WILPINJONG COAL PROJECT

APPENDIX HC

Bat Fauna Assessment

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WILPINJONG COAL PROJECT

BAT FAUNA ASSESSMENT

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JANUARY 2005
Document No. BFARO1-J.DOC

TABLE OF CONTENTS

Section			Page
HC1	INTRODUCTION		HC-1
	HC1.1	SURVEY OBJECTIVES	HC-1
HC2	STUDY AREA AND SURROUNDS		HC-1
HC3	METHODS		HC-1
	HC3.1	BACKGROUND INFORMATION	HC-1
	HC3.2	FIELD SURVEY	HC-5
		HC3.2.1 Survey Timing and Weather Conditions	HC-5
		HC3.2.2 Sampling Sites	HC-5
		HC3.2.3 Habitat Assessment	HC-8
		HC3.2.4 Survey Techniques	HC-9
		HC3.2.4.1 Targeted Surveys for Threatened Species	HC-9
		HC3.2.4.2 Electronic Bat Detection, Harp Trapping and Spotlighting	HC-9
HC4	RESULTS AND DISCUSSION		HC-10
	HC4.1	HABITAT ASSESSMENT	HC-10
	HC4.2	BAT FAUNA COMPOSITION	HC-12
		HC4.2.1 Species Diversity and Relative Abundance	HC-12
		HC4.2.2 Habitat Utilisation	HC-13
	HC4.3	THREATENED BAT FAUNA	HC-17
	HC4.4	THREATENED BAT FAUNA NOT RECORDED	HC-19
HC5	POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES		HC-20
	HC5.1	LOSS OF FORAGING HABITAT	HC-20
	HC5.2	LOSS OF ROOST SITES	HC-21
HC6	REFERENCES		HC-21

LIST OF TABLES

Table HC-1	Bat Fauna Recorded from the Wider Region
Table HC-2	Overview of Autumn Bat Fauna Sampling Sites
Table HC-3	Overview of Spring Bat Fauna Sampling Sites
Table HC-4	Index of Roost Availability at Each Sampling Site
Table HC-5	Bat Species Recorded
Table HC-6	Number of Echolocation Calls Recorded for each Bat Species at each Site during the Autumn Survey
Table HC-7	Number of Echolocation Calls Recorded for each Bat Species at each Site during the Spring Survey
Table HC-8	Bat Habitat Utilisation Patterns Based on Site Occurrence
Table HC-9	Habitat Utilisation Patterns of Threatened Bat Species
Table HC-10	Threatened Species Recorded from the Wider Region but not Recorded by the Autumn or Spring Surveys

TABLE OF CONTENTS (continued)

LIST OF FIGURES

Figure HC-1 Project Location
Figure HC-2 Project General Arrangement
Figure HC-3 Panoramic Photograph of the Study Area
Figure HC-4 Bat Fauna Sampling Sites
Figure HC-5 Habitat Complexity Scores for Sampling Sites
Figure HC-6 Approximate Location of Threatened Bat Species Identified during the Surveys

LIST OF ATTACHMENTS

Attachment HC-A Weather Data for Autumn and Spring Survey Periods
Attachment HC-B Digital Photographs of Bat Fauna Sampling Sites

HC1 INTRODUCTION

Greg Richards and Associates Pty Ltd was commissioned to conduct a bat fauna assessment for the Wilpinjong Coal Project (the Project), located in the New South Wales (NSW) Western Coalfield approximately 11 kilometres (km) south-east of the Ulan Coal Mines and approximately 185 km north-west of Newcastle (Figure HC-1).

The Project general arrangement is shown on Figure HC-2. A detailed description of the Project is provided in Section 2, Volume 1 of the Project Environmental Impact Statement (EIS).

HC1.1 SURVEY OBJECTIVES

The objectives of the bat fauna surveys were to:

- conduct bat fauna surveys during autumn and late spring 2004 using recognised survey techniques;
- assess bat fauna species diversity, relative abundance and habitats present within the study area;
- conduct targeted surveys for threatened bat species considered possible occurrences within the study area or surrounds including those listed in the Schedules of the NSW *Threatened Species Conservation Act, 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*; and
- report on the findings of the bat fauna surveys.

HC2 STUDY AREA AND SURROUNDS

The study area consists of a large open valley located between the Goulburn River National Park to the north, and Munghorn Gap Nature Reserve to the south. Both of these conservation reserves are large in area (approximately 70,000 ha and 6,000 ha, respectively), and consist of elevated plateaus with foothills and slopes extending from escarpments into the cleared and open valley (Figure HC-3). The reserves are briefly described in two recent fauna survey reports (NPWS, 2001; NPWS, 2002).

This panorama is composed of four sequential digital photographs taken from the vicinity of autumn site 11 in the south, to illustrate the general terrain of the study area and surrounds. Note the steep wooded slopes rising from the cleared valley floors, and adjacent sandstone escarpments that may provide roost sites for cave bats. The ranges in the distant background are part of Goulburn River National Park.

HC3 METHODS

HC3.1 BACKGROUND INFORMATION

Prior to the commencement of the survey, the consultant's database of bat distribution records, the NSW Department of Environment and Conservation (DEC) Atlas of NSW Wildlife and regional fauna studies were searched to extract records of bat species from the local area and surrounding region. The resulting list of bat species is shown in Table HC-1.

Searches of appropriate mapping were also carried out to establish whether any abandoned mines were present in or surrounding the study area. The search found that the study area and surrounds are not recognised as a karst area and no caves are documented in the Australian Karst Index (Matthews, 1985). However, an abandoned mine is known to occur on the eastern side of the Crown Reserve to the east of the study area. In addition, there are a number of caves located in the Munghorn Gap Nature Reserve to the south of the study area and Goulburn River National Park to the north of the study area, as well as caves in sandstone escarpments and associated slopes proximal to the proposed disturbance area.

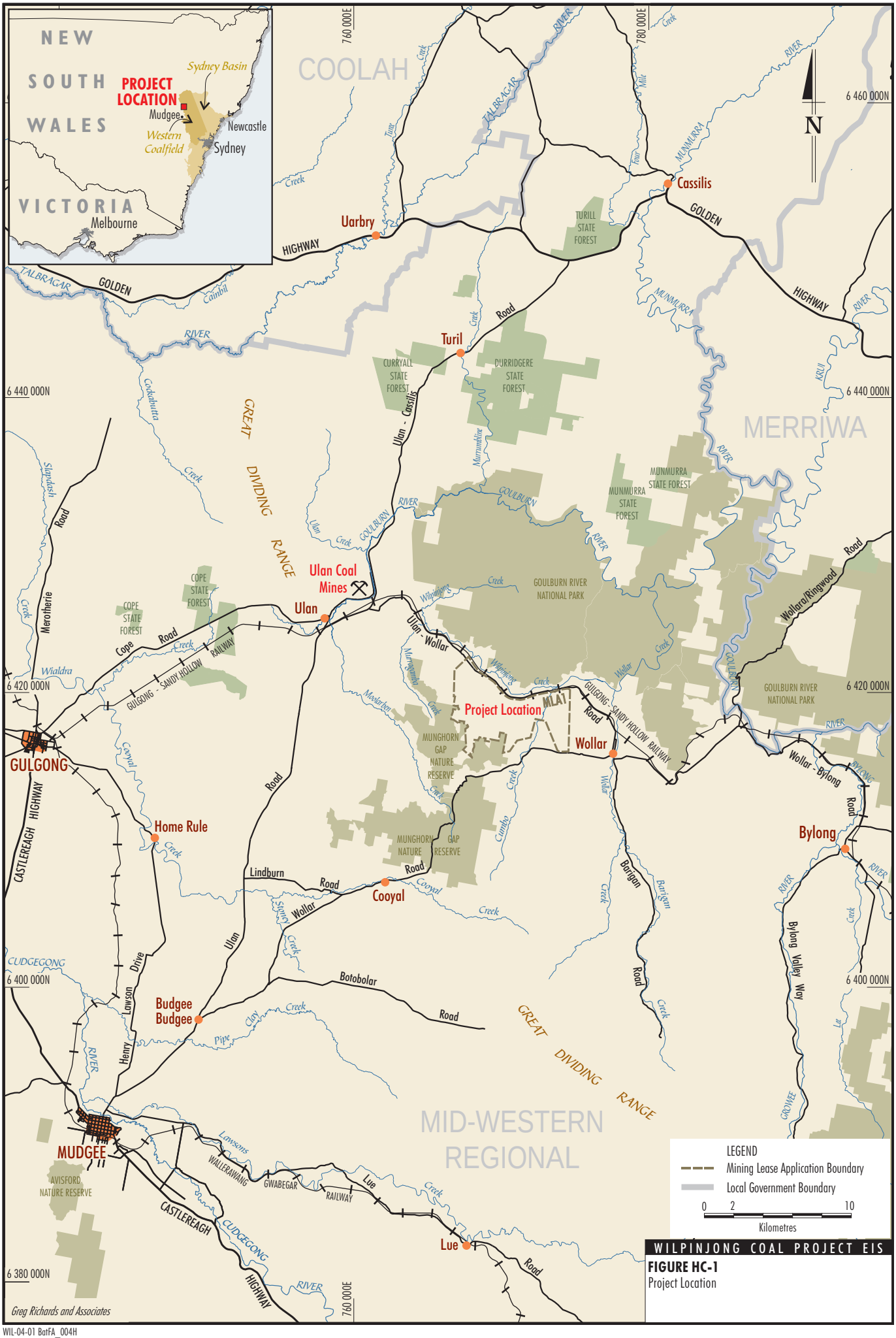

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FIGURE HC-1
Project Location

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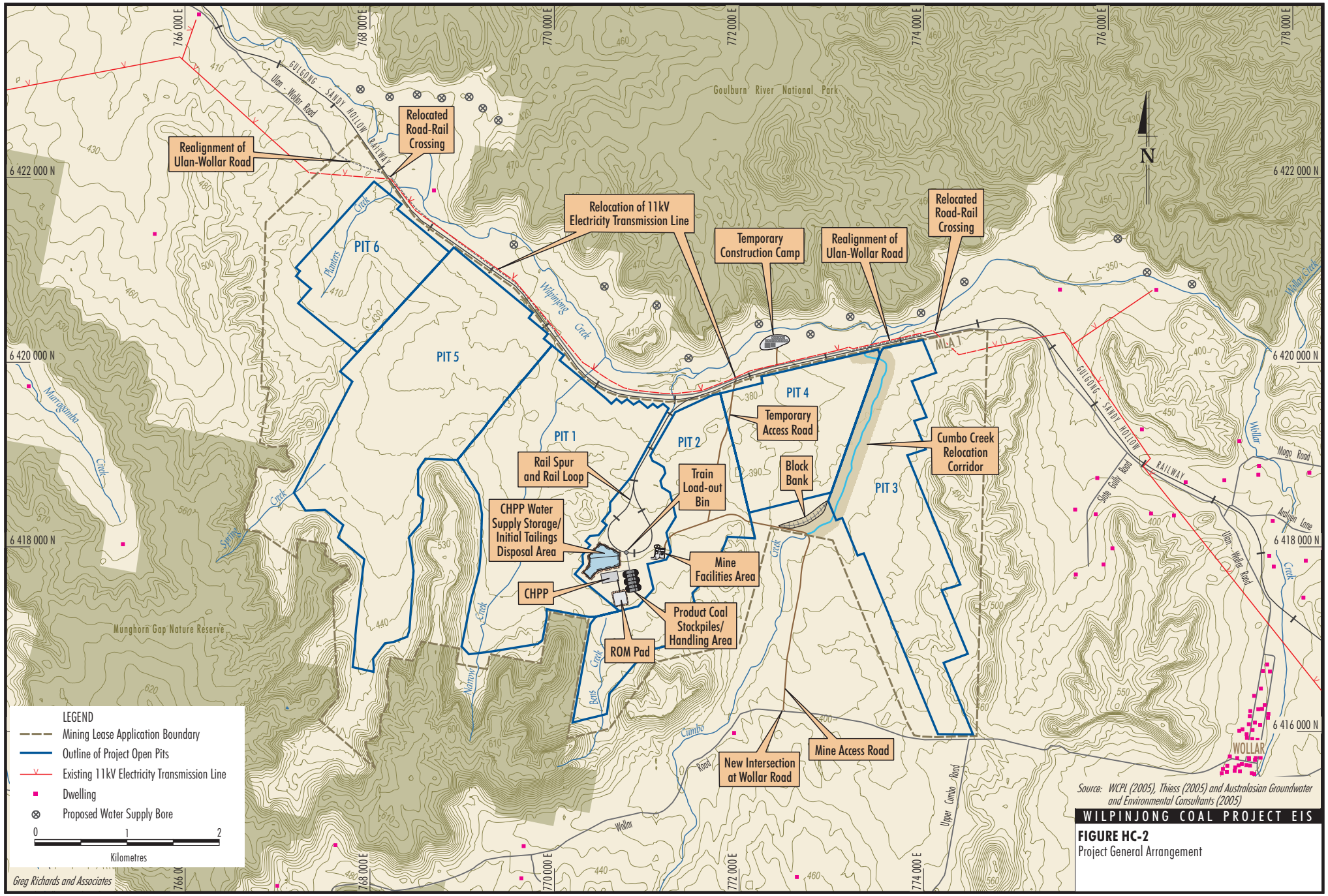
WIL-04-01 BatFA_004H



WILPINJONG COAL PROJECT EIS

FIGURE HC-2
Project General Arrangement

WIL-04-01 BatFA_006N

Figure HC-3: Panoramic Photograph of the Study Area

Table HC-1
Bat Fauna Recorded from the Wider Region

Common Name	Taxon	Conservation Status		DEC Atlas of NSW Wildlife [3]				Consultant's Database[4]	Regional Studies[5-8]
		TSC Act[1]	EPBC Act[2]	8833	8933	8832	8932		
Fruit Bats	**Pteropodidae**								
Grey-headed Flying Fox	*Pteropus poliocephalus*	V	V					●	
Little Red Flying Fox	*Pteropus scapulatus*	-	-					●	
Horseshoe Bats	**Rhinolophidae**								
Eastern Horseshoe Bat	*Rhinolophus megaphyllus*	-	-	●	●		●		5,6,7
Sheathtail Bats	**Emballonuridae**								
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	V	-						
Freetail Bats	**Molossidae**								
Little Northern Freetail Bat	*Mormopterus loriae*								
East-coast Freetail Bat	*Mormopterus norfolkensis*	V	-						6
Undescribed Freetail Bat[9]	*Mormopterus* sp.	-	-	●	●		●		5
Little Freetail Bat	*Mormopterus planiceps*	-	-	●	●		●		5,6,7
White-striped Freetail Bat	*Tadarida australis*	-	-	●	●	●	●		5,6,7
Ordinary Bats	**Vespertilionidae**								
Golden-tipped Bat	*Kerivoula papuensis*	V	-						
Little Bentwing Bat	*Miniopterus australis*	V	-						
Large Bentwing Bat	*Miniopterus schreibersii*	V	CD	●			●	●	5,7
Lesser Longeared Bat	*Nyctophilus geoffroyi*	-	-	●	●	●	●	●	5,6,7
Gould's Longeared Bat	*Nyctophilus gouldi*	-	-	●	●	●	●	●	5,6,7,8
Greater Longeared Bat	*Nyctophilus timoriensis*	V	V	●	●				5,7
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	●	●		●	●	5,6,7
Gould's Wattled Bat	*Chalinolobus gouldii*	-	-	●	●	●	●	●	5,6,7
Chocolate Wattled Bat	*Chalinolobus morio*	-	-	●	●	●	●	●	5,6,7
Eastern Falsistrelle	*Falsistrellus tasmaniensis*	V	-	●	●		●	●	6
Southern Myotis	*Myotis macropus*	V	-						
Inland Broadnosed Bat	*Scotorepens balstoni*	-	-	●	●		●		5,6,7
Eastern Broadnosed Bat	*Scotorepens orion*	-	-				●	●	6
Greater Broadnosed Bat	*Scoteanax rueppellii*	V	-				●		

Table HC-1 (Continued)
Bat Fauna Recorded from the Wider Region

Common Name	Taxon	Conservation Status		DEC Atlas of NSW Wildlife [3]				Consultant's Database[4]	Regional Studies[5-8]
		TSC Act[1]	EPBC Act[2]	8833	8933	8832	8932		
Ordinary Bats (Cont.)									
Large Forest Bat	*Vespadelus darlingtoni*	-	-				●	●	6
Eastern Forest Bat	*Vespadelus pumilus*	-	-		●			●	
Southern Forest Bat	*Vespadelus regulus*	-	-		●		●		6
Little Cave Bat	*Vespadelus troughtoni*	V	-		●		●	●	5,6
Little Forest Bat	*Vespadelus vulturnus*	-	-	●	●	●	●		5,6,7

1 Status under the NSW *Threatened Species Conservation Act, 1995* (current as at 18 January 2005).

2 Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (current as at 18 January 2005).

V Vulnerable

CD Conservation Dependent

3 DEC Atlas of NSW Wildlife Records for the Gulgong (8833), Merriwa (8933), Mudgee (8832) and Mount Pomany (8932) 1: 100,000 map sheets (12 January 2005).

4 A search block which had the boundaries 31º50'30" to 32º44'30"S by 149º17'10" to 150º21'05"E was used.

5 NPWS (2001) *The Fauna of Goulburn River National Park*. NSW National Parks and Wildlife Service.

6 NPWS (2002) *Vertebrate Fauna of Munghorn Gap Nature Reserve*. NSW National Parks and Wildlife Service, July 2002. Note that several species were recorded by echolocation call detectors, for which "the reliability of identifications of these recordings is low" These species were the East-coast Freetail Bat (*Mormopterus norfolkensis*), Inland Broadnosed Bat (*Scotorepens balstoni*), Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and the Little Cave Bat (*Vespadelus troughtoni*).

7 Mount King Ecological Surveys (1998) *Ulan Coal Mines Ltd. Proposed Mine Expansion Project. Species Impact Statement*. In, Ulan Coal Mines Ltd (1998) *Ulan Coal Mining Lease Application No. 80.* Report prepared by Kinhill Pty Ltd.

8 Australian Museum Database Records for the Search Area – 149°44' to 150°00'E by 32°15' to 32°28'S (July 2004)

9 The taxonomy of the genus *Mormopterus* is currently in a state where taxa can be separated (especially via molecular biology) but the correct nomenclature is not known. The Atlas of NSW Wildlife refer to *Mormopterus* sp 1, while NPWS (2001) (listed above) refer to *Mormopterus* sp. (big penis).

HC3.2 FIELD SURVEY

HC3.2.1 Survey Timing and Weather Conditions

The autumn survey was conducted from the 30 March to 3 April 2004, timed to coincide with the period when the basal adult (ie. breeding) population and surviving recruitment of yearlings was active. The spring survey was conducted from 27 to 29 November 2004, timed to coincide with activity of the basal breeding population, before young would have been recruited into the population in early 2005. The weather during both the autumn and spring 2004 surveys, in general, was fine and mild, and no rain fell during the survey periods. Weather data is provided in Attachment HC-A. The autumn survey coincided with the last quarter of the moon phase. The spring survey coincided with a full moon, however the moon rose late (ie. after midnight), after the main period of evening bat activity. Moon rise and set times can be obtained from the Geosciences Australia website[1].

HC3.2.2 Sampling Sites

During the autumn survey, 17 bat fauna sampling sites were established in the study area, with 13 sampling sites established in major vegetation communities and four sampling sites located at water points (ie. stock dams) which are generally regarded as focal points where bats forage or drink during warm weather.

During the spring survey, 11 sampling sites were established. Some sites were located in the vicinity of sites used during the autumn survey, some sites were located to expand the area of coverage and some sites were located in areas identified as good quality habitat sites during the autumn terrestrial fauna surveys (Mount King Ecological Surveys, 2005).

1 http://www.ga.gov.au/

The sampling sites are shown in Figure HC-4 and are described in Tables HC-2 and HC-3.

Table HC-2
Overview of Autumn Bat Fauna Sampling Sites

Sampling Site	Dominant Overstorey Vegetation[1]	Landscape Unit	Easting	Northing
1	Yellow Box - Blakely's Red Gum, shrubs generally absent	Moister deep soils on valley floor	768054	6419005
2	Blakely's Red Gum, dense sapling and shrub strata	Moister deep soils on valley floor	772895	6417644
3	Grey Box - Narrow-leaved Ironbark	Lower slopes of sandstone range	773856	6418481
4	Eucalypt species, a few low shrubs and saplings	Steep slope on range	774210	6419535
5	Grey Box and Black Cypress Pine	Slope with clay dominated soils	767594	6419116
6	Rough-barked Apple and Black Cypress Pine, moderate shrub layer	Poorly drained flat in undulating terrain	768070	6420308
7	Rough-barked Apple, dense sapling layer, no shrubs	Sheltered slope of range	767731	6416065
8	Narrow-leaved Ironbark with Black Cypress Pine, a dense low shrub layer	Low stony hill	767946	6420971
9	Narrow-leaved Ironbark, very few shrubs	Dry elevated flat on upper valley slope	774202	6418941
10	White Box, very few shrubs	Lower slopes of sandstone range	768657	6418930
11	White Box - Black Cypress Pine, dense tall shrub layer	Exposed mid-slope of range	769621	6417145
12	Grey Gum - Black Cypress Pine, average tall shrub layer, no low shrubs or saplings	Exposed small plateau on mid-slope of range	767745	6417871
13	White Box - Black Cypress Pine, dense layer of saplings and tall shrubs	Upper slope of range	769641	6417067
14	Stock dam in close proximity to nearby wooded range	Lower slope of range	767639	6416069
15	Stock dam in relatively bare open paddock, distant from wooded ranges, a few trees nearby	Undulating valley floor	769383	6419992
16	Stock dam in open paddock, a few trees nearby, distant from wooded ranges	Undulating valley floor	771890	6419364
17	Stock dam in close proximity to nearby wooded range, several trees nearby	Lower slope of range	769282	6418287

[1] Dominant overstorey vegetation species in accordance with vegetation mapping conducted by FloraSearch (2005)

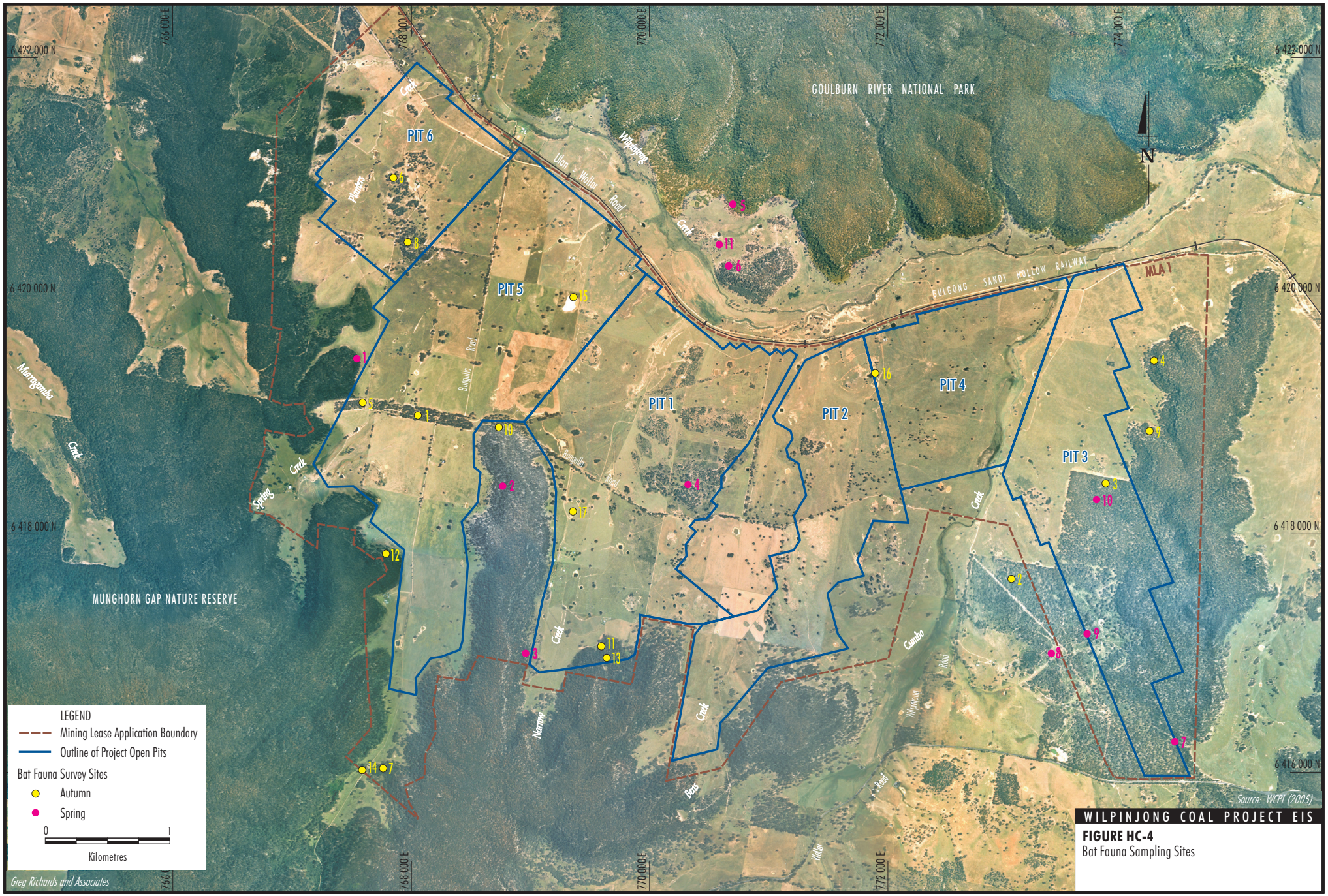


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FIGURE HC-4
Bat Fauna Sampling Sites

WIL-04-01 BatFA_001N

Table HC-3
Overview of Spring Bat Fauna Sampling Sites

Sampling Site	Dominant Overstorey Vegetation[1]	Landscape Unit	Easting	Northing
1	White Box-Black Cypress Pine, densely wooded dry gully	Lower slopes of sandstone range	0767506	6419309
2	White Box-Black Cypress Pine, situated approximately 150 m from a stock dam	Lower slopes of sandstone range	0768657	6418215
3	White Box – Black Cypress Pine, with many shrubs in flower	Lower slopes of sandstone range	0768908	6416785
4	Rough-barked Apple - Narrow-leaved Ironbark, isolated woodland remnant, very open	Isolated low stony hill	0770140	6418494
5	Dense eucalypt vegetation to the south of Goulburn River National Park	Lower slopes of sandstone range	0770673	6420800
6	Isolated hill, very rocky and exposed, Eucalypt species and Black Cypress Pine	Lower slopes of sandstone range	0770561	6420217
7	White Box, with moderately dense low shrub layer	Moister deep soils on valley floor	0774295	6416076
8	Narrow-leaved Ironbark, with dense low shrub layer	Moister deep soils on valley floor	0773257	6416809
9	Dense Rough-barked Apple, near areas of dense regrowth	Moister deep soils on valley floor	0773562	6416972
10	Dense Eucalypt regrowth with occasional Black Cypress Pine	Lower slopes of sandstone range	0773637	6418100
11	Small pool on Wilpinjong Creek, only grass and reeds	Valley floor	0770480	6420243

[1] Dominant overstorey vegetation species in accordance with vegetation mapping conducted by FloraSearch (2005)

HC3.2.3 Habitat Assessment

Each sampling site was assessed using a 'Habitat Complexity Score'. This was developed using the study of insectivorous bats in coastal temperate forests (Richards, 2002), which showed that (apart from foliage nutrient levels), the major determinants of bat species richness and abundance were usually the structure and the extent of the eucalypt canopy, and the extent and type of understorey. At each site, the following parameters were assessed (and scored) to provide a quantitative indication of habitat quality for bats:

Eucalypt canopy type:	mature = 3, immature = 2, regrowth = 1, none = 0
Subcanopy (sapling) layer:	dense = 3, scattered = 2, a few= 1, none = 0
Tall (>2m) shrub layer:	dense = 3, medium or scattered = 2, a few = 1, none = 0
Low (<2m) shrub layer:	dense = 3, medium or scattered = 2, a few = 1, none = 0
Ground cover:	shrubs or ferns = 2, grass = 1, bare ground = 0
Live potential roost trees:	6-10 = 3, 3-5 = 2, 1-2 = 1, none = 0
Dead stag trees:	>4 = 3, 3-4 = 2, 1-2 = 1, none = 0

Data for the two roost parameters was obtained by estimating the number of potential roost trees within approximately 50 m of the bat sampling point.

Digital photographs were taken at each sampling site. One photograph was taken towards the detector, showing the vegetation behind it, and a series of photographs were taken over an approximate 180º arc in front of the detector, which would be the area where passing bats would be recorded. The series of photographs were later merged in sequence using dedicated software to provide a panoramic view of each site. Digital photographs of each sampling site are provided in Attachment HC-B.

HC3.2.4 Survey Techniques

The autumn and spring surveys were designed to obtain baseline data on bat fauna species utilising the study area and to target bat fauna species listed in the Schedules of the NSW *Threatened Species Conservation Act, 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*.

HC3.2.4.1 *Targeted Surveys for Threatened Species*

Threatened bat species listed in the NSW *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*, known and/or considered possible occurrences within the wider region was reviewed prior to the study to ensure that appropriate field methods were selected to target threatened species. It was concluded that all of the threatened bat species could be recorded via the electronic detection of echolocation calls, with the exception of the Greater Long-eared Bat (*Nyctophilus timoriensis*) and Grey-headed Flying Fox (*Pteropus poliocephalus*).

Where possible, sampling sites containing water (such as Wilpinjong Creek) were included in the survey to target species such as the Southern Myotis (*Myotis macropus*) that favour foraging over smooth water bodies.

There are no known subterranean roost sites such as caves or derelict mines within the proposed disturbance area. There is however an abandoned mine to the east of the study area and known caves (ie. potential roost sites) peripheral to the proposed disturbance area, as well as within the Munghorn Gap Nature Reserve and Goulburn River National Park.

To assess the usage of the study area by Grey-headed Flying Foxes (*Pteropus poliocephalus*), observations of flowering trees were made throughout the daytime whilst traversing the study area. If any areas were established as possibly providing a food source for nectarivorous bats, then these areas were to be inspected by spotlight to establish presence/absence of this species. Spotlighting for these and other animals was also conducted for the Project Terrestrial Fauna Assessment (Mount King Ecological Surveys, 2005).

HC3.2.4.2 *Electronic Bat Detection, Harp Trapping and Spotlighting*

Electronic Call Detection

All sampling sites were monitored with Anabat™ echolocation call detection systems, each controlled by a call activated switching device. This allowed automatic operation of each detector from dusk to dawn, with calls being recorded on compact flash cards for later analysis from computer displays[2]. Each site was sampled for two consecutive nights and over the entire night to account for any temporal variation that may occur with the usage of a site by each species, particularly threatened species (Richards, 1996; Richards, 2001).

Harp Trapping

Richards (1996) showed that it is essential in some survey locations to use traps and detectors in tandem during bat surveys to encompass all ecological groups. Austbat™ harp traps were set at sampling points that bats were expected to use as flyways, or where flight may be restricted by gaps in vegetation. During the spring survey, two harp traps were set at sites where vegetation was suitable for Longeared bats (*Nyctophilus* sp.*)* (ie. dense vegetation with subcanopy layers) to target for the threatened Greater Longeared Bat (*N. timoriensis*). One trap was located within site 2, and the other was in close proximity to site 6.

[2] Ten “CF-Zcaim” Anabat detectors (formally termed ‘Anabat CF Storage Zero Crossings Analysis Interface Module’) which use Compact Flash memory cards to store bat call data were used. The timer facilities incorporated in each unit allow the bat call detection period to be programmed to switch on and off at selected times, simultaneously switching the bat detector on and off. Each CF-Zcaim was programmed to commence operation approximately 30 minutes before sunset and 30 minutes after sunrise.

A distinct advantage of the CF-Zcaim over any other detection systems is that it automatically creates a computer file at each ultrasound event, using the clock from its internal microprocessor to create the filename. When ultrasound is sensed by the microphone, the data is stored with the date and time of occurrence, with an accuracy of fractions of a second. The accurate timing facility of the CF-Zcaims allowed activity patterns to be examined.

Spotlighting

Spotlighting was conducted by Mount King Ecological Surveys (2005) for the Project Terrestrial Fauna Assessment. Spotlighting would have identified flying foxes if they were foraging at night.

HC4 RESULTS AND DISCUSSION

The results of the habitat assessment are discussed in Section HC4.1. Bat species diversity and abundance, as well as habitat utilisation by bat fauna species is discussed in Section HC4.2, and the occurrence of threatened species in Section HC4.3.

HC4.1 HABITAT ASSESSMENT

Habitat Complexity Scores for each sampling site are presented in Figure HC-5. Photographs showing examples of each habitat type are provided in Attachment HC-B.

There was a wide variation in the level of habitat complexity between sites (Figure HC-5), with higher scores (10 to 12) predominantly being recorded at sites situated in extensive tracts of woodland in the south and east of the study area, reflecting the greater complexity in mid and lower storey vegetation (for example, compare photographs of autumn sites 1 [lower habitat complexity] and 2 [higher habitat complexity] in Attachment HC-B). Site 8, situated in a small remnant surrounded by cleared agricultural land in the autumn survey, also recorded a high habitat complexity, primarily due to the occurrence of potential roosting habitat (ie. live and dead trees with hollows). Lower habitat complexity scores for many other sites reflect the lack of overstorey, mid or lower storey vegetation, as well as a lack of potential roosting habitat at these sites.

Similarly, there was wide variation in the availability of potential roosts in hollow branches of live trees and in dead stags. Autumn site 8 had a high score for both potential roost types, some roosts were available at autumn sites 1, 4, 5 and 9 and spring sites 1, 2, 3 and 8, and the remainder of sites had few potential roosts or none at all (Table HC-4).

Table HC-4
Index of Roost Availability at Each Sampling Site

Scores for Dead Stag Trees	Survey Period	Scores for Live Roost Trees			
		3	2	1	0
3	Autumn	-	-	-	-
	Spring	-	-	-	-
2	Autumn	-	Site 8	Sites 1, 5	-
	Spring	Site 1	-	-	-
1	Autumn	-	Site 9	-	-
	Spring	Sites 2, 3	Site 8	Site 6	-
0	Autumn	-	Site 4	Sites 2, 3, 10, 12	Sites 7, 11, 13-17
	Spring	-	Sites 4, 7, 9	-	Sites 5, 10, 11

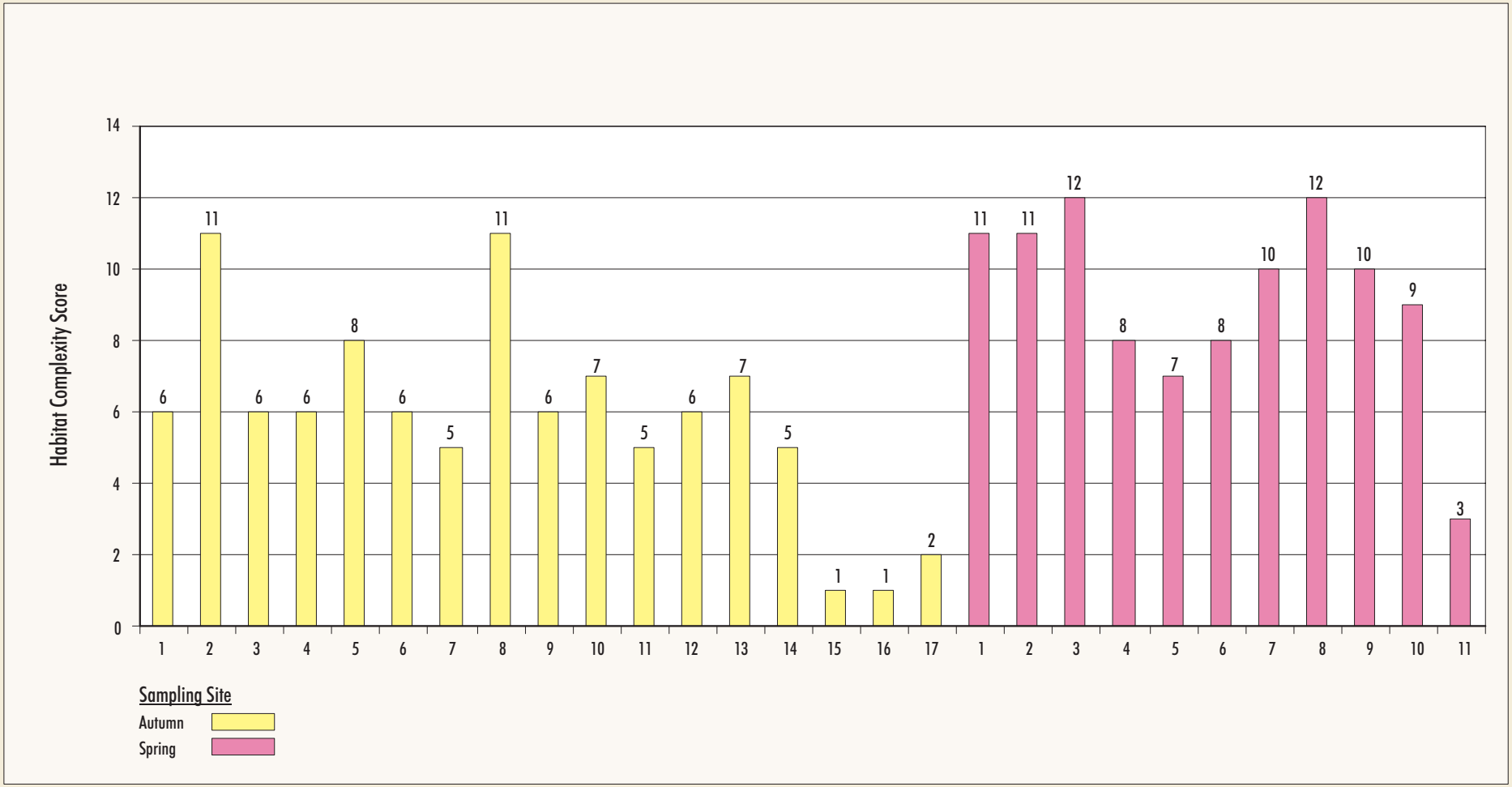

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FIGURE HC-5
Habitat Complexity Scores for Sampling Sites

Greg Richards and Associates

WIL-04-01 BatFA_002D

HC4.2 BAT FAUNA COMPOSITION

HC4.2.1 Species Diversity and Relative Abundance

Seventeen bat species were recorded by the surveys from over 13,000 echolocation calls and are listed in Table HC-5. The Eastern Falsistrelle was only recorded during the spring survey. All other species were recorded during both the autumn and spring surveys.

During both the autumn and spring surveys, the highest number of calls was recorded from the Large Forest Bat, Chocolate Wattled Bat, Southern Forest Bat, Eastern Freetail Bat and the Little Forest Bat (Table HC-5). Similarly, the highest number of total calls was recorded from these same five species (with over 1,000 calls in total). The total number of calls recorded for each of the remaining 12 species was less than 1,000 calls. For five of the species (Large-eared Pied Bat, Eastern Falsistrelle, East-coast Freetail Bat, Eastern Horseshoe Bat and Yellow-bellied Sheathtail Bat) the total number of calls recorded for each species was less than 100 calls.

Table HC-5
Bat Species Recorded[1]

Common Name	Scientific Name	Number of Echolocation Calls			Number of Trap Captures[3]
		Autumn	Spring	Total	
Large-eared Pied Bat	***Chalinolobus dwyeri***	33	34	67	0
Gould's Wattled Bat	*Chalinolobus gouldii*	529	309	838	0
Chocolate Wattled Bat	*Chalinolobus morio*	1,154	975	2,129	4
Eastern Falsistrelle	***Falsistrellus tasmaniensis***	0	8	8	0
Little Bentwing Bat	***Miniopterus australis***	110	110	220	0
Large Bentwing Bat	***Miniopterus schreibersii***	345	362	707	0
East-coast Freetail Bat	***Mormopterus norfolkensis***	44	15	59	0
Eastern Freetail Bat	*Mormopterus* sp.2	1,049	426	1,475	0
Longeared Bats[2]	*Nyctophilus* spp.	319	206	525	-
- Lesser Longeared Bat	*Nyctophilus geoffroyi*	-	-	-	8
- Gould's Longeared Bat	*Nyctophilus gouldi*	-	-	-	5
Eastern Horseshoe Bat	*Rhinolophus megaphyllus*	46	37	83	0
Yellow-bellied Sheathtail Bat	***Saccolaimus flaviventris***	60	36	96	0
Eastern Broadnosed Bat	*Scotorepens orion*	204	103	307	0
White-striped Freetail Bat	*Tadarida australis*	200	169	369	0
Large Forest Bat	*Vespadelus darlingtoni*	1,969	1,285	3,254	0
Eastern Forest Bat	*Vespadelus pumilus*	71	30	101	0
Southern Forest Bat	*Vespadelus regulus*	1,091	621	1,712	0
Little Forest Bat	*Vespadelus vulturnus*	826	489	1,315	3
	Total	**8,050**	**5,215**	**13,265**	**20**

1 Species listed as threatened in the NSW *Threatened Species Conservation Act, 1995* or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* are shown in bold. Status current as at 18 January 2005.

2 Due to the similarities in frequency ranges, the echolocation calls of *Nyctophilus* spp are indistinguishable beyond genus level.

3 Two harp traps operated for two nights (27 and 28 November 2004) at spring sites 2 and 6.

Four of the species recorded are known to roost in subterranean structures such as caves or abandoned mines (ie. the Large-eared Pied Bat, Little Bentwing Bat, Large Bentwing Bat and Eastern Horseshoe Bat). While the Eastern Falsistrelle has been found to roost in caves[3] and abandoned buildings, it predominantly roosts in tree hollows. No such structures are known to occur in the proposed disturbance area. However, an abandoned mine is known to occur on the eastern side of the Crown Reserve to the east of the study area. There are also a number of caves located in the Munghorn Gap Nature Reserve to the south of the study area and Goulburn River National Park to the north of the study area, as well as caves in sandstone escarpments and associated slopes proximal to the proposed disturbance area.

3 It is understood that there is only one record of cave roosting by *F. tasmaniensis* (Jenolan Caves); this species is not considered to be a regular user of caves (Hall and Richards, 2004)

HC4.2.2 Habitat Utilisation

Species Diversity

The total number of species recorded at each site during the autumn and spring surveys is provided in Tables HC-6 and HC-7, respectively. During the autumn survey, the highest diversity of bat species was recorded at a stock dam in the south of the study area at site 14 and in remnant vegetation at site 7, with 16 and 15 species respectively (Table HC-6 and Figure HC-4). It is postulated that this stock dam, being close to extensive tracts of woodland, was a foraging focal point for bat fauna in the immediate vicinity, and the high species count at site 7 is a result of this influence. The next most diverse was site 3, with 13 species recorded. Species diversity at other woodland/forest sites ranged from 9-11, but was much lower (3 – 4 species) at the two stock dams in cleared agricultural land (sites 15 and 16).

During the spring survey, the highest diversity of bat species was recorded at sites 1, 2 and 3 (15 species), followed by a number of sites with 12 species (sites 5, 7, 9 and 10) (Table HC-7 and Figure HC-4). Similar to the autumn survey, sites away from woodland/forest areas tended to have a lower diversity of species.

During both the autumn and spring surveys, eight of the 17 species (Gould's Wattled Bat, Chocolate Wattled Bat, Eastern Freetail Bat, Longeared Bats, White-striped Freetail Bat, Large Forest Bat, Southern Forest Bat and Little Forest Bat) recorded used the majority of sites (ie. 15 to 17 sites in the autumn survey and 10 to 11 sites in the spring survey) including small and large areas of remnant vegetation and stock water dams. Two species, the Large Bentwing Bat and Yellow-bellied Sheathtail Bat, were recorded predominantly at sites with remnant vegetation, tending not to be recorded at most stock dams. Six species (Large-eared Pied Bat, Eastern Falsistrelle, Little Bentwing Bat, East-coast Freetail Bat, Eastern Horseshoe Bat and Eastern Forest Bat) were recorded at five sites or less during both the autumn and spring surveys, the majority of which were associated with extensive tracts of vegetation and the stock dam at autumn site 14. There appeared to be no clear pattern in habitat usage by the remaining species, the Eastern Broadnosed Bat, which was recorded at sites situated in smaller remnants, larger remnants and at stock dams, yet was not recorded in other sites containing similar habitat.

Individual species usage of sampling sites, described above, appeared to be influenced by three distinct habitat utilisation patterns shown within the bat community, indicating that the overall (ie. study area) community is composed of generalist and specialist assemblages, as noted for bat communities in coastal forests (Richards, 2002). These patterns are shown in Table HC-8, where there is one group of species recorded only from 0-5 sites per survey, another group of species recorded from 10 sites or less during each survey, and another group recorded at 10-17 sites per survey. It is notable that there is no overlap in the number of sites utilised by the three groups.

Table HC-6
Number of Echolocation Calls Recorded for each Bat Species at each Site during the Autumn Survey

Site	Bat Species[1]																	Number of Calls	Number of Species	Number of Threatened Species[2]
	Cdwy	Cgou	Cmor	Ftas	Maus	Msch	Mnor	Msp2	Nyct	Rme	Sflv	Sori	Taus	Vdar	Vpum	Vreg	Vvul			
1	-	35	81	-	-	-	-	27	17	18	-	-	5	131	-	20	50	384	9	-
2	-	49	108	-	-	74	-	34	26	-	8	22	14	182	-	93	73	683	11	2
3	-	15	55	-	21	35	14	69	12	-	3	22	5	133	-	65	31	480	13	4
4	-	19	37	-	20	35	-	18	6	-	9	-	11	76	-	65	49	345	11	3
5	12	34	83	-	-	-	-	47	20	11	-	-	7	145	13	48	34	454	11	1
6	-	16	17	-	-	-	-	7	14	-	-	6	16	37	-	23	24	160	9	-
7	5	48	162	-	19	29	10	75	34	-	6	28	13	227	22	330	78	1,086	15	5
8	-	30	103	-	-	-	-	35	11	4	-	4	5	157	-	62	67	478	10	-
9	-	24	22	-	-	24	-	92	14	-	6	12	31	122	-	25	18	390	11	2
10	-	49	136	-	19	42	-	46	24	-	-	-	19	136	-	96	38	605	10	2
11	6	12	16	-	-	-	-	4	10	-	4	9	2	32	-	31	46	172	11	2
12	-	20	15	-	-	-	-	81	11	-	-	-	27	103	7	34	26	324	9	-
13	-	27	45	-	-	45	-	41	25	-	5	10	4	109	-	76	44	431	11	2
14	10	138	189	-	31	61	20	366	89	13	10	75	12	357	29	76	189	1,665	16	5
15	-	-	-	-	-	-	-	11	-	-	-	-	2	4	-	3	-	20	4	-
16	-	-	-	-	-	-	-	3	-	-	-	-	9	-	-	5	-	17	3	-
17	-	13	85	-	-	-	-	93	6	-	9	16	18	18	-	39	59	356	10	1
Total	**33**	**529**	**1,154**	**0**	**110**	**345**	**44**	**1,049**	**319**	**46**	**60**	**204**	**200**	**1,969**	**71**	**1,091**	**826**	**8,050**	**16**	**5**

Note: '-' symbol in the table represents zero (0)

[1] Species mnemonics are:

Cdwy = Large-eared Pied Bat (*Chalinolobus dwyeri)*,
Cgou = Gould's Wattled Bat (*Chalinolobus gouldi),*
Cmor = Chocolate Wattled Bat (*Chalinolobus morio),*
Ftas = Eastern Falsistrelle (*Falsistrellus tasmaniensis)*,
Maus = Little Bentwing Bat (*Miniopterus australis),*
Msch = Large Bentwing Bat (*Miniopterus schreibersii)*,
Mnor = East-coast Freetail Bat *(Mormopterus norfolkensis)*,
Msp2 = Eastern Freetail Bat (*Mormopterus* sp.2),
Nyct = Longeared Bats (*Nyctophilus* spp.),
Rme = Eastern Horseshoe Bat *(Rhinolophus megaphyllus)*,
Sflv = Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris)*,
Sori = Eastern Broadnosed Bat (*Scotorepens orion),*
Taus = White-striped Freetail Bat (*Tadarida australis),*
Vdar = Large Forest Bat (*Vespadelus darlingtoni),*
Vreg = Southern Forest Bat (*Vespadelus regulus)*,
Vpum = Eastern Forest Bat *(Vespadelus pumilus)*,
Vvul = Little Forest Bat (*Vespadelus vulturnus)*

[2] Species listed as threatened in the NSW *Threatened Species Conservation Act, 1995* or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* are: Cdwy = Large-eared Pied Bat (*Chalinolobus dwyeri)*, Ftas = Eastern Falsistrelle (*Falsistrellus tasmaniensis)*, Maus = Little Bentwing Bat (*Miniopterus australis),* Msch = Large Bentwing Bat (*Miniopterus schreibersii)*, Mnor = East-coast Freetail Bat *(Mormopterus norfolkensis)* and Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris)*. Status current as at 18 January 2005.

Table HC-7
Number of Echolocation Calls Recorded for each Bat Species at each Site during the Spring Survey

Site	Bat Species[1]																	Number of Calls	Number of Species	Number of Threatened Species[2]
	Cdwy	Cgou	Cmor	Ftas	Maus	Msch	Mnor	Msp2	Nyct	Rme	Sflv	Sori	Taus	Vdar	Vpum	Vreg	Vvul			
1	15	38	153	-	23	8	-	50	20	12	7	11	24	181	18	56	47	663	15	4
2	11	44	141	-	19	41	-	39	24	4	3	8	19	121	12	77	33	596	15	4
3	8	22	133	-	30	46	11	45	25	5	5	10	14	134	-	87	52	627	15	5
4	-	41	65	-	-	-	-	27	11	-	-	-	2	111	-	37	78	372	8	-
5	-	31	103	-	19	33	-	41	14	8	3	-	21	97	-	88	57	515	12	3
6	-	41	121	-	19	21	-	40	30	8	-	-	19	143	-	69	61	572	11	2
7	-	33	98	5	-	82	-	33	27	-	7	22	14	134	-	94	41	590	12	3
8	-	8	32	-	-	44	-	14	15	-	5	19	12	122	-	22	41	334	11	2
9	-	22	87	3	-	34	-	41	28	-	2	21	7	139	-	56	44	484	12	3
10	-	29	42	-	-	51	4	81	12	-	4	12	31	92	-	35	28	421	12	3
11	-	-	-	-	-	2	-	15	-	-	-	-	6	11	-	-	7	41	5	1
Total	**34**	**309**	**975**	**8**	**110**	**362**	**15**	**426**	**206**	**37**	**36**	**103**	**169**	**1,285**	**30**	**621**	**489**	**5,215**	**17**	**6**

Note: '-' symbol in the table represents zero (0)

[1] Species mnemonics are:
Cdwy = Large-eared Pied Bat (*Chalinolobus dwyeri)*,
Cgou = Gould's Wattled Bat (*Chalinolobus gouldi),*
Cmor = Chocolate Wattled Bat (*Chalinolobus morio),*
Ftas = Eastern Falsistrelle (*Falsistrellus tasmaniensis)*,
Maus = Little Bentwing Bat (*Miniopterus australis),*
Msch = Large Bentwing Bat (*Miniopterus schreibersii)*,
Mnor = East-coast Freetail Bat *(Mormopterus norfolkensis)*,
Msp2 = Eastern Freetail Bat (*Mormopterus* sp.2),
Nyct = Longeared Bats (*Nyctophilus* spp.),
Rme = Eastern Horseshoe Bat *(Rhinolophus megaphyllus)*,
Sflv = Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris)*,
Sori = Eastern Broadnosed Bat (*Scotorepens orion),*
Taus = White-striped Freetail Bat (*Tadarida australis),*
Vdar = Large Forest Bat (*Vespadelus darlingtoni),*
Vreg = Southern Forest Bat (*Vespadelus regulus)*,
Vpum = Eastern Forest Bat *(Vespadelus pumilus)*,
Vvul = Little Forest Bat (*Vespadelus vulturnus)*

[2] Species listed as threatened in the NSW *Threatened Species Conservation Act, 1995* or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* are: Cdwy = Large-eared Pied Bat (*Chalinolobus dwyeri)*, Ftas = Eastern Falsistrelle (*Falsistrellus tasmaniensis)*, Maus = Little Bentwing Bat (*Miniopterus australis),* Msch = Large Bentwing Bat (*Miniopterus schreibersii)*, Mnor = East-coast Freetail Bat *(Mormopterus norfolkensis)* and Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris)*. Status current as at 18 January 2005.

Table HC-8
Bat Habitat Utilisation Patterns Based on Site Occurrence

Common Name	Scientific Name	Number of Sampling Sites at which Species was Recorded		
		Autumn	Spring	Both Surveys
Restricted to a small proportion of sites				
Eastern Falsistrelle	*F. tasmaniensis*	0	2	2
East-coast Freetail Bat	*M. norfolkensis*	3	2	5
Eastern Forest Bat	*V. pumilus*	4	2	6
Large-eared Pied Bat	*C. dwyeri*	4	3	7
Eastern Horseshoe Bat	*R. megaphyllus*	4	5	9
Little Bentwing Bat	*M. australis*	5	5	10
Present on more than half of the sites				
Yellow-bellied Sheathtail Bat	*S. flaviventris*	9	8	17
Eastern Broadnosed Bat	*S. orion*	10	7	17
Large Bentwing Bat	*M. schreibersii*	8	10	18
Present on the majority of sites				
Gould's Wattled Bat	*C.gouldii*	15	10	25
Chocolate Wattled Bat	*C. morio*	15	10	25
Longeared Bats	*Nyctophilus* spp.	15	10	25
Little Forest Bat	*V. vulturnus*	15	11	26
Large Forest Bat	*V. darlingtoni*	16	11	27
Southern Forest Bat	*V. regulus*	17	10	27
Eastern Freetail Bat	*Mormopterus* sp. 2	17	11	28
White-striped Freetail Bat	*T. australis*	17	11	28
	Total sites sampled	**17**	**11**	**28**

Species Relative Abundance

The total number of calls recorded for each species at each site is also provided in Tables HC-6 and HC-7.

The highest number of calls overall was recorded at the sites that also had the highest species diversity (ie. site 7 [1,086 calls] and site 14 [1,665 calls] in autumn; site 1 [663 calls], site 2 [596 calls] and site 3 [627 calls] in spring), and are discussed in the previous section. The next highest number of calls for autumn was recorded at site 2 (683 calls) and site 10 (605 calls), while the next highest number of calls for spring was recorded at site 7 (590 calls) and site 6 (572 calls) (Tables HC-6 and HC-7; Figure HC-4). The lowest number of total calls recorded for the autumn and spring surveys were at site 15 (20 calls) and site 16 (17 calls), both stock water dams in autumn, and at site 11 (41 calls, Wilpinjong Creek) and site 8 (334 calls) in spring.

The number of calls recorded for each species in autumn (Table HC-6) indicate a general preference for the stock water dam at site 14 (Figure HC-4) for eleven of the 16 species. The highest number of calls recorded in autumn for each of the remaining species varied. For example, the highest number of calls was recorded at site 9 for the White-striped Freetail Bat, at site 2 for the Large Bentwing Bat and at site 5 for the Large-eared Pied Bat.

In spring, the highest number of calls was recorded at site 1 for five species (Large-eared Pied Bat, Chocolate Wattled Bat, Eastern Horseshoe Bat, Large Forest Bat and Eastern Forest Bat), at site 7 for four species (Large Bentwing Bat, Eastern Falsistrelle, Eastern Broadnosed Bat and Southern Forest Bat), while the highest number of calls recorded for the Yellow-bellied Sheathtail Bat was tied for sites 1 and 7 (Table HC-7 and Figure HC-4). The highest number of calls for the Little Bentwing Bat and East-coast Freetail Bat were recorded at site 3, the Little Forest Bat at site 4, Longeared Bats at site 6, and at site 10 for both the Eastern Freetail Bat and White-striped Freetail Bat.

HC4.3 THREATENED BAT FAUNA

Six threatened species were recorded by the surveys, *viz.* the Large-eared Pied Bat (*C. dwyeri*), Eastern Falsistrelle (*F. tasmaniensis*), Little Bentwing Bat (*M. australis*), Large Bentwing Bat (*M. schreibersii*), East-coast Freetail Bat (*M. norfolkensis)* and the Yellow-bellied Sheathtail Bat (*S. flaviventris*) (Figure HC-6). The Eastern Falsistrelle may occupy the study area on a seasonal basis. All species are listed as Vulnerable in the NSW *Threatened Species Conservation Act, 1995*. The Large-eared Pied Bat is also listed as Vulnerable and the Large Bentwing Bat as Conservation Dependent in the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*.

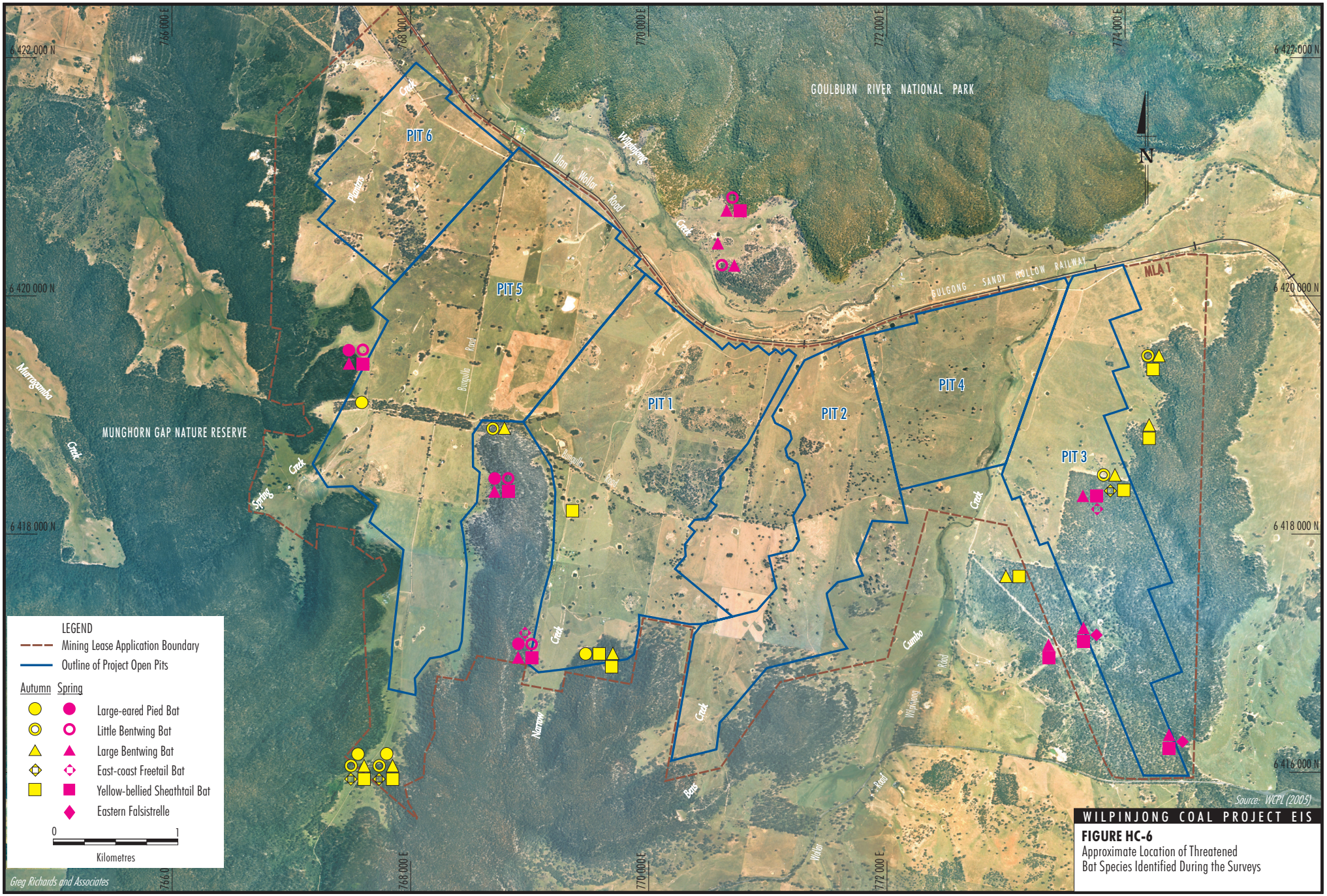
The number of echolocation calls identified to threatened species was 1,157, or approximately 8.7% of the total number of calls (ie. 13,265). Although there were slight trends, there was no significant relationship between Habitat Complexity Scores at sites where threatened species were recorded and the number of calls, nor the number of threatened species at each site (linear regression R^2 = 0.085 and 0.152 respectively). Threatened species were recorded at 21 of the 28 sites that were surveyed. Sites without threatened species were sites 1, 6, 8, 12, 15 and 16 in autumn and at site 4 in spring. Site utilisation patterns of threatened species are shown in Table HC-9 and on Figure HC-6.

The Eastern Falsistrelle (*F. tasmaniensis*) and the East-coast Freetail Bat (*M. norfolkensis*) were the rarest threatened species recorded during the surveys and both were only found in small portions of the study area (Table HC-9 and Figure HC-6). The Eastern Falsistrelle has been recorded in the wider region and within Munghorn Gap Nature Reserve (Table HC-1). This species is thought to favour wet habitats where trees are more than 20 m high (Churchill, 1998). The East-coast Freetail Bat is thought to prefer large and mature canopy trees in forest that also has a dense subcanopy and shrubby understorey (Richards, 2002). The disjunct records (ie. no other records between distant sites) of the Eastern Falsistrelle and East-coast Freetail Bat supports the literature that these two species are more likely to occur in extensive and less disturbed vegetation remnants such as those in Munghorn Gap Nature Reserve and Goulburn River National Park. The Eastern Falsistrelle was recorded by the spring survey only and this may indicate that the species may be an occasional visitor to the study area.

The Large-eared Pied Bat (*C. dwyeri*) was recorded at sites 5, 7, 11 and 14 in autumn and at sites 1, 2 and 3 in spring (Table HC-9, Figures HC-4 and HC-6). All records of this species are from extensive tracts of vegetation in the south-east corner of the study area, on the fringe of the Munghorn Gap Nature Reserve.

The two bentwing bats (ie. the Large Bentwing Bat [*M. schreibersii*] and the Little Bentwing Bat [*M. australis*]) used a wide variety of habitats (Table HC-9) and the latter was always sympatric with the former at the ten sites at which it was recorded (Figures HC-4 and HC-6). It is possible that the two species roost together in caves (or their substitutes) in the region (eg. Munghorn Gap Nature Reserve and Goulburn River National Park), but no caves are known from the proposed disturbance area.

The Yellow-bellied Sheathtail Bat (*S. flaviventris*) has widespread records across the study area (Figure HC-6), however it was recorded via just a few calls each night (Table HC-9), so should be considered locally rare. Given the extent of habitat and the availability of potential tree-hollow roosts in the regional landscape, the rarity of this species is difficult to explain.



WILPINJONG COAL PROJECT EIS

FIGURE HC-6
Approximate Location of Threatened Bat Species Identified During the Surveys

WIL-04-01 BatFA_003K

Table HC-9
Habitat Utilisation Patterns of Threatened Bat Species

Sampling Site	Habitat Complexity Score	Bat Species[1]						Total
		Cdwy	Ftas	Maus	Msch	Mnor	Sflv	
Autumn								
2	11	-	-	-	74	-	8	82
3	6	-	-	21	35	14	3	73
4	6	-	-	20	35	-	9	64
5	8	12	-	-	-	-	-	12
7	5	5	-	19	29	10	6	69
9	6	-	-	-	24	-	6	30
10	7	-	-	19	42	-	-	61
11	5	6	-	-	-	-	4	10
13	7	-	-	-	45	-	5	50
14	5	10	-	31	61	20	10	132
17	2	-	-	-	-	-	9	9
Spring								
1	11	15	-	23	8	-	7	53
2	11	11	-	19	41	-	3	74
3	12	8	-	30	46	11	5	100
5	7	-	-	19	33	-	3	55
6	8	-	-	19	21	-	-	40
7	10	-	5	-	82	-	7	94
8	12	-	-	-	44	-	5	49
9	10	-	3	-	34	-	2	39
10	9	-	-	-	51	4	4	59
11	3	-	-	-	2	-	-	2
Total Number of Calls		**67**	**8**	**220**	**707**	**59**	**96**	**1,157**
Number of Sites		**7**	**2**	**10**	**18**	**5**	**17**	**21**

Note: '-' symbol in the table represents zero (0)

[1] Species mnemonics are: Cdwy = Large-eared Pied Bat (*Chalinolobus dwyeri)*, Ftas = Eastern Falsistrelle (*Falsistrellus tasmaniensis)*, Maus = Little Bentwing Bat (*Miniopterus australis),* Msch = Large Bentwing Bat (*Miniopterus schreibersii)*, Mnor = East-coast Freetail Bat *(Mormopterus norfolkensis)*, Sflv = Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris)*.

HC4.4 THREATENED BAT FAUNA NOT RECORDED

Table HC-10 lists threatened bat fauna that have been recorded in the wider region, however not recorded during the surveys. Considering the extensive database search area (for example, the DEC Atlas of NSW Wildlife records were obtained for four 1:100,000 scale map sheets, and the consultant's database search block was approximately 100 x 100 km) many unique habitats that were not present in the study area were included in the regional analysis. Potential reasons for the likely absence of the regional threatened species not recorded during the surveys are provided in Table HC-10.

Table HC-10
Threatened Species Recorded from the Wider Region but not Recorded by the Autumn or Spring Surveys

Common Name	Species	Likely Explanation for Absence During Surveys
Grey-headed Flying Fox	*P. poliocephalus*	Occurrence of this nomadic species is dependent upon extensive flowering or fruiting in forests. Few flowering eucalypts were observed during the surveys.
Golden-tipped Bat	*K. papuensis*	This species prefers wet gullies that enhance the availability of spider prey, and appears to prefer to roost in the suspended moss nests constructed by acanthizid wrens (Schulz, 1995; Schulz and Wainer, 1997). No suitable habitat was available in the study area or immediate surrounds.
Greater Longeared Bat	*N. timoriensis*	This species is very difficult to include in bat fauna assessments and survey methods have been the subject of recent peer group discussion, which concluded that although presence in some areas can be established, absence would be difficult to confirm (Richards *et al.,* 2004). Difficulties arise because its echolocation calls are indistinguishable from other species in this genus such as *N. geoffroyi* and *N. gouldi* that are sympatric in most regions. Hence, harp trapping was conducted which recorded both *N. geoffroyi* and *N. gouldi*. Although the study area is marginal in regard to this species' distribution, the Precautionary Principle will be applied, and the impacts of the Project on this species will be assessed.
Southern Myotis	*M. macropus*	This species appears to require open water surfaces so that it can forage for aquatic invertebrates and small fish (Richards, 1998). Such habitat was limited in the study area during the time of the surveys, however may be available following significant rainfall events when Wilpinjong Creek (in the north of the study area and adjacent to Goulburn River National Park) contains more water.
Greater Broadnosed Bat	*S. rueppellii*	The Greater Broadnosed Bat prefers moist gullies in mature coastal forest or rainforest between the Great Dividing Range and the coast (Churchill, 1998). Richards (2002) also found that this species appears to prefer tall forest with a dense understorey, tall shrub and sapling layer (Richards, 2002), habitat which is not present in the study area or surrounds.
Little Cave Bat	*V. troughtoni*	This species is readily identified by its echolocation calls (Pennay *et al.,* 2004). This species may require specialised subterranean roosts which may not be present in the study area or surrounds.

HC5 POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Seventeen species were recorded by the bat fauna surveys. Of these, six are listed as threatened in the NSW *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*, namely, the Large-eared Pied Bat, Eastern Falsistrelle, Little Bentwing Bat, Large Bentwing Bat, East-coast Freetail Bat and the Yellow-bellied Sheathtail Bat. Impacts on foraging and roosting habitat for bat fauna are described in Sections HC5.1 and HC5.2. The likely impacts of the Project on threatened bat species have been assessed by Eight Part Tests of Significance which are provided in Appendix HE of the Project EIS.

HC5.1 LOSS OF FORAGING HABITAT

The Project would necessitate the removal of remnant native vegetation and the loss of foraging habitat for bat fauna. Project impacts on foraging habitat are primarily associated with the removal of remnant vegetation in Pit 3. Sixteen of the 17 bat species were recorded both within and outside of the proposed disturbance area. The remaining species were recorded near the boundary of the proposed disturbance area. The highest number of calls recorded during the autumn and spring surveys were recorded at sites situated outside the proposed disturbance area (ie. at sites 7 [1,086 calls], 14 [1,665 calls] and 2 [683 calls] in autumn and at sites 1 [663 calls], 2 [596 calls] and 3 [627 calls] in spring). Similar and better quality habitat areas occur in the surrounding region (eg. in the Goulburn River National Park, Munghorn Gap Nature Reserve and proximal areas of remnant vegetation outside the proposed disturbance area).

In addition to the clearance of remnant vegetation, the Project would include the removal of some water sources (eg. stock dams) where bats forage or drink. However, a number of water storages would be established early in the mine life which would provide sources of water for bat fauna. Some of these would be situated in close proximity to areas of remnant vegetation situated outside of the proposed disturbance area.

To mitigate the impacts of the Project, it is recommended that the mine rehabilitation programme establish areas of woodland vegetation in order to increase the amount of native vegetation in the valley and establish links between woodland rehabilitation and areas of existing remnant vegetation. It is also recommended that proximal areas of remnant vegetation be improved/enhanced.

HC5.2 LOSS OF ROOST SITES

The bat community in the study area consists of a mixture of species that either roost in caves (or their substitutes) or in tree hollows.

Four of the 17 bat species are known to roost in caves or their substitutes, namely, the Large-eared Pied Bat, Little Bentwing Bat, Large Bentwing Bat and Eastern Horseshoe Bat. No such structures are known to occur in the proposed disturbance area. However, an abandoned mine is known to occur to the east of the study area and there are a number of caves located in the Munghorn Gap Nature Reserve to the south and Goulburn River National Park to the north, as well as caves in sandstone escarpments and associated slopes proximal to the proposed disturbance area.

Vegetation clearance will result in the loss of roosting habitat for hollow-roosting species. However, given the occurrence of forest/woodland habitats outside of the proposed disturbance area, including better quality habitat within Goulburn River National Park and Munghorn Gap Nature Reserve, the local bat fauna are not considered likely to be dependent upon roosts in the proposed disturbance area. Notwithstanding, it is recommended that measures be incorporated into the vegetation clearance programme to minimise impacts on hollow-roosting bat species. In the event that a threatened hollow-roosting bat species is found roosting within the proposed disturbance area, it is recommended that, where practicable, the roost be relocated away from the proposed disturbance area.

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ATTACHMENT HC-A

WEATHER DATA FOR AUTUMN AND SPRING SURVEY PERIODS

Autumn 2004 Survey

Temperatures measured at Mudgee Airport (40 km distant) (Station Number 62101) and Gulgong Post Office (30 km distant) (Station Number 62013) respectively for the autumn survey period were mild and ranged from:

Date (2004)	Mudgee		Gulgong	
	Minimum	Maximum	Minimum	Maximum
29 March	10.7	28.9	12.4	29.6
30 March	11.0	28.4	15.3	29.2
31 March	3.6	28.4	7.0	29.2
1 April	8.9	27.6	12.1	27.8
2 April	4.5	28.1	7.8	28.2
3 April	13.7	28.3	15.3	28.5

The onset of dusk commenced at around 6.30 pm EST[4], with darkness complete by approximately 7.00 pm EST. Weather conditions at 7 pm, by which time bats would have become active, were warm and mild and ranged from 21.8 – 22.9°C, with relative humidity ranging from 28-31%.

Spring 2004 Survey

Temperatures measured at Mudgee Airport (Station Number 62101) and Gulgong Post Office (Station Number 62013) respectively for the spring survey period were mild and ranged from:

Date (2004)	Mudgee		Gulgong	
	Minimum	Maximum	Minimum	Maximum
27 November	6.4	32.6	11.1	34.2
28 November	11.9	35.7	13.5	36.9
29 November	13.1	37.5	17.5	38.7

The onset of dusk commenced at around 7.35 pm EST[5], with darkness complete by approximately 8.00 pm EST. Weather conditions at 8.00 pm, by which time bats would have become active, measured with an automatic weather station recording to a data logger every 20 minutes, were warm and mild and ranged from 22.1 – 26.1°C, with relative humidity ranging from 20-21%.

[4] EST = Eastern Standard Time

ATTACHMENT HC-B

DIGITAL PHOTOGRAPHS OF BAT FAUNA SAMPLING SITES

AUTUMN SITES

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

Site 8

Site 9

Site 10

Site 11

Site 12

Site 13

Site 14

Site 15

Site 16

Site 17

SPRING SITES

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

Site 8

Site 9

Site 10

Site 11