

# **Ashton Coal Longwalls 5 to 9**

## ***Flora and Fauna Assessment***

Ashton Coal Operations Pty Ltd



October 2008

0087472 FINAL

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Date:	<u>30 October 2008</u>

Environmental Resources Management Australia Pty Ltd Quality System

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## **INTRODUCTION**

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Ashton Coal Operations Pty Ltd to assess the potential flora and fauna impacts of the extraction of longwall (LW) and miniwall (MW) panels 5 to 9. The assessment will accompany the Subsidence Management Plan for these longwalls and has been undertaken in order to satisfy the requirements set out in the *Guideline for Applications for Subsidence Management Approval* (NSW DMR, 2003).

The Application Area (or subsidence impact zone) is defined by the 'Guideline for Applications for Subsidence Management Approvals' as the surface area that is likely to be affected by the proposed underground coal mining and is generally considered to be no less than the surface area defined by the depth of cover, angle of draw of 26.5 degrees and the limit of the proposed extraction area (DMR, 2003).

### **1.1**

#### **PURPOSE OF THE REPORT**

The purpose of this assessment was to:

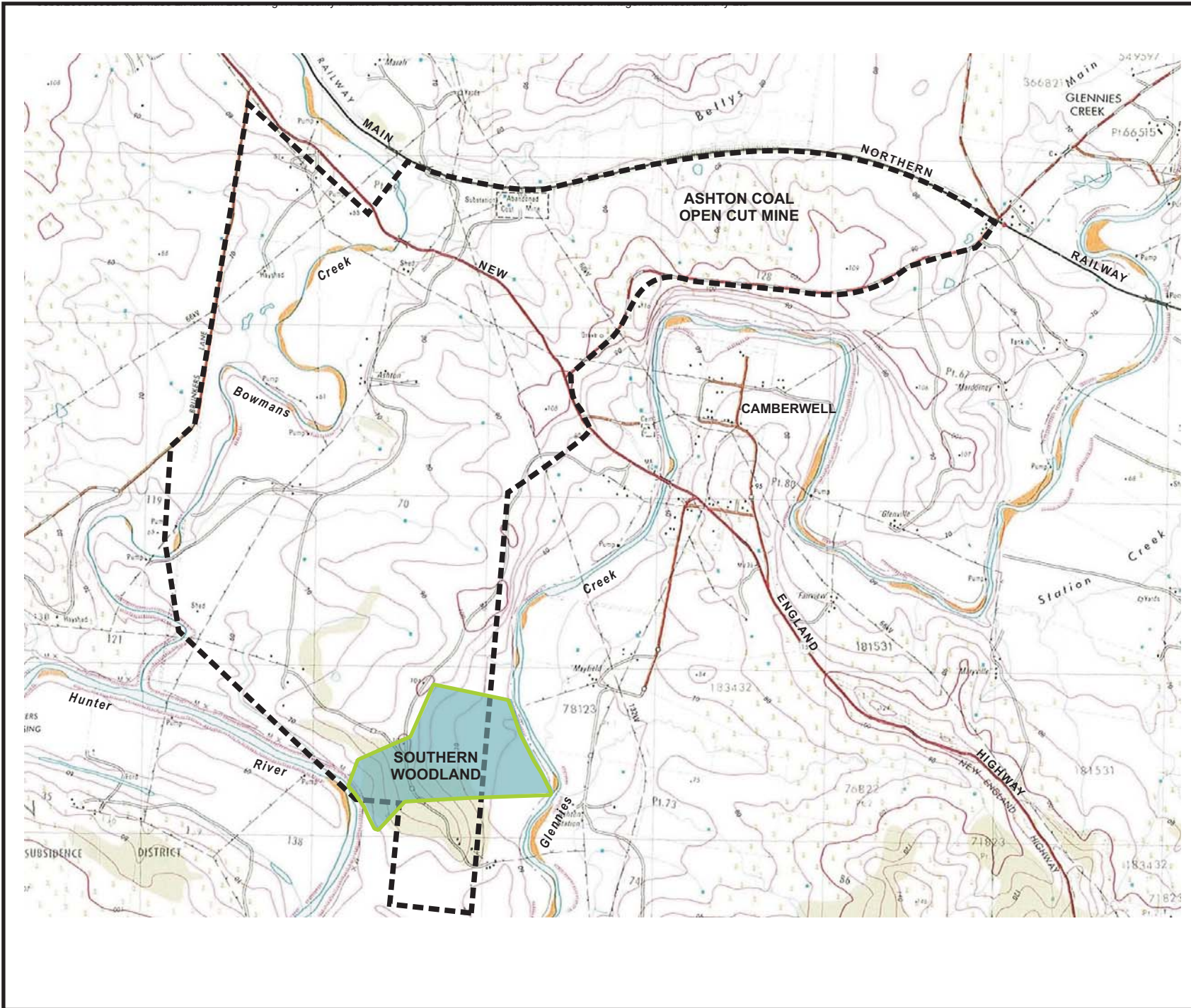
- identify and describe the conservation significance of vegetation communities and flora species;
- identify and describe the conservation significance of fauna habitats and fauna species;
- assess the type and degree of impacts of mining on the flora and fauna in the Application Area, any threatened species, populations and ecological communities likely to occur in the Application Area; and
- identify mitigation measures to avoid or minimise the extent of impacts of mining on flora and fauna.

### **1.2**

#### **APPLICATION AREA DESCRIPTION**

The proposed Application Area is located approximately 14 kilometres (km) northwest of Singleton, near the village of Camberwell in the Hunter Valley region of New South Wales (*Figure 1.1*). The extent of LW/MW 5 to 9 is defined by a setback from the Hunter River alluvium to the south, by Longwall 4 to the east, the Ashton Coal lease boundary to the west and the New England Highway to the north.

The soil is characterised by the Bayswater and Hunter soil landscapes as described by Kovac and Lawrie (1991). The Bayswater soil landscape is formed in situ from parent rock with alluvium in the drainage lines. The soil is characterised by sandy clay loam and loamy sand to sandy clay in alluvial



- Legend**
-  Mine Lease Boundary
  -  Indicative Voluntary Conservation Area

**Figure 1.1**  
**Locality Plan**

Client:	Ashton Coal		
Project:	SMP Longwalls 5-9		
Drawing No:	0087472hv_smp_lw5-9_01		
Date:	12/09/08	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JW
Source:	1:25,000 Topo Series Camberwell Sheet		
Scale:	Refer to Scale Bar		



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soils. Moderate sheet and gully erosion is common in the slopes within this soil landscape. The Hunter soil landscape covers the floodplains of the Hunter River and its tributaries. The main soils are formed in the alluvium. Minor stream bank erosion occurs on the watercourses with minor sheet and gully erosion on adjacent terraces (Kovac and Lawrie, 1991).

The Application Area lies within the downstream limits of the Bowmans Creek catchment. The land surface generally consists of undulating hills dominated by open grasslands and floodplains of the lower reaches of Bowmans Creek. Bowmans Creek traverses the Application Area, however miniwalls have been laid out beneath Bowmans Creek and its associated saturated alluvium to limit subsidence and prevent direct hydraulic connection to the underground workings.

Land use is predominantly livestock grazing, with some irrigation and cultivation on the Bowmans Creek floodplain. Since European settlement, the most commonly constructed surface features within the Application Area are fences and farm dams required for livestock grazing. There are also residential dwellings owned by Ashton Coal, telephone and electricity infrastructure and access roads.

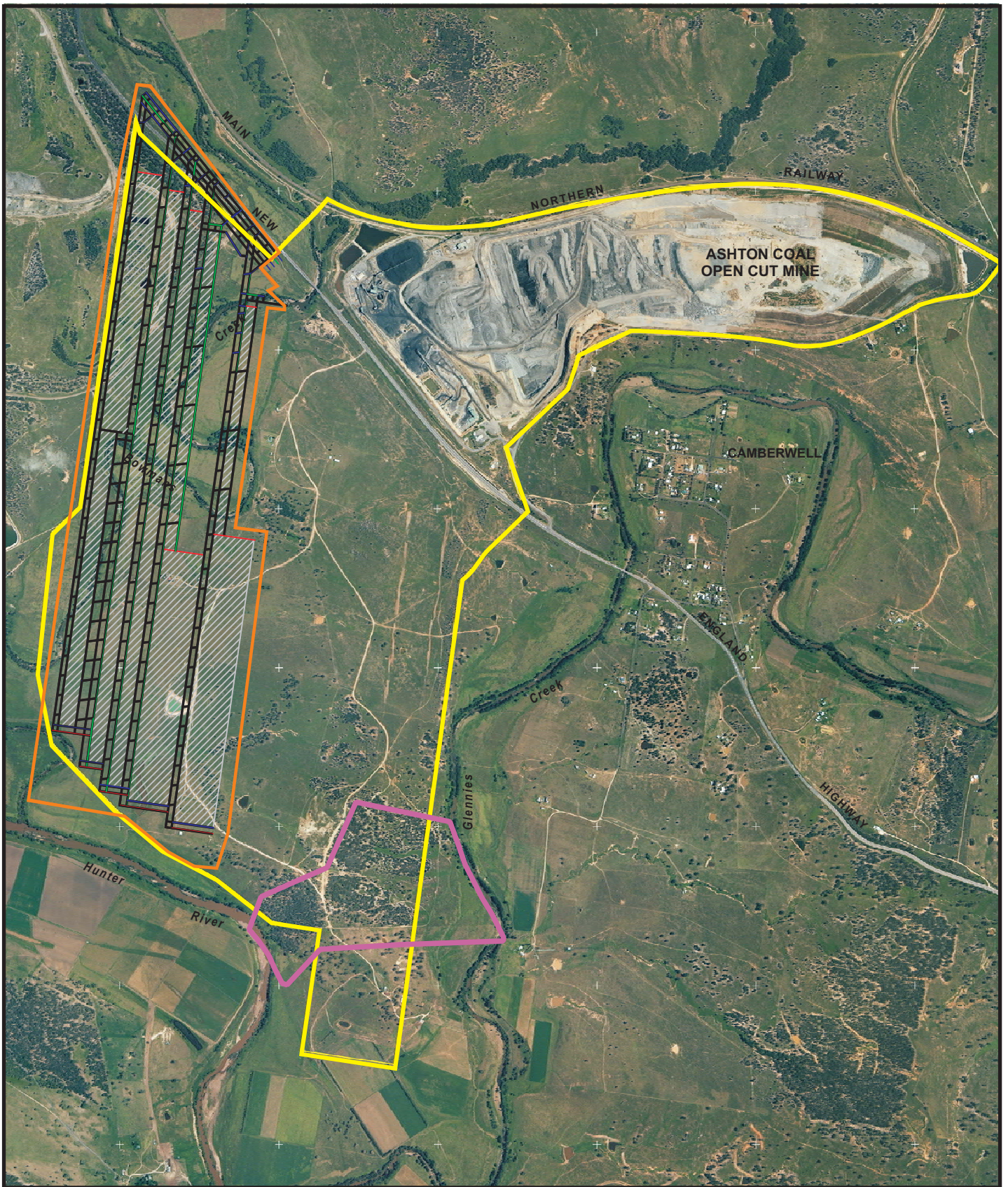
### 1.3

#### *DESCRIPTION OF THE PROPOSAL*

The layout of the mine is shown in *Figure 1.2* including the main roadways, current area of extraction and the proposed longwall and miniwall panels. The panels are oriented in a north south direction.

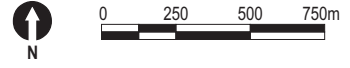
LW/MW 5 to 9 have been designed to reduce the surface subsidence below Bowmans Creek to sufficiently low levels so as to prevent direct hydraulic connection to the creek and its associated alluvium. Full width longwall blocks are proposed at the southern end of Longwall 5 and Longwall 6. Miniwalls will be mined beneath Bowmans Creek and the saturated alluvium (Miniwalls 5, 6, 7, 8, and 9), with a mid width longwall block at the northern end of Longwall 9.

The overburden depth ranges from 85 to 190 metres over the SMP Application Area and 100 to 190 metres over the proposed longwall panels (refer to *Table 1.1*). The seam thickness ranges from 2.2 to 3.2 metres but is generally 2.4 metres.



- Legend**
- Mine Lease Boundary
  - Application Area
  - Longwall/miniwall Layout
  - Southern Woodland

Client:	Ashton Coal	
Project:	SMP Longwalls 5-9	
Drawing No:	0087472hv_smp_lw5-9_02	
Date:	24/10/08	Drawing size: A4
Drawn by:	JD	Reviewed by: JW
Source:	Ashton Coal Operations	
Scale:	Refer to Scale Bar	



**Figure 1.2**

**Mine Layout**

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*Table 1.1 Summary of Panel Widths for the Proposed Longwalls*

Longwall/Miniwall	Panel Width (m)	Overburden Depth	W/D (max)
LW 5	216	110-155	1.4 - 2.0
MW 5	60	100-125	0.5 - 0.6
LW 6	216	130-160	1.3 - 1.7
MW 6	70	115-150	0.5 - 0.6
MW 7	81	130-170	0.5 - 0.6
MW 8	87	140-175	0.5 - 0.6
MW 9	93	160-190	0.5 - 0.6
LW 9	141	140-180	0.8 - 1.0

*SCT (2008)*

*2.1**LITERATURE REVIEW*

Various sources of published information are available on flora and fauna within the Application Area and surrounding areas. The following were reviewed in the preparation of this assessment.

- ERM (2005) Final Ashton Coal Bi-annual Fauna Monitoring Autumn Census. Report prepared for Ashton Coal Operations Pty Ltd, September 2005;
- ERM (2006a) Final Flora and Fauna Baseline Monitoring Bowmans Creek, October 2006;
- ERM (2006b) Final Ashton Coal Bi-annual Fauna Monitoring Summer Census. Report prepared for Ashton Coal Operations Pty Ltd, September 2006;
- ERM (2007a) Final Ashton Coal Bi-annual Fauna Monitoring Spring Census. Report prepared for Ashton Coal Operations Pty Ltd, May 2007;
- ERM (2007b) Final Ashton Coal Bi-annual Fauna Monitoring Autumn Census. Report prepared for Ashton Coal Operations Pty Ltd, October 2007;
- ERM (2008) Final Ashton Coal Bi-annual Fauna Monitoring Spring Census. Report prepared for Ashton Coal Operations Pty Ltd, January 2008;
- ERM (in prep) Ashton Coal Bi-annual Fauna Monitoring Autumn Census. Report prepared for Ashton Coal Operations Pty Ltd;
- HLA-Envirosciences (2001) Environmental Impact Statement Ashton Coal Project Volume 1;
- Marine Pollution Research Pty Ltd (2007) Aquatic Ecology Monitoring of Bowmans and Glennies Creeks Autumn 2007. Report prepared for Ashton Coal Operations Pty Ltd;
- Parsons Brinckerhoff (2004a) Ashton Coal Project Pre-clearing Flora and Fauna Surveys – Combined Report; and
- Parsons Brinckerhoff (2004b) Ashton Coal – Southern Woodland Preliminary Ecological Assessment.

The area of woodland at the southern end of Longwalls 1 and 2 has been established as a conservation area and has been the subject of biannual fauna surveys since 2005. This conservation area is located outside of the current Application Area although the results of the various assessments have been

referred to within this report as they provide valuable information on habitat use within the Ashton Coal mine lease area.

A search of the Department of Environment and Climate Change (DECC) Wildlife Atlas database was conducted for all recent records of threatened flora and fauna within a 10 kilometre radius of the Application Area. A search of the on-line database maintained by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) was conducted in order to identify the likely presence of nationally listed threatened and migratory species in the locality.

All flora and fauna database records were analysed to determine the likelihood that threatened flora and fauna could occur within habitats on the Application Area. It should be noted that the DEWHA search is based on habitat requirements rather than actual records, and the assessment is based on those listed species likely to inhabit the Application Area.

## 2.2 *FLORA SURVEY METHODOLOGY*

Previous assessments conducted over the mine lease area and aerial photography were used to identify vegetation communities within and adjacent to the Application Area. The disturbance history was assessed from a review of previous surveys noting the occurrence of grazing, logging/clearing, rubbish dumping and encroachment of weeds.

## 2.3 *FAUNA SURVEY METHODOLOGY*

Previous assessments conducted over the mine lease area and aerial photography were used to identify the diversity and general habitat value of the Application Area. This was undertaken by appraising the extent of likely habitat, searching for secondary indications of threatened species and incidental observations during the previous surveys. The assessment considered the following:

- continuity with similar habitat adjacent to the Application Area, or connection with similar habitat outside the mine lease area;
- percentage cover of nesting/shelter/basking sites such as tree hollows, leaf litter, ground exposures, logs, vegetation and rock outcrops;
- presence of freshwater aquatic habitats such as streams, swamps and pools;
- cover abundance of dominant canopy species; and
- the extent and nature of previous disturbances.

The presence of flowering eucalypts and other plants were recorded as these may provide foraging resources for threatened species such as Squirrel Gliders and Honeyeaters.

Habitat use by fauna was documented through analysis of tracks, scats, diggings, feathers and other evidence. Previous surveys were conducted opportunistically and included:

- searches for whitewash, prey remains and owl pellets;
- searches for obvious nests of raptors;
- searches for nest of known threatened species such as the Grey-crowned Babbler, Speckled Warbler and Hooded Robin;
- investigation of any possible den sites for Tiger Quoll;
- searches for characteristics scats, tracks and diggings; and
- checking trees for scratches consistent with arboreal mammals.

### 3.1 FLORA SURVEYS

#### 3.1.1 *Vegetation Communities*

The Application Area has been disturbed through grazing and clearing. Weed encroachment is most evident adjacent to the roads and within the riparian habitat along Bowmans Creek. Two vegetation communities were identified within the Application Area being Grassland and Hunter Valley River Oak Forest. Hunter Valley Floodplain Red Gum Woodland has been identified to the east of the Application Area and has been included within this assessment due to its regional significance (refer to *Figure 3.1*).

A full list of flora species identified within the Application Area has been provided in *Annex A*.

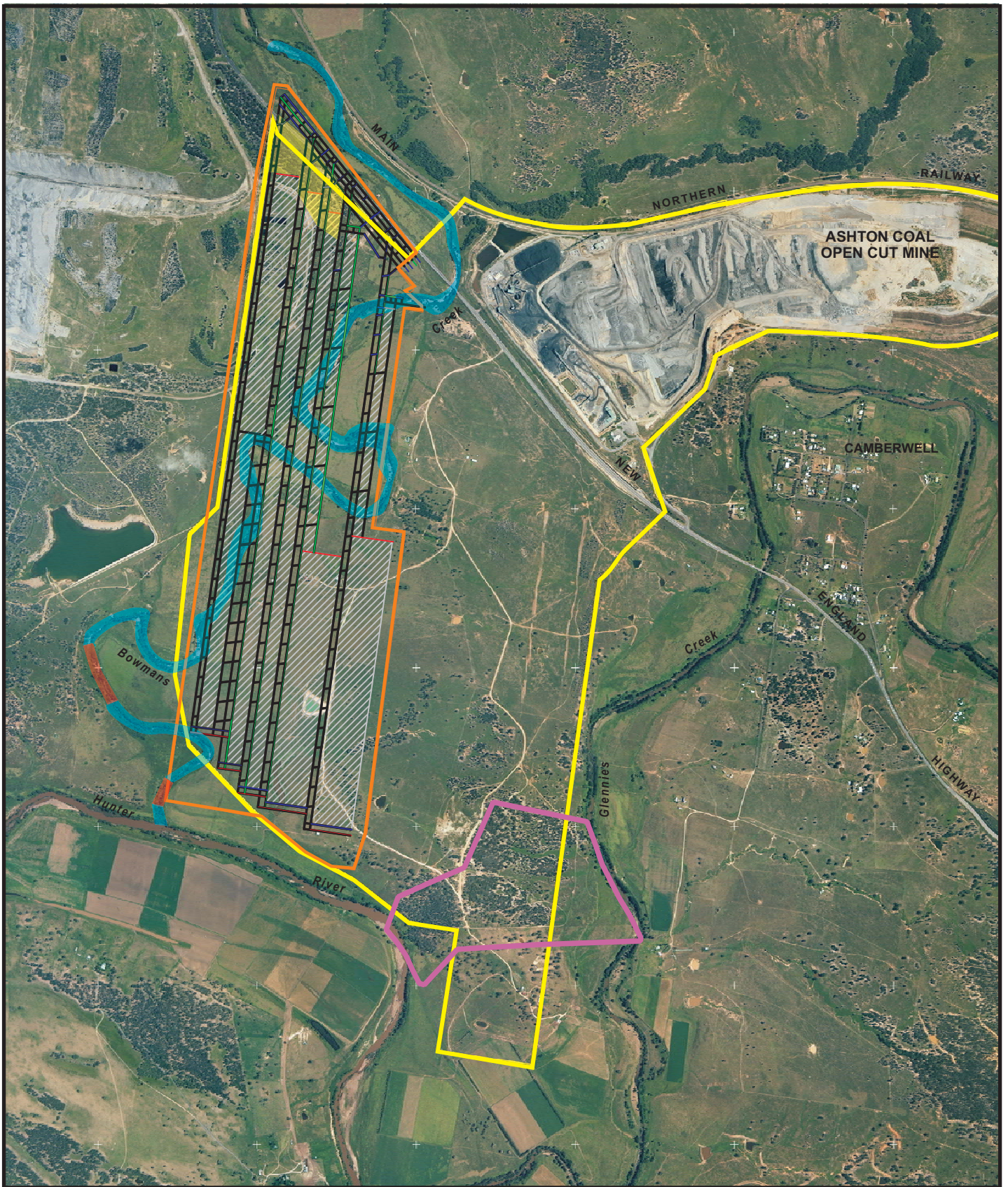
##### *Grassland*

Two grassland sub-communities occur, namely dry pasture and pasture that has been improved in the past. Within the areas of dry pasture, isolated trees exist and some regeneration is occurring. Scattered trees noted include *Allocasuarina luehmannii*, (Bullock) *Eucalyptus crebra* (Narrow-leaved Ironbark), *Eucalyptus melliodora* (Yellow Box) and *Eucalyptus moluccana* (Grey Box). scattered shrubs of *Maireana microphylla* (Eastern Cotton Bush) and *Acacia amblygona* (Fan Wattle) occur. Exotic species such as the woody weed *Lycium ferocissimum* (African Boxthorn) occur below the canopy of the isolated trees.

The improved pasture community is located on the alluvial creek flats. Many exotic herbaceous species are present. Species used to improve the pasture for grazing value include *Lolium sp.* (Rye Grass), *Chloris gayana* (Rhodes Grass), *Paspalum dilatatum* (Paspalum), *Medicago sativa* (Lucerne), *Trifolium repens* (White Clover) and *Pennisetum clandestinum* (Kikuyu). Additional common pasture species noted include *Aristida vagans*, *Cymbopogon refractus*, *Dichelachne rara*, *Microlaena stipoides* and *Lomandra glauca*. The percentage cover of the ground layer varies with grazing intensity.

##### *Hunter Valley River Oak Forest*

The Bowmans Creek riparian corridor was dominated by an overstorey of *Casuarina cunninghamia* (River Oak) supporting a sparse to absent midstorey and moderate groundcover (see *Photograph 1*). Isolated occurrences of *Schinus areira* (Pepper Tree), *Angophora floribunda* (Rough Barked Apple), *Populus alba* (White Poplar) and *Salix babylonica* (Weeping Willow) were also noted throughout this community.



**Legend**

- Mine Lease Boundary
- Application Area
- Longwall/miniwall Layout
- Southern Woodland

**Communities**

- Revegetated Areas
- Hunter Valley River Oak Forest
- Hunter Valley Floodplain Red Gum Woodland

Client:	Ashton Coal	
Project:	SMP Longwalls 5-9	
Drawing No:	0087472hv_smp_lw5-9_03	
Date:	24/10/08	Drawing size: A4
Drawn by:	JD	Reviewed by: JW
Source:	Ashton Coal Operations	
Scale:	Refer to Scale Bar	



**Figure 3.1**

**Vegetation Communities**

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**Photograph 1**

River oak woodland.



**Photograph 2**

River red gum population.

The shrub layer was restricted to scattered thickets of *Lycium ferrosom* (African Boxthorn) and the occasional stand of *Arundo donax* (Bamboo).

The groundcover was dominated by *Verbena bonariensis* (Purpletop), *Cynodon dactylon* (Common Couch), *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) and *Bidens pilosa* (Cobblers Pegs). In lower lying areas, sedges and rushes dominated the ground cover and included species such as *Juncus usitatus* and *Schoenus apogon* (River Club Rush). *Typha orientalis* (Broad-leaved Cumbungi) was commonly encountered in isolated pockets of the creek.

The Hunter Remnant Vegetation Project has described the Hunter Valley River Oak Forest as regionally significant as the extant community is approximately 955 ha, that is approximately 98.9% has been cleared (Peake 2006). Further, it is poorly conserved with only a very small area in Towarri National Park. Key threats to this community are weed invasion, livestock grazing and the lack of structural intactness. Most threats occur as a result of the very high edge to area ratio that is exhibited by the long narrow stands of River Oak (Peake, 2006).

This regionally significant vegetation community is unlikely to be directly impacted by the proposed mining activities as Bowmans Creek is over the miniwall mine design that will result in very low levels of subsidence. The potential for indirect impacts such as lowering of the water table and increased salinity have been assessed in *Section 4.1*.

#### *Red Gum Woodland*

This community was recorded within the southern portion of the lease area, outside of the subsidence impact zone (see *Figure 3.1*). The canopy was dominated by *Eucalyptus camaldulensis* (River Red Gum), with isolated occurrences of *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus moluccana* (Grey Box) extending into the adjacent paddocks (see *Photograph 2*).

The Hunter Remnant Vegetation Project has described the Hunter Valley Floodplain Red Gum Woodland as regionally significant as the extant community is approximately 436 ha from a modelled range of 41 142 ha, that is, approximately 98.9% has been cleared (Peake 2006). Further, it is not formally conserved within any conservation areas (Peake, 2006).

The NSW Scientific Committee, established by the *Threatened Species Conservation Act 1995* (TSC Act), has made a further preliminary determination to list the 'Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions' as an endangered ecological community under Part 3 Schedule 1 of the TSC Act (NSW Scientific Committee, August 2008). This further highlights the conservation significance of this community.

After direct clearing, floodplain alienation has probably been the most significant threatening process. Without regular flooding, *E. camaldulensis*



struggles to compete with other species. The introduction of non-indigenous hybrid species for revegetation projects could also have a very serious impact on the survival of pure stands of River Red Gum in the Hunter Valley (Peake 2006).

This vegetation remnant is also consistent with *Eucalyptus camaldulensis* (River Red Gum) Open Woodland as described by DEC (2005) and constitutes an endangered population in the Hunter Catchment as discussed below.

### 3.1.2 *Endangered Populations*

The River Red Gum population in the Hunter Catchment has been identified as an endangered population under Part 2 Schedule 1 of the TSC Act 1995. The population of River Red Gum in the Hunter is unique in NSW being the only one to occur in a coastal catchment.

#### *Habitat Description*

The River Red Gum population is of conservation significance as the community is dominant in distinct riparian and floodplain vegetation types. It generally occurs in association with *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus melliodora* (Yellow Box), *Casuarina cunninghamia* (River Oak) and *Angophora floribunda* (Rough Barked Apple) (DEC, 2005a).

#### *Distribution*

The Hunter population occurs from the west at Bylong, south of Merriwa, to the east at Hinton, on the bank of the Hunter River, in the Port Stephens local government area. It has been recorded in the local government areas of Lithgow, Maitland, Mid-Western Regional, Muswellbrook, Port Stephens, Singleton and Upper Hunter.

The former range of suitable habitat for this population in the Hunter catchment was between 10 000 to 20 000 hectares. The River Red Gum population is currently restricted to approximately 100 hectares in 19 stands. Remnant size is restricted to one or several trees with the largest remnant between 15 to 20 hectares (DEC, 2005a).

#### *Presence and Quality of Habitat*

The presence of this community within the Ashton Coal mine lease area is restricted to a narrow band along either side of Bowmans Creek, to the south of the predicted subsidence area. No regeneration of *E. camaldulensis* is evident and the maximum diameter at breast height was 45 cm.

The understorey species were similar to the remaining vegetation communities and was characterised by both native and introduced grass

species. Relatively high levels of disturbance were noted along the entire length of the riparian corridor and included cattle grazing, clearing, weed invasion and erosion (see *Photograph 3*).

### *Recommendations*

In accordance with the Conditions of Consent, the identification of this endangered population requires the development of appropriate amelioration measures prior to the commencement of mining under Bowmans Creek. Management of this endangered ecological population will form part of the flora and fauna management plan.

This population will not be directly impacted by the proposed mining and associated subsidence, or indirect impacts such as increased salinity and a reduction in the water table as addressed in *Section 4.1*.

### **3.1.3** *Threatened Flora Species*

No threatened flora species were recorded within the Application Area during the various surveys.

The DECC database search identified one threatened flora species, *Digitaria porrecta* (Finger Panic Grass), within 10 kilometres of the Application Area. Habitat for an additional three threatened flora species has been recorded on the DEWHA database within 10 kilometres of the Application Area being, *Diuris tricolor* (Pine Donkey Orchid), *Eucalyptus glaucina* (Slaty Red Gum) and *Thesium australe* (Austral Toadflax).

Each species was assessed to their likelihood of occurrence within the Application Area (refer to *Table 3.1*).

## **3.2** *FAUNA*

### **3.2.1** *Habitat Assessment*

The Application Area contains two broad habitat communities being Riparian Woodland and Grassland.




The myrtaceous tree species in the canopy and the sparse shrub layer would provide a year-round seasonal foraging resource for nectivorous birds and mammals (*Eucalyptus paniculata* flowers May to January, *Eucalyptus melliodora* flowers September to February and *Eucalyptus moluccana* flowers January to May). The variety of tree species would provide suitable feeding/foraging resources for folivorous fauna such as the Common Brushtail Possum and insectivorous birds such as Treecreepers. The limited number of mature



**Legend**

-  Mine Lease Boundary
-  Application Area
-  Longwall/miniwall Layout
-  Southern Woodland

**Species**

-  Grey-crowned Babler Population
-  Speckled Warbler
-  Hooded Robin

Client:	Ashton Coal	
Project:	SMP Longwalls 5-9	
Drawing No:	0087472hv_smp_lw5-9_04	
Date:	24/10/08	Drawing size: A4
Drawn by:	JD	Reviewed by: JW
Source:	Ashton Coal Operations	
Scale:	Refer to Scale Bar	



**Figure 3.2**

**Threatened Species Recorded on Site**

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eucalypt trees provide hollows capable of providing shelter and breeding habitat for a number of bird and arboreal mammal species.

The grasses and sedges provide seed and stem resources for granivorous and herbivorous species. The *Allocasuarina* species in the mid-storey and understorey strata may also provide a limited seasonal foraging resource for highly mobile granivorous fauna such as Black-Cockatoos. The *Allocasuarina* species and eucalypts also provide suitable nesting habitat for the Grey-crowned Babbler. Understorey species such as *Lycium ferocissimum* provide foraging resources for many species favouring fruits and berries.

The riparian habitat has a moderate layer of leaf litter (five centimetres deep), fallen logs and rock outcrops that provide sheltering resources for small ground-dwelling mammals and reptiles. The grassy understorey and fallen timber also provides a suitable foraging substrate for the Grey-crowned Babbler and Speckled Warbler.

Aquatic habitat is provided within the numerous farm dams, as well as within Bowmans Creek and the adjacent Hunter River. These water resources provide permanent and ephemeral habitat for aquatic avifauna and amphibians as well as a drinking resource for many native species. A separate aquatic habitat assessment has been prepared by Marine Pollution Research (2008).

### 3.2.2 *Threatened Fauna Species*

Previous surveys conducted by ERM (refer to *Section 2.1*) identified the presence of three bird species and three microchiropteran bat species listed as vulnerable under the TSC Act 1995 (refer to *Figure 3.2*). A survey conducted by Parsons Brinckerhoff also identified the presence of the Grey-headed Flying-fox (Parsons Brinckerhoff, 2004b).

Four *Pyrholaemus sagittatus* (Speckled Warbler) have been observed foraging in the southern woodland, to the south east of the current Application Area (ERM, 2006b). This species is also likely to occur within the riparian corridor along Bowmans Creek. Speckled Warblers prefer a range of eucalypt dominated communities supporting a grassy understorey within gullies or rocky ridges. Nests are built with a side entrance in areas of dense branches and other litter. Habitat ranges are up to 10 hectares.

*Melanodryas cucullata cucullata* (Hooded Robin) has been identified in two locations within the southern woodland (ERM, 2007a) and are also likely to occur within the riparian corridor along Bowmans Creek. Home ranges of the Hooded Robin vary from 10 hectares in the breeding season up to 30 hectares outside of the breeding season. Hooded Robins prefer eucalypt woodland supporting a diverse range of structures including mature eucalypt, saplings, shrubs and tall, native, grassy understorey (DEC, 2005b). Roosting habitat includes fallen timber and low dead stumps. Breeding occurs between July and November during which cup-shaped nests are constructed of grasses and

cobwebs located one to five metres above the ground (Fitri and Ford, 2003). Threats to survival include clearing resulting in habitat fragmentation and modification or destruction of habitat through heavy grazing, timber removal, frequent fire and exotic grass invasion (Robinson *et al*, 1996).

*Pomatostomus temporalis* (Grey-crowned Babbler) have been commonly encountered within the southern woodland and near the Bowmans Creek oxbow. The family group occupying the southern woodland was reported to have increased from eight birds in September 2004 to twelve in January 2005 with the number of nests increasing from two to six respectively (Parsons Brinckerhoff, 2004b). The most recent survey (ERM, in prep) reported that the number of Grey-crowned Babblers within the Application Area appeared to be stable at around six individuals, with a total of thirteen nests identified.

*Pteropus poliocephalus* (Grey-headed Flying-fox), *Mormopterus norfolkensis* (Eastern Freetail-bat), *Miniopterus schreibersii oceansis* (Eastern Bentwing-bat) and *Myotis adversus* (Large-footed Myotis) were recorded within the southern woodland during previous surveys (ERM, 2006b; Parsons Brinckerhoff 2004b). The current Application Area provides potential hunting and roosting habitat for *Mormopterus norfolkensis* and hunting/foraging habitat only for *Miniopterus schreibersii oceansis*, *Myotis adversus* and *Pteropus poliocephalus*.

Marine mammals and shoreline birds were excluded from the threatened species assessment, as it is reasonable to assume they are not present or dependent on habitats within the site. Those species identified as likely to be impacted by the proposal (*see Table 3.1*) have been collectively assessed in the threatened species impact assessment in *Chapter 4*.

A full list of fauna species recorded within the Application Area and adjacent Southern Woodland during the various surveys has been included in *Annex B*.

**Table 3.1 Likelihood of Threatened Fauna Occurring within the Application Area**

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<b>Flora</b>					
<i>Bothriochloa biloba</i> (lobed blue-grass)	-	V	Prefers poorer soils supporting woodland.	Potential habitat is available and this species has been recorded within the locality. Subsidence and the associated low levels of tilt and strain are unlikely to impact this species.	No
<i>Eucalyptus glaucina</i> Slaty Red Gum	V	V	Prefers grassy woodland and dry eucalypt forest on deep moderately fertile soil.	Potential habitat is available along the riparian corridor. This species has not been recorded on site and the areas of potential habitat are largely outside of the subsidence impact zone based on the mini wall mine design.	No
<i>Diuris tricolor</i> Pine Donkey Orchid	V	V	Grows in sclerophyll forest among grass, often with native cypress pine. It is found in sandy soils, either on flats or small rises.	Preferred sandy soils and vegetation associations are not available within the Application Area.	No
<i>Digitaria porrecta</i> Finger Panic Grass	E	E	Found in native grassland, woodlands or open forest with a grassy understorey, on richer soils. In NSW it is found on the north west slopes and plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran.	Potential habitat is available although this species has not been recorded within the local area.	No

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<i>Thesium australe</i> Austral Toadflax	V	V	Occurs in grassland or grassy woodland in association with <i>Themeda australis</i> (Kangaroo Grass).	Potential habitat is available although this species has not been recorded within the local area.	No
<b>Endangered Population</b> <i>Acacia pendula</i> Weeping Myall population in the Hunter Catchment	E	-	Prefers heavy soils occasionally growing on floodplain margins.	This species was recorded 1 km north of the current Application Area. No records of this species have been identified during the various surveys and the proposed mining activities will not significantly impact potential habitat along Bowmans Creek.	No
<i>Eucalyptus camaldulensis</i> River Red Gum population in the Hunter Catchment	E	-	Occurs in association with <i>Eucalyptus tereticornis</i> , <i>Casuarina cunninghamiana</i> subsp <i>cunninghamiana</i> , <i>Angophora floribunda</i> and <i>E. melliodora</i> .	This community occurs beyond the eastern extent of the Application Area and will not be directly impacted by the mining activities. Indirect impacts have the potential to decrease the regeneration potential of this population.	Yes
<b>Endangered Ecological Community</b> White Box-Yellow Box Blakely's Red Gum grassy woodland and derived native grassland	E	E	Prefers relatively fertile soils on the western slopes and tablelands of NSW where rainfall is between 400 and 800 millimetres at an altitude of approximately 170 to 1200 metres (NPWS, 2004).	This community has not been recorded within the Ashton mine lease area and there is no potential for significant impact to this EEC.	No

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<b>Birds</b>					
<i>Tyto novaehollandiae</i> Masked Owl	V	-	Dry sclerophyll forest and woodland with a low sparse understorey, foraging in open or partly cleared land. Roosting and nest sites in large tree hollows in sheltered aspects.	Potential hunting habitat is available across the Application Area although suitable roosting hollows are limited. Given the large home range of the Masked Owl and the limited amount of potential habitat disturbance (if any) this species is unlikely to be impacted by the proposed mining activities.	No
<i>Ninox connivens</i> Barking Owl	V	-	Open woodlands and dry open forests, nesting in the crown of mature trees.	Potential hunting habitat is available across the Application Area although suitable roosting hollows are limited. Given the large home range of the Barking Owl and the limited amount of potential habitat disturbance (if any) this species is unlikely to be impacted by the proposed mining activities.	No
<i>Melithreptus gularis gularis</i> Black-chinned Honeyeater	V	-	Dry forests and woodlands particularly along rivers.	Potential habitat is available along Bowmans Creek. This species has been recorded within Ravensworth State Forest to the north of the current Application Area and has the potential to occur within the riparian corridor as a transient species. Based on the high mobility of this species and the limited amount of habitat disturbance (if any) there is no potential for significant impact.	No



Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<i>Erythrotriorchis radiatus</i> Red Goshawk	E	V	Prefers woodlands and forests with a mosaic of vegetation types that contain permanent water. Nests may be up to 1 km away from a permanent freshwater.	Limited habitat is available within the vegetated riparian corridor although it does not contain a mosaic of vegetation types preferred by this species. This species has not been recorded within the local area.	No
<i>Climacteris picumnus</i> Brown Treecreeper	V	-	Drier forests and woodlands particularly among fallen timber.	Potential habitat is available along Bowmans Creek. This species has been recorded 3 km to the north of the current Application Area and is likely to occur within the riparian corridor as a transient species. Based on the high mobility of this species and the limited amount of habitat disturbance (if any) there is no potential for significant impact.	No
<i>Stagonopleura guttata</i> Diamond Firetail	V	-	Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum woodlands. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Potential habitat is available along Bowmans Creek. A breeding record has been noted 8 km to the north of the current Application Area and this species is likely to occur within the riparian corridor as a transient species. Based on the high mobility of this species and the limited amount of habitat disturbance (if any) there is no potential for significant impact.	No

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<i>Pyrholaemus sagittatus</i> Speckled Warbler	V	-	Lives in a wide range of eucalypt dominated communities that have a grassy understorey. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	This species has been recorded above longwalls 1 and 2, and is likely to use the resources present within the current Application Area.	Yes
<i>Lathamus discolor</i> Swift Parrot	E	E	Migratory species frequenting eucalypt forest and woodland, following winter flowering eucalypts (eg. swamp mahogany). Breeds in Tasmania.	Preferred seasonal habitat is limited within the Application Area and this species is unlikely to dependant on the resources present. Based on the high mobility of this species and the limited amount of habitat disturbance (if any) there is no potential for significant impact.	No
<i>Melanodryas cucullata cucullata</i> Hooded Robin	V	-	Prefers open woodland, acacia scrub, mallee or clearings.	This species has been recorded above longwalls 1 and 2, and is likely to use the resources present within the current Application Area.	Yes
<i>Pomatostomus temporalis</i> Grey-crowned Babbler	V	-	Open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs and an intact cover of grass and forbs. Also along streams in cleared areas.	This species has been recorded above longwalls 1, 2 and 4, and is likely to use the resources present within the current Application Area.	Yes
<i>Oxyura australis</i> Blue-billed duck	V	-	During breeding season prefers well vegetated deep freshwater marshes. Prefers more open waters in non-breeding season.	The dams within the Application Area provide a limited habitat resource although they do not contain dense fringing vegetation preferred by this species. Unlikely to be significantly impacted by the proposed mining activities.	No

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<i>Stictonetta naevosa</i> Freckled duck	V	-	Breeding occurs in permanent fresh swamps heavily vegetated with cumbungi, lignum, cane grass or tea tree. Also inhabits large open lakes, sewage ponds, dams, creeks and floodwaters.	Bowmans Creek and farm dams within the Application Area provide a limited habitat resource although they do not contain dense fringing vegetation preferred by this species. Unlikely to be significantly impacted by the proposed mining activities.	No
<i>Xanthomyza phrygia</i> Regent Honeyeater	E	E,M	Nomadic species following rich sources of nectar, primarily winter flowering species.	Preferred seasonal habitat is limited within the Application Area and this species is unlikely to be dependant on the resources present. Based on the high mobility of this species and the limited amount of habitat disturbance (if any) there is no potential for significant impact.	No
<b>Mammals</b>					
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	Roosts in caves. Variety of habitat types including dry and wet sclerophyll forest and tall open eucalypt forest with a rainforest sub-canopy.	Limited hunting habitat only is available within the riparian corridor. Suitable roosting sites are not present. Unlikely to be impacted by the proposed mining activities.	No.
<i>Dasyurus maculatus</i> Spotted-tail Quoll	V	E	Wide range of forested habitats including rainforest, open forest, coastal heath, riparian forest. Nests in caves, hollow logs or tree hollows.	Limited habitat is available within riparian corridor although the high levels of surrounding disturbance and the open nature of the shrub layer would deter this species. Unlikely to be impacted by the proposed mining activities.	No

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<i>Miniopterus australis</i> Little Bentwing-bat	V	-	Roosts in caves, old mines, stormwater channels; forages below the forest canopy.	Potential hunting habitat only is available across the Application Area. Suitable roosting sites are not present. Unlikely to be impacted by the proposed mining activities.	No
<i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat	V	-	Roosts in caves, old mines, stormwater channels; forages above the forest canopy.	Potential hunting habitat only is available across the Application Area. Suitable roosting sites are not present. This species has been recorded above Longwalls 1 and 2.	Yes
<i>Mormopterus norfolkensis</i> Eastern Freetail-bat	V	-	Wide range of forested habitats including rainforest to dry open forest. Roosts in tree hollows and under loose bark.	Potential hunting and roosting habitat is available across the Application Area. This species has been recorded above Longwalls 1 and 2 and is likely to occur on site.	Yes
<i>Myotis adversus</i> Large-footed Myotis	V	-	Roosts in caves, tunnels, under bridges and in dense vegetation. Forages over nearby lakes, rivers, large streams.	Potential hunting habitat only is available across the Application Area. Preferred roosting sites are not present although this species has been recorded roosting in trees in the upper catchment of the Bettys Creek (Umwelt 2006). This species has been recorded above Longwalls 1 and 2 and is likely to occur on site.	Yes

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<i>Nyctophilus timoriensis</i> Greater Long-eared Bat	V	V	Inhabits a variety of vegetation types, including mallee, bull oak and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.	Potential hunting and roosting habitat is available across the Application Area. Unlikely to be impacted by the proposed mining activities.	No
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat	V	-	Rivers and creeks within the ranges, roosting in tree hollows.	Potential hunting and roosting habitat is available across the Application Area, particularly within the riparian corridors. Unlikely to be impacted by the proposed mining activities.	No
<i>Petaurus norfolcensis</i> Squirrel Glider	V	-	Dry sclerophyll forest and remnant woodland containing mature or mixed aged stands with gum-barked and winter flowering trees, and mature <i>Acacia</i> species. Nests socially in tree hollows.	Suitable foraging and nesting habitat is available within the riparian corridor. Unlikely to be impacted by the proposed mining activities.	No
<i>Petaurus australis</i> Yellow-bellied Glider	V		Prefer areas of high rainfall in tall mature eucalypt forest, moist coastal gullies, creek flats and tall montane forest.	No suitable habitat is available within the Application Area. A tentative identification from an audible call was made (2001, White Mining EIS) however it is unlikely to occur in the Application Area.	No

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby	E	V	Occupy north facing cliffs in dry eucalypt forest and woodland. They shelter in rock crevices, caves or overhangs during the day, feeding in grassy areas above and below the cliffs in the evening.	No suitable habitat is available within the Application Area. Unlikely to be impacted by the proposed mining activities.	No
<i>Phascolarctos cinereus</i> Koala	V	-	Forests typically on high nutrient soils characterised by presence of preferred feed trees.	A koala was recorded in 1984 in the north eastern corner of Longwall 1 however no recent records or habitat use has been recorded since then. Koalas are not likely to utilise the habitat within the Application Area.	No
<i>Pseudomys oralis</i> Hastings River Mouse	V	-	Damp, dense fern or sedge understorey along drainage lines, but also utilises drier areas with grassy or heathy ground cover.	Limited habitat is available within the riparian corridor. Unlikely to be impacted by the proposed mining activities.	No
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	Forages on fruits, blossoms and nectar of eucalypts. In early summer roosts in large groups (camps) in forests or mangroves.	Seasonal foraging habitat is available within the Application Area. No suitable roost sites were noted. This species has been recorded above Longwalls 1 and 2 and is likely to occur on site on a seasonal basis.	Yes

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat	Likelihood of Occurrence and Potential for Significant Impact	7-part Test Required?
<b>Frogs</b>					
<i>Litoria aurea</i> Green and Golden Bell Frog	V	V	In NSW the species occupies disturbed habitats and breeds largely in ephemeral ponds.	This species was not recorded within the Ashton Coal mine lease area however potential habitat is available within the riparian corridor. Areas of Bettys Creek catchment to the north have records of this species from 1994-1999 and the status of this population is unconfirmed. Based on the fact that Bowmans Creek is unlikely to be impacted by the mining activities, any population of this species within the area will not be significantly impacted.	No
<i>Mixophyes iteratus</i> Southern Barred Frog	V	V	Forage and live amongst deep, damp leave litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest at elevations below 1000 m. Breeds around shallow, flowing rocky streams.	No preferred habitat is available within the Application Area.	No
<i>Status in NSW as per Schedules 1 and 2 of TSC Act: E = Endangered; V = Vulnerable. Status as per EPBC Act: E = Endangered; V = Vulnerable; M = Migratory</i>					

The most direct environmental impact of underground mining is subsidence, which causes changes in the level of the ground surface. Predicted maximum subsidence is up to 1600 mm in longwall areas and 350 mm in miniwall areas as shown in *Table 4.1*.

**Table 4.1** *Subsidence Predictions*

Longwall and Miniwall Panels	Max. Vertical Subsidence (mm)	Max. Tensile Strain (mm/m)	Max. Compressive Strain (mm/m)	Max. Tilt (mm/m)
LW 5	1600	20	27	67
MW 5	200	3.2	4.2	11
LW 6	1600	17	23	57
MW 6	350	3.2	4.2	11
MW 7	350	3.2	4.2	11
MW 8	350	3.2	4.2	11
MW 9	200	3.2	4.2	11
LW 9	1200	15	20	50

*Source: SCT, 2008.*

SCT (2008) states that maximum tilts of 11 to 67 mm/m and horizontal strains of 3.2 to 20 mm/m in tension and 4.2 to 27 mm/m in compression are expected to develop over most of the Application Area as a result of the proposed mining. Localised high levels of strain and tilt are expected over the full and mid-width panels.

The following section predicts impacts on flora and fauna. These include tilt, strain, subsidence, clearing, noise, alterations to watertable levels, increased salinity and surface water flows.

#### 4.1 FLORA

All of those threatened flora species and ecological communities likely to occur within the Application Area as detailed in *Table 3.1* have been collectively referred to within this impact assessment.

##### 4.1.1 Tilt

Subsidence will cause a trough centred above each longwall/miniwall panel. Subsidence troughs are formed through the vertical settlement of rock into the void created as the coal is removed between the chain pillars. As a trough is formed, the ground surface is subjected to certain tilts and strains depending on the geology, depth of cover, panel dimensions and position above the panel.

Surface cracking and tilting are expected to cause some groups of trees to lean permanently at tilts of up to 67 mm/m. Some individual trees with roots



directly impacted by surface cracks may fall over altogether (SCT, 2006). Conversely any trees leaning away from the subsidence induced tilt would be straightened. It is unlikely that any isolated falls that may occur would significantly alter the community composition. To date, no trees have fallen over as a result of longwall mining (Longwalls 1 to 3).

Tilt will not affect shrubs, herbs or grasses, as they are too short to exert significant leverage on root systems. The predicted minor tilting due to subsidence will not cause measurable short or long term damage to any threatened plants, endangered ecological communities or populations within the Application Area.

#### **4.1.2**      *Strain*

Tensile strains pull on structures commonly damaging inflexible material by stretching and rupturing. Over most of the Application Area predicted subsidence will cause maximum tensile strains of 20 mm/m and maximum compressive strains of 27 mm/m (SCT, 2008). Tension cracks are expected to appear along the gate edge and progress behind the retreating longwall face at less than 200 mm across the full width extraction longwall blocks.

This will have little impact on plant roots due to their inherent flexibility. Compressive and tensile strains caused by subsidence act on plant roots much the same as a high wind. In windy weather, particularly on the leeward side of trees, roots are compressed as the trunk sways away from the wind. Roots on the windward side are placed under tension, although this alternates with compression as the trunk sways back and forth.

#### **4.1.3**      *Ponding*

Temporary or permanent ponding of water in flat lying areas following heavy rain or flooding is a potential effect of vertical subsidence. Temporary ponding may occur in areas of water accumulation due to the progress of the longwall face, and will generally cease to be an issue once the face progresses. Permanent ponding may occur where a depression remains once the longwall face has passed.

Subsidence associated with the southern extents of LW/MW 6 to 9, in the vicinity of the flats along Bowmans Creek, may result in localised ponding of surface runoff in these areas following rainfall. Risk of ponding in these areas is considered low given the generally small vertical subsidence predicted in these areas. Ponding may also occur in other isolated areas along drainage lines where they travel perpendicular to the chain pillars. Ponding is most likely to occur in LW6 (up to 1.6 m subsidence) where there are low surface grades and an existing dam.

Ponding of water for an extended time may kill the submerged grasses in these areas or result in a change in the vegetation composition. No areas of

riparian woodland will be impacted by ponding based on the proposed mini wall design.

#### **4.1.4**      *Lowering of the Watertable Beyond the Reach of Plants*

There have been no groundwater dependent ecosystems identified over LW/MW 5 to 9, although a series of small dams and Bowmans Creek support aquatic vegetation. Based on the longwall/miniwall mine design baseflow impact on Bowmans Creek is predicted to be approximately 1.2 L/s, with predicted changes to groundwater levels within the saturated alluvium ranging from 0 to 2.5 m, with an average of 0.8 m drawdown across the Bowmans Creek floodplain. Drawdowns close to Bowmans Creek are predicted to be mostly less than 0.1 m (AquaTerra, *pers comm*). It is therefore unlikely that the watertable will be lowered beyond the reach of plants.

#### **4.1.5**      *Subsiding Vegetation into the Groundwater Zone*

Subsiding vegetation communities close to the water table could potentially affect individual plants. For example, subsiding a dry community into the water table could cause dieback and a transition to those species more suited to wet conditions. Subsiding a wet community further into the water table may extend or improve this community.

Given the nature and depth of the groundwater system it is not expected that plant communities would be subsided into the groundwater zone.

#### **4.1.6**      *Salinity*

Mining under Bowmans Creek floodplain and the associated predicted subsidence will have the effect of reducing baseflow from the Permian sediments to Bowmans Creek and therefore it is not anticipated that mining will cause an increase in salinity in the Bowmans Creek surface flows (AquaTerra, *pers. comm.*).

#### **4.1.7**      *Clearing*

Cracking is likely to occur across the Application Area although it is not expected that clearing of vegetation associated with significant remediation works will be required. It may be more difficult to remediate surface cracking that occurs through the vegetated areas, meaning that cattle would need to be restricted in these areas until such times as natural remediation had filled the cracks.

Remediation to date has been undertaken with the use of a small bob cat and mini excavator, with no vegetation clearing required.

#### 4.1.8 *Changes to Flooding Frequency and Surface Drainage*

Subsidence will alter the topography, potentially impacting on surface catchment flow patterns and altering the minor drainage lines. It will cause a marginal decrease in the water inflow to Bowmans Creek and temporarily increase the percolation characteristics of the strata. Localised ponding of water could result in concentrated water flows and associated erosion. Monitoring for surface drainage impacts, such as ponding, will be carried out before, during and after mining, utilising visual monitoring, and existing topographic surveys. Given the proposed monitoring and management procedures, the alteration of natural flow regimes is unlikely to be of a significant scale and is unlikely to reduce the recruitment potential of the Endangered Population.

#### 4.1.9 *Cumulative Impacts*

Farming, grazing and the nearby open cut mines have resulted in native vegetation clearance. The minor impacts of the Ashton Coal LW/MW 5 to 9 will not significantly increase the effects of the surrounding native vegetation clearance and associated impacts, particularly given that Bowmans Creek is located over the miniwalls and the Endangered Population is outside of the subsidence impact zone.

#### 4.2 *FAUNA*

All of those threatened fauna species likely to occur within the Application Area have been collectively referred to within this impact assessment.

##### 4.2.1 *Vegetation Loss*

Minimal vegetation clearance is expected to occur, if any. The proposed longwall mining is not likely to isolate or reduce the extent of the local vegetation communities present. The proposal will not remove fallen timber, which provides a foraging resource for the Grey-crowned Babbler or reduce the grassy foraging habitat for the Speckled Warbler and Hooded Robin.

##### 4.2.2 *Rock Shelters and Burrows*

Bats may roost in existing rock cracks and a number of burrowing animals such as Wombats are known to occur within the locality. Subsidence may widen or close these fissures and burrows. It is not possible to quantify the likelihood or number of crack closures or burrow collapses. Whilst subsidence could threaten roosting and shelter sites, similar habitat is common within the local area. In some cases, cracking may actually increase the total roosting and shelter habitat for threatened species within the Application Area.

#### 4.2.3

##### *Aquatic Habitats*

Bowmans Creek, Glennies Creek and the Hunter River are not expected to be significantly impacted by the proposed mining activities and only minor impacts to channel morphology are anticipated directly from subsidence movements. A separate aquatic impact assessment has been prepared by Marine Pollution Research (2008).

Subsidence will alter the topography within the Application Area, potentially impacting on surface catchment flow patterns and altering the minor drainage lines. Changes in overland flow contributing to Bowmans Creek will be negligible and unlikely to impact on the quality of the aquatic habitats given the large seasonal and environmental variations already experienced within Bowmans Creek (ERM, 2006a).

Mining under Bowmans Creek and the associated predicted subsidence will have the effect of reducing baseflow from the Permian sediments to Bowmans Creek and therefore it is not anticipated that mining will cause an increase in salinity to water quality (AquaTerra, *pers. comm.*).

#### 4.2.4

##### *Drying of Springs, Soaks and Dams*

Subsidence may cause surface cracking and a consequent reduction in yield from soaks and springs. Whilst the loss of individual springs cannot be discounted, it is unlikely there will be significant changes to the way groundwater is released to receiving watercourses.

Dams across the Application Area are unlikely to require draining ahead of mining. The farm dams have relatively low aquatic habitat value and the Application Area is bordered by Bowmans Creek, Glennies Creek and the Hunter River, which provide an alternate water source for native fauna. Impacts from the underground mining of LW/MW 5 to 9 are unlikely to significantly impact this habitat resource such that a local population of threatened species would be placed at risk.

#### 4.2.5

##### *Cumulative Impacts*

Farming, grazing and the nearby open cut mines have resulted in native vegetation and associated habitat clearance. The minor impacts of the LW/MW 5 to 9 are unlikely to cumulatively increase the effects of the surrounding native vegetation clearance and subsequent habitat loss.

## 5.1 ASSESSMENT OF SIGNIFICANCE

The assessment of significance addresses the potential impact of LW/MW 5 to 9 on threatened species, populations and ecological communities which have been recorded on the Application Area or are likely to be significantly impacted by the proposed mining activities.

The following assessment is based on the Assessment of Significance in Section 5A of the *EP&A Act* as amended by the *Threatened Species Amendment Act 2004*. These factors allow a determination of whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats.

(a) *In the case of threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

### Flora

#### Avifauna

##### *Pyrrholaemus sagittatus* (Speckled Warbler)

The Speckled Warbler has been recorded foraging amongst leaf litter above Longwalls 1 and 2 (ERM, 2006b), and is likely to use the resources present within the Bowmans Creek riparian corridor. Speckled Warblers prefer a range of eucalypt dominated communities supporting a grassy understorey within gullies or rocky ridges. Nests are built with a side entrance in areas of dense branches and other litter. No nests have been confirmed within the Application Area.

The proposed mining will result in surface cracking and tilting causing some trees to lean permanently. This is unlikely to alter the community composition or significantly reduce the extent of potential nest sites. It is not expected that clearing of vegetation associated with significant remediation works will be required. No fallen timber will be removed during the proposed mining and there will be no significant impact to the foraging or breeding habitat of this local population such that it would be placed at risk of extinction.

##### *Pomatostomus temporalis* (Grey-crowned Babbler)

The home range of the Grey-crowned Babbler can reach 12 hectares (Frith, 1982) and previous surveys have identified two distinct breeding populations within the mine lease area. This species has been commonly encountered within the southern woodland and near the Bowmans Creek oxbow. The family group occupying the southern woodland was reported to have

increased from eight birds in September 2004 to twelve in January 2005 with the number of nests increasing from two to six respectively (Parsons Brinckerhoff, 2004b). The most recent survey (ERM, in prep) reported that the number of Grey-crowned Babblers within the Application Area appeared to be stable at around six individuals, with a total of thirteen nests identified. A separate population has been identified within the mine lease area to the north of the New England Highway.

The proposed mining will result in surface cracking and tilting causing some trees to lean permanently. This is unlikely to alter the community composition or significantly reduce the extent of potential nest sites. It is not expected that clearing of vegetation associated with significant remediation works will be required. No fallen timber will be removed during the proposed mining and there will be no significant impact to the foraging or breeding habitat of the local population such that it is placed at risk of extinction.

#### *Melanodryas cucullata cucullata* (Hooded Robin)

The Hooded Robin has been identified in two locations within the southern woodland (ERM, 2007a) and is also likely to occur within the riparian corridor along Bowmans Creek. This species prefers lightly wooded country, usually open eucalypt woodland, Acacia scrub and mallee, often in or near clearings or open areas. Preferred habitat is structurally diverse with four strata present. The territories range from between 10 to 30 hectares during breeding and non-breeding seasons respectively. Breeding occurs between July and November. Threats to survival include clearing resulting in habitat fragmentation and modification or destruction of habitat through heavy grazing, timber removal, frequent fire and exotic grass invasion (Robinson *et al*, 1996).

The proposed mining will result in surface cracking and tilting causing some trees to lean permanently. This is unlikely to alter the community composition or significantly reduce the extent of potential nest sites. It is not expected that clearing of vegetation associated with significant remediation works will be required. No fallen timber will be removed during the proposed mining and there will be no significant impact to the foraging or breeding habitat of this local population such that it is placed at risk of extinction.

#### Microchiropteran bats

##### *Mormopterus norfolkensis* (Eastern Freetail-bat)

The Eastern Freetail-bat occurs within a wide range of forested habitats from rainforest to dry open forest. This species roosts in tree hollows and under loose bark. Minimal disturbance to the resources within the Application Area is expected as a result of the predicted subsidence. No hollow bearing trees will be removed and riparian habitat will not be directly impacted as a result of the proposed extraction. The proposed mining is therefore unlikely to

affect the breeding cycle, roosting or foraging behaviour of the Eastern Freetail-bat.

*Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)

The Eastern Bentwing-bat roost in caves, old mines, stormwater channels and forage above and below the forest canopy. The Eastern Bentwing-bat has been recorded above Longwalls 1 and 2 and is likely to occur within the current Application Area. The proposed mining may actually increase the roosting habitat available for Eastern Bentwing-bat and will not impact the availability or extent of suitable hunting habitat. The lifecycle of this species will not be directly impacted such that the local population will be placed at risk of extinction.

*Myotis adversus* (Large-footed Myotis)

Large-footed Myotis roosts in caves, tunnels, under bridges and in dense vegetation and forages over nearby rivers and large streams. This species is expected to utilise the Application Area for hunting purposes only although this species has been noted roosting in trees in the upper catchment of Bettys Creek (Umwelt 2006). Subsidence induced cracking may result in the loss of some potential hunting habitat within the farm dams, although subsidence impacts to the adjacent Bowmans Creek, Glennies Creek and the Hunter River will be minimal and provide a superior foraging resource. Therefore, the proposed mining will not directly impact the lifecycle of this species such that a local viable population would be placed at risk of extinction.

Megachiropteran bats

*Pteropus poliocephalus* (Grey-headed Flying-fox)

The Grey-headed Flying-fox forages on fruits, blossoms and nectar of eucalypts. This species roosts in large groups (camps) in forests or mangroves in early summer. This species has been recorded within the Application during previous surveys (Parsons Brinckerhoff, 2004b). No suitable roost sites are located within the Application Area however seasonal foraging habitat is available within the riparian corridor.

The proposed mining will result in surface cracking and tilting causing some trees to lean permanently. This is unlikely to alter the community composition or significantly reduce the extent of potential foraging habitat. It is not expected that clearing of vegetation associated with significant remediation works will be required. There will be no significant impact to the foraging habitat of the Grey-headed Flying-fox and the site does not contain suitable roosting habitat. Therefore, the proposed mining activities will not directly impact the lifecycle of this species such that a local extinction would occur.

*(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*

The River Red Gum population in the Hunter Catchment listed as an endangered population under Part 2 Schedule 1 of the TSC Act 1995 was identified adjacent to Bowmans Creek to the west of the subsidence impact zone during previous investigations (ERM, 2006a).

This population will not be directly impacted by the proposed mining and associated subsidence or indirect impacts such as increased salinity and a reduction in the water table.

*(c) In the case of a critically endangered or endangered ecological community, whether the action proposed:*

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

No endangered ecological communities have been recorded on the Application Area. Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions has a preliminary determination to list it as an endangered ecological community under Part 3 Schedule 1 of the TSC Act (NSW Scientific Committee, August 2008). This community has been assessed an endangered population and is unlikely to be impacted by the proposal.

*(d) in relation to the habitat of a threatened species, population or ecological community:*

- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The predicted levels of subsidence are unlikely to significantly modify the structure or availability of the habitat resources provided within the Application Area. It is not expected that clearing of vegetation associated with significant remediation works will be required.



*(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

The proposed mining may result in isolated disturbance to vegetated areas as a result of subsidence induced erosion or surface cracking although it is not expected that clearing of vegetation associated with significant remediation works will be required. The disturbance is not likely to further fragment or isolate the habitat available within the Application Area.

*(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.*

The open grassy woodland is relatively well represented within the locality, although it currently provides only tenuous links with the surrounding vegetation. The proposed mining may result in isolated disturbance to vegetated areas as a result of subsidence induced erosion or surface cracking although it is not expected that clearing of vegetation associated with significant remediation works will be required. The minimal amount of disturbance will not fragment important areas of connecting habitat given the existing tenuous links to surrounding vegetation.

*(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

At present, there is no critical habitat listed in the locality.

*(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

The property is monitored (general observations) for the presence of feral animals including the fox as part of Ashton's existing management framework. If levels of activity are significant, culling techniques are carried out within the Application Area. Relevant threat abatement plans include predation by red fox.

*g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

At present there are 32 key threatening processes listed on Schedule 3 of the TSC Act 1995, as detailed in Table 5.1.

**Table 5.1** Key Threatening Processes Listed in Schedule 3 of the TSC Act

Threatening Process	Applicable to Project
Alteration of habitat following subsidence due to longwall mining	Yes
Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands.	Yes
Bushrock Removal	No
Clearing of native vegetation	Yes
Competition and grazing by the feral European rabbit	Yes
Competition and habitat degradation by feral goats	No
Competition from feral honeybees	No
Death or injury to marine species following capture in shark control programs on ocean beaches	No
Ecological consequences of high frequency fires	No
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments	No
Herbivory and environmental degradation caused by feral deer	No
Human-caused Climate Change	No
Importation of red imported fire ants into NSW	No
Infection by <i>Psittacine circoviral</i> (beak & feather) disease affecting endangered psittacine species	No
Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis	No
Infection of native plants by <i>Phytophthora cinnamomi</i>	No
Introduction of the large earth bumblebee ( <i>Bombus terrestris</i> )	No
Invasion and establishment of exotic vines and scramblers	No
Invasion and establishment of the Cane Toad	No
Invasion of native plant communities by Bitou Bush & Boneseed	No
Invasion of native plant communities by exotic perennial grasses	Yes
Invasion of the Yellow Crazy Ant ( <i>Anoplolepis gracilipes</i> )	No
Invasion, establishment and spread of Lantana ( <i>Lantana camara</i> )	No
Invasion and establishment of Scotch Broom	No
Loss and/or degradation of sites used for hill-topping by butterflies	No
Loss of hollow-bearing trees	No
Predation by feral cats	No
Predation by the European Red Fox	No
Predation by the Plague Minnow ( <i>Gambusia holbrooki</i> )	No
Predation by the Ship Rat ( <i>Rattus rattus</i> ) on Lord Howe Island	No
Predation, habitat degradation, competition and disease transmission by Feral Pigs ( <i>Sus scrofa</i> )	No
Removal of dead wood and dead trees	Yes

Threatening processes relevant to the proposed modification are discussed below.

#### *Alteration of Habitat Following Subsidence Due to Longwall Mining*

Species and ecological communities that depend on aquatic and semi-aquatic habitats are particularly susceptible to the impacts of subsidence. Subsidence can also cause decreased stability of slopes and escarpments; lead to the contamination of groundwater by acid drainage, increased sedimentation, bank instability, creation or alteration of riffle and pool sequences, changes to flood behaviour, increased rates of erosion and deterioration of water (DEC,

2005c). The proposed longwall mining and predicted subsidence levels will not adversely impact any threatened species as detailed in *Chapter 4*.

#### *Alteration of Natural Flow Regimes*

There are no groundwater dependent ecosystems supported within the Application Area. Subsidence will alter the topography, potentially impacting on surface catchment flow patterns and altering the minor drainage lines. It will cause a marginal decrease in the water inflow to Bowmans Creek and temporarily increase the percolation characteristics of the strata. Localised ground surface changes could result in concentrated water flows and associated erosion. Monitoring for surface drainage impacts, such as ponding, will be carried out before, during and after mining, utilising visual monitoring, and existing topographic surveys. Given the proposed monitoring and management procedures, the alteration of natural flow regimes is unlikely to be of a significant scale.

#### *Clearing of Native Vegetation*

The proposed mining may result in isolated disturbance to vegetated areas as a result of subsidence induced erosion or surface cracking although it is not expected that clearing of vegetation associated with significant remediation works will be required. The disturbance will not result in significant impact to the habitat available within the Application Area.

#### *Competition and Grazing by the Feral European Rabbit (*Oryctolagus Cuniculus*)*

The Application Area is already affected by a feral European rabbit population. The proposed longwall mining will not result in an increase of rabbits within the Application Area. The collapse of warrens due to subsidence may actually assist in culling this feral population.

#### *Invasion of Native Plant Communities by Exotic Perennial Grasses.*

The impacts from extraction of LW/MW 5 to 9 will not result in an increase of invasive exotic perennial grasses given the grazing history across the Application Area and minimal disturbance to vegetation.

#### *Predation by Fox (*Vulpes Vulpes*).*

The existing fox population will not be affected by the extraction of LW/MW 5 to 9.

## *Removal of Dead Wood and Dead Trees*

Whilst subsidence may result in isolated tree fall, no hollow bearing trees or fallen timber will be removed from the site.

### 5.2

#### **COMMONWEALTH THREATENED AND MIGRATORY SPECIES**

The Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* requires approval for actions that may have a significant impact on matters of national environmental significance or Commonwealth land. There are no World Heritage properties, National Heritage Places, Ramsar wetlands, Commonwealth marine areas or nuclear actions in or near the Application Area. Commonwealth listed ecological communities and threatened species recorded or likely to occur on the Application Area have been assessed in *Table 3.1*.

Provided the environs continue to function as a wildlife corridor and winter flowering resources are retained, the proposed longwall mining is not expected to cause detrimental impacts upon the health of the remaining vegetation in the Application Area. The assessment of significance considered whether the proposal would:

- decrease the size of a population;
- reduce the area of occupancy of the species;
- fragment an existing population;
- adversely affect critical habitat;
- disrupt the breeding cycle of a population;
- affect the availability or quality of habitat to the extent that the species is likely to decline;
- result in harmful invasive species becoming established on the Application Area;
- introduce disease that may cause species to decline; or
- interfere with the recovery of the species.

The assessment of significance under state legislation concludes that threatened species, communities and populations are not going to be placed at risk of extinction by the proposed extraction. Therefore, it is unnecessary to reassess the threatened species listed in the EPBC Act.

Seven migratory bird species have been identified as having the potential to occur within 10 kilometres of the Application Area. Five of these are

terrestrial birds and two are wetland birds. Habitat for the wetland birds (Latham's Snipe and Painted Snipe) is not provided on the Application Area.

The terrestrial migratory birds are:

- *Haliaeetus leucogaster* (White-bellied Sea-eagle);
- *Hirundapus caudacutus* (White-throated Needletail);
- *Monarcha melanopsis* (Black-faced Monarch);
- *Myiagra cyanoleuca* (Satin Flycatcher); and
- *Rhipidura rufifrons* (Rufous Fantail).

These species may occasionally use the site as foraging habitat. However, the proposal will not result in the removal of any significant area of habitat and the distribution of vegetation communities is not confined to the site. As these species are wide-ranging with generalist habitat requirements, it is unlikely that the proposed longwall mining will have a significant impact on these migratory species. Therefore, the proposed modification will not:

- substantially modify, destroy or isolate an area of important habitat of the migratory species;
- result in harmful invasive species becoming established in the Application Area; or
- seriously disrupt the life cycle of an ecologically significant proportion of a population of the species.

The proposed mining is not expected to have a significant effect upon the health and viability of any threatened or migratory species listed under the provisions of the EPBC Act.

Given the proposal will not impact on matters of national environmental significance, approval from the Commonwealth Minister for the Environment, Heritage and the Arts is not required.

## CONCLUSION

The Application Area is characterised by River Oak Forest along the Bowmans Creek Riparian Corridor and grassland. No threatened flora species have been identified within the Application Area.

The endangered River Red Gum population in the Hunter Catchment was identified adjacent to Bowmans Creek to the west of the subsidence impact zone during previous investigations. Whilst this population will not be impacted by the current proposal the identification of this endangered population requires the development of appropriate amelioration measures. Management of this endangered population will form part of the flora and fauna management plan.

Seven threatened fauna species have been identified within the Application Area, *Pteropus poliocephalus* (Grey-headed Flying-fox), *Miniopterus schreibersii oceansis* (Eastern Bentwing-bat), *Mormopterus norfolkensis* (Eastern Freetail-bat), *Myotis adversus* (Large-footed Myotis), *Pyrrholaemus sagittatus* (Speckled Warbler), *Melanodryas cucullata cucullata* (Hooded Robin) and a breeding population of *Pomatostomus temporalis* (Grey-crowned Babbler). With consideration given to the predicted subsidence levels, the proposal will not significantly impact any of these threatened species, nor will it significantly alter their habitat resources on the site and surrounding lands.

Although no additional threatened species were located in the Application Area during the survey periods, should any be present at other times of the year, they would be unlikely to be significantly impacted directly by the proposed longwall mining operations or indirectly through significant alteration to the habitat resources on the site and surrounding lands.

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Annex A

Flora Species Recorded  
within the Bowmans Creek  
Riparian Corridor

**Table A.1 Flora List – Bowmans Creek Riparian Corridor**

Scientific Name	Common Name
<b>ANACARDIACEAE</b>	
<i>Schinus areira</i>	Pepper Tree
<b>APIACEAE</b>	
<i>Apium leptophyllum</i>	Slender Celery
<i>Foeniculum vulgare</i>	Fennel
<b>ASCLEPIADACEAE</b>	
<i>Gomphocarpus fruticosus</i>	Narrow Leaved Cotton Bush
<b>ASTERACEAE</b>	
<i>Ageratina adenophora</i>	Crofton Weed
<i>Bidens pilosa</i>	Cobblers Pegs
<i>Carthamus lanatus</i>	Saffron Thistle
<i>Cirsium vulgare</i>	Spear Thistle
<i>Conyza albida</i>	Tall Fleabane
<i>Lactuca serriola</i>	Prickly Lettuce
<i>Onopordum acanthium</i>	Scotch Thistle
<i>Senecio madagascariensis</i>	Fireweed
<i>Senecio quadridentatus</i>	Cotton Fireweed
<i>Sonchus oleraceus</i>	Common Sow Thistle
<i>Tagetes minuta</i>	Stinking Roger
<i>Taraxacum officinale</i>	Dandelion
<i>Tragopogon porrifolius</i>	Oyster Plant
<i>Xanthium spinosum</i>	Bathurst Burr
<i>Xanthium occidentale</i>	Noogora Burr
<b>AZOIACEAE</b>	
<i>Galenia pubescens</i>	
<i>Galenia secunda</i>	Galenia
<b>BASELLACEAE</b>	
<i>Anredera cordifolia</i>	Madeira Vine
<b>BRASSICACEAE</b>	
<i>Brassica juncea</i>	Indian Mustard
<i>Brassica fruticulosa</i>	
<i>Lepidium hyssopifolium</i>	Peppercress
<b>BORAGINACEAE</b>	
<i>Heliotropium amplexicaule</i>	Blue Heliotrope
<b>CACTACEAE</b>	
<i>Opuntia aurantiaca</i>	Tiger Pear
<i>Opuntia humifusa</i>	Prickly Pear
<b>CARYOPHYLLACEAE</b>	
<i>Petrorhagia nanteuillii</i>	Proliferous Pink
<i>Stellaria media</i>	Chickweed
<b>CASUARINACEAE</b>	
<i>Casuarina cunninghamia</i>	River She-oak
<b>CHENOPODIACEAE</b>	
<i>Atriplex</i> sp.	Saltbush
<i>Einadia nutans</i>	Native Seaberry
<i>Einadia hastata</i>	
<b>CLUSIACEAE</b>	
<i>Hypericum perforatum</i>	St John's Wort
<b>COMMELINACEAE</b>	
<i>Commelina cyanea</i>	Scurvy Weed
<b>CONVOLVULACEAE</b>	
<i>Convolvulus erubescens</i>	

Scientific Name	Common Name
<b>CRASSULACEAE</b>	
<i>Bryophyllum delagoense</i>	Mother of Millions
<b>CYPERACEAE</b>	
<i>Cyperus eragrostis</i>	
<i>Cyperus exaltatus</i>	
<i>Cyperus gracilis</i>	
<i>Cyperus sanguinolentus</i>	
<i>Schoenus apogon</i>	River Club Rush
<b>EUPHORBIACEAE</b>	
<i>Chamaesyce drummondii</i>	Caustic Weed
<i>Euphorbia peplus</i>	Petty Spurge
<i>Ricinus communis</i>	Castor Oil Plant
<b>FABACEAE</b>	
<i>Glycine clandestina</i>	Love Creeper
<b>GENTIANACEAE</b>	
<i>Centaurium erythraea</i>	Common Centaury
<b>JUNCACEAE</b>	
<i>Baumea articulata</i>	Jointed Twig Rush
<i>Juncus acutus</i>	
<i>Juncus sarophorus</i>	
<i>Juncus subsecundus</i>	Finger Rush
<i>Juncus usitatus</i>	
<b>LAMIACEAE</b>	
<i>Marrubium vulgare</i>	White Horehound
<b>LOMANDRACEAE</b>	
<i>Lomandra longifolia</i>	Mat Rush
<b>MALVACEAE</b>	
<i>Pavonia hastata</i>	Pavonia
<i>Sida rhombifolia</i>	Paddy's Lucerne
<b>MELIACEAE</b>	
<i>Melia azedarach</i>	White Cedar
<b>MIMOSOIDEAE</b>	
<i>Acacia farnesiana</i>	Mimosa Bush
<i>Prosopis juliflora</i>	Mesquite
<b>MYOPORACEAE</b>	
<i>Eremophila debilis</i>	Amulla
<b>MYRTACEAE</b>	
<i>Angophora floribunda</i>	Rough Barked Apple
<i>Eucalyptus camaldulensis</i>	River Red Gum
<i>Eucalyptus crebra</i>	Narrow Leaved Ironbark
<i>Eucalyptus melliodora</i>	Yellow Box
<i>Eucalyptus microcarpa</i>	Grey Box
<b>ONAGRACEAE</b>	
<i>Oenothera indecora</i> ssp. <i>bonariensis</i>	Small Flower Evening Primrose
<i>Oenothera stricta</i>	Common Evening Primrose
<b>OXALIDACEAE</b>	
<i>Oxalis corniculata</i>	Yellow Wood Sorrel
<b>PAPAVERACEAE</b>	
<i>Argemone ochroleuca</i>	Mexican Poppy
<b>PHYTOLACCACEAE</b>	
<i>Phytolacca octandra</i>	Inkweed
<b>PITTOSPORACEAE</b>	
<i>Plantago lanceolata</i>	Plantain
<b>POACEAE</b>	
<i>Anisopogon avenaceus</i>	Oat Speargrass

Scientific Name	Common Name
<i>Aristida vagrans</i>	Three-awn Spear Grass
<i>Arundo</i> sp.	
<i>Austrodanthonia</i> sp	Wallaby Grass
<i>Avena fatua</i>	Wild Oats
<i>Bromus catharticus</i>	Prairie Grass
<i>Bromus molliformis</i>	Soft Brome
<i>Chloris ventricosa</i>	Tall Windmill Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cynodon dactylon</i>	Common Couch
<i>Dichelachne crinata</i>	Longhair Plume Grass
<i>Dichelachne micrantha</i>	Short-haired Plume Grass
<i>Digitaria coenicola</i>	
<i>Eleusine tristachya</i>	
<i>Enneapogon nigricans</i>	Bottle Washers
<i>Setaria geniculata</i> var <i>pauciseta</i>	Slender Pigeon Grass
<i>Setaria verticillata</i>	Whorled Pigeon Grass
<i>Sporobolus creber</i>	Slender Rat's Tail Grass
<i>Stipa bigeniculata</i>	Yanganbill
<i>Panicum maxima</i>	
<i>Panicum simile</i>	Two Colour Panic
<i>Paspalum dilatatum</i>	Common Paspalum
<i>Pennisetum clandestinum</i>	Kikuyu Grass
<i>Phalaris minor</i>	Lesser Canary Grass
<i>Phyllostachys</i> sp.	Bamboo
<i>Stipa scabra</i>	Rough Speargrass
POLYGONACEAE	
<i>Acetosa sagittata</i>	Turkey Rhubarb
<i>Rumex acetosella</i>	Sheep Sorrel
<i>Rumex brownii</i>	Swamp Dock
<i>Rumex conglomeratus</i>	Clustered Dock
<i>Rumex crispus</i>	Curled Dock
<i>Persicaria decipiens</i>	
<i>Persicaria praetermissa</i>	
PRIMULACEAE	
<i>Anagalis arvensis</i>	Scarlet Pimpernel
RANUNCULACEAE	
<i>Ranunculus</i> sp.	Buttercup
RUTACEAE	
<i>Geigeria parviflora</i>	Wilga
ROSACEAE	
<i>Prunus</i> sp	Peach Tree
<i>Rosa</i> sp	Rose
SALICACEAE	
<i>Populus nigra</i>	Lombardy Poplar
SCHIZAEACEAE	
<i>Cheilanthes distans</i>	Bristly Cloak Fern
<i>Cheilanthes sieberi</i>	Mulga Fern
SOLANACEAE	
<i>Cestrum parqui</i>	Green Cestrum
<i>Lycium ferocissimum</i>	African Boxthorn
<i>Solanum pseudocapsicum</i>	Jerusalem Cherry
SCROPHULARIACEAE	
<i>Verbascum virgatum</i>	Twiggy Mullein
SALICACEAE	
<i>Salix babylonica</i>	Weeping Willow

Scientific Name	Common Name
TYPHACEAE	
<i>Typha orientalis</i>	
VALLISNERIA	
<i>Vallisneria gigantea</i>	Ribbon Weed
VERBENACEAE	
<i>Verbena bonariensis</i>	Purpletop
<i>Verbena rigida</i>	
ZYGOPHYLLACEAE	
<i>Tribulus terrestris</i>	Cat Head

Annex B

Fauna Species Recorded  
within the Application Area  
and Adjacent Southern  
Woodland

## FAUNA SPECIES RECORDED IN THE STUDY AREA

The following list includes all species of birds, mammals, reptiles and frogs observed in the Application Area and adjacent southern woodland during the various field surveys. These records are based on field observations and literature searches.

### *Scientific and Common Names*

Scientific names for each fauna assemblage are in accordance with the following references:

- Birds           Christidis and Boles (1994)
- Mammals       Strahan (1995)
- Reptiles       Cogger (1992)
- Amphibians   Cogger (1992)
- Introduced species are indicated by an asterisk (\*)

### *Conservation Status*

Commonwealth conservation status is referenced according to the *Environment Protection and Biodiversity Conservation Act 1999*, as follows:

E Endangered;

X Presumed Extinct;

V Vulnerable; and

M Migratory

Conservation status is referenced according to the *Threatened Species Conservation Act 1995* as follows:

E Endangered;

X Presumed Extinct; and

V Vulnerable

Surveys:

2001 White Mining EIS

2004 Parsons Brinckerhoff

2006 to present ERM

**Table B.1 Fauna Species Recorded in the Application Area and Adjacent Southern Woodland**

Family Scientific Name	Common Name	EPBC	TSC	2001	2004	Summer 2006	Autumn 2006	Spring 2006	Autumn 2007	Spring 2007
<i>i. Birds</i>										
ACCIPITRIDAE										
<i>Haliastur sphenurus</i>	Whistling Kite			☐		☐	☐	☐	☐	☐
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle					☐	☐	☐	☐	☐
<i>Accipiter novaehollandiae</i>	Grey Goshawk			☐		☐	☐	☐	☐	☐
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk					☐	☐	☐	☐	☐
<i>Aquila audax</i>	Wedge-tailed Eagle			☐	☐	☐	☐	☐	☐	☐
<i>Circus approximans</i>	Swamp Harrier			☐					☐	☐
AEGOTHELIDAE										
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar			☐		☐	☐	☐	☐	☐
ALAUDIDAE										
<i>Cincloramphus mathewsi</i>	Rufous Songlark			☐	☐					☐
ALCEDINIDAE										
<i>Alcedo azurea</i>	Azure Kingfisher					☐	☐	☐	☐	☐
ANATIDAE										
<i>Chenonetta jubata</i>	Australian Wood Duck			☐	☐			☐	☐	☐
<i>Anas superciliosa</i>	Pacific Black Duck				☐	☐	☐		☐	☐
ANHINGIDAE										
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant			☐				☐	☐	☐
ARDEIDAE										
<i>Egretta novaehollandiae</i>	White-faced Heron					☐	☐	☐	☐	☐
<i>Ardea alba</i>	Great Egret			☐		☐	☐	☐	☐	☐





Family Scientific Name	Common Name	EPBC	TSC	2001	2004	Summer 2006	Autumn 2006	Spring 2006	Autumn 2007	Spring 2007
<i>Ocyphaps lophotes</i>	Crested Pigeon			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CUCULIDAE										
<i>Cuculus pallidus</i>	Pallid Cuckoo					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Chalcites basalis</i>	Horsefield's Bronze Cuckoo			<input type="checkbox"/>						<input type="checkbox"/>
<i>Eudynamys scolopacea</i>	Common Koel			<input type="checkbox"/>	<input type="checkbox"/>					<input type="checkbox"/>
<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo									<input type="checkbox"/>
<i>Platalea regia</i>	Royal Spoonbill					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DICAERIDAE										
<i>Dicaeum hirundinaceum</i>	Mistletoebird				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DICRURIDAE										
<i>Grallina cyanoleuca</i>	Magpie-lark					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Rhipidura fuliginosa</i>	Grey Fantail					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Rhipidura leucophrys</i>	Willie Wagtail			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FALCONIDAE										
<i>Falco berigora</i>	Brown Falcon					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Falco cenchroides</i>	Nankeen Kestrel					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HALCYONIDAE										
<i>Dacelo novaeguineae</i>	Laughing Kookaburra					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HIRUNDINIDAE										
<i>Hirundo neoxena</i>	Welcome Swallow					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MALURIDAE										
<i>Malurus cyaneus</i>	Superb Fairy-wren			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Malurus lamberti</i>	Variegated Fairy-wren			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MELIPHAGIDAE										

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<i>Anthochaera chrysoptera</i>	Little Wattlebird			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Philemon corniculatus</i>	Noisy Friarbird				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Manorina melanocephala</i>	Noisy Miner				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Plectorhyncha laneolata</i>	Striped Honeyeater			<input type="checkbox"/>						<input type="checkbox"/>
MEROPIDAE				<input type="checkbox"/>						
<i>Merops ornatus</i>	Rainbow Bee-eater			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MOTACILLIDAE				<input type="checkbox"/>						
<i>Anthus novaeseelandiae</i>	Richard's Pipit					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ORIOLIDAE				<input type="checkbox"/>						
<i>Oriolus sagittatus</i>	Olive-backed Oriole				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PACHYCEPHALIDAE				<input type="checkbox"/>						
<i>Colluricincla harmonica</i>	Grey Shrike-thrush			<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Pachycephala pectoralis</i>	Golden Whistler			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Pachycephala rufiventris</i>	Rufous Whistler					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PARDALOTIDAE				<input type="checkbox"/>						
<i>Sericornis frontalis</i>	White-browed Scrub Wren			<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Chthonicola sagittata</i>	Speckled Warbler		V			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Pardalotus punctatus</i>	Spotted Pardalote					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Pardalotus striatus</i>	Striated Pardalote			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Smicrornis brevirostris</i>	Weebill			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Acanthiza lineata</i>	Striated Thornbill				<input type="checkbox"/>					<input type="checkbox"/>
<i>Acanthiza pusilla</i>	Brown Thornbill					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Family Scientific Name	Common Name	EPBC	TSC	2001	2004	Summer 2006	Autumn 2006	Spring 2006	Autumn 2007	Spring 2007
STRIGIDAE				<input type="checkbox"/>						
<i>Ninox novaeseelandiae</i>	Southern Boobook					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
STURNIDAE				<input type="checkbox"/>	<input type="checkbox"/>					
* <i>Acridotheres tristis</i>	* Common Myna					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
THRESKIORNITHIDAE					<input type="checkbox"/>					
<i>Threskiornis spinicollis</i>	Straw-necked Ibis			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TURNICIDAE										
<i>Turnix varia</i>	Painted Button-quail			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TYTONIDAE										
<i>Tyto alba</i>	Barn Owl			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
RALLIDAE										
<i>Porphyrio porphyrio</i>	Purple Swamphen			<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ZOSTEROPIDAE				<input type="checkbox"/>						
<i>Zosterops lateralis</i>	Silvereye			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>ii. Mammals</b>										
BOVIDAE				<input type="checkbox"/>						
* <i>Bos Taurus</i>	* Cattle					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CANIDAE				<input type="checkbox"/>						
* <i>Canis familiaris</i>	* Dog					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
* <i>Vulpes vulpes</i>	* Fox			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DASYURIDAE				<input type="checkbox"/>						
<i>Antechinus flavipes</i>	Yellow-footed Antechinus			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EQUIDAE										
* <i>Equus caballus</i>	* Horse			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Family Scientific Name	Common Name	EPBC	TSC	2001	2004	Summer 2006	Autumn 2006	Spring 2006	Autumn 2007	Spring 2007
<i>FELIDAE</i>										
* <i>Felis catus</i>	* Cat			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>LEPORIDAE</i>										
* <i>Lepus capensis</i>	* Brown Hare			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
* <i>Oryctolagus cuniculus</i>	* Rabbit					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>MACROPODIDAE</i>										
<i>Macropus giganteus</i>	Eastern Grey Kangaroo			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Wallabia bicolor</i>	Swamp Wallaby			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>MURIDAE</i>										
<i>Mus musculus</i>	House Mouse			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Rattus rattus</i>	Black Rat			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>PERAMELIDAE</i>										
<i>Isodon macrourus</i>	Northern Brown Bandicoot					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Perameles nasuta</i>	Long-nosed Bandicoot			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>PETAURIDAE</i>										
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Petaurus breviceps</i>	Sugar Glider					-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>PHALANGERIDAE</i>										
<i>Trichosurus vulpecula</i>	Common Brushtail Possum			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>PTEROPODIDAE</i>										
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>MOLOSSIDAE</i>										
<i>Mormopterus beccarii</i>	Beccari's Freetail-bat		V			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat		V	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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<i>Mormopterus planiceps</i>	Southern Freetail-bat					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Mormopterus</i> sp 2	Freetail-bat			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>VESPERTILIONIDAE</b>										
<i>Chalinolobus gouldii</i>	Gould's wattled bat			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Chalinolobus morio</i>	Chocolate Wattled Bat			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Miniopterus schreibersii oceanis</i>	Eastern Bentwing-bat		V			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Myotis adversus</i>	Fishing Bat		V	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Vespadelus vulturnus</i>	Little Forest Bat					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Tadarida australis</i>	White-striped Mastiff Bat			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>iii. Reptiles</b>										
<b>SCINCIDAE</b>										
<i>Lampropholis guichenoti</i>	Garden Skink				<input type="checkbox"/>					
<i>Morethia boulengeri</i>				<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Pseudemoia trilineata</i>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Tiliqua scincoides</i>	Blue Tongue Lizard					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Egernia striolata</i>	Tree Skink					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>AGAMIDAE</b>										
<i>Physignathus lesuerii</i>	Eastern Water Dragon					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Pogona barbata</i>	Eastern Bearded Dragon							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Tympanocryptis diemensis</i>	Mountain Dragon					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Diporiphora australis</i>	Tommy Roundhead			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>SCINCIDAE</b>										
<i>Ctenotus robustus</i>	Striped Skink							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>TYPHLOPIDAE</b>										
				<input type="checkbox"/>						







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