

17 January 2007

Mr Carl Bagnall  
Mt Arthur Coal Pty Limited  
Private Mail Bag 8  
MUSWELLBROOK NSW 2333

Dear Carl

**Re: 2006 Ecological Monitoring Report – Mt Arthur Coal**

Mt Arthur Coal commissioned Umwelt (Australia) Pty Limited (Umwelt) to undertake a program of ecological monitoring in spring-summer 2006, which followed similar monitoring in 2003, 2004 and 2005. The ecological monitoring program was to be completed in accordance with the requirements of Mt Arthur Coal's Environmental Management System (EMS) including both the MAN Flora and Fauna Management Plan and the Bayswater Rail Loading Facility Flora and Fauna Management Plan. The EMS also encapsulates the requirements of Mt Arthur Coal's various development consents and other approvals and commitments made in the operation's environmental impact statements (EISs).

In 2005 ecological monitoring across the Mt Arthur Coal mining lease area was undertaken at five flora and fauna monitoring sites and three nest box monitoring sites. The number of sites sampled in 2006 was reduced to three flora and fauna monitoring sites and two new nest box monitoring sites following the expiration monitoring requirements of the Bayswater Rail Loading Facility Flora and Fauna Management Plan and the Bayswater No. 3 EIS.

This document reports on the annual 2006 ecological monitoring program which was undertaken in accordance with the above requirements. The report includes the survey methods employed during the monitoring program; the monitoring results obtained; a discussion of the findings; and draws conclusions and makes recommendations to assist Mt Arthur Coal in the continual improvement of their ecological management practices.

**Objective**

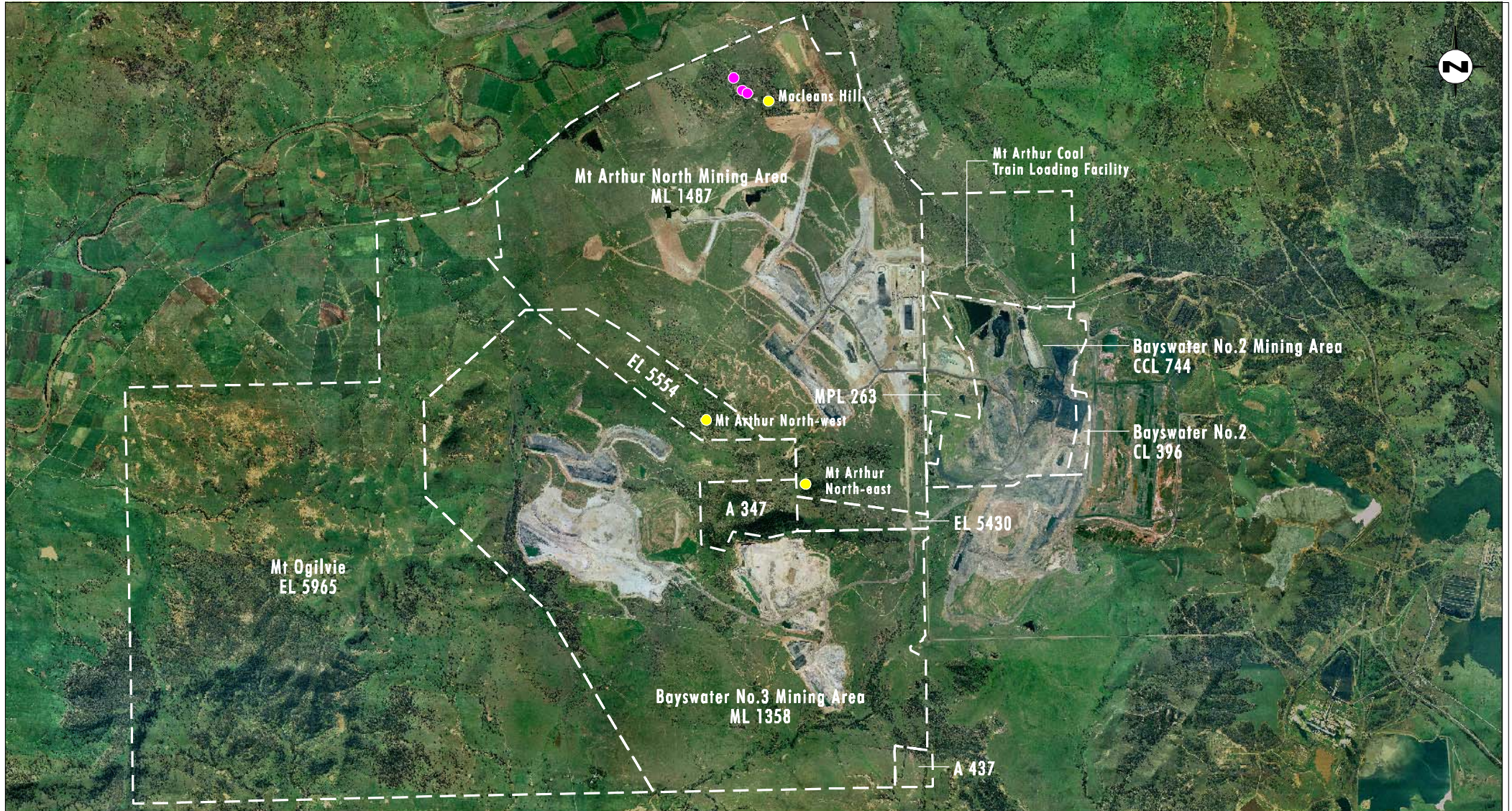
The objective of the flora and fauna monitoring program is to determine if there is any change (including improvements or deterioration) in flora and fauna habitat within Mt Arthur Coal's area of operation and, where appropriate, provide management recommendations to improve ecological management.

**Methods**

**Monitoring Locations**

Three locations at Mt Arthur Coal were monitored in 2006 (**Figure 1**). The three sites were:

- Macleans Hill;
- foothills of Mt Arthur NE (hereafter referred to as Mt Arthur Northeast Slopes); and
- foothills of Mt Arthur NW (hereafter referred to as Mt Arthur Northwest Slopes).



Source: Mt Arthur Coal

0 1 2 4 km  
1:85 000

**Legend**

-  Mining and Exploration Lease Boundaries
-  Remnant Vegetation & Fauna Monitoring Site
-  Speckled Warbler

FIGURE 1

Monitoring Site and Threatened Species Locations

## **Flora Monitoring Methodology**

### **Plot-based Sampling**

Flora monitoring was undertaken in November 2006. Conditions were very warm to hot, with occasional storms over the survey period.

One 400 metre squared permanent vegetation survey plot was sampled at each of the monitoring locations in order to assess flora diversity and abundance. At each site, roughly 45 to 60 minutes were spent searching for all vascular flora species present within the plot. Species located outside the plot were marked as being present but were not assigned a cover-abundance value. Species within the plot were assigned a cover-abundance value to reflect their relative cover and abundance in the plot.

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

### **Plant Identification and Taxonomic Convention**

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler et al. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2006), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide common names. Where the identity of a specimen was unknown or uncertain, it was lodged with the National Herbarium of New South Wales at the Royal Botanic Gardens Sydney.

### **Fauna Monitoring Methods**

At each of the three fauna monitoring locations a range of monitoring techniques were utilised to determine the fauna utilisation of the Mt Arthur Coal area, including the identification of threatened species. At each monitoring location the following was undertaken:

- two hours of spotlighting over two nights;
- two diurnal bird census points;
- two diurnal herpetological surveys in appropriate habitat areas (covering an approximate 1 hectare area);
- two nocturnal herpetological surveys in appropriate habitat areas; and
- a minimum of two all night Anabat bat echolocation call surveys.

Fauna monitoring was undertaken during November 2006, over a total of three nights and two days. Weather conditions during the monitoring period ranged from dry and warm to hot with some daytime temperatures exceeding 35 °C, to cool and dry with strong south easterly winds.

### **Spotlighting**

Spotlighting was conducted on foot using 30 watt Lightforce hand-held spotlights. A total of two person hours of spotlighting over two nights were conducted at each monitoring location. Spotlighting was undertaken generally between 8.30 pm and 11.00 pm.

## **Diurnal Bird Census**

Two diurnal bird surveys of one person hour were undertaken at each of the monitoring locations on two different days. Each survey consisted of a slow walking transect, including numerous stationary points. Species were identified from characteristic calls and by observation, using a 15-45 × 60 spotting scope or 10 × 50 binoculars. Opportunistic observations of bird species were also recorded during other aspects of the field survey. The threatened grey-crowned babbler (*Pomatostomus temporalis temporalis*) and speckled warbler (*Pyrholaemus sagittata*) were targeted during diurnal bird surveys following their identification during previous survey periods.

## **Herpetological Surveys**

Two diurnal and two nocturnal herpetological surveys of one person hour were conducted in likely habitat areas at each monitoring location on two separate days. During each diurnal search, likely microhabitats were examined, such as under rocks, logs, tree bark, ground litter and in wet soak areas. The diurnal searches were typically conducted between 9.00 am and 5.00 pm. Nocturnal herpetological surveys involved searches of dams, drainage lines and ground cover, and were typically conducted between dusk and midnight.

## **Micro-bat Echolocation Recording**

A minimum of two all night Anabat echolocation recordings of micro-bat echolocation calls were conducted at each monitoring location. All calls were later analysed by Glenn Hoye of Fly by Night Bat Surveys Pty Limited. A 30 watt Lightforce hand-held spotlight was used during each walking transect to locate any megachiropteran bat species present.

## **Nest Box Monitoring**

Fifty nest boxes were erected at Mt Arthur Coal in the MAN mining area in January 2006. Monitoring of these nest boxes was undertaken to determine the level of usage by native fauna species and to determine if the boxes have been successful in the provision of alternative habitat for arboreal species. Each nest box was assessed for:

- the presence of fauna:
  - when fauna were identified within a nest box no further assessment of the box from the ladder was undertaken to minimise disturbance to the resident animal(s);
  - in the absence of fauna within the box, signs of usage such as nest building within the box or chew marks around the entrance hole were recorded;
- the condition of the nest box, particularly collapsing joints, bowing timber and/or timber perishing with age;
- additional design features that may aid the use of un-used boxes; and
- the condition of the attachment of the nest box to the tree.

## **Spotted-tailed Quoll Habitat Survey**

During the first half of 2006 a possible sighting of the spotted-tailed quoll was recorded by Mt Arthur staff on the main access road to the Mt Arthur Coal offices adjacent to the A171 authorisation area. An earlier 2003-2004 possible sighting of the spotted-tailed quoll was also made on a haul road in the Bayswater mining area. A survey of nearby possible habitat areas was undertaken at the A171 Authorisation Area, the site of the recent possible sighting.

## Results

### Flora Monitoring Results

A total of 52 flora species were identified across the three sites in 2006 (see **Appendix 1**). A total of 23 flora species were identified at the Mt Arthur Northwest Slopes site, including three introduced species. A total of 32 flora species were identified at the Mt Arthur Northeast Slopes site, including seven introduced species. A total of 20 flora species were identified at the Macleans Hill site, including two introduced species. The total number of species recorded at each site was less than the number recorded at each site in 2005 and is most likely a reflection of the continued drought conditions experienced in the area during 2006.

The Mt Arthur Northwest Slopes site was dominated by narrow-leaved ironbark (*E. crebra*) and kurrajong (*Brachychiton populneus* subsp. *populneus*) with 30% cover to a height of 12 to 16 metres. A very sparse understorey was present, with <5% cover and one to two metres height. It was dominated by juvenile eucalypts. The groundcover was of medium density with a lot of dieback evident. Common species within the ground layer included Jericho wiregrass (*Aristida jerichoensis* var. *jerichoensis*), blue flax lily (*Dianella caerulea*) and wattle mat-rush (*Lomandra filiformis*) and a range of other native grasses and forbs. It was generally less than 0.5 metres in height, with a cover of about 60%. Mt Arthur Northwest Slopes site showed evidence of dieback in the ground cover stratum while the canopy appears healthy and flowering. There were many areas of bare soil due to the dieback within the ground layer. Prickly pear (*Opuntia stricta* var. *stricta*) was recorded within this site during 2004, 2005 and 2006. Prickly pear is listed under the NSW *Noxious Weeds Act 1993* and requires special control techniques to assist in its management.

The Mt Arthur Northeast Slopes site was dominated by spotted gum (*C. maculata*) to a height of 18 to 20 metres, and a cover of 60%. A very sparse understorey consisting of native olive (*Notelaea microcarpa* var. *microcarpa*) was present, being one to two metres in height and less than 5% cover. Coffee bush (*Breynia oblongifolia*) was present in very low numbers. The groundcover was of medium density (50% cover) and low (<1 metre), and was dominated by Jericho wiregrass (*Aristida jerichoensis* var. *jerichoensis*) and wallaby grass (*Austrodanthonia fulva*), as well as a range of other less frequent forbs and grasses. Some dieback was evident within the shrub and ground layers but is most likely attributed to the continuing drought. Prickly pear (*Opuntia stricta* var. *stricta*) was recorded within this site during 2004, 2005 and 2006. Prickly pear is listed under the NSW *Noxious Weeds Act 1993* and requires special control techniques to assist in its management.

The Macleans Hill site was dominated by narrow-leaved ironbark (*E. crebra*) to a height of 12 to 15 metres and density of 15%. A very sparse understorey of <5% cover and one to two metres height was present, dominated by regenerating narrow-leaved ironbark (*E. crebra*). A moderately dense groundcover was present, up to 75% cover and less than one metre in height, dominated by Jericho wiregrass (*Aristida jerichoensis* var. *jerichoensis*), winter apple (*Eremophila debilis*) and Paddy's lucerne (*Sida rhombifolia*), as well as a range of other native and non-native grasses and forbs. Some dieback within the ground layers was evident while the canopy appears to be in good health. The weed species African boxthorn (*Lycium ferocissimum*) was recorded in 2004, 2005 and 2006. This species is listed under the NSW *Noxious Weeds Act 1993*. Management of African boxthorn (*Lycium ferocissimum*) at the site has been undertaken in this area and should be continued to ensure it does not become problematic. Prickly pear (*Opuntia stricta* var. *stricta*) was recorded in low numbers within this site for the first time during 2006. Prickly pear is listed under the NSW *Noxious Weeds Act 1993* and requires special control techniques to assist in its management.

### Fauna Monitoring Results

A total of 67 fauna species were identified across the three sites in 2006 (see **Appendix 2**). A total of 26 fauna species were identified at the Mt Arthur Northwest Slopes site, comprising 13 bird, two reptile and 11 mammal species. A total of 32 fauna species were identified at the Mt Arthur Northeast Slopes site, comprising 18 bird, one reptile, 12 mammal and one frog species. A total of 46 fauna species were identified at the Macleans Hill site, comprising 27 bird, five reptile, 11 mammal and three frog species.

The total number of fauna species at Mt Arthur Northwest Slopes site has decreased, however the number occurring at both Mt Arthur Northeast Slopes site and Macleans Hill site have remained the same or increased. The slight variation in numbers of total species could be attributed mostly to the

natural daily movement patterns of species. At any one time, a species may or may not be present at a survey point as it moves around its daily home range area. As a result, a species present in an area may be recorded during one survey but not another.

A single threatened bird species was recorded during the survey at the Macleans Hill site, with the threatened speckled warbler (*Pyrrholaemus sagittata*) recorded on three occasions (see **Figure 1**). Four threatened micro-bat species were recorded across the three sites comprising eastern freetail-bat (*Mormopterus norfolkensis*), large-eared pied bat (*Chalinolobus dwyeri*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) and the eastern cave bat (*Vespadelus troughtoni*). The eastern freetail-bat has not been recorded at the Mt Arthur Northeast Slopes site before, however it has been recorded at the Saddlers Creek and MD2 sites during the 2005 monitoring survey. The eastern bentwing-bat was recorded at the Mt Arthur Northwest Slopes site in 2004, 2005 and again in 2006, while at the Mt Arthur Northeast Slopes this species was recorded in 2003 and not again until 2006. The Macleans Hill site recorded the eastern bentwing-bat in 2004 and not again until 2006. The large-eared pied bat and the eastern cave bat are both new records for the Mt Arthur monitoring in 2006. The eastern cave bat has been previously recorded at Mt Arthur as part of investigations for the Mt Arthur Underground Project, however the record of the large-eared pied bat is new for the MAN area.

### **Nest Box Monitoring Results**

Twenty-five nest boxes were inspected at the Macleans Hill site on 27 and 28 November 2006. The twenty-five nest boxes comprised six brush-tailed possum (*Trichosurus* spp.), seven glider (*Petaurus* spp.), seven rosella (*Platycercus* spp.) and five bat designed nest boxes. The only animals recorded in the nest boxes were an Australian owlet nightjar (*Aegotheles cristatus*) nestling in nest box 74, an adult Australian owlet nightjar in nest box 72 and a juvenile lace monitor (*Varanus varius*) on the lid of nest box 73. Eight other nest boxes showed signs of use including chew marks around the entrance hole or grass nests within the nest box. Three rosella designed nest boxes contained grass nests and it is likely that the three nest boxes were used for breeding during spring 2006 by eastern rosella's (*Platycercus eximius*).

Twenty-five nest boxes were inspected at the Mt Arthur Northeast Slopes site on 29 and 30 November 2006. The twenty-five nest boxes comprised ten brush-tailed possum (*Trichosurus* spp.), five glider (*Petaurus* sp.), five rosella (*Platycercus* spp.) and five cockatoo designed nest boxes. Common brushtail possums (*Trichosurus vulpecula*) were recorded in five nest boxes, comprising three brush-tailed possum and two cockatoo designed nest boxes. Two of the five nest boxes contained an adult female and a single juvenile possum. All brush-tailed possum and cockatoo designed nest boxes displayed signs of use by brush-tailed possums.

All nest boxes inspected at the Macleans Hill and Mt Arthur Northeast Slopes sites were found to be in excellent structural condition and showed no signs of deterioration. A single nest box (number 97) was found at the base of its tree. Nest box 97 was un-damaged and appeared to have simply slid down the tree trunk following an unknown factor that caused the wire around the trunk to stretch. Nest box 97 was placed at the base of nearby nest box 101 due to a lack of suitable wire to re-erect the nest box on the day and requires re-erection.

### **Spotted-tailed Quoll Habitat Survey**

A walking habitat search of area A171 failed to identify an individual spotted-tailed quolls or any specific habitat features that would identify the recent or prolonged presence of the spotted-tailed quoll in the area. It is likely that the reported spotted-tailed quoll (if it was a spotted-tailed quoll) was moving through the area during dispersal from an unknown area of habitat or was moving through the area as part of a very large foraging range.

### **Presence of Painted Diuris (*Diuris tricolor*) at A171**

As discussed with you previously, the threatened orchid painted diuris (*Diuris tricolor*) is known to occur within the A171 remnant and is listed on the DEC Wildlife Atlas Database. This species is a small terrestrial orchid that is known to flower during September and October each year. It is not able to be detected outside of flowering times, so any surveys of its presence can only be done during this period, preferably early October. Painted diuris is listed as Vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act*

1999 (EPBC Act). Its synonym is *Diuris sheaffiana*, and it is listed as this under the EPBC Act. This species is also the subject of a recent Preliminary Determination by the NSW Scientific Committee, which proposes to list an Endangered Population of *Diuris tricolor* for the Muswellbrook local government area, within which A171 is located.

A stand of potentially several hundred individuals is known to occur in the remnant at A171. Peake (2006) regards this stand to be under significant threat from the invasive Coolatai grass (*Hyparrhenia hirta*), and recommends that crash grazing may be an important tool in controlling weeds and ensuring the continued viability of the species. This stand is regarded as one of the most significant stands of this species in the upper Hunter Valley.

## Conclusion

The total number of flora species recorded at each site was less than in 2005. The most likely reason for the decline in numbers is the continued drought conditions experienced in the area during 2005 and 2006. While the prickly pear (*Opuntia stricta* var. *stricta*) was recorded at all three sites in 2006, the level of infestation was not large enough to warrant additional control measures above those listed in the MAN Flora and Fauna Management Plan and the Bayswater Rail Loading Facility Flora and Fauna Management Plan.

The total number of fauna species at Mt Arthur Northwest Slopes site has decreased, however the numbers present at both Mt Arthur Northeast Slopes site and Macleans Hill site have remained the same or increased. The slight variation in numbers of total species is most likely attributed to the natural daily movement patterns of species.

All nest boxes surveyed were in excellent structural condition and showed no signs of deterioration. Nest box 97 was not damaged during its descent down its tree and should be repositioned in a nearby or the same tree. While no rosellas were recorded in nest boxes, signs of use in the form of old nests within the nest boxes indicated that several of the rosella designed nest boxes provided breeding habitat for the species during spring 2006. Possum designed nest boxes were also successful in providing habitat for common brush-tailed possums at both sites during 2006. While no individual common brush-tailed possums were recorded in nest boxes at Macleans Hill several showed signs of prolonged and recent use. At Mt Arthur Northeast Slopes common brushtail possums were recorded in five nest boxes including cockatoo designed nest boxes.

## Recommended Actions for the Management of Painted Diuris

Given the conservation significance of painted diuris, and the likely substantial size of the population present at A171, it will be important to firstly establish the size and location of the population, and then to manage the environment of the site to ensure the ongoing viability of the population. It is therefore recommended that:

- a targeted botanical survey of the remnant at A171 be conducted in late September or early October 2007 to map the location of the population, record the number of individuals present, and to identify and map significant weed threats, particularly Coolatai grass, or other threats;
- a *Diuris tricolor* Management Plan for A171 should be prepared by early 2008;
- management actions, which are likely to include crash grazing and potentially controlled ecological burning, should commence at the beginning of autumn 2008; and
- ongoing management and monitoring should be undertaken in accordance with the management plan.

As mentioned previously, because of the species' highly restricted flowering season, it will not be possible to undertake surveys for it after probably late October.

## General Recommendations

Following the above investigations of the remnant vegetation and fauna communities across the three monitoring sites, the implementation of the following management recommendations will continue to improve the ecological values of the flora and fauna across the Mt Arthur Coal mining lease area:

- the level of infestation of the weed prickly pear (*Opuntia stricta* var. *stricta*) across the Mt Arthur Coal mining area should continue to be monitored at least annually;
- Mt Arthur Coal should co-ordinate with local authorities that may currently be implementing control programs for prickly pear in the area;
- domestic stock should continue to be excluded from remnant vegetation sites where possible. Domestic stock should only be permitted in remnant vegetation areas where they are needed to reduce wildfire fuel levels in the form of long grass;
- vertebrate pest management measures outlined in the MAN Flora and Fauna Management Plan and the Bayswater Rail Loading Facility Flora and Fauna Management Plan should continue to be implemented on an ongoing basis; and
- nest box 97 should be re-installed in a nearby or the same tree.

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If you require further information please do not hesitate to contact either Steven Cox, Senior Ecologist, or myself on 4950 5322.

Yours faithfully



Travis Peake  
Ecology Manager

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## Appendix 1 - Flora Species List

This appendix presents the floristic data collected at all nine monitoring sites during the 2005 and 2004 monitoring surveys.

- Species denoted with an asterisk (\*) are not native to the study area.
- Numbers denote cover-abundance scores for species within plots as explained in the table below.

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

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

- X denotes species found immediately adjacent to but not inside the survey plot.

Family/Subfamily	Scientific Name	Common Name	Mt Arthur North-West Slopes			Macleans Hill			Mt Arthur North-east Slopes		
			06	05	04	06	05	04	06	05	04
<b>Filicopsida (Ferns)</b>											
ADIANTACEAE	<i>Cheilanthes distans</i>	bristly cloak fern		2			2	2			
	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	poison rock fern		2			2	2		2	1
<b>Magnoliopsida (Flowering Plants) – Liliidae (Monocots)</b>											
ANTHERICACEAE	<i>Arthropodium</i> sp.	a vanilla lily									1
	<i>Dichopogon</i> sp.	a chocolate lily			1						
CYPERACEAE	<i>Carex inversa</i>	knob sedge						1			
	<i>Cyperus gracilis</i>	a sedge					2	2			
LOMANDRACEAE	<i>Lomandra confertifolia</i>								2	2	2
	<i>Lomandra filiformis</i>	wattle mat-rush	2	1	1						
	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	many-flowered mat-rush				2	2	2			
LUZURIAGACEAE	<i>Eustrephus latifolius</i>	wombat berry								2	2
	<i>Geitonoplesium cymosum</i>	scrambling lily							2	2	
PHORMIACEAE	<i>Dianella caerulea</i>	blue flax lily	2	2	1						
POACEAE	<i>Aristida jerichoensis</i>	Jericho wiregrass	2	3	3	2	2	3		2	3
	<i>Austrodanthonia fulva</i> (syn. <i>Danthonia linkii</i> var. <i>fulva</i> )	wallaby grass	2	2	1		2	2	2	2	3
	<i>Austrodanthonia richardsonii</i>	straw wallaby-grass							2	2	2
	<i>Austrostipa scabra</i> (syn. <i>Stipa scabra</i> )	speargrass		1	2	2	2	2			
	<i>Austrostipa verticillata</i> (syn. <i>Stipa verticillata</i> )	slender bamboo grass		1	1		2	3			
	<i>Bothriochloa macra</i>	red grass			1						
	<i>Chloris ventricosa</i>	tall chloris	2			1					
	<i>Cymbopogon refractus</i>	barbed wire grass		2	2		2	2		1	2
	<i>Cynodon dactylon</i>	couch		2	1					2	2
	<i>Dichanthium sericeum</i>	Queensland bluegrass			1						
	<i>Elymus scaber</i>	wheatgrass			1		2	1		2	
	<i>Elymus scaber</i> var. <i>scaber</i>	common wheatgrass									2
	<i>Entolasia stricta</i>	wiry panic					2	2			
	<i>Eragrostis brownii</i>	Brown's lovegrass				1	2	2		2	1
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	weeping grass								2	2
	<i>Panicum</i> sp.						1		1	1	
	<i>Poa sieberiana</i>	snow grass								2	2
	<i>Sporobolus creber</i>	slender rat's tail grass			2						
	<i>Themeda australis</i>	kangaroo grass					2				
<b>Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)</b>											
ACANTHACEAE	<i>Brunoniella australis</i>	blue trumpet						2			2
	<i>Pseuderanthemum variabile</i>	pastel flower		1							

Family/Subfamily	Scientific Name	Common Name	Mt Arthur North-West Slopes			Macleans Hill			Mt Arthur North-east Slopes		
			06	05	04	06	05	04	06	05	04
ACANTHACEAE (cont)	<i>Rostellularia adscendens</i> var. <i>adscendens</i>			2		1	2		2	2	
AIZOACEAE	* <i>Galenia pubescens</i>	galenia				2					
ASCLEPIADACEAE	* <i>Gomphocarpus fruticosus</i>	narrow-leaved cotton-bush		1	1			1			
ASTERACEAE	* <i>Bidens pilosa</i>	cobbler's pegs						1		1	1
	<i>Calotis lappulacea</i>	yellow burr-daisy		2	2	2		2			
	<i>Cassinia quinquefaria</i>	cough-bush			1				1	2	2
	<i>Chrysocephalum apiculatum</i>	common everlasting		1	2	1	2	2		1	1
	* <i>Cirsium vulgare</i>	spear thistle						1			
	* <i>Conyza sumatrensis</i> (syn. <i>Conyza albida</i> )	tall fleabane						1			
	<i>Glossogyne tannensis</i>	cobbler's tack		2	2		2	1			
	* <i>Hypochaeris radicata</i>	catsear								2	1
	<i>Pseuderanthemum variabile</i>	pastel flower			2						
	* <i>Senecio madagascariensis</i>	fireweed		1	1	1		2		1	2
	<i>Senecio</i> sp.						2				
	* <i>Sonchus oleraceus</i>	common sowthistle						1			
	<i>Vernonia cinerea</i> var. <i>cinerea</i>									2	1
	<i>Vittadinia</i> sp.	a fuzzweed									2
	<i>Vittadinia sulcata</i>	a fuzzweed					2				
BORAGINACEAE	<i>Cynoglossum australe</i>	Australian hound's tongue									1
BRASSICACEAE	* <i>Lepidium africanum</i>	common peppergrass			1	2		2			
CACTACEAE	* <i>Opuntia aurantiaca</i>	tiger pear	1								
	* <i>Opuntia stricta</i> var. <i>stricta</i>	common prickly pear	2	2	2	2			2	2	1
CAMPANULACEAE	<i>Wahlenbergia communis</i>	tufted bluebell	2	2	2	1	2	2			
	<i>Wahlenbergia gracilis</i>	sprawling bluebell							1	2	2
	<i>Wahlenbergia</i> sp.	native bluebell								1	
CARYOPHYLLACEAE	* <i>Silene gallica</i> var. <i>gallica</i>	a campion									2
CASUARINACEAE	<i>Allocasuarina luehmannii</i>	bulloak				1					
CHENOPODIACEAE	<i>Einadia hastata</i>	berry saltbush				1					
	<i>Einadia nutans</i>	climbing saltbush		1		2	2	1			
	<i>Einadia nutans</i> subsp. <i>linifolia</i>	climbing saltbush	2								
	<i>Einadia trigonos</i>	fishweed					2				
	<i>Enchylaena tomentosa</i>	ruby saltbush	1			1		1			
	<i>Maireana microphylla</i>	eastern cottonbush				1	2	2			
CHLOANTHACEAE	<i>Spartothamnella juncea</i>	square-stemmed broom		1	1	1				1	1
CLUSIACEAE	<i>Hypericum gramineum</i>	small St. John's wort							1		
CONVOLVULACEAE	<i>Convolvulus erubescens</i>	a bindweed			1						
	<i>Dichondra repens</i>	kidney weed		2						2	2

Family/Subfamily	Scientific Name	Common Name	Mt Arthur North-West Slopes			Macleans Hill			Mt Arthur North-east Slopes		
			06	05	04	06	05	04	06	05	04
EUPHORBIACEAE	<i>Breynia oblongifolia</i>	coffee bush		1						3	2
	<i>Phyllanthus</i> sp.	a spurge						1	1		
	<i>Phyllanthus virgatus</i>	a spurge	2		1					2	1
FABACEAE (MIMOSOIDEAE)	<i>Acacia falcata</i>	hickory wattle								1	1
	<i>Acacia implexa</i>	hickory wattle	2	2	1						
FABACEAE (FABOIDEAE)	<i>Desmodium varians</i>	slender tick-trefoil		2	2	1	2	1	1	2	2
	<i>Glycine clandestina</i>	twining glycine	2			2	2		2	2	2
	<i>Glycine tabacina</i>	a glycine	2	2	2	2	2	2	2	2	2
	<i>Hardenbergia violacea</i>	false sarsaparilla								1	1
GENTIANACEAE	* <i>Centaurium spicatum</i>	spike centaury							2		
	* <i>Centaurium tenuiflorum</i>	branched centaury				2					
GOODENIACEAE	<i>Brunonia australis</i>	blue pincushion								2	
	<i>Goodenia pinnatifida</i>									1	
LORANTHACEAE	<i>Amyema pendulum</i> subsp. <i>pendulum</i>	drooping mistletoe				2	2	1			
MALVACEAE	<i>Sida corrugata</i>	corrugated sida	2	1		2	2	2			
	* <i>Sida rhombifolia</i>	Paddy's lucerne		2	2	3	2	3		2	2
	<i>Sida</i> sp.				2		2				
MYOPORACEAE	<i>Eremophila debilis</i>	winter apple	2	2	2	2	2	2	2	2	1
	<i>Myoporum montanum</i>	western boobialla									1
MYRTACEAE	<i>Corymbia maculata</i>	spotted gum							5	4	4
	<i>Eucalyptus albens/moluccana</i> intergrade	white/grey box	3	2	2						
	<i>Eucalyptus crebra</i>	narrow-leaved ironbark	3	3	3	3	2	2			
NYCTAGINACEAE	<i>Boerhavia dominii</i>	tarvine			1						2
OLEACEAE	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	native olive	2	2	2	X			3	2	2
OXALIDACEAE	<i>Oxalis exilis</i>	a wood sorrel					2			2	1
PITTIOSPORACEAE	<i>Bursaria spinosa</i> subsp. <i>spinosa</i> (syn. <i>B. spinosa</i> var. <i>spinosa</i> )	blackthorn					2	2			
PLANTAGINACEAE	* <i>Plantago lanceolata</i>	lamb's tongues		1	1			2		1	1
POLYGONACEAE	* <i>Polygonum aviculare</i>	wireweed						1			
PORTULACACEAE	<i>Portulaca oleracea</i>	pigweed			1						
PRIMULACEAE	* <i>Anagallis arvensis</i>	scarlet pimpernell		1							
RANUNCULACEAE	<i>Clematis glycinoides</i> var. <i>glycinoides</i>	headache vine	2	2	2				2	3	2
RUBIACEAE	<i>Galium propinquum</i>	Maori bedstraw								1	
	<i>Galium</i> sp.			1							
SCROPHULARIACEAE	* <i>Linaria pelisseriana</i>	Pelisser's toadflax			2						
SOLANACEAE	* <i>Lycium ferocissimum</i>	African boxthorn	2			2	2	1			
	<i>Solanum brownii</i>	violet nightshade	2	2	2	1	2	2			1

Family/Subfamily	Scientific Name	Common Name	Mt Arthur North-West Slopes			Macleans Hill			Mt Arthur North-east Slopes		
			06	05	04	06	05	04	06	05	04
STACKHOUSIACEAE	<i>Stackhousia viminea</i>	slender stackhousia				2		2			1
STERCULIACEAE	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	kurrajong	3	2	2				1	2	2
THYMELAEACEAE	<i>Pimelea linifolia</i>	slender rice flower			1						

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## Appendix 2 – Mt Arthur Coal Fauna Monitoring – Species List (2003, 2004, 2005 & 2006)

The following list was developed from monitoring surveys of three monitoring sites Mt Arthur Coal. It includes all species of vertebrate fauna observed at Mt Arthur Coal during fieldwork.

The following column headings are used to identify the monitoring sites:

- Site 1 Mt Arthur Northwest slopes;
- Site 2 Mt Arthur Northeast slopes; and
- Site 3 Macleans Hill.

The following symbols are used to identify the timing and method of detection in the appendix table:

- X Identified from visual sighting or characteristic call during 2003 survey;
- O Identified from visual sighting or characteristic call during 2004 survey;
- A Identified from visual sighting or characteristic call during 2005 survey;
- B Identified from visual sighting or characteristic call during 2006 survey; and
- E “Definite” identification from hair and skull sample by Barbara Triggs.

All following abbreviations or symbols signify 2005 records.

- S Identified from scat sample(s) in field;
- D “Definite” identification from scat or hair sample by Barbara Triggs;
- Pr “Probable” identification from scat or hair sample by Barbara Triggs;
- H Identified from hair funnel sample(s);
- T Identified from tracks and/or traces such as burrows, nests or feathers;
- C “Confident” identification by Fly by Night Bat Surveys Pty Ltd;
- P “Probable” identification by Fly by Night Bat Surveys Pty Ltd; and
- Po “Possible” identification by Fly by Night Bat Surveys Pty Ltd.

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

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

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The following abbreviations or symbols are used in the list:

- asterisk (\*) denotes species not indigenous to the study area;
- subsp.      subspecies;
- MAR      Listed marine species under the *Environment Protection and Biodiversity Act 1999* (EPBC Act);
- MIG      Listed migratory species under the EPBC Act 1999;
- V      Vulnerable under Schedule 2 of the *Threatened Species Conservation Act 1995*; and,
- E      Endangered under Schedule 2 of the *Threatened Species Conservation Act 1995*.

Birds recorded were identified using descriptions in Slater et al. (2003) and the scientific and common name nomenclature of Birds Australia. Reptiles recorded were identified using keys and descriptions in Cogger (1994), Swan et al. (2004), Weigel (1990) and Wilson & Swan (2003) and the scientific and common name nomenclature of Cogger (1994).

Amphibians recorded were identified using keys and descriptions in Cogger (1994), Robinson (1998), Anstis (2002) and Barker et al. (1995) and the scientific and common name nomenclature of Cogger (1994). Mammals recorded were identified using keys and descriptions in Strahan (1995), Churchill (1998) and Menkhorst & Knight (2004) and the scientific and common name nomenclature of Strahan (1995) for non-bat species and Churchill (1998) for bats.

Scientific Name	Common Name	Conservation Status		Sites		
		TSC Act	EPBC Act	Mt Arthur North-West Slopes	Macleans Hill	Mt Arthur North-East Slopes
<b>BIRDS</b>						
<b>Phasianidae</b>						
<i>Coturnix ypsilophora</i>	brown quail					A
<b>Charadriidae</b>						
<i>Vanellus miles</i>	masked lapwing					A
<b>Accipitridae</b>						
<i>Elanus notatus</i>	black-shouldered kite					X
<i>Aquila audax</i>	wedge-tailed eagle			OB	OA	OB
<b>Falconidae</b>						
<i>Falco berigora</i>	brown falcon					O
<i>Falco cenchroides</i>	nankeen kestrel			B	O	OXB
<b>Columbidae</b>						
<i>Ocyphaps lophotes</i>	crested pigeon					OB
<b>Cacatuidae</b>						
<i>Cacatua roseicapilla</i>	galah			OX	XB	OA
<i>Cacatua galerita</i>	sulphur-crested cockatoo			X	OXAB	A
<b>Psittacidae</b>						
<i>Alisterus scapularis</i>	Australian king-parrot			A	OA	
<i>Platycercus eximius</i>	eastern rosella				XA	OAB
<i>Psephotus haematonotus</i>	red-rumped parrot					
<b>Podargidae</b>						
<i>Podargus strigoides</i>	tawny frogmouth			O	AB	A
<b>Aegothelidae</b>						
<i>Aegotheles cristatus</i>	Australian owlet-nightjar			OAB		B
<b>Apodidae</b>						
<i>Hirundapus caudacutus</i>	white-throated needletail				A	
<b>Halcyonidae</b>						
<i>Dacelo novaeguineae</i>	laughing kookaburra			OA		AB
<i>Todiramphus sanctus</i>	sacred kingfisher				O	
<b>Climacteridae</b>						
<i>Corombates leucophaeus</i>	white-throated treecreeper			O	OA	
<b>Maluridae</b>						
<i>Malurus cyaneus</i>	superb fairy-wren			OAB	OAB	OAB
<b>Pardalotidae</b>						
<i>Pardalotus punctatus</i>	spotted pardalote			OXA	OA	A
<i>Pardalotus striatus</i>	striated pardalote				OAB	OAB
<i>Sericornis frontalis</i>	white-browed scrubwren				O	
<i>Pyrrholaemus sagittata</i>	speckled warbler	V				OAB
<i>Smicronis brevirostris</i>	weebill			OAB		OAB
<i>Gerygone mouki</i>	brown gerygone			A		O

Scientific Name	Common Name	Conservation Status		Sites		
		TSC Act	EPBC Act	Mt Arthur North-West Slopes	Macleans Hill	Mt Arthur North-East Slopes
<i>Gerygone olivacea</i>	white-throated gerygone			O		O
<i>Acanthiza reguloides</i>	buff-rumped thornbill			O	A	
<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill			OAB	OA	OAB
<i>Acanthiza nana</i>	yellow thornbill			X		X
<i>Acanthiza pusilla</i>	brown thornbill					X
<b>Acanthizidae</b>						
<i>Gerygone fusca</i>	western gerygone			B	B	AB
<b>Parulidae</b>						
<i>Dendroica dominica</i>	yellow-throated warbler			A		
<b>Meliphagidae</b>						
<i>Philemon corniculatus</i>	noisy friarbird			OA	A	OAB
<i>Philemon citreogularis</i>	little friarbird				B	O
<i>Manorina melanocephala</i>	noisy miner			OAB	AB	OA
<i>Lichenostomus penicillatus</i>	white-plumed honeyeater				OAB	B
<i>Melithreptus brevirostris</i>	brown-headed honeyeater				OB	
<i>Melithreptus lunatus</i>	white-naped honeyeater					X
<b>Petroicidae</b>						
<i>Petroica goodenovii</i>	red-capped robin					B
<b>Pomatostomidae</b>						
<i>Pomatostomus temporalis</i>	grey-crowned babbler	V				
<b>Neosittidae</b>						
<i>Daphoenositta chrysoptera</i>	varied sittella			OA	O	
<b>Pachycephalidae</b>						
<i>Pachycephala rufiventris</i>	rufous whistler				O	OAB
<i>Pachycephala pectoralis</i>	golden whistler			X		
<i>Culluricincla harmonica</i>	grey shrike-thrush			X	X	X
<b>Dicruridae</b>						
<i>Grallina cyanoleuca</i>	magpie-lark			AB		OA
<i>Rhipidura fuliginosa</i>	grey fantail			OXA	X	X
<i>Rhipidura leucophrys</i>	willie wagtail				OAB	AB
<b>Campephagidae</b>						
<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike			OA	OB	OAB
<i>Lalage sueurii</i>	white-winged triller					AB
<b>Oriolidae</b>						
<i>Oriolus sagittatus</i>	olive-backed oriole					B

Scientific Name	Common Name	Conservation Status		Sites		
		TSC Act	EPBC Act	Mt Arthur North-West Slopes	Macleans Hill	Mt Arthur North-East Slopes
<b>Artamidae</b>						
<i>Artamus cyanopterus</i>	dusky woodswallow				OB	B
<i>Artamus superciliosus</i>	white-browed woodswallow			B		
<i>Cracticus torquatus</i>	grey butcherbird			O	AB	OA
<i>Cracticus nigrogularis</i>	piebald butcherbird				B	O
<i>Gymnorhina tibicen</i>	Australian magpie			OAB	OXA	OXAB
<i>Strepera graculina</i>	piebald currawong			OXAB	OAB	B
<b>Corvidae</b>						
<i>Corvus coronoides</i>	Australian raven			OXAB	OXAB	OAB
<b>Corcoracidae</b>						
<i>Corcorax melanorhamphos</i>	white-winged chough			OXA	OXAB	X
<b>Motacilidae</b>						
<i>Anthus novaeseelandiae</i>	Richard's pipit					B
<b>Passeridae</b>						
<i>Taeniopygia bichenovii</i>	double-barred finch			OAB		
<i>Neochmia temporalis</i>	red-browed finch				O	
<b>Dicaeidae</b>						
<i>Dicaeum hirundinaceum</i>	mistletoebird			OA	AB	OAB
<b>Sylviidae</b>						
<i>Cincloramphus mathewsi</i>	rufous songlark					B
<b>REPTILES</b>						
<b>Cheloniidae</b>						
<i>Chelodina longicollis</i>	snake-necked turtle					A
<b>Gekkonidae</b>						
<i>Diplodactylus vittatus</i>	stone gecko				O	B
<b>Varanidae</b>						
<i>Varanus varius</i>	lace monitor			OAB	B	B
<b>Agamidae</b>						
<i>Pogona barbata</i>	eastern bearded dragon			O		O
<i>Amphibolurus muricatus</i>	jacky lizard					B
<b>Scincidae</b>						
<i>Carlia tetradactyla</i>	southern rainbow skink			A	OA	A
<i>Ctenotus robustus</i>	striped skink			B		B
<i>Egernia modesta</i>						
<i>Egernia striolata</i>	tree skink			A	X	B
<i>Lampropholis delicata</i>	garden skink				X	
<b>Elapidae</b>						
<i>Furina diadema</i>	red-naped snake					A

Scientific Name	Common Name	Conservation Status		Sites		
		TSC Act	EPBC Act	Mt Arthur North-West Slopes	Macleans Hill	Mt Arthur North-East Slopes
<b>MAMMALS</b>						
<b>Tachyglossidae</b>						
<i>Tachyglossus aculeatus</i>	short-beaked echidna			O,S(5)B	OB	
<b>Vombatidae</b>						
<i>Vombatus ursinus</i>	common wombat			X,S(A)B	X,S(A)B	
<b>Phalangeridae</b>						
<i>Trichosurus vulpecula</i>	common brushtail possum			OAB	OXAB	B
<b>Macropodidae</b>						
<i>Macropus giganteus</i>	eastern grey kangaroo			OXAB	OXAB	OXAB
<i>Macropus robustus</i>	common wallaroo			OB	X	OA
<i>Macropus rufogriseus</i>	red-necked wallaby			AB	OXA	OXAB
<i>Wallabia bicolor</i>	swamp wallaby					
<b>Molossidae</b>						
<i>Nyctinomus australis</i>	white-striped freetail-bat			B	X	B
<i>Mormopterus norfolkensis</i>	eastern freetail-bat	V				B(C)
<i>Mormopterus planiceps</i>	southern freetail-bat			B(C)	B(C)	B(C)
<i>Mormopterus</i> sp.	little freetail bat					
<i>Mormopterus</i> sp. 2						B(P)
<i>Chalinolobus dwyeri</i>	large-eared pied bat	V	V		B(Po)	
<i>Chalinolobus gouldii</i>	Gould's wattled bat			O(P) A(C) B(C)	X B(P)	A(C) B(C)
<i>Chalinolobus morio</i>	chocolate wattled bat				X B(P)	B(C)
<i>Miniopterus schreibersii oceanensis</i>	eastern bentwing-bat	V		O(P) A(C) B(C)	X	O(P) B(C)
<i>Myotis adversus</i>	large-footed myotis	V			X	
<i>Nyctophilus</i> sp.	long-eared bat					
<i>Scotorepens balstoni</i>	inland broad-nosed bat			O(P) B(P)	X B(C)	B(C)
<i>Vespadelus regulus</i>	southern forest bat					A(PO)
<i>Vespadelus troughtoni</i>	eastern cave bat	V			B(P)	
<i>Vespadelus vulturnus</i>	little forest bat				X A(P) B(P)	A(PO) B(C)
<b>Muridae</b>						
* <i>Mus musculus</i>	house mouse					H(A)
<b>Canidae</b>						
* <i>Vulpes vulpes</i>	fox				O	

Scientific Name	Common Name	Conservation Status		Sites		
		TSC Act	EPBC Act	Mt Arthur North-West Slopes	Macleans Hill	Mt Arthur North-East Slopes
<b>Leporidae</b>						
<i>*Oryctolagus cuniculus</i>	rabbit			X	O	
<i>*Lepus capensis</i>	brown hare			A	OXA	
<b>Mustelidae</b>						
<i>*Mustela putorius</i>	ferret				E†	
<b>AMPHIBIANS</b>						
<b>Myobatrachidae</b>						
<i>Crinia signifera</i>	brown froglet					A
<i>Limnodynastes ornatus</i>	ornate burrowing frog					B
<i>Limnodynastes tasmaniensis</i>	spotted marsh frog			OA	A	OAB
<i>Uperoleia laevigata</i>	smooth toadlet					OA
<b>Hylidae</b>						
<i>Litoria fallax</i>	green reed frog, dwarf tree frog					A
<i>Litoria latopalmata</i>	broad-palmed frog			O		OAB
<i>Litoria peronii</i>	Peron's tree frog			O	B	A

Note: † Approximately 500 metres east of the site.