle of the Squirrel Glider, due to the low abundance of habitat resources within the Modification area caused by the long history of disturbance at the Mount Arthur site. The Modification would remove and modify minor habitat resources potentially used by this species.

A number of existing measures were developed to avoid and mitigate potential impacts on these species as they occur in the surrounds. These measures would continue to be implemented for the Modification:

- Control of weeds to minimise their potential to degrade the species potential habitat on Company-owned land.
- Pest control to minimise the potential for pests to impact this species or its habitats.
- Nest box monitoring and maintenance to ensure that nest boxes located outside of the Modification area are maintained and suitable for Squirrel Gliders.
- Vegetation clearance procedures, such as pre-clearance surveys of forests and woodland areas to be removed, would be undertaken to identify the presence of any Squirrel Gliders. Should any Squirrel Gliders be recorded, they would be captured and translocated to potential habitat outside of the Modification area into one of the conservation, offset or revegetation areas.
- Creation of habitat corridors to link isolated remnant vegetation stands.

- Control of dust emissions to minimise the potential for dust to impact this species.
- Implement noise control measures to minimise the potential for noise to impact this species.

In addition, two new offset areas are proposed as part of the Modification (**Figure 10**). These offsets would have similar habitat to that found within the Modification area. The Squirrel Glider has been confirmed to occur in the Middle Deep Creek Offset (**Appendix 8**).

These on-going measures would continue to benefit wildlife following the implementation of the Modification as discussed further in **Section 8**.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Squirrel Glider is primarily found in woodland and open forest, with an overstorey including *Eucalyptus* spp., *Angophora* spp. or *Corymbia* spp. and a shrubby understorey of *Acacia* spp. or *Banksia* spp. (Van Dyck and Strahan, 2008). Those flora species appear to be important components of the Squirrel Glider habitat, and provide a winter source of nectar and hollow-bearing trees for shelter (Van Dyck and Strahan, 2008).

The Modification would remove and modify approximately 53.4 ha of potential/actual habitat resources in the form of woodland and forest used by the Squirrel Glider. However, these resources are limited given that the habitat is highly fragmented and has not been previously widely used. In addition, this species was not recorded utilising habitat within the Modification area during the recent survey conducted by Niche (**Appendix 1**).

It is unlikely that the Modification would significantly affect, if at all, the Squirrel Glider.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Squirrel Glider is not at the limit of its range in the study area. In NSW, this species occurs on the North Coast and on the inland slopes, probably as two populations as it is sparse or absent on the higher elevations of the tablelands (NSW Scientific Committee, 2008).

7.4.8 Grey-headed Flying-fox

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded within the Modification area during the current surveys conducted by Niche (**Appendix 1**). This species was recorded within the Modification Area C in the Central Hunter Ironbark – Spotted Gum – Grey Box Forest (MU27) vegetation community, which would be removed as part of the Modification (**Figure 10**). The species was seen foraging for nectar and pollen on blossoming Spotted Gum. No breeding or roosting colonies were present. There is a draft national recovery plan for the Grey-headed Flying-fox (DECCW, 2009b).

The breeding range of the Grey-headed Flying-fox is currently from Maryborough to Melbourne (Van Dyck and Strahan, 2008). Up to 75% of foraging forays are within 20 km of the camp, but may be up to 50 km for a productive food source (Van Dyck and Strahan, 2008).

While the Grey-headed Flying-fox may be attracted to foraging within the Modification area, a number of existing measures were developed to avoid and mitigate potential impacts on this species as it occurs in the surrounds. These measures would continue to be implemented for the Modification. Pre-clearance surveys of forests and woodland areas to be removed would be undertaken to identify the presence of any Grey-headed Flying-foxes. Should any Grey-headed Flying-foxes be recorded, they would be captured and translocated to potential habitat outside of the Modification area into one of the conservation, offset or revegetation areas. These areas have been developed to ensure that potential habitat for these species is available surrounding the Modification. In addition, several habitat corridors have been created to link isolated remnant vegetation stands.

Two new offset areas are proposed as part of the Modification. These offsets would have similar habitat to that found within the Modification area (**Figure 10**). The Grey-headed Flying-fox has been confirmed to occur in the Middle Deep Creek Offset (**Appendix 8**).

These on-going measures would continue to benefit wildlife following the implementation of the Modification as discussed further in **Section 8**.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Grey-headed Flying-fox roosts by day, gives birth and mates at 'camps' in dense riparian vegetation (Van Dyck and Strahan, 2008). Grey-headed Flying-foxes form camps in almost any dense vegetation greater than 3 m in height and usually roost near water in stands of vegetation such as mangrove, rainforest, Melaleuca, Casuarina or introduced trees (Churchill, 2008).

The Modification would remove and modify approximately 53.4 ha of potential/actual foraging and roosting habitat resources in the form of woodland and forest used by the Grey-headed Flying-fox. These resources are limited given that the habitat is highly fragmented.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Grey-headed Flying-fox is not at the limit of its range in the study area (SEWPaC, 2012b).

7.4.9 Tree-dwelling Bats

Introduction

This section assesses the potential impacts of the Modification on tree-dwelling bat species. There are a number of threatened tree-dwelling bat species that may potentially occur within the Modification area based on their known distribution (listed in **Table 14** and discussed in **Section 5.2.1**). However, one species (the Corben's Long-eared Bat [*Nyctophilus corbeni*]) listed in **Table 14** and discussed in **Section 5.2.1** is not likely to occur in the Modification area or close surrounds and is therefore not listed in **Table 18**.

The Corben's Long-eared Bat is unlikely to be affected by the Modification. It is considered unlikely that this species would occur within the Modification area, as indicated by the lack of records for this species in the Modification area and close surrounds. On this basis, it is considered unlikely that this species would be affected by the Modification. This species is not considered further.

Threatened Tree-dwelling Bat Species Likely to be Affected

Five threatened tree-dwelling bat species may be potentially impacted by the Modification, namely the: Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Southern Myotis (*Myotis adversus*).

The Eastern Freetail-bat was recorded within the Modification area while the Eastern False Pipistrelle was possibly recorded within the Modification area during the recent surveys conducted by Niche (**Appendix 1**). An assessment on the potential impacts to these species as a result of the Modification is provided below.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Yellow-bellied Sheathtail-bat has been recorded in the general locality of the Modification by Dames and Moore (2000). This species was detected using echolocation recording during the Northern Open Cut study, where it was recorded foraging over Spotted Gum open forest remnants associated with the north-eastern slopes of Mount Arthur (Cumberland Ecology, 2009a). The exact location of this record is unknown, however, it may be close to or within the Modification Area C. This species was also detected by Dames and Moore (2000) foraging over remnant woodland and open forest in the northern and eastern sections of the Northern Open Cut Project area (Cumberland Ecology, 2009a), however, exact locations are unknown.

Spotted Gum forest and woodland would be removed as part of the Modification. This species has also been recorded in the OEH (2013) database surrounding the Modification (**Figure 11**). This species was not recorded during the current surveys conducted by Niche (**Appendix 1**) within the Modification area.

The Eastern Freetail-bat was recently recorded by Niche (**Appendix 1**) within the Modification area in Modification Areas C and D (**Figure 11**). This species has also been recorded during previous surveys surrounding the Modification (**Figure 11**). This species was recorded within the Central Hunter Ironbark – Spotted Gum – Grey Box Forest (MU27) vegetation community (**Figure 15**), which would be removed as part of the Modification.

The Eastern False Pipistrelle was possibly recorded during the current surveys (**Appendix 1**) within the Modification area in Modification Area A (**Figure 11**). This species was recorded in the Central Hunter Box - Ironbark Woodland Wybong Slaty Box Variant vegetation community (**Figure 15**), which would be removed as part of the Modification.

The Greater Broad-nosed Bat has been previously recorded in the general locality surrounding the Modification area by Umwelt (2007b) and has also been recorded in the OEH (2013) database (**Figure 11**). This species was not recorded during the current surveys conducted by Niche (**Appendix 1**) within the Modification area.

The Southern Myotis has been previously recorded within the Modification area within the Modification Area C (**Figure 11**). This species has also been recorded on numerous occasions surrounding the Modification and was recorded in the OEH (2013) database (**Figure 11**). This species was recorded within the Central Hunter Ironbark – Spotted Gum – Grey Box Forest (MU27) vegetation community, which would be removed as part of the Modification (**Figure 15**). This species was not recorded during the current surveys conducted by Niche (**Appendix 1**) within the Modification area.

While tree-dwelling bats may be attracted to foraging and roosting habitats within the Modification area, a number of existing measures were developed to avoid and mitigate potential impacts on these species as they occur in the surrounds. These measures would continue to be implemented for the Modification. Pre-clearance surveys of forests and woodland areas to be removed would be undertaken to identify the presence of any threatened bat species. Should any threatened bats be recorded, they would be captured and translocated to potential habitat outside of the Modification area into one of the conservation, offset or revegetation areas. These areas have been developed to ensure that potential habitat for these species is available surrounding the Modification. In addition, several habitat corridors have been created to link isolated remnant vegetation stands.

Two new offset areas are proposed as part of the Modification. These offsets would have similar habitat to that found within the Modification area (**Figure 11**). The habitat within the proposed offsets would also provide potential habitat for the tree-dwelling bat species listed above.

These on-going measures would continue to benefit wildlife following the implementation of the Modification as discussed further in **Section 8**.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat requirements for the threatened tree-dwelling bat species are as follows:

- The Yellow-bellied Sheathtail-bat can be found in most habitats, including wet and dry forests, grasslands, shrublands, Mallee and open woodlands (Churchill, 2008). This species roosts in large tree hollows and has been found in the abandoned nests of Sugar Gliders and are usually found in mixed-sex groups of two to six and occasionally up to 30 (Churchill, 2008; Van Dyck and Strahan, 2008).

- The Eastern Freetail-bat inhabits rainforest, Melaleuca forest, monsoon forest, tall open forest, River Red Gum and Yellow Box woodlands, riparian open forest and dry sclerophyll forest (Churchill, 2008). The Eastern Freetail-bat roosts mainly in tree hollows but will also roost under bark, in buildings and cracks in posts (Churchill, 2008). All known natural roosts have occurred within the hollows of large mature *Eucalyptus* spp. (Van Dyck and Strahan, 2008). Several hundred have been previously recorded in a roost (Churchill, 2008).
- The Eastern False Pipistrelle is found in wet sclerophyll and coastal Mallee and prefer habitats with tall trees, greater than 20 m in height and a dense understorey (Churchill, 2008). This species generally roosts in hollows of Eucalyptus trees in colonies of three to 80 (Churchill, 2008) and sometimes in buildings (Van Dyck and Strahan, 2008).
- The Greater Broad-nosed Bat inhabits a variety of habitats including moist gullies in mature coastal forest, rainforest, open woodland, Melaleuca swamp woodland, wet and dry sclerophyll forests, cleared paddocks with remnant trees and tree-lined creeks in open areas (Churchill, 2008). The Greater Broad-nosed Bat roosts in tree hollows, cracks and fissures in trunks and dead branches, under exfoliating bark, as well as the roofs of old buildings (Churchill, 2008; Van Dyck and Strahan, 2008).
- The Southern Myotis have a strong association with streams and permanent waterways, most frequently at low elevations and in flat or undulating country and usually in areas that are vegetated rather than cleared (Churchill, 2008). This species roosts near water in caves, tree hollows, among vegetation, in clumps of *Panadanus* spp., under bridges, in mines, road culverts and stormwater drains (Churchill, 2008; Van Dyck and Strahan, 2008). They are often found roosting alone or in pairs in disused Fairy Martin nests (Churchill, 2008).

The Modification is likely to remove and modify approximately 226.4 ha of potential/actual foraging and roosting habitat resources for the Yellow-bellied Sheathtail-bat. Approximately 53.4 ha of potential/actual foraging and roosting habitat resources may be removed/modified for the Modification for the Eastern Freetail-bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Southern Myotis. This small loss of habitat is not expected to significantly affect these species, since large patches of suitable habitat exist in the surrounding area and in the greater locality.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

None of the threatened tree-dwelling bat species listed above are at the limits of their known distributions.

7.4.10 Cave-dwelling Bats

Introduction

This section assesses the potential impacts of the Modification on cave-dwelling bat species. There are a number of threatened cave-dwelling bat species that may potentially occur within the Modification area based on their known distribution (listed in **Table 14** and discussed in **Section 5.2.1**). However, one species (the Little Bentwing-bat [*Miniopterus australis*]) listed in **Table 14** and discussed in **Section 5.2.1** is not likely to occur in the Modification area or close surrounds and is therefore not listed in **Table 18**.

The Little Bentwing-bat is unlikely to be affected by the Modification. It is considered unlikely that this species would occur within the Modification area, as indicated by the lack of records for this species in the Modification area and close surrounds. On this basis, it is considered unlikely that this species would be affected by the Modification. This species is not considered further.

Threatened Cave-dwelling Bat Species Likely to be Affected

Three threatened cave-dwelling bat species may be potentially impacted by the Modification, namely the Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and Eastern Cave Bat (*Vespadelus troughtoni*).

The Eastern Bentwing-bat and Eastern Cave Bat were possibly recorded within the Modification area during the recent surveys conducted by Niche (**Appendix 1**). An assessment on the potential impacts to these species as a result of the Modification is provided below.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Large-eared Pied Bat was recorded to the north of Modification Area B outside of the Modification area (**Figure 11**). It has also been recorded in the OEH (2013) database at Muswellbrook (**Figure 11**). This species was not recorded during the current surveys conducted by Niche (**Appendix 1**) within the Modification area. There is a national recovery plan for the Large-eared Pied Bat (Queensland Department of Environment and Resource Management, 2011).

The Eastern Bentwing-bat and Eastern Cave Bat were possibly found during the recent fauna surveys within the Modification area (**Appendix 1**) in all Modification Areas other than Area E (**Figure 11**). These species were recorded within the Central Hunter Ironbark – Spotted Gum – Grey Box Forest (MU27) and Derived Native Grassland vegetation communities which would be removed as part of the Modification (**Figure 15**). These species have also been recorded during previous surveys and were recorded in the OEH (2013) database surrounding the Modification area (**Figure 11**).

While cave-dwelling bats may be attracted to foraging habitats within the Modification area, a number of existing measures were developed to avoid and mitigate potential impacts on these species as they occur in the surrounds. These measures would continue to be implemented for the Modification. Pre-clearance surveys of forests and woodland areas to be removed would be undertaken to identify the presence of any threatened bat species. Should any threatened bats be recorded, they would be captured and translocated to potential habitat outside of the Modification area into one of the conservation, offset or revegetation areas. These areas have been developed to ensure that potential habitat for these species is available surrounding the Modification. In addition, several habitat corridors have been created to link isolated remnant vegetation stands.

Two new offset areas are proposed as part of the Modification. These offsets would have similar habitat to that found within the Modification area (**Figure 11**). The habitat within the proposed offsets would also provide potential habitat for the cave-dwelling bat species listed above.

These on-going measures would continue to benefit wildlife following the implementation of the Modification as discussed further in **Section 8**.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat requirements for the threatened cave-dwelling bat species are as follows:

- The Large-eared Pied Bat inhabits dry sclerophyll forests and woodlands, but also occur in sub-alpine woodland, the edges of rainforest, wet sclerophyll forest, *Callitris* spp. dominated forests and sandstone outcrop country (Churchill, 2008). This species roosts in caves, crevices in cliffs and mines and abandoned, disused mud nests of Fairy Martins in colonies of three to 40 (Churchill, 2008; Van Dyck and Strahan, 2008).
- The Eastern Bentwing-bat is found in rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forests and open grasslands (Churchill, 2008). The Eastern Bentwing-bat roosts in caves as well as man-made constructions such as abandoned mines and road culverts (Churchill, 2008).

- The Eastern Cave Bat inhabits tropical mixed woodland, wet and dry sclerophyll forest along the coast and the Great Dividing Range, extending to the drier forests of the western slopes and inland areas (Churchill, 2008). This species roosts in small groups in well-lit areas in sandstone overhanging cliffs, boulder piles, mines, road culverts and occasionally in buildings (Churchill, 2008; Van Dyck and Strahan, 2008).

The Modification is likely to remove and modify approximately 226.4 ha of potential/actual foraging and roosting habitat resources for the Eastern Bentwing-bat. Approximately 53.4 ha of potential/actual foraging and roosting habitat resources may be removed/modified for the Modification for the Large-eared Pied Bat and Eastern Cave Bat. This small loss of habitat is not expected to significantly affect these species, since large patches of suitable habitat exist in the surrounding area and in the greater locality.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

None of the threatened tree-dwelling bat species listed above are at the limits of their known distributions.

8 Impact Avoidance, Mitigation and Offset Measures

8.1 Existing Impact Avoidance and Mitigation Measures at the Mt Arthur Coal Mine

A *Biodiversity and Rehabilitation Management Plan* (BHP Billiton, 2012) has been developed to facilitate the management of biodiversity at the existing approved Mt Arthur Coal Mine. **Table 19** outlines the existing impact avoidance and mitigation measures that are currently implemented (after BHP Billiton, 2012).

Table 19: Existing impact avoidance and mitigation measures at the Mt Arthur Coal Mine

Measure	Description
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). However, the strategy aims for a net increase in native vegetated areas at the end of mine life. Surface development areas associated with the Mt Arthur Coal Mine are progressively rehabilitated and revegetated with species characteristic of native species endemic to the local area. Annual ecological monitoring has taken place at the Mt Arthur Coal Mine from 2003 (Umwelt, 2003, 2005, 2006b, 2007a; Cumberland Ecology, 2009b, 2010b, 2010c; Wildthing Environmental Consultants, 2008). Permanent monitoring plots within remnant and rehabilitation areas have been established throughout the Mt Arthur Coal Mine site and are monitored annually. The *Biodiversity and Rehabilitation Management Plan* (BHP Billiton, 2012) describes the use of artificial roosting/nesting boxes, nesting structures (mammal and avian), fallen timber and creation of drainage depressions for frogs.
Rehabilitation of creeks and drainage lines on the site	The drainage pattern of the final landform would be designed to integrate with the surrounding catchments and revegetated to achieve long-term stability and erosion control.
Management of salinity	Salinity levels in topsoil and subsoil are monitored to prevent salinity impacting on vegetation establishment and landform stability.
Conservation and reuse of topsoil	Topsoil is currently conserved so that it can be respread onto the surface during rehabilitation. Respread topsoil may contain native seed and beneficial micro-organisms which have been shown to be advantageous to the more rapid development of a sustainable and productive ecosystem.
Vegetation Clearance	
Protection of vegetation and soil outside of the disturbance areas	Conservation and offset areas have been created to protect vegetation and soil outside of the disturbance area.
Pre-clearance surveys	Pre-clearance surveys are conducted within all patches of forest and woodland to be cleared and threatened flora and fauna species detected are translocated 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.

Table 19 (continued): Existing impact avoidance and mitigation measures at the Mt Arthur Coal Mine

Measure	Description
Vegetation Clearance (Continued)	
Collecting and propagating seed	Seed present during land clearance activities would be collected for use in plant propagation programmes to provide tube stock for revegetation activities. The Mt Arthur Coal Mine has an existing Consent Condition requiring re-establishment of *Acacia pendula*. This has involved collection of seed from *Acacia pendula* to be used in a propagation programme.
Salvaging and reusing material from the site for habitat enhancement	Large woody debris deemed suitable for habitat enhancement is identified as part of pre-clearance and post-clearance and are salvaged and reused for habitat enhancement.
General Management	
Nest Box Programme	A nest box monitoring programme is currently undertaken at the Mt Arthur Coal Mine. A total of 48 nest boxes have been established at two remnant sites (one site is within the Thomas Mitchell Drive Offset area). These boxes are visually examined annually for the presence of scats, nesting material, chewing or scratching marks, discarded bones, etc.). Box types include: Squirrel Glider boxes, microbat boxes and bird boxes.
Controlling weeds	In 2010, HVEC developed a weed action plan to improve the management of noxious and environmental weeds, which identifies priority areas as well as individual species requiring management.
Controlling feral pests	Measures to control exotic animals are implemented by an appropriately qualified person(s) and include: the destruction of pests habitat, trapping, targeted shooting programmes and baiting. Follow-up inspections would be undertaken to assess the effectiveness of control measures implemented and the requirement for any additional control measures.
Managing grazing and agriculture on-site	Several measures are currently undertaken to manage grazing including managing stock, grazing and fertiliser use.
Controlling access	Access is controlled by restricting vehicle access, preventing access to open pits or other hazardous locations, and constructing a safety berm and/or security fence at the void crest (highwalls and endwalls) to provide an engineered barrier between the pit and the surrounding area.
Bushfire management	Several measures are currently undertaken to manage bushfire including monitoring fuel loads, fire bans, restriction of potential ignition sources, emergency preparedness training for mine-site personnel and the establishment of firebreaks.

8.2 Proposed Impact Avoidance and Mitigation Measures for the Modification

Table 20 outlines the proposed impact avoidance and mitigation measures that would be implemented for the Modification.

Table 20: Proposed additional impact avoidance and mitigation measures for the Modification

Proposed Impact Avoidance and Mitigation Measure	Description of Measure
Pine Donkey Orchid (*Diuris tricolor)* translocation	If any *Diuris tricolor* are identified in the Modification area during the pre-clearance surveys an evaluation of whether or not the plants should be translocated would be made by an appropriately qualified person. For example, if only one plant was found then it may not be worth translocating due to the presence of known populations in the Thomas Mitchell Drive Offset area.
Weeping Myall (*Acacia pendula*) Propagation	The Mt Arthur Coal Mine has an existing Consent Condition requiring re-establishment of *Acacia pendula*. To date this has involved collection of seed from *Acacia pendula* to be used in a propagation programme. However, it is believed that the seed is being collected from local planted *Acacia pendula* not the *Acacia pendula* which is 'native' to the Hunter Catchment. Re-establishment of *Acacia pendula* would focus on trials of growing the plants from cuttings because the *Acacia pendula* which is 'native' to the Hunter Catchment isn't known to produce seed (**Section 7.1.1**).
Weeping Myall (*Acacia pendula*) Translocation	If the trial to re-establish *Acacia pendula* using cuttings is not successful, the possibility of translocating *Acacia pendula* plants would be investigated. An evaluation of whether or not the plants should be translocated would be made by an appropriately qualified person.
Threatened Species Database	Threatened species sightings at the Mt Arthur Coal Mine would be reported to the environmental officer and maintained on a database.

Koala Monitoring

As described in **Section 7.4.6**, a Koala has been sighted in the Thomas Mitchell Drive Off-site Offset area (OEH, 2013) and within the approved Mt Arthur Coal Mine to the south-west of the Thomas Mitchell Drive Offset area (HVEC, pers. comm., 2012) (**Figure 10**).

The Koala would continue to be monitored through annual ecological monitoring surveys and pre-clearance surveys.

Revegetation of the Post-mine Landforms

Refinements to the revegetation of the post-mine landforms would include:

- limiting the location of the 'rehabilitation areas' to approved disturbance areas;
- increasing the width of the 'rehabilitation areas' corridors to a minimum of 500 m;
- post-mining land use compatible with surrounding land uses to provide environmental and community benefits; and
- consideration of the landform and location of final voids.

8.3 Existing Biodiversity Offset Strategy

The NSW and Commonwealth Project Approvals for the approved Mt Arthur Coal Mine describe the existing biodiversity offset strategy for the mine (**Table 21**). The offset strategy for the approved Mt Arthur Coal Mine comprises 3,939 ha of existing vegetation and cleared land (**Figure 18; Table 21**).

Table 21: Overview of the Existing Biodiversity Offset Strategy

Area	Offset Type	Existing Minimum Size (ha)
Development Consent Condition 36		
Mt Arthur Conservation Area	Existing vegetation	105
Saddlers Creek Conservation Area	Existing vegetation	295
Thomas Mitchell Drive Off-site Offset Area	Existing vegetation and vegetation to be established	495
Thomas Mitchell Drive On-site Offset Area	Vegetation to be established	222
Roxburgh Road 'Constable' Offset Area	Existing vegetation and vegetation to be established	110
Additional Off-site Offset Area (Expansion of the Thomas Mitchell Drive Off-site Offset Area – **Figure 19**)	Existing vegetation and vegetation to be established	165
Rehabilitation Areas	Vegetation to be established	1,915* (including 500 ha of Box-Gum Woodland)
Additional Areas under Commonwealth Approval (EBPC 2011/5866)		
Middle Deep Creek Offset Area	Existing vegetation and vegetation to be established	632** (including 493 ha of Box-Gum Woodland)
	Total	3,939

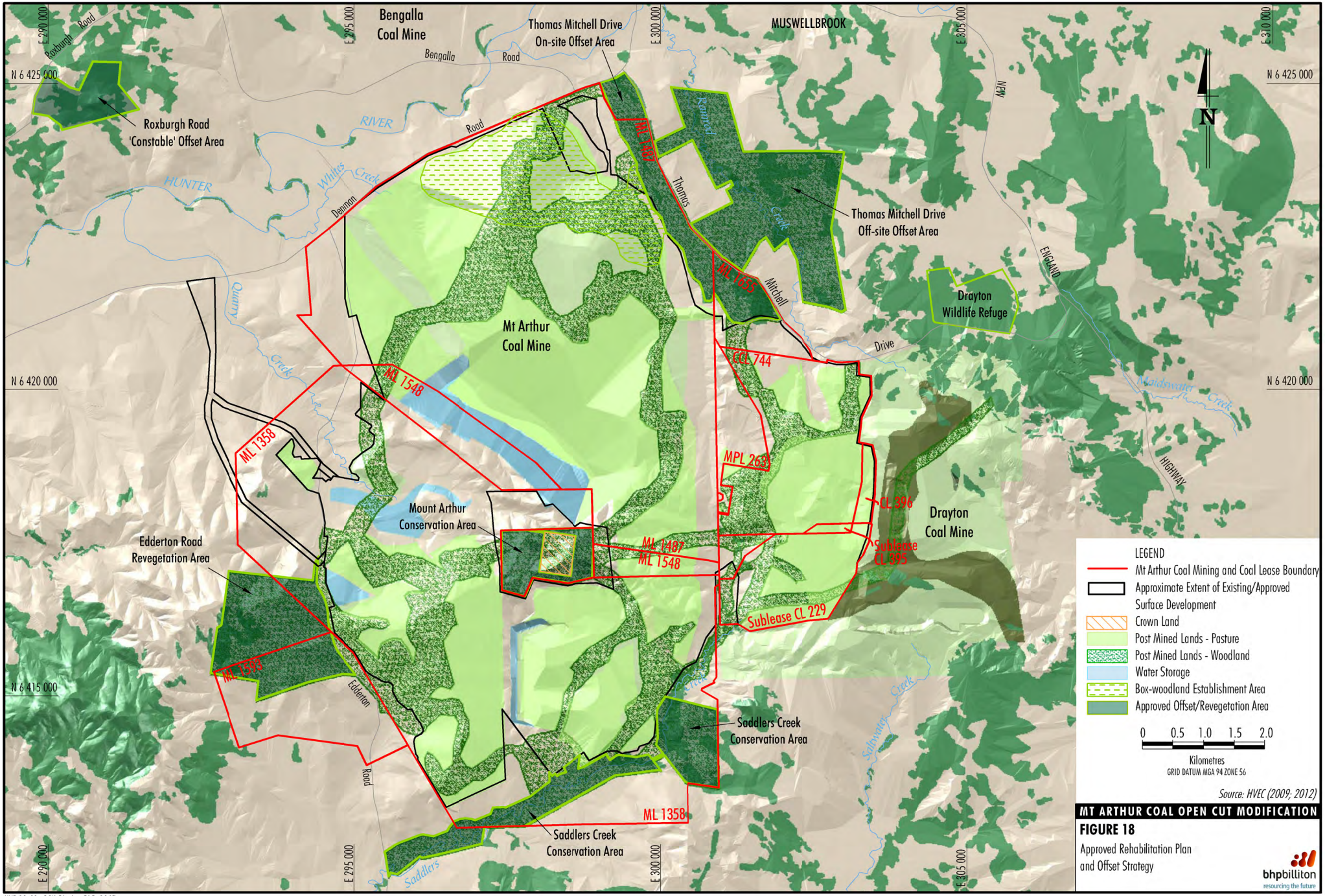
Source: NSW and Commonwealth Project Approvals for the approved Mt Arthur Coal Mine.

* Includes the Edderton Road Revegetation Area (154 ha).

** Umwelt (2011).

In accordance with Consent Condition 37, HVEC is to identify an additional offset area which expands the Thomas Mitchell Drive Off-site Offset area (**Table 21**). HVEC's proposed location for the additional offset area is shown on **Figure 19** and is comprised of 165 ha consisting of primarily of derived grassland with paddock trees and a creek line dominated by Swamp Oak (*Casuarina glauca*). This location is to be confirmed by detailed surveys and following consultation with the relevant regulatory authority.

The existing NSW and Commonwealth Environmental Approvals specify 'rehabilitation areas' in the existing biodiversity offset strategy (**Table 21**). This includes 1,915 ha of vegetation (including 500 ha of Box-Gum Woodland) to be established in corridors as shown on **Figure 19**. The existing NSW approval states that the rehabilitation strategy must provide for at least 30% of the disturbance area for open cut operations at the Mt Arthur Coal Mine to be rehabilitated to woody vegetation.



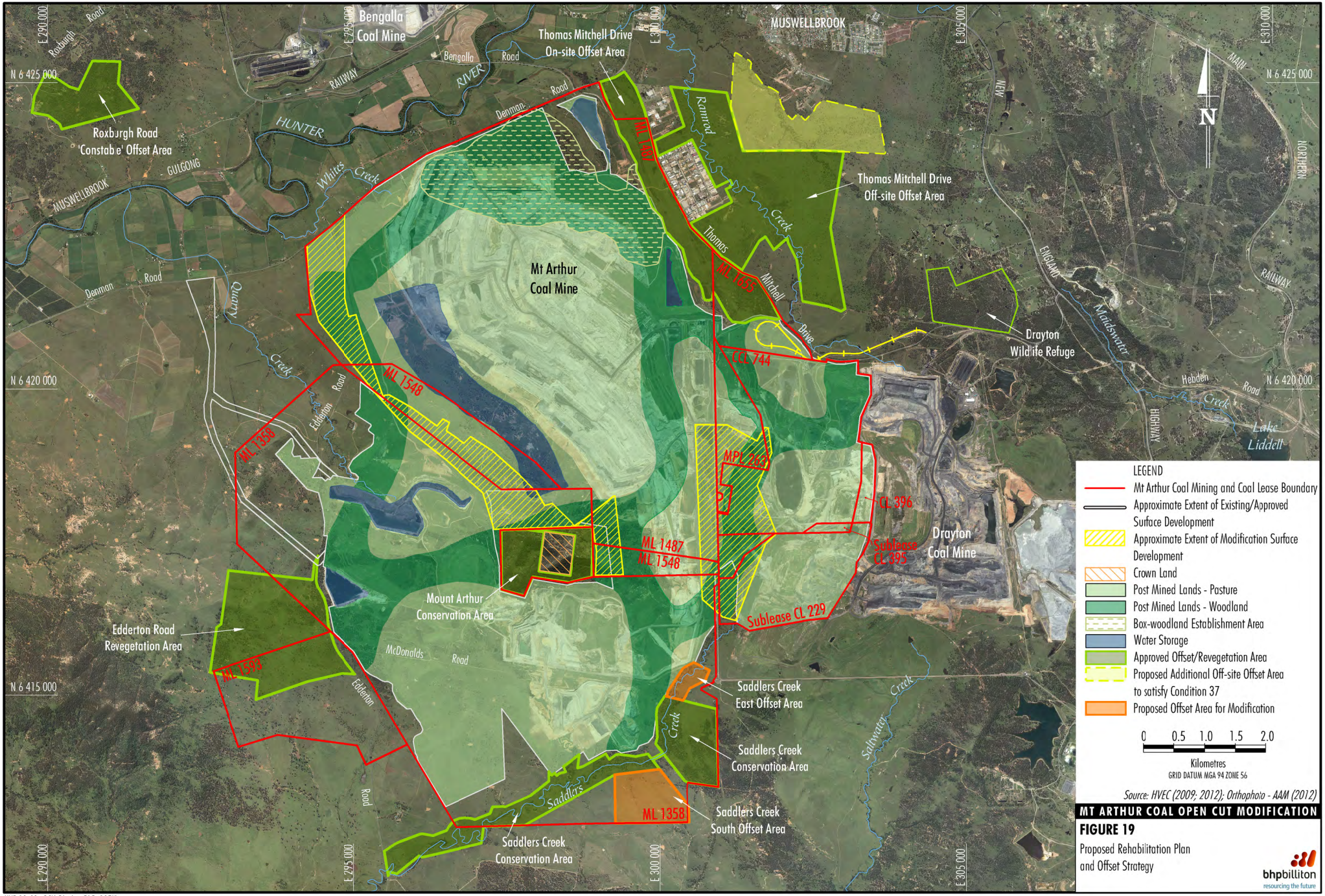
MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 18

Approved Rehabilitation Plan and Offset Strategy

bhpbilliton resourcing the future

HVE-11-01_OCM EA_App F&F_104E



MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 19

Proposed Rehabilitation Plan and Offset Strategy

bhpbilliton
resourcing the future

HVE-11-01_OCM EA_App F&F_105H

Key components of the existing offset areas are:

- Management of livestock grazing in accordance with *A Guide to Managing Box Gum Grassy Woodlands* (Rawlings *et al.,* 2010) and re-establishment of vegetation within the offset areas.
- Management and monitoring of the offset areas against performance and completion criteria (including monitoring of the *Diuris tricolor* in the Thomas Mitchell Drive Offset area).
- Nest Box Programme in the Thomas Mitchell Drive Offset area.
- Long-term security of the offset areas.
- Provision of a conservation bond to the NSW Government.
- Reporting to NSW and Commonwealth Governments.

8.4 Proposed Biodiversity Offset Strategy

Measures that are proposed to avoid and mitigate impacts from the Modification on flora and fauna are described in **Section 8.2**. This section describes an offset proposal aimed at addressing the residual impacts from the Modification.

The Director-General's Requirements for the Modification state that a comprehensive offset strategy is required as part of the Modification to ensure the proposal maintains or improves the terrestrial and aquatic biodiversity values in the region in the medium to long-term.

The revised biodiversity offset strategy is shown in **Table 22**. The Modification would require the following changes to the existing biodiversity offset strategy:

- **Refinement of the location of the 'rehabilitation areas'**. The existing NSW and Commonwealth Environmental Approvals specify 'rehabilitation areas' in the existing biodiversity offset strategy (**Table 21**). This includes 1,761 ha[1] of vegetation (including 500 ha of Box-Gum Woodland) to be established in corridors as shown on **Figure 19**. Refinements would include:
  - limiting the location of the 'rehabilitation areas' to approved disturbance areas;
  - increasing the width of the 'rehabilitation areas' corridors to a minimum of 500 m (except for a portion where the width is 380 m);
  - integration of the 'rehabilitation areas' with the landform and location of final voids; and
  - maintaining woodland corridors across greater than 30% of the disturbance area for open cut operations at the Mt Arthur Coal Mine.

[1] This number excludes the Edderton Road Revegetation Area.

- **Additional offset area to account for additional clearance.** This would include:
  - expanding the existing Saddlers Creek Conservation area by 131 ha (**Figure 19**); and
  - expanding the existing Middle Deep Creek Offset area by 410 ha (**Figure 20**).

Table 22: Revised Biodiversity Offset Strategy

Area	Offset Type	Existing Minimum Size (ha)	Proposed Minimum Size (ha)
Development Consent Condition 36			
Mt Arthur Conservation Area	Existing vegetation	105	105 (no change)
Saddlers Creek Conservation Area	Existing vegetation and vegetation to be established	295	426
Thomas Mitchell Drive Off-site Offset Area	Existing vegetation and vegetation to be established	495	495 (no change)
Thomas Mitchell Drive On-site Offset Area	Vegetation to be established	222	222 (no change)
Roxburgh Road 'Constable' Offset Area	Existing vegetation and vegetation to be established	110	110 (no change)
Additional Off-site Offset Area	Existing vegetation and vegetation to be established	165	250.1*
Edderton Road Revegetation Area	Existing vegetation and vegetation to be established	154	154 (no change)
Rehabilitation Areas	Vegetation to be established	1,761**** (including 500 ha of Box-Gum Woodland)	2,642** (including 500 ha of Box-Gum Woodland)
Middle Deep Creek Offset Area	Existing vegetation and vegetation to be established	632*** (including 493 ha of Box-Gum Woodland)	1,042 (including 596 ha of Box-Gum Woodland)
	Total	3,939	5,446.1

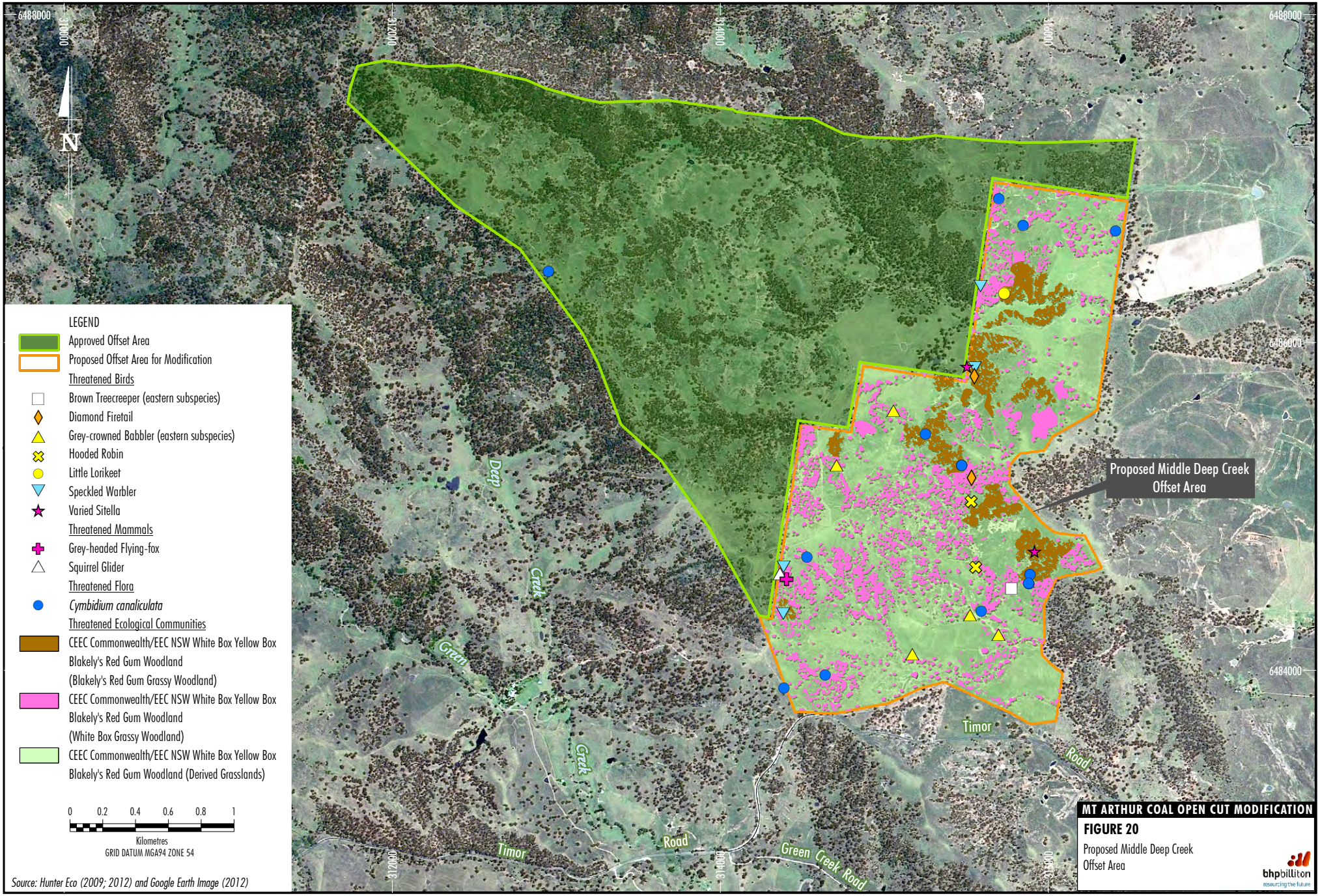
Highlighted rows have been updated.

* HVEC would provide an additional 21.3 ha offset for Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC and an additional 63.8 ha offset for Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC in a location to be determined.

** This value is 34% of the total mine disturbance footprint.

*** Umwelt (2011).

**** This number excludes the Edderton Road Revegetation Area.



MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 20

Proposed Middle Deep Creek Offset Area

bhpbilliton resourcing the future

HVE-11-01_OCM EA_App F&F_205J

Vegetation Communities

The additional offset areas are described in detail in **Appendix 8** and below. The proposed offset areas contain the following vegetation communities based on Peake (2006), or their equivalent:

- MU10 Central Hunter Box – Ironbark Woodland;
- MU24 Hunter Lowlands Red Gum Forest;
- MU11 Upper Hunter White Box – Ironbark Grassy Woodland; and
- MU19 Hunter Valley Weeping Myall Woodland.

Table 23 compares the vegetation types/map units within the Modification area with those in the proposed offset area.

Table 23: Quantification of vegetation types within the disturbance area and offset area

Disturbance				**Offset by:**	
Vegetation Type	**Vegetation Community**	**HRVP Equivalent**	**Area (ha)**	**Vegetation Community**	**Area (ha)**
Grassland	Derived Native Grassland	no HRVP equivalent	136.8	MU10 Central Hunter Box - Ironbark Woodland (Derived grassland) (Saddlers Creek East and South) [1, 2]	120
Grassland (Cooba Wattle Regrowth)	Derived Native Grassland, with Cooba Wattle Regrowth	no HRVP equivalent	1	MU11 Upper Hunter White Box – Ironbark Grassy Woodland (Derived grassland) (Middle Deep Creek) [1, 2]	307
Grassland	Derived Native Grassland, derived from Box-Gum Woodland[1, 2]	no HRVP equivalent	35.2		
Reed Drainage Line	*Typha* Dominated Drainage Line*	no HRVP equivalent	2.5		
		subtotal	175.5		427
Box-Gum (grassy)	Central Hunter Box – Ironbark Woodland[1, 2, 3]	MU10	23	MU10 Central Hunter Box – Ironbark Woodland (Saddlers Creek East) [1, 2, 3]	5.2
Box-Gum (grassy)	Blakely's Red Gum Woodland[1, 2]	no HRVP equivalent	0.2	HVEC would also provide an additional 63.8 ha offset for this community in a location to be determined	63.8
Box-Gum (shrubby)	Upper Hunter Hills Box – Ironbark – Red Gum Woodland	MU9	3.4		
Slaty Box	Central Hunter Box – Ironbark Woodland Wybong Slaty Box Variant	MU10	17.9	MU11 Upper Hunter White Box – Ironbark Grassy Woodland (Middle Deep Creek) [1, 2]	103
		subtotal	44.5		170.2

Table 23 (continued): Quantification of vegetation types within the disturbance area and offset area

Disturbance				Offset by:	
Red Gum	Hunter Lowlands Red Gum Forest[4]	MU24	1.7	MU24 Hunter Lowlands Red Gum Forest (Saddlers Creek East) [4]	5.1
Spotted Gum	Central Hunter Ironbark – Spotted Gum – Grey Box Forest[5]	MU27	7.1	HVEC would provide an additional 21.3 ha offset for this community in a location to be determined.	21.3
Weeping Myall	Weeping Myall Woodland[6]	MU19	0.1	MU19 Hunter Valley Weeping Myall Woodland (Saddlers Creek South) [6]	0.4
		Total	**228.9**		**624**

1 White Box Yellow Box Blakely's Red Gum Woodland EEC.

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

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

4 Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC.

5 Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC.

6 Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion EEC.

* This is also partly offset by the inclusion of the Saddlers Creek and Middle Deep Creek watercourse in the offset strategy.

The vegetation communities in the proposed offset areas are generally a good match for those which are proposed to be cleared. In most cases, the area multipliers are very good, with a greater quantity of the vegetation communities represented in the proposed offset areas when compared to the disturbance areas (**Table 23**).

Of particular note, all of the vegetation communities in the proposed offset areas are listed as one or more TECs (**Table 23**) suggesting the conservation values of the proposed offset areas are overall greater.

There is one TEC which is not represented in the Saddlers Creek and Middle Deep Creek Offset areas, namely the Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (7.1 ha) (**Table 23**). This TEC occurs in multiple patches in the Modification area (Areas B, C and D – **Figure 15**). HVEC would provide an additional 21.3 ha offset for this community in a location to be determined.

In addition, only 5.2 ha of the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC is represented in the proposed offset areas (**Table 23**). This EEC occurs in multiple patches in the Modification area (Areas B and C – **Figure 15**). HVEC would provide an additional 63.8 ha offset for this community in a location to be determined.

The proposed offset areas are suitably located to increase existing offset areas established by HVEC. The Middle Deep Creek Offset area is located approximately 70 km north of the Modification area (**Figure 20**), and therefore there are some differences in the vegetation. The Box-Gum (grassy) Woodland in the Modification area largely meets the definition of MU10 while the Box-Gum (grassy) Woodland in the offset area meets the definition of MU11 (after Peake, 2006) (**Table 23**). However, both represent the Box-Gum Woodland EEC/CEEC. A small stand of Blakely's Red Gum Woodland (0.2 ha) was recorded in the Modification area and Blakely's Red Gum is present in the Middle Deep Creek Offset area but has been included in mapping of MU11 (**Appendix 8**).

The proposed offset areas contain 1.6 km of Saddlers Creek as well as an array of creek lines at Middle Deep Creek. These creek lines are a beneficial inclusion as they provide a habitat resource for a range of plants and animals, some of which may be aquatic. Noting also that the *Typha* Dominated Drainage Line is partly offset by the inclusion of these watercourses into the offset strategy (**Table 23**).

The proposed offset areas contain substantially more Box-Gum Woodland EEC/CEEC than would be cleared for the Modification (**Table 24**). This is largely because approximately 137.8 ha of non-threatened derived grasslands would be offset with derived grasslands of the Box-Gum Woodland EEC/CEEC (**Table 24**).

Table 24: Quantification of threatened ecological communities within the disturbance area and offset area

Community	Conservation Status[1]		Disturbance Area (ha)	Offset by:
	TSC Act	EPBC Act		
Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion	E	-	0.1	0.4
White Box Yellow Box Blakely's Red Gum Woodland[2]	E	CE	58.4 ha comprising: • 35.2 ha of Derived Native Grassland, derived from Box-Gum Woodland; • 23 ha of Central Hunter Box – Ironbark Woodland; and • 0.2 ha of Blakely's Red Gum Woodland.	537 ha comprising: • 120 ha of MU10 Central Hunter Box - Ironbark Woodland (Derived grassland); • 307 ha of MU11 Upper Hunter White Box – Ironbark Grassy Woodland (Derived grassland); • 5.2 ha of MU10 Central Hunter Box – Ironbark Woodland; and • 103 ha of MU11 Upper Hunter White Box – Ironbark Grassy Woodland.

Table 24 (continued): Quantification of threatened ecological communities within the disturbance area and offset area

	Disturbance			Offset by:
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	E	-	23	69
Central Hunter Ironbark – Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions	E	-	7.1	21.3
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	E	-	1.7	5.1

[1] Threatened population, vegetation community, flora species or fauna species status listed under the TSC Act and/or EPBC Act (current at 24 January 2013).

E = Endangered; CE = Critically Endangered.

[2] Listed as the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC under the EPBC Act.

Threatened Species

Table 25 lists the threatened populations and species with the potential to occur in the proposed offset area.

Table 25: Threatened populations and species with the potential to occur in the proposed offset area

Scientific Name	Common Name	Conservation Status[1]		Affected by the Modification	Recorded (R) or Potential (P) Habitat in the Proposed Offset area
		TSC Act	EPBC Act		
Flora					
Acacia pendula in the Hunter Catchment	Weeping Myall population in the Hunter Catchment	E	-	Yes	R
Cymbidium canaliculatum	*Cymbidium canaliculatum* population in the Hunter Catchment	E	-	No	R
Fauna					
Birds					
Chthonicola sagittata	Speckled Warbler	V	-	No	R
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	No	R
Stagonopleura guttata	Diamond Firetail	V	-	No	R

Table 25 (continued): Threatened populations and species with the potential to occur in the proposed offset area

Scientific Name	Common Name	Conservation Status[1]		Affected by the Modification	Recorded (R) or Potential (P) Habitat in the Proposed Offset area
		TSC Act	EPBC Act		
Birds (Continued)					
Daphoenositta chrysoptera	Varied Sittella	V	-	Yes	R
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	Yes	R
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	No	P
Anthochaera phrygia	Regent Honeyeater	CE	E	No	P
Tyto novaehollandiae	Masked Owl	V	-	No	P
Circus assimilis	Spotted Harrier	V	-	No	P
Hieraaetus morphnoides	Little Eagle	V	-	No	P
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	No	R
Petroica boodang	Scarlet Robin	V	-	No	P
Glossopsitta pusilla	Little Lorikeet	V	-	No	R
Neophema pulchella	Turquoise Parrot	V	-	No	P
Lathamus discolor	Swift Parrot	E	E	No	P
Mammals					
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	No	P
Petaurus norfolcensis	Squirrel Glider	E	-	No	R
Phascolarctos cinereus	Koala	V	V	No	P
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Yes	R
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	No	P
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Yes	P
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Possibly	P
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	No	P
Myotis macropus	Southern Myotis	V	-	Yes	P
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	No	P
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Possibly	P
Vespadelus troughtoni	Eastern Cave Bat	V	-	Possibly	P

[1] Threatened population, flora species or fauna species status listed under the TSC Act and/or EPBC Act (current at 24 January 2013).

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

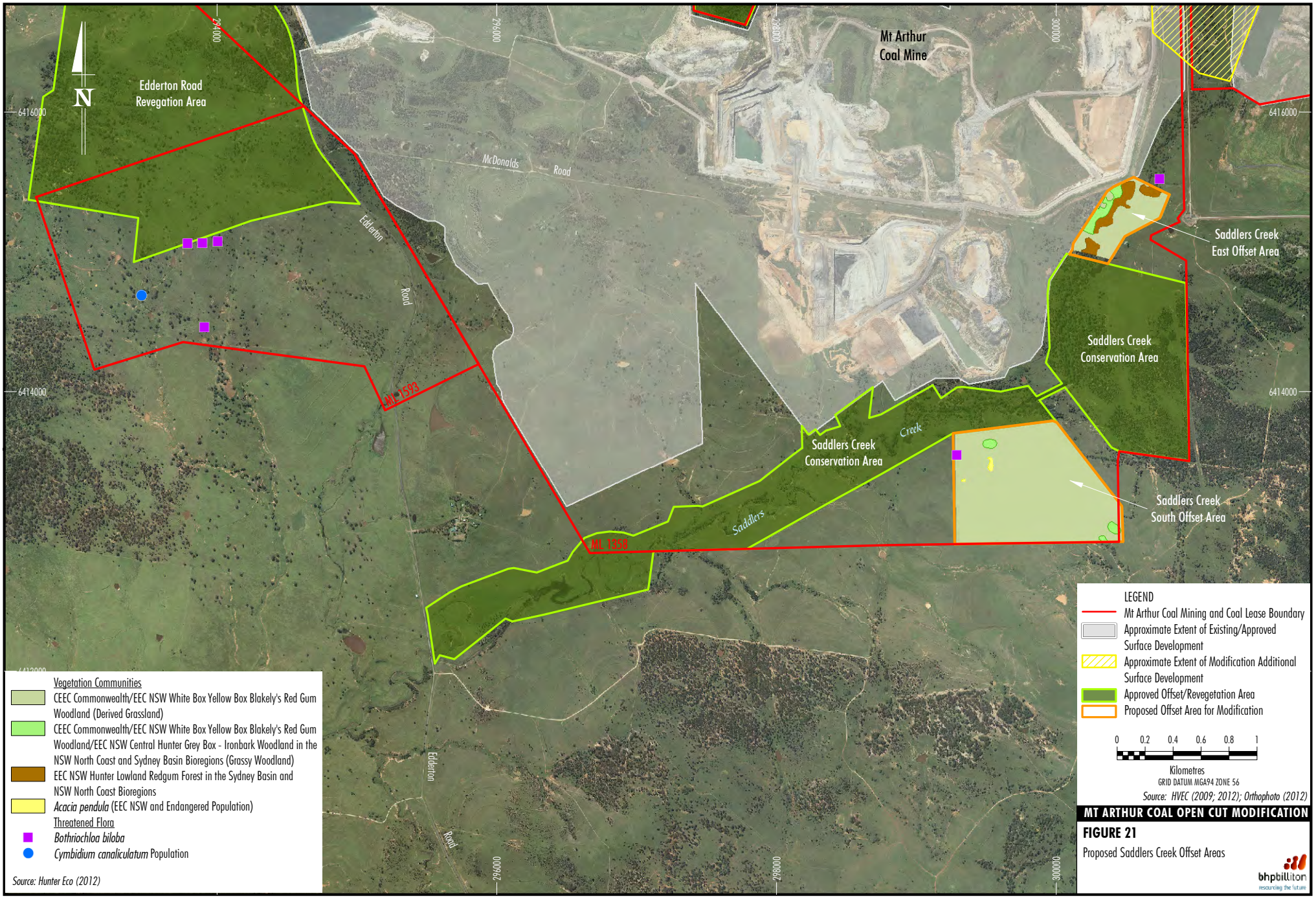
Key Benefits of the proposed offset areas

Key benefits of the proposed additional Saddlers Creek Conservation area (**Figures 19 and 21**) are:

- Presence of the endangered population, *Acacia pendula* (a tree) in the Hunter Catchment and the EEC Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion.
- Presence of the Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC.
- Presence of the Box-Gum Woodland EEC/CEEC.
- Presence of the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions.
- Scattered patches of *Bothriochloa biloba* across the open grassland.
- Inclusion of approximately 930 m of Saddlers Creek.
- Potential to benefit local fauna populations (and threatened fauna) impacted by the Modification.
- A large number of trees with habitat hollows.

Key benefits of the proposed additional Middle Deep Creek Offset area are:

- Presence of the Box-Gum Woodland EEC/CEEC.
- Thirteen Tiger Orchid (*Cymbidium canaliculatum*) plants were recorded being part of the NSW listed endangered population *Cymbidium canaliculatum Population in the Hunter Catchment*.
- A number of threatened woodland birds were recorded: Diamond Firetail, Speckled Warbler, Hooded Robin (south-east form), Grey-crowned Babbler (eastern subspecies), Varied Sittella, Little Lorikeet and Brown Treecreeper (eastern subspecies). The Squirrel Glider and Grey-headed Flying-fox were also recorded.
- Potential habitat for the threatened Swift Parrot, Regent Honeyeater, Little Eagle, Scarlet Robin, Flame Robin, Brush-tailed Phascogale, Spotted-tailed Quoll, Yellow-bellied Glider, perhaps the Common Planigale and Eastern Bentwing-bat.
- Inclusion of an array of creek lines at Middle Deep Creek.
- A large number of trees with habitat hollows.



MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 21

Proposed Saddlers Creek Offset Areas

bhpbilliton
resourcing the future

HVE-11-01_OCM EA_App F&F_206H

Management

The additional proposed offset areas would be managed, secured, monitored in the same way as the existing offset areas in accordance with the Project Approval for the existing Mt Arthur Coal Mine. This includes, control of weeds and feral animals, restriction of grazing, fire management and control of vehicular access. Ecological monitoring will continue and management plans would be updated to reflect the additional Modification areas.

Enduring security of the offset areas would be provided within 12 months following approval of the Modification (e.g. a Voluntary Planning Agreement [VPA] under the EP&A Act).

The *Biodiversity and Rehabilitation Management Plan* (BHP Billiton, 2012) would be revised to include the additional proposed offset areas. Within 6 months of the approval of the revised plan, HVEC would provide a conservation bond to the NSW Government to ensure that the revised offset strategy is implemented.

Measures specific to the additional proposed offset areas are described below.

Revegetation

A considerable part in the additional proposed offset areas are cleared lands (approximately 427 ha) comprising derived native grassland or introduced grassland. The aim of revegetation would be to reinstate woodland using a range of canopy, mid and understorey flora species.

If livestock grazing continued, the derived grasslands would not regenerate to forest and woodland. Consequently, livestock grazing would be largely excluded from the additional proposed offset areas through installation and maintenance of stock proof fencing. Strategic grazing may be used as a management tool for conservation purposes in accordance with *A Guide to Managing Box Gum Grassy Woodlands* (Rawlings *et al.,* 2010). Reasons for grazing may be to control weeds, to control biomass or to manipulate species composition or sward structure (Rawlings *et al.,* 2010).

Additional Habitat Features in the Saddlers Creek Conservation Area

The existing next box programme (**Section 8.1**) would be expanded to include the Saddlers Creek Conservation area. Nest boxes would be installed within the proposed offset areas to supplement arboreal habitat. Data relating to the utilisation and condition of the nest boxes would be collected on an on-going basis.

Large woody debris from felled trees and existing logs in the approved Mt Arthur Coal Mine footprint deemed suitable for habitat enhancement would be relocated to the Saddlers Creek Conservation area.

8.4.1 Reconciliation of the Proposed Offset Strategy against OEH Offset Principles

As described earlier, the Director-General's Requirements for the Modification state that a comprehensive offset strategy is required as part of the Modification to ensure the proposal maintains or improves the terrestrial and aquatic biodiversity values in the region in the medium to long-term.

A substantial net gain in biodiversity would result from the combined Modification and proposed offsets considering the habitat values of the proposed offset areas would increase through active management. The offsets would be established, and their management plans implemented, within 12 months following approval of the Modification enabling habitat to increase in the order of ten years before open cut mining extends into the Modification areas. This timing would also enable rehabilitation and revegetation of the post mine landforms to be advanced.

A reconciliation of the proposed offset proposal against the OEH Offset Principles (OEH, 2012) is shown in **Table 26**.

Table 26: Reconciliation of the proposed offset strategy against OEH offset principles

OEH Offset Principles (OEH, 2012)	How the Proposed Offset Addresses the OEH Offset Principles
Impacts must be avoided first by using prevention and mitigation measures.	Measures to avoid and mitigate impacts are described in this section. The proposed offset strategy addresses residual impacts.
All regulatory requirements must be met.	HVEC is required to meet all statutory requirements. The proposed offset strategy does not duplicate other licence/approval requirements.
Offsets must never reward ongoing poor performance.	The proposed offset strategy is proposed to address residual impacts associated with the Modification only.
Offsets will complement other government programmes.	The offset would be added to the reserve network in NSW.
Offsets must be underpinned by sound ecological principles.	The proposed offsets were selected for their similarity to the habitat that would be lost as a result of the Modification proceeding.
Offsets should aim to result in a net improvement in biodiversity over time.	The proposed offsets have a history of clearing and grazing and are currently dominated by derived native grassland. There is considerable evidence of woodland regeneration in the proposed offset areas and this would develop further under careful management. Significant areas of scouring and erosion in the proposed offset areas would be the subject of active remediation. Significant weeds would be controlled or eradicated. The proposed Saddlers Creek Offset areas have considerable scope for regeneration and rehabilitation of grassland to woodland. This area also contains a substantial patch of the non-pendulous form of *Acacia pendula* that can be allowed to regenerate from prior and future grazing by being fenced. The proposed Middle Deep Creek Offset area is superior in ecological value to any of the habitat to be cleared in the Modification. This is demonstrated by the confirmed presence of seven threatened woodland bird species, Squirrel Glider, Grey-headed Flying-fox and 13 Tiger Orchids. Its value would only increase as natural regeneration proceeds along with active rehabilitation of selected areas.

Table 26 (continued): Reconciliation of the proposed offset strategy against OEH offset principles

OEH Offset Principles (OEH, 2012)	How the Proposed Offset Addresses the OEH Offset Principles
Offsets must be enduring. They must offset the impact of the development for the period that the impact occurs.	The land tenure underlying the proposed offset area would be secured in perpetuity for wildlife conservation (e.g. a VPA under the EP&A Act).
Offsets should be agreed prior to the impact occurring.	The offset strategy is proposed as part of the Modification. The implementation of the biodiversity offset is likely to be a condition of Project Approval.
Offsets must be quantifiable. The impacts and benefits must be reliably estimated.	Refer to **Tables 22 and 23**.
Offsets must be targeted.	The proposed offsets were selected for their similarity to the habitat that which would be lost as a result of the Modification proceeding.
Offsets must be located appropriately.	The proposed offset areas expand upon existing offset areas established for the Modification.
Offsets must be supplementary.	The proposed offsets have not previously been used for offsetting other actions.
Offsets and their actions must be enforceable through Development Consent conditions, licence conditions, conservation agreements or a contract.	Measures to monitor and independently audit the biodiversity offset are provided. The implementation of the biodiversity offset is likely to be a condition of Project Approval.

9 Conclusion

The Modification would occur in a landscape that has been substantially altered, in the first instance by many years of clearing and grazing, and more recently by mining. The ecological impact of this has been demonstrated over many years of surveys, including current surveys, showing much reduced biodiversity in comparison with what would be expected in an undisturbed landscape. On the scale of the overall currently approved HVEC operations the Modification is small.

Offset areas have been proposed for along Saddlers Creek immediately south of the existing Mt Arthur operations area, Middle Deep Creek in the Timor district located approximately 70 km north of Muswellbrook and the Edderton Road Revegetation Area located adjacent and to the west of the Modification. These areas provide similar habitat to that which would be lost as a result of the Modification. In the case of the Middle Deep Creek Offset area, the habitat is superior, as demonstrated by confirmation of seven threatened woodland bird species, two mammals and members of one endangered population. Habitat values of the proposed offset areas would increase through management actions that involve reduction or exclusion of grazing, land remediation and active rehabilitation. It is important to note that the offsets would be established, and their management plans implemented, immediately upon approval of the Modification. In addition, the Modification area would be rehabilitated upon completion of mining and a substantial net gain in biodiversity would result from the combined Modification and proposed offsets.

10 References

Australasian Groundwater and Environmental Consultants Pty Ltd (2012) *Mt Arthur Coal Mine Open Cut Modification Groundwater Assessment.*

Australian Museum (2012) *Database Records within the following Search Area: -32.2663, 150.9616; -32.4402, 150.9616; -32.4402, 150.7535; -32.2663, 150.7535.* Data received: 27 April 2012.

Barrett, G., Silcocks, A., Barrym S., Cunningham. R. and Poulter, R. (2003) *The new atlas of Australian birds*. RAOU, Melbourne.

Bell, S., Peake, T. and Driscoll, C. (2007) Dealing with taxonomic uncertainty in Weeping Myall *Acacia pendula* from the Hunter catchment, NSW. *Australian Plant Conservation*, 16, 14-15.

BHP Billiton (2012) *Biodiversity and Rehabilitation Management Plan*.

Birdlife Australia (2012) *Birds in Backyards*.
Website: http://www.birdsinbackyards.net
Date Accessed: 1 August 2012.

Birds Australia (2011) *National Recovery Plan for the Swift Parrot Lathamus discolor*.

Birds Australia (2012) *Database Records within the following Search Area: -32.2663, 150.9616; -32.4402, 150.9616; -32.4402, 150.7535; -32.2663, 150.7535.* Data received: 9 May 2012.

Bishop, T. (2000) *Field Guide to the Orchids of NSW and Victoria. University of NSW Press, Sydney.*

Blakers, M., Davies, S.J.J.F. and Reilly, P.N. (1984) *The Atlas of Australian Birds*. Melbourne University Press, Melbourne.

Brumm, H. and Slabbekoorn, H. (2005) *Acoustic Communication in Noise*. In Academic Press, pp. 151209.

Bureau of Meteorology (2012) *Webpage.*
Website: http://www.bom.gov.au/
Date Accessed: July 2012.

Burrows, G.E. (1999) A survey of 25 remnant vegetation sites in the South Western Slopes, NSW. *Cunninghamia* 6(2):283-314.

Chan, A.A.Y.H. and Blumstein, D.T. (2011) Attention, noise, and implications for wildlife conservation and management. *Applied Animal Behaviour Science*, 131(1-2), pp.1-7.

Churchill, S. (2008) *Australian Bats.* Allen and Unwin, Crows Nest, Australia.

Clarke, K.R. and Gorley, R.N., (2001) *PRIMER v6: User Manual/Tutorial*. PRIMER-E, Plymouth. 91 pp.

Cumberland Ecology (2009a) *Mount Arthur Coal Consolidation Project Ecological Assessment*. A report prepared by Cumberland Ecology for Hansen Bailey Pty Ltd. August 2009.

Cumberland Ecology (2009b) *Mount Arthur Coal 2008 Flora and Fauna Monitoring Program. Ecological Monitoring Report*. A draft report prepared by Cumberland Ecology for BHP Billiton. January 2009.

Cumberland Ecology (2010a) *Mount Arthur Coal Extension Project EPBC referral.*

Cumberland Ecology (2010b) *Mount Arthur Coal 2009 Flora and Fauna Monitoring Program Ecological Monitoring Report.* A draft report prepared by Cumberland Ecology for Hunter Valley Energy Coal. February 2010.

Cumberland Ecology (2010c) *Mount Arthur Coal Flora and Fauna Monitoring Program Spring 2010 Ecological Monitoring Report*. A draft report prepared by Cumberland Ecology for Mount Arthur Coal. October 2010.

Cumberland Ecology (2010d) *Briefing Report on Spring 2010 Monitoring of Painted Diuris (Diuris tricolor) at A171, Mt Arthur Coal.*

Cumberland Ecology (2011) *Briefing Report on Spring 2011 Monitoring of Diuris tricolor at A171, Mount Arthur Coal* A report prepared by Cumberland Ecology for Mount Arthur Coal. November 2011.

Dames and Moore (2000) *Mount Arthur North Coal Project EIS Flora and Fauna Report.* A report prepared by Dames and Moore for Coal Operations of Australia Limited. April 2000.

Department of Environment and Climate Change (2007a) *Loss of Hollow-bearing Trees – key threatening process determination*. NSW Scientific Committee.

Department of Environment and Climate Change (2007b) *Threatened Species Assessment Guidelines: The Assessment of Significance.* Department of Environment and Climate Change (NSW), Sydney.

Department of Environment and Climate Change (2008a) *Vegetation of the Cessnock-Kurri Region, Survey, Classification & Mapping, Cessnock LGA, NSW*, Department of Environment and Climate Change (NSW), Sydney.

Department of Environment and Climate Change (2008b) *Recovery Plan for the Koala (Phascolarctos cinereus).*

Department of Environment and Conservation (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft*.

Department of Environment and Conservation (2006) *Recovery Plan for the Large Forest Owls – Powerful Owl, Sooty Owl and Masked Owl*.

Department of Environment and Conservation and Department of Primary Industries (2005) *Draft Guidelines for Threatened Species Assessment.* Department of Environment and Conservation and Department of Primary Industries. July 2005.

Department of the Environment and Heritage (2006a) *White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands*.

Department of Environment and Heritage (2006b) *Management of Phytophthora cinnamomi for Biodiversity Conservation in Australia*.

Department of Environment and Resource Management (2011) *National Recovery Plan for the Large-eared Pied Bat Chalinolobus dwyeri*.

Department of Environment, Climate Change and Water (2009a) *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna Amphibians for Development and Activities.*

Department of Environment, Climate Change and Water (2009b) *Draft National Recovery Plan for the Grey-headed Flying-fox (Pteropus poliocephalus).*

Department of Land and Water Conservation (2002a) *The NSW State Groundwater Dependent Ecosystems Policy.*

Department of Land and Water Conservation (2002b) *Draft Western Riverina Regional Vegetation Management Plan – Advisory Manual, Appendix 3 – Threatened Species.*

Department of Mineral Resources (1999) *Lower North East Region 1:250,000 scale equivalent geology (lner5ge_p (polygons) and lner5ge_l (lines or arcs) geological coverage comprising the area covered by parts of the Dorrigo, Tamworth, Hastings, Singleton and Newcastle 1:250 000 sheet areas, Hunter Coalfield and Newcastle Coalfield Regional Geology 1:100 000 sheet areas and part Sydney 1:250 000 sheet area. CRA project Lower North East.*

Department of Sustainability, Environment, Water, Population and Communities (2011a) *Survey Guidelines for Australia's Threatened Mammals.*

Department of Sustainability, Environment, Water, Population and Communities (2011b) *Survey Guidelines for Australia's Threatened Reptiles*.

Department of Sustainability, Environment, Water, Population and Communities (2012a) *EPBC Act Protected Matters Search for the following Search Area: -32.2663, 150.9616; -32.4402, 150.9616; -32.4402, 150.7535; -32.2663, 150.7535.* Data received: 13 April 2012.

Department of Sustainability, Environment, Water, Population and Communities (2012b) *SPRAT Profiles.*
Website: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies
Date Accessed: 18 July 2012.

Department of the Environment, Water, Heritage and the Arts (2010a) *Survey Guidelines for Australia's Threatened Bats.*

Department of the Environment, Water, Heritage and the Arts (2010b) *Survey Guidelines for Australia's Threatened Birds.*

Department of the Environment, Water, Heritage and the Arts (2010c) *Survey Guidelines for Australia's Threatened Frogs.*

Garnett, S.T., Szabo, J.K. and Dutson, G. (2011) *The Action Plan for Australian Birds 2010. CSIRO Publishing, Collingwood, Australia.*

Gilbert and Associates (2012) *Mt Arthur Coal Open Cut Modification Surface Water Assessment.* Report prepared for Hunter Valley Coal Pty Ltd.

Herrera-Montes, M.I. and Aide, T.M. (2011) Impacts of traffic noise on anuran and bird communities. *Urban Ecosystems*.

Higgins, P.J. and Peter, J.M. (Eds.) (2002) *Handbook of Australian, New Zealand and Antarctic birds (vol. 6).* Oxford University Press, Melbourne.

Hoskin, C.J. and Goosem, M.W. (2010) Road impacts on abundance, call traits, and body size of rainforest frogs in Northeast Australia. *Ecology and Society*, 15(3), p.15.

Institute for Environmental Monitoring and Research (2001) *Fifth Annual Report.*

Jones, D.L. (1993) *Diuris*. In Harden, G.J. (Ed.) *Flora of New South Wales*. Pages 138-145, New South Wales University Press, Kensington.

Kaseloo, P.A. (2005) *Synthesis of Noise Effects on Wildlife Populations.* Department of Biology, Virginia State University.

Kodela, P.G. and Harden, G.J. (2002) In: *Flora of New South Wales* Vol 2 (ed. G.J. Harden) p 432. UNSW Press.

Kovak, M. and Lawrie J.W. (1991). *Soil Landscapes of the Singleton 1:250 000 Sheet*. Soil Conservation Service of NSW, Sydney.

Krauss, S.L. (2000) Patterns of mating in *Persoonia mollis* (Proteaceae) revealed by an analysis of paternity using AFLP: implications for conservation. *Australian Journal of Botany*, 48, 349-356.

Long, K. and Nelson, J. (2004) *Draft National Recovery Plan for the Spotted-tailed Quoll Dasyurus maculatus.*

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. and Hopkins, M.S. (1998) *Australian Soil and Land Survey Field Handbook*. Second Edition (Australian Collaborative Land Evaluation Program, CSIRO Land and Water, Canberra).

Menkhorst, P., Schedvin, N. and Geering, D. (1999) *Regent Honeyeater Recovery Plan 1999 – 2003*.

Morcombe, M. (2004) *Field Guide to Australian Birds.* Steve Parish Publishing Pty Ltd, Archerfield, Australia.

National Library of Australia (2012) *The Allen Cunningham Project*
Website: http://www.artuccino.com/Allan_Cunningham/index.html
Date Accessed: July 2012.

National Parks and Wildlife Services (1999a) *Threatened Species Information – Turquoise Parrot.*

National Parks and Wildlife Services (1999b) *Threatened Species Information – Squirrel Glider.*

Niche Environment and Heritage (2012) *Mount Arthur Coal Fauna Survey Report.*

NSW Fisheries (1999) *Policy and Guidelines – Aquatic Habitat Management and Fish Conservation.*

NSW Scientific Committee (2000) *Final Determination – Swift Parrot*.
Website: http://www.environment.nsw.gov.au/determinations/SwiftParrotEndSpListing.htm
Date Accessed: 24 July 2012.

NSW Scientific Committee (2001a) *Final Determination – Clearing of Native Vegetation*.
Website: http://www.environment.nsw.gov.au/determinations/ClearingNativeVegKTPListing.htm
Date Accessed: 17 July 2012.

NSW Scientific Committee (2001b) *Final Determination – Speckled Warbler*.
Website: http://www.environment.nsw.gov.au/determinations/SpeckledWarblerVulSpListing.htm
Date Accessed: 17 July 2012.

NSW Scientific Committee (2001c) *Final Determination – Diamond Firetail*.
Website: http://www.environment.nsw.gov.au/determinations/DiamondFiretailVulSpListing.htm
Date Accessed: 17 July 2012.

NSW Scientific Committee (2001d) *Final Determination – Grey-crowned Babbler (eastern subspecies)*.
Website: http://www.environment.nsw.gov.au/determinations/GreycrownedBabblerVulSpListing.htm
Date Accessed: 18 July 2012.

NSW Scientific Committee (2001e) *Final Determination – Black-chinned Honeyeater (eastern subspecies).*
Website: http://www.environment.nsw.gov.au/determinations/BlackchinnedHoneyeaterVulSpListing.htm
Date Accessed: 18 July 2012.

NSW Scientific Committee (2001f) *Final Determination – Brown Treecreeper*.
Website: http://www.environment.nsw.gov.au/determinations/BrownTreecreeperVulSpListing.htm
Date Accessed: 18 July 2012.

NSW Scientific Committee (2001g) *Final Determination – Hooded Robin (south-eastern form).*
Website: http://www.environment.nsw.gov.au/determinations/HoodedRobinSoutheasternFormVulSpListing.htm
Date Accessed: 19 July 2012.

NSW Scientific Committee (2007) *Final Determination – Diuris tricolor.*
Website: http://www.environment.nsw.gov.au/determinations/DiurisTricolorEndPop.htm
Date Accessed: 19 July 2012.

NSW Scientific Committee (2008) *Squirrel Glider Petaurus norfolcensis Review of Current Information in NSW.*

NSW Scientific Committee (2009a) *Final Determination – Little Lorikeet.* Website: http://www.environment.nsw.gov.au/determinations/littlelorikeetFD.htm Date Accessed: 19 July 2012.

NSW Scientific Committee (2009b) *Turquoise Parrot Neophema pulchella Review of Current Information in NSW.*

NSW Scientific Committee (2010a) Determination – Hunter Valley Weeping Myall Woodland. Website: http://www.environment.nsw.gov.au/determinations/huntervalley weepingmyall36a.htm Date Accessed: 25 September 2012.

NSW Scientific Committee (2010b) *Final Determination – Varied Sittella*. Website: http://www.environment.nsw.gov.au/determinations/variedsittellaFD.htm Date Accessed: 19 July 2012.

NSW Scientific Committee (2010c) *Final Determination – Regent Honeyeater*. Website: http://www.environment.nsw.gov.au/determinations/regenthoneyeater FD.htm Date Accessed: 24 July 2012.

NSW Scientific Committee (2010d) *Final Determination – Spotted Harrier*. Website: http://www.environment.nsw.gov.au/determinations/spottedharrierFD.htm Date Accessed: 18 July 2012.

NSW Scientific Committee (2010e) *Final Determination – Little Eagle*. Website: http://www.environment.nsw.gov.au/determinations/littleeagleFD.htm Date Accessed: 18 July 2012.

NSW Scientific Committee (2010f) *Final Determination – Scarlet Robin*. Website: http://www.environment.nsw.gov.au/determinations/scarletrobinFD.htm Date Accessed: 19 July 2012.

Office of Environment and Heritage (2012) *Offset Principles.*

Office of Environment and Heritage (2013) *Database Records within the following Search Area: -32.2663, 150.9616; -32.4402, 150.9616; -32.4402, 150.7535; -32.2663, 150.7535.* Data received: 19 April 2012.

PAEHolmes (2012) *Mt Arthur Coal Open Cut Modification Air Quality Impact Assessment.* Report prepared for Hunter Valley Coal Pty Ltd.

Parris, K.M., Velik-Lord, M. and North, J.M. (2009) Frogs Call at a Higher Pitch in Traffic Noise. *Ecology and Society*, 14(1), p.25.

Peake, T.C. (2006). *The Vegetation of the Central Hunter Valley, New South Wales. A report on the findings of the Hunter Remnant Vegetation Project*. Hunter–Central Rivers Catchment Management Authority, Paterson.

Phillips, S., and Callaghan, J. (2011) The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*. Australian Zoologist, 35, (3) 774-780.
Radle, A.L. (2007) *The Effect of Noise on Wildlife: A Literature Review.* College of Education, University of Oregon, Eugene, Oregon.

Radle (2007) *The Effect of Noise on Wildlife: A Literature Review.* College of Education, University of Oregon, Eugene, Oregon.

Rawlings, K., Freudenverger, D. and Carr, D. (2010*) A Guide to Managing Box Gum Grassy Woodlands.*

Royal Botanic Gardens Sydney and the Domain (2012) *Database Records within the following Search Area: -32.2663, 150.9616; -32.4402, 150.9616; -32.4402, 150.7535; -32.2663, 150.7535.* Data received: 30 May 2012.

Schodde, R. and Mason, I.J. (1999) *The Directory of Australian Birds: Passerine*. CSIRO, Melbourne.

Slabbekoorn, H. and Peet, M. (2003) Birds sing at a higher pitch in urban noise. *Nature*, 424, p.267.

Stone, G.N., Raine, N.E., Prescott, M. and Willmer, P.G. (2003) Pollination ecology of acacias (Fabaceae , Mimosoideae). *Australian Systematic Botany*, 16, 103-118.

Umwelt Environmental Consultants (2003) *Ecological Monitoring Report*. A report prepared by Umwelt (Australia) Pty Limited for Mount Arthur Coal Pty Limited. November 2003.

Umwelt Environmental Consultants (2005) *2004 Ecological Monitoring Report*. A report prepared by Umwelt (Australia) Pty Limited for Mount Arthur Coal Pty Limited. May 2005.

Umwelt Environmental Consultants (2006a) *Ecological Assessment Proposed South Pit Extension Project*. A report prepared by Umwelt (Australia) Pty Limited for Mount Arthur Coal Pty Limited. October 2006.

Umwelt Environmental Consultants (2006b) *2005 Ecological Monitoring Report*. A report prepared by Umwelt (Australia) Pty Limited for Mount Arthur Coal Pty Limited. September 2006.

Umwelt Environmental Consultants (2006c) *Ecological Assessment for Downcast Ventilation Shaft Facility.*

Umwelt Environmental Consultants (2007a) *2006 Ecological Monitoring Report – Mount Arthur Coal.* A report prepared by Umwelt (Australia) Pty Limited for Mount Arthur Coal Pty Limited. January 2007.

Umwelt Environmental Consultants (2007b) *Ecological Assessment Proposed Mount Arthur Underground Project*. A report prepared for Mount Arthur Coal. December 2007.

Umwelt Environmental Consultants (2007c) *Ecological Assessment for Downcast Ventilation Shaft Facility.*

Umwelt Environmental Consultants (2008a) *Plan of Management for the Painted Diuris (Diuris Tricolor) at A171.*

Umwelt Environmental Consultants (2008b) *Draft Briefing Report on Spring 2008 Monitoring of Painted Diuris (Diuris tricolor) at A171 Mount Arthur Coal.*

Umwelt Environmental Consultants (2010) *Briefing Report on Spring 2009 Monitoring of Painted Diuris (Diuris tricolor) at A171, Mt Arthur North.*

Umwelt Environmental Consultants (2011) Preliminary Documentation for Department of Sustainability, Environment, Water, Population and Communities. Prepared by Umwelt (Australia) Pty Limited on behalf of Hunter Valley Energy Coal Pty Ltd.

Van Dyck, S. and Strahan, R. (Eds.) (2008) *The Mammals of Australia.* Reed New Holland, Chatswood, Australia.

Wildthing Environmental Consultants (2008) *Draft 2007 Ecological Monitoring Report – Mount Arthur Coal.*

Wilkinson Murray (2012) *Mt Arthur Coal Open Cut Modification Noise and Blasting Assessment.* Report prepared for Hunter Valley Coal Pty Ltd.