

APPENDIX 5

Flora and Fauna Assessment

Mt Arthur Coal

Ecological Assessment Proposed South Pit Extension Project

October 2006

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1.0 Introduction

Mt Arthur Coal Pty Limited (Mt Arthur Coal) is a member of the Energy Coal division of BHP Billiton and operates an open cut coal mine near Muswellbrook in the upper Hunter Valley of NSW (refer to **Figure 1.1**). Mt Arthur Coal propose to extend the currently approved Mount Arthur North (MAN) mining area South Pit further south into the Bayswater No. 3 Mining Lease (ML), in order to maximise resource recovery, maximise productivity of their mining equipment and improve overburden handling efficiencies and rehabilitation outcomes. Umwelt (Australia) Pty Limited (Umwelt) has been commissioned by Mt Arthur Coal to prepare an Environmental Assessment to support the development application for this project, with this ecological assessment undertaken as part of the Environmental Assessment.

1.1 Project Area

The project area covers approximately 330 hectares within the Mt Arthur Coal operations area (refer to New Disturbance Footprint on **Figure 1.2**) plus an area of overburden emplacement within existing mining areas in the Bayswater No. 2 ML and Drayton West Pit (refer to **Figure 1.2**). The proposed additional mining area covers an area of approximately 195 hectares (refer to **Figure 1.2**). The entire south pit extension area was surveyed as part of the Mt Arthur North Project Environmental Impact Statement (EIS) (URS 2000) or the Bayswater No. 3 EIS (Resource Planning 1993). The current project area was resurveyed due to the time that has elapsed since the conduct of these assessments. An additional area along Saddlers Creek was surveyed as part of the project due to its proximity to the project area and the likelihood that species utilising the southern end of the project area may also utilise Saddlers Creek. It was considered that fauna species utilising the southern end of the project area and Saddlers Creek were more likely to be detected at Saddlers Creek where there are significantly more denning, shelter and perching opportunities.

1.2 Proposed Project and Site Disturbance

1.2.1 South Pit Extension Concept Mine Plan

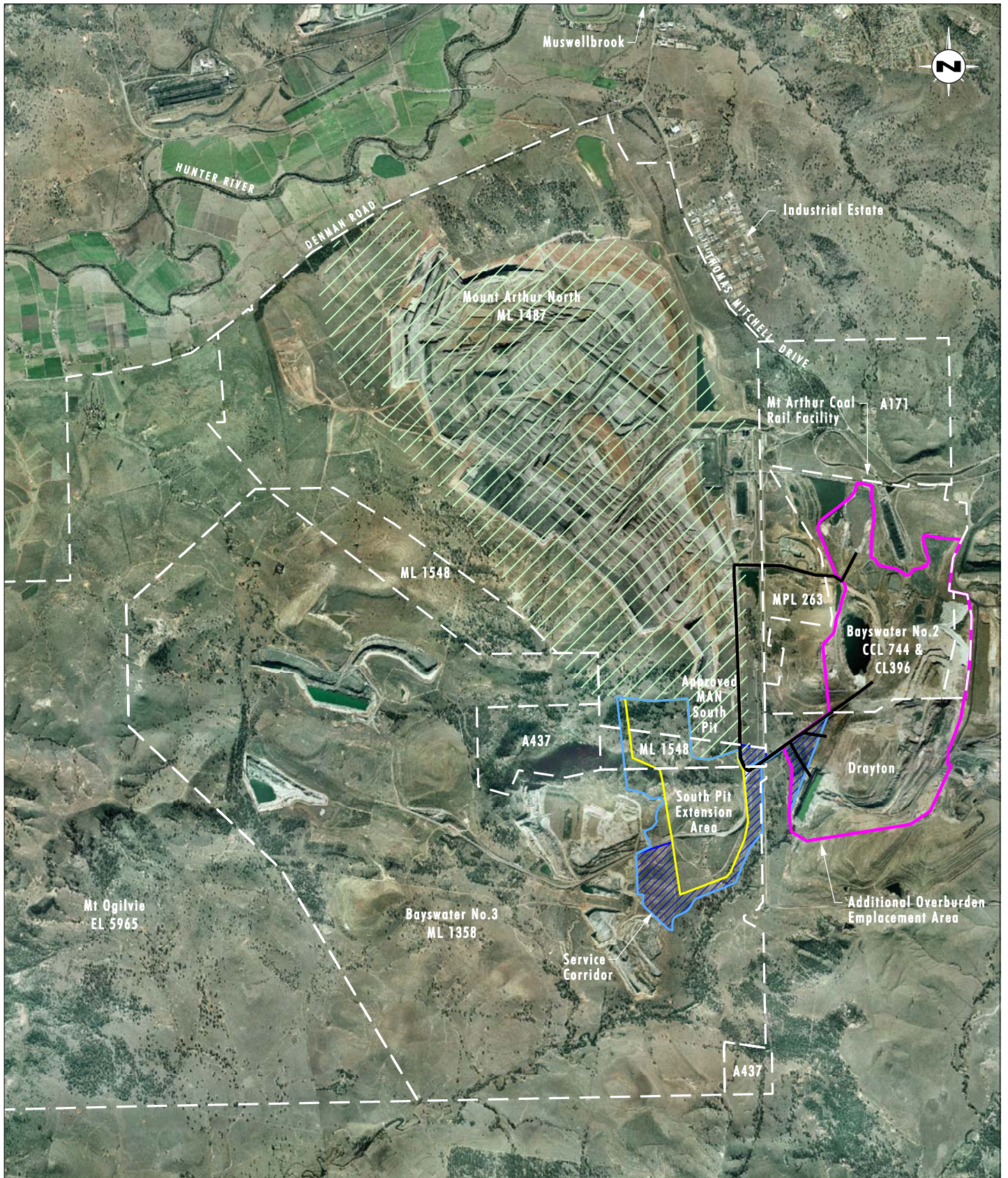
The MAN South Pit was approved as part of Mt Arthur Coal's MAN Coal Mine in 2001. The extent of the currently approved MAN mining area is shown on **Figure 1.2** and extends close to the southern boundary of the MAN ML. The proposed South Pit Extension project will extend the existing approved South Pit further south into the Bayswater No. 3 ML increasing resource recovery from within Mt Arthur Coal's existing mining area. The project will extend the limit of the South Pit approximately 2.4 kilometres further south, as illustrated in **Figure 1.2**. This will involve the disturbance of an additional approximately 190 hectares not currently disturbed by mining and result in the recovery of an additional approximately 25 million tonnes of coal over the proposed 21 year project life.

Approval is sought to mine in the South Pit Extension area for 21 years, which will be for approximately five years beyond the currently approved life of the MAN mining area. The MAN mining area has substantial resources beyond the 21 year approval granted in the 2001 development consent (DA 144-05-2000) and is planned to continue beyond 21 years subject to gaining approval at the time.

Mining in the proposed South Pit Extension area will be managed as part of the existing open-cut operation utilising the existing environmental management system. All coal from the project area will be taken to Mt Arthur Coal's existing coal handling and preparation



FIGURE 1.1
Locality Plan



Source: Mt Arthur Coal

0 1 2 3 km
1:65 000

Legend

- | | |
|--|---------------------------------------|
| Mining and Exploration Lease Boundary | Proposed Service Corridor |
| Approved MAN Mining Area | Approximate New Disturbance Footprint |
| South Pit Extension Mining Area | |
| Additional Overburden Emplacement Area | |
| Main Haul Roads | |

FIGURE 1.2

Proposed South Pit Extension Project

facilities for processing then transported off-site for sale using current rail loading and conveyor facilities (refer to **Section 1.2.3**).

1.2.2 Overburden Emplacement Areas

The majority of overburden extracted from within the extended South Pit will be emplaced in the Bayswater No. 2 mining area and also within the neighbouring Drayton West Pit, in agreement with Anglo Coal (Drayton Management) Pty Ltd. The emplacement of overburden in these two areas as part of the South Pit Extension project will allow rehabilitation of these areas to be completed, providing an improved final landform. The emplacement of additional overburden material in these areas will also assist in remediating areas currently subject to spontaneous combustion, providing a further environmental benefit as part of the project. The conceptual overburden emplacement area design is shown on **Figure 1.2**.

Overburden from the South Pit Extension area may also be emplaced in either the MAN or Bayswater No. 3 mining areas within existing approved dumping areas. Overburden from each of these mining areas may also be taken to the South Pit void or to the Bayswater No. 2 or Drayton emplacement areas to retain the overall overburden emplacement area balance and achieve desirable rehabilitation outcomes. As all overburden emplacement will be undertaken within existing mining areas, no previously undisturbed areas will be impacted by overburden emplacement activities except to construct haulage corridors.

1.2.3 Mine Infrastructure

One of the aims of the project is to maximise use of Mt Arthur Coal's currently approved equipment and infrastructure. The project will make use of the existing coal handling and preparation plant and coal transportation (rail loading and conveyor) facilities without requiring any changes to these currently approved facilities. Total coal processing will remain within the current limit of 20 Mtpa approved as part of the MAN development consent (DA 144-05-2000).

The South Pit Extension will result in the removal of the existing haul road that connects the Bayswater No. 3 mining area with the MAN and Bayswater No. 2 mining areas, with this haul road needing to be relocated around the southern end of the South Pit. The haul road will be relocated within the proposed services corridor shown on **Figure 1.2**, with this corridor also providing sufficient space for placement of other Mt Arthur Coal operational infrastructure such as water pipelines and powerlines which will need to be relocated as the South Pit progresses further south.

1.2.4 Disturbance Footprint

The total disturbance footprint for this project that has the potential to impact on ecological values includes the proposed additional mining area, the services corridor and an area around the edge of the mining pit which will be required for access tracks, diversion drains, sediment control structures and other ancillary mining activities. The additional mining area will result in new disturbance of approximately 190 hectares, whilst the total new potential disturbance footprint is approximately 330 hectares. It is highly unlikely that this entire 330 hectare area will be impacted by mining activities, as the majority of disturbances outside the mining pit will be linear or localised disturbances, however, to provide a conservative impact assessment, it has been assumed that total disturbance will occur within the disturbance footprint (refer to New Disturbance Footprint on **Figure 1.2**).

1.3 Objectives

The objectives of the flora and fauna assessment were to:

- record the flora and fauna species, populations and ecological communities in the project area;
- identify any threatened flora and fauna species, especially those listed under Schedules 1 and 2 of the NSW *Threatened Species Conservation Act* 1995 (TSC Act 1995) and the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act 1999);
- assess the impact that the project will have on the flora and fauna species, populations and ecological communities recorded in the project area, particularly those listed under the TSC Act 1995 and EPBC Act 1999; and
- provide recommendations for the management and monitoring of flora and fauna species and communities, including any threatened species, populations or endangered ecological communities recorded.

2.0 Survey Methodology

Extensive ecological survey has been completed in the wider Mt Arthur Coal operations area for numerous environmental assessments and ecological monitoring. The information gathered from these surveys has been assessed and used in the compilation of potential threatened species lists, habitat assessments and survey design (Resource Planning 1993; URS 2000; Umwelt 2001; Umwelt 2004; Umwelt 2005).

The entire south pit extension area has previously been surveyed as part of either the Mt Arthur North Project (URS 2000) or the Bayswater No. 3 Environmental Impact Statement (EIS) (Resource Planning 1993). The project area was, however, resurveyed due to the amount of time that has elapsed since the conduct of these assessments. The combination of additional field survey and previous assessments ensures that the entire project area has been appropriately surveyed and mapped, ensuring that an adequate assessment of the impacts of the project on ecological values was able to be completed.

Prior to the commencement of flora and fauna field surveys, searches of the Department of Environment and Conservation (DEC) Atlas of NSW Wildlife Database and the Commonwealth Department of Environment and Heritage (DEH) Protected Matters Database were undertaken to build on the information gathered from previous local work.

2.1 Flora Survey

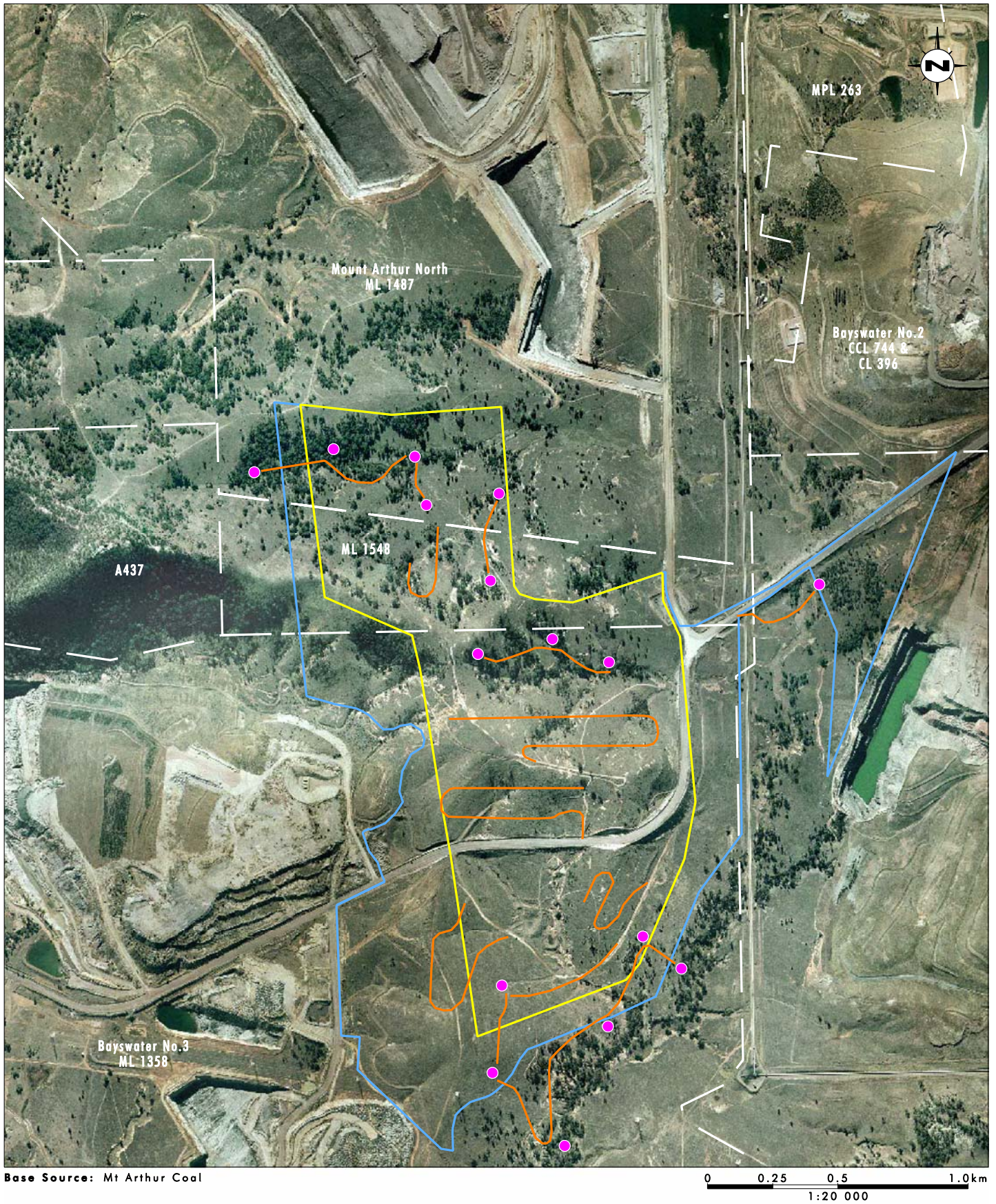
Thirteen vegetation survey plots were sampled within and immediately adjacent to the project area on 16, 17 and 18 February 2005 to assess species composition and vegetation community structure. An additional three plots were surveyed on 30 November 2005. Walking transects and aquatic vegetation assessments were also undertaken within the project area to assess vegetation communities and target potentially occurring threatened species (refer to **Figure 2.1**). General observations of the area were also made including the level of disturbance, vegetation community age structure, erosion and density of weed infestations.

2.1.1 Vegetation Survey

Systematic 400 m² plots were used to undertake semi-quantitative sampling of vegetation (refer to **Figure 2.1**). This plot size is used widely, including by the Royal Botanic Gardens Sydney and DEC. The typical dimensions of the plot are 20 metres by 20 metres; however some plots were 10 metres by 40 metres, particularly in riparian areas. When being used to describe vegetation communities, plot-based (or quadrat) surveys have distinct advantages over transects, as they:

- enable a quantitative examination of species distribution and abundance;
- are more likely to detect inconspicuous or threatened species as a smaller area is sampled in a concentrated search; and
- provide a basis for any subsequent monitoring.

At each plot, roughly 45 to 60 minutes were spent searching for all vascular flora species present within the plot. Species within the plot were assigned a cover-abundance value to reflect their relative cover and abundance in the plot. Species located outside the plot were marked as being present but were not assigned a cover-abundance value.



Legend

- Mining and Exploration Lease Boundary
- South Pit Extension Mining Area
- Approximate New Disturbance Footprint
- Walking Transects
- Vegetation plots

FIGURE 2.1

Flora Survey Methodology

A modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with selected modifications sourced from Poore 1955 and Austin et al. 2000) was used to estimate cover-abundances of all plant species within each plot. **Table 2.1** shows the cover-abundance categories used.

Table 2.1 - Modified Braun-Blanquet Crown Cover-abundance Scale

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

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

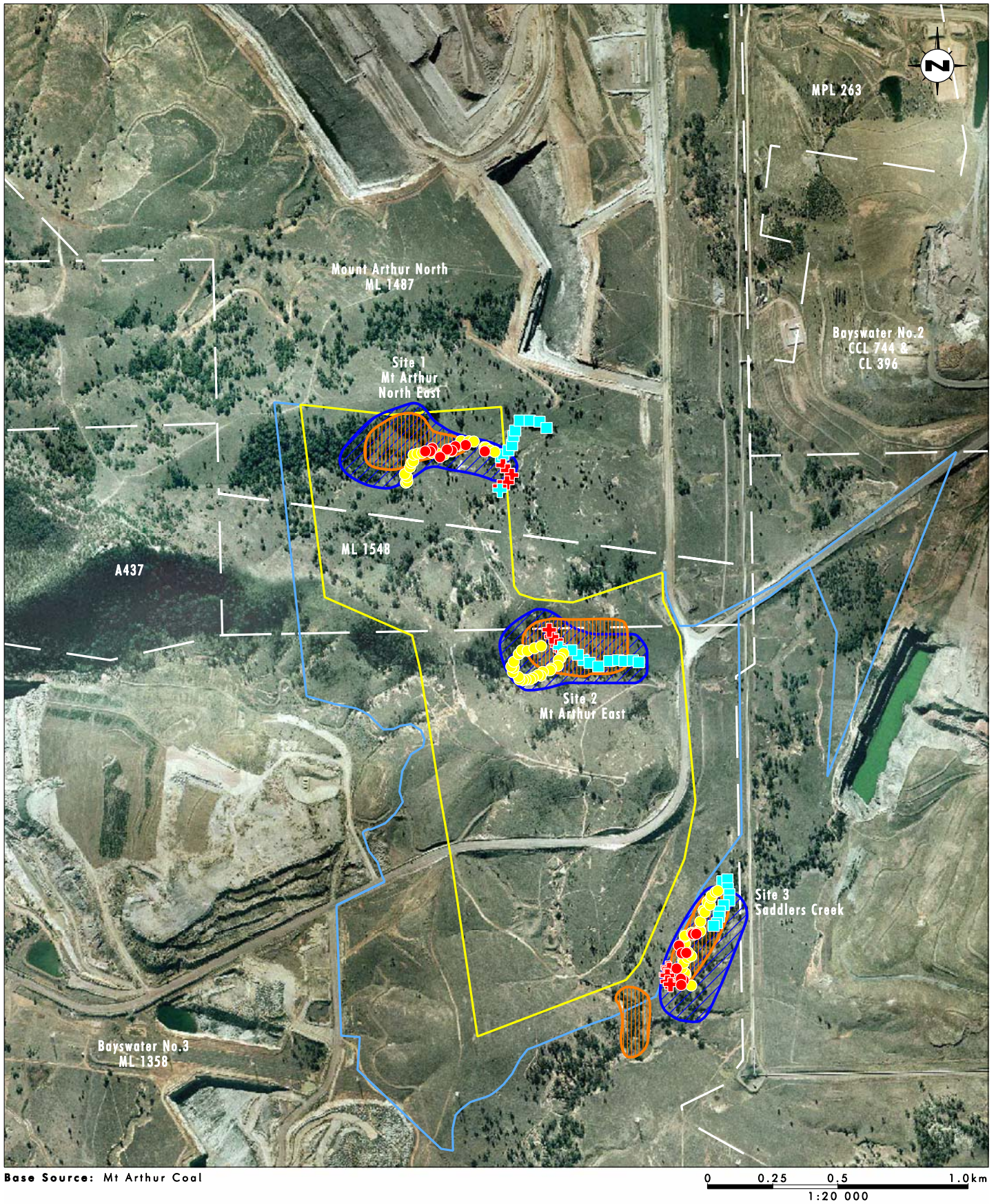
In addition, information was gathered on the condition of the vegetation at each of the survey sites. The general health of the vegetation; evidence of natural regeneration; occurrence and abundance of weeds; evidence of disturbance and feral animals; and other observable impacts were also recorded.

Walking transects were also used to assess vegetation community boundaries and to search for rare plant species (**Figure 2.1**).

2.2 Fauna Survey

A fauna survey of the project area was undertaken between 21 and 25 February 2005. Weather conditions during the survey period were very warm to hot and dry days, with dry warm nights.

Three survey sites were established across the project area as shown on **Figures 2.2** and **2.3**. Site 1, referred to as Mt Arthur north-east, was located at the northern end of the project area, approximately one kilometre east north east of the eastern side of Mt Arthur. Mt Arthur north east was positioned along a drainage line consisting of first and second order ephemeral drainage lines with a small, relatively steep catchment draining east from Mt Arthur. Site 2, referred to as Mt Arthur East, was located towards the middle of the project area, approximately one and half kilometres east of the eastern edge of Mt Arthur. Mt Arthur east was positioned at the top of a small catchment area comprising first order ephemeral drainage lines draining eastwards. Site 3, referred to as Saddlers Creek, is located at the southern end and outside of the project area. Saddlers Creek was included as a survey site due to its proximity to the project area and the likelihood that species utilising the southern end of the project area are also likely to utilise Saddlers Creek. Species utilising the southern end of the project area and Saddlers Creek were considered more likely to be detected within the riparian zone where there are significantly more denning, shelter and perching opportunities.

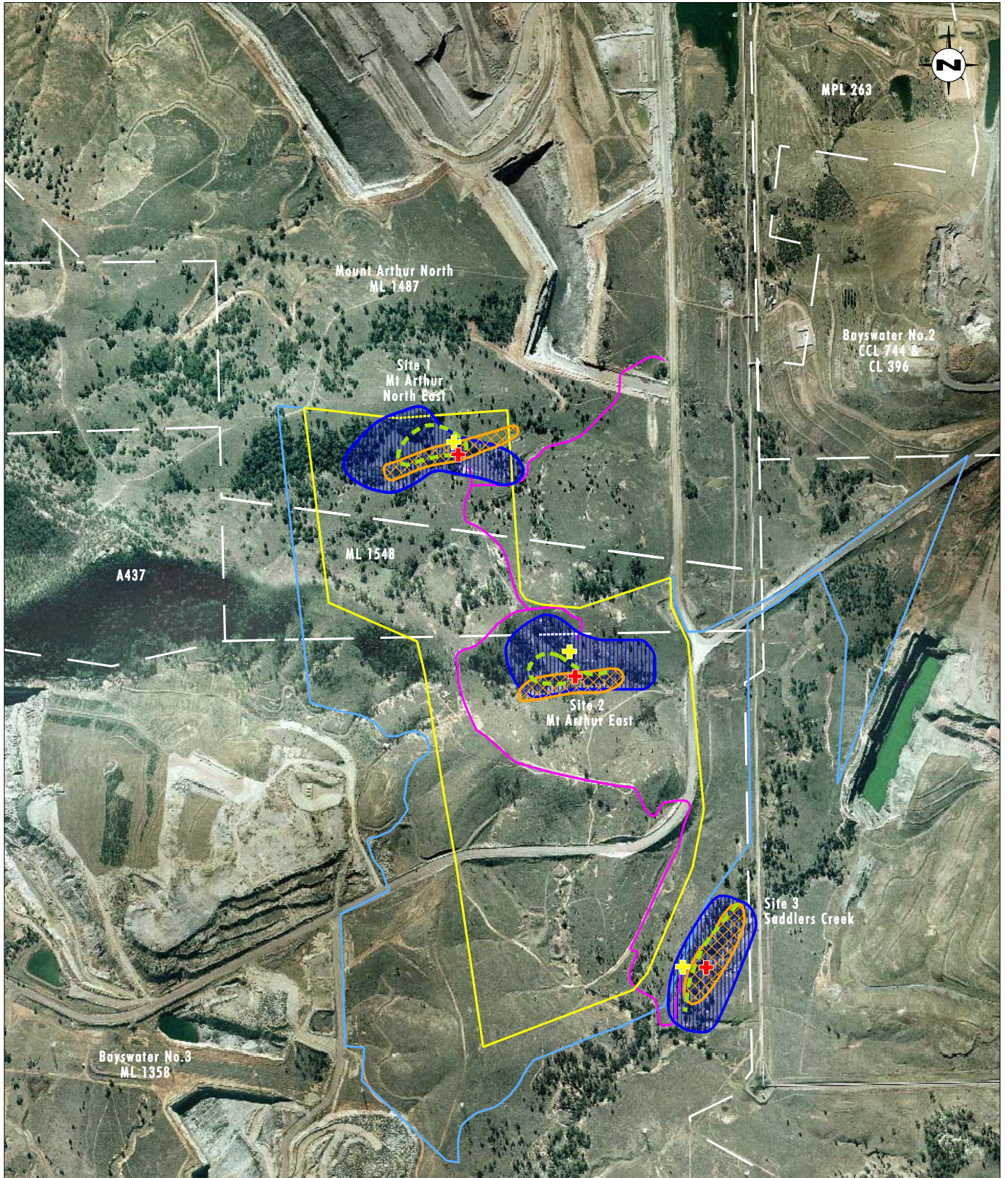


Legend

- | | |
|---------------------------------------|----------------------------|
| Mining and Exploration Lease Boundary | Arboreal Elliot B Traps |
| South Pit Extension Mining Area | Terrestrial Elliot A Traps |
| Approximate New Disturbance Footprint | Paired Hair Tubes |
| Bird Search Area | Harp Traps |
| Reptile Search Area | Cage Traps |

FIGURE 2.2

Trap Positions and Diurnal Fauna Survey Effort



Base Source: Mt Arthur Coal

0 0.25 0.5 1.0 km
1:20 000

Legend

- | | |
|---|---|
| — Mining and Exploration Lease Boundary | Spotlight Search Area |
| — South Pit Extension Mining Area | Amphibian Search Area |
| — Approximate New Disturbance Footprint | All Night Anabat Echolocation Recording |
| — Walking Anabat Transect | Nocturnal Call Playback |
| — Vehicle Spotlighting Transect | |

FIGURE 2.3

Nocturnal Fauna Survey Effort

Trapping methods used at each of the survey sites included:

- Elliot A traps;
- Elliot B traps;
- cage traps;
- hair funnels with meat bait; and
- hair funnels with oat and peanut butter bait.

Surveys also included bird searches, diurnal reptile and amphibian searches, spotlighting transects, nocturnal reptile and amphibian searches, Anabat II echolocation recording transects, fixed all night Anabat II echolocation recording and habitat assessment.

Arboreal Elliot B traps were used to sample arboreal fauna at Mt Arthur north east and Saddlers Creek. Arboreal Elliot B trapping was not undertaken at Mt Arthur East.

Harp traps were used to sample micro-bats at Mt Arthur north east and Mt Arthur east survey sites. Suitable flyways were not identified along Saddlers Creek, decreasing the probability of captures, and harp traps were not employed at this site.

2.2.1 Trapping

A variety of mammal traps were utilised at each survey site targeting terrestrial, arboreal and flying mammals. **Table 2.2** shows the total number of trap nights conducted during the survey. One trap night is equal to one trap set for one entire night.

Table 2.2 - Number of Mammal Trap Nights

Trap Type	Trap Nights Mt Arthur North East	Trap Nights Mt Arthur East	Trap Nights Saddlers Creek	Totals trap nights
Elliot A Terrestrial	100	100	100	300
Elliot B				
- Terrestrial	80	80	80	240
- Arboreal	40	-	40	80
Cage traps	20	20	20	60
Hair funnels				
- meat bait	80	80	80	240
- oats/peanut bait	80	80	80	240
Harp Trap	3	3	-	6
Total Trap Nights	403	363	400	1166

Elliot A and Elliot B traps baited with a mixture of rolled oats and peanut butter were set in pairs approximately 20 metres apart on the ground. Each trap line consisted of 25 Elliot A and 20 Elliot B traps positioned amongst habitat features such as logs, fallen bark, rocks and ground cover. All Elliot traps were covered with a plastic bag to prevent rain entering and lined with woollen wadding to provide insulation for trapped animals.

Elliot B traps baited with a mixture of rolled oats, peanut butter and honey were set approximately 30 metres apart on tree trunks. Traps were positioned on platforms attached

to the trunks of large trees. Large trees with hollows were targeted as trap sites, although several traps were set on trees without hollows. The trunk and trap entrance were sprayed with a honey and water mixture to attract arboreal mammals to the traps. Each trap line consisted of 10 Elliot B traps. All Elliot traps were covered with a plastic bag to prevent rain entering and lined with woollen wadding to provide insulation for trapped animals. Each trap position was designed to be in shade during the first hours of morning sun to prevent traps overheating.

Five single-ended cage traps baited with chicken necks were set at each survey site. Traps were positioned in morning shady positions and covered with a clear plastic bag. Half of the length of each trap was covered in 95% shade cloth to provide shade for trapped diurnal animals.

Hair funnels were set in pairs. Each pair contained one hair funnel baited with cat food and the other with a rolled oats and peanut butter mixture. Standard Faunatech hair funnels were used. A total of 480 trap nights were sampled across the three survey sites, with each pair approximately 25 metres apart. Each transect consisted of 10 pairs of funnels. All hair funnels were positioned terrestrially and set for eight consecutive nights. All hair samples were identified by industry recognised expert Barbara Triggs.

Harp trapping was undertaken at Mt Arthur North East and Mt Arthur East where suitable relatively narrow bat flyways could be found along drainage lines. Only large open space bat flyways were present along Saddlers Creek where a low chance of capture was likely. A single harp trap was used at each survey site and set for three consecutive nights. Harp traps were set in morning shaded positions to prevent bats overheating in direct sunlight. Bats captured in harp traps were identified according to Churchill (1998).

2.2.2 Area Searches

2.2.2.1 Spotlighting

A total of 8.5 person hours of spotlighting was conducted in the project area comprising six hours walking surveys, 1.5 person hours driving surveys and one person hour opportunistic spotlighting during other nocturnal activities such as reptile and amphibian searches. Each site was surveyed over two nights. Each night two ecologists, each with a 30 watt Lightforce spotlight, undertook a 30 minute walking spotlight transect (refer to **Figure 2.3** for the total area surveyed at each site) and a 20 minute driving spotlighting transect between survey sites.

Vehicle spotlighting was undertaken from a slowing moving vehicle with only the passenger spotlighting. Steep terrain, a lack of existing tracks and long grass up to one metre in height prevented extensive driving spotlight transects at each survey site. Spotlighting was undertaken between 7.30 pm and 11.30 pm. Spotlight searches specifically targeted flying mammals such as flying foxes, arboreal mammals such as possums and gliders, terrestrial mammals such as kangaroos, wallabies, quolls, foxes and cats, and nocturnal birds such as owls and nightjars. Spotlighting also included opportunistic searches for reptiles, amphibians and micro-bats.

2.2.2.2 Reptile and Amphibian Searches

Two diurnal reptile and amphibian searches were completed at each survey site (refer to **Figure 2.2**) on different days, totalling six person hours. Each search was undertaken by two ecologists for a period of at least 30 minutes between 11 am and 4 pm. Diurnal reptile and amphibian searches, specifically targeting reptiles and opportunistically targeting

amphibians were undertaken during warm (approximately 25 °C) to hot (approximately 35 °C) parts of the day.

Two nocturnal searches specifically targeting amphibians and opportunistically targeting reptiles were completed at each survey site (refer to **Figure 2.3**) on different days. Each search was undertaken by two ecologists for a period of at least 30 minutes in the first three hours of the night. Habitat features investigated during nocturnal reptile and amphibian searches included water bodies, emergent vegetation, wet soak areas, logs, rocks, loose tree trunk bark, leaf litter and open grasslands. Amphibians not identifiable from their calls were captured for identification.

2.2.2.3 Bird Searches

Two diurnal 60 minute bird surveys were undertaken at each survey site (refer to **Figure 2.2**). Bird surveys were undertaken in a range of habitat types at various times of the day, primarily in early to mid morning and mid to late afternoon. Opportunistic observations were recorded during all other aspects of the field survey, particularly while checking trap lines and travelling between sites. Individual bird species were identified from characteristic calls and by observation using a 15 - 45 × 50 spotting scope (bird searches) and 10 × 60 binoculars (opportunistic sightings).

2.2.2.4 Area Search Survey Effort Summary

Table 2.3 shows the total number of person hours undertaken for each area search method and the total number of searching hours across the study area.

Table 2.3 - Area Search Effort Summary

Area Search Method	Total Person Hours
Spotlighting	8
Diurnal reptile and amphibian	6
Nocturnal reptile and amphibian	6
Bird searches	6
Total	26 hours

2.2.3 Echolocation Recording

Bat echolocation recordings were made using a single 'Anabat II Bat Detector' and 'Anabat CF Storage ZCAIM'. Hereafter the detector and storage unit will collectively be referred to as the 'Anabat detector'.

2.2.3.1 Walking Transects

One walking bat echolocation recording transect was completed at each survey site (refer to **Figure 2.3**). Each transect was recorded during walking spotlight searches of the survey sites for a minimum of 30 minutes. The Anabat detector was placed in a backpack, positioned vertically and given a clear view of the sky. All walking transects were completed within the first two hours after dusk.

2.2.3.2 All night recordings

One all night bat echolocation recording was made at each survey site (refer to **Figure 2.3**). At each site the Anabat detector was attached to a tree trunk via a small platform and

positioned with a clear view of possible bat flyways. The Anabat detector began recording no later than two hours after dark and programmed to stop recording half an hour after sunrise the following morning.

2.2.3.3 Bat Echolocation Call Identification

All Anabat detector recordings were analysed by Glenn Hoyer of Fly by Night Surveys Pty Limited. The echolocation calls of species were identified to one of three levels of confidence:

- Confident;
- Probable; and
- Possible.

All three levels of identification confidence were treated as positive identifications.

2.2.4 Signs of Presence

Searches for evidence of animal presence were conducted opportunistically during all survey activities, particularly during nocturnal and diurnal reptile and amphibian searches. Evidence of presence included scats, feathers, nests, burrows, bones from carcasses, sections of hair and scratch marks on trees. All hair, scat and bone samples were identified by Barbara Triggs.

2.2.5 Call Playback

A single call playback session was undertaken at each survey site. Call playback sessions included the calls of the:

- sugar glider (*Petaurus breviceps*);
- squirrel glider (*Petaurus norfolcensis*);
- koala (*Phascolarctos cinereus*);
- Australian owl nightjar (*Aegotheles cristatus*);
- barn owl (*Tyto alba*);
- masked owl (*Tyto novaehollandiae*);
- barking owl (*Ninox connivens*); and
- powerful owl (*Ninox strenua*).

Call playback sessions commenced with a quiet listening period of approximately five minutes. Each call was played for a minimum four minutes followed by a listening period of two minutes before the beginning of the next species call. Calls were broadcast using a 10 watt directional loud hailer and all call playback sessions began at dusk. Mammal calls were played before bird calls to prevent the calls of predators (large owls) decreasing the likelihood of prey species (gliders) responding to call playback.

3.0 Flora Survey Results

3.1 Vegetation of the Region

The upper Hunter Valley has been largely cleared of native vegetation, primarily for agricultural and other land uses, including urban development and mining. The valley floodplain areas have been subject to the most intensive agricultural use. Similar land use patterns occur in the vicinity of the project area, which is surrounded by agricultural land, open cut coal mines, and patches of remnant vegetation.

Two large national parks occur to the south-west and south-east of the project area (Wollemi and Yengo National Parks). Smaller, yet significant areas of national park also exist to the northeast (Mt Royal and Barrington Tops National Parks). These conserved areas are located generally on the edge of the valley and connectivity to and from these conservation reserves is patchy due to the variety of land tenures and long history of land modification. In terms of the main valley floor area, formally protected areas constitute about 1.9% (Peake 2006).

Ravensthorpe State Forest (approximately 25 kilometres to the north east) represents a significant link and refuge area between remnant patches of vegetation in the central Hunter Valley. This forest forms an important and integral part in the preservation of the flora and fauna of the upper Hunter Valley (Bell and Russell 1993). Vegetated linkages to this remnant will be limited in the short to medium term by the expansion of open cut mining at Mt Owen and other mining developments in the central Hunter Valley.

On a local scale, the project area contains a number of scattered vegetated fragments that form a “stepping-stone” corridor for fauna species that can readily move across large gaps of open country. Although the lack of continuous movement corridors somewhat reduces the flora and fauna habitat potential of a number of these areas, the remnants are still significant on local and regional scales. Vegetation on Mt Arthur to the immediate north-west of the project area is protected from mining under a draft voluntary conservation agreement (VCA) and represents a significant area of flora and fauna habitat in the local area. There is a tenuous corridor linkage from Mt Arthur through the riparian habitats associated with Saddlers Creek and adjacent woodland areas to Mt Ogilvie to the south west. A highly fragmented, but significant corridor follows north from Mt Arthur, through spotted gum (*Corymbia maculata*) dominated woodland to the Antienne area, with approved mining activity at Mt Arthur Coal and neighbouring Drayton Mine impacting on this corridor. The potential exists for fauna movement throughout this corridor from the project area; however, the New England Highway provides a significant barrier to movement of some species in this direction.

Areas of remnant vegetation also occur to the east of the project area within the Macquarie Generation buffer zones. These habitats are not linked via vegetation corridors to habitats within the project area.

3.2 Hunter Remnant Vegetation Project

The vegetation communities of the project area were mapped as part of the Hunter Remnant Vegetation Project (HRVP) (Peake 2006). Five native vegetation communities were mapped within two kilometres of the project area, with an additional ‘Planted Area’ also mapped and described. Each of these communities is summarised below from the vegetation community profiles described in the HRVP (Peake 2006). Reference to the HRVP should be made for full community descriptions.

Narrabeen Footslopes Slaty Box Woodland

A low to mid-high woodland dominated by slaty box (*Eucalyptus dawsonii*) and grey box (*Eucalyptus moluccana*). Cooba (*Acacia salicina*) and bulloak (*Allocasuarina luehmannii*) may form a low tree stratum 4-10 metres high or may be part of the upmost canopy. Other obvious trees which may be present include kurrajong (*Brachychiton populneus* subsp. *populneus*), black cypress pine (*Callitris endlicheri*), narrow-leaved ironbark (*Eucalyptus crebra*) and grey gum (*Eucalyptus punctata*).

The shrub layer is typically mid-dense to dense, and 0.5-3 metres in height, and is dominated by sticky daisy bush (*Olearia elliptica* subsp. *elliptica*), knife-leaved wattle (*Acacia cultriformis*), shiny-leaved canthium (*Canthium odoratum*), native olive (*Notelaea microcarpa* var. *microcarpa*), wedge-leaf hop-bush (*Dodonaea viscosa* subsp. *cuneata*), western golden wattle (*Acacia decora*), native blackthorn (*Bursaria spinosa* subsp. *spinosa*), western boobialla (*Myoporum montanum*) and violet nightshade (*Solanum brownii*).

The groundcover, typically up to 0.5 metre high, is typically sparse to very sparse and is relatively species poor. It includes kidney weed (*Dichondra repens*), many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*), wire grass (*Aristida ramosa*), blue trumpet (*Brunoniella australis*), barbed wire grass (*Cymbopogon refractus*), large tick-trefoil (*Desmodium brachypodum*), winter apple (*Eremophila debilis*), common fringe-rush (*Fimbristylis dichotoma*) and corrugated sida (*Sida corrugata*).

Central Hunter Box - Ironbark Woodland

A low to mid-high (15-22 metres high) woodland dominated by narrow-leaved ironbark (*Eucalyptus crebra*), kurrajong (*Brachychiton populneus* subsp. *populneus*) and grey box (*Eucalyptus moluccana*). Rough-barked apple (*Angophora floribunda*) and black cypress pine (*Callitris endlicheri*) may also occur in abundance in places. Bulloak (*Allocasuarina luehmannii*) is dominant in the small tree layer, and lamboto (*Canthium odoratum*), hickory wattle (*Acacia implexa*) and particularly cooba (*Acacia salicina*) may also occur as small trees, in abundance at some locations.

A shrubby understorey is often present, 0.5-2 metres high, and may be dense through to sparse or absent. Common shrubs include native olive (*Notelaea microcarpa* var. *microcarpa*), native blackthorn (*Bursaria spinosa*), coffee bush (*Breynia oblongifolia*), cough-bush (*Cassinia quinquefaria*), western golden wattle (*Acacia decora*), water bush (*Myoporum montanum*) and hop bush (*Dodonaea viscosa*), as well as numerous others. In rocky areas the shrubby understorey becomes increasingly dense, and species such as *Notelaea microcarpa* var. *microcarpa* and *Acacia salicina* may dominate, forming a tall shrub or small tree stratum.

The groundcover varies from mid-dense to dense (45-70% cover), may be sparse in rocky areas, and is generally less than 0.5 metre high. It is typically composed of a large variety of forbs, many grasses, and a small number of sedges, ferns and twiners. Commonly occurring species include barbed wire grass (*Cymbopogon refractus*), threeawned wire grass (*Aristida ramosa*), kidney weed (*Dichondra repens*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), tall chloris (*Chloris ventricosa*), corkscrew grass (*Austrostipa scabra*), slender tick-trefoil (*Desmodium varians*), weeping grass (*Microlaena stipoides* var. *stipoides*), paddock lovegrass (*Eragrostis leptostachya*) and slender rat's tail grass (*Sporobolus creber*). A large number of other species may be present, however, in various combinations. A small number of vines, and a diversity of terrestrial orchids and mistletoes are also present.

Central Hunter Ironbark - Spotted Gum - Grey Box Forest

An open forest to woodland of 25-35% cover and 17-30 metres height dominated by narrow-leaved ironbark (*Eucalyptus crebra*), spotted gum (*Corymbia maculata*) and grey box (*Eucalyptus moluccana*). Common shrub species include gorse bitter pea (*Daviesia ulicifolia* subsp. *ulicifolia*), grey bush pea (*Pultenaea spinosa*), coffee bush (*Breynia oblongifolia*), bushy needlebush (*Hakea sericea*), native blackthorn (*Bursaria spinosa* subsp. *spinosa*) and hickory wattle (*Acacia falcata*). Ground cover of less than one metre height consists of numerous forbs, fewer grass species, and a limited number of ferns, sedges or other herbs. Common species include poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), barbed wire grass (*Cymbopogon refractus*), whiteroot (*Pratia purpurascens*), many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*), pomax (*Pomax umbellata*), variable glycine (*Glycine tabacina*), blue flax lily (*Dianella revoluta*), slender wire lily (*Laxmannia gracilis*), weeping grass (*Microlaena stipoides* var. *stipoides*), Vernonia cinerea var. *cinerea*, peach heath (*Lissanthe strigosa*), blue trumpet (*Brunoniella australis*) and variable tick-trefoil (*Desmodium varians*) along with a variety of other species.

Mt. Arthur Forest Complex

The vegetation of Mt. Arthur is very complex and to date inadequate systematic plot work has been undertaken to describe separate communities. The analysis grouped together virtually all plots undertaken at Mt. Arthur into one unit. The floristic description provided below, and in the diagnostic species list, therefore covers at least three variations found on the slopes of Mt. Arthur: a hot, dry north-eastern aspect; sandstone outcrops and slopes; and sheltered, southerly aspect slopes.

In general, the forests of Mt. Arthur are mid-high to tall, with 15-50% cover, depending on aspect. Dominant tree species are grey gum (*Eucalyptus punctata*), grey box (*Eucalyptus moluccana*), kurrajong (*Brachychiton populneus* subsp. *populneus*) and forest oak (*Allocasuarina torulosa*). Rough-barked apple (*Angophora floribunda*), Blakely's red gum (*Eucalyptus blakelyi*) and Port Jackson fig (*Ficus rubiginosa* f. *rubiginosa*) may all be present at lower densities, while black cypress pine (*Callitris endlicheri*) is infrequent but locally common.

A mid-dense to dense understorey is present in most areas. On exposed sandstone slopes and outcrops, it is composed of native olive (*Notelaea microcarpa* var. *microcarpa*), water bush (*Myoporum montanum*), shiny-leaved canthium (*Canthium odoratum*), sticky daisy bush (*Olearia elliptica* subsp. *elliptica*), western golden wattle (*Acacia decora*), sticky wallaby bush (*Beyeria viscosa*) and grass tree (*Xanthorrhoea johnsonii*). In sheltered sites, especially on the southern slope, hairy clerodendrum (*Clerodendrum tomentosum*) may form a very dense shrub layer 2-4 metres in height, and coffee bush (*Breynia oblongifolia*) may be common. On the exposed north-eastern ridge, mealy saltbush (*Rhagodia parabolica*) is the most common shrub, with native broom (*Spartothamnella juncea*) being common.

The groundcover is variable, and may cover 30% through to 60% of any site. Common species include kidney weed (*Dichondra repens*), slender plantain (*Plantago debilis*), Galium spp., Dianella spp., small St Johns wort (*Hypericum gramineum*), many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*), wire grass (*Aristida ramosa*), slender bamboo grass (*Austrostipa verticillata*), wallaby grass (*Austrodanthonia fulva*), couch (*Cynodon dactylon*), short-stem sedge (*Carex breviculmis*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), Arthropteris tenella, necklace fern (*Asplenium flabellifolium*), and the cycad *Macrozamia flexuosa*. Variable tick-trefoil (*Desmodium varians*) and false sarsaparilla (*Hardenbergia violacea*) are common twiners.

Central Hunter Bulloak Forest Regeneration

A low to mid-high (4-12 metres) open to closed forest (10-60% cover), clearly dominated by the canopy-forming bulloak (*Allocasuarina luehmannii*). Other tree or low tree species are uncommon, but they may include species such as rough-barked apple (*Angophora floribunda*), swamp oak (*Casuarina glauca*), narrow-leaved ironbark (*Eucalyptus crebra*), grey box (*Eucalyptus moluccana*) or dogwood (*Jacksonia scoparia*). There is typically no shrub stratum present, or at best a very sparse one.

The low (<0.5 metre high) groundcover can be quite varied, and is typically sparse (5-60% cover), due to the presence of a high abundance of fallen branchlets. Grasses are typically sparse tussocks and may include the following species: threeawn speargrass (*Aristida vagans*), couch (*Cynodon dactylon*), paddock lovegrass (*Eragrostis leptostachya*), slender bamboo grass (*Austrostipa verticillata*), barbed wire grass (*Cymbopogon refractus*), hairy panic (*Panicum effusum*), bent summer-grass (*Paspalidium aversum*), threeawn grass (*Aristida ramosa*), umbrella grass (*Digitaria divaricatissima*) and weeping grass (*Microlaena stipoides* var. *stipoides*). Forbs, sedges and ferns are also sparse in the groundcover. The aerial hemiparasitic shrub harlequin mistletoe (*Lysiana exocarpi*) is also present on occasion.

Plantations

This unit comprises various plantations dominated by native species, and has been included in the HRVP mapping largely for completeness and consistency with the vegetation community map.

Plantations recorded in this unit are dominated by native species in the canopy stratum, i.e. 90% or more of the canopy consists of native species. However, plantations were not mapped or ignored based on whether the native species were locally-occurring (i.e. indigenous) or non-local.

3.3 Flora of the Project Area

3.3.1 Flora Species Recorded

A total of 119 flora species were recorded in the project area as a result of systematic and opportunistic surveys. Of these, 94 (79%) are indigenous to the project area, while 25 (21%) are exotic or non-local natives. A flora species list for the project area is included as **Attachment A**.

Flowering plants comprised 118 of the total number of species (monocots 27 and dicots 92), with only one fern species recorded.

The most abundant plant families recorded were Poaceae (grasses) – 16 species; Asteraceae (daisies) – 12 species; Fabaceae (peas and wattles) 9 species; and Myrtaceae (myrtles and eucalypts) – seven species.

The floristic diversity of the project area is regarded as low. The overall number of plant species recorded is likely to be affected by the site's history of ongoing mining and agricultural disturbance, however, it is expected that the majority of all vascular plant species present were recorded. Despite this, it is likely that floristic diversity is representative of similar disturbed woodlands and derived grasslands occurring widely across the Hunter Valley.

3.3.2 Vegetation of the Project Area

The vegetation communities in the project area have been heavily modified by past and ongoing agricultural activities and mining which have resulted in their fragmentation or degradation. Grazing, which has been widespread across the project area in the past, often has probably largely modified the species assemblage of the area.

The location of each of the vegetation communities identified within the project area is shown on **Figure 3.1**. Vegetation communities have been named in accordance with the vegetation communities mapped by Peake (2006), except where the communities are not consistent with these descriptions. A description of vegetation communities recorded in the project area is provided below.

Hunter Floodplain Red Gum Woodland Complex

Hunter Floodplain Red Gum Woodland Complex was identified along Saddlers Creek to the immediate south of the new disturbance area (refer to **Figure 3.1**). The canopy ranged from 15-20 metres on the banks of the creek and 8-10 metres within the creek bed. The vegetation was highly disturbed, with the creekline suffering from severe erosion and impacts due to cattle grazing. The tree canopy was dense in places along the creek bank with a very sparse shrub layer. The ground cover was dense and included many introduced species.

Dominant canopy species along Saddlers Creek include narrow-leaved ironbark (*Eucalyptus crebra*), forest red gum (*E. tereticornis*), grey box (*E. moluccana*) and rough-barked apple (*Angophora floribunda*). The shrub layer was sparse and ranged in height from 1-3 metres. Dominant species include cooba (*Acacia salicina*), *Cassinia quinquefaria*, native olive (*Notelaea microcarpa* var. *microcarpa*) and small-leaved bluebush (*Maireana microphylla*).

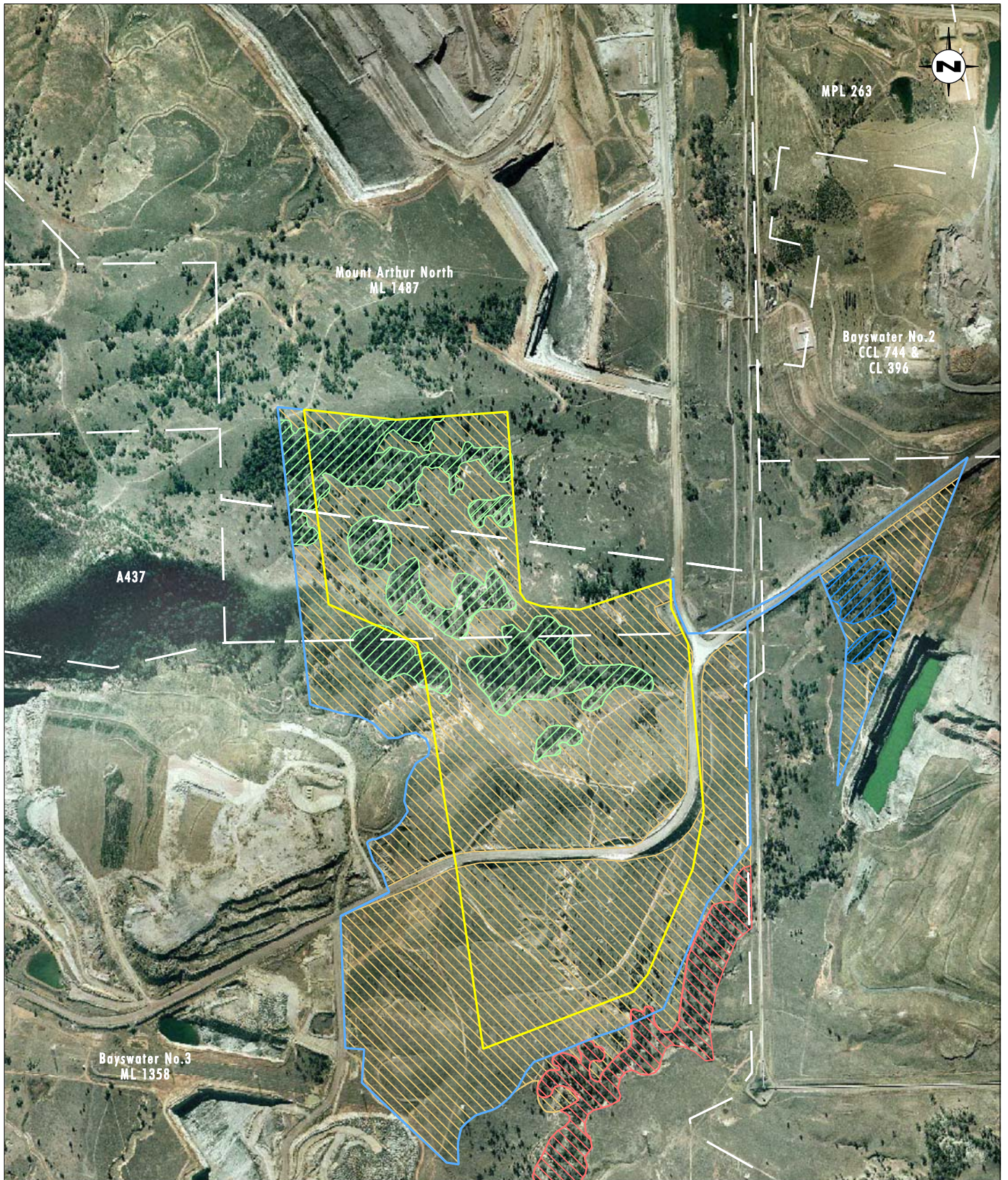
The ground cover was diverse and ranged in height from 0-1 metre. Dominant species include slender rat's tail grass (*Sporobolus creber*), plump windmill grass (*Chloris ventricosa*), couch (*Cynodon dactylon*), hairy panic (*Panicum effusum*), kangaroo grass (*Themeda australis*), *Sida corrugata*, berry saltbush (*Einadia hastata*), scurvy grass (*Commelina ensifolia*), kidney weed (*Dichondra repens*), many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*) and yellow buttons (*Chrysocephalum apiculatum*).

Weed species were common throughout this vegetation community, with commonly recorded species including African boxthorn (**Lycium ferocissimum*), tall fleabane (**Conyza sumatrensis*), fire weed (**Senecio madagascariensis*) and paspalum (**Paspalum dilatatum*).

Central Hunter Ironbark-Spotted Gum-Grey Box Forest

Central Hunter Ironbark-Spotted Gum-Grey Box Forest was identified across the northern portion of the project area with a canopy ranging in height from 25-30 metres (refer to **Figure 3.1**). A moderately dense shrub and ground layer was noted throughout this community, with weed species scattered throughout. This vegetation community is considered to be in poor to moderate condition as a result of grazing, weed invasion and past clearance.

The dominant canopy species within this community include spotted gum (*Corymbia maculata*), grey gum (*Eucalyptus punctata*), grey box (*E. moluccana*) and narrow-leaved ironbark (*E. crebra*). The shrub layer ranged in height from 1-3 metres and consisted of cooba (*Acacia salicina*), early wattle (*A. genistifolia*), hickory wattle (*A. implexa*), slender rice flower (*Pimelea linifolia*), winter apple (*Eremophila debilis*), *Cassinia quinquefaria*, Australian indigo (*Indigofera australis*), native olive (*Notelaea microcarpa* var. *microcarpa*), kurrajong (*Brachychiton populneus* subsp. *populneus*) and bulloak (*Allocasuarina luehmanni*).



Base Source: Mt Arthur Coal

0 0.25 0.5 1.0 km
1:20 000

Legend

- Mining and Exploration Lease Boundary
- South Pit Extension Mining Area
- Approximate New Disturbance Footprint
- ▨ Central Hunter Ironbark-Spotted Gum-Gray Box Forest
- ▨ Derived Grassland
- ▨ Hunter Floodplain Red Gum Woodland Complex
- ▨ Central Hunter Bullock Forest Regeneration

FIGURE 3.1

Vegetation Communities

The ground cover was moderately dense in places and ranged in height from 0.1 to 1 metre high. Commonly encountered species include poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), barbed wire grass (*Cymbopogon refractus*), whiteroot (*Pratia purpurascens*), many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*), pomax (*Pomax umbellata*), variable glycine (*Glycine tabicina*), kidney weed (*Dichondra repens*), common everlasting (*Chrysocephalum apiculatum*) and kangaroo grass (*Themeda australis*).

Common weed species throughout this community include cotton bush (*Gomphocarpus fruticosus*), fire weed (*Senecio madagascariensis*), Pelisser's toadflax (*Linaria pelisseriana*), Paddy's lucerne (*Sida rhombifolia*), prickly pear (*Opuntia stricta* var. *stricta*), fleabane (*Conyza sumatrensis*) and purpletop (*Verbena bonariensis*).

Central Hunter Bulloak Forest Regeneration

This vegetation community was located within the eastern portion of the new disturbance area. The canopy ranged in height from 8 to 10 metres and was dominated by bulloak (*Allocasuarina luehmannii*). One other canopy species were noted within this vegetation community, being grey box (*Eucalyptus moluccana*).

The shrub layer was dominated by juvenile bulloaks and eucalypts to a height of three metres. Sifton bush (*Cassinia arcuata*) and *Pultenaea retusa* were also recorded.

The ground layer comprised those species under one metre in height and consisted of *Elymus scaber* var. *scaber*, common couch (*Cynodon dactylon*), yellow buttons (*Chrysocephalum apiculatum*), creeping mint (*Mentha saturioides*), barbed wire grass (*Cymbopogon refractus*) and Jericho wiregrass (*Aristida jerichoensis*).

Derived Grassland

Derived grassland was identified over approximately 85% of the new disturbance area, as shown on **Figure 3.1**. The height of this community is less than one metre and the condition was found to vary between very poor due to past grazing, clearing and intense weed invasion and extremely good where the community is dominated by native grasses and herbs. Generally, the divide between good and poor condition is found along the haul road which bisects the project area, with the most disturbed areas found to the south of the haul road. **Figure 1.2** shows that much of the Derived Grassland area has been subject to past disturbance such as contouring powerlines and vehicle tracks.

Commonly encountered species in the least disturbed portion of the community include barbed wire grass (*Cymbopogon refractus*), slender bamboo grass (*Austrostipa verticillata*), plump windmill grass (*Chloris verticosa*), windmill grass (*C. truncata*), slender rat's tail grass (*Sporobolus creber*), *Sida corrugata*, threeawn spear grass (*Aristida vagans*), peppergrass (*Lepidium pseudohyssopifolium*), *Pomax umbellata*, kidney weed (*Dichondra repens*), winter apple (*Eremophila debilis*), slender flat-sedge (*Cyperus gracilis*), couch (*Cynodon dactylon*), biddy biddy (*Acaena novae-zelandiae*), fuzzweed (*Vittadinia cuneata* var. *cuneata*), *Vittadinia muelleri*, climbing saltbush (*Einadia nutans*), caustic weed (*Chamaesyce drummondii*), Queensland blue grass (*Dichanthium sericeum*), violet nightshade (*Solanum brownii*), wallaby grass (*Austrodanthonia bipartita*), common everlasting (*Chrysocephalum apiculatum*) and hairy panic (*Panicum effusum*).

Weed species were scattered throughout the northern portion of the community but in low numbers. Common weed species include paspalum (*Paspalum dilatatum*), Rhodes grass (*Chloris gayana*), lamb's tongue (*Plantago lanceolata*), Paddy's lucerne (*Sida rhombifolia*) and *Richardia stellaris*.

Derived grassland in the middle and southern portions of the project area was dominated by introduced species which included Scotch thistle (**Onopordum acanthium*), paspalum (**Paspalum dilatatum*), cotton bush (**Gomphocarpus fruticosus*), Rhodes grass (**Chloris gayana*), prickly pear (**Opuntia stricta*), fireweed (**Senecio madagascariensis*), **Richardia stellaris*, lamb's tongue (**Plantago lanceolata*), Paddy's lucerne (**Sida rhombifolia*), Pelisser's toadflax (**Linaria pelisseriana*) and purpletop (**Verbena bonariensis*). Native species included kangaroo grass (*Themeda australis*), yellow buttons (*Chrysocephalum apiculatum*) and slender rat's tail grass (*Sporobolus creber*).

Isolated native trees and shrubs were scattered throughout the derived grassland community. Narrow-leaved ironbark (*Eucalyptus crebra*) was the only tree species identified within this community, occurring as isolated individuals. The native shrub *Cassinia quinquefaria* is the only native shrub to occur within this community and is generally less than 1.5 metres in height, occurring in isolated pockets.

Aquatic Communities

Aquatic vegetation was recorded within the bed of Saddlers Creek and also fringing some of the farm dams within the disturbance area. The dominant species within this community was broad-leaf cumbungi (*Typha orientalis*). Other common species include slender flat sedge (*Cyperus gracilis*), many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*), swamp dock (*Rumex brownii*) and *Bolboschoenus caldwellii*.

Many native grass species were also recorded within this community such as barbed wire grass (*Cymbopogon refractus*), tall chloris (*Chloris ventricosa*), common couch (*Cynodon dactylon*) and slender bamboo grass (*Austrostipa verticillata*). Scattered bulloak (*Allocasuarina luehmannii*) were also recorded within this community.

Several weed species were common within the Aquatic Community such as paspalum (**Paspalum dilatatum*), mother-of-millions (**Bryophyllum delagoense*), tall fleabane (**Conyza sumatrensis*), Scotch thistle (**Onopordum acanthium*) and narrow-leaved cotton bush (**Gomphocarpus fruticosus*).

3.3.3 Conservation Status of Vegetation Communities

The HRVP includes an assessment of the conservation status of vegetation communities using the established DEH (2006) criteria (Peake 2006) listed in **Table 3.1**. The HRVP covered the entire extent of the project area. The vegetation communities recorded in the project area were compared to the vegetation communities and conservation assessment described in the HRVP. This allowed an assessment of the current conservation status of vegetation in the project area.

Table 3.1 - DEH (2003) Criteria for Listing threatened Species, Populations and Endangered Ecological Communities

DEH (2003) Criteria	
1 (C)	critically endangered, very severe decline of 95% or more of original distribution.
1 (E)	endangered, severe decline of 90-95% of original distribution.
1 (V)	vulnerable, substantial decline of 70-90% of original distribution.
2 (V)	very restricted with demonstrable threat; total area of occupancy is < 1,000 hectares, or total extent of occurrence is < 10,000 hectares or patch sizes generally < 10 hectares.
2 (R)	restricted with demonstrable threat; total area of occupancy is 1,000-10,000 hectares, or total extent of occurrence is 10,000-100,000 hectares or patch sizes generally 10-100 hectares.
2 (L)	limited with demonstrable threat; total area of occupancy is 10,000-100,000 hectares, or total extent of occurrence is 100,000-1,000,000 hectares.

Both the Hunter Floodplain Red Gum Woodland Complex and Central Hunter Ironbark-Spotted Gum-Grey Box Forest communities recorded in the project area were considered to have high conservation value and are considered by Peake (2006) to warrant listing as endangered ecological communities under either state or Commonwealth legislation. A summary of the conservation assessment provided in the HRVP by Peake (2006) for each of the vegetation communities occurring in the project area is provided below.

Hunter Floodplain Red Gum Woodland Complex

The pre-clearing extent of Hunter Floodplain Red Gum Woodland Complex was modelled together with Hunter Valley River Oak Forest and Central Hunter Swamp Oak Forest, as these could not be readily separated from each other because of the high degree of overlap in the habitat that they each occupy. Despite the complexities of the pre-clearing areas of occupancy, it is certain that Hunter Floodplain Red Gum Woodland Complex has suffered massive clearing, and meets the Criterion 1 (C) under DEH (2006). Even when other occurrences outside of the project area around Maitland (Hill 2003a) and along the Goulburn River (Peake et al. in prep.) are included in the assessment, it still meets Criterion 2 (V), because it has an area of occupancy of about 430 hectares and suffers from serious threats, including land clearing, dieback, lack of recruitment and invasion by weeds.

Central Hunter Ironbark-Spotted Gum-Grey Box Forest

This vegetation community dominates the eastern and central eastern parts of the HRVP study area, and was mapped and modelled to a moderately high degree of accuracy. About 61% of its pre-clearing extent has been removed and it is subjected to high levels of threat from major infrastructure development, land clearing, weed invasion and altered fire regimes. It has a total extent of occurrence of about 97,000 hectares, thus it meets Criterion 2 (R).

Central Hunter Bulloak Forest Regeneration

Central Hunter Bulloak Forest Regeneration occurs throughout the floor of the central Hunter Valley, and more or less coincides with Central Hunter Ironbark – Box Woodland, as well as Central Hunter Ironbark – Spotted Gum – Grey Box Forest. It is threatened by land clearing, weed invasion and altered fire regimes. There is some doubt as to whether or not this is a naturally occurring vegetation community; however there is no strong evidence to support the contention that it is not, so it is regarded here as natural. It is likely that a substantial area of this vegetation community has been removed, but whether or not this is likely to exceed 70%

of its former area is unknown. However, it has a total extent of occurrence of about 153,000 hectares, which coupled with its demonstrable threats means that it meets Criterion 2 (L) Vulnerable of DEH (2006).

Although both Hunter Floodplain Red Gum Woodland Complex and Central Hunter Ironbark-Spotted Gum-Grey Box Forest meet relevant criteria for listing as threatened at either State or National level, neither of these communities is currently listed and they are therefore considered to be of regional significance.

3.4 Significant Flora and Vegetation Communities

3.4.1 Threatened Flora Species

No threatened flora species were identified within the project area during the flora survey. Several species have, however, been previously recorded within 20 kilometres of the project area as discussed below.

The threatened flora species, lobed bluegrass (*Bothriochloa biloba*), is known to occur within the Mt Arthur Coal operations area. This species has recently been removed from the TSC Act, however it remains listed as a vulnerable species on the EPBC Act. This species was recorded in two locations during surveys for the Mt Arthur Coal Underground Project and is also known from a site adjacent to Edderton Road and the Mt Arthur Coal access road (Peake 2006). The locations of local lobed bluegrass recordings are shown on **Figure 3.2**.

Tricolor diuris (*Diuris tricolor*), a terrestrial orchid is also known to occur within the Mt Arthur Coal operations area, near Thomas Mitchell Drive, close to the Mt Arthur Coal access road (DEC Atlas of NSW Wildlife 2006). This species is listed on both the TSC Act and EPBC Act as a vulnerable species.

A search of the DEH Protected Matters Database identified seven flora species with the potential to occur in suitable habitat, in the project area. These species are listed in **Table 1** of **Attachment C**, with an assessment of their potential to occur within the project area. The assessment findings are discussed in **Section 5.5**.

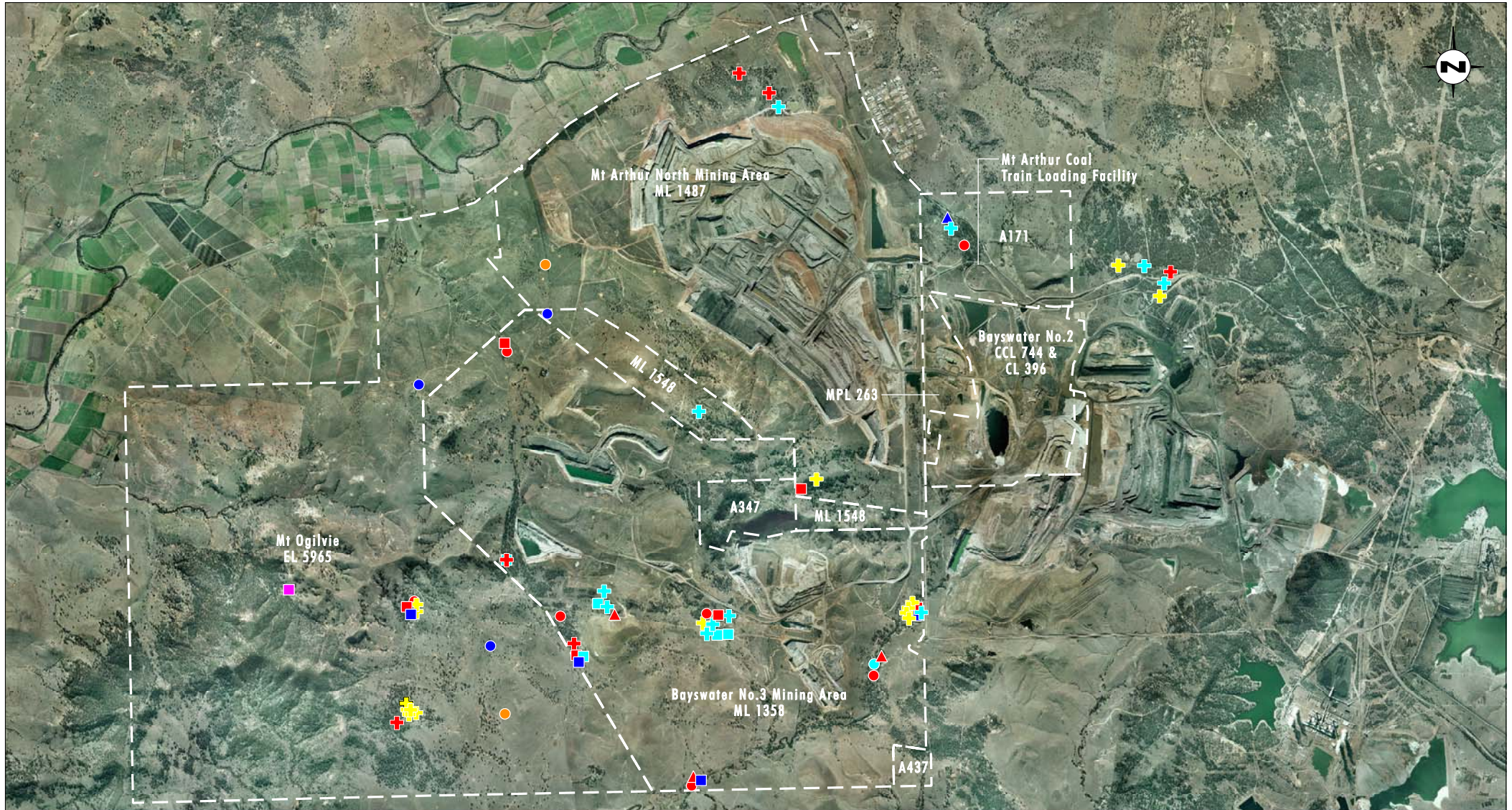
In addition to those species listed as nationally significant, 11 flora species listed as threatened under the NSW TSC Act 1995 have been recorded within 20 kilometres of the project area. These species were identified on the DEC Atlas of NSW Wildlife, in a review of flora assessments from the local area or considered to potentially occur within the region. These species are also listed in **Table 1** of **Attachment C**, along with an assessment of their potential to occur within the project area. The assessment findings are discussed in **Section 5.5**.

3.4.2 Endangered Populations

Searches of the schedules of the TSC and EPBC Act identified three endangered flora populations that are known to occur in the Hunter Valley. Each of these populations is described below.

***Eucalyptus camaldulensis* Hunter Catchment Population**

Eucalyptus camaldulensis Hunter Catchment Population is listed as an endangered population under the TSC Act 1995. While river red gum (*E. camaldulensis*) was not recorded during flora surveys undertaken for the project, the species has previously been



Base Source: Mt Arthur Coal

0 1 2 4 km
1:85 000

Legend

- | | | |
|---|----------------------------------|-------------------------|
| Mining and Exploration Lease Boundaries | grey-crowned babbler nest | eastern cave bat |
| <i>Bothriochloa biloba</i> | yellow-bellied sheath tailed bat | greater broad-nosed bat |
| <i>Acacia pendula</i> | speckled warbler | eastern freetail bat |
| <i>Cymbidium canaliculatum</i> | squirrel glider | large-footed myotis |
| grey-crowned babbler | eastern bent-wing bat | |

File Name (A4): R04_V1/2000_097.dgn

FIGURE 3.2

**Previously Recorded
Threatened Species Locations**

reported as occurring on a tributary of Saddlers Creek to the south west of the project area (Resource Planning, 1993). This tributary is approved for mining under the Bayswater No 3 development consent.

The following information is summarised from the NSW Scientific Committee's final determination to list the population (NSW Scientific Committee 2005a).

In NSW, *Eucalyptus camaldulensis* occurs along the western flowing rivers but is known from only one coastal catchment, the Hunter. Prior to European settlement, it is likely that *Eucalyptus camaldulensis* formed extensive stands of woodland and open woodland on the major floodplains of the Hunter and Goulburn rivers, especially in areas where water impoundment occurs after flood (T Peake pers. comm.). Since settlement, most of the floodplains have been cleared of woody vegetation. Flood mitigation works now prevent most minor floods from inundating floodplains. These flow changes, coupled with the clearing of native vegetation, have greatly reduced the extent of habitat favourable to *Eucalyptus camaldulensis* in the Hunter catchment.

Prior to European settlement, between 10,000 and 20,000 hectares of habitat suitable for *Eucalyptus camaldulensis* occurred in the Hunter catchment. Today, there are only 19 known stands, occupying at most c. 100 hectares, the largest remnant being 15 – 20 hectares in extent. The total number of individuals is estimated to be between 600 – 1000 mature or semi mature trees. Smaller remnants contain only one to several trees. Most of the occurrences are on private land and there are no known occurrences in conservation reserves (T Peake pers. comm.). *Eucalyptus camaldulensis* may occur with *Eucalyptus tereticornis*, *Eucalyptus melliodora*, *Casuarina cunninghamiana* subsp. *cunninghamiana* and *Angophora floribunda*.

River red gum does not occur in the project area and was not recorded along the surveyed portion of Saddlers Creek immediately bordering the project area. Survey work completed along the remainder of Saddlers Creek upstream of Edderton Road in 2005/06 for the Mt Arthur Coal Underground Project also failed to identify this species.

***Acacia pendula* (a tree) in the Hunter Catchment**

Weeping myall (*Acacia pendula*) has been recorded at two sites in the Mt Arthur Coal operations area, as shown on **Figure 3.2**. This species was not recorded in the project area despite targeted surveys.

The following information is summarised from the NSW Scientific Committee's final determination to list the population (NSW Scientific Committee 2005b).

A disjunct population of *Acacia pendula* occurs in the Hunter Valley, at the eastern edge of the distributional limit of the species. The Hunter population is known to occur naturally as far east as Warkworth, and extends northwest to Muswellbrook and to the west of Muswellbrook at Wybong. The Hunter population of *Acacia pendula* is fewer than 1000 individuals from six locations – Jerry's Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. It is not known to occur in conservation reserves. The currently known Hunter population occurs on private land and is potentially vulnerable to clearing.

Weeping myall is known to occur adjacent to Edderton Road to the north west of the project area and to the west of the project area within the underground project survey area. Weeping myall was not recorded in the project area and therefore this endangered population does not occur.

***Cymbidium canaliculatum* in the Hunter Catchment**

Tiger orchid (*Cymbidium canaliculatum*) has been recorded along Saddlers Creek to the south west of the project area (refer to **Figure 3.2**). The species was not recorded in the project area despite targeted surveys, however potential habitat was identified.

The following information is summarised from the NSW Scientific Committee's final determination to list the community (NSW Scientific Committee 2005f).

Cymbidium canaliculatum has a scattered distribution in northern and eastern Australia from northeast NSW, through Queensland and the Northern Territory to Western Australia (Harden 1993). In NSW it occurs within dry sclerophyll forests and woodlands of tablelands and western slopes, growing in hollows of trees (Bishop 1996, Harden 1993). The population of *C. canaliculatum* in the Hunter Catchment is at the south-eastern limit of the geographic range for this species (Peake 2006).

The Hunter Catchment population of *C. canaliculatum* refers to all plants of *C. canaliculatum* occurring within the Hunter Catchment, as defined by Australia's River Basins (Geoscience Australia 1997). The Hunter Catchment includes the local government areas of Cessnock, Maitland, Dungog, Singleton, Muswellbrook, Newcastle, Port Stephens, part of Mid-western Regional, and part of Upper Hunter. The population of *C. canaliculatum* in the Hunter Catchment is at the south-eastern limit of the geographic range for this species (Peake 2006).

Within the Hunter Catchment, tiger orchid is most commonly found in white box-dominated woodlands (*Eucalyptus albens*), usually occurring singly or as a single clump, typically between two and six metres above the ground (Peake unpubl. data). It has been found, less commonly, to grow on slaty box (*E. dawsonii*), narrow-leaved ironbark (*E. crebra*), grey box (*E. moluccana*), rough-barked apple (*Angophora floribunda*), cooba (*Acacia salicina*) (Peake unpubl. data) and on some other species.

3.4.3 Endangered Ecological Communities

Assessment of the TSC Act Endangered Ecological Community (EEC) listings and the EPBC Act EEC listings was undertaken to compile a list of EECs that may occur within the project area based on their distribution. One EPBC listed community, Weeping Myall - Coobah - Scrub Wilga Shrubland of the Hunter Valley, is known to occur in the vicinity of the project area, and three TSC Act communities were identified. Each of these communities is assessed below, however none were recorded in the project area.

3.4.3.1 EPBC Act 1999 Listed Endangered Ecological Community

Weeping Myall - Coobah -Scrub Wilga Shrubland of the Hunter Valley

The following information is summarised from the Threatened Species Scientific Committee Commonwealth Listing Advice (Threatened Species Scientific Committee 2005).

This ecological community consists of a woodland of weeping myall (*Acacia pendula*) up to 10 metres high with coobah (*Acacia salicina*) and scrub wilga (*Geijera salicifolia*). Yarran (*Acacia omalophylla*) and stiff canthium (*Canthium buxifolium*) are also present in the small tree/shrub layer. The ground stratum is dense and primarily grassy. Grasses include kangaroo grass (*Themeda triandra/australis*), wallaby grass (*Austrodanthonia spp.*), snow grass (*Poa sieberiana*) and barbed wire grass (*Cymbopogon refractus*) (Benson in prep.).

The Weeping Myall - Coobah - Scrub Wilga Shrubland of the Hunter Valley is known from one location in a small (approximately two hectares) stand at Jerry's Plains, which includes the cemetery (Benson in prep.). The community was not recorded in the project area and is not expected to occur.

White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands

The following information is summarised from the Threatened Species Scientific Committee Commonwealth Listing Advice (Threatened Species Scientific Committee 2006a).

White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasses is listed as a critically endangered ecological community under the Environment Protection and Biodiversity Conservation Act 1999. The canopy of this community is, or was, dominated by white box (*Eucalyptus albens*), yellow box (*Eucalyptus melliodora*) and Blakely's red gum (*Eucalyptus blakelyi*). A number of other canopy species such as grey box (*Eucalyptus microcarpa*) may occur within this community and may occur as co-dominant species. The community is characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs.

This community was considered to have potential to occur within the project area based on the DEH Protected Matters Database and the presence of flora species that form part of this the endangered ecological community.

An agglomerative cluster analysis (using PATN software) was undertaken to determine the similarity of the community recorded in the project area to the listing advice of the EEC and to communities delineated as part of the HRVP (Peake 2006). This analysis showed that the Central Hunter Ironbark-Spotted Gum-Grey Box Forest present in the project area does not constitute the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands EEC. Therefore this EEC is not present within the project area.

3.4.3.2 TSC Act 1995 Listed Endangered Ecological Communities

White Box - Yellow Box - Blakely's Red Gum Woodland

The following information is summarised from the NSW Scientific Committee's final determination to list the community (NSW Scientific Committee 2005f).

White Box - Yellow Box - Blakely's Red Gum Woodland is an endangered ecological community which is listed under the NSW Threatened Species Conservation (TSC) Act 1995, and the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999. The canopy of the EEC is dominated by white box (*Eucalyptus albens*), yellow box (*Eucalyptus melliodora*) and Blakely's red gum (*Eucalyptus blakelyi*). Occasionally a sub-canopy layer of black cypress pine (*Callitris endlicheri*) is present. Canopy associations may change in different geographic locations.

Shrub layer species potentially occurring include shiny cassinia (*Cassinia longifolia*), kangaroo thorn (*Acacia paradoxa*), black thorn (*Bursaria spinosa*) and dogwood (*Jacksonia scoparia*), although the diversity of shrubs has been reduced as a consequence of the grazing history in this area. Potential species characterising the herb layer include mulga fern (*Cheilanthes sieberi*), flax lily (*Dianella longifolia*), cut-leaf cranesbill (*Geranium solanderi*), tufted hedgehog grass (*Echinopogon caespitosus*), barbed wire grass (*Cymbopogon refractus*) and tussock grass (*Poa labillardieri*).

Based on an assessment of the DEC Atlas of NSW Wildlife, as well as professional knowledge, it was considered possible that the White Box Yellow Box Blakely's Red Gum Woodland EEC, listed under the TSC Act, could be present in the project area.

An agglomerative cluster analysis (using PATN software) was undertaken to determine the similarity of the community recorded in the project area to the final determination of the EEC and to communities delineated as part of the HRVP (Peake 2006). Analysis showed that Central Hunter Ironbark-Spotted Gum-Grey Box Forest present in the project area has no strong similarity to either of the white box EECs. The results indicate that white box woodland as listed under the TSC Act is not present in the project area.

Hunter Lowlands Redgum Forest

Hunter Lowlands Redgum Forest in the Sydney Basin and NSW North Coast Bioregions is the name given to the ecological community found on gentle slopes arising from depressions and drainage flats on permian sediments of the Hunter Valley floor. Hunter Lowlands Redgum Forest extends from Muswellbrook to the Lower Hunter where it appears on gentle slopes arising from depressions. Much of its former extent has been depleted for agricultural activities (NSW Scientific Committee 2004).

The Hunter Lowland Redgum Forest is generally an open forest with the most common canopy trees species being *Eucalyptus tereticornis* and *Eucalyptus punctata* although other frequently occurring canopy species are *Angophora costata*, *Corymbia maculata*, *Eucalyptus crebra* and *Eucalyptus moluccana*, with a number of other eucalypts being less frequently recorded. The mid stratum is characterised as open with sparse shrubs of *Breynia oblongifolia*, *Leucopogon juniperinus*, *Daviesia ulicifolia* and *Jacksonia scoparia*. There is consistently a ground layer of grasses and herbs, characterised by *Microlaena stipoides* var. *stipoides*, *Cymbopogon refractus*, *Echinopogon caespitosus* var. *caespitosus*, *Cheilanthes sieberi* subsp. *sieberi* and *Pratia purpurascens* (NSW Scientific Committee 2004).

Riparian communities adjacent to the project area do not conform to the description provided in the final determination of the Hunter Lowland Redgum Forest EEC provided by the NSW Scientific Committee (NSW Scientific Committee 2004). The nearest mapped occurrence of this community to the project area is at is off Pamger Drive, just west of the Thomas Mitchell Drive turn off the New England Highway (T Peake unpubl. data).

Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion

As discussed above, weeping myall has been recorded from the Mt Arthur Coal operations area, as shown on **Figure 3.2**. This species, and therefore the Hunter Valley Weeping Myall Woodland EEC of which it is indicative, was not recorded in the project area despite targeted surveys.

The following information is summarised from the NSW Scientific Committee's final determination to list the community (NSW Scientific Committee 2005c).

Hunter Valley Weeping Myall Woodland of the Sydney Basin bioregion typically has a dense to open tree canopy up to about 15 metres tall, depending on disturbance and regrowth history (Peake 2005). 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. Understorey shrubs may include *Canthium buxifolium* (Stiff Canthium), *Dodonaea viscosa* (Sticky Hopbush), *Geijera parviflora* (Wilga), *Notelaea microphylla* var. *microphylla* (Native Olive) and *Senna zygomphylla* (Silver Cassia). However, the shrub stratum is absent from some stands. The groundcover varies from dense to sparse, and is comprised of

grasses such as *Austrodanthonia fulva* (a wallaby grass) and *Themeda australis* (Kangaroo Grass), and low shrubs and herbs such as *Chrysocephalum apiculatum* (Common Everlasting), *Einadia nutans subsp. nutans* (Climbing Saltbush), *Enchylaena tomentosa* (Ruby Saltbush), *Maireana microphylla* (Eastern Cotton Bush) and *Ptilotus semilanatus*.

Hunter Valley Weeping Myall Woodland of the Sydney Basin bioregion is currently known from parts of the Muswellbrook and Singleton Local Government Areas, but may occur elsewhere in the bioregion. It may also occur in the Upper Hunter Local Government Area within the Brigalow Belt South bioregion, although its presence has not yet been confirmed there.

Hunter Valley Weeping Myall Woodland was not recorded in the project area and is not expected to occur.

3.4.4 Regionally Significant Flora Species

The project area occurs within the Hunter Region, which consists of the Upper Hunter, Muswellbrook, Singleton, Gosford, Wyong, Cessnock, Maitland, Lake Macquarie, Newcastle and Port Stephens local government areas. There are numerous flora species considered to have conservation significance within this region. There a number of criteria used to list regionally significant species, some of which include:

- endemic taxa – known distribution restricted to this region;
- uncommon taxa – less than 50 known populations;
- records close to the limit of the species' geographical range; and
- significant reductions in population size or area occupied.

The Hunter Rare Plants Database (Peake et. al. 2003) provides a comprehensive list of flora species within the Hunter Region that are considered to be regionally significant. From this Database, there are ten regionally significant flora species which have been recorded within the project area. These are listed in **Table 3.2** below.

Table 3.2 - Regionally Significant Flora Species within the Project Area

Species	Criteria
<i>Lepidium pseudohyssopifolium</i>	U
<i>Maireana microphylla</i>	E?
<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	U?
<i>Acacia salicina</i>	E
<i>Corymbia maculata</i>	W
<i>Eucalyptus punctata</i>	N W
<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	S
<i>Canthium odoratum</i>	S
<i>Solanum brownii</i>	W E
<i>Rostellularia adscendens</i>	S

Key to Criteria

U = everywhere uncommon

N, E, S or W = distributional limit in HR

? = code is uncertain

Most of these species are listed on the database because they are at, or are close to, their known distributional limit where they occur in the Hunter Region. None of these species are regarded by Peake et. al. (2003) as being rare or threatened in the Hunter Region.

4.0 Fauna Survey Results

4.1 Fauna Habitat of the Project Area

The assessment of terrestrial fauna habitat identified a range of habitat characteristics, which contribute to the distribution, abundance and diversity of terrestrial fauna within the project area. Habitat characteristics which were assessed included:

- tree hollows;
- rocky outcrops;
- wetland, riverine and wet soak areas;
- density of shrub and ground layers;
- canopy cover;
- soil type;
- fallen logs;
- leaf litter;
- decorticating bark;
- winter flowering species; and
- stags.

An assessment of habitat quality was made, based on the relative abundance of fauna microhabitats and the provision of the above habitat characteristics. The greater the diversity and abundance of microhabitats and habitat characteristics, the greater the habitat value of the area.

Several general fauna habitats are located within the project area. Each of these broad habitat units has a range of fauna habitat characteristics, which influence the fauna habitat value, and the range of species which are identified within each unit. The broad habitats were woodland, grassland, riparian and aquatic habitats.

4.1.1 Mt Arthur North East

The Mt Arthur North East survey site (refer to **Figure 2.2**) comprised relatively small isolated clumps of open eucalypt woodland and scattered trees along a drainage line running east from Mt Arthur. A woodland remnant of approximately 12 hectares occurring higher in the drainage line neighbours the site to the west. The majority of canopy cover was formed by middle-aged, regenerating and sapling trees. Tree hollows of all sizes were common in the scattered mature trees and rare in middle-aged trees. Mistletoe infestation of trees was common amongst the scattered and edge trees, and scattered within clumps of woodland.

In the woodland remnants there was no shrub layer and ground cover was approximately half leaf litter and half a combination of leaf litter, herbs, forbs, sedges and grasses rarely reaching one metre in height. Logs ranged in size from 100 to 600 mm in diameter (largest cross section of log) and were found to be scattered within woodland clumps and extremely rare in open areas. At the time of the survey the drainage line was almost completely dry with only a few scattered, small, shallow pools of water remaining. Outside the woodland remnants ground cover consisted predominately of grasses ranging up to one metre in height forming a blanket of cover across open areas.

Vegetation in the form of scattered trees and small isolated patches of woodland occur to the north-west, west, south-west and south of the Mt Arthur North East survey site. While trees are present they provide a poor linking function in the landscape due to their scattered to highly scattered distribution. Mt Arthur, containing approximately 50 hectares of remnant vegetation, occurs approximately 600 metres to the west of the survey site but is separated by approximately 200 metres of highly scattered tree cover. Mt Arthur North East is poorly linked in the landscape.

The above habitat features present at Mt Arthur North East combine to give the following qualitative measures of habitat quality for the following taxonomic groups.

Table 4.1 - Qualitative fauna habitat quality at Mt Arthur North East

Fauna Group	Qualitative Fauna Habitat Quality				
	Poor	Marginal	Moderate	Good	Excellent
Arboreal mammals					
Large terrestrial mammals					
Medium terrestrial mammals					
Small terrestrial mammals					
Bats					
Reptiles					
Amphibians					
Birds					

4.1.2 Mt Arthur East

The Mt Arthur East survey site (refer to **Figure 2.2**) comprised relatively small, isolated clumps of open eucalypt woodland principally restricted to drainage lines. Old growth trees were highly scattered across the site and restricted to woodland clumps in drainage lines. Mature trees were scattered across the site and the majority of canopy cover was formed by middle-aged, regenerating and sapling trees. Tree hollows of all sizes were common in the old growth trees and rare in mature and middle-aged trees. Mistletoe infestation of trees was common amongst the scattered and edge trees, and scattered within clumps of woodland.

A scattered shrub layer of 0.5 to 1.0 metre in height occurred in the clumps of woodland, and ground cover was approximately 40% leaf litter and 60% a combination of leaf litter, herbs, forbs, sedges and grasses. Log cover was highly scattered within woodland clumps and extremely rare in open areas. At the time of the survey only a few scattered, small, shallow pools of water remained in the drainage line. Outside the woodland patches ground cover consisted predominately of grasses ranging up to one metre in height, forming a blanket of cover across open areas.

Vegetation in the form of scattered trees and small isolated patches of woodland occur to the north, north-west and west of the Mt Arthur East survey site. While trees are present, they provide a poor linking function in the landscape due to their scattered to highly scattered distribution. Saddlers Creek occurs to the south and south-east but is separated by significant areas of open grassland with scattered tree cover. Mt Arthur East is poorly linked in the landscape.

The above habitat features present at Mt Arthur East combine to give the following qualitative measures of habitat quality for the following taxonomic groups.

Table 4.2 - Qualitative fauna habitat quality at Mt Arthur East

Fauna Group	Qualitative fauna habitat quality				
	Poor	Marginal	Moderate	Good	Excellent
Arboreal mammals					
Large terrestrial mammals					
Medium terrestrial mammals					
Small terrestrial mammals					
Bats					
Reptiles					
Amphibians					
Birds					

4.1.3 Saddlers Creek

The Saddlers Creek survey site (refer to **Figure 2.2**) comprised scattered trees fringing and within the 20 to 30 metre wide and five metre deep channel of Saddlers Creek. The majority of trees were mature with some scattered old growth and middle aged trees. Regenerating trees and saplings were highly scattered across the site both above and within the drainage channel. Tree hollows of all sizes were common in many trees and several trees reached heights of 25 metres. Mistletoe infestation of trees was significant in some individuals but mild across the site.

Shrubs were predominately absent and ground cover was dominated by grasses rarely reaching above one metre. Log cover was highly scattered and where present ranged from small branches to fallen trees. The channel of Saddlers Creek ranged from one to four metres in width and was dominated by tall emergent reeds reaching above 1.8 metres. Much of the water surface was covered by the emergent reeds except where the reeds had been trampled by livestock that in the past have passed through this area to reach paddocks on the other side of the creek.. At the time of the survey the creek line was dominated by shallow pools of emergent vegetation connected by very low flows through grass cover. Within the channel ground cover was dominated by grasses and broad leaf weeds to one metre in height. Outside the channel ground cover was dominated by grasses to 1.2 metres in height.

The Saddlers Creek survey site is linked to the north east and south west by scattered tree cover along Saddlers Creek, but isolated to the east and west were trees are absent for several hundred metres.

The above habitat features present at the Saddlers Creek survey site combine to give the following qualitative measures of habitat quality for the following taxonomic groups.

Table 4.3 - Qualitative fauna habitat quality at Saddlers Creek

Fauna Group	Qualitative fauna habitat quality				
	Poor	Marginal	Moderate	Good	Excellent
Arboreal mammals					
Large terrestrial mammals					
Medium terrestrial mammals					
Small terrestrial mammals					
Bats					
Reptiles					
Amphibians					
Birds					

4.2 Fauna Survey Results

A total of 67 fauna species, including four species listed on the TSC Act 1995 and seven species listed as migratory on the EPBC Act 1999 (five of which are marine and two are migratory and marine) were recorded in the project area. A detailed summary of the results is provided below, and **Attachment B** lists all fauna species recorded in the project area.

4.2.1 Birds

A total of 39 bird species were recorded in the project area during the five days of survey.

A total of 27 bird species were identified at Mt Arthur North East. The most commonly recorded species were the eastern rosella (*Platycercus eximius*), noisy miner (*Manorina melanocephala*), weebill (*Smicromis brevirostris*) and the Australian magpie (*Gymnorhina tibicen*). No threatened bird species and three EPBC listed migratory species, the black-faced cuckoo shrike (*Coracina novaehollandiae*), silvereye (*Zosterops lateralis*) and rainbow bee-eater (*Merops ornatus*), were identified at Mt Arthur North East.

A total of 21 bird species were recorded at Mt Arthur East. Commonly recorded species included white-plumed honeyeater (*Lichenostomus penicillatus*), pied butcherbird (*Cracticus nigrogularis*), striated pardalote (*Pardalotus striatus*) and mistletoe bird (*Dicaeum hirundinaceum*). No threatened bird species and two EPBC listed migratory species, the black-faced cuckoo shrike and Australian kestrel (*Falco longipennis*), were identified at Mt Arthur East.

A total of 19 bird species were recorded at Saddlers Creek. Commonly recorded species included the eastern rosella, grey butcherbird (*Cracticus torquatus*), striated pardalote and mistletoe bird. No threatened bird species and a single EPBC listed migratory species; the magpie-lark (*Grallina cyanoleuca*), was identified at Saddlers Creek.

Seven bird species were recorded opportunistically between survey sites. Three species, the white-throated needletail (*Hirundapus caudacutus*, EPBC listed), Richard's pipit (*Anthus novaeseelandiae*), EPBC listed and crested pigeon (*Ocyphaps lophotes*) were not recorded at any of the survey sites.

4.2.2 Reptiles

A total of seven reptile species were identified across the three survey sites. No threatened reptile species were recorded.

Three skink species were identified during diurnal reptile searches of Mt Arthur North East; the southern rainbow skink (*Carlia tetradactyla*), copper-tailed skink (*Ctenotus taeniolatus*) and eastern blue-tongued lizard (*Tiliqua scincoides*). A total of seven individual skinks less than 150 mm snout-vent length evaded capture during diurnal reptile searches at Mt Arthur North East.

Five reptile species were identified at Mt Arthur North East. The southern rainbow skink, copper-tailed skink and eastern blue-tongued lizard were identified during diurnal reptile searches and a single lace monitor (*Varanus varius*) was captured in a cage trap. A total of six individual skinks less than 150 mm snout-vent length evaded capture during diurnal reptile searches at Mt Arthur North East including a possible gecko species. A single blue-bellied black snake (*Pseudechis guttatus*) was recorded opportunistically during other survey activities at Mt Arthur East.

Four reptile species were identified at Saddlers Creek. The southern rainbow skink, eastern bearded dragon (*Pogona barbata*) and tree skink (*Egernia striolata*) were identified during diurnal reptile searches and a single lace monitor was recorded opportunistically during trap checking. A total of five individual skinks less than 150 mm snout-vent length evaded capture during diurnal reptile searches at Saddlers Creek.

4.2.3 Amphibians

A total of three amphibian species were identified across the three survey sites. No threatened amphibian species were recorded.

Only the spotted marsh frog (*Limnodynastes tasmaniensis*) was recorded at Mt Arthur North East, calling at a single point along the drainage line.

Three amphibian species were recorded at Mt Arthur East. The broad-palmed frog (*Litoria latoplamata*), spotted marsh frog and common brown froglet (*Crinia signifera*) were all recorded at small pools of water in the drainage line.

Only the spotted marsh frog was recorded at Saddlers Creek, with a few individuals calling from within the vegetated creek line.

No additional amphibian species were recorded as opportunistic sightings.

4.2.4 Mammals

A total of 17 mammal species were recorded in the project area during the five days and nights of survey.

Six mammal species including three introduced species were recorded at Mt Arthur North East. No threatened mammal species were recorded at Mt Arthur North East. Eastern grey kangaroos (*Macropus giganteus*) were commonly recorded during the day and several brush-tailed possums (*Trichosurus vulpecula*) were recorded during spotlighting. The eastern forest bat (*Vespadelus pumilus*) was the only bat captured at the site and no bat species were recorded via echolocation recording. The introduced house mouse (*Mus musculus*) was recorded from hair tube samples. The introduced rabbit (*Oryctolagus*

cuniculus) and brown hare (**Lepus capensis*) were both recorded in low numbers during spotlighting.

Ten mammal species, including two introduced species, were recorded at Mt Arthur East. One species listed on the TSC Act, the eastern cave bat (*Vespadelus troughtoni*), was recorded at the site and no EPBC listed mammal species were recorded. Eastern grey kangaroos were commonly recorded during the day and several brush-tailed possums were recorded during spotlighting. The southern forest bat (*Vespadelus regulus*) and little forest bat (*Vespadelus vulturnus*) were captured and recorded via echolocation recording, while Gould's wattled bat (*Chalinolobus gouldii*) and the threatened eastern cave bat (*Vespadelus troughtoni*) were identified solely via echolocation recordings. The introduced house mouse and brown antechinus (*Antechinus stuartii*) were recorded in Elliot traps and the introduced fox (**Vulpes vulpes*) was recorded in low numbers during spotlighting.

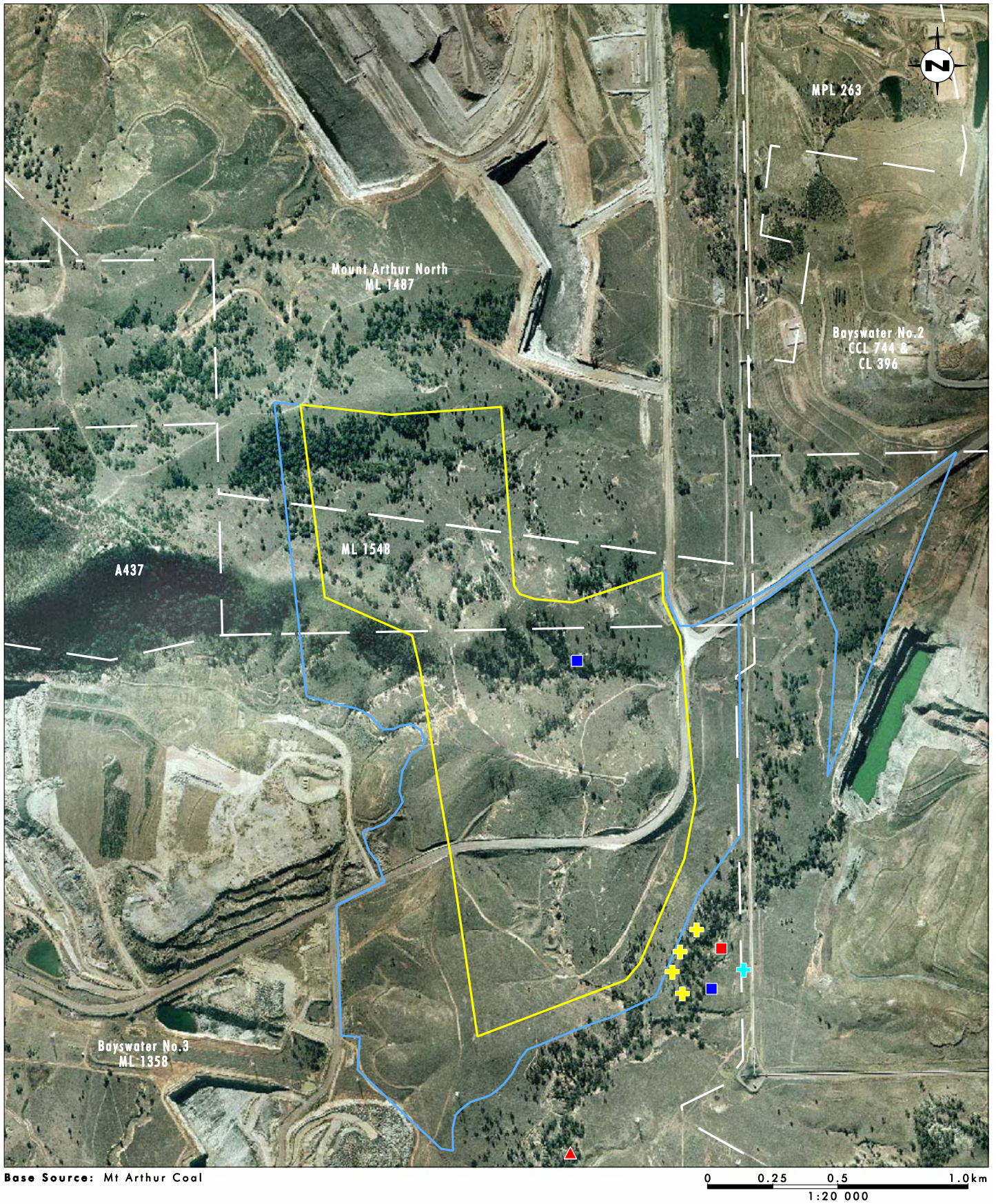
Fourteen mammal species, including three introduced species, were recorded at Saddlers Creek. Four species listed on the TSC Act, the squirrel glider (*Petaurus norfolcensis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), eastern cave bat (*Vespadelus troughtoni*) and large-footed myotis (*Myotis adversus*) were recorded at the site however, no EPBC listed mammal species were recorded. Eastern grey kangaroos were commonly recorded during the day and brush-tailed possums and squirrel gliders were recorded during spotlighting. Seven bat species were identified during echolocation recording including the two threatened species. The introduced house mouse was recorded in Elliot traps and the introduced rabbit and brown hare were recorded in low numbers during spotlighting.

No additional mammal species were recorded as opportunistic sightings.

4.3 Significant Fauna Species and Populations

Four threatened species were recorded during surveys conducted for the South Pit project. These species include the squirrel glider (*Petaurus norfolcensis*), and three micro-bats: the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), large footed myotis (*Myotis adversus*) and the eastern cave bat (*Vespadelus troughtoni*). All threatened species were recorded in riparian vegetation to the immediate south of the new disturbance area (refer to **Figure 1.2**); however all species are expected to utilise the habitats of the project area. The eastern cave bat was also recorded at the Mt Arthur East survey site within the new disturbance area. The location of threatened fauna species recorded in the project area is shown on **Figure 4.1**. Grey-crowned babbler (*Pomatostomus temporalis temporalis*) nests have been recorded to the south of the project area along Saddlers Creek. The grey-crowned babbler was not utilizing the study area for nesting purposes due to the lack of their very characteristic nests.

A total of 13 threatened species, including the four species identified in the project area, have previously been recorded within the Mt Arthur Coal operations area. These species include threatened woodland birds, micro-bats and two mammal species. Two species, the hooded robin (*Melanodryas cucullata cucullata*) and diamond firetail (*Stagonopleura guttata*) were recorded as part of the MAN EIS and were not listed as threatened at the time of the assessment. The parma wallaby was also tentatively recorded on Mt Arthur via predatory scat analysis. The location of threatened species recorded within the Mt Arthur Coal operations area is shown on **Figure 3.2**. The locations of threatened species recorded during the MAN EIS and Bayswater No 3 EIS are not shown as precise locations are not known.



Legend

- | | |
|--|--|
| — Mining and Exploration Lease Boundary | ■ eastern cave bat |
| — South Pit Extension Mining Area | ■ large-footed myotis |
| — Approximate New Disturbance Footprint | |
| + eastern bentwing bat | |
| + squirrel glider | |

FIGURE 4.1

**South Pit Extension Project
Threatened Species Locations**

4.3.1 Threatened Species

A total of thirty species listed as threatened under the TSC Act 1995 have been recorded within 20 kilometres of the project area, as listed on the DEC Atlas of NSW Wildlife. This includes fifteen birds, fourteen mammals, and one amphibian. Four threatened fauna species are known to occur in or adjacent to the project area, as shown on **Figures 3.2 and 4.1**. **Table 2** in **Attachment C** lists these species and the assessed likelihood of their occurrence within the project area. A total of 12 species are considered likely to occur within the project area due to the identification of suitable habitat and the species occurrence within the Mt Arthur Coal operations area. A number of these species are also listed under the EPBC Act 1999 and were identified on the DEH Protected Matters Database as species which may, or are likely to occur in the project area in suitable habitat.

4.3.2 Endangered Populations

No endangered fauna populations are listed in the upper Hunter Valley and none are expected to occur.

5.0 Impact Assessment

5.1 Proposed Site Disturbance

The South Pit Extension Project Environmental Assessment is being prepared to assess new impacts associated with the South Pit Extension Project. New disturbance areas resulting from the project include the:

- additional South Pit coal extraction area including potential topsoil stockpile areas,
- additional main haul roads; and
- service corridor to provide safe access around working areas.

The new disturbance area associated with the project is shown on **Figure 1.2**. Overburden emplacement activities associated with the project will not result in the disturbance of any previously undisturbed land.

5.2 Impact on Flora Species

The project will result in the disturbance of an area of up to approximately 330 hectares within the project area. This will include the removal of up to approximately 48 hectares of Central Hunter Ironbark-Spotted Gum-Grey Box Forest, approximately 4.5 hectares of Central Hunter Bulloak Regeneration, approximately 0.3 hectares of Hunter Floodplain Red Gum Woodland Complex and approximately 280 hectares of Derived Grassland.

In terms of general diversity of flora species, the project area appears to be reasonably representative of surrounding areas. Overall, plant species diversity is considered low, with a total of 119 species being recorded, of which 25 (21%) were not native to the area. Ten species listed as regionally significant on the Hunter Rare Plants Database (REF) were recorded in the project area, but none are regarded by Peake et al. (2003) as rare or threatened.

The project will not result in a significant loss of floristic diversity in the project area, Mt Arthur Coal operations area or region. Floristic diversity in the project area is considered to be representative of surrounding areas, including habitat management and conservation areas established as part of the existing operations including Mt Arthur, McLean's Hill, parts of Saddlers Creek and in the A171 area adjacent to Thomas Mitchell Drive (formally Travelling Stock Reserve). The project will not result in a significant loss of regionally significant species, as the species recorded in the project area are known to occur widely across the Mt Arthur Coal operations area (Umwelt 2001; Umwelt 2004; Umwelt 2005; URS 2000).

5.3 Impact on Vegetation Communities

Up to approximately 48 hectares of Central Hunter Ironbark-Spotted Gum-Grey Box Forest is proposed to be removed as a result of the project. This community is considered to be regionally significant as discussed in **Section 3.3.3**. These remnants are considered to be heavily impacted by ongoing mining activities and past grazing and agricultural activities. It is proposed to reinstate Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the rehabilitation of overburden; such that there is a net gain of this vegetation community as a result of the project in the medium and long term (refer to **Section 6.0**). The tree rehabilitation seed mix currently used by Mt Arthur Coal includes these species.

Up to approximately 4.5 hectares of Central Hunter Bulloak Regeneration will also be removed by the project. This community is relatively widespread throughout Mt Arthur Coal's operational area and the upper Hunter Valley and this loss is therefore not considered significant. The area removed will, however, be replaced by rehabilitation works in the medium to long term such that there is no net loss of this vegetation community (refer to **Section 6.0**).

Approximately 0.3 hectares of Hunter Floodplain Red Gum Woodland Complex may need to be removed along Saddlers Creek, within the proposed service corridor. Due to the extent of this community occurring across the remainder of Saddlers Creek, this is not regarded as being of significance. To compensate for this loss, it is proposed to fence off the remaining area of Saddlers Creek where it adjoins the project area and to encourage the regeneration of this community on currently cleared floodplains through the removal of stock (refer to **Section 6.0**).

The Derived Grassland identified within the development area is a degraded community which has been significantly affected by past clearing, grazing practices and mining activities such that it is dominated by introduced species in most areas. The community exhibits a high proportion of weed species and no threatened flora species were identified, or are expected to occur within the community. The removal of this vegetation as part of the project is considered unlikely to be significant from a local or regional perspective, due to the dominance of Derived Grassland communities in the Hunter Valley.

Areas of Derived Grassland that are dominated by native grassland species have been recorded widely across the Mt Arthur Coal operations area and will not be significantly impacted by the removal of up to approximately 280 hectares by the proposed south pit extension.

Aquatic vegetation to be removed for the project was identified as the fringing sedge and rush vegetation of farm dams. These vegetation communities are widespread in the local area and region and are not considered significant. Water management structures constructed as part of the project are expected to be colonised by similar fringing vegetation resulting in no net loss of aquatic habitat for the project area.

The proposal incorporates significant habitat re-instatement objectives (refer to **Section 6.4**) with the aim to recreate both vegetation communities and fauna habitats. The recreation of habitat in the medium to long term will compensate for the loss of all native vegetation communities currently occurring within the project area.

5.4 Impact on Fauna Species

The project area is located in a region that has been subject to a long history of vegetation clearing for agricultural purposes, such as grazing and in the last 20 years, open cut coal mining. This has led to the current condition where the vegetation of the region is highly fragmented and disturbed. Furthermore, many such fragments consist mainly of canopy species with little diversity in the understorey. This may be due to grazing, underscrubbing or domination of particular species benefited by such disturbances.

The project will result in the loss of up to approximately 330 hectares of fauna habitat within the project area. This comprises approximately 52 hectares of woodland habitat, and approximately 280 hectares of highly disturbed grassland habitat. The habitats of Saddlers Creek will not be impacted by the project.

The vegetation in the project area, and in the local area generally, is highly fragmented with pockets of vegetation of varying sizes, features and habitat quality. Many fragments consist of canopy species only, with little or no understorey vegetation. Such areas are likely to provide greatly reduced protection to fauna species, particularly when dispersing. While the project is likely to contribute to the fragmentation of the existing vegetation of the local area, ameliorative measures proposed include the re-instatement of native vegetation communities as part of rehabilitation works. These rehabilitation works will be designed to connect the habitats of Saddlers Creek to the conserved habitats of Mt Arthur.

Detailed ameliorative measures will be implemented as part of the project to limit impacts on fauna species. Such measures include the re-establishment of arboreal habitat; the revegetation of mining areas with native vegetation communities (as discussed above), erection of nest boxes and implementation of pre-clearing surveys to reduce the impact on native fauna, particularly threatened species. Proposed management measures are discussed in detail in **Section 6.0**.

5.5 Impact on Threatened Species, Populations and Endangered Ecological Communities

5.5.1 Impact on TSC Act Listed Species, Populations and Endangered Ecological Communities

No threatened flora species, endangered populations or EECs listed on the TSC Act were recorded in the project area. It is possible that three threatened flora species may occur due to the identification of suitable habitat, even though these species were not located during flora surveys. An assessment of significance was undertaken using an initial screening process to identify species that may be potentially significantly impacted, with a full assessment of significance being completed for these species. The assessment of significance is included in **Attachment C** and concludes that the project will not have a significant impact on any threatened flora species, endangered populations or EECs.

A total of 23 threatened fauna species listed under the TSC Act are considered likely to occur in the project area, with four of these species recorded during fauna surveys conducted as part of the project. The threatened fauna species recorded during surveys comprise the squirrel glider (*Petaurus norfolcensis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), large footed myotis (*Myotis adversus*) and the eastern cave bat (*Vespadelus troughtoni*). An assessment of significance was used to determine the impact of the project on the threatened species recorded, or considered likely to occur in the area of affectation (as shown on **Figure 1.2**). The assessment of significance, provided in **Attachment C**, found that the loss of up to approximately 52 hectares of woodland habitat and approximately 280 hectares of grassland habitat as a result of the project will not result in a significant impact on any potentially occurring threatened species. It is unlikely that the project will disrupt the lifecycle of any of the identified potentially occurring threatened species such that a viable population will be placed at risk of extinction. The assessment therefore concluded that the project will not have a significance impact on identified threatened species or species considered likely to occur.

5.5.2 Impact on EPBC Act Listed Species and Endangered Ecological Communities

No EPBC Act listed threatened species or EECs were recorded in the project area during surveys, however the grass *Bothriochloa biloba* and the orchid *Diuris tricolor* are known to occur within the Mt Arthur Coal operations area (Umwelt 2006 and DEC Atlas Database

2006). An assessment of significance was conducted for these species (refer to **Attachment C**), along with an additional two threatened species, *Goodenia macbarronii* and *Thesium australe*, which were considered to potentially occur within the project area. The assessment concluded that the project will not have a significance impact on threatened species.

Two migratory and five marine species were recorded in the project area (refer to **Section 4.0** and **Attachment C**). An assessment of significance was undertaken, which determined that the project will not have a significant impact on listed migratory species (refer to **Attachment C**).

5.5.3 SEPP 44 Assessment

The project is subject to assessment under State Environmental Planning Policy (SEPP) No. 44 (Koala Habitat Protection) as it lies in a local government area listed in Schedule 1 of the policy. SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline. Any development application in an identified local government area, affecting land one hectare or greater, including adjoining lands on the same holding, must be assessed under the policy.

Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala habitat. This is determined by assessing whether the Eucalypt species present in Schedule 2 constitutes 15% or more of the total number of trees in the upper or lower strata of the tree component. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat.

The species listed in Schedule 2 of the policy are:

Scientific Name	Common Name
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Eucalyptus microcorys</i>	Tallowwood
<i>Eucalyptus punctata</i>	Grey Gum
<i>Eucalyptus viminalis</i>	Ribbon or Manna Gum
<i>Eucalyptus camaldulensis</i>	River Red Gum
<i>Eucalyptus haemastoma</i>	Broad Leaved Scribbly Gum
<i>Eucalyptus signata</i>	Scribbly Gum
<i>Eucalyptus albens</i>	White Box
<i>Eucalyptus populnea</i>	Bimble Box or Poplar Box
<i>Eucalyptus robusta</i>	Swamp Mahogany

Vegetation communities were assessed and it was found that white-grey box (*Eucalyptus albens/moluccana* intergrade), grey gum (*Eucalyptus punctata*) and forest red gum (*Eucalyptus tereticornis*) were all recorded within the project area. It is considered that these overstorey species are likely to comprise 15% of overstorey species within the project area, which indicates that the project area contains potential koala habitat.

Given that potential koala habitat occurs in the project area, the policy requires that it must be determined whether the area forms core koala habitat under the definition of SEPP 44. Core koala habitat is defined under this legislation as; “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”. Targeted searches

and area searches for scats failed to identify the koala and there is no historical record of the species within the project area.

It is likely that a resident population of koalas does not occur within the project area, as there was no evidence of koala use of the area. There are also no historical records of koalas occurring in the project area. The area is not considered to be core koala habitat as defined under SEPP 44, hence the preparation of a Koala Plan of Management is not required. SEPP 44 does not place any constraints on the project.

6.0 Ecological Management and Monitoring

6.1 Existing Mt Arthur Coal Ecological Monitoring and Management Strategies

Mt Arthur Coal currently has a number of ecological management and monitoring plans pertaining to different portions of the site. Monitoring and management strategies include revegetation monitoring, remnant vegetation monitoring and fauna and threatened species monitoring. It is proposed to build on these existing programs and implement an integrated management and monitoring program which assesses the habitats of the Mt Arthur Coal complex as a whole unit.

Ecological management plans currently exist for the Mt Arthur North mining area and Bayswater Rail Facility, which build on the commitments made in the EISs for these projects. There are also various draft management plans that apply to the Saddlers Creek area including a draft Habitat Management Plan. Commitments relating to ecological issues were also made in the Bayswater No. 3 EIS (Resource Planning 1993). While each plan contributes to the management of ecological issues within the Mt Arthur Coal complex, the numerous plans result in different approaches to ecological management across the site. Mt Arthur Coal has largely integrated the requirements of these various plans over the past few years to apply a consistent management approach over most of the site, however, it is recommended that where development consent condition constraints allow, a single management plan is developed and applied to the entire site.

6.2 General Ecological Management Strategies

A range of management strategies will be used by Mt Arthur Coal to limit impacts on native flora and fauna in the project area. The strategies will include:

- management of noise and dust to minimise impacts to adjoining vegetation communities and fauna (as addressed in the Main Text of the Environmental Assessment (EA));
- feral animal and noxious weed control consistent with existing practice at Mt Arthur Coal;
- rehabilitation of disturbed areas with a mix that includes local indigenous species (as addressed in **Section 6.4**);
- use of local indigenous species in revegetation, and the linkage and integration of rehabilitation areas with existing vegetated areas to improve ecological function and provide habitat (as addressed in **Section 6.4**);
- management of erosion and sedimentation to ensure that adjoining vegetation communities and aquatic systems are not disturbed (as addressed in the Main Text of the EA);
- management of surface water to ensure that adjoining vegetation communities, aquatic systems and associated fauna are not disturbed (as addressed in the Main Text of the EA);
- adaptive management, as required, if a previously unrecorded or assessed threatened species is identified in the project area during operations (as addressed in **Section 6.5.4**);
- ongoing monitoring and maintenance of all revegetation works and habitat enhancement activities;

- ongoing monitoring of native flora and fauna across the Mt Arthur Coal site (as discussed in **Section 6.5**); and
- creation of habitat corridors linking isolated remnant vegetation stands (refer to **Section 6.4**).

6.3 Protection and Management of Arboreal Habitat

Mt Arthur Coal has a pre-clearance survey and clearing procedure in place for the existing operation. This clearing procedure will be implemented for all clearing works associated with the project. Ecological advice will be sought as required by Mt Arthur Coal environmental personnel responsible for implementation of the procedure.

Trees will be cleared in accordance with the procedure described below. Micro-habitats (tree hollows, logs etc.) will be assessed for relocation to areas lacking in tree hollow habitat or for use in rehabilitation once re-established vegetation is suitably aged. The identification of tree hollows is to be undertaken as part the pre-clearance inspection.

The following site clearing procedure has been prepared to minimise the potential for impact on native fauna species, including threatened species, as a result of the clearing of hollow bearing trees. The clearing procedure will be used in combination with pre-clearance inspections, which will determine if any hollow-bearing trees or significant habitat resources are to be affected.

- Within the area of clearing, hollow bearing trees and other habitat structures such as stags, nests, logs and stumps will be marked by a qualified ecologist to prevent accidental clearing.
- Vegetation surrounding the marked habitat structures will be cleared and the marked structures left undisturbed for a period of 24 hours.
- Marked, hollow-bearing trees will be shaken prior to felling using a bulldozer and then left for a short period to allow any fauna using the hollows to be observed.
- Hollow-bearing trees will be slowly pushed over using a bulldozer, with care taken to avoid damage to hollows or nests.
- Following felling each of the identified hollows and nests will be examined for fauna.
- Where practical, felled trees will be left for a 24-hour period prior to removal in order to allow species to move in to adjoining vegetation of their own volition.
- Nocturnal species which do not immediately move into adjoining vegetation will be captured (as appropriate) and kept in a warm, dark and quiet place prior to release at night within the same vegetation community from which they were captured.
- Captured nocturnal animals will be released on the day of capture and will not be held for extended periods of time.
- Tree hollows and other habitat structure including logs, stumps and stags suitable for relocation to areas not intended for future development or for use in rehabilitation, will be selected.
- Hollows intended for re-erection will be removed using a chainsaw and then capped with marine plywood or other suitable material.
- Logs, stumps, stags and hollows intended for ground habitat will be cut into sections, as required and relocated to suitable habitat areas.

- In the event that injured fauna are identified, species will be immediately taken to the nearest veterinarian or certified wildlife carer for treatment.

The timing of clearing operations will be designed to reduce the potential impact on breeding species, particularly the squirrel glider and micro-bats. Clearing will avoid the winter months, where practicable, when micro-bats are hibernating and the squirrel glider begins breeding.

6.3.1 Enhancement of Arboreal Habitat

The enhancement of arboreal habitat will be achieved through the relocation of salvaged tree hollows, and, where required, the establishment of nest boxes in the surrounding remnant vegetation and post mining landscape once the re-instated vegetation is of sufficient age to support nest boxes and fauna species. The number of artificial nest boxes to be erected has been determined based on each home range and habitat requirements of key species identified in the project area (refer to **Table 6.1**).

Table 6.1 – Nest Box Numbers

	Bats	Squirrel Glider	Brushtail Possum	Parrots	
Recommended Density of Roosts/hectare	1.0/ha	0.5/ha	0.5/ha	0.5/ha	
Vegetation Communities proposed for clearance	Recommended No. of Artificial Hollows				Total
Central Hunter Ironbark-Spotted Gum-Grey Box Forest (48 hectares)	48	24	24	24	120
Bullock (4.5 hectares)	0	0	0	0	0
Hunter Floodplain Red Gum Woodland Complex (0.3 hectare)	1	1	1	1	4
Total	48	25	25	25	124

The nest boxes will be erected in the follow areas:

- 25 in vegetation along Saddlers Creek to the south of the South Pit Extension area, prior to the commencement of clearing;
- 25 in vegetation on the eastern slopes of Mt Arthur, prior to the commencement of clearing;
- 25 in vegetation on the northern slopes of Mt Arthur, prior to the commencement of clearing; and
- 49 in the proposed vegetated corridor 10 years after establishment, or otherwise when trees are established sufficiently to accommodate nest boxes.

Nest boxes have been shown to be effective at providing arboreal habitat at Mt Arthur Coal (Umwelt 2003 and 2004) for a range of species including the brushtail possum, gliders and the Australian Owlet nightjar, which have all been recorded in nest boxes across the Mt Arthur Coal complex.

6.3.2 Enhancement and Protection of Threatened Species Habitat

The squirrel glider was identified to the south of the project area in habitats associated with Saddlers Creek. The species has been widely recorded across the Mt Arthur Coal operations area. It is likely that the squirrel glider utilises the woodland habitats that are proposed to be

removed as part of the project. Threatened micro-bats, including the eastern bentwing-bat, eastern cave bat and the large-footed myotis, were also recorded along Saddlers Creek. These species are also likely to utilise the woodland habitats in the project area for foraging. In order to minimise impacts on the threatened species recorded in the project area, the following habitat enhancement and protection recommendations will be implemented:

- Saddlers Creek near to the project area will be fenced off to protect the riparian corridor and encourage natural regeneration. This will be supplemented, where necessary, with plantings of indigenous species to provide future foraging and nesting habitat for the squirrel glider and enhanced foraging resources for the threatened micro-bats recorded;
- nest boxes and relocated tree hollows suitable for squirrel gliders will be established within rehabilitated communities following mining, once the vegetation is able to support fauna populations and is structurally mature enough to support nest boxes;
- cattle grazing (other than as a land management tool) will be removed from within Saddlers Creek near to the project area, with watering points established outside of the riparian zone. The removal of grazing will promote natural regeneration and improve threatened species' habitat quality; and
- the monitoring of nest boxes established for squirrel gliders will be included in the ongoing monitoring of nest boxes (refer to **Section 5.4.3**) and the habitats of Saddlers Creek will continue to be monitored annually to assess any change in habitat quality and threatened species utilisation of the area following the south pit extension.

6.4 Establishment of Vegetation Communities in Post-Mining Landscape

The aim of the rehabilitation of the South Pit extension area will be to re-create those vegetation communities and fauna habitats currently occurring in the project area, provide a net increase in forest/woodland habitat and connect the habitat areas of Mt Arthur and Saddlers Creek with a vegetated corridor. Rehabilitation will also include the establishment of woodland/forest areas across the rehabilitated overburden emplacement areas of Bayswater No. 2. Mt Arthur Coal will also continue to work with Drayton Mine to achieve consistent revegetation communities across the mutual lease boundary, including the proposed overburden employment area in Drayton's West Pit. A range of criteria relating to biodiversity issues have been developed to direct the rehabilitation activities. The rehabilitation biodiversity criteria will be used in rehabilitation planning, and comprise:

- re-establishment of native vegetation communities in the post-mining landform;
- a net increase of forest/woodland vegetation across the project area with no net loss of any forest/woodland community;
- Central Hunter Spotted Gum – Ironbark - Grey Box Forest established as part of the project will exceed the extent of clearing of this regionally significant vegetation community;
- connection of the Mt Arthur and Saddlers Creek habitat areas by a vegetated corridor;
- use of native grasses with improved pastures in establishment of grassland areas in the rehabilitated landform;
- re-establishment of threatened species habitat; and
- compliance with the recommendations of the Synoptic Landscape Plan (Andrews Neil 1999).

6.4.1 Vegetation Community Establishment

Rehabilitation works will ensure that the area of native vegetation established is greater than the pre-mining extent of native vegetation. Central Hunter Spotted Gum – Ironbark - Grey Box Forest will be established at a ratio that exceeds 1:1 to replace the area of this vegetation community cleared as a result of the project, with Central Hunter Bulloak Forest Regeneration replaced to ensure that there is no net loss of this community. Native grasses will also be used in grassland areas established as part of the rehabilitated landform. Vegetation community establishment in the South Pit mining area and surrounds will enable the connection of remnant vegetation associated with Saddlers Creek to conserved vegetation communities on Mt Arthur.

Woodland/forest vegetation will also be established over part of the rehabilitated overburden emplacement areas in the Bayswater No. 2 mining lease. These works will be consistent with the Synoptic Landscape Plan (Andrews Neil 1999). The following vegetation communities will be targeted for rehabilitation works in these areas:

- Central Hunter Spotted Gum – Ironbark - Grey Box Forest;
- Central Hunter Ironbark - Grey Box Woodland;
- Central Hunter Bulloak Forest Regeneration; and
- grassland.

Further details of rehabilitation planning including delineation of areas in which woodland/forest vegetation establishment is proposed are included in the main text of the Environmental Assessment.

Where seed is commercially available, the composition of vegetation communities established as part of rehabilitation works will be generally consistent with the pre-mining vegetation as described in **Section 3.3** and in the Hunter Remnant Vegetation Project (Peake 2006). A list of species suitable for use in the rehabilitation is provided in **Attachment D**. Current investigations of the benefits from using local provenance seed will be continued as part of this project.

6.4.2 Fauna Habitat Reinstatement

Following the completion of topsoiling and seeding in rehabilitation areas Mt Arthur Coal will re-establish ground fauna habitat through the relocation of cleared vegetation and rocks in targeted rehabilitation areas. This will re-instate ground fauna habitat which will contribute to fauna diversity in the medium to long term as vegetation re-establishment progresses. This will only occur in areas approved as native habitat by the NSW Department of Primary Industries.

Once the rehabilitated vegetation communities are of sufficient maturity, nest boxes will be installed to supplement arboreal habitat as discussed in **Section 6.3.1**. Nest boxes will be maintained within rehabilitation areas for the life of the mine to ensure that hollow-roosting and nesting species are able to inhabit rehabilitated areas. The design of nest boxes will include a range of boxes suitable for the full range of arboreal fauna species known to occur within the project area prior to mining.

6.4.3 Rehabilitation Completion Criteria

A number of completion criteria have been formulated to determine the success of habitat re-establishment initiatives. The management of rehabilitation areas will continue until the completion criteria have been met. The completion criteria are:

1. The area of forest/woodland vegetation re-established is greater than the pre-mining extent.
2. Native grasses have been used in all rehabilitated grassland areas.
3. The species composition of the re-established vegetation communities is consistent with benchmark sites (refer to **Section 6.5.1**).
4. There are no significant weed infestations and weeds do not comprise a significant proportion of the species in any stratum.
5. Re-established vegetation communities provide habitat for a suite of fauna species similar to the pre-mining fauna communities as determined by monitoring.

Progress in meeting the completion criteria will be considered in mine closure planning and reported to the Department of Primary Industries as required.

6.5 Monitoring and Maintenance

Mt Arthur Coal currently has an existing ecological monitoring program which is implemented at the site with the results reported externally in the Annual Environmental Management Report. This program includes monitoring of fauna, remnant vegetation, rehabilitated areas and the use of nest boxes. The program includes monitoring of remnant vegetation in the vicinity of the project area and therefore no additional remnant vegetation monitoring sites are considered necessary for this project.

Proposed additions to the existing monitoring program at Mt Arthur Coal are discussed in the following sections.

6.5.1 Rehabilitation Monitoring

Standard 20 metre by 20 metre survey plots will be established in rehabilitation and regeneration areas, which will be re-sampled over time and compared to benchmark sites (where possible, data from existing monitoring points will be used). The locations of the plots and the selection of benchmark sites will be determined following the commencement of rehabilitation, and additional plots will be added to the monitoring program as rehabilitation continues.

The standard monitoring approach will be completed by an appropriately qualified and competent botanist in selected rehabilitation areas at least every three years to record species diversity and structural composition of the vegetation. This will allow for a comparison of flora species and abundance over time and will be used to determine whether the rehabilitation has achieved its objective of re-establishing existing vegetation communities.

Monitoring of any revegetated areas will also include annual inspections of the following aspects by site environmental personnel:

- revegetation germination rates;
- plant health;
- feral animals and the need for control;
- weed infestation and the need for control;
- requirements for additional planting to be undertaken;

- need for further fertilisation;
- requirement for application of lime or gypsum to control pH and improve soil structure;
- erosion and the need for repair of eroded areas;
- fire management;
- quality and effectiveness of fencing;
- signs of disturbance, either by animals or humans; and
- success of any management programs implemented following previous monitoring inspections.

In the event that the monitoring reveals unsatisfactory progress, recommendations will be provided to rectify the situation.

6.5.2 Fauna Monitoring

A fauna monitoring site will be established in remnant vegetation on Saddlers Creek to the south of the South Pit Extension area and included in the existing fauna monitoring program implemented by Mt Arthur Coal. This site will be monitored as there is not currently a fauna monitoring point on the main channel of Saddlers Creek, and several threatened species were identified in this remnant vegetation area as part of field work conducted for this project. The fauna monitoring techniques used at this site will be consistent with the existing monitoring program including spotlighting, hair funnels/tubes, bat surveys, bird surveys and amphibian/reptile searches.

Fauna monitoring will also be undertaken in selected rehabilitation areas as rehabilitation progresses. This strategy will allow a comparison between the fauna utilisation of retained, mature fauna habitats and rehabilitation areas at a range of age classes. The results of the wider Mt Arthur Coal fauna monitoring program will be used for comparison with rehabilitation monitoring.

At each of the proposed monitoring points, a range of fauna survey techniques will be employed to assess ongoing fauna use of habitat within the project area, particularly focussing on the ongoing presence of threatened species. It is proposed that thorough monitoring of fauna be undertaken at least once every three years, consistent with rehabilitation monitoring (refer to **Section 6.5.1**). The types of surveys that will be required to undertake adequate monitoring of fauna may include spotlighting, herpetological surveys, diurnal bird surveys, Anabat echolocation call detection, and the use of hair funnels to detect terrestrial and arboreal mammals. As the rehabilitated communities mature, the range of fauna monitoring techniques will increase, as microhabitats and niches for a wider range of species become established. Fauna surveys will specifically target threatened species previously recorded, or with reasonable potential to occur within the area. The results of the monitoring will be analysed and compared to previous survey results to determine general population trends. In the event that negative trends are identified, indicating the possible decline of particular threatened species, appropriate amelioration measures will be determined.

In the event that further threatened species are identified within the project area the monitoring program will incorporate surveys to adequately assess and monitor these species.

6.5.3 Nest Box Monitoring

Nest box monitoring will be undertaken every three years to record the effectiveness of artificial habitat structures. This monitoring will report on the degree of use of nest boxes and make recommendations regarding maintenance activities as required.

Monitoring should be undertaken during spring when the use of boxes by bird species can be detected. While mammal species will den in the nest boxes all year, bird species such as parrots using the boxes solely for breeding will only be present for 8 to 12 weeks during early to late spring.

At these times, nest box condition monitoring will also be undertaken and boxes replaced as required to prevent the loss of boxes through deterioration over time.

6.5.4 Identification of Additional Threatened Species

If, through the course of monitoring or through during general operation of the project, additional threatened species, or new populations of threatened species, are identified, such records will be assessed by a qualified ecologist to advise on the most appropriate management. This may result in:

- certain planned activities being postponed or modified; and/or
- modification of the monitoring program; and/or
- immediate survey and assessment of the new record, and implementation of specific management measures as required.

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ATTACHMENT A

Flora Species List

Attachment A – Flora Species List

The following list was developed from surveys of the project area detailed in **Section 2.0** of the main report. It includes all species of vascular plants observed on the project area during fieldwork. The list will not be comprehensive, because not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

- sp. specimens that are identified to genus level only;
- ? specimens for which identification was uncertain;
- prob. specimens for which identification was considered highly likely but not definite;
- poss. specimens for which identification was considered likely but not definite.

The following abbreviations or symbols are used in the list:

- asterisk (*) denotes species not indigenous to the study area;
- subsp. subspecies;
- var. variety;
- f. forma; and
- X hybrid.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler et al. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2005), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Family/Subfamily	Scientific Name	Common Name
Filicopsida (Ferns)		
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	poison rock fern
Magnoliopsida (Flowering Plants) – Liliidae (Monocots)		
Anthericaceae	<i>Dichopogon fimbriatus</i>	nodding chocolate lily
Commelinaceae	<i>Commelina cyanea</i>	scurvy weed
Cyperaceae	<i>Bolboschoenus caldwellii</i>	
Cyperaceae	<i>Cyperus gracilis</i>	a sedge
Juncaceae	<i>Juncus usitatus</i>	a rush
Lomandraceae	<i>Lomandra multiflora</i>	many-flowered mat-rush
Luzuriagaceae	<i>Eustrephus latifolius</i>	wombat berry
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	scrambling lily

Family/Subfamily	Scientific Name	Common Name
Phormiaceae	<i>Dianella caerulea</i>	blue flax lily
Poaceae	<i>Aristida vagans</i>	threeawn speargrass
Poaceae	<i>Austrodanthonia bipartita</i>	wallaby grass
Poaceae	<i>Austrostipa verticillata</i>	slender bamboo grass
Poaceae	* <i>Chloris gayana</i>	Rhodes grass
Poaceae	<i>Chloris truncata</i>	windmill grass
Poaceae	<i>Chloris ventricosa</i>	tall chloris
Poaceae	<i>Cymbopogon refractus</i>	barbed wire grass
Poaceae	<i>Cynodon dactylon</i>	couch
Poaceae	<i>Dichanthium sericeum</i>	Queensland bluegrass
Poaceae	<i>Echinopogon ovatus</i>	forest hedgehog grass
Poaceae	<i>Eriochloa pseudoacroticha</i>	early spring grass
Poaceae	<i>Panicum effusum</i>	hairy panic
Poaceae	<i>Paspalidium gracile</i>	slender panic
Poaceae	* <i>Paspalum dilatatum</i>	paspalum
Poaceae	<i>Sporobolus creber</i>	slender rat's tail grass
Poaceae	<i>Stenotaphrum secundatum</i>	buffalo grass
Poaceae	<i>Themeda australis</i>	kangaroo grass
Typhaceae	<i>Typha orientalis</i>	broad-leaved cumbungi
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)		
Acanthaceae	<i>Rostellularia adscendens</i>	
Asclepiadaceae	* <i>Gomphocarpus fruticosus</i>	narrow-leaved cotton-bush
Asteraceae	* <i>Aster subulatus</i>	wild aster
Asteraceae	<i>Brachyscome multifida</i>	cut-leaved daisy
Asteraceae	<i>Calotis lappulacea</i>	yellow burr-daisy
Asteraceae	<i>Cassinia quinquefaria</i>	cough-bush
Asteraceae	<i>Chrysocephalum apiculatum</i>	common everlasting
Asteraceae	* <i>Conyza sumatrensis</i>	tall fleabane
Asteraceae	* <i>Hypochaeris radicata</i>	catsear
Asteraceae	* <i>Onopordum acanthium</i> subsp. <i>acanthium</i>	Scotch thistle
Asteraceae	* <i>Senecio madagascariensis</i>	fireweed
Asteraceae	<i>Vittadinia cuneata</i>	fuzzweed
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	fuzzweed
Asteraceae	<i>Vittadinia muelleri</i>	a fuzzweed
Asteraceae	<i>Vittadinia</i> sp.	a fuzzweed
Brassicaceae	<i>Lepidium pseudohyssopifolium</i>	a peppergrass
Cactaceae	* <i>Opuntia stricta</i> var. <i>stricta</i>	common prickly pear
Campanulaceae	<i>Wahlenbergia</i> sp.	native bluebell
Caryophyllaceae	* <i>Cerastium fontanum</i>	a chickweed
Caryophyllaceae	* <i>Silene gallica</i> var. <i>gallica</i>	a campion
Casuarinaceae	<i>Allocasuarina luehmannii</i>	bulloak
Chenopodiaceae	<i>Einadia hastata</i>	berry saltbush
Chenopodiaceae	<i>Einadia nutans</i>	climbing saltbush

Family/Subfamily	Scientific Name	Common Name
Chenopodiaceae	<i>Maireana enchylaenoides</i>	
Chenopodiaceae	<i>Maireana microphylla</i>	eastern cottonbush
Chloanthaceae	<i>Spartothamnella juncea</i>	square-stemmed broom
Commelinaceae	<i>Commelina ensifolia</i>	scurvy grass
Convolvulaceae	<i>Convolvulus erubescens</i>	a bindweed
Convolvulaceae	<i>Dichondra repens</i>	kidney weed
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	
Crassulaceae	* <i>Bryophyllum delagoense</i>	mother-of-millions
Euphorbiaceae	<i>Chamaesyce drummondii</i>	caustic weed
Euphorbiaceae	<i>Phyllanthus similis</i>	
Euphorbiaceae	<i>Phyllanthus</i> sp.	a spurge
Euphorbiaceae	<i>Phyllanthus virgatus</i>	a spurge
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	twining glycine
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	a glycine
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	false sarsaparilla
Fabaceae (Faboideae)	<i>Indigofera australis</i>	native indigo
Fabaceae (Faboideae)	* <i>Melilotus indicus</i>	Hexham scent
Fabaceae (Faboideae)	* <i>Trifolium repens</i>	white clover
Fabaceae (Mimosoideae)	<i>Acacia genistifolia</i>	early wattle
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	hickory wattle
Fabaceae (Mimosoideae)	<i>Acacia salicina</i>	cooba
Geraniaceae	<i>Geranium</i> sp.	
Goodeniaceae	<i>Goodenia pinnatifida</i>	
Goodeniaceae	<i>Goodenia</i> sp.	a goodenia
Lamiaceae	* <i>Marrubium vulgare</i>	horehound
Lamiaceae	<i>Mentha</i> prob. <i>satureioides</i>	creeping mint
Lamiaceae	<i>Mentha satuireioides</i>	creeping mint
Lauraceae	<i>Cinnamomum camphora</i>	camphor laurel
Loranthaceae	<i>Amyema</i> sp.	a mistletoe
Malvaceae	<i>Sida cordifolia</i>	
Malvaceae	<i>Sida corrugata</i>	corrugated sida
Malvaceae	<i>Sida filiformis</i>	
Malvaceae	* <i>Sida rhombifolia</i>	Paddy's lucerne
Myoporaceae	<i>Eremophila debilis</i>	winter apple
Myrtaceae	<i>Angophora floribunda</i>	rough-barked apple
Myrtaceae	<i>Corymbia maculata</i>	spotted gum
Myrtaceae	<i>Eucalyptus albens/moluccana</i> intergrade	white/grey box
Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved ironbark
Myrtaceae	<i>Eucalyptus moluccana</i>	grey box
Myrtaceae	<i>Eucalyptus punctata</i>	grey gum
Myrtaceae	<i>Eucalyptus tereticornis</i>	forest red gum
Oleaceae	<i>Notelaea microcarpa</i>	native olive

Family/Subfamily	Scientific Name	Common Name
Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	native olive
Oleaceae	* <i>Olea europaea</i> subsp. <i>cuspidata</i>	common olive
Oxalidaceae	<i>Oxalis exilis</i>	a wood sorrel
Pittosporaceae	<i>Bursaria spinosa</i>	blackthorn
Plantaginaceae	<i>Plantago debilis</i>	slender plantain
Plantaginaceae	* <i>Plantago lanceolata</i>	lambs' tongues
Polygonaceae	<i>Rumex brownii</i>	swamp dock
Primulaceae	* <i>Anagallis arvensis</i>	scarlet pimpernell
Ranunculaceae	<i>Clematis glycinoides</i>	headache vine
Ranunculaceae	<i>Clematis glycinoides</i> var. <i>glycinoides</i>	headache vine
Rosaceae	<i>Acaena novae-zelandiae</i>	bidgee-widgee
Rosaceae	<i>Rubus fruitcosus</i>	blackberry
Rosaceae	<i>Rubus</i> sp.	
Rubiaceae	<i>Canthium odoratum</i>	shiny-leaved canthium
Rubiaceae	<i>Pomax umbellata</i>	pomax
Rubiaceae	* <i>Richardia stellaris</i>	field madder
Scrophulariaceae	* <i>Linaria pelisseriana</i>	Pelisser's toadflax
Scrophulariaceae	<i>Veronica</i> sp.	
Solanaceae	* <i>Lycium ferocissimum</i>	African boxthorn
Solanaceae	<i>Solanum brownii</i>	violet nightshade
Sterculiaceae	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	kurrajong
Thymelaeaceae	<i>Pimelea linifolia</i>	slender rice flower
Verbenaceae	* <i>Verbena bonariensis</i>	purpletop
Verbenaceae	* <i>Verbena rigida</i>	veined verbena
Viscaceae	<i>Notothixos</i> sp.	a mistletoe

ATTACHMENT B

Fauna Species List

Attachment B – Fauna Species List

Common Name	Scientific Name	Conservation Status		EPBC	Sites			
		TSC Act	EPBC Act		Mt Arthur North East	Mt Arthur East	Saddlers Creek	Opportunistic sightings
BIRDS								
Accipitridae								
black-shouldered kite	<i>Elanus notatus</i>						✓	
wedge-tailed eagle	<i>Aquila audax</i>				✓	✓	✓	
Falconidae								
Australian hobby	<i>Falco longipennis</i>					✓		
nankeen kestrel	<i>Falco cenchroides</i>		MAR			✓		✓
brown falcon	<i>Falco berigora</i>				✓			
Charadriidae								
masked lapwing	<i>Vanellus miles</i>						✓	
Cacatuidae								
galah	<i>Cacatua roseicapilla</i>				✓	✓	✓	
sulphur-crested cockatoo	<i>Cacatua galerita</i>				✓	✓	✓	✓
Psittacidae								
eastern rosella	<i>Platycercus eximius</i>				✓	✓	✓	
Tytonidae								
barn owl	<i>Tyto alba</i>				✓	✓		
Podargidae								
tawny frogmouth	<i>Podargus strigoides</i>						✓	
Apodidae								
white-throated needletail	<i>Hirundapus caudacutus</i>		MAR & MIG					✓
Maluridae								
superb fairy-wren	<i>Malurus cyaneus</i>				✓	✓	✓	

Common Name	Scientific Name	Conservation Status		EPBC	Sites			
		TSC Act	EPBC Act		Mt Arthur North East	Mt Arthur East	Saddlers Creek	Opportunistic sightings
Pardalotidae								
striated pardalote	<i>Pardalotus striatus</i>				✓	✓	✓	
weebill	<i>Smicromnis brevirostris</i>				✓	✓	✓	
yellow-rumped thornbill	<i>Acanthiza chrysorrhoa</i>				✓	✓		
western gerygone	<i>Gerygone fusca</i>				✓			
Meliphagidae								
yellow-faced honeyeater	<i>Lichenostomus chrysops</i>				✓			
white-plumed honeyeater	<i>Lichenostomus penicillatus</i>				✓	✓		
noisy miner	<i>Manorina melanocephala</i>				✓	✓	✓	
noisy friarbird	<i>Philemon corniculatus</i>				✓			
Pachycephalidae								
grey shrike-thrush	<i>Colluricincla harmonica</i>				✓			
Dicruridae								
willie wagtail	<i>Rhipidura leucophrys</i>				✓			
magpie-lark	<i>Grallina cyanoleuca</i>		MAR				✓	
Campephagidae								
black-faced cuckoo-shrike	<i>Coracina novaehollandiae</i>		MAR		✓	✓		
Artamidae								
grey butcherbird	<i>Cracticus torquatus</i>						✓	
piebald butcherbird	<i>Cracticus nigrogularis</i>				✓	✓	✓	
Australian magpie	<i>Gymnorhina tibicen</i>				✓	✓	✓	
piebald currawong	<i>Strepera graculina</i>				✓	✓	✓	✓
Corvidae								
Australian raven	<i>Corvus coronoides</i>				✓	✓	✓	
Corcoracidae								
white-winged chough	<i>Corcorax melanorhamphos</i>					✓		

Common Name	Scientific Name	Conservation Status		EPBC	Sites			
		TSC Act	EPBC Act		Mt Arthur North East	Mt Arthur East	Saddlers Creek	Opportunistic sightings
Motacilidae								
Richard's pipit	<i>Anthus novaeseelandiae</i>		MAR					✓
Passeridae								
double-barred finch	<i>Taeniopygia bichenovii</i>				✓			
Dicaeidae								
mistletoebird	<i>Dicaeum hirundinaceum</i>				✓	✓	✓	✓
Zosteropidae								
silveryeye	<i>Zosterops lateralis</i>		MAR		✓			
Columbida								
crested pigeon	<i>Ocyphaps lophotes</i>							✓
western gerygone	<i>Gerygone fusca</i>				✓			
Halcyonidae								
laughing kookaburra	<i>Dacelo novaeguineae</i>					✓	✓	
Meropidae								
rainbow bee-eater	<i>Merops ornatus</i>		MAR & MIG		✓			
MAMMALS								
Dasyuridae								
brown antechinus	<i>Antechinus stuartii</i>					✓		
Petauridae								
squirrel glider	<i>Petaurus norfolcensis</i>	V					✓	
Phalangeridae								
brush-tailed possum	<i>Trichosurus vulpecula</i>				✓	✓	✓	
Macropodidae								
eastern grey kangaroos	<i>Macropus giganteus</i>				✓	✓	✓	✓
	<i>Trichosurus sp.</i>				D	D	Pr	

Common Name	Scientific Name	Conservation Status		EPBC	Sites			
		TSC Act	EPBC Act		Mt Arthur North East	Mt Arthur East	Saddlers Creek	Opportunistic sightings
Vespertilionidae								
eastern bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V					C	
Gould's wattled bat	<i>Chalinolobus gouldii</i>					C	C	
chocolate wattled bat	<i>Chalinolobus morio</i>						C	
large-footed myotis	<i>Myotis adversus</i>	V					P	
inland broad-nosed bat	<i>Scotorepens balstoni</i>						Po	
eastern forest bat	<i>Vespadelus pumilus</i>				✓			
southern forest bat	<i>Vespadelus regulus</i>					✓, Po	P	
eastern cave bat	<i>Vespadelus troughtoni</i>	V				Po	Po	
little forest bat	<i>Vespadelus vulturnus</i>					✓, P	C	
Muridae								
house mouse	<i>Mus musculus</i>				D	✓	✓	
Canidae								
fox	<i>Vulpes vulpes</i>					✓		
Leporidae								
rabbit	<i>Oryctolagus cuniculus</i>				✓		✓	
brown hare	<i>Lepus capensis</i>				✓		✓	
AMPHIBIANS								
Hylidae								
broad-palmed frog	<i>Litoria latopalmata</i>					✓		
Myobatrachidae								
brown froglet	<i>Crinia signifera</i>					✓		
spotted marsh frog	<i>Limnodynastes tasmaniensis</i>				✓	✓	✓	

Common Name	Scientific Name	Conservation Status		EPBC	Sites			
		TSC Act	EPBC Act		Mt Arthur North East	Mt Arthur East	Saddlers Creek	Opportunistic sightings
REPTILES								
Varanidae								
lace monitor	<i>Varanus varius</i>					✓	✓	
Agamidae								
Eastern bearded dragon	<i>Pogona barbata</i>						✓	
Scincidae								
tree skink	<i>Egernia striolata</i>						✓	
southern rainbow skink	<i>Carlia tetradactyla</i>				✓	✓	✓	
copper-tailed skink	<i>Ctenotus taeniolatus</i>				✓	✓		
Eastern blue-tongued lizard	<i>Tiliqua scincoides</i>				✓	✓		
Elapidae								
blue-bellied black snake	<i>Pseudechis guttatus</i>					✓		

Legend:

- V = Listed as vulnerable under the *Threatened Species Conservation Act 1995*
 MAR = Listed marine species under the *Environment Protection and Biodiversity Act 1999*
 MIG = Listed migratory species under the *Environment Protection and Biodiversity Act 1999*

 C = 'Confident' identification by Fly By Night Bat Surveys Pty Ltd
 P = 'Probable' identification by Fly By Night Bat Surveys Pty Ltd
 Po = 'Possible' identification by Fly By Night Bat Surveys Pty Ltd

 D = 'Definite' hair sample identification by Barbara Triggs
 Pr = 'Probable' hair sample identification by Barbara Triggs

ATTACHMENT C

Threatened Species Assessment of Significance

ATTACHMENT C - ASSESSMENT OF SIGNIFICANCE

Significant ecological survey has been completed in the wider Mt Arthur Coal operations area over the past 10-15 years for numerous environmental assessments and ecological monitoring (Resource Planning 1993; URS 2000; Umwelt 2001; Umwelt 2005; Umwelt 2006). The information gathered from these surveys has been assessed and used in the compilation of potential threatened species lists, habitat assessments and survey design. Threatened species recorded during the previous surveys and during surveys undertaken for the project area are listed in **Tables 1** and **2**, with an assessment of significance completed where appropriate.

Searches of the Department of Environment and Conservation (DEC) Atlas of NSW Wildlife Database and the Department of Environment and Heritage (DEH) Protected Matters Database were undertaken prior to field surveys to identify threatened flora and fauna species, populations and endangered ecological communities previously recorded, or considered likely to occur in suitable habitat within a 20 kilometre radius of the project area. Species not recorded on the databases but known to occur in the region were included based on an intuitive assessment. **Tables 1** and **2** list the species identified during threatened species searches.

1.0 THREATENED FLORA

The threatened flora species, *Bothriochloa biloba*, is known to occur within the Mt Arthur Coal operations area. This species has recently been removed from the TSC Act, however it remains listed as a vulnerable species on the EPBC Act. This species was recorded in two locations during surveys for the Mt Arthur Coal Underground Project west of the project area and is also known from a site adjacent to Edderton Road and the Mt Arthur North access road (Peake 2006). It was not recorded in the South Pit Extension Area, despite targeted survey. The location of *Bothriochloa biloba* is shown on **Figure 3.2**. A test of significance under the EPBC Act has been prepared for this species, and is presented in this appendix.

Diuris tricolor, a terrestrial orchid is also known to occur within the Mt Arthur Coal operations area, in A171, close to the Mt Arthur North access road (DEC Atlas of NSW Wildlife, 2006), north of the project area. This species is listed on both the TSC Act and EPBC Act as a vulnerable species.

A search of the DEH Protected Matters Database identified nine EPBC Act listed threatened flora species with the potential to occur in suitable habitat, in the project area. These species are listed in **Table 1**, with an assessment of their potential to occur within the project area.

In addition to those species listed as nationally significant, 11 flora species listed as threatened under the NSW TSC Act 1995 have been recorded within 20 kilometres of the project area. These species were identified on the DEC Atlas of NSW Wildlife and in a review of flora assessments from the local area. These species are also listed in **Table 1**, along with an assessment of their potential to occur within the project area.

Table 1 - Threatened Flora Assessment

Species	Legal Status	Specific Habitat	Likely Occurrence in the Project Area
A donkey orchid <i>Diuris tricolor</i>	V EPBC Act V TSC Act	<i>Diuris tricolor</i> is a terrestrial herb flowering September to November (Jones 1993a). <i>Diuris tricolor</i> grows in sclerophyll forest among grass and is often found with <i>Callitris</i> (Jones 1993a). <i>Diuris tricolor</i> has been recorded on the Northern and Central Tablelands and Slopes (Jones 1993a). It is found in sandy soils, either on flats or small rises. This species has also been recorded from red earth soil in a bumble box (<i>Eucalyptus populnea</i>) community in western NSW (DEC 2006). This species is sporadically distributed on the western slopes of NSW, extending from south of Narrandera to the far north of NSW. Localities include the Condobolin-Nymagee road, Wattamondara towards Cowra, Cooyal, Adelong, Red Hill north of Narrandera, Coolamon, near Darlington Point, Eugowra, Girilambone, Dubbo, Muswellbrook, and several sites west of Wagga Wagga (DEC 2006). The Muswellbrook local government area is the eastern limit of the species range and the only recorded occurrence of <i>D. tricolor</i> in the Sydney Basin Bioregion (Australia's Virtual Herbarium 2006). The <i>D. tricolor</i> population in Muswellbrook appears to be an isolated population and therefore this population may be genetically distinct. The species is considered likely to have declined in recent years and is threatened by the spread of invasive, exotic grasses, such as Coolatai grass (<i>Hyparrhenia hirta</i>) (Peake 2006).	The project area contains habitats suitable for this species, however, the species was not recorded. As potential habitat occurs further assessment is provided below.
slaty red gum <i>Eucalyptus glaucina</i>	V EPBC Act V TSC Act	A tree to 30 metres high with smooth white or grey bark that sheds in large plates or flakes. It occurs in grassy woodland on deep, moderately fertile and well-watered soils. It is considered by Harden (2002) to be locally frequent but very sporadic. It is generally distributed near Casino, and from Taree to Broke.	The project area does not provide potential habitat for this species and the species was not recorded during flora surveys. Further assessment of this species is not required.

Table 1 - Threatened Flora Assessment (cont)

Species	Legal Status	Specific Habitat	Likely Occurrence in the Project Area
narrow goodenia <i>Goodenia macbaronii</i>	V EPBC Act V TSC Act	A small, annual herb with basal leaves growing to 30 cm high. Glabrous except for flowers. Leaves mostly basal, margins toothed, thick, 5-11 cm long, 2-5 mm wide. Flowers in racemes on almost leafless scapes, stalks to 5 cm long (Carolin 1992). <i>Goodenia macbaronii</i> occurs west of the Great Dividing Range from southeast Queensland through to central Victoria. In NSW, the range of this species is thought to be south of the Guyura and Inverell districts (Carolin 1992). In the Hunter Valley, the species is only known to occur in the Wybong district where several sub-populations have been recorded (Peake 2005). Specific sites in which <i>G. macbaronii</i> has been recorded include Yarrabandai and Ulan (HLA 2003).	The project area contains habitats suitable for this species, however, the species was not recorded. As potential habitat occurs further assessment is provided below.
<i>Lasiopetalum longistamineum</i>	V EPBC Act V TSC Act	<i>Lasiopetalum longistamineum</i> is a spreading shrub to 1.5 metres high with densely rusty-tomentose branches (Harden 2000). Leaves are generally 4-11 cm long and 12-25 mm wide, with upper surface green and sparsely pubescent to glabrous, and lower surface densely white-tomentose with veins raised and rusty coloured (Harden 2000). Flowers are crowded in spike-like branches, 3-4 mm long and densely tomentose (Harden 2000). <i>Lasiopetalum longistamineum</i> is only known to occur within the Central West Slopes botanical subdivision, in the Gungal-Mt Dangar area (Harden 2000).	This species was not recorded during flora surveys undertaken in the project area and it is not expected to occur. Further assessment of this species is not required.
<i>Ozothamnus tessellatus</i>	V EPBC Act V TSC Act	<i>Ozothamnus tessellatus</i> is a dense shrub to 1 metres high (Everett 1992). Leaves are spreading, oblong, 4-5 mm long, <1 mm wide, upper surface is green and shining viscid and lower surface white-woolly (Everett 1992). Heads are approximately 4 mm long, 4.5 mm in diameter and in dense corymbs (Everett 1992). <i>Ozothamnus tessellatus</i> is only known to occur in the area north of Rylstone in the Central Western Slopes botanical subdivision (Everett 1992).	Targeted searches were undertaken for this species during flora surveyed undertaken for this project. The species was not identified and the species is not expected to occur. Further assessment is not required.

Table 1 - Threatened Flora Assessment (cont)

Species	Legal Status	Specific Habitat	Likely Occurrence in the Project Area
<i>Philotheca ericifolia</i>	V EPBC Act V TSC Act	<i>Philotheca ericifolia</i> is a spreading shrub 1-2 metres high (Weston and Harden 2002). Leaves are needle-like, 4-8 mm long and 0.5 mm wide (Weston and Harden 2002). Flowers are 1-6 in sessile clusters and pink to purple (Weston and Harden 2002). <i>Philotheca ericifolia</i> occurs in the upper Hunter Valley and northern Pilliga Scrub to Peak Hill district (Weston and Harden 2002). In the Hunter Valley <i>P. ericifolia</i> is known from Wingen Maid Nature Reserve, near Scone (Hill et al. 2001, Hosking and Bruhl 2000). This species is believed to be well protected in the Hunter Valley (Peake 2006).	The species was not recorded during targeted threatened species surveys undertaken in the project area and further assessment is not required.
<i>Pomaderris queenslandica</i>	E TSC Act	Shrub 2-3 metres high, stems whitish, shortly stellate-tomentose with some scattered longer simpler hairs. Leaves ovate-narrow elliptic, 2.5-7 cm long, 10-25 mm wide, apex acute to obtuse, upper surface glabrous, lower surface whitish with whitish curly hairs. Flowers cream in terminal panicles, petals usually absent (Harden 2000). This species is rare in NSW and more common in Queensland. Within NSW, <i>P. queenslandica</i> occurs on the slopes north from the Peak Hill district and also in the Gloucester district (Harden 2000). In the Hunter Valley, the species has been recorded at Myambat Army Depot (Fallding et al. 1999), on the slopes of the Glen Range in Towarri NP (Hill et al. 2001), in the Wybong uplands at Anvil Hill and Limb of Addy Hill and also in Manobalai NR (Bell 2001b).	The project area does not provide potential habitat for this species and the species was not recorded during flora surveys. Further assessment of this species is not required.
<i>Thesium australe</i> austral toadflax	V EPBC Act V TSC Act	<i>Thesium australe</i> is an erect perennial herb to 40 cm high, glabrous and pale green to yellow-green in colour (Wiecek 1992). Leaves are linear and usually 1-4 cm long and 0.5-1.5 mm wide and have acute apex (Wiecek 1992). Flowers are green-yellow, solitary and axillary. <i>Thesium australe</i> is distributed through northern and central NSW, as well as Queensland, Victoria and Tasmania (Wiecek 1992). There have been unconfirmed reports of this species in the Hunter Valley (Peake 2006).	The project area contains habitats suitable for this species, however, it was not recorded during targeted surveys. As potential habitat occurs further assessment is provided below.

Table 1 - Threatened Flora Assessment (cont)

Species	Legal Status	Specific Habitat	Likely Occurrence in the Project Area
<i>Pomaderris reperta</i>	E TSC Act	Walsh and Coates (1997) describe <i>Pomaderris reperta</i> as a shrub growing 1-3 metres high with young stems densely villous. Leaves are ovate to broad-ovate, 10-35 mm long and 8-20 mm wide, with the apex obtuse or shallowly emarginated. The upper surface of the leaves have short, simple hairs, while the lower surface has rusty simple hairs over white or grayish stellate hairs. Inflorescences are of 1-several globoid clusters each of c. 10-30 flowers, in terminal panicle, 3-4 cm long and 3-4 cm wide. Flowers are cream and externally villous with spreading silvery or pale rusty simple hairs overlaying grayish stellate hairs. Fruits are dark grey-brown, obovoid and c. 3.5 mm long. The range of <i>P. reperta</i> is restricted to the Central West Slopes botanical subdivision, occurring as an isolated population in the Upper Hunter Valley, NSW. The species is known to occur in Myambat Army Depot (Fallding et al. 1999) and also west of Denman (Bell 2001b).	The project area does not provide potential habitat for this species and the species was not recorded during flora surveys. Further assessment of this species is not required.
<i>Bothriochloa biloba</i>	V EPBC Act	An erect or decumbent caespitose perennial to c. one metre high, flowering during summer (Jacobs and Wall 1993a). The species typically grows in woodlands on poorer soils (Jacobs and Wall 1993a, Wheeler et al. 2002), and is known to occur on slopes and northern parts of NSW, and Queensland (Peake 2006). Regionally, the species has been recorded across much of the central and upper Hunter Valley with fewer records in the lower Hunter but as far east as Maitland (Hill 2003a). Bean (1999) has suggested that grazing may have a positive effect on this species in two ways: firstly, unrestricted grazing reduces the growth the dominant purple wiregrass (<i>Aristida ramosa</i>); and secondly, stock selectively graze grass species other than <i>B. biloba</i> because of its coarser culms. Abnormal embryology has been suggestion as the reason for poor seed production by this species (Yu et al. 2003).	The project area contains habitats suitable for this species, however, it was not recorded in the project area despite targeted survey. As potential habitat occurs further assessment is provided below.

Table 1 - Threatened Flora Assessment (cont)

Species	Legal Status	Specific Habitat	Likely Occurrence in the Project Area
Finger Panic Grass <i>Digitaria porrecta</i>	E EPBC Act E TSC Act	A loosely tufted, erect or bent greyish pubescent perennial grass to 60 cm high and flowering during summer (Jacobs and Wall 1993b). The species grows in grassland, woodland or open forests with a grassy understorey, on richer soils and it is often found in road reserves or travelling stock reserves which experience light grazing and occasional fire (DEC 2006). In NSW the species occurs on the North West Slopes and Plains from near Moree south to Tambar Springs and from Tamworth to Coonabarabran (DEC 2006).	There are no records of this species within the Muswellbrook 1:100,000 Map Sheet, and it is unlikely that the area covered by this sheet is an important area for this species. This species was not recorded within the project area, and it is considered unlikely that potential habitat exists for this species within the project area, or in the immediate locality.
<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	V TSC Act	<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i> is a divaricate shrub 0.5-2 metres high that is strongly aromatic and viscid (Conn 1992). Branches are usually not distinctly hairy (Conn 1999). Leaves are 6-9 mm long and 2-3 mm wide with apex obtuse, base cuneate to obtuse and margins have 3 or 4 obtuse lobes on either side (Conn 1992). Flowers are axillary and corolla is mauve and 11-15 mm long (Conn 1992). The subspecies that is confined to NSW is <i>P. cryptandroides</i> subsp. <i>cryptandroides</i> (Conn 1999). <i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i> is only known from two disjunct populations. One population is located at Glen Davis in the Central Tablelands botanical division. The other is known from the Denman-Baerami and Widden Valleys in the Central Western Slopes botanical division (NPWS 2000).	The project area does not provide potential habitat for this species and the species was not recorded during flora surveys. Further assessment of this species is not required.

Table 1 - Threatened Flora Assessment (cont)

Species	Legal Status	Specific Habitat	Likely Occurrence in the Project Area
<i>Isotropis foliosa</i>	Preliminary Determination TSC Act 1995	<i>Isotropis foliosa</i> is a subshrub to 60 cm high, and is rusty or whitish-pubescent. Leaves are 1-foliolate, 8-30 mm long, 8-15 mm wide, and sparsely hairy to glabrous. Inflorescence is a loose terminal raceme. Corolla orange with purple veins and a yellow spot at base, wings and keel orange to red. <i>Isotropis foliosa</i> is not common and occurs chiefly on the Slopes, north of Denman (Porteners 2002). The distribution of this species extends to south-east Queensland, however only a small number of populations have been recorded (Peake 2006). In the Hunter Valley, <i>I. foliosa</i> is known to occur between Appletree Flat (Wollemi NP), Dingo Creek (Wollemi NP) and Scone (Peake 2005). The Hunter Valley appears to be a stronghold for the species however, there are relatively few populations in total and most populations across NSW are comprised of very few individuals (Peake 2006).	The preferred habitat for this species was not recorded in the project area and this species is unlikely to occur. Further assessment is not required.

1.1 ENDANGERED ECOLOGICAL COMMUNITIES

The South Pit Extension Area occurs within the Sydney Basin Bioregion where a large number of EECs occur. Three of those communities have previously been recorded, or are considered likely to occur in the area covered by the Muswellbrook 1:100,000 topographic map sheet. Based on the projects' location, and the geomorphology and habitats present, the following EECs have a reasonable potential of occurring.

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

One EPBC listed community, Weeping Myall - Coobah -Scrub Wilga Shrubland of the Hunter Valley, is known to occur in the vicinity of the project area, and three TSC Act listed communities were identified as potentially occurring within the project area based on their regional distribution and habitat preferences. No EECs were, however, recorded within the project area during detailed vegetation surveys (as discussed in the main text of the Ecology report) and further assessment of these EECs to determine the significance of the impact of the project is therefore not required.

1.2 ENDANGERED POPULATIONS

Searches of the schedules of the TSC and EPBC Act identified three endangered flora populations that are known to occur in the Upper Hunter Valley. Each of these populations is described in **Section 3.4.2** of the Ecology report and include:

- *Eucalyptus camaldulensis* Hunter Catchment Population;
- *Acacia pendula* (a tree) in the Hunter Catchment; and
- *Cymbidium canaliculatum* in the Hunter Catchment

None of the endangered populations were recorded during flora survey in the project area, however each of the populations is known to occur within the Mt Arthur Coal operations area. As none of the populations were recorded in the project area, further assessment of the significance of the project on these populations is not required.

2.0 THREATENED FAUNA

A total of thirty species listed as threatened under the TSC Act 1995 have been recorded within 20km of the project area, as listed on the DEC Atlas of NSW Wildlife. This includes fifteen birds, fourteen mammals and one amphibian. Four threatened fauna species are known to occur in or adjacent to the project area, as shown on **Figure 3.2**. **Table 2** lists these species and assesses the likelihood of their occurrence within the project area. A number of these species are also listed under the EPBC Act 1999 and were identified on the DEH Protected Matters Database as species which may, or are likely to occur in the project area in suitable habitat.

Table 2 - Threatened Fauna Assessment

Species	Legal Status	Specific Habitat	Potential to Occur
green and golden bell frog <i>Litoria aurea</i>	V (EPBC Act 1999) E (TSC Act 1995)	The green and golden bell frog occurs in eastern and south-eastern NSW to far eastern Victoria, largely at low altitudes (Cogger 2000). Once widespread, it is now restricted to isolated coastal populations, and occurs among vegetation in permanent water bodies such as streams, swamps, lagoons, dams and ponds (Cogger 2000), particularly where bullrush (<i>Typha</i> spp.) and spikerush (<i>Elaeocharis</i> spp.) occur (NPWS 1999r). Green and golden bell frogs are known to occur in degraded water bodies such as brick-pits and industrial sites (NPWS 1999r). Breeding occurs in summer and tadpoles feed on vegetation including algae, while adults forage for insects and other frogs (NPWS 1999r). This species is known to be cannibalistic (Cogger 2000).	Potential habitat was identified for this species within the project area. Further assessment is provided below.
bush stone-curlew <i>Burhinus grallarius</i>	E (TSC Act 1995)	Distributed along the north, west and east coasts of Australia and many coastal islands (Pizzey & Knight 1997). In NSW, the species range has contracted to isolated areas near Gosford, Port Macquarie, Grafton, Port Stephens and Karuah (NPWS 1999L). Preferred habitat includes open woodland, dry watercourses with fallen branches, leaf litter and sparse grass; sandplains with spinifex and mallee; coastal scrub and mangrove fringes, golf courses and rail reserves; also suburbs and towns, cities in Queensland and resort islands (Pizzey & Knight 1997). Often associated with <i>Casuarina</i> , <i>Eucalyptus</i> and <i>Acacia</i> spp. (NPWS 1999L). The Bush Stone-curlew has a diet of insects, molluscs, centipedes, crustaceans, spiders, frogs, lizards, snakes and some vegetation (NPWS 1999L). Lays approx. 2 eggs on bare ground (usually under trees) Aug-Jan (Pizzey & Knight 1997).	This species is not expected to occur within the project area due to the history of disturbance and ongoing mining activities in the vicinity. Further assessment of this species is not required.
freckled duck <i>Stictonetta naevosa</i>	V (TSC Act 1995)	The Freckled duck is generally recorded from a wide area across eastern and south western Australia, occurring elsewhere, particularly during years of inland drought (NSW NPWS 1999e). In wet years, breeding levels are high, followed by wide dispersal, particularly toward the coast (Garnett & Crowley 2000). Generally, they are nomadic between ephemeral inland wetlands. In eastern Australia, this species occurs in large numbers on brackish to hyposaline wetlands that are densely vegetated with Lignum, where they breed (Garnett & Crowley 2000). Other habitat types include large open lakes, creeks, farm dams, sewage ponds and floodwaters (NSW NPWS 1999e). Breeding occurs between June and December (NSW NPWS 1999e).	The project area does not provide sufficient habitat for this species. The Freckled Duck is not expected to occur and further assessment is not required.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
gang cockatoo <i>Callocephalon fimbriatum</i>	V (TSC Act 1995)	In summer, the Gang-gang Cockatoo occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (DEC 2006). The species may also occur in sub-alpine Snow Gum <i>Eucalyptus pauciflora</i> woodland and occasionally in temperate rainforests (DEC 2006). In winter, the Gang-gang Cockatoo occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (DEC 2006).	Potential habitat was identified for this species within the project area. Further assessment is provided below.
glossy black-cockatoo <i>Calyptorhynchus lathami</i>	V (TSC Act 1995)	The glossy black-cockatoo has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland (NSW NPWS 1999k). In New South Wales, it has been recorded as far inland as Cobar and Griffith. Habitat for this species includes forests on low-nutrient soils, specifically those containing key <i>Allocasuarina</i> feed species (NSW NPWS 1999k). This species can be highly selective in its choice of food trees, choosing casuarinas that produce seeds with a high nutrient value. A pair may visit various feed trees, before settling to harvest all mature cones within reach. They will also eat seeds from eucalypts, angophoras, acacias, cypress pine and hakeas, as well as eating insect larvae. Breeding occurs in autumn and winter, with large hollows required (NSW NPWS 1999k).	The project area contains bullock which is an <i>Allocasuarina</i> species. However, this species is not a primary food source for the glossy black-cockatoo and it is not considered that the glossy black-cockatoo would rely solely on this resource. No further assessment is required.
grey-crowned babbler <i>Pomatostomus temporalis</i>	V (TSC Act 1995)	This species is known from isolated populations within the Hunter Valley and occurs in open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs and an intact ground cover of grass and forbs. This species is insectivorous and forages in leaf litter and on the bark of trees.	This species has been recorded previously at Mt Arthur Coal. Further assessment is provided below.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
brown treecreeper (eastern subsp.) <i>Climacteris picumnus victoriae</i>	V (TSC Act 1995)	This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys (NSW Scientific Committee 2001). Typical habitat for this species includes drier forests, woodlands and scrubs with fallen branches; river red gums on watercourses and around lake-shores; paddocks with standing dead timber; and margins of denser wooded areas (Pizzey & Knight 1997). Prefers areas without dense understorey (NSW Scientific Committee 2001). Occupies permanent territories, building a nest of grass usually in tree hollow 3-10 metres or higher, or in stumps or fence posts. This species is highly sensitive to habitat fragmentation, with disrupted dispersal due to habitat isolation being the primary threat (Walters et al. 1999).	The project area contains potential habitat for this species. Further assessment is provided below.
turquoise parrot <i>Neophema pulchella</i>	V (TSC Act 1995)	The turquoise parrot occupies a variety of habitats, primarily eucalypt woodland and open forest near open water and forested hills. Also found in coastal heath, pasture, roadsides and orchards (Pizzey & Knight 1997). Habitat typically has a dense ground cover and a low understorey of shrubs (NPWS 1999ad). Feeds primarily on seeds, but may also utilise flowers, nectar, fruits, leaves and scale insects (NPWS 1999ad). Foraging species of the turquoise parrot include <i>Eucalyptus albens</i>, <i>E. meliodora</i>, <i>E. blakelyi</i>, <i>Leucopogon microphyllus</i>, <i>Dillwynia</i> spp. <i>Hordeum murinum</i>, <i>Carthamnus lanatus</i>, <i>Urtica urens</i> etc. (DEC 2006). Breeds August to December and April to May (Pizzey & Knight 1997). The nest is built in a hollow of a small tree, a stump, fence post or even a hollow log on the ground.	This species has been tentatively recorded previously at Mt Arthur Coal during surveys conducted for the Bayswater No 3 EIS (Resource Planning 1993). Further assessment is provided below.
swift parrot <i>Lathamus discolor</i>	E (TSC Act 1995) E (EPBC Act 1999)	The swift parrot breeds in Tasmania, migrating to the mainland in May to August, where it forages on flowering eucalypts mainly in Victoria and NSW (Swift Parrot Recovery Team 2001). In NSW, it has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW (Swift Parrot Recovery Team 2001). This species often visit box-ironbark forests, feeding on nectar and lerp (Garnett & Crowley 2000). In NSW, typical feed species include mugga ironbark, grey box, swamp mahogany, spotted gum, red bloodwood, narrow-leaved red ironbark, forest red gum and yellow box (Swift Parrot Recovery Team 2001). Of such species, larger trees bearing more flowers are selected.	Potential habitat is present within the project area for this species. Further assessment is provided below.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
regent honeyeater <i>Xanthomyza phrygia</i>	E (EPBC Act 1999) E (TSC Act 1995)	The regent honeyeater has a patchy distribution across the eastern states of Australia (NSW NPWS 1999n). This semi-nomadic species generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine <i>Casuarina</i> woodlands (NSW NPWS 1999n). An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills (Garnet & Crowley 2000). Breeding occurs between July and November. Known breeding sites are rare, with the most important sites being in the Warrumbungles NP, Pilliga NR, Barraba district, Gosford area, Hunter Valley and Capertee Valley (NSW NPWS 1999n).	Potential habitat is present within the project area for this species. Further assessment is provided below.
hooded robin <i>Melanodryas cucullata cucullata</i>	V (TSC Act 1995)	This form of the hooded robin is distributed throughout south-eastern Australia, from central Queensland to the Spencer Gulf, South Australia. This form occurs throughout NSW except for the north-west, where it intergrades with the northern form <i>M. cucullata picata</i> (NSW Scientific Committee 2001f). The species occupies a range of eucalypt woodlands, Acacia shrublands and open forests. In temperate woodlands, it favours open areas adjoining large woodland blocks, with areas of dead timber and sparse shrub cover (NSW Scientific Committee 2001f). In semi-arid western NSW, the species favours open woodlands of belah, rosewood, mulga and cypress. Hooded robins live in small family groups, and build cup-shaped nests. Home ranges are relatively large, and averaged 18 hectares for birds from the New England Tableland (NSW Scientific Committee 2001f). The species appears unable to survive in remnants smaller than 100-200 hectares (NSW Scientific Committee 2001f).	Woodland communities provide potential habitat for this species. Further assessment is provided below.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
speckled warbler <i>Pyrrholaemus saggitata</i>	V (TSC Act 1995)	The speckled warbler has a distribution from south-eastern Queensland, through central and eastern NSW to Victoria. In NSW, this species occupies eucalypt and cypress woodlands, generally on the western slopes of the Great Dividing Range. They inhabit woodlands with a grassy understorey, leaf litter and shrub cover, often on ridges or gullies (Garnett & Crowley 2000). This species has also been recorded in cypress woodlands of the northern Riverina and in drier coastal areas such as the Cumberland Plain, Western Sydney and the Hunter and Snowy River valleys (NSW Scientific Committee 2001e). The species is sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. Home ranges vary from 6-12 hectares (NSW Scientific Committee 2001). Barrett et al. (1994) found that the species decreased in abundance as woodland area decreased, and it appears to be extinct in districts where no fragments larger than 100 hectares remain.	This species has been recorded across Mt Arthur Coal at McLean's Hill, in the Bayswater rail facility area and within the project area. Further assessment is provided below.
diamond firetail <i>Stagonopleura guttata</i>	V (TSC Act 1995)	The diamond firetail occurs through central and eastern NSW, north into southern and central Queensland and south through Victoria to South Australia. In NSW, it mainly occurs west of the Great Dividing Range, although populations are known from drier coastal areas such as the Cumberland Plain and the Hunter, Clarence, Richmond and Snowy River valleys (NSW Scientific Committee 2001b). Habitat includes a range of eucalypt dominated communities with a grassy understorey, including woodland, forest and mallee (Garnett & Crowley 2000). It appears that populations are unable to persist in areas where there are no vegetated remnants larger than 200 hectares (NSW Scientific Committee 2001b).	This species was recorded during fauna survey undertaken for the MAN EIS prior to the species being listed as threatened (URS 2000). Woodland communities within the project area provide potential habitat for this species. Further assessment is provided below.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
masked owl <i>Tyto novaehollandiae</i>	V (TSC Act 1995)	The masked owl occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea (Kavanagh 2002a). This species is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land (Kavanagh 2004). Home range estimates vary between 800 and 1200 hectares (Kavanagh 2002a). Masked owls nest (and roost) in large hollows of old trees. They also roost among dense foliage in variety of sub-canopy trees (Kavanagh 2004). <i>Tyto</i> species have a variable breeding season (likely to be in response to prey fluctuations), however, they are most likely to breed in autumn or winter (Kavanagh 2002a). Masked Owls commonly prey on small terrestrial and scansorial mammals, occasionally supplementing with diurnal birds (Kavanagh 2002b).	Potential habitat is present within the project area for this species. Further assessment is provided below.
barking owl <i>Ninox connivens</i>	V (TSC Act 1995)	The barking owl is distributed sparsely throughout temperate and semi-arid areas of mainland Australia; however, it is most abundant in the tropical north (Kavanagh 2002a). Most records for this species occur west of the Great Dividing Range (Kavanagh 2004). Habitat for this species includes dry forests and woodlands (Kavanagh 2002a), often in association with hydrological features such as rivers and swamps (Taylor et al. 2002). Taylor <i>et al.</i> (2002) reports that not enough data has been collected to accurately estimate home range sizes, however, one has been radio-tracked over 226 hectares. Large hollows are required for breeding. Barking owls are strictly seasonal breeders, laying in late winter or spring (NSW NPWS 2003). The species has a broad diet dominated by ground-dwelling mammals, birds and insects (Kavanagh 2002b).	This species was tentatively recorded during surveys conducted for the South Saddlers EIS (Dames and Moore 1996) to the south of the project area. This species may occur within the project area as part of a wider home range. Further assessment is provided below.
powerful owl <i>Ninox strenua</i>	V (TSC Act 1995)	The powerful owl occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south western Victoria to Bowen in Queensland (Garnett & Crowley 2000). This species inhabits a variety of woodland and open forest habitats. Home ranges are estimated to range between 800 and 1000 hectares (Kavanagh 2002a).	The sparsely wooded and open grassland habitats of the project area are unlikely to provide habitat for the Powerful Owl. The species is not expected to occur and further assessment is not required.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
spotted-tailed quoll <i>Dasyurus maculatus maculatus</i>	E (EPBC Act 1999) V (TSC Act 1995)	In NSW, the spotted-tailed quoll occurs on both sides of the Great Dividing Range, with highest densities occurring in the north east of the state. It occurs from the coast to the snowline and inland to the Murray River (Edgar & Belcher 2002). A separate subspecies (<i>gracilis</i>) exists in northern Queensland (NSW NPWS 1999g). Habitat for this species is highly varied, ranging from sclerophyll forest, woodlands, coastal heathlands and rainforests. Records exist from open country, grazing lands and rocky outcrops (NSW NPWS 1999g). Suitable den sites including hollow logs, tree hollows, rocky outcrops or caves are necessary (NSW NPWS 1999g). Home range estimates for this highly mobile species vary between 800 hectares and 20 km ² . These home ranges are often defined by a number of 'latrines' (Edgar & Belcher 2002) which are often in exposed areas such as rocky outcrops. Breeding occurs generally between April and July (Edgar & Belcher 2002). This species feeds on a variety of species, ranging in size from small wallabies to insects and carrion (Edgar & Belcher 2002).	Potential habitat is present within the project area for this species. Further assessment is provided below.
koala <i>Phascolarctos cinereus</i>	V (TSC Act 1995)	The koala has a fragmented distribution throughout eastern Australia, with the majority of records from NSW occurring on the central and north coasts, as well as some areas further west (NSW NPWS 1999h). It is known to occur along inland rivers on the western side of the Great Dividing Range (NSW NPWS 1999h). This species inhabits eucalypt forest and woodland, with suitability influenced by tree species and age, soil fertility, climate, rainfall and fragmentation patterns (NSW NPWS 1999h). The species is known to feed on a large number of eucalypt and non-eucalypt species, however it tends to specialise on a small number in different areas (NSW NPWS 1999h). <i>Eucalyptus tereticornis</i> , <i>E. punctata</i> , <i>E. cypellocarpa</i> , <i>E. viminalis</i> , <i>E. microcorys</i> , <i>E. robusta</i> , <i>E. albens</i> , <i>E. camaldulensis</i> and <i>E. populnea</i> are some preferred species (NSW NPWS 1999h). Home ranges vary considerably according to habitat quality, with an average of 10 to 15 hectares in the Pilliga State Forest (north-western NSW) to an average of 80 to 90 hectares on the NSW lower North Coast at Port Stephens (NSW NPWS 2003c). Young are generally produced in summer, remaining with the mother for up to 3 years (NSW NPWS 1999h).	The project area is considered to contain potential koala habitat under SEPP 44. However no koalas or koala scats were recorded within the project area and no historical records of the koala exists within the project area. While up to 52 hectares of potential habitat will be lost as a result of the project, significant areas of alternative habitat will remain within the Mt Arthur Coal operations area. Therefore this species is not likely to be significantly affected by the project and further assessment is not required.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
parma wallaby <i>Macropus parma</i>	V (TSC Act 1995)	The parma wallaby occurs from the Watagan State Forest to the Richmond Range in north eastern NSW (Griffiths 2002). This species prefers habitat with a moist shrubby understorey and grassy patches where foes are scarce/absent (DEC 2006). The parma wallaby is generally a nocturnal species, feeding on grasses and herbs in open patches after dusk. This species shelters in dense low shrubs during the day (Strahan 1995). Breeding occurs from March to July, dependant upon the nutritional state of the female (Strahan 1995).	This species was recorded through predator scat analysis during surveys undertaken for the MAN EIS (URS 2000). Habitat suitable for the species was not identified within the project area. Further assessment is not required.
brush-tailed rock-wallaby <i>Petrogale penicillata</i>	E (TSC Act 1995)	The Brush-tailed Rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia (DEC 2006). Their distribution roughly followed the Great Dividing Range for 2500 kilometres from the Grampians in West Victoria to Nanango in south-east Queensland, with outlying populations in coastal valleys and ranges to the east of the Divide, and the slopes and plains as far west as Cobar in NSW and Injune (500km NW of Brisbane) in Queensland (DEC 2006).	The project area does not contain habitat suitable for this species. Further assessment is not required
squirrel glider <i>Petaurus norfolcensis</i>	V (TSC Act 1995)	The squirrel glider occupies a sparse range along the east coast and immediate inland districts from western Victoria to north Queensland (NSW NPWS 1999j). It generally inhabits dry sclerophyll forest and woodland, also being recorded from coastal and wet forests in the northern parts of NSW and Queensland (Suckling 2002). Preferred foraging habitat contains a regenerating understorey of eucalypts, wattles and flowering shrubs, allowing them to feed on arboreal invertebrates, eucalypt nectar, pollen and sap, and the seeds and gum of acacia species (NSW Scientific Committee 2000). Winter flowering species such as red ironbark, spotted gum and coastal banksia are particularly important when other food sources are limited. Family groups den in tree hollows, particularly in smooth-barked species (NSW NPWS 1999j). Home ranges vary between 0.65 and 8.55 hectares (NSW NPWS 1999j), and a number of hollows will be used in rotation. Births occur throughout the year, and can vary according to food availability (NSW NPWSj).	This species has been recorded widely across Mt Arthur Coal and was recorded along Saddlers Creek during surveys conducted for the project. Further Assessment is provided below.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
grey-headed flying-fox <i>Pteropus poliocephalus</i>	V (TSC Act 1995) V (EPBC Act 1999)	This species has been recorded along the eastern coastal plain from Bundaberg in Queensland, through NSW and south to eastern Victoria. They have been recorded from Melbourne, some occurring west to Warnambool (NSW Scientific Committee 2001c). Regular movements are made over the Great Dividing Range to the western slopes of NSW and Queensland. The species feeds on a variety of flowering and fruiting plants, including native figs and palms, blossoms from eucalypts, angophoras, tea-trees and banksias (Tidemann 2002). It plays an important role in seed dispersal (NSW NPWS 2001). Camps sites are usually formed in gullies, usually in vegetation with a dense canopy and not far from water (Tidemann 2002). Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring (NSW Scientific Committee 2001c). Most births occur in September or October (Churchill 1998).	Recorded at Mt Arthur Coal during survey work for the Underground Project (Umwelt in prep) and during pre-clearing surveys at Mt Arthur (Umwelt 2005). This species is likely to use the habitat within the project area. Further assessment is provided below.
eastern freetail-bat <i>Mormopterus norfolkensis</i>	V (TSC Act 1995)	This species has a distribution along the east coast of NSW from south of Sydney north into south east QLD, near Brisbane (Churchill 1998). Most records are from dry eucalypt forest and woodland east of the Great Dividing Range. The species has also been recorded over a rocky river in rainforest and wet sclerophyll forest (Churchill 1998). Generally only solitary animals are recorded (Allison & Hoyer 2002). This species generally roosts in tree hollows, however, it has been recorded from roofs, under bark and the metal caps of telegraph poles (Churchill 1998). It generally forages above the forest canopy, over water and also on the ground.	Recorded at Mt Arthur Coal for the Mt Arthur Coal Underground Project (Umwelt in prep). This species is likely to occur in the project area and further assessment is provided below.
eastern bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	V (TSC Act 1995) Conservation Dependant EPBC Act	This species has an eastern distribution from Cape York along the coastal side of the Great Dividing Range and into the southern tip of South Australia (Churchill 1998). Habitat ranges widely, from rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grasslands (Churchill 1998). It is cave-dwelling, congregating in maternity caves for breeding and later dispersing to satellite caves, generally within 300 kilometres (Churchill 1998). It hibernates over winter in southern parts of their range (Churchill 1998). They have been recorded roosting in a variety of man-made structures including buildings and culverts (Dwyer 2002b). A single young is born in December (Churchill 1998).	This species is known to occur within the Mt Arthur Coal area and was recorded within the project area. Further assessment is provided below.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V TSC Act	This species has a range from south eastern Queensland, through NSW, Victoria and into Tasmania (Churchill 1998). Habitat includes sclerophyll forest from the Great Dividing Range to the coast. They appear to prefer wet habitats, with trees over 20 metres high (Churchill 1998). They generally roost in tree hollows or trunks, in groups of 6 – 36. Occasionally recorded from caves or buildings (Churchill 1998). The species appears to hibernate over winter in southern parts (DEC 2006). A single young is born in December (Churchill 1998).	Potential habitat was identified within the project area for this species. Further assessment is provided below.
greater broad-nosed bat <i>Scoteanax rueppellii</i>	V TSC Act	The greater broad-nosed bat appears to prefer moist environments such as moist gullies in coastal forests, or rainforest (Churchill 1998). They have also been found in gullies associated with wet and dry sclerophyll forests and open woodland (Churchill 1998). The greater broad-nosed bat roost in hollows in tree trunks and branches and has also been found to roost in the roofs of old buildings (Churchill 1998). Females congregate in maternity colonies in suitable trees prior to young being born in January (DEC 2006, Churchill 1998).	Potential habitat was identified within the project area for this species. Further assessment is provided below.
yellow-bellied sheath-tail bat <i>Saccolaimus flaviventris</i>	V TSC Act	The Yellow-bellied sheath-tail bat is wide ranging throughout tropical Australia, with records extending into south eastern areas (Churchill 1998). This species has been recorded from a wide variety of habitats, from wet and dry sclerophyll forest, open woodland, acacia shrubland, mallee, grasslands and deserts (Churchill 1998). In eucalypt forests, this species forages above the canopy, however ventures closer to the ground when in open country (DEC 2006). This species is generally solitary, however may form small groups around spring (Churchill 1998). Roosting is generally recorded from tree hollows. A single young is born between December and March (Churchill 1998).	This species has been recorded previously in the A171 area at Mt Arthur Coal (near Thomas Mitchell Drive) (Umwelt 2000). This species is expected to occur in the project area and further assessment is provided below.
large-footed myotis <i>Myotis adversus</i>	V TSC Act	The Large-footed myotis is a coastal species, ranging from the Kimberley to South Australia (Churchill 1998). This species will occur in most habitat types providing they are near to water (DEC 2006). This species is commonly cave-dwelling, however roosting has been recorded from tree hollows, dense vegetation, bridges, mines and constructed drains (Churchill 1998). When breeding, this species may roost in small groups, with males defending a territory and a harem of females (DEC 2006). A single young is born in November – December (Churchill 1998).	This species was recorded in the project area. Further assessment is provided below.

Table 2 - Threatened Fauna Assessment (cont)

Species	Legal Status	Specific Habitat	Potential to Occur
eastern cave bat <i>Vespadelus</i> <i>troughtoni</i>	V TSC Act	The eastern cave bat inhabits wet sclerophyll forest and tropical mixed woodland from the coast to the dividing range. They also extend into drier forests of the western slopes and inland areas (Churchill 1998). The eastern cave bat is generally found in reasonably well-lit areas in stone overhang caves, boulder piles, mine tunnels and buildings (Churchill 1998). This species will roost in small avons or domes in the roof of caves and also cracks and crevices (Churchill 1998). Colonies of this species have been found to consist of single sex and an equal mix of male and female. The single sex colonies ranged from 6 to 50 individuals, while an equal sex-ratio colony was comprised of approximately 500 individuals (Churchill 1998).	This species was recorded in the project area. Further assessment is provided below.
large-eared pied bat <i>Chalinolobus dwyeri</i>	V TSC Act V EPBC Act	This species has a distribution from south western Queensland to NSW from the coast to the western slopes of the Great Dividing Range (Churchill 1998). It is generally found in a variety of drier habitats, including dry sclerophyll forests and woodlands, however, it probably tolerates a wide range of habitats (Hoye & Dwyer 2002). The species tends to roost in the twilight zones of mines and caves, generally in colonies or common groups (Churchill 1998). Females give birth (generally to twins) in November (Churchill 1998).	Potential habitat was identified within the project area for this species. Further assessment is provided below.

Notes: EPBC Act = Commonwealth Environment Protection and Biodiversity Conservation Act 1999
TSC Act = NSW Threatened Species Conservation Act 1995
V = vulnerable
E = endangered

3.0 ASSESSMENT OF SIGNIFICANCE UNDER THE THREATENED SPECIES CONSERVATION ACT 1995

Under Part 3A of the Environmental Planning and Assessment Act 1979, Section 5A of the Act relating to impacts on threatened species is not applicable. Part 3A does, however, require an assessment of significance relating to impacts on threatened species. An assessment that applies the key aspects of the Section 5A assessment that are relevant at regional and State levels has therefore been cited for this period.

Three threatened flora species and 16 threatened fauna species listed under the TSC Act have been recorded or are considered likely to occur in the project area. The threatened fauna species recorded during surveys include the squirrel glider (*Petaurus norfolcensis*), and three microchiropteran bats; the eastern bentwing-bat (*Miniopterus schreibersii*), large-footed myotis (*Myotis adversus*) and the eastern cave bat (*Vespadelus troughtoni*).

3.1 THREATENED SPECIES RECORDED IN THE PROJECT AREA

1. Squirrel glider – *Petaurus norfolcensis*

The squirrel glider (*Petaurus norfolcensis*) is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria (DEC 2006). This species generally inhabits dry sclerophyll forest and woodland, also being recorded from coastal and wet forests in the northern parts of NSW and Queensland (Suckling 2002). Preferred foraging habitat contains a regenerating understorey of eucalypts, wattles and flowering shrubs, allowing them to feed on arboreal invertebrates, eucalypt nectar, pollen and sap, and the seeds and gum of acacia species (NSW Scientific Committee 2000). Winter flowering species such as red ironbark (*Eucalyptus fibrosa*), spotted gum (*Corymbia maculata*) and coast banksia (*Banksia integrifolia*) are particularly important when other food sources are limited. Family groups den in tree hollows, particularly in smooth-barked species (NSW NPWS 1999). Home ranges vary between 0.65 and 8.55 hectares (NSW NPWS 1999). This species nests in bowl-shaped, leaf lined nests in tree hollows. They live in family groups of a single adult male one or more adult females and offspring, and require abundant tree hollows for refuge and nest sites (DEC 2006). Births occur throughout the year, and can vary according to food availability (NSW NPWS). Diet varies seasonally and consists of *Acacia* gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The squirrel glider was not recorded within the proposed disturbance area; however the species was recorded in the project area at Saddlers Creek and is known to occur widely across the Mt Arthur Coal operations area. The species is likely to occur in the disturbance area. Up to approximately 52 hectares of woodland will be removed by the extension of South Pit. Due to the mobile nature of this species and the presence of extensive areas of similar habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place the locally occurring squirrel glider population at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

There are a large number of records of this species from the Hunter Valley, however most of these records are from coastal or near-coastal areas. Records of this species from the floor of the Upper Hunter region are not common. There are a number of records of this species from fringing conservation reserves, particularly from Yengo and Wollemi National Parks and the species is known to occur in conserved habitats at Mt Owen Mine, approximately 20 km from the project area.

It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species. The habitats to be removed by the project occur within a highly fragmented landscape, modified extensively by mining activities. Saddlers Creek will not be impacted under the proposal and therefore an extensive area of habitat that is recognised as an important regional corridor will remain intact for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There is one record of the squirrel glider (*Petaurus norfolcensis*) in both Goulburn River National Park and Mount Royal National Park (DEC website 2006), while there are 14 records for Wollemi National Park (NPWS Wildlife Atlas Database 2006).

Although present within three of the larger national parks within the region, the number of recorded sightings of the squirrel glider is very low. As such, it is not considered that this species is adequately protected within conservation reserves in the region.

d) *Whether the species is at the limit of its known distribution.*

The squirrel glider (*Petaurus norfolcensis*) is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria (DEC 2006). This species generally inhabits dry sclerophyll forest and woodland, also being recorded from coastal and wet forests in the northern parts of NSW and Queensland (Suckling 2002). The species is not at the limit of its distribution in the project area.

2. Eastern bentwing-bat – *Miniopterus schreibersii oceanensis*

This species has an eastern distribution from Cape York along the coastal side of the Great Dividing Range, and into the southern tip of South Australia (Churchill 1998). Habitat varies widely, from rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grasslands (Churchill 1998). It is generally a cave-dwelling species, congregating in maternity caves with very specific temperature and humidity ranges (DEC 2006). During the non-breeding season, this species will disperse to satellite caves, generally within 300 kilometres (Churchill 1998). Breeding or roosting colonies can number from 100 to 150,000 individuals (DEC 2006). The eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) hibernates over winter in the southern parts of its range (Churchill 1998). It has been recorded roosting in a variety of man-made structures including buildings and culverts (Dwyer 2002b), as well as derelict mines and storm-water tunnels. A single young is born in December (Churchill 1998). The species hunts in forested areas, catching moths and other flying insects above the tree tops.

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) was recorded at three locations during the fauna survey, with one record within the new disturbance footprint and two records from along Saddlers Creek. The species has also been previously recorded

within the Mt Arthur Coal operations area. Up to approximately 52 hectares of woodland foraging habitat will be removed by the extension of south pit. The project area is not expected to provide roosting or breeding habitat for this species. Due to the highly mobile nature of this species and the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place the locally occurring eastern bentwing-bat population at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

There is a large concentration of records of this species in the coastal areas of the Hunter Valley. Most of these records are from the Newcastle area. Records also exist further up the Valley; however the number of these records diminishes further to the west.

The highly mobile nature of this species is likely to offset any impacts from increased isolation as a result of the project. The species is not expected to be significantly impacted by habitat modification as a result of the project.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There has been one record of the eastern bentwing bat (*Miniopterus schreibersii oceanensis*) occurring within Goulburn River National Park, 14 records of this species within Wollemi National Park, and one record in Manobalai Nature Reserve (DEC website 2006).

Despite there being several records of the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) within conservation reserves in the region, available habitat for this species has drastically declined due to high rates of land clearance and degradation through mining and agricultural activities. As such, it is not considered that this species is adequately protected within conservation reserves in the region.

d) *Whether the species is at the limit of its known distribution.*

This species has an eastern distribution from Cape York along the coastal side of the Great Dividing Range, and into the southern tip of South Australia (Churchill 1998). The record of this species within the project area is approaching the western edge of the known distribution for this species.

3. Large-footed myotis – *Myotis adversus*

The large-footed myotis is a coastal species, ranging from the Kimberley to South Australia (Churchill 1998). It is rarely found more than 100 km inland, except along major rivers (DEC 2006). It will occur in most habitat types providing they are near to water (Richards 1995b). It will forage over streams and pools catching insects and small fish by raking their feet across the water surface (DEC 2006). This species is commonly cave-dwelling in groups of 10 to 15, however it is also recorded from tree hollows, dense vegetation, bridges, mines and drains (Churchill 1998). When breeding, it roosts in small groups, with males defending a territory and a harem of females (Richards 1995b). A single young is born in November through to December (Churchill 1998).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The large-footed myotis (*Myotis adversus*) was recorded along Saddlers Creek, but not within the proposed disturbance area. Saddlers Creek is expected to provide preferred habitat for this species in relation to the project area. Woodland communities and farm dams within the project area are expected to provide potential foraging habitat, however the new disturbance area is not expected to provide a significant area of roosting or breeding habitat for this predominantly cave roosting species.

The project will clear up to approximately 52 hectares of woodland habitat, due to the extension of south pit. Due to the highly mobile nature of this species and the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place the locally occurring large-footed myotis population at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The majority of records of this species are from the Hunter Valley from coastal regions, surrounding Newcastle and Raymond Terrace. There are a small number of records from the Ravensworth area, in the central Hunter Valley.

The highly mobile nature of this species is likely to offset any impacts from increased isolation as a result of the project. The species is not expected to be significantly impacted by habitat modification as a result of the project.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are two records of the large-footed myotis (*Myotis adversus*) occurring within Wollemi National Park (DEC website 2006). Given that this species has only been recorded within one conservation reserve within the region, it is not considered that this species is adequately protected.

d) *Whether the species is at the limit of its known distribution.*

The large-footed myotis is predominantly a coastal species, ranging from the Kimberley to South Australia (Churchill 1998). It is rarely found more than 100 km inland, except along major rivers (DEC 2006). It will occur in most habitat types providing they are near to water (Richards 1995b). The records of this species within the project area are likely to occur close to the westerly extent of the known distribution of this species.

4. Eastern cave bat – *Vespadelus troughtoni*

The eastern cave bat has been recorded in a broad band along eastern Australia on both sides of the Great Dividing Range, from Cape York to Kempsey (Churchill 1998). There are additional records of this species from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT (DEC 2006). This cave roosting species is known from dryer forests and tropical woodlands from the coastal zone and Great Dividing Range to the semi-arid zone (DEC 2006). It is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals (DEC 2006). It is occasionally recorded roosting in buildings (DEC 2006). The species is occasionally found along cliff-lines in wet eucalypt forest and rainforest. Roost sites are frequently in well-lit areas. Little further is

known about the species biology, its feeding or breeding requirements or behaviour (DEC 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The eastern cave bat (*Vespadelus troughtoni*) was recorded within the project area along Saddlers Creek on two occasions. The species was not recorded in the proposed disturbance area however, woodland communities within the disturbance area are expected to provide foraging habitat. The new disturbance area is not expected to provide a significant area of roosting or breeding habitat for this predominantly cave roosting species.

The project will clear up to approximately 52 hectares of woodland habitat, due to the extension of south pit, however this is not expected to significantly impact this species. Due to the highly mobile nature of this species and the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place the locally occurring eastern cave bat population at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

There are very few records of this species from New South Wales, with most concentrated in the north eastern corner of the state. There are a small number of records from the Hunter Valley, these coming from the western parts of Goulburn River National Park, and Manobalai Nature Reserve.

The highly mobile nature of this species is likely to offset any impacts from increased isolation as a result of the project and the species is not expected to be significantly impacted as a result of habitat modification.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are ten records of the eastern cave bat (*Vespadelus troughtoni*) within Goulburn River National Park (DEC website 2006), one record within both Manobalai Nature Reserve and Wollemi National Park (DEC website 2006).

Despite the eastern cave bat being recorded within three of the larger conservation reserves in the region, available habitat for this species has drastically declined due to high rates of land clearance and degradation through mining and agricultural activities. As such, it is not considered that this species is adequately protected within conservation reserves in the region.

d) *Whether the species is at the limit of its known distribution.*

This species has been recorded in a broad band along eastern Australia on both sides of the Great Dividing Range, from Cape York to Kempsey (Churchill 1998). There are additional records of this species from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT (DEC 2006). The records of this species within the project area represent one of the few scattered records of this species within NSW. This record forms part of a small, isolated cluster of records covering parts of Wollemi and Goulburn River National Parks, and surrounding areas.

3.2 THREATENED SPECIES CONSIDERED TO POTENTIALLY OCCUR IN THE PROJECT AREA

5. *Diuris tricolor*

Diuris tricolor is a terrestrial herb flowering September to November (Jones 1993b). *Diuris tricolor* grows in sclerophyll forest among grass and is often found with *Callitris* (Jones 1993b). *Diuris tricolor* has been recorded on the Northern and Central Tablelands and Slopes (Jones 1993b). It is found in sandy soils, either on flats or small rises. This species has also been recorded from red earth soil in a bumble box (*Eucalyptus populnea*) community in western NSW (DEC 2006). This species is sporadically distributed on the western slopes of NSW, extending from south of Narrandera to the far north of NSW. Localities include the Condobolin-Nymagee Road, Wattamondara towards Cowra, Cooyal, Adelong, Red Hill north of Narrandera, Coolamon, near Darlington Point, Eugowra, Girilambone, Dubbo, Muswellbrook, and several sites west of Wagga Wagga (DEC 2006). The Muswellbrook local government area is the eastern limit of the species range and the only recorded occurrence of *D. tricolor* in the Sydney Basin Bioregion (Australia's Virtual Herbarium 2006). The *D. tricolor* population in Muswellbrook appears to be an isolated population and therefore this population may be genetically distinct. The species is considered likely to have declined in recent years and is threatened by the spread of invasive, exotic grasses, such as Coolatai grass (*Hyparrhenia hirta*) (Peake 2005).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

Diuris tricolor was not recorded within the project area; however this species is known to occur in open woodland within the Mt Arthur Coal operations area. The project area will clear up to approximately 52 hectares of woodland due to the extension of south pit. Due to the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of *Diuris tricolor* at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

There are only a small number of records of this species from the Hunter Valley, with the majority of these records being from a small cluster around Muswellbrook. An outlying record exists from south of Gungahlin. It is unlikely that the south pit project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

Diuris tricolor has been recorded as being present within a conservation reserve(s) within the region (Briggs and Leigh 1995), however there are no records stating which reserve(s) the species occurs in. Given the lack of records available, the specific habitat requirements of this species, the extensive disturbance of habitat from mining and agricultural practices within the region, it is not considered that this species is adequately represented within conservation reserves.

d) *Whether the species is at the limit of its known distribution.*

This species is sporadically distributed on the western slopes of NSW, extending from south of Narrandera to the far north of NSW. Localities include the Condobolin-Nymagee road, Wattamondara towards Cowra, Cooyal, Adelong, Red Hill north of Narrandera, Coolamon, near Darlington Point, Eugowra, Girilambone, Dubbo, Muswellbrook, and several sites west of Wagga Wagga (DEC 2006). The Muswellbrook local government area is the eastern limit of the species range and the only recorded occurrence of *D. tricolor* in the Sydney Basin Bioregion (DEC 2006). The Mt Arthur Coal operations area is likely to be at, or approaching, the eastern limit of the known distribution of this species.

6. *Goodenia macbarronii*

Goodenia macbarronii is a small, annual herb to 30 cm high with peak flowering time occurring October to March (Carolin 1992). *Goodenia macbarronii* grows in damp sandy soils in seepages. The species is usually found in shaded, seasonally damp sites in clay-loam, sandy-loam and sandy soils. Habitats in NSW include a recently graded roadside drain adjacent to narrow-leaved ironbark (*Eucalyptus crebra*) and white cypress pine (*Callitris glaucophylla*) woodland, dry eucalypt forest with low shrubby undergrowth in sandy soil, damp sandy patches in bushland areas, along roadsides, near water in a shallow excavation which has exposed the clay subsoil, on the banks of a sandy creek and in Blakely's red gum (*Eucalyptus blakelyi*) and rough-barked apple (*Angophora floribunda*) woodland (DEC 2006). Sites often have some form of recent disturbance, such as depressions made by grading and excavation along roadsides. Other sites include grazed paddocks and clearings with a large proportion of weed and exotic species, and cleared open grazing land which was formerly eucalypt woodland (DEC 2006). This species grows on the western slopes of the Great Dividing Range in NSW, south from the Guyra and Inverell districts. It is widely distributed throughout the tablelands, western slopes and western plains. The species also occurs in north-eastern Victoria and the Darling Downs in Queensland (DEC 2006). In NSW it has been recorded at Tingha, Guyra, the Warrumbungle Ranges, east of Rylstone, the Pilliga and Denobollie State Forests, the Narrabri, Coonabarabran, Torrington and Tocumwal districts, Grenfell, Weddin Mountain, Gungahlin, the Milthorpe district, and Holbrook (the Type locality) (DEC 2006). In the Hunter Valley, the species is only known to occur in the Wybong district where several sub-populations have been recorded (Peake 2005).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

Goodenia macbarronii was not recorded at the site however it is considered that it may potentially occur. Due to the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of *Goodenia macbarronii* at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

There are only a small number of records of this species from the Hunter Valley, with the majority of these being located in the large vegetation remnant containing Manobalai Nature Reserve. It is unlikely that the south pit project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

Goodenia macbarronii has been recorded as being present within a conservation reserve(s) within the region (Briggs and Leigh 1995), however there are no records stating which reserve(s) the species occurs in. Given the lack of records available, in addition to the extensive disturbance of potential habitat for this species as a result of mining and agricultural practices within the region, it is not considered that this species is adequately represented within conservation reserves.

d) Whether the species is at the limit of its known distribution.

This species grows on the western slopes of the Great Dividing Range in NSW, south from the Guyra and Inverell districts. It is widely distributed throughout the tablelands, western slopes and western plains. In the Hunter Valley, the species is only known to occur in the Wybong district where several sub-populations have been recorded (Peake 2005). Any occurrences of this species within the Mt Arthur Coal operations area are likely to be approaching the eastern limit of this species in the Hunter Valley.

7. Toadflax - *Thesium australe*

Toadflax (*Thesium australe*) is a small, straggling herb to 40 cm tall (DEC 2006), flowering in spring. This species is often hidden amongst grasses and herbs and is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia (DEC 2006). Recorded habitat for this species is either grassland or grassy woodland, and it is often found in damp sites in association with kangaroo grass (*Themeda australis*).

a) Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

Toadflax (*Thesium australe*) was not recorded at the site however it is considered that potential habitat may occur. Due to the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of *Thesium australe* at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

Toadflax (*Thesium australe*) was not identified during flora surveys. The project area does not contain a significant area of known habitat for this species, and it is considered unlikely that this species is present within the project area, despite the identification of suitable habitat.

A significant area of known habitat for this species will not be modified or removed, or isolated from currently interconnecting or proximate areas as a result of the project.

Records of this species in New South Wales are mainly from the north east and south east corners of the state. Within the Hunter Valley region, a small number of records exist from the Cassilis and Blackville areas.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

There are no records of toadflax (*Thesium australe*) documented for any of the nine conservation reserves identified within the region surrounding the project area. As such, it is

not considered that this species is adequately represented in conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia (DEC 2006). A record of this species from the project area would represent one of the few records from the Hunter Valley, and would be the easternmost record of this species in the Hunter Valley, however not in New South Wales.

8. Green and golden bell frog – *Litoria aurea*

The green and golden bell frog occurs in eastern and south-eastern NSW to far eastern Victoria, largely at low altitudes (Cogger 2000). Once widespread, it is now restricted to isolated coastal populations, and occurs among vegetation in permanent water bodies such as streams, swamps, lagoons, dams and ponds (Cogger 2000), particularly where bullrush (*Typha* spp.) and spikerush (*Elaeocharis* spp.) occur (NPWS 1999r). Green and golden bell frogs are known to occur in degraded water bodies such as brick-pits and industrial sites (NPWS 1999r). Breeding occurs in summer and tadpoles feed on vegetation including algae, while adults forage for insects and other frogs (NPWS 1999r). This species is known to be cannibalistic (Cogger 2000).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The green and golden bell frog (*Litoria aurea*) was not recorded at the site however it is considered that potential habitat may occur. Due to the presence of farm dams adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of *Litoria aurea* at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The green and golden bell frog (*Litoria aurea*) was not identified during fauna surveys. The project area does not contain a significant area of known habitat for this species, and it is considered unlikely that this species is present within the project area, despite the identification of suitable habitat.

A significant area of known habitat for this species will not be modified or removed, or isolated from currently interconnecting or proximate areas as a result of the project.

Records of this species in New South Wales are consistent along the east coast of the state. Within the Hunter Valley region, a small number of records exist from the Muswellbrook and Kurri Kurri areas.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are no records of the green and golden bell frog (*Litoria aurea*) documented for any of the nine conservation reserves identified within the region surrounding the project area. As such, it is not considered that this species is adequately represented in conservation reserves within the region.

d) Whether the species is at the limit of its known distribution.

This species is formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria where it extends into east Gippsland (DEC 2006). There are records from west to Bathurst, Tumut and the ACT region (DEC 2006). Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population) (DEC 2006). There is only one known population on the NSW Southern Tablelands. The project area is not located at the limit of this species known distribution.

9. Gang-gang Cockatoo – *Callocephalon fimbriatum*

In summer, the gang-gang cockatoo occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (Frith 1969). The species may also occur in sub-alpine snow gum *Eucalyptus pauciflora* woodland and occasionally in temperate rainforests (Forshaw 1989). In winter, the gang-gang cockatoo occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (Shields and Crome 1992).

a) Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

The gang-gang cockatoo (*Callocephalon fimbriatum*) was not identified within the project area, despite targeted surveys. It is considered that a viable population of this species could be present within the project area due to the potential habitat available for this species. The project will result in the loss of up to approximately 52 hectares of woodland habitat due to the extension of South Pit. Due to the presence of similar quality habitat adjacent to the site as well as in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the gang-gang cockatoo at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

The gang-gang cockatoo (*Callocephalon fimbriatum*) was not identified during fauna surveys. The project area does not contain a significant area of known habitat for this species, and it is considered unlikely that this species is present within the project area, despite the identification of suitable habitat.

A significant area of known habitat for this species will not be modified or removed, or isolated from currently interconnecting or proximate areas as a result of the project.

Records of this species in New South Wales are mainly from the south east corner of the state. Within the Hunter Valley region, a small number of records exist from the Cessnock and Singleton areas.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

There are two records of the gang-gang cockatoo from Goulburn River National Park, one record from Barrington Tops National Park, 62 records from Yengo National Park and 190 records from Wollemi National Park. As such, it may be considered that this species is adequately represented in conservation reserves within the region.

d) Whether the species is at the limit of its known distribution.

The Gang-gang Cockatoo is distributed from southern Victoria through south and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. The project area is not located at the limit of this species known distribution.

10. Grey-crowned babbler – *Pomatostomus temporalis temporalis*

The grey-crowned babbler (*Pomatostomus temporalis temporalis*) is found throughout parts of northern Australia and south-eastern Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay (DEC 2006). It is less common on the higher tablelands (NSW Scientific Committee 2001). It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW (DEC 2006). This species inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. They have been recorded from open forest and woodland, acacia scrubland and adjoining open areas (Garnett & Crowley 2000). This species is highly susceptible to habitat fragmentation (Garnett & Crowley 2000), as birds are generally unable to cross large open areas (DEC 2006). This species lives in sedentary family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging (DEC 2006). The species feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses (DEC 2006). This species will build and maintain several conspicuous, dome-shaped stick nests, which are used as dormitories for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones (DEC 2006). This species breeds between July and February. Young birds are fed by all members of the group (DEC 2006). Territories range from one to fifty hectares (usually around ten hectares) and are defended all year (DEC 2006).

a) Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

The project area provides known potential habitat for this species, with a number of characteristic nests recorded to the south of the project area along Saddlers Creek. The species has previously been recorded within the Mt Arthur Coal operation area. It is considered that a small population of this species exists, as annual ecological monitoring of Mt Arthur Coal operations has identified the species irregularly. The lack of conspicuous stick nests indicates that a family group of the species is not currently utilising the habitats of the project area.

The project will result in the loss of up to approximately 52 hectares of woodland habitat due to the extension of south pit. This habitat loss is not expected to significantly impact this species. Due to the highly mobile nature of this species and the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place the locally occurring grey-crowned babbler population at risk of extinction.

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- b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.**

There are a large number of records of this species from the Hunter Valley. The majority of these records are from the valley floor, with some records from the fringing National Parks such as Wollemi and Goulburn River. Significant areas of potential habitat occur within the Mt Arthur Coal operations area. The species is not expected to be significantly impacted as a result of further habitat modification and isolation as a result of the project.

- c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.**

There are two records of the grey-crowned babbler documented for Goulburn River National Park and four records of this species within Wollemi National Park (DEC website 2006). Although present within two of the larger national parks within the region, the number of recorded sightings of the grey-crowned babbler (*Pomatostomus temporalis temporalis*) is very low. As such, it is not considered that the species is adequately protected within conservation reserves in the region.

- d) Whether the species is at the limit of its known distribution.**

In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay (DEC 2006). It is less common on the higher tablelands (NSW Scientific Committee 2001). It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW (DEC 2006). The records of this species within the project area do not represent an extension to the known distribution of this species, within the Hunter Valley, or New South Wales.

11. Turquoise parrot – *Neophema pulchella*

The turquoise parrot's (*Neophema pulchella*) range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range (DEC 2006). The turquoise parrot occupies a variety of habitats, primarily eucalypt woodland and open forest near open water and forested hills. The species is also found in coastal heath, pasture, roadsides and orchards (Pizzey & Knight 1997). Habitat typically has a dense ground cover and a low understorey of shrubs (NPWS 1999). The species feeds primarily on seeds, but may also utilise flowers, nectar, fruits, leaves and scale insects (NPWS 1999). This species is known to forage in white box (*Eucalyptus albens*), yellow box (*Eucalyptus meliodora*), Blakely's red gum (*Eucalyptus blakelyi*), *Leucopogon microphyllus*, *Dillwynia* spp., and the introduced sea barley grass (*Hordeum marinum*), saffron thistle (*Carthamnus lanatus*) and small nettle (*Urtica urens*) (NPWS 1999). Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter (DEC 2006). Breeds August to December and April to May (Pizzey & Knight). The nest is built in a hollow of a small tree, a stump, fence post or even a hollow log on the ground.

- a) Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.**

The turquoise parrot was not recorded at the site; however the species has previously been tentatively recorded within the Mt Arthur Coal operations area during field surveys conducted for the Bayswater No 3 EIS (Resource Planning 1993). Up to approximately 52 hectares of

woodland will be cleared due to the extension of south pit. Due to the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the turquoise parrot at risk of extinction.

- b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.***

There are not a large number of records of this species from the Hunter Valley, however there are a small number from the valley floor (DEC 2006). The majority of records of this species from the region are from the large, heavily vegetated conservation reserves such as Goulburn River and Wollemi National Parks (DEC 2006).

While a small area of potential habitat will be removed, the generalist nature of the habitat requirements of this species suggests that there will not be a significant loss of known foraging and potential nesting habitat to those turquoise parrots in the Mt Arthur Coal operations area and region. This impact is not likely to disrupt the life cycle of this species, such that a viable population is likely to be placed at risk of extinction.

- c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.***

The Goulburn River National Park has 15 recordings of the turquoise parrot (*Neophema pulchella*), while Wollemi National Park has 46 records (NPWS Wildlife Atlas Database 2006).

Despite there being several records of the turquoise parrot (*Neophema pulchella*) within conservation reserves in the region, available habitat for this species has drastically declined due to high rates of land clearance and degradation through mining and agricultural activities. As such, it is not considered that this species or its habitat is adequately protected within conservation reserves in the region.

- d) *Whether the species is at the limit of its known distribution.***

The turquoise parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range (DEC 2006). The project area does not represent an extension to the known distribution of this species within the Hunter Valley, or within New South Wales.

12. Swift parrot – *Lathamus discolor*

The swift parrot breeds in Tasmania, migrating to the mainland in May to August, where it forages on flowering eucalypts mainly in Victoria and NSW (Swift Parrot Recovery Team 2001). In NSW, it has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW (Swift Parrot Recovery Team 2001). This species often visit box-ironbark forests, feeding on nectar and lerp (Garnett & Crowley 2000). In NSW, typical feed species include mugga ironbark, grey box, swamp mahogany, spotted gum, red bloodwood, narrow-leaved red ironbark, forest red gum and yellow box (Swift Parrot Recovery Team 2001). Of such species, larger trees bearing more flowers are selected.

- a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.***

The swift parrot was not recorded at the site; however potential habitat for this species is considered to occur. Up to approximately 52 hectares of woodland will be cleared due to the extension of south pit. Due to the highly mobile nature of this species and the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the swift parrot at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The swift parrot (*Lathamus discolor*) was not identified during fauna surveys. The project area does not contain a significant area of known habitat for this species, and it is considered unlikely that this species is present within the project area, despite the identification of suitable habitat.

A significant area of known habitat for this species will not be modified or removed, or isolated from currently interconnecting or proximate areas as a result of the project.

Records of this species in New South Wales are mainly from the south east corner of the state. Within the Hunter Valley region, a small number of records exist from the Cessnock area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are two records of the swift parrot (*Lathamus discolor*) documented within Wollemi National Park. As such, it is not considered that this species is adequately represented in conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

This species is found from Victoria and eastern parts of South Australia to south-east Queensland (DEC 2006). The project area is not located at the limit of this species known distribution.

13. Regent honeyeater – *Xanthomyza phrygia*

The regent honeyeater has a patchy distribution across the eastern states of Australia (NSW NPWS 1999n). This semi-nomadic species generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine *Casuarina* woodlands (NSW NPWS 1999n). An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills (Garnet & Crowley 2000). Breeding occurs between July and November. Known breeding sites are rare, with the most important sites being in the Warrumbungles NP, Pilliga NR, Barraba district, Gosford area, Hunter Valley and Capertee Valley (NSW NPWS 1999n).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The regent honeyeater was not recorded at the site; however potential habitat for this species is considered to occur. Up to approximately 52 hectares of woodland will be cleared due to the extension of south pit. Due to the presence of extensive areas of similar habitat

adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the regent honeyeater at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The regent honeyeater (*Xanthomyza phrygia*) was not identified during fauna surveys. The project area does not contain a significant area of known habitat for this species, and it is considered unlikely that this species is present within the project area, despite the identification of suitable habitat.

A significant area of known habitat for this species will not be modified or removed, or isolated from currently interconnecting or proximate areas as a result of the project.

Records of this species in New South Wales are mainly from the north east and south east corners of the state. Within the Hunter Valley region, a small number of records exist from the Muswellbrook, Singleton and Cessnock areas.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are 10 records of the swift parrot from Goulburn River National Park, three records from Yengo National Park and 38 records from Wollemi National Park. As such, it may be considered that this species is adequately represented in conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

This species is found between north-east Victoria and south-east Queensland. The project area is not located at the limit of this species known distribution.

14. Diamond firetail – *Stagonopleura guttata*

The diamond firetail (*Stagonopleura guttata*) is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. The species is not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW and is also found in the Australian Capital Territory, Queensland, Victoria and South Australia (DEC 2006). Habitat includes a range of eucalypt-dominated communities with a grassy understorey, including woodland, forest and mallee (Garnett & Crowley 2000). It appears that populations are unable to persist in areas where there are no vegetated remnants larger than 200ha (NSW Scientific Committee 2001). This species feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Diamond firetails (*Stagonopleura guttata*) are usually encountered in flocks of between five to 40 birds, occasionally more. Groups separate into small colonies to breed, between August and January. Birds roost in dense shrubs or in smaller nests built especially for roosting. This species appears to be sedentary, though some populations move locally, especially those from southern areas (DEC 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The diamond firetail was recorded during fauna surveys conducted for the Mt Arthur North EIS. This record was prior to the diamond firetail being listed as a threatened species. The project area provides potential habitat for this species. The project will result in the loss of up to 52 hectares of potential habitat for this species. Due to the presence of extensive areas of similar habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the diamond firetail at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

This species has been recorded from a number of sites within the Hunter Valley. A number of these records are from Wollemi and Goulburn River National Parks, however there are also a number of records from the Muswellbrook area. It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

Three records of the diamond firetail (*Stagonopleura guttata*) have been documented within Goulburn River National Park, and 12 records are known for Wollemi National Park. Although present within two of the larger national parks within the region, the number of recorded sightings of the diamond firetail is very low. As such, it is not considered that this species is adequately protected within conservation reserves in the region.

d) *Whether the species is at the limit of its known distribution.*

The diamond firetail (*Stagonopleura guttata*) is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW. Also found in the Australian Capital Territory, Queensland, Victoria and South Australia (DEC 2006). The project area is not located at the limit of the species distribution.

15. Masked owl – *Tyto novaehollandiae*

The masked owl occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea (Kavanagh 2002a). This species is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land (Kavanagh 2004). Home range estimates vary between 800 and 1200 hectares (Kavanagh 2002a). Masked owls nest (and roost) in large hollows of old trees. They also roost among dense foliage in variety of sub-canopy trees (Kavanagh 2004). *Tyto* species have a variable breeding season (likely to be in response to prey fluctuations), however, they are most likely to breed in autumn or winter (Kavanagh 2002a). Masked Owls commonly prey on small terrestrial and scansorial mammals, occasionally supplementing with diurnal birds (Kavanagh 2002b).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The masked owl (*Tyto novaehollandiae*) was not identified within the project area, despite targeted surveys. It is considered that a viable population of this species could be present within the project area due to the potential habitat available for this species. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the masked owl at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The masked owl (*Tyto novaehollandiae*) was not identified during fauna surveys. The project area does not contain a significant area of known habitat for this species, and it is considered unlikely that this species is present within the project area, despite the identification of suitable habitat.

A significant area of known habitat for this species will not be modified or removed, or isolated from currently interconnecting or proximate areas as a result of the project.

Records of this species in New South Wales are consistent along the east coast of the state. Within the Hunter Valley region, a small number of records exist from the Cessnock and Singleton areas.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are two records of the masked owl from Goulburn River National Park, eight records from Barrington Tops National Park, two records from Yengo National Park and three records from Wollemi National Park. Despite the masked owl being recorded from four conservation reserves in the region the number of records are quite low. As such, it is not considered that this species is adequately represented in conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

The masked owl extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. The project area is not located at the limit of the species distribution.

16. Barking owl – *Ninox connivens*

The barking owl is distributed sparsely throughout temperate and semi-arid areas of mainland Australia, however, it is most abundant in the tropical north (Kavanagh 2002a). Most records for this species occur west of the Great Dividing Range (Kavanagh 2004). Habitat for this species includes dry forests and woodlands (Kavanagh 2002a), often in association with hydrological features such as rivers and swamps (Taylor et al. 2002). Taylor et al. (2002) reports that not enough data has been collected to accurately estimate home range sizes, however, one has been radio-tracked over 226 ha. Large hollows are required for breeding. Barking owls are strictly seasonal breeders, laying in late winter or spring (NSW NPWS 2003). The species has a broad diet dominated by ground-dwelling mammals, birds and insects (Kavanagh 2002b).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The barking owl (*Ninox connivens*) was not identified within the project area, despite targeted surveys. It is considered that a viable population of this species could be present within the project area due to the potential habitat available for this species. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the presence of extensive areas of similar habitat adjacent to the site and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the barking owl at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The barking owl (*Ninox connivens*) was not identified during fauna surveys. The project area does not contain a significant area of known habitat for this species, and it is considered unlikely that this species is present within the project Area, despite the identification of suitable habitat.

A significant area of known habitat for this species will not be modified or removed, or isolated from currently interconnecting or proximate areas as a result of the project.

Records of this species in New South Wales are mainly from the south east and north west corners of the state. Within the Hunter Valley region, a small number of records exist from the Singleton and Cessnock areas.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are two records of the barking owl from Goulburn River National Park, one record from Barrington Tops National Park, three records from Yengo National Park and six records from Wollemi National Park. Despite the barking owl being recorded from four conservation reserves in the region the number of records are quite low. As such, it is not considered that this species is adequately represented in conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

The barking owl is found throughout Australia except for the central arid regions and Tasmania (DEC 2006). It is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution across NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains. It is rarely recorded in the far west or in coastal and escarpment forests (DEC 2006). The project area is not located at the limit of the species distribution.

17. Speckled warbler – *Pyrrholaemus sagittata*

The speckled warbler (*Pyrrholaemus sagittata*) has a distribution from south-eastern Queensland, through central and eastern NSW to Victoria. In NSW, this species occupies eucalypt and cypress woodlands, generally on the western slopes of the Great Dividing Range. It is rarely recorded from coastal areas (DEC 2006). They inhabit woodlands with a grassy understorey, leaf litter and shrub cover, often on ridges or gullies (Garnett & Crowley 2000). This species has also been recorded in cypress woodlands of the northern Riverina and in drier coastal areas such as the Cumberland Plain, Western Sydney and the Hunter and Snowy River valleys (NSW Scientific Committee 2001e). Typical habitat for this species

would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy (DEC 2006). The species is sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. Home ranges vary from 6-12 hectares (NSW Scientific Committee 2001). The nest is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter (DEC 2006). Breeding occurs between August and January, with cooperative breeding occasionally occurring (DEC 2006). Barrett et al. (1994) found that the species decreased in abundance as woodland area decreased, and it appears to be extinct in districts where no fragments larger than 100ha remain. Speckled warblers (*Pyrrholaemus sagittata*) often join mixed species feeding flocks in winter, with other species such as yellow-rumped thornbill (*Acanthiza chrysorrhoa*), buff-rumped thornbill (*Acanthiza reguloides*), brown thornbill (*Acanthiza pusilla*) and striated thornbill (*Acanthiza lineata*) (DEC 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The speckled warbler was not recorded during fauna surveys conducted for the project however the species has previously been recorded within the Mt Arthur Coal operations area. The project area provides potential habitat for this species. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the presence of extensive areas of similar habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the speckled warbler at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

There are a large number of records of this species from the Hunter Valley. There are a number of records from the valley floor, however the majority appear to be from the fringing Wollemi and Goulburn River National Parks, as well as the large vegetated remnants of the project area and nearby Manobalai Nature Reserve. It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

The speckled-warbler (*Pyrrholaemus sagittata*) has been recorded within several conservation reserves within the region. These are Goulburn River National Park (9 records), Wollemi National Park (16 records), Wingen Maid Nature Reserve (one record), Manobalai Nature Reserve (seven records) and Burning Mountain Nature Reserve (1 record) (DEC website 2006).

Despite there being several records of the speckled warbler (*Pyrrholaemus sagittata*) within conservation reserves in the region, available habitat for this species has drastically declined due to high rates of land clearance and degradation through mining and agricultural activities. As such, it is not considered that this species is adequately protected within conservation reserves in the region.

d) *Whether the species is at the limit of its known distribution.*

The speckled warbler (*Pyrrholaemus sagittata*) has a distribution from south-eastern Queensland, through central and eastern NSW to Victoria. In NSW, this species occupies eucalypt and cypress woodlands, generally on the western slopes of the Great Dividing

Range. It is rarely recorded from coastal areas (DEC 2006). The project area does not represent the limit of the species' known distribution.

18. Hooded robin (south east form) - *Melanodryas cucullata cucullata*

The hooded robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania (DEC 2006). The south-eastern form of the hooded robin (*Melanodryas cucullata cucullata*) is found from Brisbane to Adelaide throughout much of inland NSW, with the exception of the north-west. This form occurs throughout NSW except for the north-west, where it intergrades with the hooded robin northern form (*Melanodryas cucullata picata*) (NSW Scientific Committee 2001). This species prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Hooded robins (*Melanodryas cucullata cucullata*) require structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses (DEC 2006). They often perch on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey. It is considered a sedentary species, with relatively large home ranges (ranging from 10 hectares during the breeding season, to 30 hectares in the non-breeding season) but local seasonal movements are possible (DEC 2006). This species may breed any time between July and November, often rearing several broods (DEC 2006). Two females often cooperate in brooding (DEC 2006). Hooded robins (*Melanodryas cucullata cucullata*) appear unable to survive in remnants smaller than 100-200ha (NSW Scientific Committee 2001).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The hooded robin was not recorded during fauna surveys conducted for the project and the species has not previously been recorded within the Mt Arthur Coal operations area. The project area provides potential habitat for this species. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the presence of extensive areas of similar habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the speckled warbler at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

There are a number of records of this species within the Hunter Valley. These records come from along the valley floor, as well as from the adjoining National Parks along the southern side of the valley (Wollemi and Goulburn River). It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There has been one sighting of the hooded robin (*Melanodryas cucullata cucullata*) recorded for Goulburn River National Park, and two records within Wollemi National Park (DEC website 2006). Although present within two of the larger national parks within the region, the number of recorded sightings of the hooded robin is very low. As such, it is not considered that the species is adequately protected within conservation reserves in the region.

d) Whether the species is at the limit of its known distribution.

The hooded robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania (DEC 2006). The south-eastern form of the hooded robin (*Melanodryas cucullata cucullata*) is found from Brisbane to Adelaide throughout much of inland NSW, with the exception of the north-west. This form occurs throughout NSW except for the north-west, where it intergrades with the hooded robin northern form (*Melanodryas cucullata picata*) (NSW Scientific Committee 2001). The project area does not represent the limit of the known distribution of this species within the Hunter Valley, or New South Wales.

19. Brown treecreeper – *Climacteris picumnus victoriae*

The brown treecreeper (*Climacteris picumnus victoriae*) is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges (DEC 2006). The western boundary of the range of brown treecreeper (*Climacteris picumnus victoriae*) runs approximately through Wagga Wagga, Temora, Forbes, Dubbo and Inverell and along this line the subspecies intergrades with the arid zone subspecies of brown treecreeper (*Climacteris picumnus picumnus*) (DEC 2006). This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys (NSW Scientific Committee 2001). Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and river red gum (*Eucalyptus camaldulensis*) forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains (DEC 2006). This species is sedentary, territorial year-round, although some birds may disperse locally after breeding (DEC 2006). This species is gregarious and is usually observed in pairs or small groups of eight to 12 birds; it is active, noisy and conspicuous while foraging on trunks and branches of trees and amongst fallen timber. This species is known to spend more time foraging on the ground and fallen logs than other treecreepers (DEC 2006). Hollows in standing dead or live trees and tree stumps are essential for nesting. The species breeds in pairs or co-operatively in territories which range in size from 1.1 to 10.7 hectares (mean = 4.4 hectares). Each group is composed of a breeding pair with retained male offspring and, rarely, retained female offspring. Breeding can be cooperative in this species, with groups of two to five birds participating. This species is highly sensitive to habitat fragmentation, with disrupted dispersal due to habitat isolation being the primary threat (Walters et al. 1999). Major declines of this species have occurred in remnant vegetation fragments smaller than 300 hectares that have been isolated or fragmented for more than 50 years (DEC 2006).

a) Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

The brown treecreeper was not recorded during fauna surveys conducted for the project and the species has not previously been recorded within the Mt Arthur Coal operations area. The project area provides potential habitat for this species. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the presence of extensive areas of similar habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the brown treecreeper at risk of extinction.

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- b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.**

There are many records of this eastern subspecies across the Hunter Valley. Clusters of records of this species occur within the project area, nearby Manobalai Nature Reserve, Goulburn River National Park, Wollemi National Park and Weston (DEC 2006). It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

- c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.**

The brown treecreeper (*Climacteris picumnus victoriae*) has been recorded in four conservation reserves within the region. These are Goulburn River National Park (25 records), Wollemi National Park (18 records), Manobalai Nature Reserve (4 records) and Wingen Main Nature Reserve (1 record) (DEC website 2006).

Despite there being several records of the brown treecreeper (*Climacteris picumnus victoriae*) within conservation reserves in the region, available habitat for this species has drastically declined due to high rates of land clearance and degradation through mining and agricultural activities. As such, it is not considered that this species is adequately protected within conservation reserves in the region.

- d) Whether the species is at the limit of its known distribution.**

The western boundary of the range of the brown treecreeper (*Climacteris picumnus victoriae*) runs approximately through Wagga Wagga, Temora, Forbes, Dubbo and Inverell and along this line the subspecies intergrades with the arid zone subspecies of brown treecreeper (*Climacteris picumnus picumnus*) (DEC 2006). The project area does not represent the limit of the known distribution of this species.

20. Spotted-tailed quoll – *Dasyurus maculatus maculatus*

In NSW, the spotted-tailed quoll occurs on both sides of the Great Dividing Range, with highest densities occurring in the north east of the state. It occurs from the coast to the snowline and inland to the Murray River (Edgar & Belcher 2002). A separate subspecies (*gracilis*) exists in northern Queensland (NSW NPWS 1999g). Habitat for this species is highly varied, ranging from sclerophyll forest, woodlands, coastal heathlands and rainforests. Records exist from open country, grazing lands and rocky outcrops (NSW NPWS 1999g). Suitable den sites including hollow logs, tree hollows, rocky outcrops or caves are necessary (NSW NPWS 1999g). Home range estimates for this highly mobile species vary between 800 hectares and 20 km². These home ranges are often defined by a number of 'latrines' (Edgar & Belcher 2002) which are often in exposed areas such as rocky outcrops. Breeding occurs generally between April and July (Edgar & Belcher 2002). This species feeds on a variety of species, ranging in size from small wallabies to insects and carrion (Edgar & Belcher 2002).

- a) Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.**

The spotted-tailed quoll (*Dasyurus maculatus maculatus*) was not identified within the project area, despite targeted surveys. It is considered that a viable population of this species could be present within the project area due to the potential habitat available for this species. The

project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the highly mobile nature of this species and the presence of similar quality habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the spotted-tailed quoll at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The spotted-tailed quoll (*Dasyurus maculatus maculatus*) was not identified during fauna surveys. The project area does not contain a significant area of known habitat for this species, and it is considered unlikely that this species is present within the project area, despite the identification of suitable habitat.

A significant area of known habitat for this species will not be modified or removed, or isolated from currently interconnecting or proximate areas as a result of the project.

Records of this species in New South Wales are consistent along the east coast of the state. Within the Hunter Valley region, a small number of records exist from the Singleton and Cessnock areas.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are 33 records of the spotted-tailed quoll from Barrington Tops National Park, one record from Yengo National Park and five records from Wollemi National Park. Despite the spotted-tailed quoll being recorded from three conservation reserves in the region the number of records are quite low. As such, it is not considered that this species is adequately represented in conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

The range of the spotted-tailed quoll has contracted considerably since European settlement (DEC 2006). It is now found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. The project area does not represent the limit of the known distribution of this species.

21. Grey-headed flying-fox – *Pteropus poliocephalus*

This species has generally been recorded within 200 km of the eastern coast, from Bundaberg in Queensland, through NSW and south to eastern Victoria. It has been recorded from Melbourne, some occurring west to Warrnambool (NSW Scientific Committee 2001). Regular movements are made over the Great Dividing Range to the western slopes of NSW and Queensland. This species is known to occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops (DEC 2006). Grey-headed flying-foxes (*Pteropus poliocephalus*) feed on a variety of flowering and fruiting plants, including native figs and palms, blossoms from eucalypts, angophoras, tea-trees and banksias (Tidemann 2002). This species will travel up to 50 kilometres a night to forage (DEC 2006). It plays an important role in seed dispersal (NSW NPWS 2001). Camp sites are usually formed in gullies, usually in vegetation with a dense canopy and not far from water (Tidemann 2002). Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring (NSW Scientific Committee 2001). Single camps may have tens of thousands of animals. Most births occur in September or October (Churchill 1998).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The grey-headed flying-fox (*Pteropus poliocephalus*) was not recorded within the project area, however, potential foraging habitat for this species was identified. The project area does not provide habitat typical for camp sites. This highly mobile species is able to travel large distances daily, and likely to make use of habitat within a number of vegetated areas within the region. It is considered that there is not a local viable population of this species centred within the project area. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the highly mobile nature of the species and the presence of similar quality habitat adjacent to the project area as well as in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the grey-headed flying-fox at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The majority of the records for this species within the Hunter Valley are from coastal or near-coastal regions. There is only one record of this species to the west of Singleton, this being from near Coolah. The distribution of this species shows a strong affinity to area east of Singleton, and it is possible that the rare records to the west of this area may be a result of this species following large rivers inland. It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There have been 19 records of the grey-headed flying fox (*Pteropus poliocephalus*) documented for Wollemi National Park (DEC website 2006). Given that this species has only been recorded within one conservation reserve within the region, it is not considered that this species is adequately protected.

d) *Whether the species is at the limit of its known distribution.*

This species has generally been recorded within 200 kilometres of the eastern coast, from Bundaberg in Queensland, through NSW and south to eastern Victoria. It has been recorded from Melbourne, some occurring west to Warrnambool (NSW Scientific Committee 2001). Regular movements are made over the Great Dividing Range to the western slopes of NSW and Queensland. The species would not be considered to be at the limit of its distribution in the project area.

22. Eastern freetail-bat – *Mormopterus norfolkensis*

This species has a distribution along the east coast of NSW from south of Sydney north into south east Queensland, near Brisbane (Churchill 1998). Most records are from dry eucalypt forest and woodland east of the Great Dividing Range (DEC 2006). This species has also been recorded over a rocky river in rainforest and wet sclerophyll forest (Churchill 1998). Generally only solitary animals are recorded (Allison & Hoyer 2002). This species generally roosts in tree hollows, however have been recorded from roofs, under bark and the metal caps of telegraph poles (Churchill 1998). Generally forage above the forest canopy, over water and also on the ground.

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The eastern freetail bat was not recorded during fauna surveys conducted for the project however the species has previously been recorded within the Mt Arthur Coal operations area. The project area provides potential foraging and roosting habitat for this species. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the highly mobile nature of this species and the presence of similar quality habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the eastern freetail-bat at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

There are a number of records of this species within the Hunter Valley, with the majority being from the coastal regions. Records of this species further west along the valley are uncommon, with most being from the Singleton/Muswellbrook area. It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are 16 records of the eastern freetail-bat (*Mormopterus norfolkensis*) for Wollemi (DEC website 2006) and one record of this species within Manobalai Nature Reserve (NPWS Wildlife Atlas Database 2006).

Despite there being several records of eastern freetail-bat (*Mormopterus norfolkensis*) within conservation reserves in the region, available habitat for this species has drastically declined due to high rates of land clearance and degradation through mining and agricultural activities. As such, it is not considered that this species is adequately protected within conservation reserves in the region.

d) *Whether the species is at the limit of its known distribution.*

This species has a distribution along the east coast of NSW from south of Sydney north into south east Queensland, near Brisbane (Churchill 1998). Most records are from dry eucalypt forest and woodland east of the Great Dividing Range (DEC 2006). The species is not considered to be at the limit of its distribution in the project area.

23. Eastern false pipistrelle – *Falsistrellus tasmaniensis*

This species has a range from south eastern Queensland, through NSW and Victoria and into Tasmania (Churchill 1998). Habitat includes sclerophyll forest from the Great Dividing Range to the coast. This species prefers moist habitats, with trees taller than 20 m (DEC 2006). It generally roosts in tree hollows in groups of 6 – 36, but is occasionally recorded from caves or buildings (Churchill 1998). This species hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. The eastern false pipistrelle (*Falsistrellus tasmaniensis*) appears to hibernate over winter in southern parts (Phillips 1995). A single young is born in December (Churchill 1998).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The eastern false pipistrelle was not recorded within the project area however potential foraging habitat for this species was identified. The species has not previously been recorded within the Mt Arthur Coal operations area. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the highly mobile nature of this species and the presence of similar quality habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the eastern false pipistrelle at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The majority of records for this species from the Hunter Valley are from the heavily-vegetated conservation reserves fringing the valley, such as Wollemi, Yengo and Goulburn River National Parks. There are a small number of records from the vegetated areas of the Cessnock district, however there are no further records of this species from the valley floor. It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

Within Goulburn River National Park, there has been one record of the eastern false pipistrelle and there are 26 records of this species occurring within Wollemi National Park (DEC website 2006).

Although present within two of the larger national parks within the region, the number of recorded sightings of the eastern false pipistrelle is very low. As such, it is not considered that this species is adequately protected within conservation reserves in the region.

d) *Whether the species is at the limit of its known distribution.*

This species has a range from south eastern Queensland, through NSW and Victoria and into Tasmania (Churchill 1998). Habitat includes sclerophyll forest from the Great Dividing Range to the coast. The project area is approaching the western edge of the known distribution for this species.

24. Large-eared pied bat – *Chalinolobus dwyeri*

The large-eared pied bat (*Chalinolobus dwyeri*) is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands (DEC 2006). It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes (DEC 2006). It has been recorded frequenting low to mid-elevation dry open forest and woodland close roosting habitat (DEC 2006). Found in well-timbered areas containing gullies. It is likely to tolerate a wide range of habitats (Hoye & Dwyer 2002). This species tends to roost in the twilight zones of mines and caves, generally in colonies or common groups (Churchill 1998). This species is likely to hibernate through the coolest months (DEC 2006). Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years (DEC 2006). Females give birth (generally to twins) in November (Churchill 1998). The relatively short, broad wing combined with the low weight per unit area of wing indicates

manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The large-eared pied bat was not recorded within the project area; however, potential foraging habitat for this species was identified. The species has not previously been recorded within the Mt Arthur Coal operations area. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the highly mobile nature of this species and the presence of similar quality habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the large-eared pied bat at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

There are not a large number of records of this species from the floor of the Hunter Valley; however there are a number of records from the heavily-vegetated conservation reserves nearby. There are a small number of records from the Newcastle and Maitland areas. It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There are nine records of the large-eared pied bat (*Chalinolobus dwyeri*) for the Goulburn River National Park and 52 records of this species for Wollemi National Park (DEC website 2006).

Despite there being several records of the large-eared pied bat (*Chalinolobus dwyeri*) within conservation reserves in the region, available habitat for this species has drastically declined due to high rates of land clearance and degradation through mining and agricultural activities. As such, it is not considered that this species is adequately protected within conservation reserves in the region.

d) *Whether the species is at the limit of its known distribution.*

The large-eared pied bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands (DEC 2006). It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes (DEC 2006). The project is within the known distribution for this species.

25. Greater broad-nosed bat – *Scoteanax rueppellii*

The greater broad-nosed bat (*Scoteanax rueppellii*) is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m (DEC 2006). This species occurs in moist gullies and river systems draining the Great Dividing Range, as well as a variety of woodland, forest and rainforest habitats (Hoye & Richards 2002). It has

been recorded roosting in hollow tree trunks and branches, as well as old buildings (Churchill 1998). This species forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species (DEC 2006). Little is known of the reproductive cycle of the species, however, females congregate at maternity sites, located in suitable trees, where they appear to exclude males for the birth and raising of the single young in January (Hoye & Richards 2002).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The greater broad-nosed bat was not recorded during fauna surveys conducted for the project however the species has previously been recorded within the Mt Arthur Coal operations area. The project area provides potential foraging and roosting habitat for this species. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the highly mobile nature of this species and the presence of a large extent of similar quality habitat adjacent to the project area as well as in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the greater broad-nosed bat at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The majority of records of this species are from the Hunter Valley are from coastal regions, surrounding Newcastle, Maitland and Raymond Terrace. There are a small number of records further along the valley, from Barrington Tops National Park, and a single record near Jerrys Plains. It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

The greater broad-nosed bat (*Scoteanax rueppellii*) has been recorded within Wollemi National Park, with nine sightings being documented (DEC website 2006). Given that this species has only been recorded within one conservation reserve within the region, it is not considered that this species is adequately protected.

d) *Whether the species is at the limit of its known distribution.*

The greater broad-nosed bat (*Scoteanax rueppellii*) is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m (DEC 2006). This species occurs in moist gullies and river systems draining the Great Dividing Range. Records of this species within the Mt Arthur Coal operations are considered to be towards the westerly extent of the known distribution of this species within the Upper Hunter.

26. Yellow-bellied sheath-tail bat – *Saccolaimus flaviventris*

The yellow-bellied sheath-tail-bat (*Saccolaimus flaviventris*) is wide ranging throughout tropical Australia, with records extending into south eastern areas (Churchill 1998). In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South

Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes (DEC 2006). Has been recorded from a wide variety of habitats, from wet and dry sclerophyll forest, open woodland, *Acacia* shrubland, mallee, grasslands and deserts (Churchill 1998). In eucalypt forests this species forages above the canopy, however ventures lower when in open country (Richards 1995a). This species is generally solitary, however may form small groups around spring (Churchill 1998). Roosting is generally recorded from tree hollows and buildings, however use mammal burrows in treeless areas (DEC 2006). When foraging for insects, these bats fly high and fast over the forest canopy, but lower in more open country. It forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory (DEC 2006). Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn (DEC 2006). A single young is born between December and March (Churchill 1998).

a) *Whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.*

The yellow-bellied sheath-tail bat was not recorded during fauna surveys conducted for the project however the species has previously been recorded within the Mt Arthur Coal operations area. The project area provides potential foraging and roosting habitat for this species. The project will result in the loss of up to 52 hectares of woodland due to the extension of south pit. Due to the highly mobile nature of this species and the presence of extensive areas of similar habitat adjacent to the project area and in the wider Mt Arthur Coal operations area it is considered unlikely that the project will place a potentially occurring population of the yellow-bellied sheath-tail bat at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

Records of this species are scattered across New South Wales, with a small cluster of records from the Newcastle area. There are no further records of this species from the remainder of the Hunter Valley. There are a number of records from the Coonabarrabran area. It is unlikely that the project will result in a significant area of potential habitat being modified or removed, or isolated from currently interconnecting or proximate areas of known habitat for this species.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

There have been no sightings of the yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*) recorded within any of the nine conservation reserves identified within the region surrounding the project area. As such, it is not considered that this species is adequately represented in conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

The yellow-bellied sheath-tail-bat (*Saccolaimus flaviventris*) is wide ranging throughout tropical Australia, with records extending into south eastern areas (Churchill 1998). In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. While a record of this species from the project area would not represent an extension to the known distribution of this species, it would certainly represent one of the very few records of this species from the Hunter Valley.

4.0 KEY THREATENING PROCESSES

a) *Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.*

There are currently a total of 30 key threatening processes (KTPs) (including those pending finalisation) listed under the *Threatened Species Conservation Act 1995*. Of these, a number have been discounted from this assessment, due to their irrelevance to the project area. The remaining KTPs are listed below, with a discussion on their relevance to the proposed project, and the likelihood of the project causing an increase in the incidence of these processes within the project area.

Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is recognised as a major factor contributing to loss of biological diversity and ecological function in aquatic ecosystems, including floodplains.

Works within or across a number of creek/drainage lines will be required as part of the proposed project and surface water capture by the mine and associated disturbance areas will impact on flow regimes.

Bushrock removal

Bushrock removal is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation. Bushrock removal removes and/or disturbs habitat of native species, which may find shelter in or under rocks, may use rocks for basking, or which grow in rocky areas.

The proposed project will require the removal of bushrock from within the proposed disturbance area, however this will only be done as part of approved mining activities. This excludes this activity from the definition of this KTP. It is unlikely that any activities associated with the proposed project will cause an increase in the incidence of this KTP within the project area, or locality in general.

Clearing of native vegetation

Parts of the project area have already been impacted by historic clearing for agricultural purposes, selective logging, tracks/roads and mining exploration. Clearing of native vegetation is recognised as a major factor contributing to loss of biological diversity.

Clearing within the proposed disturbance area will increase the incidence of this KTP within the project area, and locality. While detailed ameliorative measures (such as rehabilitation and progressive revegetation of the open cut area) have been included within the proposed project, up to approximately 52 hectares of vegetation is required to be cleared within the proposed disturbance area, and this loss is likely to contribute to the loss of habitat within the project area and local area in general.

Invasion of native plant communities by exotic perennial grasses

A number of exotic perennial grasses invade and may dominate native plant communities. The changed structure and fire regimes of the habitat are likely to adversely impact on both native vertebrate and invertebrate fauna. This may result in local and regional declines of many native species and communities, possibly to the extent that they become endangered. Many of the perennial exotic grasses establish following disturbances such as overgrazing,

road works and management of roadside areas. Spread of these grasses is often aided by slashing, weed control, forestry and mining operations, movement or addition of fertilisers and nutrients, changes to drainage and fire regimes.

The project area already contains moderate to high levels of exotic perennial grasses, thus this KTP is already operating within the project area. The proposed project may increase the prevalence of these species within the project area, particularly due to disturbances due to earthworks. Despite this, it is likely that ecological monitoring of remnant vegetation, and management actions such as weeding and revegetation will control and manage the incidence of this KTP in the project area.

Removal of dead wood and dead trees

The accelerated and ongoing removal of standing dead trees and woody debris on the ground caused by human activity has been recognised as a factor contributing to loss of biological diversity. The removal of dead wood, either standing or fallen, can cause the broadscale change of woodlands into paddocks with isolated standing trees, with little natural understorey and no woody debris on the ground. Removal of dead wood and dead trees may seriously affect the long term availability and viability of habitat.

The proposed project will require the removal of dead wood and dead trees from within the proposed disturbance area. However, the proposed ameliorative measures will involve the placement of removed hollow logs, salvaged hollows and fallen timber into areas that will not be affected by the mine as part of the habitat augmentation program. A detailed nest box strategy was also included within the project in order to address the loss of hollows and mature trees from the proposed disturbance area.

5.0 CRITICAL HABITAT

Will critical habitat be affected?

There are currently four listings on the Critical Habitat Register, these being:

- Bomaderry zieria within the Bomaderry bushland - critical habitat recommendation;
- *Wollemia nobilis* (the Wollemi pine) - critical habitat recommendation;
- Little penguin population in Sydney's North Harbour - critical habitat declaration; and
- Mitchell's Rainforest Snail in Stotts Island Nature Reserve - critical habitat declaration.

None of these areas are in any proximity to the project area. The project will not impact on any areas of declared critical habitat.

6.0 ASSESSMENT OF SIGNIFICANCE UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1995

Under the Commonwealth *Environment Protection and Biodiversity Conservation* (EPBC) Act 1999, approval from the Commonwealth Minister for the Environment & Heritage is required for any action that may have a significant impact on matters of national environmental significance. These matters are:

-
- World Heritage properties;
 - National Heritage Places;
 - Ramsar wetlands;
 - Cetaceans, migratory species, threatened species, critical habitats or ecological communities listed under the EPBC Act 1999;
 - Commonwealth land, marine areas or reserves; and
 - Nuclear actions (including uranium mining).

None of the matters of national environmental significance are found in the project area. One threatened flora species, *Bothriochloa biloba*, was recorded during vegetation surveys undertaken for the Mt Arthur Coal Underground Project (Umwelt in prep) to the west of the project area. As discussed in the main text, this species was previously listed on the NSW TSC Act, however, it has recently been removed as it is now known to be more abundant than previously thought.

Two additional species, *Diuris tricolor* and *Goodenia macbarroni*, may also potentially occur in the project area due to the presence of suitable habitat, with *Diuris tricolor* previously recorded on Mt Arthur Coal owned land to the north. These species were not recorded in the project area despite targeted surveys.

No listed threatened fauna species were recorded during fauna surveys undertaken for the project, however the swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*), spotted-tailed quoll (*Dasyurus maculatus maculatus*), green and golden bell frog (*Litoria aurea*), grey-headed flying-fox (*Pteropus poliocephalus*) and large-eared pied bat (*Chalinobius dwyeri*) are considered to potentially occur within the project area due to the identification of suitable habitat.

Seven migratory species were recorded during surveys. However, only two EPBC listed migratory species were recorded within the project area during the surveys and have been assessed below.

An action requires approval from the Minister for the Environment & Heritage if the action has, will have, or is likely to have a significant impact on listed threatened species and ecological communities. An assessment of whether or not a significant impact occurs is undertaken using a test of significance. An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

6.1 CRITICALLY ENDANGERED AND ENDANGERED SPECIES

The endangered species swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) and spotted-tailed quoll (*Dasyurus maculatus maculatus*) are considered to have

potential habitat within the project area. An assessment according to the relevant significant impact criteria is provided below.

In this case, a *population* means:

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

No individuals of the swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) or spotted-tailed quoll (*Dasyurus maculatus maculatus*) were recorded within the project area. The project area does not contain a geographically distinct regional population, or collection of local populations for these species. The project area does not contain a regional population, or collection of local populations of these species that occur within the Sydney Basin bioregion.

The test of significance for threatened species is included below. The significance assessment has found that the project will not modify, destroy or isolate an area of 'important habitat' for identified or potentially occurring threatened or migratory species.

6.2 TEST OF SIGNIFICANCE – ENDANGERED SPECIES LISTED UNDER THE EPBC ACT

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

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

No populations of swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) and spotted-tailed quoll (*Dasyurus maculatus maculatus*) were recorded within the project area. The project will not lead to a long-term decrease in the size of a *population* of these species.

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

No populations of swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) and spotted-tailed quoll (*Dasyurus maculatus maculatus*) were recorded within the project area. The project will not lead to a long-term decrease in the size of a *population* of these species.

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

No populations of swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) and spotted-tailed quoll (*Dasyurus maculatus maculatus*) were recorded within the project area. The project will not fragment an existing *population* of these species into two or more populations.

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

No populations of swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) and spotted-tailed quoll (*Dasyurus maculatus maculatus*) were recorded within the project area. The project will not adversely affect habitat critical to the survival of these species.

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

No populations of swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) and spotted-tailed quoll (*Dasyurus maculatus maculatus*) were recorded within the project area. The project will not disrupt the breeding cycle of a population of these species.

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

No populations of swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) and spotted-tailed quoll (*Dasyurus maculatus maculatus*) were recorded within the project area. The project will not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that these species are likely to decline.

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

No populations of swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) and spotted-tailed quoll (*Dasyurus maculatus maculatus*) were recorded within the project area.

The project will not result in invasive species that are harmful to these species becoming established in their habitat.

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

No populations of swift parrot (*Lathamus discolor*), regent honeyeater (*Xanthomyza phrygia*) and spotted-tailed quoll (*Dasyurus maculatus maculatus*) were recorded within the project area. The project will not interfere with the recovery of these species.

6.3 VULNERABLE SPECIES

The vulnerable species, *Bothriochloa biloba*, *Diuris tricolor*, *Goodenia macbarroni*, green and golden bell frog (*Litoria aurea*), grey-headed flying-fox (*Pteropus poliocephalus*) and large-eared pied bat (*Chalinolobus dwyeri*) are considered to have potential habitat within the project area. An assessment according to the DEH principal significant impact guidelines is provided below.

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal; or
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

None of the recorded or potentially occurring threatened species are considered to comprise important populations, as defined above. None of the species were identified as key populations for breeding or dispersal or for maintaining genetic diversity. Only *Diuris tricolor*,

which was not identified in the project area, is considered to be at the eastern limit of its distribution in the local area.

The test of significance for threatened species is included below. The significance assessment has found that the project will not modify, destroy or isolate an area of 'important habitat' for identified or potentially occurring threatened or migratory species.

6.4 TEST OF SIGNIFICANCE – VULNERABLE SPECIES LISTED UNDER THE EPBC ACT

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

- **lead to a long-term decrease in the size of an important population of a species;**

No listed threatened species were identified in the project area, however *Bothriochloa biloba* and *Diuris tricolor* are known to occur within the Mt Arthur Coal operations area, approximately eight and ten kilometres from the project area respectively. The project will result in the removal of up to approximately 52 hectares of woodland and up to 280 hectares of derived grassland. The ongoing management of significant areas of potential habitat for these species by Mt Arthur Coal will ensure that the project will not lead to a long term decrease in the size of an important population of a threatened species.

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

The project will result in the loss of up to approximately 52 hectares of woodland and up to 280 hectares of derived grassland which provides known potential threatened species habitat. The site does not however support an important population of any threatened species and the project will not result in the significant reduction in the area of occupancy of these species.

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

The project will not lead to the fragmentation of an existing important population into two or more populations.

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

The EPBC Act administrative guidelines describes habitat critical to the survival of a species or ecological community as areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal,
- for succession,
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species/community.

The habitats occurring within the project area are not considered to form critical habitat for any threatened species considered to potentially occur within the project area.

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

The project area is not considered to support important breeding habitat for any of the threatened species considered to potentially occur in the project area. As such, the project is not expected to disrupt the breeding cycle of an important population.

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

The project is considered unlikely to result in a significant reduction in the availability or quality of habitat for potentially occurring threatened species such that the species' are likely to decline. Significant areas of suitable habitat are located widely across the Mt Arthur Coal operations area.

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

The project is not expected to result in the introduction of any non-endemic species which may be detrimental to any vulnerable species or their habitat.

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

The project will not result in the loss of important habitat for potentially occurring threatened species, and is not expected to substantially interfere with the recovery of any threatened species potentially occurring in the project area.

6.5 MIGRATORY SPECIES

The migratory species white-throated needletail (*Hirundapus caudacutus*) and rainbow bee-eater (*Merops ornatus*) were recorded within the project area. An assessment according to the significant impact criteria is provided below.

An area of *important habitat* is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; or
- habitat utilised by a migratory species which is at the limit of the species range; or
- habitat within an area where the species is declining.

The white-throated needletail and rainbow bee-eater were recorded within the project area during the surveys. Records of these species are distributed broadly across NSW, with no obvious concentrations of records in the local area to suggest the presence of an ecologically significant proportion of the entire population of these species. The project area is not at the limit of the known distribution for these species, nor is there any evidence to suggest these species are declining in the local area. It is unlikely that the project area forms an area of important habitat for the white-throated needletail or the rainbow bee-eater. As there are no areas of *important habitat* for the white-throated needletail and rainbow bee-eater no further assessment is required.

ATTACHMENT D

Flora Species List Suitable for use in Rehabilitation

Attachment D – Flora Species List Suitable for use in Rehabilitation

Central Hunter Box – Ironbark Woodland	Central Hunter Ironbark – Spotted Gum – Grey Box Forest	Central Hunter Bulloak Regeneration	Native Grassland
TREES	TREES	TREES	GRASSES
<i>Eucalyptus crebra</i>	<i>Corymbia maculata</i>	<i>Allocasuarina luehmannii</i>	<i>Cymbopogon refractus</i>
<i>Eucalyptus moluccana</i>	<i>Eucalyptus moluccana</i>	<i>Eucalyptus moluccana</i>	<i>Austrostipa verticillata</i>
<i>Eucalyptus albens</i>	<i>Eucalyptus crebra</i>	<i>Eucalyptus crebra</i>	<i>Chloris ventricosa</i>
<i>Allocasuarina luehmannii</i>	<i>Eucalyptus punctata</i>	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	<i>Chloris truncata</i>
<i>Brachychiton populneus</i> subsp. <i>populneus</i>	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	SHRUBS	<i>Sporobolus creber</i>
<i>Angophora floribunda</i>	<i>Allocasuarina luehmannii</i>	<i>Pultenaea retusa</i>	<i>Aristida vagans</i>
<i>Callitris endlicheri</i>	SMALL TREE/SHRUB	<i>Cassinia arcuata</i>	<i>Cynodon dactylon</i>
SMALL TREE/SHRUB	<i>Acacia parvipinnula</i>	<i>Acacia implexa</i>	<i>Austroanthonia bipartita</i>
<i>Canthium odoratum</i>	<i>Acacia salicina</i>	<i>Acacia salicina</i>	<i>Panicum effusum</i>
<i>Acacia implexa</i>	<i>Acacia genistifolia</i>	<i>Jacksonia scoparia</i>	<i>Dichanthium sericeum</i>
<i>Acacia salicina</i>	<i>Acacia implexa</i>	<i>Lissanthe strigosa</i>	<i>Themeda australis</i>
<i>Jacksonia scoparia</i>	<i>Cassinia quinquefaria</i>	GROUND COVERS	HERBS
<i>Bursaria spinosa</i>	<i>Indigofera australis</i>	<i>Cymbopogon refractus</i>	<i>Sida corrugata</i>
<i>Breynia oblongifolia</i>	<i>Daviesia ulicifolia</i> subsp. <i>ulicifolia</i>	<i>Cynodon dactylon</i>	<i>Eremophila debilis</i>
<i>Cassinia quinquefaria</i>	<i>Breynia oblongifolia</i>	<i>Aristida jerichoensis</i>	<i>Vittadinia cuneata</i> var. <i>cuneata</i>
<i>Acacia decora</i>	<i>Pultenaea spinosa</i>	<i>Elymus scaber</i>	<i>Vittadinia muelleri</i>
<i>Myoporum montanum</i>	<i>Lissanthe strigosa</i>	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	<i>Chrysocephalum apiculatum</i>
<i>Dodonaea viscosa</i>	<i>Melichrus urceolatus</i>	<i>Mentha satyroides</i>	
<i>Spartothamnella juncea</i>	GROUND COVERS	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	
GROUND COVERS	<i>Pimelea linifolia</i>	<i>Lomandra filiformis</i>	
<i>Maireana microphylla</i>	<i>Eremophila debilis</i>	<i>Eragrostis leptostachya</i>	
<i>Cymbopogon refractus</i>	<i>Cymbopogon refractus</i>	<i>Austrostipa verticillata</i>	
<i>Aristida ramosa</i>	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>		
<i>Chloris ventricosa</i>	<i>Themeda australis</i>		
<i>Austrostipa scabra</i>	<i>Dianella revoluta</i> var. <i>revoluta</i>		

Central Hunter Box – Ironbark Woodland	Central Hunter Ironbark – Spotted Gum – Grey Box Forest	Central Hunter Bulloak Regeneration	Native Grassland
<i>Microlaena stipoides</i> var. <i>stipoides</i>	<i>Goodenia hederacea</i> var. <i>hederacea</i>		
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	<i>Microlaena stipoides</i> var. <i>stipoides</i>		
<i>Vittadinia cuneata</i>	<i>Aristida ramosa</i>		
<i>Lomandra confertifolia</i>	<i>Aristida vagans</i>		
<i>Sida corrugata</i>	<i>Eragrostis leptostachya</i>		
<i>Bothriochloa decipiens</i>			
<i>Eragrostis leptostachya</i>			
<i>Austrostipa verticillata</i>			
<i>Cynodon dactylon</i>			