Appendix G

Noise Assessment

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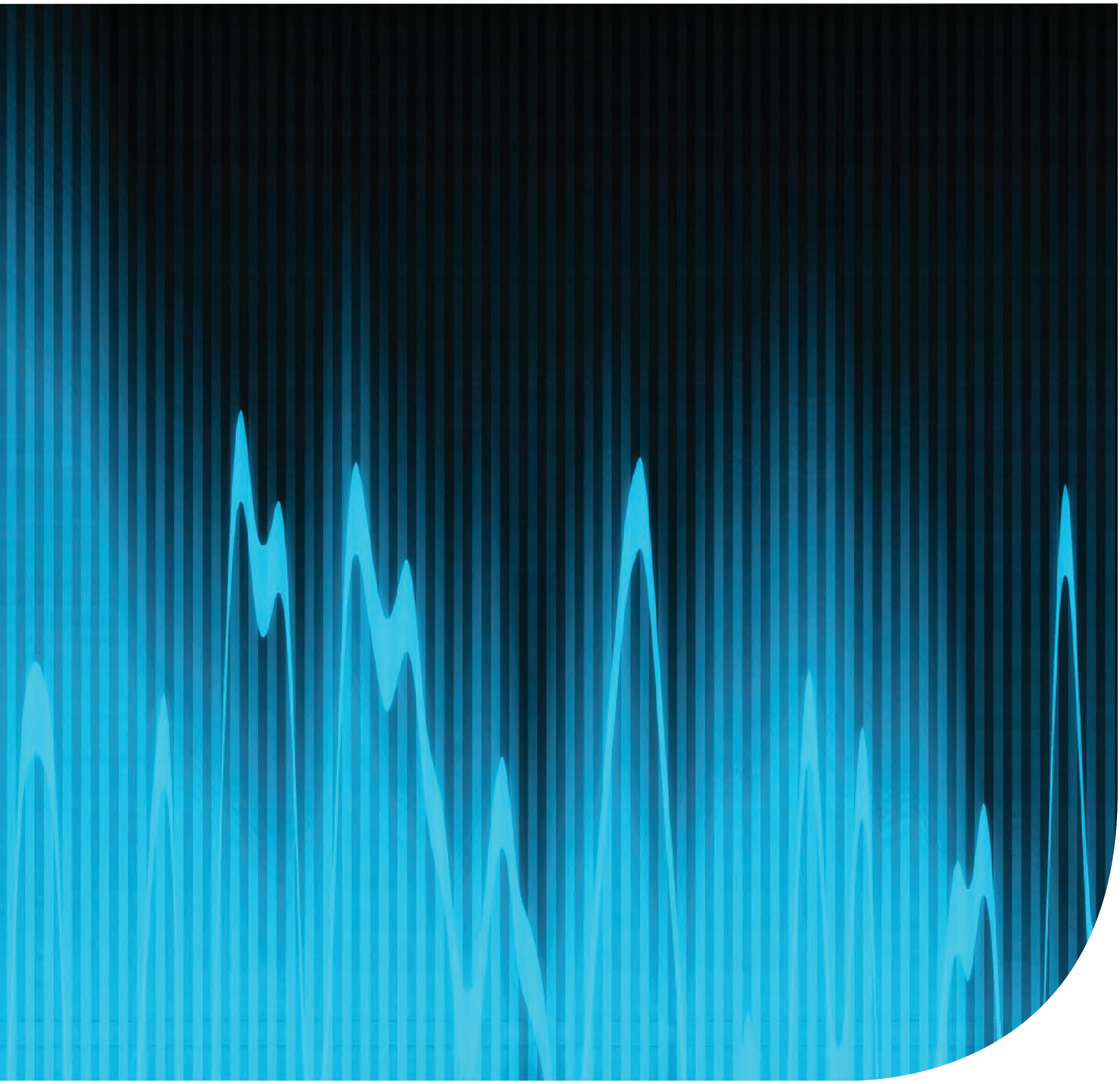
Berrima Colliery
Continued Operations

Noise Impact Assessment Report

Prepared for Boral | September 2010



Noise Assessment

Final

Prepared for Boral Cement | 25 September 2010

Prepared by	**Najah Ishac**	Approved by	**Brett McLennan**
Position	Director	Position	Director
Signature		Signature	
Date	25/09/2010	Date	25/09/2010

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Document Control

Version	Date	Prepared by	Reviewed by
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Table of Contents

Tables

Figures

Appendices

1 Introduction

1.1 Purpose of report

Berrima Colliery, owned and operated by Boral Cement, is an existing underground coal mine located at Medway, approximately seven kilometres (km) west of Berrima in the Southern Highlands of NSW (Figure 1.1). The colliery has been operating under existing use rights since 1926, pursuant to the *Environmental Planning and Assessment Act 1979* (EP&A Act). Berrima Colliery is required to obtain planning approval for continued operations (the proposal) due to recent changes to both the EP&A Act and the *Mining Act 1992.* The proposal is classified as a major development and is to be considered under Part 3A of the EP&A Act. Part 3A applications are required to be accompanied by an Environmental Assessment (EA) which provides a description of the proposal and considers its potential environmental, social and economic impacts supported by specialist technical reports.

This noise assessment was prepared by EMGA Mitchell McLennan (EMM) for Boral Cement to assess environmental noise emissions resulting from the proposal and to provide relevant technical information for the production of the EA.

1.2 Overview of proposal

Berrima Colliery is a bord and pillar operation with pit top facilities located at the end of Medway Road adjacent to the Wingecarribee River. The colliery currently produces around 220,000 tonnes per annum (tpa) of product coal with capacity to produce a maximum of 500,000tpa. Under the proposal the colliery will produce a maximum of 460,000tpa consistent with past operations.

Product coal will be transported by trucks travelling either east to Berrima Cement Works, to external customers located north and south of the colliery or to the stockpiling area located at Loch Catherine (approximately one km south-west of Berrima Colliery). Trucks travelling to Berrima Cement Works and other external customers travel along Medway Road and through Medway Village.

Aspects of the proposal that relate to noise include operational noise from the pit top and stockpiling facilities and traffic noise generated by trucks transporting product coal.

1.3 Report structure

This noise assessment provides the following:

- description of the existing environment including results of ambient noise levels and noise surveys;
- project specific noise criteria to be applied;
- modelling parameters such as noise source emission levels and local meteorological conditions;
- predicted operational noise levels based on measured existing plant levels and inclusive of the effect of prevailing meteorological conditions;
- predicted noise levels and assessment against the relevant criteria;
- assessment of cumulative noise impacts; and

- recommendation of noise management and mitigation measures where required.

A preliminary noise report for Berrima Colliery was undertaken by Heggies Pty Ltd in November 2009 and is provided as Appendix A of this report. The Heggies report provides background noise monitoring data and establishes site specific noise criteria, which are adopted in this assessment.

A number of technical terms are required for the discussion of noise and vibration. These are explained in the Glossary section at the end of this report.

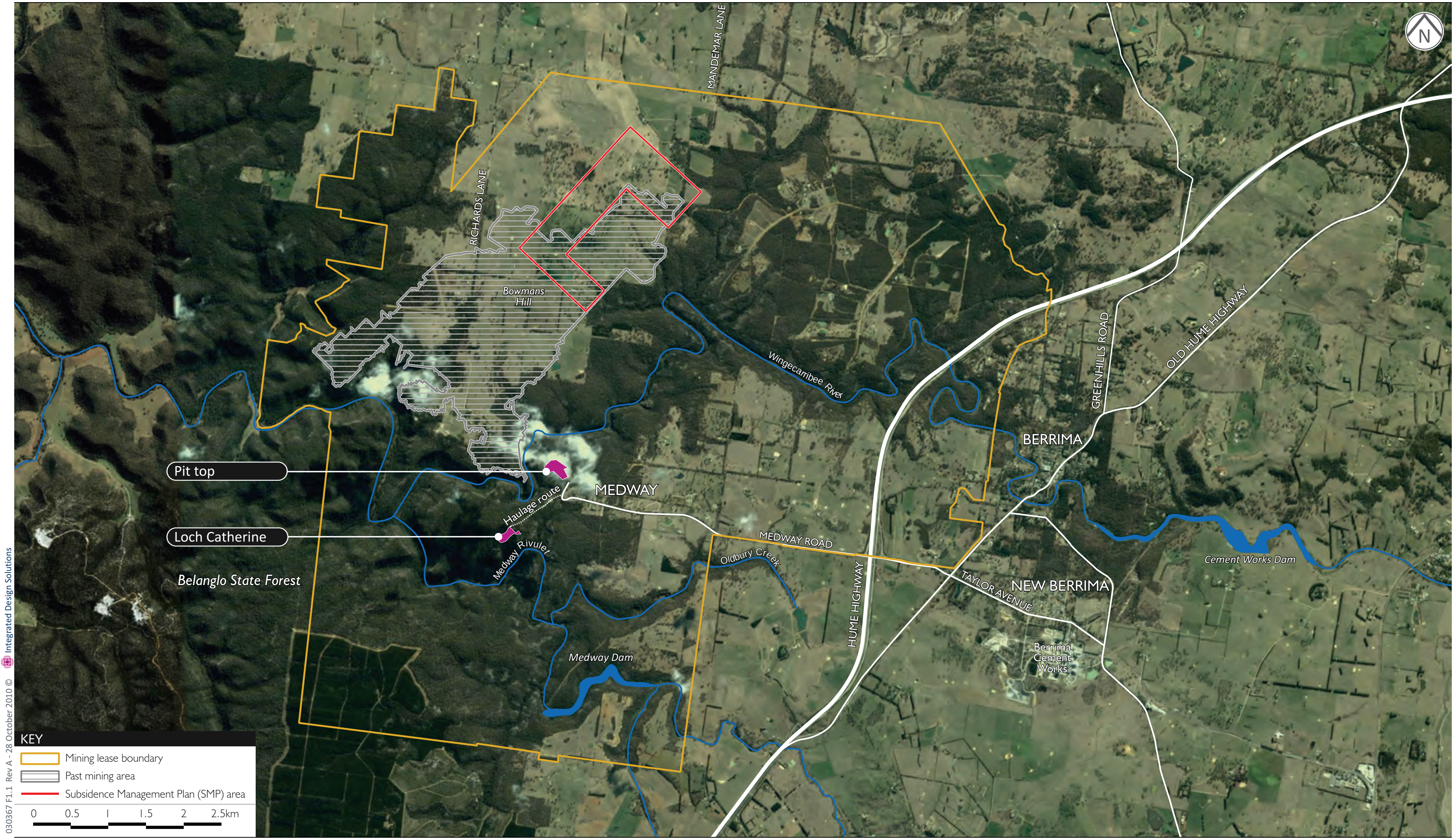

FIGURE 1.1
Locality plan

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2 Existing environment

In October 2009, unattended long term and attended short term noise monitoring was undertaken to establish the baseline noise climate at nearby sensitive receivers within Medway Village. Monitoring locations are shown in Figure 2.1. The data obtained is summarised below in Tables 2.1 and 2.2.

The reported background noise levels are typical of rural residential settings with little influence from non-natural sources. The night time 30dB(A) background noise level at all three locations is consistent with the recommended minimum threshold background noise level as provided in the Department of Environment, Climate Change and Water's (DECCW) Industrial Noise Policy (INP) released in January 2000. The evening and daytime background noise levels are also relatively low at between 30dB(A) to 33dB(A), again reflecting the rural setting of the area. Where evening background noise levels are shown to be higher than that of the daytime, the daytime level is adopted for the evening assessment consistent with the INP application notes provided by DECCW. The site's existing operations are considered to be predominantly inaudible at all monitoring locations (Heggies 2009). The reported background noise levels, therefore, are considered to be free from any site related noise.

Table 2.1 Summary of existing ambient noise levels

Location	Period	Rating background level (RBL), L_{90} dB(A)	Measured $L_{Aeq,period}$, dB(A)
6 Railway Street, Medway	Day	32	50
	Evening	30	47
	Night	30	45
140 Liebmans Road, Medway	Day	31	47
	Evening	33	46
	Night	30	39
605 Richards Lane, Medway	Day	31	49
	Evening	32	44
	Night	30	46

Notes: *Daytime 7.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night-time 10.00pm to 7.00am*

On Sundays and Public Holidays, Daytime 8.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night-time 10.00pm to 8.00am

The LA90 noise metric is used to determine the RBL as per the INP and represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level

L_{Aeq} *– The equivalent continuous noise level is defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period.*

Source: *Heggies Pty Ltd 2009, Berrima Colliery Preliminary Report.*

The operator attended noise measurements and observations summarised in Table 2.2 reflect the influence of natural sounds, domestic activity and local traffic on the noise environment.

Table 2.2 Operator attended noise survey results

Location	Date/ start time/ weather	Primary noise descriptor, dB(A)					Description of noise emission and typical maximum noise levels L_{Amax}, dB(A)
		L_{max}	L_1	L_{10}	L_{90}	L_{eq}	
Location 1: 6 Railway Street, Medway	06/10/09 12:22 Temp 19 °C Wind Calm	76	60	46	33	47	Birds 36 to 61 Resident noise 41 to 51 Resident Moving Car 45 to 67 Sneeze 76 Truck on Medway Road 42 to 51 Plane flyover 39 to 42
	20/10/09 10:10 Temp24 °C Wind W 2m/s	74	60	46	33	48	Birds 36 to 55 Dog 37 to 46 Resident Noise 37 to 39 Trucks on Medway Road 44 to 56 Traffic on Railway St 42 to 73 Colliery (crusher/conveyor) <.35 Plane flyover 43 to 48
Location 2: 140 Liebmans Road, Medway	06/10/09 12:58 Temp 19 °C Wind Calm	71	51	36	26	39	Birds 29 to 44 Residents Car 40 to 53 Traffic on Medway Road 28 to 31
	26/3/09 10:39 Temp 26 °C Wind W 2-3m/s	73	52	43	33	49	Birds 34 to 68 Wind Gusts 34 to 45 Truck on Medway Road 33
Location 3: 605 Richards Lane, Medway	06/10/09 14:02 Temp 20 °C Wind Calm	69	50	42	29	41	Resident Noise 57 Resident Car 48 to 53 Birds 35 to 69 Wind Gusts 36 to 41 Plane flyover 30 to 35
	26/03/09 11:29 Temp 40 °C Wind W 2m/s	64	58	46	38	45	Tractor on residents property 37 to 47 Wind gusts 39 to 45 Local Traffic (Truck) 44 to 64 Birds 38 to 43

Source: Heggies Pty Ltd 2009, Berrima Colliery Preliminary Report.

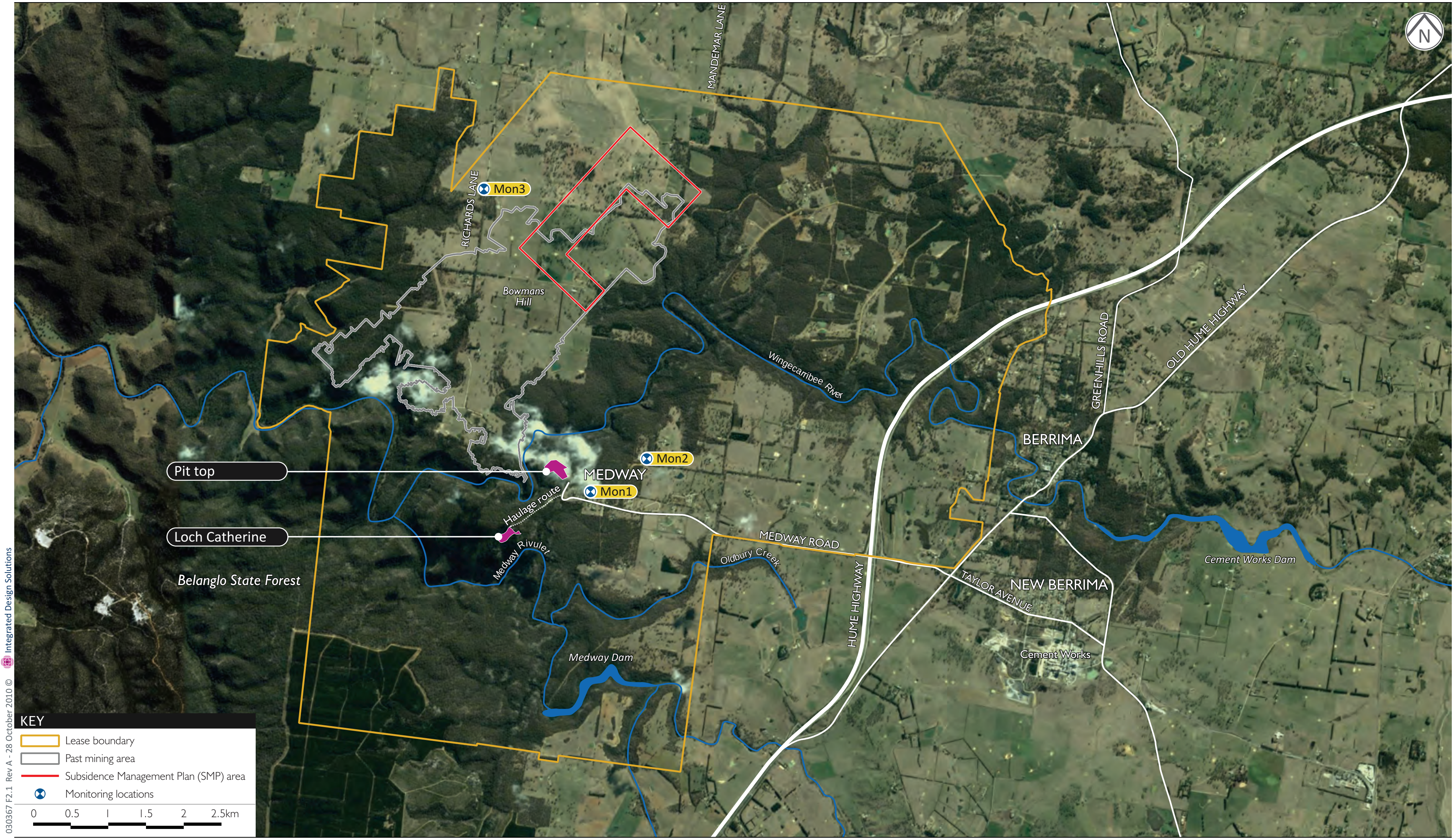

FIGURE 2.1
Noise monitoring locations

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3 Noise criteria

3.1 Operational noise criteria

The current Environment Protection Licence for the site does not contain noise limits as it has not been required under a planning approval. As stated earlier, the site is currently operating under existing use rights, however, planning approval is now required for continued operations due to recent legislative changes. Industrial sites, including mines, in NSW that are regulated by the Department of Planning (DoP) or DECCW usually have a set of conditions for operations which include noise limits. These limits are normally derived from operational noise criteria that apply at residences and that are based on guidelines stipulated in the INP or are achievable noise limits following the application of all reasonable and feasible noise mitigation. The latter usually applies to existing sites, such as the subject premises, so as not to unduly jeopardise the viability of their operations. It is often the case that where existing sites have been operating without conflict with their neighbours, noise limits are set so that noise at receivers is not increased on current levels.

The DECCW, in its INP, provides guidelines for assessing industrial facilities, including mines. The INP states with respect to the criteria:

"*They are not mandatory, and an application for a noise producing development is not determined purely on the basis of compliance or otherwise with the noise criteria. Numerous other factors need to be taken into account in the determination. These factors include economic consequences, other environmental effects and the social worth of the development.*"

Furthermore, the INP dedicates a chapter (Chapter 10 "Applying the policy to existing industrial premises") to addressing existing facilities. To that end, the policy states:

"*Where noise emissions from the site exceed the project-specific noise levels, the regulatory authorities and the noise-source manager need to negotiate achievable noise limits for the site. The project-specific noise levels should not be applied as mandatory noise limits. The project-specific noise levels supply the initial target levels and drive the process of assessing all feasible and reasonable control measures. Achievable noise limits result from applying all feasible and reasonable noise control measures. For sites with limited mitigation measures the achievable noise limits may sometimes be above the project-specific noise levels. In many instances the site will be required to reduce its noise emissions progressively to achieve the specified noise limits by specified dates. This will require noise to be managed as an integral part of site upgrades. However, the development of formal operating practices to reduce noise generation often need not be linked to site upgrades, and where feasible these operating practices should be applied at the earliest opportunity. The measures required to achieve the noise limits would usually be set out in a noise reduction program, with mitigation measures staged over time. The noise reduction program would typically be attached as a licence condition. Efforts should be aimed at achieving a reduction in noise in a manner that provides the greatest benefit to residents without undue impact on the existing business. This may be accomplished by prioritising the various noise-control measures.*"

The subject site is not undergoing an upgrade but merely continuation of existing operations and hence at this point in time does not provide an opportunity to mitigate noise emissions if levels are above project specific criteria.

Assessment criteria depend on the existing amenity of areas potentially affected by a proposed development. Assessment criteria for sensitive receivers near industry are based on the following objectives:

- protection of the community from excessive intrusive noise; and
- preservation of amenity for specific land uses.

In order to ensure that these objectives are met, two separate criteria are prescribed by the DECCW, namely the intrusiveness criteria and the amenity criteria. A fundamental difference between the intrusiveness and the amenity criteria is that the former is applicable over 15 minutes in any period, while the latter covers the entire assessment period (day, evening and night).

3.1.1 Intrusiveness criteria

The intrusiveness criterion requires that $L_{eq,15min}$ noise levels from a newly introduced source during the day, evening and night do not exceed the existing RBL by more than 5dB. This is expressed as:

$$L_{eq,15min} \leq RBL + 5 - K$$

$L_{eq,15min}$ is the L_{eq} noise level from the source (i.e. site), measured over a 15 minute period and K is a series of adjustments for various noise characteristics. Where the RBL is less than 30dB(A), a value of 30dB(A) is used.

3.1.2 Amenity criteria

The DECCW's amenity criterion requires industrial noise to be within an acceptable level for the particular locality and land use. Where ambient noise is already high, the acoustic environment should not be deteriorated significantly. The strategy behind the amenity criterion is a holistic approach to noise, where all industrial noise (existing and future) received at a given location does not exceed the recommended goals.

The amenity criteria taken from the INP are given below in Table 3.1 for various receiver land use categories. For the residences local to the site, the category that best represents their environment is either rural or suburban. The only difference between these two categories is the daytime period target, otherwise evening and night amenity targets are identical. As will be shown later this is inconsequential to the assessment since the intrusiveness criteria is the limiting criteria for the site.

The other important consideration is cumulative noise from other industrial sites in the area and therefore the need to make allowances for this in the derivation of the amenity targets for the site. However, this is not an issue for the local residences as there are no other industrial sites in the area apart from the subject facility. Hence no adjustment to the amenity targets is needed.

Table 3.1 Amenity criteria – recommended L_{eq} noise levels from Industrial noise sources

Type of receiver	Indicative noise amenity area	Time period	Recommended L_{eq} (period) noise level (dBA)	
			Acceptable	Maximum
Residential	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50

Table 3.1 Amenity criteria – recommended L_{eq} noise levels from Industrial noise sources

Type of receiver	Indicative noise amenity area	Time period	Recommended L_{eq} (period) noise level (dBA)	
			Acceptable	Maximum
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
		Day	65	70
		Evening	55	60
		Night	50	55
School classrooms - internal	All	Noisiest 1 hour period when in use	35	40
Hospital wards	All	Noisiest 1 hour period		
- internal			35	40
- external			50	55
Place of worship - internal	All	When in use	40	45
Area specifically reserved for passive recreation (eg National Park)	All	When in use	50	55
Active recreation area (eg school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Notes: Daytime 7.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night-time 10.00pm to 7.00am

On Sundays and Public Holidays, Daytime 8.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night-time 10.00pm to 8.00am.

The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

3.1.3 Project specific noise criteria

The INP requires that both the intrusiveness and amenity criteria are satisfied. However, the more limiting of the two becomes the project specific noise criteria (PSNC) or operational criteria for this site alone. In this case, and for all assessment locations, the intrusiveness criteria are the more limiting of the two and hence the PSNC are those presented below in Table 3.2 for all privately owned residential assessment locations identified through mapping and our site visit. These locations constitute the closest and potentially most exposed residences to the operations (refer to Figure 3.1 for assessment locations R1 to R15).

Table 3.2 Proposed project specific noise criteria

Location		MGA co-ordinates		Intrusiveness criteria $L_{eq,15min}$, dB(A)			Basis of criteria
		Easting	Northing	Day	Evening	Night	
R1	Medway Village	249055	6180141	37	35	35	6 Railway Street
R2	Medway Village	249069	6180176	37	35	35	6 Railway Street
R3	Medway Village	249113	6180220	37	35	35	6 Railway Street
R4	Medway Village	249152	6180239	37	35	35	6 Railway Street
R5	Medway Village	249168	6180249	37	35	35	6 Railway Street
R6	Medway Village	249170	6180135	37	35	35	6 Railway Street
R7	Medway Village	249214	6180133	37	35	35	6 Railway Street
R8	Medway Village	249237	6180139	37	35	35	6 Railway Street
R9	Medway Village	249192	6180252	37	35	35	6 Railway Street
R10	Medway Village	249284	6180147	37	35	35	6 Railway Street
R11	Medway Village	249365	6180036	37	35	35	6 Railway Street
R12	1.1km ESE of Loch Catherine	249422	6179305	35	35	35	INP minimum
R13	1.5km ESE of Loch Catherine	249831	6179288	35	35	35	INP minimum
R14	950m WNW of the Berrima Colliery Pit Top Facility	248039	6180831	36	36	35	605 Richardson Lane
R15	1km NW of the Berrima Colliery Pit Top Facility	248066	6181060	36	36	35	605 Richardson Lane

Notes: Daytime 7.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night 10.00pm to 7.00am;
On Sundays and Public Holidays, Daytime 8.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night-time 10.00pm to 8.00am
Evening criteria adjusted to no greater than daytime period as per INP Application Notes

3.2 Sleep disturbance criteria

The aforementioned criteria, which consider the average noise emission of a source over 15 minutes, are appropriate for assessing noise from relatively steady-state sources, such as engine noise from conveyors, screens and crushers. However, noise from sources such as reversing alarms, empty truck bodies and the banging of tail gates is intermittent (rather than continuous) in nature, and as such, needs to be assessed using the L_1 or L_{max} noise metrics.

The most important impact of such intermittent noises would be to disturb the sleep of nearby residents. While the INP does not specify a criterion for assessing sleep disturbance, DECCW's *Environmental Criteria for Road Traffic Noise* (ECRTN) (then Environment Protection Authority (EPA) 1999) policy indicates that levels below 50 to 55dB(A) inside residences are unlikely to wake sleeping occupants. The likely number of noise events per night should also be considered. If bedroom windows are open, this corresponds to an external maximum noise level of approximately 60 to 65dB(A) L_{max} at a residence. However, this is can be considerably higher than the DECCW's previous position on sleep disturbance in its *Environmental Noise Control Manual* (EPA, 1994) which recommends that L_1 noise from a source should not exceed the existing background noise level by more than 15dB. For the purpose of this assessment, the descriptors L_{max} and L_1 may be considered interchangeable. This is the DECCW's current position on sleep disturbance criteria.

As part of the background noise monitoring, it was established that background noise levels for all local residences are at the INP minimum threshold value of 30dB(A). As such, the sleep disturbance criterion will be 45dB(A) L_{max} for all residences. This target should be adopted although night time operations are not considered to contain intermittent sources that could occasion sleep disturbance and hence no further calculations are provided herein.

3.3 Road traffic noise design criteria

The ECRTN provides external traffic noise criteria. To determine suitable traffic noise criteria for a particular project, the road or roads must be categorised with respect to the ECRTN definitions. The access to the site is via Medway Road, which could be categorised as collector road, which is defined in the ECRTN as:

"a road situated in a built up area that collects local traffic leaving a locality and connects to a sub-arterial road".

Also, given the operation of the site since 1926, the classification of Medway Road is best described as a principal haulage route. If defined as such by Wingecarribee Shire Council, this would attract ECRTN noise criteria associated with collector roads which is given in Table 3.3 below.

Table 3.3 Road traffic noise criteria

Type of development	Criteria		
	Day (7am – 10pm)	**Night (10pm – 7am)***	**Where criteria are already exceeded**
Land use developments with potential to create additional traffic on collector road (principal haulage route)	L_{eq} (1 hour) 60 dBA	L_{eq} (1 hour) 55 dBA	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

*Notes: *There will be no heavy vehicle movements to/from the quarry during the night-time period.*

FIGURE 3.1
Noise assessment locations

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4 Noise modelling parameters

4.1 Local weather characteristics

The INP provides guidance on how noise due to varying meteorological conditions is to be assessed. The procedure is based on identifying and combining worst case meteorological conditions at the site (referred to as the "prevailing meteorology") and assessing the site noise levels against the relevant limits.

During wind and temperature gradient conditions, noise levels at residences may increase or decrease compared with noise during calm conditions. This is due to refraction caused by the varying speed of sound with increasing height above ground. The level of noise received increases when the wind blows from source to receivers or under temperature inversion conditions, and conversely, decreases when the wind blows from receivers to source or under temperature lapse conditions.

In some circumstances, compliance achieved under calm conditions generally results in compliance being achieved under "prevailing meteorological" conditions when higher received noise levels may prevail. Despite the increase in noise at properties caused by adverse winds, ambient noise also increases during such weather conditions (due to wind induced vegetation noise) and mine noise is masked.

A detailed analysis of the vector components of hourly wind speed and direction obtained from the Bureau of Meteorology (BoM) station at Moss Vale between 2005 and 2010 was undertaken in accordance with the INP. To that end, the DECCW encourage the use of their "Wind Calculator" program which is provided on their website, so that a consistent approach to noise modelling is undertaken throughout NSW. This assessment has utilised this programme and accordingly, our analysis is consistent with the DECCW's "Wind Calculator" with respect to 'feature' wind directions.

The wind directions determined to be a 'feature' of the area in accordance with the DECCW's wind calculator are summarised in Table 4.1. The percentage values in bold indicate the assessable wind direction, season and period of the day to be considered.

Table 4.1 Assessable winds as per the DECCW Calculator – Percentage occurrence

Direction of wind ±90 degrees	Season	Day (%)	Evening (%)	Night (%)
North	Summer	26.9	29.0	28.7
	Autumn	27.5	**36.3**	29.4
	Winter	**35.5**	**43.4**	**40.7**
	Spring	**32.7**	**34.2**	**30.7**
South	Summer	16.7	22.5	21.2
	Autumn	24.2	25.8	24.8
	Winter	24.7	24.4	20.9
	Spring	17.9	19.5	21.5
East	Summer	29.6	**35.8**	**53.9**
	Autumn	29.9	**48.0**	**34.4**
	Winter	18.5	26.1	15.6
	Spring	23.4	**42.3**	**40.7**
West	Summer	10.2	12.2	14.6
	Autumn	18.3	14.4	23.6
	Winter	19.1	22.6	24.8

	Spring	12.5	13.6	19.6
North-east	Summer	17.6	24.3	29.7
	Autumn	18.5	29.3	21.4
	Winter	11.0	21.3	12.1
	Spring	15.8	25.1	26.1
South-east	Summer	16.9	25.8	23.2
	Autumn	18.8	29.0	20.2
	Winter	14.3	17.0	11.9
	Spring	14.4	21.3	17.2
South-west	Summer	23.1	23.5	26.9
	Autumn	29.8	25.8	**30.7**
	Winter	25.8	26.7	**32.6**
	Spring	22.9	23.4	26.6
North-west	Summer	26.5	**31.0**	**38.4**
	Autumn	26.4	**32.8**	**35.2**
	Winter	23.6	**34.1**	**35.5**
	Spring	23.0	**35.4**	**37.2**

It is demonstrated in Table 4.1 that the assessable winds occur during the day from a northerly direction in winter and spring, and during the evening and night time from various directions and seasons. For modelling purposes the winds from the north during the day and evening, and north-west during the night time period were modelled and represent the worst case directions for the closest residences at Medway. The upper 10th percentile wind speed for each was determined as 2.4 metres per second (m/s) during the daytime and 2.1m/s during the night time period. The evening period upper 10th percentile wind speed was assumed to be the same as that for the daytime, given the smaller and therefore less statistically robust four hour period.

The meteorological data obtained from the BoM weather station did not contain sigma theta data to allow a temperature inversion assessment. As a worst case scenario temperature inversions are assumed a feature of the area and modelling includes the effects of a three degrees Celsius per 100 metres (^{0}C/m) temperature inversion for the night time period (inversions are only prevalent during the night).

5 Predicted operational noise levels

The prediction of noise from the operations was undertaken using the Environmental Noise Model (ENM) prediction software. The ENM predicts total noise levels at residences from the concurrent operation of multiple noise sources. The model included consideration of factors such as the lateral and vertical location of plant, source-to-receiver distances, ground effects, atmospheric absorption, topography of the mine and surrounding area and meteorological conditions. This section outlines the base parameters used in the noise modelling and the resulting noise levels at receivers.

It is important to note that these predictions are considered to represent existing emissions from the site and that whilst there is an increase in production rates, in noise terms there is no change in expected peak $L_{eq,15minute}$ noise levels from site. It is a continuation of current operations which have existed for decades.

5.1 Modelled noise sources

Two operating scenarios were modelled, one representing the daytime activities and the other the night time operations. These are described in Table 5.1 along with each sources emission level as measured on site by Heggies and as provided to EMM for modelling purposes. It should be noted that the general plant noise level includes the crusher, which is inside a clad structure.

Table 5.1 Main noise sources of the project

Operating period	Typical plant or activity	Representative $L_{eq,15minute}$ sound power level, dB(A)
Daytime	**Loch Catherine**	
	Front-end-loader	108
	Road truck	103
	Pit Top	
	General pit top plant (conveyors, crusher etc.)	93
	Dolly cart	85
	Truck being loaded at surge bin	96
	Road truck entering pit top	99
	Forklift	93
	Truck pass by at north end of private road to Loch Catherine	85
Evening	**Loch Catherine**	
	Road truck	103
	Pit Top	
	General pit top plant (conveyors, crusher etc.)	93
	Dolly cart	85
	Truck being loaded at surge bin	96

Table 5.1 Main noise sources of the project

Operating period	Typical plant or activity	Representative $L_{eq,15minute}$ sound power level, dB(A)
Night	General pit top plant (conveyors, crusher etc.)	93
	Dolly cart	85

5.2 Results

The wind and temperature inversion conditions described earlier were used in the modelled predictions of operational noise levels. The prediction of noise during periods of calm and 'prevailing INP meteorology' is presented in Table 5.2 for day, evening and night operations. The results are also presented as noise contours in Figures 5.1 and 5.2 for the daytime and night time periods respectively. The contours represent both calm and adverse weather conditions for the two assessment periods, consistent with the weather parameters in Table 5.2.

The results presented in Table 5.2 were derived in accordance with the INP assessment methodology and considered the effect of only adverse (prevailing) INP-assessable meteorological conditions and not all possible wind conditions that may be experienced at site. This means that at other times, noise levels can be lower than those presented (eg during winds blowing from receivers towards the site or during temperature lapse conditions).

The results demonstrate that noise levels satisfy the DECCW's non-mandatory INP project specific criteria at all assessment locations during the night and at most locations during the evening and daytime. The predicted noise levels that are more than marginally (3dB) above criteria are shown in bold text. The levels above criteria are not considered to result in significant impacts at residences as they are not more than 10dB above background noise levels. The DECCW's INP defines significant impact where $L_{eq,15minute}$ from industrial noise is more than 10dB above background noise levels. Furthermore, existing ambient noise levels at residences during the are typically higher than predicted site noise as evident in Table 2.2, and therefore would somewhat mask site noise. The potential for noise impacts is therefore considered low, even though site noise levels are predicted to be marginally above target criteria during adverse weather conditions during the day and evening at the four closest residences.

As discussed earlier, the DECCW's INP does not expect existing industrial facilities to necessarily achieve INP project specific criteria with limited opportunity for mitigation and suggests achievable noise levels should be set. The site is not undergoing an upgrade but is continuing current operations. Given this and based on no known noise complaints from local residents to current operations, predicted noise levels are considered to be appropriate limits that will not cause impacts at residences.

Table 5.2 Predicted operation noise level

Receiver	Predicted Operational Noise Levels, dB(A)							INP Criteria, dB(A)		
	Day		Evening		Night			Day	Evening	Night
	Calm	Wind 2.4m/s	Calm	Wind 2.1m/s	Calm	30C/100m Temp.Inv	Wind 2.1 m/s			
1	36	42	<35	39	<35	<35	<35	37	35	35
2	36	42	<35	39	<35	<35	<35	37	35	35

Table 5.2 Predicted operation noise level

Receiver	Predicted Operational Noise Levels, dB(A)							INP Criteria, dB(A)		
3	39	42	<35	39	35	35	<35	37	35	35
4	<35	41	<35	39	<35	<35	35	37	35	35
5	<35	40	<35	38	<35	<35	<35	37	35	35
6	<35	39	<35	35	<35	<35	<35	37	35	35
7	<35	38	<35	<35	<35	<35	<35	37	35	35
8	36	37	<35	<35	<35	<35	<35	37	35	35
9	35	40	<35	38	<35	<35	<35	37	35	35
10	<35	36	<35	<35	<35	<35	<35	37	35	35
11	<35	36	<35	<35	<35	<35	<35	37	35	35
12	<35	36	<35	<35	<35	<35	<35	35	35	35
13	<35	<35	<35	<35	<35	<35	<35	35	35	35
14	<35	<35	<35	<35	<35	<35	<35	36	36	35
15	<35	<35	<35	<35	<35	<35	<35	36	36	35

5.3 Road traffic noise

The assessment of potential road traffic noise impacts on local residents is provided below. The assessment is provided for a representative residence closest to Medway Road at Medway village for existing and future traffic scenarios. The façade of this representative location is 15 metres (m) from Medway Road, which is the road used by staff and trucks accessing the site.

As described earlier, the road traffic criteria is to apply to the peak traffic generating hour in the day and night periods. The accompanying traffic impact assessment provides all the necessary data as summarised in Table 5.3. It is important to note that truck movements are limited to the daytime period, with a one hour excursion outside this in the morning 6am to 7am period. The peak hour volumes assume all staff arrive in separate vehicles via Medway Road for each shift, with one shift change coinciding with the daytime and one with the night time assessment period. The total employee numbers (38 current and 63 future) are assumed to be evenly split between the daytime and night time shifts.

For road traffic noise assessment purposes the DECCW's ECRTN defines daytime as 7am to 10pm and night time 10pm to 7am. The day peak hour is assumed to occur between 4pm and 5pm when the morning shift employees are leaving, and truck deliveries are occurring. The night peak is assumed to occur between 5am to 6am when the morning shift employees arrive as well as 6am to 7am when trucks deliveries begin. Based on results obtained from the *Transport Impact Assessment for Berrima Colliery, Appendix A – Traffic Count Data* (Arup 2010) the current peak hour volumes were assumed as the average seen over a seven day period ie. 24 for 5am – 6am, 20 for 6am to 7am and 52 for 4pm – 5pm. Existing volumes of non-site vehicles were determined by subtracting the site vehicles from the total traffic volumes and were assumed to be the same for future traffic volumes.

Table 5.3 Medway Road traffic volumes

	Existing traffic volumes	Future traffic volumes with increased production
Total AADT*	511	647
Site related	118 total: 48 coal truck movements (24 trucks), 70 cars	195 total: 100 coal truck movements (50 trucks), and 95 cars
Peak hour day**	52 total: 19 staff, 4 truck movements, 29 non-site	67 total: 31 staff, 7 truck movements, 29 non-site
Peak hour night**		
5am – 6am	22 total: 19 staff, 3 non-site	35 total: 32 staff, 3 non-site
6am – 7am	20 total: 4 truck movements, 16 non-site	23 total: 7 truck movements, 16 non-site

Notes: **Annual Average Daily Traffic*

***For road traffic noise assessment purposes the DECCW's ECRTN defines daytime as 7am to 10pm and night time 10pm to 7am.*

Volumes exclude Loch Catherine trucks (ie 12 movements existing and 32 movements future)

Peak hour total volumes are assumed to be 10% of AADT, which is typical and as stated in the traffic report.

Based on the above traffic volumes, traffic noise at the closest representative residence with a facade 15m from the centre of Medway Road is calculated in Table 5.4. This location is representative of residences east of the Loch Catherine access road and therefore excludes related truck movements. The calculation is conservatively based on a traffic speed of 50km/h and adopts the Calculation of Road Traffic Noise (CoRTN) algorithm, which is a UK based prediction algorithm adopted for Australian conditions. The CoRTN algorithm is widely used as a reliable prediction tool and is endorsed by the DECCW.

The results in Table 5.4 indicate that existing and future road traffic noise levels are expected to satisfy the DECCW ECRTN criteria at the closest residence to Medway Road. It is also important to note that site related traffic movements are nil for the majority of the more sensitive night time period between 10pm to 5am.

Table 5.4 Calculated road traffic noise levels for a façade 15m from Medway Rd, dB(A)

	Existing Peak hour $L_{eq,1hour}$ Noise Levels			Future Peak hour $L_{eq,1hour}$ Noise Levels		
	Day	**Night**		**Day**	**Night**	
		5am-6am	**6am-7am**		**5am-6am**	**6am-7am**
	54	48	52	55	50	54
Criteria	**60**	**55**	**55**	**60**	**55**	**55**

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FIGURE 5.1
Daytime operational $L_{eq,\ 15\ minute}$ noise levels, dB(A)

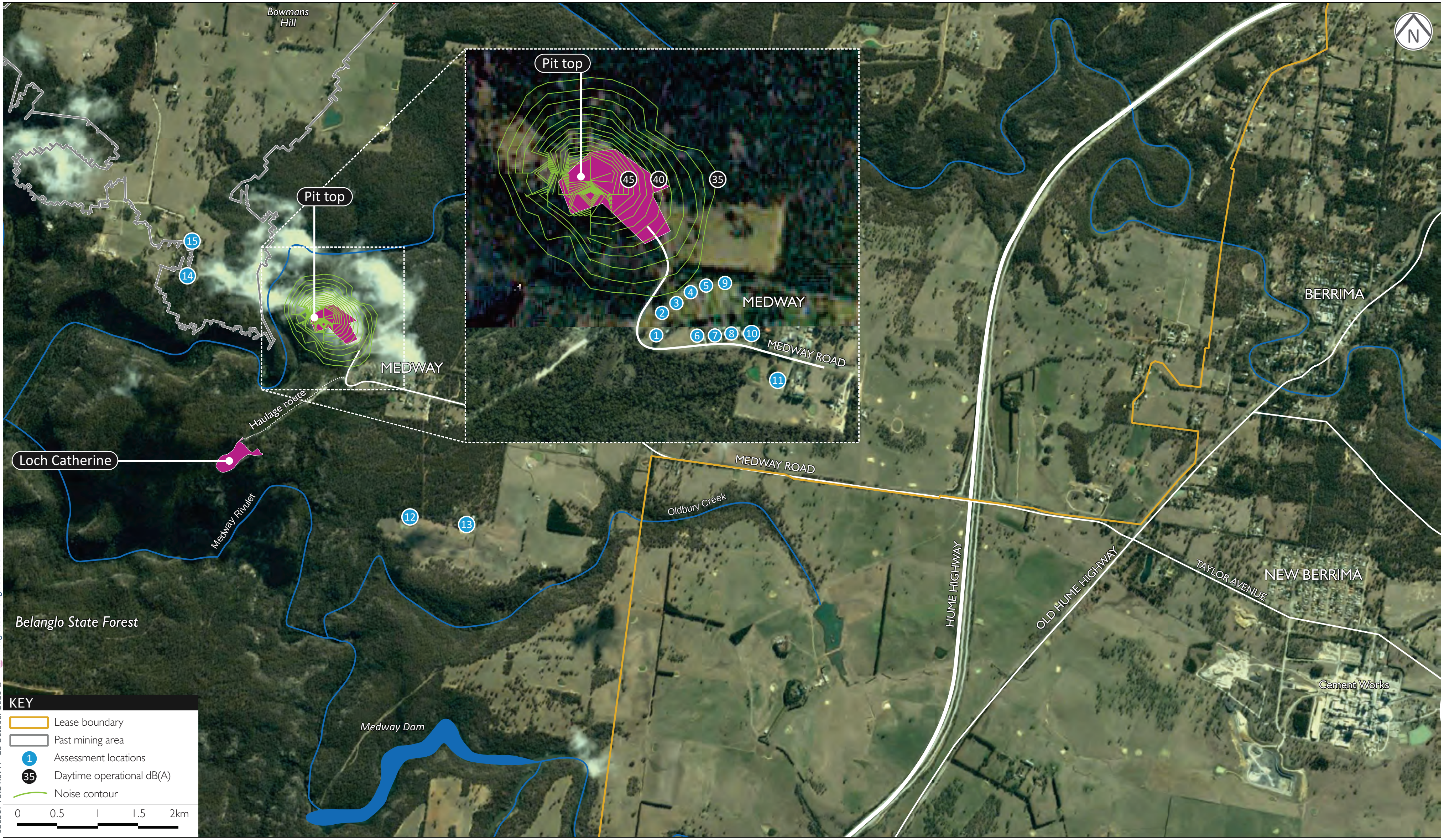

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FIGURE 5.2
Night time operational $L_{eq,\ 15\ minute}$ noise levels, dB(A)

6 Conclusion

EMM has completed an environmental noise impact assessment for the continued operations at the Boral Cement operated Berrima Colliery. The study included on site noise monitoring of existing emissions, predictions of onsite operational noise under adverse weather conditions in accordance with DECCW policy for varying activities into the future for the day, evening and night time activities, and road traffic noise calculations.

The results demonstrate that noise levels satisfy the DECCW's non-mandatory INP project specific criteria at all assessment locations during the night and at most locations during the evening and daytime. The predicted noise levels at four of the closest residences are above criteria during the evening and daytime periods. However, these are not considered to result in significant impacts at residences as they are not more than 10dB above background noise levels and are representative of existing emissions. The potential for noise impacts is therefore considered low, even though site noise levels are predicted to be marginally above target criteria during adverse weather conditions during the day and evening at the four closest residences.

The DECCW's INP does not expect existing industrial facilities to necessarily achieve INP project specific criteria with limited opportunity for mitigation and suggests achievable noise levels should be set. The site is not undergoing an upgrade but is continuing current operations. Given this and based on no known noise complaints from local residents to current operations, predicted noise levels are considered to be appropriate limits that will not cause impacts at residences.

Glossary of Terms

dB(A) - Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.

DECCW - The NSW Department of Environment, Climate Change & Water.

ECRTN - Environmental Criteria for Road Traffic Noise policy (Published by the Environment Protection Authority (now DECCW) in 1999).

ENM - Environmental Noise Model – Noise prediction software developed by RTA Technology

INP - NSW Industrial Noise Policy (Published by the Environment Protection Authority (now DECCW) in 2000).

L1 - The noise level exceeded for 1 % of a measurement period.

L10 - A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.

L90 - Commonly referred to as the background noise, this is the level exceeded 90 %of the time.

Leq - It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period. The Leq,15min descriptor refers to an Leq noise level measured over a continuous 15 minute period.

Lmax - The maximum root mean squared sound pressure level received at the microphone during a measuring interval.

RBL - The Rating Background Level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.

SI - SI ("Still Isothermal") refers to calm weather conditions (ie. The absence of any wind or temperature gradients).

Sound Power Level - This is a measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.

Temperature Inversion - A positive temperature gradient. A meteorological condition where atmospheric temperature increases with altitude.

(sq) sigma-theta - The standard deviation of horizontal wind fluctuation

Appendix A

Heggies Pty Ltd Berrima Colliery Preliminary Report

HEGGIES

30 November 2009

30-2359 Preliminary Report 20091130

Mitchell McLennan
Level 1, 66 Spit Road
Mossman NSW 2088

Attention: Brett McLennan

Dear Brett

Berrima Colliery
Preliminary Report

1 Introduction

Heggies Pty Ltd (Heggies) has been commissioned by Mitchell McLennan on behalf of Blue Circle Southern Cement Limited to conduct a noise impact assessment for the Berrima Colliery. Broadly, the objective of the noise assessment was to identify the potential impacts of noise from the proposed development, including construction and operation of the facility and associated rail and road traffic movements, and to provide advice with regard to effective mitigation strategies where necessary.

2 Ambient Noise Monitoring

In order to determine existing ambient noise levels at residential locations surrounding the site, a background monitoring survey was undertaken at three locations given in **Table 1**. The noise monitoring locations are identified in the location map provided in **Appendix A**.

Table 1 Ambient Noise Monitoring Locations

Location	Address / Description
Location 1	6 Railway Parade, Medway
Location 2	140 Liebmans Road, Medway
Location 3	605 Richardson Lane, Medway

The background noise monitoring consisted of continuous, unattended noise logging and operator attended noise surveys. The operator attended noise surveys are used to define the type and character of ambient noise sources in the area and to qualify the unattended noise logging results.

3 Impact Assessment Procedures

3.1 General Objectives

Responsibility for the control of noise emission in New South Wales is vested in Local Government and the Department of Environment Climate Change and Water (DECCW). The Industrial Noise Policy (INP) was released in January 2000 and provides a framework and process for deriving noise criteria for consents and licences that will enable the DECC to regulate premises that are scheduled under the Protection of the Environment Operations Act, 1997.

The specific policy objectives are:

- To establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses.
- To use the criteria as the basis for deriving project specific noise levels.
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.
- To outline a range of mitigation measures that could be used to minimise noise impacts.
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development.
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the Act.

3.2 Assessing Intrusiveness

For assessing intrusiveness, the background noise level must be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than five decibels above the measured background level (L_{A90}).

3.3 Assessing Amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. For high-traffic areas there is a separate amenity criterion.

An extract from the INP that relates to the amenity criteria is given in **Table 2** and **Table 3**.

Table 2 Amenity Criteria - Recommended LAeq Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq(Period) Noise Level (dBA)	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban/Industrial Interface (for existing situations only)	Day	65	70
		Evening	55	60
		Night	50	55
School classrooms - internal	All	Noisiest 1 hour period when in use	35	40
Hospital wards	All	Noisiest 1 hour period		
- internal			35	40
- external			50	55
Place of worship - internal	All	When in use	40	45
Area specifically reserved for passive recreation (eg National Park)	All	When in use	50	55
Active recreation area (eg school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Table 3 Modification to Acceptable Noise Level (ANL)* to Account for Existing Levels of Industrial Noise

Total Existing L_{Aeq} noise level from Industrial Noise Sources	Maximum L_{Aeq} Noise Level for Noise from New Sources Alone, dBA
≥ Acceptable noise level plus 2 dBA	If existing noise level is *likely to decrease* in future acceptable noise level minus 10 dBA If existing noise level is *unlikely to decrease* in future existing noise level minus 10 dBA
Acceptable noise level plus 1 dBA	Acceptable noise level minus 8 dBA
Acceptable noise level	Acceptable noise level minus 8 dBA
Acceptable noise level minus 1 dBA	Acceptable noise level minus 6 dBA
Acceptable noise level minus 2 dBA	Acceptable noise level minus 4 dBA
Acceptable noise level minus 3 dBA	Acceptable noise level minus 3 dBA
Acceptable noise level minus 4 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 5 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 6 dBA	Acceptable noise level minus 1 dBA
< Acceptable noise level minus 6 dBA	Acceptable noise level

* ANL = recommended acceptable L_{Aeq} noise level for the specific receiver, area and time of day from **Table 2**

The DECCW has acknowledged that *"where early morning (5 am - 7 am) operations are proposed, it may be unduly stringent to expect such operations to be assessed against the night-time criteria - especially if existing background noise levels are steadily rising in these early morning hours"*. For this reason, the morning shoulder period (6.00 am - 7.00 am) has been considered separately as part of this assessment.

3.4 Assessing Sleep Disturbance

The DECCW has acknowledged that the relationship between maximum noise levels and sleep disturbance is not currently well defined. Criteria for assessing sleep disturbance has not been identified under the INP and hence, sleep arousal has been assessed using the guidelines set out in the Environmental Noise Control Manual (ENCM) Chapter 19-3.

To avoid the likelihood of sleep disturbance the ENCM recommends that the $L_{A1(1minute)}$ noise level of the source under consideration should not exceed the background noise level (L_{A90}) by more than 15 dBA when measured outside the bedroom window of the receiver during the night-time hours (10.00 pm to 7.00 am).

3.5 Road Traffic Noise

The Environment Protection Authority released the *"Environmental Criteria for Road Traffic Noise"* (ECRTN) in May 1999. The policy sets out noise criteria applicable to different road classifications for the purpose of defining traffic noise impacts.

4 Existing Acoustical and Meteorological Environment

4.1 General Methodology

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS 1259.2-1990, "Sound Level Meters" and carries current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA.

4.2 Unattended Continuous Noise Monitoring

Background noise levels were monitored by Heggies. The objective of the background noise survey was to measure $L_{A90(period)}$ and $L_{Aeq(15minute)}$ noise levels at the nearest potentially affected residential locations during the day, evening and night-time periods to enable the determination of the intrusiveness and amenity criteria for the proposed development.

Background noise levels were monitored at three separate locations, considered to be representative of the nearest potentially affected receivers, from Tuesday 6 October to Tuesday 20 October 2009, inclusive. Details of monitoring locations are provided in **Table 4**.

Table 4 Noise Monitoring Locations

Location	Details	Description	Logger Type	Serial Number
1	6 Railway Parade, Medway	Front yard of residence	ARL EL316	16-207-020
2	140 Liebmans Road, Medway	Between Residential Building and Shed	ARL EL316	16-207-021
3	605 Richardson Lane, Medway	Eastern side of Property adjacent veggie patch	ARL EL316	16-306-039

ARL Type EL316 noise loggers were used to monitor the ambient noise levels at each location. The noise loggers were programmed to record statistical noise level indices continuously in 15 minute intervals, including L_{Amax}, L_{A1}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and L_{Aeq}. Precautions were taken to minimise influences from extraneous noise sources and reflections from adjacent buildings.

Weather data for the survey period was obtained from the nearest Bureau of Meteorology station located at Moss Vale. Noise data corresponding to periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 18 km/h) were discarded in accordance with INP data exclusion methodology. A summary of the results of the background surveys is given in **Table 5**. Results are displayed graphically in **Appendix B** for details.

There was a malfunction associated with the logger at location 3 which meant that data for a full seven (7) day period was not obtained.

Table 5 Summary of Existing Ambient Noise Levels

Location	Period	Background L_{A90} Noise Level Rating Background Level	Measured $L_{Aeq(Period)}$	Estimated Existing Industrial Contribution L_{Aeq}
6 Railway Street, Medway	Day	32	50	<40
	Evening	30	47	<37
	Night	30	45	<35
140 Liebmans Road, medway	Day	31	47	<37
	Evening	33	46	<36
	Night	30	39	<29
605 Richardson Lane, Medway	Day	31	49	<37
	Evening	32	44	<36
	Night	30	46	<29

Note: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am
On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am
The L_{A90} represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level
L_{Aeq} - The equivalent continuous noise level is defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period

4.3 Operator Attended Noise Monitoring

Operator attended noise measurements were conducted during the daytime period at each monitoring location. Each measurement was conducted over a 15 minute period using a using a B & K 2260 integrating sound level meter (S/N 2487418). The results of the operator attended noise measurements are given in **Table 6**. Ambient noise levels given in the table include all noise sources such as road traffic, birds, residents as well as any industrial operations.

Table 6 Operator Attended Noise Survey Results

Location	Date/ Start time/ Weather	Primary Noise Descriptor (dBA re 20 μPa)					Description of Noise Emission, Typical Maximum Levels LAmax (dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Location 1 6 Railway Street, Medway	06/10/09 12:22 Temp 19 °C Wind Calm	76	60	46	33	47	Birds 36 to 61 Resident noise 41 to 51 Resident Moving Car 45 to 67 Sneeze 76 Truck on Medway Road 42 to 51 Plane flyover 39 to 42
	20/10/09 10:10 Temp 24 °C Wind W 2m/s	74	60	46	33	48	Birds 36 to 55 Dog 37 to 46 Resident noise 37 to 39 Trucks on Medway Road 44 to 56 Traffic on Railway St 42 to 73 Colliery (crusher/conveyor) <.35 Plane flyover 43 to 48
Location 2 140 Liebmans Road, Medway	06/10/09 12:58 Temp 19 °C Wind Calm	71	51	36	26	39	Birds 29 to 44 Residents Car 40 to 53 Traffic on Medway Road 28 to 31
	26/3/09 10:39 Temp 26 °C Wind W 2-3m/s	73	52	43	33	49	Birds 34 to 68 Wind Gusts 34 to 45 Truck on Medway Road 33
Location 3 605 Richardson Lane, Medway	06/10/09 14:02 Temp 20 °C Wind Calm	69	50	42	41	29	Resident Noise 57 Resident Car 48 to 53 Birds 35 to 69 Wind Gusts 36 to 41 Plane flyover 30 to 35
	26/3/09 11:29 am Temp 40 °C Wind W 2m/s	64	58	46	38	45	Tractor on residents property 37 to 47 Wind Gusts 39 to 45 Local Traffic (Truck) 44 to 64 Birds 38 to 43

Results of the operator attended noise surveys indicate that noise from birds, resident activities and traffic are the main contributors to ambient noise levels at each residential location. The colliery operations were predominantly inaudible at all locations at the time of monitoring.

4.4 Effects of Meteorology on Noise Levels

4.4.1 Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Weather data was obtained, for a period of 12 months, from a DECCW weather station located in Moss Vale. This location is approximately 11 km south west of the subject site. This data was analysed to determine the frequency of occurrence of winds up to speeds of 3 m/s for daytime, evening and night in each season. Details of the weather data analysis are provided as **Appendix C**. A summary of the most frequently occurring winds is contained within **Table 7**, **Table 8** and **Table 9**. The percentage occurrence figures provided in bold exceed the 30% threshold.

Table 7 Seasonal Frequency of Occurrence of Wind Speed Intervals - Daytime

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	0.2%	ESE±45	2.8%	12.2%	15.0%
Autumn	3.3%	ESE±45	7.8%	15.6%	23.4%
Winter	3.3%	W±45	10.2%	11.3%	21.5%
Spring	0.4%	NE±45	3.4%	12.0%	15.4%

Table 8 Seasonal Frequency of Occurrence of Wind Speed Intervals - Evening

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	1.2%	ESE±45	12.2%	19.0%	**31.2%**
Autumn	13.0%	ENE±45	14.6%	15.5%	**30.0%**
Winter	10.8%	WNW±45	16.2%	11.8%	28.0%
Spring	2.9%	NE±45	11.9%	14.0%	25.9%

Table 9 Seasonal Frequency of Occurrence of Wind Speed Intervals - Night

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 – 3 m/s
Summer	14.6%	NNE±45	18.8%	12.0%	**30.8%**
Autumn	21.1%	SE±45	12.2%	7.3%	19.5%
Winter	15.5%	W±45	22.3%	12.0%	**34.3%**
Spring	8.8%	NNE±45	13.0%	12.2%	25.2%

Seasonal wind records indicate that certain winds are a feature of the area. The frequency of winds below 3 m/s is above the 30% threshold in the evening and night time for various seasons. Modelling under prevailing wind is therefore recommended as part of this investigation.

4.4.2 Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total night-time during winter, or about two nights per week.

Meteorological data, obtained from the DECCW weather station at Moss Vale did not contain sigma theta data to allow a temperature inversion assessment. As a worst case scenario temperature inversions are assumed a feature of the area.

5 Project Specific Noise Criteria

5.1 Operational Noise Design Criteria

The noise emission design criteria for the proposed development at Berrima have been established with reference to the INP outlined in **Section 3** of this report.

The existing L_{Aeq} noise levels in the vicinity of the subject site are dominated by natural sources (i.e. birds, dogs) and traffic (predominantly haul trucks from the colliery) and include limited noise from colliery operations. The amenity criteria have been established using the results of ambient noise measurements in accordance with the INP.

The acoustical environment typifies a suburban environment, with intermittent traffic flows, and evening noise defined by the natural environment. Therefore, the residences in the general area have been assessed as "suburban" receiver types.

The resulting operational project specific noise criteria for the colliery are shown in **Table 10.**

Table 10 Proposed RDC Project Specific Noise Criteria

Location	Period	Intrusiveness Criteria $L_{Aeq(15minute)}$	Amenity Criteria $L_{Aeq(Period)}$
Location 1 6 Railway Street, Medway	Day	37	55
	Evening	35	45
	Night	35	40
Location 2 140 Liebmans Road, Medway	Day	36	55
	Evening	36*	45
	Night	35	40
Location 3 605 Richardson Lane, Medway	Day	36	55
	Evening	36*	45
	Night	35	40

Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night 10.00 pm to 7.00 am;
On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am

* Evening criteria adjusted to no greater than daytime period as per INP Application Notes

The INP states that these criteria have been selected to protect at least 90% of the population, living in the vicinity of industrial noise sources, from the adverse effects of noise for at least 90% of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

5.2 Sleep Disturbance Noise Goals

The relevant sleep disturbance noise goals for each residential area are provided in **Table 11**.

Table 11 Sleep Disturbance Noise Goals

Location	Period	Sleep Disturbance Goal $L_{A1(1minute)}$
Location 1 6 Railway Street, Medway	Night	45
Location 2 140 Liebmans Road, Medway	Night	45
Location 3 605 Richardson Lane, Medway	Night	45

5.3 Road Traffic Noise Design Criteria

All traffic to and from the colliery uses Medway Road and Taylor Avenue. The ECRTN identifies the concept of a 'principal haulage route' and states the following:

> *"..some industries (such as mines and extractive industries) are, by necessity, in locations that are often not served by arterial roads. Heavy vehicles must be able to get to their bases of operation, and this may mean traveling on local roads. Good planning practice recognises that we must acknowledge this type of road use and develop ways of managing any associated adverse impacts. To this end, the concept of 'principal haulage routes' has been endorsed by the Department of Urban Affairs and Planning's North Coast Extractive Industries Standing Committee.*

...Where local authorities identify a 'principal haulage route', the noise criteria for the route should match those for collector roads, recognising the intent that they carry a different level and mix of traffic to local roads."

The criterion relevant to a collector road, and hence principal haulage route, is provided in **Table 12** (reproduced from Table 1 of the ECRTN). This criterion is deemed to be relevant at residential premises located on Medway Road and Taylor Avenue since it is the only primary access to the colliery.

Table 12 Road Traffic Noise Criteria

Type of Development	Criteria		
	Day (7 am - 10 pm)	**Night (10 pm - 7 am)**	**Where criteria are already exceeded**
Land use developments with potential to create additional traffic on collector road (principal haulage route)	LAeq(1hour) 60 dBA	LAeq(1hour) 55 dBA	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

*There will be no heavy vehicle movements to/from the quarry during the night-time period

The criteria provided in **Table 12** apply 1m from the residential façade that is most affected by road traffic noise at a height of 1.5m above the ground floor level.

The ECRTN also provides criteria for other noise-sensitive developments such as schools, hospitals, etc. The ECRTN states that *"In cases where existing schools are affected by noise from proposed roads, the daytime criterion is $L_{Aeq(1hour)}$ 45 dBA (internal).* Heggies has assumed that this criterion is also relevant where land use developments have the potential to create additional traffic on a collector road.The ECRTN also draws the following conclusions with regard to maximum noise levels and the likelihood of sleep disturbance:

- Maximum internal noise levels below 50-55 dBA are unlikely to cause awakening reactions.
- One or two noise events per night, with maximum internal noise levels of 65-70 dBA, are not likely to affect health and wellbeing significantly.

I trust that the above information is sufficient for your requirements. If there are any further comments or queries please do not hesitate to contact me on 02 42843933 or email michael.fernandez@heggies.com.

M. Fernandez

MICHAEL FERNANDEZ
BE (Env)(Hons)
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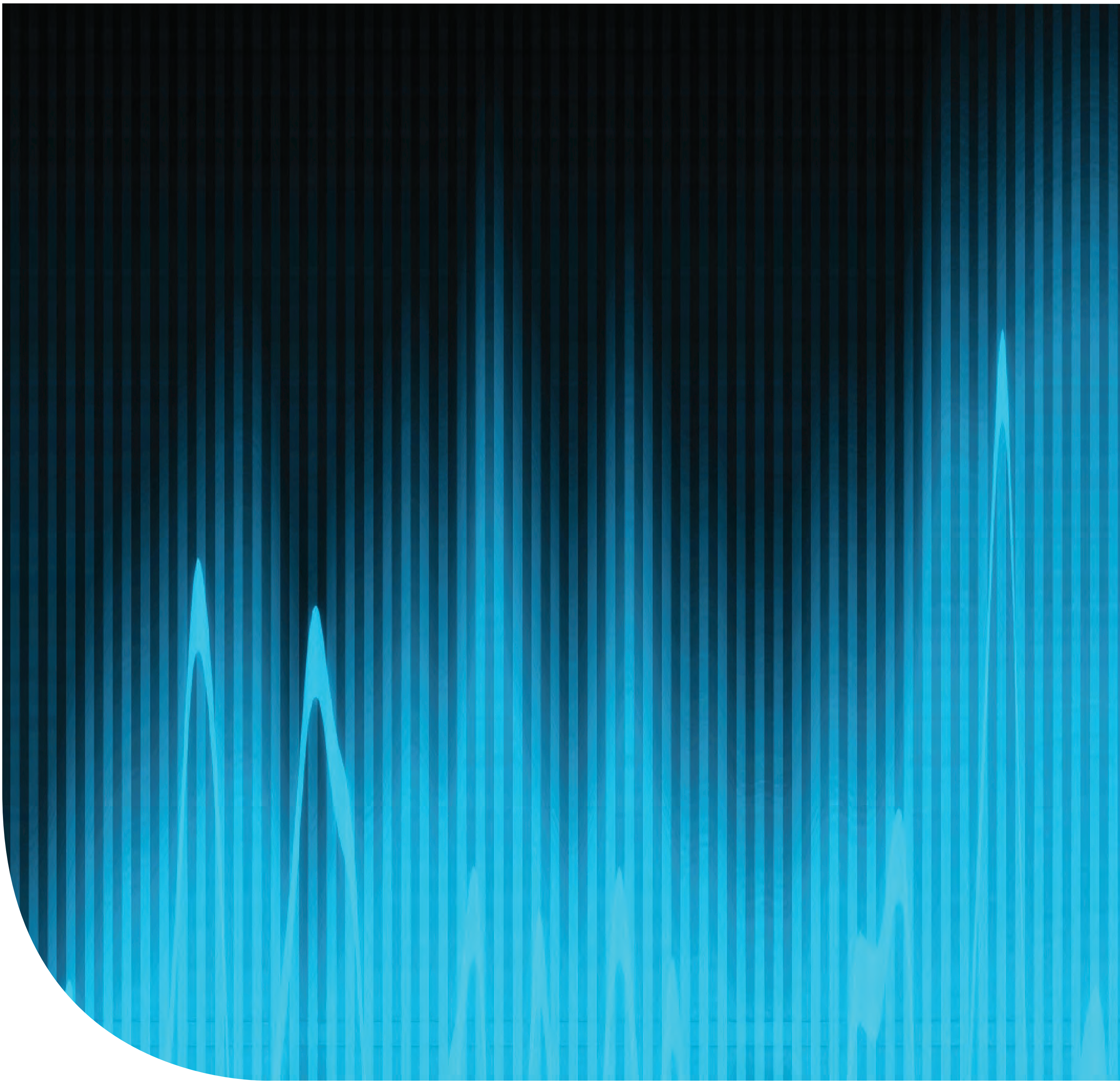

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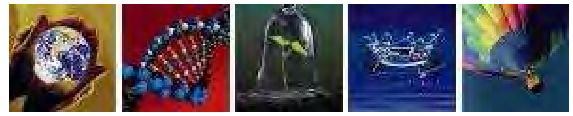
Appendix H

Air Quality Assessment



Berrima Colliery Continued Operations Project – Air Quality Assessment

Prepared for:
Boral Cement

On behalf of:
Berrima Colliery

Prepared by:
ENVIRON Australia Pty Ltd

Date:
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Project Number:
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ENVIRON

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Contents

List of Figures and Tables

List of Appendices

Executive Summary

ENVIRON Australia Pty Ltd (ENVIRON) has been commissioned by Boral Cement to undertake an Air Quality Assessment for the Berrima Colliery Continued Operations Project (“the Project”).

Berrima Colliery is a currently operational underground coal mine located at Medway in the Southern Highlands of NSW. The colliery currently produces approximately 220,000 tpa of run-of-mine (ROM) coal, with this coal being crushed and trucked off-site either directly or via the Loch Catherine stockpile area. Coal from Berrima Colliery currently represents the primary source of fuel for the Berrima Cement Works’ cement kiln.

The Continued Operations at Berrima Colliery Project comprises the use of existing site infrastructure, including the ROM bin, primary crusher, coal loading bin, existing paved and unsealed haul routes and the Loch Catherine stockpile area, with provision made for a maximum production of 460,000 tpa. This volume is consistent with the maximum volume produced at the colliery in the past.

The scope of the Project was restricted to the assessment of emissions generated within the Mining Lease thus including the Berrima Colliery Pit Top facility, the Loch Catherine stockpile area, the ventilation shaft in the vicinity of the underground mine entrance, and the access road as far at the Hume Highway on-ramp.

Existing air quality was characterised for the purpose of assessing the potential for cumulative air pollution levels, given predicted Project-related concentrations. Site-specific background air quality was characterized as follows:

- Dust: Average dust deposition, established on the basis of dust deposition sampling conducted by Berrima Colliery, was concluded to be in the range of 2.0 to 2.6 g/m^2/month, as recorded during the October 2009 to June 2010 period.
- PM_{10}: Site-specific PM_{10} monitoring data are not available with reference made to data from the NSW Department of Environment, Climate Change and Water (DECCW) Oakdale Air Quality Monitoring Station as this station was concluded to be generally representative of concentration ranges within more rural areas. Annual average PM_{10} (or particulate matter with an aerodynamic diameter of less 10 microns) concentrations were observed to be in the range of 12 to 14 µg/m^3, with highest 24-hour averages varying between 40 and 70 µg/m^3. Typically up to one exceedance of the DECCW daily PM_{10} criterion occurs per year.

An assessment of the local meteorological conditions was conducted referencing automatic weather station data from the Bureau of Meteorology’s Moss Vale station and site representative data from the nearby Berrima Cement Works.

Atmospheric dispersion modelling predictions of fugitive emissions from existing Berrima Colliery operations and the Project were undertaken using the AERMOD Gaussian Plume Dispersion Model software developed by the United States Environment Protection Agency (USEPA).

Predicted air quality impacts were concluded to comply with DECCW air quality criteria, provided adequate operational dust management strategies are adhered to for the life of the Project. In addition to dust control measures currently being implemented as part of the existing Berrima Colliery operations, it is required that the following measures (or alternative measures with equivalent control efficiencies) be implemented:

- Ensure the effectiveness of watering on unpaved roads to achieve a control efficiency of 80% (as calculated based on water application rates). This control effectiveness, if found not to be achievable through watering could be achieved by applying water extender chemicals or chemical road stabilizers.
- Maintain paved road silt loadings below 2 g/m^2 through preventative measures and periodic sweeping.
- Implement a speed limit of 30 km/hr on road sections in the vicinity of the Medway village for haul and delivery trucks.

Berrima Colliery's monitoring network currently includes dust deposition sampling at three sites, including one site located in proximity to the Medway Village. It is recommended that dust deposition sampling at the Medway Village site, as a minimum, be continued for the life of mine to track deposition trends. In the event that average dust deposition rates at this site are observed to be increasing, it is recommended that a PM_{10} monitoring campaign be undertaken to assess suspended particulate concentrations. All monitoring should be conducted in accordance with applicable Australian Standards.

1 Introduction

ENVIRON Australia Pty Ltd (hereafter, “ENVIRON”) has been commissioned by Boral Cement to undertake an Air Quality Assessment for the Berrima Colliery Continued Operations Project (hereafter, “the Project”).

Berrima Colliery, owned by Boral Limited and operated by Delta Mining, is a currently operational underground coal mine located at Medway in the Southern Highlands of NSW (**Figure 1**).

Berrima Colliery currently operates under existing use rights. Due to changes to both the *Environmental Planning and Assessment Act 1979* and the *Mining Act 1992*, Berrima Colliery is required to obtain a planning approval for continued operations by December 2010. EMGA Mitchell McLennan has been appointed to undertake an Environmental Assessment (EA) for the Berrima Colliery Continued Operations Project.

The current Air Quality Assessment forms a component of the EA and is required, as a minimum, to cover the following aspects:

- Characterisation of the existing environment, specifically the existing air quality, prevailing meteorology and regulatory context;
- Quantification and modelling of dust emissions for the Project based on clear assumptions and approved methodologies;
- Presentation and evaluation of predicted total suspended particulate (TSP) and particulate matter with an aerodynamic diameter of less than 10 microns (PM_{10}) concentrations and dust deposition against applicable air quality criteria;
- Recommendation of potential mitigation measures where necessary, with an assessment of control efficiencies achievable; and
- Account for cumulative impacts associated with nearby developments.

Air quality monitoring has not historically been undertaken at Berrima Colliery. Three dust deposition sites were however established in October 2009 with six months of dust deposition data available for use in the baseline air quality characterisation.

Berrima Colliery operates under Consolidated Coal Lease (CCL) 748, with the Berrima Colliery workings being located in the north western portion of the lease. The scope of the air quality assessment is restricted to the assessment of air emissions arising from existing and Project-related sources located within the Mine Lease area. Potential emissions occurring outside of the Mine Lease area, associated with coal delivery operations, are not included in this assessment.

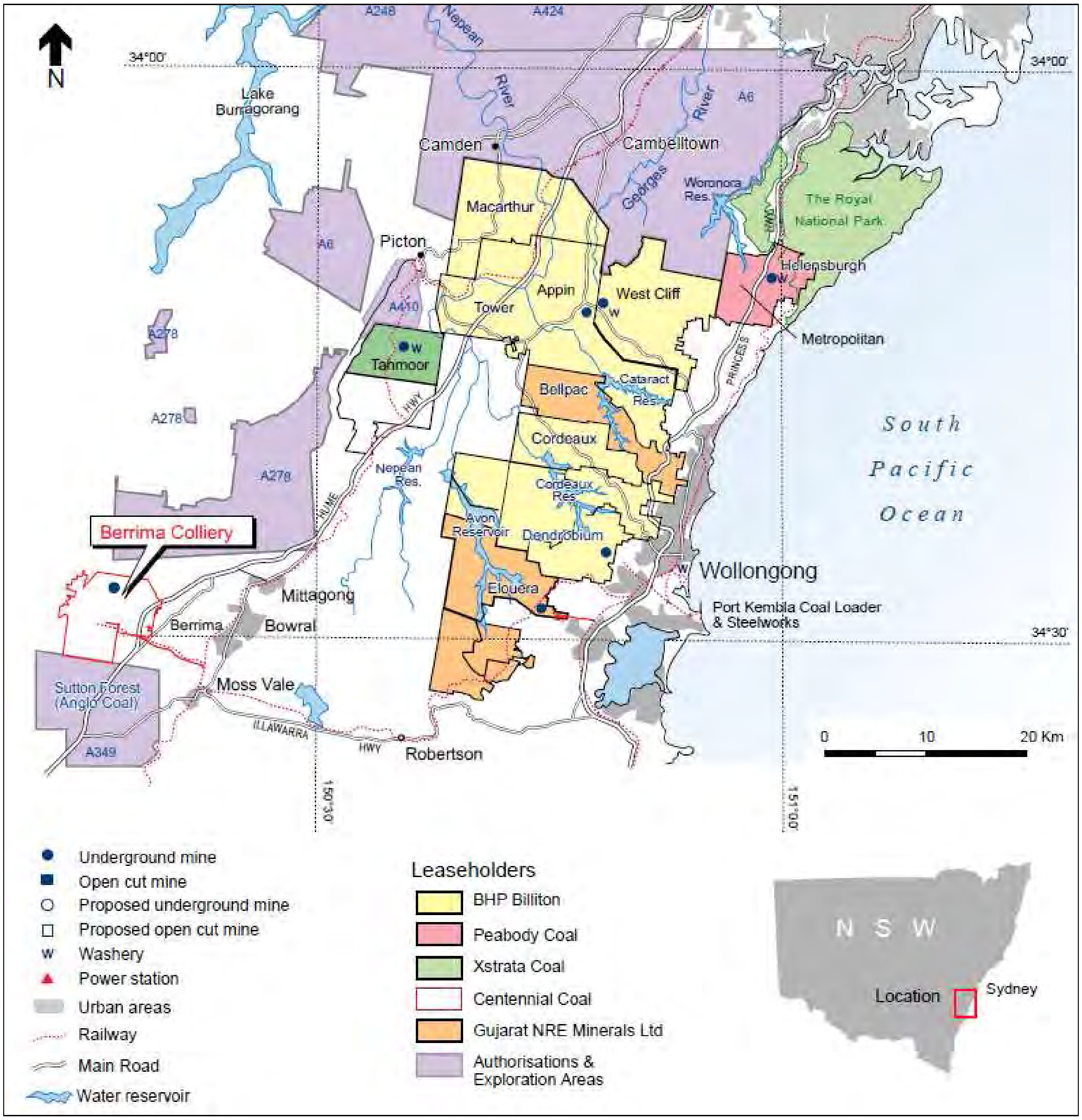

Figure 1: Location of Berrima Colliery within the Southern Highlands, NSW
Source: Berrima Colliery AEMR 2009

2 Project Overview

2.1 Existing Mining Operations

Berrima Colliery is a bord and pillar operation with pit-top facilities located at the end of Medway Road adjacent to the Wingecarribee River.

Berrima Colliery currently produces approximately 220,000 tpa of run-of-mine (ROM) coal, with this coal representing the primary source of fuel for the Berrima Cement Works' cement kiln. Annual production rates in recent financial years have been as follows: 210,000 t in 2009, 220,281 t in 2008, 209,874 t in 2007, 209,565 t in 2006 and 210,900 t in 2005. Historically, Berrima Colliery has produced up to about 460,000 tpa, with coal supplied to operations other than Berrima Cement Works, such as Berrima Power Station, Tallawarra Power Station and the Maldon Cement Plant.

Coal is transported from underground by conveyor to a 450 t bin, and subsequently conveyed to a primary crusher and screen (**Figure 2**). The single deck screen is used for undersize bypass, followed by an impact style crusher for oversized material. No beneficiation of the coal is undertaken other than crushing, with crushed coal being conveyed to the coal loading bin.

Coal is either trucked directly from the coal loading bin off-site or trucked and stockpiled at the Loch Catherine stockpile area located approximately 1 km southwest of the pit-top facilities. This stockpile area has the capacity to store approximately 100,000 t of coal. Stockpiled coal is subsequently recovered by front end loader, loaded to trucks, and trucked off-site. Currently about 25% of all coal goes to Loch Catherine prior to being recovered and transported off site. In the 2009 financial year, the stockpiled coal was of the order of 52,500 t.

The mine's hours of production are from 0600 to 0045 Monday to Friday (i.e. 18 hrs 45 mins per day), with 210 production days per year. Coal delivery is conducted during the hours of 0600 and 2100 Monday to Friday and 0600 to 1400 on Saturday.

Two tri-axle tippers are currently used to haul coal. On average, there are 23 truck trips per day from the loading bin directly off-site, with 8 truck trips to Loch Catherine, and 8 truck trips from Loch Catherine off-site. The average vehicle speed whilst on site is 30 km/hr.

The volume of coal stored at Loch Catherine generally varies in the range of 20,000 t to 70,000 t, with the average surface area of the storage pile being 11,100 m^2 and the storage pile height given as 6 m (**Figure 2**). As previously stated, the site has the capacity to store approximately 100,000 t.

(a) Conveyor from mine to plant

(b) Coal ROM bin (450 t)

(c) Primary crusher and screen

(d) Coal loading bin (ring road in foreground)

(e) Ventilation shaft

(f) Unsealed area at the workshops

Figure 2. Photographs of Berrima Colliery operations and site (taken 28 May 2010)

(g) Unsealed road to Loch Catherine

(h) Coal stockpiling at Loch Catherine

Figure 2 (continued). Photographs of Berrima Colliery operations and site (taken 28 May 2010)

Dust control measures in place at Berrima Colliery are as follows:

- coal is wet (generally 8% moisture content),
- conveyors are either partially covered or covered,
- the crusher is enclosed,
- a truck loading chute is used.
- unpaved haul road sections and trafficked unsealed areas of the site are watered using a water cart, and
- occasional sweeping is implemented.

There are no dust extraction systems operational above ground. The average volumetric flow of the ventilation shaft associated with underground extraction is given as 51.1 m^3/s.

2.2 Project-related Mining Operations

The Continued Operations at Berrima Colliery Project comprises the following key components of relevance to the Air Quality Assessment:

- Mining within the 'smaller mining area' – referenced as the SMP (or Subsidence Management Plan) in the *Preliminary Environmental Assessment* (**Figure 3**);
- Maximum production of 460,000 tpa (maximum daily coal processing rate of 2,000 t);
- Quantity of coal per annum to be stockpiled and recovered from Loch Catherine to be increased to a maximum of 115,000 tpa;
- The surface area of the coal stockpile at Loch Catherine will be 15,100 m^2, with a stockpile height of 6 m;
- Two production shifts (as per current shift times) will be extended to 7 days a week;
- Production days per year will be increased from 210 days to 340 days;

- Delivery hours will remain unchanged (i.e. of 0600 to 2100 Monday to Friday and 0600 to 1400 on Saturday);
- Coal delivery will comprise 50 truck trips from the loading bin directly off-site, 16 truck trips to Loch Catherine and 16 truck trips from Loch Catherine off-site.

The Project area is depicted in **Figure 3**. Existing surface infrastructure will be used by the Project, including the ROM bin, primary crusher, coal loading bin, existing paved and unsealed haul routes and the Loch Catherine stockpile area (**Figure 4**).

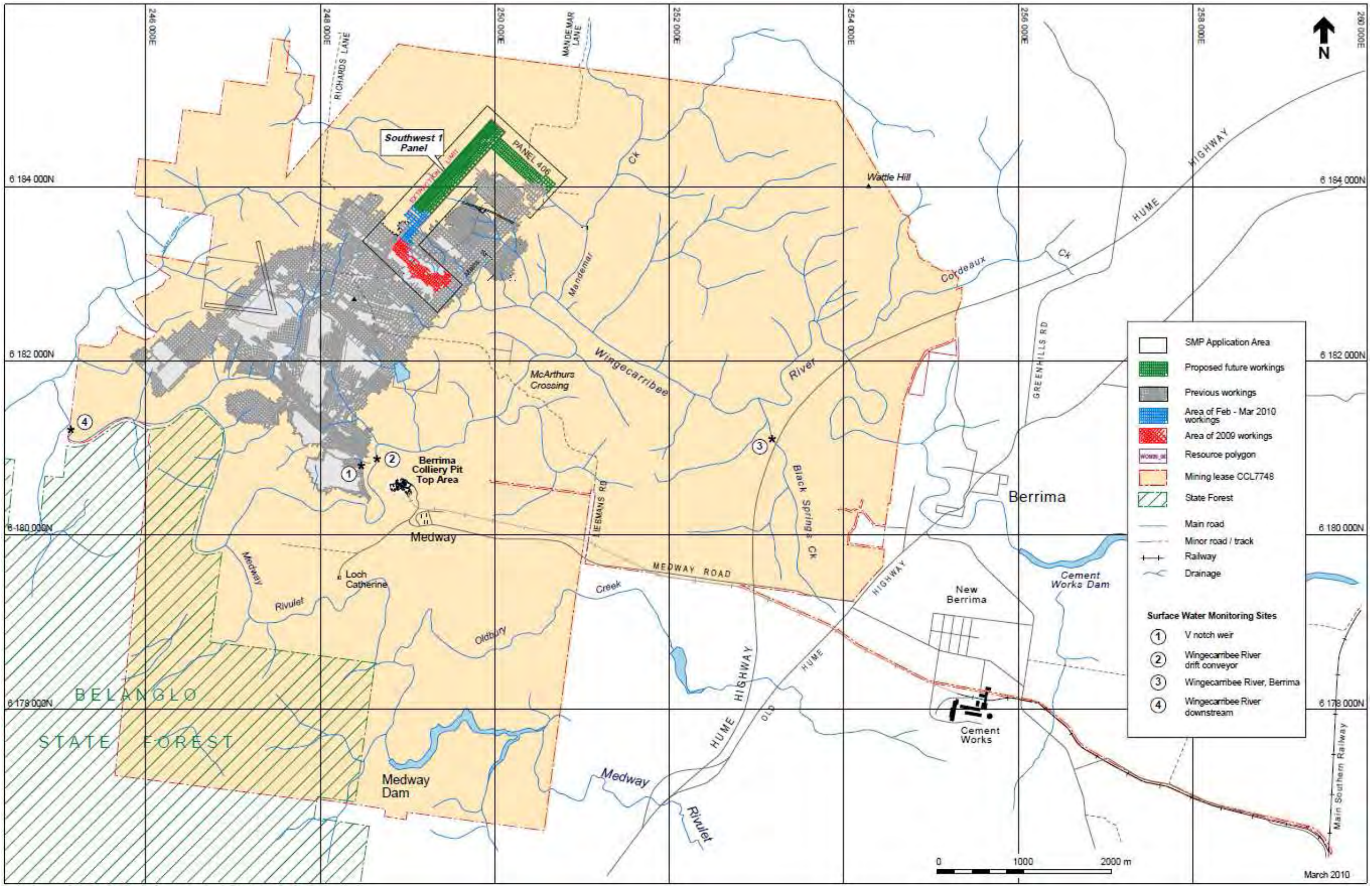

Figure 3: Berrima Colliery Continued Operations Project Area
Source: Mitchell McLennan, 2009

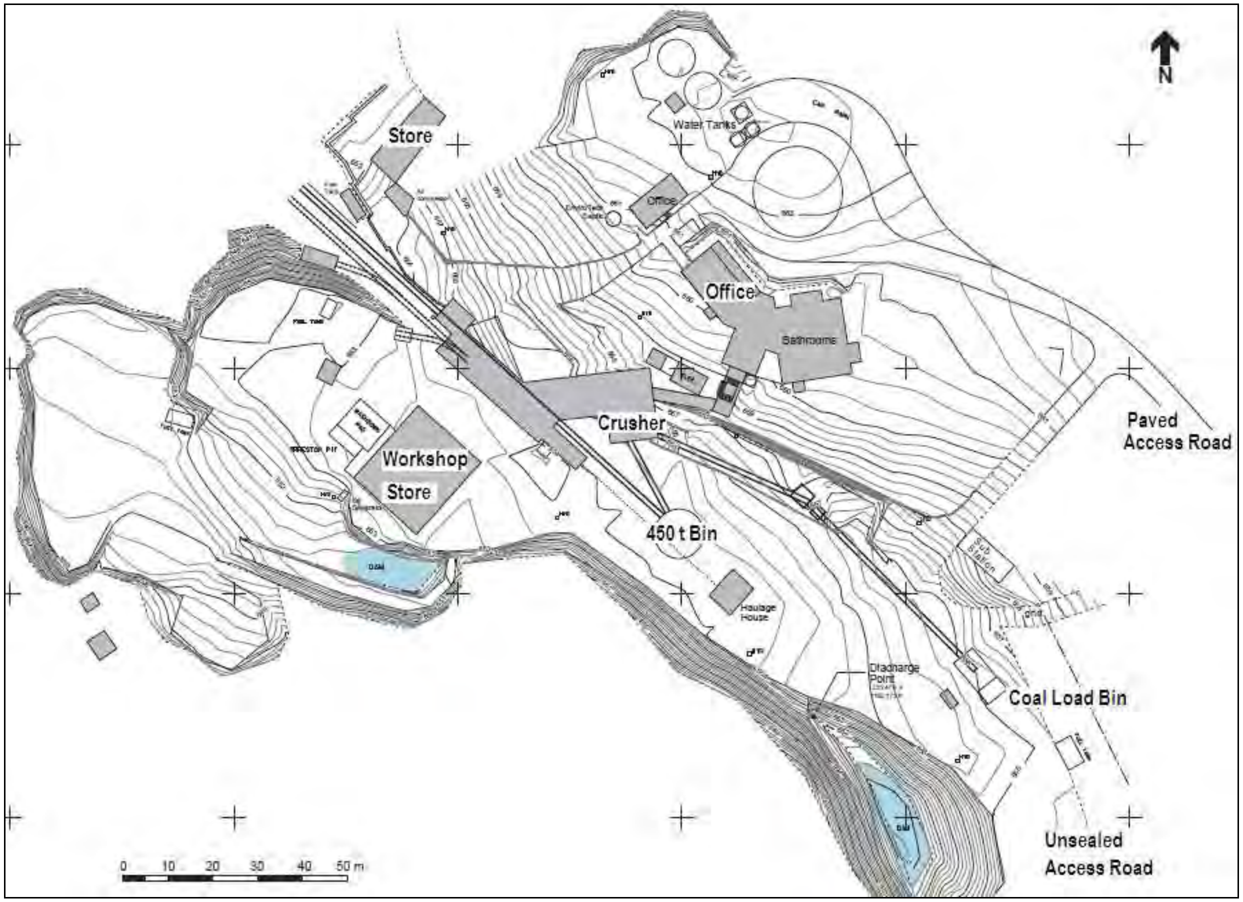

Figure 4: Berrima Colliery Pit Top Layout
Source: Berrima Colliery AEMR 2009

2.3 Project Area Land Use and Topography

Berrima Colliery operates under CCL 748, with the Berrima Colliery workings located in the north western portion of the lease. The majority of the lease area consists of privately owned rural (grazing) properties typically ranging in size from 40 to 100 ha. The southern part of the lease area contains the north eastern portion of the Belanglo State Forest. The village of Medway is located immediately south east of the pit-top facilities. The Hume Highway intersects the lease in the east. The town of Berrima and New Berrima are located beyond the Hume Highway, about 6 km east of the Berrima Colliery.

The Berrima Colliery surface workings are located at an altitude of approximately 660m AHD. A three-dimensional representation of the topography of the region surrounding the Project area is presented in **Figure 5**. The Wingecarribee River represents the dominant geomorphological feature, intersecting the middle of the lease boundary. The land within the Project area is however generally undulating and predominantly cleared with patches of remnant native vegetation.

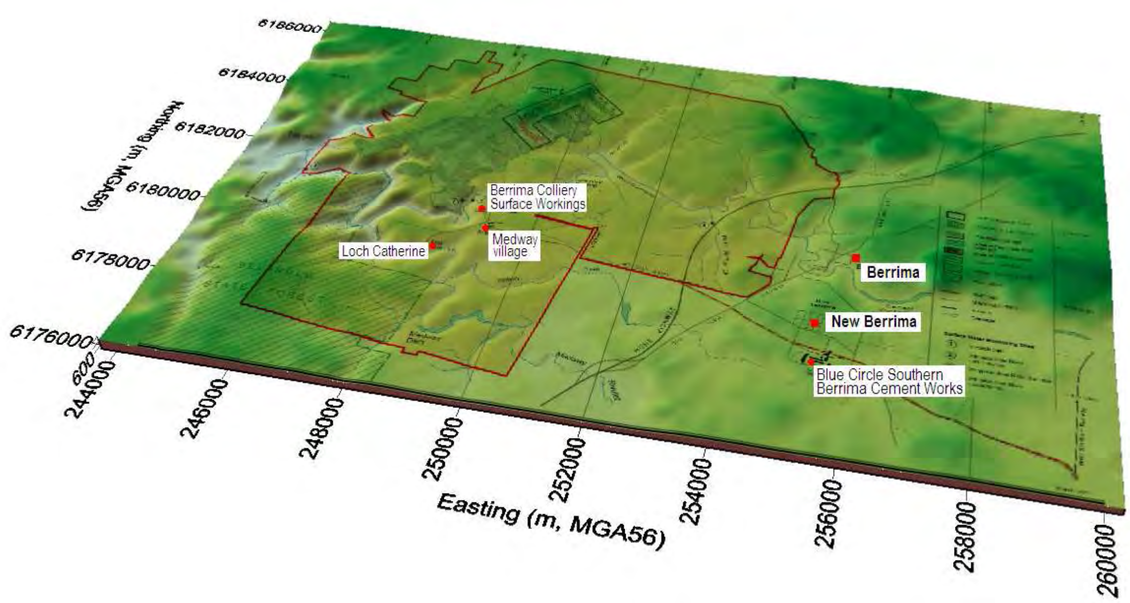

Figure 5: Regional topography showing Berrima Colliery mining lease area and neighbouring areas

2.4 Nearest Residences

As indicated in **Figure 5** the village of Medway is located immediately south east of the Berrima Colliery pit-top facilities. This village contains about 25 houses. A representative sample of the nearest potentially affected dwellings that are non-project related are depicted in **Figure 6** and listed in **Table 1**.

Table 1: Nearest Potentially Affected Non-Project Related Residential Dwellings			
Residence # Identifier	Location	MGA Dwelling Coordinates	
		East (m)	North (m)
R1	Medway Village	248,808	6,180,093
R2	Medway Village	248,827	6,180,147
R3	Medway Village	248,864	6,180,173
R4	Medway Village	248,900	6,180,195
R5	Medway Village	248,943	6,180,206
R6	Medway Village	248,924	6,180,083
R7	Medway Village	248,986	6,180,088
R8	Medway Village	249,027	6,180,092
R9	Medway Village	248,993	6,180,198
R10	Medway Village	249,131	6,180,081
R11	Medway Village	249,169	6,179,995
R12	1.1km ESE of Loch Catherine	249,175	6,179,257
R13	1.5km ESE of Loch Catherine	249,579	6,179,235
R14	950m WNW of the Berrima Colliery Pit Top Facility	247,794	6,180,778
R15	1km NW of the Berrima Colliery Pit Top Facility	247,822	6,181,003
R16	New Berrima	255,244	6,178,897

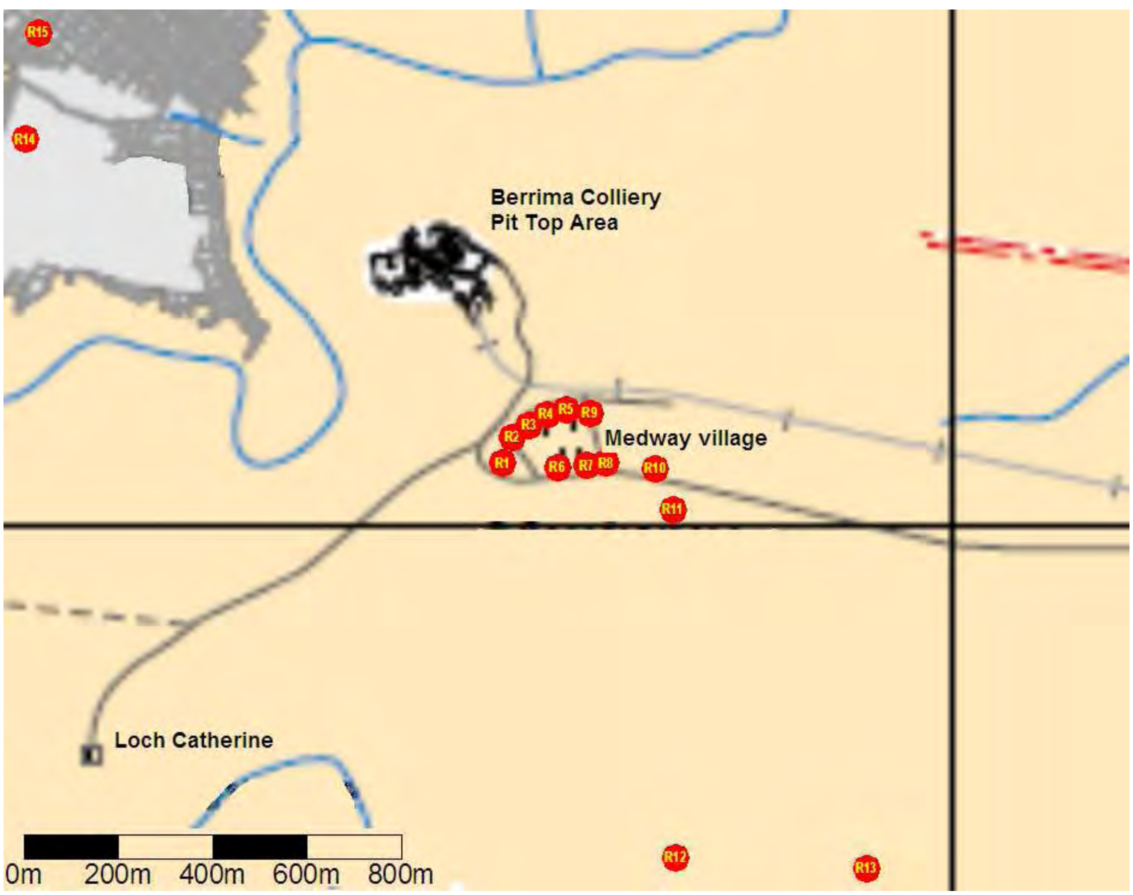

Figure 6: Location of Nearest Potentially Affected Non-Project Related Receptors

3 Air Quality Assessment Criteria

To be in compliance, proposed operations must demonstrate that cumulative air pollutant concentrations, taking into account incremental concentrations due to the operation's emissions and existing background concentrations, are within ambient air quality limits. Relevant ambient air quality criteria applicable to the Project are presented in this section.

3.1 Goals Applicable to Airborne Particulate Matter

Air quality limits for particulates are typically given for various particle size fractions, including TSP and inhalable particulates or PM_{10}. Although TSP is defined as all particulate with an aerodynamic diameter of less than 100 µm, an effective upper limit of 30 µm aerodynamic diameter is frequently assigned. PM_{10} is of concern due to its health impact potential. Such fine particles are able to be deposited in, and cause damage to, the lower airways and gas-exchanging portions of the lung. Potential adverse health impacts associated with exposure to PM_{10} include increased mortality from respiratory and cardiovascular diseases, chronic obstructive pulmonary disease, and heart disease and reduced lung capacity in asthmatic children (Pope and Dockery, 2006; WHO, 2007).

Despite the international medical community not having been able to establish a threshold value for particulate matter below which there are no adverse health impacts, air quality limits are routinely issued for this pollutant, including by federal and state governments in Australia. Air quality limits issued by federal and NSW government for particulates are given in **Table 2**.

Table 2: Impact assessment goals for airborne particulates

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)	Reference
TSP	annual	90	NSW DECCW(a)(b)
PM_{10}	24 hours	50	NSW DECCW(a)
	24 hours	50(d)	NEPM(c)
	annual	30	NSW DECCW(a)

(a) NSW DECCW, 2005 *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*
(b) NSW DECCW impact assessment goal based on the subsequently rescinded National Health and Medical Research Council (NHMRC) recommended goal.
(c) NEPC, 2003, *National Environment Protection (Ambient Air Quality) Measure, as amended.*
(d) Provision made for up to five exceedances of the limit per year.

The NSW 24-hour PM_{10} assessment goal of 50 $\mu g/m^3$ is numerically identical to the equivalent National Environment Protection Measure (or NEPM) reporting standard except that the NEPM reporting standard allows for five exceedances per year. The NEPM goals were developed by the National Environmental Protection Council (NEPC) in 1998 to be achieved within 10 years of commencement.

Air quality goals for TSP were typically set prior to the development of an improved understanding of the relationship between health impacts and exposure to fine particulate concentrations, and have subsequently either been discarded or given reduced importance by countries internationally. The NSW DECCW TSP impact assessment goal is based on the goal recommended by the NHMRC (DECCW, 2005; NHMRC, 1996). (The NHMRC goals have subsequently been rescinded.)

In mining areas, the PM_{10} particle size fraction is typically of the order of 40% of the TSP mass (SPPC, 1986). In semi-urban and urban areas impacted by motor vehicles, such as the current Project site, this percentage may be expected to be even higher. Based on this PM_{10} to TSP ratio, the impact assessment goal for TSP would be equivalent to an annual PM_{10} goal of at least 36µg/m^3. Thus, the historical NHMRC goal may be regarded as less stringent than the DECCW PM_{10} goal of 30 µg/m^3 expressed as an annual average.

While it is anticipated therefore that the annual TSP goal will be seen to be achieved if the annual PM_{10} goal is satisfied, predictions of annual average TSP concentrations are provided within this report for completeness.

3.2 Dust Deposition Criteria

Nuisance dust deposition is regulated through the stipulation of maximum permissible dust deposition rates. The NSW DECCW impact assessment goals for dust deposition are given in **Table 3** illustrating the allowable increment in dust deposition rates above ambient (background) dust deposition rates which would be acceptable so that dust nuisance could be avoided.

Table 3: DECC Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2g/m^2/month	4g/m^2/month
Source: AMMAAP, 2005		

3.3 Project Air Quality Assessment Criteria

The NSW DECCW air quality impact assessment criteria applicable to the assessment of the current Project are as follows.

PM_{10}: A 24-hour maximum of 50 µg/m^3

An annual average of 30 µg/m^3

TSP: An annual average of 90 µg/m^3

Dust deposition: Nuisance expected to impact at surrounding residences when total annual average dust deposition levels exceed 4g/m^2/month.

4 Existing Air Quality Environment

The quantification of cumulative air pollution concentrations and the assessment of compliance with ambient air quality limits necessitate the characterisation of baseline air quality. Given that particulate matter represent the primary emissions from the Project, it is pertinent that existing sources and resultant ambient suspended particulate concentrations and dust deposition be considered.

4.1 Existing Local Sources of Atmospheric Emissions

Industrial activities operating within a 15 km radius of the Berrima Colliery which are either National Pollutant Inventory (NPI) reporting activities and/or DECCW licence holders are listed in **Table 4**.

Table 4: Industrial Operations and Mines Situated in Proximity to the Project

Facility Name	Approximate Distance from Project Site	Description
Boral Cement - Berrima Cement Works	6.8 km south west of the Berrima Colliery Pit Top Facility	Cement manufacturing plant, reported to emit 73 tpa of PM_{10} according to the NPI Emissions Inventory.
Inghams Enterprises Pty Ltd - Berrima Feedmill	8.3 km south west of the Berrima Colliery Pit Top Facility	Prepared animal and bird feed manufacturing process, reported to emit 7.2 tpa of PM_{10} according to the NPI Emissions Inventory.
Austral Bowral Brickworks	13 km east of the Berrima Colliery Pit Top Facility	Brickworks, reported to emit 87 tpa of PM_{10} according to the NPI Emissions Inventory.

Due to the Berrima Cement Works' proximity and the extent of its particle emissions, this facility holds a greater potential for cumulative impacts on nearby receptors compared to the other facilities listed. The cement works being situated over 6 km east of the Medway village (**Figure 5**), and the prevalence of westerly winds (refer to **Section 5**) is however expected to limit the potential for cumulative impacts from this plant.

Other potential sources of atmospheric emissions in the vicinity of the Project Site include:

- Dust entrainment due to vehicle movements along unsealed roads and sealed roads with high silt loading levels;
- Vehicle exhaust and rail related emissions;
- Wind blown dust from open areas; and
- Episodic emissions from vegetation fires.

Long-range transport of fine particles and precursors are also expected to contribute to background concentrations in the region.

4.2 Monitoring Data Available for Baseline Air Quality Characterisation

Air quality monitoring has not historically been undertaken at Berrima Colliery. In October 2009 three dust deposition sampling sites were established for use in the baseline air quality characterisation (**Table 5**). The first site is situated in close proximity to the Berrima Colliery Offices and coal loading bin (**Figure 7**). The second site is located immediately north of Medway village. A third site is situated adjacent to, but not in the immediate vicinity of, the unsealed haul road leading to the Loch Catherine stockpile area.

Table 5: Monitoring Data used in the Baseline Air Quality Characterisation

Data Owner / Data Set	Sampling Sites	Parameters Measured	Monitoring Duration
Berrima Colliery	Site 1 – Office	Dust deposition (monthly)	12 Oct 2009 – 12 June 2010
	Site 2 - Medway Village		
	Site 3 – Stockpile		
DECCW	Oakdale Monitoring Station	PM_{10} (24 hour averages)	2005 - 2009


(a)


(b)

Figure 7. Photographs of two of Berrima Colliery's dust deposition sampling sites, (a) Site 1 – situated near the Offices and Coal Loading Bin (evident in background), and (b) Site 2 – located adjacent to the unsealed haul route to Loch Catherine stockpile area.

Airborne particulate concentrations are not recorded at Berrima Colliery. Although ambient PM_{10} monitoring is conducted at the Berrima Cement Works, data from such monitoring was not available for use in the current assessment. Given the proximity of this PM_{10} monitoring to the cement works, concentrations recorded at this site are not expected to be representative of the ambient PM_{10} levels occurring more generally in the area and specifically in the vicinity of the Medway village. Given the absence of large dust sources in the vicinity of the village, significantly lower PM_{10} concentrations are likely to occur there.

Given the absence of site specific PM_{10} monitoring data, reference was made to PM_{10} measurements from the DECCW Oakdale air quality monitoring site. The Oakdale air quality monitoring site is located on residential property at Ridge Road, Oakdale. It is in a rural area on the far south-west edge of the Sydney basin and is at an elevation of 457 m. Due to its rural setting and it being located at a similar distance inland, it is considered that data recorded at this site will be sufficiently indicative of typical baseline PM_{10} concentrations in Project area (i.e. excluding any contribution from the existing Berrima Colliery's operations).

PM_{10} concentrations are recorded at the Oakdale air monitoring site using a tapered element oscillating microbalance (TEOM). Reference was made to data for the most recent five year period (2005 – 2009).

4.3 Dust Deposition

Dust deposition rates recorded at the Berrima Colliery sampling sites are summarised in **Table 6**. Period average deposition rates were recorded to be in the range of 2.0 to 2.6 g/m²/month and thus within the DECCW cumulative dust deposition criterion of 4 g/m²/month.

Table 6: Dust deposition rates recorded at Berrima Colliery sampling sites(a)

Dates	Site 1 - Office	Site 2 - Medway village	Site 3 - Stockpile
Oct/Nov 2009	1.2	1.3	1.1
Nov/Dec 2009	4.0	5.7	2.4
Dec 2009/Jan 2010	1.7	2.2	3.2
Jan/Feb 2010	2.5	2.0	3.9
Feb/Mar 2010	1.7	1.8	2.0
Mar/Apr 2010	3.3	1.3	2.9
Apr/May 2010	1.1	1.2	4.1
May/Jun 2010	0.7	0.8	1.1
Maximum	**4.0**	**5.7**	**4.1**
Average	**2.0**	**2.0**	**2.6**

(a) As total insoluble solids.

4.4 Ambient PM_{10} Concentrations

Summary statistics for PM_{10} concentrations recorded at the DECCW Oakdale air monitoring site for the period 2005 to 2009 are given in **Table 7**. Annual average PM_{10} concentrations are typically recorded to be in the range of 12 µg/m³ to 14 µg/m³, and maximum 24-hour concentrations in the range of 40 µg/m³ to 70 µg/m³. Exceedances of the NSW DECCW 24-hour impact assessment criterion of 50 µg/m³ is usually restricted to one day per year with such exceedences likely to have been associated with bush fires or dust storms.

Table 7: PM_{10} concentrations recorded at the DECCW Oakdale monitoring site

Year	Data Availability (%)	Average Annual (µg/m³)	Median 24-hour (µg/m³)	Minimum 24-hour (µg/m³)	Maximum 24-hour (µg/m³)	No. of Days >50µg/m³
2005	92.9	13.5	12.4	3.4	42.3	0
2006	96.4	14.0	12.6	3.4	56.5	1
2007	97.3	12.8	11.2	3.3	49.2	0
2008	96.7	12.3	10.7	2.8	68.2	1
2009	91.2	20.1	12.7	3.2	1528.3	6

The 2009 year represents an exception to the typical PM_{10} concentrations described above. Regional dust storms resulted in peak concentrations in excess of 1000 µg/m³ being recorded on the 23rd of September 2009 across a significant portion of NSW. Other PM_{10} peak 24-hourly concentrations occurred on the 15th and 16th of April 2009 (130 µg/m³; 151 µg/m³), the 26th of November 2009 (131 µg/m³) and the 28th and 29th of November 2009 (82 µg/m³; 96 µg/m³). These peaks are also likely to have been due to regional natural events.

4.5 Background Air Quality Environment for Assessment Purposes

For the purposes of assessing the potential air quality impacts of the Project, an estimate of background air quality parameters is required. The PM_{10} concentrations and dust deposition rates expected to be characteristic of baseline conditions, as determined based on the monitoring data analysed as discussed in previous sections, is summarised in **Table 8**.

Table 8: Background dust levels for cumulative assessment purposes

Averaging Period	Ambient PM_{10} Concentrations	Dust Deposition
Highest Daily Average	40 – 70 µg/m³	N/A
Exceedances of Daily Limit	0 – 1 days/year	N/A
Annual Average	12-14 µg/m³	2.0 – 2.6 g/m²/month

PM_{10} concentrations recorded during the 2009 year are concluded to have been substantially impacted by regional natural events and atypical of average baseline conditions. This year was therefore excluded from use in the baseline air quality characterisation for cumulative impact assessment purposes.

In the case of PM_{10} concentrations, where exceedances of the DECCW daily impact assessment criterion has been observed to occur, it is necessary to determine whether incremental PM_{10} concentrations due to the Project could results in additional exceedances.

5 Climate and Dispersion Meteorology

Meteorological mechanisms govern the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. Dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading. Pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, concurrent variations in the mixing depth, and shifts in the wind field (Oke, 2003; Sturman and Tapper, 2006).

Climate statistics obtained from the Bureau of Meteorology's long-term weather station at Moss Vale (Station number 068045), and hourly meteorological data obtained from the Moss Vale Automatic Weather Station (AWS) and from the Boral Cement meteorological monitoring station were used to characterise the climate and dispersion meteorology of the study area. The data completeness of the hourly data obtained for both Moss Vale AWS and Boral Cement meteorological station was in excess of 95%.

5.1 Climate Statistics

Climate statistics from the Bureau of Meteorology's Moss Vale (Hoskins Street) Station (Station number 061055) are presented in **Appendix A**.

5.2 Ambient Temperature

Air temperature is important, both for determining the effect of plume buoyancy and determining the development of the mixing and inversion layers. The study area is characterised by a mild climate, with mean daily temperatures in the range of 7℃ to 19℃ based on the long-term record. Peaks occur during summer months with the highest temperatures typically being recorded in January to February. The lowest temperatures are usually experienced during July and August.

5.3 Rainfall

Precipitation is important to air pollution studies since it represents an effective removal mechanism of atmospheric pollutants. Annual rainfall ranges from approximately 370 mm to 1850 mm, and is on average about 960 mm. Although significant inter-annual variations in rainfall occur, intra-annual variations are small with rainfall occurring during all months of the year. The highest rainfall typically occurs during the February to June period (>80 mm/month). On average 119 rain days occur per year, with 9 to 11 rain days experienced each month on average.

5.4 Prevailing Wind Regime

Due to significant spatial variations in wind field, emphasis is usually placed on site-specific meteorological data in terms of characterising the local wind regime. At least one year of wind data is required to adequately characterise seasonal fluctuations in the wind field for analysis and dispersion modelling purposes.

Hourly average meteorological data for the period May 2009 to June 2010 were obtained from the Boral Cement monitoring station for use in the current assessment. This station is located about 0.5km due east of the Berrima Cement Works, and about 7.5 km southeast of the Berrima Colliery Pit Top Facility (34°30'39.15"S; 1 50°20'41.89"E). The Boral Cement monitoring station is located in flat undulating terrain, with no significant terrain perturbations between this site and the Berrima Colliery Pit Top Facility. The wind field recorded at the Boral Cement monitoring station is therefore expected to be representative of the wind field at the Berrima Colliery assuming that measurements at this site have been conducted in an accurate manner.

The validity of the Boral Cement meteorological station data were assessed through range checks, data completeness analysis and by comparing wind field measurements at the site with airflow patterns recorded at the BoM's Moss Vale AWS. The Moss Vale AWS is located about 7.2 km east south east of the Boral Cement monitoring station (34°31'31.08"S; 150°25'18.12"E). Wind data availability is noted t o be greater than 99% for the Boral Cement station.

Period-average wind roses from the Boral Cement and Moss Vale monitoring stations are compared in **Figure 8**. The airflow patterns are noted to compare fairly well, with westerly component wind noted to prevail at both sites. Significantly lower wind speeds and a greater frequency of calm wind conditions are however recorded at the Boral Cement station.

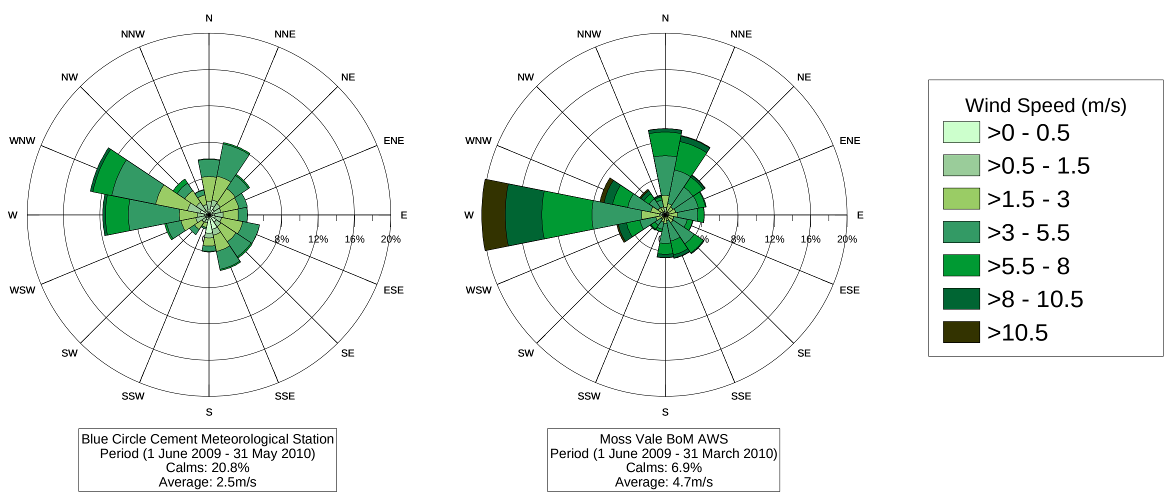

Figure 8: Period-average wind roses generated based on Boral Cement and Moss Vale AWS monitoring data sets

Annual average wind roses for the period 2005 to 2009 are given in **Appendix B** for the Moss Vale AWS. The period average wind rose for the Moss Vale AWS depicted in **Figure 8** is noted to be representative of annual wind roses occurring during the 2005 to 2009 period.

Seasonal and diurnal wind roses generated based on the Boral Cement meteorological dataset are presented in **Appendix B**.

Distinct seasonal shifts in the wind field are evident. During Summer easterly-component airflow prevails, with a significantly lower incidence of westerly winds. With the onset of Spring, westerly and west-northwesterly winds become increasingly prevalent. Winter is dominated by westerly and west-northwesterly wind, with such airflows also being associated with peak wind speeds.

During the Autumn the frequency of westerly component airflow is reduced, with a return to the more diverging easterly-component flow patterns. Generally lower wind speeds and a higher frequency of calm conditions is noted to occur in Autumn.

No significant diurnal shift in airflow was noted to occur, with daytime and night-time airflow patterns being similar (**Appendix B**). This indicates that thermo-topographic flows are not prevalent at the site. Daytime wind speeds were on average higher (3.0 m/s) than nocturnal wind speeds (1.9%), with a lower incidence of calm periods (12%) compared to the night-time (30%).

5.5 Atmospheric Stability and Boundary Layer Depth

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. This layer is directly affected by the earth's surface, either through the retardation of flow due to the frictional drag of the earth's surface (mechanical mechanisms), or as result of the heat and moisture exchanges that take place at the surface (convective mixing) (Stull, 1997; Oke, 2003).

During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface and the extension of the mixing layer to the lowest elevated subsidence inversion. Elevated inversions may occur for a variety of reasons including anticyclonic subsidence and the passage of frontal systems. Due to radiative flux divergence, nighttimes are typically characterised by weak vertical mixing and the predominance of stable conditions. These conditions are normally associated with low wind speeds, and hence lower dilution potentials.

For low level, wind independent, continuous sources, the highest ground level concentrations tend to occur during stable night-time conditions with pollutants accumulating close to the source. Sources characteristic of the proposed Project are mostly low level and wind dependent, with some of the dust generating activities restricted to day time hours. Atmospheric conditions conducive to peak ground level concentrations from such sources are more complicated and best characterised through the application of dispersion modelling in which temporal variations in atmospheric conditions and source profiles are adequately represented.

Diurnal variations in period average boundary layer depth modelled for the Project using AERMET are illustrated in **Figure 9**. Average convectively-generated and mechanically-generated boundary layer depths are also indicated in the figure. Higher day-time wind velocities and the onset of insolation, resulting in increased mechanical and convective mixing respectively, contribute to greater mixing depths during the day-time.

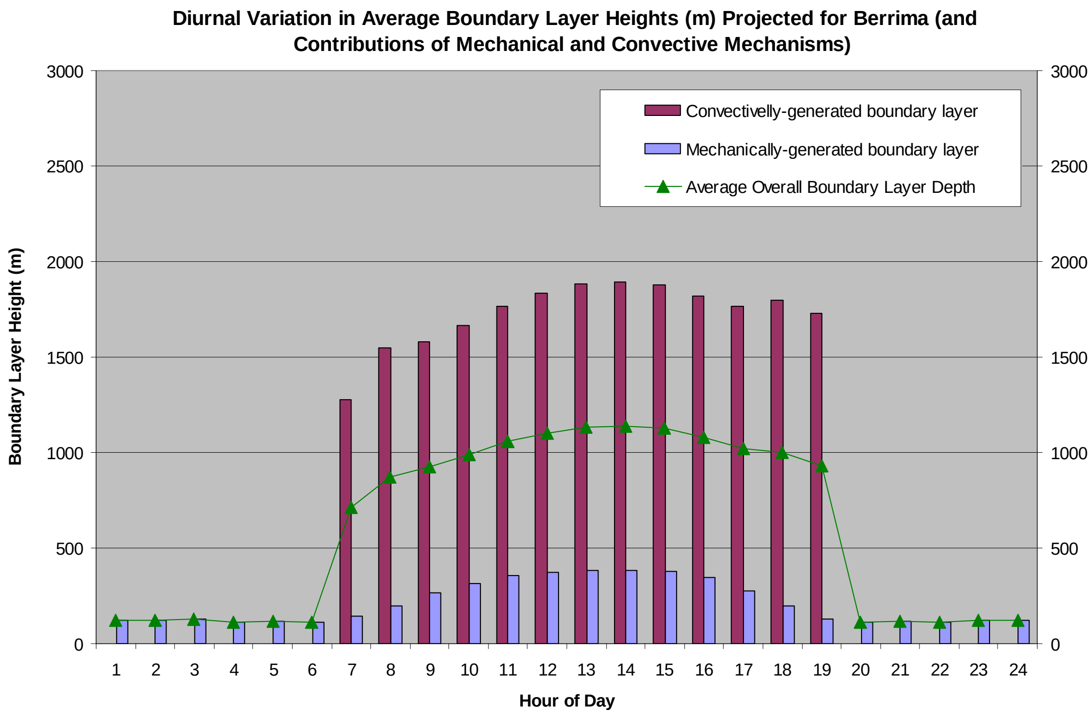

Figure 9: Diurnal variations in period average boundary layer depth for the Project area, with contributions by convective and mechanical mixing illustrated

The Monin-Obukhov length (L) provides a measure of the stability of the surface layer (i.e. the layer above the ground in which vertical variation of heat and momentum flux is negligible; typically about 10% of the mixing height).

Period-average diurnal variations in Monin-Obukhov Length modelled for the Project area using AERMET are illustrated in **Figure 10**. The Monin-Obukhov Length is zero for neutral conditions, and positive (negative) for stable (unstable) conditions. Stable conditions prevail during the night-time with unstable conditions occurring in the day as may be expected.

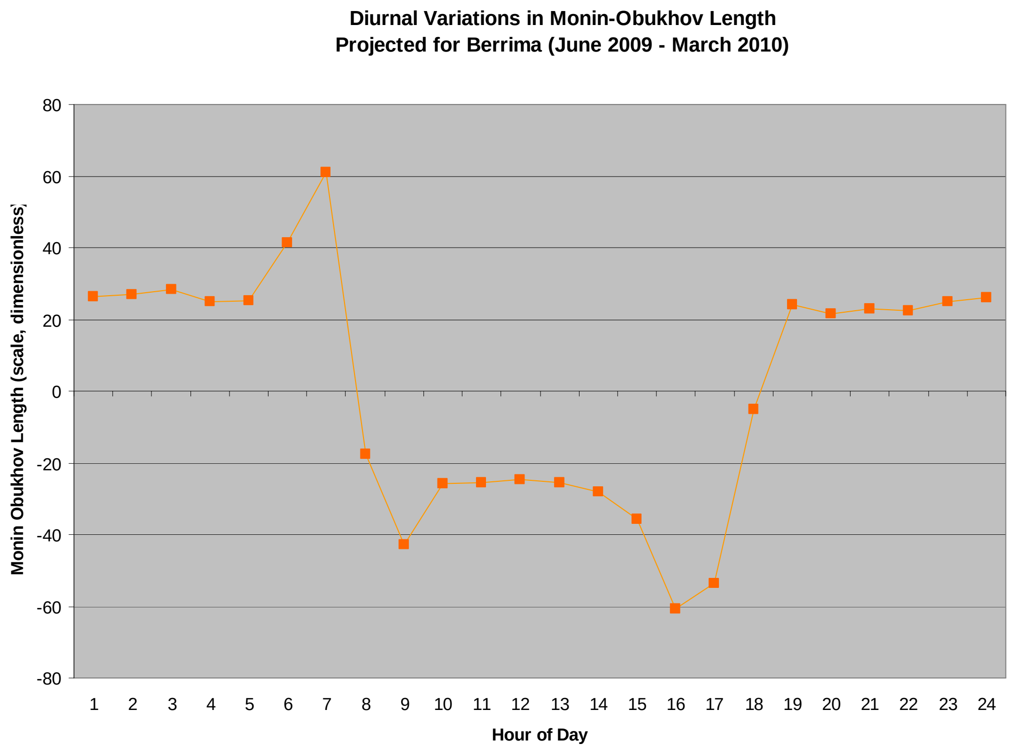

Figure 10: Period-average diurnal variations in average Monin-Obukhov Lengths for the Project area

6 Emission Estimation

To assess both total and incremental emissions and associated impacts due to the Project, emissions were quantified from both existing and maximum Berrima Colliery operations.

The Project comprises the continuation of existing surface operations at the Berrima Colliery, but makes provision for a maximum production rate of 460,000 tpa ROM coal. This maximum production rate is higher than the 220,000 tpa reported to have been recently produced, but is consistent with maximum volumes produced in the past at the colliery.

The approach adopted was to compile an emissions inventory for existing Berrima Colliery operations which could be used to simulate the contribution of Berrima Colliery to ambient suspended particulates and dust deposition rates. The emissions inventory compiled for existing Berrima Colliery operations was then appropriately scaled to reflect the increased ROM coal throughput and related increases in activity rates.

6.1 Quantification of Existing Berrima Colliery Emissions

A description of current Berrima Colliery operations is provided in Section **2.1**. Potential sources of atmospheric emission associated with such operations, identified based on information received from EMGA Mitchell McLennan and observations made during a site visit undertaken on 28 May 2010, were as follows:

- Coal handling operations, including:
  - coal transfer to the 450 t bin and subsequently to the primary crusher;
  - coal transfer to the loading bin;
  - top loading of trucks from the loading bin; and
  - stockpiling and recovery of coal at the Loch Catherine storage area.
- Coal crushing operations;
- Haul truck entrainment of road silt while in transit along the paved access road;
- Haul truck entrainment of road silt from the unpaved road sections between the loading bin and the Loch Catherine stockpile area;
- Entrainment of dust by delivery trucks and light vehicles;
- Wind blown dust from the coal stockpile at Loch Catherine;
- Ventilation shaft emissions;
- Front end loader and forklift activity within the unpaved stores area;
- Front end loader activity at the Loch Catherine stockpile area (loading of trucks); and
- Vehicle exhaust releases.

Vehicle exhaust emissions were considered a minor source due to the limited on-site traffic movements and were therefore not quantified. Instead the assessment focused on the quantification of fugitive dust emissions.

Current dust control measures being implemented at the Berrima Colliery are as follows:

- coal is wet (generally 8% moisture content);
- conveyors are either partially covered or covered;
- the crusher is enclosed;
- a truck loading chute is used;
- unpaved haul road sections and trafficked unsealed areas of the site are watered using a water cart; and
- there is occasional sweeping of paved roads and areas.

Fugitive dust sources were quantified through the application of Australian NPI emission estimation techniques and United States Environmental Protection Agency (USEPA) AP-42 predictive emission factor equations. Particulate releases were quantified for various particle size fractions, with the TSP fraction being estimated and simulated to provide an indication of nuisance dust deposition rates. Fine particulates (PM_{10}) were estimated and resultant concentrations simulated for the purpose of assessing compliance with air quality criteria which are protective of human health.

Emissions estimates for current Berrima Colliery operations, taking account of the above documented dust mitigation measures, are presented in **Table 9**. Information on the emission factors applied in the quantification of sources and the inputs used in predictive emission factor equations are also provided.

No site-specific monitoring data are available to quantify the extent of particulate emissions from the ventilation shaft. In estimating particulate emissions from the ventilation shaft reference was made to measured PM_{10} emissions undertaken previously by EML Air (2005) for the ventilation shaft of an operational underground coal mine with an annual production of 5.2 Mtpa. Given that the current (0.22 Mtpa) and maximum proposed (0.45 Mtpa) production rates at Berrima Colliery are significantly lower, 10% of the PM_{10} emission rate recorded by EML (2005) was calculated for use in the emissions inventory.

EML Air (2005) measured the PM_{10} concentrations within the vent to be 1.6 mg/m³. A vent concentration of 0.16 mg/m³ was therefore multiplied by the volumetric flow for the ventilation shaft at Berrima Colliery (51.1 m³/s) to provide a PM_{10} emission estimate, as given in **Table** 9. Vent parameters inventoried to permit the modelling of the vent shaft as point sources are given in **Table 10**.

Table 9: Estimated emissions for existing Berrima Colliery operations

Source	TSP	PM_{10}	Emission Factor Applied	Calculation Inputs
	tpa	tpa		
Paved roads	6.30	1.21	USEPA AP-42 Revised Paved Roads Equation (June 2010, Draft Section 13.2.1)	A silt loading of 2.4 g/m² was assumed based on visual inspection of the roadway and the lower bound silt loading given by the USEPA as being characteristic of paved roads within quarry operations. This represents a conservative assumption given that the paved access road is a public road. Vehicle kilometres travelled (VKT) estimated to be approximately 289 per day over the 231 delivery days per annum. This estimate is based on 32 delivery trips per day (and equivalent return trips along a significant portion of the paved road length), and the estimated paved road length of 4.86 km from the Hume Highway off-ramp to the Berrima Colliery Pit Top Facility. The mean vehicle weight was estimated to be 30 t (accounting for full, 45 t, and empty, 15 t, vehicle weights; with a payload of 30 t). Vehicle speeds were taken to be 70 km/hr.
Unpaved roads	5.75	1.48	USEPA AP-42 Unpaved Roads, Equation 1a Industrial Roads (Section 13.2.2) (November 2006)	The silt content of the road surface material was assumed to be 5.1%, given by the USEPA as being characteristic of production roads within western surface coal mining operations. The mean vehicle weight was taken to be 30 t (accounting for full and empty trips). VKT were estimated to be approximately 29 per day. The dust control efficiency due to watering was assumed to be 60%.
Materials handling	2.43	1.07	NPI EETM for Mining Version 2.3, Dec 2001	Default emission factors for coal loading (trucks and transfer points) were used. Volumes handled were taken to be 220,000 tpa ROM coal, of which 55,000 tpa were noted to be stockpiled and recovered and the remainder transferred off-site without stockpiling.
Coal Crushing	2.20	0.88	NPI EETM for Mining Version 2.3, Dec 2001	Emission factor corresponding to High Moisture Ores (>4%) selected for coal crushing, due to the coal moisture content (8%). A coal throughput of 220,000 tpa was used.
Front End Loader operations	1.60	0.77	NPI EETM for Mining Version 2.3, Dec 2001	The default NPI emission factors for a front end loader operating on coal was applied, with 55,000 tpa being handled. The loader was assumed to operate intermittently during coal delivery hours 6 am to 9 pm.
Stockpile Wind Erosion	3.89	1.94	Wind dependant emission rates applied	The area of the coal stockpile is given as 11,100 m². Emissions were estimated based on the NPI default emission factor, with apportionment

Table 9: Estimated emissions for existing Berrima Colliery operations				
Source	TSP	PM_{10}	Emission Factor Applied	Calculation Inputs
	tpa	tpa		
			consistent with USEPA AP-42 Industrial Wind Erosion (Section 13.2.5 (2006)	of emissions by wind speed class based on the USEPA Industrial Wind Erosion emission factor. The threshold wind velocity was conservatively taken to be 5.4 m/s.
Vent Shaft Emissions	0.52	0.26	Ventilation shaft measurements for underground coal mine producing 5.2 Mtpa (EML Air, 2005)	EML (2005) measured the PM_{10} concentrations within the vent to be 1.6 mg/m³. To account for the lower ROM production, 10% of this vent concentration was multiplied by the volumetric flow rate for Berrima Colliery's vent shaft (51.1 m³/s) to determine the PM_{10} emission rate. TSP emissions were assumed to be twice that of PM_{10} emissions.
TOTAL	**22.69**	**7.62**		

Table 10: Ventilation shaft parameters and estimated emission rates							
Source	Diameter of Vent Shaft	Area	Release Height	Gas Exit Velocity	Gas Exit Temperature	TSP Emission Rate	PM_{10} Emission Rate
	m	m^2	m	m/s	K	g/s	g/s
Ventilation Shaft	1.8	3.93	0.9	20	Ambient	0.016	0.0082

Total emissions from existing Berrima Colliery operations are estimated to be about 22.7 tpa for TSP and 7.6 tpa for PM_{10}. Estimated source contributions to total emissions are illustrated in **Figure 11**.

Vehicle entrainment from paved and unpaved roads represent the most significant sources of TSP emissions despite assumed control efficiencies due to the use of water spays on unpaved roads and the periodic use of road sweeping. The contributions of these sources are lower for PM_{10} due to the smaller percentage of fines in road surface material relative to other sources. Although estimated unit emissions (grams/VKT) are lower for paved roads, total emissions from paved roads are similar to those of unpaved roads due to the longer road length (4.9 km paved; 1.5 km unpaved) and the greater volume of truck traffic on the paved sections.

Wind erosion from the coal stockpile at Loch Catherine represents a significant contribution to both TSP and PM_{10} emissions, with the contribution of coal crushing, front end loader operations and materials handling being of a similar order.

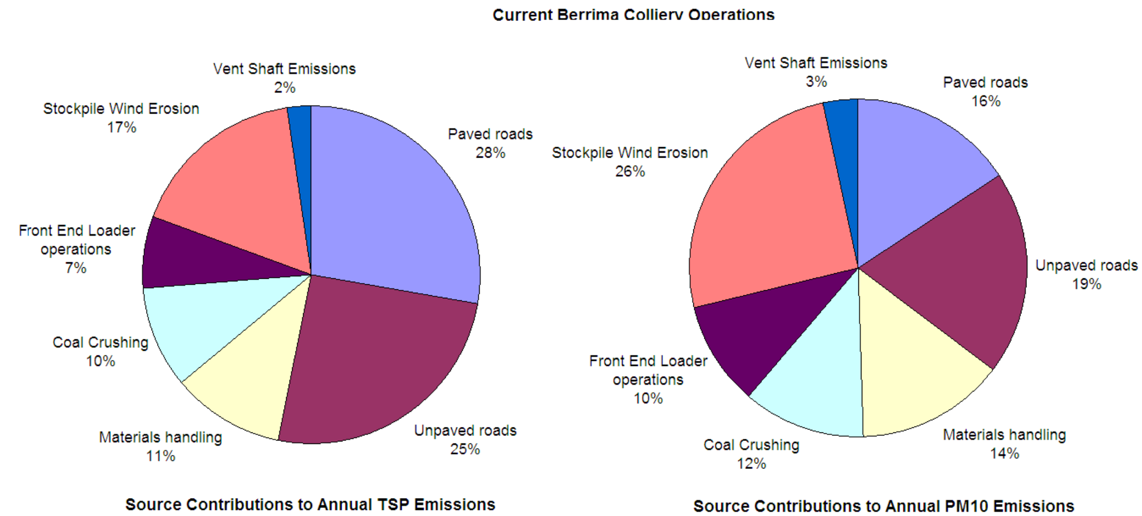

Figure 11: Source contributions to estimated emissions from existing Berrima Colliery operations

6.2 Quantification of Project-related Emissions

A description of Project-related Berrima Colliery operations is provided in **Section 2.2**. Existing colliery operations were increased and emissions recalculated for Project-related operations to reflect the increased ROM coal throughput as documented in **Table 11**. The nature of site operations are assumed to remain largely unchanged from existing operations, with only the rates of activities estimated to increase in line with the increased production rate.

Initially control measures and related control efficiencies were retained unchanged as per existing colliery operations. Preliminary air dispersion modelling however demonstrated that greater control efficiencies would be required for paved and unpaved roads to reduce the potential for impacts due to the proximity of these sources to residences.

The current control efficiency achieved through the watering of unpaved roads (60%) was required to be increased to 80%. This control effectiveness, if found not to be achievable through an enhanced watering regime could be achieved through the use of water extender chemicals or chemical road stabilizers.

Emission reductions from the paved road sections can be achieved in various ways including: reducing the road surface silt loading (currently assumed to be 2.4 g/m^2) by sweeping and avoiding track-on from unpaved areas; reducing the vehicle speed; and reducing traffic volumes. Given uncertainties regarding current road surface silt loadings and the load reductions achievable through sweeping and it being impractical to reduce truck traffic, the regulation of vehicle speed was selected as a feasible control. To achieve a higher control efficiency on paved road sections, with the specific purpose of reduced emissions in the vicinity of receptors, the restriction of vehicle speed within the vicinity of Medway to 30 km/hr was applied. This measure is estimated to result in an additional 12% reduction in vehicle entrained emissions from paved roads.

Table 11: Estimated emissions for Project-related Berrima Colliery operations

Source	TSP	PM_{10}	Emission Factor Applied	Calculation Inputs
	tpa	tpa		
Paved roads	11.18	2.15	USEPA AP-42 Revised Paved Roads Equation (June 2010, Draft Section 13.2.1)	A silt loading of 2.4 g/m² was assumed based on visual inspection of the roadway and the lower bound silt loading given by the USEPA as being characteristic of paved roads within quarry operations. This represents a conservative assumption given that the paved access road is a public road. VKT estimated to be approximately 587 per day over the 231 delivery days per annum. This estimate is based on 66 delivery trips per day (and equivalent return trips along a significant portion of the paved road length), and the estimated paved road length of 4.86 km from the Hume Highway off-ramp to the Berrima Colliery Pit Top Facility. The mean vehicle weight was estimated to be 30 t (accounting for full, 45 t, and empty, 15 t, vehicle weights; with a payload of 30 t). Vehicle speeds were taken to be 30 km/hr in the vicinity of Medway village and 50 km/hr closer to the Hume Highway onramp.
Unpaved roads	5.78	1.49	USEPA AP-42 Unpaved Roads, Equation 1a Industrial Roads (Section 13.2.2) (November 2006)	The silt content of the road surface material was assumed to be 5.1%, given by the USEPA as being characteristic of production roads within western surface coal mining operations. The mean vehicle weight was taken to be 30 t (accounting for full and empty trips). VKT were estimated to be approximately 29 per day. The dust control efficiency due to watering was assumed to be 80%.
Materials handling	4.98	2.19	NPI EETM for Mining Version 2.3, Dec 2001	Default emission factors for coal loading (trucks and transfer points) were used. Volumes handled were taken to be 460,000 tpa ROM coal, of which 112,500 tpa were noted to be stockpiled and recovered and the remainder transferred off-site without stockpiling.
Coal Crushing	4.50	1.80	NPI EETM for Mining Version 2.3, Dec 2001	Emission factor corresponding to High Moisture Ores (>4%) selected for coal crushing, due to the coal moisture content (8%). A coal throughput of 460,000 tpa was used.
Front End Loader operations	3.26	1.58	NPI EETM for Mining Version 2.3, Dec 2001	The default NPI emission factors for a front end loader operating on coal was applied, with 112,500 tpa being handled. The loader was assumed to operate intermittently during coal delivery hours 6 am to 9 pm.

Table 11: Estimated emissions for Project-related Berrima Colliery operations				
Source	**TSP**	**PM_{10}**	**Emission Factor Applied**	**Calculation Inputs**
	tpa	**tpa**		
Stockpile Wind Erosion	5.29	2.65	Wind dependant emission rates applied consistent with USEPA AP-42 Industrial Wind Erosion (Section 13.2.5 (2006)	The area of the coal stockpile is given as 15,100 m^2. Emissions were estimated based on the NPI default emission factor, with apportionment of emissions by wind speed class based on the USEPA Industrial Wind Erosion emission factor. The threshold wind velocity was conservatively taken to be 5.4 m/s.
Vent Shaft Emissions	0.52	0.26	Ventilation shaft measurements for underground coal mine producing 5.2 Mtpa (EML Air, 2005)	EML (2005) measured the PM_{10} concentrations within the vent to be 1.6 mg/m^3. To account for the lower ROM production, 10% of this vent concentration was multiplied by the volumetric flow rate for Berrima Colliery's vent shaft (51.1 m^3/s) to determine the PM_{10} emission rate. TSP emissions were assumed to be twice that of PM_{10} emissions.
TOTAL	**35.51**	**12.11**		

Total emissions from Project-related Berrima Colliery operations are estimated to be 35.51 tpa for TSP and 12.11 tpa for PM_{10}. Whereas the increase in production from 220,000 tpa to 460,000 tpa represents a factor of 2.1 increase in production rates, site emissions are estimated to increase by a factor of 1.6 due to the higher control efficiencies allocated for paved and unpaved roads.

Estimated source contributions to total Project-related emissions are illustrated in **Figure 12**. Despite the enhanced controls, the contribution of vehicle entrainment from paved and unpaved roads to total emissions remains significant. Other significant sources include wind erosion of the coal stockpile, materials handling, coal crushing and front end loader operations.

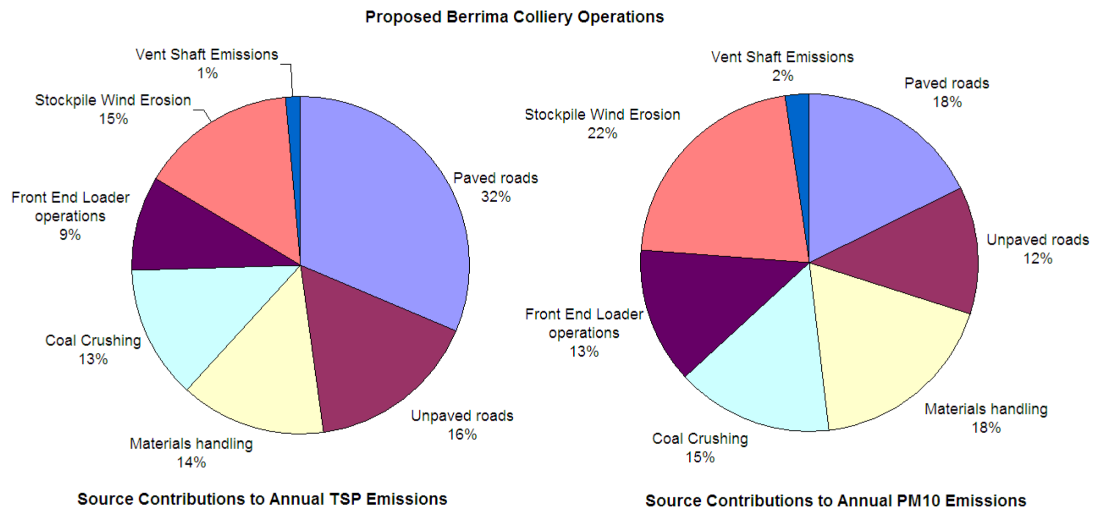

Figure 12: Source contributions to estimated Project-related emissions

7 Dispersion Modelling Method and Results

7.1 Dispersion Model Selection and Methodology

The atmospheric dispersion modelling carried out in the present assessment utilises the USEPA regulatory AERMOD model. A detailed account of the model selection and modelling methodology is presented in **Appendix C**. An overview of model inputs and results is given in this section.

7.2 AERMOD Dispersion Model Inputs

Input data types required for the AERMOD model include: topography, meteorological field derived from the AERMET model based on site representative monitoring data, source data from the emissions inventory compiled, and information on the nature of the receptor grid.

7.2.1 *Project Topography*

As discussed in **Section 2.3**, the topography between the Project and the nearest receptors is relatively uncomplicated. However, topography within the modelling domain has been incorporated in the dispersion simulations using NASA's Shuttle Radar Topography Mission (SRTM) Data. This data set provides high-resolution topography at 3 arc-second (~90m) grid spacings.

7.2.2 *Meteorological Inputs*

AERMET generated meteorological files were used as input in the dispersion simulations. A detailed account of the AERMET modelling undertaken is given in **Appendix C**.

7.2.3 *Source and Emissions*

Emissions estimated for existing Berrima Colliery operations and for the Project, as documented in **Section 6**, were simulated. Hourly varying TSP and PM_{10} emission rates allocated based on hours of operation and wind speed class were input in the dispersion modelling to facilitate the projection of dust deposition rates and suspended PM_{10} concentrations.

Atmospheric emissions from existing Berrima Colliery operations were modelled to establish the Colliery's current contribution to suspected particulate concentrations and dust deposition rates.

Estimated emissions from the Project were simulated to determine incremental concentrations and deposition rates due to future Berrima Colliery operations, taking into account the maximum production rate of 460,000 tpa.

Given that site-specific PM_{10} data are not available with reference made to monitoring data expected to be indicative of background PM_{10} concentrations, total Project-related PM_{10} concentrations (rather than incremental concentrations given current impacts) were taken into account in assessing cumulative PM_{10} levels.

In the case of dust deposition, where sampling data used for baseline characterization are site-specific and therefore inclusive of the dust deposition due to current Berrima Colliery operations, incremental dust deposition rates due to the Project were considered in the cumulative assessment.

7.2.4 *Receptor Grid and Discrete Receptors*

The dispersion of pollutants was modelled for an area covering 10 km by 10 km. Gridded receptor points were specified at intervals of 200 m, with discrete receptor points also being specified for selected sensitive receptor points coinciding with nearby residences (**Table 1**).

Ground-level concentrations and deposition rates were simulated for the gridded receptors for use in the generation of isopleth plots to demonstrate spatial variations in pollutant concentrations/deposition rates. Model outputs for discrete receptor points were used in the compliance assessment of cumulative levels.

7.3 Model Results

Dispersion simulations were undertaken and results analysed for annual average dust deposition and highest 24-hour and annual average PM_{10} concentrations.

Results are presented as isopleth plots of PM_{10} concentrations and deposition rates due to existing Berrima Colliery operations and Project-related emissions (**Appendix D**). These isopleth plots illustrate spatial variations in particulate concentrations and dust deposition.

Tabulated results for discrete receptor points are presented in **Section 8** for PM_{10}, TSP and dust deposition, for the purpose of existing mine impact contribution analysis and Project-related cumulative impact assessment.

8 Air Quality Assessment

In assessing the air quality impacts due to Berrima Colliery operations it is relevant to evaluate annual average TSP concentrations and dust deposition rates, and maximum daily and annual average PM_{10} concentrations against regulatory assessment criteria. Criteria relevant to the Project are documented in **Section 3.3**. Dust deposition criteria are designed to be protective of amenity, whereas PM_{10} criteria have been primarily established to reduce the potential for human health impacts.

8.1 Dust Deposition

8.1.1 Contribution of Current Operations to Measured Ambient Levels

Atmospheric emissions from current Berrima Colliery operations are expected to have contributed to dust deposition rates recorded in the vicinity (as documented in **Section 4.3**). To assess likely increases in dust deposition levels due to up-scaled, continued operations (the Project), and the significance of such increases, it was therefore necessary to establish the contribution of current operations to dust deposition rates.

The predicted contribution of current Berrima operations to measured dust deposition rates at dust deposition sampling sites are presented in **Table 12**.

Table 12: Comparison of Measured Dust Deposition with Dust Deposition Predicted due to Current Berrima Colliery Operations

Monitoring Site	Period-Average Dust Deposition ($g/m^2/month$)		
	Measured ($g/m^2/month$)	Predicted due to Berrima Colliery ($g/m^2/month$)	Predicted as % of Measured
Site 1 - Office	2.0	2.5	125
Site 2 - Medway village	2.0	0.9	40
Site 3 - Stockpile	2.6	1.0	39

Emissions from current operations were predicted to be responsible for over 100% of the measured period-average dust deposition recorded at Site 1 (Office) indicating a conservative estimate has been made of Berrima Colliery Pit Top Facility’s contribution to ambient deposition levels.

Emissions from colliery operations were predicted to account for about 40% of the dust deposition rates recorded at Site 2 (Medway village) and Site 3 (stockpile).

8.1.2 Dust Deposition Levels at Receptors

Dust deposition levels at nearby residences predicted to occur due to current and Project-related Berrima Colliery operations are presented in **Table 13**, an illustrated for the entire area in **Appendix D**.

Table 13: Dust Deposition Predicted due to Berrima Colliery Operations

Receptor	Location	Dust Deposition ($g/m^2/month$)		Incremental Dust Deposition Rates due to Up-scaled Operations ($g/m^2/month$)	Project-related Deposition as a % of the Incremental Deposition Criterion of 2 $g/m^2/month$
		Current Operations	Project-related Operations		
R1	Medway Village	0.64	1.07	0.42	53.4
R2	Medway Village	0.44	0.69	0.26	34.7
R3	Medway Village	0.26	0.43	0.17	21.5
R4	Medway Village	0.20	0.31	0.11	15.5
R5	Medway Village	0.18	0.25	0.08	12.6
R6	Medway Village	0.38	0.70	0.32	34.9
R7	Medway Village	0.43	0.82	0.39	40.8
R8	Medway Village	0.37	0.69	0.33	34.7
R9	Medway Village	0.14	0.20	0.06	10.1
R10	Medway Village	0.34	0.66	0.31	32.8
R11	Medway Village	0.24	0.46	0.22	22.8
R12	1.1km ESE of LC	0.01	0.02	0.01	1.1
R13	1.5km ESE of LC	0.01	0.02	0.01	0.9
R14	950m WNW of Pit Top	0.01	0.01	0.00	0.7
R15	1km NW of Pit Top	0.01	0.01	0.00	0.6
R16	New Berrima	0.00	0.00	0.00	0.2
Maximum Across Receptors		**0.64**	**1.07**	**0.42**	**53.4**

The highest colliery-related dust deposition rates across selected receptor sites were predicted to occur at R1 within Medway Village. Project-related dust deposition rates are predicted to be 1.1 $g/m^2/month$ at this site, representing 53% of the DECCW Incremental Dust Deposition Criterion of 2 $g/m^2/month$ and an increment of 0.4 $g/m^2/month$ above levels predicted due to current operations.

In assessing cumulative dust deposition due to the Project, the period-average dust deposition rate measured at the Medway village site (Site 2; 2.0 $g/m^2/month$) was conservatively assumed to be representative of existing deposition across selected receptors. Project-related increments in annual average dust deposition were summed with this rate to provide an estimate of cumulative dust deposition (**Table 14**). Maximum cumulative dust deposition rates were estimated to be 2.4 $g/m^2/month$ representing about 60% of the DECCW Cumulative Dust Deposition Criterion of 4 $g/m^2/month$.

Berrima Colliery's contribution to dust deposition rates at residential sites further afield than Medway village, such as New Berrima, are predicted to be negligible.

Table 14: Assessment of Projected Cumulative Dust Deposition					
Receptor	Location	Existing Dust Deposition (g/m²/month)	Incremental Dust Deposition Rates due to Project (g/m²/month)	Cumulative Dust Deposition Rates due to Project (g/m²/month)	Cumulative Deposition as a % of the Cumulative Deposition Criterion of 4 g/m²/month
R1	Medway Village	2.0	0.42	2.42	61
R2	Medway Village	2.0	0.26	2.26	57
R3	Medway Village	2.0	0.17	2.17	54
R4	Medway Village	2.0	0.11	2.11	53
R5	Medway Village	2.0	0.08	2.08	52
R6	Medway Village	2.0	0.32	2.32	58
R7	Medway Village	2.0	0.39	2.39	60
R8	Medway Village	2.0	0.33	2.33	58
R9	Medway Village	2.0	0.06	2.06	52
R10	Medway Village	2.0	0.31	2.31	58
R11	Medway Village	2.0	0.22	2.22	56
R12	1.1km ESE of LC	2.0	0.01	2.01	50
R13	1.5km ESE of LC	2.0	0.01	2.01	50
R14	950m WNW of Pit Top	2.0	0.00	2.00	50
R15	1km NW of Pit Top	2.0	0.00	2.00	50
R16	New Berrima	2.0	0.00	2.00	50
Maximum Across Receptors		**2.0**	**0.42**	**2.42**	**61**

8.2 TSP Concentrations

Annual average TSP concentrations at nearby residences predicted to occur due to current and Project-related Berrima Colliery operations are presented in **Table 15**, an illustrated for the entire area in **Appendix D**.

The highest Project-related annual average TSP concentration across selected receptor sites was predicted to occur at R1 within Medway Village (14.4 µg/m³), with peak increments in annual TSP concentrations due to production up-scaling occurring at R7 within Medway village (6.4 µg/m³ increment).

The DECCW Annual Average TSP Criterion is given for cumulative concentrations. Due to the absence of monitoring data to quantify background TSP concentrations, Project-related TSP concentrations are compared to the criterion to be indicative of the relative significance of such concentrations. The highest Project-related TSP concentrations predicted at nearby residences represents 7% of the Criterion value of 90 µg/m³.

Berrima Colliery's contribution to ambient TSP concentrations at residential sites further afield than Medway village, such as New Berrima, are predicted to be negligible.

Table 15: Annual TSP Concentrations Predicted due to Berrima Colliery Operations					
Receptor	Location	Annual Average TSP Concentrations (µg/m³)		Increment in Annual TSP Concentrations due to Up-scaled Operations (µg/m³)	Project-related Annual TSP Concentrations as a % of the DECCW Criterion(a)
		Current Operations	Project-related Operations		
R1	Medway Village	9.0	14.4	5.4	6.0
R2	Medway Village	7.7	12.2	4.5	5.0
R3	Medway Village	3.9	6.4	2.5	2.7
R4	Medway Village	2.7	4.3	1.6	1.8
R5	Medway Village	2.2	3.3	1.1	1.3
R6	Medway Village	6.2	11.1	4.9	5.4
R7	Medway Village	7.4	13.7	6.4	7.1
R8	Medway Village	6.0	11.1	5.1	5.7
R9	Medway Village	1.9	2.9	1.0	1.1
R10	Medway Village	4.6	8.6	4.0	4.4
R11	Medway Village	3.2	5.9	2.7	3.0
R12	1.1km ESE of LC	0.8	1.2	0.4	0.5
R13	1.5km ESE of LC	0.6	0.9	0.4	0.4
R14	950m WNW of Pit Top	0.3	0.4	0.1	0.1
R15	1km NW of Pit Top	0.2	0.3	0.1	0.1
R16	New Berrima	0.0	0.1	0.0	0.0
Maximum Across Receptors		**9.0**	**14.4**	**6.4**	**7.1**

(a) The DECCW Annual Average TSP Criterion is given for cumulative concentrations. Ambient TSP concentrations are very site specific. Due to the absence of monitoring data to quantify background TSP concentrations, Project-related TSP concentrations are compared to the criterion to demonstrate the relative significance of such levels.

8.3 Ambient PM_{10} Concentrations

8.3.1 Predicted PM_{10} Concentrations due to Colliery Operations

Ambient maximum daily and annual average PM_{10} concentrations at nearby residences predicted to occur due to current and Project-related Berrima Colliery operations are presented in **Table 16** and **Table 17**, an illustrated for the entire area in **Appendix D**.

The highest Project-related maximum daily and annual average PM_{10} concentration across selected receptor sites was predicted to occur at R1 within Medway Village (46.8 µg/m³ and 8.7 µg/m³ respectively). The increment in annual PM_{10} concentrations at this receptor due to up-scaling of production was predicted to be 3.1 µg/m³. Peak increment in peak daily average PM_{10} concentration due to up-scaling was predicted to occur at R7 within Medway village (19.8 µg/m³ increment).

Berrima Colliery's contribution to ambient PM_{10} concentrations at residential sites further afield than Medway village, such as New Berrima, are predicted to be negligible.

Table 16: Highest Daily PM_{10} Concentrations Predicted due to Berrima Colliery Operations

Receptor	Location	Maximum Daily PM_{10} Concentrations (µg/m³)		Increment in Maximum Daily PM_{10} Concentrations due to Up-scaled Operations (µg/m³)
		Current Operations	Project-related Operations	
R1	Medway Village	30.6	46.8	16.1
R2	Medway Village	35.9	43.8	7.9
R3	Medway Village	20.1	25.7	5.6
R4	Medway Village	14.7	19.0	4.3
R5	Medway Village	10.0	13.6	3.6
R6	Medway Village	25.1	39.7	14.6
R7	Medway Village	19.6	39.4	19.8
R8	Medway Village	17.3	29.1	11.9
R9	Medway Village	9.1	10.8	1.7
R10	Medway Village	11.7	19.9	8.2
R11	Medway Village	6.7	10.7	4.0
R12	1.1km ESE of LC	9.1	16.4	7.2
R13	1.5km ESE of LC	7.9	13.5	5.6
R14	950m WNW of Pit Top	1.5	1.6	0.1
R15	1km NW of Pit Top	1.6	1.8	0.2
R16	New Berrima	0.2	0.3	0.1
Maximum Across Receptors		**35.9**	**46.8**	**19.8**

Table 17: Annual PM_{10} Concentrations Predicted due to Berrima Colliery Operations

Receptor	Location	Annual Average PM_{10} Concentrations (µg/m³)		Increment in Annual PM_{10} Concentrations due to Up-scaled Operations (µg/m³)
		Current Operations	Project-related Operations	
R1	Medway Village	5.6	8.7	3.1
R2	Medway Village	4.2	6.4	2.3
R3	Medway Village	2.2	3.6	1.3
R4	Medway Village	1.6	2.5	0.9
R5	Medway Village	1.3	2.0	0.7
R6	Medway Village	4.1	7.1	3.0
R7	Medway Village	3.6	6.4	2.8
R8	Medway Village	3.0	5.4	2.3
R9	Medway Village	1.2	1.8	0.6
R10	Medway Village	2.3	4.1	1.8
R11	Medway Village	1.7	3.0	1.3
R12	1.1km ESE of LC	0.7	1.0	0.3
R13	1.5km ESE of LC	0.5	0.8	0.3
R14	950m WNW of Pit Top	0.2	0.2	0.1
R15	1km NW of Pit Top	0.1	0.2	0.0
R16	New Berrima	0.0	0.0	0.0

Table 17: Annual PM_{10} Concentrations Predicted due to Berrima Colliery Operations				
Receptor	Location	Annual Average PM_{10} Concentrations (µg/m³)		Increment in Annual PM_{10} Concentrations due to Up-scaled Operations (µg/m³)
		Current Operations	Project-related Operations	
Maximum Across Receptors		**5.6**	**8.7**	**3.1**

8.3.2 Potential for Cumulative PM_{10} Concentrations

The DECCW PM_{10} Criteria are expressed for cumulative concentrations. Site-specific PM_{10} monitoring data having not been available, reference was made to monitoring data from a more remote site anticipated to be representative of background PM_{10} concentrations within similar (rural) environments, but excluding colliery operations (see **Section 4.4**). It is therefore not applicable to consider the contribution of current Berrima Colliery operations to recorded PM_{10} concentrations (as was done for dust deposition).

In assessing cumulative annual average PM_{10} concentrations due to the Project, annual average PM_{10} concentrations measured at the DECCW Oakdale air quality monitoring station was assumed representative of background levels across selected receptors, as discussed in **Section 4.5**.

Project-related annual average PM_{10} concentrations were summed with this 'background level' and compared with the Criterion (**Table 18**). Maximum cumulative annual average PM_{10} deposition rates were estimated to be 22.7 µg/m³, representing 76% of the DECCW Criterion.

Table 18: Assessment of Projected Cumulative Annual Average PM_{10} Concentrations					
Receptor	Location	Baseline Annual Average PM_{10} Concentration (µg/m³)(a)	Project-related Annual Average PM_{10} Concentration (µg/m³)	Cumulative Annual Average PM_{10} Concentration (µg/m³)	Cumulative Concentration as a % of the DECCW Criterion
R1	Medway Village	14.0	8.7	22.7	76
R2	Medway Village	14.0	6.4	20.4	68
R3	Medway Village	14.0	3.6	17.6	59
R4	Medway Village	14.0	2.5	16.5	55
R5	Medway Village	14.0	2.0	16.0	53
R6	Medway Village	14.0	7.1	21.1	70
R7	Medway Village	14.0	6.4	20.4	68
R8	Medway Village	14.0	5.4	19.4	65
R9	Medway Village	14.0	1.8	15.8	53
R10	Medway Village	14.0	4.1	18.1	60
R11	Medway Village	14.0	3.0	17.0	57
R12	1.1km ESE of LC	14.0	1.0	15.0	50
R13	1.5km ESE of LC	14.0	0.8	14.8	49

Table 18: Assessment of Projected Cumulative Annual Average PM_{10} Concentrations					
Receptor	**Location**	**Baseline Annual Average PM_{10} Concentration (µg/m³)(a)**	**Project-related Annual Average PM_{10} Concentration (µg/m³)**	**Cumulative Annual Average PM_{10} Concentration (µg/m³)**	**Cumulative Concentration as a % of the DECCW Criterion**
R14	950m WNW of Pit Top	14.0	0.2	14.2	47
R15	1km NW of Pit Top	14.0	0.2	14.2	47
R16	New Berrima	14.0	0.0	14.0	47
Maximum Across Receptors		**14.0**	**8.7**	**22.7**	**76**

(a) Background concentrations characterized based on PM_{10} monitoring at the DECCW Oakdale air monitoring station. Annual PM_{10} concentrations during the 2005 to 2008 period were in the range of 12 µg/m³ to 14 µg/m³ with the upper bound value adopted in the current analysis. Average annual PM_{10} concentrations recorded in 2009 were concluded to be atypical due to the occurrence of extreme dust storm events during this year.

In the case of daily PM_{10} concentrations, where exceedances of the DECCW Criterion of 50 µg/m³ has been observed to occur, it is necessary to determine whether PM_{10} concentrations due to Berrima Colliery operations are likely to result in additional exceedances of the Criterion.

The DECCW daily PM_{10} Criterion of 50 µg/m³ is typically exceeded on up to one occasion per year at the Oakdale air monitoring station (except for extreme dust storm years such as 2009 when six exceedances occurred). Infrequent criterion exceedances generally occur in the broader region, primarily due to dust storm and vegetation burning events.

In assessing the probability of peak Project-related concentrations coinciding with peak background concentrations it is useful to consider frequency distributions for these data sets (**Figure 13**, **Figure 14**).

Prior to such analysis it is of note that significant spatial and temporal variations in daily PM_{10} concentrations predicted due to Project-related emissions occur. The spatial variability is evident from the contour plots presented in **Appendix D** and by the comparison of concentrations predicted at Receptor Site R1 with concentrations predicted within 200m of R1 within the centre of the clustered Medway village houses (**Figure 14**, **Figure 15**). Temporal trends in predicted concentrations at R1 and within the centre of the Medway residential cluster are also illustrated in the figures.

In cases where the daily PM_{10} Criterion is already exceeded, DECCW (2005) stipulates that proposed developments may not result in any increase in the number of exceedances. It is therefore pertinent to assess daily varying PM_{10} concentrations due to Berrima Colliery operations and assess the probability of such concentrations resulting in Criterion exceedances at nearby receptors.

About 47% of the time at R1 and 90% of the time at Medway village centre, predicted daily average PM_{10} concentrations are below 5 µg/m³. The frequency of higher predicted concentrations at these sites are illustrated in **Figure 14**. Given the low percentage of time that background concentrations exceed 45 µg/m³ (ranges from 0.3% to 0.6% across years) it is evident that there is a low probability of Project-related PM_{10} concentrations predicted at Medway village centre resulting in an additional exceedance of the Daily PM_{10} Criterion.

So by example, the peak daily PM_{10} concentration predicted for the centre of Medway village (18 µg/m³) would need to coincide with measured concentrations of >32 µg/m³ in order to result in an exceedance. Such concentrations occur less than 2% of the time.

A greater probability exists of an additional exceedance occurring based on the PM_{10} concentrations predicted to occur at R1. However, the spatial extent of such exceedances in the event that they occur will be localised and not representative of exposures within the village in general.

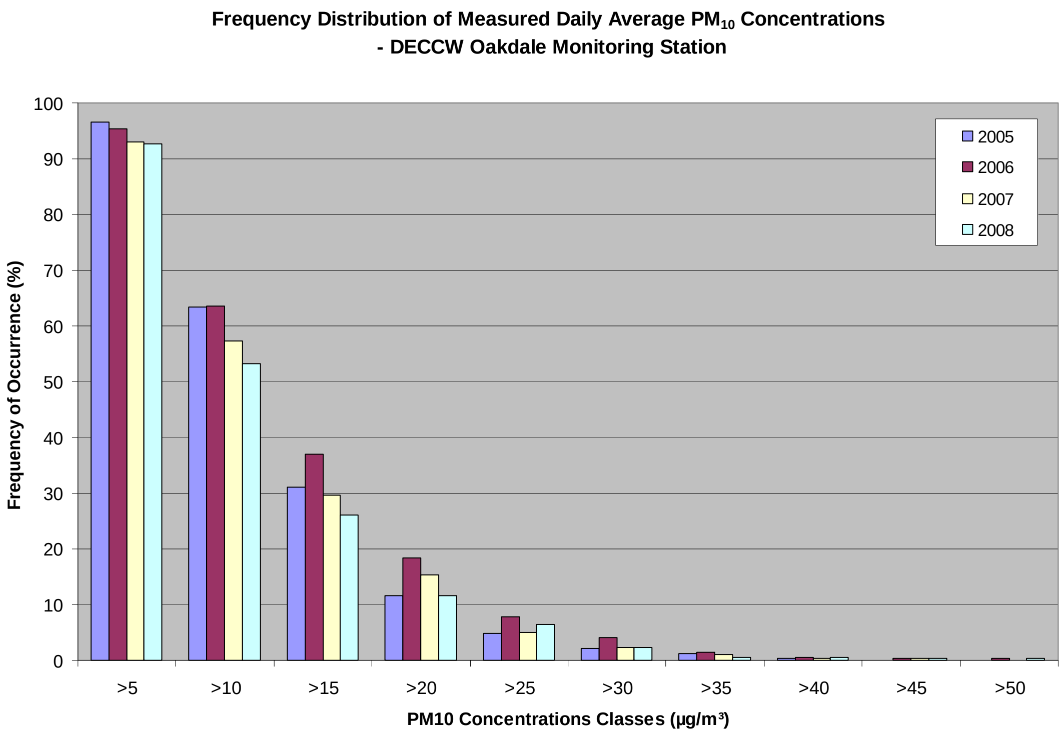

Figure 13: Frequency distribution of measured daily average PM_{10} concentrations recorded at DECCW Oakdale Monitoring Station

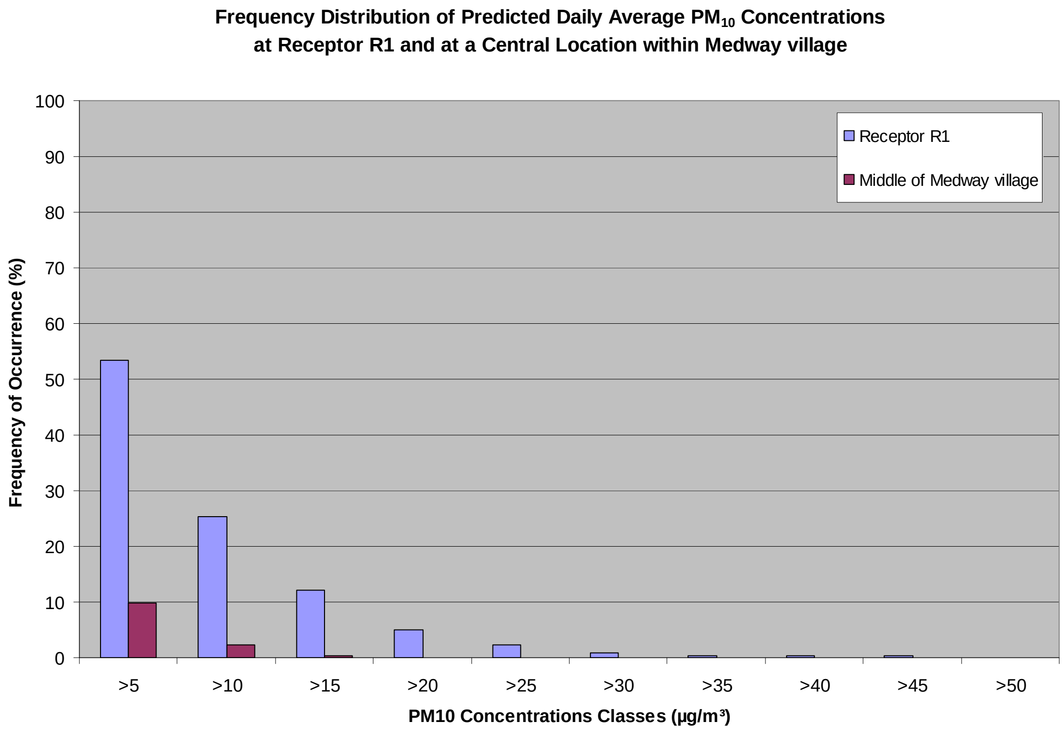

Figure 14: Frequency distribution of daily average PM_{10} concentrations predicted to occur due to Project-related emissions

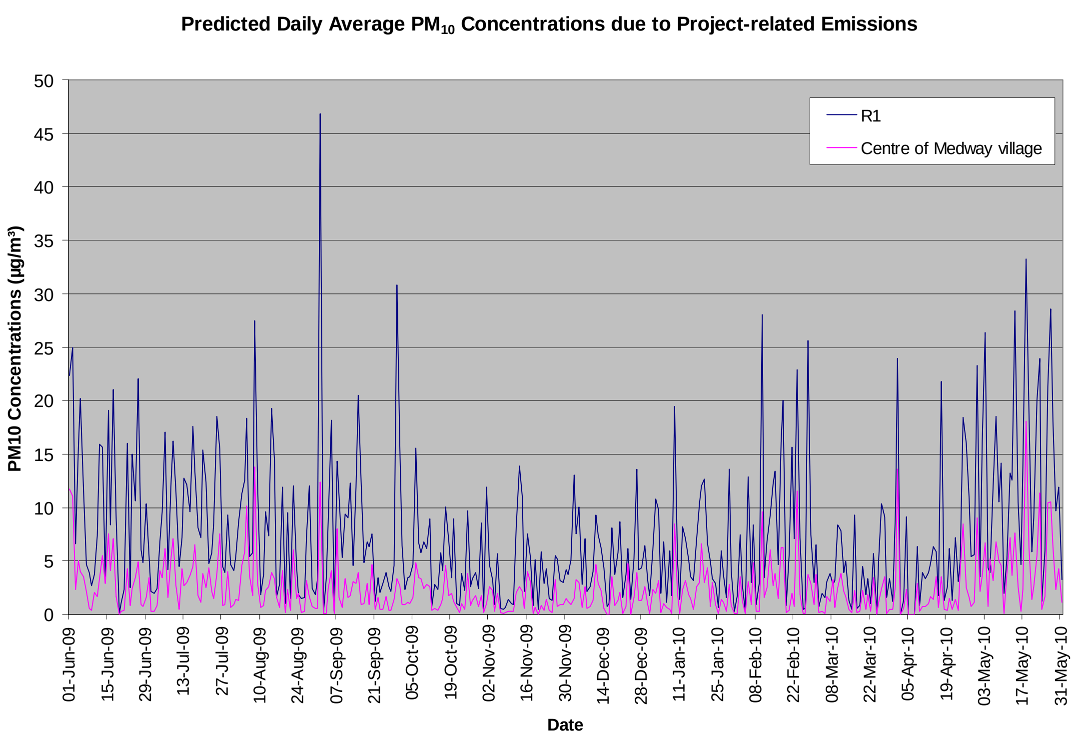

Figure 15: Daily average PM_{10} concentrations predicted at R1 and at the centre of Medway village due to Project-related emissions

9 Dust Management and Monitoring Recommendations

9.1 Operational Dust Management

Predicted air quality impacts will comply with Project air quality criteria, provided adequate operational dust management strategies are adhered to for the life of the Project.

In addition to dust control measures currently being implemented as part of the existing Berrima Colliery operations as documented in **Section 6**, it is required that the following measures (or alternative measures with equivalent control efficiencies) be implemented:

- Ensure the effectiveness of watering on unpaved roads to achieve a control efficiency of 80% (as calculated based on water application rates). This control effectiveness, if found not to be achievable through watering could be achieved by applying water extender chemicals or chemical road stabilizers.
- Maintain paved road silt loadings below 2 g/m^2 through preventative measures and periodic sweeping.
- Implement a speed limit of 30 km/hr on road sections in the vicinity of the Medway village for haul and delivery trucks.

9.2 Air Quality Monitoring Recommendations

Berrima Colliery's monitoring network currently includes dust deposition sampling at three sites. Suspended particulate concentration monitoring is not conducted.

It is recommended that dust deposition sampling at the Medway Village site, as a minimum, be continued for the life of mine to track deposition trends.

In the event that average dust deposition rates at the Medway Village site are observed to be increasing, it is recommended that a PM_{10} monitoring campaign be undertaken to assess suspended particulate concentrations at the Medway village.

All monitoring should be conducted in accordance with the following Australian Standards:

- Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales (DEC, 2007);
- AS 2922-1987 Ambient Air - Guide for the Siting of Sampling Units.

Monitoring for dust deposition should be conducted in accordance with the following Australian Standard:

- AS 3580.10.1-2003 Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method (DECC Method AM-19).

Monitoring for PM_{10} should be undertaken according to the following Australian Standard, or using another approved continuous method:

- AS 3580.9.6-2003 Particulate Matter - PM_{10} - high volume sampler with size-selective inlet (DECC Method AM-18).

10 Conclusion

Modelling of fugitive dust and particulate matter emissions was undertaken to determine the resulting air quality impacts of the Berrima Colliery Continued Operations Project.

Atmospheric dispersion modelling predictions of fugitive emissions from existing Berrima Colliery operations and the Project were undertaken using the AERMOD Gaussian Plume Dispersion Model software developed by the USEPA. Existing air quality was characterised for the purpose of assessing the potential for cumulative air pollution levels, given predicted Project-related incremental levels.

These predictions indicate that, provided the general design and operational safeguards documented within this report are implemented, particulate matter and dust deposition emissions attributable to the Project are anticipated to be within the current NSW DECCW air quality goals at all surrounding non-Project related residences. Dust control measures proposed are routinely implemented at other mines and are therefore considered feasible.

11 References

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12 Glossary of Acronyms And Symbols

AHD	Australian Height Datum
AMMAAP	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,
AWS	Automatic Weather Station
bcm	Bench cubic metres - a measure of volumes mined, equal to the weight of material divided by its specific gravity.
BoM	Australian Bureau of Meteorology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DECCW	NSW Department of the Environment, Climate Change and Water
EETMM	Emission Estimation Technique Manual for Mining, Version 2.3
ENVIRON	ENVIRON Australia Pty Ltd
ktpa	kilotonnes per annum
mg	Milligram (g x 10-3)
µg	Microgram (g x 10-6)
µm	Micrometre or micron (metre x 10-6)
m^3	Cubic metre
Mtpa	Megatonnes per annum
ML	Mining Licence
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NPI	National Pollutant Inventory
PM_{10}	Particulate matter less than 10microns in aerodynamic diameter
ROM	Run of Mine
TAPM	"The Air Pollution Model"
TEOM	Tapered Element Oscillating Microbalance
The Project	Berrima Colliery Continued Operations Project
TSP	Total Suspended Particulate
USEPA	United States Environmental Protection Agency

Appendices

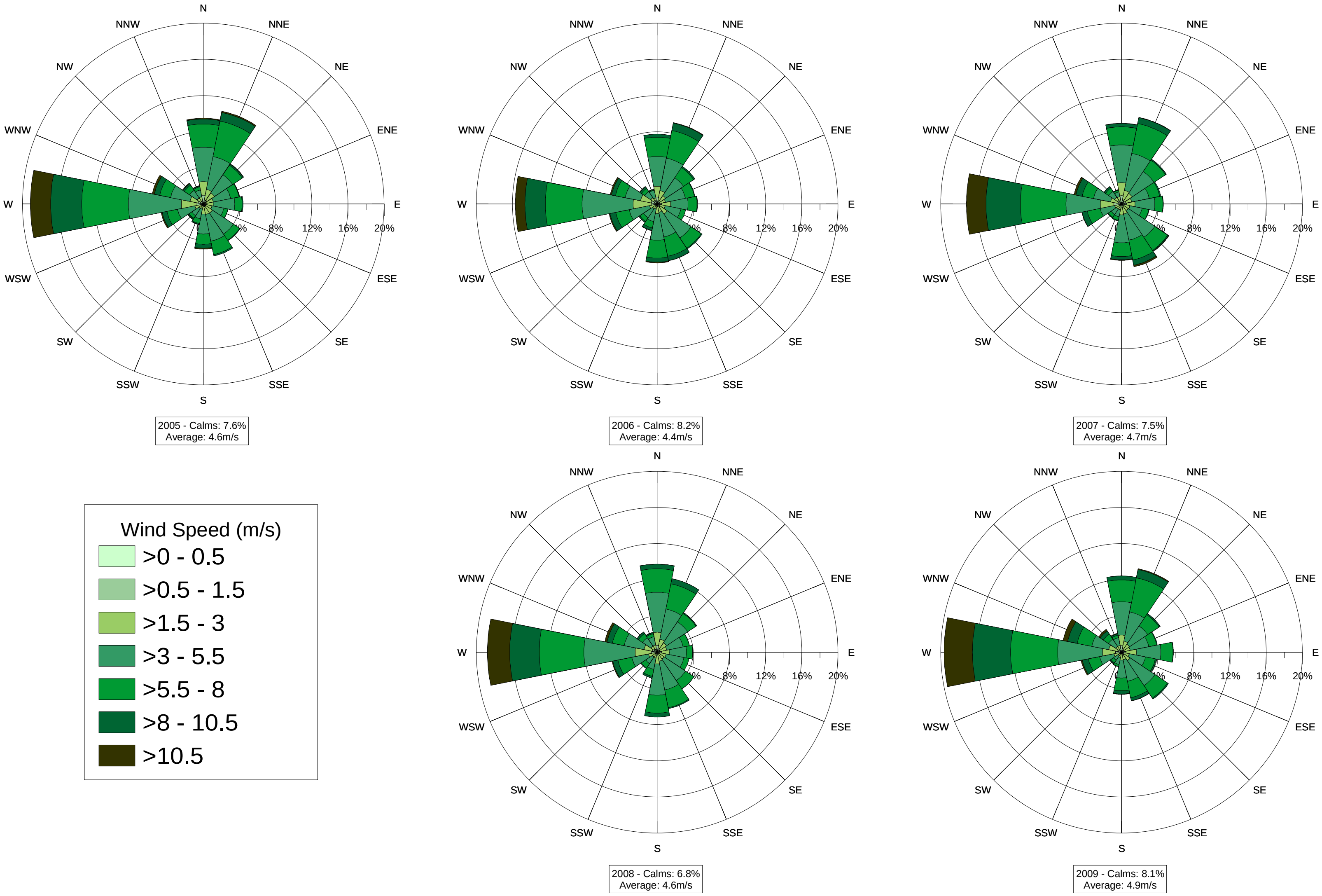
Appendix A
Climate Statistics for Bureau of Meteorology – Moss Vale (Hoskins Street) Station (Number 068045)

Climate Statistics for the Bureau of Meteorology Moss Vale (Hoskins Street) Station, Station Number 068045, 34.54°S, 150.38°E, 675 m elevation													
Statistic Element	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Mean maximum temperature (Degrees C) for years 1907 to 1975	25.8	25.2	23.1	19.2	15.3	12.3	11.8	13.4	16.7	19.9	22.6	25	19.2
Highest temperature (Degrees C) for years 1962 to 1975	38.3	38.3	35	27.8	25	18.5	20	23	28.3	30.7	33.3	37.8	38.3
Lowest maximum temperature (Degrees C) for years 1962 to 1975	13.1	11.1	12.2	10	6.7	6.7	5.2	2.2	6	7.2	10	11.7	2.2
Mean minimum temperature (Degrees C) for years 1907 to 1975	12.4	12.6	10.8	7.4	4.3	2.3	1.3	2	4	6.5	8.8	11.1	7
Mean rainfall (mm) for years 1870 to 2010	89.1	95.8	90.1	80.8	85	99.9	75.8	63.6	60.4	74.8	72.9	76.5	964.7
Highest rainfall (mm) for years 1870 to 2010	268.8	399.1	518.4	464.4	583.8	527	473.6	410.2	260.7	346	266.7	380.5	1846.1
Date of Highest rainfall for years 1870 to 2010	1895	1873	1978	1927	1943	1991	1904	1998	1879	1959	1961	1920	1950
Lowest rainfall (mm) for years 1870 to 2010	3.6	4.3	0.8	0.6	1.8	0	1.1	0.4	3.7	1.4	0	2.8	373.5
Date of Lowest rainfall for years 1870 to 2010	1932	1968	1940	1997	1982	1918	1970	1995	1957	2006	1922	1979	1888
Mean number of days of rain	10.9	10.8	10.9	9.6	9.6	9.9	9.3	9.1	9.2	9.9	10.2	9.9	119.3
Mean daily solar exposure (MJ/(m*m)) for years 1990 to 2010	22.8	19.6	16.9	13.7	10.3	8.6	9.7	12.9	16.8	20.2	21.7	23.6	16.4
Mean number of clear days for years 1962 to 1975	6.1	5.7	5.9	7.9	8.8	7.4	10.4	8.4	10	6.6	7.1	6.7	91
Mean number of cloudy days for years 1962 to 1975	11.7	10.9	12.6	9.2	10.3	10.2	7.5	9.2	8.8	11.5	10.9	10.5	123.3
Mean 9am temperature (Degrees C) for years 1946 to 1975	18.5	18.4	16.8	13.1	9.2	6.5	5.5	7.1	10.7	13.7	16	18.2	12.8
Mean 9am wet bulb temperature (Degrees C) for years 1946 to 1975	15.2	15.6	14.4	11.2	7.8	5.3	4.1	5.2	7.9	10.4	12.1	14.1	10.3
Mean 9am relative humidity (%) for years 1946 to 1965	70	75	81	80	82	81	79	73	66	64	60	62	73
Mean 9am cloud cover (okas) for years 1907 to 1975	3.8	4.1	4	3.6	3.4	3.8	3.1	2.9	2.9	3.4	3.6	3.7	3.5
Mean 9am wind speed (km/h) for years 1962 to 1975	10.6	9.3	10	10.7	11.7	10.7	12.8	13.2	13.5	12.3	12.8	10.4	11.5
Mean 3pm temperature (Degrees C) for years 1962 to 1975	22.9	22.6	20.8	17.9	13.7	11.2	10.5	11.5	14.6	17	19.4	21.6	17
Mean 3pm wet bulb temperature (Degrees C) for years 1962 to 1975	16.9	17.1	15.7	13.3	10.2	8.1	7	7.5	9.7	11.9	13.9	15.7	12.2
Mean 3pm cloud cover (oktas) for years 1962 to 1975	5	5.2	5.1	4.3	4.5	4.6	4	4.6	4.2	5.1	4.8	5	4.7
Mean 3pm wind speed (km/h) for years 1962 to 1975	12.5	10.6	11.4	12	13.7	13.4	15.6	15.5	14.9	13.6	14.4	12.5	13.3

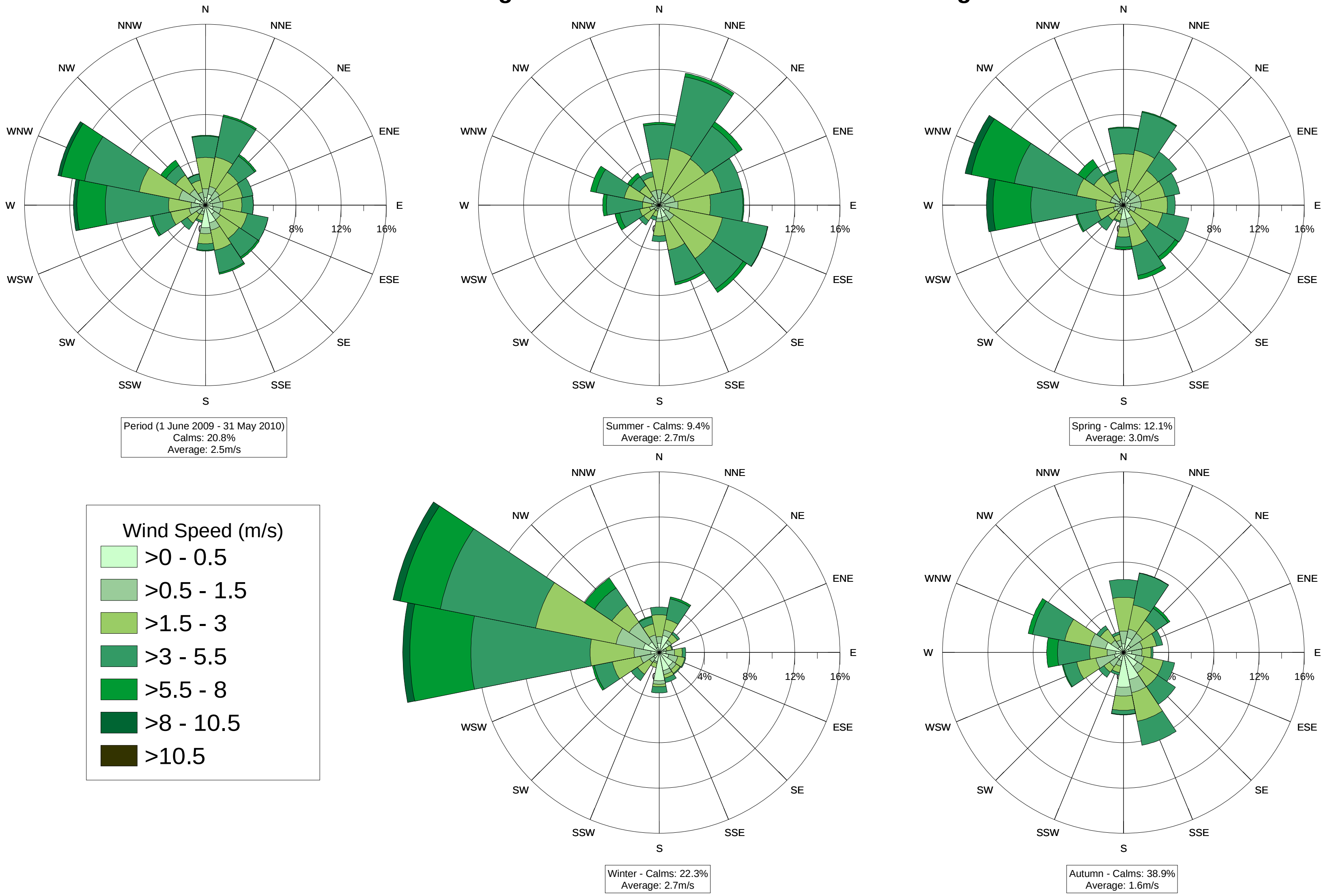
Source: Bureau of Meteorology (2010)

Appendix B
Annual and Seasonal Wind Roses

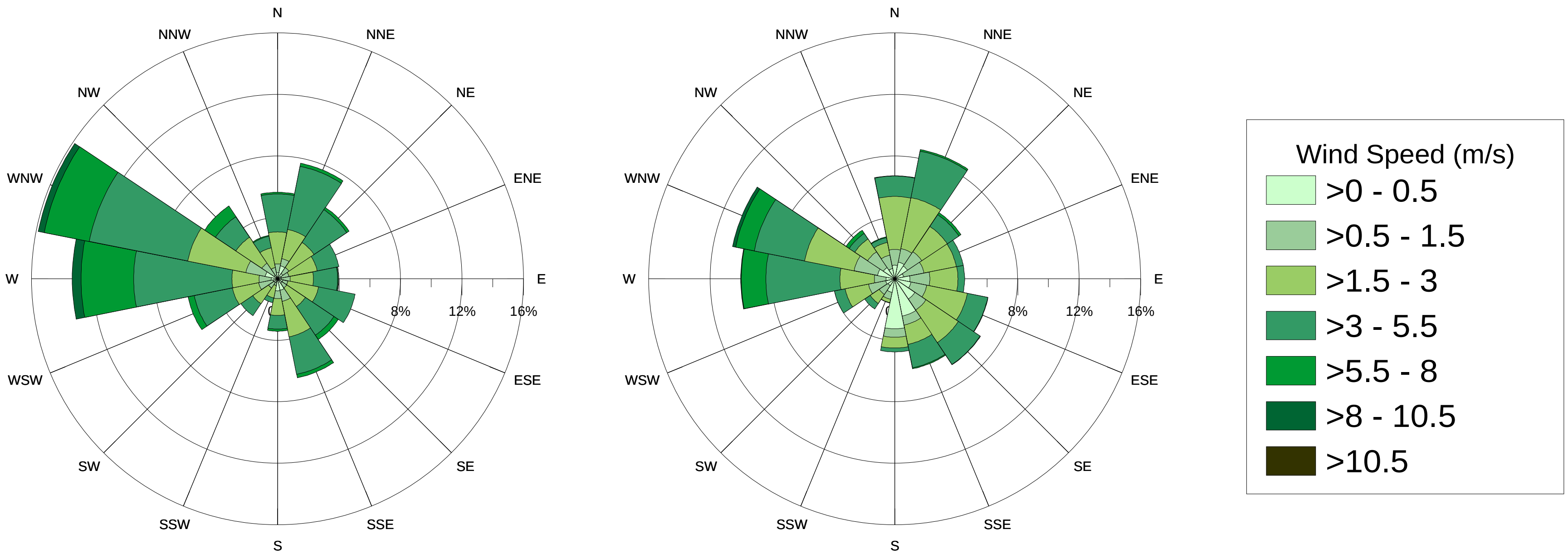
Moss Vale AWS – Annual Wind Roses



Boral Cement – Meteorological Data – Period and Seasonal Average Wind Roses



Boral Cement – Meteorological Data – Diurnal Wind Roses



Day-time Wind Rose
Period (1 June 2009 - 31 May 2010)
Calms: 12%
Average: 3.0m/s

Night-time Wind Rose
Period (1 June 2009 - 31 May 2010)
Calms: 30%
Average: 1.9m/s

Appendix C
Dispersion Modelling Methodology

Dispersion Model Selection and Application

Dispersion models compute ambient concentrations and deposition rates as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations. Knowledge of spatial and temporal variations in pollutant concentrations is essential for the assessment of the potential which exists for non-compliance with ambient air quality limits and for impact on human health and the biophysical environment.

Given the nature of the source and the local environment, AERMOD was selected for application in the prediction of ambient particulate concentrations and dust deposition rates occurring due to WWC operations. AERMOD is the USEPA's recommended steady-state plume dispersion model for US regulatory purposes. AERMOD is designed to handle a variety of pollutant source types, including surface and buoyant elevated sources, in a wide variety of settings such as rural and urban as well as flat and complex terrain(1). Source types for which AERMOD is able to predict pollutant concentrations include point, area and volume sources in addition to 'open pit' sources.

AERMOD replaced the Industrial Source Complex (ISC) model for regulatory purposes in the US in December 2006 as it provides more realistic results with concentrations that are generally lower and more representatives of actual concentrations compared to the conservative ISC model. Ausplume, a steady state Gaussian plume dispersion model developed by the Victorian EPA and frequently used in Australia for simple near-field applications, is largely based on the ISC model.

Compared to ISC and Ausplume, AERMOD represents an advanced new-generation model which requires additional meteorological and land use inputs in order to provide more refined predictions. The most important feature of AERMOD, compared to ISC and Ausplume, is its modification of the basic dispersion model to account more effectively for a variety of meteorological factors. In particular it uses the Monin-Obukhov length scale rather than Pasquill-Gifford stability categories to account for the effects of atmospheric stratification. Whereas Ausplume and ISC parameterise dispersion based on semi-empirical fits to field observations and meteorological extrapolations, AERMOD uses surface-layer and boundary-layer theory for improved characterisation of the planetary boundary layer turbulence structure.

Verification studies have been undertaken for AERMOD both locally and abroad (Hanna *et al.,* 2001*;* Perry *et al*., 2005; Hurley 2006). Hanna *et al.* (2001) concluded that AERMOD performed better than ISC with predictions generally within a factor of two of actual values. It was noted that AERMOD did tend to under-predict actual concentrations by 20% to 40%, with predictions more accurate for short-term averaging periods. Perry *et al.* (2005) summarises the performance of AERMOD across 17 field study databases placing emphasis on statistics that demonstrate the model's abilities to reproduce the upper end of the concentration distribution which are of importance in terms of regulatory modelling. The field studies include flat and complex terrain cases, urban and rural conditions and elevated and surface releases with and without building wake effects. Perry et al. (2005) concludes

1 Under complex wind conditions and for regional applications, CALPUFF is the USEPA's recommended model for regulatory purposes.

that, with few exceptions AERMOD's performance was superior to that of the other applied models tested.

Hurley (2006) compared the performance of Ausplume, AERMOD and TAPM across several case studies including flat terrain, flat terrain with building downwash, in complex terrain and coastal terrain. AERMOD was determined to perform acceptably for all of the datasets but was found unable to simulate shoreline fumigation in the case of the Kwinana case study. This potential limitation of AERMOD is not expected to significantly influence dispersion within the modelling domain for this Project due to the nature of the project area.

AERMET Meteorological Modelling

The AERMOD system is composed of two pre-processors on top of the dispersion model: AERMET (for the preparation of meteorological data) and AERMAP (for the preparation of terrain data. Terrain data for the modeling domain was sourced from NASA's Shuttle Radar Topography Mission (SRTM) Data. This data set provides high-resolution topography at 3 arc-second (~90m) grid spacings.

AERMET provides information to AERMOD for the characterisation of the planet boundary layer (PBL) such as friction velocity, mixing height. Inputs in the AERMET modeling are described below.

Surface Characteristics

In applying the AERMET meteorological processor to prepare the meteorological data for the AERMOD model appropriate values for three surface characteristics needed to be determined, viz.: surface roughness length, albedo, and Bowen ratio. The surface roughness length is related to the height of obstacles to the wind flow and is, in principle, the height at which the mean horizontal wind speed is zero based on a logarithmic profile. The surface roughness length influences the surface shear stress and is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. The albedo is the fraction of total incident solar radiation reflected by the surface back to space without absorption. The daytime Bowen ratio, an indicator of surface moisture, is the ratio of sensible heat flux to latent heat flux and is used for determining planetary boundary layer parameters for convective conditions driven by the surface sensible heat flux.

Aerial photographs and site observations were used to inform the designation of land use and associated effective surface roughness on a sector-by-sector basis within a 1 kilometer radius around the Boral Cement meteorological station. Values of Bowen ratio and albedo were determined over a greater domain (10 km by 10 km) centered on the Boral Cement meteorological station as recommended.

The Boral Cement meteorological station is located in a clearing surrounded primarily by grassed and treed areas, with dams and the Berrima Cement Works being located to the west of the station. Reference was made to the AERMET user's guide (EPA, 2004) and to Sturman and Tapper (2006) in assigning surface roughness, Bowen ratio and albedo values.

The land use values of surface roughness, Albedo and Bowen rations are tabulated below. The surface roughness was allocated consistent with a grassed area. The Bowen ratio and Albedo were allocated on a monthly varying basis to account for seasonal effects, as indicated by the ranges given in the table.

Surface Roughness	Albedo	Bowen
0.001 – 0.1	0.18 – 0.6	0.4 – 1.5

Meteorological Inputs

AERMET typically requires surface and upper air meteorological data as input. AERMET however facilitates the projection of upper air meteorological parameters in the absence of site-representative upper air measurements using the PBLAER module.

PBLAER computes mixing heights in the absence of upper air sounding data, using a semi-empirical method to estimate the surface similarity parameters of friction velocity, sensible heat flux, temperature scale and Monin-Obukhov length using the routinely collected meteorological variables of cloud cover, ceiling height, wind speed, temperature and estimates of surface roughness.

Surface meteorological data for the modeling period (June 1 2009 to March 31 2010) from the Boral Cement meteorological station was input into the model, including: wind speed, wind direction, temperature, pressure, rainfall, relative humidity and solar radiation. Cloud cover and cloud height data from the Bureau of Meteorology's Moss Vale station was input into the modeling to improve the site representiveness of mixing depth projections.

AERMET Outputs

AERMET calculates planetary boundary layer parameters, including: friction velocity, Monin-Obukhov length, convective velocity scale, temperature scale, mixing height and surface heat flux. These parameters are used, in conjunction with measurements, to calculate vertical profiles of wind speed, lateral and vertical turbulent fluctuations, potential temperature gradient and potential temperature.

AERMET outputs two files: a surface data file and a profile data file for input to AERMOD (USEPA, 2004).

AERMOD Dispersion Modelling

Model Inputs

Input data types required for the AERMOD model include: topography, meteorological data (from AERMET), source data (from the emissions inventory compiled), and information on the nature of the receptor grid. These data inputs are described in Section **7**.

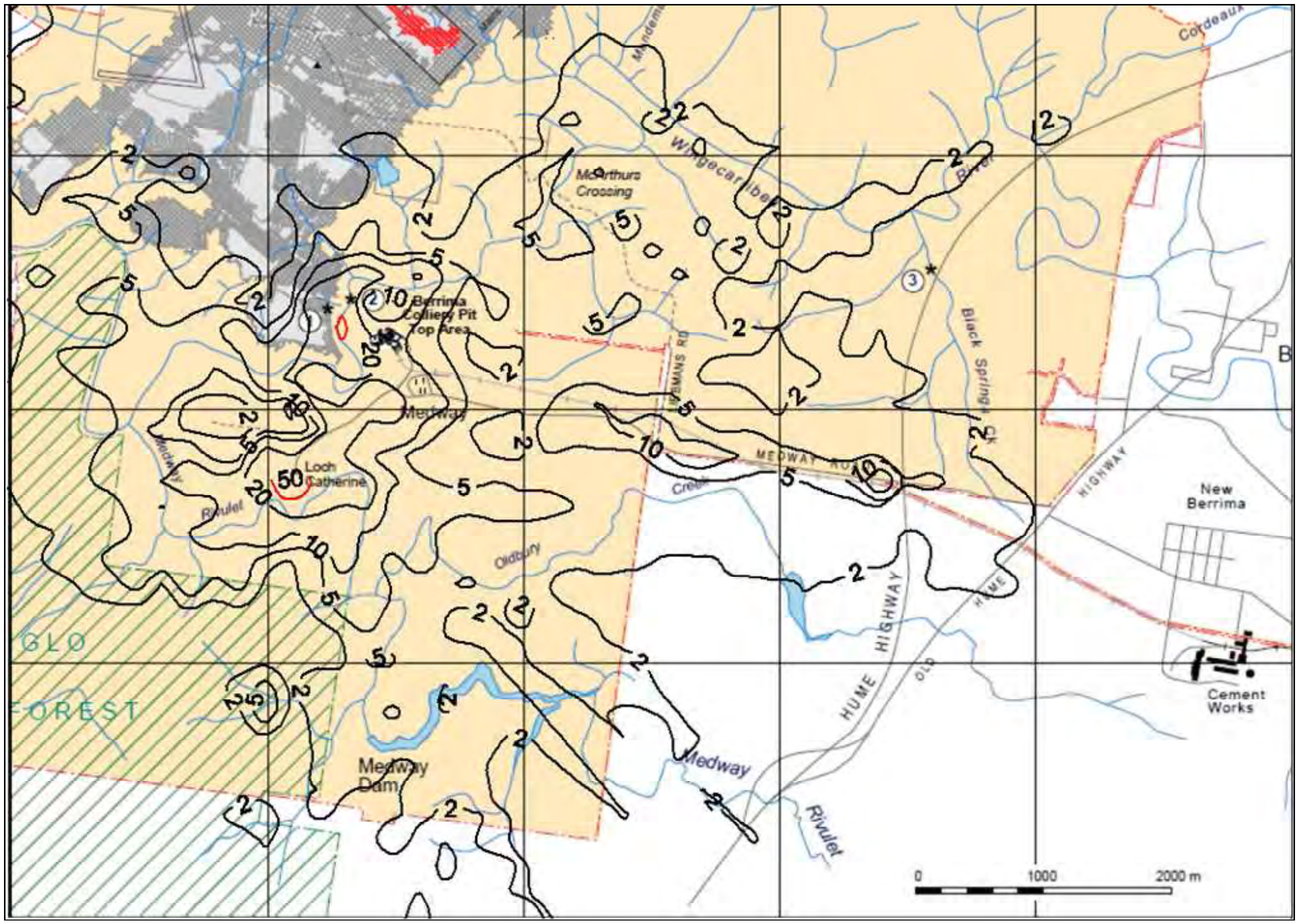
Model Accuracy

Base on the findings of the verification studies it is expected that AERMOD will perform well in the current case, particularly given the near-field and flat terrain nature of the application. AERMOD predictions are likely to be within 20% of actual peak concentrations and within 40% of longer-term averages.

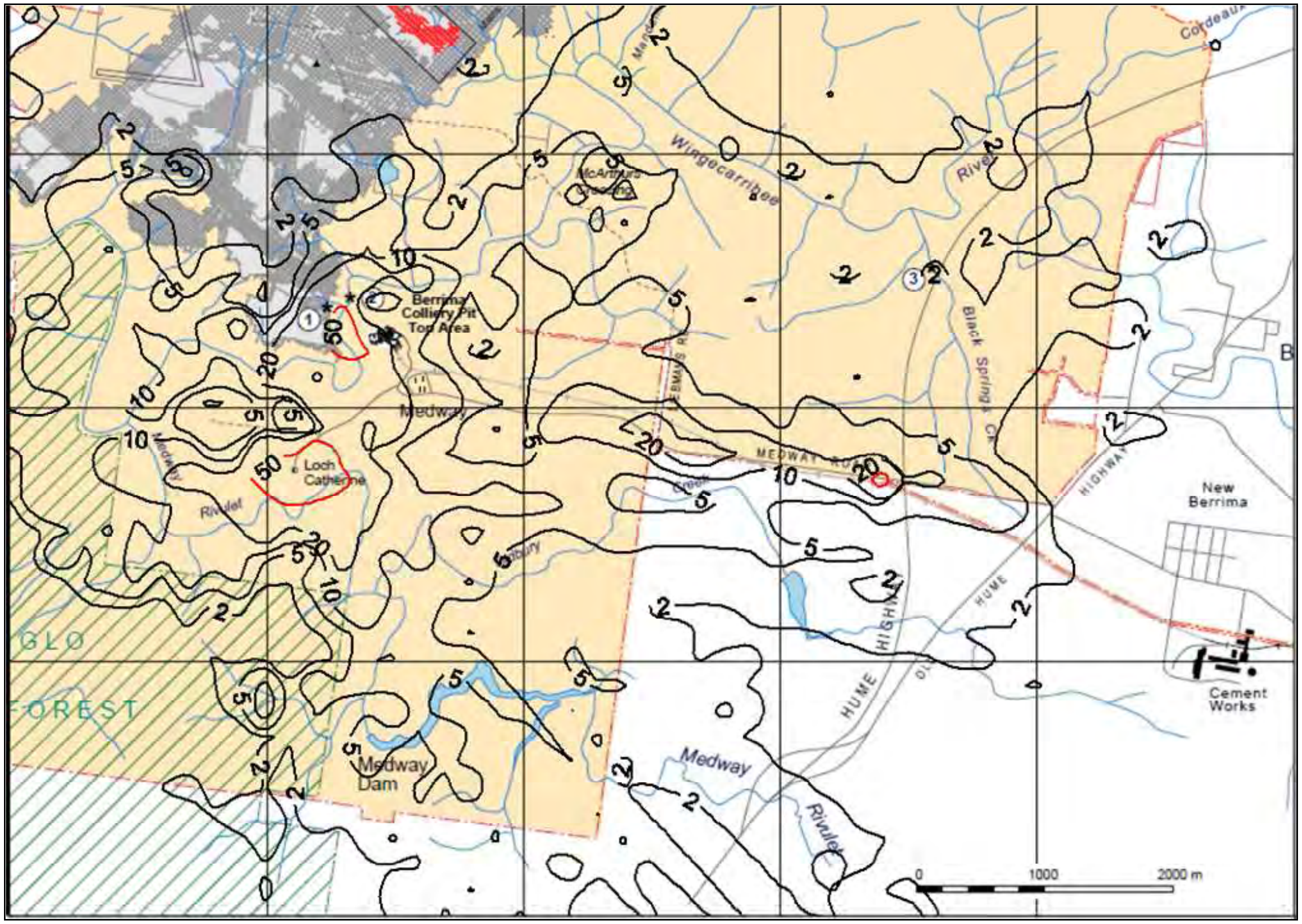
The accuracy of model predictions is dependent on model suitability, the accuracy of the emissions and meteorological data use and the complexity of the terrain and is typically in the range of -50% to 200%. Considering the ratings of the emission factors applied, the high level of meteorological data availability, the uncomplicated nature of the local terrain and the capabilities of the dispersion model selected, the level of uncertainty in the model predictions is estimated to be well in the typical range. Model performance and accuracy was taken into account in the air quality assessment.

Appendix D
Isopleth Plots of PM_{10} Concentrations and Dust Deposition due to Current Berrima Operations and Project-related Operations

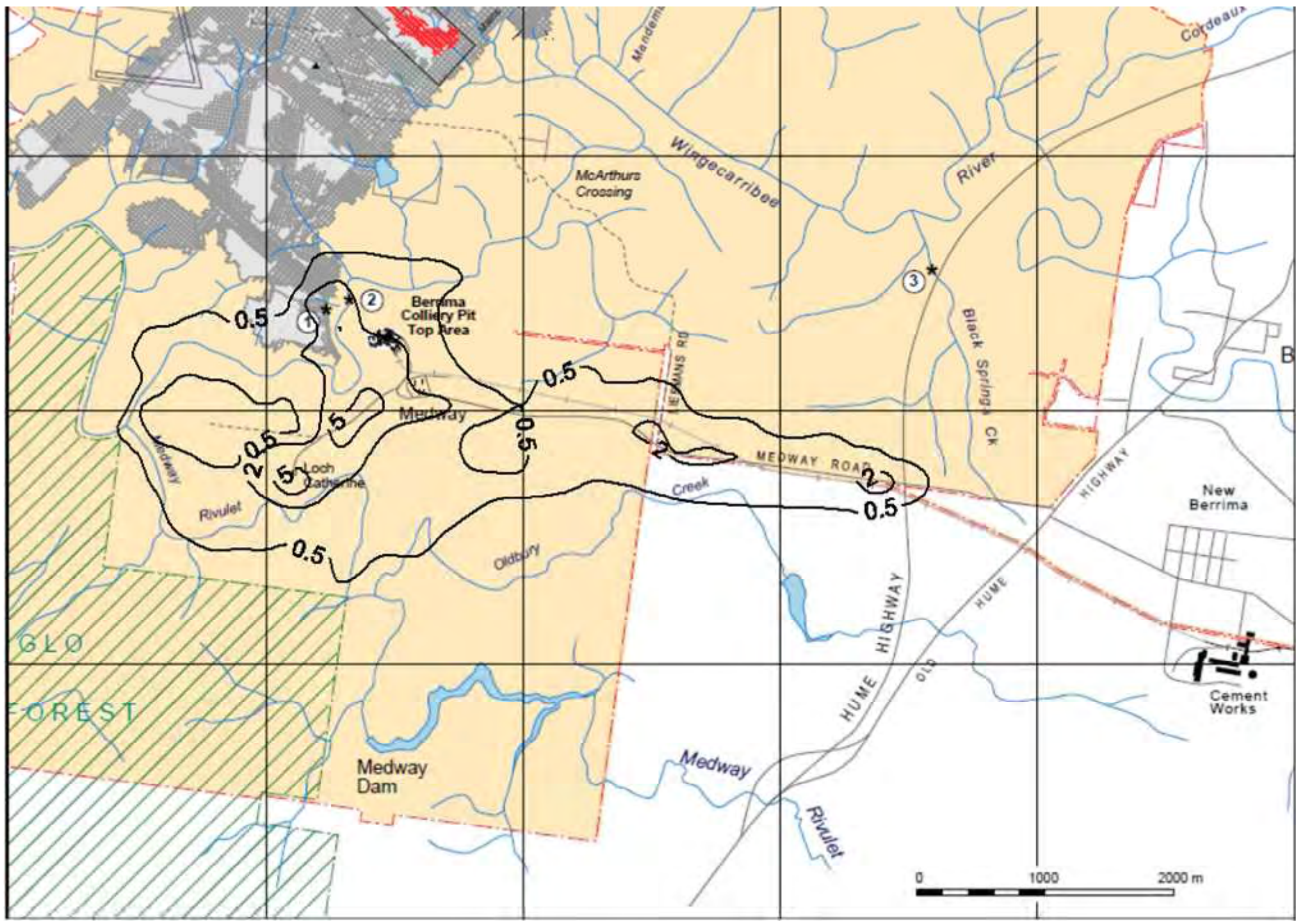
Predicted Maximum Daily Average PM_{10} Concentrations due to Current Berrima Colliery Operations (µg/m³)



Predicted Maximum Daily Average PM_{10} Concentrations due to Project-related Berrima Colliery Operations (µg/m³)

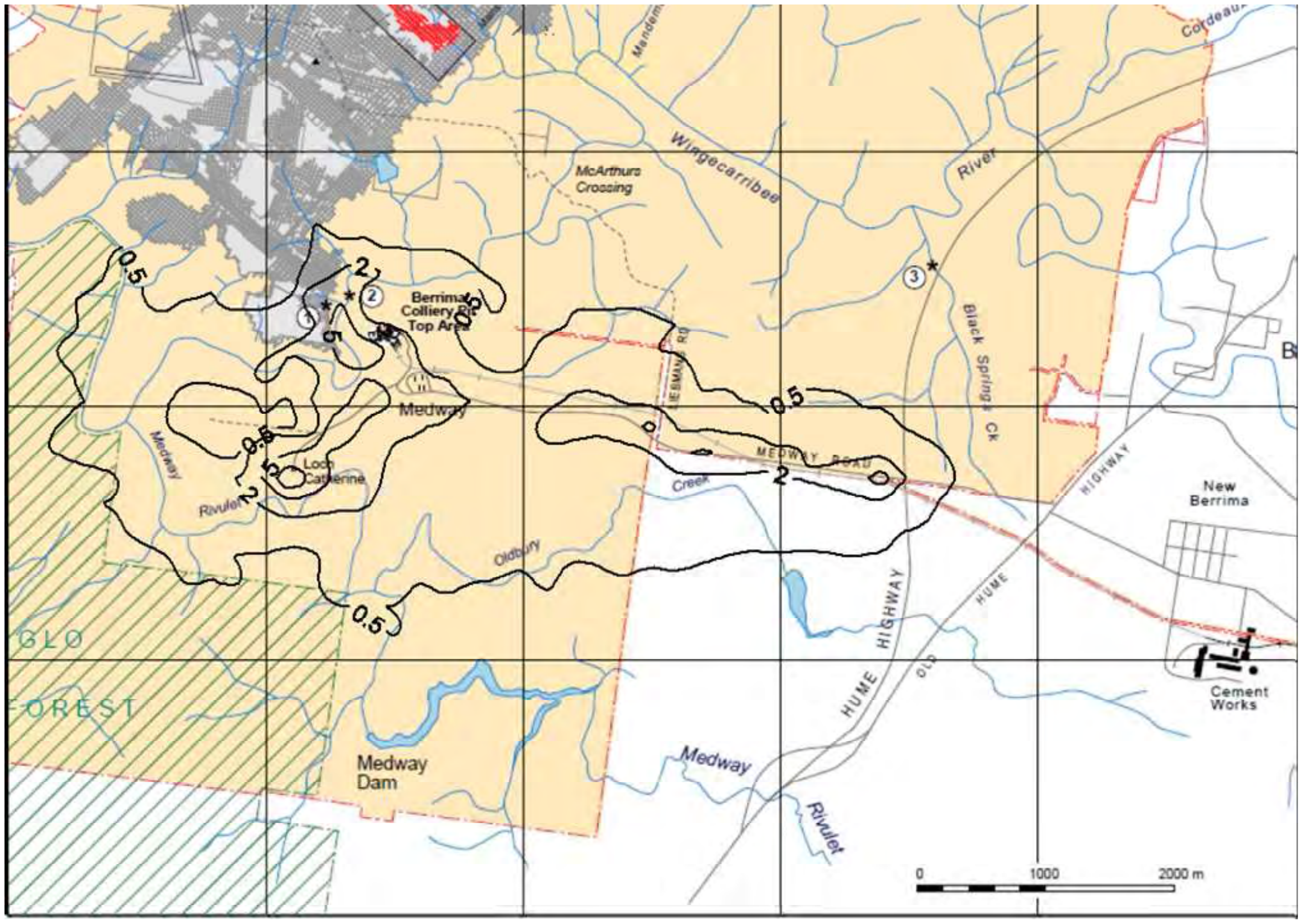


Predicted Annual Average PM_{10} Concentrations due to Current Berrima Colliery Operations (µg/m³)



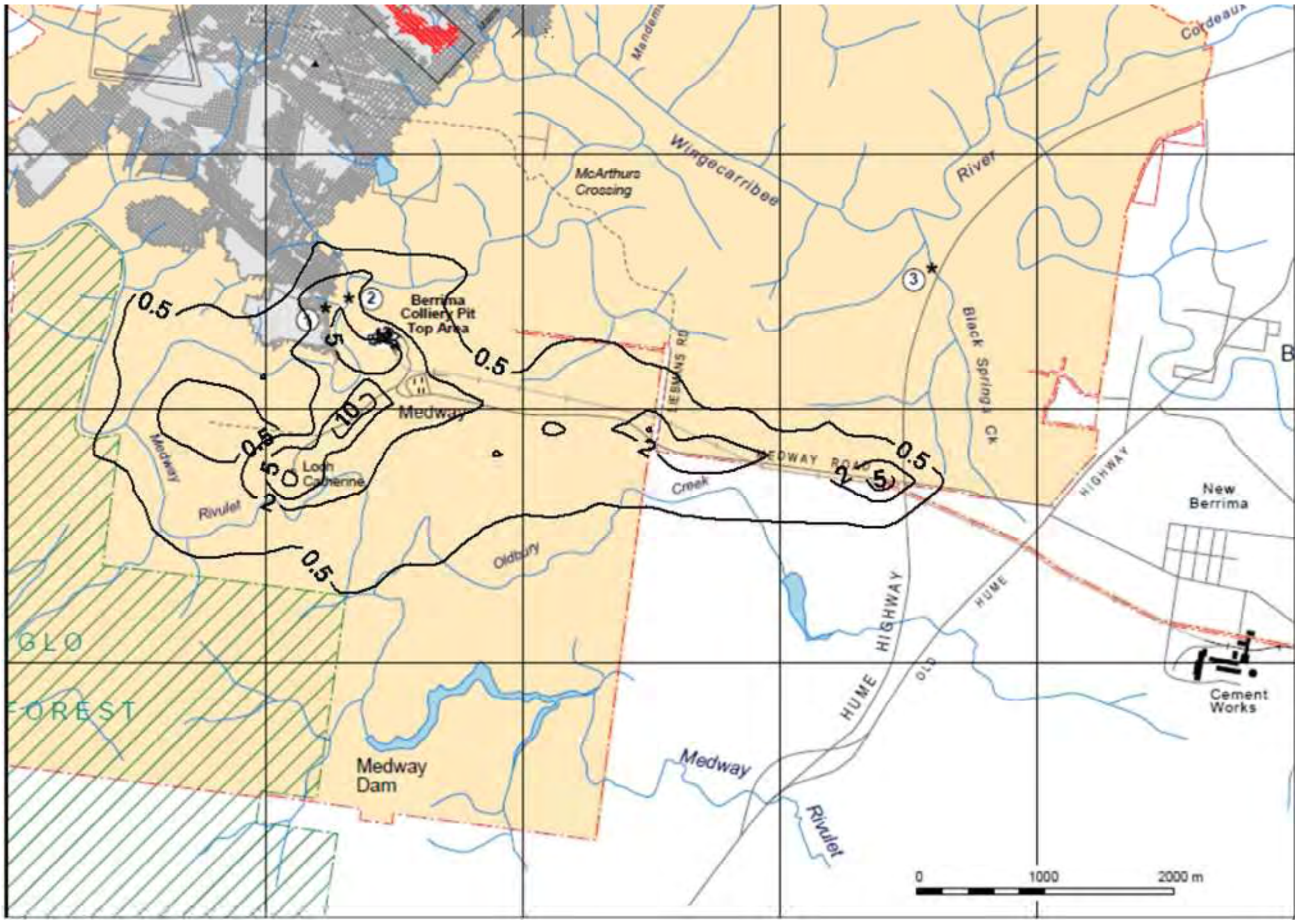
ENVIRON

Predicted Annual Average PM_{10} Concentrations due to Project-related Berrima Colliery Operations (µg/m³)



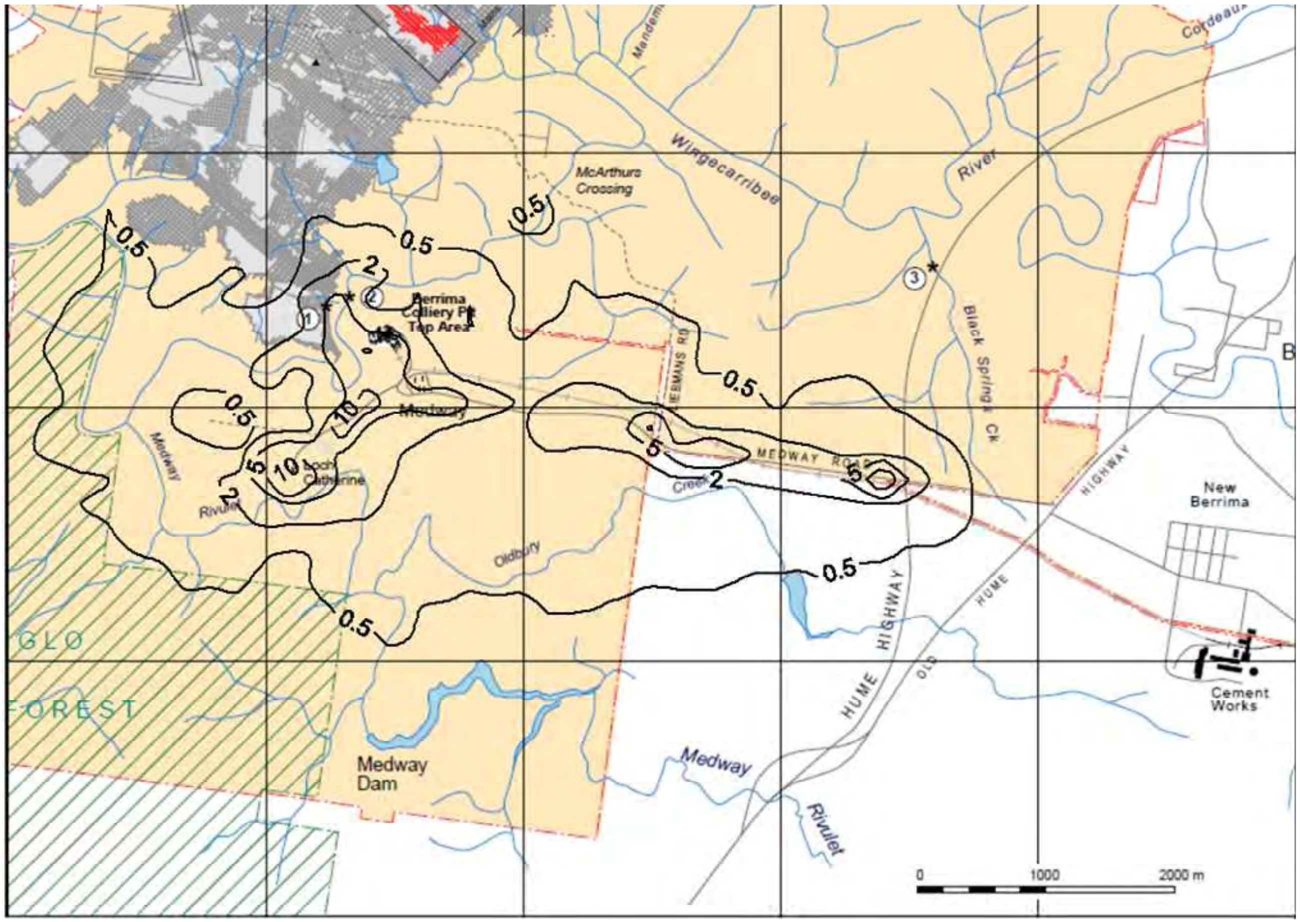
ENVIRON

Predicted Annual Average TSP Concentrations due to Current Berrima Colliery Operations (µg/m³)



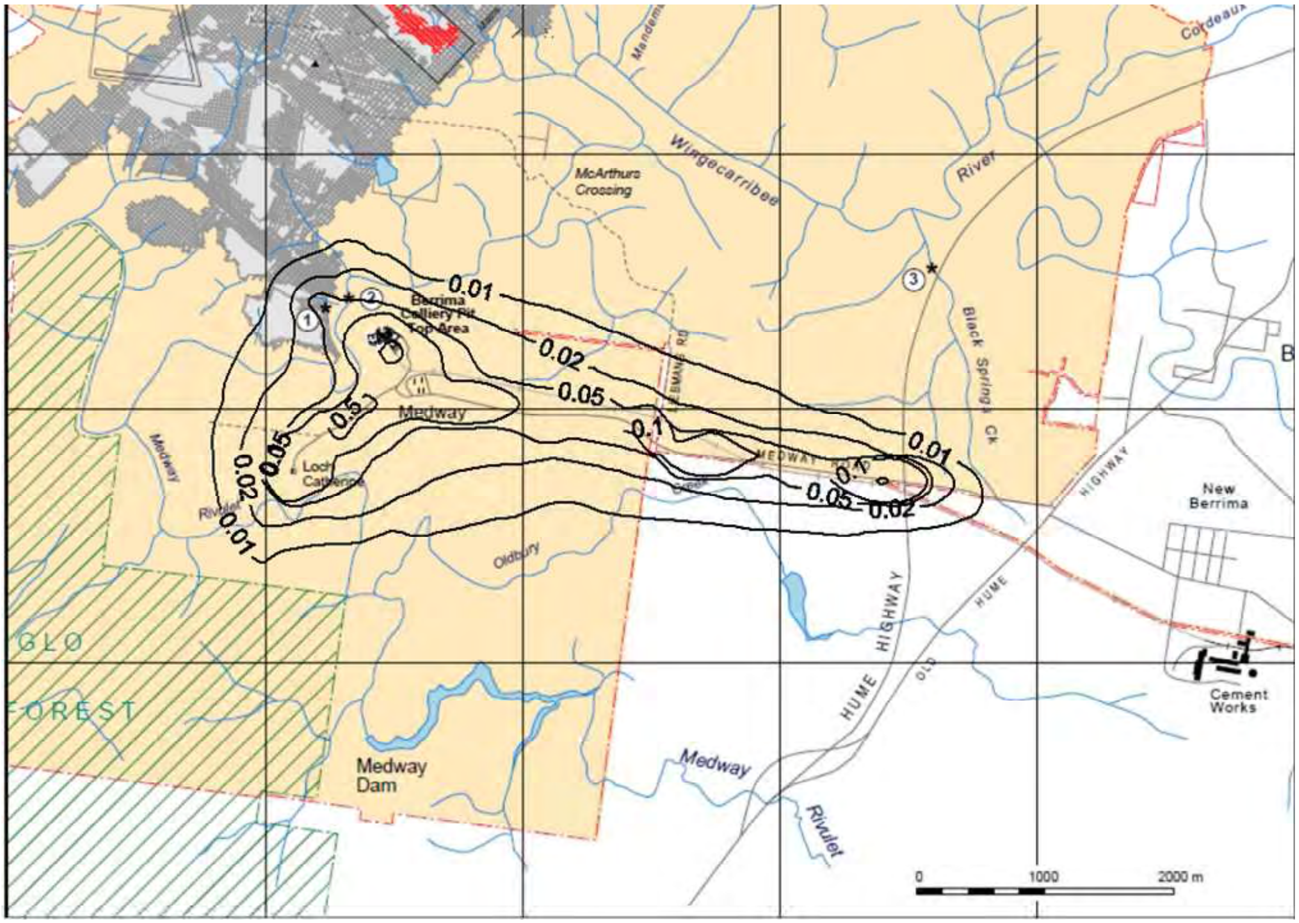
ENVIRON

Predicted Annual Average TSP Concentrations due to Project-related Berrima Colliery Operations (µg/m³)



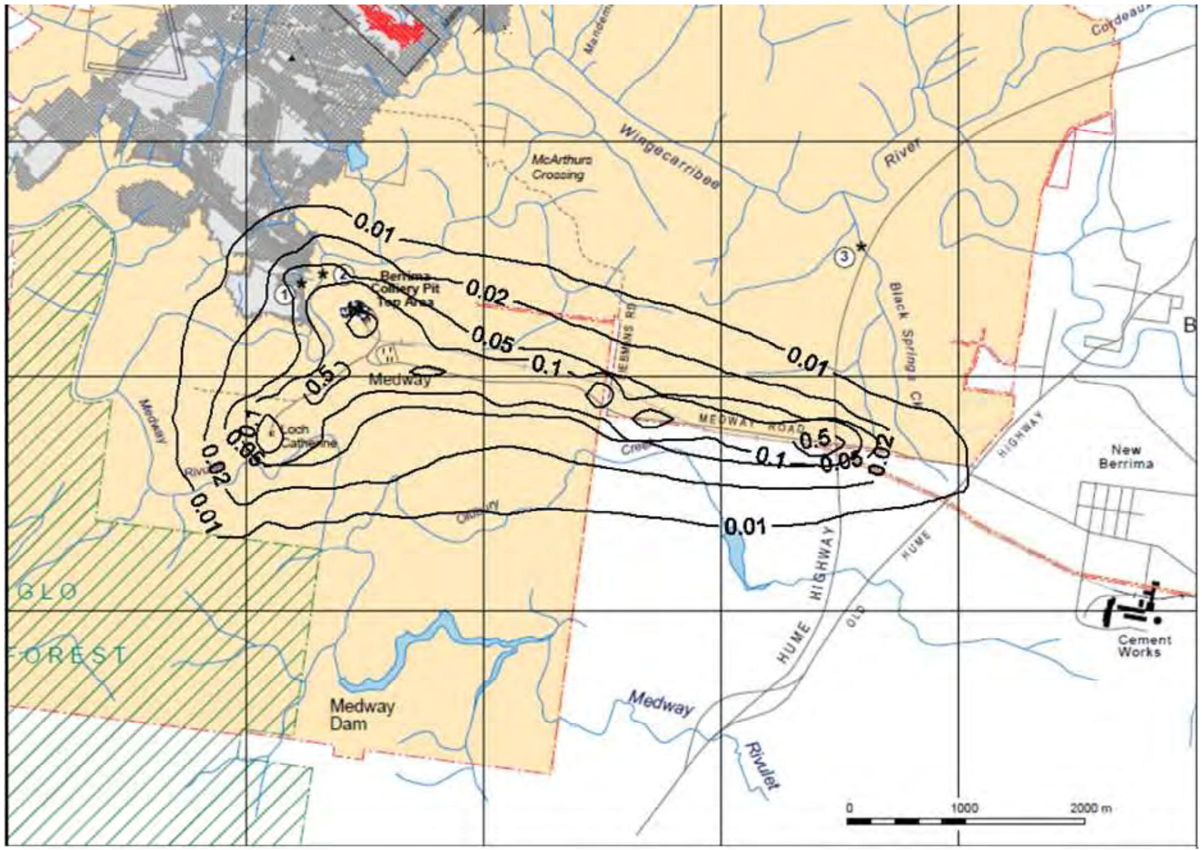
ENVIRON

Predicted Annual Average Dust Deposition due to Current Berrima Colliery Operations (g/m²/month)



ENVIRON

Predicted Annual Average Dust Deposition due to Project-related Berrima Colliery Operations (g/m²/month)



ENVIRON

Appendix I

Greenhouse Gas Emissions Assessment

Planning + Environment + Acoustics

Berrima Colliery
Continued Operations

Greenhouse Gas Emissions Assessment

Prepared for Boral | October 2010

Greenhouse Gas Emissions Assessment

Final

Report V1| Prepared for Boral Limited | 25 October 2010

Prepared by	**Brett McLennan**	Approved by	**Brett McLennan**
Position	Director	Position	Director
Signature		Signature	
Date	25/10/2010	Date	25/10/2010

This Report has been prepared in accordance with the brief provided by the Client and has relied upon the information collected at or under the times and conditions specified in the Report. All findings, conclusions or recommendations contained within the Report are based only on the aforementioned circumstances. Furthermore, the Report is for the use of the Client only and no responsibility will be taken for its use by other parties.

Document Control

Version	Date	Prepared by	Reviewed by
V1	25.10.10	Brett McLennan	Brett McLennan

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Table of Contents

Tables

1 Introduction

This assessment examines the scientific principles that relate to greenhouse gases (GHG) and the global warming effect and estimates emissions of GHGs associated with the proposal for continued operations at Berrima Colliery. It is demonstrated that when all categories of GHG emissions, including Scope 1, 2 and 3 emissions, from the proposal are taken into account the proposal's contribution to GHG emissions globally are negligible.

Scope 1 and Scope 2 are direct emissions from the actual operation of the Berrima Colliery, whereas Scope 3 are indirect emissions that would result from the off-site transport and burning of the coal produced by the colliery.

For this assessment, the greenhouse calculations were based on all operations at Berrima Colliery for an estimated five-year life.

2 Greenhouse gas inventories

Greenhouse gas inventories are calculated according to a number of different methods. The procedures specified under the Kyoto Protocol United Nations Framework Convention on Climate Change are the most common. The protocol nominates the following GHGs:

- carbon dioxide (CO_2);
- methane (CH_4);
- nitrous oxide (N_2O);
- hydrofluorocarbons (HFCs); and
- perfluorocarbons (PFCs).

From the point of view of Berrima Colliery, only CO_2, CH_4 and N_2O are relevant.

Gases CO_2 and N_2O are formed and released during the combustion of gaseous, liquid and solid fuels. They are liberated when fuels are burnt in diesel powered equipment and in the generation of electrical energy that will be used by Berrima Colliery. Methane is released as a fugitive emission during the extraction of coal.

Inventories of greenhouse gas emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion.

The global warming potentials assumed by Department of Climate Change (DCC)[1] are as follows:

- CO_2 – 1;
- CH_4 – 21; and
- N_2O – 310.

When the global warming potentials are applied to the estimated emissions then the resulting estimate is referred to in terms of CO_2-equivalent (CO_2-e) emissions.

[1] "National Greenhouse Account (NGA) Factors" June 2009. Published by the Department of Climate Change. Available from http://www.climatechange.gov.au

3 Emission factors

The National Greenhouse Accounts (NGA) Factors have been used to convert fuel usage and electricity consumption into CO_2-e emissions. The relevant emission factors are summarised in the table below.

Table 1. Summary of greenhouse gas emission factors

Type of fuel and electricity	Emission factor		GHG	Scope
Diesel – on-site activities	2.7	kg CO_2-e/GJ	CO_2	1
	0.1	kg CO_2-e/GJ	CH_4	1
	0.2	kg CO_2-e/GJ	N_2O	1
	5.3	kg CO_2-e/GJ	-[1]	3
	38.6	GJ/kL	Energy content factor	
Electricity	0.89	kg CO_2-e/kWh	-	2
	0.18	kg CO_2-e/kWh	-	3
Extraction of coal	0.045	t CO_2-e/tonne ROM	CH_4	1
Transport of coal (road)	11	t CO_2-e/Mt.km	-	3
Transport of coal (ship)	[2]	t CO_2-e/Mt.km	-	3

Notes: 1. Refers to all equivalent greenhouse gases where applicable.

2. The emission factor associated with the transport of coal using ships varies depending on type of ship used.

4 Berrima Colliery greenhouse emissions

The CO_2-e emissions from continued operations at Berrima Colliery will result from the following sources:

- the extraction of coal due to the combustion of diesel fuel (used in diesel-powered equipment) and use of electrical energy;
- the liberation of fugitive emissions from the coal seam during mining;
- the transport of coal including the potential transport of the product coal overseas; and
- the combustion of coal.

Further information is provided in the following section.

4.1 Emissions from extraction

The table below summarises the likely electricity and diesel use for Berrima Colliery over the next five years.

Table 2 Summary of electricity and diesel use for Berrima Colliery

Year	Coal production (t/y)	Electricity use (MWh)	Diesel use (kL)
1	260,000	3,256	1,518
2	310,000	3,882	1,809
3	360,000	4,508	2,101
4	410,000	5,134	2,393
5	460,000	5,760	2,685

Notes: t = tonnes; MWh = mega watt hours
t/y = tonnes per year; kL = kilo litres

Table 3 summarises the estimated annual average CO_2-e emissions from the continued operation of Berrima Colliery due to extraction and processing using the above emissions factors.

Unlike most other coal mines in NSW, Berrima Colliery produces very little fugitive emissions from mining of coal. Notwithstanding this, a standard emission factor obtained from the NGA Factors has been applied to calculate fugitive emissions generated from the mining of the coal. As such, the assessment is considered to be conservative.

Table 3 Summary of estimated CO_2 emissions from mining at Berrima Colliery (tonnes/year)

Year	CO_2-e from electrical energy usage		CO_2-e from diesel usage		CO_2-e from CH4 released during mining	Total CO_2-e from mining and processing coal
	Scope 2	Scope 3	Scope 1	Scope 3	Scope 1	Scope 1, 2 & 3
1	2,898	586	4,097	8,043	11,700	27,324
2	3,455	699	4,885	9,590	12,950	32,579
3	4,012	811	5,673	11,137	16,200	37,833
4	4,569	924	6,461	12,683	18,450	43,088
5	5,126	1,037	7,249	14,230	20,700	48,343
Total	**20,060**	**4,057**	**28,367**	**55,684**	**81,000**	**189,167**

5 Emissions from transport and burning of coal

5.1 Emissions from off-site transport of product coal

This section estimates the emissions generated from the transport of the product coal.

For this assessment, it has been conservatively estimated that 120,000 tonnes per annum (tpa) of coal will be transported to the Berrima Cement works with the remainder being transported to Port Kembla. In Year 5 up to 340,000tpa (or 74%) will be transported to Port Kembla by road for export to overseas customers. The remaining coal will be used locally within the Berrima Cement Plant.

For the purpose of this analysis, it is assumed that coal transported to Port Kembla will travel a distance of approximately 95km (one way) while coal transported to the Berrima Cement Plant will travel a distance of 10km.

An emission rate of 0.138kg CO_2-e/t.km has been assumed.

Table 4 summarises CO_2 emissions from transporting the product coal from Berrima Colliery to Port Kembla and locally to the Berrima Cement Plant. We have conservatively assumed that emissions generated from the return journey will be the same.

Table 4 Summary of estimated CO_2-e emissions from transport of coal (t/y)

Year	Coal production (t/y)	Distance transported from Berrima Colliery (km)	Total CO_2-e from transport from Berrima Colliery (t)	Total CO_2-e from transport to Berrima Colliery (t)
1	260,000	322,226	44,467	44,467
2	310,000	427,781	59,034	59,034
3	360,000	533,337	73,600	73,600
4	410,000	638,892	88,167	88,167
5	460,000	744,448	102,734	102,734
Total	1,800,000	2,666,684	368,002	368,002

Table 5 details the approximate distance travelled, the type of ship used and the associated emission factor for each ship in 2008. The percentage of product coal distributed to each of these destinations has been estimated based on potential markets for Berrima Colliery quality coal. It should be noted that the type of ship and the final destinations and uses of the coal will vary over the life of the mine and is difficult to assume.

An emission rate of 3.459kg CO_2-e/Mt.km has been assumed.

Table 5 Summary of coal transport to overseas customers

Destination	Approximate distance (km)	Emission factor (t CO_2-e/Mt.km)	Percentage of total coal distribution
Oceania	2,200	3.459	85%
Asia	6,500	3.459	15%

Using the information provided in Tables 4 and 5, CO_2-e emissions have been estimated for the continued operation of Berrima Colliery and are presented in Table 6. Conservatively we have also assumed that emissions generated from return journeys are equal to the emissions generated during the transport.

Table 6 Summary of estimated CO_2-e emissions from transport of coal (t)

Year	Ship Transport			Road Transport		Total CO_2-e emissions (t)
	Oceania	Asia	Return Journeys	To Client	Return Journeys	
1	906	472	1,278	44,467	44,467	91,690
2	1,229	641	1,870	59,034	59,034	121,808
3	1,552	809	2,361	73,600	73,600	151,922
4	1,876	978	2,854	88,167	88,167	182,042
5	2,199	1,147	3,346	102,734	102,734	212,160
Total	**7,762**	**4,047**	**11,809**	**368,002**	**368,002**	**759,622**

5.2 Emissions from use of coal

There will inevitably be GHG emissions associated with the end use given coal is used to create energy. The adopted convention is that these emissions for the use of the coal are attributed to the user of the coal not the producer. Notwithstanding this, estimates of the GHG emissions associated with the use of the coal have been made.

The convention of not including these emissions avoids double counting of the emissions leaving the accounting of the emissions from the use of the coal to the end user is also desirable as emissions due to the end use depend on how the coal is used to produce energy and any control measures that might be in place. Various methods of burning will be used by different customers. Given the assumptions used in this assessment that the majority of coal from continued operations at Berrima Colliery is to be exported, any assessment of greenhouse emissions by its use in those other jurisdictions will be speculative and potentially unreliable.

The quantity of CO_2 emitted can be estimated with a reasonable degree of reliability if the carbon content of the coal is known. It is reasonable to assume that all the carbon will be converted to CO_2 and that minor emissions of CO will be converted to CO_2 reasonably quickly. There will, however, be some uncertainty as to the production of N_2O, which depends not only on the nitrogen content in the fuel but the temperature of the combustion process. Some small quantity of carbon will also be retained in the ash following combustion of the coal.

It is assumed that emissions for all coal combusted are equivalent to a power station in NSW burning black coal. The assumed emission factor for electricity generation is 2.52 tonnes CO_2-e per tonne of black coal.

Table 7 summarises the estimated CO_2 emissions for continued operations at Berrima Colliery.

Table 7 Summary of estimated CO_2-e emissions from usage of coal from Berrima Colliery

Year	Coal produced (t)	CO_2-e from power production (t)
1	260,000	655,200
2	310,000	781,200
3	260,000	907,200
4	410,000	1,033,200
5	460,000	1,159,200
Total	**1,800,000**	**4,536,000**

6 Total CO_2-equivalent emissions

Table 8 summarises the total emissions from all sources

Table 8 Summary of total estimated CO_2-e emissions all sources (t)

Year	CO_2-e Mining (t)			CO_2-e Transport of coal (t)	CO_2-e Usage of product coal (t)	CO_2-e total (t)	
	Scope 1	Scope 2	Scope 3	Scope 3	Scope 3	Scope 1 & 2	Scope 3
1	15,797	2,898	8,629	91,690	655,200	18,695	755,519
2	18,835	3,455	10,289	121,808	781,200	22,290	913.297
3	21,873	4,012	11,948	151,922	907,200	25,855	1,071,070
4	24,911	4,569	13,607	182,042	1,033,200	29,480	1,228,849
5	27,949	5,126	15,267	212,160	1,159,200	33,075	1,386,627
					Total (Mt)	**0.13**	**5.36**
					Total Scope 1, 2 & 3 (Mt)	**5.49**	
					Annual average (Mt/y)	**1.098**	

7 Contribution of greenhouse gas emissions from Berrima Colliery to state, national and global emissions

This section discusses the contribution of continued operations at Berrima Colliery to global emissions. Because the relationship between global warming and greenhouse gas concentrations is not linear, there is no accepted method to determine the contribution that a given emission of greenhouse gases might make to global warming.

At any point in time, it would be reasonably simple to compare the estimated emission of CO_2-e from the various activities with the 3,000 gigatonnes (Gt) of CO_2-e currently estimated to be stored in the atmosphere. On this basis, average annual emissions from continued operations at Berrima Colliery from the mining and use of coal (including mining, transporting and usage of the coal) are estimated to be less than 0.001% of the current global CO_2–e atmospheric load. Thus, the proposed continuation of mining at Berrima Colliery could be considered to contribute 0.001% to the increase in global temperatures caused by the increase in greenhouse gas emissions as they are currently. This invites the question as to what temperature rise might be attributed to the GHG emissions from continued operations at Berrima Colliery.

Based on the IPPC[2] estimate that a doubling of the CO_2-e concentration in the atmosphere would lead to a 2.5°C increase in global average temperature, and that the current global CO_2–e load is approximately 3,000Gt, it can be estimated that the annual average emissions (Scope 1, 2 and 3) during the life of the proposal for Berrima Colliery (including mining, transporting and usage of the coal) could lead to an annual increase in global temperature of 0.00003°C [(3.6 x 107/3,000 x 109) x 2.5°C].

The total CO_2–e emissions for the State of NSW in 2007 were 162.7Mt CO_2 –e[3]. The average annual emissions estimated for the lifetime of the proposal for Berrima Colliery (Scope 1 and 2) is 1.098Mt CO_2–e. This equals approximately 0.67% of the total emissions for NSW in 2007.

In 2007, Australia's total greenhouse gas emissions were estimated at 541.2Mt CO^2-e[4]. When comparing emissions for (Scope 1 and 2) associated with the proposal for Berrima Colliery, the predicted increase is 0.2% of total 2007 Australian emissions.

The GHG contribution to world emissions from CO2–e emissions produced from the proposal for Berrima Colliery is an increase of 0.001%, when comparing emissions for the full fuel cycle (i.e. Scope 1, 2 and 3) to the current global CO2–e load of approximately 3,000Gt CO2-e[5].

Based on the above, there are not likely to be any measurable environmental effects due to the emissions of GHGs from the proposed continuation of mining at Berrima Colliery, i.e. the contribution of the project on GHG emissions is minor.

In practice, of course, the effects of global warming and associated climate change are the cumulative effect of many thousands of such sources and it is the cumulative effects that pose a threat to the environment.

[2] "Climate Change 1995 – The Science of Climate Change – Contribution of Working Group 1 to the Second Assessment Report of the Intergovernmental Panel on Climate Change" Edited by Lakeman J.A., Published by Cambridge University Press, ISB 0 521 56436 0.
[3] "State and Territory Greenhouse Gas Inventories 2007".May 2009. Published by the Department of Climate Change. Available from http://www.climatechange.gov.au
[4] Ibid
[5] "National Greenhouse gas inventory data for the Period 1990-2007" United Nations Framework Convention on Climate Change, Document reference FCCC/SBI/2009/12, 21 October 2009.

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Appendix J

Water Quality Assessment

Water Quality Assessment

Berrima Colliery
Medway, NSW

Prepared by:

Mark Passfield
SEEC Reference 10000019-WQ-01

21 April, 2011

Strategic Environmental & Engineering Consulting

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

Mark Passfield
Director
SEEC

21 April 2011

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Contents

1 Introduction

SEEC have been commissioned by Blue Circle Southern Cement to provide this Water Quality Assessment for an existing colliery at Medway. The colliery, known as Berrima Colliery, is located at the end of Medway Road, Medway.

The Water Quality Assessment is required to accompany an Environmental Assessment for the continued operation of the colliery. The mine produces groundwater from the underground workings which is:

- re-used at the pit head (in showers and toilets);
- stored and made available to the residents of Medway for garden irrigation; and
- released to the Wingecarribee River, which forms part of Sydney's Drinking water catchment.

The assessment describes the results of recent water quality testing and compares the results to current environmental and health guidelines. It recommends a series of new Water Quality Objectives (WQOs) to be incorporated into the existing Environmental Protection License (EPL) for the Medway Colliery.

2 Background

Berrima Colliery is an underground coal mine which has been operating since the late 1800s. It operates as a Board and Pillar colliery with most of its product being used in the nearby Berrima Cement Works. The colliery has an extensive lease area with the current operating face located in the northwest of it (Figure 1).

Groundwater enters the mine workings and is transferred to a discharge point close to a discharge adit (Figure 1). Here it is either pumped for re-use in the pit head and the village or it is released into the Wingecarribee River through a V-Notch Weir. Most of it does the latter.

Surface water at the pit head and the coal stockpile area ("Loch Catherine") are managed separately and are the subject of a separate Soil and Water Management Plan also prepared by SEEC.

The colliery currently discharges water to the river under the an existing EPL (no 608). The existing EPL permits discharge to the river subject to the following water quality being achieved:

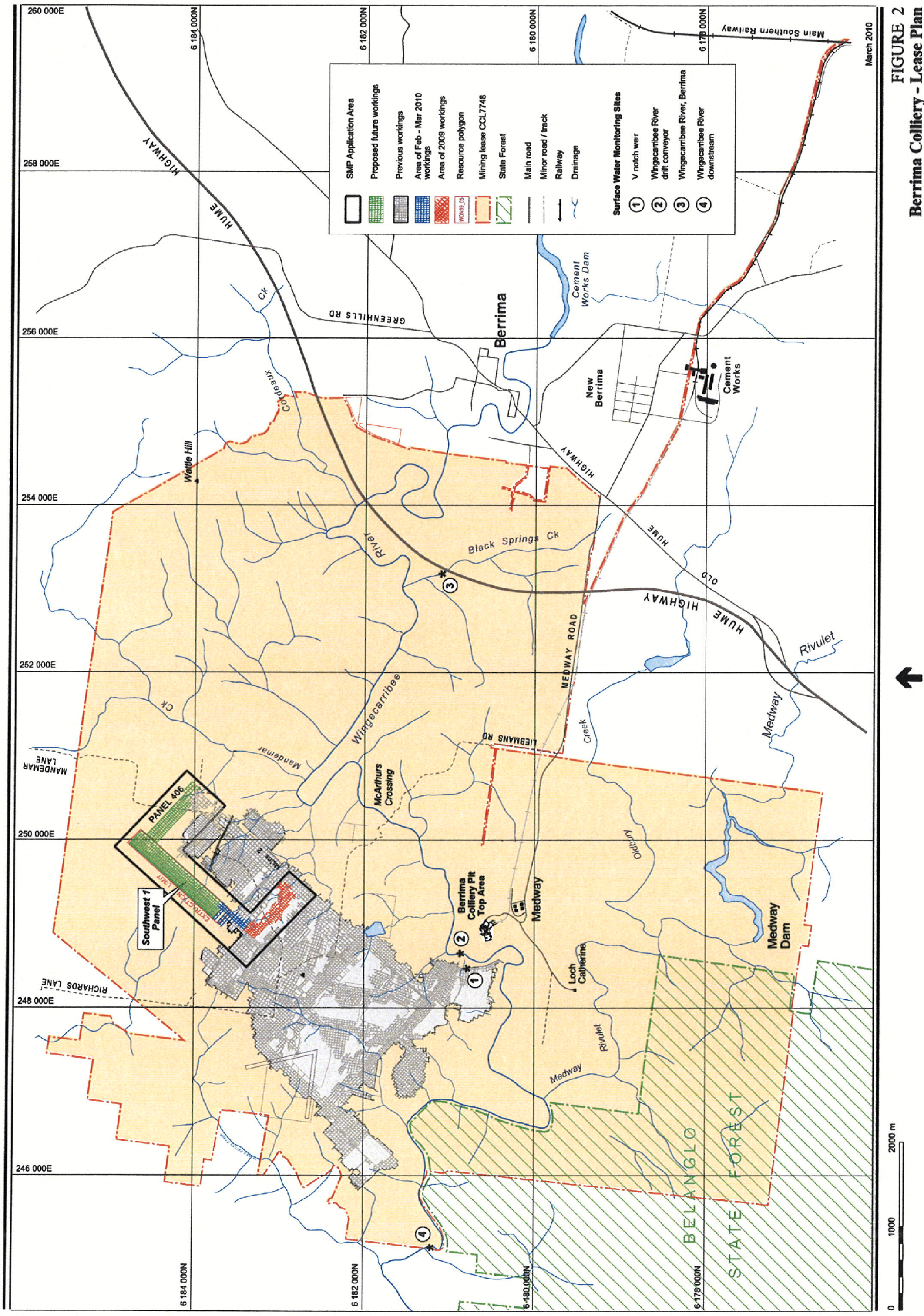


FIGURE 2
Berrima Colliery - Lease Plan
March 2010
SMP Application Area
Proposed future workings
Previous workings
Area of Feb - Mar 2010 workings
Area of 2009 workings
Resource polygon
Mining lease CCL7748
State Forest
Main road
Minor road / track
Railway
Drainage
Surface Water Monitoring Sites
V notch weir
Wingecarribee River drift conveyor
Wingecarribee River, Berrima
Wingecarribee River downstream
Main Southern Railway
HUME HIGHWAY
Berrima
New Berrima
Cement Works
Cement Works Dam
Black Springs Ck
Wingecarribee River
Medway
Medway Dam
Loch Catherine
PANEL 406
Southwest 1 Panel
McArthurs Crossing
Berrima Colliery Pit Top Area
BELANGLO STATE FOREST

Figure 1

Table 1 - Current EPL Water Quality Targets

Parameter	100th percentile Concentration Limit
Oil and Grease	10 mg/L
Total Suspended Solids (TSS)	50 mg/L
pH	6.5-8.5
Biological Oxygen Demand (BOD)	20 mg/L

3 Water Quality Assessment

3.1 Water Quality Objectives

3.1.1 Health Targets

Groundwater is currently used in:

(i) the pit head for showers and toilets; and

(ii) the village of Medway, by the residents for garden irrigation.

Both these uses result in direct contact with the water and so it must be of a suitably high quality. That quality is given by the Department of Water and Energy (DWE) (2008), now NSW Office of Water (NOW). For direct human contact the following water quality is required (Table 2).

Table 2 – Required Water Quality for Direct Human Contact

Parameter	**100th percentile Concentration Limit**
E Coli	<1 cfu/100 ml
BOD	< 10 mg/L
pH	6.5 - 8.5
Turbidity	< 2 NTU (95th percentile) < 5 NTU (100th percentile)

3.1.2 Environmental Targets (HRC, 1998)

The Wingecarribee River is part of the Hawkesbury-Nepean system. Water Quality Objectives (WQOs) for this river system are given in Table 2 in The NSW Healthy Rivers Commission Inquiry into the Hawkesbury Nepean Catchment (HRC, 1998). The values for “Forested Areas and Drinking Water Catchment” are reproduced here as Table 3.

Table 3 - Hawkesbury-Nepean WQOs (HRC, 1998).

Parameter	**50th percentile concentrations**
Total Phosphorous	50 µg/L
Total Nitrogen	700 µg/L
Chlorophyll-a	7 µg/L

For substances other than those given in Table 3, HRC, 1998 requires the ANZECC (2000) Guidelines are to be adopted. The ANZECC WQOs for “Recreational Purposes” are reproduced in Table 4. We have adopted these values on the assumption that water of this quality is sufficiently good to enable easy treatment for drinking water. Note that we have not included that part of the table giving maximum concentrations of pesticides as that is irrelevant to coal mine drainage.

Table 4 - Adopted Environmental WQOs from ANZECC (2000).

Parameter	Guideline values (µg/L unless otherwise stated)
Inorganic:	
Arsenic	50
Asbestos	NR
Barium	1000
Boron	1000
Cadmium	5
Chromium	50
Cyanide	100
Lead	50
Mercury	1
Nickel	100
Nitrate-N	10 000
Nitrite-N	1000
Selenium	10
Silver	50
Organic:	
Benzene	10
Benzo(*a*)pyrene	0.01
Carbon tetrachloride	3
1,1-Dichloroethene	0.3
1,2-Dichloroethane	10
Pentachlorophenol	10
Polychlorinated biphenyls	0.1
Tetrachloroethene	10
2,3,4,6-Tetrachlorophenol	1
Trichloroethene	30
2,4,5-Trichlorophenol	1
2,4,6-Trichlorophenol	10
Radiological:	
Gross alpha activity	0.1 Bq/L
Gross beta activity (excluding activity of ^{40}K)	0.1 Bq/L
Other chemicals:	
Aluminium	200
Ammonia (as N)	10
Chloride	400 000
Copper	1000
Oxygen	>6.5 (>80% saturation)
Hardness (as $CaCO_3$)	500 000
Iron	300
Manganese	100
Organics (CCE & CAE)	200
pH	6.5–8.5
Phenolics	2
Sodium	300 000
Sulfate	400 000
Sulfide	50
Surfactant (MBAS)	200
Total dissolved solids	1 000 000
Zinc	5000

NR = No guideline recommended at this time; MBAS Methylene blue active substances

3.1.3 Environmental Targets - SCA

The Sydney Catchment Authority (SCA) have water quality objectives for their catchments, including primary tributaries. These are given Table 5. Most of these are lower than Table 4. Presumably the upper values represent the 100th percentile value.

Table 5 - WQOs for Sydney Catchment tributaries (SCA, 2010)

Parameter (unit)	Range
pH	6.5 -8.5
Chlorophyll-a (µg/L)	0-5
Total Nitrogen (µg/L)	0 - 250
Dissolved Oxygen (%sat)	80-100
Total Phosphorous (µg/L)	0 - 20
Turbidity (NTU)	0-15
Thermotolerant Coliforms (cfu/100 ml)	0-150

3.2 Revised, Recommended, Water Quality Objectives for Berrima Colliery

Accepting that the groundwater is used for domestic purposes as well as being released to a drinking water catchment, the following table gives the recommended WQOs that will be adopted at this project. The parameters chosen reflect the nature of the mine water (i.e we have omitted organic, radiological and pesticide indicators).

Table 6 – Proposed Water Quality Objectives

Parameter	Concentration Limits (µg/L unless shown otherwise)
E Coli	<1 cfu/100 ml [1]
BOD	< 10 mg/L
Turbidity	< 2 NTU (95th percentile) < 5 NTU
pH	6.5 - 8.5
Total Phosphorous	20
Total Nitrogen	250
Chlorophyll-a	5
Arsenic	50

1 These cells are shaded as they relate to health requirements for direct human contact.

Barium	1000
Boron	1000
Cadmium	5
Chromium	50
Cyanide	100
Lead	50
Mercury	1
Nickel	**100**
Selenium	10
Silver	50
Aluminium	200
Ammonia (as N)	10
Chloride	400 000
Copper	1000
Oxygen	>6.5 (>80% saturation)
Hardness ($CaCO_3$)	500 000
Iron	300
Manganese	**100**
Sodium	300 000
Sulfate	400 000
Sulfide	50
Surfactant	200
Total Dissolved Solids (TDS)	1 000 000 [Equivalent EC = 1,700 µS/cm]
Zinc	5000
Oil and Grease	10 000

Notes:

- 1 mg = 1,000 µg
- Total Dissolved Solids (µg/L) = Electrical conductivity (µS/cm) x 600

4 Water Quality Monitoring

4.1 Existing Data

SEEC are in receipt of water quality data from various sampling locations in the colliery area and in the Wingecarribee River upstream and downstream of the release point (Figure 1). The data are given in Appendix 1. There are three reports from Ecowise, four reports from ALS Laboratory Group and recent testing (2010-2011) undertaken by ALS. Together they cover a monitoring period from August 2009 to February 2011. We are also in receipt of limited data from 2008, presented at part of a report by International Environmental Consultants P/L (we understand this data has been submitted to the Department of Environment, Climate Change and Water (DECCW) in the past, as part of the license to operate).

4.1.1 Data at the V-Notch Weir

We have reviewed the data in Appendix 1 and, in particular the data from the V-Notch weir. This is because it is here that discharges to the river occur. From that data we draw the following conclusions:

(i) Not all the WQOs given in Table 6 have been tested for, although all the parameters given in Table 1 have.

(ii) The WQOs given in Table 6 are met except for:

- Manganese, which is consistently about 3,000 µg/L (30 times the WQO).
- Nickel which is consistently about 150 - 200 µg/L (twice the WQO);
- One reported value of pH was 6.21 in December 2008.

(iii) Iron is elevated but does not exceed the WQO (although it did in the River itself on 11th March 2010).

(iv) The concentrations of most substances are very low and, in many cases, are undetectable.

(v) Turbidity was not tested but we note TSS was generally very low (<5 mg/L) and so turbidity would be expected to be low too.

(vi) The water is suitable for domestic re-use.

There are no known health issues with an elevated manganese level but there are possible aesthetic issues (e.g. it stains clothing if present in water).

4.1.2 Data in the River

We have reviewed the data in Appendix 1 and, in the case of water sampled in the Wingecarribee River itself we draw the following conclusions.

(i) Simultaneous upstream and downstream monitoring of the river and of the mine discharge is available on a number of occasions in the last 16 months. This simultaneous data shows that the mine discharge (at about

260 µg/L manganese) does increase the concentration of manganese in the river by about 40 µg/L. However, the data, and other recent data, shows that the mean concentration of manganese in the river is about 96 µg/L, which is less than the WQO (100 µg/L).

(ii) Similar testing on the 11th March 2010 gave manganese concentrations in the river of 247 µg/L and 214 µg/L upstream and downstream of the release point respectively. Therefore, it seems elevated levels can occur in the river regardless of the mine. Testing in the river on that day also showed elevated levels of iron.

4.2 Ground Water Volume

The volume of groundwater varies depending on conditions at the coal face but it is consistently about 3 ML per day and is released at the V-Notch weir. The current license allows for 10 ML/day. Flow in the Wingecarribee River is heavily regulated by releases from Wingecarribee Dam.

A search on the NSW Water Information website found no active gauging stations on the Wingecarribee River but the SCA monitor it at Berrima Weir. They advise that, during the period January 2007 to March 2010, flow varied from 1.4 to 9,500 ML/day (Figure 2).

During this period the SCA regularly released water from Tallawa Dam to Warragamba Dam. That was done at about 400 ML/day (Figure 2). Therefore, when water releases occur, the volume of mine water is less than 1 percent of the total flow. However, when water releases do not occur, the environmental flow from Wingecarribee Dam is about 4 ML/day and so during those periods the volume of mine water is significant. It means that the mine water has been part of the “environmental” flow of the river for many years.

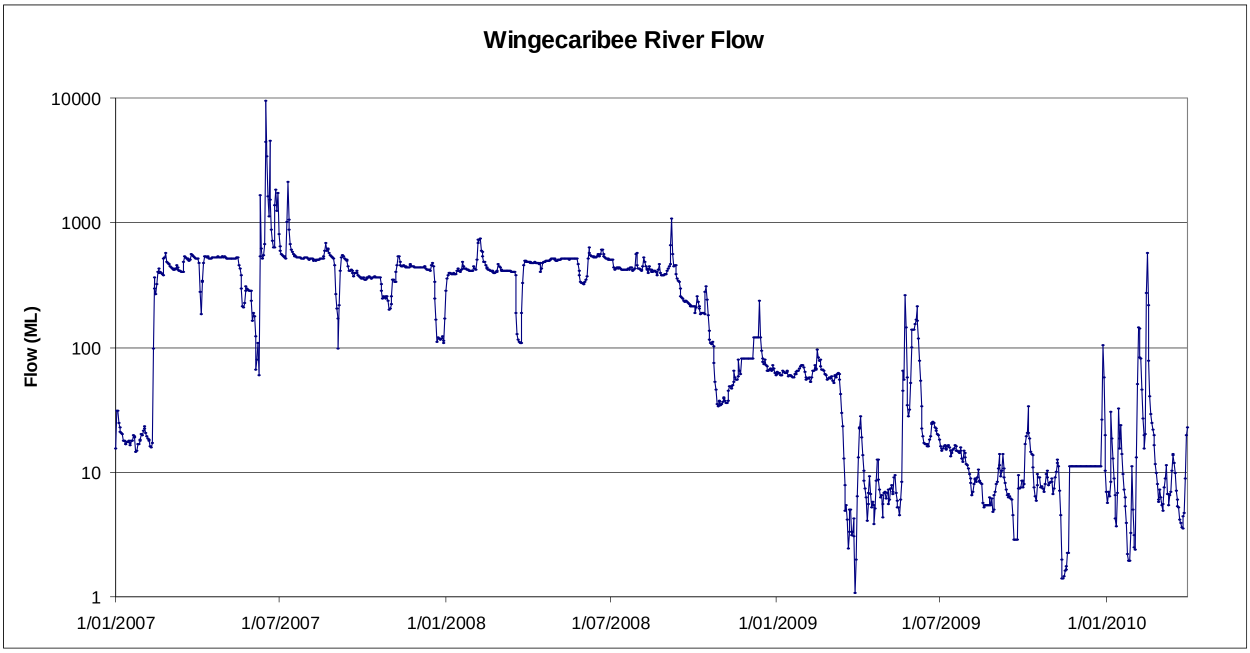


Figure 2 – River Flow 2007 to 2010.

4.3 Data Validity

We are in receipt of a limited amount of water quality data which is not statistically valid. It covers a short period between late 2008 and early 2011. The mine has been operating for about 90 years. Nevertheless, the results over that period have been quite consistent.

In addition, many of the water quality indicators in Table 6 have not been tested for and so we cannot accurately comment on all the results. However, the data that is available suggests that the quality of the mine water is generally very good, with the exception of a high concentration of manganese and a slightly elevated level of nickel. The data also suggests that although the mine water is able to raise the concentration of manganese in the river by about 40 µg/L the concentration remains at, or close to, the WQO.

4.4 Application of the WQOs in Table 6

With the exception of the first four indicators [2], the WQOs given in Table 6 are objectives that technically apply to the receiving water (the Wingecarribee River), not to the mine water itself. However, the philosophy is that, if the mine water quality meets the WQOs, then it can be said that it will have no detrimental affect on the river.

2 These are related to health, as the water is used for domestic purposes (direct human contact) in the bath houses and the village.

The quality of the river water will be affected by conditions outside the control of the colliery owners. Therefore, the WQOs in Table 6 will be treated as *triggers*, to trigger the need for further assessment. That assessment is summarised below.

Simultaneous (same dry [3] day) water quality testing will be undertaken at three locations:

(i) At the V-Notch weir.

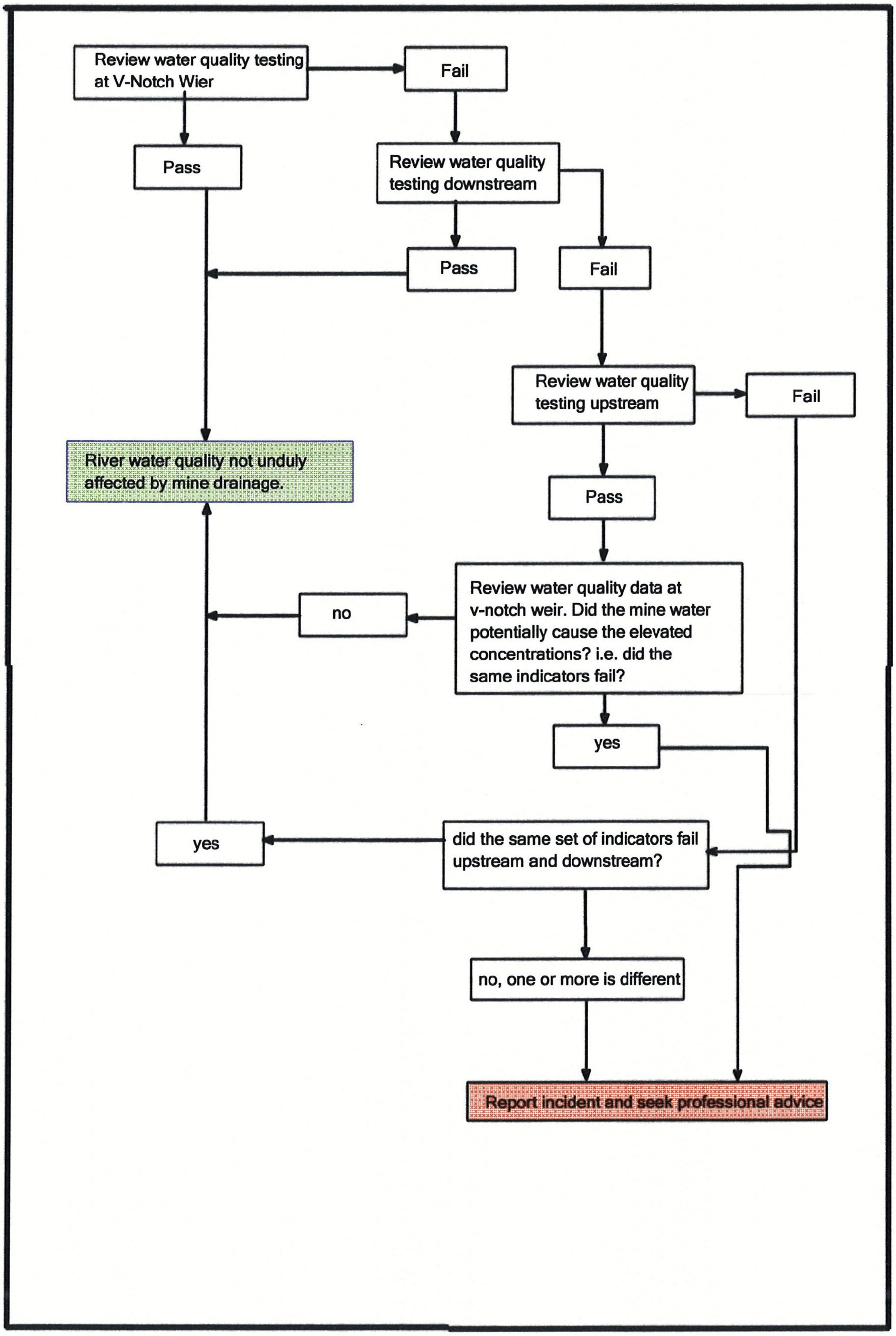
(ii) Upstream of the V-Notch weir (but as close as possible to it).

(iii) Downstream of the V-Notch weir, at a point far enough downstream to allow adequate mixing but preferably above Medway Rivulet.

Having sampled the water, Figure 2 identifies the actions to be taken with each round of testing.

As time progresses water quality data will become more reliable. Once there becomes a statistically valid number of data (*n*) (at least 10) a trigger for further investigation will be deemed to occur when the median concentration of *n* samples exceeds the value given in Table 6. If a trigger occurs a suitably qualified consultant will be employed to investigate, report, liaise with DECCW and suggest remedial measures if required.

3 A wet day might cause variable river flows and hence variable concentrations.


Review water quality testing at V-Notch Wier
Fail
Pass
Review water quality testing downstream
Pass
Fail
Review water quality testing upstream
Fail
River water quality not unduly affected by mine drainage.
Pass
Review water quality data at v-notch weir. Did the mine water potentially cause the elevated concentrations? i.e. did the same indicators fail?
no
yes
yes
did the same set of indicators fail upstream and downstream?
no, one or more is different
Report incident and seek professional advice

5 Conclusion

Mine water is released from Medway Colliery into the Wingecarribee River at a reasonably constant rate of 3 ML / day.

Although there is not a statistically valid amount of water quality data, what data there is shows that the mine water appears to be of very high quality and meets almost all of the water quality objectives of ANZECC, 2000 (aesthetic purposes) and the SCA. It also meets the health requirements of NOW for high risk potable water (mine water is used for showers, toilets and village supply (outdoor)).

Two metals appear to be consistently higher than the WQOs in the mine water . Those are Nickel and Manganese, especially the latter, that can be 30 times the WQO. However, the concentrations of both these metals are lowered in the river by dilution. Recent tests performed on simultaneous days upstream, at the V-Notch Weir and downstream show that, after dilution, the level of Manganese is reduced to about the WQO whilst the level of Nickel is reduced to below the WQO.

The National Pollutant Inventory states *"Insufficient data are available to evaluate or predict the short-term and long-term effects of manganese and its compounds on plants, birds, or land animals"* and so we do not know the effect of slightly elevated manganese in the river. However, we note that mine water has been draining to the river for more than 100 years, at a volume about equal to the environmental flow released by the SCA from the Wingecarribee Dam. It has, therefore, become a significant part of the river's flow.

An ongoing monitoring program has been recommended with samples taken both upstream and downstream of the release point. The results will be compared to the WQOs summarised in this document (Table 6) and, if necessary, further investigations will be done and NOW advised accordingly.

6 References

ANZECC, 2000. *Australian and New Zealand Guidelines For Fresh and Marine Water Quality.* Australian and New Zealand Environment and Conservation Council.

DWE, 2008. *Interim NSW Guidelines for management of Private Recycled water Schemes.* NSW Department of Water and Energy, Sydney.

HRC, 1998. *Independent Inquiry into the Hawkesbury Nepean River System*. Healthy Rivers Commission, Sydney.

International Environmental Consultants P/L, 2010. Extract from *Berrima Colliery, Annual Environmental Management Report*.

SCA, 2010. *Annual Water Quality Monitoring Report 2008-2009.* Sydney catchment Authority, Sydney.

Personal communications with SCA May 2010.

7 Appendix 1 - Water Quality Testing (overpage)

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1007307**	Page	: 1 of 6
Client	: **BERRIMA COAL PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR ROBERT BYRNES	Contact	: Charlie Pierce
Address	: C/O BERRIMA POST OFFICE BERRIMA NSW, AUSTRALIA 2577	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: robert.byrnes@iec.com.au	E-mail	: charlie.pierce@alsenviro.com
Telephone	: +61 48785502	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 48785503	Facsimile	: +61-2-8784 8500
Project	: ENVIRONMENT PROTECTION LICENCE MONITORING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 20-APR-2010
Sampler	: RB	Issue Date	: 30-APR-2010
Site	: BERRIMA COLLIERY		
		No. of samples received	: 9
Quote number	: ----	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Inorganics
Natalie Lalor	Microbiologist	Microbiology
Wisam.Marassa	Metals Coordinator	Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EG020: LCS recovery for Vanadium falls outside ALS Dynamic Control Limit. However, it is within the acceptance criteria based on ALS DQO. No further action is required.**
- **EG020A-T: An unpreserved aliquot from the natural bottle was used for analysis.**
- **Microbiological Comment: HPC results are reported as approximate (~) when the count of colonies on the plate is outside the range of 10 - 300cfu, in accordance with ALS work instruction QWI-MIC/MW002.**
- **Microbiological Comment: Membrane filtration (MF) results are reported as approximate (~) when the growth of bacteria on the filter membrane is counted <10cfu and/or >100cfu in accordance with ALS work instruction QWI-MIC04.**
- **MW002 is ALS's internal code and is equivalent to AS4276.3.1.**
- **MW006 is ALS's internal code and is equivalent to AS4276.7.**

Analytical Results

Sub-Matrix: WATER			Client sample ID	ADIT POINT 1	STAFF BATH HOUSE	MAIN BATH HOUSE	DRINKING WATER TANK	WINGECARRIBEE RIVER UPSTREAM
			Client sampling date / time	20-APR-2010 14:00	20-APR-2010 09:00	20-APR-2010 09:00	20-APR-2010 09:00	20-APR-2010 08:00
Compound	CAS Number	LOR	Unit	ES1007307-001	ES1007307-002	ES1007307-003	ES1007307-004	ES1007307-005
EA005: pH								
pH Value	----	0.01	pH Unit	**7.25**	----	----	**6.97**	**7.89**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**763**	----	----	**28**	**268**
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**4**	----	----	<1	**4**
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	----	----	<0.01	**0.04**
Dysprosium	7429-91-6	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Erbium	7440-52-0	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	<0.05	<0.05
Europium	7440-53-1	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**0.288**	----	----	**0.004**	**0.073**
Barium	7440-39-3	0.001	mg/L	**0.061**	----	----	**0.008**	**0.040**
Gadolinium	7440-54-2	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	----	----	<0.01	<0.01
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Gallium	7440-55-3	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	**0.0006**	----	----	<0.0001	<0.0001
Hafnium	7440-58-6	0.01	mg/L	<0.01	----	----	<0.01	<0.01
Tellurium	22541-49-7	0.005	mg/L	<0.005	----	----	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	**0.060**	----	----	<0.001	<0.001
Holmium	7440-60-0	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Indium	7440-74-6	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	**0.003**	<0.001
Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Rubidium	7440-17-7	0.001	mg/L	**0.012**	----	----	<0.001	**0.007**
Lithium	7439-93-2	0.001	mg/L	**0.068**	----	----	<0.001	<0.001
Lutetium	7439-94-3	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	<0.001	<0.001

Analytical Results

Sub-Matrix: **WATER**			Client sample ID	ADIT POINT 1	STAFF BATH HOUSE	MAIN BATH HOUSE	DRINKING WATER TANK	WINGECARRIBEE RIVER UPSTREAM
			Client sampling date / time	20-APR-2010 14:00	20-APR-2010 09:00	20-APR-2010 09:00	20-APR-2010 09:00	20-APR-2010 08:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES1007307-001**	**ES1007307-002**	**ES1007307-003**	**ES1007307-004**	**ES1007307-005**
EG020T: Total Metals by ICP-MS - Continued								
Manganese	7439-96-5	0.001	mg/L	**3.22**	----	----	**0.001**	**0.049**
Neodymium	7440-00-8	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	<0.001	**0.001**
Praseodymium	7440-10-0	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.208**	----	----	<0.001	<0.001
Samarium	7440-19-9	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Terbium	7440-27-9	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Thulium	7440-30-4	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	<0.01	<0.01
Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Thallium	7440-28-0	0.001	mg/L	<0.001	----	----	<0.001	<0.001
Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	<0.005	<0.005
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	**0.298**	----	----	**2.24**	<0.005
Iron	7439-89-6	0.05	mg/L	**0.16**	----	----	<0.05	**0.24**
EP020: Oil and Grease (O&G)								
^ Oil & Grease	----	5	mg/L	<5	----	----	----	<5
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	**10**	----	----	**12**	**2**
MW002: Heterotrophic Plate Count								
Heterotrophic Plate Count (22°C/72hrs)	----	1	CFU/mL	----	**46**	<1	**110**	**760**
Heterotrophic Plate Count (36°C)	----	1	CFU/mL	----	**100**	**~2**	**130**	**1000**
MW006: Faecal Coliforms & E.coli by MF								
Escherichia coli	Ecoli	1	CFU/100mL	----	<1	<1	<1	**40**

Analytical Results

Sub-Matrix: WATER			Client sample ID	WINGECARRIBEE RIVER DOWNSTREAM	SW2 FAULT	406 PANEL	SW1 FACE	----
			Client sampling date / time	20-APR-2010 08:00	20-APR-2010 14:00	20-APR-2010 14:00	20-APR-2010 14:00	----
Compound	CAS Number	LOR	Unit	ES1007307-006	ES1007307-007	ES1007307-008	ES1007307-009	----
EA005: pH								
pH Value	----	0.01	pH Unit	**7.62**	**6.54**	**6.43**	**6.64**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**284**	**240**	**339**	**292**	----
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**4**	<1	**4**	**6**	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.04**	<0.01	<0.01	<0.01	----
Dysprosium	7429-91-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Erbium	7440-52-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Europium	7440-53-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Strontium	7440-24-6	0.001	mg/L	**0.084**	**0.049**	**0.106**	**0.123**	----
Barium	7440-39-3	0.001	mg/L	**0.031**	**0.025**	**0.284**	**0.221**	----
Gadolinium	7440-54-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Gallium	7440-55-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0002**	<0.0001	<0.0001	----
Hafnium	7440-58-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.068**	<0.001	<0.001	----
Holmium	7440-60-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Rubidium	7440-17-7	0.001	mg/L	**0.006**	**0.004**	**0.006**	**0.008**	----
Lithium	7439-93-2	0.001	mg/L	**0.004**	**0.012**	**0.025**	**0.048**	----
Lutetium	7439-94-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----

Analytical Results

Sub-Matrix: WATER			Client sample ID	WINGECARRIBEE RIVER DOWNSTREAM	SW2 FAULT	406 PANEL	SW1 FACE	----
			Client sampling date / time	20-APR-2010 08:00	20-APR-2010 14:00	20-APR-2010 14:00	20-APR-2010 14:00	----
Compound	CAS Number	LOR	Unit	ES1007307-006	ES1007307-007	ES1007307-008	ES1007307-009	----
EG020T: Total Metals by ICP-MS - Continued								
Manganese	7439-96-5	0.001	mg/L	**0.110**	**1.30**	**0.481**	**0.492**	----
Neodymium	7440-00-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Praseodymium	7440-10-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	**0.003**	**0.149**	**0.001**	<0.001	----
Samarium	7440-19-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Terbium	7440-27-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thulium	7440-30-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	**0.007**	**0.299**	<0.005	<0.005	----
Iron	7439-89-6	0.05	mg/L	**0.42**	**0.31**	**7.18**	**5.03**	----
EP020: Oil and Grease (O&G)								
^ Oil & Grease	----	5	mg/L	**5**	----	----	----	----
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	**3**	<2	**2**	<2	----
MW002: Heterotrophic Plate Count								
Heterotrophic Plate Count (22°C/72hrs)	----	1	CFU/mL	**830**	----	----	----	----
Heterotrophic Plate Count (36°C)	----	1	CFU/mL	**1200**	----	----	----	----
MW006: Faecal Coliforms & E.coli by MF								
Escherichia coli	Ecoli	1	CFU/100mL	**~18**	----	----	----	----

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Analytical Report

Berrima Colliery **C/- Post Office** **Berrima** **NSW, 2577**		Contact Name:	**Robert Byrnes**
		Report Number:	**W10/0124**
		Sample(s) Received:	**12/01/2010**
Phone:	**02 4877 1206**	Client Reference:	**Monthly Water**
Fax:	**02 4878 5503**	Batch Number:	**W32071**

Notes:

Symbols Used:
< = less than.
> = greater than.
MPN = Most Probable Number.
cfu = Colony Forming Units.
MF = Membrane Filtration Method
(app) = Approximate
(est) = Estimated
The results stated in this report relate only to the sample(s) as submitted by the client.
Samples analysed as received.

Results Approved By:

G. Davies

Glenn Davies
Laboratory Manager

Tony de Souza
Microbiologist

NATA Accredited Laboratory
No: 992

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Analytical Report

Report No: W10/0124

Results:

Client Id		V Notch	River			
Laboratory Id		**W32071/001**	**W32071/002**			
E. coli MF						
Method: EMMM 009	*Units: cfu/100mL*	<2	10 (app)			
Oil & Grease (IR)						
Method: WCM077	*Units: mg/L*	0.2	0.3			
pH						
Method: WCM015	*Units: pH units*	6.9	7.7			
Total suspended solids						
Method: WCM004	*Units: mg/L*	2	5			
BOD5						
Method: WCM012	*Units: mg/L*	<2	<2			
Conductivity (uS/cm)						
Method: WCM051	*Units: uS/cm@25℃*	750	330			

Method(s):

EMMM 009	E. coli MF
WCM004	Total suspended solids
WCM012	BOD5
WCM015	pH
WCM051	Conductivity (uS/cm)
WCM077	Oil & Grease (IR)

Date Reported: Tuesday January 19, 2010

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Analytical Report

Berrima Colliery
C/- Post Office
Berrima
NSW, 2577

Phone: **02 4877 1206**
Fax: **02 4878 5503**

Contact Name: **Robert Byrnes**
Report Number: **W10/0315**
Sample(s) Received: **22/01/2010**
Client Reference: **Water Samples**
Batch Number: **W32203**

Notes:

Sample analysed at ALS Sydney. Report No. ES1001416

The NATA scope of accreditation of Ecowise Environmental - Wollongong do not cover analysis performed by external laboratories.
The results stated in this report relate only to the sample(s) as submitted by the client.
Samples analysed as received.

Results Approved By:

Brett Thompson
Lab Supervisor

NATA Accredited Laboratory
No: 992

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Results:

Client Id		Face Seepage	V Notch Weir	406 Panel Dyke	SW2 2 Line Fault	
Laboratory Id		W32203/001	W32203/002	W32203/003	W32203/004	
Ammonia as N (external)						
Method: Contracted	*Units: mg/L*	0.02	0.01	0.05	0.04	
Arsenic (external)						
Method: Contracted	*Units: mg/L*	<0.001	<0.001	<0.001	<0.001	

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Analytical Report ***Report No: W10/0315***

Results:

Client Id		Face Seepage	V Notch Weir	406 Panel Dyke	SW2 2 Line Fault	
Laboratory Id		**W32203/001**	**W32203/002**	**W32203/003**	**W32203/004**	
Bicarbonate (external)						
Method: Contracted	*Units: mg CaCO3/L*	8	51	81	47	
Bromine (external)						
Method: Contracted	*Units: mg/L*	<0.1	0.2	0.2	0.1	
Cadmium (external)						
Method: Contracted	*Units: mg/L*	0.0013	0.0002	<0.0001	<0.0001	
Calcium (external)						
Method: Contracted	*Units: mg/L*	21	51	11	5	
Chloride (external)						
Method: Contracted	*Units: mg/L*	28	44	46	34	
Chromium (external)						
Method: Contracted	*Units: mg/L*	<0.001	<0.001	<0.001	<0.001	
Conductivity (uS/cm) (external)						
Method: Contracted	*Units: uS/cm@25℃*	410	800	320	220	
Copper (external)						
Method: Contracted	*Units: mg/L*	<0.001	<0.001	<0.001	<0.001	
Fluoride (external)						
Method: Contracted	*Units: mg/L*	<0.1	0.2	0.1	<0.1	
Hydroxide (as CaCO3) External						
Method:	*Units: mg/L*	<1	<1	<1	<1	
Iron (external)						
Method: Contracted	*Units: mg/L*	4.77	<0.05	5.62	9.35	
Lead (external)						
Method: Contracted	*Units: mg/L*	0.014	<0.001	<0.001	<0.001	
Magnesium (external)						
Method: Contracted	*Units: mg/L*	18	47	15	10	
Mercury (external)						
Method: Contracted	*Units: mg/L*	0.0001	<0.0001	<0.0001	<0.0001	
Nickel (external)						
Method: Contracted	*Units: mg/L*	0.322	0.125	<0.001	0.010	
Nitrate (NO3 as N)(external)						
Method: Contracted	*Units: mg/L*	<0.01	0.02	<0.01	<0.01	
Nitrite (NO2 as N) (external)						
Method: Contracted	*Units: mg/L*	<0.01	<0.01	<0.01	<0.01	
pH (external)						
Method: Contracted	*Units: pH units*	7.1	7.2	7.4	7.5	

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Analytical Report ***Report No: W10/0315***

Results:

Client Id		Face Seepage	V Notch Weir	406 Panel Dyke	SW2 2 Line Fault	
Laboratory Id		**W32203/001**	**W32203/002**	**W32203/003**	**W32203/004**	
Potassium (external)						
Method: Contracted	*Units: mg/L*	1	4	2	<1	
Sodium (external)						
Method: Contracted	*Units: mg/L*	27	36	26	17	
Sulphate (external)						
Method: Contracted	*Units: mg/L*	141	284	4	3	
Total dissolved solids (external)						
Method: Contracted	*Units: mg/L*	350	620	190	140	
Total phosphorus (external)						
Method: Contracted	*Units: mg/L*	<0.01	<0.01	0.02	0.03	
Zinc (external)						
Method: Contracted	*Units: mg/L*	2.84	0.174	<0.005	0.023	
Carbonate as CaCO3 (external)						
Method: Contracted	*Units: mg CaCO3/L*	<1	<1	<1	<1	

Method(s):

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Analytical Report

Berrima Colliery
C/- Post Office
Berrima
NSW, 2577

Phone: **02 4877 1206**
Fax: **02 4878 5503**

Contact Name: **Robert Byrnes**

Report Number: **W10/0325**

Sample(s) Received: **18/01/2010**
Client Reference: **Berrima Colliery Potability**
Batch Number: **W32149**

Notes:

Ammonia analysed at ALS Sydney. Report No. ES1000803
N02 and N03 were mistakenly not requested for external results, so no results were available.

The NATA scope of accreditation of Ecowise Environmental - Wollongong do not cover analysis performed by external laboratories.
The results stated in this report relate only to the sample(s) as submitted by the client.
Samples analysed as received.

Results Approved By:

Brett Thompson
Lab Supervisor

NATA Accredited Laboratory
No: 992

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Results:

Client Id		**V Notch Wier u/g**	**Wingecarabee Under the Bridge**			
Laboratory Id		**W32149/001**	**W32149/002**			
Aluminium						
Method: WCM073A	*Units: mg/L*	0.01	0.01			
Ammonia as N (external)						
Method: Contracted	*Units: mg/L*	0.03	0.09			

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Analytical Report — *Report No: W10/0325*

Results:						
Client Id		**V Notch Wier u/g**	**Wingecarabee Under the Bridge**			
Laboratory Id		**W32149/001**	**W32149/002**			
Antimony						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Arsenic						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Barium						
Method: WCM073A	*Units: mg/L*	0.06	0.04			
Beryllium						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Boron						
Method: WCM073A	*Units: mg/L*	0.03	0.03			
Cadmium						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Calcium						
Method: WCM073A	*Units: mg/L*	53	12			
Chromium						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Cobalt						
Method: WCM073A	*Units: mg/L*	0.04	<0.01			
Colour - True (external)						
Method: Contracted	*Units: Pt Co units*	<1	8			
Conductivity (uS/cm)						
Method: WCM051	*Units: uS/cm@25℃*	790	310			
Copper						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Iron						
Method: WCM073A	*Units: mg/L*	0.22	0.04			
Lead						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Magnesium						
Method: WCM073A	*Units: mg/L*	48	7.6			
Manganese						
Method: WCM073A	*Units: mg/L*	2.9	0.15			
Mercury						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Molybdenum						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			

Ecowise Environmental (Victoria) Pty Ltd ABN 94 105 060 320

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Results:

Client Id		V Notch Wier u/g	Wingecarabee Under the Bridge			
Laboratory Id		W32149/001	W32149/002			
Nickel						
Method: WCM073A	*Units: mg/L*	0.14	<0.01			
Nitrate (NO3 as N)(external)						
Method: Contracted	*Units: mg/L*	-	-			
Nitrite (NO2 as N) (external)						
Method: Contracted	*Units: mg/L*	-	-			
pH						
Method: WCM050	*Units: pH units*	7.5	7.4			
Potassium						
Method: WCM073A	*Units: mg/L*	3.2	4.5			
Salinity (ppt) (external)						
Method: Contracted	*Units: ppt*	<2	<2			
Selenium						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Silver						
Method: WCM073A	*Units: mg/L*	0.09	0.07			
Sodium						
Method: WCM073A	*Units: mg/L*	38	29			
Strontium						
Method: WCM073A	*Units: mg/L*	0.29	0.08			
Thallium (external)						
Method: Contracted	*Units: mg/L*	<0.01	<0.01			
Tin						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Total dissolved solids						
Method: WCM002	*Units: mg/L*	760	180			
Total suspended solids						
Method: WCM004	*Units: mg/L*	6	5			
Turbidity						
Method: WCM024	*Units: mg/L*	4.7	3.4			
Vanadium						
Method: WCM073A	*Units: mg/L*	<0.01	<0.01			
Zinc						
Method: WCM073A	*Units: mg/L*	0.19	<0.01			

Method(s):

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WCM002	Total dissolved solids
WCM004	Total suspended solids
WCM024	Turbidity
WCM050	pH
WCM051	Conductivity (uS/cm)
WCM073A	Aluminium
WCM073A	Antimony
WCM073A	Arsenic
WCM073A	Barium
WCM073A	Beryllium
WCM073A	Boron
WCM073A	Cadmium
WCM073A	Calcium
WCM073A	Chromium
WCM073A	Cobalt
WCM073A	Copper
WCM073A	Iron
WCM073A	Lead
WCM073A	Magnesium
WCM073A	Manganese
WCM073A	Mercury
WCM073A	Molybdenum
WCM073A	Nickel
WCM073A	Potassium
WCM073A	Selenium
WCM073A	Silver
WCM073A	Sodium
WCM073A	Strontium
WCM073A	Tin
WCM073A	Vanadium
WCM073A	Zinc

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Parameter	Unit	V Notch Weir (12 Jan 2010)	V Notch Weir (18 Jan 2010)	V Notch Weir (22 Jan 2010)	V Notch Weir (26 Feb 2010)	V Notch Weir (20 April 2010)	V Notch Weir (7 May 2010)	V Notch Weir (5 July 2010)	V Notch Weir (7 July 2010)	V Notch Weir (23 July 2010)	V Notch Weir (28 July 2010)	V Notch Weir (6 Aug 2010)	V Notch Weir (13 Aug 2010)	V Notch Weir (25 Aug 2010)	V Notch Weir (3 Sep 2010)	V Notch Weir (8 Sep 2010)	V Notch Weir (17 Sep 2010)	V Notch Weir (1 Oct 2010)	V Notch Weir (12 Oct 2010)	V Notch Weir (21 oct 2010)	V Notch Weir (29 Oct 2010)	V Notch Weir (4 Nov 2010)	V Notch Weir (10 November 2010)	V Notch Weir (24 November 2010)	V Notch Weir (9 December 2010)	V Notch Weir (15 December 2010)	V Notch Weir (23 December 2010)	V Notch Weir (25 January 2011)	V Notch Weir (31 January 2011)	V Notch Weir 17 February 2011)
Arsenic	mg/L		<0.01	<0.001	<0.001	<0.001																				<0.001		<0.001	<0.001	<0.001
Barium	mg/L																									0.046		0.050	0.043	0.044
Boron	mg/L																									<0.05		<0.05	<0.05	<0.05
Cadmium	mg/L		<0.01	0.0002	0.0006	0.0006	0.0004	0.0004	0.0003	0.0004	0.0003	0.0003	0.0002	0.0002	0.0003	0.0003	0.0003	0.0004	0.0003	0.0004	0.0004	0.0003	0.0004	0.0004	0.0004	0.0005	0.0003	0.0005	0.0003	0.0003
Calcium	mg/L		53	51	55		49	47	44	51	51	46	50	51	49	49	50	46	47	44	45	46	46	47	50		42	47	46	41
Cobalt	mg/L		0.04		0.053	0.060	0.054	0.049	0.046	0.048	0.045	0.045	0.042	0.038	0.047	0.042	0.046	0.047	0.047	0.053	0.050	0.055	0.053	0.053	0.054		0.052	0.059	0.050	0.054
Copper	mg/L		<0.01	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium	mg/L																									<0.010		<0.010	<0.010	<0.002
Flouride	mg/L																									0.2	0.153	0.1	0.11	0.222
Iron	mg/L		0.22	<0.05	0.20	0.16	0.36	0.15	0.18	0.26	0.40	<0.05	<0.05	0.06	<0.05	0.24	0.12	0.16	0.05	0.09	0.25	0.32	0.14	0.20	1.61	0.37	0.21	0.89	0.25	0.37
Magnesium	mg/L		48	47	45		42	42	40	46	46	42	46	47	45	48	45	43	41	49	41	41	42	40	41		41	38	41	37
Manganese	mg/L		2.9		2.94	3.22	3.37	2.90	2.67	2.44	2.44	2.52	2.29	2.27	2.77	2.29	2.51	2.66	2.75	2.82	2.58	2.94	2.54	2.74	3.35	2.84	3.14	3.53	2.78	3.10
Mercury	mg/L																									<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L																									<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L		0.14	0.125	0.213	0.208	0.181	0.161	0.152	0.157	0.149	0.144	0.138	0.132	0.159	0.140	0.148	0.165	0.175	0.182	0.172	0.178	0.183	0.180	0.186		0.174	0.165	0.151	0.169
Potassium	mg/L		3.20	4	3.00		3.00	3	3	4	3	3	4	3	4	4	3	4	4	3	4	3	4	3	4		4	4	2	4
Sodium	mg/L		38	36	32		33	33	28	35	34	31	34	35	34	35	38	34	38	29	34	30	32	33	35	30	38	37	34	32
Zinc	mg/L		0.19	0.174	0.323	0.298	0.260	0.224	0.225	0.253	0.242	0.234	0.218	0.217	0.248	0.240	0.267	0.300	0.312	0.297	0.305	0.316	0.335	0.324	0.335	0.332	0.319	0.308	0.261	0.322
Bromide	mg/L						0.08	0.117	0.067	0.087	0.185	0.120	0.183	0.085	0.100	0.043	0.092	0.092	0.098	0.385	0.119	0.09	0.112	0.098	<0.010		<0.010	0.077	0.11	0.055
Chloride	mg/L			44			43.80	37.10	44.5	42.8	42.1	48.0	46.7	42.3	44.1	42.7	42.8	43.3	49.2	41.7	43.7	38	43.5	44.2	54		46.0	48	48.6	43.0
Bicarbonate	mg CaCo3/L			51				36	37	39	38	36	38	43	38	35	42	31	34	30	34	33	35	32	30		40	35	33	32
Sulphate	mg/L			284			256	280	221	300	277	237	274	275	278	278	284	273	264	270	269	245	268	247			233		259	220
Sulfate as SO4 - Turbidimetric	mg/L																								257	265		244		
Hydroxide Alkalinity as CaCO3	mg/L							<1	<1	<1	<1	<1	<1	<	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1
Total Alkalinity as CaCO3	mg/L							36	37	39	38	36	38	43	38	35	42	31	34	30	34	33	35	32	30		40	35	33	32
Ammonia as N	mg/L							0.01	<0.01	<0.01	0.09	0.01	0.05	<0.01	<0.01	0.02	0.02	0.02	<0.01	0.01	0.02	0.05	0.01	<0.01	0.03		<0.01	<0.01	0.08	0.02
Nitrite as N	mg/L							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L							0.03	0.03	0.02	0.04	0.02	0.04	0.03	0.22	0.02	0.05	0.04	0.02	0.18	0.01	0.11	0.04	0.04	0.05	0.03	0.02	<0.01	0.11	0.04
Nitrite + Nitrate as N	mg/L							0.03	0.03	0.02	0.04	0.02	0.04	0.03	0.22	0.02	0.05	0.04	0.02	0.18		0.11	0.04	0.04	0.05	0.03	0.03	<0.01	0.11	0.04
Total Phophorus as P	mg/L							<0.01	<0.01	0.04	0.05	0.03	<0.01	0.15	0.02	<0.01	0.17	0.10	0.24	<0.01	<0.01	0.01	0.66	<0.01	<0.01		<0.01	<0.01	0.05	0.09
Phenol-d6	%																											36.4	35.5	26.4
2-Chlorophenol-d4	%																											75.4	63.8	60.3
2,4,6-Tribromophenol	%																											70.8	45.4	67.7
2-Fluorobiphenyl	%																											61.8	38.4	63.4
Anthracene-d10	%																											72.0	50.1	68.0
4-Terphenyl-d14	%																											66.4	69.2	69.5
Benzo(a)pyrene	ug/L																									<0.5		<0.5	<0.5	<0.05
Carbonate as CaCO3	mg CaCo3/L			<1				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1
Total Anions	meq/L						7.45	7.59	6.59	8.23	7.71	7.00	7.79	7.76	7.8	7.69	7.96	7.53	7.57	7.40	7.52	6.84	7.51	7.02	7.48		6.95	7.13	7.42	6.44
Total Cations	meq/L						7.41	7.34	6.79	7.92	7.85	7.18	7.84	8.02	7.75	7.97	8.00	7.44	7.53	7.57	7.24	7.09	7.27	7.21	7.45		7.23	7.23	7.20	6.58
Ionic Balance	%						0.26	1.64	1.47	1.92	0.89	1.28	0.33	1.59	0.29	1.80	0.22	0.62	0.24	1.12	1.90	1.76	1.61	1.31	0.18		1.96	0.69	1.47	1.04
Salinity	ppt		<2																											
pH Value	pH units	6.9	7.5	7.2	6.8	7.25	6.72	6.78	6.63	8.08	7.95	6.99	6.65	6.8	7.54	6.8	6.9	7.0	7.0	7.80	6.99	7.0	7.0	7.2	6.7	7.7	6.77	7.5	7.7	6.9
Electrical Conductivity at 25°C	uS/cm	750	790	800	819	763	782	748	721	765	760	734	756	780	766	720	760	769	760	763	761	730	820	843	740	867	769	710	770	810
Total Dissolved Solids @ 180°C	mg/L																									470	512	460	492	498
Suspended Solids	mg/L	2	6		<1	4	4	1	4	<1	10	3	1	<1	4	<1	3	2	<1	2	3	<1	2	2	<5	8	6	21	12	<5
Oil and Grease	mg/L	0.2			6	<5	<5	<10	<5	<5	<5	<5	6	<5	<5	<5	<5	<5	18	<5	<5	<5	<5	<5	<5	<5		<5	<5	
Total Dissolved Solids	mg/L		760	620																										
Total Hardness as CaCO3	mg/L																									298	299	274	284	270
Turbidity	NTU		4.7(mg/L)																							12.8	3.3	5.5	5.0	2.9
Faecal Coliforms (*E.coli*)	CFU/100ml	<2																								<1	<1	<1	<1	<2

Wingecarribee River Upstream Water Qualtiy Data

Parameter	Unit	Wingecarribee River Upstream (11 March 2010)	Wingecarribee River Upstream (20 April 2010)	Wingecarribee River Upstream (10 May 2010)	Wingecarribee River Upstream (8 July 2010)	Wingecarribee River Upstream (25 Aug 2010)	Wingecarribee River Upstream (1 Oct 2010)	Wingecarribee River Upstream (29 Oct 2010)	Wingecarribee River Upstream (2 December 2010)	Wingecarribee River Upstream (1 February 2011)
Arsenic	mg/L	<0.001	<0.001							
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0083	<0.0001	<0.0001	0.0001	<0.0001
Calcium	mg/L	12		10	6	11	13	12	11	5
Cobalt	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.003	0.002	0.002	0.002	<0.001	0.001	0.004	<0.001
Iron	mg/L	0.61	0.24	0.52	0.38	0.96	0.35	0.33	1.88	0.71
Magnesium	mg/L	6		5	4	7	8	7	5	4
Manganese	mg/L	0.247	0.049	0.115	0.029	0.042	0.049	0.080	0.113	0.034
Nickel	mg/L	0.003	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.003	<0.001
Potassium	mg/L	5		5	3	4	6	5	4	<1
Sodium	mg/L	14		20	12	18	25	23	13	9
Zinc	mg/L	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	0.009	<0.005
Bromide	mg/L			0.08	0.048	0.060	0.087	0.110	0.083	0.10
Chloride	mg/L			29.2	22.5	36.9	44.5	42.6	26	15.9
Bicarbonate	mg CaCo3/L				22	39	42	51	38	21
Sulphate	mg/L			21.4	11.2	11.7	20.0	14.7		5.83
Sulfate as SO4 - Turbidimetric	mg/L								<1	
Hydroxide Alkalinity as CaCO3	mg/L				<1	<1	<1	<1	<1	<1
Total Alkalinity as CaCO3	mg/L				22	39	42	51	38	21
Ammonia as N	mg/L				<0.01	0.04	0.02	0.05	0.10	<0.01
Nitrite as N	mg/L				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L				0.025	0.44	0.18	0.02	0.39	<0.01
Nitrite + Nitrate as N	mg/L				0.025	0.44	0.18		0.39	<0.01
Total Phophorus as P	mg/L				0.18	0.10	0.14	0.12	0.13	0.1
Carbonate as CaCO3	mg CaCo3/L				<1	<1	<1	<1	<1	<1
Total Anions	meq/L			1.98	1.31	2.07	2.50	2.53	1.50	1.00
Total Cations	meq/L			1.88	1.19	2.02	2.58	2.33	1.66	0.96
Ionic Balance	%									
Salinity	ppt									
pH Value	pH units	7.83	7.89	7.43	6.74	7.4	7.9	7.44	7.4	7.6
Electrical Conductivity at 25°C	uS/cm	206	268	217	146	200	280	264	197	80
Suspended Solids	mg/L	14	4		12	7	6	6	34	26
Oil and Grease	mg/L	<5	<5	<5						
BOD (mg/L)	mg/L	<2	2	3						
Faecal Coliforms (*E.coli*)	CFU/100ml		40	30						
Total Dissolved Solids	mg/L									
Turbidity	mg/L									
Heterotrophic Plate Count (22°C/72 hrs)	CFU/ml		760	2600						
Heterotrophic Plate Count (36°C)	CFU/ml		1000	~500						

Wingeccarribee River Downstream Water Quality Data

	Unit	Wingecarribee River Downstream (11 March 2010)	Wingecarribee River Downstream (20 April 2010)	Wingecarribee River Downstream (10 May 2010)	Wingecarribee River Downstream (8 July 2010)	Wingecarribee River Downstream (25 Aug 2010)	Wingecarribee River Downstream (1 Oct 2010)	Wingeccarribee River Downstream (29 Oct 2010)	Wingecarribee River Downstream (2 December 2010)	Wingecarribee River Downstream (1 February 2011)
Arsenic	mg/L	<0.001	<0.001							
Cadmium	mg/L	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0002
Calcium	mg/L	17		13	11	12	15	16	12	6
Cobalt	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Copper	mg/L	0.002	0.002	0.004	0.002	0.002	<0.001	<0.001	0.006	<0.001
Iron	mg/L	0.50	0.42	0.40	0.45	0.82	0.26	0.23	2.14	0.65
Magnesium	mg/L	10		7	8	8	10	11	6	4
Manganese	mg/L	0.217	0.110	0.078	0.063	0.055	0.090	0.122	0.165	0.081
Nickel	mg/L	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.002
Potassium	mg/L	4		6	3	4	5	4	5	<1
Sodium	mg/L	18		23	14	21	24	22	18	10
Zinc	mg/L	0.006	0.007	0.009	<0.005	0.006	<0.005	<0.005	0.011	<0.005
Bromide	mg/L			0.09	0.049	0.070	0.079	0.101	0.085	0.1
Chloride	mg/L			34.0	24.7	41.4	44.2	41.0	23	17.2
Bicarbonate	mg CaCo3/L				30	44	38	50	49	22
Sulphate	mg/L			30.2	29.4	17.9	40.2	38.0		8.7
Sulfate as SO4 - Turbidimetric	mg/L								10	
Hydroxide Alkalinity as CaCO3	mg/L				<1	<1	<1	<1	<1	<1
Total Alkalinity as CaCO3	mg/L				30	44	38	50	49	22
Ammonia as N	mg/L				<0.01	<0.01	<0.01	0.03	0.07	<0.01
Nitrite as N	mg/L				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L				0.016	0.30	0.12	0.03	0.24	<0.01
Nitrite + Nitrate as N	mg/L				0.016	0.30	0.12		0.24	<0.01
Total Phophorus as P	mg/L				0.30	0.11	0.08	0.02	0.04	0.05
Carbonate as CaCO3	mg CaCo3/L				<1	<1	<1	<1	<1	<1
Total Anions	meq/L			2.45	1.91	2.42	2.84	2.94	1.84	1.11
Total Cations	meq/L			2.38	1.89	2.28	2.82	2.77	2.00	1.05
Ionic Balance	%									
Salinity	ppt									
pH Value	pH units	7.73	7.62	7.40	6.89	7.3	7.5	7.36	7.4	7.8
Electrical Conductivity at 25°C	uS/cm	297	284	275	208	230	270	316	164	100
Suspended Solids	mg/L	7	4		12	3	2	4	88	16
Oil and Grease	mg/L	<5	5	<5						
BOD (mg/L)	mg/L	2	3	3						
Faecal Coliforms (*E.coli*)	CFU/100ml		~ 18	72						
Total Dissolved Solids	mg/L									
Turbidity	mg/L									
Heterotrophic Plate Count (22°C/72 hrs)	CFU/ml		830	2000						
Heterotrophic Plate Count (36°C)	CFU/ml		1200	780						

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES0912767**	Page	: 1 of 3
Client	: **BERRIMA COAL PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR ROBERT BYRNES	Contact	: Charlie Pierce
Address	: C/O BERRIMA POST OFFICE BERRIMA NSW, AUSTRALIA 2577	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: robert.byrnes@iec.com.au	E-mail	: charlie.pierce@alsenviro.com
Telephone	: +61 48785502	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 48785503	Facsimile	: +61-2-8784 8500
Project	: ENVIRONMENT PROTECTION LICENE MONITORING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 26-AUG-2009
Sampler	: ROB BYRNES	Issue Date	: 31-AUG-2009
Site	: BERRIMA COLLIERY		
		No. of samples received	: 4
Quote number	: ----	No. of samples analysed	: 4

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Duyen Nguyen	Senior Microbiologist	Microbiology
Hoa Nguyen	Inorganic Chemist	Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: WATER			Client sample ID	ADIT POINT1	STAFF BATH HOUSE	MAIN BATH HOUSE	TANK WATER	----
			Client sampling date / time	[26-AUG-2009]	[26-AUG-2009]	[26-AUG-2009]	[26-AUG-2009]	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES0912767-001**	**ES0912767-002**	**ES0912767-003**	**ES0912767-004**	**----**
EA005: pH								
pH Value	----	0.01	pH Unit	**7.17**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**737**	----	----	----	----
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**2**	----	----	----	----
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	----	----	----	----
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	----	----	----	----
MW006: Faecal Coliforms & E.coli by MF								
Escherichia coli	Ecoli	1	CFU/100mL	----	<1	<1	<1	----

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1003657**	Page	: 1 of 4
Client	: **BERRIMA COAL PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR ROBERT BYRNES	Contact	: Charlie Pierce
Address	: C/O BERRIMA POST OFFICE BERRIMA NSW, AUSTRALIA 2577	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: robert.byrnes@iec.com.au	E-mail	: charlie.pierce@alsenviro.com
Telephone	: +61 48785502	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 48785503	Facsimile	: +61-2-8784 8500
Project	: ENVIRONMENT PROTECTION LICENCE MONITORING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 26-FEB-2010
Sampler	: RB	Issue Date	: 08-MAR-2010
Site	: BERRIMA COLLIERY		
		No. of samples received	: 4
Quote number	: ----	No. of samples analysed	: 4

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

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Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Spectroscopist	Inorganics
Hoa Nguyen	Inorganic Chemist	Inorganics
Sarah Axisa	Microbiologist	Microbiology

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **Microbiological comment: QWI-MIC04, estimate (~) is reported where the colonies forming unit on the filtered membrane is counted <10cfu and/or >100cfu.**
- **MW002 is ALS's internal code and is equivalent to AS4276.3.1.**
- **MW006 is ALS's internal code and is equivalent to AS4276.7.**

Analytical Results

Sub-Matrix: WATER			Client sample ID	V NOTCH ADIT POINT 1	STAFF BATH HOUSE	MAIN BATH HOUSE	DRINKING WATER TANK	----
			Client sampling date / time	26-FEB-2010 14:30	26-FEB-2010 14:50	26-FEB-2010 14:50	[26-FEB-2010]	----
Compound	CAS Number	LOR	Unit	ES1003657-001	ES1003657-002	ES1003657-003	ES1003657-004	----
EA005: pH								
pH Value	----	0.01	pH Unit	**6.80**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**819**	----	----	----	----
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	<1	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**55**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**45**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**32**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**3**	----	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	----	----	----	----
Dysprosium	7429-91-6	0.001	mg/L	<0.001	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	----	----
Erbium	7440-52-0	0.001	mg/L	<0.001	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Europium	7440-53-1	0.001	mg/L	<0.001	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.275**	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.052**	----	----	----	----
Gadolinium	7440-54-2	0.001	mg/L	<0.001	----	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Gallium	7440-55-3	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0006**	----	----	----	----
Hafnium	7440-58-6	0.01	mg/L	<0.01	----	----	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.053**	----	----	----	----
Holmium	7440-60-0	0.001	mg/L	<0.001	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.011**	----	----	----	----

Analytical Results

Sub-Matrix: WATER			Client sample ID	V NOTCH ADIT POINT 1	STAFF BATH HOUSE	MAIN BATH HOUSE	DRINKING WATER TANK	----
			Client sampling date / time	26-FEB-2010 14:30	26-FEB-2010 14:50	26-FEB-2010 14:50	[26-FEB-2010]	----
Compound	CAS Number	LOR	Unit	ES1003657-001	ES1003657-002	ES1003657-003	ES1003657-004	----
EG020T: Total Metals by ICP-MS - Continued								
Lithium	7439-93-2	0.001	mg/L	**0.073**	----	----	----	----
Lutetium	7439-94-3	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**2.94**	----	----	----	----
Neodymium	7440-00-8	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Praseodymium	7440-10-0	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.213**	----	----	----	----
Samarium	7440-19-9	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Terbium	7440-27-9	0.001	mg/L	<0.001	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Thulium	----	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	----	----	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.323**	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.20**	----	----	----	----
EP020: Oil and Grease (O&G)								
^ Oil & Grease	----	5	mg/L	**6**	----	----	----	----
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	**2**	----	----	----	----
MW002: Heterotrophic Plate Count								
Heterotrophic Plate Count (22°C/72hrs)	----	1	CFU/mL	----	----	----	**180**	----
Heterotrophic Plate Count (36°C)	----	1	CFU/mL	----	----	----	**70**	----
MW006: Faecal Coliforms & E.coli by MF								
Escherichia coli	Ecoli	1	CFU/100mL	----	<1	<1	**~6**	----

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1004616**	Page	: 1 of 5
Amendment	: **1**		
Client	: **BERRIMA COAL PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR ROBERT BYRNES	Contact	: Charlie Pierce
Address	: C/O BERRIMA POST OFFICE BERRIMA NSW, AUSTRALIA 2577	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: robert.byrnes@iec.com.au	E-mail	: charlie.pierce@alsenviro.com
Telephone	: +61 48785502	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 48785503	Facsimile	: +61-2-8784 8500
Project	: MONITORING	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 11-MAR-2010
Sampler	: ----	Issue Date	: 08-APR-2010
Site	: ----		
		No. of samples received	: 2
Quote number	: ----	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

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Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Spectroscopist	Inorganics
Hoa Nguyen	Inorganic Chemist	Inorganics

General Comments

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Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **LCS recovery for some elements falls outside ALS Dynamic Control Limit. However, they are within the acceptance criteria based on ALS DQO. No further action is required.**

Analytical Results

Sub-Matrix: WATER			Client sample ID	WINGECARRIBEE RIVER UPSTREAM	WINGECARRIBEE RIVER DOWNSTREAM	----	----	----
			Client sampling date / time	[11-MAR-2010]	[11-MAR-2010]	----	----	----
Compound	CAS Number	LOR	Unit	ES1004616-001	ES1004616-002	----	----	----
EA005: pH								
pH Value	----	0.01	pH Unit	7.83	7.73	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	206	297	----	----	----
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	14	7	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	12	17	----	----	----
Magnesium	7439-95-4	1	mg/L	6	10	----	----	----
Sodium	7440-23-5	1	mg/L	14	18	----	----	----
Potassium	7440-09-7	1	mg/L	5	4	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.05	0.04	----	----	----
Dysprosium	7429-91-6	0.001	mg/L	<0.001	<0.001	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	----	----	----
Erbium	7440-52-0	0.001	mg/L	<0.001	<0.001	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	----	----	----
Europium	7440-53-1	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	0.094	0.090	----	----	----
Barium	7440-39-3	0.001	mg/L	0.040	0.039	----	----	----
Gadolinium	7440-54-2	0.001	mg/L	<0.001	<0.001	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Gallium	7440-55-3	0.001	mg/L	<0.001	<0.001	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Hafnium	7440-58-6	0.01	mg/L	<0.01	<0.01	----	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Holmium	7440-60-0	0.001	mg/L	<0.001	<0.001	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	0.001	0.002	----	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	----	----	----

Analytical Results

Sub-Matrix: **WATER**			*Client sample ID*	**WINGECARRIBEE RIVER UPSTREAM**	**WINGECARRIBEE RIVER DOWNSTREAM**	----	----	----
			Client sampling date / time	[11-MAR-2010]	[11-MAR-2010]	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1004616-001**	**ES1004616-002**	**----**	**----**	**----**
EG020T: Total Metals by ICP-MS - Continued								
Rubidium	7440-17-7	0.001	mg/L	**0.006**	**0.006**	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.006**	**0.006**	----	----	----
Lutetium	7439-94-3	0.001	mg/L	<0.001	<0.001	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.247**	**0.217**	----	----	----
Neodymium	7440-00-8	0.001	mg/L	<0.001	<0.001	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	----	----	----
Praseodymium	7440-10-0	0.001	mg/L	<0.001	<0.001	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.003**	**0.003**	----	----	----
Samarium	7440-19-9	0.001	mg/L	<0.001	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Terbium	7440-27-9	0.001	mg/L	<0.001	<0.001	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	----	----	----
Thulium	7440-30-4	0.001	mg/L	<0.001	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	----	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	----	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.006**	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.61**	**0.50**	----	----	----
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	<5	----	----	----
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	**2**	----	----	----

Appendix K

Soil and Water Management Plans

CONSTRUCTION AND MAINTENANCE NOTES

DIVERSION DRIANS

- ALL DIVERSION DRAINS ARE TO BE MAINTAINED IN A FUNCTIONING CONDITION.
- ANY SEDIMENTS ACCUMULATING IN THE DIVERSION DRAINS/STRUCTURES ARE TO BE REMOVED AND DEPOSITED IN A SAFE AREA.
- DIVERSIONS DRAINS ARE TO BE INSPECTED FORTNIGHTLY AND AFTER THE CONCLUSION OF ANY RAINFALL EVENT AND ANY DAMAGED OR ERODED AREAS REPAIRED.

SEDIMENT BASINS

- SEDIMENT BASIN SIZES AND DETAILS ARE SHOWN ON THE RELEVANT DRAWINGS (10000019-SWMP01 AND 10000019-SWMP02).
- ALL SEDIMENT BASINS ARE TO BE BUILT TO INCORPORATE A PRIMARY OUTLET (WEIR OVERFLOW) SIZED TO HAVE A CAPACITY TO PASS THE 100 YEAR PEAK FLOW. WEIR OVERFLOW SIZES ARE DETAILED ON THE RELEVANT DRAWINGS (10000019-SWMP01 AND 10000019-SWMP02). ALL WEIR OVERFLOWS ARE TO BE ROCK LINED.
- ENERGY DISSIPATERS ARE TO BE CONSTRUCTED AT THE OUTLETS OF THE WEIR OVERFLOWS. CONSTRUCT OUT OF ROCK RIP-RAP (6-INCH). SEE STANDARD DRAWING SD 5-8.
- SEDIMENT BASINS ARE TO BE DRAINED IN ACCORDANCE WITH THE DETAILS AND REQUIREMENTS FOR THE INDIVIDUAL SEDIMENT BASINS AS SHOWN ON THE RELEVANT DRAWINGS (10000019-SWMP01 AND 10000019-SWMP02)
- ENSURE ALL BASINS HAVE A MINIMUM 3:1 LENGTH TO WIDTH RATIO TO MAXIMISE SETTLING OF SUSPENDED SEDIMENTS. IF THIS IS NOT PRACTICAL INSTALL BAFFLES TO ACHIEVE THIS.
- A "FULL OF SEDIMENT MARKER" SHOULD BE PLACED WITHIN EACH BASIN TO SHOW WHEN LESS THAN DESIGN DESIGN CAPACITY OCCURS AND SEDIMENT REMOVAL IS REQUIRED.
- THE SETTLING ZONE SHOULD BE A MINIMUM OF 0.6M DEEP ABOVE THE SEDIMENT STORAGE ZONE.
- ALL PUMPS SHOULD BE FLOAT ACTIVATED - DRAW WATER FROM THE TOP.
- THE SEDIMENT BASINS MUST BE INSPECTED FORTNIGHTLY AND AFTER ANY RAINFALL EVENT AND ANY DAMAGED OR ERODED AREAS REPAIRED.

SEDIMENT BASIN 1 (SB1)

CATCHMENT AREA (CA1) DETAILS
TOTAL CA1 = 0.38ha
DISTURBED CA1 = 0.38ha
SLOPE GRADIENT = 10%
SLOPE LENGTH = 80m
LS FACTOR = 2.81
SOIL LOSS = 217 tonnes/ha/year

REQUIRED BASIN VOLUME
SEDIMENT STORAGE VOLUME = $11m^3$
SETTLING ZONE VOLUME = $29m^3$
TOTAL BASIN VOLUME = $40m^3$

CONSTRUCT SB1 IN ACCORDANCE WITH STANDARD DRAWING SD 6-1

CRITICAL BASIN ELEMENTS:
ENSURE THE FOLLOWING FEATURES ARE INCORPORATED INTO THE SEDIMENT BASIN:

- LENGTH TO WIDTH RATIO OF 3:1 (ie. 12m LONG BY 4m WIDE)

- HAVE A MINIMUM BASIN SURFACE AREA OF $48m^2$

- SETTLING ZONE DEPTH = 0.6m (MINIMUM)

- SPILLWAY:
BASE: 1m
SIDE SLOPES: 1:3
DEPTH: 0.3m
ROCK LINED

SB1 & SB2 DRAINING REQUIREMENTS

SEDIMENT BASINS SB1 AND SB2 TO BE DRAINED AND CLEANED OUT WITHIN 5 DAYS AFTER THE CONCLUSION OF ANY RAINFALL EVENT.

THIS WILL REQUIRE PUMPING THE BASINS DRY AND REMOVING ANY SEDIMENT ACCUMULATING ABOVE THE "FULL OF SEDIMENT" MARKER.

FLOAT ACTIVATED PUMPS (THAT PUMP THE WATER FROM THE SURFACE) WITH SUFFICIENT CAPACITY TO DRAIN THE SETTLING ZONE VOLUMES OF THE SEDIMENT BASINS WITHIN 3 DAYS SHOULD BE PROVIDED:
- SB1 PUMP TO HAVE PUMPING CAPACITY OF 0.12L/s
- SB2 PUMP TO HAVE PUMPING CAPACITY OF 0.4L/s

WATER FROM THESE BASINS SHOULD BE PUMPED INTO SB3 FOR FINAL SETTLING OF SUSPENDED SEDIMENTS. HOWEVER, IF THE WATER CONTAINS 50mg/L OR LESS OF SUSPENDED SEDIMENTS (TESTING IS REQUIRED TO ENSURE THIS) IT CAN BE SIMPLY PUMPED ONTO A STABILISED OUTLET POINT NEXT TO SB1/SB2.

PUMPS ARE TO BE LOCATED AT THE OPPOSITE ENDS OF THE BASINS TO THE DIVERSION DRAIN INLETS (AS SHOWN) TO MAXIMISE SETTLING OF SUSPENDED SEDIMENTS.

SEDIMENT BASIN 2 (SB2)

CATCHMENT AREA (CA2) DETAILS
TOTAL CA2 = 1.29ha
DISTURBED CA2 = 0.712ha
SLOPE GRADIENT = 8%
SLOPE LENGTH = 80m
LS FACTOR = 2.05
SOIL LOSS = 158 tonnes/ha/year

REQUIRED BASIN VOLUME
SEDIMENT STORAGE VOLUME = $15m^3$
SETTLING ZONE VOLUME = $98m^3$
TOTAL BASIN VOLUME = $113m^3$

EXISTING BASIN
ESTIMATED CAPACITY = $162m^3$
(ASSUMING 30m x 6m x 0.9m)
(SUFFICIENT)

CRITICAL BASIN ELEMENTS:
ENSURE THE FOLLOWING FEATURES ARE INCORPORATED INTO THE SEDIMENT BASIN:

- LENGTH TO WIDTH RATIO OF 3:1
(SUFFICIENT)

- HAVE A MINIMUM BASIN SURFACE AREA OF $164m^2$
(SUFFICIENT)

- SETTLING ZONE DEPTH = 0.6m (MINIMUM)

- SPILLWAY:
BASE: 2m
SIDE SLOPES: 1:3
DEPTH: 0.3m
ROCK LINED
(REBUILD IN LOCATION SHOWN)

SEDIMENT BASIN 3 (SB3)

CATCHMENT AREA (CA3) DETAILS
TOTAL CA3 = 2.694ha
DISTURBED CA3 = 0.69ha
SLOPE GRADIENT = 10%
SLOPE LENGTH = 80m
LS FACTOR = 2.81
SOIL LOSS = 217 tonnes/ha/year

REQUIRED BASIN VOLUME
SEDIMENT STORAGE VOLUME = $20m^3$
SETTLING ZONE VOLUME = $205m^3$
TOTAL BASIN VOLUME = $225m^3$

SB3 TO INCORPORATE ADDITIONAL VOLUME TO TAKE SETTLING ZONE VOLUMES OF SB1 AND SB1 WHEN REQUIRED.

ADDITIONAL REQUIRED VOLUME = $127m^3$

EXISTING BASIN
ESTIMATED CAPACITY = $1200m^3$
(SUFFICIENT)

CRITICAL BASIN ELEMENTS:
ENSURE THE FOLLOWING FEATURES ARE INCORPORATED INTO THE SEDIMENT BASIN:

- SB3 IS TO BE SELF DRAINING
(SUFFICIENT)

- LENGTH TO WIDTH RATIO OF 3:1
(SUFFICIENT)

- HAVE A MINIMUM BASIN SURFACE AREA OF $225m^2$
(SUFFICIENT)

- SETTLING ZONE DEPTH = 0.6m (MINIMUM)

- SPILLWAY:
BASE: 3m
SIDE SLOPES: 1:3
DEPTH: 0.4m
ROCK LINED
(REBUILD TO SUIT)

REV	DATE	BY	APP.	REVISION DETAILS
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DRAWN BY	A.J.B.	05/10
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PROJECT TITLE
BERRMIA COLLIERY
MEDWAY
WATER MANAGEMENT UPGRADE

DRAWING TITLE
SWMP MAIN COLLIERY AREA, CONSTRUCTION & MAINTENANCE NOTES

PROJECT NO.	SHEET NO.	REV
10000019	SWMP01	A

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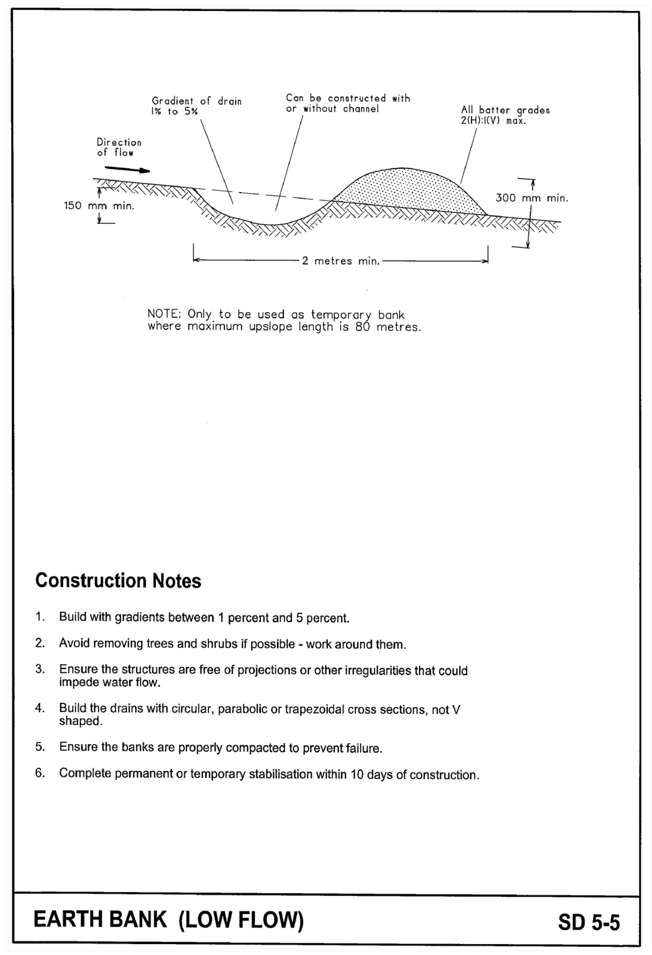
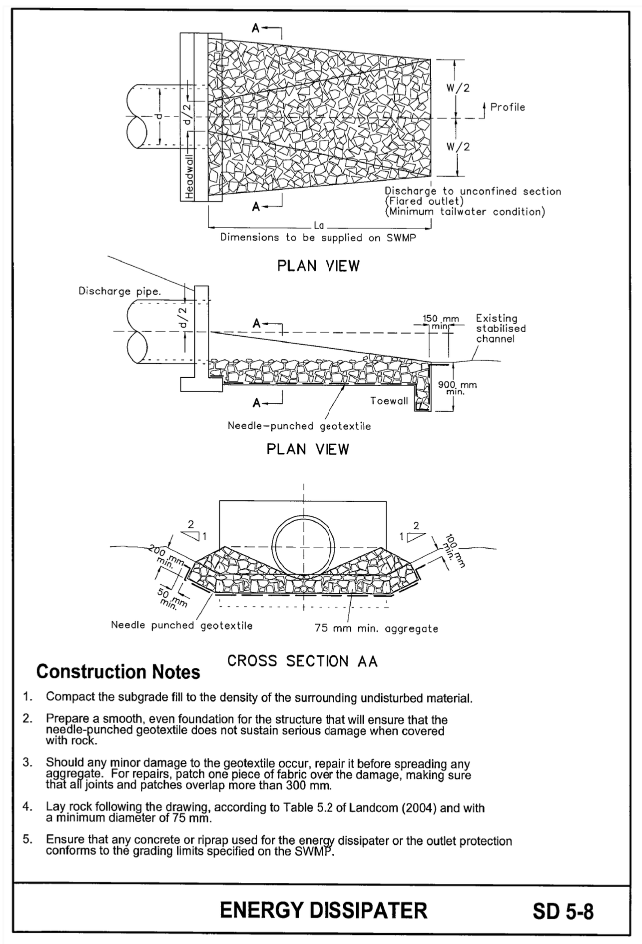


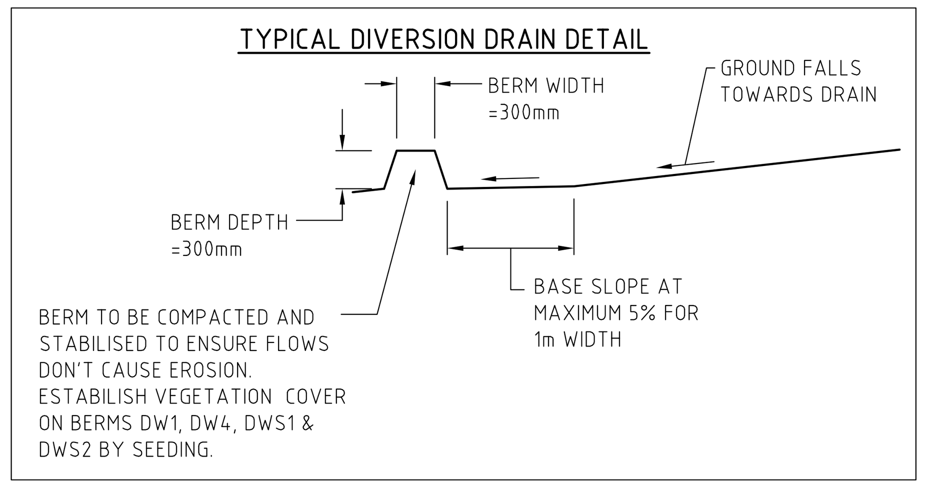


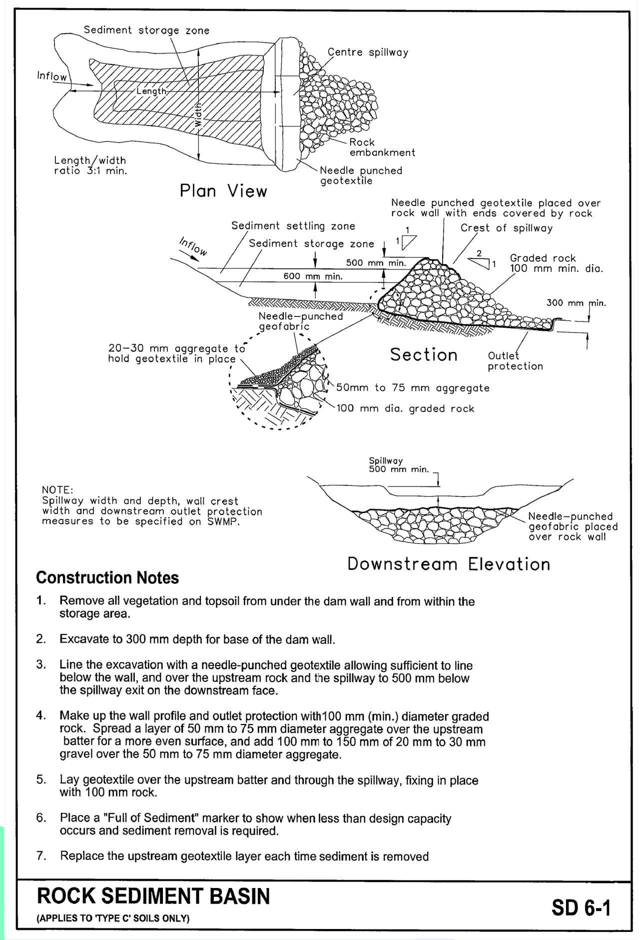
DIVERSION DRAIN DETAILS

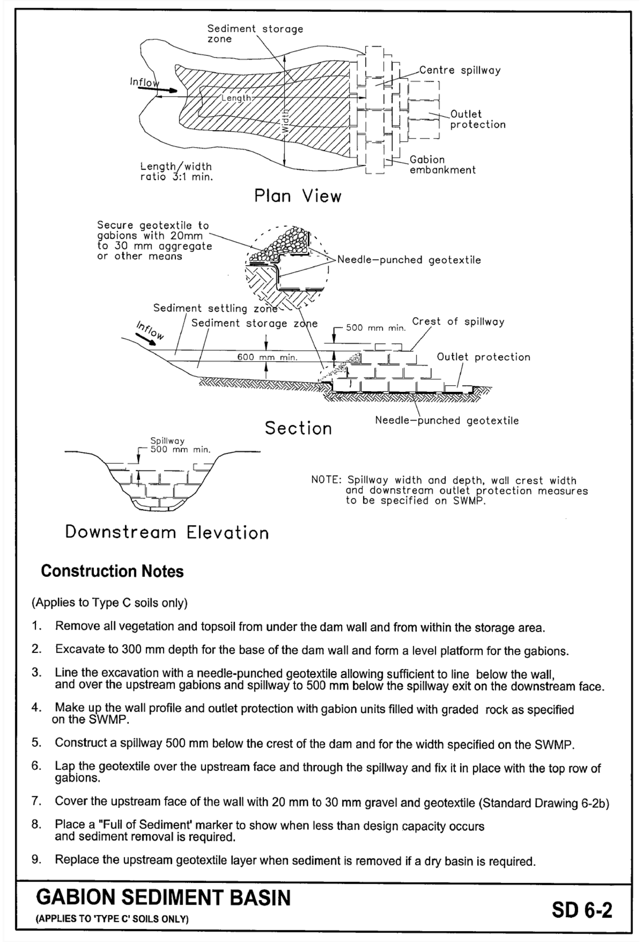
DIVERSION DRAIN	TYPE	COMMENT
CW1	EXISTING ROADSIDE DRAIN	SATISFACTORY
CW2	EXISTING ROADSIDE DRAIN	SEDIMENT BASINS SB2 & SB3 HAVE SUFFICIENT SIZE TO TAKE CLEAN WATER FLOWS ENTERING FROM CW2, CW3, CW4, CW5, GD1 & GD2 IF THEY SHOULD FAIL. THEREFORE THESE DRAINS DO NOT NEED TO BE SIZED TO TAKE THE DESIGN STORM EVENT. HOWEVER, THESE DRAINS SHOULD STILL REMAIN AND BE PROPERLY MAINTAINED (IN ACCORDANCE WITH THE MAINTENANCE NOTES) IN ORDER TO MINIMISE THE CLEAN WATER FLOWS FROM MINOR STORM EVENTS ENTERING THE WORKS AREA.
CW3	EXISTING CLEAN WATER DIVERSION DRAIN	
CW4	EXISTING CLEAN WATER DIVERSION DRAIN	
CW5	EXISTING CLEAN WATER DIVERSION DRAIN	
GD1	EXISTING GRATED DRAIN ACROSS ROADWAY	
GD2	EXISTING GRATED DRAIN ACROSS ROADWAY	
P1	EXISTING PIPE CULVERT UNDER ACCESS TRACK	SATISFACTORY
DW1	NEW DIRTY WATER DIVERSION DRAIN	CONSTRUCT AS PER DIVERSION DRAIN DETAIL
DW2	NEW DIRTY WATER DIVERSION MOUND	CONSTRUCT AS A LOW FLOW EARTH BANK (SEE SD 5-5)
DW3	EXISTING DIRTY WATER DIVERSION DRAIN	UPGRADE AS PER DIVERSION DRAIN DETAIL
DW4	EXISTING DIRTY WATER DIVERSION DRAIN	UPGRADE AS PER DIVERSION DRAIN DETAIL AND DETAIL 1
DW5	EXISTING DIRTY WATER DIVERSION	UPGRADE AS PER DIVERSION DRAIN DETAIL AND DETAIL 1
DWS1	NEW DIRTY WATER DIVERSION MOUND	CONSTRUCT AS PER DIVERSION DRAIN DETAIL
DWS2	NEW DIRTY WATER DIVERSION DRAIN	CONSTRUCT AS PER DIVERSION DRAIN DETAIL
DWS3	EXISTING SURFACE WATER FLOWS	SATISFACTORY

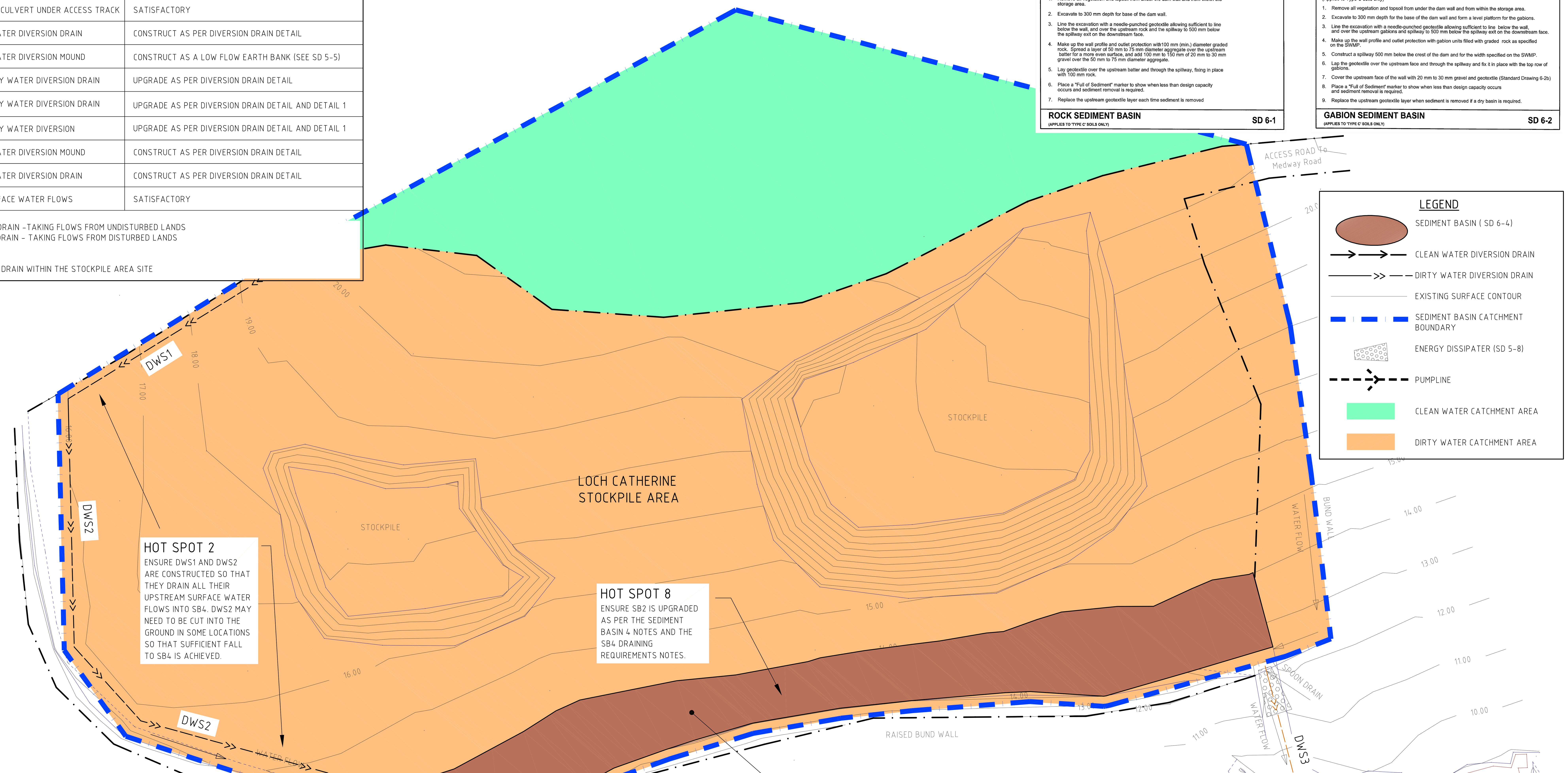
CW - CLEAN WATER DIVERSION DRAIN - TAKING FLOWS FROM UNDISTURBED LANDS
DW - DIRTY WATER DIVERSION DRAIN - TAKING FLOWS FROM DISTURBED LANDS
GD - GRATED DRAIN
P - PIPE/CULVERT
DWS - DIRTY WATER DIVERSION DRAIN WITHIN THE STOCKPILE AREA SITE

TYPICAL DIVERSION DRAIN DETAIL









BACKGROUND AND CALCULATIONS

RUSLE: A = SOIL LOSS (tonnes/ha/yr) = R.K.LS.P.C.

THE AVERAGE ANNUAL SOIL LOSS CALCULATIONS WERE UNDERTAKEN USING THE "BLUE BOOK" - MANAGING URBAN STORMWATER (LANDCOM, 2004)

R-FACTOR	2200 (MANAGING URBAN STORMWATER, LANDCOM (2004))
K-FACTORS MEASURED	0.027 (MAIN QUARRY AREA - SB1, SB2 & SB3) 0.023 (STOCKPILE AREA - SB4)
LS-FACTOR	SEE INDIVIDUAL SEDIMENT BASIN CATCHMENT AREA NOTES
P-FACTOR	1.3 - DEFAULT ASSUMED
C-FACTOR	1 - DEFAULT ASSUMED
SOIL LOSS	SEE INDIVIDUAL SEDIMENT BASIN CATCHMENT AREA NOTES

THE "BLUE BOOK" REQUIRES THE INSTALLATION OF A SEDIMENT BASIN IF THE SOIL LOSS > 200 tonnes/yr FROM THE SITE.
THEREFORE SEDIMENT BASINS ARE REQUIRED.

SEDIMENT BASIN 4

CATCHMENT AREA (CA4) DETAILS
TOTAL CA = 2.964ha
DISTURBED CA = 2.39ha
SLOPE GRADIENT = 9%
SLOPE LENGTH = 150m
LS FACTOR = 3.6
SOIL LOSS = 237 tonnes/ha/year

REQUIRED BASIN VOLUME
SEDIMENT STORAGE VOLUME = $74m^3$
SETTLING ZONE VOLUME = $226m^3$
TOTAL BASIN VOLUME = $300m^3$

EXISTING SEDIMENT CAPTURE AREA
ESTIMATED CAPACITY = $600m^3$
(ASSUMING 0.8m DEPTH TO SPILLWAY)
(SUFFICIENT)

CRITICAL BASIN ELEMENTS:
ENSURE THE FOLLOWING FEATURES ARE INCORPORATED INTO THE SEDIMENT BASIN:

- SETTLING ZONE DEPTH = 0.6m (MINIMUM)

- SPILLWAY:
  BASE: 3m
  SIDE SLOPES: 1:3
  DEPTH: 0.4m
  ROCK LINED
  (REBUILD TO SUIT)

SB4 DRAINING REQUIREMENTS

SEDIMENT BASIN SB4 IS TO BE SELF DRAINING, HOWEVER, IF WATER DOESN'T DRAIN FROM THIS BASIN TO AT LEAST 0.6m BELOW THE SPILLWAY LEVEL (IE. THE SETTLING ZONE DEPTH) WITHIN 5 DAYS AFTER THE CONCLUSION OF A RAINFALL EVENT IT SHOULD BE PUMPED/SIPHONED INTO THE FILTER DAM BELOW FOR FINAL SETTLING.

IF THE FILTER DAM BELOW SB4 IS REQUIRED FOR FINAL SETTLING PURPOSES, ENSURE IT HAS PREVIOUSLY BEEN SIPHONED DRY AND CLEANED OUT AFTER ADEQUATE SETTLING OF THE WATER WAS ACHIEVED.

REV	DATE	BY	APP.	REVISION DETAILS
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PROJECT TITLE
BERRMIA COLLIERY
MEDWAY
WATER MANAGEMENT UPGRADE

DRAWING TITLE
SWMP STOCKPILE AREA, STANDARD DRAWINGS, NOTES & DETAILS

PROJECT NO.	SHEET NO.	REV
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Appendix L

Terrestrial Ecology Assessment

Environmental &
Heritage Management P/L

Berrima Colliery continued operations and implementation of Asset Protection Zones.

Terrestrial Ecology Assessment

Wingecarribee Local Government Area

August 2010

Report Prepared by

OzArk Environmental & Heritage Management Pty Ltd

For

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Executive Summary

This ecological report was commissioned by Boral Cement. This assessment is to document ecological values in the Subsidence Management Plan Area (SMP), assess ecological impacts associated with extending the area of occupancy of the existing coal stockpile at Loch Catherine (by 20 m north and east) as well as implementing a 20 m Asset Protection Zone (APZ) and implementing an APZ around the existing Berrima Colliery pit top area.

Works for the APZ and coal stockpile extension will require vegetation clearing and ground disturbing activities.

This report has been prepared to support an application under Part 3A of the Environmental Planning & Assessment Act 1979 for continued operations at the colliery.

Within the SMP Area vegetation was mapped as follows:

- Wingecarribee Woodland on valley floors (two main remnants of 9.76 + 0.3 ha = 10.06 ha);
- Robertson Basalt Tall Open-forest EEC in NSW (three main remnants of 0.5 + 3.56 +0.1 ha = 4.16 ha);
- Southern Highlands Shale Woodlands EEC in NSW (three main remnants of 1.56 + 0.5 + 1.88 ha = 3.94 ha);
- Mittagong Sandstone Woodland on lower slopes (2.32 ha); and
- Cleared land (approximately 152 ha).

Predicted subsidence would not place any of these vegetation communities at risk of local extinction, nor would it place at risk any threatened species dependant on the habitat values upon which it contains.

Implementing a 20 m APZ around the existing Berrima Colliery pit top would see all understorey removed and tree thinning within:

- Regrowth Wingecarribee Woodland on valley floors (0.08 ha); and
- Regrowth Mittagong Sandstone Woodland on lower slopes (1.27 ha).

The nature and scale of the activity within this regrowth vegetation is unlikely to place any of the regions threatened species at risk of local extinction. One species of ROTAP ‘rare’ tree *Eucalyptus apiculata* (a mallee) was recorded within the Impact Footprint (the area to be physically altered) and beyond. Recommendations within this report would see individuals avoided where possible and work crews inducted so as to educate them about the species so any extant individuals would be identified and protected. It is unlikely that the activity would place this ROTAP species at risk of local extinction.

Extension of the existing coal stockpile area at Loch Catherine would see 1.17 ha in the APZ and 1.07 ha in the extension area of Mittagong Sandstone Woodland on lower slopes removed. Although vegetation within this study area is comprised largely of regrowth, the stockpile extension area and APZ to its north would see approximately 10 to 15 hollow bearing trees removed. An inspection of these trees did not reveal they were in use by dependant species. Further, removal is unlikely to place dependant species at risk as surrounding vegetation has an abundance of this key habitat element.

Having given consideration to the ecology within the Project Site, it is concluded that the Proposal would be:

- unlikely to significantly affect any of the listed threatened species, fauna populations or communities that if the recommended amelioration measures are adopted, implemented and maintained;
- unlikely to augment or significantly contribute to any of the National or State listed key threatening processes;
- unlikely to significantly affect any Ramsar wetland or any CAMBA or JAMBA listed species;
- unlikely to significantly affect any of the creeks if adequate safeguards are adopted for water run-off from the Berrima Colliery and Loch Catherine stock pile;
- unlikely to impact Koalas as the vast majority of vegetation to be affected does not support State Environmental Planning Policy 44 (SEPP44) feed tree species; and
- is consistent with Economically Sustainable Development principles with regard to fauna and would not adversely affect the local biodiversity (no issue of inter-generational or value added matters are relevant in this instance).

Predicted subsidence would not place any of these vegetation communities at risk of local extension, nor would it place at risk any threatened species dependant on the habitat values upon which it contains.

Contents

Figures

Tables

1.0 Introduction

1.1 Brief description of the Project

This ecological report was commissioned by Boral Cement, it documents ecological values in the Subsidence Management Plan Area (SMP), assess ecological impacts associated with extending the area of occupancy of the existing coal stockpile at Loch Catherine (by 20 m north and east) as well as implementing a 20 m Asset Protection Zone (APZ) and considerers impacts associated with implementing an APZ around the existing Berrima Colliery pit top area.

Works for the APZ and coal stockpile extension will require vegetation clearing and ground disturbing activities.

This report has been prepared to support an application under Part 3A of the EP&A Act for continued operations at the colliery.

1.2 Location

Berrima Colliery is located adjacent to the Wingecarribee River in southeast NSW approximately 120km southwest of Sydney (**Figures 1** and **2**) within the Wingecarribee Local Government Area (LGA).

1.3 Date of assessment and prevailing weather conditions

The field assessment for this project was undertaken over two days on the 18th and 19th of August 2010. Weather was cool, overcast occasionally windy to strong winds and showery, with temperatures ranging from 5^{o} and 15^{o} Celsius on both days. Generally, weather (apart from nocturnal assessments) was not an impediment for the investigation.

1.4 OzArk EHM Involvements

This assessment was undertaken by Phillip Cameron (BSc, Ass Dip App Sci, MECA) of OzArk under NSW Industry and Investment (I&I) Ethics Approval No 07/1601 & NSW Scientific Research License 11194 Department of Environment and Climate Change and Water (DECCW) Data Licence No. CON99042. Heidi Kolkert (BA, BSc Hons, AMECA) and Phillip Cameron wrote this report.

Figure 1: The Project site.

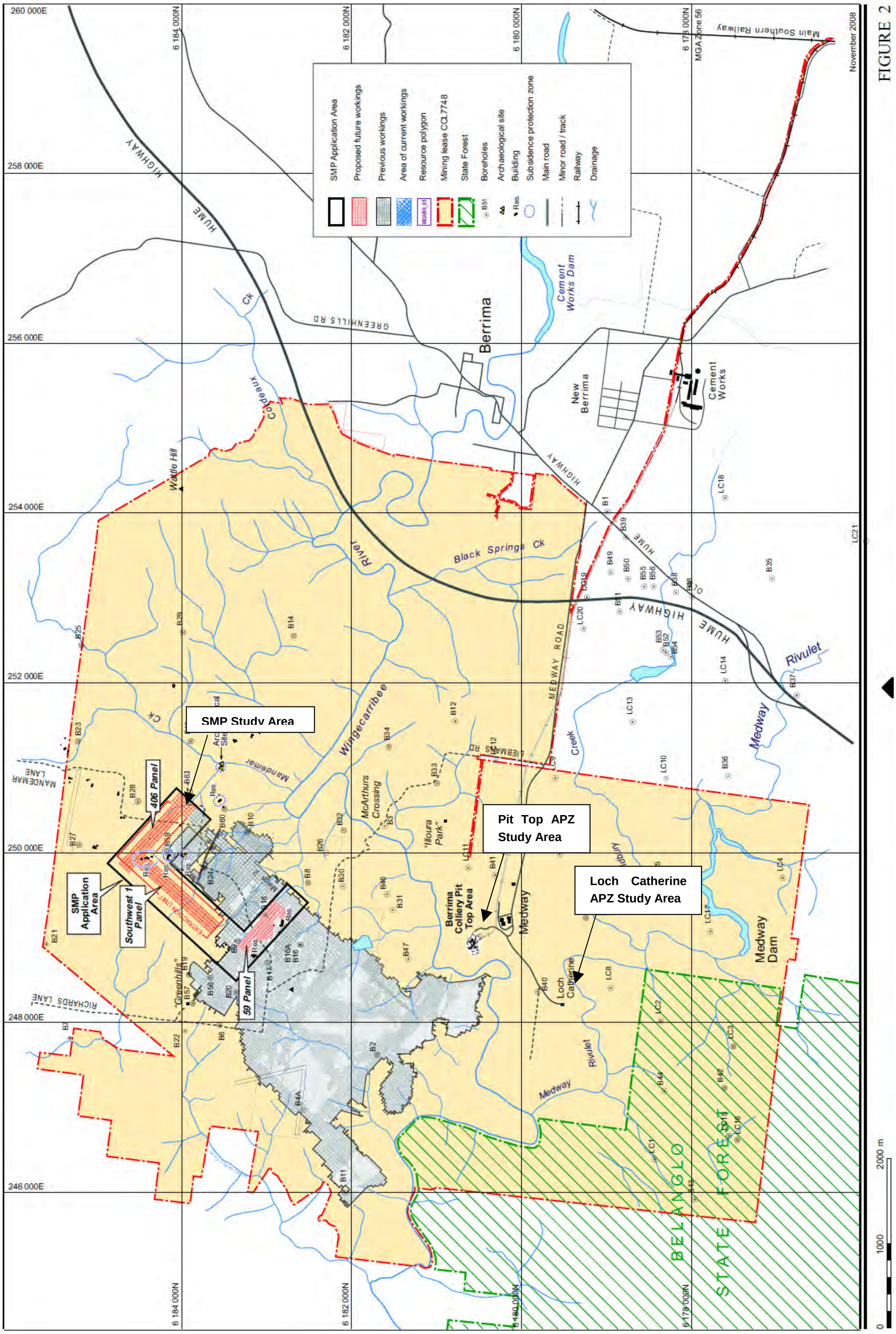


Figure 2: Subsidence Management Plan (SMP) Area

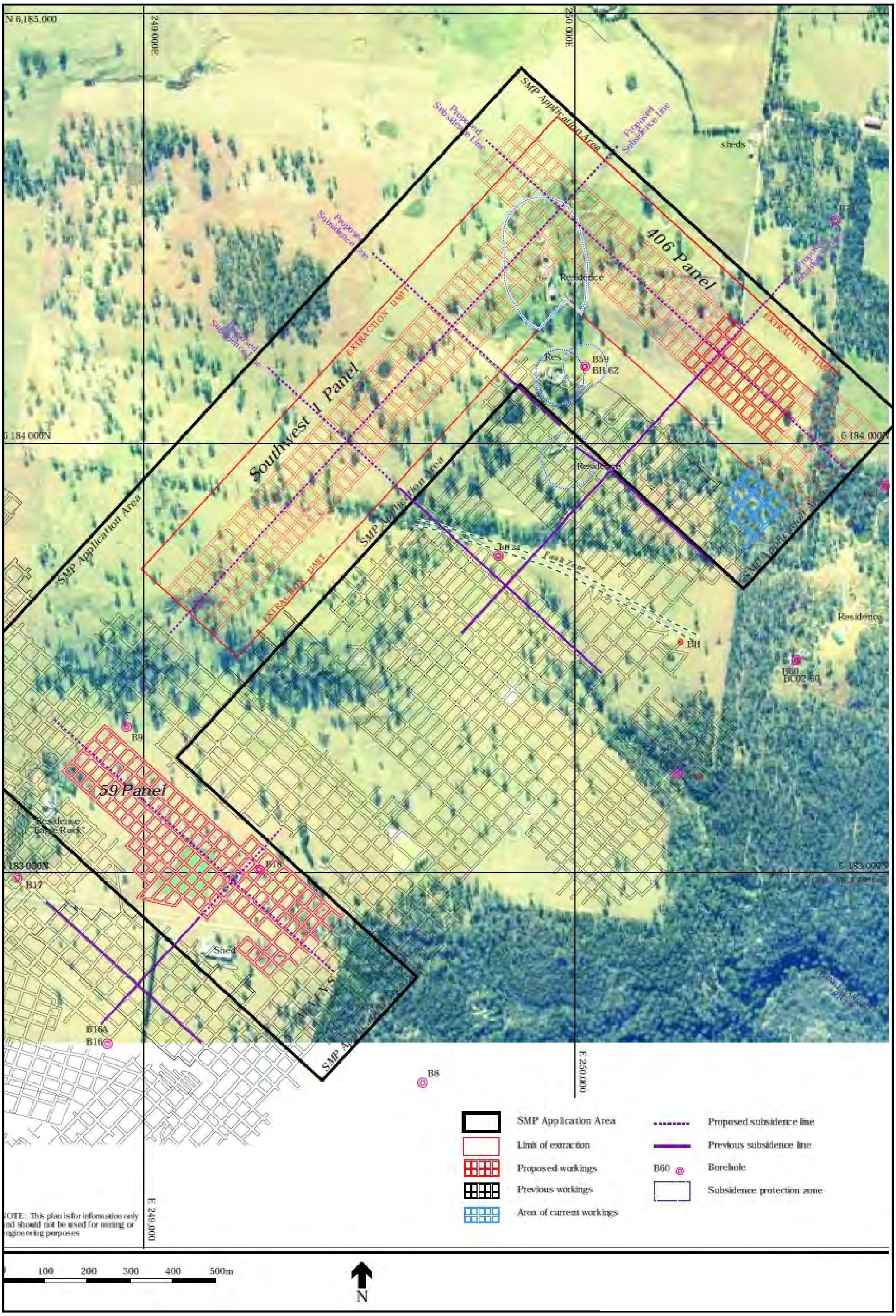
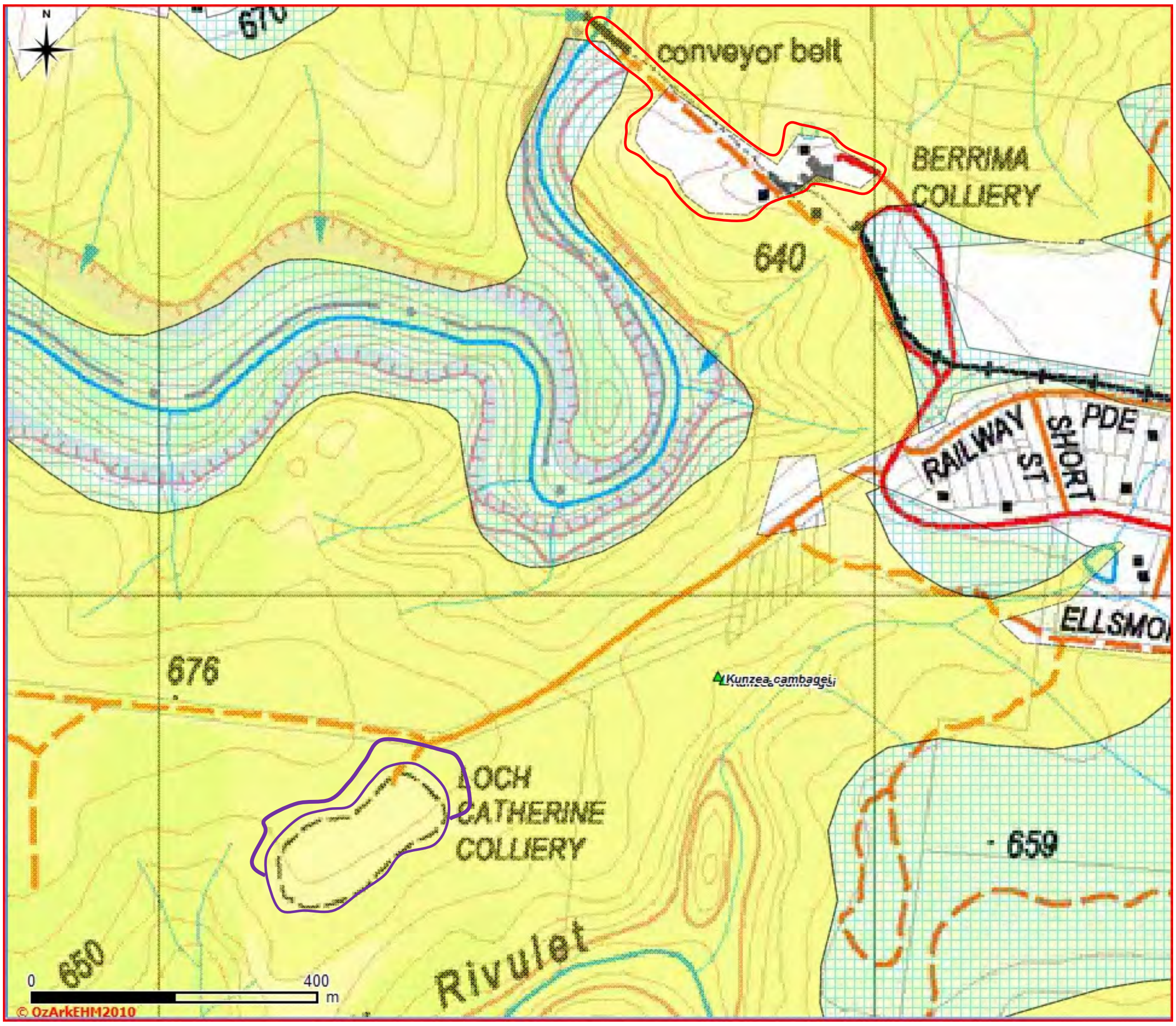


Figure 3: The Berrima Pit Top APZ (red) and Loch Catherine APZ (purple).

Note: The location of the NSW threatened plant *Kunzea cambagei* is shown on this figure to prevent duplication of the same image in later sections of this report.



2.0 The Project

2.1 Proposed Works

As part of the proposal to undertake continued operations at the Berrima Colliery within the approved Subsidence Management Plan (SMP) Area, Boral Cement proposes to extend the existing Berrima Collieries coal stockpile at Loch Catherine and implement Asset Protection Zones (APZ) surrounding Berrima Colliery pit top facilities and the coal stockpile at Loch Catherine.

For the purposes of this report these areas are collectively referred to as the 'Project Site' and discussed individually as the 'XX' Study Area.

There are three discrete Study Areas within the Project Site;

- The SMP Study Area (**Figure 2**);
    - ➢ The SMP includes three separate mining areas or panels – 59 Panel, Southwest 1 Panel and 406 Panel. All potential impacts relate to potential subsidence;
    - ➢ This area is approximately 160 ha.
- The Berrima Pit Top APZ Study Area (**Figure 3**);
    - ➢ All understorey and the majority of trees will be removed from a 20 m area extending from the existing cleared edge of disturbance within the APZ. There is a possibility to leave individual well spaced trees where they do not pose a risk to mine assets. All trees on the southern side of the conveyer belt in the APZ will be removed to protect underground communications lines. The red line in **Figure 3** indicated the line of disturbance.
    - ➢ This area comprises approximately 1.35 ha of regrowth native vegetation and 2.39 ha of disturbed land).
- Loch Catherine APZ Study Area (**Figure 3**);
    - ➢ All trees and understory will be removed in the APZ (to protect the coal stockpile). This area is approximately 1.17 ha.
    - ➢ The coal stockpile area will be expanded to the north and east of the existing area by a further 20 m (i.e. 20 m for stockpile extension and 20 m for APZ totalling 40 m is needed to be cleared in this area). Collectively this is approximately 1.07 ha.

2.2 Assessment Methodology

The assessment was undertaken following the general auspices of the DEC[1] Biodiversity Survey Guidelines Working Draft 2004, Threatened Species Assessment Guidelines: The Part 5A of the EP&A Act 7-part Assessment of Significance and DECCW Field Survey Methods 2009. Notable

[1] NSW DEC and DECC is now known as the Department of Environment Climate Change and Water (DECCW).

constraints have been included in Section 2.3 of this report. To predict the likely effect of the Proposal on species generally detected through this type of survey effort, the precautionary principle has been applied.

2.2.1 Consistency with DECCW Biodiversity Survey Guidelines November 2004

This assessment applied the DECCW 'precautionary principle'.

The DECCW Threatened Biodiversity Survey Guidelines (2004: 30–34) state '*It is advised that where adequate surveys have not been conducted within the Study Area due to time limitations (*you can also infer season timing etc)*, the precautionary principle should always be adopted. This involves assuming that threatened biodiversity which are likely to occur in the Study Area (based upon the presence of suitable habitat and recent records) inhabit the whole of the Study Area. The Assessment of Significance (7-part tests) would then be conducted on this basis*'

2.2.2 Flora

Rationale and mapping

Survey of the Study Area was conducted according to the Random Meander Method described by Cropper (1993: 30). Detailed botanical survey for native plants was carried out and the observed species composition within the community was aligned to *BioMetric.* Plant identification was made according to recent nomenclature in Harden 1990–2002, Cunningham *et al.* 1992, Royal Botanic Gardens (RBG 2010), and PlantNet NSW Flora Online (RBG 2010). The national conservation significance of flora was determined by referencing *Rare or Threatened Australian Plants* (ROTAP–Briggs and Leigh 2006) and the Schedules associated with the *Threatened Species Conservation Act 1995* (TSC Act) or the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Special consideration was given to locating rare or threatened plants identified in the NSW Wildlife Atlas database (DECCW 2010a) or those being predicted to occur by DECCW (DECCW 2010b) or DEWHA (DEWHA 2010) for the Wingecarribee LGA respectively (**Appendix I**).

Visibility was good and plants without flowers/seed heads were relatively straightforward to identify given that the *BioMetric* database provides detailed lists of known species associations with the greatest affiliation with the community.

Where areas had a combination of key habitat elements which were more likely to provide an environment in which a threatened plant would be recorded, it was given closer inspection.

Community composition, health, age status, habitat value for fauna and flora species, overall conservation significance and structural or habitat importance of the vegetation present was assessed. The extent/distribution of the vegetation communities was mapped in the field.

Tree health

Tree health index was judged by following guidelines used by NSW Forests (**Table 1**):

Table 1: Tree health index guide.

Canopy Stress Category	Description
0	Perfectly healthy: Full crown of normally developed leaves on the ends of fine branchlets. There may be dead branches below the green crown in younger trees.
1	Healthy: Leaves mostly on the ends of fine branchlets. Canopy may be slightly thin with some fine branchlets dead.

Canopy Stress Category	Description
2	Stressed: Leaves distributes along fine branches. Some dead fine branches in the upper canopy. May have dead medium branches in the lower canopy; or crown of normally developed shoots on medium/large branches (representing recovery from category 3 or 4).
3	Highly stressed: Many dead fine branches some dead medium branches. Sparse crown of normally developed shoots or moderately full crown mostly comprising epicormic shoots, on medium branches; or A moderately full crown of normally developed shoots on large branches (representing recovery from category 4).
4	Severely stressed: Medium branches mostly dead. Crown may comprise clumps of epicormic shoots on the large branches and bole.
5	Dead: Canopy recently dead. Tree still carries some dead fine branches and bark.
Notes: • Where recovery from a higher stress category is apparent, note this in the comments. • If discoloured/deformed/infected leaved are apparent in addition to other symptoms—classify it in higher stress category. • Normally developed shots are initiated periphery of the live crown and contain leaves of adult form and arrangement. • Branchlets are soft and not woody up to 3mm diameter—branches are woody • Fine medium and large branches are relative to the crown volume for age. Small to medium trees—3 to 20 mm diameter, medium 20 to 50/75 mm, large >50/75 mm.	

2.2.3 Red flag areas and determination of ‘Good, Moderate’ or ‘Low’ condition

A red flag area (DECCW Biobanking Assessment Methodology 2008) is an area of land that has high biodiversity conservation values. An area of land is regarded as having high biodiversity conservation values if it contains one of more of the following:

- a vegetation type that has greater than 70% cleared as listed in the Vegetation Types Database “BioMetric database” (that is, has less than 30% of its estimated distribution remaining in the catchment management authority (CMA) area before the year 1750) and the vegetation is not in low condition as defined below.
- a critically endangered or endangered ecological community listed under the TSC Act or EPBC Act, and the vegetation is not in low condition as defined below.
- one or more threatened species identified in the Threatened Species Profile Database that cannot withstand further loss in the CMA area because of one or more of the following:
    - the species is naturally very rare, is critically endangered, has few populations or a restricted distribution
    - the species or its habitat needs are poorly known
    - the species is an identified population, as defined in section 4.6 of this methodology and listed in the Identified Population Database (when published).

Vegetation in low condition means:

- woody native vegetation with native over-storey percent foliage cover less than 25% of the lower value of the over-storey percent foliage cover benchmark for that vegetation type, and:
    - less than 50% of ground cover vegetation is indigenous species, or
    - greater than 90% of ground cover vegetation is cleared.
- native grassland, wetland or herbfield where:

  - less than 50% of ground cover vegetation is indigenous species, or
  - more than 90% of ground cover vegetation is cleared.

If native vegetation is not in low condition, it is in moderate to good condition.

The percentages for the ground cover calculations must be made in a season when the proportion of native ground cover vegetation compared to non-native ground cover vegetation in the area is likely to be at its maximum.

2.2.3 Fauna

Fauna surveys included general habitat searches and targeted surveys for threatened species. Tailored searches for species identified as likely to occur (based upon the habitat present) but not previously recorded were undertaken.

Identification of the species present, and their diversity, can indicate the type of habitat that is present within the Study Area. Further, an assessment of the habitat present within the Study Area will also dictate which identified threatened species, although they remained unobserved during the current survey, may utilise it (the basis of the precautionary principle). The likely impacts of development can be addressed through this process.

Fauna identification was achieved via:

- Identification of scats, diggings, tracks and other traces (Triggs 2004);
- Direct observation: i.e. bird watching;
- Ground, leaf litter and other refuge searches;
- Call identification; and
- Searches for indirect evidence of mammals (vocalisation, tracks, scats, burrows etc).

2.2.4 Field data capture

Within the Study Area point data of individual areas requiring greater attention were mapped using a Magellan MobileMapper with attributes of each tree captured that identified:

- Locational data in Zone 55 MGA;
- Issue i.e. species of biota;
- Notes (where appropriate i.e. very large tree with hollows);
- Constraint Category for removal i.e.:
  - **Constraint Category 0**—No constraint.
  - **Constraint Category 3**—Low levels of constraint, i.e. tree is very unlikely to provide breeding or roosting sites for threatened species and it possesses common habitat elements for the environment or a tree without hollows that provides nectar/insects as a resource.
  - **Constraint Category 2**—Medium levels of constraint, i.e. tree has potential to provide breeding or roosting habitat for a threatened species but is located in

an environment where this is unlikely—but not out of the question. Tree may also possess hollows or other habitat values that are limited in the local environment i.e. moderate sized hollows or moderate volumes of decorating bark etc.

- **Constraint Category 1**—Highest levels of constraint, i.e. tree is a threatened species, provides known breeding/roosting habitat for a threatened species or possesses unique or rare habitat values within the landscape: such as large hollows suitable for forest owls in an environment in which the owls would breed—such as a riverbank with low levels of disturbance.

2.3 Survey constraints

2.3.1 General

Not all animals and plants can be fully accounted for within any given Study Area. The potential for inaccuracy increases exponentially with the size of a study area. This report is based upon data acquired from recent and current surveys, however, it should be recognised that the data gathered is indicative of the environmental conditions of the site at the time the report was prepared. The presence of threatened species is not static. It changes over time, often in response to longer term natural forces that can, at any time, be dramatically influenced by anthropomorphic disturbance.

This report has reviewed State and National agency records centred on the Study Area to establish a predictive model concerning the likelihood of flora and fauna species to occur within the Study Area. Any failings of the database records have been mentioned within the appropriate sections of this report.

For the purpose of this report, the principle author believes that adequate assessment has been undertaken but acknowledges that the precautionary principle has been adopted where appropriate. Inconsistencies for flora/fauna detection include but are not limited to:

- The majority of the region's rare animals and plants would have more potential to be recorded when or after long periods of rain (estimated to be three times a century).
- Due to the number of threatened species which all have potential to be recorded in the Study Area, the focus of this survey was to detect those animals or plants which:
  - have core habitat elements in the Project Site;
  - were regarded as 'likely to occur' in the current climatic conditions; and
  - do not have the ability to flee in the face of mechanised disturbance and thus be at risk of death or injury in the face of the proposed works.

Any opposition to a development related project would interpret 'adequate surveys' in many different ways. In reality, commercial ecology has its limitations due to time constraints, seasonality of animals and plants, weather patterns and a general lack of prolonged base line assessments in most study areas. Further notes of inconsistencies were as follows:

- The methods used to detect the majority of animals listed were considered to be consistent with DECCW requirements and were able to detect species currently listed as threatened. This statement is based upon the available habitat being regionally fragmented in nature, having a small patch size and being located distant to permanent water in a road corridor and as such 'unlikely habitat' for the majority of the regions threatened species.

- AnaBat detection was undertaken over one night with cold freezing rain (temperatures a few degrees above zero), not the most desirable situation. Potential impacts to microbats have also been based upon previous records of bat species and the availability/abundance of habitat in the Study Area; and
- Threatened orchids were not in flower at the time of the assessment. The effect of this constraint was assessed in the field by tying to identify areas of potential habitat for these species.

3.0 The Study Area

Berrima Colliery is located within the Sydney Basin Bioregion, Hawkesbury-Nepean (Burragorang Part A) CMA and Wingecarribee LGA, approximately 120 km southwest of Sydney (**Figure 1**). Specifically the colliery is located to the west of Berrima on the western side of the Hume Highway, within land zoned as Rural Landscape (RU2) and Environmental Conservation (E2) on the Wingecarribee 2010 Local Environment Plan.

3.1 Topography of the Project Site

The Sydney Basin Bioregion is an extensive area of major landscape features including coastal plains, foothills, isolated ranges, the lower inland slopes of the Great Dividing Range and forested mountains of the Illawarra Escarpment.

The following section has been extracted from the SMP Application (International Environmental Consultants 2010) and accurately describes the landform characteristic of the SMP Study Area and Berrima Pit Top APZ Study Area within Berrima Colliery itself:

- *Berrima Colliery is located at the interface between the mature and relatively stable landform of the Woronora-Nattai Plateau and the rugged and actively changing landform of the Plateau margin.*
- *The existing pit top is located on a flat area of land with an elevation in the order of 660 m AHD.*
- *To the east, this area connects with the central tablelands at a similar elevation. However, immediate north, west and south, the Plateau surface has been deeply cut into by the Wingecarribee River, which flows past in a southerly direction.*
- *Adjacent to those sections of the river south of Medway, escarpment formation is well advanced. The river valley has a characteristic V-shape, bounded at a distance by vertical cliffs in the order of 20 to 30 m high.*
- *Upstream of Medway, the River Valley has a U-shaped cross section, becoming broader and flatter with increasing distance upstream. The southern boundary of the Colliery Holding is roughly contiguous with the right or western bank of the Wingecarribee River which, south of Medway, has eroded the coal seams away. To the north, the Holding generally is confined within the limits of the Plateau surface.*
- *The principal topographical features within the Colliery Holding are Mandemar Ridge in the north western corner, the incised Wingecarribee River, and its northern tributary, Mandemar Creek. Mandemar Ridge rises to a maximum height of 750 m AHD, approximately 50 m higher than the Plateau surface in that area.*
- *The ridge consists of three, late Tertiary basalt flows surrounded by Wiannamatta Shales.*

3.2 Hydrology of the Project Site

Many water courses, drainage lines and tributaries of creeks exist within the vicinity of the Project Site including: Cordaeux Creek, Black Spring Creek, Medway Rivulet, Medway Dam, Oldbury Creek, Jackey Jackeys Creek, Woolshed Creek, Bowmans Creek and the Wingecarribee River.

Tributaries of Jackey Jackeys Creek, Woolshed Creek, Bowmans Creek Mandemar Creek and the Wingecarribee River traverse the SMP Study Area. Mandemar Creek, a tributary of the Wingecarribee River runs along the south-eastern extent of the SMP. To the east of the SMP Study Area, Mandemar Creek exists as a shallow ephemeral stream flowing largely through farmland areas (IEC 2010). Towards its confluence with the Wingecarribee River, Mandemar Creek becomes semi permanent and rock lined, and flows through a steep sided valley with overhanging rock cliffs (IEC 2010).

The Berrima Pit Top APZ Study Area is close to the Wingecarribee River, while the Loch Catherine Stockpile Expansion and APZ Study Area is bound to the north west and south by Medway Rivulet (approximately 550 m to 1 km away).

There are a number of local domestic water supply bores currently accessing the local ground water resource.

3.3 Vegetation of the Project site

According to Morgan (2001) Vegetation of the Burragorang sub-region is characterised by heath, shrubland and woodland with Black Ash, Hard-leaved Scribbly Gum, Sydney Peppermint and Red Bloodwood on sandstone similar to other parts of the Basin. Deane's Gum, Turpentine, Blue-leaved Stringybark immediately below escarpment passing to grey gum, Narrow-leaved Ironbark and Thin-leaved Stringybark on bouldery slopes. River oak occurs along main streams below the plateaus.

3.4 Climate of the Project site

The sub-humid climate of the majority of the Sydney Basin Bioregion (SBB) consists of hot summers and no dry season. The Study Area is located within the elevated western bioregion boundary that is characterised by a more montane climate zone. The Bureau of Meteorology (2010) reports that the mean annual maximum temperature nearby Bowral (approximately 6.5 km away) is 18.8°C, whilst the mean annual minimum temperature is 8.8°C, with the mean minimum temperature being 2 – 11.6°C in July and mean maximum temperature being 13.3 - 25.4°C in January. Mean annual rainfall is 903.8 mm.

3.5 Geology of the Project site

Wianamatta Shale consisting of shale and sandstone mixing from the Triassic Sandstone underlies the Project Site, with some younger residual basalt caps. A water seepage area forms in these mixed areas providing permanently damp or water logged soils giving rise to moisture thriving vegetation communities i.e. melaleuca. Within the SMP area moisture dependent communities have either been cleared or do not currently exist.

3.6 Existing Levels of Disturbance

The following section has been extracted from IEC 2010 and accurately describes existing disturbance associated with the Project Site:

- *For the first 60 years of the mine, extraction was limited to the rugged forested terrain to the north of the Wingecarribee River.*
- *Neither the river nor any of its associated cliff lines were undermined and there has been no evidence of rock falls or cracking in any of its tributaries or rock outcrops.*
- *Over the past 20 years, the mine has been progressively working beneath undulating cleared or partially cleared agricultural land.*
- *For the past 10 years mining has been almost exclusively beneath cleared agricultural land.*
- *The proposed 406 and South West 1 Panels lie entirely beneath privately owned and cleared agricultural land.*
- *The main roadways lie under flat partly cleared but regrowing pasture while 406 Panel crosses a cleared but relatively steep hill. This hill shows evidence of slumping indicating surface instability. The instability is a result of previous clearing and grazing practices. The current land owners are aware of the unstable surface and have fenced off sections to allow vegetation to re-establish. This instability is not related to mining but will be the subject of ongoing monitoring to establish if mining induced subsidence has any additional effect on the existing slopes. Subsidence monitoring stations have already been established along the face of this slope.*

Vegetation in the SMP Study Area has been relatively cleared as a result of previous and current agricultural practices.

4.0 Ecological Context

4.1 Overview of the Hawkesbury / Nepean CMA

The following sub-section has been surmised from the Hawkesbury / Nepean CMA website (Hawkesbury \ Nepean CMA 2008):

- The Hawkesbury Nepean CMA stretches for 22,000 km^2 (2.2 million ha) from south of Goulburn to near Cessnock, west from Lithgow to Palm Beach on the coast and north to the Putty Valley.
- The CMA has a river system which flows 470 km from near Lake Bathurst to Broken Bay and includes major rivers such as the Hawkesbury, Nepean, Wollondilly, Mulwaree, Tarlo, Wingecarribee, Nattai, Nepean, Coxs, Kowmung, Grose, Capertee, Colo and Macdonald.
- The CMA is important for providing the majority of drinking water for over 4 million people living in Sydney, the Illawarra, the Blue Mountains, the Southern Highlands, Lithgow Valley and the Central Coast (70% of New South Wales population). It also provides a thriving commercials fishing industry and supports over $6 million a year in commercial seafood industries (including the state's second largest estuarine trawl industry for prawns and squid) and is enjoyed by 43,000 recreational fishers.
- The CMA supplies 80% of the sand and gravel used in Sydney's construction industry worth an estimated $100 million a year. It also provides 23% of NSW's electricity using water from the Coxs River in the Wallerwang and Lower Portland power stations.

In terms of reserves and wildlife habitat the CMA protects 50% of the catchment in over 1 million ha of National Parks and reserves and boasts the Greater Blue Mountains World Heritage Area that includes the 13% of the worlds Eucalypt species and almost 10% of Australia's vascular plant species.

The CMA protects 288 threatened species (28% of all New South Wales' threatened species) as well as 33 endangered ecological communities, supports 22 species of frogs, 17 species of snakes, 42 species of lizards, one species of turtle, two species of monotremes, 30 species of marsupials, 21 species of bats, six species of native rodents and the dingo.

Five important regional wildlife corridors have been further identified within the CMA being the: Nattai-Woronora, Blue Mountains, Wollondilly, Joadja and Shoalhaven.

4.2 Regional and Local Ecological Context

A desktop search was conducted on the following databases to identify any potential issues (**Table 2**).

The NSW Wildlife Atlas online database was searched so that any gaps in DECCW data from other agencies (Royal Botanic Gardens, I&I-Fisheries and Forest NSW and the Australian Museum) could be identified. The NSW Wildlife Atlas mapping function was used to determine the locations of any previously recorded threatened species in relation to the current Project Site.

Table 2: Database search results for ecological issues.

Name of database searched	Date of search	Type of search	Comment
Department of Environment, Water Resources, Heritage and the Arts (DEWHA) Protected Matters (EPBC Act) Database; http://www.environment.gov.au/erin/ert/epbc/index.html	24.8.2010	Wingecarribee LGA	Five Endangered Ecological Communities, 63 threatened species (42 of which are plants), 14 migratory birds and 12 listed marine species.
Department of Environment and Climate Change (DECCW) Threatened Species online database; http://www.threatenedspecies.environment.nsw.gov.au/index.aspx	24.8.2010	Hawkesbury/ Nepean (Burragorang Part A)	89 results returned. ten Endangered Ecological Communities, one community no longer listed ("Natural Temperate Grassland of the Southern Tablelands NSW and ACT)", 32 threatened plants species and 46 threatened animals.
NSW Wildlife Atlas online database 2010 http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlasSpecies.jsp	24.8.2010	Mittagong Map Sheet Moss vale Map Sheet And Wingecarribee LGA	Seven threatened plants have been previously recorded within 10 km^2 from the Study Area: *Acacia bynoeana, Eucalyptus aggregate, Eucalyptus macarthurii, Kunzea cambagei, Persoonia glaucescens, Phyllota humifusa,* and *Pomaderris sericea.* *Kunzea cambagei* is the most frequently recorded plant in the searched area and has been recorded within proximity to Berrima Colliery (Berrima Pit Top APZ) and Loch Catherine Stockpile APZ. Two species of fauna (Koala and Spotted Tailed Quoll) have been previously recorded within 10 km of the Study Area. No Endangered populations or Critical Habitat exists in the search area, two Critically Endangered Ecological Communities, 43 Endangered Ecological Communities, three Vulnerable Communities ECs and 31 Key Threatening Processes.
NSW Legislation website: SEPP 44 (Koala Habitat Protection) http://www.legislation.nsw.gov.au/fragview/inforce/epi%2B5%2B1995%2Bcd%2B0%2BN?	24.8.2010	Schedule 1: LGAs listed and Schedule 2: Feed Trees listed	The Wingecarribee LGA is listed in Schedule 1 of SEPP 44. *Eucalyptus punctata* which is a common species in the Project Site is a listed 'feed tree species' in Schedule 2. The Wildlife Atlas shows many records of the species in the locality – as such the wider environments lie within vegetation types mapped as Core Koala Habitat.
Wingecarribee Shire Local Environment Plan 2010	24.8.2010	Wingecarribee Shire Council	Part 7 clause 7.4 "Regional Wildlife Habitat Corridor" on the Natural Resources Sensitivity Map NRS 007. 50 m of land either side of Wingecarribee River is classed as an Environmental Corridor and 30 m of land either side of creeks in the Study Area is classed Aquatic and Terrestrial Habitat.
Wingecarribee Tree Preservation Order	24.8.2010	Wingecarribee Shire Council	Council's TPO restricts the removal of trees from: 5(C) and 2(b) zones; within Endangered Ecological Communities; certain significant and rare trees.

Name of database searched	Date of search	Type of search	Comment
Wingecarribee Bushfire Risk Management Plan	24.8.2010	Wingecarribee Shire Council	Implementing Asset Protection Zones around the Project Site is consistent with the aims of this plan.
The Drinking Water Catchments Regional Environmental Plan No 1	24.8.2010	Wingecarribee Shire Council	The Drinking Water Catchments Regional Environmental Plan No 1 (REP No.1) is a key planning instrument for this Shire. It replaces State Environmental Planning Policy No 58 Protecting Sydney's Water Supply (SEPP 58). The Wingecarribee River is used to transfer water from the Shoalhaven River to the Warragamba Dam. Thus, the Sydney CMA has vested interest in the quality of water in the river.
Illawarra Regional Environmental Plan No.1	24.8.2010	Wingecarribee Shire Council	Part 4 Provisions relating to Coal applies.
Sydney Regional Environmental Plan No. 20 - Hawkesbury-Nepean River 1996.	24.8.2010	Wingecarribee Shire Council	Wingecarribee LGA not listed. This plan does not apply.

A search of the NSW Wildlife Atlas database of the Mittagong and Mossvale Map Sheets reveal an extensive list of threatened flora and fauna species. Within a 10 x 10 km area centred on Berrima Colliery, seven protected plant species and two protected marsupials have been recorded in proximity to the Project Site.

Cambage Kunzea *(Kunzea cumbagei,* TSC & EPBC Act) has been previously recorded twice between Berrima Colliery and Loch Catherine Colliery (**Figure 3**). Although outside the Study Areas, the area west of Berrima along the Wingecarribee River supports the largest known population of this species. Mittagong Geebung (*Persoonia glaucescens* TSC & EPBC Act) has also been recorded within 3 km of Berrima Colliery (recorded 81 times in the Wingecarribee LGA). Berrima is the present southern limit of distribution for this species.

Further afield within 10 km of the Project Site *Eucalyptus aggregate, Eucalyptus macarthurii, Phyllota humifusa, Pomaderris sericea* and *Acacia bynoeana* have also been recorded.

A Spotted-tailed Quoll (*Dasyurus maculatus,* TSC & EPBC Act) has been previously recorded 2 km northwest of colliery. Five records of Koalas (*Phascolarctos cinereus*, TSC & EPBC Act) exist within 10 km of the Project Site. Koalas are considered to be 'frequently recorded' in the region (336 records existing for the Wingecarribee LGA) hence this ecological assessment concluding that the locality as a whole is 'Core Koala Habitat'.

Although no threatened microbats have been recorded on the NSW Wildlife Atlas database in close proximity to Berrima Colliery it's more than likely that they would utilise existing habitat in the Project Site. The closest records of threatened microbat species on the NSW Wildlife Atlas include the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis)* recorded approximately 15 km south of the Project Site and within surrounding State Forests, Southern Myotis (*Myotis macropus*) recorded approximately 12 km south of the Project Site at the edge of Meryla State Forest.

Within closer proximity to the Berrima Colliery pit top and Loch Catherine Study Areas, the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis,* Vulnerable in NSW) has been recorded at adits below the old Loch Catherine Colliery (in the escarpments below the stockpile site, < 1km). These records do not appear on the NSW Wildlife Atlas.

The NSW and nationally Vulnerable Grey-headed Flying-fox (*Pteropus poliocephalus*) has been previously recorded approximately 12 km south of the Project Site at the edge of Meryla State Forest. Most records for bat species exist around the State Water Supply area to the east of the Project Site.

Furthermore the Squirrel Glider (*Petaurus norfolcensis),* Yellow-bellied Glider (*Petaurus australis)* and Eastern Pygmy-possum (*Cercartetus nanus)* records are centred on surrounding State Forests and National Parks approximately 15 to 20 km from the Project Site.

It is noteworthy that the majority of flora and fauna records exist around Meryla State Forest, Nattai National Park, Jellore State Forest, Belanglo State Forest and the Water Supply Reserve area to the east of Berrima Colliery. This does not reflect the accurate distribution of species but rather the development driven nature of surveys and research derived assessments for the purpose of characterising biodiversity in State Forest and National Park areas.

The NSW Wildlife Atlas database search of the Mittagong and Moss vale Map Sheets also produced an extensive list of protected ecological communities. The majority of these EECs do not occur within the Project Site (as detailed in the following chapter), they have been presented as a full list demonstrating that they have been considered as part of this Proposal:

Critically Endangered Ecological Communities:

- Blue Gum High Forest in the Sydney Basin Bioregion; and
- Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion.

Endangered Ecological Communities

- Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion;
- Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion;
- Sun Valley Cabbage Gum Forest in the Sydney Basin Bioregion;
- Mount Gibraltar Forest in the Sydney Basin Bioregion;
- Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions;
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion;
- Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion;
- White Box Yellow Box Blakely's Red Gum Woodland;
- Robertson Rainforest in the Sydney Basin Bioregion;
- Southern Highlands Shale Woodlands in the Sydney Basin Bioregion;

- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Robertson Basalt Tall Open-forest in the Sydney Basin Bioregion;
- Moist Shale Woodland in the Sydney Basin Bioregion;
- Kurri Sand Swamp Woodland in the Sydney Basin Bioregion;
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion;
- Milton Ulladulla Subtropical Rainforest in the Sydney Basin Bioregion;
- Melaleuca armillaris Tall Shrubland in the Sydney Basin Bioregion;
- Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions;
- Illawarra Subtropical Rainforest in the Sydney Basin Bioregion;
- Shale/Sandstone Transition Forest;
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions;
- Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion;
- Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion;
- Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion;
- Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Agnes Banks Woodland in the Sydney Basin Bioregion;
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions;
- Western Sydney Dry Rainforest in the Sydney Basin Bioregion;
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion;
- Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion;
- Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions;
- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion;
- Warkworth Sands Woodland of the Sydney Basin Bioregion;
- Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions;

- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions;
- O'Hares Creek Shale Forest;
- Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Shale gravel Transition Forest in the Sydney Basin Bioregion;
- Duffys Forest Ecological Community in the Sydney Basin Bioregion; and
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Vulnerable Ecological Communities

- Blue Mountains Swamps in the Sydney Basin Bioregion;
- Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion; and
- Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions.

4.2 Previous assessments

Several vegetation and biodiversity assessments have been undertaken in the CMA. The most recent and relevant to the Project Site is the Wingecarribee Biodiversity Strategy (EcoLogical Australia 2003). Further vegetation assessments with relevance to the Project Site are listed below:

- Fisher, M., Ryan, K. and Lembit, R. (1995) The Natural Vegetation of the Burragorang 1:100 000 Map Sheet. *Cunninghamia* 4(2):143-215;
- NPWS (2000a) *Forest Ecosystem Classification and Mapping for the Southern CRA Region, Volume II Appendices.* A report undertaken for the NSW CRA/RFA Steering Committee, Project Number NS 08EH;
- NPWS (2003) *The Native Vegetation of the Woronora, O'Hares and Metropolitan Catchments.* Unpublished Report, NSW National Parks and Wildlife Service, Hurstville;
- DECC (2004) *The Native Vegetation of the Nattai and Bargo Reserve*;
- Keith (2004) *Ocean Shores to Desert Dunes: The Native Vegetation of New South Wales and the ACT*, Department of Environment and Conservation NSW, Sydney; and
- Sattler and Creighton (2002) *Australian Terrestrial Biodiversity Assessment*. National Land and Water Resources Audit.

The Wingecarribee Biodiversity Strategy (EcoLogical Australia 2003) identified approximately 63% of the Shire as being covered with native vegetation and within this 49 different vegetation communities were identified in the LGA. The predominant vegetation communities are:

- Mittagong Sandstone Woodland;
- Hawkesbury Sandstone Woodland;
- Wingecarribee Woodland;

- Bindook Porpphry Woodland; and
- Communities of the Woronora Plateau.

These communities collectively account for over half of the remnant vegetation in the LGA, Mittagong Sandstone Woodland, Hawkesbury Sandstone Woodland and Wingecarribee Woodland are mapped within the Project Site.

During recent years DECCW has been conducting extensive mapping and research within the bioregion aimed at describing and recording many of the natural assets (DECCW 2008 citing Gibbons *et al.* 2005). Benson *et al.* 2006 and Benson 2008 have reviewed all previous published and much unpublished work to compile a comprehensive list and descriptions of the plant communities of the NSW western plains as part of a major project, the NSW Vegetation Classification and Assessment Project (NSWVCA), to classify the vegetation of NSW. The vegetation communities recognised by Benson *et al.* (2006) are expected to form the basis of a standard vegetation classification for the state. Accordingly, vegetation communities identified in the Wingecarribee Biodiversity Strategy report have been matched to vegetation communities described by Benson *et al.* (2006) (NSWVCA is referred to as the *BioMetric* database in this report) and used in this report.

4.3 Predictive model for threatened species detection

The concepts of the modelling described below formed the basis of the methodology designed for the current assessment. These reflect the predominant patterns of threatened species distribution as elicited from prior survey work and from applying habitat preference for those species within a transport corridor.

Remnant patch size is the primary factor appearing to determine the location of threatened plants and animals in the region and to a lesser degree in disturbed habitats proximity to a permanent water supply. Predictive modelling for EECs in the region is fairly straight forward as it can be summarised as likely to be any native vegetation left in the valley floor and on the undulating hills. Due to the substantial list of EECs for the Wingecarribee LGA it is likely that some may occur in the Project Site, particularly those occupying fertile flat land that have been predominately cleared in the LGA.

It is possible / an expectation that the threatened plant *Kunzea cumbagei* would be recorded within the Project Site and there is a possibility that Mittagong Geebung (*Persoonia glaucescens)* may be recorded.

As noted in the regional overview, the Spotted-tailed Quoll and Koala is the most likely threatened fauna to be recorded in the Project Site.

Although no threatened microbats have been recorded in proximity to the Study Area it is more than likely that they would utilise habitat in the Project Site. The Wingecarribee Biodiversity Strategy modelled the potential habitat of threatened species. The model showed that all the rare flora species in the Wingecarribee LGA are associated with either Sandstone or swamp vegetation. With regards to fauna habitats, the model indicated that there is a potential for the occurrence of at least two threatened species to occur in every vegetation community. Dry Nattai Escarpment Forest (which in itself is not listed as an EEC) has been identified as having potential habitat for as many as 15 of the threatened fauna species found in the Shire. This vegetation community does not occur within the Project Site.

5.0 Survey Results

5.1 Vegetation mapping

All vegetation in the Study Area has been previously mapped as part of the Wingecarribee Biodiversity Strategy (EcoLogical Australia 2003). Vegetation in the Berrima Pit Top and the Loch Catherine Stockpile APZ Study Areas are consistent with vegetation community profiles previously described by EcoLogical Australia (2003) as Mittagong Sandstone Woodland. Vegetation within the SMP Study Area is more complex with four vegetation community profiles consistent with NSW listed EECs:

- Robertson Basalt Tall Open-forest in the Sydney Basin Bioregion EEC (TSC Act) on the hill tops (erosion resistant Basalt caps on hills);
- Southern Highlands Shale Woodlands in the Sydney Basin Bioregion on hill slopes EEC (TSC Act);
- Wingecarribee Woodland on valley floors.
- Mittagong Sandstone Woodland on lower slopes.

Figure 4 shows the mapped vegetation communities in the SMP Study Area; **Figure 5** shows the Berrima Pit Top APZ Study Area and **Figure 6** shoes the Loch Catherine Stockpile APZ Study Area.

Figure 4: Mapped vegetation in the SMP Study Area.

Figure 5: Mapped vegetation in the Berrima Pit Top APZ Study Area.

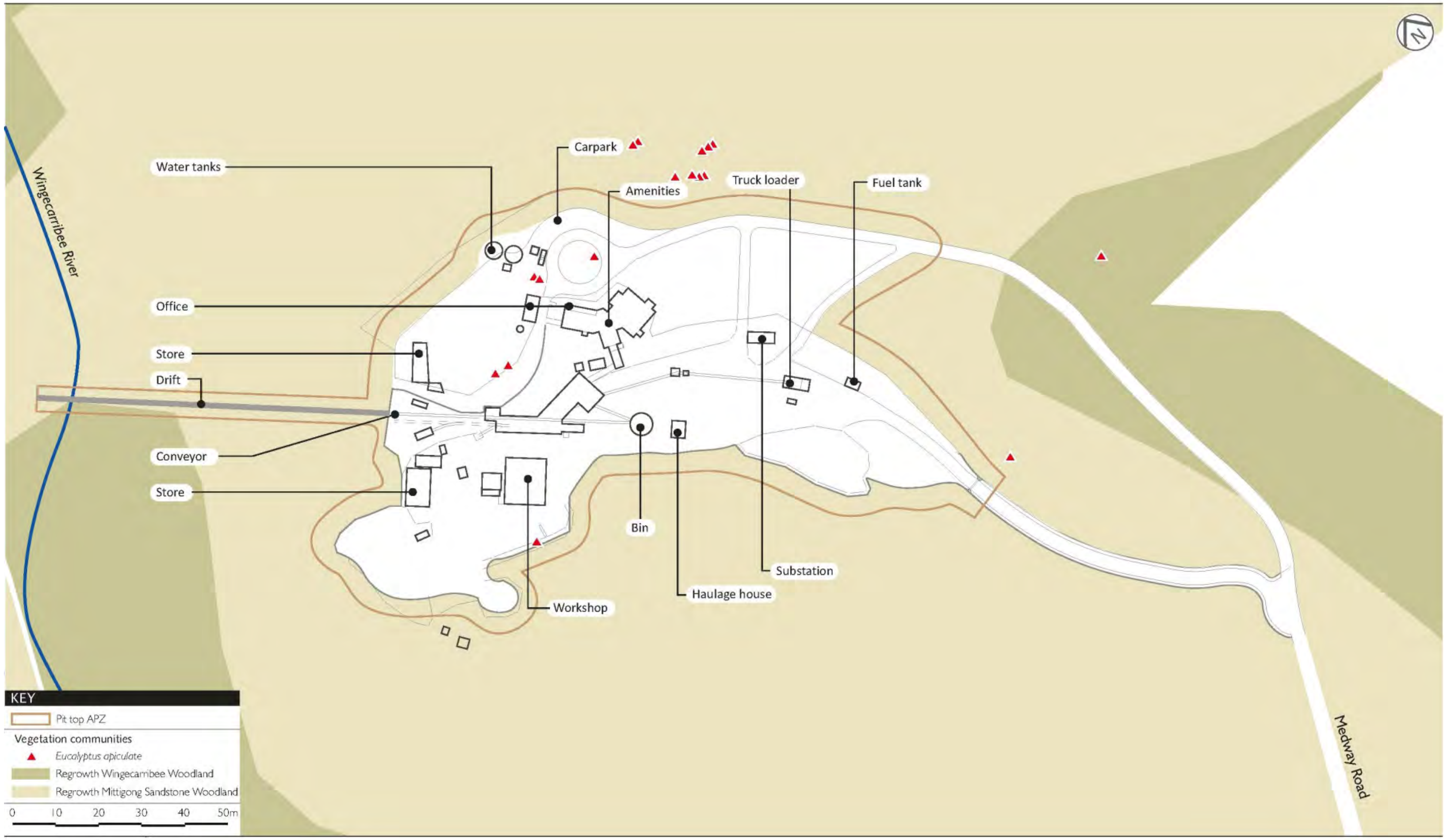


Figure 6: Mapped vegetation in the Loch Catherine Stockpile Expansion (orange) and APZ (green) Study Area.

Vegetation profiles of all communities discussed in this section have been provided as **Appendix 3.**

5.2 Vegetation clearing required

- No vegetation would require clearing or would be altered by subsidence within the SMP Study Area.
- The Berrima Pit Top APZ Study Area would require clearing of:
  - 0.08 ha of Regrowth Wingecarribee Woodland on valley floors; and
    - Note the GIS mapping does not show this area within the APZ. The abovementioned figure and community represents ground truthing of the area in the field.
  - 1.27 ha of Regrowth Mittagong Sandstone Woodland on lower slopes.
- The Loch Catherine Stockpile APZ Study Area would require clearing of:
  - 1.17 ha of Mittagong Sandstone Woodland on lower slopes in the APZ; and
  - 1.07 ha of Mittagong Sandstone Woodland on lower slopes in the extension area.

In terms of the constraints associated with removing native vegetation (Constraint Category 0—no constraint, Constraint Category 3—minor precautions required, Constraint Category 2—precautions required and Constraint Category 1—many precautions:

- Constraint Category 1: - No study areas would require the highest level of precautions prior to impact;
- Constraint Category 2:
  - The Loch Catherine Study Area:
    - Would require a pre-impact assessment to occur immediately prior to clearing specifically to ensure that inadvertent impacts to koalas would not occur. This level of constraint reflects the locality being 'Core Koala Habitat' but the vegetation type to be impacted being mapped as not containing species of feed trees listed in SEPP44;
    - Would require an induction informing the contractor undertaking works of the presence of *Eucalyptus apiculata* a mallee tree listed as 'rare in ROTAP (Rare or Threatened Australian Plants 1995). The induction would include providing the gps coordinates of individuals recorded during the assessment as well as an A4 fact sheet with colour pictures. The contractor would avoid individuals where possible.
    - Would require an induction informing the contractor undertaking works of the presence of *Kunzea cambagei* a species of plant listed as threatened in the NSW TSC Act. This species is outside but within proximity of the Study Area and precautions reflect that a survey does not cover every square inch of a Study Area. The induction would include providing the contractor an A4 fact sheet with colour pictures. The contractor would stop work in the area and notify Mine Management if individuals are observed.
- Constraint Category 3:

  - o All areas requiring tree clearing (Loch Catherine and Berrima Pit Top) would require general mitigation and pre-clearing precautions. These are detailed in the recommendations of this report.
  - o General monitoring of remanent native vegetation which has been mapped as an EEC in this report would be required within the SMP Study Area. Monitoring would aim to provide an accurate assessment on community health, nature and extent as a snapshot in time within the SMP Area.

- Constraint Category 0.

The main constraints associated with the activity are associated with impacts to habitat that has potential to possess threatened biota.

5.3 Endangered Ecological Communities (EEC)

Two EECs were recorded in the Project Site, both are located within the SMP Study Area:

- Robertson Basalt Tall Open-forest EEC in NSW, three remnants of 0.5 + 3.56 +0.1 ha (4.16ha) in the SMP Study Area.
- Southern Highlands Shale Woodlands EEC in NSW, three remnants of 1.56 + 0.5 + 1.88 ha (3.94 ha) in the SMP Study Area.

All remnant EECs were assessed as ‘Good’ (low) condition following BioBanking methodology. Little natural recruitment was observed and threats from grazing agriculture are likely to cause local (long term) extinction of local population under the current management regimes.

5.4 Threatened species

No threatened species were observed. Interviews with local residences confirmed that the Powerful Owl (*Ninox strenua*, V TSC Act) has been recorded within the SMP Study Area (Rob Byrnes pers comm, a local resident and qualified ecologist). A targeted owl and bat survey undertaken by Cumberland Ecology in 2009 did not record threatened owls in the Berrima Pit Top or Loch Catherine APZ Study Areas.

No microbats were recorded during ultrasonic detection (one night during freezing rain where temperatures were close to zero with strong winds) adjoining the SMP Study Area. This was not an unexpected result. Cumberland Ecology (2009) recorded Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) and Eastern Horseshoe Bat (*Rhinolophus megaphyllus*) over a two night period (focussing on Loch Catherine Mine Adits, less than 1km from the Loch Catherine and Berrima Pit Top Study Areas). The Eastern Bentwing Bat is listed as vulnerable under the TSC Act. The Eastern Bentwing Bat is a cave dependant species and hunts in forested areas, catching moths and other flying insects above the tree tops. This species would have a portion of its resource collection zone removed however, the nature and scale of vegetation removal for the APZs within context of the local environment would not affect its ability to naturally locally recover.

One ROTAP ‘rare’ species was recorded. *Eucalyptus apiculata,* (a mallee tree) was recorded within the Berrima Colliery and Loch Catherine Study Areas. The locations of individual plants have been shown as small green triangles on **Figures 5 and 6** respectively. Approximately seven individuals were recorded within the Berrima Colliery APZ Study Area (many others recorded and observed beyond the boundary limits) and although none were recorded within the Loch Catherine APZ Study Area at least 10 were observed beyond the impact limits.

Koalas were noted as 'likely to occur' however trees within the Impact Footprint (the area to be physically altered) that were inspected did not show evidence of the species, nor were scats observed. Impacts to vegetation are limited to Mittagong Sandstone Woodland, a vegetation type not mapped as SEPP44 habitat.

5.5 Noxious weeds

Serrated tussock, a weed listed as noxious was observed throughout the SMP Study Area.

No noxious weeds were recorded in the Berrima Pit Top or the Loch Catherine Study Areas.

6.0 Discussion

6.1 Likely changes to habitat value of communities and trees assessed

The SMP Study Area

To date we have been informed that shallow aquifers, drainage and natural hydrology would not be altered by the Proposal. The following section has been written on this premise.

It is unlikely that changes to native vegetation would occur in the SMP area. An inspection of the 'old workings' within and adjacent to the SMP Area was undertaken to understand the degree of subsidence experienced in the area and there was no discernable difference between areas that are currently not undermined.

There were no discernable ground water dependant communities at risk of impact nor were any of the dams and drainage lines observed likely to undergo changes to communities with the predicted levels of subsidence.

The SMP application notes an area of land 'slumping' through natural processes, although it is evident that land clearing on the steep slope has accelerated this process. We have been advised that subsidence would again further increase the nature and extent of this slumping however very little native vegetation would be affected as it is devoid of native understorey or canopy vegetation.

All other habitat values noted i.e. rocky areas, tree hollows, areas suited for rare plants etc are also likely to retain current potential to host the regions threatened biota.

The Berrima Colliery Pit Top Study Area

Vegetation surrounding the Berrima Pit Top is regrowth, no old growth trees or trees with hollows occur within the APZ. The current series of topographic maps provides a good example as the area mapped as 'cleared' on the western side of the pit top is currently occupied by native vegetation. Photographs of the mine since the 1920s show the area surrounding the pit top as devoid of native vegetation. It is suspected that regrowth encroached the previously cleared areas in the 1970s.

Vegetation to be impacted does not provide opportunities for hollow dependant specie to breed, similarly Koalas although having possibilities to occur have a much lower probability to be recorded in <u>Regrowth</u> Mittagong Sandstone Woodland, a vegetation type not mapped as SEPP44 habitat. Koalas have a higher probability of being recorded in It is possible that koalas may be recorded in <u>Regrowth</u> Wingecarribee Woodland on valley floors that runs along the drainage line (0.08 ha within the APZ). Although the probability of impacting Koalas is considered low pre clearing precautions such as pre clearing assessments and inductions would be required to ensure environmental due diligence.

The activity would target removal of understorey and thinning of the tree canopy except on the southern side of the drift where all trees within 40 m of communications lines would be removed. It is not envisaged that this activity would place any of the regions threatened species at risk. The activity is small scale in nature and does not affect habitat types likely to harbour nests etc, further the regions threatened plants are more likely to be recorded in areas with less prior disturbance.

Several individuals of *Eucalyptus apiculata* were recorded in the APZ and beyond (shown as small red triangles on **Figure 5**). Although this ROTAP listed 'rare' tree actually has no legislative status recommendations within this report would see individuals protected and work crews inducted to ensure extant individuals are identified prior to clearing occurring.

The Loch Catherine Study Area

The Loch Catherine Study Area has been historically cleared and has re-established successfully, however within the Stockpile Extension Study Area there are between five and ten hollow bearing trees that would require removal. These trees, which are all located on the northern side of the existing stockpile, have habitat elements suited for small to medium sized hollow dependant animals.

Good visibility combined with a reasonably extensive search in the area did not detect any threatened plants. It is unlikely that unobserved individuals would remain.

The APZ area, again on the northern side contains an additional circa ten hollow bearing trees that would require removal. A close inspection of these trees was undertaken and no polished hollows, white wash, fur or feathers were observed around the entrances. Although the assessment was limited (in terms of duration) it was taken at the optimum time to detect breeding activity (preparation of nests).

Although a collective loss of ten to 15 habitat trees would occur it was not considered to be significant as the local environment (vegetation as well as harder to replace habitat elements such as tree hollows) are well represented immediately surrounding the assessed area.

The issue of impacting Koalas was considered in the APZ localities. All but 0.08 ha of vegetation to be impacted has been mapped as Mittagong Sandstone Woodland, this community is not mapped as a SEPP44 community. Presence of a non-SEPP44 community in an APZ in the Project Site reduces the probability of a Koala being present within the Impact Footprint.

One individual of *Eucalyptus apiculata* was recorded within the APZ and several beyond the APZ and stockpile extension area (shown as small red triangles on **Figure 6**).It is recommended that individuals of this ROTAP listed ‘rare’ tree be protected and work crews inducted to ensure extant individuals are identified prior to clearing occurring.

6.2 Affected threatened biota

Subsidence within the SMP Area is unlikely to affect habitat values within the Study Area and as such the ecological status quo would remain unaltered. As noted previously, this assumption has been based upon advice stating that waterways, drainage and local hydrology would not be affected by the Proposal.

It is not considered that Endangered Ecological Communities within the SMP Study Area would be affected by the proposal. No further assessment is considered requisite.

Cambage Kunzea (*Kunzea cambagei*) is known to occur within damp, sandy soils in wet heath or mallee open scrub at higher altitudes on sandstone outcrops or Silurian group sediments and has been mapped (NSW Wildlife Atlas) as occurring 400 m east of the Loch Catherine APZ Study Area.

This species was not recorded within the Berrima Colliery or Loch Catherine APS Study Areas and extant individuals are considered as unlikely to be present and remain undetected. ‘Unlikely’ reflects the differences in landforms of the discrete locations to reduce but not exclude the possibility. The site of the Wildlife Atlas records (two closely occurring locations) appear at the break of slope at the top of a low thin tow slope terrace 65 m from a drainage line. Breaks of slopes are associated with higher levels of moisture / damper soils, a habitat niche favoured by this species.

It is noted that *Eucalyptus apiculata* has been recorded in the Berrima APZ and occurs adjacent to the Loch Catherine APZ. As habitat for this or this species includes 'mallee open scrub at higher altitudes on sandstone outcrops' potential exists for the species to occur however, the assessment did not record any individuals. Although it is determined that this species will remain unaffected by the proposal and no further assessment is requisite it is apropos to include due diligence management in this report for the potential for encountering extant individuals within the APZ Study Areas. It is duly noted that 100% coverage of any given Study Area is unlikely and as such it better to manage than disregard this possibility.

Microbats are the group of animals most at risk by vegetation removal however, the true context is discrete as only ten to 15 trees of an age to possess hollows would be removed (all located within the Loch Catherine Study Area). As noted in the survey constraints, cold freezing rain a few degrees above zero degrees Celsius and gusty winds occurred on the night ultrasonic bat detection was undertaken resulting in and no effective records being captured were captured. Further the only targeted assessment at the Loch Catherine Study Area (close enough to the Berrima Pit top to be relevant) was focussed on adits a habitat niche mutually exclusive to bat species of interest in this assessment.

It is possible that threatened bats would be impacted by tree clearing (habitat based assumption) and as such precautions are requisite. As threatened microbats are difficult to detect inside a tree and cannot be handled by an unvaccinated individual, recommendations to reduce risk to these species focus on methods of tree removal rather than a requirement for further identification of potential roosts prior to clearing. It is considered extremely unlikely that roosts, if present, would be used for breeding.

As potential exists for threatened tree roosting microbats to be affected by the APZs, further assessment following NSW and National assessment criteria has been provided (**Appendix II**). Assessments of significance demonstrate that no species of threatened bats with potential to be affected would be placed at risk of local extinction and further assessment is not requisite.

It is possible that Squirrel Gliders (TSC Act), Spotted-tail Quoll (TSC and EPBC Act) and much less likely the Pygmy Possum (TSC Act) have potential to be affected by tree clearing at Loch Catherine Study Area.

A habitat based assessment focussing on Squirrel Gliders concluded that trees with hollows to be removed were all alive and 'smooth barked' thus much less likely to provide refuge for the species (prefer dead trees, stags and rough barked trees where the animals can get purchase whilst moving). It was concluded that Squirrel Gliders are unlikely to be 'affected' by the APZ within context of the Proposal.

A habitat based assessment of the abovementioned area was undertaken for Spotted-tail Quoll. The wider environments were considered likely Quoll habitat but the APZ Study Areas were considered unlikely habitat within the broader definition because:

- The presence of Squirrel Gliders (food source) as unlikely, although it was noted that common species of possums have potential to be recorded;
- Tree hollows observed were considered too small to provide refuge for the species, however the possibility of not seeing the all tree hollows present was not discarded;
- Ground debris did not provide refuge of the species;

- Opportunities for likely food species (other than possums) were infrequent and limited to canopy dependant species, i.e. birds, microbats hunting / feeding on the wing;
- Due to the proximity of urbanised areas there is a higher risk of predation / competition by foxes, dogs and cats which are all recognised as outcompeting Quoll for this habitat niche; and
- Evidence of other physical traces i.e. latrine sites were not observed.

For the reasons noted above, the Spotted-tail Quoll is not considered to be ‘affected’ by the Proposal and as such no further assessment is considered requisite.

Pygmy Possums are unlikely to be affected as feed tree / shrub species such as dense stands of Banksia do not occur in the APZ Study Areas. The principle author has direct experience with managing habitat utilised by this species in the Newnes Plateau Lithgow LGA, which is the same CMA area as the current Proposal and is confident that this species would remain unaffected. No further assessment is requisite.

0.08 ha of Wingecarribee Woodland on valley floors, a SEPP44 vegetation type, would be removed to protect communications lines for the Berrima Colliery underground. It is very unlikely that impacts to this area would cause the species to be ‘affected’ by the proposal as it is immediately adjacent to the drift of an operational coal mine. Justification for this conclusion is that the area immediately surrounding the opening to the drift has higher levels of human activity than surrounding bushland and as such has a higher potential to be unattractive to extant local resident populations / individuals. Although it is considered the species would remain ‘unaffected’ by the Proposal, further assessment following NSW assessment criteria has been provided (**Appendix II**).

Further assessment recognises the wider locality being considered ‘core koala habitat’. Impacts to 0.08 ha of Koala habitat concluded that the Proposal is unlikely to result in a significant impact to the species. Further a Plan of Management is not an effective way to manage the potential impact to the species so specific recommendations have been provided in this report. Precautions prior to clearing are requisite. Pre-clearing checks and inductions would form part of the activity to ensure environmental due diligence.

It is not considered that removal of vegetation or habitat would ‘affect’ any other species, populations or communities noted on the DECCW and DEWHA database searches, consequently no additional assessments of significance are required.

6.3 Indirect and operational impacts

Indirect impacts associated with the SMP Study Area are limited to potential altered hydrology and exacerbation of slumping on one property. Altered hydrology has been stated as ‘unlikely’ as a result of the Proposal. A qualifier of the aforementioned is that ground water data is historically scarce. The Proponent is implementing a better systematic sampling regime aimed at obtaining an understanding of ground water behaviour. Should a risk be established at a later date it will be managed through the SMP.

Slumping of steep cleared hillsides within the SMP has naturally occurred, hastened by existing agricultural practices. It is possible that further slumping would occur with subsidence. The mine has implemented several monitoring points in the slumped area and has been assisting the landholder with management of the issue. Monitoring of management the situation is considered the only pathway forward with the body of knowledge available. Slumping is distant to sources of water, drainage lines and areas of native vegetation. It is not expected that further slumping would place any existing vegetation at risk. It is also understood that further slumping would be actively managed through the SMP to avoid movement of soil.

6.4 Will the Proposal exacerbate any Key Threatening Process?

The DECCW list of Key Threatening Processes (KTP) was reviewed (search date: 30.6.2010: http://www.environment.nsw.gov.au/threatenedspecies/KeyThreateningProcessesByDoctype.htm).

14 KTPs are active within the Study Area, of these, three (‘clearing of native vegetation’, ‘loss of hollow-bearing trees’ and ‘removal of dead wood and dead trees’) will be exacerbated by activities associated with APZ implementation and extension of the coal stockpile at Loch Catherine (**Table 5**). The nature and extent of the proposed impacts have been discussed in the preceding sections however it is noted that there are few dead trees and dead wood.

6.5 TSC Act: 7–Part Tests and EPBC Act Assessment of Significance

The appropriate management of ecological items is usually determined on the basis of their assessed significance as well as the likely impacts of any Proposal. Significance of a species, population or community is determined by appointed NSW and National Scientific Committees, cultural and public significance are considerations within the significance determination process. Within the framework of an impact assessment impacts to listed significant item must be assessed at a State (under the TSC Act) or National (under the EPBC Act) level: even if it is the same species, population or community.

The following sections identify State or Nationally listed threatened (significant) species, communities or populations identified as ‘affected’ then determines if the effects are ‘significant’. Seven part tests / Assessments of Significance as specified under the TSC and EPBC Act were completed to properly characterise the threat to:

1. Species of threatened tree hollow dependant microbats:
    a. Large-eared Pied Bat, Large Pied Bat (*Chalinolobus dwyeri*) EPBC;
    b. Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), TSC;
    c. Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), TSC;
    d. Eastern Freetail-bat (*Mormopterus norfolkensis)* TSC;
    e. Greater Broad-nosed Bat (*Scoteanax rueppellii*) TSC;
    f. Large-footed Myotis (*Myotis macropus* - formally *Myotis adversus*) TSC; and
    g. Little Bentwing-bat (*Miniopterus australis*) TSC.
2. Koala (TSC).

As can be seen above all species with the exception of *Chalinolobus dwyeri* require assessment under NSW legislation.

6.3.1 Significant NSW communities, populations or species within the Study Area

Two EECs have been identified in the Study Area and were considered as not ‘affected’ by the Proposal.

6.3.2 Nationally significant communities, populations or species within the Study Area

Shale – Sandstone Transition Forest was identified in the Study Area (referred to in this report as 'Southern Highlands Shale Woodlands'). This EEC will remain unaffected by the Proposal. Further consideration is not requisite.

Other Matters of National Environmental Significance have been addressed in **Table 3.**

Table 3: Matters of National Environmental Significance.

Issue		Impact
a)	Any environmental impact on a World Heritage property	No
b)	Any impacts on wetlands of international importance	No.
c)	Any environmental impact on Commonwealth listed threatened species or ecological communities	No.
d)	Any environmental impact on Commonwealth listed migratory species	No. Unlikely removal of breeding habitat, minor reduction in winter flowering feeding resource but not considered to 'affect' Nationally listed species.
e)	Does the project affect any national heritage places	No
f)	Does any part of the proposal involve a nuclear action?	No.
g)	Any environmental impact on Commonwealth marine area?	No
h)	Any direct or indirect effect on Commonwealth land?	No

6.6 Management Options

Appropriate management of ecological items is primarily determined on the basis of their assessed significance as well as the likely impacts of the proposed development. The following management options are general principles, in terms of best practice and desired outcomes based upon a 'maintain or improve' outcome for biodiversity.

- Avoid impact by altering the development proposal.
    - Under the current Proposal, avoidance is not possible given the nature of the outcome i.e. both the APZs and the SMP area cannot be relocated.
- If impact is unavoidable then reduce the nature and extent of the impact and offset loss of habitat to achieve a 'maintain or improve' outcome for local biodiversity.
    - Impacts associated with the Loch Catherine coal stockpile expansion area have potential to be relocated in other areas surrounding the stockpile with fewer hollow bearing trees.
    - An assessment of landform immediately surrounding the stock pile area showed that moving the impacts elsewhere would bring the stockpile closer to drainage lines and they would be located on land with a steeper slope.
    - Works require to 'level' the substrate for the stockpile area would result in a bigger Impact Footprint.
    - As noted earlier impacting landforms closer to drainage lines with a break in slope on them provide habitat for at least one species of threatened plant known to occur

within 400 m. Avoidance of this landform type decreases risk of impacts to this species (and or permanent loss of suitable habitat for subsequent re-colonisation).

- Further, in terms of habitat fragmentation, the preferred extension area would see vegetation closer to an existing track affected. No new fragmentation proposed would exceed 100 m in gap between adjoining areas.

Overall, general management can be limited to:

1. Offsetting;
2. Inducting; and
3. Due diligence.

Details of the three areas noted above have been provided as recommendations in this report.

7.0 Relevant Legislation

7.1 National legislation

7.1.1 Environmental Protection and Biodiversity Act 1999 (EPBC Act)

Relevance to the current project: In relation to this Act, items of national environmental significance are detailed in this report.

7.2 State legislation

7.2.1 Environmental Planning and Assessment Act, 1979 (EP&A Act)

Relevance to the current proposal: This assessment has considered critical habitat, threatened species, populations or ecological communities, or their habitats which occur in the Study Area.

7.2.1.1 Ecologically Sustainable Development (ESD)

Relevance to the current proposal: Consideration has been given to how the proposed modifications accord with ESD principles throughout the assessment, particularly with regard to the environmental constraints posed in the Study Area. It is summarised that the impact would be discrete such that those ecological values present / or having potential to occur would be protected or managed for future generations.

7.2.2 Protection of the Environment Operations Act, 1997 (PoEO Act)

Management of environmental impacts in relation to air, noise and water quality falls under the provisions of the *Protection of the Environment Operations Act 1997* which have been discussed through the SMP Approval process. There are no overlapping issues other than ensuring legislative compliant soil and sediment controls that require further discussion within this report.

7.2.3 The Native Vegetation Act 2003 (NV Act)

Relevance to the current proposal: This project will be assessed under Part 3A of the EP&A Act. The environmental approvals from which approved Part 3A projects are exempt include the consent to clear native vegetation under the *Native Vegetation Act 2003.*

7.2.4 The Noxious Weeds Act 1993 (NW Act)

Relevance to the current proposal: The ecological assessment included a search for noxious weeds and notes that Serrated Tussock was observed within the SMP area.

7.2.5 The Fisheries Management Act 1994 (FM Act)

Relevance to the current project: None.

7.2.6 The Water Management Act 2000 (WM Act).

Relevance to the current proposal: This project will be assessed under Part 3A of the EP&A Act. The environmental approvals from which approved Part 3A projects are exempt include approvals under the *Water Management Act 2000.*

7.2.7 Threatened Species Conservation Act 1995 (TSC Act)

Items within the TSC Act relevant to the current proposal include:

Threatened Species, Populations and Ecological Communities

Relevance to the current proposal: In relation to the Study Area, desktop and field investigations have occurred to identify if any threatened species, populations and ecological communities occur in the Study Area.

Key Threatening Processes

Relevance to the current proposal: In terms of the Key Threatening Processes as listed in Schedule 3 of the TSC Act, the project would involve clearing of native vegetation and dead timber.

The NSW planning and licensing system (the EP&A Act) and its relationship to threatened species, populations or ecological communities, or their habitats.

Relevance to the current proposal: Assessments of significance have been undertaken within this document.

7.2.8 Threatened Species Conservation Amendment (Biodiversity Banking) Act 2006

Relevance to the current proposal: This project has not been assessed using the Biobanking scheme.

7.2.9 State Environmental Planning Policies (SEPP)

SEPP 44 – Koala Habitat Protection

The Wingecarribee LGA is identified under Schedule 1 (Local Government Areas) of State Environmental Planning Policy No 44 (SEPP 44)—Koala Habitat Protection. This policy seeks to protect the species by encouraging the proper conservation and management of areas that provide habitat for koalas.

The Study Area is considered core koala habitat due to the frequency of koala records around the Project Site and recording of “feed tree species” as listed in Schedule 2 of SEPP 44. A Plan of Management for the species is not recommended as:

1. Only 0.08 ha of a regrowth sub par SEPP44 community would be impacted;
2. A Plan of Management for the species would not achieve a greater level of protection for potential impacts to Koalas within the Impact Footprint;
3. A Plan of Management is not required fro the long-term management of the species in the Project Site in context with this Approval.

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 aims to facilitate the effective delivery of infrastructure across the state.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by *State Environmental Planning Policy No. 14 – Coastal Wetlands, State Environmental Planning Policy No. 26 – Littoral Rainforests or State Environmental Planning Policy (Major Projects) 2005.*

With respect to the above, the REF being under Part 3A of the EP&A Act removes the need for development consent. This ecological assessment provides a supporting specialist study for the Approval.

7.2.10 Regional Environment Plans (REP) and Local Environment Plans (LEP)

Where an LEP or REP prohibits the type of development being applied for under Part 3A, the Planning Minister can only approve the development if the project application is also accompanied by a concept plan.

Relevance to the current proposal: There are no ecological issues other than those already addressed under the TSC and EPBS Acts.

8. Recommendations

Overall, general management can be limited to:

1. Offsetting

    1.1 Native vegetation and habitats within the SMP area would remain unaffected by the Proposal. It is considered that offsetting would not be required.

    1.2 Vegetation to be affected in the Berrima Colliery Study Area is regrowth. Offsetting is not requisite.

    1.3 Vegetation to be affected within the Loch Catherine Study Area is predominately regrowth however, it has been noted that between 10 to 15 hollow bearing trees would require removal. Replacement of habitat values associated with loss of hollows is considered appropriate. Five microbat boxes and five next boxes suited for small parrots would be appropriate compensation. Placement of these nest boxes would be within land managed by the colliery and the boxes would be monitored (annually) and replaced as required.

2. Inducting

    2.1 All personnel undertaking works should be inducted such that they are aware that any stand of native vegetation beyond the limits of clearing (APZ and coal stockpile expansion area) is protected and as such, there are legislative consequences of deliberately or accidentally impacting it without approval under Part 3A of the EP&A Act.

    2.2 Evidence of all personnel receiving an induction must be kept on file (signed induction sheets etc). Should an incident happen followed by a DECCW investigation, this process is likely to reduce the severity of the repercussions to Proponent whilst encouraging the willingness to comply with the ground crews.

    2.3 Limiting effects to *Eucalyptus apiculata* would form part of the wider vegetation management within the area. Inductions would include an A4 sheet with information about the species and colour photographs that would assist the lay person undertaking clearing to identify them in the field and as such conserve them in-situ. There is scope within the Berrima Colliery Study Area to avoid individuals within the Impact Footprint without compromising the integrity of the APZ. A specific A4 sheet for this species has been provided as **Appendix III** of this report.

    2.4 Similarly, to reduce potential harm to *Kunzea cambagei* which remain undetected in the Study Area, the induction would include an A4 sheet with information about the species and colour photographs that would assist the lay person undertaking clearing to identify them in the field and as such conserve them in-situ. There is scope within the Berrima Colliery Study Area to avoid individuals within the Impact Footprint without compromising the integrity of the APZ. A specific A4 sheet for this species has been provided as **Appendix III** of this report.

    2.5 Threatened microbats have potential to utilise habitat within the Impact Footprint. When a tree is cleared it would be pushed then and left overnight prior to stacking / removal so that bats have an opportunity to flee that night. It is understood that the logistics of vegetation removal would require some areas to be manipulated to a higher degree than others however, the intention is to encourage the highest survival rate for microbats during habitat removal as possible.

2.6 Inductions would notify all personnel not to touch or handle any species of bat if encountered. A bite from a bat has potential to cause a viral affect that has potential to damage human health. If a bat is seen leave it where it is and relocate the work into a different area until the next day.

4. Due diligence

2.7 To ensure potential impacts to Koalas (both indirect and direct) are minimised, an inspection of the trees to be cleared in the APZs would be undertaken by a qualified environmental manager (ecologist / environmental scientist) immediately prior to clearing. The inspection would be undertaken each morning and work could start immediately after any given area is declared a ‘safe place of work’. An additional inspection of each tree to be removed would be undertaken by the contractor immediately prior to removal to add an extra layer of protection for the species. If a Koala is observed all work within a 50 m radius would be stopped and the relevant Mine environmental personnel contacted for advice.

2.8 To ensure there are no errors in tree clearing, the Mine Environmental Manager would ensure that the areas to be cleared and retailed are clearly marked with an effective method (i.e. rope, paint etc) in the field. The induction would include the contractor demonstrating an understanding between areas to be cleared and retained. The Mine Environmental manager would audit the nature an extent of the work each day.

2.9 Monitoring the health status, nature and extent of EECs within the SMP Study Area is the only effective way that the predicted ‘no effect to EECs’ can be determined. Base line data combined with other specialist information i.e. ground water monitoring could be used to manage any effects to the EECs through the SMP should they arise. Annual monitoring (preferably in spring / summer) would provide the best results however, opportunistic collection of data from winter and autumn may be used to target individual species within the EECs as required. The proposal to undertake the work should request the consultant to justify sampling methods and minimum number of plots to be considered as having statical meaningfulness.

9. CONCLUSION

Within the SMP Area vegetation was mapped as follows:

- Wingecarribee Woodland on valley floors (two main remnants of 9.76 + 0.3 ha = 10.06 ha);
- Robertson Basalt Tall Open-forest EEC in NSW (three main remnants of 0.5 + 3.56 +0.1 ha = 4.16ha);
- Southern Highlands Shale Woodlands EEC in NSW (three main remnants of 1.56 + 0.5 + 1.88 ha = 3.94 ha);
- Mittagong Sandstone Woodland on lower slopes (2.32 ha); and
- Cleared land (approximately 152 ha).

Predicted subsidence would not place any of these vegetation communities at risk of local extinction, nor would it place at risk any threatened species dependant on the habitat values upon which it contains. Annual monitoring of the EECs has been recommended to establish base line data should a situation arise where the Proponent needs to demonstrate that subsidence has not had an effect to these EECs.

Implementing a 20 m APZ around the existing Berrima Colliery pit top would see all understorey removed and tree thinning within:

- <u>Regrowth</u> Wingecarribee Woodland on valley floors (0.08 ha); and
- <u>Regrowth</u> Mittagong Sandstone Woodland on lower slopes (1.27 ha).

The nature and scale of the activity within this regrowth vegetation is unlikely to place any of the regions threatened species at risk of local extinction. One species of ROTAP ‘rare’ tree *Eucalyptus apiculata* (a mallee) was recorded within the Impact Footprint (the area to be physically altered) and beyond.

Recommendations within this report would see individual *Eucalyptus apiculata* avoided and the same process of contractor education would be used to increase awareness of Koalas and *Kunzea cambagei* through inductions. These would educate work crews so any extant individuals would be identified and protected.

Extension of the existing coal stockpile area at Loch Catherine would see 1.17 ha in the APZ and 1.07 ha in the extension area of Mittagong Sandstone Woodland on lower slopes removed. Although vegetation within this study area is comprised largely of regrowth, the stockpile extension area and APZ to its north would see approximately 10 to 15 hollow bearing trees removed. An inspection of these trees did not reveal they were in use by dependant species however habitat values lost would be replaced with nest boxes. Further, removal of the tree hollows is unlikely to place dependant species at risk as surrounding vegetation has an abundance of this key habitat element. Similarly to the above, inductions for Koala and *Kunzea cambagei* would occur.

Having given consideration to the ecology within the Project Site, it is concluded that the Proposal would be:

- unlikely to significantly affect any of the listed threatened species, fauna populations or communities that if the recommended amelioration measures are adopted, implemented and maintained;
- unlikely to augment or significantly contribute to any of the National or State listed key threatening processes;
- unlikely to significantly affect any Ramsar wetland or any CAMBA or JAMBA listed species;
- unlikely to significantly affect any of the creeks if adequate safeguards are adopted for water run-off from the Berrima Colliery and Loch Catherine stock pile;
- unlikely to impact Koalas as the vast majority of vegetation to be affected does not support State Environmental Planning Policy 44 (SEPP44) feed tree species; and
- is consistent with Economically Sustainable Development principles with regard to fauna and would not adversely affect the local biodiversity (no issue of inter-generational or value added matters are relevant in this instance).

Predicted subsidence would not place any of these vegetation communities at risk of local extension, nor would it place at risk any threatened species dependant on the habitat values upon which it contains.

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Plates

Appendix I: Database Searches

DECCW Threatened Species search results

EPBC Protected Matters Search (Wingecarribee LGA)

Wildlife Atlas Search Results (Wingecarribee LGA)

DECCW Threatened Species search results

Your search returned **89** results. You searched for the following information:

- geographic region: **Hawkesbury/Nepean > Burragorang (Part A)**
- vegetation type: **all**
- type: **all**

Table 4: DECCW Threatened Species search results.

Scientific Name	Common Name	Level of Threat
Asterolasia buxifolia	*Asterolasia buxifolia*	Endangered
Persoonia bargoensis	Bargo Geebung	Endangered
Ninox connivens	Barking Owl	Vulnerable
Genoplesium baueri	Bauer's Midge Orchid	Vulnerable
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Vulnerable
Eulamprus leuraensis	Blue Mountains Water Skink	Endangered
Litoria booroolongensis	Booroolong Frog	Endangered
Hoplocephalus bungaroides	Broad-headed Snake	Endangered
Eucalyptus aquatica	Broad-leafed Sallee	Vulnerable
Pomaderris brunnea	Brown Pomaderris	Vulnerable
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Vulnerable
Petrogale penicillata	Brush-tailed Rock-wallaby	Endangered
Acacia bynoeana	Bynoe's Wattle	Endangered
Kunzea cambagei	Cambage Kunzea	Vulnerable
Eucalyptus benthamii	Camden White Gum	Vulnerable
Eucalyptus macarthurii	Camden Woollybutt	Vulnerable
Pomaderris cotoneaster	Cotoneaster Pomaderris	Endangered
Zieria covenyi	Coveny's Zieria	Endangered
Meridolum corneovirens	Cumberland Land Snail	Endangered

Cumberland Plain Woodland	Cumberland Plain Woodland	Critically Endangered Ecological Community
Boronia deanei	Deane's Boronia	Vulnerable
Baloskion longipes	Dense Cord-rush	Vulnerable
Stagonopleura guttata	Diamond Firetail	Vulnerable
Acacia pubescens	Downy Wattle	Vulnerable
Rulingia prostrata	Dwarf Kerrawang	Endangered
Phyllota humifusa	Dwarf Phyllota	Vulnerable
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable
Mormopterus norfolkensis	Eastern Freetail-bat	Vulnerable
Cercartetus nanus	Eastern Pygmy-possum	Vulnerable
Bossiaea oligosperma	Few-seeded Bossiaea	Vulnerable
Petroica phoenicea	Flame Robin	Vulnerable
Acacia flocktoniae	Flockton Wattle	Vulnerable
Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable
Heleioporus australiacus	Giant Burrowing Frog	Vulnerable
Petalura gigantea	Giant Dragonfly	Endangered
Calyptorhynchus lathami	Glossy Black-cockatoo	Vulnerable
Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable
Litoria aurea	Green and Golden Bell Frog	Endangered
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable
Gyrostemon thesioides	Gyrostemon thesioides	Endangered
Persoonia hirsuta	Hairy Geebung	Endangered
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Vulnerable
Hygrocybe anomala var.	*Hygrocybe anomala* var. *ianthinomarginata*	Vulnerable

ianthinomarginata		
Acacia clunies-rossiae	Kanangra Wattle	Vulnerable
Carex klaphakei	Klaphake's Sedge	Endangered
Phascolarctos cinereus	Koala	Vulnerable
Hakea dohertyi	Kowmung Hakea	Endangered
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable
Myotis macropus (formally Myotis adversus)	Large-footed Myotis	Vulnerable
Leionema lachnaeoides	*Leionema lachnaeoides*	Endangered
Miniopterus australis	Little Bentwing-bat	Vulnerable
Hieraaetus morphnoides	Little Eagle	Vulnerable
Litoria littlejohni	Littlejohn’s Tree Frog	Vulnerable
Tyto novaehollandiae	Masked Owl	Vulnerable
Melaleuca sp. Megalong Valley	Megalong Valley Bottlebrush	Vulnerable
Persoonia glaucescens	Mittagong Geebung	Endangered
Moist Shale Woodland in the Sydney Basin Bioregion	Moist Shale Woodland in the Sydney Basin Bioregion	Endangered Ecological Community
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps	Montane Peatlands and Swamps	Endangered Ecological Community
Mount Gibraltar Forest in the Sydney Basin Bioregion	Mount Gibraltar Forest in the Sydney Basin Bioregion	Endangered Ecological Community
Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)	Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)	Not listed
Persoonia acerosa	Needle Geebung	Vulnerable
Ninox strenua	Powerful Owl	Vulnerable
Paralucia spinifera	Purple Copper Butterfly (Bathurst Copper Butterfly)	Endangered
Pseudophryne australis	Red-crowned Toadlet	Vulnerable

Xanthomyza phrygia	Regent Honeyeater	Endangered
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	River-Flat Eucalypt Forest on Coastal Floodplains	Endangered Ecological Community
Robertson Basalt Tall Open-forest in the Sydney Basin Bioregion	Robertson Basalt Tall Open-forest in the Sydney Basin Bioregion	Endangered Ecological Community
Varanus rosenbergi	Rosenberg's Goanna	Vulnerable
Petroica boodang	Scarlet Robin	Vulnerable
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Endangered Ecological Community
Prasophyllum fuscum	Slaty Leek Orchid	Critically Endangered
Pultenaea glabra	Smooth Bush-Pea	Vulnerable
Solanum armourense	*Solanum armourense*	Endangered
Tyto tenebricosa	Sooty Owl	Vulnerable
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Endangered
Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	Endangered Ecological Community
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	Endangered
Pyrrholaemus saggitatus	Speckled Warbler	Vulnerable
Circus assimilis	Spotted Harrier	Vulnerable
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable
Petaurus norfolcensis	Squirrel Glider	Vulnerable
Mixophyes balbus	Stuttering Barrred Frog	Endangered
Lathamus discolor	Swift Parrot	Endangered
Sydney Turpentine-Ironbark Forest	Sydney Turpentine-Ironbark Forest	Endangered Ecological Community
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands	Tableland Basalt Forest	Endangered Ecological Community

Bioregions		
Neophema pulchella	Turquoise Parrot	Vulnerable
Gentiana wingecarribiensis	Wingecarribee Gentian	Endangered
Petaurus australis	Yellow-bellied Glider	Vulnerable

EPBC Protected Matters Search (Wingecarribee LGA)

Table 5: EPBC Protected Matters search results.

World Heritage Properties [Dataset Information]		
The Greater Blue Mountains Area NSW		
National Heritage Places [Dataset Information]		
The Greater Blue Mountains Area NSW		
Threatened Ecological Communities [Dataset Information]	Status	Type of Presence
Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory	Endangered	Community may occur within area
Shale/Sandstone Transition Forest	Endangered	Community likely to occur within area
Temperate Highland Peat Swamps on Sandstone	Endangered	Community may occur within area
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area
Threatened Species [Dataset Information]	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater	Endangered	Species or species habitat likely to occur within area
Dasyornis brachypterus Eastern Bristlebird	Endangered	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog	Vulnerable	Species or species habitat may occur within area
Litoria booroolongensis Booroolong Frog	Endangered	Species or species habitat may occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria)	Vulnerable	Species or species habitat likely to occur within area
Mammals		

Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered	Species or species habitat may occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot	Endangered	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby	Vulnerable	Species or species habitat may occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland)	Vulnerable	Species or species habitat may occur within area
Pseudomys fumeus Konoom, Smoky Mouse	Endangered	Species or species habitat may occur within area
Pseudomys novaehollandiae New Holland Mouse	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Ray-finned fishes		
Macquaria australasica Macquarie Perch	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling	Vulnerable	Species or species habitat may occur within area
Reptiles		
Delma impar Striped Legless Lizard	Vulnerable	Species or species habitat may occur within area
Hoplocephalus bungaroides Broad-headed Snake	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acacia bynoeana Bynoe's Wattle, Tiny Wattle	Vulnerable	Species or species habitat likely to occur within area
Acacia flocktoniae	Vulnerable	Species or species habitat likely to occur within area
Apatophyllum constablei	Endangered	Species or species habitat may occur within area
Baloskion longipes	Vulnerable	Species or species habitat likely to occur within area
Boronia deanei Deane's Boronia	Vulnerable	Species or species habitat likely to occur within area
Bossiaea oligosperma	Vulnerable	Species or species habitat likely to occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid	Vulnerable	Species or species habitat may occur within area

Cynanchum elegans White-flowered Wax Plant	Endangered	Species or species habitat likely to occur within area
Daphnandra johnsonii a tree	Endangered	Species or species habitat likely to occur within area
Dillwynia tenuifolia	Vulnerable	Species or species habitat likely to occur within area
Diuris aequalis Buttercup Doubletail	Vulnerable	Species or species habitat may occur within area
Eucalyptus aquatica Mountain Swamp Gum, Broad-leaved Sallee, Broad-leaved Sally	Vulnerable	Species or species habitat likely to occur within area
Gentiana wingecarribiensis Wingecarribee Gentian	Endangered	Species or species habitat likely to occur within area
Grevillea molyneuxii	Endangered	Species or species habitat likely to occur within area
Grevillea parviflora subsp. parviflora Small-flower Grevillea	Vulnerable	Species or species habitat likely to occur within area
Grevillea rivularis Carrington Falls Grevillea	Endangered	Species or species habitat likely to occur within area
Irenepharsus trypherus Delicate Cress, Illawarra Irene	Endangered	Species or species habitat likely to occur within area
Kunzea cambagei	Vulnerable	Species or species habitat likely to occur within area
Lepidium hyssopifolium Basalt Pepper-cress	Endangered	Species or species habitat likely to occur within area
Leucochrysum albicans var. tricolor Hoary Sunray	Endangered	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark	Vulnerable	Species or species habitat may occur within area
Melaleuca deanei Deane's Melaleuca	Vulnerable	Species or species habitat may occur within area
Persoonia acerosa	Vulnerable	Species or species habitat likely to occur within area
Persoonia bargoensis	Vulnerable	Species or species habitat likely to occur within area
Persoonia glaucescens Mittagong Geebung	Vulnerable	Species or species habitat likely to occur within area
Persoonia hirsuta	Endangered	Species or species habitat likely to occur within area
Phyllota humifusa Dwarf Phyllota	Vulnerable	Species or species habitat likely to occur within area
Pomaderris brunnea Rufous Pomaderris	Vulnerable	Species or species habitat likely to occur within area
Pomaderris cotoneaster Cotoneaster Pomaderris	Endangered	Species or species habitat likely to occur within area

Pomaderris sericea Bent Pomaderris	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum fuscum Tawny Leek-orchid, Slaty Leek-orchid	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum uroglossum Wingecarribee Leek-orchid, Dark Leek-orchid	Endangered	Species or species habitat likely to occur within area
Pterostylis pulchella Pretty Greenhood	Vulnerable	Species or species habitat likely to occur within area
Pterostylis saxicola Sydney Plains Greenhood	Endangered	Species or species habitat may occur within area
Pultenaea elusa	Endangered	Species or species habitat likely to occur within area
Rulingia prostrata Dwarf Kerrawang	Endangered	Species or species habitat likely to occur within area
Thelymitra sp. Kangaloon (D.L.Jones 18108) Kangaloon Sun-orchid	Critically Endangered	Species or species habitat known to occur within area
Thesium australe Austral Toadflax, Toadflax	Vulnerable	Species or species habitat likely to occur within area
Triplarina nowraensis Nowra Heath-myrtle	Endangered	Species or species habitat may occur within area
Zieria granulata Hill Zieria, Hilly Zieria, Illawarra Zieria	Endangered	Species or species habitat likely to occur within area
Zieria murphyi	Vulnerable	Species or species habitat likely to occur within area
Migratory Species [Dataset Information]	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Migratory	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Migratory	Breeding may occur within area
Myiagra cyanoleuca Satin Flycatcher	Migratory	Breeding likely to occur within area
Rhipidura rufifrons Rufous Fantail	Migratory	Breeding may occur within area
Xanthomyza phrygia Regent Honeyeater	Migratory	Species or species habitat likely to occur within area
Migratory Wetland Species		
Birds		
Ardea alba	Migratory	Species or species habitat may occur within

Great Egret, White Egret		area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Listed Marine Species [Dataset Information]	Status	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
Lathamus discolor Swift Parrot	Listed - overfly marine area	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
Myiagra cyanoleuca Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
Rhipidura rufifrons	Listed - overfly marine	Breeding may occur within area

Rufous Fantail	area	
Rostratula benghalensis s. lat. Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area

Wildlife Atlas Search Results (Wingecarribee LGA)

(Note: GIS data plotted over the Study Area to cross check if any records occur in or near to the Stud Area).

Table 6: Wildlife Atlas search results: animals.

Animal	Map	Scientific Name	Common Name	Legal Status	Count
Amphibia	Map	Scientific Name	Common Name	Legal Status	Count
Hylidae					
		Litoria littlejohni	Littlejohn's Tree Frog	V	11
Myobatrachidae					
		Heleioporus australiacus	Giant Burrowing Frog	V	6
		Mixophyes balbus	Stuttering Frog	E1	1
		Pseudophryne australis	Red-crowned Toadlet	V	15
Aves	Map	Scientific Name	Common Name	Legal Status	Count
Acanthizidae					
		Calamanthus fuliginosus	Striated Fieldwren	E1	1
		Pyrrholaemus saggitatus	Speckled Warbler	V	13
Accipitridae					
		Hieraaetus morphnoides	Little Eagle	V	1
Anatidae					
		Oxyura australis	Blue-billed Duck	V	6
		Stictonetta naevosa	Freckled Duck	V	1
Ardeidae					
		Botaurus poiciloptilus	Australasian Bittern	V	9
Cacatuidae					
		Callocephalon fimbriatum	Gang-gang Cockatoo	V	114
		Calyptorhynchus lathami	Glossy Black-Cockatoo	V	85
Climacteridae					
		Climacteris picumnus	Brown Treecreeper	V	10
		Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	15
Dasyornithidae					
		Dasyornis brachypterus	Eastern Bristlebird	E1	3
Estrildidae					
		Stagonopleura guttata	Diamond Firetail	V	19
Meliphagidae					
		Xanthomyza phrygia	Regent Honeyeater	E1	6
Neosittidae					
		Daphoenositta chrysoptera	Varied Sittella	V	32
Petroicidae					
		Melanodryas cucullata	Hooded Robin	V	7
		Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	5
		Petroica boodang	Scarlet Robin	V	44
		Petroica phoenicea	Flame Robin	V	5

Psittacidae					
		Glossopsitta pusilla	Little Lorikeet	V	1
		Neophema pulchella	Turquoise Parrot	V	3
Strigidae					
		Ninox connivens	Barking Owl	V	3
		Ninox strenua	Powerful Owl	V	51
Tytonidae					
		Tyto novaehollandiae	Masked Owl	V	5
		Tyto tenebricosa	Sooty Owl	V	12
Insecta	**Map**	**Scientific Name**	**Common Name**	**Legal Status**	**Count**
Petaluridae					
		Petalura gigantea	Giant Dragonfly	E1	10
Mammalia	**Map**	**Scientific Name**	**Common Name**	**Legal Status**	**Count**
Burramyidae					
		Cercartetus nanus	Eastern Pygmy-possum	V	6
Dasyuridae					
		Dasyurus maculatus	Spotted-tailed Quoll	V	35
Macropodidae					
		Petrogale penicillata	Brush-tailed Rock-wallaby	E1	15
Molossidae					
		Mormopterus norfolkensis	Eastern Freetail-bat	V	8
Peramelidae					
		Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E1	4
Petauridae					
		Petaurus australis	Yellow-bellied Glider	V	144
		Petaurus norfolcensis	Squirrel Glider	V	8
Phascolarctidae					
		Phascolarctos cinereus	Koala	V	336
Potoroidae					
		Potorous tridactylus	Long-nosed Potoroo	V	10
Pteropodidae					
		Pteropus poliocephalus	Grey-headed Flying-fox	V	5
Vespertilionidae					
		Chalinolobus dwyeri	Large-eared Pied Bat	V	21
		Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	24
		Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	41
		Myotis macropus	Southern Myotis	V	35
		Scoteanax rueppellii	Greater Broad-nosed Bat	V	19
Reptilia	**Map**	**Scientific Name**	**Common Name**	**Legal Status**	**Count**
Elapidae					
		Hoplocephalus bungaroides	Broad-headed Snake	E1	3
Varanidae					
		Varanus rosenbergi	Rosenberg's Goanna	V	4

Table 7: Wildlife Atlas search results: plants.

Plants	Map	Scientific Name	Common Name	Legal Status	Count
Brassicaceae					
		Irenepharsus trypherus	Illawarra Irene	E1	3
Cyperaceae					
		Carex klaphakei	Klaphake's Sedge	E1	4
Ericaceae					
		Epacris purpurascens var. purpurascens		V	5
Euphorbiaceae					
		Amperea xiphoclada var. pedicellata		E4	2
Fabaceae (Faboideae)					
		Phyllota humifusa	Dwarf Phyllota	V	35
		Pultenaea aristata	Prickly Bush-pea	V	2
		Pultenaea elusa		E4A	1
		Swainsona sericea	Silky Swainson-pea	V	1
Fabaceae (Mimosoideae)					
		Acacia bynoeana	Bynoe's Wattle	E1	7
		Acacia flocktoniae	Flockton Wattle	V	1
		Acacia pubescens	Downy Wattle	V	1
Gentianaceae					
		Gentiana wingecarribiensis	Wingecarribee Gentian	E1	26
Myrsinaceae					
		Lysimachia vulgaris var. davurica	Yellow Loosestrife	E1	105
Myrtaceae					
		Eucalyptus aggregata	Black Gum	V	3
		Eucalyptus aquatica	Broad-leaved Sally	V	25
		Eucalyptus benthamii	Camden White Gum	V	1
		Eucalyptus macarthurii	Camden Woollybutt	V	57
		Kunzea cambagei	Cambage Kunzea	V	6
		Melaleuca deanei	Deane's Paperbark	V	4
Orchidaceae					
		Cryptostylis hunteriana	Leafless Tongue Orchid	V	1
		Diuris aequalis	Buttercup Doubletail	E1	1
		Genoplesium plumosum	Tallong Midge Orchid	E4A	1
		Prasophyllum uroglossum	Wingecarribee Leek Orchid	E4A	50
		Pterostylis pulchella	Waterfall Greenhood	V	21
Polygonaceae					
		Persicaria elatior	Tall Knotweed	V	1
Proteaceae					
		Grevillea molyneuxii	Wingello Grevillea	V	14
		Grevillea parviflora		V	15
		Grevillea rivularis	Carrington Falls Grevillea	E1	23

		Persoonia acerosa	Needle Geebung	V	5
		Persoonia bargoensis	Bargo Geebung	E1	7
		Persoonia glaucescens	Mittagong Geebung	E1	81
		Persoonia hirsuta	Hairy Geebung	E1	235
Restionaceae					
		Baloskion longipes	Dense Cord-rush	V	8
Rhamnaceae					
		Pomaderris cotoneaster	Cotoneaster Pomaderris	E1	2
		Pomaderris sericea	Silky Pomaderris	E1	5
		Pomaderris walshii	Carrington Falls Pomaderris	E4A	13
Rutaceae					
		Boronia deanei	Deane's Boronia	V	8
		Zieria murphyi	Velvet Zieria	V	16
Solanaceae					
		Solanum amourense		E1	2
		Solanum celatum		E1	1
Sterculiaceae					
		Rulingia prostrata	Dwarf Kerrawang	E1	13

Appendix II: 7–Part Test/Assessment of Significance

Significant NSW communities, populations or species within the Project Site

Significant NSW communities, populations or species within the Project Area

The following NSW threatened communities, populations or species have potential to be identified in the Study Area and affected by direct impacts associated with APZ implementation at Loch Catherine. It is not considered the NSW species populations or communities would be affected in the subsidence area or at the Berrima Pit Top APZ.

<u>NSW Threatened microbat species with in NSW</u>

- Species of threatened tree hollow dependant microbats:
    - Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), TSC;
    - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), TSC;
    - Eastern Freetail-bat (*Mormopterus norfolkensis)* TSC;
    - Greater Broad-nosed Bat (*Scoteanax rueppellii*) TSC;
    - Large-footed Myotis (*Myotis macropus* - formally *Myotis adversus*) TSC; and
    - Little Bentwing-bat (*Miniopterus australis*) TSC.
- Definition of ‘local population’: No individuals recorded in Study Area but have potential to use resources in the Study Area. Unlikely core breeding habitat within Study Area.
- Extent of habitat use within the Study Area: All remnant native vegetation, will feed in highly modified exotic grass dominated paddocks that adjoin the Study Area to the east.
- Type of modification affecting this species: Possible removal of lower potential breeding hollows (at Loch Catherine). The Loch Catherine Stockpile APZ Study Area would require clearing of:
    - 1.17 ha of Mittagong Sandstone Woodland on lower slopes in the APZ; and
    - 1.07 ha of Mittagong Sandstone Woodland on lower slopes in the extension area.

An assessment of significance for the species of shows that the Proposal is unlikely to cause local extinction of NSW listed threatened microbat species**.**

Table 8: 7–Part test of significance for NSW listed threatened microbat species with potential to occur in the Loch Catherine Study Area.

1)	in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.	• There are few risks associated with managing any extant population of these species. • Due to the discrete nature of the impacts to suitable habitat trees it is unlikely that a local population within the Study Area would be impacted such that it would placed at risk of local extinction.
2)	in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.	• Not relevant
3)	in the case of an endangered ecological community or critically endangered ecological community,	• Not relevant

whether the action proposed: (i) is likely to have an adverse effect on the extent of the ecological community such that its occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,	
4) in relation to habitat of a threatened species, population or ecological community: i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	• Details of vegetation removal have been provided above. • The impacts will have only minor fragmentary effects from other areas of habitat. • Any component of an habitat / resource for these species is important.
5) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	• Critical habitat does not occur in the locality.
6) whether the actions proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	• There are no recovery or threat abatement plans for these species.
7) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	• Clearing of native vegetation and loss of hollows KTP's apply.
Conclusion	• The proposal will remove trees that have potential roosting habitat for this species. Recommendations in this report will ensure that risk associated with removing the trees will be low for the species and that the removal of potential habitat trees within the Impact Footprint is justified. It's possible that the Proposal will reduce the extent of a feeding resource within the Project Area however it is not considered that it would cause a significant impact to the local population.

<u>NSW Threatened mammal species: Koala</u>

- Definition of 'local population': No individuals recorded in Study Area but have potential to use resources in the Study Area. Unlikely core breeding habitat within the Berrima Pit Top or Loch Catherine Study Areas. Koalas have been previously recorded in the locality.
- Extent of habitat use within the Study Area: 0.08 ha of Wingecarribee Woodland on valley floors, a SEPP44 vegetation type, would be removed to protect communications lines for the Berrima Colliery underground. Vegetation to be removed at Loch Catherine is not mapped as a SEPP44 community.
- Type of modification affecting this species: 0.08 ha of Wingecarribee Woodland which has the potential to provide food and refuge of the species.

Table 9: 7–Part test of significance for the NSW listed threatened species: Koala.

	Koala V – TSC Act
1) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.	• The Study Area falls within a LGA that has core breeding habitat for the species. • The removal of 0.08 ha Wingecarribee Woodland on valley floors, a SEPP44 vegetation type, is unlikely to place any breeding population at risk of harm. • It is unlikely that a local population within the Study Area would be impacted by the proposal such that it placed the population at risk of local extinction.
2) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.	Not relevant.
3) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: (i) is likely to have an adverse effect on the extent of the ecological community such that its occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,	Not relevant.
4) in relation to habitat of a threatened species, population or ecological community: iii) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and iv) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and v) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	• The removal of 0.08 ha Wingecarribee Woodland on valley floors, a SEPP44 vegetation type, would occur at the Berrima Pit Top APZ area. • Net habitat fragmentation will not occur. • Any component of an habitat/resource for this species is important.
5) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	Critical habitat does not occur in the locality.
6) whether the actions proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	Clearing native vegetation, particularly that mapped as SEPP44 habitat is not consistent with the draft koala recovery plan.
7) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Clearing of native vegetation, loss of deadwood (stags) and loss of hollows KTPs apply.
Conclusion	The proposal is unlikely to directly remove breeding habitat—but it will reduce the extent of a feeding resource within the Study Area. The proposal is unlikely to cause impact to a locally occurring population of this species such that it is placed at risk of local extinction. A SIS is not warranted if recommendations within this report area fully implemented.

Nationally significant communities, populations or species within the Project Area

- Large-eared Pied Bat, Large Pied Bat (*Chalinolobus dwyeri*) EPBC;

An assessment of significance for Large-eared Pied Bat following DEWHA guidelines shows that the Loch Catherine Proposal is unlikely to cause local extinction of this species **(Table 10).**

Table 10: Assessment of significance for Large-eared Pied Bat.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	Large-eared Pied Bat, Large Pied Bat (*Chalinolobus dwyeri*) (V) EPBC Act 1999.
lead to a long-term decrease in the size of a *important population*, or	• The region does not have an *important population*. • It is considered that suitable habitat would l remain unaffected by the Proposal. .
reduce the area of occupancy of an *important population*, or	• It is considered unlikely that proposal will reduce the area of occupancy for this species. It may reduce the volume of a feeding resource, however, the nature and extent of the habitat loss is negligible.
fragment the existing *important population*[2] into two or more populations, or	The proposal will not fragment the existing vegetation.
adversely affect *habitat critical*[3] to the survival of a species, or	• Breeding habitat is critical for the long term survival of the local population. Breeding habitat is not considered to occur within the Loch Catherine Study Area.
disrupt the breeding cycle of a *population*, or	In absence of any information the proposal is unlikely to disrupt the breeding cycle of the local population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or	• The proposal is unlikely to destroy preferred breeding habitat for the species. • The proposal will reduce the quality of habitat available for the species.
result in *invasive species* that are harmful to a vulnerable species becoming established in the species habitat, or	• Fragmentation of the existing remnant increases the probability of invasion by the European blackbird and starlings. • Increased numbers of noisy minors also has the potential to occur.
interferes substantially with the recovery of the species.	• It is unlikely that Proposal will interfere with the natural recovery of this species.
Conclusion	• It is unlikely that this species will be significantly impacted by the Proposal. Referral to the D-G of DEWHA is not required.

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[2] An *important* population is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

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

[3] Habitat critical to the survival of a species refers to:

- habitat identified in a recovery plan for the species as habitat critical for those species or communities; and/or
- habitat listed on the Register of Critical Habitat maintained by the Minister under the Act; and/or
- areas that are necessary:
- for activities such as foraging, breeding, roosting, or dispersal;
- for succession;
- to maintain genetic diversity and long term evolutionary development; or
- for the reintroduction of populations or recovery of the species.

Appendix III: Species A4 Induction Sheets

Cambage Kunzea - profile

- Sweet scented leaves, ellipse shaped to 8 mm long by 3 mm wide, finely hairy when young.
- Flowers cream to yellowish in colour, grouped in head-like clusters at the ends of branches.
- The base of the flower is silky hairy, with tiny petals the flower is dominated by the numerous stamens.

Eucalyptus apiculata - profile

- A slender, upright tree from the Central tablelands, growing to 4m tall
- Glossy green foliage and white flowers in summer
- Silver/greenish smooth trunks when bark is shed
- Linear leaves; green juvenile leaves, adult leaves held erect with acute side veins.
- Buds club shaped, thick on one end.

Appendix M

Aboriginal Heritage Assessment

Rocky outcrops surrounding Berrima Colliery, NSW.

Environmental and
Heritage Management P/L

Aboriginal Heritage Assessment

Berrima Colliery: continued operations.

Wingecarribee Local Government Area

Date: May 2011

Report Prepared by

OzArk Environmental & Heritage Management Pty Ltd

For

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Executive Summary

OzArk Environmental & Heritage Management P/L (OzArk) was commissioned by Boral Cement to conduct an Indigenous heritage assessment at Berrima Colliery, near Berrima, NSW.

The Proponent proposes extend the underground workings of the existing Berrima Colliery and undertake maintenance within the Asset Protection Zone (APZ) around the Berrima Pit Top and Loch Catherine stockpile area. Works will require vegetation clearing and ground disturbing activities in the latter two study areas.

For the purposes of the current report, the Study Area consisted of three areas associated with Berrima Colliery:

- Subsidence Management Plan (SMP) area over underground workings ;
- Berrima Pit Top Study Area Asset Protection Zone (APZ); and
- Loch Catherine Study Area APZ.

One (1) Indigenous archaeological site – an open artefact scatter (BC-OS1) – was recorded within the SMP Study Area during the current field assessment. This site should not be directly impacted by the Continued Operations.

To ensure the continued preservation of this site, an Aboriginal Cultural Heritage Management Plan (ACHMP) should be developed in consultation with the registered Aboriginal stakeholders for the project.

The ACHMP should include within it provisions for subsidence monitoring of the landform upon which site BC-OS1 is located such that the predicted low likelihood of impact to the area from subsidence can be tested through time. Depending on the results of such monitoring, provision may be made within the ACHMP for further assessment if impacts change.

Although no Aboriginal sites were recorded in the APZ study areas, care must be taken to ensure that no ground surface disturbing activities occur outside the 20-30m zones assessed for this project, as sensitive landforms do occur beyond the Study Area boundaries of the Berrima Pit Top APZ.

Should any other ‘objects’ or other Aboriginal sites be identified during the course of the project, work in that area should cease and the Department of Environment, Climate Change and Water (DECCW) Southeastern Region Office be contacted to discuss how to proceed.

Contents

Figures

Tables

1 Introduction

1.1 Brief Description of the Project

This archaeological heritage report was commissioned by Boral Cement to accompany an Environmental Assessment (EA) for continued operation at Berrima Colliery. As part of the proposal Boral Cement propose to extend the underground workings of the existing Berrima Colliery within the approved Subsidence Management Plan (SMP), and undertake maintenance within the Asset Protection Zone (APZ) around the Berrima pit top and stockpile area. Works will require vegetation clearing and ground disturbing activities.

1.2 Location

Berrima Colliery (**Figures 1** to **3**) is located adjacent to the Wingecarribee River in southeast NSW approximately 120km southwest of Sydney within the Wingecarribee Local Government Area (LGA).

1.3 Date of Heritage Assessment

The field assessment for this project was undertaken over two days on the 18th and 19th of August 2010. Weather was cool, overcast and showery, with temperatures ranging from 5^{o} and 15^{o} Celsius on both days. Weather was not an impediment for the investigation.

1.4 Aboriginal Community Involvement

The Berrima Colliery Project has been undertaken according to the Department of Environment and Climate Change (DECCW 2010) Aboriginal Cultural Heritage Consultation Requirements (*ACHCR's*) as recommended in the Department of Environment and Conservation (DEC) 2005 *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (for Part 3A assessments)[1]. An advertisement appeared in the Southern Highland News on the 5th May 2010. Letters were also sent to the Illawarra Local Aboriginal Land Council (ILALC), DECCW, Wingecarribee Shire Council, NTSCORP, Hawkesbury Nepean Catchment Management Authority (CMA), National Native Title Tribunal and the Register of Aboriginal Owners. A second round of letters were then sent to additional groups identified as a consequence of the first round of advertising and agency contact. As a result of these processes, the following organisations / individuals formally registered interest by the close of Stage 1:

- Illawarra Local Aboriginal Land Council;
- Korewal Elouera Jerrungarugh (KEJ);
- Gundungurra Aboriginal Heritage Association (GAHA);
- Peter Falk Consultancy; and
- Buru Ngunawal Aboriginal Corporation (BNAC).

ACHCR Stage 2 / 3 letters presenting information about the proposed project and describing the proposed heritage assessment methodology were sent to all stakeholders with a request for any specific cultural information (should any be available), as well as inviting comment / input on the methodology proposed.

[1] These Guidelines refer to the Interim Community Consultation Requirements (*ICCR's*) which, in April 2010, were replaced by the DECCW *ACHCR's.*

Written replies were received from the BNAC, Peter Falk Consultancy and GTLAC, whilst Mr Rueben Brown, on behalf of KEJ, directed his verbal response to the OzArk office. Only two of the organisations actually chose to comment and were supportive of the methodology proposed, **Appendix 1** contains the Aboriginal Community correspondence associated with this project.

Several positions were made available for Aboriginal community representatives to participate in the heritage assessment fieldwork. These were chosen from the pool of registered stakeholders. Choice of possible participants was based on several factors including experience with and local knowledge of Aboriginal heritage places / sites in the Berrima area, provision of relevant Workers Compensation insurance documents and breadth of representation in relation to group membership.

The OzArk survey team was accompanied in the field during the survey by representatives from both the BNAC KEJ. It is noteworthy that Mr Tyrone Bell (BNAC) contacted the Ozark office on the first day of the survey advising, due to family illness, he was unable to accompany the team. Mr Bart Brown, representing KEJ, participated in the survey of the Berrima Study Area on the 17th and 18th August 2010, and Mr Bell was involved on the 18th August, 2010.

Confirmation to participate in the survey was not received from Illawarra LALC and Gundungurra Aboriginal Heritage Association (GAHA). In addition Peter Falk indicated due to medical reasons he was unable to take part in the field assessment at this time. These organisations, as well as all Aboriginal stakeholders, will continue to be involved in the consultation process and the development of the ACHMP.

Discussions were held on-site during the field surveys and the topics covered included survey methodology, cultural significance, management options and recommendations.

A copy of the draft report was issued to registered stakeholders in December 2010 and feedback was invited within the recommended twenty one (21) day time frame. Responses were received from Peter Falk Consultancy and Buru Ngunawal Aboriginal Corporation, supporting the recommendations held within the draft report. The response from Peter Falk suggested monitoring by Aboriginal Stakeholders during any ground disturbing works, and the need for a training programme for contractors. A log and copies of correspondence with Aboriginal community stakeholders is presented in **Appendix 1**.

1.5 Desktop Database Searches Undertaken

A desktop search was conducted on the following databases to identify any potential issues (Table 1):

Table 1: Desktop-database search results

Name of database searched	Date of search	Type of search	Comment
Australian Heritage Database http://www.environment.gov.au/heritage/ahdb/	1.9.10.	Wingecarribee LGA.	No places on the search are within the Study Area
NSW Heritage Office State Heritage Register and State Heritage Inventory http://www.heritage.nsw.gov.au/	1.9.10.	Wingecarribee LGA.	No places on the search are within the Study Area
National Native Title Claims Search http://www.nntt.gov.au/Applications-And-Determinations/Search-Applications/Pages/Search.aspx	Search date 1.9.10. Map last updated June 30 2010	NSW	Claim NC97/7 Gundungurra Tribal Aboriginal Corporation Claim #6
Department of Environment, Water Resources, Heritage and the Arts (DEWHA) Protected Matters (EPBC Act) Database; http://www.environment.gov.au/erin/ert/epbc/index.html	1.9.10.	Wingecarribee LGA.	None of the Aboriginal places on the RNE occur near the Study Area.

Department of Environment, Climate Change and Water (DECCW) Aboriginal Heritage Information Management System (AHIMS);	1.9.10.	10 x 10 km centred on the Study Area	14 sites within the search area. None within actual project Study Area.
Local Environment Plan	1.9.10.	Wingecarribee LEP of 2010	None of the Aboriginal places noted occur near the Study Area.

Figure 1: Locality map.

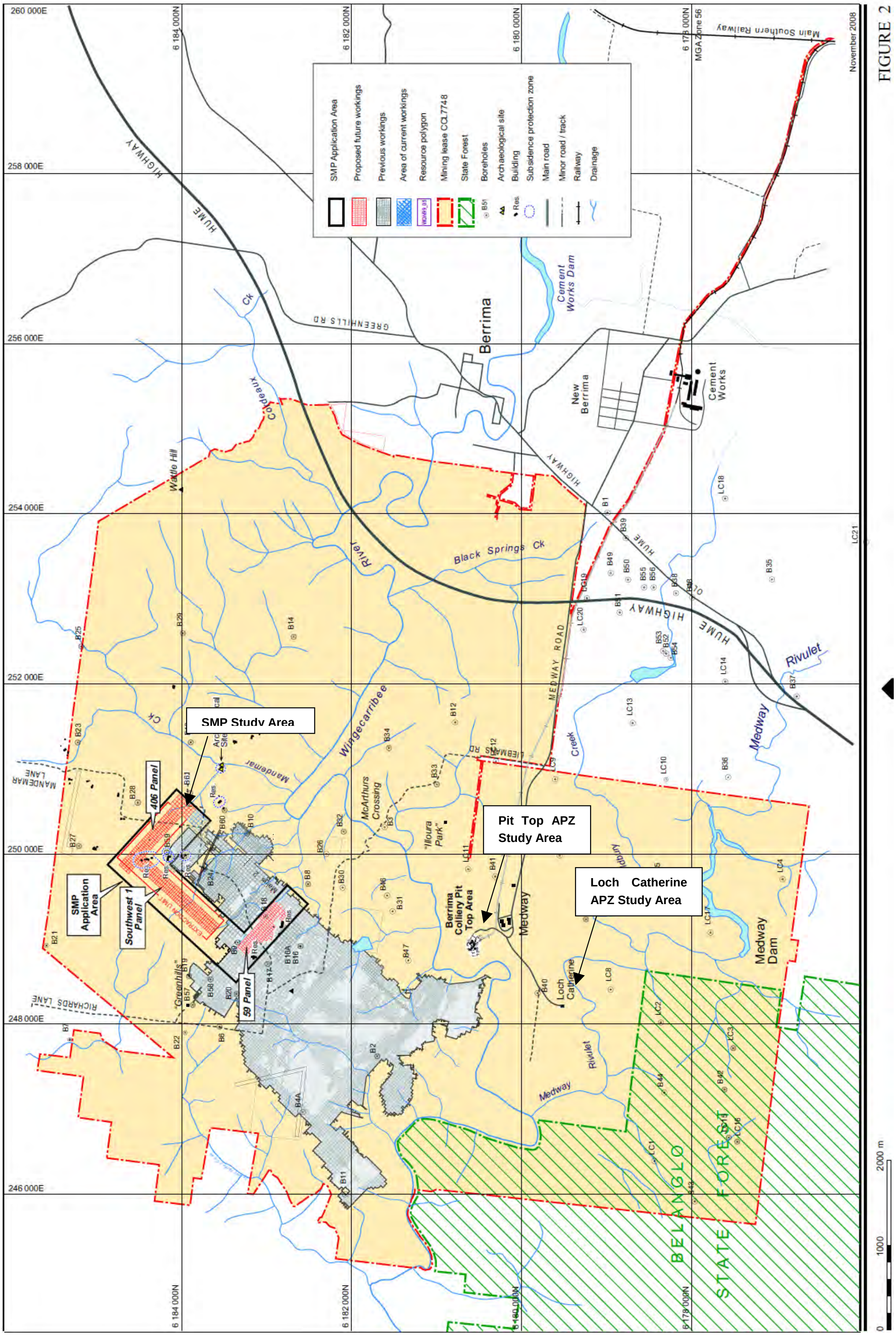
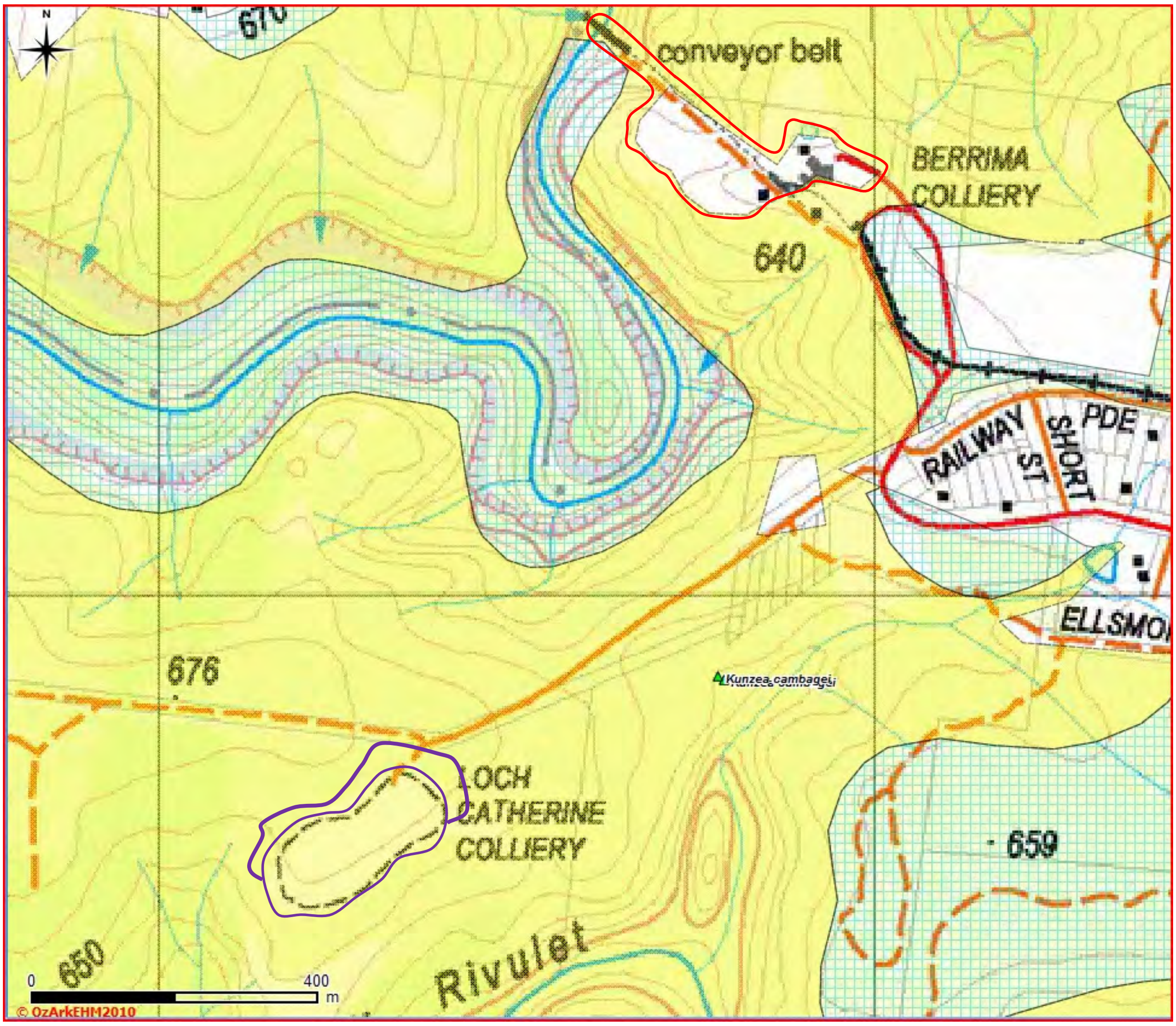


Figure 2: Subsidence Management Plan (SMP) Area.

Figure 3: The Berrima Pit Top APZ and Loch Catherine Stockpile Expansion and APZ.



1.6 OzArk EHM Involvement

This assessment was undertaken by Dr Jodie Benton. Mr Kim Tuovinen, Ms Heidi Kolkert and Dr Benton wrote and edited this report.

2 The Project

2.1 Proposed Works

As part of the proposal for continued operation at Berrima Colliery, it is proposed to extend the underground workings at Berrima Colliery within the existing SMP area, and undertake maintenance within the APZ surrounding the pit top and stockpile site of Berrima Colliery.

There are three discrete Study Areas within the Project Site, including;

- The SMP Area (**Figure 2**);
    - ➢ The SMP includes three separate mining areas or panels – 59 Panel, Southwest 1 Panel and 406 Panel. All potential impacts relate to potential subsidence.
- The Berrima Pit Top APZ (**Figure 3**);
    - ➢ All understorey and the majority of trees will be removed from a 20 m area extending from the existing cleared edge of disturbance within the APZ. There is a possibility to leave individual well spaced trees where they do not pose a risk to mine assets. All trees on the southern side of the conveyer belt in the APZ will be removed to protect underground communications lines. The red line in Figure 3 indicated the line of disturbance.
- Loch Catherine Stockpile APZ (**Figure 3**);
    - ➢ All trees and understory will be removed in the APZ (to protect the coal stockpile). The coal stockpile area will be expanded to the north and east of the existing area by a further 20 m (i.e. 20m for stockpile extension and 20 m for APZ totalling 40 m is needed to be cleared in this area).

2.2 Heritage Assessment Methodology

The Study Area was inspected via pedestrian transects and vehicle transects in the SMP area where visibility was very low. Particular attention was given to:

all trees of an age to bear a cultural scar within each of the Study Areas;

areas of exposed ground surfaces with more than 10% visibility; and

any archaeologically sensitive landforms, such as elevated terraces above creeks.

2.3 Heritage Survey Constraints

Visibility of ground surfaces was the primary constraint to the identification of deposit / ground surface based sites, or potentially grinding grooves. Thick grasses covered much of the SMP Study Area, and in areas where woodlands were present (parts of the SMP Study Area and both ASZ Study Areas) leaf litter was an impediment to artefact detection.

3 The Study Area

Berrima Colliery is located within the Sydney Basin Bioregion, Hawkesbury-Nepean (Burragorang Part A) CMA and Wingecarribee LGA, approximately 120 km southwest of Sydney (**Figure 1**). Specifically the colliery is located to the west of Berrima on the western side of the Hume Highway, within land zoned as Rural Landscape (RU2) and Environmental Conservation (E2) on the Wingecarribee 2010 Local Environment Plan.

3.1 Topography of the Study Area

The Sydney Basin Bioregion is an extensive area of major landscape features including coastal plains, foothills, isolated ranges, the lower inland slopes of the Great Dividing Range and forested mountains of the Illawarra Escarpment.

The following section has been extracted from IEC 2010 and accurately describes the landform characteristic of the SMP Study Area and Berrima Pit Top APZ Study Area within Berrima Colliery itself.

> *Berrima Colliery is located at the interface between the mature and relatively stable landform of the Woronora-Nattai Plateau and the rugged and actively changing landform of the Plateau margin. The existing pit top is located on a flat area of land with an elevation in the order of 660 m AHD. To the east, this area connects with the central tablelands at a similar elevation. However, immediate north, west and south, the Plateau surface has been deeply cut into by the Wingecarribee River, which flows past in a southerly direction. Adjacent to those sections of the river south of Medway, escarpment formation is well advanced. The river valley has a characteristic V-shape, bounded at a distance by vertical cliffs in the order of 20 to 30 m high. Upstream of Medway, the River Valley has a U-shaped cross section, becoming broader and flatter with increasing distance upstream. The southern boundary of the Colliery Holding is roughly contiguous with the right or western bank of the Wingecarribee River which, south of Medway, has eroded the coal seams away. To the north, the Holding generally is confined within the limits of the Plateau surface. The principal topographical features within the Colliery Holding are Mandemar Ridge in the north western corner, the incised Wingecarribee River, and its northern tributary, Mandemar Creek. Mandemar Ridge rises to a maximum height of 750 m AHD, approximately 50 m higher than the Plateau surface in that area. The ridge consists of three, late Tertiary basalt flows surrounded by Wiannamatta Shales.*

3.2 Hydrology of the Study Area

Many water courses, drainage lines and tributaries of creeks exist within the vicinity of the Project Site including: Cordaeux Creek, Black Spring Creek, Medway Rivulet, Medway Dam, Oldbury Creek, Jackey Jackeys Creek, Woolshed Creek, Bowmans Creek and the Wingecarribee River.

Tributaries of Jackey Jackeys Creek, Woolshed Creek, Bowmans Creek Mandemar Creek and the Wingecarribee River traverse the SMP Study Area. Mandemar Creek, a tributary of the Wingecarribee River runs along the south-eastern extent of the SMP. To the east of the SMP Study Area, Mandemar Creek exists as a shallow ephemeral stream flowing largely through farmland areas (IEC 2010).

Towards its confluence with the Wingecarribee River, Mandemar Creek becomes semi permanent and rock lined, and flows through a steep sided valley with overhanging rock cliffs (IEC 2010).

The Berrima Pit Top APZ Study Area is close to the Wingecarribee River, while the Loch Catherine Stockpile Expansion and APZ Study Area is bound to the north west and south by Medway Rivulet (approximately 550 m to 1 km away).

There are a number of local domestic water supply bores accessing the local groundwater resource.

3.3 Vegetation of the Study Area

According to Morgan (2001) Vegetation of the Burragorang sub-region is characterised by heath, shrubland and woodland with Black Ash, Hard-leaved Scribbly Gum, Sydney Peppermint and Red Bloodwood on sandstone similar to other parts of the Basin. Deane's Gum, Turpentine, Blue-leaved Stringybark immediately below escarpment passing to grey gum, Narrow-leaved Ironbark and Thin-leaved Stringybark on bouldery slopes. River oak occurs along main streams below the plateaus.

3.4 Climate of the Study Area

The sub-humid climate of the majority of the Sydney Basin Bioregion (SBB) consists of hot summers and no dry season. The Study Area is located within the elevated western bioregion boundary that is characterised by a more montane climate zone. The Bureau of Meteorology (2010) reports that the mean annual maximum temperature nearby Bowral (approximately 6.5 km away) is 18.8°C, whilst the mean annual minimum temperature is 8.8°C, with the mean minimum temperature being 2 – 11.6°C in July and mean maximum temperature being 13.3 - 25.4°C in January. Mean annual rainfall is 903.8 mm.

3.5 Geology of the Study Area

Wianamatta Shale consisting of shale and sandstone mixing from the Triassic Sandstone underlies the Project Site, with some younger residual basalt caps. A water seepage area forms in these mixed areas providing permanently damp or water logged soils giving rise to moisture thriving vegetation communities i.e. melaleuca.

3.6 Existing Levels of Disturbance

The following section has been extracted from IEC 2010 and accurately describes existing disturbance associated with the Project Site

> *For the first 60 years of the mine, extraction was limited to the rugged forested terrain to the north of the Wingecarribee River. Neither the river nor any of its associated cliff lines were undermined and there has been no evidence of rock falls or cracking in any of its tributaries or rock outcrops. Over the past 20 years, the mine has been progressively working in undulating cleared or partially cleared agricultural land. For the past 10 years mining has been almost exclusively within cleared agricultural land. The proposed 406 and South West 1 Panels (current SMP Study Area) lie entirely within privately owned and cleared agricultural land. The main roadways lie under flat partly cleared but regrowing pasture while 406 Panel crosses a cleared but relatively steep hill. This hill shows evidence of slumping indicating surface instability. The instability is a result of previous clearing and grazing practices. The current land owners are aware of the unstable surface and have fenced off sections to allow vegetation to re-establish. This instability is not related to mining but will be the subject of ongoing monitoring to*

> *establish if mining induced subsidence has any additional effect on the existing slopes. Subsidence monitoring stations have already been established along the face of this slope.*

The APZ Study Area specifically around the pit top at Berrima Colliery has suffered varying levels of disturbance through being situated close to a significantly developed area, with impacts including tracks, mounded / transported soil (Plates 11-12).

4 Indigenous Heritage

4.1 Ethno-historic Sources of Past Aboriginal Culture

According to Tindale (SA Museum 2009), the current Study Area falls within the eastern limits of the lands occupied by the Gandangara tribe. However due to the location of this area in the hinterland of the Sydney Basin, the area appears to have been a zone of interaction between the Gandangara, the Wodiwodi to the east and the Ngunawal to the south.

Linguistically, Gandangara, like the Ngunawal language of the inland and the Dharawal language of the coast, belongs to the Yuin sub-group of the Yuin-Kuric Aboriginal languages, themselves belonging to the Pama-Nyungan family (AIATSIS 2010). According to Navin Officer (2007), Gandandara appears to show more affinity with the Ngunawal language than the Dharawal. It has been speculated that the name of the nearby Joadja area derived from a Gandangara phrase meaning 'valley of plenty', although several alternative theories posit English or Scottish origins for the name (Knapman 1988: 13).

Contact between the Gandangara people and Europeans during the early nineteenth century was initially peaceful, with the French explorer Francis Barrallier befriending members of the tribe in the vicinity of 'The Cowpastures', near today's Camden (Barrallier 1897). In contrast, Governor Macquarie's response to the escalating conflict between 1814 and 1816 resulted in the deaths of fourteen Gandangara men, women and children in the vicinity of Appin (Biosis 2007; Kohen 1993). As Surveyor-General, Major Thomas Mitchell encountered Gandangara people during road construction works, noting their amusement at the Europeans' efforts (UTS n.d.).

Kohen (1993) reports a number of early observations of the Gandangara's ceremonial culture. The *burringilling* were animal-people who lived in clouds, trees, mountains and water-holes. Of these spirits, the most important was *Dharamulan*. *Dharamulan* was associated with trees and participated in various men's initiation rites. He also gave his name to the dharamulan, or bull-roarer, whose noise was said to sound like *Dharamulan's* voice. Trees played a significant role in mortuary rites, with important people wrapped in bark and placed amongst the branches. Such sites were often associated with carved trees. Upright inhumation was the norm for other people. Several bora grounds (where ceremonial activities such as initiation took place) and a number of carved trees associated with burials are also known from historical accounts to have existed in the broader district (McDonald 2002: 5). It is likely that these practices were widespread over the Southern Tablelands and Highlands, including the Berrima area.

Early ethnohistoric observations in the 1830s of Aboriginal hunting and gathering in the nearby Goulburn and Goulburn Plains area include a report of roasting echidna, the hunting of platypus on the Wollondilly River using a digging stick to open the burrow, and the eating of *Banksia sp.* nectar, the manna of *Eucalyptus mannifera* and sow thistles (Sonchus). Aboriginal bark huts on the Goulburn Plains were observed as consisting of tree branches placed over bark sheets, and people in the Yass district manufactured possum skin cloaks (McDonald 2002: 5).

However, at the time that these observations were made, Aboriginal people in the Goulburn district had already experienced tremendous social and economic upheaval as a result of the spread of European settlement and its concomitant diseases such as influenza and small pox. Surveyor Govett commented on the destruction of traditional food resources and society in 1836: 'The kangaroos have either been killed, or have fled in search of more retired forests. Sheep and cattle have taken their place, the emu and turkey are seldom seen, the millions of parrots have even become scarce, and the few harmless blacks remaining, having lost their native energy, now even here court the white man for rum, his tobacco, and his bread!' (cited in McDonald 2002: 5).

4.2 Regional Archaeological Context

Pleistocene occupation of south-eastern New South Wales is evidenced at sites such as Burrill Lake Shelter (Lampert 1971), Bass Point open site (Bowdler 1979), Lake George (Jones 1989; Singh et.al. 1981a; Singh et.al. 1981b; Wright 1986) and Birrigai Shelter (Flood et.al. 1987; Jones 1989). The earliest dated site (circa (c.) 20,000 BP) in the region is Burrill Lake Shelter, a coastal site situated to the east of the current Study Area. Further afield, a rockshelter midden near Wentworth Falls in the Blue Mountains (Kings Table) is dated to c. 22,000 BP (Stockton and Holland 1974). Pleistocene sites in the region are, however, rare, with the vast majority of Aboriginal sites dated to the Holocene. The apparent disparity between the numbers of Pleistocene and Holocene sites is attributed to taphonomic processes, population increase, changing sea levels / resource availability associated with climate change, and technological change (Boot 2002; TEC 2006).

Within the Southern Highlands region, Total Earth Care (TEC 2006) recorded one open site and five isolated finds during an Aboriginal heritage and archaeological assessment to the south-west of Moss Vale. During the same year, Total Earth Care also recorded one open site and nine isolated finds at Gibbergunyah near Mittagong (Hassell 2006). TEC's Moss Vale survey (TEC 2006) was conducted in response to Wingecarribee Shire Council's (WSC) proposal to release land for residential subdivision. Oliver Brown of TEC, together with Alan Carriage of Northern Illawarra Aboriginal Collection, Sharyn Halls of Gundungurra Tribal Council Aboriginal Corporation and Peter Falk representing the Andrews family, recorded eighteen (18) stone artefacts during field assessments over three days in December. Thirteen (13) of these artefacts were concentrated at one 50 x 70 m site (MVSW1) whilst the remaining five (5) were recorded as isolated finds up to 250 m from MVSW1. The finds were located on an elevated and level ridgeline, distant from permanent water. Brown interpreted the assemblage as having accumulated over a long period of sporadic daytime use rather than as a more permanent domestic campsite (TEC 2006: 18-19). During 2006, TEC also conducted a heritage study as part of Hassell's Environmental Study of the property 'Gibbergunyah' at Mittagong, NSW (Hassell 2006). The Aboriginal heritage component of this study recorded one (1) open site of high archaeological significance, nine (9) isolated finds of medium archaeological significance and an un-stated number of possible grinding grooves and scarred trees of low archaeological significance.

Approximately 40 km to the south-west of the current Study Area, Johnston (2007) conducted a preliminary archaeological assessment at a proposed hard rock quarry at Marulan, NSW, for Gunlake Quarries. Five (5) Aboriginal sites were recorded over two days in June 2007. These sites consisted of four (4) small open sites and one (1) isolated find, the locations of which (gently undulating slopes within close proximity to permanent / semi-permanent water – three sites; hill crest above permanent / semi-permanent water – one site; hilly terrain – one site) largely conformed to Johnston's predictive modelling. The materials identified consisted of silcrete (53.3%), quartzite (26.7%) and chert, metamorphic and quartz (6.7% each). Johnston regarded all five sites as being of low archaeological significance.

4.3 Local Archaeological Context

Few archaeological studies have been undertaken within the immediate environs of the current Study Area. A recent study by Kelton (2002) identified three Aboriginal sites at Berrima Colliery's underground mining area. Further details on these sites are provided in Section 4.3.2. According to the results of a DECCW Aboriginal Heritage Information Management System (AHIMS) database search (17 August 2010), Koettig identified four sites to the south-east of the current Study Area (near Berrima) and Taplin identified four Aboriginal sites to the west (one at Joadja, one at Mandewar and two at Medway).

4.3.1 DECCW AHIMS Database

A search of the DECCW AHIMS database revealed eleven (11) previously recorded Aboriginal sites located within a 10 x 10 km area centred on the Study Area (Search date: 17 August 2010).

A summary of the registered sites is presented in **Table 2**. This table indicates that open camp sites are the most frequent site type recorded (45.5%), with rock shelter sites with Art following at 36.3%. The low frequency of axe grinding grooves can be attributed to the highly porous and weathered sandstone of the region, whilst the low frequency of scarred trees is probably a result of the overall high levels of clearance in the areas that have been subject to Indigenous heritage survey.

Table 2: Summary of AHIMS registered sites.

Site Type	Total	%Frequency
Open Camp Site	5	*45.5*
Rock Shelter with Art	4	*36.3*
Axe Grinding Groove	1	*9.1*
Scarred Tree	1	*9.1*
Totals	**11**	***100***

Of these 11 sites, none are located within the current Study Area, as shown on **Figure 4**. Three sites, including two rock shelters and one open site, are located immediately adjacent to the current Study Area.

4.3.2 Previous studies in the immediate vicinity of the Study Area

4.3.2.1 J. Kelton 2002. A Summary Report on an Aboriginal Archaeological Study of the Proposed Extraction Area, Berrima Colliery, Near Berrima. Report for International Environmental Consultants Pty Ltd.

Kelton conducted field assessments at Berrima Colliery’s underground mining area during September, 2002. These assessments were conducted over a wide range of landforms including hill / ridge crests, low and upper-mid hillslopes, ephemeral and spring-fed creeks, alluvial and colluvial terraces and exposed sandstone formations. Of these, Kelton predicted that the areas of highest archaeological sensitivity would be undisturbed creeklines, alluvial / colluvial terraces, adjacent low ridge crests and outcrops of exposed sandstone.

Confirming Kelton’s predictive modelling, three (3) Aboriginal sites were recorded, consisting of two (2) rock shelters with art and deposit and one (1) open site. Of these, one rock shelter (MC-S-1) was located on the eastern side of Mandemar Creek at AMG 250940 6183370, the second rock shelter (MC-S-2) was situated approximately 200 m to the north-west of MC-S-1 at AMG 250912 6183413, and the open site (MC-OS-1) was located on a low hillslope / low ridge crest overlooking an unnamed tributary of Wingecarribee River (AMG 250223 6183058). The only Potential Archaeological Deposits (PADs) identified by Kelton were those associated with sites MC-S-1 and MC-S-2. The proposed works (extraction of Panels 403 to 410 and 501 to 504, inclusive) were unlikely to have direct or indirect impacts on any of the three sites. Kelton made the following recommendations:

- any subsequent mining activities should be designed to avoid Aboriginal sites;
- existing tracks should be used wherever possible;
- test drill pads should be situated as close as possible to existing tracks; and
- proposed track / drill pad sites in archaeologically sensitive areas should be inspected archaeologically prior to the commencement of works.

In relation to sites MC-S-1 and MC-S-2, he specifically recommended that:

- a subsidence protection zone should be established to prevent disturbance to sites MC-S-1 and MC-S-2 and the wider sandstone gorge formation;
- both sites should be inspected prior to and following mining in their vicinity; and
- further comprehensive documentation of these sites would be required prior to a Section 90-sanctioned destruction.

4.4 Predictive Model For Site Location

Proximity to a permanent water supply is the primary factor appearing to determine the location of Aboriginal campsites. Results of an integrated series of studies including a serious excavation component, suggests a high correlation between the permanence of a water source and the permanence and/or complexity of the areas' Aboriginal occupation (McDonald 1997). This was further reflected in the lithic assemblages from sites close to permanent water, which suggested that a greater range of activities were represented (e.g. tool use, manufacture and maintenance, food processing and quarrying). Sites near ephemeral water sources had evidence for one-off occupation (e.g. isolated knapping floors or tool discard), and creek junctions were also proven to be foci for site activity.

Using the concept of stream ordering, the following general predictions can be made regarding the nature of sites and their location in the current study area (not taking into account factors of site preservation):

- the area surrounding first order streams and headwaters is most likely to contain evidence of sporadic occupation and may consist of little more than a background scatter of artefactual material;
- in the vicinity of second order creeks, archaeological evidence may be sparse, but may indicate focussed activity (one-off camp sites and knapping events);
- in the lower reaches of tributary creeks (third order), archaeological evidence will be more frequent and intense, indicating more permanent or repeated occupation by small groups and may show evidence of concentrated activities;
- on major creek lines and rivers (fourth order) more permanent and repeated occupation may be evidenced by a more diverse stone tool assemblage indicating greater range of lithic activities. Sites in this location may even be stratified;
- creek junctions may provide a popular location for occupation and the size of the confluence (in terms of stream ranking nodes) may influence the size of the site; and
- ridgetop locations between drainage lines are likely to contain limited archaeological evidence in the form of one-off activities.

From the known sites of the region outlined previously in **Section 4.2**, it is possible to say that the most likely sites to be encountered in the study area are:

- scarred trees (frequently close to creeks and rivers but also found further a field);
- open sites, close to permanent / temporary water;
- isolated finds may occur anywhere, especially in disturbed locations near water sources or in areas close to ephemeral water – i.e. headwaters;
- carved trees (unlikely); and
- rock shelters (whilst known in the local vicinity, rock shelters are unlikely in the SMP Study Area, although potentially present outside the Berrima Colliery, in the vicinity of the conveyor belt).

4.5 Survey Results

4.5.1 Aboriginal sites recorded

One Aboriginal site (BC-OS1) was recorded as a result of the current field assessment (**Table 3**).

No additional parts of the Study Area were assessed as holding significant potential to contain further, undetected, Aboriginal objects or sites. This assessment is based on the widespread disturbance within the SMP Study Area and the lack of suitable landforms in regards to the APZ Study Areas to contain intact archaeological deposits and on the results of the current heritage assessment.

<u>Site BC-OS1</u>

Although only a few small artefacts (Plate 9) were recorded over this elevated, flat spur (Plates 7-8), it is indeed possible and expected that further artefacts will be present below the leaf litter and indeed below the surface, although deposits though this area are not anticipated to be deep.

Table 3: Details of Aboriginal site recorded during the assessment.

Administrative Details				
Site Type/Site Name	**Acronym**	**Location/Property Details**	**Date recorded**	**Grid reference:**
Berrima Colliery Open Site No.1	<u>BC-OS1</u>	Located on a vegetated spur in the south-eastern portion (Panel 59) of the Study Area on Lot 6 DP 261133, Wingecarribee Local Government Area (LGA), Joadja Road, Mandemar, NSW.	18 Aug 2010	**System**: MGA/GDA **Zone**: 56 **Easting**: 250402 **Northing**: 6183920 **Elevation AHD**: c. 675 m

Environmental Information					
Landform	**Vegetation**	**Land use history**	**Geology/soils**	**Distance to water**	**Source of water**
Western spur of re-entrant.	Cleared / regrowth eucalypt.	Cleared, grazed.	Sandstone derived, thin skeletal sand.	60 to 140 m	Unnamed trib of Mandemar Ck.

Artefact Details					
Type	**Material**	**Dims L x W x D (mm)**	**Platform**	**Negative Flake Scars**	**Remarks**
Broken flake	Grey chert	27 x 24 x 16		2 possible	High quality grey chert artefact located in secondary deposit.
Broken flake	Grey banded chert	30 x 18 x 4			
Flake	Pale creamy chert	10 x 12 x 8			

Figure 4: Locality map of Aboriginal sites within or adjacent to the Study Area (Base map source: Department of Lands).

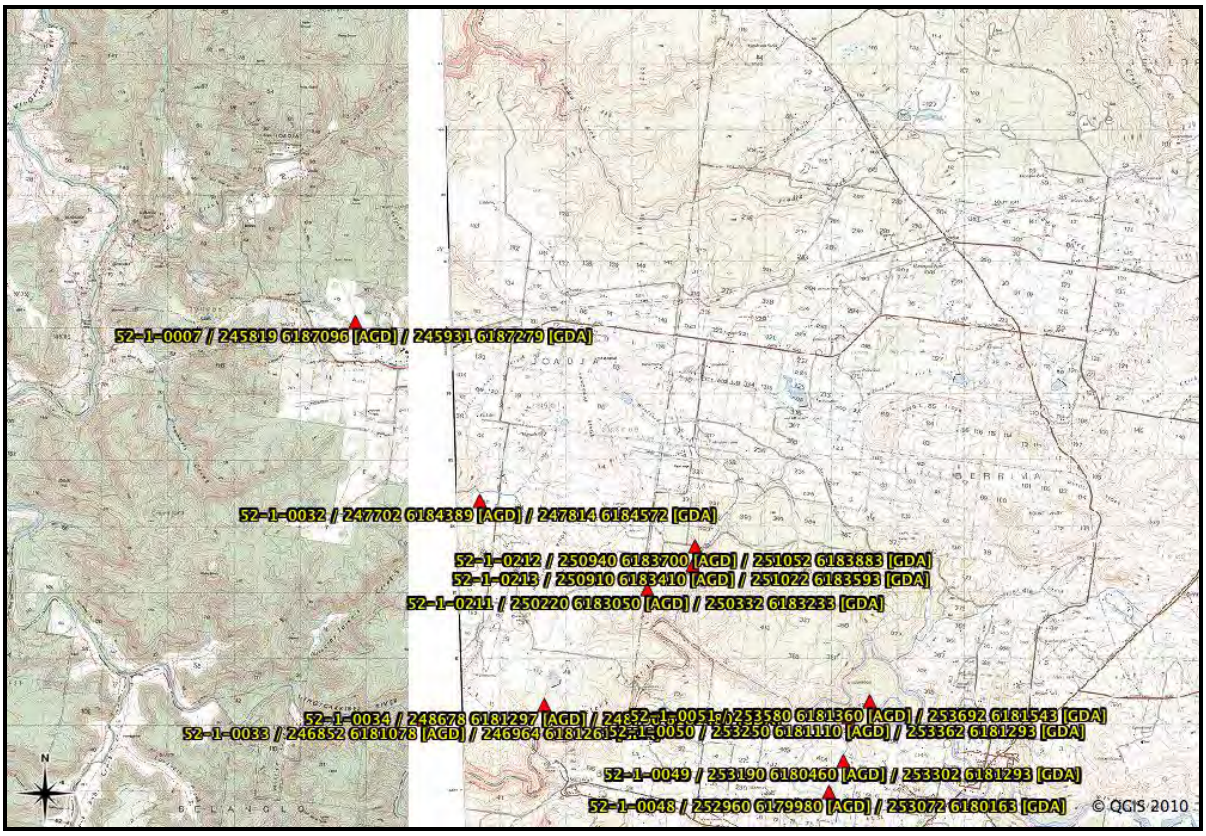
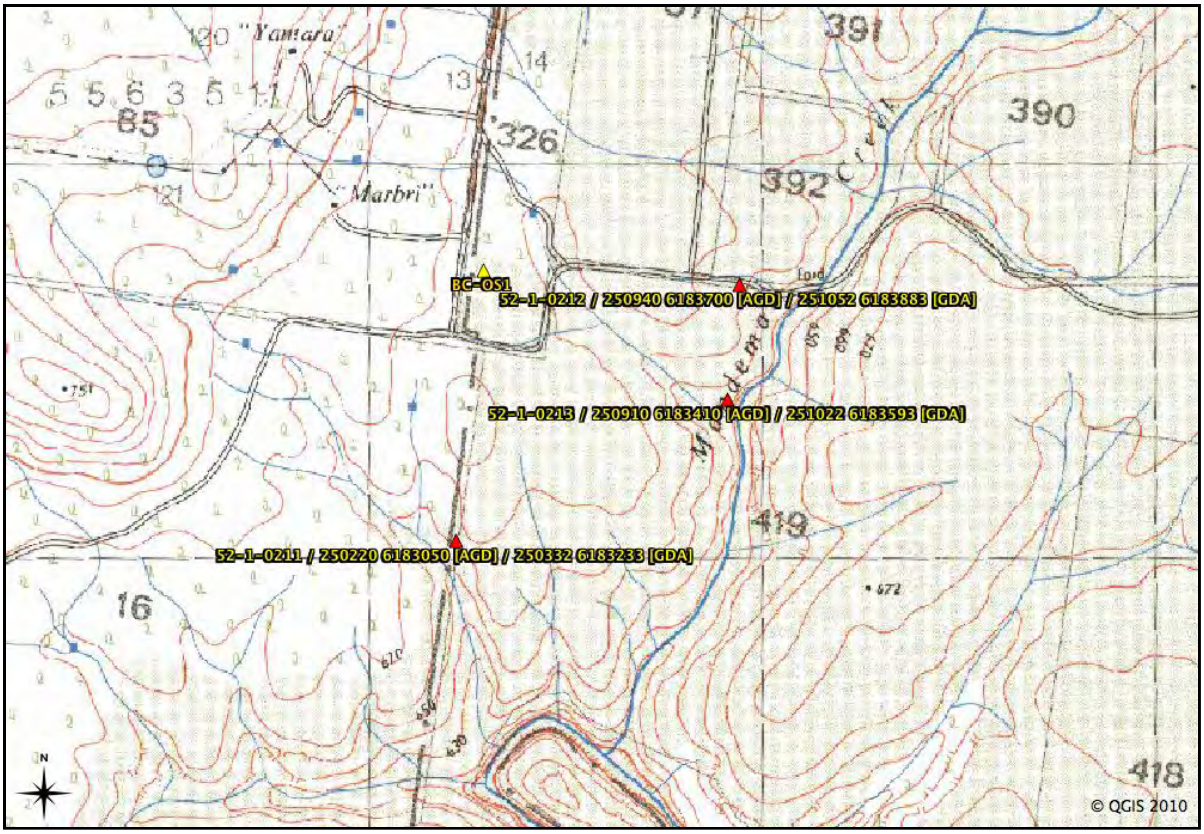


Figure 5: Locality map showing the site BC-OS1 (Base map source: Department of Lands).



4.6 Discussion

The current SMP Study Area is comprised, in the main, of a ridgeline trending roughly north-south with elevations ranging from approximately 670 m AHD to 750 m AHD. The ridgeline falls away to Mandemar Creek in the east, with numerous tributaries flowing into that waterway. Mandemar Creek is located adjacent to, but outside, the current SMP Study Area.

Within the region, overlaying site locations with the general landform unit divisions shows most recorded sites are situated on or close to permanent water sources and hence the predictive model for this project anticipated that occupation sites may be infrequently recorded surrounding 1st order streams. Permanent water-courses, such as Mandemar Creek (outside the Study Area), have greater potential to be associated with occupation sites. The predictive model also noted that mature trees, where present, had potential to possess cultural scars.

The results of the current assessment accord with the predictive model in that only one small site was recorded, found near an ephemeral watercourse, that is a tributary into Mandemar Creek. As no more permanent waterways are present within the SMP Study Area, it can be anticipated that large, complex sites are not present. Consequently, the low frequency of sites can also be understood as resulting from factors such as the moderate level of prior disturbance across much of the Study Area (clearing, grazing and vehicle movement) and poor ground surface visibility off track exposures but is also considered to reflect the fact that the Study Area is characterised by temporary, rather than permanent, water-courses. The lack of culturally modified trees within the Study Area is a reflection of the general scarcity of native trees of an age to bear scars.

There was a reasonable quality of exposed sandstone in the creek beds in the SMP Study Area (Plates 5 and 10), and all visible areas were checked for grinding grooves. While none were observed, two issues are relevant – the nature of the sandstone, which was coarse and comprised of a lot of longitudinal ridging, making this not ideal sandstone for grooves, as well as the overall high levels of siltation of the creeks, which may have covered grinding evidence.

In terms of the lack of sites recorded over the Berrima Colliery Pit Top and Loch Catherine APZ Study Areas, this is likely to be the result of a combination of factors, including: the small scale of the areas assessed, the lack of close water sources (especially Loch Catherine) and the overall steep nature of the landscape (especially surrounding the Berrima Pit Top, Plates 12-14). This latter Study Area, whilst not possessing any specific sandstone overhangs potentially suitable as shelter sites within its boundaries, does however have exhibit such features within close proximity (Plate 13).

4.7 Assessment of Heritage Significance

4.7.1 Introduction

The appropriate management of cultural heritage items is usually determined on the basis of their assessed significance as well as the likely impacts of any proposed developments. Scientific, cultural and public significance are currently identified as baseline elements of this assessment, and it is through the combination of these elements that the overall cultural heritage values of a site, place or area are resolved.

Cultural significance

This area of assessment concerns the importance of a site or feature to the relevant cultural group - in this case the Aboriginal community. Aspects of cultural significance include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of significance may not be in accord with interpretations made by the archaeologist - a site may have low scientific significance but high Aboriginal significance (or vice versa).

Scientific significance

Assessing a site in this context involves placing it into a broader regional framework, as well as assessing the site's individual merits in view of current archaeological discourse. This type of significance relates to the ability of a site to answer current research questions and is also based on a site's condition (integrity), content and representativeness.

The overriding aim of cultural heritage management is to preserve a representative sample of the archaeological resource. This will ensure that future research within the discipline can be based on a valid sample of the past. Establishing whether or not a site can contribute to current research also involves defining 'research potential' and 'representativeness'. Questions regularly asked when determining significance are: can this site contribute information that no other site can? Is this site representative of other sites in the region?

The scientific significance of scarred trees is extremely variable and dependent upon several factors relating to:

Preservation: What is the condition of the tree? Is it within an intact resource zone which reflects why the scar may have been made to the tree in the first place? What is the condition of the scar itself (its integrity and thus its potential).

Representativeness: Is this the type of site one may expect in this landscape? (relates back to the predictive model); Do many such sites occur nearby? Is this species of tree commonly scarred (i.e. eucalypt verus a cypress pine or a kurrajong) or is the tree one of only few remaining in an area (More often associated with highly developed areas);

Is there anything else (material, types or combinations thereof) that are rare in the area or unusual for that type of site (Is it a carved tree? Are there stone axe marks? Is it part of a larger ‘site complex’ that would give us an insight to a broader range of Aboriginal activities in a given location?

Public significance

Sites that have public significance do so because they can educate people about the past. By reducing ignorance about why sites are important to the Aboriginal and scientific community, important sites can be protected from ignorant or inadvertent destruction. Educating the public to understand the need for site preservation should increase the likelihood of maintaining an archaeological resource into the future. For a site to have high public significance it should contain easily identifiable and interpretable elements, and be relatively easily accessed.

Most open artefact scatters and isolated finds, when in-situ, are usually extremely difficult for the lay person to appreciate unless the artefact(s) is/are in someway very unusual or numerous.

4.7.2 Assessed significance of the recorded sites

Cultural significance

The cultural significance of the open site to the local Aboriginal community has not as yet been determined. Survey results and management options in this report will be forwarded to the relevant Aboriginal community stakeholders for review and comment. Once received, this section will be updated.

Scientific significance

Open sites currently comprise the most frequent site type within a 10 x 10 km area surrounding the Study Area (AHIMS Search: 17 August 2010), matching data from other parts of the wider region such as Moss Vale (TEC 2006: 16). Nothing about the objects recorded was considered to be unique or rare, however deposits of the site appear to be relatively intact and hence there is potential for sub-surface archaeological material to be present. BC-OS1 is consequently assessed as holding **moderate scientific significance**.

Public significance

The site is in an area unlikely to be visited by the public and the artefacts are unlikely to be easily seen or identifiable by the lay person as being Aboriginal in origin. Consequently BC-OS1 is assessed as holding **low public significance**.

4.8 Likely impacts on Indigenous Heritage

4.8.1 General impacts of underground mining

The primary surface impact from underground mining, other than construction of the requisite surface infrastructure, is the potential surface subsidence resulting from coal seam extraction. Such subsidence may take the form of a trough or a series of parallel troughs in the ground surface directly above areas where full seam extraction has occurred when longwall mining is used, however, the methods for Berrima Colliery underground mining is the bord an pillar approach which produces far less surface subsidence.

Open sites may be impacted by subsidence causing disruption, i.e. shifting/lowering of the archaeological deposits or indirect impacts such as altered hydrology may cause erosion patterns to change. The possible collapse of cliffs or cracking in sandstone escarpment country also has the potential to impact rock shelter sites (Byrne *et al* 1997) or axe-grinding groove sites (Kuskie 2006: 12). The type and extent of subsidence is variable and challenging to predict, although there have been significant advances in computer generated modelling of potential subsidence based on data including the depth of the coal seam from the surface, the thickness of the coal seam, the depth and nature of the intervening deposits and the methods of coal extraction.

Typically, the largest vertical movements occur in areas of total extraction, while vertical movements diminish outside the edge of the mined area, becoming more likely to be horizontal movements (tilt and strain) along the line of draw. According to Byrne (1997: 2), it is the horizontal movements that are most likely to impact sandstone formations and these are amplified in areas of significant surface slope.

Depending on the site specific circumstances, the effects of underground mining may be immediate and/or cumulative or delayed. Likewise the potential for slippage or altered hydrology may appear immediately or may not occur for some time depending upon other natural, subsequent environmental conditions.

4.8.2. Generic impacts of underground mining on Aboriginal archaeological site types

With respect to potential underground mining impacts on archaeological sites, there is a reasonable body of literature from which generic information can be gleaned. It must be remembered, however, that the impacts of underground mining are exceptionally variable, depending upon the mining method, depth of the coal seam, the properties of the intervening geological strata, the mine plan design as well as many other less major considerations. Hence although review of other studies is illuminating, they must been accepted as only generically applicable. In contrast, specific and detailed investigations and modelling of subsidence for the Berrima underground operations have been undertaken and reported as part of the as part of the EA for continued operations and the approved Subsidence Management Plan (SMP).

Axe-grinding grooves

As grinding grooves occur on sandstone outcrops, they have potential to be impacted by subsidence, tilt and strain. Often grooves are located on outcropping or boulderised sandstone near water, i.e. creek beds, and in these areas natural breaks in the rocks may allow them to the shift independently without breaking the rock on which a series of grooves are located. In other cases, the massive nature of a sandstone outcrop on a ridge top may result in the edifice being cracked.

Open sites

Tension cracking, tilt and subsidence may impact open sites/artefact scatters through directly through disruption to the stratigraphic integrity of the deposits. Or indirectly through alteration to the water table or alter water flow, which may precipitate erosion, siltation or soil stripping which could further impact archaeological sites.

4.8.3 Likely impacts to Aboriginal heritage from the Continued Operations at Berrima Colliery

Whilst the site BC-OS1 is located within the current SMP Study Area, it is not within any area assessed as being likely to be significantly disturbed by surface impacts. The subsidence assessment prepared for the EA for continued operations states that:

"Based on the subsidence predictions, it is assessed that no significant impact is expected to occur to the artefact scatter site above 59 Panel. It is therefore considered unnecessary for the mine to establish further protection measures for the site."

Accordingly, based on the information available, it is not anticipated that there will be any significant impacts to this site as a result of the underground mining activities. Activities associated with the APZ around the Berrima Pit Top and the extension of local Catherine and the APZ surround it, should have no impact on Aboriginal heritage so long as impacts remain within the assessed areas (c. 20-30 m from the edge of the existing infrastructure / development footprint).

4.9 Management Options

Appropriate management of cultural heritage items is primarily determined on the basis of their assessed significance as well as the likely impacts of the proposed development. **Sections 4.7 & 4.8** describe respectively the significance/potential of the recorded sites and the likely impacts of the development. The following management options are general principles, in terms of best practice and desired outcomes, rather than mitigative measures against individual site disturbance.

The recorded site and others that may potentially occur, are held to hold unknown (potentially high) cultural significance, low-moderate scientific significance and low public significance, and should be avoided and preserved. While the site(s) will not be impacted by the day to day activities of the mine either through the construction or extraction phases, the locations of the sites should be noted and avoided should any future work need to take place on the surface.

4.9.1 Specific management recommendations

As formalised applications for permits, as previously required under the National Parks and Wildlife Act (NP&W Act), are no longer required under the Part 3A assessment process, this section consolidates the appropriate responsibilities and actions that the Proponent should undertake in terms of potential impacts to the heritage resource within SMP Study Area.

Part 3A projects generally require a Statement of Commitments, which then form the basis of the Conditions that the Minister for Planning may place within the Project Approval for the project. This usually generates a requirement for an Archaeological and Cultural Heritage Management Plan (ACHMP).

This ACHMP should be developed in conjunction with the registered Aboriginal stakeholders for the project and may include within it provisions for the monitoring of the landform upon which site BC-OS1 is located such that the predicted low likelihood of impact to the area from subsidence can be tested. Depending on the results of such monitoring, provision may be made within the ACHMP for further assessment.

4.10 Relevant Legislation

Baseline principles for the conservation of heritage places and relics can be found in the Burra Charter[2], which recognizes that there are places worth keeping because they can enrich our lives on many levels. The significance of such places may be embodied in fabric (physical material), environmental setting, contents, use or its meaning to people, and should be assessed through methodical data collection. Since its adoption in 1979, The Burra Charter has become the standard of best practice in the conservation of heritage places in Australia, and heritage organisations and local government authorities have incorporated the inherent principles and logic into guidelines and other conservation planning documents. The Burra Charter generally advocates a cautious approach to changing places of heritage significance. This conservative notion embodies the basic premise behind legislation designed to protect our heritage, which operates primarily at a State level.

A number of Acts of parliament provide for the protection of Aboriginal heritage at various levels of government[3]. The three most important statutes in New South Wales are the:

- *Environmental Planning and Assessment Act 1979* (EP&A Act), amended by the *Environmental Planning and Assessment Amendment (Infrastructure and Other Planning Reform) Act* 2005 (EP&AA Act); and
- NPW Act.

While at Commonwealth level, the following statute is relevant:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) amended by the *Environment and Heritage Legislation Amendment Act (no. 1) 2003*.

4.10.1 State legislation

The EP&A Act requires consideration of environmental impacts, including cultural heritage at a land-use planning and decision making level.

Under this Act, Aboriginal heritage is protected in three different ways:

[2] The Burra Charter defines the basic principles and procedures to be followed in the conservation of all kinds of places such as monuments, buildings, Aboriginal sites, roads, archaeological sites, whole districts or even regions. It was first adopted in 1979, based on the Australian ICOMOS (International Council on Monuments and Sites) review (1977) of the 1966 Venice Charter (Australian ICOMOS Inc. 1998).

[3] NSW Heritage Office 1998: *Living with Aboriginal Culture*, p. 3.

1. Through planning instruments such as State Environmental Planning Policies (SEPP) and Local Environmental Plans (LEPs). Such plans outline permissible land use as well as identifying potential constraints. Section 112 (1) of the EP&A Act delineates that no approval for either prescribed developments or developments likely significantly affect the environment, may be granted without prior appropriate environmental impact assessment.
2. Section 79C of the Act lists impacts to the environmental resource, including cultural heritage, which must be considered before development approval is granted.
3. All State Government agencies acting as determining authorities on environmental issues must consider a range of community and cultural factors, including Aboriginal heritage, in their decision-making process. The factors to be considered in such assessments are set out in the EP&A Regulations 2000.

In 2005 the NSW Parliament passed the EP&AA Act., of which a key component is the insertion of Part 3A (Major Projects) into the EP&A Act. The aim was to facilitate major project and infrastructure delivery and encourage economic development, while strengthening environmental safeguards and community participation. The new Part 3A consolidates the assessment and approval regime for all major projects previously addressed under Part 4 (Development Assessment) or Part 5 (Environmental Assessment) of the *Act*.

Part 3A applies to major State government infrastructure projects, development previously classified as State significant, and other projects, plans or programs of works declared by the Minister.The amendments provide a streamlined assessment and approvals regime for major infrastructure and other projects of State or regional significance. They also improve the mechanisms available under the EP&A Act to enforce compliance with approval conditions or the *Act*.

The NPW Act (as amended; particularly sections 83-91A) provides statutory protection for all Aboriginal relics and places, regardless of significance, land tenure or whether they have been previously recorded in the DECCW AHIMS. Areas may be gazetted as Aboriginal ‘places’ when the Minister is satisfied that sufficient evidence exists to demonstrate that the area is or was of special significance to Aboriginal people.

Under Section 90 of this Act it is an offence to knowingly damage, deface or cause or permit the destruction of an Aboriginal relic or place without the prior written consent of the Director-General of the NSW DECCW. Prosecution for such offences may include the imposition of financial penalties and/or imprisonment. Reporting the discovery of previously unknown Aboriginal sites to the Director-General of the DECCW within a reasonable time of discovery is also obligatory under Section 91 of the Act.

The *Heritage Act 1977* (amended 1999) protects the State’s natural and cultural heritage and contains measures to protect archaeological remains. Generally, Aboriginal sites are protected by the NPW Act, but if certain sites are deemed as having great significance, they can be further protected by a heritage order, issued by the Minister, on the advice of the Heritage Council.

4.10.2 Commonwealth legislation

The EPBC Act protects the environment, particularly matters of National Environmental Significance. It streamlines national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places. Under the EPBC Act, definitions of the ‘environment’ include the following:

- ecosystems and their constituent parts, including people and their communities;
- natural and physical resources;
- the qualities and characteristics of locations, places and areas;
- heritage values of places; and
- the social, economic and cultural aspects of a thing mentioned in the above points.

The EPBC Act provides that any action assessed as likely to have a significant effect on listed matters of national environmental significance is to be known as a *controlled action*, and may only proceed with the Minister of the Environment's approval.

In January 2004 changes to the protection of national heritage came into effect through amendments to the EPBC Act (*Environment and Heritage Legislation Amendment Act (no. 1) 2003*).

4.10.3 Applicability to the Study Area

4.10.3.1 State legislation

The current project is governed by Part 3A of the EP&AA Act.

4.10.3.2 Commonwealth legislation

No places or sites within the Study Area are governed by the EPBC Act. The proposal will not impact on any matters of National Environmental significance.

5 Recommendations

Under Section 91 of the NPW Act the Director General of the NSW DECCW must be notified of the location of all Aboriginal sites recorded under any auspices. As a professional in the field of cultural heritage management it is the responsibility of OzArk EHM to ensure this process is undertaken. To this end it is noted that one (1) site was recorded within the Study Area.

The appropriate site card has been forwarded to DECCW for registration on the AHIMS database.

The following recommendations are made on the basis of:

- legal requirements under the terms of the National Parks and Wildlife Act of 1974 (as amended) whereby it is illegal to damage, deface or destroy an Aboriginal relic/object without the prior written consent of the Director, DECCW;
- the findings of the current investigations undertaken within the study area; and,
- the interests of the registered Aboriginal stakeholders and the Indigenous community.

It is recommended that:

1. One Indigenous site; an open artefact scatter, was recorded during the heritage survey (BC-OS1). This site is located within the SMP Study Area and should not be directly impacted by mining operations at Berrima Colliery;
2. To ensure the continued preservation of this site, an ACHMP should be developed in consultation with the registered Aboriginal stakeholders for the project.
3. The ACHMP should include within it provisions for subsidence monitoring of the landform upon which site BC-OS1 is located such that the predicted low likelihood of impact to the area from subsidence can be tested through time. Depending on the results of such monitoring, provision may be made within the ACHMP for further assessment if impacts change.
4. Although no Aboriginal sites were recorded in the APZ study areas, care must be taken to ensure that no ground surface disturbing activities occur outside the 20-30m zones assessed for this project, as sensitive landforms do occur beyond the Study Area boundaries of the Berrima Pit Top APZ;
5. Should any other 'objects' or other Aboriginal sites be identified during the course of the project, work in that area should cease and the DECCW Southeastern Region Office be contacted to discuss how to proceed;
6. Two copies of this report should be sent to:

   Department of Environment, Climate Change & Water
   AHIMS Registrar
   Attention: Cheryl Brown
   PO Box 1967
   Hurstville NSW 1481
7. One copy of this report should be sent to each of the Registered Stakeholders for the Project, as listed in **Appendix 2.**

6 References

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7 Plates

Plate 1: View of regrowth woodland in the southeastern corner of 59 Panel.

Plate 2: View of swampy creekline in the southeastern corner of 59 Panel.

Plate 3: View of recent graded track through the woodland of the southeast corner of the SMP study area in 59 Panel.

Plate 4: View of boundary between the predominantly cleared and grazed land of the SMP Study Area and the wooded regrowth.

Plate 5: View of the silted up creekline in the southeast corner of 59 panel with some exposed sandstone.

Plate 6: Common appearance of the landscapes of the SMP Study Area. Note the grass cover and low visibity.

Plate 7: View of woodland in the northeast corner of the SMP study area, in 406 panel. It is on this woodland that site BC-OS1 is located.

Plate 8: Find spot of one artefact from site BC-OS1. Note the leaf litter impeding ground surface visibility.

Plate 9: Artefacts from site BC-OS1. Both found in the bare areas around the base of trees.

Plate 10: Creek line adjacent to the knoll on which site BC-OS1 was located (right of picture). Note the outcropping sandstone and pooled water, a useful resource for an Aboriginal camp site.

Plate 11: View of Berrima Pit Top APZ Study Area. Note slope and disturbance.

Plate 12: View of Berrima Pit Top APZ Study Area along conveyor belt APZ zone heading down to the Wollondilly River. Again disturbance levels are high in the APZ zone.

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Plate 13: View of Berrima Pit Top, just outside APZ Study Area. In the background, sandstone outcrops with potential to contain shelters.

Plate 14: View of Berrima Pit Top APZ Study Area. Note historic water trough in the foreground. This is outside the area of impact of the APZ.

Plate 15: View of Berrima Pit Top APZ Study Area.

Plate 16: View of Berrima Pit Top APZ Study Area. Note slope and disturbance.

Plate 17: Bushland of the Loch Catherine Extension area. Note dense ground vegetation and lack of visibility.

Plate 18: View of bushland of the Loch Catherine Extension area. Note bunding around existing stockpile site.

Plate 19: View of historic remains of early coal mining in the vicinity of Loch Catherine. These areas will not be impacted by the APZ activities.

Appendix 1 - Aboriginal Community Correspondence

17/05 2010 11:51 FAX 002

BURU NGUNAWAL ABORIGINAL CORPORATION

ABN : 24 059 704 833

REGISTRATION OF INTEREST

OzArk EHM
PO Box 2069
Dubbo NSW 2830

We wish to lodge an expression of interest for:

PROPOSED OPERATIONS AT BERRIMA COLLIERY

We offer the following information in support of our expression of interest in relation to Aboriginal Cultural Heritage:

Organisation:	Buru Ngunawal Aboriginal Corporation (BNAC)	
Name:	Mr Walter R Bell	
Contact Details:	Postal Address:	PO Box 6900, Charnwood ACT 2615
	Phone:	02 6259 1672 Fax: 02 6258 1264
	Mb:	0419 425 347 Email: walbell@bigpond.net.au

BNAC's members, the NGUNAWAL people, are the Traditional Carers for this area with close ties and connection to Country for the proposed study area. BNAC is an incorporated organisation whose constitution and rules of governance state that we as an organisation will endeavour to protect our Aboriginal culture and heritage to the best of our collective abilities. Being part of the consultative/planning process will ensure that the proper protection and preservation of our culture and heritage continues. As the Traditional Carers we hold cultural knowledge relevant to determining the cultural significance of Aboriginal objects or places in the proposed Study Area.

The qualifications and previous experience that we have in Aboriginal cultural heritage assessment work has come from over 35 years experience working on jobs such as the Eastern Gas pipeline, Gas pipeline and Water Sewerage pipeline at Goulburn NSW, Towrang NSW road widening, Yass NSW Bypass, Coolac NSW Bypass all for the RTA, Galong Lime Mine Bypass, the Marulan South Limestone Mine project, Transgrid power easement regeneration at Tidbinbilla, Woodlawn Wind farm at Tarago NSW, Capital Wind Farm at Lake George, the proposed Yass Wind Farm, the Crookwell II Wind Farm, the Department of Defence HQJOC and the gas feeder main connecting HQJOC to Eastern Gas main pipeline, fibre optic cable from Canberra to DHQJOC and most recently the enlarged Cotter Dam project, ACT. We have also been engaged in survey work for residential development that takes place within the Ngunawal Tribal boundary in both urban and rural situations.

During our years of carrying out this Cultural heritage management type work we have come in contact with numerous archaeologists of whom the following three have indicated that they are more than please to support us in our endeavours to preserve our cultural heritage. They are Ms Megan Russell – 0427 753 322, Mr Doug Williams – 02 4474 5736, 0412 997 177 and Mr Wilfred Shawcross – 02 6248 7336.

PO Box 6900, CHARNWOOD ACT 2615 Ph: 02 62591672 Fax: 02 6258 1264 Email: walbell@bigpond.net.au

The Ngunawal people are the Traditional Carers and are recognised as such by the Australian Capital Territory Chief Minister, Mr Jon Stanhope MLA. We are also recognised by Mr Steven Free, Acting Manager, Planning & Aboriginal Heritage, Department of Environment and Climate Change, QUEANBEYAN NSW 2620. Recognition is forthcoming of us, by Local Government Agencies and Shire Councils within the Ngunawal Tribal boundary, as the Ngunawal Traditional Carer group.

The Ngunawal people, have had in place a Native Title claim that has been registered with the National Native Title Tribunal which requires stringent guidelines to be met in order to be registered as Native Title claimants. The most important of which is to prove connection to country as the Traditional Carers.

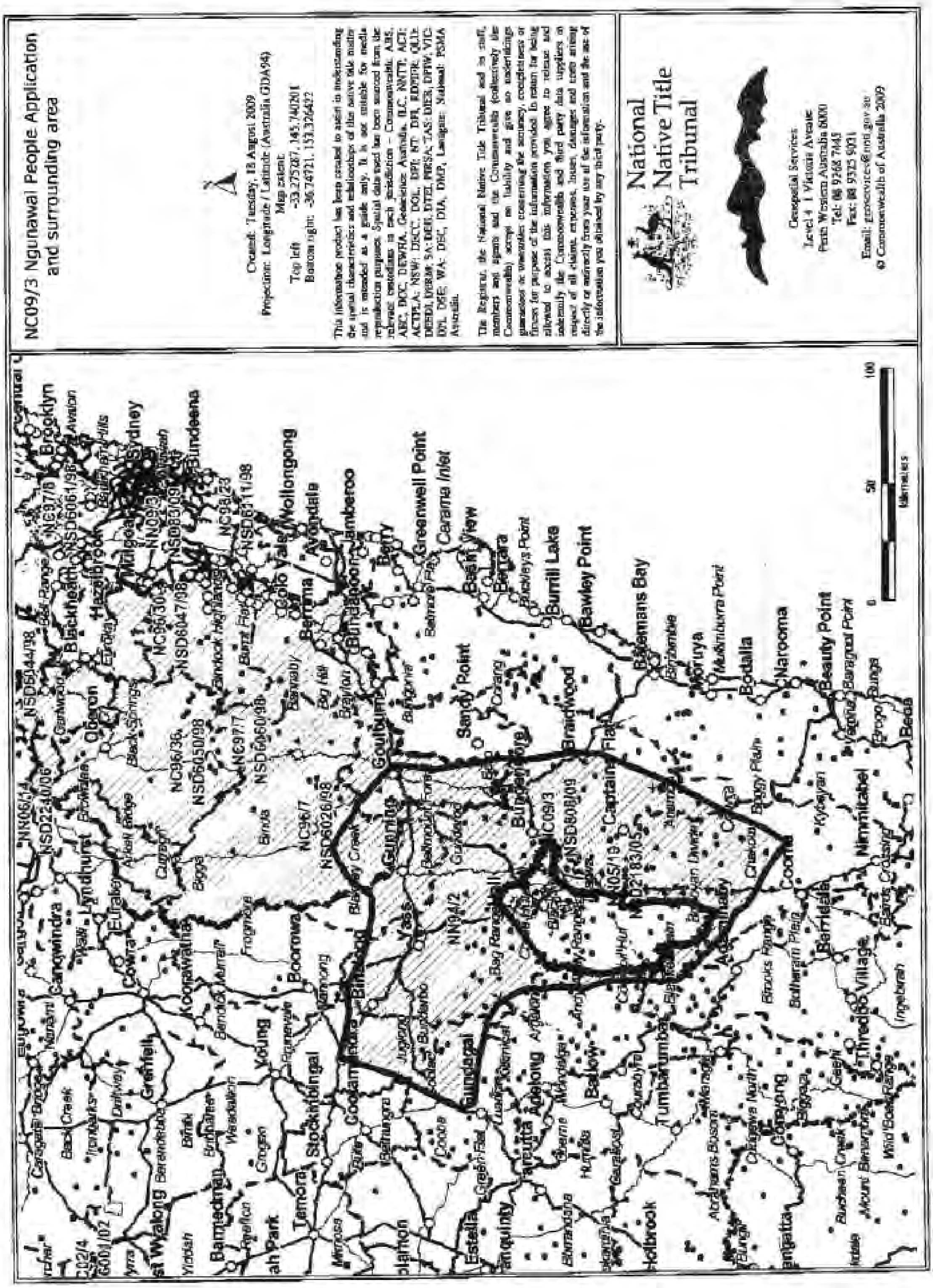
We also provide the following attachments to support our claims;

- a map indicating the area covered by the Native Title Claim;
- copy of our organisations Workers Compensation Insurance;
- our fee structure.

Mr Wally Bell (Ngunawal Traditional Carer)
Chair

On behalf of BNAC members

17 May 2010


NC09/3 Ngunawal People Application
and surrounding area
National
Native Title
Tribunal

Peter Falk Consultancy

PO Box 1018, Mittagong NSW 2575

0401938060

OzArk Environmental NSW Heritage Management P/L

PO Box 2069

Dubbo 2830 July 15, 2010

Attn: Dr Jodie Benton

Subject: Aboriginal Heritage Assessment-Berrima Colliery

Under the United Nations Declaration on the Rights of Indigenous Peoples, as endorsed by the Australian Federal Government, the following must be considered on ALL sites being surveyed within Australia:

Article 8,

1. Indigenous Peoples and individuals have the right not to be subjected to forced assimilation or destruction of their culture.

Article 11,

. 1. Indigenous Peoples have the right practice and revitalize their cultural traditions and customs. This includes the right to maintain, protect and develop the past, present and future manifestations of their cultures, such as archaeological and historical sites, artefacts, designs, ceremonies, technologies and visual and performing arts and literature.

2. States shall provide redress through effective mechanisms, which may include restitution, developed in conjunction with Indigenous Peoples, with respect to their cultural, intellectual, religious and spiritual property taken without their free, prior and informed consent or in violation of their laws, traditions and customs.

Article 12,

1. Indigenous Peoples have the right to manifest, practice, develop and teach their spiritual and religious traditions, customs and ceremonies; the right to maintain, protect, and have access in privacy to their religious and cultural sites; the right to the use and control of their ceremonial objects; and the right to the repatriation of their human remains.

As the area to be surveyed is close to the Wollindilly River and the Wingecarribee River the potential for Aboriginal Sites to be present is very high. It is known to Cultural knowledge

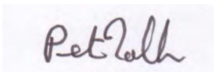
Holders that there are numerous sites unfound and found in the survey area and outside of this survey area.

The site is located within the D’harawal Nation area and should be acknowledged as such. As the D’harawal people have lived in and on this land for thousands of years, and the loss of the initiated Elders and Knowledge holders, due to the introduction of disease and massacres by the white man has destroyed most of the knowledge of the land.

As I am a stakeholder as registered with DECCW and have knowledge of this country I am suitably qualified to be on this survey. I have been working in the Southern Highlands and surrounding area for the past 9 years on surveys and excavations.

If you require further information please do not hesitate to contact me.

Yours truly,



Peter Falk

National
Native Title
Tribunal

New South Wales and
Australian Capital Territory
Registry
Level 25, 25 Bligh Street
Sydney NSW 2000
GPO Box 9973
Sydney NSW 2000
Telephone (02) 9235 6300
Facsimile (02) 9233 5613

12 May 2010

Cheryl Burke
Office Manager
OzArk Environmental & heritage Management P/L
145 Wingewarra St
DUBBO NSW 2830

Our Reference: 3458/10kc
Your Reference:

Dear Cheryl

Native Title Search Results of Wingecarribee Local Government Area

Thank you for your letter of 5 May 2010.

My search on 12 May 2010 found:

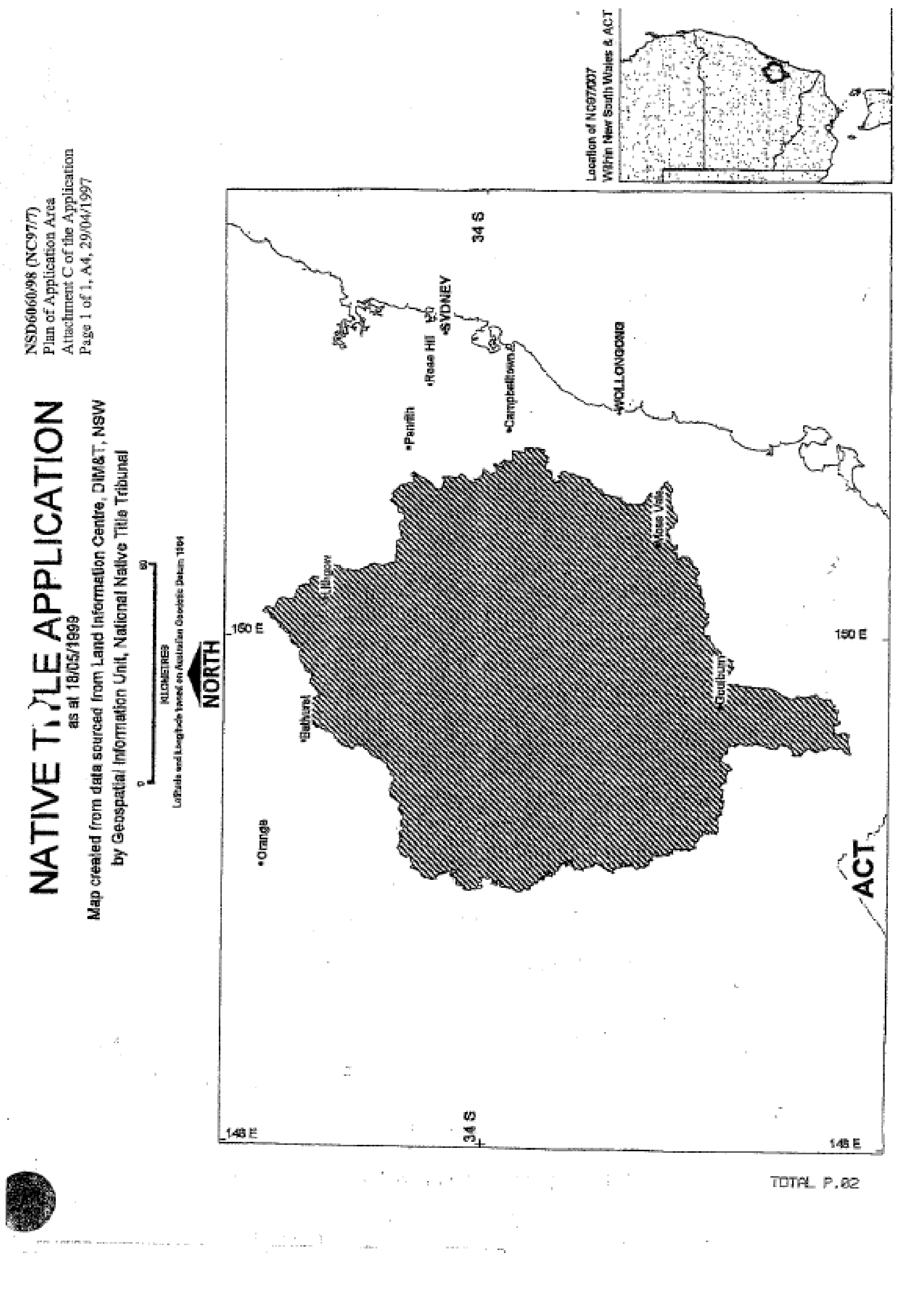
Register Type	NNTT Reference Numbers
National Native Title Register	Nil.
Register of Native Title Claims	NC97/7
Unregistered Claimant applications	Nil.
Register of Indigenous Land Use Agreements	Nil.

I have included an extract from the Register of Native Title Claims, mapping of the application area and a NNTT Registers fact sheet to help you understand the search result.

Please note that there may be a delay between a native title determination application being lodged in the Federal Court and its transfer to the Tribunal. As a result, some native title determination applications recently filed in the Federal Court may not appear on the Tribunal's databases.

Resolution of native title issues over land and waters.

Freecall 1800 640 501
www.nntt.gov.au


NATIVE TITLE APPLICATION
as at 18/05/1999
Map created from data sourced from Land Information Centre, DIM&T, NSW
by Geospatial Information Unit, National Native Title Tribunal
NSD6060/98 (NC97/7)
Plan of Application Area
Attachment C of the Application
Page 1 of 1, A4, 29/04/1997
KILOMETRES
NORTH
Location of NC97/007
Within New South Wales & ACT
34 S
150 E
148 E
SYDNEY
Rose Hill
Penrith
Campbelltown
WOLLONGONG
Lithgow
Bathurst
Orange
Goulburn
ACT
TOTAL P.02

Peter Falk Consultancy
PO Box 1018, Mittagong NSW 2575
0401938060

Ozark Environment & Heritage Management P/L
PO Box 2069
Dubbo NSW 2830 January 3, 2011
Attn: Cheryl Burke

Subject: Aboriginal heritage Assessment Berrima Colliery: Continued Operations

Under the United Nations Declaration on the Rights of Indigenous Peoples, as endorsed by the Australian Federal Government, the following must be considered on ALL sites being surveyed within Australia:

Article 8,

3. Indigenous Peoples and individuals have the right not to be subjected to forced assimilation or destruction of their culture.

Article 11,

. 1. Indigenous Peoples have the right practice and revitalize their cultural traditions and customs. This includes the right to maintain, protect and develop the past, present and future manifestations of their cultures, such as archaeological and historical sites, artifacts, designs, ceremonies, technologies and visual and performing arts and literature.

4. States shall provide redress through effective mechanisms, which may include restitution, developed in conjunction with Indigenous Peoples, with respect to their cultural, intellectual, religious and spiritual property taken without their free, prior and informed consent or in violation of their laws, traditions and customs.

Article 12,

2. Indigenous Peoples have the right to manifest, practice, develop and teach their spiritual and religious traditions, customs and ceremonies; the right to maintain, protect, and have access in privacy to their religious and cultural sites; the right to the use and control of their ceremonial objects; and the right to the repatriation of their human remains.

The study area was used extensively by the Aboriginal people prior to the invasion of the white settlers. The Bong Bong Common area was covered in numerous species of trees and understory growth (refer to Thorsby's diaries) this was cleared by Thorsby for cattle grazing.

With the clearing of this land, the destruction of Aboriginal food sources commenced in the area. As Aboriginal food sources disappeared, the Aboriginal People move off the land to other areas in the Southern Highlands.

In all Aboriginal areas, Aboriginal People used a rotational farming method of sourcing food based on the weather cycles of the area, and based on this rotational farming method white explorers incorrectly wrote that Aboriginal People were “hunter Gatherers”.

Aboriginal Context

Language Groups:

Based on Tindale 1974, he wrote on page 196 that the South Eastern Australian Aboriginal Groups could only be described as a “dog’s breakfast” and to sort it out would be near impossible. But known facts found in the Mitchell Library, that there was a drought in the Gundungurra Tribal area west of the Woolondilly River in1812-13 and the D’harrawal People allowed the Gundungurra People into their land to source food. The Wodi-Wodi groups spoke D’harrawal language, and were a sub-group of the D’harrawal People who lived on the coast. The D’harrawal people on the highlands were the sweet water people and the D’harrawal People who lived on the coast were known as the bitter water people.

Some people think that the name Wodi-Wodi came from Aboriginal People who came up from the Murray River and who were known as the Wardie-Wardie people. Proof of this is to be sorted out as there are some people on the coast who came from families from the Wardie-Wardie People.

Contact History:

With the bringing of disease and poisons, the white settler almost wiped out the Aboriginal People of Greater Sydney and surrounding areas, then there was the massacres carried out by the 43rd Regiment at Appin and in the Southern Highlands. These massacres were instigated by white settlers who wrongly assumed that they could just take over any land given to them by the Government of the day and when the Aboriginal People complained the settlers called in the army to remove the problem.

Regional Archaeological Context

With reference to the report of Total Earth Care (TEC2006) of the Moss Vale Economical Zone for Wingecarribee Shire Council, there was found a site along Stoney Creek east of the Boral Cement Works, consisting of a sandstone platform approximately 70 metres in length of groovings, and then south of this position approximately 75 metres away a further sandstone platform with groovings and water collection holes.

Local Archaeological Context

As the study area falls within an area surrounded by rivers and other water ways, it can be assumed that the use of the land by Aboriginal People was greater in this area because of the available water and plentiful food sources. But due to the white settlers clearing land for farming the diminishing food sources for Aboriginal People forced them to move to more remote areas along the Wollindilly River.

The Southern Highlands has been used by Aboriginal People and is still regarded by Aboriginal People as a highly significant area for ceremonial and spiritual reasons and should remain as such.

Likely Impacts on Aboriginal Heritage

Any form of mining is liable to create subsidence, as indicated in the Aboriginal Heritage Study at BHP Appin mine site extension; BHP could not and would not guarantee that damage could happen to the shelter sites or any other site above any long wall mining. As the Berrima site does not do long wall mining then the extent of surface damage will be minimal, but will still need to be monitored.

Recommendations

In addition to your recommendations the following must also be considered:

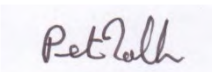
1. Any clearing of vegetation and ground disturbing activities in the area of the Berrima Pit top and the Loch Catherine area should be monitored by the Aboriginal Stakeholders for the discovery of any Aboriginal Artifacts or PADs.
2. A Cultural Heritage Training program be set up for training of all contractors and sub-contractors, this to be done by a qualified Aboriginal Person.

Aboriginal Cultural Heritage Management Plan

The ACHMP will include future monitoring of the sites for the possible occurrence of ground subsidence. It should also include the provisions for the Aboriginal Cultural training of employees of the Berrima Colliery.

If you require any further information please do not hesitate to contact me.

Yours truly



Peter Falk

BURU NGUNAWAL ABORIGINAL CORPORATION

ABN : 24 059 704 833

10 January 2011

OzArk Environmental & Heritage
Management P/L
PO Box 2069
DUBBO NSW 2830

Attention: Dr Jodie Benton

Dear Jodie

Re: Draft Aboriginal Heritage Assessment at Berrima Colliery

Thank you for your email dated 17 December 2010, advising of the above Draft Aboriginal Heritage Assessment at Berrima Colliery, and requesting input from Buru Ngunawal Aboriginal Corporation (BNAC) as the Traditional Owner group.

As the Traditional Owners, we agree with OzArk Environmental and Heritage Management's draft report for the project, but we are of the belief that decision-making is a collaborative process involving all concerned parties. Being inclusive develops a strong working relationship with respect for opinions and an understanding of values and may increase the understanding of the need to protect our cultural heritage.

If you have any queries, please do not hesitate to contact Walter on the number below, or by email, or myself on 0407 517844.

Thank you for the opportunity to provide comment. We look forward to working with you collaboratively on future projects.

Yours faithfully

Tyronne Bell
Director/Senior Sites Officer

PO Box 6900, CHARNWOOD ACT 2615 Ph: 02 62591672 Fax: 02 6258 1264 Email: walbell@bigpond.net.au

Appendix 2 - Aboriginal Community Consultation Log

Date	Organisation /	Contact Name	Comment	OzArk staff/ method
04.05.10	Southern Highland News	Classifieds - Heather 'classifieds.highlandnews@ruralpress.com'	placed advert to appear in Southern Highland News - EOI Closure date 19th May 2010	email - CB
Aboriginal Community Consultation Stage 1				
05.05.10	Office of The Registrar, ALRA	Courtney Field 11-13 Mansfield Street Glebe NSW 2037	mailed Stage 1 letter. EOI date 21st May 2010	post - CB
05.05.10	NTSCORP	Admin/Notification Team PO box 2105 Strawberry Hills 2012	mailed Stage 1 letter. EOI date 21st May 2010	post - CB
05.05.10	DECCW	Norman Laing DECCW Metropolitan PO Box 668 Parramatta 2124	mailed Stage 1 letter. EOI date 21st May 2010	post - CB
05.05.10	Wingecarribee Shire Council	GM / Mr J Gordon PO Box 141 Moss Vale 2577	mailed Stage 1 letter. EOI date 21st May 2010	post - CB
05.05.10	National Native Title Tribunal	Admin/Notification Team GPO Box 9973 Sydney NSW 2001	mailed Stage 1 letter. EOI date 21st May 2010	post - CB
05.05.10	Hawkesbury Nepean CMA	Aboriginal Cultural Heritage Officer Shop 4, Calaroga Centre, Kirkham St PO Box 957 Moss Vale 2577	mailed Stage 1 letter. EOI date 21st May 2010	post - CB
05.05.10	Illawarra LALC	C/- Chairperson 3 Ellen Street Wollongong 2500	mailed Stage 1 letter. EOI date 21st May 2010	post - CB
Aboriginal Community Consultation Stage 1 Round 2				
05.05.10	Peter Falk	Peter Falk Consultancy PO Box 1080 Mittagong NSW 2575 ph: 0401 938 060 e: 'kanga26@live.com.au'	Mr Falk phoned to express interest in the project.	cb - phone
11.05.10	Wingecarribee Shire Council	Mr J Gordon / General Manager	received fax with contact details of relevant Indigenous organsiations that should be contacted. (listed below, Illawarra LALC were in this list as was Peter Falk Consultancy).	
12.05.10	Cubbitch Barto	Glenda Chalker	posted Stage 1 Round 2 letter, EOI closure date 28 May 2010	
12.05.10	Tharawal LALC	Ross Evans, Chairperson	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	
12.05.10	Indigenous Historical Research	Adrian Shafer	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	
12.05.10	Gundungurra Ab.Herit.Assoc.	Merle Williams	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	
12.05.10	Moyengully Natural Resource Mgmt Group	John Steward	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	
12.05.10	Coomaditchie United Ab.Corp	Chairperson	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	

Date	Organisation /	Contact Name	Comment	OzArk staff/ method
12.05.10	Korewal Elouera Jerrungarugh	Uncle Ruben / Aunty Gwen Brown	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	
12.05.10	Wodo Wodi TO Corporation	Aunty Elaine	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	
12.05.10	Pejar LALC	Delise Freeman	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	
12.05.10	Bellambi Indig.Corp.	Kim Moran	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	
12.05.10	Yamanda Aboriginal Assoc.	Chairperson	posted Stage 1 Round 2 letter, EOI closure date 28 May 2011	
12.05.10	National Native Title Tribunal	Kashana Cohen-McMeekin	received letter via email with results from search - identified Gundungurra Tribal Council Aboriginal Corp c/- Eddy Neumann Lawyers. Emailed Stage 1 letter to appropriate office of Eddy Neumann	
14.05.10	Korewal Elouera Jerrungarugh	Uncle Ruben Brown PH; 4271 3069 (ph/fx)	Ruben phoned to confirm that KEJ would like to become registered stakeholders to be consulted on the Berrima Colliery Project.	
17.05.10	Buru Ngunawal Aboriginal Corporation	Wally Bell ph: 6259 1672 e: 'walbel@bigpond.net.au'	recevied faxed letter from BNAC expressing interest in the project.	
19.05.10	Gundungurra Ab.Herit.Assoc.	Sharon Halls (on behalf of Merle Williams) ph: 4757 3223 (PO Box 37, Lawson)	Sharon phoned to confirm that GAHA would like to register interest and be consulted about the project.	
21.05.10	Illawarra LALC	Sheraline Robinson	Sheraline phoned to express interest on behalf of ILALC and will confirm in writing Tuesday 25th May.	
31.05.10	DECCW Metropolin Branch	Lou Ewins / Miranda Morton	Received reply from DECCW recommending we contact the following *Tharawal LALC *Cubbitch Barta *Peter Falk Consultancy. Note that these organisations have been identified and sent a Stage1 Round 2 letter	
31.05.10	Office of The Registrar, ALRA	Courtney Field	received reply from Registrar suggesting we contact Illawarra LALC.	
Aboriginal Community Consultation Stage 2/3				
17.06.10	BNAC	Members: BNAC c/- Mr W Bell PO box 6900 Charnwood ACT 2615	Stage 2/3 letter mailed, inviting comment on methodology and including information/maps about the project. Due date of feedback 16July 2010	
17.06.10	ILALC	Members: ILALC C/- Sharralyn Robinson 3 Ellen Street Woolongong NSW 2500	Stage 2/3 letter mailed, inviting comment on methodology and including information/maps about the project. Due date of feedback 16July 2010	

Date	Organisation /	Contact Name	Comment	OzArk staff/ method
17.06.10	Buru Ngunawal Aboriginal Corporation	c/- Mr W Bell PO box 6900 Charnwood ACT 2615	Stage 2/3 letter mailed, inviting comment on methodology and including information/maps about the project. Due date of feedback 16July 2010	
17.06.10	GAHA Inc	Members: Gundungurra Ab.heritage Assoc c/-Merle Williams / Sharon Halls PO Box 37 Lawson NSW 2783	Stage 2/3 letter mailed, inviting comment on methodology and including information/maps about the project. Due date of feedback 16July 2010	
17.06.10	Peter Falk	Mr Peter Falk Peter Falk Consultancy PO Box 1080 Mittagong NSW 2575	Stage 2/3 letter mailed, inviting comment on methodology and including information/maps about the project. Due date of feedback 16July 2010	
13.07.10	Gundungurra Ab.Herit.Assoc.	Sharyn Halls	Emailed received with Workers Compensation Certificate of Currency 'Good Morning Jodie, Gundungurra Aboriginal Heritage Assoc Inc would like to register it's interest in the Aboriginal Heritage Assessment for the continued operations at Berrima Colliery. Please find attached our Certificate of Currency for year 2010, 2011. Look forward to hearing from you Regards Sharyn Halls GAHAI	
15.07.10	Buru Ngunawal Aboriginal Corporation	Tyronne Bell	Received email from Tyronne Bell with letter attached in response to Stage 2/3 - in part 'As the Traditional Owners, we agree with OzArk's proposed Methodology for the project, but we are of the belief that decision-making is a collaborative process involving all concerned parties. Being inclusive develops a strong working relationship with respect for opinions and an understanding of values and may increase the understanding of our need to protect our cultural heritage' see Appendix for copy of entire correspondence.	

Date	Organisation /	Contact Name	Comment	OzArk staff/ method
16.7.10	Korewal Elouera Jerrungarugh	Uncle Ruben Brown PH; 4271 3069 (ph/fx)	Ruben Brown called about Closing date to date for comment on Stage 2/3 methods. He wanted to say he is happy with methods proposed and consultation to date. He further noted: Top of escarpment was area for trading - fish and sea resources for stone for tools. Also there was black ochre that came from around Berrima. Valued resource. Also many engravings up there. Ruben's Grt grandmother was from Bass Point and her father was Wollonggolow, a famous tracker and elder of the Elouera tribe. Wollongong was named after him. Ruben says that whole Berrima area is important and significant to Aboriginal community. He said he will try to write this up into a letter and send it through next week.	
18.07.10	Peter Falk	Mr Peter Falk kanga26@live.com.au	Jodie Please find attached my registration for consideration in this survey. Regards Peter Peter Falk Consultancy Aboriginal Cultural Landscape Profiler	
04.08.10	Gundungurra Ab.Herit.Assoc.		sent letter advising FW date and asking for confirmation to fees & availability of site officer by Friday 13 August	CB
04.08.10	Buru Ngunawal Aboriginal Corporation		sent letter advising FW date and asking for confirmation to fees & availability of site officer by Friday 13 August	CB
04.08.10	Korewal Elouera Jerrungarugh		sent letter advising FW date and asking for confirmation to fees & availability of site officer by Friday 13 August	CB
04.08.10	Peter Falk		sent letter advising FW date and asking for confirmation to fees & availability of site officer by Friday 13 August	CB
04.08.10	Illawarra LALC		sent letter advising FW date and asking for confirmation to fees & availability of site officer by Friday 13 August	CB

Date	Organisation /	Contact Name	Comment	OzArk staff/ method
6.8.2010	Buru Ngunawal Aboriginal Corporation	Wally Bell Chair Buru Ngunawal Aboriginal Corporation Traditional Carer Group PO Box 6900 CHARNWOOD ACT 2615 Ph: 02 6259 1672 Fax: 02 6258 1264 Mb: 0419 425 347	In relation to the fee offer and scheduled dates we wish to confirmation that our representative is available to participate in the field assessment at the rates that have been specified in this correspondence. As noted these rates are all inclusive of kilometres, meal expenses and any accommodation costs. Our nominated site officer's name is Tyronne Bell and we provide information on his experience in Aboriginal cultural heritage matters and the field assessment process in the attached document	Wally emailed CB
9.8.10	Korewal Elouera Jerrungarugh	Uncle Ruben Brown; PH; 4271 3069 (ph/fx)	Ruben called to discuss fieldwork. Jodie not in, Said we would call back.	Phone KT
10.8.10	Korewal Elouera Jerrungarugh	Uncle Ruben Brown; PH; 4271 3069 (ph/fx)	Ruben called and discussed FW details with JB. JB noted that Ruben was planning to send a representative for the FW next week and reminded him that we needed to see a Cert of currency for Workers Comp before we can take a representative from KEJ in the field. Ruben noted he was aware of this and that they did have insurance and that he would fax through that document to our office before Friday. JB also asked if he give us a call back before survey just to give us the name and mobile number of the rep so that we could stay in touch on the day of FW.	Phone JB
12.8.2010	Korewal Elouera Jerrungarugh	Uncle Ruben Brown; PH; 4271 3069 (ph/fx)	Recieved fax from Ruben re workers comp insurance. Also noting that Bart Brown would be available and attend the field work.	Fax HK
13.8.2010	Korewal Elouera Jerrungarugh	Uncle Ruben Brown; PH; 4271 3069 (ph/fx)	Rang Ruban and left a message for him with another person. In the documents faxed through it specifically says that his policy does not cover him for workers compensation insurance. I said that he should contact his insurance broker immediatley to arrange for coverage as he cannot participate in the field work next week without it.	Phone HK

Date	Organisation /	Contact Name	Comment	OzArk staff/ method
16.8.10	Korewal Elouera Jerrungarugh	Uncle Ruben Brown; PH; 4271 3069 (ph/fx)	Ruban rang twice to indicate that he did not need Workers Comp Insurance as his organisation does not pay more than $7500 per annum. KT read out example letter so that Ruban would send confirmation that Elouera would not be paying more than $7500 this financial year and thus waive WCI requirement. Received fax from Ruban to this effect, although with wording "will not be paying any individuals no more than seven thousand five hundred dollars".	Phone / Fax KT.
17.8.2010	Gundungurra Ab.Herit.Assoc. Merle Williams	Ph 47573223	Left a message on Merles answering machine regarding possible participation in the survey tomorrow. Asked her to phone OzArk back before 4.30.	Phone HK
17.8.2010	From: Peter Falk [mailto:kanga26@live.com.au]		Sent: Tuesday, 17 August 2010 10:58 AM To: Jodie Subject: Berrima Colliery Jodie I will be unable to do the survey as due to bad knees and hips my walking distance has been curtailed to 500 metres until I have replacements installed later this year. I am able to do excavation work if the job requires such. Thank you Peter Peter Falk Consultancy Aboriginal Cultural Landscape Profiler	Emailed JB
19.8.2010	Gundungurra Ab.Herit.Assoc. Merle Williams mwilliams18@bigpond.com (found email address of website)	PO Box 37 Lawson NSW 2783	Letter returned to sender not at this address	HK Mail
FW PARTICIPATION				
17-18.8.2010	Buru Ngunawal Aboriginal Corporation	PO Box 6900 Charnwood ACT 2615	Tyronne Bell participated in feild work Tuesday to Wednesday 17-18th of August.	
17-18.8.2010	Korewal Elouera Jerrungarugh	Uncle Ruben Brown PH; 4271 3069 (ph/fx)	Bart Brown participated in feild work Tuesday to Wednesday 17-18th of August.	

Date	Organisation /	Contact Name	Comment	OzArk staff/ method
27.8.2010	Korewal Elouera Jerrungarugh	Uncle Ruben Brown; PH; 4271 3069 (ph/fx)	Ruban rang to check that his fax had cme through including an invoice for the Berrima Work. I said that I not sure who is paying him but someone will let him know (CB phoned Mr Brown to advise it would be Boral Cement)	HK-phone and Fax
14.10.2010	Geoff O'Connor	Geoff O'Connor Catchment Officer Hawkesbury-Nepean Catchment Management Authority	back in May you wrote to us regarding an 'Aboriginal heritage assessment for the continued operations at Berrima Colliery' and any info we could provide re Aboriginal groups in the local area. Apologies for not replying earlier, there have been staff & role changes in this office that have held things up. I assume by now you will have moved on with this matter and hopefully you will have had some feedback from Wingecarribee SC ? about any relevant Aboriginal groups in the Berrima area. However if you are still seeking this information you can contact John Lennis, our Aboriginal Communities Officer, Ph 02 4725 3046 Mob 0409 390 520 e:john.lennis@cma.nsw.gov.au regards Geoff O'Connor Catchment Officer Hawkesbury-Nepean Catchment Management Authority PO Box 957, Moss Vale 2577 Ph: 02 4861 9012 Fax: 02 4868 3588	CB - email
17.12.10	Gundungurra Aboriginal Heritage Assoc. Inc.	Attn: Members Gundungurra Aboriginal Heritage Assoc. Inc. c/ - Merle Williams / Sharon Halls PO Box 37 Lawson NSW 2783 ghal6522@bigpond.net.au	draft report sent to stakeholders inviting comment by 10th January 2011.	cb - mail / email - received read receipt
17.12.10	Illawara LALC	Members – Illawara LALC c/- Sharralyn Robinson / CEO 3 Ellen Street Wollongong NSW	draft report sent to stakeholders inviting comment by 10th January 2011.	cb - mail

Date	Organisation /	Contact Name	Comment	OzArk staff/ method
17.12.10	Korewal Elouera Jerrungarugh	Attn: Members Korewal Elouera Jerrungarugh c/ - Uncle Ruben 86 Hertford Street Berkeley NSW 2506	draft report sent to stakeholders inviting comment by 10th January 2011.	cb - mail
17.12.10	Peter Falk Consultancy	Mr Peter Falk Peter Falk Consultancy PO Box 1080 Mittagong NSW 2575 kanga26@live.com.au	draft report sent to stakeholders inviting comment by 10th January 2011.	CB - email / mail
17.12.10	Buru Ngunawal Aboriginal Corporation	e: walbell@bigpond.net.a u PO Box 6900 Charnwood ACT 2615		CB - email / mail
10.01.11	Peter Falk Consultancy	Mr Peter Falk Peter Falk Consultancy PO Box 1080 Mittagong NSW 2575 kanga26@live.com.au	received email response from Peter Falk, see report for inclusion of this correspondence.	CB - email
11.01.11	Buru Ngunawal Aboriginal Corporation	e: walbell@bigpond.net.a u Tyronne Bell	received email response from Tyronne Bell see report for inclusion of this correspondence.	CB - email