CONTENTS

LIST OF TABLES

3.0 ANALYSIS OF EXISTING ENVIRONMENT

Key points

- The land comprising the Ashton Coal Project consists of undulating slopes of foothills and floodplains;
- Detailed flora and fauna surveys did not locate any threatened flora or fauna within the project area;
- Aquatic habitat assessment of Bowmans Creek and Glennies Creek classified the streams as major fish habitat;
- Groundwater flow is generally to the west towards Bowmans Creek and the Ravensworth void;
- PM_{10} data collected from the village of Camberwell is well within the $50\mu g/m^3$ NEPM standard;
- Ambient noise levels were obtained from noise monitoring results on three separate occasions within and near Camberwell;
- An archaeological survey identified 24 archaeological sites;
- Coal mining is a major employer in the Singleton LGA; and
- The export of coal contributes significantly to the local and state economies.

3.1 Methodology

The analysis of the existing environment has been undertaken through the preparation of specialist studies. The findings of the specialist studies have been incorporated into this report and are contained in full in **Volume 2.**

3.2 Regional Setting

The Ashton Coal Project is situated 14km north west of Singleton in the Hunter Valley of NSW. The project is located in close proximity to the village of Camberwell.

The Ashton Coal Project is bounded by the Main Northern Railway to the north, Glennies Creek Road and Glennies Creek to the east, the Hunter River to the south and Brunkers Lane and Bowmans

Creek to the west.

The land within the Ashton Coal Project is generally undulating, with a ridge line located in the eastern portion of the site which trends in a north-south direction. The majority of the site has been cleared and previously used for agricultural purposes. Most of the surface drainage is towards Bowmans Creek that flows to the south, prior to its confluence with the Hunter River. A smaller portion of the site drains to the east into Glennies Creek, which also joins the Hunter River further to the south.

3.3 Climate

General climatic data has been sourced from a number of weather stations. Temperature and rainfall data has been sourced from the weather stations at Jerrys Plains and Liddell Power Station. These data sets have been adopted due to the length of time data has been collected at each of the stations. In addition, wind data has been collected from the Camberwell mine weather station and the Glendell weather station located near the village of Ravensworth. These are located to the east and west of the Ashton Coal Project area respectively. Therefore, the data collected from around the project area provides a comprehensive understanding of climatic conditions which prevail in the locality.

3.3.1 Temperature and Humidity

Mean monthly values of daily maximum and minimum temperatures, and humidity for Jerrys Plains and Liddell Power Station meteorology climatic stations are shown in **Table 3.1** and **Table 3.2** respectively. It is noted that mean monthly temperatures at both sites are quite similar. Summers are often characterised by extremely hot conditions, with temperatures in excess of 32^{o}C being recorded on many occasions over the period of record. On the other hand, minimum temperatures during the winter months tend to be very low with frosts frequently recorded in the general locality.

TABLE 3.1
JERRYS PLAINS, WEATHER STATION
CLIMATIC DATA

Month	Temperature (^oC) (1957-2001)		Average Humidity (%) (1957-2001)		Rainfall (mm) (1884-2001)	
	Mean Max.	Mean Min.	Mean Max.	Mean Min.	Mean	Rain Days
January	31.7	17.1	67.0	47.0	78.9	7.9
February	30.9	17.0	72.0	50.0	70.0	7.2
March	29.0	15.0	71.0	50.0	58.6	7.3
April	25.3	10.8	71.0	47.0	45.3	6.3
May	21.2	7.3	77.0	52.0	41.6	6.5
June	17.9	5.2	79.0	54.0	46.2	7.4
July	17.3	3.7	78.0	50.0	44.7	7.0
August	19.4	4.4	72.0	45.0	36.5	7.0
September	22.8	6.9	65.0	43.0	41.8	6.6
October	26.2	10.2	60.0	44.0	51.9	7.5
November	29.3	13.1	59.0	41.0	57.9	7.6
December	31.4	15.7	60.0	42.0	66.8	7.5
Monthly Average	25.2	10.5	69.0	47.0	48.3	7.1

Source: Bureau of Meteorology 2001

TABLE 3.2
LIDDELL POWER STATION, WEATHER STATION
CLIMATIC DATA

Month	Temperature (^oC) (1970-1979)		Average Humidity (%) (1970-1979)		Rainfall (mm) (1970-1987)		Evaporation (mm) 1970-1979
	Mean Max.	Mean Min.	Mean Max.	Mean Min.	Mean	Rain Days	Mean
January	30.8	17.0	71.0	52.0	93.0	7	245
February	29.4	16.6	70.0	52.0	58.0	7	171
March	27.9	15.8	73.0	40.0	70.0	6	173
April	24.9	12.2	76.0	37.0	33.0	5	108
May	21.0	8.6	74.0	46.0	47.0	6	78
June	17.8	6.9	74.0	67.0	32.0	6	89
July	17.2	5.2	76.0	59.0	25.0	6	101
August	19.0	5.6	65.0	56.0	32.0	6	109
September	21.7	8.7	66.0	54.0	37.0	6	144
October	25.2	11.5	66.0	53.0	68.0	7	185
November	27.6	13.0	66.0	54.0	54.0	7	216
December	30.9	16.1	60.0	45.0	48.0	4	231
Monthly Average	24.5	11.4	70.0	51.0	50.0	6	154

Source: Electricity Commission of New South Wales.

3.3.2 Rainfall

The rainfall data presented in **Tables 3.1** and **Table 3.2** show an important seasonal factor in the distribution of annual rainfall, with a greater proportion of rainfall occurring during the summer months. Over the remaining seasons, the rainfall is spread more evenly with minimum totals generally being recorded in winter.

Evaporation at Liddell is measured using a US Class “A” pan. The record for the period 1970 to 1979 indicates a mean monthly evaporation rate of 154 mm with monthly variations between 78 mm in May and 245 mm in January. Much of the year is characterised by a water deficit.

3.3.3 Wind

Summer winds are predominantly from the south-southeast. The pattern in autumn and spring are similar and show winds from both the north-northwest and south-southeast, with approximately equal frequency. Winds in winter are generally confined to the north-northwest and northwest. **Figure 3.1** and **Figure 3.2** contain annual and seasonal wind roses generated from data collected at the Camberwell mine and Glendell weather station.

3.3.4 Inversions

Temperature inversions occur when relatively dense, cool air bodies are trapped below warmer, lighter air masses. Inversions typically represent still wind conditions at the surface and the two bodies of air do not mix readily. An inversion, therefore, inhibits the dispersion of dust and gases, tending to cause higher concentrations at ground level. An inversion can also effectively “trap” sound energy near the ground leading to an increase in noise levels.

Inversions tend to be more prevalent in winter, during cold still nights, and can persist until 11.00am. Mild temperature inversions are likely to occur for approximately 20% to 25% of mornings and evenings in winter.

3.4 Air Quality

An Air Quality Assessment was conducted by Holmes Air Science for the Ashton Coal Project. This study is included as **Appendix F** of **Volume 2.**

3.4.1 Existing Air Quality in Camberwell

An assessment was conducted on the existing air quality within Camberwell village, with a view to determine the capacity of the area to accept additional emissions. Data on both dust concentration and deposition levels are considered. The review covers data from the existing monitoring networks that have been operated over many years by Rixs Creek, Ravensworth South and Camberwell mines and in addition includes data from a monitoring program commenced for the Ashton Coal Project in July 1999. This includes dust deposition data from 6 sites in and around Camberwell and PM_{10} data from a site within the village of Camberwell. These sites are shown in **Figure 3.3**.

Air Quality Criteria

The Environment Protection Authority (EPA) is responsible for the management of air quality in NSW. The EPA set standards, goals and guidelines for air quality that can be used to assess air quality that are relevant to this project. These are referred to as air quality criteria. In addition, there are a number of internationally applied goals that provide useful benchmarks for assessing air quality. These are provided in **Table 3.3** and **Table 3.4**

The figures which appear in bold in **Table 3.3** are the criteria adopted for the air quality assessment. The other standards are either reporting standards or regional goals. Compliance with regional goals requires management and control of all sources and this is beyond the scope of the Ashton Coal Project.

Table 3.4 shows the maximum acceptable increase in dust deposition over a range of existing dust levels. In assessing cumulative impacts, where all dust sources are considered, the upper limit is taken to be $4g/m^2$/month.

TABLE 3.3
HEALTH BASED AIR QUALITY STANDARDS/GOALS FOR PARTICULATE MATTER CONCENTRATIONS

Pollutant	Standard / Goal	Agency
Total Suspended Particulate Matter (TSP)	**90 µg/m^3 (annual mean)**	**National Health Medical Research Council (NHMRC)**
Particulate Matter <10µm (PM_{10})	**150 µg/m^3 (average of 99th percentile of 24-hour averages over 3 years)**	**US EPA Standard**
	50 µg/m^3 (annual mean)	**US EPA Standard**
	50 µg/m^3 (24-hour maximum)	NSW EPA reporting standard
	30 µg/m^3 (annual mean)	NSW EPA long-term reporting goal
	50 µg/m^3 (24-hour average, 5 exceedences permitted per year)	National Environment Protection Measure (NEPM) reporting standard
Particulate matter <2.5µm ($PM_{2.5}$)	65µg/m^3 (98th percentile of 24-hour averages over 3 years)	US EPA standard
	15µg/m^3 (1 year average)	US EPA standard

TABLE 3.4
NSW EPA AMENITY BASED CRITERIA FOR DUST FALLOUT

Existing dust fallout level (grams/m^2/month)	Maximum acceptable increase over existing fallout levels (grams/m^2/month)	
	Residential	Other
2	2	2
3	1	2
4	0	1

TSP and PM_{10} Concentrations

Mining operations at Rix’s Creek, Ravensworth South and Camberwell, have collected air quality data on the concentration of Total Suspended Particulate (TSP) matter, Particulate Matter (PM_{10}) and dust deposition over a number of years and at a number of sites both in and around the village of Camberwell and in the more general area. In addition, since June 2001 the Ashton Coal Project has monitored 24-hour PM_{10} concentrations every sixth day at the central part of Camberwell. This background information provides a reasonable database from which to describe existing air quality. The historical data provides a confused picture as to the true position regarding air quality in the

Camberwell area and the new PM_{10} monitor established in June in the central part of the village is expected to resolve these uncertainties over time. The initial indications are that dust levels in the village are currently at reasonable levels.

The major difficulty in the past in using the existing data to characterise air quality in the village is the highly variable nature of the TSP concentrations recorded and the fact that the monitor appears to be located near to an area where trail bikes periodically generate large quantities of dust. Without reliable records as to when these emissions occur it is not possible to reliably determine background levels in the village. A further complication is that current air quality standards and goals are expressed in terms of concentrations of PM_{10} rather than TSP, which is the form in which the historical data in the village are available. This problem has been overcome with the installation of a new PM_{10} monitor within the village.

Utilizing data from the high volume air sampler at the St Clements Anglican Church, plots were produced for TSP and inferred PM_{10} (taken as 40% of TSP) for the 4 year period January 1996 to September 2001. These plots show that in the past, for example late 1997 to mid 1998 the annual average TSP concentration exceeded the NHMRC 90 $\mu g/m^3$ annual average guideline value for TSP concentrations. The last 12-months of data show the annual average has been 66 $\mu g/m^3$, which is 24 $\mu g/m^3$ below the NHMRC guideline of 90 $\mu g/m^3$

The inferred PM_{10} plot contained in **Appendix F** of **Volume 2** shows that in 1999 the inferred annual average PM_{10} concentration was 26.3 $\mu g/m^3$, which is 23.7 $\mu g/m^3$ below the US EPA Standard of 50 $\mu g/m^3$ and 3.7 $\mu g/m^3$ below the NSW EPA long-term goal of 30 $\mu g/m^3$. The inferred 24-hour average PM_{10} concentrations in 1999 remained below the US EPA Standard of 150 $\mu g/m^3$.

Provided in **Table 3.5** is PM_{10} data collected from the monitor installed in the village in June 2001. The data show an average for 24-hour PM_{10} concentrations of 18.3 $\mu g/m^3$ with a range of 8 to 33 $\mu g/m^3$. These are well within the 50 $\mu g/m^3$ 24-hour NEPM standard and 150 $\mu g/m^3$ 24-hour US EPA Standard and suggest that the long-term average will also be within the US EPA annual average standard of 50 $\mu g/m^3$. The average is also significantly less than the 26.3 $\mu g/m^3$ inferred annual average derived from the TSP monitor at the St Clements Anglican Church.

TABLE 3.5 24-HOUR PM_{10} CONCENTRATIONS IN CENTRAL CAMBERWELL	
Date	Concentration $\mu g/m^3$
26/6/01	13
5/7/01	27
11/7/01	20
17/7/01	23
23/7/01	13
29/7/01	8
4/8/01	13
10/8/01	28
16/8/01	33
22/8/01	20
28/8/01	12
3/9/01	17
9/9/01	21
15/9/01	16
21/9/01	17
	Average 18.7$\mu g/m^3$

Dust Deposition

Dust deposition data for Camberwell is available from monitoring site D6 which is depicted in **Figure 3.3**. Annual average dust deposition (insoluble solids) for the period 1996 to 2000 are shown in **Table 3.6** below:

TABLE 3.6 ANNUAL AVERAGE DUST DEPOSITION AT CAMBERWELL	
Year	Grams/m²/month
1996	2.4
1997	3.2
1998	1.3
1999	1.2
2000	1.7

Data for dust deposition which has been collected for the Ashton Coal Project is summarised in **Table 3.7**.

TABLE 3.7 DUST DEPOSTION DATA FROM ASHTON COAL PROJECT MONITORING NETWORK						
Date	D1(g/m²)	D2(g/m²)	D3(g/m²)	D4(g/m²)	D5(g/m²)	D6(g/m²)
June 2001	1.0	3.8	2.6	0.8	1.8	1.9
July 2001	0.7	5.3(C)	2.9	2.4	3.2	1.1
Aug 2001	1.2	3.3	4.5	0.8	1.2	1.8
Sept 2001	0.9	1.7	5.6	2.3	1.8	1.1
Average to date	1.0	3.5	3.9	1.6	2.0	1.5

C = Possible contamination.

The collected data suggests an acceptable increment in annual average dust deposition would be in the order of 2 grams/m^2/month. (Refer to **Table 3.4**)

Air quality in the village of Camberwell is currently within acceptable limits. The Ashton Coal Project will result in some increase in TSP, PM_{10} or dust deposition levels and the proposed mine will need to be designed to minimise emissions to ensure air quality standards and goals are not exceeded.

3.5 Acoustic Environment

A Noise and Vibration Assessment was conducted by HLA Envirosciences for the Ashton Coal Project. This study is included as **Appendix G** of **Volume 2.**

3.5.1 Ambient Noise Levels

The acoustical environment of the area has been characterised following the conduct of three noise surveys. The first noise survey was conducted near the southern boundary of the Bowman property, north of Mason Dieu for the period 12th March 2000 to 19th March 2000.

The second noise survey was conducted at two locations within the village of Camberwell during the period 15th August 2001 to 28th August 2001.

A third noise survey was conducted in response to requests from Camberwell residents at a community meeting, during the period 25th September 2001 to 9th October 2001.

The locations of the noise monitoring points N_1, N_2 and N_3 are shown in **Figure 3.3.**

Table 3.8 provides a summary of the lowest measured values of ambient noise levels from the three surveys.

TABLE 3.8 MEASURED AMBIENT NOISE LEVELS			
Location	Day (7am*-6pm)	Evening (6pm-10pm)	Night(10pm-7am*)
Bowman, southern boundary (*N1*)	33dB(A),L90	35dB(A),L90	34dB(A),L90
	50dB(A),Leq	42dB(A),Leq	43dB(A),Leq
Stevens (*N2*)	42dB(A),L90	40dB(A),L90	31dB(A),L90
	60dB(A),Leq	59dB(A),Leq	56dB(A),Leq
Clark (*N3*)	33dB(A),L90	35dB(A),L90	32dB(A),L90
	50dB(A),Leq	47dB(A),Leq	45dB(A),Leq

** 8am on Sundays and public holidays.*

3.5.2 Noise and Vibration Criteria

This section presents noise and vibration criteria for potentially affected residential properties not owned by mining companies. Criteria for the noise monitoring locations were derived from the NSW EPA Industrial Noise Policy (INP), whereas criteria for properties *R10*, *R11* and *R15* - *R18* was adopted from a recent study conducted in the area by HLA-Envirosciences.

Operational Noise Goals

The INP specifies two noise criteria: an *intrusiveness criterion* which limits Leq noise levels from the industrial source to a value of 'background plus 5dB' and an *amenity criterion* which aims to protect against excessive noise levels where an area is becoming increasingly developed. EPA acceptable industrial noise levels are summarised in **Table 3.9** below, for rural and suburban residences.

A conservative approach was adopted in setting the amenity criteria. The underlying assumption was that all residential receivers are assumed to be in a "Rural" noise amenity area.

TABLE 3.9 EPA RECOMMENDED Leq NOISE LEVELS FROM INDUSTRIAL SOURCES				
Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended Leq Noise Level, dB(A)	
			Acceptable (ANL)	Recommended Maximum
Residence	Rural	Day	**50**	55
		Evening	**45**	50
		Night	**40**	45
Residence	Suburban	Day	**55**	60
		Evening	**45**	50
		Night	**40**	45

It is implicit in the INP that cumulative industrial noise impacts be investigated because the noise contribution from other mines in the area needs to be quantified in order to set amenity criteria for the Ashton Coal Project. This was achieved by referring to EIS reports for Camberwell, Ravensworth/Narama, Lemington, Rix's Creek and Glendell mines.

Table 3.10 shows the predicted maximum total noise levels from existing and approved mines at the assessed locations under each of the 3 atmospheric conditions.

TABLE 3.10
COMBINED NOISE LEVELS FROM EXISTING AND APPROVED MINES, dB(A)Leq

Location	Neutral	Inversion	NW wind
Camberwell Village	30	36	35
Bowman property	28	35	31
Proctor	27	39	32
Donellan	34	40	36

The industrial noise levels in **Table 3.10** may be used as a basis for setting amenity criteria for the Ashton Coal Project.

Table 3.11 shows intrusiveness and amenity criteria established for all receivers in accordance with the INP, and the project specific noise goals. Receiver locations have been classified according to acoustically similar environments, mainly governed by proximity to the New England Highway.

TABLE 3.11
EPA CRITERIA FOR OPERATIONAL NOISE LEVELS

Location	Criterion	Day	Evening	Night
1. A. Bowman	Intrusiveness – Db(A),Leq(15 min)	38	40	39
	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**38**
2. W. Bowman (*N1*)	Intrusiveness – dB(A),Leq(15 min)	38	40	39
	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**38**
3. P. Moore	Intrusiveness – dB(A),Leq(15 min)	38	40	39
	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**38**
4. C. & M. Lane	Intrusiveness – dB(A),Leq(15 min)	38	40	39
	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**38**
5. A. & L. Horadam	Intrusiveness – dB(A),Leq(15 min)	38	40	37
	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**37**

Table 3.11 continued on page 12.

	Intrusiveness – dB(A),Leq(15 min)	38	40	37
6. J. Wearmouth	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**37**
	Intrusiveness – dB(A),Leq(15 min)	47	45	36
7. G. & B. Burgess (*N2*)	Amenity - dB(A),Leq(period)	50	49	46
	Project Specific Noise Goal	**47**	**45**	**36**
	Intrusiveness – dB(A),Leq(15 min)	38	40	37
8. R. & L. Moss	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**37**
	Intrusiveness – dB(A),Leq(15 min)	38	40	37
9. N. & M. Smiles	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**37**
	Intrusiveness – dB(A),Leq(15 min)	39	43	39
10. D. Proctor*	Amenity - dB(A),Leq(period)	50	44	34
	Project Specific Noise Goal	**39**	**43**	**34**
	Intrusiveness – dB(A),Leq(15 min)	39	43	39
11. B. & R. Richards*	Amenity - dB(A),Leq(period)	50	44	34
	Project Specific Noise Goal	**39**	**43**	**34**
	Intrusiveness – dB(A),Leq(15 min)	38	40	37
12. J. & T. McInerney	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**37**
13. T. Clarke & Location	Intrusiveness – dB(A),Leq(15 min) Criterion	38 Day	40 Evening	37 Night
J. Vollerbreght (*N3*)	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**37**
	Intrusiveness – dB(A),Leq(15 min)	38	40	37
14. D. Scholz	Amenity - dB(A),Leq(period)	50	45	38
	Project Specific Noise Goal	**38**	**40**	**37**
	Intrusiveness – dB(A),Leq(15 min)	36	41	38
15. G. Donellan*	Amenity - dB(A),Leq(period)	50	38	32
	Project Specific Noise Goal	**36**	**38**	**32**
	Intrusiveness – dB(A),Leq(15 min)	36	41	38
16. A. & C. Klasen*	Amenity - dB(A),Leq(period)	50	38	32
	Project Specific Noise Goal	**36**	**38**	**32**
	Intrusiveness – dB(A),Leq(15 min)	36	41	38
17. B. & R. Richards*	Amenity - dB(A),Leq(period)	50	38	32
	Project Specific Noise Goal	**36**	**38**	**32**

* *Intrusiveness criteria obtained from Camberwell Coal SEE, HLA-Envirosciences 2001.*

The above noise goals are to be satisfied during prevailing conditions of winds and mild temperature inversions.

Sleep Arousal

To help protect people against waking from their sleep, the EPA recommends that 1-minute L1 noise levels (effectively, the Lmax noise level from impacts, etc) should not exceed the background level by more than 15dB(A).

Rail Traffic

The current EPA rail traffic noise and vibration criteria apply to trains within the Rail Infrastructure Corporation (RIC) corridor. Chapter 163 of the EPA *Environmental Noise Control Manual* (ENCM) specifies limits on train noise levels as follows:

Descriptor	Planning Levels	Maximum Levels
Leq, 24 hour	55dB(A)	60dB(A)
Lmax	80dB(A)	85dB(A)

Construction Noise

The proposal will require a period of 26 weeks for construction works with the potential to have a noise impact on residential receivers:

Recommended construction noise criteria vary depending on construction time, as outlined in Section 157 of the ENCM and are reproduced below:

- Construction period less than 4 weeks — Background + 20 dB
- Construction period more than 4 weeks but less than 26 weeks — Background + 10 dB

For construction periods longer than 26 weeks, the operational criteria are assumed to apply.

3.5.3 Blasting

Noise and vibration levels for blasting have been established by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication "*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990*". These criteria are summarised as follows:

- The recommended maximum overpressure level for blasting is 115 dB;
- The level of 115 dB may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120 dB at any time;
- The recommended maximum vibration velocity for blasting is 5 mm/s Peak Vector Sum (PVS);
- The PVS level of 5 mm/s may be exceeded for up to 5% of the total number of blasts over a 12-

month period, but should not exceed 10 mm/s at any time;

- Blasting should generally only be permitted during the hours of 9 am to 5 pm Monday to Saturday, and should not take place on Sundays and Public Holidays; and
- Blasting should generally take place no more than once per day.

The above annoyance criteria (ANZECC) for both vibration and blast overpressure are more stringent then the Building Damage Criteria detailed below. The ANZECC criteria have been adopted as the design goals for the Ashton Coal Project.

Building Damage Criteria

Building damage assessment criteria are nominated in Australian Standard (AS) 2187.2-1993 *"Explosives – Storage, Transport and Use. Part 2: Use of Explosives"* and summarised in **Table 3.12**.

TABLE 3.12
BLASTING CRITERIA TO LIMIT DAMAGE TO BUILDINGS (AS 2187)

Building Type	Vibration Level (mm/s)	Airblast Level (dB re 20 Pa)
Sensitive (and Heritage)	5	133
Residential	10	133
Commercial/Industrial	25	133

In addition to the above criteria, a vibration limit of 20mm/s applies to 4 drainage culverts located along the Main Northern Railway adjacent the proposed Ashton Open Cut Mine.

3.6 Surface Water

Bowmans and Glennies Creeks flow through the Ashton Coal Project area and are tributaries of the Hunter River. Glennies Creek meanders around the village of Camberwell, prior to its confluence with the Hunter River to the south. Bowmans Creek flows from the north west and underneath the New England Highway, then meanders south along the western boundary of the project area, prior to its confluence with the Hunter River.

3.6.1 Water Quality

Water quality data has been collected for Bowmans Creek, Glennies Creek and the Hunter River by HLA Envirosciences since July 1999. Background water quality is presented in **Table 3.13.** The sampling locations are depicted in **Figure 3.3**.

TABLE 3.13 BACKGROUND WATER QUALITY DATA FOR BOWMANS CREEK (W1), GLENNIES CREEK (W2), HUNTER RIVER (W3).												
	pH			EC (µS/cm)			TSS (mg/l)			TDS (mg/l)		
	W1	W2	W3	W1	W2	W3	W1	W2	W3	W1	W2	W3
July 1999	7.6	7.2	8.4	1670	297	864	2	110	5	1000	236	515
August 1999	7.9	7.9	8.6	1240	638	906	2	4	3	721	344	514
Sept 1999	7.9	8.1	8.4	1330	676	913	4	7	8	751	368	477
Oct 1999	7.9	7.7	8.3	899	626	760	13	9	158	507	380	443
Nov 1999	7.6	7.7	8.3	251	461	630	194	10	44	230	265	400
Dec 1999	7.9	8.0	8.5	1070	455	845	10	7	15	593	229	477
Jan 2000	8.0	7.9	8.6	962	535	893	43	15	30	668	308	538
Feb 2000	7.7	7.6	8.4	1370	242	663	10	5	21	836	149	374
Mar 2000	7.6	7.6	8.0	1120	548	569	26	10	30	660	350	422
Apr 2000	8.0	7.4	7.9	557	336	343	9	18	53	341	254	266
May 2000	7.9	7.9	8.3	496	546	735	11	7	10	360	296	449
June 2000	8.0	7.9	8.5	960	554	828	3	2	3	572	328	487
July 2000	8.0	7.7	8.4	1090	590	747	3	5	6	570	408	396
Aug 2000	8.0	7.8	8.3	1020	428	661	8	6	12	600	328	340
Sept 2000	8.0	7.6	8.5	880	670	689	7	10	8	612	410	403
Oct 2000	7.7	7.4	8.6	1230	356	893	6	8	18	698	190	512
Nov 2000	7.7	7.7	8.4	1320	340	778	12	12	19	828	160	458
Dec 2000	7.9	7.6	8.2	2330	460	566	36	35	44	1750	272	338
Jan 2001	7.7	7.5	8.4	1380	250	684	23	9	53	1010	186	496
Feb 2001	7.8	7.1	8.5	884	470	866	76	47	27	576	288	556
Mar 2001	8.1	7.4	ns	1050	596	ns	13	5	Ns	556	344	ns
Apr 2001	7.6	7.6	8.2	291	700	521	438	13	26	262	460	310
May 2001	7.9	7.6	ns	908	535	ns	15	6	Ns	506	278	ns
June 2001	8.1	7.7	8.4	983	712	758	ns	ns	Ns	522	350	436
July 2001	8.0	7.8	8.4	898	651	603	3	9	2	546	370	430
August 2001	8.1	7.7	8.4	931	638	653	4	10	6	546	332	369
Sept 2001	7.7	7.7	8.4	1380	636	599	23	13	12	1010	362	342
Average	7.9	7.7	8.4	1056	517	719	38	15	26	660	305	430
Criteria ANZECC 2000	6.5-7.5			30-350								

ns = no sample

The pH of the waters is generally alkaline (a pH above 7). The pH range for Bowmans Creek is 7.6 to 8.1, and Glennies Creek is 7.1 to 8.1 and the Hunter River is 7.9 to 8.6.

Electrical Conductivity (EC) is a measure of the total ions (dissolved salts) in the water. The EC range for Bowmans Creek is 251 to 2330, Glennies Creek is 242 to 712 and the Hunter River is 343 to 913.

Total Suspended Solids (TSS) is a measure of the total suspended load within an aqueous solution. The TSS range for Bowmans Creek is 2 to 438, Glennies Creek 2 to 110 and the Hunter River is 3 to 158.

Total Dissolved Solids (TDS) is a measure of the concentration of dissolved solids within an aqueous solution. The TDS range for Bowmans Creek is 262 to 1750, Glennies Creek 149 to 460 and the Hunter River is 340 to 556.

Criteria from the ANZECC 2000 draft guidelines are included in **Table 3.13.** These criteria are for inland rivers in NSW. The water quality in Bowmans Creek, Glennies Creek and the Hunter River exceed the criteria for both EC and pH.

3.6.2 Bowmans Creek Catchment

Bowmans Creek is a major tributary of the Hunter River that drains a catchment of 265 km^2. The creek rises in the foothills of the Mount Royal Range, which is located about 50 kilometres north-west of Singleton. It generally flows in a southerly direction until it joins the Hunter River about 56 kilometres from its headwaters. The creek is generally perennial, although it reportedly ceases to flow during severe droughts such as during 1994.

The catchment is characterised by steeply sloping terrain in the upper section which transitions to form a relatively flat and open floodplain that extends downstream of the village of Ravensworth.

Most of the catchment is cleared and has been used for grazing. Ravensworth State Forest is located in the central section of the catchment, but covers less than 5% of the total catchment area.

3.6.3 History of Flooding

Flooding in the upper Hunter River has occurred on numerous occasions since european settlement of the area in the 1820s. The largest floods since european settlement occurred in 1893, 1913, 1955 and 1971. All of these floods are considered to be of 20 year recurrence or rarer, at Singleton. The most severe was the flood of February 1955 which inundated large areas of the valley and caused extensive damage to public and private property. In the upper Hunter Valley, the 1955 flood is often regarded as being of similar magnitude to the design 100 year recurrence flood.

During the 1955 flood, the Hunter River reached a peak level of 64.2m Australian Height Datum (AHD) in the vicinity of the Ashton Coal Project site (*pers. comm. DLWC, 2001*). In this event, a substantial proportion of the Ashton Coal Project site downstream from the New England Highway was inundated. The extent of inundation of the Ashton mine site in the 1955 flood is shown in **Figure 3.4**.

At the same time, rainfall in the Bowmans Creek catchment led to the concentration of runoff along Bowmans Creek. Large flows were distributed downstream and flooded extensive areas of the Bowmans Creek floodplain. Available records suggest that a peak flood level of 67.8 m AHD occurred on the upstream side of the New England Highway bridge during the 1955 flood.

3.6.4 Predicted Extent of Flooding in the Vicinity of the Ashton Coal Project

Hunter River Flooding

In major Hunter River floods, floodwaters "back-up" along the Bowmans Creek channel and spill onto its floodplain. The extent of inundation across the site is shown **Figure 3.4**.

Data from reports (*Singleton Shire Council, 1984 and Sinclair Knight & Partners, 1981*) documenting previous flood levels were used to estimate the peak level for the design 20 and 5 year recurrence floods in the Hunter River at the site.

The adopted peak flood levels for the Hunter River at the site are listed in **Table 3.14**.

TABLE 3.14

HUNTER RIVER FLOOD LEVELS

DESIGN FLOOD EVENT	PEAK LEVEL (m AHD)		
	Denman	Ashton Mine Site	Singleton
1955 Flood		**64.2**	42.3
1 in 100 year	111.2	**64.2**	42.3
1 in 20 year	110.5	***63.4****	41.7
1 in 5 year	107.2	***60.3****	38.5

* *Values interpolated from peak levels estimated for Denman and Singleton by flood frequency analysis procedures.*

Flooding of Bowmans Creek

Although inundation of the Ashton site would be most influenced by major flooding of the Hunter River, there is also potential for significant inundation of the site due to flooding of Bowmans Creek. Furthermore, flooding of Bowmans Creek could cause inundation of the site to beyond the limits shown in **Figure 3.4**, which only represent backwater effects due to the 1955 flood in the Hunter River.

Hydrologic modelling of the Bowmans Creek catchment was undertaken to assess the potential maximum extent of inundation of the site.

Results from the hydrologic modelling were used to determine peak flood levels along Bowmans Creek. Selected peak flood levels along sections of Bowmans Creek within the Ashton site are listed in **Table 3.15**.

TABLE 3.15

PREDICTED PEAK FLOOD LEVELS ALONG BOWMANS CREEK

DESCRIPTION OF LOCATION ALONG BOWMANS CREEK	PREDICTED WATER SURFACE ELEVATIONS (m AHD)		
	100 Year	20 Year	5 Year
Just upstream of Bettys Creek Confluence	68.7	67.9	67.2
Immediately upstream of New England Highway Bridge crossing	68.2	67.4	66.6
About 1.3 km downstream of New England Highway Bridge crossing	66.2	65.3	64.5
About 150 m upstream of the DLWC Streamflow Gauging Station No.210042	63.2	62.4	61.6
Just upstream of confluence with the Hunter River	56.4	54.8	53.2

Combined Flooding of Bowmans Creek and the Hunter River

An envelope of the maximum extent of flooding across the Ashton Coal Project was developed for the 100, 20 and 5 year recurrence events. This was developed by comparison of flood extents due to flooding from the Bowmans Creek catchment only, and from inundation of the site due to backwater flooding from the Hunter River.

The envelope of flood extent along Bowmans Creek for each of the 100, 20 and 5 year events is shown in **Figure 3.5.** Although rarer floods could occur, the 100 year recurrence flood was adopted to provide a relevant design guide that shows the potential “worst-case” impact of flooding across the site.

3.6.5 Geomorphology of Bowmans Creek

Above Bowmans Creek bridge the creek follows a meandering path through a relatively narrow alluvial floodplain. The channel typically has a “v-shape” formed by the natural floodplain topography. The stream exhibits a pool and riffle sequence formed by gravel shoals and in-channel gravel point bars. Some of the gravel point bars extend to 20 metres beyond water level under low flow conditions. The bed of the channel is lined by cobbles with occasional outcropping of bedrock.

In the area downstream of the New England Highway bridge, the channel becomes deeply incised within the floodplain of the Hunter River. In some areas the channel is incised to bedrock. Between the bridge and the Hunter River, there are two major meanders that deflect the stream from its generally southerly flow direction.

3.6.6 Surface Drainage

The Ashton Coal Project area is centrally located across the floodplain of the lower reaches of Bowmans Creek. It also covers the rolling hills that form the southern limit of the catchment. Elevations range from approximately 60mAHD above across the floodplain near the confluence of Bowmans Creek and the Hunter River, to approximately 100mAHD on the ridge line running north-south adjacent to Glennies Creek.

The majority of the mine site drains naturally to Bowmans Creek. Bettys Creek is the only tributary and this joins Bowmans Creek near the northern site boundary between the New England Highway and the Main Northern Railway. Runoff from the site generally discharges overland as sheetflow, with only occasional concentration of runoff along gullies that serve as poorly defined watercourses.

3.7 Groundwater Systems

A report was prepared by HLA-Envirosciences to assess the impacts of the proposed Ashton Coal Project on groundwater. The report is contained in **Appendix H** of **Volume 2.** Two distinct groundwater systems occur in this area of the Hunter Valley, namely fractured rock acquifer systems in the Permian Coal Measures and porous sediment acquifers in the alluvium.

3.7.1 Coal Measures

The coal measures strata have little primary or intergranular permeability, but joints and fissures impart secondary or fracture permeability to the rock mass, especially in the coal seams due to closely spaced joints or cleats. The bulk permeability of the coal measures ranges from about 1×10^{-6}m/sec in the seams to about 1×10^{-7}m/sec in the intervening strata (AGC 1984). Observations underground in nearby mines indicates cleats and joints are open and seepages more common at rolls in the seam.

3.7.2 Alluvium

The Bowmans Creek alluvium consists of 3 to 5m of silts and sandy silts underlain by silty sands and gravels that form a basal aquifer. Permeability calculated from two pumping tests in the basal aquifer is about 5 x 10^{-6}m/sec, which is relatively low for gravel due to the silty matrix. The alluvial aquifer is narrow and thin and maybe discontinuous due to the presence of rock bars. It is likely to be in hydraulic connection with Bowmans Creek and is expected to maintain water holes, which are essentially windows in the water table, during droughts. The estimated storage volume in the Bowmans Creek alluvium within the project area is about 750 Ml and the natural underflow through the aquifer is estimated at about 0.1 Ml/day, which is les than 5% of the low flow in Bowmans Creek.

A Technical Working Group was formed by the DMR and consisting of representatives of the DMR, DLWC and WML, addressed water issues with respect to this project . The group recommended that the underground mine be located so that there would be no subsidence cracking under the Hunter River and its alluvium or under Glennies Creek and its alluvium. The limits of these alluviums are shown in **Figure 3.6**.

3.7.3 Groundwater Levels and Flow

Groundwater level contours in the coal measures have been estimated based on the three deep monitoring wells and observations during pervious coal exploration drilling. Groundwater level elevations are highest under the ridge and lowest under Bowmans and Glennies Creeks. Groundwater flow is from the ridges and recharge areas toward the natural discharge areas along the low lying alluvial flats. The groundwater flow rates in the coal measures are very low due to the low permeability of the coal measures strata. Slightly higher flow rates occur in the basal alluvial aquifer. The location of groundwater bores for the Ashton Coal Project are shown in **Figure 3.7**.

3.7.4 Groundwater Quality

The salinity of groundwater from the coal measures typically ranges form about 3,000 S/cm to 10,000 S/cm, with an average of between 6,000 and 8,000 S/cm. Salinity of ground water from the Bowmans alluvium ranges from about 900 to 1,200 S/cm (HLA 2000).

3.7.5 Groundwater Use

There are currently no known extractions of groundwater from either the Bowmans alluvium or the coal measures within the Ashton site. A large diameter shallow well exists in the alluvium which is understood to have supplied water to the abandoned dairy and houses in the past. The nearest recorded water bores are located less then 1km outside the lease. These include wells in the Hunter River alluvium, Bowmans Creek alluvium and the Glennies Creek alluvium, it is not known how many of these wells or bores are still in use.

3.8 Regional Geology

The project area is located within the Hunter Coalfields of the Sydney Basin and includes coal resources and reserves that occur within the Foybrook Formation. This formation is part of the Vane Subgroup of the Whittingham Coal Measures and is the basal coal bearing sequence of the Singleton Supergroup.

The major coal seams identified in the project area are, in descending stratigraphic order, the Lemington, Pikes Gully, Arties, Upper Liddell, Middle Liddell, Upper Lower Liddell, Lower Lower Liddell, Upper Barrett and lower Barrett seams.

The strata within the Foybrook Formation comprises in order of predominance, fine to coarse grained sandstone, siltstone, conglomerate, mudstone, shale and coal. The top of the formation corresponds with the base of the overlying Bulga Formation which in turn is overlain by the Archerfield Sandstone and Jerrys Plains Sub group respectively. The later includes the Bayswater Seam that has been mined in the adjacent Ravensworth development. Only a remnant portion of the Bayswater seam exists in the far western part the project area.

3.9 Soils

A Soil and Land Capability Assessment was conducted by HLA Envirosciences and is included in **Appendix I** of **Volume 2**.

The Ashton Coal Project area is within the Bayswater, Hunter and Roxburgh Landscapes of the Soil Landscapes of the Singleton 1:250,000 Sheet mapped by the Soil Conservation Service of NSW (Kovac, M and Lawrie, J.W, 1991). Additional data was also sourced from the Camberwell Geological Series Sheet No. 9133 (Edition 1, 1991), 1:8,000 ortho photomap compiled from the 1:37,500 aerial photo of July 2001, the NSW Soil Conservation Service Land Capability maps and the Land Suitability maps of the Department of Urban Affairs and Planning (based on data compiled by NSW Agriculture 1983).

The soils of the Ashton Coal Project are described below: -

Bayswater (bz)– These soils cover the majority of the project area, and, as described by Kovac and Lawrie (1991) cover the undulating low hills of the area. The main soils are Yellow Solodic Soils on slopes with alluvial soils in drainage lines. Moderate sheet and gully erosion is common on slopes, with gullies (to 3m) associated with the highly erodible Yellow Solodic Soils. These yellow soils also have a high hazard and salinity rating and a very high to extreme erosion hazard rating.

Hunter (hu)– These soils cover the floodplains of Bowmans Creek and Glennies Creek within the project area. The main soils are formed in alluvium and include Brown Clays and Black Earths on prior stream channels and on tributary flats, with Red Podsolic Soils and Lateric Podzolic Soils on older terraces. These soils may seasonally crack and or crust under cultivation, with a high risk of structural degradation and erosion.

Roxburgh (rx)– Soils of this group are located on the area of EL5860 and the adjoining land lying to the east of Glennies Creek. Yellow Podzolic Soils occur on the upper to mid slopes with Red Solodic Soils on the more rounded hills. Lithosols occur on the crests. Brown Podzolic Soils occur on slopes on conglomerate with associated flat pavements. Minor to moderate sheet erosion is common on these soils with gullies up to 3m occurring on the dispersible solodic soils. These soils possess a high risk of structural degradation and are often hard setting on the surface.

3.9.1 Field Investigation

Target representative soil pit sites were located, based on the data from the desktop survey, with the field work taking place during the first week of September 2001. **Figure 3.8** shows the location of the soil sample sites, soil landscapes and sites of erosion.

The analysis of the soil samples provide details on the physical and chemical properties of the soils of the Ashton Coal Project area. When combined with details from other sources i.e. soil landscape maps, predictions may be made in context of soil management and handling.

3.9.2 Land Capability

The NSW Department of Land and Water Conservation's (DLWC) rural land capability assessment system consists of eight classes that categorise land on the basis of increasing soil erosion hazard and decreasing versatility of use. It recognises three types of land use;

i. Land suitable for cultivation;
ii. Land suitable for grazing; and
iii. Land not suitable for rural production.

These capability classifications identify the limitations to the use of the land. The principal limitation recognised by these capability classifications is the stability of the soil mantle. The eight classes are shown in **Table 3.16.**

TABLE 3.16
LAND CAPABILITY CLASSIFICATION

Land Class	Soil Conservation Practices
	Land Suitable for Regular Cultivation
I	No special soil conservation works or practices.
II	Soil conservation practices such as strip cropping, conservation tilling and adequate crop rotation.
III	Structural soil conservation practices such as graded banks, waterways, and diversion banks together with soil conservation practices such as conservation tillage and adequate crop rotation.
	Land Suitable for Grazing and Occasional Cultivation
IV	Soil conservation practices such as pasture improvements, stock control and application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture.
V	Structural soil conservation works such as absorption banks, diversion banks and contour ripping, together with practices as in Class IV.
	Land Suitable for Grazing Only
VI	Soil conservation practices including limitation of stock, broadcasting of seed and fertiliser, prevention of fire and destruction of vermin. May include some isolated structural works.
	Land Unsuitable for General Rural Production
VII	Land best protected by green timber
VIII	Cliffs, lakes or swamps and other lands unsuitable for agricultural and pastoral production.
U	Urban Affairs
M	Mining and quarrying areas.

The project area Land Classes are shown on **Figure 3.9** and are as per the maps of the Soil Conservation Service of NSW. The project area is predominantly covered by Classes III, IV and V which are suited for grazing and occasional cultivation or in the case of Class III regular cultivation with intensive soil conservation measures. The ridgeline areas and those sites of steep slope have been classified as Class VI and are suitable for grazing only. The main criteria being the maintenance of adequate ground cover.

3.9.3 Agricultural Suitability

The suitability of the land to support various forms of agriculture has been mapped by the Department of Environment and Planning based on data supplied by NSW Agriculture on the 1:50,000 sheet (1983). Details for the agricultural suitability of the Ashton Coal Project area are shown on **Figure 3.10.**

The areas along Bowmans Creek and Glennies Creek are Class 1, that is, suitable for agriculture, intensive horticulture and cropping. The more open areas of the site are Class 3 and are suited for pasture or cultivated for the occasional crop in the form of pasture improvement. The adjoining sections of land are generally class 4 and are poor grazing lands. Areas of greater slope are Class 5 and are not suited to agriculture.

3.10 Flora, Fauna and Aquatic Habitat

A flora and fauna study was undertaken by HLA-Envirosciences for the Ashton Coal Project. This study is included in **Appendix J** of **Volume 2.**

The flora and fauna assessment incorporated field studies together with the results of previous ecological studies undertaken in the general area. The National Parks and Wildlife Service (NPWS) GIS database (Wildlife Atlas) was also searched. The assessment considered the legislative aspects of the Threatened Species Conservation Act, 1995, the Environmental Planning and Assessment Act, 1979, the State Environmental Planning Policy (SEPP) No. 44 – Koala Habitat Protection, Native Vegetation Conservation Act 1997 and the Environment Protection and Biodiversity Conservation Act, 1999.

3.10.1 Flora Assessment

The flora of the site was characterised by defining broad vegetation communities from aerial photography and field investigations to identify species. Each vegetation community had at least one 20m x 20m plot established within a representative area and all species were identified within them. Field investigations took place on 23-26 April 2001, 12 July 2001 and 23 August 2001.

A total of 170 species of plant were identified within the study area comprising of 6 broad vegetation communities and a number of sub-communities. The broad communities in order of area covered are described below and are shown in **Figure 3.11**.

Grassland

The grassland communities within the study area are a result of extensive clearing of the original woodland vegetation. Two sub-communities occur; dry pasture and pasture that has been improved or cropped in the past. Within the dry pasture, trees exist as isolated individuals or small stands. In some places regeneration is occurring, however, this is the exception. Shrubs within this community are primarily limited to scattered occurrences of Eastern Cotton Bush and Fan Wattle. Exotic species such as the noxious weed African Boxthorn occur below the canopy of the isolated trees where seed consumed by bird species are voided.

The improved - cropped pasture community is located on the floodplains associated with Bowmans and Glennies Creeks. It has been extensively cleared of trees and has since deteriorated with many exotic herbaceous species present. Species used to improve the pasture for grazing value are prevalent in this area.

Woodland

There are two main occurrences of a closed woodland vegetation community within the study area. One is located to the north and the other in the southern part of the study area. Mature specimens of the Narrow-leaved Ironbark and Grey Gum dominate the canopy. Mature Bull Oak to 10m dominates small patches within this community. Grass species that are present include Wallaby Grass and Threeawn Speargrass.

The ground cover is related to the amount of canopy closure. Where regeneration is occurring or mature trees form a dense stand, leaf litter dominates the ground cover. In open areas within the woodland and towards the fringes of the woodland, dry pasture grass species dominate the ground cover.

Scattered throughout the woodland communities are noxious species such as Prickly Pear and African Boxthorn. The southern woodland is infested in places with Tiger Pear.

Bull Oak

The Bull Oak community excluded most other tree and shrub species within that area. The canopy cover for mature stands for this community is greater than 75%. Under this density the fallen cladodes suppress much of the lower vegetation with very few low shrubs occurring. Native grasses including Barbed Wire Grass, Slender Rats Tail, Couch and Windmill Grass dominate. Herbaceous species form an open ground cover. Some exotic species, most commonly Prickly Pear and Fireweed, occur in very low densities.

Riparian

Riparian vegetation occurs along the banks of Bowmans and Glennies Creek. River Oak dominates the banks of the northern section of Bowmans Creek, with a lesser component of Rough-barked Apple. Weeping Willow became more common further downstream and these suppress ground and shrub vegetation where they form a monotypic canopy. The shrub layer was limited by the grazing of cattle and impact by rabbits. The dominant shrubs were exotic species, mainly African Boxthorn. The ground cover is dominated by grass species, particularly where cattle were excluded, with the occasional patch dominated by Stinging Nettle, Pitchforks and Purple Top. The riparian vegetation of Glennies Creek was similar in species present.

Aquatic

For the purposes of this vegetation community survey, aquatic habitats are areas of permanent water associated with stock dams, as distinct from habitats associated with flowing water of drainage lines. Most aquatic habitats have had a history of disturbance from cattle grazing. There is considerable variation in vegetation quality depending on the level of disturbance. Only one stock dam, located in the north-eastern woodland, had a significant component of emergent vegetation, namely Cumbungi.

Some dams had a significant covering of floating vegetation, especially those located south of the New England Highway. Many aquatic environments are fringed by Sharp Rush.

Rail Corridor

The rail corridor is a highly modified environment, with weed species dominating the embankment of the Main Northern Railway. To the east, the ground cover is dominated by a mixture of exotic and native grass species that are present in adjacent pasture or commonly used in rehabilitation. Common species include Fennel, Wall Fumitory, Turnip weed and Pimpernel, amongst others. Shrubs are rare in this community and include Eastern Cotton Bush and Bull Oak, with the greatest number occurring adjacent to woodland.

3.10.2 Fauna Assessment

A total of 97 species of vertebrate were observed during the course of the field investigations. The most common taxonomic group were bird species, of which 60 species were observed, 3 of these were exotic.

Most species of bird were observed within the woodlands, woodland grassland interface or associated with the riparian vegetation. The majority of bird species which were recorded in the study area were regarded as common. A flock of the regionally significant Grey-crowned Babbler was observed in the southern woodland.

Within the study area 12 mammal species were recorded, 5 of which were of exotic origin. The most common non-domesticated mammal species observed was the Eastern-grey Kangaroo. The presence of the Eastern Water Rat at Bowmans Creek was determined by the presence of a feeding station. The only aboreal mammal species observed during field surveys was the Common Brushtail Possum.

Other terrestrial species associated with aquatic environments included 7 frog species, associated with stock dams and pools created from excavations. No frog species were observed near either Bowmans or Glennies Creeks despite turning of several hundred cobbles.

A total of 9 lizard species were observed, which included a Bearded Dragon (*Pogona barbata*) located within a shallow burrow.

No vulnerable or endangered species as listed within the Threatened Species Conservation Act 1995 or the Environmental Protection and Biodiversity Conservation Act 1999 were observed during the course of the field investigations.

3.10.3 Aquatic Assessment

An assessment of aquatic ecology for the Ashton Coal Project was undertaken by Marine Pollution Research Pty Ltd, which is included in **Appendix K** of **Volume 2.**

Table 3.17 shows the combined fish list for the Hunter River plus streams feeding to the Hunter River, resulting from the literature review undertaken for the study. Of the species listed in **Table 3.17** there are no “endangered or vulnerable” fish species reported or expected from the study area or region.

TABLE 3.17
FRESHWATER FISH SPECIES RECORDED FROM GLENNIES CREEK AND LOCALITY

Family	Species	Common Name	Native/	Glennies
			Introduced	Creek*
				(Cooke 01)
Anguillidae	*Anguilla australis*	Short-finned Eel	N	
Anguillidae	*Anguilla reinhardtii*	Long-finned Eel	N	
Clupidae	*Potamalosa richmondia*	Freshwater Herring	N	Ex
Cyprinidae	*Carassius auratus*	Goldfish	I	
Cyprinidae	*Cyprinus carpio*	Common Carp	I	
Galaxiidae	*Galaxias maculatus*	Common Jollytail	N	?
Galaxiidae	*Galaxias olidus*	Mountain Galaxias	N	Ex
Gobiidae	*Gobiomorphus australis*	Striped Gudgeon	N	
Gobiidae	*Gobiomorphus coxii*	Cox's Gudgeon	N	
Gobiidae	*Hypseleotris compressa*	Empire Gudgeon	N	Ex
Gobiidae	*Hypseleotris galli*	Firetail Gudgeon	N	Ex
Gobiidae	*Hypseleotris klunzingeri*	Western Carp Gudgeon	N	?
Gobiidae	*Philypnodongrandiceps*	Flat-headed Gudgeon	N	
Gobiidae	*Philypnodon sp.*	Dwarf Flat-head Gudgeon	N	Ex
Mugilidae	*Mugil cephalus*	Striped Mullet	N	
Mugilidae	*Myxus petardi*	Freshwater Mullet	N	?
Mugilidae	*Valamugil georgii*	Fantail Mullet	N	?
Percichthyidae	*Macquaria novemaculeata*	Australian Bass	N	
Plotosidae	*Tandanus tandanus*	Freshwater Catfish	N*	
Poecilliidae	*Gambusia holbrooki*	Plague Minnow	I	
Retropinnidae	*Retropinna semomi*	Australian Smelt	N	
Scorpaenidae	*Notesthes robusta*	Bullrout	N	
Notes *				
Species actually recorded in Glennies Creek marked with a . Ex = Expected. ? = Possible.				

3.11 Heritage

3.11.1 Aboriginal Archaeology

An assessment of Aboriginal archaeology was undertaken by HLA Envirosciences for the Ashton Coal Project area. This study is included in **Appendix L** of **Volume 2**. The assessment included a combination of review of recent surveys in the vicinity of the study area, a search of the NPWS Aboriginal Sites Register and field survey. The field survey was conducted between 25-29 June 2001, in conjunction with representatives of the Upper Hunter Wonnarua Council.

Landform Units

Landscape analysis is an important part of an archaeological survey. Knowledge of the different types of terrain present within a survey area can assist in determining the survey strategy. Different types of landforms will have been used differently in the past, therefore a background understanding of what landforms are present within a study area will help in formulating models of areas of archaeological potential, as well as determining what areas are likely to be effected by tapanomic process potentially harmful to archaeological deposits. Landscape analysis also assists with management outlines, as different landform units will need to be handled in different ways.

Several key features of the landscape within the study area can be seen as important to the overall picture of the area, most notably the two substantial creek lines that feed into the Hunter and the main ridge line that runs through the eastern half of the study area just to the west of Glennies Creek.

For the purposes of the analysis the distinct essential features of the study area and surrounds can be defined by 7 archaeological landform units (LFU's). This is intended to assist in the analysis of material found. An analysis of the ridges and some estimates of grades were made by an inspection of the topographic maps. Likewise the major streams and drainage lines were determined from topographic information and confirmed in the field.

Landform Unit 1 (LFU 1)

The Hunter River, while not falling within the study area itself is a significant feature for the region. The river would have been an important transit way as well as a resource zone for communities living in the area in the past. The Hunter River flats have been designated LFU1. These fall outside the area of impact. The connection between the broad flats along the Hunter River and the two major creek lines is evident.

Landform Unit 2 (LFU 2)

Bowmans and Glennies Creeks (formerly Foy and Fal Brook respectively) are waterways within the region. Glennies Creek to the east of the study area does not form part of the survey, as it will not be affected by the current proposal. It has been included in the landform analysis as it clearly forms an important element in the landscape. Bowmans Creek flows into the Hunter River and will be impacted by the Ashton Coal Project and is included in LFU2.

Landform Unit 3 (LFU 3)

There are numerous small drainage channels that run into larger creek lines throughout the study area. While these are not expected to provide resources as extensive as larger waterways, they are often areas of major exposure allowing for site detection. These occur throughout the study area.

Landform Unit 4 (LFU 4)

The sloped areas falling between the creek/flat landforms and the areas or ridge crests have been designated LFU 4. While it is very unusual to find sites located on areas of slope greater than 5º some areas within the slope landforms are likely to be flat. The designation 'slope' relates to position relative to the other areas around i.e. these areas are neither high nor low lying. It does not indicate that all areas must be of a certain slope angle. This unit occurs throughout the study area.

Landform Unit 5 (LFU 5)

Is a series of lower ridge lines running off the main ridge line through the study area (LFU 6). These minor ridges run roughly east west through the central part of the study area and north south in the northern section. There are 16 separate areas of this landform which fall either totally or partly within the current study boundaries.

Landform Unit 6 (LFU 6)

This landform is the major ridgeline running through the eastern edge of the study area. The ridgeline runs north-south through most of the area then turns east-west in the north of the study area. This ridgeline overlooks Glennies Creek to the east and provides an uninterrupted view of the ridges and flats running down to Bowmans Creek. It would undoubtedly have formed an important vantage point from which to view the resources of the area. It could also have been used as an efficient transit route between different zones of the landscape. The southern end of this landform provides good views across the Hunter River.

Landform Unit 7 (LFU 7)

Landform Unit 7 is a series of high crest points within LFU 6. These crests are over 100m Australian Height Datum (AHD) and would have provided particular vantage points across the entire area. There are 8 of these LFUs which fall wholly or partly within the study area.

Survey Results

Twenty-four sites were recorded. All of the sites consisted of stone artefacts. Three sites contained only 1 isolated artefact. The remaining twenty-one sites varied in size between 2 and over 100 artefacts of varying types. **Figure 3.12** shows the location of archaeological sites and landform units.

3.11.2 Heritage

The European heritage of the area has been sourced primarily from Lillian Noble's, *Glennies Creek Story* and is summarised below:-

The 1820's was an important era in the history of Glennies Creek and surrounding area. During this period, European exploration and occupation developed at a rapid rate. In 1824 the colonial surveyor Henry Danger was commissioned to explore land north of Singleton to establish parishes and reserves for township sites, facilitating continued expansion. Dr. James Bowman's property "Ravensworth," then the farthest settlement in the north, was chosen as a base camp by Dangar.

Dangar's survey led to the Falbrook (Glennies) and Foybrook (Bowmans) streams, extending to the Mount Royal Range. Permanent water, streams and tributaries, along with the lush vegetation and scenery was noted, highlighting the extensive hardwood forests and large flats of good grazing land suitable for farming.

Settlement in the area was initiated with the allocation of extensive land grants to settlers including the Nowlands, George and James Bowman, James Glennie and the reverend Samuel Marsden.

James Glennies original grant on Falbrook was originally "Dulwich" after his home town in Surrey, England. In 1832 "Dulwich" became a supply point for travellers and troopers going north. Beh's Inn at Upper Hebden was the last inn north at the time. In 1824 George Bowman was allocated 1,130 acres of land adjoining the Hunter River, which he called "Arrowfield". A further purchase of land at the junction of Falbrook Creek and the Hunter River was called "Archerfield". In 1838 Bowman brought sheep and two goats from England; the beginning of a thriving wool enterprise which saw Bowman sending quality wool to England.

James Bowman was allocated 12,160 acres extending from Foybrook Creek to Falbrook Creek which he named "Ravensworth." The sandstone homestead and outbuildings at "Ravensworth" were built in 1832. A family letter (1845) reveals Bowman's concern with the continuing drought "Falbrook has ceased to flow…Even at Ashton, there is so much green weed in the river…we have to delay the shearing."

Falbrook was originally divided into three parts; Upper, Middle and Lower. Upper Falbrook is now known as Carrowbrook and Mt. Olive. The lower region of Middle Falbrook to Camberwell was later changed to Glennies Creek after the Glennies of "Dulwich". Henry Dangar determined Lower Falbrook was the most suitable site for the village of Camberwell.

Contributing to the development of Camberwell were the Nowland brothers who established shops, hotels and a transport business on their allocated land. The transport business expanded with increased settlement and exploration of the district until finally being sold to Cobb and Co. The allocation of small selections to pardoned convicts and the sale of land by larger selectors encouraged continued expansion of the area.

The *Government Gazette (1860)* referred to Camberwell "as a small Government village…ten miles from Singleton, twenty miles from Muswellbrook and seven miles from Warkworth." The village was a prominent centre in the 1860's having a population of over 500 residents, three hotels, two wine shops, a post office and a goods depot. Camberwell was also a traveller's rest stop and coach point.

In 1866 the Camberwell Station was established four miles from the village, only to be closed a few years later when a new station (since demolished) was built at Glennies Creek. The building of the railway line created significant employment opportunities in the area. Sleepers for the new line had to be milled and cut, logs sawn for the new bridges and poles were cut as pit props for local mines.

The first train to Muswellbrook travelled through Glennies Creek on the 18th April, 1869. In 1908 a four span steel railway bridge over Glennies Creek replaced the original wooden bridge which washed away in the 1893 flood. The expansion of the coal mining industry following World War II prompted the government's upgrade to a double rail line from Muswellbrook to Singleton.

Testing for coal in the area began in the 1870's when the Bowman family engaged William Longworth to sink a shaft at Rix's Creek. His report suggested there was not a sufficient quantity of coal or the quality to merit mining, so the shaft was closed. Longworth eventually returned and secured the mining rights and established a mine he called "Whodathoughtit." In 1879 William and his brother Thomas opened another mine a few miles away at Nundah which they called the "Elsmere Colliery" (later known as Rosedale Mine).

The "New Park" mine opened in 1881 and in 1885 a rail spur was built into this mine. Mining expansion continued over the intervening years contributing particularly to the development of the Rix's Creek area. In the early 1900's Rix's Creek had three hotels, two stores, a church and sports facilities. The expansion of underground and open cut mines has continued in the surrounding areas of Ravensworth and Liddell, with a number of the employees residing at Glennies Creek. Many of the District's population were employed in mining and associated industries leading to the continued growth of the area.

No items of environmental heritage are located within the Ashton Coal Project boundaries. St Clements Anglican Church (located west of the village of Camberwell and Glennies Creek) and the Camberwell Community Hall (located south of the New England Highway) are listed in the Singleton LEP 1996 as being items of environmental heritage of local significance.

3.12 Land Use

Agricultural activities currently taking place on land in and adjacent the project area include cattle grazing on less productive slopes and ridges, dairying on the alluvial flats and a horse stud situated on Glennies Creek Road.

A number of rural dwellings are also scattered around the proposed mine site. **Figure 3.13** shows the pattern of land ownership in the surrounding district whilst **Figure 3.14** shows the ownership in the village of Camberwell.

The village of Camberwell is situated east of the project area. Camberwell now represents a small, dispersed rural settlement containing 49 houses. Glennies Creek forms the village boundaries on two sides. The streets generally form a grid, which is cut by the New England Highway at the southern end of the village. The dwellings are of various construction types, age and quality.

3.13 Social Environment

Much of the following information has been extracted from the 1996 Census. In addition to regional and Singleton Shire Council information, data has been obtained that relates to the local area around Camberwell village. The small area used for census purposes is termed a Collector District. Collector District No 1130805 cover the village of Camberwell and surrounding area, which is shown by **Figure 3.15**.

3.13.1 Regional Setting

The Hunter Valley is of great significance to NSW. Not only does it contain a substantial part of the state's coal resource it also contributes greatly to power generation, metal manufacturing and agricultural productivity. The regional population has grown steadily since the post war period and now accounts for approximately 10% of the population of NSW. The Hunter Valley is second to Sydney as the state's most populated region.

The Singleton Shire is located within the Hunter Valley. It has sound agricultural, industrial, resource and commercial bases, and provides a wide range of community, social and recreational activities and services. Singleton Shire also has a rich history, which helps support a growing tourism market.

3.13.2 Population and Growth

At the 1996 Census Singleton Shire had a population of 20,133. This represented 3.7% of the Hunter Valley population and 0.3% of NSW. Singleton Shire has a higher proportion of males (52.2%) than females (47.8%). This is opposite to the trend in the Hunter Valley, NSW and Australia where there are slightly more females than males.

The Camberwell collector district had a population of 584 in 1996. This was made up of 308 males (52.7 %) and 276 females (47.3%). The number of people aged 15 years and over was 434.

In comparison with the Hunter Valley and NSW the Singleton local government area (LGA) has:

- A significantly higher percentage of population aged 0 - 12 years;
- A marginally higher percentage of population in the 13 - 24 and 25 - 54 year age groups; and
- A significantly lower percentage of population in the 55 year plus age group.

The above information tends to suggest that on average the Singleton LGA has a young population with families moving into the area to take advantage of job opportunities in the resource sector. It also suggests many people leave the area upon retirement, probably seeking coastal settlement.

The age profile has significant implications for the types of services provided within a local government area. The average annual compound population growth for the Singleton LGA between 1991 and 1996 was 1.5%. This is significantly higher than the growth rates for the Hunter Valley and NSW of approximately 1.0%. In terms of numbers, the population of the Singleton LGA increased by 1,472 people during those 5 years.

Singleton Shire Council has made projections for population growth for the period 1996 - 2021. The projections have been made using the DUAP's growth projections at a rate of 1.1%. This anticipated rate of growth is greater than that of the Hunter Valley (0.8%) and NSW (0.7%). The population of Singleton LGA is expected to reach 26,700 by 2021.

3.13.3 Housing Structure

In 1996 34.6% of dwellings (2,492 dwellings) in Singleton Shire were fully owned by its occupants and 26.8% (1,925) were being rented. At the time of the 1996 Census there were 502 unoccupied private dwellings or 7.0% of all dwellings.

Nearly 85% (6,106 dwellings) of all private dwellings in the Singleton Shire are separate houses. This is above the Hunter Valley average of 81% and well above the NSW figure of 70.2%. Of the dwellings, 9.5% are flats, units, townhouses, terraces or apartments.

The average occupancy rate for the Singleton LGA was 2.7 people per dwelling. This occupancy rate is higher than that occurring in the Hunter Valley of 2.3 people and in NSW of 2.4.

3.13.4 Income

Singleton Shire households, in 1996, generally had higher weekly household incomes than the Hunter Valley or NSW. The most common weekly income per household (with 18.2%) was the $1,000 to $1,499 level. This compares with the Hunter Valley average of 13.5% and NSW at 14.5%. A higher proportion of Singleton Shire households (17.9%) had income of $1,500 or more per week than compared to the Hunter Valley (8.2%) and NSW (12%).

3.13.5 Employment

In 1996, 61% of all residents of the Singleton Shire 15 years and over were employed. This figure is significantly higher than the Hunter Valley (50%) and NSW (54%). The unemployment rate was 6.8%, which equates to 666 people being recorded as unemployed. This is a much better situation than the Hunter Valley, which had a rate of 11.3% at that time. It was also better than the NSW figure of 8.8%. However, the rate of female unemployment was 9% compared to the male rate of

5.6%.

In 1996, the Camberwell Collector District workforce consisted of 288 people. The unemployment rate at that time was 4.5%, or 13 persons.

The latest unemployment figures obtained from the Department of Employment, Workplace Relations and Small Business are for the March quarter, 2001. Those figures indicated there were 313 unemployed people in the Singleton LGA or a rate of 3.0%. The NSW average was 5.3%. For the previous four quarters this figure ranged from 1.7% to 5.7%. The workforce for the Singleton LGA in March 2001 was listed as 10,301.

In 1996 1,701 people were employed in the mining industry. This represented 18.8% of the workforce with 27.5% of all employed males working in mining. These percentages are higher than the Hunter Valley and NSW averages.

The next highest participation rate in the Singleton LGA was retail trading with 11.6% of the workforce. This is well below the Hunter Valley rate of 15.1% and the NSW rate (13.3%). Another significant industry within the Singleton LGA was government administration and defence where 10.2% of the workforce was employed. Other important industries for employment are agriculture, foresting and fishing (7.9%), construction (6.7%), property and business services (6.3%), health and community services (6.2%) and manufacturing (5.0%).

3.13.6 Services

The Singleton LGA has a wide range of community services and facilities available to its residents.

Childcare

There are a number of childcare centres in Singleton. There are two long day care centres and three pre-schools. There is also a mobile childcare centre providing a 1 day a week service to the Singleton Army Camp, Broke, Bulga, Jerrys Plains, Mitchells Flat and Glennies Creek. Overall these centres provide extensive facilities for children aged 3 - 5 years.

There is capacity for additional places in this age group. Whilst there are places for children 0 - 3 years in these centres, they are limited. Singleton Family Day Care essentially fills this gap. That organisation has advised that it is normally able to recruit new carers whenever there is an increase in demand.

Education

Within Singleton LGA there are a number of educational establishments, namely:

- 8 public schools, 5 in rural areas, 2 in Singleton and 1 in Singleton Heights;

- 1 Christian primary school, 1 Catholic infants school and 1 Catholic primary school (all situated in Singleton);
- 1 Catholic high school and 1 State high school, both located in Singleton;
- Singleton TAFE; and
- Other educational services such as professional tutoring and adult education.

Communications with each of the schools has indicated the following:-

- The rural schools have the capacity for further enrolments. Most of these schools have been operating at higher capacities in the past;
- There is capacity for additional growth at Singleton Heights Public, King Street Public and the Community Christian School. Singleton Primary (Hunter Street) is at capacity and cannot accept any further enrolments above its present level due to site limitations. This school has had to turn away enrolments;
- Both St Xaviers Infants and Primary Schools are at capacity with waiting lists for enrolments. The same situation exists at St Catherines College. This indicates that all levels of the Catholic School System at Singleton are at capacity;
- Singleton High School caters for approximately 1,200 pupils. It has displayed steady growth over the past few years but could easily cope with additional enrolments; and
- The Hunter Institute of Technology has campuses at both Singleton and Muswellbrook with enrolments currently in the order of 750 - 800 students. The TAFE alters its courses to suit economic and social climates that exist at any time. For example, there has been an increased emphasis towards tourism and hospitality courses and a swing away from courses based on technologies that may be relevant in, say, the coal mining industry.

Health

The Singleton District Hospital services Singleton. This is officially a 65 bed hospital, inclusive of 4 renal beds. However, normal day to day operating is around 40 beds per day. The hospital is staffed and resourced more around the day to day level. It can cope with larger workloads on a temporary basis but more resources would be required should it run as a 65 bed hospital on a full time basis.

There is no doctor at the hospital, but 12 local practitioners are contracted to the hospital on an "on call" basis. A 24-hour, level 3, Emergency Department is provided.

In addition to the hospital a community health centre is located in Singleton. This centre provides services such as social workers, psychologists, community nurse, women's health nurse, early childcare nurse occupational therapist, speech pathologist, aboriginal liaison and counselling.

There are 6 medical practices with a total of 14 doctors in Singleton. There are also a number of private health providers including dental care, orthodontists, chiropractors, physiotherapists, optometrists, naturopaths, radiologists and pathology services.

With respect to aged care, there are 5 nursing homes in Singleton. The following organisations provide services for the aged community of the area: Meals on Wheels, NSW Home Care Services, Home Maintenance and Modifications, Home and Community Care (HACC) Support Service, Singleton Activity Centre, Neighbour Aid and Singleton Community Transport and Senior Citizens Centre.

Recreation

The Singleton LGA is well catered for in terms of available recreational facilities.

Sports available to the residents of the Singleton area include Australian rules football, baseball, basketball, bowling (lawn and ten pin), BMX, cricket (indoor and outdoor), cycling, golf, gymnastics, horse riding (gymkhana), netball (indoor and outdoor), ballet, physical culture, rugby league, rugby union, soccer (indoor and outdoor), softball, squash, badminton, tennis, athletics, swimming, aerobics and gymnasiums.

There are 5 licensed clubs in and around Singleton (RSL, Golf, Bowling and Rugby Union). In addition to each of the clubs main activities, they also offer carpet bowls, snooker, darts, bingo, euchre, bridge and provide meeting places for a number of organisations.

Cultural and artistic activities include, arts and music society, theatrical society, town band, pottery, ceramics, folk art, spinning, weaving, quilting photography, stamp and coin collecting, and a gardening club.

3.14 Economic Environment

3.14.1 Regional Economy

The Hunter Valley's 10% of NSW population is matched by the fact that the region also produces 10% of NSW's manufacturing output with a value added component of $5.5 billion. 28% of NSW's shipping export income is generated through the Port of Newcastle. Whilst coal represents the bulk of exports, wheat and aluminium are also exported from the Port.

Coal represents approximately 76% of NSW mining income. $3.8 billion was earned in 1998-1999 from the export of 76.4MT of high grade thermal and coking coal. This represents a slight increase of 0.6% over the previous year. A further 12Mt of domestic coal was purchased by Bayswater and

Liddell Power Stations.

Overall 134Mt of coal was produced in NSW in 1997-98 dropping to 131Mt in 1998-99. 78% is produced in the Hunter and Newcastle coalfields (103.5Mt). From 1996-97 to 1997-98 NSW coal production increased by 10.3Mt, with the Hunter coalfields accounting for 94% of the increase (1999 and 2000 Coal Industry Profile).

Table 3.18 gives a breakdown of goods exported through the Port of Newcastle for the years 1997-2000.

TABLE 3.18
HUNTER VALLEY EXPORTS – PORT OF NEWCASTLE 1997 – 2000

	Tonnes 1997-98	% Total Exports	Tonnes 1998-99	% Total Exports	Tonnes 1999 – 2000	% Total Exports
Aluminium	241,836	0.3	220,076	0.3	226,403	0.3
Iron and Steel	614,545	0.9	442,219	0.6	99,342	0.1
Concentrates	312,095	0.4	308,956	0.4	320,759	0.5
Grain	2,078,389	3.0	1,116,469	1.6	1,409,632	2.1
Woodchips	352,687	0.5	304,842	0.4	182,408	0.3
Sands	88,985	0.1	83,311	0.1	54,461	0.1
Coal	65,309,315	94.0	68,207,181	95.5	64,425,353	95.6
Other	150,045	0.2	201,711	0.3	274,763	0.4
Coastal	307,716	0.4	450,780	0.6	337,129	0.5
Total	**69,503,186**		**71,392,573**		**68,403,868**	

Primary production for the Hunter Valley for the years 1995 - 1999 is shown in **Table 3.19**

TABLE 3.19
HUNTER PRIMARY PRODUCTION 1995/96 TO 1999

Commodity	1995/96	1996/97	1997/98	1998/99
Hay (tonnes)	76,600	69,200	77,800	74,400
Wheat (tonnes)	40,200	85,200	58,200	45,300
Sorghum (tonnes)	48,200	53,500	34,700	99,500
Barley (tonnes)	11,900	16,600	13,800	9,900
Grapes for Wine (tonnes)	18,700	24,500	19,000	29,600
Sunflower Oil Seeds (tonnes)	5,800	4,900	4,000	13,500
Potatoes (tonnes)	3,200	3,100	4,900	Not Available
Sheep/Lamb (No.)	478,000	488,600	572,200	426,100
Beef Cattle (No.)	541,100	545,400	519,200	473,700
Milk Cattle (No.)	65,600	68,400	73,600	65,800
Chickens – Meat (No.)	12,404,100	11,723,300	10,880,300	11,308,00
Chickens – Eggs (No.)	444,400	461,500	346,00	274,300

Other important regional economic statistics include:-

- Aluminium smelters at Kurri Kurri and Tomago produce 40% of Australia's aluminium. 85% of this local product is exported, mostly to Asian destinations;

- In 1998 expenditure generated by tourism in the Hunter Valley was $709 million;

- 80% of the NSW's electricity is produced in the region;

- Agricultural production for the 1995-96 season was valued at $342 million. The most important economic contribution was made by poultry production ($100 million), milk production ($88 million) and beef cattle ($73 million); and

- 39 million litres of wine worth more than $270 million is produced annually. 8 million litres of wine is exported each year to Europe (39%), USA (26%) and Asia (22%). This generates $43 million annually in export revenue.

(Source: Hunter Valley Research Foundation, 1999 and NSW Tourism, 2001).

3.14.2 Local Economy

In 1997-98 coal mines situated within Singleton LGA produced 59.1 million tonnes of raw coal of which 38.03Mt was saleable. These mines employed (in 1998) approximately 4,000 people and it has been estimated that for each job in the industry another two are generated (Singleton Shire Council, 1999). Such additional positions are indirect employment in areas such as transport, construction, business services and manufacturing industries. A significant number of induced employment positions are likely to occur in retail and wholesale trades, financial and business services, health, community and other service industries. From the employment figures it is apparent that over 50% of mine workers located at operations in the Singleton LGA reside outside the Singleton Shire.

The following observations and statistics are applicable to the Singleton LGA (Singleton Council, 1999):

- Well developed structural and mechanical engineering facilities exist to support the mining industry. 6 major firms are present in Singleton plus many smaller operators;

- Dairying has traditionally been an important sector of the Singleton economy. Although the number of producers has been reduced over the years, total milk production is increasing. Singleton generally produces approximately 25% of the total Hunter Region milk production (42 million litres in 1995); Communications with Australian Co-op Foods Pty Ltd (Mr Bob Thompson’s personal communication) indicates the number of dairy farms in the Singleton/Muswellbrook area has declined from 80 to 53 since the rationalisation of the dairy industry took place in July 2000. A number of farmers exited the industry soon after deregulation, but this trend declined rapidly. The remaining farms are generally larger and more efficient, largely due to the amalgamation of farms. Overall milk production has remained at pre July 2000 levels.

- Singleton accounts for 11% of the region's beef cattle production. Increasing the importance of the beef industry to Singleton is the presence of the Singleton Livestock Markets which services the Hunter Valley, Western Slopes and New England areas. The market represents the fourth largest sales of cattle in NSW with the value of cattle being in excess of $10Mpa; Adding to the importance of livestock production was the recent opening of the Whittingham Abattoirs.

- There are 36 vineyards in the Broke-Fordwich area. The wine grapes produced in the area are used for high quality wines valued at $24M. There are also other producers in the Belford area. In 1995, 800 hectares were under cultivation in the Singleton LGA; and

- Other agricultural products of notable value include fodder crops and vegetables valued at $36.1M in 1995. Mushroom and olive growing industries are also developing in the district.

3.15 Transport

3.15.1 Roads and Traffic

A Traffic Impact Assessment was undertaken by Russell Humble, Traffic Consultant, which is included in **Appendix M** of **Volume 2**. This report analyses the existing road infrastructure and traffic flows and predicts the impact on local traffic.

Access to the site is proposed via Glennies Creek Road, which intersects with the New England Highway (SH9). This intersection is currently classified as an AUSTROADS type “C”. Glennies Creek Road continues in an easterly direction, before heading north and crossing the Main Northern Railway. Glennies Creek Road is bitumen sealed, and has faint line markings to the area of the proposed vehicle entrance to the mine site. From this corner and heading north there are no line markings. There are no formalised drainage systems within the road reservation, with the exception of the intersection with the New England Highway. Glennies Creek Road is approximately 7.8m in width. There is no signage on the road indicating speed limits. It is therefore assumed to be 100km/hr.

Brunkers Lane is located adjacent and along the western boundary of EL4918. It is a bitumen-sealed road, approximately 7m in width. Line markings are very faint and there is no formalised drainage within the road reservation. As the road turns to the south, it becomes gravel. There are no residents properties accessed by this road.

The RTA has a traffic volume counting station (Stn No. 05.037) at Bowmans Creek Bridge. The counting station has Average Annual Daily Traffic (AADT) figures of 11,468 vehicles per day for 1998. In 1995 traffic volumes at this counting station were 12,643 vehicles per day indicating a decline in traffic over the three years.

3.15.2 Rail

The Main Northern Railway is situated on the northern boundary of the Ashton Coal Project. There are dual tracks providing rail transportation to Newcastle and north-western NSW. This railway is used for the movement of both freight and passengers.

3.16 Visual

Since early settlement much of the upper Hunter Valley has been cleared for livestock grazing, agriculture and timber activities. Coal mining, whilst having an important role in the development and growth of the Hunter Valley, has impacted upon the visual amenity and character of the region. The Environmental Study that accompanied the Hunter REP (1989) stated "The considerable growth of modern open-cut mining in the Upper Hunter is transforming the landscape and livelihood of this district".

Scenic quality increases as:-

- Topographic ruggedness and relative relief increases;
- Presence of water forms, water edge and water areas increase;
- Patterns of grassland and forests become more diverse;
- Natural and agricultural landscapes increase and man made landscapes decrease; and
- Land use compatibility increases and land use edge diversity decreases.

The impact of mining in the area can be viewed clearly from the New England Highway as one travels between Singleton and Muswellbrook. The presence in this locality of a number of coal mines is the dominant visual feature and there is an agglomeration of mines between Singleton and the Bayswater and Liddell Power Stations.

Two main visual landscape units have been identified within the Ashton Coal Project area, these being:-

- Undulating foothills, which form the most typical landscape unit in the subject area; and
- Floodplains of the Hunter River, Bowmans Creek and Glennies Creek.

Both these units can be found across the site as follows:

3.16.1 South of the New England Highway

Generally, much of the land south of the New England Highway has been cleared. There are areas of eucalypt woodland (open and closed) towards the southern end of this area, between Bowmans and Glennies Creeks. Narrow-leafed Ironbarks and Grey Gum dominate the woodland areas. Slopes in this unit are predominately to the west and north-west and are in the order of 2° – 5°. Steeper slopes exist between the main ridgeline and Glennies Creek.

The floodplain associated with Bowmans Creek has been extensively cleared, with exotic grasslands (improved pasture) being the dominant vegetation. Apart from creek banks, slopes are in the order of 2°. Riparian vegetation consisting of River Oak is found along the creek line.

Relief for this area ranges from 60m to 100m AHD.

3.16.2 North of the New England Highway

The area to the north of the New England Highway is again mostly within the undulating foothills unit. Slopes fall more towards the north in this area and gradients are around 3%. There is more vegetation existing within this area than on the southern side of the New England Highway. In addition to open and closed eucalypt woodland (with dominant Narrow-leafed Ironbark and Grey Gum) there are also areas of open and closed Bull Oak woodland. Extensive grasslands also exist north of the New England Highway and Main Northern Railway.

Much of the area adjacent to the New England Highway has partially been cleared of trees. Some areas of open Bull Oak are situated in this particular area.

The north-eastern portion of the land is a spur trending in an easterly direction bounded by Glennies Creek Road and the Main Northern Railway. The western part of the spur contains some closed Bull Oak woodland and open eucalypt woodland. The majority of the eastern portion of the spur is cleared and vegetated by grasses. The land slopes in the order of 4° to the east. North facing side slopes are in the order of 3°. Local relief is from 80m to 110m AHD.

Relief for part of the area ranges from 70m to 110m AHD.

Based on the above criteria the existing visual amenity is considered to be moderate. The topography is not rugged with relief being low. Forested areas and grasslands are not diverse.

3.17 Utility Services

Power

Power supply is provided by Energy Australia. The power supply network is configured around 132 and 66kV ring feeders. The nearest 132/66kV substation is located at Mason Dieu, approximately 15kms south of Ashton. The northern 66kV ring feeder, originating from Mason Dieu passes through the north-eastern portion of the licence area.

Water Supply

There is no reticulated water supply in the vicinity of the project area.

Gas

There is no reticulated gas supply to the project area.

Optic Fibre

Two optic fibre cables exist in the vicinity of the Ashton Coal Project. Powertel manage the fibre optic cable, which is located along the New England Highway. The cable runs along the southern side of the New England Highway, prior to crossing the New England Highway just north of Bowmans Creek bridge. The cable then continues along the northern boundary of the New England Highway.

A Telstra fibre optic cable is located on the southern side of the Main Northern Railway. It travels parallel with the rail line, outside the railway corridor.

Landfill

A former landfill is located on Camberwell Temporary Common. This site is now closed and waste material located within the landfill has been covered. The type of waste material within the landfill is unknown, as no testing has been conducted. It is assumed that general domestic waste from local residents would have been deposited in the landfill.