

# Berrima Colliery

Continued Operations

ENVIRONMENTAL ASSESSMENT - Volume 1

Prepared for Boral Cement Limited | May 2011



# ENVIRONMENTAL ASSESSMENT STATEMENT

## Submission of Environmental Assessment [EA]

Under Section 75E of the *Environmental Planning and Assessment Act 1979*

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### EA Prepared by

Brett McLennan

Rachael Russell

*BTP (Hons)*

*BSc; MEnvP*

EMGA Mitchell McLennan  
Ground Level, Suite 01  
20 Chandos St  
St Leonards NSW 2065

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### Applicant

Boral Cement Limited

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### Land to be Developed

Land within Consolidated Coal Lease 748 - Refer to Project Application and land identified in EA

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### Proposed Development

Continuation of operations at Berrima Colliery, Medway.

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### Environmental Assessment

An EA for the proposal is attached

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### Certification

We certify that we have prepared the contents of this EA in accordance with the Director-General's requirements and to the best of our knowledge the information contained in this EA is neither false nor misleading



Brett McLennan  
**Director**

18 May 2010



Rachael Russell  
**Environmental Planner**

18 May 2010

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## Berrima Colliery Continued Operations

Final

Prepared for Boral Cement Limited | 18 May 2011

|             |                                                                                   |             |                                                                                     |
|-------------|-----------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------|
| Prepared by | <b>Rachael Russell</b>                                                            | Approved by | <b>Brett McLennan</b>                                                               |
| Position    | Environmental Planner                                                             | Position    | Director                                                                            |
| Signature   |  | Signature   |  |
| Date        | 18/05/2011                                                                        | Date        | 18/05/2011                                                                          |

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results 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.

### Document Control

| Version | Date       | Prepared by     | Reviewed by    |
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Environmental Assessment

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## Executive Summary

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### ES1 Background

Berrima Colliery is an existing underground bord and pillar coal mine owned by Boral Limited and managed by one of its operating subsidiaries, Boral Cement Limited (Boral). It is operated on Boral's behalf by Delta Mining. It is located approximately 7km west of Berrima in the town of Medway in the Southern Highlands.

The colliery is currently operating under existing use rights, however, recent amendments to the *Environmental Planning and Assessment Act 1979* (EP&A Act) as well as the *Mining Act 1992* require planning approval under Part 3A of the EP&A Act for continued operations. Part 3A applications are to be accompanied with an Environmental Assessment (EA) which addresses the Director-General's requirements (DGRs) issued by the New South Wales (NSW) Director-General of Planning and Infrastructure.

This EA provides the information needed by the NSW Minister for Planning and Infrastructure to determine the proposal in an appropriately informed manner. The EA consists of a series of technical studies by a range of technical experts as referenced throughout the document.

### ES2 Existing operations

Mining began at Berrima Colliery in 1872 with continuous operations since 1926. Surface infrastructure is located at the 'pit-top' at the end of Medway Road in Medway. A conveyor system extends from the pit-top westwards across Wingecarribee River to enter the mine. Past underground workings extend west and to the north, with current workings in the South-West 1 (SW1) extraction panel approximately 3.5km north of the pit-top.

Production rates at the colliery have varied over time between 125,000 and 460,000 tonnes per annum (tpa) of run of mine (ROM) coal with capacity to produce up to 500,000 tpa. The current production rate at Berrima Colliery is around 220,000 tpa. A total of 38 employees operate in morning and afternoon production shifts from Monday to Friday with a third production shift when required and an occasional maintenance shift.

Coal is crushed on site to meet product requirements with no other beneficiation (such as washing of the coal) undertaken. ROM coal is supplied to customers or stockpiled. Coal has traditionally been supplied to a variety of customers and is the sole supplier of fuel to the Boral owned Berrima Cement Works, approximately 7.5km east-south-east of the colliery. Coal is trucked six days per week either directly to Berrima Cement Works and other customers (including overseas customers) or stockpiled at Loch Catherine, around 1km south of the pit-top facilities at Medway. Coal is stockpiled at Loch Catherine using a front end loader with the capacity to stockpile 100,000t.

Berrima Colliery currently operates under Consolidated Coal Lease (CCL) 748, Exploration Licence (EL) 748, a Mining Operations Plan (MOP), a Subsidence Management Plan (SMP) and Environment Protection Licence (EPL) 608.

### ES3 The proposal

The proposal for continued operations at Berrima Colliery will involve little variation from existing operations and approvals. Underground mining will continue using the bord and pillar method within the

approved SMP area, specifically extraction panels SW1, 406 and 49. The proposed maximum production will equal past maximum production rates of 460,000 tpa ROM coal.

Coal will continue to be supplied to a variety of customers north and south of the colliery as well as to Berrima Cement Works. Coal will continue to be trucked to these customers along Medway Road and then either along Hume Highway, Old Hume Highway or Taylor Avenue depending on the destination. Coal will also be transported to Port Kembla by truck for export to international customers.

Coal will continue to be stockpiled at Loch Catherine with the total capacity increased to 115,000 t. The increase in capacity will require an expansion to the stockpiling area. This will require the clearing of 2.24 ha of vegetation within this expansion area and a surrounding Asset Protection Zone (APZ). An APZ will also be implemented at the pit-top with the clearing of around 1.35 ha of vegetation required. The APZs are required to reduce the risk of bushfire destroying the mine's assets.

Existing mining facilities and support structures will be operated with possible upgrades where required. Any replacement of existing facilities and support structures will be subject to separate applications and approvals. The exception is the replacement of the old septic system on the amenities block which forms part of the proposal.

A separate application is being prepared to modify the development consent for the Berrima Cement Plant to increase stockpiling of coal at the plant. This increased stockpile would be used for the transportation of the majority of coal required for export shipments through Port Kembla which would significantly reduce impacts associated with campaign haulage of trucks on Medway Road.

## ES4 Potential impacts and management measures

Environmental and social risks associated with the proposal were identified during the early stages of the EA in consultation with regulatory agencies and members of the community, as reported in the Preliminary Environmental Assessment (PEA). This enabled technical studies to focus on higher risk matters compared to more general aspects. The potential impacts and associated management measures are described below, in general order of the risk assessment.

### ES4.1 Socio-economic

Potential socio-economic impacts of the proposal include employment, both direct and indirect, and the supply of fuel for the production of cement at Berrima Cement Works. The cement works is the largest cement plant in NSW and supplies, along with Maldon Cement Works (another Berrima Colliery customer), over 60% of NSW's cement needs. The proximity of Berrima Colliery to the cement works has resulted in a cheap and secure supply of fuel for the cement kiln which has had a positive effect on cement prices and associated construction costs.

If the proposal was to be refused socio-economic risks include increased unemployment from the loss of jobs at the colliery, indirect unemployment in associated sectors, and the increased cement and construction costs associated with the cessation of coal supplied to Berrima Cement Works. The costs of regional and state infrastructure projects would also be negatively affected resulting in decreased provision of public facilities.

Overall the proposal is expected to have a positive socio-economic impact. Potential negative socio-economic impacts from subsidence, loss of groundwater, traffic noise and air quality, surface water quality, ecology and heritage have been assessed and found to be non-significant. These potential impacts are discussed below in individual sections.

## ES4.2 Subsidence

Underground mining can result in lowering of the overlying surface, known as subsidence. The level of subsidence depends on a number of geological factors. Maximum subsidence occurs during the second workings of underground mining when the coal 'pillars' are extracted. During the formation of the pillars, known as first workings, only minimum subsidence of less than 20 mm occurs.

Potential impacts of subsidence include damage to residential properties located above the underground workings. Dwellings and large dams on residential properties will be protected under the proposal by Subsidence Protection Zones (SPZs) where only first workings will occur. Other potential subsidence impacts include surface and sub-surface cracking, landslips, upsidence and ponding. While these impacts are considered unlikely under the proposal, control measures will be put in place where required to reduce the likelihood of potential impacts. If subsidence impacts do eventuate, appropriate mitigation measures will be implemented.

Potential subsidence impacts on ecology and Aboriginal heritage are discussed in the relevant sections below.

## ES4.3 Groundwater

The potential impacts of the proposal on groundwater were assessed through the review of monitoring data, the results of field investigations and an analytical impact assessment. Mining of the coal seam results in groundwater flowing into the underground workings. Over the life of the colliery, the levels of inflow have reached a relatively steady state. Groundwater monitoring data suggests that groundwater levels at nearby production and monitoring bores are sustained by rainfall recharge.

The likely impacts of the proposal will result in a marginal increase of 7% from current inflow. This is within past observed flows and is not expected to have significant impacts on the groundwater levels in nearby bores.

An enhanced groundwater monitoring program will be implemented under the proposal. The features of this program will include monitoring of flows in Wingecaribee River, the zone of depressurisation in the coal seam, water levels and quality in nearby bores and groundwater inflows at the colliery. In addition the monitoring program will involve the drilling of two additional groundwater monitoring bores, which will increase the reliability of the monitoring program.

Groundwater inflows are predominantly discharged into Wingecaribee River at a licensed discharge point. Groundwater is also reused at the pit top facilities and supplied to the residents of Medway Village for non-potable purposes. The multifaceted uses of the groundwater require both environmental and human health water quality criteria to be met. The quality of the groundwater is monitored at several locations and has been assessed in the surface water chapter.

## ES4.4 Traffic

A traffic impact assessment has been undertaken to assess the impacts of trucks travelling along local and regional roads under the proposal. Impacts were assessed in terms of predicted traffic volumes and the impacts on surrounding road networks safety and efficiency.

Under existing conditions and production volumes, coal from the colliery is transported to customers by trucks travelling along Medway Road. Trucks travelling to Berrima Cement Works pass under Hume highway and onto Taylor Avenue. Trucks transporting coal to customers north of the colliery turn onto Hume Highway from Medway Road and either continue north or turn onto Picton Road. Trucks travelling

south can use the Old Hume Highway to travel southwards along the Hume Highway. At present around 32 trucks are dispatched from the colliery, with 24 transporting coal to customers and 8 transporting coal to the stockpiling area at Loch Catherine. The stockpiling area is located approximately 1 km south of the colliery and is accessed via a private haul road off Medway Road.

Under the proposal trucks will continue to transport coal to Berrima Cement Works and customers to the north and south. The number of trucks dispatched under the maximum production rate of 460,000tpa will be 66 per day, with 50 travelling to customers and 16 travelling to Loch Catherine. Staff levels will also increase to 63 at maximum production levels. The assessment concluded that existing road networks are well serviced and have spare capacity. The local and regional road networks are, therefore, able to accommodate the predicted increase in traffic levels from trucks and staff members under the proposal.

Existing parking facilities at Berrima Colliery were assessed as sufficient to accommodate the increase in staff levels. There is also space available at the pit-top for expansion to the parking area if required.

Commitments under the proposal in relation to traffic include implementing a “Truck Driver Code of Conduct” and to continue to not transport coal on the Illawarra Highway.

#### ES4.5 Noise

A noise study has been completed in accordance with the NSW Industrial Noise Policy (INP), the Environmental Criteria for Road Traffic Noise (ECRTN) and other relevant guidelines. It covers operational activities during the day, evening and night as well as noise generated from trucks travelling along Medway Road. The study included specific examination of potential effects at representative receivers in the area.

Background noise levels were determined from unattended long term and attended short term noise monitoring conducted in late 2009. Potential noise impacts were assessed under a range of meteorological conditions. Under worst case meteorological conditions the results showed that some receivers in Medway Village would experience operational noise above the INP criteria. The predicted noise levels are not considered to result in significant impacts as they are not more than 10 decibels (dB) above background noise levels even under worst case conditions.

The study showed that noise levels generated from trucks travelling along Medway Road are below the relevant criteria even at the most affected residential receiver and are, therefore, unlikely to result in significant impacts.

Short term attended monitoring will be conducted quarterly at three representative locations in proximity to the colliery to ensure that operations under the proposal are not producing significant noise impacts. Results from noise monitoring will be provided in an Annual Environmental Management Report (AEMR).

#### ES4.6 Air quality

Air quality impacts from emissions generated within mining lease were assessed for the proposal. Potential emissions sources are operations at the pit-top facilities, the stockpile area at Loch Catherine, the ventilation shaft, and Medway Road.

Concentrations of total suspended particulates (TSP), particulate matter with an aerodynamic diameter of less than 10 microns (PM<sub>10</sub>) and dust deposition were modelled based on existing concentration levels, typical local weather patterns and operations under the proposal. The predicted concentrations at nearby residential receivers were assessed against the applicable air quality criteria.

There are several dust control measures currently in place at Berrima Colliery these include the wetting of coal, covering of conveyors, an enclosed crusher, use of a truck loading chute, watering of unpaved or unsealed road sections and areas on site, and occasional sweeping. These measures will continue under the proposal. Additional measures include the increased watering of unpaved roads and a restricted vehicle speed within the vicinity of Medway village of 30 km/hr.

Under the current and proposed measures the concentrations of TSP and PM<sub>10</sub> and dust deposition levels are predicted to be under the relevant air quality criteria. TSP concentrations and dust deposition are predicted to be well below the criteria.

Cumulative air quality impacts as a result of the proposal were assessed for TSP, PM<sub>10</sub> and dust deposition against the applicable criteria. Cumulative maximum TSP and PM<sub>10</sub> concentrations and dust deposition at Medway village are predicted to be well below the criterion. Occasional exceedances of daily PM<sub>10</sub> concentrations above applicable criteria have been observed to occur on average for zero to one day per year. Additional exceedances as a result of the proposal are considered to be of very low probability as background PM<sub>10</sub> levels aren't observed to exceed the criteria and very rarely come close.

Air quality monitoring of dust deposition in the vicinity of Medway village will continue under the proposal. TSP and PM<sub>10</sub> monitoring is not considered necessary due to predicted levels being below the criterion. Air quality monitoring results will be included in the colliery's AEMR.

#### ES4.7 Surface water

A water quality assessment was conducted to determine the quality of groundwater produced from the underground workings at the colliery and surface water management systems for the pit-top and Loch Catherine.

Groundwater produced at Berrima Colliery is predominantly discharged at a licensed discharge point into Wingecarribee River. Given the operational age of Berrima Colliery, this discharge now forms a steady state and part of the river's inflows. A portion of groundwater is pumped for re-use in the pit-top or stored and made available for use by residents of Medway village. The multiple uses for groundwater mean that the water quality must meet both environmental criteria for discharge as well as human health criteria for re-use.

The discharge point at the V-notch weir is currently permitted under the colliery's EPL which provides certain water quality criteria to be achieved. For the proposal groundwater quality was assessed against a set of water quality objectives (WQOs) which incorporated the EPL criteria as well as other relevant environment and health requirements.

Water quality monitoring was undertaken at four locations: the V-notch weir, downstream of the weir and two locations upstream of the weir. Results of monitoring at the V-notch weir show that the WQOs are mostly met with some exceptions. Monitored levels of manganese and nickel exceed the WQOs though they are not known to have any health issues. Elevated levels and one exceedance of the WQO for iron were also observed. These are not expected to have significant environmental or health impacts. The assessment concluded that groundwater was suitable for domestic re-use.

Monitoring will continue under the proposal at the four locations with the WQOs used as triggers for further assessment. Water quality monitoring results and any actions required will be provided in the colliery's AEMR.

## ES4.8 Ecology

Potential ecological impacts resulting from the proposal include the clearing of around 3.59ha of natural vegetation and potential impacts on the species present. The vegetation proposed to be cleared does not consist of any threatened species or communities and clearing is unlikely to have impacts in terms of availability of habitat for fauna species. However, clearing will result in the loss of some habitat hollows which will be compensated for through the provision of hollows constructed in surrounding vegetation. There is potential for negative impacts on fauna species during clearing of vegetation. Management and mitigation measures during clearing are to be undertaken to ensure negative impacts to any species are avoided.

Subsidence impacts on overlying vegetation are unlikely to be significant as the area above the underground workings has been mostly cleared of vegetation for agricultural purposes. There are no groundwater dependant ecosystems likely to be impacted by subsidence, or otherwise, under the proposal.

## ES4.9 Heritage

An Aboriginal heritage assessment conducted for the proposal identified one site of Aboriginal heritage significance. The site is located above the SMP area on the corner of the 406 extraction panel. The site consists of a few artefact scatters covered by leaf litter in proximity to the surface. Its location is within land previously cleared for agricultural grazing purposes.

Potential subsidence impacts from the proposal may occur within the SMP area. However, under the proposal predicted subsidence within the area will be minor and is therefore unlikely to have a significant impact on the site and subsidence protection is not warranted.

No other sites were identified within the SMP area or within areas to be cleared at the pit-top and Loch Catherine. However, if objects or sites are identified during the project works will cease and relevant government departments will be consulted before any work progresses in the area.

A search of heritage databases for non-Aboriginal heritage items showed none were located within the vicinity of the Pit Top, Loch Catherine or the SMP area. Elements of the Pit Top that may have some potential historical significance are unaffected by the proposal.

## ES5 Justification and conclusions

Decision makers need to weigh the positives and negatives of proposed developments in a balanced way to make fair and proper decisions. The Director-General has requested through the DGRs, an overall weighing of the proposal on economic, social and environmental grounds and on its consistency with the objects of the EP&A Act.

Consideration of the economic, social and environmental impacts of the proposal is complex. Many of the economic and social impacts of the proposal are integrated. These socio-economic impacts include direct employment of the colliery's employees and indirect local and regional employment. Royalties paid to state government will have positive economic benefits state wide.

Potential negative social impacts may arise from mining operations. These include damage to dwellings and properties through subsidence, noise and dust impacts, traffic impacts, impacts to groundwater and water quality, and impacts to ecology and Aboriginal heritage. Assessments of these potential impacts have been conducted for the proposal. The likely impacts are minimal and considered non-significant. In all cases under the proposal potential adverse impacts can be easily managed or mitigated. Monitoring of

potential impacts under the proposal will further decrease the likelihood of adverse impacts to neighbours, the community and the environment.

In conclusion, the proposal will enable the orderly and logical use of existing natural, physical and human resources, would have net positive economic benefits and residual environmental impacts following management and mitigation are considered insignificant. The proposal is, therefore, consistent with the objects of the EP&A Act and is considered to be in society's interest for the proposal to proceed.

# 1 Introduction

## 1.1 Purpose of report

EMGA Mitchell McLennan Pty Limited (EMM) has been engaged by Boral Cement Limited to prepare this Environmental Assessment (EA) under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for continued operations at Berrima Colliery (the proposal). Berrima Colliery currently operates under existing use rights pursuant to the EP&A Act. Under changes to both the EP&A Act and the *Mining Act 1992*, Berrima Colliery is required to obtain a planning approval for continued operations.

## 1.2 Context to the proposal

A Preliminary Environmental Assessment (PEA) was submitted to the Director-General of the then NSW Department of Planning (DoP) now NSW Department of Planning and Infrastructure (DoPI) on 10 May 2010 with a description of the proposal (EMM 2010). The PEA contained information relating to potential environmental and social impacts as a consequence of the proposal and a ranking of significance to assist the Director-General with preparing the Director-General's requirements (DGRs) for the proposal.

A Planning Focus Meeting (PFM) was held at Berrima Colliery on 25 November 2009. A draft PEA was provided as background information. The PFM included discussion on the potential environmental impacts resulting from the proposal to be focused upon in the EA. These matters are reflected in the DGRs. The PFM was attended by relevant personnel from:

- Boral;
- Delta Mining;
- DoPI;
- the then NSW Department of Industry and Investment (DII) now the NSW Department of Trade and Investment, Regional Infrastructures and Services (DTIRIS);
- the then NSW Department of Environment, Climate Change and Water (DECCW) now the Office of Environment and Heritage (OEH);
- Sydney Catchment Authority (SCA); and
- Wingecarribee Shire Council (WSC).

Apologies were received from NSW Office of Water (NOW) and Roads and Traffic Authority (RTA).

Following the PFM, meetings were held, either in person or by teleconference, with the above agencies to discuss technical matters in detail.

## 1.3 Site description and proponent

Berrima Colliery is an underground coal mine located at Medway in the Southern Highlands of NSW within the Wingecarribee local government area (Wingecarribee LGA). The colliery is approximately 7km west of Berrima village and 5km west of the Hume Highway (see Figure 1.1). It is a bord and pillar operation that has been in continuous production since 1926.

The colliery's pit-top facilities are located at the end of Medway Road adjacent to the Wingecarribee River. The mine has one entry located over a bridge on the opposite side of the river. The current mining area is located approximately 3.5km north of the pit top facilities (see Figure 1.2).

The proponent and owner of Berrima Colliery is Boral Cement, formerly known as Blue Circle Southern Cement (BCSC), which is a wholly owned subsidiary of Boral Limited. Boral Limited is the holder of Berrima Colliery's current mining lease. Delta Mining is the appointed operator of the mine under contract to Boral Cement.

For the purposes of this EA, Boral Cement and Boral Limited are commonly referred to as Boral.

## 1.4 The proposal

The proposal is for the continued operations of Berrima Colliery, specifically the continued underground mining of coal using a bord and pillar method. The proposal involves the maintenance of past production rates and the operation of existing mining facilities and support structures. Transportation of coal to current and future markets or to the stockpiling area will continue per the current method of road freight using trucks.

A more detailed description of the proposal is provided in Chapter 5 of this EA.

## 1.5 Structure of report

The EA provides an overview of the proposal supported by the specialist technical reports which are provided in the Appendices. The EA is structured as follows:

- Chapter 1 – Introduction – provides an introduction to the proposal, including the purpose of this report, context to the proposal and a description of the site and proponent.
- Chapter 2 – Background – details the history of the colliery, the existing operations and stakeholder engagement.
- Chapter 3 – Planning and Statutory Framework – describes the relevant planning and environmental approvals for the proposal.
- Chapter 4 – Site and Surrounds – provides a description of the site locally and regionally.
- Chapter 5 – The Proposal – provides details of the proposal.
- Chapter 6 – Stakeholder engagement – provides relevant stakeholders and engagement activities associated with the proposal
- Chapter 7 – Issues Identification – outlines the preliminary environmental risk assessment and the environmental matters to be addressed in the EA.
- Chapter 8 – Socio-economic.
- Chapter 9 – Subsidence.
- Chapter 10 – Groundwater.
- Chapter 11 – Traffic.

- Chapter 12 – Noise.
- Chapter 13 – Air Quality.
- Chapter 14 – Surface Water.
- Chapter 15 – Ecology.
- Chapter 16 – Heritage.
- Chapter 17 – Environmental Management and Commitments – summaries the proposed environmental management measures to mitigate the potential impacts as a consequence of the proposal and provides the Statement of Commitments.
- Chapter 18 – Justification and Conclusion – provides justification for the proposal taking into account the social, economic and environmental impacts and benefits as well as the principals of ecologically sustainable development.

Chapters 8 to 16 constitute the environmental assessment component of this EA and include summaries of the relevant technical reports provided as appendices to the EA. Each of these chapters is generally structured in the same manner, including:

- a description of the existing environment relating to the particular technical assessment;
- an assessment of the potential impacts that the proposal is likely to have on the existing environment; and
- a description of the proposed management measures to mitigate against potential impacts.

## 1.6 Director-General's requirements

As required under section 75F of the EP&A Act this EA has been prepared in accordance with the DGRs. The DGRs for the proposal were issued on 8 October 2010 and are provided in Appendix A.

A summary of each of the requirements and the section of the EA that addresses the requirements is provided in Table 1.1.

**Table 1.1 Director-General's requirements**

| Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | EA reference      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>General requirements</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                   |
| The EA of the project must include:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |
| <ul style="list-style-type: none"> <li>an executive summary</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Executive Summary |
| <ul style="list-style-type: none"> <li>a detailed description of the project, including: <ul style="list-style-type: none"> <li>need for the project;</li> <li>alternatives considered, including justification for the proposed mine plan; and</li> <li>various stages of the project;</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                             | Chapters 5 & 18   |
| <ul style="list-style-type: none"> <li>a risk assessment of the potential environmental impacts of the project, identifying the key issues for further assessment;</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Chapter 7         |
| <ul style="list-style-type: none"> <li>a detailed assessment of the key issues specified below, and any other significant issues identified in the risk assessment, which includes: <ul style="list-style-type: none"> <li>a description of the existing environment, using sufficient baseline data;</li> <li>an assessment of the potential impacts of the project, including any cumulative impacts, taking into consideration any relevant guidelines, policies, plans and statutory provisions; and</li> </ul> </li> </ul>                                                                                                                                                                            | Chapters 8 – 16   |
| <ul style="list-style-type: none"> <li>a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the project, including detailed contingency plans for management of any significant risks to the environment;</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                               | Chapter 17        |
| <ul style="list-style-type: none"> <li>a conclusion justifying the project on economic, social and environmental grounds, taking into consideration whether the project is consistent with the objects of the EP&amp;A Act; and</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Chapter 18        |
| <ul style="list-style-type: none"> <li>a signed statement from the author of the EA, certifying that the information contained within the document is neither false nor misleading.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Front of EA       |
| <b>Key issues</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |
| <b>Subsidence</b> – including:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Chapter 9         |
| <ul style="list-style-type: none"> <li>accurate predictions of the potential subsidence effects of the proposed mining; and</li> <li>a detailed assessment of the potential impacts and environmental consequences of these subsidence effects on both the natural and built environment.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                       |                   |
| <b>Groundwater and surface water</b> – including:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Chapters 10 & 14  |
| <ul style="list-style-type: none"> <li>an assessment of the potential impacts of the project on the quantity and quality of the surface and groundwater resources in the project area, including an explanation of site water balance and groundwater drawdown;</li> <li>an assessment of the potential impacts of mine water discharge on the Wingecarribee River and its tributaries, paying particular attention to downstream uses of the water;</li> <li>a description of measures that would be implemented to prevent adverse impacts on the Wingecarribee River and its tributaries; and</li> <li>a detailed description of surface water management at the pit-tip and Loch Catherine.</li> </ul> | Appendix K        |
| <b>Heritage</b> – including the potential impacts of the project on Aboriginal and non-Aboriginal heritage, both within the surface infrastructure areas and the proposed mining areas.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Chapter 16        |
| <b>Biodiversity</b> – including an assessment of the potential impacts of the project on any terrestrial and aquatic threatened species of populations of their habitats, or endangered ecological communities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Chapter 15        |
| <b>Transport</b> – including a detailed assessment of the potential impacts of the project on the safety and performance of the road network, specifically along Medway Road and its intersections with Hume Highway and Old Hume Highway.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Chapter 11        |
| <b>Noise</b> – including on-site construction and operational noise and off-site road noise and vibration impacts from the haulage of coal along Medway Road.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Chapter 12        |
| <b>Air Quality</b> – including a consideration of the impacts of the impacts that surface infrastructure operations and coal haulage of coal along Medway Road.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Chapter 13        |
| <b>Greenhouse Gas</b> – including:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Section 13.3.7    |

**Table 1.1**      **Director-General's requirements (Cont'd)**

| Requirements                                                                                                                                                                                                                                                                                                                                                                                | EA reference             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <ul style="list-style-type: none"> <li>• a quantitative assessment of the potential scope 1, 2 and 3 greenhouse gas emissions of the project, and qualitative assessment of the potential impacts of these emissions on the environment; and</li> <li>• a detailed description of the measures that would be implemented on site to ensure that the project is energy efficient.</li> </ul> |                          |
| <b>Waste</b> – including:                                                                                                                                                                                                                                                                                                                                                                   | Section 5.11             |
| <ul style="list-style-type: none"> <li>• estimates of the quantity and nature of the potential waste streams of the project, including details on any waste water management systems; and</li> <li>• a detailed description of the measures that would be implemented to minimise, reuse, recycle and dispose of any waste produced on site.</li> </ul>                                     |                          |
| <b>Hazards</b> – paying particular attention to public safety.                                                                                                                                                                                                                                                                                                                              | Section 5.9              |
| <b>Rehabilitation</b> – including a detailed description of the proposed rehabilitation strategy for the mine, taking into consideration any relevant strategic land use planning or resource management plans or policies, including:                                                                                                                                                      | Section 5.10             |
| <ul style="list-style-type: none"> <li>• identifying post-mining land use options;</li> <li>• clearly defining project rehabilitation objectives;</li> <li>• outlining mine sealing works and general rehabilitation methods and procedures; and</li> <li>• a conceptual final landform design.</li> </ul>                                                                                  |                          |
| <b>Social &amp; Economic</b> – including the costs of rehabilitation, remediation and repair, and socio-economic benefits for the NSW community.                                                                                                                                                                                                                                            | Section 5.10 & Chapter 8 |
| <b>Hazards</b> – including bushfires.                                                                                                                                                                                                                                                                                                                                                       | Section 5.9              |



FIGURE 1.1  
Regional setting

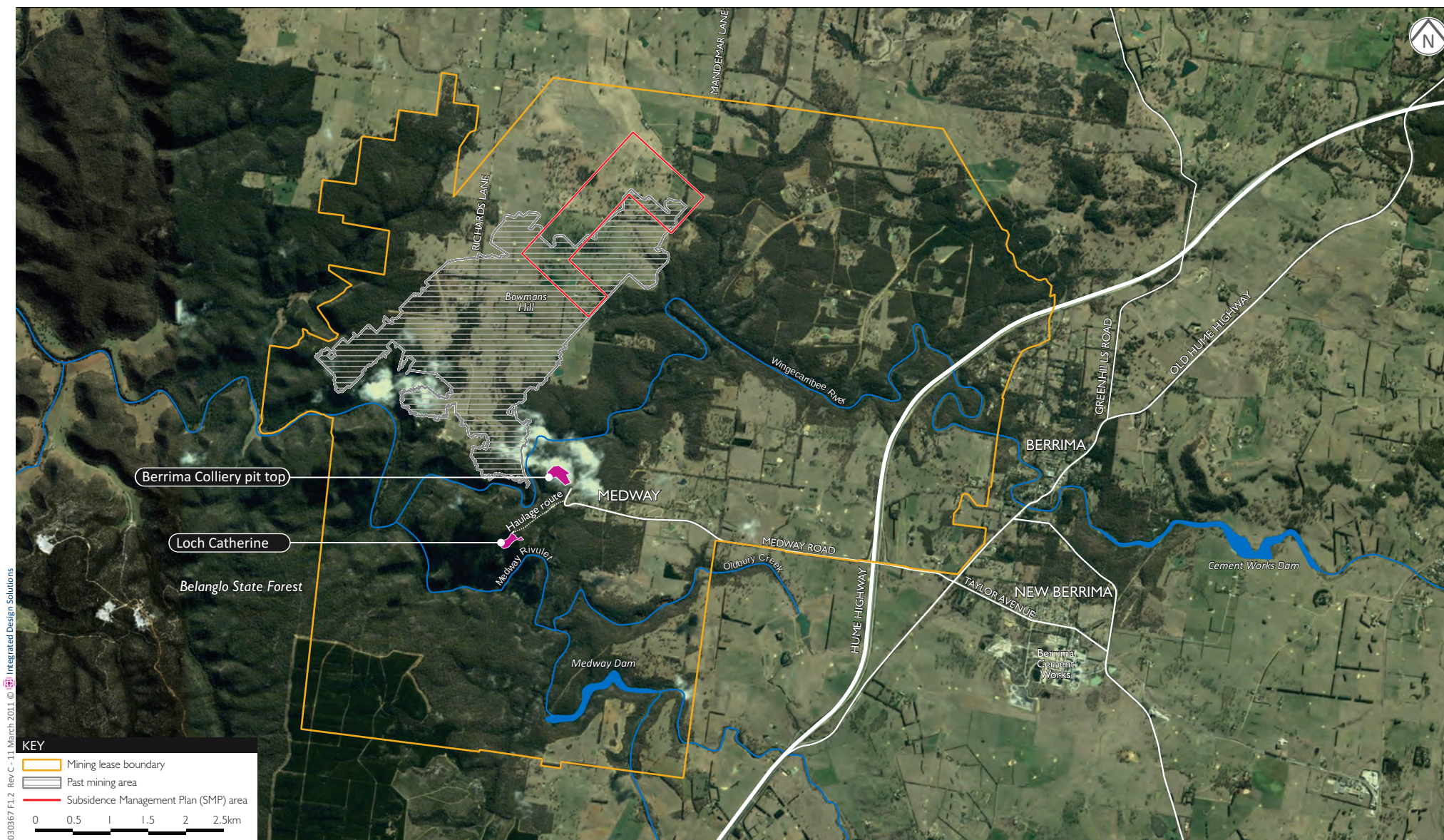


FIGURE 1.2  
Local setting

## 2 Background

### 2.1 History of Berrima Colliery

Berrima Colliery has a long history dating back to 1872. The following provides an overview of the history of mining within the general boundaries of the current mining lease:

- mining at Berrima Colliery first commenced in 1872 when the Rockroof Colliery commenced. This mine closed in 1875.
- Great Southern Colliery was opened in 1890 and operated until 1924 when the Medway Colliery and Railway Company was formed. The mine then became known as the Medway Colliery.
- in approximately 1924 a rail spur from Medway Colliery to Moss Vale was constructed.
- in 1926 the village of Medway developed to principally service the mine.
- in 1926 the Southern Portland Cement and Coal Company was formed to construct a cement works south of Berrima. The Medway Colliery and Railway Company was taken over and the mine became the source of kiln fuel for the cement works.
- in 1974 ownership of Berrima Colliery was transferred to BCSC, which was formed by an amalgamation of several Australian cement companies (including Southern Portland Cement).
- in 1983 BCSC lodged a development application with WSC to expand production at the colliery to 1.5 million tonnes per annum (Mtpa). The application included the upgrade of existing facilities, the construction of a coal processing plant near the existing pit top facilities, the transportation of coal by rail and the expansion of the workforce. The mining method was to be both longwall and bord and pillar. Following a Commission of Inquiry that was held over 1986 and 1987, development consent was granted by the then Minister for Planning for the expanded operation in 1987. The development consent lapsed in 1992.
- in 1988 BCSC was purchased by Boral Limited.
- between 1994 and the end of August 2009, operations at Berrima Colliery was operated by Berrima Coal Pty Limited, a subsidiary of Centennial Coal Company Limited. Berrima Coal operated the mine under a sublease arrangement with Boral.
- At the beginning of September 2009, Delta Mining was appointed operator of Berrima Colliery by Boral Limited.

### 2.2 Existing operations and facilities

Operations at Berrima Colliery involve the underground mining of the basal section of the Wongawilli seam using the bord and pillar method. The pillars of coal are extracted using the Wongawilli method utilising breaker line supports and a continuous miner.

The colliery has a single entry point (or portal) located at the pit top facilities in Medway. Currently coal is transported from underground by conveyor to an onsite crusher and loaded on to trucks to be transported to customers (including predominantly the Berrima Cement Works) or stockpiled at Loch Catherine.

No beneficiation of the coal is undertaken other than crushing to meet product requirements.

Coal mined from the colliery is the only current source of fuel for the Berrima Cement Works cement kiln which currently consumes approximately 220,000 tonnes per annum (tpa) depending upon market conditions. The kiln is the main production unit of the cement works and requires fuel to create very high temperatures to transform raw materials into cement.

The Berrima Colliery currently employs 38 people and operates two production shifts from Monday to Friday; a day shift commencing at 6.00am and finishing at 4.00pm and an afternoon shift commencing at 2.45pm and finishing at 12.45am. When required, a third production shift is undertaken. The colliery also undertakes maintenance shifts on weekdays from 11.30pm to 8.15am and occasionally on weekends.

Past production levels of the Berrima Colliery have varied between approximately 125,000 tpa and 460,000 tpa. While the colliery has traditionally supplied Berrima Cement Works, it has historically supplied other customers as well, including but not limited to the Berrima Power Station, Tallawarra Power Station and Maldon Cement Plant. Recently, coal has been trucked to Port Kembla for supply to overseas customers.

Berrima Colliery is an underground coal mine with an established pit top and surface infrastructure. The current mining equipment in operation includes:

- two continuous miners;
- two shuttle cars;
- feeder breaker; and
- three breaker line supports.

Surface equipment includes mine support facilities such as an administration building and bathhouse, ventilation fan, conveyors, coal handling systems and mobile plant. There is also a truck fleet, water cart and front-end loader for the transportation of coal.

The Berrima Colliery's existing equipment has the capacity to produce up to approximately 500,000 tpa.

## 3 Planning and Statutory Framework

### 3.1 Existing approvals

Berrima Colliery operates under existing use rights under the EP&A Act and the following approvals and licences:

- Consolidated Coal Lease (CCL) 748 granted under the provisions of the *Mining Act 1992*;
- Exploration Licence (EL) 748 also granted under the provisions of the *Mining Act 1992*;
- a Mining Operations Plan (MOP) detailing mining operations for the period 1 January 2007 to 1 January 2014 required under conditions of CCL 748;
- a Subsidence Management Plan (SMP) detailing subsidence management for mining operations related to mining within 59 Panel, South West 1 Panel (SW1) and 406 Panel required under conditions of CCL 748; and
- Environment Protection Licence (EPL) 608 granted under the provisions of the *Protection of the Environment Operations Act 1997* (POEO Act).

The extent of mining proposed under the SMP can be seen in Figure 3.1.

### 3.2 Current applications

Boral has submitted an application for a licence from the NOW to extract groundwater at Berrima Colliery under Part 5 of the *Water Act 1912*. This licence will allow Berrima Colliery to extract groundwater which flows into the underground workings. The application was submitted in early 2009 and draft licence conditions have been received from NOW.

An application has also been submitted to DTIRIS for the renewal of CCL 748. The application was submitted in late 2008 and an instrument of renewal with draft lease conditions has been received by Boral. The instrument of renewal will not be executed until approval is granted for continued operations.

In addition, Boral is currently liaising with WSC regarding the use of b-doubles on Medway Road. While approval was granted by WSC in late 2010 for the use of b-doubles on Medway Road, the approval has not been forwarded to the RTA for gazettal. At the time of writing, WSC were in the process of arranging a meeting between Boral, the residents of Medway and WSC to discuss traffic measures to be implemented on Medway Road to minimise impacts of b-doubles on local residents and road users of Medway Road.

At the time of writing, a separate application was being prepared for increased stockpiling of coal from Berrima Colliery at the Berrima Cement Works. The application will be made under section 75W of the EP&A Act to modify the development consent for the cement works. The purpose of increased stockpiling is to reduce impacts at Medway Village during when coal is transported by campaign to Port Kembla for export.

### 3.3 Environmental Planning and Assessment Act 1979

#### 3.3.1 Part 3A

Part 3A of the EP&A Act relates to major development deemed to be significant to the state of NSW. Section 75(B) states that Part 3A applies to:

*“...the carrying out of development that is declared under this section to be a project to which this part applies:*

- (a) by a State environmental planning policy, or*
- (b) by order of the Minister published in the Gazette.”*

*State Environmental Planning Policy (Major Development) 2005* (Major Development SEPP) defines certain developments that fall under Part 3A; that is, development deemed to be significant to NSW. Clause 6 of the Major Development SEPP states:

*“(1) Development that, in the opinion of the Minister, is development of a kind:*

- (a) that is described in Schedule 1 or 2, or*

*...*

*Is declared to be a project to which Part 3A of the Act applies.”*

Schedule 1 of the Major Development SEPP specifies certain classes of developments considered to be major development. In relation to coal mining, it states:

*“(1) Development for the purpose of mining that:*

- (a) is coal or mineral sands mining, or*

*...”*

Since the proposal is for the continued mining of coal at Berrima Colliery, it is classified as a major development and therefore should be considered under Part 3A of the EP&A Act for which the Minister for Planning (the Minister) is the consent authority.

Under Section 75R(3) of the EP&A Act environmental planning instruments (EPIs) other than State Environmental Planning Policies (SEPPs) do not apply Part 3A projects. Notwithstanding the above Section 75J(3) of the EP&A Act states that the provisions of any EPIs that would ordinarily apply to the project if it were not to be assessed under Part 3A may, but are not required to, be taken into account by the Minister in deciding whether or not to approve the carrying out of the proposal. Clause 8N, and similarly 8O, of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulations) state that, for the purpose of Section 75J(3) of the EP&A Act, that a project under Part 3A cannot be approved if it is prohibited by an EPI that would not apply to the project due to Section 75R(3), unless it is permitted by the application of another EPI.

The determination of the proposal will involve consideration of the provisions and objectives of the following environmental planning instruments:

- *Wingecarribee Local Environmental Plan 2010* (the WLEP); and
- *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP).

Under the WLEP, the Berrima Colliery holdings including the pit top facilities, Loch Catherine stockpile area and the old, existing and proposed mining areas are located on or under land. 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), Environmental Conservation (E2), and Environmental Management (E3) in the WLEP. Under the zone RU2 mining is a permissible land use, however, it is prohibited under zones E2 and E3.

The pit top facilities and Loch Catherine stockpile area are located on land zoned E3. The old mining areas are located under land zoned RU2, E2 and E3, while the existing and proposed mining areas are located under land zoned RU2 and E3. Accordingly, while some of the old mining areas are contained under land zoned E2 which prohibits mining, existing and proposed mining areas are contained under land zoned RU2 which permits mining.

Notwithstanding the above, the Mining SEPP, among other things, establishes permissibility of mining. The Mining SEPP overrides any land use controls in LEPs, including the WLEP. Clause 7 of the Mining SEPP states, inter alia, that development for the purposes of underground mining on any land may be carried out with development consent.

In addition, the Berrima Colliery has been operating in accordance with existing use rights conferred under the EP&A Act.

### 3.3.2 Other approvals under the Environmental Planning and Assessment Act 1979

Other approvals under the EP&A Act may be required to carry out the proposal as described in Chapter 5 of this EA. Additional approvals will be further investigated and, if required, will be sought.

## 3.4 Other NSW legislation and policies

The proposal for continued operations at Berrima Colliery is likely to require a modification to the existing EPL under the POEO Act.

Berrima Colliery is located within the Sydney drinking water catchment and is therefore subject to the provisions of State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011. Under clause 9 the proposal is required to incorporate the SCA's current recommended practices and standards. These have been incorporated in the relevant technical assessments and consideration of whether the proposal will have a neutral or beneficial effect on water quality is considered in section 14.3.3 of this EA.

## 3.5 Commonwealth legislation

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to protect matters deemed to be of national environmental significance (NES). The EPBC Act lists seven matters of NES, including:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;

- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas; and
- nuclear actions (including uranium mining).

If an action (or proposal) will, or is likely to, have a significant impact on any matters of NES, it is deemed to be a Controlled Action and requires approval from the Commonwealth Minister for the Environment. The continued operation of the Berrima Colliery is not likely to have any significant impacts on any matters of NES and therefore the proposal does not require approval under the EPBC Act (see Appendix L).

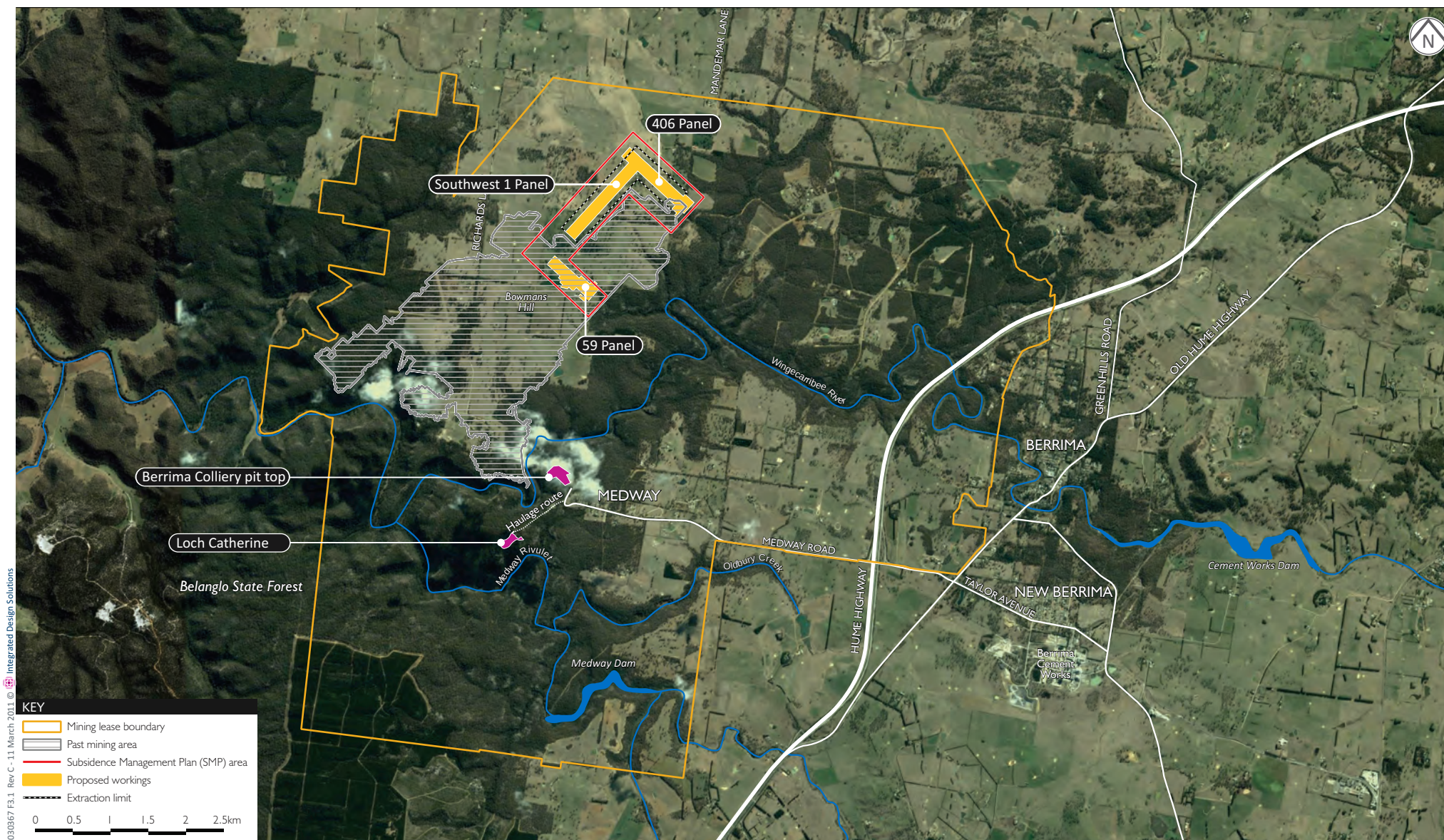


FIGURE 3.1  
Proposed workings

## 4 Site and Surrounds

Berrima Colliery's pit-top facilities are located at the end of Medway Road adjacent to the Wingecarribee River. The mine has one entry located over a bridge on the opposite side of the river. Oblique aerial photographs of the pit-top facilities can be seen in Figure 4.1.

Coal is stockpiled at the Loch Catherine stockpile area which is located approximately 1km south of the pit-top facilities. This stockpile area has the capacity to store approximately 100,000 t of coal. A photograph of the Loch Catherine stockpile area can be seen in Figure 4.1.

Berrima Colliery operates under CCL 748. It is a large lease holding with an area of 6,157ha. The Hume Highway intersects the lease in the east, while the Wingecarribee River, the dominant geomorphologic feature, intersects the middle of the lease boundary running generally east to west. The Berrima Colliery workings are located in the north western portion of the lease. The current mining area (SW1 panel) is located approximately 4km north of the pit top facilities. The extent of past mining within the colliery can be seen in Figure 1.2.

The majority of the lease area consists of a privately owned rural properties ranging in size. The majority of properties range from 40 to 100 ha. The southern part of the lease area contains the north eastern portion of the Belanglo State Forest. The exception to this is the village of Medway which is located immediately south east of the pit-top facilities. This village proper, which was originally developed to provide housing for mine workers in 1926, contains approximately 30 houses.

The predominant land use in the current mining area is rural (grazing). The land is gently undulating and predominantly cleared. Patches of remnant native vegetation occur in the area, particularly the surrounding the Wingecarribee River.

No non-Aboriginal (or European) heritage items of significance have been, or are expected to be, identified on site or in surrounding areas.



Viewpoint 1 - Looking north east towards Berrima Colliery



Viewpoint 2 - Looking south west towards Berrima Colliery



Viewpoint 3 - Looking south east along conveyor



Viewpoint 4 - Looking south towards workshop



Viewpoint 5 - Looking north east towards bin

## 5 The Proposal

### 5.1 Overview

Boral requires planning approval to continue existing operations of the colliery. This includes:

- continued underground mining of coal using the bord and pillar method within the approved SMP area;
- produce up to 460,000 tpa of run of mine (ROM) coal which is consistent with historic production rates;
- continue operation of existing mining facilities and support structures with the possibility to upgrade these within the future; and
- continued transportation of product by road using trucks to current and future markets or to stockpiling areas.

Each of these matters is discussed below.

### 5.2 Continuation of mining

It is proposed to continue underground mining in accordance with the approved SMP, including extraction within 59, SW1 and 406 Panels.

The approved SMP area can be seen in Figure 3.1.

Mining within the SW1 and 406 Panels will include secondary extraction using pillar-lifting techniques to left and right of regularly spaced 'run-outs' while Panel 59 will be a first workings panel only, providing access and ventilation to the newer areas of the mine.

The panels are located at a depth of approximately 130 to 180 m below the surface with the cover depth generally increases from the east to west over the SMP area.

The panels will have an average face extraction height of 2.6 m in the base section of the Wongawilli Seam.

SW1 Panel, which was recently extracted, was formed on a south-west / north-east orientation, with three central access headings driven at 25 m centres to create 19.35 m wide x 24.5 m long pillars. A 64 m wide barrier was left between the completed 404 Panel to the southeast.

For the SW1 panel, 148 m long run outs will be driven to the west at 30 m centres. The run out pillars so-formed will then be lifted to the left and right on retreat back to within 22.5 m distance of the central access headings. The effective panel width after second workings will be 132 m.

Run outs of 93.5 m length will then be formed along the east side of SW 1 Panel at 30 m spacing and also lifted left and right to within 22.5 m of the central headings. The effective panel width after second workings will be 71 m.

The 406 Panel will be formed on a north-west / south-east orientation with five access headings driven along the southern side of the panel at 25 m centres to create 19.5 m wide x 24.5 m long pillars. A 70 m wide barrier will be left between the completed 404 Panel to the south-west.

For the 406 Panel, 72 m long run outs will then be driven to the north at 30 m centres. The run out pillars so-formed will then be lifted to the left and right on retreat back to within 22.5 m distance of the access headings. The effective panel width after second workings will be 49.5 m.

First workings pillars in each of the production panels will be 19.5 m wide by 24.5 m long (solid) with 5.5 m wide nominal roadway widths.

### 5.3 Proposed production rate

While Berrima Colliery currently produces approximately 220,000 tpa of ROM coal, records indicate that it has produced up to approximately 460,000 tpa in the past and has the capacity to produce up to 500,000 tpa utilising existing equipment and infrastructure.

As part of the proposal for continued operations, it is proposed to produce up to a maximum of 460,000 tpa of ROM coal. Current production rates are below economic scale and an increase is required to improve the commercial viability of the colliery.

Coal would continue to be supplied to Berrima Cement Works. Other potential Boral internal operations may also be supplied coal from the colliery, but only if coal quality was sufficient. Other Boral internal operations that could be supplied coal from the colliery include the Maldon Cement Works, Waurin Ponds Cement Works, and the limestone kilns at Marulan and Galong Limestone Mines.

In accordance with past operations, it is also proposed to supply other external customers, including export coal through Port Kembla.

### 5.4 Stockpiling

Under the proposal, the quantity of coal per annum to be stockpiled and recovered from Loch Catherine will be increased from 100,000 t to a maximum of 115,000 t. To allow for this increase, the stockpile area will be expanded to the north and west by approximately 20m. This will include the clearing of mostly regrowth that had grown into the edges of the stockpile area. In addition, a further 20 m perimeter around the expanded stockpile area will be cleared to provide an asset protection zone (APZ) to protect coal stockpiles during bushfires. Collectively, approximately 1 ha of vegetation will be cleared to expand the stockpile area and provide the APZ. The proposed extension to the Loch Catherine stockpile area and the APZ can be seen in Figure 5.1.

The surface area of the coal stockpile at Loch Catherine will be around 15,100 m<sup>2</sup>, with a stockpile height of approximately 6 m. These figures may vary depending upon the layout of the stockpile at various times.

### 5.5 Modernisation of facilities and support structures

Some of the existing facilities and support structures at Berrima Colliery have been in operation for many years and may need to be modernised and/or replaced over time. Modernisation to these facilities and structures will be necessary to maintain existing operations.

Any replacement of existing facilities and support structures will be subject to separate applications and approvals. The exception to this is the main amenities' septic system which will be replaced and upgraded as part of the proposal.

## 5.6 Transportation

Coal mined from Berrima Colliery is predominantly transported to Berrima Cement Works by trucks travelling east along Medway Road and Taylor Avenue. Recently, the colliery has been exporting small volumes of coal through Port Kembla. Historically, the supply of other customers (including other Boral internal customers and external customers) involved the transportation of product by truck travelling north or south along Hume Highway.

As part of the proposal for continued operations, Berrima Colliery would continue to transport coal by road. This would include transportation along Medway Road and Taylor Avenue to the Berrima Cement Works, and transportation both north and south along the Hume Highway to other Boral internal customers and external customers.

Customers supplied to the north would mainly include the Maldon Cement Works and exports through Port Kembla. Customers supplied to the south would mainly include the Waurin Ponds Cement Works, and the limestone kilns at Marulan and Galong Limestone Mines.

The amount of coal supplied to the Berrima Cement Works, other Boral internal operations and external customers will vary dependent upon demand, but will not exceed 460,000 tpa. Berrima Cement Works is Berrima Colliery's priority customer. Forecasts indicate that demand from the Berrima Cement Works may fluctuate between 120,000 and 250,000 tpa. Should the demand be 120,000 tpa, then a maximum of 340,000 tpa would be supplied to other Boral internal operations and external customers. Should demand at the Berrima Cement Plant be 250,000 tpa, then a maximum of 210,000 tpa would be supplied to other Boral internal operations and external customers.

Notwithstanding the above, the amount of coal despatched to Port Kembla for export would not exceed 340,000 tpa but in reality is likely to be much less than this figure.

As previously discussed, a separate application is being prepared to modify the development consent for the Berrima Cement Plant to increase stockpiling of coal. This stockpile would be used for the transportation of the majority of coal required for export shipments through Port Kembla.

## 5.7 Employment and shifts

Should production increase from current levels to 460,000 tpa, up to 63 employees would be employed at the Berrima Colliery, which is an increase of 25 employees.

The two current production shifts would be extended to seven days a week. A third production shift would still be undertaken when required. Maintenance shifts would continue on weekdays from 11.30pm to 8.15am and occasionally on weekends.

The number of production days would increase to 340 days a year.

## 5.8 Asset Protection Zones

As previously discussed, a 20 m APZ is proposed to be provided around the expanded stockpile area at Loch Catherine. In addition, a 20 m APZ is proposed around the pit-top facilities. All understorey and the majority of trees will be removed within the zone. Some trees will be retained where they do not pose a

risk to mine assets. All trees on the southern side of the conveyor belt in the APZ will be removed to protect underground communications lines.

This area of the APZ totals 3.74 ha and comprises approximately 1.35 ha of regrowth native vegetation and 2.39 ha of disturbed land.

The proposed extension APZ for the pit-top facilities can be seen in Figure 5.2.

## 5.9 Environmental management and hazards

Berrima Colliery prepared an Environmental Management Plan (EMP) in June 2010 in accordance with Conditions 13 – 15 of the SMP approval given in October 2009. The EMP is provided as Appendix B of this EA.

The EMP provides details of the following:

- a program to monitor subsidence movements and effects;
- environmental management systems for the SMP area;
- infrastructure and property management strategies for future mining areas;
- measures to maintain public safety in the mining area;
- a stakeholder engagement plan; and
- a series of trigger action response plans to manage certain environmental goals.

A hazard risk assessment was conducted for the colliery and identified no environmental hazards other than potential downstream contamination of water bodies and bushfire.

Contamination of water bodies such as Wingecarribee River or Medway rivulet could occur through fuel spills or migration of pollution through stormwater events. Aboveground fuel tanks at Berrima Colliery are appropriately stored and maintained. Any potential hazardous materials are stored undercover and in accordance with relevant guidelines. There are surface water management measures currently in place at Berrima Colliery which manage stormwater events. Upgrades to the surface water management system under the proposal are shown in Figures 14.2, 14.3 and Appendix K.

Berrima Colliery is located on bush fire prone land with some high bush fire hazard areas near the pit-top and Loch Catherine as shown on WSC's Bush Fire Hazard Map. A Bush Fire Management Plan is to be prepared and implemented under the proposal. This plan will be prepared in accordance with the Rural Fires Service's guideline *Planning for Bush Fire Protection 2006*. The proposed APZs at the pit-top and Loch Catherine will form part of the management plan as measures to protect assets from bush fire risks.

A public safety management plan has been prepared as part of the EMP. The main issue regarding public safety is the identification and protection of dwellings and other structures such as large dams from subsidence. The introduction of Subsidence Protection Zones (SPZs) are contained within the SMP and will form part of the proposal. The proposed SPZs are discussed further in Chapter 9 of this EA.

Public safety issues have been incorporated into the mine design from the outset and additional public safety notices and actions under the proposal are not considered necessary. It is not proposed to erect signage on any public or private property around the mining area. Berrima will however keep the

landowners informed of the progress of mining and give notice prior to access being required for monitoring activities. It will not necessary to impose any property access restrictions during or after mining. However, in the event that repair work is necessary for private property, the appropriate safety systems covering earthmoving activities will be employed. Surface cracking is unlikely under the proposal and is not considered to represent a safety hazard even if it does occur. In the unlikely event that surface cracking is identified, the cracks will be immediately filled and rehabilitated. Repairs of cracks in access roads may require grading and filling with gravel but, again, are unlikely to be a safety concern.

A local cycle club holds race meetings on Medway Road several times a year. Boral will ensure ongoing consultation with the cycle club is undertaken to ensure that staff and truck drivers are made aware of race dates and safety precautions can be undertaken.

### 5.10 Rehabilitation strategy

The current rehabilitation strategy and final rehabilitation plan for Berrima Colliery is provided in the current MOP. It details the proposed rehabilitation works to be undertaken during the course of the current MOP period (2007 – 2014), and includes the following:

- consultation with relevant stakeholders;
- rehabilitation status at the beginning and end of the MOP period;
- proposed rehabilitation works during the MOP period; and
- details of final rehabilitation beyond the MOP period including areas, features, rehabilitation criteria, budget and final rehabilitation plans.

All surface infrastructure areas at the Pit Top and Loch Catherine are stable and do not require any rehabilitation works at present. All necessary rehabilitation works have already been carried out to ensure that the mine infrastructure and surface disturbance areas are stable and non-polluting. No areas remain un-rehabilitated other than at the Pit Top and Loch Catherine. In the event that operations cease final rehabilitation plans will be implemented and surface infrastructure areas will be rehabilitated.

The principal objective of final rehabilitation is to form a stable landform which will pose no long-term environmental hazard. It is therefore proposed to rehabilitate the site into a native forest ecosystem, similar to that immediately surrounding the site.

Final rehabilitation of Berrima Colliery will involve the closing of the pit top and Loch Catherine stockpile areas once all operations on site have ceased. Closure will involve the removal of all equipment and infrastructure including the electrical circuit and conveyor system.

The existing bridge over the Wingecarribee River will be maintained for access. The mine entry or drift and the ventilation shaft will be sealed in accordance with DTIRIS guidelines (*MDG 2001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams*). General site cleanup will be undertaken and will involve the remediation of any site contamination. The discharge adit from the mine will be kept open for continued discharge of groundwater.

Final revegetation will conducted following the reshaping, topsoiling and ripping of disturbed areas. Native species endemic to the local area will be used wherever possible. The only features that will remain on site are the sediment ponds associated with water management. These will be necessary until a stable landform is created following removal of all other infrastructure. Once revegetation works for

the site are advanced, the remaining sediment ponds will provide a valuable water resource to surrounding fauna.

A final rehabilitation plan for Berrima Colliery will be further developed in consultation with relevant stakeholders at the time of final close down. Conceptual final landform designs for Loch Catherine and the Pit Top are shown in Figures 5.3 and 5.4 respectively.

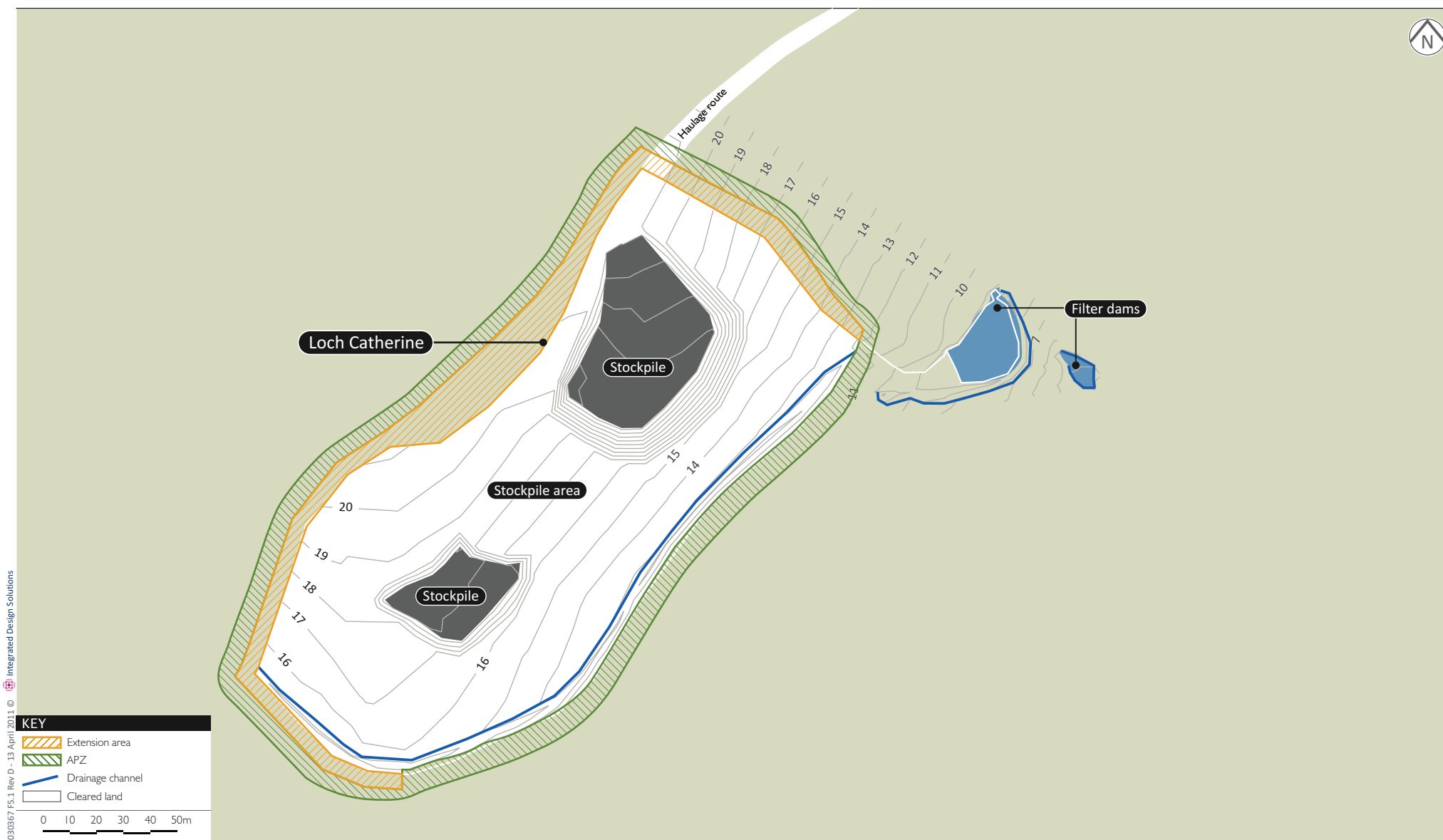
A requirement of CCL 728 is that a cost budget is to be prepared for the final close down rehabilitation of the Pit Top and Loch Catherine as detailed in the MOP. Boral has lodged a rehabilitation bond with DTIRIS and the bond is reviewed and adjusted annually under the Berrima Colliery's Annual Environmental Management Report (AEMR). The estimated cost of final rehabilitation of the colliery is approximately \$671,000 plus GST.

In addition to the above, there are four unsealed mine adits located in close proximity to the Loch Catherine stockpile area. These adits are located in the Medway Rivulet river gorge and were formed during mining in the Loch Catherine Colliery which is separate to the Berrima Colliery. Planning for closure of these adits is currently being discussed with DTIRIS. Given the relative isolated location of these adits in the river gorge and the results of bat surveys which indicate that the adits provide roosting habitat for the Eastern Bent-wing bat and Eastern Horseshoe bat, these adits are likely to be closed through fencing as opposed to bulk seals in accordance with DTIRIS guidelines.

### 5.11 Waste management

There are no major waste streams associated with existing operations or the proposal. The underground mining of coal means that no overburden is removed. Coal produced at Berrima Colliery is ROM coal with no washing of the coal undertaken. Therefore, there are no coal wastes associated with the operations or proposal i.e. no tailings, fine reject or waste water from coal washing.

The only wastes generated are general wastes at the Pit Top. There are two septic systems to collect onsite sewage, one located at the amenities and one at a portable office building. These systems are pumped out by licensed contractors when required. The septic system located at the amenities is old and will be replaced under the proposal. Other wastes include general industrial wastes such as scrap metal, oils and greases. Waste volumes generated are low. There is a management system currently in place for these industrial wastes where they are separated on site and collected by contractors.



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FIGURE 5.1  
Loch Catherine expansion and APZ

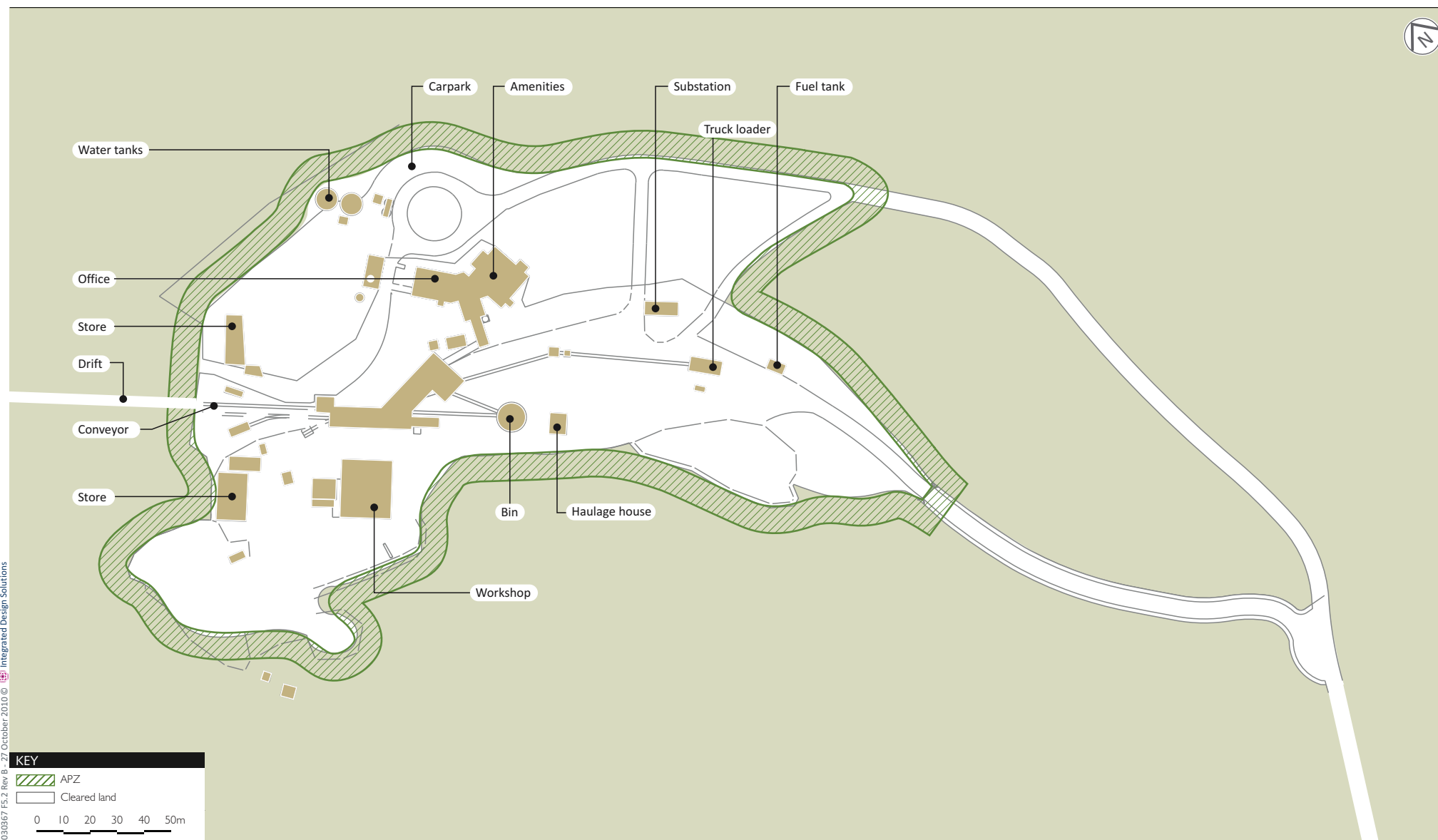
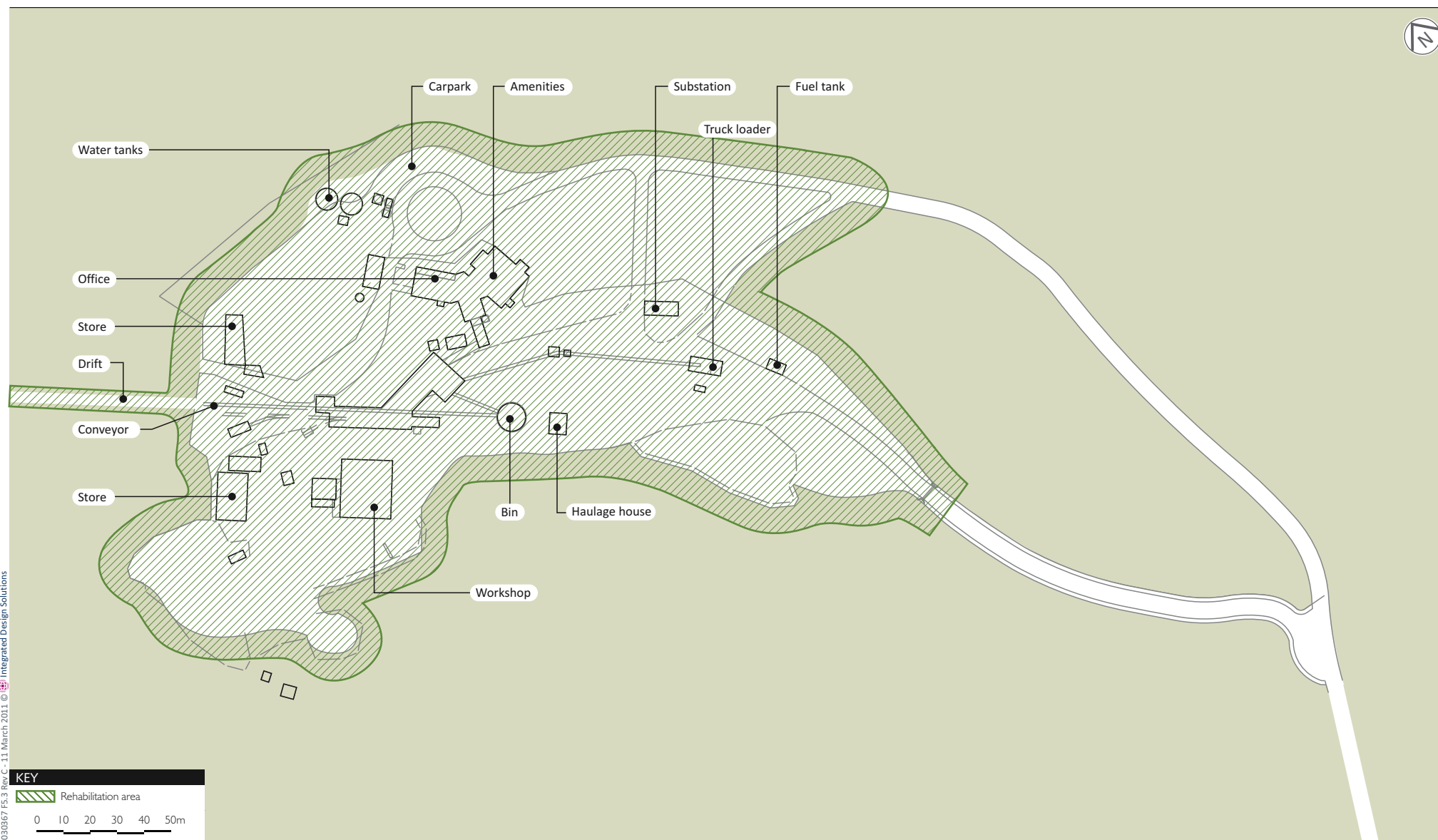


FIGURE 5.2  
Berrima Colliery Pit Top APZ



FIGURE 5.3  
Loch Catherine final rehabilitation plan



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FIGURE 5.4  
Berrima Colliery Pit Top final rehabilitation plan

## 6 Stakeholder engagement

### 6.1 Overview

A stakeholder engagement plan was developed and implemented for the proposal. Consultation with a range of stakeholders was incorporated into the plan to both inform the stakeholders of the proposal and to seek feedback from stakeholders on issues of importance for consideration in the EA process.

Specific aims of the stakeholder engagement plan were to:

- identify stakeholders who have an interest in the project and ongoing operations at Berrima Colliery;
- provide stakeholders with access to timely information on the proposal; and
- identify stakeholder issues for consideration in the EA.

### 6.2 Stakeholder identification and engagement activities

Stakeholders identified for engagement during the preparation of the EA include:

- Local and State government agencies;
- neighbours and the local community;
- Aboriginal community;
- employees (Berrima Colliery and Berrima Cement Works); and
- the media.

All identified stakeholders were engaged via a range of media as described in Table 6.1. Further details on engagement activities with the above stakeholders follows.

**Table 6.1 Stakeholder engagement activities**

| Stakeholder                         | Engagement activities                                                                                         |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Local and State Government agencies | PFM<br>PEA<br>Meetings with agencies on specific issues                                                       |
| Neighbours and local community      | Phone calls<br>Meetings<br>Community information sessions<br>Berrima Cement Plant Community Liaison Committee |
| Aboriginal community                | Phone calls<br>Participation and review of Aboriginal heritage survey assessment                              |
| Employees                           | Phone calls<br>Briefings<br>Tool box talks                                                                    |
| The media                           | Press releases and media responses as required                                                                |

### 6.3 Government engagement

All relevant levels of government have been engaged in order to identify key issues for consideration in this EA. Engagement has been via both formal and informal briefings and meetings, and information obtained has been used to assist in technical assessments.

A PFM was held at Berrima Colliery on 25 November 2009. The PFM is an important part of the EA process under Part 3A of the EP&A Act, facilitating information exchange between government agencies and the proponent relating to details of the project and matters to be addressed in the study for each government agency.

Prior to the PFM, project briefings were undertaken with key government agencies to provide an overview of the project, background and timing and provide an opportunity to discuss assessment expectations and identify key agency matters of interest early in the EA process.

A draft PEA was prepared and distributed to all participants prior to the PFM. The PEA provided details on:

- the history of mining in the area and the rationale for the proposal for continued operations;
- the proposal;
- statutory requirements for project determination;
- current and planned consultation with stakeholders;
- an initial assessment of environmental impacts with a rating of their significance; and
- conclusions identifying areas of greatest focus for the EA.

The PFM included a series of presentations on the need for the project, the proposal description and potential impacts, an open discussion about key matters for consideration in the EA and followed by a site inspection of the pit-top area and Loch Catherine stockpiles.

The following government agencies attended the PFM:

- DoPI;
- OEH;
- DTIRIS;
- SCA; and
- WSC.

At the PFM, DoPI requested that all agencies prepare a list of key issues and requirements to be addressed in the EA.

Government agencies were also separately consulted, either face-to-face or by telephone regarding specific technical issues.

Following discussions with government agencies and the preliminary results of some environmental investigations, the proposed mining area was reduced so that it was consistent with the approved SMP. This change was communicated to DoPI in May 2010 and a revised PEA issued to government agencies on 10 May 2010. The change was also communicated to key government agencies by telephone briefing.

The list of key issues and requirements discussed at the PFM and the details provided in the revised PEA formed the basis of the DGRs which were issued on 8 October 2010.

A copy of the DGRs is provided in Appendix A and a summary of the DGRs is provided in Table 1.1.

## 6.4 Community engagement

An engagement programme with the local community was developed to promote open and transparent communication and consultation processes throughout the preparation of this EA.

As previously stated, mechanisms for engaging the community included phone calls and meetings, distribution of notices and holding of community information sessions. The phone calls and meetings were generally held with residents within the mining lease area (including SMP area) and Medway village.

The community information sessions were held on Friday afternoon 4 May and Saturday morning 5 May 2010 to provide information on the proposal for continued operations at the colliery and the opportunity for residents to discuss aspects of the proposal directly with representatives from Boral Cement. Notice of the sessions was provided by phone calls and distribution of notices within the local area. Additional community information sessions were held on the 18 and 19 February 2011.

The key issues raised by the local community differed depending as to whether they were located.

Community members within the mining lease area, but not the SMP area, were generally interested in the mine in general and whether any mining would occur within close proximity or under their properties.

Community members within the SMP area (four properties) were concerned around subsidence and groundwater impacts.

Community members within Medway generally stated that they supported the colliery and recognised that it had been operating within the area for a long time and along with the cement works, formed part of the local community. Notwithstanding this, concerns were raised in relation to continued access to mine water supplied by Berrima Colliery to the majority of properties at Medway and truck movements along Medway Road.

All residents that raised the matter of access to mine water stated that they wanted access maintained into the future. Boral Cement will continue to supply water to the Medway village for non-potable purposes.

The issues raised in relation to truck movements generally related to the behaviour of truck drivers. The residents stated that while most truck drivers behaved properly and either kept within the speed limit or maintained an appropriate distance between the truck and cars that they were following, some drivers sped or stayed too close to cars in front of them on Medway Road. These concerns were exacerbated during a campaign haul of coal to Port Kembla in January 2011 where a number of additional trucks were engaged by Boral to transport coal to meet a designated shipment.

The issues raised in relation to truck movements have been communicated to the truck drivers so that they are aware of the concerns raised.

Boral also proposes to work with WSC to implement a number of measures to manage truck movements on Medway Road. These measures, which are described in Chapter 17, will be discussed in consultation with WSC and the residents of Medway and surrounding areas. At the time of writing Boral is waiting on WSC to arrange a meeting with the residents to discuss and agree on these measures.

In addition, a code of conduct has been prepared and implemented which applies to all truck drivers who despatch coal from the Berrima Colliery. A copy of this code of conduct can be found in Appendix F.

## 6.5 Aboriginal community groups

The local Aboriginal community have been consulted in relation to the proposal for continued operations at Berrima Colliery. Further details on consultation with Aboriginal community groups are provided in Chapter 16.

## 6.6 Employees

Employees of Boral and Delta Mining have been informed of the proposal through a range of briefings and toolbox talks.

## 6.7 Ongoing stakeholder engagement

Under the proposal Boral will establish and operate a Community Consultative Committee (CCC) for the Berrima Colliery. This CCC may form part of the current Community Liaison Committee (CLC) that has been established for Boral's Berrima Cement Plant and will be determined in discussions with DoPI. It is likely that the CCC will comprise an independent chair and appropriate representation from Boral, WSC and the general community. It is intended that the CCC is an advisory committee that provides a medium for the general community to receive information as well as to provide feedback on the operations at Berrima Colliery.

An AEMR that summarises the colliery's activities and performance in the areas of health, safety, environmental and community will continue to be produced under the proposal. The AEMR will be provided to DoPI, WSC and other relevant government agencies. The AEMR will also be made available to the public on a nominated website.

Boral will continue to consult with relevant stakeholders as required.

## 7 Issues Identification

### 7.1 Overview

A preliminary assessment of potential environmental impacts for the proposal was undertaken for the PEA. These potential impacts have been reviewed as part of the scoping phase for this EA, and they have been ranked according to the likelihood of their occurrence and the consequences of an event if it occurred. The results have provided a basis for prioritising the technical studies conducted for this EA.

### 7.2 Environmental issue identification

The environmental issues identified in the PEA were as follows:

- socio-economic;
- subsidence;
- groundwater;
- traffic;
- noise;
- air quality;
- surface water;
- ecology; and
- Aboriginal heritage.

The above issues are not of equal significance but their relevance to the proposal was confirmed in the DGRs received from the Director-General of DoPI.

### 7.3 Environmental risk assessment

The preliminary environmental risks of the project were rated according to their likely significance, using two variables, namely:

- the potential severity or consequences of the impact assuming the proposed safeguards, design or management measures are applied; and
- the likelihood that the proposed safeguard, management or design measure will fail or be ineffective.

In each case impacts have been rated as given below.

- Severity of consequences of impact:
  - Minor: Near-source confined and promptly reversible impact on-site, with little or no off-site impact expected;

- Medium: Near-source confined and short-term reversible impact on-site, with little and promptly reversible off-site impact;
  - Serious: Near-source confined and medium-term recovery impact on-site, with near-source confined and short-term reversible off-site impact;
  - Major: Impact that is unconfined and requiring long-term recovery, leaving residual damage on-site with near-source confined and medium-term recovery of off-site impacts; and
  - Catastrophic: Impact that is widespread-unconfined and requiring long-term recovery, leaving major residual damage on-site with off-site impact that is unconfined and requiring long-term recovery and leaving residual damage.
- Likelihood of consequence:
    - Rare: Event that is very unlikely to occur during the lifetime of a project;
    - Unlikely: Event that is unlikely to occur during the lifetime of the project;
    - Possible: Event that may occur during the lifetime of the project;
    - Likely: Event that may occur frequently during the lifetime of the project; and
    - Almost Certain: Recurring event during the lifetime of the project.

Table 7.1 below shows the matrix used to identify environmental risks and determine priorities for this EA. In each case a score of 1 to 5 is given for the consequence and likelihood of an event occurring and the scores are added to determine environmental risk. There are four classes of environmental risk that result, with these being:

- Low: Risks that are below the risk acceptance threshold and do not require active management. Certain risks could require additional monitoring;
- Moderate: Risks that lie on the risk acceptance threshold and require active monitoring. The implementation of additional measures could be used to reduce the risk further;
- High: Risks that exceed the risk acceptance threshold and require proactive management. Includes risks for which proactive actions have been taken, but further risk reduction is impracticable; and
- Critical: Risks that significantly exceed the risk acceptance threshold and need urgent and immediate attention.

**Table 7.1 Conceptual Environmental Risk Matrix**

| Likelihood of Impact | Consequence of Impact |                 |                 |                 |                   |
|----------------------|-----------------------|-----------------|-----------------|-----------------|-------------------|
|                      | 1<br>Minor            | 2<br>Medium     | 3<br>Serious    | 4<br>Major      | 5<br>Catastrophic |
|                      | 5<br>Almost Certain   | 6<br>(Moderate) | 7<br>(High)     | 8<br>(Critical) | 9<br>(Critical)   |
|                      | 4<br>Likely           | 5<br>(Moderate) | 6<br>(High)     | 7<br>(High)     | 8<br>(Critical)   |
|                      | 3<br>Possible         | 4<br>(Low)      | 5<br>(Moderate) | 6<br>(High)     | 7<br>(Critical)   |
|                      | 2<br>Unlikely         | 3<br>(Low)      | 4<br>(Low)      | 5<br>(Moderate) | 6<br>(High)       |
| 1<br>Rare            | 2<br>(Low)            | 3<br>(Low)      | 4<br>(Moderate) | 5<br>(High)     | 6<br>(High)       |

The methodology described above was applied to the potential risks identified for the proposal and the results are provided in Table 7.2 below.

It is important to note that the ratings given in the table are based on an understanding of existing and a preliminary assessment of likely impacts associated with ongoing operations, including an increase in production above existing levels. As such, individual scores should not be seen as quantitative, they are only a guide to relative significance with the purpose of prioritising issues for the EA.

**Table 7.2 Conceptual Environmental Risk Ranking**

| Issue                                            | Consequence | Likelihood | Priority     |
|--------------------------------------------------|-------------|------------|--------------|
| Subsidence                                       |             |            |              |
| Impact on residential dwellings                  | 3           | 3          | 6 (High)     |
| Impact on properties                             | 2           | 3          | 5 (Moderate) |
| Impact on physical features                      | 3           | 2          | 5 (Moderate) |
| Groundwater                                      |             |            |              |
| Impact on groundwater levels and bores           | 2           | 4          | 6 (High)     |
| Impacts of water discharge                       | 2           | 2          | 4 (Low)      |
| Surface Water                                    |             |            |              |
| Impacts on water quality                         | 2           | 2          | 4 (Low)      |
| Traffic                                          |             |            |              |
| Increases in traffic volumes                     | 2           | 5          | 7 (High)     |
| Noise                                            |             |            |              |
| Noise impacts associated with pit-top operations | 2           | 2          | 4 (Low)      |
| Noise impacts associated with increased traffic  | 2           | 5          | 7 (High)     |
| Air Quality                                      |             |            |              |
| Air quality impacts on residential receptors     | 2           | 2          | 4 (Low)      |

**Table 7.2 Conceptual Environmental Risk Ranking**

| Issue                                                 | Consequence | Likelihood | Priority     |
|-------------------------------------------------------|-------------|------------|--------------|
| Ecology                                               |             |            |              |
| Impact on threatened fauna                            | 2           | 2          | 4 (Low)      |
| Impact on threatened flora and vegetation communities | 2           | 2          | 4 (Low)      |
| Impact on habitat for native species                  | 2           | 2          | 4 (Low)      |
| Aboriginal Heritage                                   |             |            |              |
| Impact on Aboriginal sites                            | 2           | 2          | 4 (Low)      |
| Impact on Aboriginal artefacts                        | 2           | 2          | 4 (Low)      |
| Socio-economic                                        |             |            |              |
| Amenity impacts on nearby residences                  | 3           | 3          | 6 (High)     |
| Economic effects (impact of closure)                  | 4           | 5          | 9 (Critical) |

## 7.4 Results

The preliminary risk assessment has identified the following order of significance potential impacts:

- critical significance: economic impacts on local and state economy if operations at the colliery cease and fuel cannot be supplied to the Berrima Cement Works;
- high significance: impacts on properties resulting from subsidence, impact on groundwater levels and bores, traffic impacts, including noise associated with increase traffic movements, and amenity impacts; and
- low significance: noise associated with pit-top facilities, air quality, surface water management, ecology and Aboriginal heritage.

## 8 Socio-economic

### 8.1 Introduction

This chapter details the potential socio-economic impacts of the proposal. The proposal will provide the following beneficial socio-economic impacts:

- direct employment of existing and future mine workers;
- indirect employment;
- continued supply of fuel for the production of cement at Berrima Cement Works, the largest cement plant in NSW and the supplier of the majority of cement products in the NSW market; and
- supply of coal to other Boral internal customers and external customers.

The proposal may also have potential negative socio-economic impacts; however, these will be properly managed and are, therefore, not expected to be significant.

### 8.2 Existing socio-economic position

Berrima Colliery is an existing coal mine operating in the Illawarra region since 1872 and currently employs 38 workers. Coal produced at Berrima Colliery has been supplied by road to a number of Boral industrial operations including Berrima Cement Works and Maldon Cement Works. The colliery also supplies external customers and exports coal through Port Kembla.

Boral is a leading Australian construction materials producer, including leading Australia cement producer with manufacturing operations in each of the eastern states of Australia. Boral supplies the construction industry with bulk cement products and the retail hardware market with bagged cement products. Cement is the essential ingredient in concrete that provides the glue that “cements” the rock and sand together to produce the finished product.

Berrima Cement Works, together with Maldon Cement Works, supplies over 60% of NSW’s cement needs. It also supplies some of the Australian Capital Territory’s needs. Berrima Cement Works has been operating since 1929 with 155 people currently employed at the site. Berrima cement has been used in the building of commercial, residential and infrastructure including some landmark projects such as Warragamba Dam, Snowy Mountain Scheme, Sydney Opera House and the New Parliament House in Canberra.

### 8.3 Impact assessment

Under the proposal employees of the colliery will increase from the current 38 to 63 employees. The proposal will therefore not only ensure the continued employment of workers but will also provide an additional 25 people with employment.

As discussed above, coal produced at Berrima is supplied to a number of Boral operations as well as external customers. The majority of the coal produced is currently used as fuel for the Berrima Cement kilns. The proposal will therefore have positive socio-economic impacts for these operations through continuation of employment as well as the continued production of resources. Continuation of supply to Boral operations and external customers will also provide employment for road freight operations.

Cement and limestone are essential ingredients for the production of concrete and plaster used in construction. Based on the 2006 census data the construction industry directly employs 13,722 people in the Illawarra region (8.6% of total employment) and is the fifth largest employment sector in the region. The proposal will have indirect socio-economic impacts through the continuation of employment in the construction industry and the supply of construction materials for important regional and state infrastructure.

The Port Kembla Coal Terminal is a key coal exporting facility which relies on exporting coal from the Southern and Western coalfields of NSW, including Berrima Colliery, to international customers for its financial viability. The proposal will continue to export coal through the terminal.

The proposal is likely to have indirect positive impacts including employment, income and revenue for a number of different sectors of the regional economy. These are likely to include the following:

- services to the mining sector;
- other property services sector;
- legal, accounting, marketing and business management sector;
- road transport sector;
- wholesale trade sector;
- scientific research, technical and computer services sector;
- retail trade sector;
- other business services sector; and
- accommodation, cafes and restaurant sector.

Based on the above, the impacts of alternatives to the proposal, i.e. the closure of Berrima Colliery, would have significant socio-economic impacts for the region and to the state, albeit to a lesser extent. Closure would have the direct impact of unemployment for the current 38 employees as well as preventing the opportunity for employment of a further 25 people. Additionally, this would more than likely have negative impacts on the families of these workers.

Closure would also require Boral industrial operations to obtain fuel from alternative sources. While this would have negative implications for all of the colliery's customers the greatest impact would be for Berrima Cement Works which is currently supplied with an economical supply of fuel sourced from within close proximity. Supply of fuels from alternative sources would increase production costs likely affecting employment and increasing the prices of cement and limestone.

Additional negative socio-economic impacts of closure include unemployment, lower income and lower revenues within the construction, road freight and export industries as well as indirect impacts on a number of sectors described above. Regional and state infrastructure projects would also be negatively impacted by the increasing costs of construction materials.

The proposal may potentially have some negative social impacts from impacts on local properties from subsidence, loss of bore water associated with underground workings, noise, air quality and traffic impacts associated with surface operations. These impacts are assessed in the following chapters and, if

required, mitigation and management measures have been proposed. It is considered that, since the proposal will have no significant impacts and any potential impacts can be properly managed, there will be no significant negative socio-economic impacts as a result.

Additionally, as the colliery is an existing mine which has been operating since 1872 with no significant community complaints associated with the impacts described in the above paragraph, it is considered that the continuation of operations at Berrima Colliery would have significantly less impact than the commencement of a new mine within the region.

## 8.4 Conclusions

Under the proposal coal produced at Berrima Colliery will continue to be supplied to a number of customers including the nearby Berrima Cement Works. The proposal will have a number of significant positive socio-economic impacts from the continuation and provision of employment for workers at the colliery, and the continued supply of an economic fuel source for a number of regional and state significant industrial operations. The proposal will indirectly benefit a number of different sectors of the regional economy.

The alternative to the proposal, closure, will have significant negative socio-economic impacts for the colliery workers as well as for the customers of the colliery and for state and regional construction and infrastructure.

Potential negative social impacts of the proposal have been assessed as non-significant and mitigation and management measures will be implemented under the proposal where required.

## 9 Subsidence

### 9.1 Introduction

A subsidence impact assessment was undertaken by Ditton Geotechnical Services Pty Limited (DgS) to assess the proposal's potential subsidence impacts resulting from the extraction of coal. The assessment provides the following:

- subsidence predictions and general impact assessment for the proposed pillar extraction panels SW1, 406 and 59;
- design advice for SPZs;
- performance review of the existing SPZ above the extracted 404 panel and assessment of potential further impacts from the proposal; and
- recommended monitoring, mitigation and management measures for incorporation into the SMP.

This chapter provides a summary of the findings. A copy of the full subsidence impact assessment is contained in Appendix C.

The subsidence impact assessment was undertaken in consultation with DTIRIS.

### 9.2 Existing environment

The area located above the SW1, 406 and 59 panels, referred to as the SMP area, comprises of private land holdings primarily used for grazing of livestock and is substantially cleared of trees (see Figure 9.1). Within the SMP area there are the following existing developments:

- single storey brick house, in-ground supply tank, machinery shed and fibro clad cottage above the SW1 panel (the Renahan property);
- five small to medium sized earth embankment dams above the SW1 and 406 panels used for watering of livestock;
- two large earth embankment dams above the 59 panel, which are significant water supply dams with 16 mega litre (ML) and 5 ML capacity;
- unsealed gravel access roads and tracks;
- property boundary-line fences;
- suspended domestic telecommunications lines;
- full masonry brick structure, in-ground water supply tank, on-site effluent disposal system and two machinery sheds located above the north-west corner of the 404 panel (the Belbin property);
- groundwater bore located approximately 50 m north-east of the Belbin property;
- second groundwater bore located 15 m north of the Renahan property;

- weatherboard clad house with sub-surface basement, in-ground water supply tank, on-site effluent disposal system and two machinery sheds above 404 panel (the Alcorn property);
- large full masonry brick house and a garage approximately 280 m north of the north-west corner of the 406 panel (the De Rosa property);
- house and sheds on the western edge of the 59 panel (the Eaglerock property); and
- one Aboriginal heritage site (open artefact scatter) located at the south-east corner of the 406 panel (discussed further in Chapter 16 of this EA).

For the locations of the above developments refer to Figure 9.2.

The local area is not currently declared a mine subsidence district. Any change to this is the responsibility of the Mine Subsidence Board (MSB).

### 9.3 Details of proposed extraction

The proposal involves the extraction of coal from panels SW1 and 406, with an extraction ratio of up to 85%, firstly through the formation of pillars with a continuous miner and installation of rock bolts into the roof (first workings) and secondly through the 'lifting' of the pillars (secondary extraction).

The SW1 and 406 panels are located at an approximate depth of 130 to 180 m below the surface with the cover depth generally increasing from the east to west. The panels will have an average face extraction height of 2.6 m. The first working pillars of the 59 panel have already been formed and there will be no secondary extraction within this panel as part of the proposal. The 59 panel will remain first workings only to provide access and ventilation to newer areas of the mine. The 59 panel is 150 to 180 m below the surface with a cover depth of 130 m. It has been formed on a north-west/south-east orientation between two previous extraction panels (North West 1 and North West 2) with a 40 to 70 m wide barrier.

Further details of proposed extraction are provided in Section 5.2

### 9.4 Impact assessment

#### 9.4.1 Subsidence parameters

Subsidence is the vertical distance that the ground surface lowers as a result of mining. Maximum subsidence occurs during secondary extraction where the mine roof is supported by Mobile Breaker Line Supports (MBLS) and remnant coal pillars known as 'stooks'. Once the pillars have been extracted, the MBLS are withdrawn and the mine roof collapses causing the overlying strata or overburden to sag and result in a subsidence 'trough' developing at the surface. Maximum subsidence occurs in the middle of an extracted panel with the level of subsidence dependant on the mining height, panel width, cover depth, overburden strata strength and stiffness and bulking characteristics of the collapsed strata.

For the majority of high pillar extraction mining in the Southern Coalfields, maximum subsidence does not exceed 60% of the mining height. However, the maximum subsidence is usually lower than this value due to the stiffness of remnant coal pillars or stooks left in the panels and the spanning or bridging capability of the strata above the collapsed ground (or the 'goaf') and could range between 10% and 40% of the extraction height. The surface subsidence 'trough' will extend outside the limits of extraction for a certain distance (known as the angle of draw) (AoD) and is usually 0.5 – 0.7 times the depth of cover in the southern NSW coalfields. Very low levels of subsidence (i.e. <20 mm) usually occurs during first workings.

Other subsidence includes horizontal movements or displacements which are similar in magnitude to vertical subsidence as they occur within the AoD, and are related to the bending or sagging of the surface. Horizontal movements that occur outside the AoD are known as 'far-field displacements'. Undermining steep slopes can also result in tensile and compressive strain concentrations along the slope crests (potentially resulting in surface cracking) and slope bases (resulting in 'shoving') respectively, due to the rotation and down slope movements that can develop. It is also possible that small uplift movements in creek beds could occur due to stress concentration effects in near surface rocks subject to subsidence deformations. Uplift movements (usually tens of mm) can also develop along and just outside the limits of extraction, due to cantilevering overburden above the extracted areas.

The subsidence predictions presented in this chapter have considered the processes described above.

### 9.4.2 Review of existing subsidence protection zones

Pre-mining dilapidation and subsidence impact reports on the Alcorn and Belbin properties were obtained from the MSB – Picton Office. Upper (worst-case) and lower limits of measured subsidence for already extracted panels at Berrima are presented in Table 9.1. These extracted panels have similar mining geometries to the proposed extraction panels, SW1 and 406, and the data obtained was used to estimate predicted subsidence impacts resulting from their extraction and for the design of the proposed SPZs.

**Table 9.1 Summary of Berrima Colliery subsidence data**

| Parameter                             | Units | Extracted panels |             |             |             |
|---------------------------------------|-------|------------------|-------------|-------------|-------------|
|                                       |       | 403              | 404         | 405         | 500         |
| Cover depth (H)                       | m     | 135              | 135 – 145   | 125         | 120 – 125   |
| Panel Width (W)                       | m     | 150 – 180        | 210 – 80    | 200         | 180         |
| Panel W/H ratio                       | m/m   | 1.1 – 1.3        | 1.6 – 0.4   | 1.6         | 1.5         |
| Maximum subsidence ( $S_{max}$ )      | m     | 0.5 – 0.6        | 0.54 – 0.07 | 0.71 – 0.74 | 0.45 – 0.54 |
| Mining height (T)                     | m     | 2.2              | 2.3         | 2.2         | 2.2         |
| Panel extraction ratio (e)            | %     | 85               | 85          | 85          | 85          |
| Effective mining height ( $T_e$ )     | m     | 1.87             | 1.96        | 1.87        | 1.87        |
| $S_{max}/T_e$                         | m/m   | 0.27 – 0.32      | 0.28 – 0.04 | 0.38 – 0.40 | 0.24 – 0.29 |
| Maximum tilt, $T_{max}$               | mm/m  | 3 – 10           | 3 – 11      | 9 – 10      | 9 – 13      |
| Maximum convex curvature, $C_{max}$   | l/km  | 0.4              | 0.1 – 0.45  | 0.23 – 0.34 | 0.27 – 0.40 |
| (radius)                              | (km)  | (2.5)            | (10 – 2.2)  | (4.3 – 2.9) | (3.7 – 2.5) |
| Maximum concave curvature, $C_{min}$  | l/km  | 0.3              | 0.1 – 0.39  | 0.19 – 0.32 | 0.50 – 0.58 |
| (radius)                              | (km)  | (3.3)            | (10 – 2.6)  | (5.2 – 3.1) | (2.0 – 1.7) |
| Maximum tensile strain, $E_{max}$     | mm/m  | 4.1 – 4.7        | 0.5 – 1.1   | 2.0 – 2.9   | 0.5 – 2.9   |
| Maximum compressive strain, $E_{min}$ | mm/m  | 3.0 – 11.0*      | 0.5 – 2.4   | 1.6         | 0.5 – 1.5   |

Notes: \* Strain data questionable due to possible peg disturbance.

### 9.4.3 Predicted maximum subsidence

Based on the data presented in Table 9.1 the proposed mining geometries and an assumed mining height of 2.6 m the maximum subsidence above the proposed pillar extraction panels, after mining is completed, is predicted to range from 0.47 to 1.44 m. The predicted outcomes for the proposed extraction panels (in terms of subsidence, tilt, curvature and strain) were estimated from worst-case subsidence data presented in Table 9.1 and reference to Holla and Barclay (2000) and are summarised in Table 9.2.

**Table 9.2 Maximum subsidence impact parameters for 406 and SW1 panels**

| Panel #      | Cover depth,<br>H (m) | Panel Width,<br>W (m) | Panel W/H<br>ratio | Subsidence                                  | Tilt                      | Curvature                                    | Strain                          |                                     |
|--------------|-----------------------|-----------------------|--------------------|---------------------------------------------|---------------------------|----------------------------------------------|---------------------------------|-------------------------------------|
|              |                       |                       |                    | $S_{\max}$ (Berrima<br>model limits)<br>(m) | $T_{\max}$ tilt<br>(mm/m) | $C_{\max}$ sag –<br>hog ( $\text{km}^{-1}$ ) | $E_{\max}$<br>tensile<br>(mm/m) | $E_{\min}$<br>compressive<br>(mm/m) |
| 406          | 135                   | 49.5                  | 0.37               | 0.12 – 0.24                                 | 3 – 4                     | 0.15 – 0.13                                  | 1 – 2                           | 1 – 2                               |
|              | 150                   | 49.5                  | 0.33               | 0.11 – 0.21                                 | 2 – 4                     | 0.13 – 0.11                                  | 1 – 2                           | 1 – 2                               |
|              | 190                   | 49.5                  | 0.37               | 0.09 – 0.17                                 | 2 – 3                     | 0.12 – 0.10                                  | 1 – 2                           | 0.5 – 1                             |
| SW1<br>(LHS) | 160                   | 132                   | 0.83               | 0.20 – 0.54                                 | 4 – 10                    | 0.29 – 0.20                                  | 2 – 4                           | 1 – 3                               |
|              | 175                   | 132                   | 0.75               | 0.15 – 0.49                                 | 3 – 8                     | 0.24 – 0.19                                  | 2 – 3                           | 1 – 2                               |
|              | 190                   | 132                   | 0.69               | 0.11 – 0.45                                 | 2 – 8                     | 0.21 – 0.18                                  | 2 – 3                           | 1 – 2                               |
| SW1<br>(RHS) | 150                   | 71                    | 0.47               | 0.16 – 0.31                                 | 3 – 6                     | 0.20 – 0.18                                  | 1 – 2                           | 1 – 2                               |
|              | 170                   | 71                    | 0.42               | 0.14 – 0.27                                 | 3 – 5                     | 0.18 – 0.16                                  | 1 – 2                           | 1 – 2                               |
|              | 190                   | 71                    | 0.37               | 0.12 – 0.24                                 | 2 – 4                     | 0.17 – 0.15                                  | 1 – 2                           | 1 – 2                               |

Notes: LHS – Left hand side of panel, looking in-by; RHS – Right hand side of panel, looking in-by.

#### 9.4.4 Proposed subsidence protection zones

Based on the maximum subsidence impact parameters provided in Table 9.2 it is expected that there are potential impacts for the three structures on the Renahan property. A SPZ, therefore, will be provided beneath the Renahan's property above the SW1 panel. Within this SPZ the run-out pillars of the SW1 panel will not be lifted and will be first workings only with adequate set-back distances provided from high extraction areas. Subsidence development will also be limited beneath the steep slope directly below the structures.

The two large earth embankment dams above the 59 panel are considered a 'low' to 'moderate' hazard risk to life and property in the event of a breach. These dams will, therefore, be protected from significant impacts such as cracking of embankments as well as water storage loss by the provision of a SPZ beneath the two dams. These dams, and others within the SMP area, will be monitored for any evidence of damage or loss of water.

It has also been requested by the MSB that no further damage should occur at the Alcorn and Belbin properties above the 404 Panel due to the proposed mining layout.

The proposed SPZs have been designed based on acceptable damage criterion requested by the MSB and the performance of the previous SPZs. Key features of the SPZ design include:

- first workings only, i.e. no lifting of run-out pillars;
- minimum set-back distance of a 26.5° AoD, increased from 20° in previous SPZs;
- pillars of 19.5 m width with a width/height ratio of 7.5; and
- 2-layered roof and floor bearing capacity of 4.5 m and 2 m thick layers above and below the pillars.

The cost of mitigatory works to other features such as small embankment dams (<1 ML), power poles and roads in the SMP area are not considered significant enough to justify the need for SPZs. Alternative management and mitigation methods will be employed for these features and are further discussed in Section 9.5.

Based on the subsidence predictions within the 406 panel it is considered that there will be no significant impacts from subsidence on the Aboriginal artefact scatter site. Further protection measures for the site are not considered necessary. The significance and management of this site is discussed further in Chapter 16 of this EA.

#### 9.4.5 Subsidence impact assessment

The potential impacts of the predicted subsidence tilt and strains presented in Table 9.2 have been assessed for the existing natural features and developments. The potential impacts include surface cracking, sub-surface cracking, landslips, upsidence, or ponding.

Surface cracking is caused by the bending of the overburden strata as it sags down into the newly created void. Surface cracking of soil and rocks tend to occur above underground coal mines in NSW when tensile and compressive strains greater than 2 mm/m occur. Surface cracking has not previously occurred above panels in Berrima, however, based on the predicted maximum transverse tensile strains surface cracking widths of between 10 and 30 mm potentially may occur and repair works may be required.

Sub-surface cracking or fracturing in the overburden could result from caving and subsidence development with the extent dependent on the mining geometry and geology of the overburden. Sub-surface fracturing can impact on the hydraulic connection to surface creeks or alluvium and sub-surface aquifers. The occurrence of surface to seam connections is considered to be very unlikely, however, draw-down effects are expected to affect ground water bores in close proximity to the workings. Subsurface aquifers within 74 to 107 m of the workings for cover depths ranging from 135 to 190 m respectively could be affected by direct hydraulic connection to the workings above the extracted panels, with subsequent long-term increases to vertical permeability or relatively free drainage into the workings. Discontinuous fracturing would be expected to occur above these limits and increase rock mass storage and horizontal permeability without direct hydraulic connection to the workings. Interaction of discontinuous cracks with surface cracks is also possible for cover depths <190 m (i.e. all of the proposed panels). Options for controlling sub-surface fracturing will be incorporated into the SMP and are presented in Section 9.5.

Potential impacts of the proposal include the en-masse sliding (i.e. a landslide) of ridges or hills over basal siltstone beds tilted by subsidence. It has been assessed that it is 'very unlikely' that a large scale instability or landslide will occur in the long-term due to mining effects within the study area. Near surface soil slips are, however, possible as seen previously in the SMP area. Inclusion within the SMP of steps to further minimise the likelihood of slope instability have been suggested and are presented in Section 9.5.

Valley bending or upsidence can occur where mining of longwalls of high extraction pillar panels occurs beneath cliffs and sides of valleys. The likelihood of development of upsidence or valley bending is considered to be negligible within the mining lease due to the broad terrain and lack of thick, large beds of conglomerate and/or sandstone units along the creeks/valleys.

Ponding caused by depressions from subsidence trough developments is unlikely to affect surface slopes in the SMP area and is estimated at less than 0.1 m for flatter areas. The on-going review and assessment of any changes to surface drainage paths and vegetation after extraction of panels would be incorporated into the SMP.

The levels of subsidence within the existing and proposed SPZs have been assessed by comparing the maximum subsidence predictions for a range of cover depths and proposed pillar geometry and are presented in Table 9.3.

**Table 9.3** Predicted maximum subsidence above proposed SPZs

| Distance from goaf edge (AoD) | Cover depth (m) | Pillar area w x l (m)<br>(h = 2.3m) | Pre-mining vertical stress (MPa) | Full Tributary Area stress (MPa) | Service load stress (MPa) | Pillar stress increase* (MPa) | Predicted subsidence (m)   |                                  |
|-------------------------------|-----------------|-------------------------------------|----------------------------------|----------------------------------|---------------------------|-------------------------------|----------------------------|----------------------------------|
|                               |                 |                                     |                                  |                                  |                           |                               | S <sub>max</sub> (average) | 2 x S <sub>max</sub> (goaf edge) |
| Alcorn property SPZ           |                 |                                     |                                  |                                  |                           |                               |                            |                                  |
| 0m (0°)                       | 137             | 19.5 x 28                           | 3.43                             | 5.25                             | 9.68                      | 6.26                          | 0.056                      | 0.112                            |
| 50m (20°)                     | 137             | 19.5 x 28                           | 3.43                             | 5.25                             | 7.46                      | 4.04                          | 0.038                      | N/A                              |
| Belbin property SPZ           |                 |                                     |                                  |                                  |                           |                               |                            |                                  |
| 0m (0°)                       | 140             | 19.5 x 24.6                         | 3.50                             | 4.8                              | 8.15                      | 4.65                          | 0.043                      | 0.087                            |
| 50m (20°)                     | 145             | solid                               | 3.50                             | 5.69                             | 6.70                      | 1.01                          | 0.009                      | N/A                              |
| Renahan property SPZ          |                 |                                     |                                  |                                  |                           |                               |                            |                                  |
| 0m (0°)                       | 180             | 19.5 x 32                           | 4.50                             | 6.76                             | 13.69                     | 9.19                          | 0.086                      | 0.172                            |
| 65m (20°)                     | 175             | 19.5 x 32                           | 4.38                             | 6.57                             | 8.67                      | 4.30                          | 0.040                      | N/A                              |
| <b>90m (26.5°)</b>            | <b>175</b>      | <b>19.5 x 32</b>                    | <b>4.38</b>                      | <b>6.57</b>                      | <b>6.57</b>               | <b>2.20</b>                   | <b>0.021</b>               | <b>N/A</b>                       |
| 125m (35°)                    | 175             | 19.5 x 32                           | 4.38                             | 6.57                             | 6.57                      | 2.20                          | 0.021                      | N/A                              |
| Dams 1 and 2 SPZ              |                 |                                     |                                  |                                  |                           |                               |                            |                                  |
| 0m (0°)                       | 130             | 19.5 x 25                           | 3.12                             | 5.02                             | 9.2                       | 5.95                          | 0.054                      | 0.107                            |
| 47m (20°)                     | 130             | 19.5 x 25                           | 3.12                             | 5.02                             | 5.12                      | 2.00                          | 0.017                      | N/A                              |
| <b>65m (26.5°)</b>            | <b>130</b>      | <b>19.5 x 25</b>                    | <b>3.12</b>                      | <b>5.02</b>                      | <b>5.02</b>               | <b>1.90</b>                   | <b>0.016</b>               | <b>N/A</b>                       |
| 91m (35°)                     | 130             | 19.5 x 25                           | 3.12                             | 5.02                             | 5.02                      | 1.90                          | 0.016                      | N/A                              |

Notes: \* Subsidence based on difference between pillar service stress and pre-mining service

**Bold** = SPZ adopted in this EA

The total worst-case stress acting on the first and subsequent rows of pillars beneath the SPZs is estimated using the full tributary area (FTA) and abutment load concepts (ACARP 1998). Under this concept the FTA of a column of rock or overburden above a pillar and a proportion of abutment load will act upon that pillar. The results in Table 9.3 show that for an AoD of 26.5° the vertical stress is unlikely to exceed the FTA stress and subsidence over pillars will be due to stress increases from first workings only, with the maximum subsidence approximately 21 mm. No further impacts due to mining are expected at the Belbin and Alcorn properties.

## 9.5 Subsidence management, monitoring and mitigation

Based on the above assessment of potential subsidence impacts several measures to manage, monitor and mitigate are recommended. As discussed in the previous section the potential impacts from subsidence include surface cracking, sub-surface cracking, landslips, upsidence, or ponding. Potential measures that may be incorporated into the SMP for Berrima Colliery are described below.

Surface cracking of soils and rocks has not previously occurred at Berrima, however, there is potential for cracks to appear as a result of subsidence. Repair works may need to be implemented around areas of the lease affected by surface cracking. Such works may involve the pouring of gravel, concrete or grout into large deep cracks.

Sub-surface fracturing within the overburden may occur with the potential for direct hydraulic connection to the workings above the extracted panels. Methods for controlling sub-surface fracturing will be considered under the SMP and may include one or a combination of the following:

- repair surface cracks when they occur;
- decrease mining height to limit continuous fracture heights;
- decrease panel width; or
- leave a barrier pillar beneath sensitive area or limit mining to first workings.

While large-scale land slips are considered unlikely there is potential for near surface soil slips within the SMP area. To minimise the likelihood of slope instability due to mine subsidence impacts the following methods will be considered for inclusion in the SMP:

- surface slope displacement monitoring along 406 Panel centre lines (combined with subsidence monitoring plans);
- infilling of surface cracking to prevent excessive ingress of runoff into the slopes;
- protection of areas that are significantly affected by erosion with mitigation works such as re-grading and re-vegetation of exposed areas; or
- on-going review and appraisal of any significant changes to surface slopes such as cracking along ridges, increased erosion down slopes, foot slope seepages and drainage path adjustments observed during second workings;

If large-scale slope instability does occur after mining significant stabilisation works, or re-grading works, may be required. Any such works would be based on consultation with the landowners, relevant government agencies and rehabilitation works consultants. Current methods at Berrima Colliery to limit slope instability include liaising with landowners regarding remedial works, fencing off of the active

erosion area to exclude stock, planting of trees, and installation of survey control points along the slope to determine pre-mining movement.

Recommendations for the management of upsidence and valley bending effects include the following:

- installation and monitoring of survey lines along ephemeral drainage gullies and along gully crests during and after longwall undermining;
- visual inspections to locate damage such as cracking, uplift;
- review predictions of upsidence and valley crest movements during mining; or
- repairs to cracking (i.e. cement grouting) or gully slope stabilisation works (i.e. spot bolts and meshing) where required.

On-going monitoring and inspection of the Belbin and Alcorn properties will continue during mining as a precautionary measure due to the potential for slope movements or instability to occur above the properties. An inspection of mine subsidence damaged properties would be made by the MSB or qualified building consultants before, during and after mining and any repair works to internal/externals cracking or re-levelling of damaged structures would be implemented.

The unsealed gravel access roads and tracks above the proposed panels could potentially be damaged by cracking and 'shoving' at tensile and compressive strain zones. Inspection and maintenance of the roads and access tracks would be undertaken as required when the impacts occur. The impact of mining on the grazing of livestock would primarily require the management and repair of surface cracking and fences.

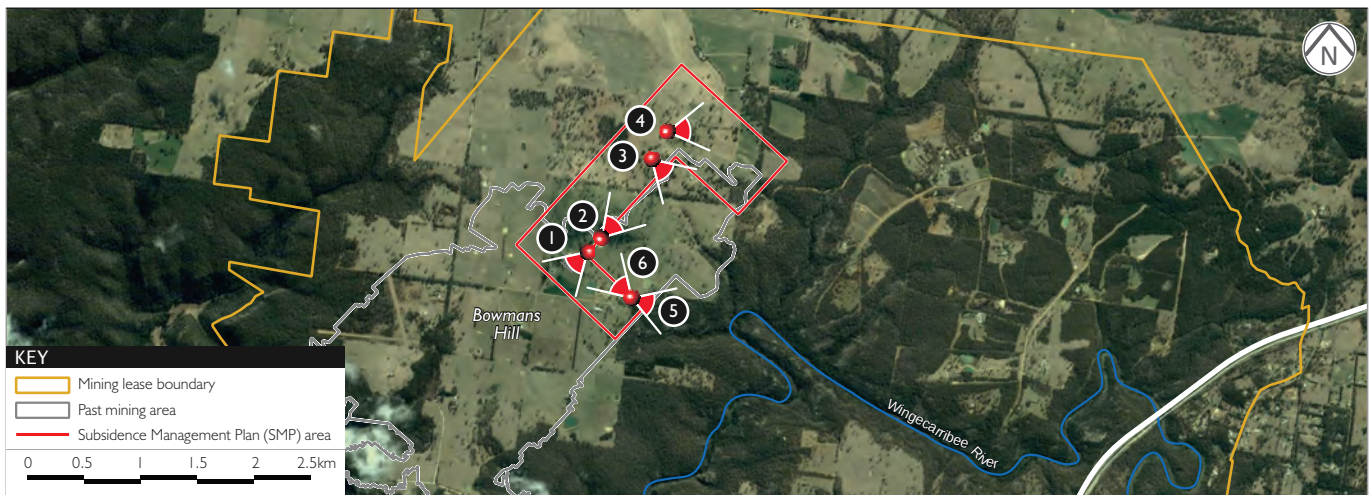
The SMP will include surface and sub-surface impact monitoring programs as recommended by DgS.

The implementation of any management, monitoring or mitigation measures will be conducted in consultation with relevant stakeholders and, where required, the MSB.

## 9.6 Conclusions

The subsidence impact assessment has determined the potential subsidence impacts of the proposal (Appendix C). Residences and structures within the SMP area will be protected by SPZs where first workings only will occur and subsidence will be less than 21 mm.

Potential subsidence impacts include surface cracking, sub-surface cracking, landslips, upsidence, or ponding. Proposed measures to mitigate and manage these impacts as well as monitoring programs have been recommended and will be considered for inclusion within the SMP.



Viewpoint 1 - Looking south west towards past mining area



Viewpoint 2 - Looking north east along SMP area boundary



Viewpoint 3 - Looking south east towards Berrima Colliery Cement Plant



Viewpoint 4 - Looking east from inside the SMP area boundary



Viewpoint 5 - Looking south east



Viewpoint 6 - Looking north west along SMP area boundary



FIGURE 9.2  
Developments within the SMP area

## 10 Groundwater

### 10.1 Introduction

A groundwater study was undertaken by Australasian Groundwater & Environmental Consultants Pty Limited (AGE) to assess the potential impacts of the proposal on groundwater.

The study provides the following:

- review of groundwater monitoring data;
- results of field investigations; and
- analytical impact assessment.

This chapter provides a summary of the findings. A copy of the full groundwater study is contained in Appendix D.

The groundwater study was undertaken following consultation with NOW, including a meeting at NOW's offices in Parramatta.

### 10.2 Existing environment

#### 10.2.1 Local topography and climate

Berrima Colliery is located at the western limit of a gentle sloping plateau that is incised by the Wingecarribee River. Wingecarribee River flows west from Berrima town and then turns to flow south-west, adjacent to the colliery. The ground surface level above the mine ranges from approximately 680 to 750 m Australian height datum (AHD). The bed of Wingecarribee River falls almost 100 m, from about 620 m AHD in the northern area of the colliery, to 520 m AHD on the south-western boundary.

The land use in the vicinity of the mine workings is a mixture of rural residential and agricultural land in the cleared areas where the topography is relatively gentle, and remnant native bushland along the riparian zone of the Wingecarribee River and the western edge of the plateau where slopes steepen.

The local climate of Berrima Colliery is temperate with an average annual rainfall of 783 mm. While average evaporation is 1,294 mm per year, rainfall exceeds evaporation during the period of May to July, when the majority of aquifer recharge is expected to occur. Monthly rainfall records were taken from Berrima West station and used to calculate the cumulative rainfall deficit (CRD) which provides a historical record of relatively wet and dry periods. The CRD for Berrima West indicates a period of below average rainfall between 2001 and 2005, with a relatively stable rainfall from 2005 onwards and no indication of a significant period of drought.

#### 10.2.2 Local geology

Berrima Colliery is an underground coal mine that uses the bord and pillar method to mine the basal section of the Wongawilli Seam. Pillars of coal are extracted using breaker line supports and a continuous miner. The Wongawilli Seam ranges in thickness from approximately 6 to 10 m and strikes in a northerly direction and dips gently to the east at 1.5°.

Permo-triassic rocks of the Sydney Basin crop out over most of the Southern Coalfield area with some formations containing economic deposits of coal. The major stratigraphic units present at Berrima Colliery include the Illawarra and Shoalhaven coal measures.

### 10.2.3 Groundwater monitoring

A search of the NOW water bore database showed a total of 151 registered bores within a 6 km radius of the SMP area, with 11 of these within a 2 km radius (Figure 10.1). Of the 151 bores, there are 108 active water licences mainly for stock and domestic purposes with 16 of the licences for irrigation. Water quality information on the database showed that groundwater in the area is typically fresh with low salinity. Bore yields range from 0.1 litres per second (L/s) to 16.5 L/s with a median yield of 1.8 L/s for the registered bores.

The only known groundwater investigation at Berrima Colliery was undertaken by Larry Cook and Associates in 2008 as part of the SMP. The investigation included a desktop review of the local hydrogeology and test pumping at two bore sites, the Belbin property bore and the Culpepper property monitoring bore. Data analysed from the pumping showed that only the Belbin bore was constructed in a perched aquifer.

Larry Cook and Associates (2008) make reference to a groundwater monitoring program at Berrima Colliery which commenced in 2007 and included inspection of three registered bores within the area of the proposed underground workings on the Belbin, De Rosa ("Culpepper") and Renahan properties (see Figure 10.2). The water levels recorded by electronic water level loggers showed a relatively stable water level of the Culpepper production bore and a slight reduction in the groundwater levels of the Culpepper monitoring bore and Belbin production bore between November 2007 and October 2009. The declining trend in groundwater levels, when compared with the CRD, was attributed to the below average rainfall over the monitoring period.

### 10.2.4 Water quality and flow

The groundwater study conducted by Larry Cook and Associates (2008) included the collection and analysis of several groundwater samples collected from seepage in the underground workings and surface water samples collected from locations on Wingecarribee River.

All the water samples collected reported total dissolved solids (TDS) concentrations in the <500 milligrams per litre (mg/L) range indicating fresh water, with most samples from the coal face and Wingecarribee River in the range 100 to 300 mg/L. The Australian Drinking Water Guidelines recommend a maximum TDS of 500 mg/L for drinking water. The only samples that exceeded this were the seepage samples collected from the colliery discharge point of the V-notch weir and the belt sump which typically recorded TDS concentrations at slightly above 500 mg/L. This appears to be largely related to an increase in sulphate concentration, which may be due to the oxidation of sulphide minerals in the coal or roof/floor units.

Analyses of the water samples indicated that the highest concentrations of trace metals were detected in the V-notch weir and two belt sump samples, likely due to the oxidation of pyrite, as discussed above. Concentrations of arsenic, copper, manganese, nickel and zinc were present at above the trigger level recommended for aquatic ecosystems at the 95% level of protection. However, the concentrations of metals were within the acceptable levels for stock water and potable drinking water due to the generally higher level of these guidelines.

An assessment was made of the groundwater quality in terms of *Australian and New Zealand Environment and Conservation Council 2000* (ANZECC) criteria and environmental value. Groundwater

produced at Berrima Colliery from the underground workings has a low salinity and is used locally for stock, domestic and irrigation purposes. It also provides baseflow to the Wingecarribee River downstream of the colliery, which supports ecosystems, potable water supply and recreation. The groundwater is therefore considered to have a high environmental value for aquatic ecosystems, primary industry, recreation/aesthetics, drinking water and industry. There are no groundwater dependent ecosystems in the Wingecarribee River Catchment, in proximity to the Berrima Colliery (DoP 2008).

Groundwater levels are sustained by rainfall infiltration. The average inflow rates of groundwater to the colliery appear to correlate with the CRD with a time lag of several months. The recharge rate of aquifers in the Southern Highlands is taken to be 10% of rainfall on exposed sandstone or basalt aquifer areas (then *Department of Environment, Water, Heritage and the Arts* (DEWHA) 2009). As the average annual rainfall for Berrima Colliery is 783 mm there is an expected rainfall recharge rate of approximately 78 mm per year. Data from the Culpepper monitoring bore does not show any rapid increases in water level due to rainfall, which suggests rainfall recharge to the coal measures occurs via a slow leakage from the overlying Hawkesbury Sandstone.

### 10.3 Impact assessment

#### 10.3.1 Existing impacts

The groundwater monitoring data in the vicinity of the colliery is limited and therefore difficult to determine the zone of depressurisation created by the colliery. However, the data collected from groundwater monitoring bores, as described above in Section 10.2.3, suggests that the zone of depressurisation around the Berrima Colliery is relatively limited and likely to extend to no more than 1 km from the workings, and potentially much less. This conclusion was drawn from bores located beyond 1 km from the workings which did not show any significant drawdown..

The relatively limited zone of influence is expected to be related to the relatively high recharge rate to the Hawkesbury Sandstone aquifer and leakage from the Hawkesbury Sandstone into the underlying coal measures which serves to maintain water pressures within the coal seam. Seepage of surface water from the Wingecarribee River into the underlying aquifers may also serve to reduce the zone of depressurisation. Recommendations to better define the zone of depressurisation by including installation of additional monitoring bores, conducting a bore census and further water chemistry monitoring within the workings are provided in the groundwater study (Appendix D).

The gradual advancement of the colliery over the past 85 years has likely resulted in the zone of depressurisation reaching its maximum extent with a steady seepage rate of groundwater into the colliery. Groundwater flows into the underground workings via inflow from the coal seam face and seepage through the roof of the coal mine via faults and dykes. The total steady state inflow of groundwater currently is estimated at 2.83 ML per day.

#### 10.3.2 Impacts from the proposal

Under the proposal the total steady state inflow of groundwater is estimated to reach 3.1 ML per day, due to an increase in roof area from 7.7 to 8.7 kilometres squared (km<sup>2</sup>), an increase of 7% in flow from the current inflow. This is within the observed range of 2 – 3.5 ML per day currently measured at the colliery.

## 10.4 Mitigation and management

Boral has submitted a licence to NOW to extract groundwater which flows into the underground workings at Berrima Colliery at a maximum rate of 2,000 ML per year, averaged over three years, which is within the predicted increase.

A monitoring program will be implemented at Berrima Colliery as part of the proposal. The program will address certain existing data gaps in groundwater monitoring at the site as well as monitoring the following:

- flows in Wingecarribee River;
- zone of depressurisation in the coal seam;
- water levels and quality in neighbouring landholder bores; and
- groundwater inflows at the V-notch weir.

Two additional groundwater monitoring bores are to be drilled as part of the proposal and are shown in Figure 10.2. There is also potential to construct additional bores in abandoned coal resource holes which have not been cemented. If these are found to be not suitable, additional locations east and north of the colliery may be chosen for new monitoring bores. Electronic water level loggers will be installed in the bores and manual water level monitoring will be undertaken on a quarterly basis. A bore licence will need to be obtained from NOW for any new monitoring bores and they will be constructed by an appropriately licensed water bore driller according to the Land and Water Biodiversity Committee (2003) guidelines.

Water quality of new and existing monitoring bores will be determined by samples collected on a six monthly basis. Samples collected will be analysed against a set of water quality objectives. Further details of these objectives are provided in Section 14.3.1 of this report.

Data collected as part of the groundwater monitoring program will be managed and reported on annually as part of the colliery's AEMR by a suitably qualified hydrogeologist.

## 10.5 Conclusions

The groundwater study has assessed the potential impacts of the proposal on the hydrogeological regime (Appendix D). The primary impact of the proposal is the ingress of groundwater into the underground workings of the colliery. Limited groundwater monitoring data suggests that groundwater inflow at the colliery has reached a steady state with groundwater levels sustained by rainfall infiltration. Under the proposal the inflow of groundwater is only expected to increase marginally and still within past ingress rates.

A groundwater monitoring program will be undertaken as part of the proposal which will monitor groundwater flow and quality in existing and proposed monitoring bores and at the V-notch weir discharge point. The results of the monitoring program will be reported on in the colliery's AEMR.



FIGURE 10.1  
Registered groundwater bore locations



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FIGURE 10.2  
Existing and proposed groundwater monitoring bore locations

## 11 Traffic

### 11.1 Introduction

A traffic impact assessment has been undertaken by Arup Pty Limited to investigate the potential traffic impacts associated with the proposal. Aspects of the proposal that relate to traffic include the transport of coal to external customers, generally located north and south of Berrima Colliery.

Arup assessed the following matters:

- existing site traffic and transport arrangements;
- site parking provisions and management;
- forecast traffic generation of the proposal and its impact to the surrounding road networks;
- truck ingress, egress and circulation into the site and its impact on external road networks; and
- impact of the proposal on road network traffic safety and efficiency.

This chapter provides a summary of the findings. A copy of the full traffic impact assessment is contained in Appendix E.

The traffic impact assessment was undertaken following consultation with WSC and the RTA.

### 11.2 Existing road conditions

#### 11.2.1 External road network

The traffic impact assessment has considered the local road network in and around Berrima Colliery, including Medway Road, Hume Highway, Old Hume Highway and Taylor Avenue. These local roads are shown in Figure 1.2.

Other roads associated with northern external coal transport routes have also been considered, including Picton Road, Mount Keira Road, the Link Road, Southern Freeway (F6), Masters Road, Springhill Road and Port Kembla Road.

#### 11.2.2 Existing site access and parking

Access to Berrima Colliery is at the main entrance located at the western end of Medway Road. The main entrance has separate access gates for trucks and general vehicles. Truck access is one way entering the site via the main entrance where coal is loaded at the coal loader and exiting through a different gate onto Medway Road approximately 20 m south of the main entrance. The general vehicle gate is also located at the main entrance although it is two way and provides access to the site office and parking facilities.

There are a total of 40 - 45 parking spaces provided on site for the 38 current employees of the colliery. Visitor numbers to the colliery average approximately five to ten visitors per day, spread out over the day.

### 11.2.3 Current product coal transport

Berrima Colliery currently produces 220,000 tpa of ROM coal with capacity to produce up to 500,000 tpa. Currently around 75% of the coal produced at Berrima Colliery is transported by road to Berrima Cement Works approximately 7 km east of the colliery on the southern side of Taylor Avenue. Two tri-axle trucks are utilised for coal transport travelling east along Medway Road, passing through the town of Medway, under the Hume Highway. The trucks pass through the roundabout of Medway Road/Old Hume Highway/Taylor Avenue in Berrima and then travel approximately 1.2 km east to Berrima Cement Works. At Berrima Cement Works two access gates are provided from Taylor Avenue: a main employee and visitor access gate; and a coal and cement truck access gate near Perth Street approximately 2 km east of Old Hume Highway.

The remainder of coal produced is either transported to other Boral industrial operations and external customers or stockpiled. Coal is stockpiled at the nearby Loch Catherine approximately 1km south of Berrima Colliery. Trucks transport coal to the stockpiling area via an unsealed road from Medway Road at Medway Village. As discussed in Section 5.3, Loch Catherine currently has capacity to store approximately 100,000 t of coal. Under the proposal the stockpiling area at Loch Catherine will be extended and capacity will increase to a maximum of 115,000 t.

Coal produced at Berrima Colliery has been supplied to Boral industrial operations such as Maldon Cement Works. External customers include the supply of export coal through Port Kembla. Coal is transported northwards, where trucks turn from Medway Road left onto Hume Highway, and southwards, with trucks turning right onto Old Hume Highway and south onto Hume Highway.

When required, additional trucks are contracted to transport coal to external customers including transporting coal to Port Kembla for export.

All coal deliveries from Berrima Colliery are mostly undertaken by tri-axle semi trailer vehicles. However, additional coal deliveries to external customers may be undertaken by B-double vehicles in the future. Any transport by B-Double would only occur if use of this type of truck was approved by both WSC and the RTA.

At the time of writing, an application was being prepared by Boral to lodge with DoPI to modify the development consent for the Berrima Cement Works. The proposed modification is to increase coal stockpile volumes at the works to 25,000 t to enable the trucking of the majority of coal to Port Kembla for export from the works. A coal bulk carrier has a capacity of 20,000 t to 25,000 t and needs to be loaded over a period of five to seven days. Coal would be transported to a coal bulk carrier at Port Kembla during five campaigns per year. Coal would be regularly transported to the Berrima Cement Works (as it currently is) and the stockpile built over time to eliminate or reduce the need for campaign hauls on Medway Road.

## 11.3 Impact assessment

### 11.3.1 Methodology

To assist in the assessment of the proposal's potential impacts related to traffic, the existing local traffic network has been reviewed and the level of service (LOS) assessed to determine its capacity to accommodate additional traffic resulting from the proposal. The RTA definitions of LOS are provided in Table 11.1 below.

**Table 11.1**      **Level of service definitions**

| Description   | Level of Service (RTA Definition) | Average Delay per Vehicle (s) |
|---------------|-----------------------------------|-------------------------------|
| Very Good     | A                                 | < 14.5                        |
| Good          | B                                 | 14.5 ≤ 28.5                   |
| Satisfactory  | C                                 | 28.5 ≤ 42.5                   |
| Near Capacity | D                                 | 42.5 ≤ 56.5                   |
| At Capacity   | E                                 | 56.5 ≤ 70.5                   |
| Over Capacity | F                                 | ≥ 70.5                        |

Source: RTA 1993.

The degree of saturation (DOS), an overall measure of the capacity of an intersection to accommodate traffic, was assessed for relevant intersections related to the proposal. The desirable, or practical, DOS is 0.85 for roundabouts, 0.90 for signalised intersections and 0.80 for priority intersections.

Current traffic volumes were determined by traffic counts conducted on Medway Road, Old Hume Highway, Taylor Avenue and at the roundabout where the three roads intersect. Traffic counts were also undertaken on Picton Road between Macarthur Road and Almond Street. Detailed count results are included in Appendix A of the traffic impact assessment (Appendix E). Mine related heavy traffic movement data for trucks using Medway Road west of the Hume Highway was supplied by Berrima Cement Works. Permanent count data of annual average daily traffic (AADT) collected by the RTA from various locations was also considered (RTA 2003).

### 11.3.2 Current traffic volumes

The total mine related traffic on Medway Road west of the Hume Highway is approximately 116 vehicle movements per day (70 car movements plus 46 truck movements) representing approximately 23% of the total daily traffic on a weekday (511 vehicle movements daily). The current daily traffic flow is low (less than 1,000 vehicle movements per day) and permits the highest LOS (LOS A) for a rural road.

The Medway Road/Old Hume Highway/Taylor Avenue roundabout has an average delay of seven seconds (s) which is within the performance indicator range of LOS A for intersections (<14.5s). Additionally the DOS, has been assessed as a maximum of 0.123, well below the practical DOS for roundabouts of 0.85. The intersection, therefore, currently has significant spare capacity to accommodate additional traffic.

### 11.3.3 Proposed product coal transport

As discussed above Berrima Colliery currently produces 220,000 tpa of ROM coal. Under the proposal coal production will increase to a maximum of 460,000 tpa. An estimated minimum of 120,000 tpa is expected to be supplied to Berrima Cement Works with the remaining 340,000 tpa available to supply external customers. However, demand from Berrima Cement Works may result in an increase in supply of up to 250,000 tpa, meaning that the amount of coal available for supply to external customers would vary each year as a result. A maximum of 115,000 tpa of the coal supplied to external customers will be temporarily stockpiled at Loch Catherine prior to delivery. Under the proposal coal will continue to be trucked.

Construction of a railway to transport coal between the Berrima Colliery and the Berrima Cement Works was considered in the initial stages of the project. Consideration was given to a range of matters, particularly the cost of constructing the railway. The distance between the colliery and the cement works (for construction of the railway line) is approximately 7.5 km. The railway line would need three road crossings, two across Medway Road and one across the Old Hume Highway. While it is difficult to

accurately estimate the cost of railway construction, estimates provided by a variety of sources suggest that to construct a single freight line with simple signalling, running across a flat, geologically sound, sparsely populated landscape would far exceed any commercial return ratio for the mine at both current and maximum production rates. A comparison of the current and proposed maximum traffic related operations is given in Table 11.2 below.

**Table 11.2 Comparison of current and maximum traffic related operations**

| Item                                             | Current                                    | Maximum                                                                            |
|--------------------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------|
| ROM coal production (tpa)                        | 220,000                                    | 460,000                                                                            |
| Number of employees                              | 38                                         | 63                                                                                 |
| Production days per annum                        | 210                                        | 340                                                                                |
| Approximate no. of coal truck deliveries per day | 32                                         | 66                                                                                 |
| General delivery times                           | 6am – 9pm weekdays &<br>6am – 2pm Saturday | 6am – 9pm weekdays &<br>6am – 2pm Saturday                                         |
| Delivery vehicles                                | Tri – Axle tipper truck                    | Tri – Axle tipper trucks and<br>B – Double trucks (subject to a separate approval) |

Berrima Colliery will continue, under the proposal, to transport all coal by road. Coal will continue to be transported along Medway Road to Berrima Cement Works and to external customers north and south via the Hume Highway. Likely customers and the traffic routes used to transport coal are detailed in Table 11.3 below.

**Table 11.3 Traffic routes to likely customers of Berrima Colliery**

| Customer                   | Distance from colliery | Traffic route                                                                                                                               |
|----------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Berrima Cement Works       | 7km east               | Medway Rd – Taylor Ave                                                                                                                      |
| Galong Limestone Mine      | 200km south            | Medway Rd – Old Hume Hwy – Hume Hwy                                                                                                         |
| Maldon Cement Works        | 60km north             | Medway Rd – Hume Hwy – Picton Rd                                                                                                            |
| Marulan Limestone Mine     | 40km south             | Medway Rd – Old Hume Hwy – Hume Hwy                                                                                                         |
| Port Kembla                | 100km east             | Medway Rd – Hume Hwy – Picton Rd – Mount Keira Rd –<br>The Link Rd – Southern Freeway (F6) – Masters Rd –<br>Springhill Rd – Port Kembla Rd |
| Potential Sydney customers | N/A                    | Medway Rd – Hume Hwy                                                                                                                        |
| Waurin Ponds Cement Works  | 830km south            | Medway Rd – Old Hume Hwy – Hume Hwy                                                                                                         |

#### 11.3.4 Estimated traffic volumes

As shown in Table 11.2 an estimated 66 truckloads of coal per day would be despatched from Berrima Colliery under the proposal. Of these around 16 truck loads per day will transport coal to Berrima Cement Works, with the remaining travelling to Loch Catherine stockpile area, Boral industrial operations or external customers. It is estimated that 90% of additional truck movements for external customers will travel north on the Hume Highway and 10% will travel south.

Berrima Colliery employee numbers are expected to increase under the proposal by an additional 25, to a total of 63 employees. Assuming all the additional employees are travelling to and from the colliery by car, there will be an additional 50 car trips per day using Medway Road.

Assuming 80% of the additional employees travel to and from the north of Berrima and the remaining 20% travel to and from the south, the overall maximum colliery related car and truck traffic increases on the regional road network have been calculated and presented in Table 11.4 below.

**Table 11.4 Maximum daily traffic increases on major roads due to increase of coal production**

| Road                  | Location                | Existing Traffic (AADT) | Source     | Traffic Increase | % Increase |
|-----------------------|-------------------------|-------------------------|------------|------------------|------------|
| Medway Rd             | W of Hume Hwy           | 511                     | Arup Count | 136              | 26.6%      |
| Hume Hwy              | S of Picton Rd          | 30,592                  | RTA        | 140              | 0.5%       |
| Old Hume Hwy          | S of Taylor Ave         | 1,116                   | Arup Count | 110              | 9.9%       |
| Picton Rd             | E of Hume Hwy           | 12,138                  | Arup Count | 100              | 0.8%       |
| Southern Freeway (F6) | Gipps Road, Gwynneville | 71,643                  | RTA        | 100              | 0.1%       |
| Masters Rd            | W of Springhill Rd      | 25,226                  | RTA        | 100              | 0.4%       |
| Springhill Rd         | N of Masters Rd         | 35,179                  | RTA        | 100              | 0.3%       |
| Springhill Rd         | S of Masters Rd         | 16,600                  | RTA        | 100              | 0.6%       |

Based on the analysis in the above table the predicted maximum traffic impacts of the proposal will be very minor, except for Medway Road where the daily traffic is expected to increase by over 27%. However, as trucks are despatched over a 15 hour (hr) period (on weekdays) there will be an average of nine additional vehicles per hr (or one vehicle every six to seven minutes) which will have very minimal impact on traffic flow conditions of the road.

With the exception of the Old Hume Highway south of Taylor Avenue, all of the predicted traffic increases on the other roads and the arterial road network generally will be insignificant (less than one %). On Old Hume Highway the potential 10% traffic increase represents seven additional vehicles per hr on average over a 15 hr day (or one vehicle every eight to nine minutes). This is a relatively minor increase of actual traffic and will have very minimal impact on the existing traffic flow conditions.

### 11.3.5 Potential impact on intersections

As discussed in Section 11.3.2, the Medway Road/Old Hume Highway/Taylor Avenue roundabout is currently operating at LOS A and with a very low DOS of 0.123. Only trucks travelling to and from external customers south of the colliery will access this intersection. Under the proposal, therefore, this intersection will experience a maximum increase of 96 additional vehicles per day. This increase is unlikely to have a significant impact on the intersection due to the existing low DOS.

In August 2008, a detailed road traffic and access study was undertaken by Cardno Eppell Olsen for the Port Kembla Coal Terminal where a number of key intersections near the port were analysed. The traffic impact assessment has used the results from this study to assess the impacts of coal transport on intersections in Port Kembla. The intersection traffic operation results have been extracted from the study and are presented in Table 11.5.

The data in Table 11.5 shows that all three intersections are currently operating within an acceptable LOS with some spare capacity. Based on the predicted traffic analysis for the future Berrima Colliery traffic distribution in Table 11.4, the Masters Road/Springhill Road intersection will potentially experience an additional 100 vehicle movements per day each. However, spread over 15 hrs this equates to approximately seven additional coal trucks travelling through each intersection per hour which will have very minimal traffic impact. Additionally, the Springhill Road/Port Kembla Road and Springhill Road/ Tom

Thumb Road intersections will experience approximately six additional coal trucks travelling through per hour which is unlikely to have noticeable impact.

**Table 11.5 Existing intersection operations at Port Kembla**

| Intersection                  | Control    | 2008 AM Peak |      |     |     | 2008 PM Peak |      |     |     |
|-------------------------------|------------|--------------|------|-----|-----|--------------|------|-----|-----|
|                               |            | DOS          | d    | Q   | LOS | DOS          | d    | Q   | LOS |
| Masters Rd/ Springhill Rd     | Signalised | 0.859        | 33.6 | 227 | C   | 0.732        | 42.0 | 172 | C   |
| Springhill Rd/ Port Kembla Rd | Signalised | 0.339        | 5.6  | 28  | A   | 0.741        | 12.4 | 63  | A   |
| Springhill Rd/ Tom Thumb Rd   | Signalised | 0.793        | 14.1 | 182 | A   | 0.809        | 16.8 | 122 | B   |

Notes: DOS = Degree of Saturation d = Delay (s) Q = Queue length LOS = Level of Service

Source: Environmental Assessment, Existing Operations & Increased Road Receiving Hours for Port Kembla Coal Terminal: Traffic Study; Volume 1 Main Report: Cardno Eppell Olsen; 26 August 2008.

### 11.3.6 Potential impact on parking facilities

As stated in Table 11.2, the proposal will result in an additional 25 employees. However, the total 63 employees will be spread out over the day and night shifts and a maintenance shift during the night and occasional weekends.

Assuming a maximum of 60% colliery employees (38 employees) working at the site at any one time, the available 40 – 45 parking spaces should adequately cater for the future peak period demand of the colliery employees and visitors (approximately four or five over the day). However, should additional parking demand arise in the future, additional on-site parking capacity can be provided by more parking spaces being constructed on level areas near the main site office of the colliery.

## 11.4 Mitigation and management

The proposal is unlikely to have any significant traffic impacts and mitigation, therefore, is generally not required. However, Boral has agreed to make the following commitments in relation to roads and transport due to specific safety concerns raised by the local community:

- Boral will work with WSC and the local community to mitigate impacts associated with trucks on Medway Road. Based on preliminary discussions with Council, mitigation measures include:
  - the erection of school bus warning signs at each end of Medway Road with the wording “7.30-9AM and 3-4.30PM SCHOOL DAYS NEXT 5 KM”;
  - that edgelines and centrelines be marked on Medway Road from the Hume Highway to Medway;
  - that sight distance for vehicles exiting Liebman's Road at Medway Road be improved by reducing vegetation on the north-eastern corner;
  - that street name signs and advance street name signs for Liebman's Road be installed on Medway Road;
- Boral trucks will not transport coal on the Macquarie Pass, i.e. the Illawarra Highway; and
- Boral will implement a “Truck Driver Code of Conduct”, principally involving conduct on Medway Road (See Appendix F).

Boral has been advised that the RTA is responsible for determining and setting speed limits on all roads in NSW. Boral will comply with any speed limits that may be imposed by the RTA on Medway Road.

It should be noted that these measures are outside of any measures that may be required if Medway Road is gazetted for use by B-doubles.

## 11.5 Conclusions

The potential transport impacts of the proposal have been assessed (Appendix E). The main factor of the proposal that will impact local and regional road networks is the increased coal production and the associated increase in transport of coal by road.

The key findings of the traffic impact assessment are the following:

- forecast traffic generation will have very minor impact. There will be an estimated additional 136 vehicle movements, over a 15 hr period, which will not generally be noticeable at any location on the existing road network;
- major intersections at Berrima and Port Kembla are all currently operating at satisfactory LOS and DOS. The very minor predicted peak hour traffic increases at these intersections are unlikely to have any noticeable impact; and
- Berrima Colliery has sufficient on-site parking to accommodate the proposed increase in employees with capacity to expand the car parking area if required.

## 12 Noise

### 12.1 Introduction

A noise assessment has been undertaken by EMM to assess the potential noise impacts of the proposal. Noise emission sources associated with the proposal include the Berrima Colliery pit top facilities, Loch Catherine and road traffic. The 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.

This chapter provides a summary of the findings. A copy of the full noise assessment is contained in Appendix G.

### 12.2 Existing environment

In October 2009, unattended long term and attended short term noise monitoring was undertaken by Heggies Pty Limited to establish the baseline noise climate at nearby sensitive receivers within Medway Village (See Appendix G - Appendix A). Background noise levels are provided in Table 12.1 for the monitoring locations shown in Figure 12.1.

The reported background noise levels (or RBL) are typical of rural residential settings with little influence from non-natural sources. The night time background noise level (30 dB(A)) at all three locations is consistent with the recommended minimum threshold background noise level as provided in the Environment Protection Authority's (EPA) Industrial Noise Policy (INP) released in January 2000. The evening and daytime background noise levels are also relatively low, at between 30 dB(A) to 33 dB(A), again reflecting the rural setting of the area. The site's existing operations are considered to be predominantly inaudible at all monitoring locations. The reported background noise levels, therefore, are considered to be free from any site related noise.

Meteorological data for the area between 2005 and 2010 was obtained from a Bureau of Meteorology (BoM) station at Moss Vale. The INP requires noise levels to be assessed under worst case meteorological conditions, referred to as 'prevailing meteorology' conditions where assessable winds are those that occur 30% or more of the time. The BoM data demonstrated 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 north-west during the night time period were modelled and represent the worst case directions for the closest residences at Medway.

**Table 12.1 Summary of existing ambient noise levels**

| Location                     | Period  | Rating background level (RBL),<br>L <sub>90</sub> dB(A) | Measured L <sub>Aeq,period</sub> , dB(A) |
|------------------------------|---------|---------------------------------------------------------|------------------------------------------|
| 6 Railway Street,<br>Medway  | Day     | 32                                                      | 50                                       |
|                              | Evening | 30                                                      | 47                                       |
|                              | Night   | 30                                                      | 45                                       |
| 140 Liebmans Road,<br>Medway | Day     | 31                                                      | 47                                       |
|                              | Evening | 33                                                      | 46                                       |
|                              | Night   | 30                                                      | 39                                       |
| 605 Richards Lane,<br>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<sub>Aeq</sub> – 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 Limited 2009, Berrima Colliery Preliminary Report.

The INP assessment process additionally requires the determining of the upper 10<sup>th</sup> percentile wind speed for the 'feature' direction. The upper 10<sup>th</sup> percentile wind speed for each was determined from the BoM data as 2.4 metres per second (m/s) during the daytime and 2.1 m/s during the evening and night time periods.

The BoM data did not contain sigma theta data to allow a temperature inversion assessment. As a worst case scenario temperature inversions were assumed a feature of the area and modelling included the effects of a three degrees Celsius per 100 metre (°C/m) temperature inversion. Temperature inversions are only experienced at night and are therefore not factored into day time noise modelling predictions.

Cumulative noise from other industrial sites in the area was considered as part of the noise impact assessment and whether allowances for this were required in the noise criteria 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. Therefore, no adjustments to the criteria were considered necessary for the assessment.

## 12.3 Impact assessment

### 12.3.1 Operational noise criteria

Guidelines for assessing noise from industrial facilities, such as mines, are provided in the INP. The INP determines criteria for assessment of intrusive noise impacts and noise amenity for sensitive receivers near industry. Both amenity and intrusiveness criterion are required to be met with the more restrictive criteria becoming the project specific noise criteria or operational criteria for the site. The intrusiveness criterion requires that operational L<sub>eq,15min</sub> noise levels (the energy average noise from a source and the equivalent continuous sound pressure level over a continuous 15 minute period) from a newly introduced source during the day, evening and night do not exceed the existing background noise levels by more than 5 decibels (dB).

Under the INP existing industrial facilities are not expected or required to necessarily achieve INP project specific criteria as existing sites have limited opportunity for mitigation and suggests only achievable noise levels are set.

Operational noise criteria was established for nearby sensitive receivers shown in Figure 12.2 and are provided below in Table 12.2.

### 12.3.2 Predicted noise limits

The predicted operational noise levels for the site were modelled based on two operating scenarios. The first represented daytime and evening activities such as stockpiling activities at Loch Catherine and general operations and loading of trucks at Berrima Pit Top. The second represented night time activities which only include general operations at Berrima Pit Top. The modelled predictions of operational noise levels during periods of calm and 'prevailing INP meteorology', wind and temperature inversion conditions described in Section 12.2, is presented in Table 12.2 for day, evening and night operations. The day and night results are also presented as noise contours in Figures 12.3 and 12.4

**Table 12.2 Predicted operational noise levels**

| Receiver | Day, dB(A) |                |                 | Evening, dB(A) |                |                 | Night, dB(A) |                                      |                |                 |
|----------|------------|----------------|-----------------|----------------|----------------|-----------------|--------------|--------------------------------------|----------------|-----------------|
|          | Calm       | Wind<br>2.4m/s | INP<br>criteria | Calm           | Wind<br>2.1m/s | INP<br>criteria | Calm         | 3°C/100m<br>Temperature<br>Inversion | Wind<br>2.1m/s | INP<br>criteria |
| 1        | 36         | <b>42</b>      | 37              | <35            | <b>39</b>      | 35              | <35          | <35                                  | <35            | 35              |
| 2        | 36         | <b>42</b>      | 37              | <35            | <b>39</b>      | 35              | <35          | <35                                  | <35            | 35              |
| 3        | 39         | <b>42</b>      | 37              | <35            | <b>39</b>      | 35              | 35           | 35                                   | <35            | 35              |
| 4        | <35        | <b>41</b>      | 37              | <35            | <b>39</b>      | 35              | <35          | <35                                  | 35             | 35              |
| 5        | <35        | 40             | 37              | <35            | 38             | 35              | <35          | <35                                  | <35            | 35              |
| 6        | <35        | 39             | 37              | <35            | 36             | 35              | <35          | <35                                  | <35            | 35              |
| 7        | <35        | 38             | 37              | <35            | <35            | 35              | <35          | <35                                  | <35            | 35              |
| 8        | 36         | 37             | 37              | <35            | <35            | 35              | <35          | <35                                  | <35            | 35              |
| 9        | 35         | 40             | 37              | <35            | 38             | 35              | <35          | <35                                  | <35            | 35              |
| 10       | <35        | 36             | 37              | <35            | <35            | 35              | <35          | <35                                  | <35            | 35              |
| 11       | <35        | 36             | 37              | <35            | <35            | 35              | <35          | <35                                  | <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            | 36              | <35            | <35            | 36              | <35          | <35                                  | <35            | 35              |
| 15       | <35        | <35            | 36              | <35            | <35            | 36              | <35          | <35                                  | <35            | 35              |

Notes: **Bold** text indicates predicted daytime noise levels that are more than marginally (3dB) above the INP criteria.

The results presented in Table 12.2 considered the effect of only worst case meteorological conditions in accordance with the INP assessment methodology and not all possible wind conditions that may be experienced at the site. At other times, therefore, noise levels can be lower than those presented.

The noise levels predominantly satisfy the non-mandatory INP project specific criteria at all assessment locations with only some locations (four) exceeding the criteria during the daytime and evening. The levels above criteria (shown in bold text in Table 12.2) are not considered to result in significant impacts at residences as they are not more than 10 dB above background noise levels (the INP defines significant

impact from industrial noise where  $L_{eq,15\text{minute}} > 10$  dB above RBL). Furthermore, existing ambient noise levels at residences during the daytime are typically higher than predicted site noise, and therefore would somewhat mask site noise. The potential for noise impacts is therefore considered low for the daytime, even though site noise levels are predicted to be marginally above target criteria during worst case weather conditions during the day.

The proposal is for the continuation of current operations for which there are no known noise complaints from local residents. Predicted noise levels are, therefore, considered to be appropriate limits that will not cause impacts to residents.

### 12.3.3 Road traffic noise

Road traffic noise from delivery of coal by trucks and site associated vehicles travelling along Medway Road may potentially impact on local residents in Medway Village. Under the proposal the number of truck movements per day is increasing from the current 48 per day to a maximum of 100 per day with hours of delivery remaining the same i.e. 6.00am to 9.00pm. Staff levels will also increase from 38 currently to 65 proposed and will be evenly split over the morning (6.00am – 4.00pm) and afternoon (2.45pm – 12.45am) operational shifts. As per current transport activities staff are expected to arrive at site in separate vehicles. Non-site related traffic volumes were also factored into potential road traffic noise calculations.

For road traffic noise assessment purposes the EPA's *Environmental Criteria for Road Traffic Noise 1999* (ECRTN) defines daytime as 7.00am to 10.00pm and night time 10.00pm to 7.00am. The site related day peak is assumed to occur between 4.00pm and 5.00pm when the morning shift employees are leaving and truck deliveries are occurring. The site related night peak is assumed to occur between 5.00am to 6.00am when the morning shift employees arrive as well as 6.00am to 7.00am when trucks deliveries begin.

Based on the above traffic volumes and peak hours, traffic noise at the closest representative residence with a façade 15 m from the centre of Medway Road is calculated in Table 12.3. This location is representative of residences east of the Loch Catherine access road and therefore excludes related truck movements which do not travel through Medway Village.

**Table 12.3** Calculated road traffic noise levels for closest representative residence, dB(A)

| Existing Peak hour $L_{eq,1\text{hour}}$ Noise Levels |                   |                   | Future Peak hour $L_{eq,1\text{hour}}$ Noise Levels |                   |                   |
|-------------------------------------------------------|-------------------|-------------------|-----------------------------------------------------|-------------------|-------------------|
| Day                                                   | Night (5am – 6am) | Night (6am – 7am) | Day                                                 | Night (5am – 6am) | Night (6am – 7am) |
| 54                                                    | 48                | 52                | 55                                                  | 50                | 54                |
| <b>Criteria*</b>                                      | <b>60</b>         | <b>55</b>         | <b>60</b>                                           | <b>55</b>         | <b>55</b>         |

Notes: \*Taken from EPA's ECRTN criteria for land use developments with potential to create additional traffic on a collector road (principal haulage route).

Road traffic noise associated with collector roads should not exceed the ECRTN noise criteria by more than 2dB. Future peak road traffic noise levels presented above in Table 12.3 are expected to increase above existing peak hour levels by 1 – 2 dB and are all below the ECRTN criteria.

As the night time peak occurs towards the end of the ECRTN's night time period there is expected to be less disturbance than if it occurred in the middle of this period. Additionally, road traffic noise levels

would be even less for weekends as there are generally no trucks deliveries on Sundays and only on Saturdays until the afternoon.

Vibration impacts from the haulage of coal by trucks along Medway Road are unlikely as the road is sealed.

#### 12.3.4 Noise monitoring

As the proposal will have no significant noise impacts no management or mitigation measures are deemed necessary. Quarterly attended noise monitoring will be conducted at the three monitoring locations shown in Figure 12.1 for the three operational shifts: day; evening; and night. The results from the quarterly monitoring and any necessary management or mitigation measures that arise will be included in the colliery's AEMR.

### 12.4 Conclusions

Potential noise impacts arising from operations at Berrima Colliery Pit Top and Loch Catherine and from road traffic have been assessed for the proposal (Appendix G).

The key findings of the noise impact assessment are the following:

- predicted operational noise levels at representative nearby receiver locations are unlikely to have significant impacts for the three operational shifts; and
- existing and future road traffic noise levels at the closest representative residence are below the relevant criteria.

Quarterly attended noise monitoring will be conducted under the proposal with the results provided in the AEMR.

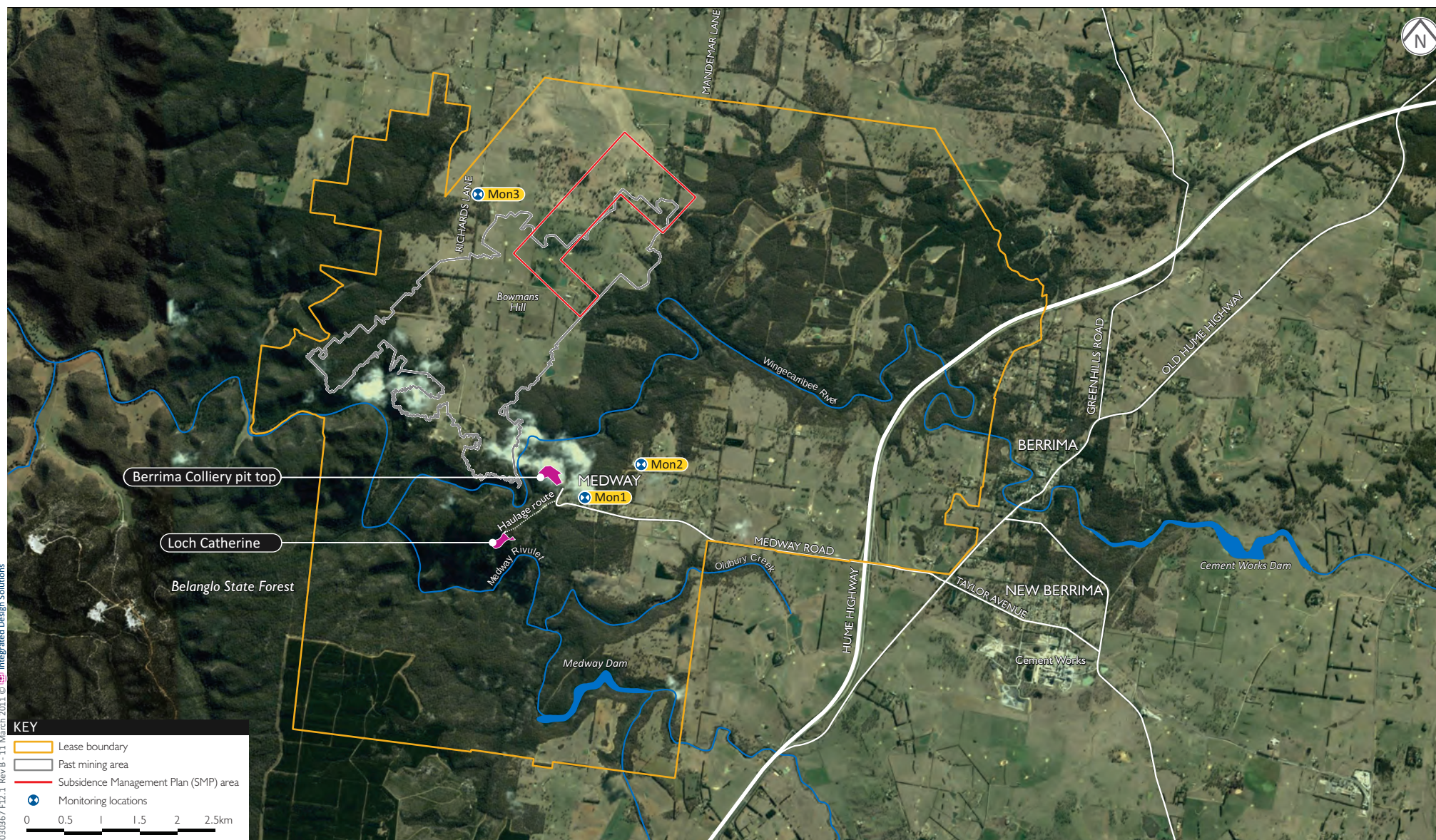


FIGURE 12.1  
Noise monitoring locations



FIGURE 12.2  
Noise assessment locations



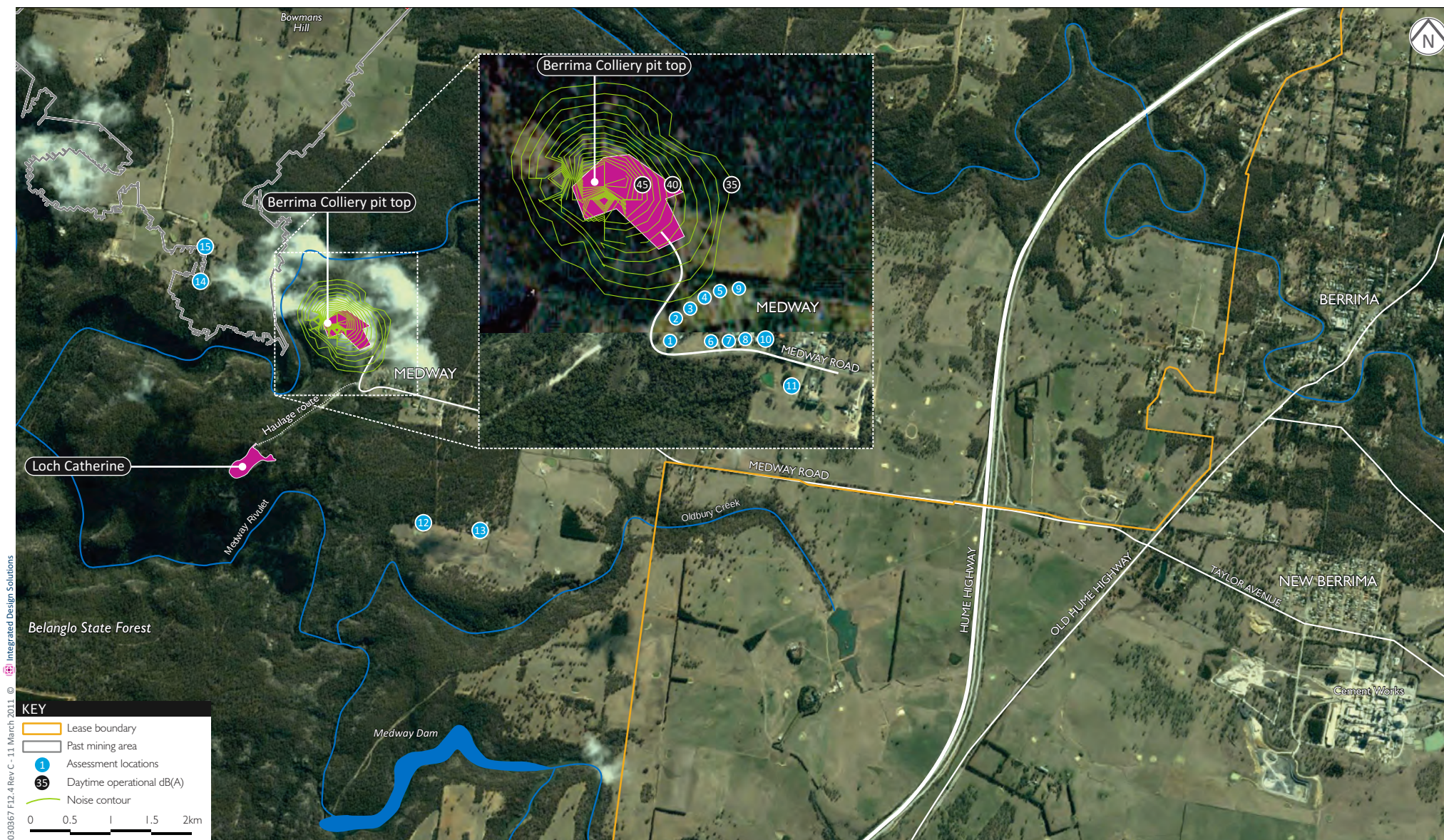


FIGURE 12.4  
Night time operational  $L_{eq, 15 \text{ minute}}$  noise levels, dB(A)

## 13 Air Quality

### 13.1 Introduction

An air quality assessment has been undertaken by ENVIRON Australia Pty Limited to investigate the potential air quality impacts associated with the proposal. The emissions generated within the Mining Lease have been assessed, specifically from 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 as the Hume Highway on-ramp.

The air quality assessment covered the following aspects of the proposal:

- characterisation of the existing environment, specifically the existing air quality, prevailing meteorology and regulatory context;
- quantification and modelling of dust emissions for the proposal 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<sub>10</sub>) 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.

This chapter provides a summary of the findings. A copy of the full air quality assessment is contained in Appendix H.

### 13.2 Existing environment

#### 13.2.1 General

Existing surface infrastructure will continue to operate under the proposal, including the ROM bin, primary crusher, coal loading bin, existing paved and unsealed haul routes and the Loch Catherine stockpile area.

Potential sources of atmospheric emissions associated with existing operations include:

- coal handling operations:
  - 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;
- windblown 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.

There are several dust control measures currently in place at Berrima Colliery which will continue under the proposal:

- coal is wet (8% moisture content);
- covered or partially covered conveyors;
- enclosed crusher;
- use of a truck loading chute;
- car park area and driveway is sealed;
- coal stockpiles and stockpile area are regularly sprayed using a water cart;
- watering of unpaved haul road sections and trafficked unsealed areas of the site using a water cart; and
- occasional sweeping.

### 13.2.2 Nearby residences and operations

The majority of Berrima Colliery's mining lease consists of privately owned rural (grazing) properties with the Berrima Colliery workings located in the north western portion of the lease. The village of Medway is located immediately south east of the pit top facilities and contains around 30 dwellings. A representative sample of the nearest potentially affected dwellings that are non-project related are shown in Figure 13.1.

Industrial activities operating within a 15 km radius of the Berrima Colliery include: Berrima Cement Works; Inghams Enterprises Pty Limited – Berrima Feedmill; and Austral Bowral Brickworks. These industrial operations are either National Pollutant Inventory (NPI) reporting activities and/or OEH licence holders and have been factored into the assessment of cumulative emissions.

### 13.2.3 Local meteorology

To characterise the climate and dispersion meteorology of the study area climate statistics were obtained from the BoM's weather station at Moss Vale and Boral Cement's meteorological monitoring station,

located 7.5 km south-east of Berrima Colliery. From these statistics it can be concluded that the study area is characterised by a mild climate, with mean daily temperatures in the range of 7°C to 19°C based on the long-term record. Peaks in temperature generally 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.

Annual rainfall ranges from approximately 370 mm to 1850 mm with the highest rainfall typically occurring during the February to June period (>80 mm per month). Although significant inter-annual variations in rainfall occur, intra-annual variations are small with rainfall occurring during all months of the year. On average 119 rain days occur per year, with nine to 11 rain days experienced each month on average.

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-north-westerly winds become increasingly prevalent. Winter is dominated by westerly and west-north-westerly 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. This indicates that thermo-topographic flows are not prevalent at the site. Daytime wind speeds were on average higher (3 m/s) than nocturnal wind speeds (1.9%), with a lower incidence of calm periods (12%) compared to the night-time (30%).

#### 13.2.4 Air quality monitoring data

Air quality monitoring has not historically been undertaken at Berrima Colliery and in October 2009 three dust deposition sampling sites were established for use in the baseline air quality characterisation. The first site is situated in close proximity to the Berrima Colliery Offices and coal loading bin, the second is located immediately north of Medway village and the third is situated adjacent to, but not in the immediate vicinity of, the unsealed haul road leading to the Loch Catherine stockpile area. Dust deposition rates recorded at these three sites are provided in Table 13.1.

**Table 13.1 Dust deposition rates recorded at Berrima Colliery sampling sites**

| 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/May 2010      | 1.1              | 1.2                      | 4.1                 |
| May/June 2010     | 0.7              | 0.8                      | 1.1                 |
| <b>Maximum</b>    | <b>4.0</b>       | <b>5.7</b>               | <b>4.1</b>          |
| <b>Average</b>    | <b>1.8</b>       | <b>2.1</b>               | <b>2.5</b>          |

Notes: \* As total insoluble solids

Airborne particulate concentrations at the colliery were determined from PM<sub>10</sub> measurements recorded at OEH's air quality monitoring site located on a residential property at Ridge Road, Oakdale. Due to its rural setting and location, similar to Berrima Colliery, it is considered that data recorded at this site will be sufficiently indicative of typical baseline PM<sub>10</sub> concentrations for the colliery. PM<sub>10</sub> concentrations are

recorded at the Oakdale air monitoring site using a tapered element oscillating microbalance. Summary statistics of PM<sub>10</sub> concentrations for the most recent five year period (2005 – 2009) are provided in Table 13.2.

**Table 13.2 PM<sub>10</sub> concentrations recorded at the OEH Oakdale monitoring site**

| Year | Data availability (%) | Average annual (µg/m <sup>3</sup> ) | Median 24-hour (µg/m <sup>3</sup> ) | Minimum 24-hour (µg/m <sup>3</sup> ) | Maximum 24-hour (µg/m <sup>3</sup> ) | No. of days >50µg/m <sup>3</sup> |
|------|-----------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|----------------------------------|
| 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                                |

PM<sub>10</sub> concentrations recorded during the 2009 year are concluded to have been substantially impacted by regional natural events (the dust storm of September 2009) and atypical of average baseline conditions. This year was therefore excluded from use in the baseline air quality characterisation for cumulative impact assessment purposes.

### 13.2.5 Background dusts levels

For the purposes of assessing the potential air quality impacts of the proposal, an estimate of background air quality parameters is required. The PM<sub>10</sub> concentrations and dust deposition rates expected to be characteristic of baseline conditions, as determined based on the air quality monitoring data, are summarised in Table 13.3.

**Table 13.3 Background dust levels for cumulative assessment purposes**

| Averaging period           | Ambient PM <sub>10</sub> concentrations | Dust deposition                   |
|----------------------------|-----------------------------------------|-----------------------------------|
| Highest daily average      | 40 – 70 µg/m <sup>3</sup>               | N/A                               |
| Exceedances of daily limit | 0 – 1 days/year                         | N/A                               |
| Annual average             | 12 – 14 µg/m <sup>3</sup>               | 1.8 – 2.5 g/m <sup>2</sup> /month |

Due to the absence of monitoring data it is difficult to quantify background TSP concentrations. For the purposes of the impact assessment project-related TSP concentrations were compared to the DECCW annual average TSP criterion to be indicative of the relative significance of such concentrations.

## 13.3 Impact assessment

### 13.3.1 Air quality criteria

#### i Dust deposition

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 13.4 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 13.4 DECCW goals for allowable dust deposition**

| Averaging period | Maximum increase in deposited dust level | Maximum total deposited dust level |
|------------------|------------------------------------------|------------------------------------|
| Annual           | 2 g/m <sup>2</sup> /month                | 4 g/m <sup>2</sup> /month          |

Source: AMMAAP, 2005

ii TSP and PM<sub>10</sub>

Air quality limits for particulates are typically given for various particle size fractions, including TSP and inhalable particulates or PM<sub>10</sub>. Although TSP is defined as all particulate with an aerodynamic diameter of less than 100 micro metres (µm), an effective upper limit of 30 µm aerodynamic diameter is frequently assigned. PM<sub>10</sub> is of concern as fine particles are able to be deposited in, and cause damage to, the lower airways and gas exchanging portions of the lung.

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 13.5.

**Table 13.5 Impact assessment goals for airborne particulates**

| Pollutant        | Averaging period | Concentration (µg/m <sup>3</sup> ) | Reference       |
|------------------|------------------|------------------------------------|-----------------|
| TSP              | annual           | 90                                 | NSW DECCW(a)(b) |
| PM <sub>10</sub> | 24 hours         | 50                                 | NSW DECCW(a)    |
|                  | 24 hours         | 50(d)                              | NEPM(c)         |
|                  | annual           | 30                                 | NSW DECCW(a)    |

Notes: (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<sub>10</sub> assessment goal of 50 µg/m<sup>3</sup> is numerically identical to the equivalent National Environment Protection Measure (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<sub>10</sub> particle size fraction is typically of the order of 40% of the TSP mass. In semi-urban and urban areas impacted by motor vehicles, such as Berrima Colliery, this percentage may be expected to be even higher. Based on this PM<sub>10</sub> to TSP ratio, the impact assessment goal for TSP would be equivalent to an annual PM<sub>10</sub> goal of at least 36 µg/m<sup>3</sup>. Thus, the historical NHMRC goal may be regarded as less stringent than the DECCW PM<sub>10</sub> goal of 30 µg/m<sup>3</sup> 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<sub>10</sub> goal is satisfied, predictions of annual average TSP concentrations are provided within this report for completeness.

### iii Project specific air quality assessment criteria

Based on the assessment goals provided in Table 13.5 and Table 13.4 the NSW DECCW air quality impact assessment criteria applicable to the assessment of the current proposal are provided below.

|                    |                                                                                                                                          |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| PM <sub>10</sub> : | A 24-hour maximum of 50 µg/m <sup>3</sup><br>An annual average of 30 µg/m <sup>3</sup>                                                   |
| TSP:               | An annual average of 90 µg/m <sup>3</sup>                                                                                                |
| Dust deposition:   | Nuisance expected to impact at surrounding residences when total annual average dust deposition levels exceed 4 g/m <sup>2</sup> /month. |

### 13.3.2 Methodology

To assess both total and incremental emissions and associated impacts of the proposal, emissions were quantified from both existing and maximum Berrima Colliery operations. The proposal comprises the continuation of existing surface operations at the Berrima Colliery with a maximum production rate of 460,000 tpa ROM coal, an increase from the current production rate of 220,000 tpa, which is consistent with maximum volumes produced in the past at the colliery.

The methodology 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.

The air quality assessment focused on the quantification of fugitive dust emissions. 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<sub>10</sub>) were estimated and resultant concentrations simulated for the purpose of assessing compliance with the air quality criteria provided in Table 13.5.

### 13.3.3 Estimation of existing Berrima Colliery emissions

Emissions for current Berrima Colliery operations were estimated taking into account the current dust mitigation measures as described in Section 13.2.1. The greatest sources of TSP emissions from the colliery were estimated to be paved roads, followed by unpaved roads and stockpile erosion. The greatest source of PM<sub>10</sub> emissions were estimated to be erosion of the stockpile at Loch Catherine, followed by unpaved roads and paved roads. Other sources that contribute to emissions (in order of contribution) include: materials handling; coal crushing; front end loader operations; and vent shaft emissions. Total emissions for current operations were estimated as 22.69 tpa for TSP and 7.62 tpa for PM<sub>10</sub>.

### 13.3.4 Estimation of Berrima Colliery emissions under the proposal

The emissions from Berrima Colliery operations under the proposal were estimated factoring in the increased production rate and associated increase in rate of activities. Additional control measures to those for existing colliery operations were included including water of unpaved roads increased from 60% to 80% and the restriction of vehicle speed within the vicinity of Medway to 30 km/hr. Given the proposed operations and the new controls the proposal-related emissions were estimated and are presented in Table 13.6.

**Table 13.6** Estimated emissions for proposal-related Berrima Colliery operations

| Source                      | TSP (tpa)    | PM <sub>10</sub> (tpa) |
|-----------------------------|--------------|------------------------|
| Paved roads                 | 11.18        | 2.15                   |
| Unpaved roads               | 5.78         | 1.49                   |
| Materials handling          | 4.98         | 2.19                   |
| Coal crushing               | 4.50         | 1.80                   |
| Front end loader operations | 3.26         | 1.58                   |
| Stockpile wind erosion      | 5.29         | 2.65                   |
| Vent Shaft emissions        | 0.52         | 0.26                   |
| <b>Total</b>                | <b>35.51</b> | <b>12.11</b>           |

Similarly to existing emissions under the proposal 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 sprays on unpaved roads and the periodic use of road sweeping. The contributions of these sources are lower for PM<sub>10</sub> due to the smaller percentage of fines in road surface material relative to other sources. Wind erosion from the coal stockpile at Loch Catherine represents a significant contribution to both TSP and PM<sub>10</sub> emissions, with the contribution of coal crushing, front end loader operations and materials handling being of a similar order to existing emissions.

### 13.3.5 Air quality assessment

In assessing the air quality impacts due to the proposal it is relevant to evaluate annual average TSP concentrations and dust deposition rates, and maximum daily and annual average PM<sub>10</sub> concentrations against regulatory assessment criteria. Criteria relevant to the proposal are provided in Section 13.3.1.iii.

#### i Dust deposition

As discussed in Section 13.2.4 atmospheric emissions from current operations are expected to have contributed to dust deposition rates recorded in the vicinity. To assess likely increases in dust deposition levels due to the proposal it is necessary to establish the contribution of current operations to dust deposition rates.

The predicted contribution of current operations to measured dust deposition rates at dust deposition sampling sites are presented in Table 13.7.

**Table 13.7 Comparison of measured dust deposition with dust deposition predicted due to current Berrima Colliery operations**

| Monitoring site         | Period Average dust deposition (g/m <sup>2</sup> /month) |                                                             |                            |
|-------------------------|----------------------------------------------------------|-------------------------------------------------------------|----------------------------|
|                         | Measured (g/m <sup>2</sup> /month)                       | Predicted due to Berrima Colliery (g/m <sup>2</sup> /month) | Predicted as % of measured |
| Site 1 – Office         | 1.8                                                      | 2.5                                                         | 133                        |
| Site 2 – Medway Village | 2.1                                                      | 0.9                                                         | 40                         |
| Site 3 – Stockpile      | 2.5                                                      | 1.0                                                         | 41                         |

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).

Dust deposition levels at nearby residences predicted to occur due to the proposal are presented in Table 13.8.

**Table 13.8 Dust deposition predicted due to Berrima Colliery operations**

| Receptor                        | Location            | Dust deposition (g/m <sup>2</sup> /month) |                            | Incremental dust deposition rates due to up-scaled operations (g/m <sup>2</sup> /month) | Project related deposition as a % of the incremental deposition criterion of 2g/m <sup>2</sup> /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                                      | 0.02                       | 0.00                                                                                    | 0.7                                                                                                   |
| R15                             | 1km NW of Pit Top   | 0.01                                      | 0.02                       | 0.00                                                                                    | 0.6                                                                                                   |
| R16                             | New Berrima         | 0.00                                      | 0.00                       | 0.00                                                                                    | 0.2                                                                                                   |
| <b>Maximum across receptors</b> |                     | <b>0.64</b>                               | <b>1.07</b>                | <b>0.42</b>                                                                             | <b>53.4</b>                                                                                           |

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<sup>2</sup>/month at this site, representing 53% of the DECCW Incremental Dust Deposition Criterion and an increment of

0.4 g/m<sup>2</sup>/month above levels predicted due to current operations. All predicted dust deposition levels at nearby receivers are below the incremental deposition criterion of 2 g/m<sup>2</sup>/month.

## ii TSP concentrations

Annual average TSP concentrations at nearby residences predicted to occur due to the proposal are presented in Table 13.9.

**Table 13.9 Annual TSP concentrations predicted due to Berrima Colliery operations**

| Receptor                        | Location            | Annual Average TSP concentrations (µg/m <sup>3</sup> ) |                            | Increment in annual TSP concentrations due to up-scaled operations (µg/m <sup>3</sup> ) | 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                                                                         |
| <b>Maximum across receptors</b> |                     | <b>9.0</b>                                             | <b>14.4</b>                | <b>6.4</b>                                                                              | <b>7.1</b>                                                                  |

Notes: (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.

The highest annual average TSP concentration across selected receptor sites was predicted to occur at R1 within Medway Village (14.4 µg/m<sup>3</sup>), with peak increments in annual TSP concentrations due to production up-scaling occurring at R7 within Medway village (6.4 µg/m<sup>3</sup> increment). All predicted TSP concentrations at nearby receivers are well below the DECCW annual average TSP criterion of 90 µg/m<sup>3</sup>.

## iii Ambient PM<sub>10</sub> concentrations

Ambient maximum daily and annual average PM<sub>10</sub> concentrations at nearby residences predicted to occur due to the proposal are presented in Table 13.10 and Table 13.11 respectively.

**Table 13.10 Highest daily PM<sub>10</sub> concentrations predicted due to Berrima Colliery operations**

| Receptor                        | Location            | Maximum daily PM <sub>10</sub> concentrations (µg/m <sup>3</sup> ) |                            | Increment in maximum daily PM <sub>10</sub> concentrations due to up-scaled operations (µg/m <sup>3</sup> ) |
|---------------------------------|---------------------|--------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------|
|                                 |                     | 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                                                                                                         |
| <b>Maximum across receptors</b> |                     | <b>35.9</b>                                                        | <b>46.8</b>                | <b>19.8</b>                                                                                                 |

The predicted PM<sub>10</sub> concentrations resulting from the proposal are below the criterion for the 24-hour maximum of 50 µg/m<sup>3</sup> and the annual average of 30 µg/m<sup>3</sup> as shown in Table 13.10 and Table 13.11. The highest project-related maximum daily and annual average PM<sub>10</sub> concentration across selected receptor sites was predicted to occur at R1 within Medway Village (46.8 µg/m<sup>3</sup> and 8.7 µg/m<sup>3</sup> respectively). The increment in annual PM<sub>10</sub> concentrations at this receptor due to up-scaling of production was predicted to be 3.1 µg/m<sup>3</sup>. Peak increment in peak daily average PM<sub>10</sub> concentration due to up-scaling was predicted to occur at R7 within Medway village (19.8 µg/m<sup>3</sup> increment).

Berrima Colliery's contribution to ambient PM<sub>10</sub> concentrations at residential sites further afield than Medway village, such as New Berrima, are predicted to be negligible.

**Table 13.11 Annual PM<sub>10</sub> concentrations predicted due to Berrima Colliery operations**

| Receptor | Location       | Annual average PM <sub>10</sub> concentrations (µg/m <sup>3</sup> ) |                            | Increment in maximum daily PM <sub>10</sub> concentrations due to up-scaled operations (µg/m <sup>3</sup> ) |
|----------|----------------|---------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------|
|          |                | 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                                                                                                         |

**Table 13.11 Annual PM<sub>10</sub> concentrations predicted due to Berrima Colliery operations**

| Receptor                            | Location            | Annual average PM <sub>10</sub> concentrations (µg/m <sup>3</sup> ) |                            | Increment in maximum daily PM <sub>10</sub> concentrations due to up-scaled operations (µg/m <sup>3</sup> ) |
|-------------------------------------|---------------------|---------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------|
|                                     |                     | Current operations                                                  | Project-related operations |                                                                                                             |
| 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                                                                                                         |
| <b>Maximum across all receptors</b> |                     | <b>5.6</b>                                                          | <b>8.7</b>                 | <b>3.1</b>                                                                                                  |

### 13.3.6 Cumulative assessment

In assessing cumulative dust deposition due to the Project, the period-average dust deposition rate measured at the Medway village site (Site 2 – 2.1 g/m<sup>2</sup>/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. Maximum cumulative dust deposition rates were predicted to occur at R1 and estimated to be 2.5 g/m<sup>2</sup>/month, 63% of the DECCW criterion of 4 g/m<sup>2</sup>/month.

As discussed in Section 13.2.5 there is a lack of sufficient monitoring data to estimate background levels and therefore to estimate the proposal's contribution to cumulative TSP emissions. The predicted TSP emissions resulting from the proposal were compared against the DECCW's annual average TSP criterion for cumulative concentrations (see Table 13.9). The project-related TSP concentrations predicted were well below the criterion of 90 µg/m<sup>3</sup> with a maximum value across all receivers of 14.4 µg/m<sup>3</sup>.

The proposal's contribution to cumulative dust deposition rates and ambient TSP concentrations at residential sites further afield than Medway village, such as New Berrima is predicted to be negligible.

As discussed in Section 13.2.4 annual average PM<sub>10</sub> concentrations measured at the Oakdale air quality monitoring station was assumed representative of background levels across selected receptors. In assessing cumulative annual average PM<sub>10</sub> concentrations due to the proposal, proposal-related annual average PM<sub>10</sub> concentrations were summed with this 'background level' and compared with the DECCW's annual average PM<sub>10</sub> criterion of 30 µg/m<sup>3</sup>. Maximum cumulative annual average PM<sub>10</sub> deposition rates were estimated to be 22.7 µg/m<sup>3</sup>, representing 76% of the DECCW criterion.

In the case of daily PM<sub>10</sub> concentrations, where exceedances of the DECCW criterion of 50 µg/m<sup>3</sup> has been observed to occur (0 - 1 days/year excluding atypical exceedances in 2009 – see Table 13.2), it is necessary to determine whether PM<sub>10</sub> concentrations due to Berrima Colliery operations are likely to result in additional exceedances of the criterion. In cases where the daily PM<sub>10</sub> 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<sub>10</sub> concentrations due to

Berrima Colliery operations and assess the probability of such concentrations resulting in criterion exceedances at nearby receptors. Given the low percentage of time that background concentrations exceed  $45 \mu\text{g}/\text{m}^3$  (ranges from 0.3% to 0.6% across years) it is evident that there is a low probability of proposal-related  $\text{PM}_{10}$  concentrations predicted at Medway village centre resulting in an additional exceedance of the daily  $\text{PM}_{10}$  criterion.

### 13.3.7 Greenhouse gas emissions

A greenhouse gas emission assessment was conducted by EMM for the proposal (Appendix I). Greenhouse gases (GHG) will be emitted as a result of the proposal from the transport and burning of coal. GHGs are categorised into direct emissions (known as Scope 1 and 2 emissions) as well as indirect emissions (known as Scope 3 emissions).

It has been estimated that the average annual emissions estimated for the lifetime of the proposal for Berrima Colliery is 1.098 Mt carbon dioxide equivalent ( $\text{CO}_2\text{-e}$ ). The total  $\text{CO}_2\text{-e}$  emissions for the State of NSW in 2007 were 162.7 megatonnes (Mt)  $\text{CO}_2\text{-e}$ . The colliery's average annual emissions of 1.098 Mt  $\text{CO}_2\text{-e}$  equal approximately 0.67% of the total emissions for NSW in 2007. In 2007, Australia's total greenhouse gas emissions were estimated at 541.2 Mt  $\text{CO}_2\text{-e}$ . When comparing emissions for the proposal, the predicted increase is 0.2% of total 2007 Australian emissions. The GHG contribution to world emissions from  $\text{CO}_2\text{-e}$  emissions produced from the proposal is an increase of 0.001%, when comparing emissions to the current global  $\text{CO}_2\text{-e}$  load of approximately 3,000 gigatonnes (Gt)  $\text{CO}_2\text{-e}$ . Based on predicted temperature increases globally annual average emissions from the proposal could lead to an annual increase in global temperature of  $0.00003^\circ\text{C}$ .

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.

## 13.4 Mitigation and management

Predicted air quality impacts were concluded to comply with DECCW's 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, the air quality assessment recommends 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  $2 \text{ g}/\text{m}^2$  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 which will continue under the proposal.  $\text{PM}_{10}$  monitoring is not currently considered necessary. However, in the event that average dust deposition rates at the Medway Village site are observed to be increasing, a

PM10 monitoring campaign will be undertaken to assess suspended particulate concentrations at the Medway village. All monitoring should be conducted in accordance with applicable Australian Standards.

### 13.5 Conclusions

The air quality assessment has assessed the potential air quality impacts of the proposal (Appendix H). Modelling fugitive dust and particulate matter emissions from existing operations and the proposal was undertaken. Existing air quality was determined to assess the proposals potential contribution to cumulative air quality levels.

The results show that, given the general design and operational safeguards documented within the air quality assessment are implemented, particulate matter and dust deposition emissions associated with the proposal are likely to be within the current NSW DECCW air quality goals at all nearby non-project related residences.

The key recommendations of the air quality assessment were additional management measures for paved and unpaved roads and PM<sub>10</sub> monitoring in Medway village.



FIGURE 13.1  
Air quality assessment locations

## 14 Surface Water

### 14.1 Introduction

A water quality assessment was undertaken by Strategic Environmental and Engineering Consulting Pty Limited (SEEC) to assess the potential impacts of the proposal on surface water. Berrima Colliery produces groundwater from the underground workings which is re-used, stored or discharged into Wingecarribee River. Groundwater produced is treated in a number of ways, either:

- re-used at the colliery; or
- stored and made available to the residents of Medway for non-potable purposes; or
- released to the Wingecarribee River, which forms part of Sydney's drinking water catchment.

The water quality assessment provides the following:

- description of results of recent water quality testing;
- comparison of results to current environmental and health guidelines; and
- recommendations for new water quality objectives (WQOs) to be incorporated into a new EPL that will be required for the site.

This chapter provides a summary of the findings. A copy of the full water quality assessment is contained in Appendix J.

Commissioning of SEEC to undertake the water quality assessment followed discussions with SCA regarding requirements for the study.

### 14.2 Existing environment

Groundwater produced at the colliery enters the mine workings and is transferred to a discharge point close to a discharge adit (see Figure 14.1). From the adit, groundwater is either pumped for re-use in the colliery and the village or it is discharged into the Wingecarribee River through a V-Notch Weir.

It is estimated that just over 3 ML of groundwater seeps into the Berrima Colliery per day. Around 98% of this is discharged into Wingecarribee River. Generally around 14 ML per year is used at the colliery for dust suppression, wash down of equipment and in the ablutions which is an average of 38,000 L per day. The maximum groundwater use at the colliery is 60,000 L and is usually on non-rainy days, operational days. Conversely on rainy, non-operational days there is minimal to no water use at the colliery. On average approximately 300 L of groundwater is used per day by residents at Medway village.

The existing EPL permits discharge into the river from the colliery subject to certain water quality criteria being achieved. The criteria for groundwater discharge are provided in Table 14.1 below.

**Table 14.1** Current EPL water quality targets

| Parameter                      | 100 <sup>th</sup> percentile concentration limit |
|--------------------------------|--------------------------------------------------|
| Oil and grease                 | 10mg/L                                           |
| Total Suspended Solids (TSS)   | 50mg/L                                           |
| pH                             | 6.5 – 8.5                                        |
| Biological Oxygen Demand (BOD) | 20mg/L                                           |

### 14.3 Impact assessment

#### 14.3.1 Water quality objectives

As discussed above, groundwater produced by the colliery is used for non-potable purposes such as garden irrigation. The water quality, therefore, needs to be suitable for direct human contact and will need to achieve the health requirements set out in the then *Department of Water and Energy 2008*. Additionally, groundwater produced from the colliery is discharged into Wingecarribee River. The water quality will also, therefore, need to achieve the relevant environmental requirements as given in *Healthy Rivers Commission 1998*, the ANZECC guidelines and *Sydney Catchment Authority (SCA) 2010*.

The health and environmental requirements described above have been combined to form proposed WQOs for the proposal and are provided in Table 14.2 below.

**Table 14.2** Proposed water quality objectives

| Parameter                                           | Concentration limits <sup>1</sup> (µg/L unless shown otherwise) |
|-----------------------------------------------------|-----------------------------------------------------------------|
| <b>Health requirements for direct human contact</b> |                                                                 |
| E Coli                                              | < 1 cfu/100ml (100 <sup>th</sup> percentile)                    |
| BOD                                                 | < 10 mg/L (100 <sup>th</sup> percentile)                        |
| Turbidity                                           | < 2 NTU (95 <sup>th</sup> percentile)                           |
|                                                     | < 5 NTU (100 <sup>th</sup> percentile)                          |
| pH                                                  | 6.5 – 8.5 <sup>2</sup>                                          |
| <b>Environmental requirements</b>                   |                                                                 |
| Total Phosphorous                                   | 20                                                              |
| Total Nitrogen                                      | 250                                                             |
| Chlorophyll-a                                       | 5                                                               |
| Arsenic                                             | 50                                                              |
| Barium                                              | 1,000                                                           |
| Boron                                               | 1,000                                                           |
| Cadmium                                             | 5                                                               |
| Chromium                                            | 50                                                              |
| Cyanide                                             | 100                                                             |
| Lead                                                | 50                                                              |
| Mercury                                             | 1                                                               |
| Nickel                                              | 100                                                             |
| Selenium                                            | 10                                                              |
| Silver                                              | 50                                                              |
| Aluminium                                           | 200                                                             |

**Table 14.2 Proposed water quality objectives**

| Parameter                     | Concentration limits <sup>1</sup> (µg/L unless shown otherwise) |
|-------------------------------|-----------------------------------------------------------------|
| Ammonia (as N)                | 10                                                              |
| Chloride                      | 400,000                                                         |
| Copper                        | 1,000                                                           |
| Oxygen                        | > 6.5 (> 80% saturation)                                        |
| Hardness (CaCO <sub>3</sub> ) | 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                          | 5,000                                                           |
| Oil and Grease                | 10,000                                                          |

Notes: 1. 80th percentile unless shown otherwise adopted from ANZECC 2000

1 mg = 1,000 µg

Total Dissolved Solids (µg/L) = Electrical conductivity (µS/cm) x 600

### 14.3.2 Water quality monitoring

#### i V-Notch Weir

Groundwater from the colliery is discharged at the V-Notch Weir in Wingecarribee River (Figure 14.1). Water quality data has been collected at this point from 2008 to date although some of this data is limited. The full data set is given in Appendix 1 of the water quality assessment (Appendix J).

From the data collected the following conclusions were drawn:

- not all the WQOs given in Table 14.2 have been tested for, although all the parameters given in Table 14.1 have;
- WQOs given in Table 14.2 are met with the following exceptions:
  - manganese, which is consistently about 3,000 micrograms per litre (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;
- iron is elevated but does not exceed the WQO (although it did in the river itself on 11 March 2010);
- concentrations of most substances are very low and, in many cases, are undetectable;
- turbidity was not tested but TSS was generally very low (<five milligrams per litre (mg/L)) and so turbidity would be expected to be low too; and

- the water is suitable for domestic re-use.

## ii Wingecarribee River

Since 2008 water quality data has been collected in Wingecarribee River upstream and downstream of the discharge point (Figure 14.1). The full data set is given in Appendix 1 of the water quality assessment (Appendix J). From the data collected the following conclusions were drawn:

- 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); and
- 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.

Accordingly, the test results from the river suggest that manganese and iron are naturally occurring metals that are present in the local system.

## iii Groundwater volume

The volume of groundwater produced at the colliery varies depending on conditions at the coal face. Generally 3 mega litres per day (ML/day) is discharged at the V-Notch weir and the EPL allows for 10 ML/day. Flow in the Wingecarribee River is heavily regulated by releases from Wingecarribee Dam. However, there is a current moratorium on releases from there and no such flows have occurred since March 2010. Prior to this, water was being transferred into the Wingecarribee from the Shoalhaven River to supplement Sydney's water supplies.

A search of the NSW Water Information website found no active gauging stations on the Wingecarribee River but there is a SCA monitor at Berrima Weir. Since March 2010, natural flows have varied from 1.4 to 9,500 ML/day. Three ML/day is, therefore, less than 1% of the natural flow and is not a significant volume of water.

### 14.3.3 Results

There is limited historical water quality data available for the colliery i.e. from 2008 to 2010. Additionally, many of the proposed WQOs have not been tested for in the past and the results therefore cannot be adequately analysed. Nevertheless, the results over that period have been quite consistent. However, the available data suggests that the mine water is generally very good, with the exceptions of high concentrations of manganese and slightly elevated levels of nickel.

Simultaneous upstream and downstream monitoring of the river showed that, after dilution, the level of Manganese is reduced to about the WQO whilst the level of Nickel is reduced to below the WQO. Testing in the river on that day also showed elevated levels of iron. The data also suggests it is possible that mine water is able to raise the concentration of manganese in the river.

The concentrations of manganese and nickel are diluted upon entering the river. In regards to the environmental impacts of manganese the NPI states the following:

*“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”.*

We do not know the effect of the elevated manganese in the river. However, as mine water has been flowing into the river for over 100 years it is considered to have become a significant part of the rivers flow. Therefore, the proposal is considered to have a neutral effect on the water quality of Wingecarribee River. There are no known health issues with an elevated manganese level but there are possible aesthetic issues (e.g. it can stain clothing if present in water).

## 14.4 Mitigation and management

### 14.4.1 Water quality

Water quality monitoring will be conducted upstream and downstream of the discharge point at the V-notch weir. The upstream monitoring point will be used as a reference point for the monitoring program. Monitoring will include event base sampling under a representative range of rainfall events to provide information on the potential pollutant loads and impacts during "wet" periods (i.e. during/following significant rainfall events). Requirements for event based monitoring will be set out in a Surface Water Management Plan for Berrima Colliery.

The WQOs given in Table 14.2, with the exception of the health requirements, are objectives that technically apply to the receiving water (the Wingecarribee River), not to the mine water itself. Past testing has shown that generally the quality of groundwater produced is good in terms of relevant health and environmental guidelines. Treatment of the groundwater prior to discharge or reuse is therefore not considered to be required. It is considered that if the mine water quality meets the WQOs then it can be said that its discharge will have no detrimental impact on the river.

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

Simultaneous (same dry (five) day) water quality testing will be undertaken at four locations:

- at the V-Notch weir;
- upstream of the V-Notch weir (but as close as possible to it);
- further upstream of the V-Notch weir; and
- downstream of the V-Notch weir, at a point far enough downstream to allow adequate mixing but preferably above Medway Rivulet.

The proposed monitoring locations are shown in Figure 14.1.

Based on the results of water testing, actions will be taken to determine whether water quality has or has not been unduly affected. As time progresses water quality data will become more reliable. Once there becomes a statistically valid number of data (at least 10) a trigger for further investigation will be deemed to occur when the 80<sup>th</sup> percentile of an indicator exceeds the value given in Table 14.2. Until that point the values will be deemed to be 100<sup>th</sup> percentile values. If a trigger occurs a suitably qualified consultant will be employed to investigate the exceedance and to liaise with NOW to develop a remedial plan. The plan will include remedial measures that will be determined based on the nature of the exceedance.

Remedial measures may include the treatment of the mine water prior to discharge if investigations show that the mine water is the source of the exceedance.

#### 14.4.2 Soil and water management

Proposed soil and water management measures are detailed in Soil and Water Management Plans (SWMPs) for the pit top and Loch Catherine shown in brief in Figures 14.2 and 14.3 respectively and in detail in Appendix K. Water run-off and sediment control measures will be implemented during the clearance of vegetation in an around the pit-top and Loch Catherine to ensure the water quality of receiving environments is not impacted.

The SWMPs have been developed in accordance with the requirements of Managing Urban Stormwater: Soils and Construction (the Blue Book) Volumes 1 and 2E – Mines and Quarries (Landcom 2004 and DECC 2008). The detailed SWMPs include notes, text and calculations as the Blue Book requires.

In summary, proposed soil and water management measures for the site include the following:

- pit top:
  - runoff from the clean water catchment area is captured in clean water diversion drains and diverted to clean water discharge points at the west and south-east of the pit top;
  - runoff from the dirty water catchment area (unpaved areas of the site) is captured in dirty water diversion drains is diverted to sediment basins 1, 2 or 3;
  - sediments basins 1 and 2 will be drained and cleaned out within five days after the conclusion of a rain fall event;
  - sediment basins 1 and 2 will be drained by pumping water to sediment basin 3 for final settling or suspension of sediments or if water contains 50mg/L or less of sediments will be pumped onto adjacent stabilised outlet point;
- Loch Catherine:
  - runoff from the dirty water catchment area is captured in a dirty water diversion drain at the south of the stockpile area and diverted to sediment basin 4 or drains directly to the basin;
  - sediment basin 4 is self draining however if water doesn't drain to at least 0.6m below the spillway level within 5 days after the conclusion of a rainfall event it will be pumped into the two filter dams to the east of the stockpile area for final settling.

#### 14.5 Conclusions

The potential impacts of the proposal on water quality have been assessed (Appendix J). Groundwater produced from at Berrima Colliery is used for domestic purposes as well as being discharged into Wingecarribee River, part of Sydney's drinking water catchment. Based on this dual use a set of WQOs have been proposed for water quality testing to achieve both health and environmental requirements.

Under the proposal water quality testing will be undertaken at three locations: the V-Notch weir, and upstream and downstream of the weir. If the WQOs are exceeded this will trigger a process of further assessment and remedial measures as required. Upgrades to the existing surface water management for Berrima Colliery and Loch Catherine will also form part of the proposal.

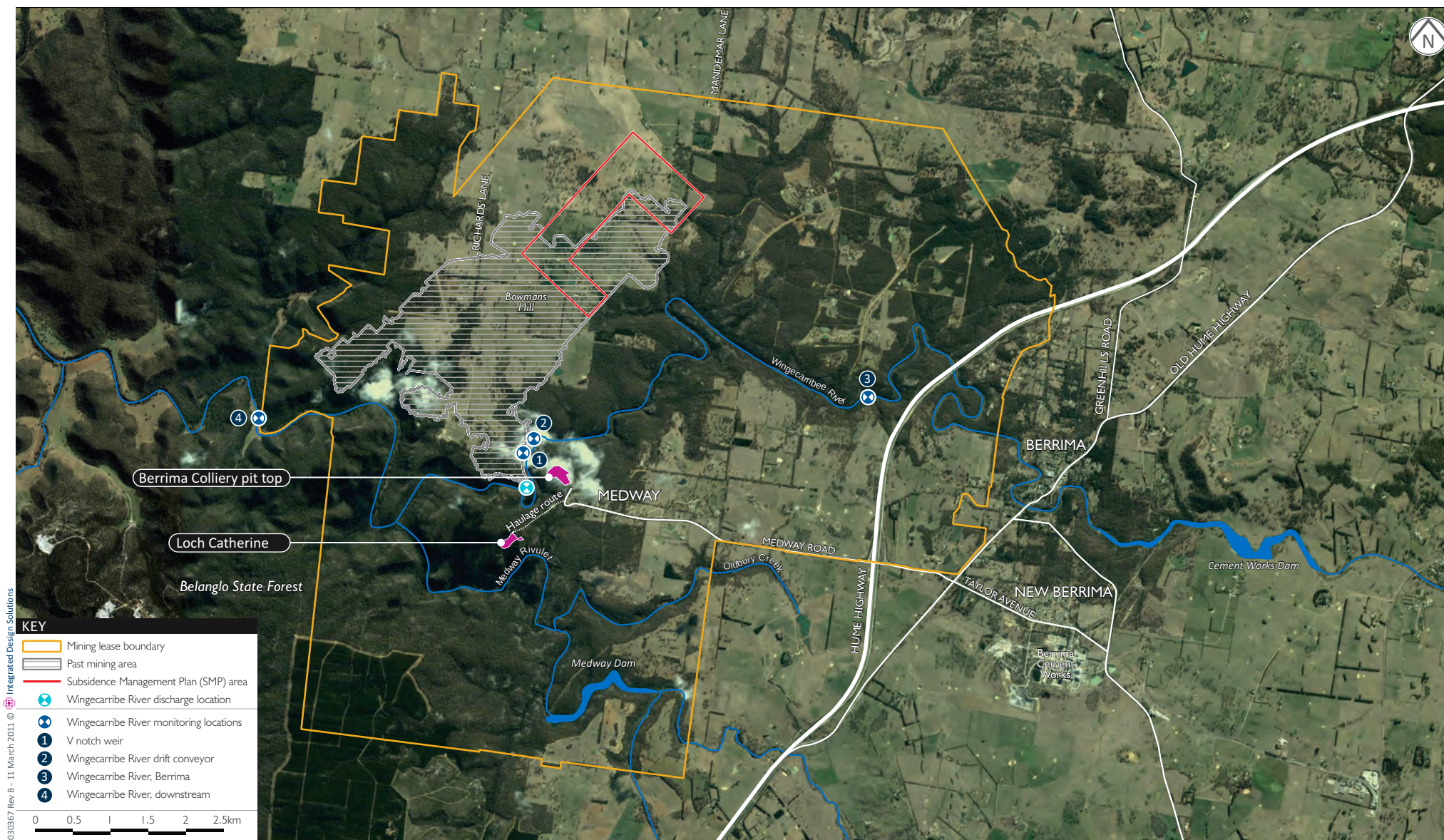


FIGURE 14.1  
Wingecarribee River discharge and monitoring locations

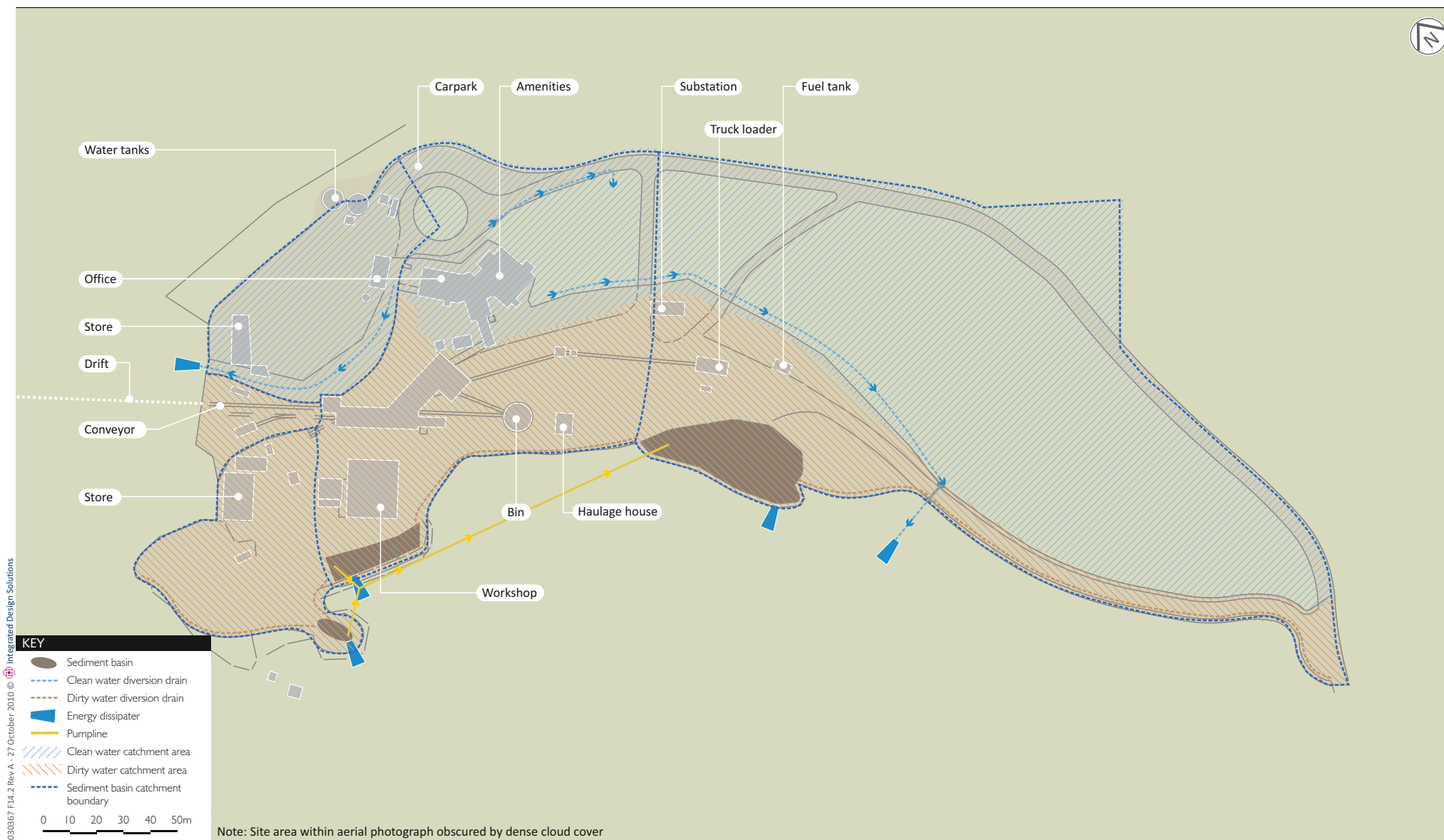


FIGURE 14.2  
Berrima Colliery Pit Top SWMP

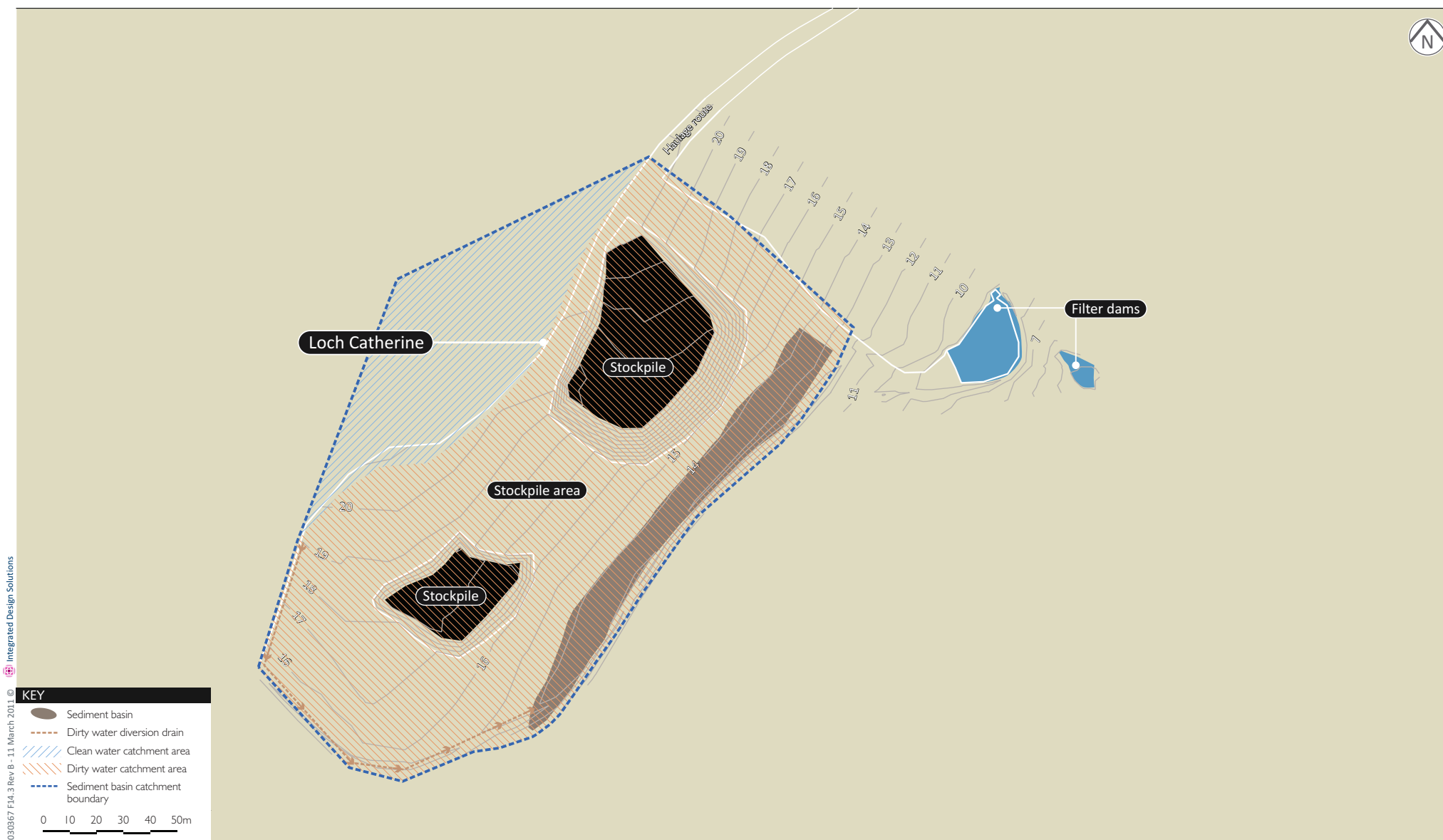


FIGURE 14.3  
Loch Catherine SWMP

## 15 Ecology

### 15.1 Introduction

A terrestrial ecology assessment was prepared by OzArk Environmental & Heritage Management Pty Limited to assess the potential ecological impacts of the proposal. Specifically the assessment includes the following:

- documentation of the ecological values in the SMP area; and
- assessment of the ecological impacts associated with the clearing of approximately 3.6ha of vegetation for:
  - extending the area of occupancy of the stockpiling area at Loch Catherine; and
  - implementing APZs around the extended Loch Catherine and the Berrima Colliery pit top area;

This chapter provides a summary of the findings. A copy of the full assessment is contained in Appendix L.

### 15.2 Existing environment

#### 15.2.1 Proposed works

Potential ecological impacts of the proposal include subsidence and clearing of habitat. Subsidence is likely to occur within an area of approximately 172.5 ha above extraction panels 59, SW1 and 406, known as the SMP area. Land within the SMP area has been predominately cleared (approximately 152ha) as a result of previous and current agricultural practices.

Under the proposal the coal stockpile area at Loch Catherine will be expanded to the north and east for 20 m. Additionally, an APZ of another 20 m will be provided around Loch Catherine to protect the coal stockpile. The expansion and provision of the APZ will require the clearance of trees and understorey.

An APZ of 20 m will also be provided around the Berrima Colliery Pit Top facilities extending from the existing cleared edge of disturbance. This area is proposed to be cleared though 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 study area, which was the focus of the ecological assessment, included the areas described above (the SMP area, the proposed Loch Catherine expansion area and APZ and the Berrima Pit Top APZ) as shown in Figures 3.1, 5.1 & 5.2).

#### 15.2.2 Assessment methodology

The assessment was undertaken following the then Department of Environment and Conservation (DEC now OEH) *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's *Field Survey Methods 2009*. Notable constraints and application of the 'precautionary principle' were addressed within the assessment.

A desktop search was conducted as part of the ecological assessment to identify any potential issues. The databases searched included government websites, relevant environmental planning instruments, and the NSW Wildlife Atlas. The full list of databases searched and a summary of the findings are provided in Table 15.1.

**Table 15.1 Database search results for ecological issues**

| Name of database searched*                                                                                             | Type of search                                                  | Findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Department of Sustainability, Environment, Water, Populations and Conservation – Protected Matters (EPBC Act) Database | Wingecarribee LGA                                               | 5 endangered ecological communities (EECs), 63 threatened species (42 of which are plants), 14 migratory birds, and 12 listed marine species.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| OEH Threatened Species online database                                                                                 | Hawkesbury/Nepean (Burrangorang Part A)                         | 89 results returned. 10 EECs, 1 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                                                                                | Mittagong map sheet; Mossvale map sheet; and Wingecarribee LGA. | <p>Seven threatened plants have been previously recorded within 10 km<sup>2</sup> from the Study Area: <i>Acacia bynoeana</i>, <i>Eucalyptus aggregate</i>, <i>Eucalyptus macarthurii</i>, <i>Kunzea cabbagei</i>, <i>Persoonia glaucescens</i>, <i>Phyllota humifusa</i>, and <i>Pomaderris sericea</i>.</p> <p>Kunzea cabbagei 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 Expansion and APZ.</p> <p>Two species of fauna (Koala and Spotted Tailed Quoll) have been previously recorded within 10 km of the Study Area.</p> <p>No endangered populations or critical habitat exists in the search area, 2 critically endangered ecological communities (CEECs), 43 EECs, 3 vulnerable ecological communities (VECs) and 31 key threatening processes (KTPs).</p> |
| NSW Legislation website: <i>State Environment Planning Policy No. 44 – Koala Habitat Protection</i> (SEPP 44).         | Schedule 1: LGAs listed; and Schedule 2: Feed trees listed.     | The Wingecarribee LGA is listed in Schedule 1 of SEPP 44. <i>Eucalyptus punctata</i> 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| WLEP                                                                                                                   | WSC                                                             | 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 (TPO)                                                                            | WSC                                                             | Council’s TPO restricts the removal of trees from: 5(C) and 2(b) zones; within EECs; certain significant and rare trees.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Wingecarribee Bushfire Risk Management Plan                                                                            | WSC                                                             | Implementing APZs around the Project Site is consistent with the aims of this plan.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| The Drinking Water Catchments Regional Environmental Plan No.                                                          | WSC                                                             | REP No.1 is a key planning instrument for this Shire. It replaces State Environmental Planning Policy No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Table 15.1 Database search results for ecological issues**

| Name of database searched*                                               | Type of search | Findings                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 **                                                                     |                | .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 SCA has vested interest in the quality of water in the river. |
| Illawarra Regional Environmental Plan No. 1                              | WSC            | Part 4 Provisions relating to coal applies.                                                                                                                                                                                |
| Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River 1996 | WSC            | Wingecarribee LGA not listed. This plan does not apply.                                                                                                                                                                    |

Notes: Database search date 24<sup>th</sup> August 2010.

\*Web addresses provided in Table 2 of Oz Ark's Report (Appendix L).

\*\* Repealed by State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 on 1 March 2011.

A field assessment to conduct flora and fauna surveys was undertaken on 18 and 19 of August 2010 by an OzArk survey team. Weather recorded over both days was cool, overcast and showery, with temperatures ranging between 5° and 15°C, and was not considered a constraint to the investigation. The field assessment was undertaken with consideration of the findings and species identified in the desktop database search (Table 15.1).

The flora survey assessed community composition, health, age status, habitat value for fauna and flora species, overall conservation significance and structural or habitat importance of the vegetation present. The extent and distribution of vegetation communities identified were mapped in the field. The OEH *Biobanking Assessment Methodology 2008* was used to determine the condition of land as being good, moderate or low and to identify land with high biodiversity conservation values.

Fauna surveys involved general habitat searches and targeted surveys for threatened species. Searches were also conducted for species identified as likely to occur based upon the habitat present but not previously recorded. The likely impacts of the proposal were assessed based on the identification of the species present, their diversity and the habitat present within the study area, which may identify threatened species unobserved during the surveys.

For areas proposed to be cleared individual trees were mapped to identify their location, species present and features to determine their level of constraint for removal.

Several vegetation and biodiversity assessments have been undertaken within the Hawkesbury-Nepean Catchment Management Area (Hawkesbury-Nepean CMA). Those relevant to the study area were factored into the assessment.

A seven-part test of significance is required under the *Threatened Species Conservation Act 1995* (TSC Act) for NSW threatened species or communities. Such tests were conducted as part of the assessment for the following species (see Appendix 2 of the terrestrial ecological assessment (Appendix L)):

- species of threatened tree hollow dependant microbats:
  - Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*, TSC Act);
  - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*, TSC Act);

- Eastern Freetail-bat (*Mormopterus norfolkensis*, TSC Act);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*, TSC Act);
- Large-footed Myotis (*Myotis macropus* - formally *Myotis adversus*, TSC Act);
- Little Bentwing-bat (*Miniopterus australis*, TSC Act);
- Koala (*Phascolarctos cinereus*, TSC & EPBC Acts); and
- Large-eared Pied Bat, Large Pied Bat (*Chalinolobus dwyeri*, EPBC Act).

## 15.3 Impact assessment

### 15.3.1 Vegetation communities

All vegetation in the study area has been previously mapped as part of the *Wingecarribee Biodiversity Strategy* (Eco Logical Australia 2003). Vegetation in the Berrima Pit Top APZ and the Loch Catherine Stockpile expansion area and APZ are consistent with vegetation community profiles previously described as Mittagong Sandstone Woodland (Eco Logical Australia 2003).

The Berrima Pit Top APZ would require the clearing of:

- 0.08 ha of regrowth Wingecarribee Woodland on valley floors; and
- 1.27 ha of regrowth Mittagong Sandstone Woodland on lower slopes.

The Loch Catherine expansion and APZ would require the 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.

Mittagong Sandstone Woodland and Wingecarribee Woodland are not listed as protected ecological communities and are predominant vegetation communities within the Wingecarribee Shire (Eco Logical Australia 2003).

The land within the SMP area is mostly cleared with around 20.5 ha of vegetation comprising of Wingecarribee Woodland, Mittagong Sandstone Woodland as well as state listed EECs Robertson Basalt Tall Open-forest and Southern Highlands Shale Woodlands. These EECs are remnants and assessed as in 'good' condition following the BioBanking methodology. Potential slumping of the land may occur within the SMP area; however, very little native vegetation would be affected as it is devoid of understorey or canopy vegetation. The primary threat to these EECs is not from subsidence but rather grazing agriculture. Other habitats such as rocky areas, tree hollows etc are likely to retain their current potential as habitat. There are no evident ground water dependent communities, nor communities located within or near dams and drainage lines likely to be impacted by predicted levels of subsidence. No EECs or other vegetation types are to be cleared within the SMP area under the proposal.

The mapped vegetation communities in the SMP area, the Berrima Pit Top APZ and the Loch Catherine Stockpile expansion area and APZ are shown in Figures 15.1 – 15.3.

### 15.3.2 Flora

One species *Eucalyptus apiculata*, a mallee tree, has been recorded within the Berrima Colliery APZ and is listed as 'rare' in Briggs and Leigh's *Rare or Threatened Australian Plants 1995* (ROTAP). Individual plants of this species were also observed beyond, but not within, the impact limits of the Loch Catherine extension area and APZ. Although it is determined that this species will remain unaffected by the proposal and no further assessment is required pre-clearing measures will be implemented.

Cabbage Kunzea (*Kunzea cabbagei*) a species of plant listed as threatened in the NSW TSC Act and EPBC Act, has been previously recorded twice between Berrima Colliery and Loch Catherine Colliery. 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.

Further a field within 10 km of the colliery the protected plant species *Eucalyptus aggregate*, *Eucalyptus macarthurii*, *Phyllota humifusa*, *Pomaderris sericea* and *Acacia bynoeana* have also been recorded.

The noxious weed, serrated tussock, was observed throughout the SMP area. No noxious weeds were recorded in the Berrima Pit Top APZ of the Loch Catherine APZ and expansion area.

Vegetation surrounding the Berrima Pit Top is regrowth Mittagong Sandstone Woodland and regrowth Wingecarribee Woodland. No old growth trees or trees with hollows within the APZ were detected during the field assessment. Clearing of vegetation with the Berrima Pit Top APZ would target removal of understorey and thinning of the tree canopy. 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.

### 15.3.3 Fauna

#### i Koalas

The locality of the Loch Catherine expansion area and APZ was identified as 'Core Koala Habitat' for the assessment as there are five records of Koalas within 10 km of the project site and 336 records for the Wingecarribee LGA. The vegetation type present within the Loch Catherine expansion area and APZ (Mittagong Sandstone Woodland), however, is not mapped as SEPP 44 habitat. Trees inspected within this area during the field assessment did not show evidence of Koalas nor were scats observed.

The Loch Catherine Study Area has been historically cleared and has re-established successfully, however within the expansion area there are between five and 10 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. Within the APZ area, on the northern side, there are around 10 hollow bearing trees that would require removal however no evidence of animals or breeding activity was detected during the field assessment. Although collectively 10 to 15 habitat trees would be removed under the proposal it is not considered to be significant as the local environment (vegetation as well as tree hollows) are well represented immediately surrounding the area.

It is possible, though considered to be low in probability, that Koalas may be recorded in the regrowth Wingecarribee Woodland, a SEPP 44 vegetation type, on valley floors that run along the drainage line (0.08 ha within the Berrima Pit Top APZ). 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 with higher levels of human activity than surrounding bushland and individuals are unlikely to frequent the area. Although it is considered the species would remain unaffected by the proposal, further

assessment following NSW criteria was conducted. A seven part test of significance concluded that the proposal is unlikely to significantly impact the species.

## ii Microbat species

No microbats were recorded during ultrasonic detection and no threatened microbats have been recorded on the NSW Wildlife Atlas database in close proximity to Berrima Colliery. However, it is considered more than likely that species of microbats would utilise existing habitat in the project site. 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, <1 km). As potential exists for threatened tree roosting microbats to be affected by the implementation of APZs, as they contain suitable habitat, further assessment following NSW and National assessment criteria (a seven part significance test) was conducted. Seven part tests of significance for each species concluded that no species of threatened bats with potential to be affected by the proposal would be placed at risk of local extinction i.e. would not be significantly impacted.

## iii Other fauna species

A number of fauna species have been previously recorded within 20 km of the colliery. The Powerful Owl (*Ninox strenua*, vulnerable under the TSC Act) has been recorded within the SMP area and a Spotted-tailed Quoll (*Dasyurus maculatus*, TSC & EPBC Act) was recorded 2 km north-west of colliery. 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.

The NSW and nationally vulnerable Grey-headed Flying-fox (*Pteropus poliocephalus*) has been previously recorded approximately 12 km south of the colliery at the edge of Meryla State Forest, though most records for the bat species exist around the State Water Supply area to the east of the colliery. Records for the Squirrel Glider (*Petaurus norfolcensis*, TSC Act), Yellow-bellied Glider (*Petaurus australis*) and Eastern Pygmy-possum (*Cercartetus nanus*, TSC Act) records are centred on surrounding State Forests and National Parks approximately 15 to 20 km from the colliery. A habitat based assessment focussing on Squirrel Gliders concluded that trees with hollows to be removed within the Loch Catherine APZ were all alive and 'smooth barked' thus much less likely to provide refuge for the species which prefer dead trees, stags and rough barked trees. It was concluded that Squirrel Gliders are unlikely to be affected by the clearing of the APZ and a seven part test of significance is not required.

A habitat based assessment of the Loch Catherine expansion area was undertaken for Spotted-tail Quoll. The wider environments were considered likely Quoll habitat whilst the APZ Study Areas were considered unlikely habitat because:

- the presence of Squirrel Gliders (food source) is 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 for 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 unlikely to be significantly impacted by the proposal. Pygmy Possums are also unlikely to be impacted as feed tree / shrub species, such as dense stands of Banksia, do not occur in the APZs. No further assessments, i.e. seven part tests of significance, were required for these species.

## 15.4 Mitigation and management

### 15.4.1 Vegetation communities

While no impacts on EECs present within the SMP area are expected the general monitoring of the health status, nature and extent of these is recommended. 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.

### 15.4.2 Flora

The ROTAP listed 'rare' tree species *Eucalyptis apiculata* within the Berrima Pit Top APZ, and beyond the Loch Catherine APZ, has no legislative status. However, it is recommended the individuals be protected and work crews inducted to ensure extant individuals are identified prior to clearing in both APZs and Loch Catherine expansion area.

Similarly, work crews are to be inducted about the presence of *Kunzea cabbagei*, a threatened species under the TSC Act. Crews would stop work in the area and notify mine management if individuals are observed.

All areas requiring tree clearing (Loch Catherine and Berrima Pit Top) would require general mitigation and pre-clearing precautions as detailed in the ecological assessment (Appendix L).

### 15.4.3 Fauna

As discussed in Section 15.3.3 the locality of the Loch Catherine expansion area and APZ is considered to be 'Core Koala Habitat' despite the assessment identifying no vegetation type to be impacted by the proposal as containing species of feed trees listed in the SEPP 44. There is also a low probability of impacting Koalas within the regrowth Wingecarribee Woodland on the valley floors that run along the drainage line within the Berrima Pit Top APZ. Pre-clearing precautions within the Loch Catherine expansion area and APZs such as pre-clearing inspections, assessments and inductions of work crews would be conducted under the proposal to ensure environmental due diligence.

It is possible due to the types of habitat present that threatened bats would be impacted by tree clearing, though only 10 – 15 hollow bearing trees exist, and precautions are therefore required. 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, and giving any species present the opportunity to relocate, rather than attempting to further identify potential roosts prior to clearing. To compensate for the loss of hollows five microbat boxes and five next boxes suited for small parrots would be placed within land managed by the colliery with annual monitoring of the boxes and replacement as required.

## 15.5 Conclusions

The features of the proposal with potential ecological impacts include the following:

- subsidence impacts within the SMP area (172.5 ha);
- clearing of vegetation (1.35 ha) within the Berrima Pit Top APZ; and
- clearing of vegetation (2.24 ha) within the Loch Catherine expansion area and APZ.

Within close proximity to Berrima Colliery (10 x 10 km area) seven protected plant species and two protected marsupials (Koala and Spotted-tailed Quoll) have been recorded previously. Threatened species of microbats are also expected to inhabit the area.

The SMP area, located above underground workings, contains two remnant EECs. The predicted levels of subsidence within these areas are unlikely to affect these communities, nor other stands of vegetation and habitats. No clearing of vegetation within the SMP area will form part of the proposal.

Clearing within the APZs are required to prevent damage to the operational facilities and coal stockpiles. The protected plant species *Cabbage Kunzea* has been previously recorded between Berrima Colliery and the non-operational Loch Catherine Colliery. A rare species of mallee tree was recorded within the Berrima Pit Top APZ and in close proximity to the Loch Catherine APZ during a field assessment. These species will be avoided where identified during clearing.

Seven-part tests of significance were conducted for several threatened species of microbats and for the Koala. It was determined that the clearing of vegetation would not significantly impact these species though pre-clearing measures and provision of habitat hollows will form part of the proposal. An assessment of the area determined that it was unlikely habitat for the Spotted-tail Quoll and that the proposal was unlikely to affect the species.



FIGURE 15.1  
Vegetation mapping of SMP area

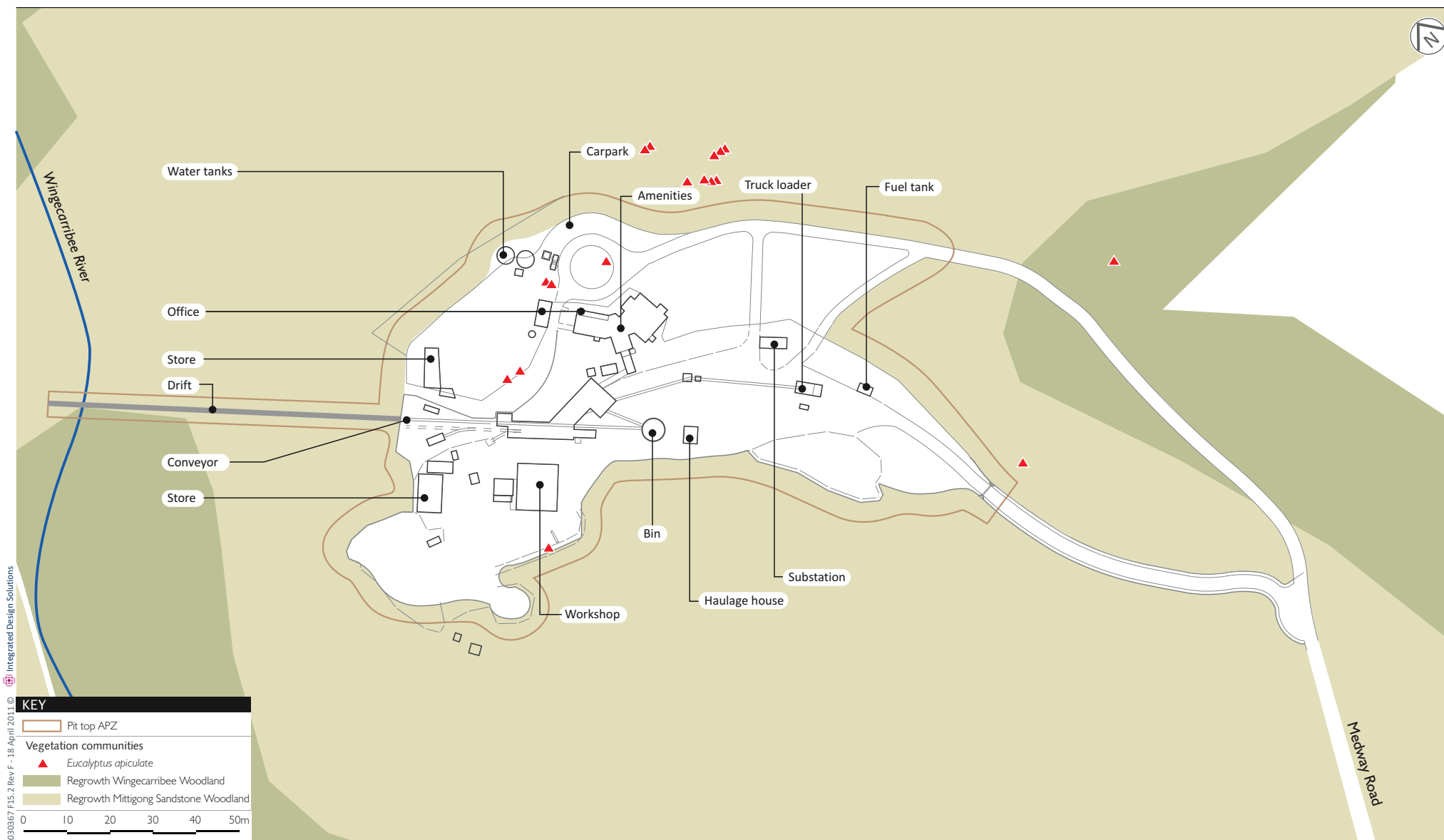
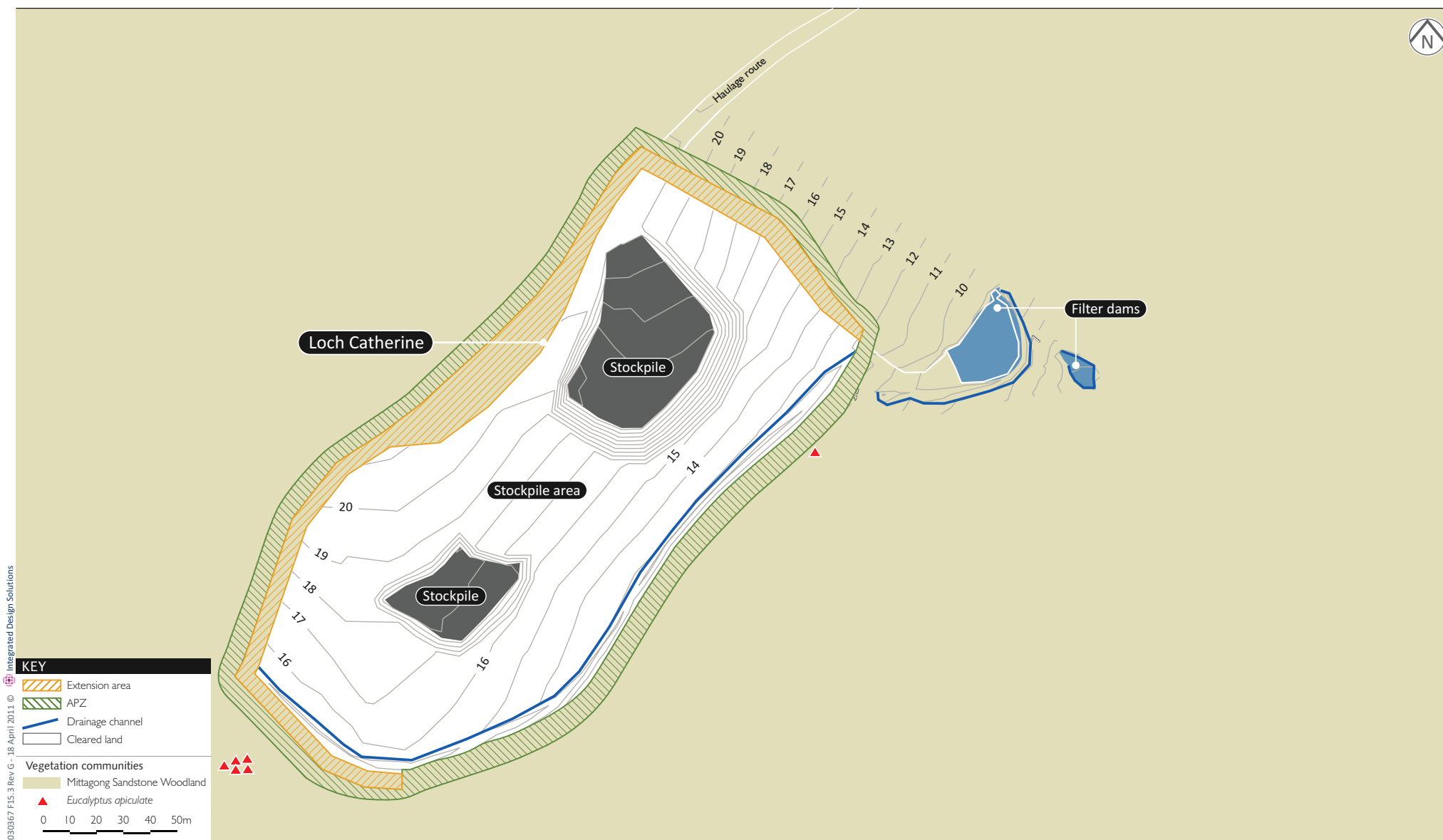


FIGURE 15.2  
Vegetation mapping of Berrima Colliery Pit Top APZ



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FIGURE 15.3  
Vegetation mapping of Loch Catherine expansion area and APZ

## 16 Heritage

### 16.1 Introduction

Potential heritage impacts relate to areas affected by subsidence and where vegetation clearing and ground disturbing activities are required for maintenance of Berrima Pit Top facilities and Loch Catherine stockpile area.

The report, therefore, focused on the following areas (the study area):

- SMP area over underground workings;
- Berrima Pit Top Study Area APZ; and
- Loch Catherine Study Area extension area and APZ.

An Aboriginal heritage assessment was prepared by OzArk Environmental & Heritage Management Pty Limited to assess the potential aboriginal heritage impacts of the proposal (Appendix M). A non-Aboriginal database search was also conducted. This chapter provides a summary of the findings.

### 16.2 Aboriginal heritage assessment methodology

#### 16.2.1 Aboriginal community involvement

Consultation with the Aboriginal community was undertaken in accordance to the OEH's Aboriginal Cultural Heritage Consultation Requirements (ACHCRs) as recommended in the *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (for Part 3A assessments)* (DEC 2005).

Letters were sent to local and regional groups as well as an advertisement placed in the Southern Highland News with invitations for involvement in the heritage assessment. The following organisations and individuals formally registered interest and invited to comment on the assessment methodology:

- Illawarra Local Aboriginal Land Council (ILALC);
- Korewal Elouera Jerrungarugh (KEJ);
- Gundungurra Aboriginal Heritage Association;
- Peter Falk Consultancy; and
- Buru Ngunawal Aboriginal Corporation (BNAC).

Several positions were made available for Aboriginal community representatives chosen from the registered stakeholders to participate in the heritage assessment fieldwork. In addition, the registered stakeholders, as well as all Aboriginal stakeholders, will be involved in the consultation process and development of the Aboriginal Cultural Heritage Management Plan.

### 16.2.2 Field assessment

A field assessment to identify potential Aboriginal sites was undertaken on 18 and 19 of August 2010. The OzArk survey team was accompanied in the field by Aboriginal community representatives from BNAC and KEJ.

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.

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 area, Loch Catherine extension area and both APZ areas) leaf litter was an impediment to artefact detection.

Weather recorded over both days was cool, overcast and showery, with temperatures ranging between 5° and 15°C, and was not considered a constraint to the investigation.

### 16.2.3 Preliminary desktop survey

A desktop database search was conducted prior to the field assessment to identify potential issues. The databases searched and the results are provided in Table 16.1.

**Table 16.1 Desktop-database search results**

| Name of database searched                                                                                                                                                                                                                              | Date of search                                             | Type of search                      | Comment                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------|--------------------------------------------------------------------------|
| Australian Heritage Database<br><a href="http://www.environment.gov.au/heritage/ahdb/">http://www.environment.gov.au/heritage/ahdb/</a>                                                                                                                | 1/09/2010                                                  | Wingecarribee LGA                   | No places on the search are within the study area                        |
| NSW Heritage Office State Heritage Register and State Heritage Inventory<br><a href="http://www.heritage.nsw.gov.au/">http://www.heritage.nsw.gov.au/</a>                                                                                              | 1/09/2010                                                  | Wingecarribee LGA                   | No places on the search are within the study area                        |
| National Native Title Claims Search<br><a href="http://www.nntt.gov.au/Applications-And-Determinations/Search-Applications/Pages/Search.aspx">http://www.nntt.gov.au/Applications-And-Determinations/Search-Applications/Pages/Search.aspx</a>         | Search data<br>1/09/2010 Map<br>last updated<br>30/06/2010 | NSW                                 | Claim NC97/7<br>Gundungurra Tribal<br>Aboriginal Corporation<br>Claim #6 |
| Department of Sustainability, Environment, Water, Populations and Conservation – Protected Matters (EPBC Act) Database;<br><a href="http://www.environment.gov.au/erin/ert/epbc/index.html">http://www.environment.gov.au/erin/ert/epbc/index.html</a> | 1/09/2010                                                  | Wingecarribee LGA                   | None of the Aboriginal places on the RNE occur near the study area.      |
| OEHS's Aboriginal Heritage Information Management System (AHIMS);                                                                                                                                                                                      | 1/09/2010                                                  | 10 x 10km centred on the study area | 14 sites within the search area. None within actual project study area.  |
| Local Environmental Plan (LEP)                                                                                                                                                                                                                         | 1/09/2010                                                  | WLEP                                | None of the Aboriginal places noted occur near the study area.           |

#### 16.2.4 Existing environment

Berrima Colliery is located within the Sydney Basin Bioregion, Hawkesbury-Nepean CMA (Burraborang Part A) and Wingecarribee LGA) approximately 120 km south-west of Sydney. 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), Environmental Conservation (E2) and Environmental Management (E3) in the WLEP.

The following features of the study area were identified as part of the assessment:

- topography;
- hydrology;
- vegetation;
- climate;
- geology; and
- existing levels of disturbance.

### 16.3 Aboriginal heritage impact assessment

#### 16.3.1 Heritage context

The study area is located within the eastern limits of the lands occupied by the Gandangara tribe, and appears to have been part of a zone of interaction between the Gandangara, Wodiwodi and Ngunawal tribes. The first European contact with the Gandangara people was during the early nineteenth century and was initially peaceful though escalating conflict between 1814 and 1816 resulted in the deaths of 14 members of the Gandangara tribe.

Early observations of the Gandangara people showed a strong association to trees in their ceremonial culture. Trees played a significant role in mortuary rites with important people wrapped in bark and placed amongst the branches. Bora grounds, where ceremonial activities such as initiation took place, and carved trees were often associated with burials and are known to have existed in the broader district. It is likely that these practices were widespread over the Southern Tablelands and Highlands, including Berrima.

Whilst a number of regional archaeological studies have been undertaken in the Southern Highlands, few have been undertaken within the vicinity of the study area. The results of an OEH Aboriginal Heritage Information Management System (AHIMS) database search (see Table 16.1) identified 11 recorded Aboriginal sites located within a 10 x 10 km area centred on the study area. Of these none are located within the study area. Three sites, including two rock shelters and one open site, are located immediately adjacent to the study area. A summary of the registered sites are provided in Table 16.2

The results from Table 16.2 indicate that open camp sites are the most frequent site type (45.5%) recorded within 10 km of the colliery, 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 16.2 Summary of AHIMS registered sites**

| Site type             | Total     | % Frequency |
|-----------------------|-----------|-------------|
| Open camp site        | 5         | 45.5        |
| Rock shelter with art | 4         | 36.3        |
| Axe grinding grove    | 1         | 9.1         |
| Scarred tree          | 1         | 9.1         |
| <b>Total</b>          | <b>11</b> | <b>100</b>  |

A recent study by Kelton (2002) identified three Aboriginal sites, two rock shelters with art and deposit and one open site, at Berrima Colliery's underground mining area. One rock shelter (MC-S-1) was located on the eastern side of Mandemar Creek, the second rock shelter (MC-S-2) was situated approximately 200 m to the north-west of MC-S-1, and the open site (MC-OS-1) was located on a low hillslope/low ridge crest overlooking an unnamed tributary of Wingecarribee River. The only potential archaeological deposits identified by Kelton were those associated with sites MC-S-1 and MC-S-2. Kelton made the following recommendations in his study:

- 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;
- further comprehensive documentation of these sites would be required prior to a Section 90-sanctioned destruction.

### 16.3.2 Predictive model for site location

The AHA determined, based on results from a series of studies, that proximity to a permanent water supply is the primary factor appearing to determine the location of Aboriginal campsites. Using the concept, the following general predictions can be made regarding the nature of sites and their location in the study area (not taking into account factors of site preservation):

- 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.

Based on the types of identified sites in the region, outlined previously in Section 16.3.1, it is likely that the site types to be encountered in the study area are the following:

- scarred trees (frequently close to creeks and rivers but also found further afield);
- 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).

The above predictive model was used as a focus for the field assessment and for assessing the heritage value of any sites recorded.

### 16.3.3 Results

One Aboriginal site, Berrima Colliery Open Site No. 1 (Boral-OS1), was recorded as a result of the field assessment. The site is located on a vegetated spur in the south-eastern portion (panel 406) of the study area on Lot 6 DP 261133, Joadja Road, Mandemar (Figure 16.1). The site is near an ephemeral watercourse that is a tributary into Mandemar Creek. Only a few small artefacts were recorded at the site. However, it is possible and expected that further artefacts are present below the leaf litter and surface, though deposits are not expected to be deep.

No additional parts of the study area were assessed as holding significant potential to contain further, undetected, Aboriginal objects or sites. In terms of the SMP study area this is based on the widespread disturbance across much of the area and the fact that the study area is characterised by temporary, rather than permanent water-courses. The lack of culturally modified trees within the SMP study area is a reflection for the general scarcity of native trees of an age to bear scars. Exposed sandstone in creek beds in the SMP study area were checked for grinding grooves in all visible areas, though none were observed likely due to the nature of the sandstone which is not ideal for grooves and the overall high levels of siltation of the creeks, which may cover grinding evidence.

In the terms of the lack of sites recorded in the APZ study areas this is likely due to the lack of suitable landforms to contain intact archaeological deposits, the small scale of the areas, the lack of close water

sources, and the overall steep nature of the landscape. The Berrima Pit Top APZ, whilst not possessing any specific sandstone overhangs potentially suitable as shelter sites within its boundaries, does however exhibit such features within close proximity.

#### 16.3.4 Assessment of heritage significance

The overall value of cultural heritage items is usually determined by assessing their cultural, scientific and public significance. To assess the heritage value of Boral-OS1, therefore, these three aspects were considered.

Cultural significance is the importance of a site or feature to the relevant cultural group - in this case the Aboriginal community. Cultural significance of Boral-OS1 to the local Aboriginal community has not as yet been determined. Survey results and management options in the Aboriginal heritage assessment will be forwarded to the relevant Aboriginal community stakeholders for review and comment. Once received, this section will be updated.

Assessing scientific significance 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. Open sites currently comprise the most frequent site type within a 10 x 10 km area surrounding the study area (see Table 16.2), matching data from other parts of the wider region such as Moss Vale (TEC 2006). 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. Boral-OS1 is consequently assessed as holding moderate scientific significance.

Sites that have public significance do so because they can educate people about the past. For a site to have high public significance it should contain easily identifiable and interpretable elements, and be relatively easily accessed. Boral-OS1 is in an area unlikely to be visited by the public and the artefacts are unlikely to be easily seen or identifiable as being Aboriginal in origin. Consequently Boral-OS1 is assessed as holding low public significance.

#### 16.3.5 Impact of proposal on Aboriginal heritage

The main aspect of the proposal that may potentially impact on Aboriginal heritage item Boral-OS1 is surface subsidence as a result of underground mining. Heritage item Boral-OS1 is located within the current SMP study area over panel 406. Underground mining activities can lead to subsidence of the overlying strata which may impact on open sites/artefact scatters 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. Bord and pillar mining, as is proposed, produces far less surface subsidence than longwall underground mining.

The likely impacts of subsidence under the proposal were assessed in Chapter 9 of this EA. The panel 406 which the heritage item is located above will likely be subject to minimal subsidence occurs (approximately 20 mm). Subsidence in this order will not directly disrupt the stratigraphic integrity of the deposits, or indirectly impact them through alteration to the water table or alter water flows. There is expected, therefore, to be no subsidence impacts on Boral-OS1 from the proposal.

Other impacts of the proposal, including the clearing and disturbance of areas for the construction of surface infrastructure, are to occur in the APZ areas where no heritage items have been, or are likely to

be, identified. The construction of surface infrastructure should, therefore, have no impact on Aboriginal heritage so long as impacts remain within the assessed area.

## 16.4 Non-Aboriginal heritage

A desktop database search for items of non-Aboriginal heritage was conducted on 8 September 2010 for the study area. The following databases were searched:

- Australian Places Heritage Inventory <http://www.heritage.gov.au/ahpi/>;
- National Heritage List  
<http://www.environment.gov.au/heritage/places/national/index.html#googlemap>;
- Australian Heritage Database <http://www.environment.gov.au/cgi-bin/ahdb/search.pl>;
- Sydney Water Heritage Database  
<http://www.sydneywater.com.au/Sustainability/OurHeritageAssets/search.cfm>;
- NSW State Heritage Register [http://www.heritage.nsw.gov.au/07\\_subnav\\_04.cfm](http://www.heritage.nsw.gov.au/07_subnav_04.cfm); and
- the WLEP.

The results of the database search showed that no non-Aboriginal heritage items are located within the study area. Non-Aboriginal heritage items in the townships of Berrima and Joadja are some distance from the study area and will not be impacted by the proposal.

Structural elements of the Berrima Colliery such as the administration building, mine entry etc. date back to the late 1900's and may potentially have some historical significance. The current proposal does not impact these structural elements in any way. However, some of the existing facilities and support structures at Berrima Colliery may need to be replaced in the near future to maintain existing operations. Any heritage impacts resulting from the replacement of existing facilities and support structures at Berrima Colliery will be assessed in a separate application(s).

## 16.5 Mitigation and management

The Aboriginal heritage assessment recognises the legal requirements under the terms of the *National Parks and Wildlife Act 1974* whereby it is illegal to damage, deface or destroy an Aboriginal relic/object without the prior written consent of the Director of OEH.

Given the above, the findings of the Aboriginal heritage assessment, and the interests of the Indigenous community, the following is recommended:

- the preparation and implementation of an Aboriginal Cultural Heritage Management Plan in consultation with the registered Aboriginal stakeholders for the proposal and should be inclusive of subsidence monitoring for the landform where Boral-OS1 is located;
- item Boral-OS1 located within the SMP study area should not be directly or indirectly impacted by the proposal;
- although no Aboriginal sites were recorded in the APZs, care must be taken to ensure that no ground surface disturbing activities occur outside the 20-30 m zones assessed for this project, as sensitive landforms do occur beyond the study area boundaries of the Berrima Pit Top APZ; and

- should any other 'objects' or other Aboriginal sites be identified during the course of the project, work in that area should cease and the OEH South-eastern Region Office be contacted to discuss how to proceed.

## 16.6 Conclusions

The Aboriginal heritage assessment has assessed the potential impacts of the proposal on Aboriginal heritage. The areas focused on for study were those with surface impacts and potential for subsidence from underground mining. Desktop database searches identified no Aboriginal heritage items within the study area.

A field assessment conducted on 18 and 19 August 2010 identified one Aboriginal heritage item, open site Boral-OS1, located within the SMP study area. Subsidence within the area surrounding the site is likely to be minimal and no direct or indirect impacts are considered likely. The field assessment concluded that other heritage items were unlikely to be present within the study area.

No items of non-Aboriginal heritage will be impacted by the proposal.

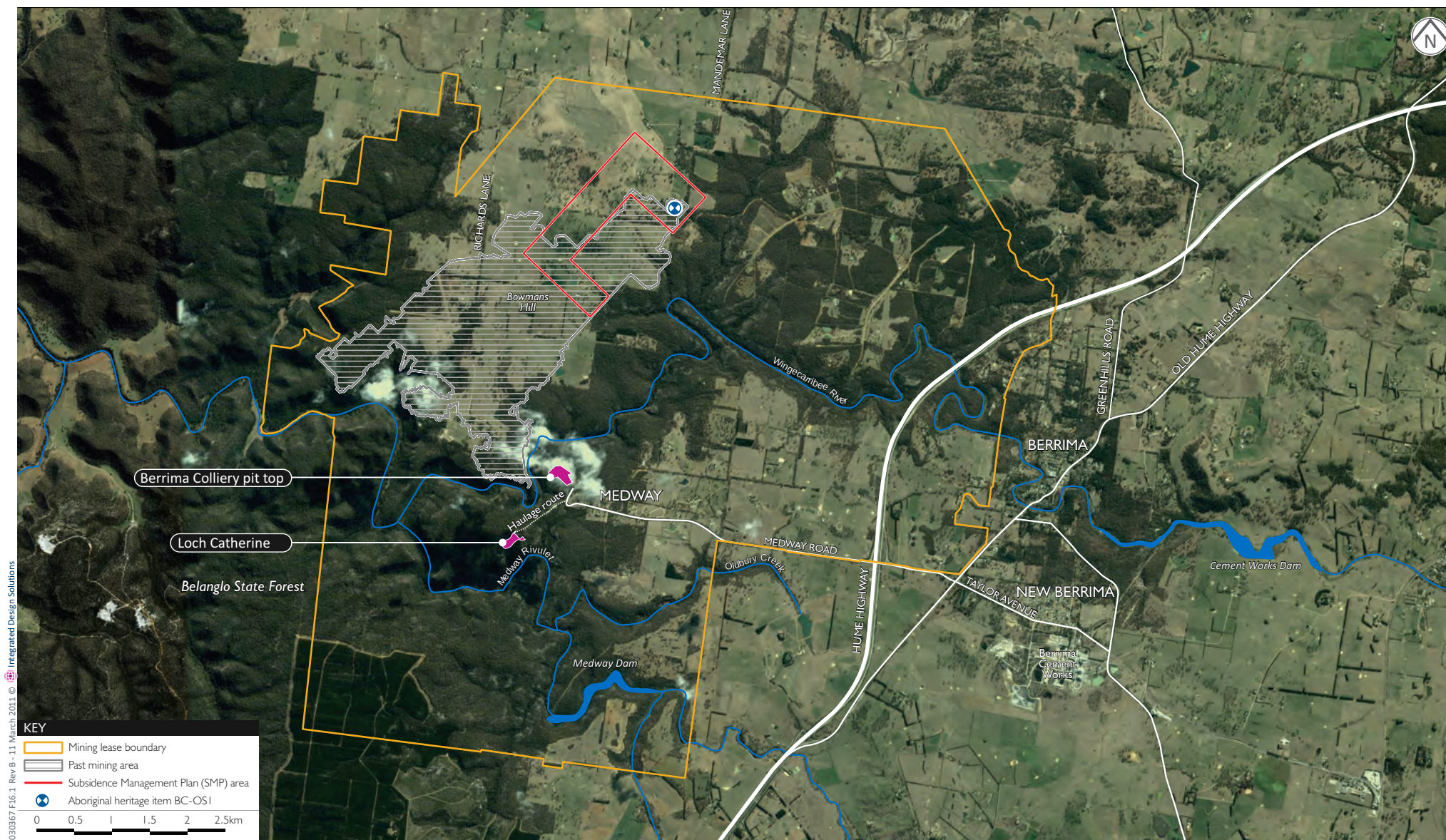


FIGURE 16.1  
Location of Aboriginal heritage item BC-OS1

## 17 Environmental Management and Commitments

### 17.1 Introduction

This chapter provides a description of the commitments made by Boral throughout the life of the proposal to manage potential impacts identified within the EA. Commitments include management, mitigation or monitoring measures as set out in the individual chapters of this EA.

### 17.2 General

Boral will undertake the following general commitments:

- Boral will carry out the proposal generally in accordance with the systems, plans and mitigation measures identified throughout this EA; and
- Boral will obtain and maintain all permits, licences and approvals required throughout the life of the proposal, as required;
- results of monitoring programs as detailed in this chapter and technical chapters within this report will be provided in the colliery's AEMR as well as any recommendations arising from these. A copy of the AEMR will be provided to relevant government agencies as well as to the public on Boral's website.

These commitments do not replace any obligations Boral has under statutory requirements.

### 17.3 Environmental management

Boral will commit to the preparation and implementation of a Bush Fire Management Plan, which will include the creation and maintenance of APZs.

### 17.4 Socio-economic

Under the proposal Boral will establish and operate a CCC which is likely to comprise an independent chair and appropriate representation from Boral, WSC and the general community such as surrounding landowners. This CCC may form part of the CLC Boral has implemented for the Berrima Cement Works.

### 17.5 Subsidence

Berrima Colliery currently has a SMP in place which will be amended in accordance with the findings of the EA and the following commitments specific to the proposal:

- Boral will implement SPZs with first workings only below the Renahan property located above extraction panel 406 and the two embankment dams located above extraction panel 59;
- Boral will ensure no further damage is caused from subsidence to the Alcorn and Belbin properties;
- Boral will implement monitoring programs as recommended by DgS (Appendix C).

## 17.6 Groundwater

Boral will undertake the following commitments in relation to groundwater:

- construction of additional groundwater monitoring bores which will involve the following:
  - drilling of two additional groundwater monitoring bores shown in Figure 10.2;
  - construction of additional bores in abandoned coal resource holes which have not been cemented or, if these are found to be not suitable, at locations east and north of the colliery.
  - installation of electronic water level loggers in new and existing bores;
  - obtain licences from NOW for any new bores;
  - any new monitoring bores will be constructed by an appropriately licensed water bore driller according to the Land and Water Biodiversity Committee (2003) guidelines;
- implementation of a groundwater monitoring program to address certain existing data gaps in groundwater monitoring at the site as well as monitoring the following:
  - flows in Wingecarribee River;
  - zone of depressurisation in the coal seam;
  - manual water level monitoring of new and existing bores undertaken on a quarterly basis;
  - water quality testing of new and existing bores on a six monthly basis and analysis against WQOs provided in Section 14.3.1;
  - groundwater inflows at the V-notch weir; and
- data collected as part of the groundwater monitoring program will be managed and reported on annually as part of the colliery's AEMR by a suitably qualified hydrogeologist.

## 17.7 Traffic

Boral will undertake the following commitments specific to traffic:

- Boral will work with WSC and the local community to mitigate impacts associated with trucks on Medway Road. Based on preliminary discussions with Council, mitigation measures include
  - the erection of school Bus warning signs at each end of Medway Road with the wording "7.30-9AM and 3-4.30PM SCHOOL DAYS NEXT 5 KM";
  - that edgelines and centrelines be marked on Medway Road from the Hume Highway to Medway;
  - that sight distance for vehicles exiting Liebman's Road at Medway Road be improved by reducing vegetation on the north-eastern corner;

- that street name signs and advance street name signs for Liebmans Road be installed on Medway Road;
- Boral trucks will not transport coal on the Macquarie Pass, i.e. the Illawarra Highway; and
- Boral will implement a “Truck Driver Code of Conduct”, principally involving conduct on Medway Road (See Appendix F).

It should be noted that these measures are outside of any measures that may be required if Medway Road is gazetted for use by B-doubles.

## 17.8 Noise

Boral will commit to the preparation of a Noise Management Plan, which will set out noise monitoring requirements and any management or mitigation measures required. Quarterly attended noise monitoring will be conducted at the three monitoring locations shown in Figure 12.1 by a suitably qualified professional. Reporting of noise monitoring results will be provided in the AEMR.

## 17.9 Air quality

Boral will undertake, in addition to current dust control measures described in Section 13.2.1, the following commitments in relation to air quality:

- ensure effectiveness of watering on unpaved roads through a control efficiency of 80% or, if found not to be achievable through watering, by applying water extender chemicals or chemical road stabilizers;
- maintain paved road silt loadings below 2 g/m<sup>2</sup> 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;
- maintain the current monitoring network at Berrima Colliery; and
- conduct all monitoring in accordance with applicable Australian Standards.

## 17.10 Surface water

Boral will commit to the following measures in relation to surface water:

- preparation of a SWMP which will contain:
  - requirements for water quality monitoring at, upstream and downstream of, the V-notch weir;
  - process for further assessment triggered by exceedances of the WQOs as described in SEEC 2010 (Appendix J); and
- upgrades to Berrima Colliery’s and Loch Catherine’s existing surface water management as shown in Figures 14.2, 14.3 and in Appendix K.

### 17.11 Ecology

The following commitments in relation to ecology will form part of the proposal:

- annual monitoring of the health status, nature and extent of EECs as required;
- induction of works crews prior to land clearing for avoidance of *Eucalyptis apiculata* and *Kunzea cabbagei* within the Berrima Pit Top APZ and the Loch Catherine expansion area and APZ;
- general mitigation and pre-clearing precautions in all areas requiring tree clearing as detailed in the ecological assessment (Appendix L);
- Koala specific pre-clearing precautions within the Loch Catherine expansion area and APZs such as pre-clearing inspections, assessments and inductions of work crews;
- implementation of tree removal methods to reduce risk to threatened microbat species; and
- installation of five microbat boxes and five nest boxes suited for small parrots within land managed by the colliery to compensate for loss of tree hollows with annual monitoring of the boxes and replacement as required.

### 17.12 Aboriginal heritage

Boral will undertake the following commitments in relation to Aboriginal heritage under the proposal:

- an Aboriginal Cultural Heritage Management Plan shall be prepared and implemented in consultation with the registered Aboriginal stakeholders for the proposal, and will include subsidence monitoring for the landform where Boral-OS1 is located;
- item Boral-OS1 will not be directly impacted by the proposal;
- no ground surface disturbing activities will occur outside the APZs; and
- should any Aboriginal sites or 'objects' be identified during the course of the proposal, work in that area will cease and the OEH South-eastern Region Office contacted to discuss how to proceed.

## 18 Justification and Conclusion

### 18.1 Introduction

This EA has comprehensively examined all potential impacts associated with the proposal. In a number of cases initial assessment showed potential for significant impacts to occur without mitigation and, consequently, a suite of mitigation and compensation measures has been developed and incorporated into the proposal. This chapter weighs the potential impacts of the proposal to determine whether it can be justified from society's perspective. The criteria used in this evaluation are those specified by the NSW Director-General of DoPI in the DGRs which state that the EA must include:

*"a conclusion justifying the project on economic, social and environmental grounds, taking into consideration whether the project is consistent with the objects of the Environmental Planning & Assessment Act 1979;"*

### 18.2 Justification of proposal

Justification of the proposal requires the legitimate comparison of positive and negative economic, social and environmental impacts.

The site contains a well established coal mine that has been in operation since 1872. Coal has been slowly mined from the colliery for over 135 years. There is predicted to remain a fairly significant supply of coal remaining to the north and east of current and proposed workings. At the same time, the site contains environmental resources such as vegetation and a site of Aboriginal cultural significance.

The operation is supported by a well established infrastructure and workforce. The main historic, and future, customer of the colliery is the Berrima Cement Works located approximately 7 km east of the colliery. The close proximity of these operations has meant that a secure and cheap source of coal can be supplied for the manufacturing of a State significant resource.

Positive impacts of the proposal relate to social and economic factors such as continued employment and public revenues. By far, the greatest positive impact of the proposal would be the continued supply of coal for cement manufacturing and, in association, the construction industry. Cement produced at Berrima Cement Works is a significant resource for the construction of local, regional and State infrastructure.

In regards to potential negative impacts on the environment, the underground mining of coal does not require clearing of vegetation and any impacts from mining activities would be the result of subsidence. While subsidence can impact on overlying vegetation there are expected to be no significant subsidence impacts under the proposal. Further, proposed mining is to occur beneath agricultural land which is predominantly cleared and subjected to grazing. Similarly, an Aboriginal cultural heritage item identified is located in an area where it is unlikely to be affected by subsidence. Some clearing of vegetation is proposed to protect the mine's assets at the pit top and Loch Catherine as well as for bush fire management. Vegetation clearing is minimal and is unlikely to significantly affect any threatened species or communities.

Other potential negative impacts include subsidence, loss of groundwater, traffic, noise, air quality and surface water quality. Assessments of these have concluded that the proposal will not have significant impacts. Where there is potential for negative impacts mitigation and management measures have been recommended and will be complied with under the proposal.

As the potential negative impacts of the proposal on the environment are predicted to be minimal they are outweighed by the potential positive impacts, which are predicted to be significant. The comparison of the positive and negative impacts of the proposal indicates that on balance there will be a net benefit resulting from the proposal. It is concluded, therefore, that the proposal is justified.

### 18.3 Objects of the Environmental Planning and Assessment Act 1979

The proposal's consistency with the EP&A Act's objectives is considered below. The objects (in italics) are to encourage:

*"The proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment"*

The proposal involves the mining of a coal resource supported by physical and human infrastructure, with compatible surrounding land uses. The proposal would facilitate the orderly use of these resources, thus promoting social and economic welfare whilst minimising the impacts to the environment with eventual rehabilitation of the surface facilities.

*"The promotion and co-ordination of the orderly and economic use and development of land"*

The proposal is an orderly extension of an existing mine that would be an economically beneficial use and development of land, as discussed above.

*"The protection, provision and co-ordination of communication and utility services"*

The proposal will have no effect on communication and utility services.

*"The provision of land for public purposes"*

The proposal is located below privately owned land. It is not feasible or practical to provide land for public purposes under the proposal.

*"The provision and co-ordination of community services and facilities"*

The proposal will involve payments to the NSW government in royalties, some of which is likely to be used for the provision of community facilities.

*"Ecologically sustainable development"*

The Commonwealth Government's National Strategy for Ecologically Sustainable Development (ESD) defines ESD as "using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased".

The proposal will use community resources including geological physical, human and financial to contribute to national resource needs and global energy needs and, in the process, to provide considerable employment and public revenues through royalties. In this way it will contribute to improvements in the total quality of life. Also, the proposal will conserve ecological processes through effective impact mitigation and will improve environmental quality at the surface facilities through eventual rehabilitation.

The principles of ESD are considered subsequently.

*Precautionary Principle:* this means that if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In practice the precautionary principle means avoiding serious or irreversible environmental damage by properly assessing potential impacts and taking necessary mitigation measures. The proposal is consistent with this principle as it is based on assessments conducted under plausible worst case conditions. All potential threats to the environment have been identified and appropriate mitigation measures developed in response. The assessment includes consideration of greenhouse gas emissions from coal production, transport and end use, and it has estimated that emissions expressed as a proportion of current annual global emissions (3,000 Gt), would contribute 0.001% annually. The principles of ESD require such impacts to be balanced against humanity's needs, including for energy and material well-being. The proposal meets these needs in a properly balanced way by providing a valuable resource for the production of cement and energy generation.

*Social equity including intergenerational equity:* the proposal contributes to social equity by providing additional employment both directly and indirectly. It will result in transformation of a geological resource into physical and human capital through investment in infrastructure and workforce training, and, indirectly, through contributions to governments which will enable greater investments in public goods. Thus, while the proposal involves exploitation of a finite geological resource, the above transformation will contribute to intergenerational equity.

*Conservation of biological diversity and maintenance of ecological integrity:* the proposal will conserve biological diversity and maintaining ecological integrity through the implementation of effective management and mitigation of impacts. The overall ecological integrity of the surface facilities will be improved with rehabilitation both at Berrima Pit Top and Loch Catherine.

*Improved valuation and pricing of environmental resources:* As described earlier the valuation and pricing of environmental resources is difficult to determine. However, as the proposal is unlikely to significantly impact environmental resources the value of these is predicted to be unaffected and is therefore compatible with this principle.

The general conclusion is that the proposal is consistent with ESD.

*"The provision and maintenance of affordable housing"*

The proposal will indirectly contribute to public revenues and manufacturing of construction materials which will provide greater capacity for the provision of infrastructure for residential development thus assisting housing affordability.

*"To promote sharing of responsibility for environmental planning between the different levels of government in the State"*

The preparation of this EA has involved considerable stakeholder engagement covering all levels of government through the PFM and the preparation of the DGRs. Exhibition of the EA will allow relevant government agencies to comment on the proposal.

*"To provide increased opportunity for public involvement and participation in environmental planning and assessment"*

This EA has been prepared with feedback from stakeholder and community consultation that has been undertaken outside the formal public exhibition period (see Chapter 6). Exhibition of the EA will enable further direct public participation in the assessment process.

The overall conclusion is that the proposal is consistent with the objectives of the EP&A Act either wholly or in the majority.

## 18.4 Conclusions

The proposal for continued operations at Berrima Colliery is strongly justified. It would enable the orderly and logical use of natural, physical and human resources existing in the area, and enhanced outcomes would result from greater investment, employment and mining efficiencies.

While the proposal has the potential to cause some adverse impacts, mitigation or compensation measures have been developed to address each of these and the residual impacts are largely minor or benign.

## Acronyms

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|                         |                                                                          |
|-------------------------|--------------------------------------------------------------------------|
| <b>%</b>                | per cent                                                                 |
| <b>µg</b>               | micro gram                                                               |
| <b>µm</b>               | micro metre                                                              |
| <b>AADT</b>             | annual average daily traffic                                             |
| <b>ACHCRs</b>           | OEH's Aboriginal Cultural Heritage Consultation Requirements             |
| <b>AEMR</b>             | Annual Environmental Management Report                                   |
| <b>AGE</b>              | Australasian Groundwater & Environmental Consultants Pty Limited         |
| <b>AHD</b>              | Australian height datum                                                  |
| <b>AHIMS</b>            | OEH's Aboriginal Heritage Information Management System                  |
| <b>ANZECC</b>           | Australian and New Zealand Environment and Conservation Council 2000     |
| <b>AoD</b>              | Angle of Draw                                                            |
| <b>APZ</b>              | Asset Protection Zone                                                    |
| <b>Boral</b>            | Boral Cement                                                             |
| <b>BCSC</b>             | Blue Circle Southern Cement                                              |
| <b>BNAC</b>             | Buru Ngunawal Aboriginal Corporation                                     |
| <b>BOD</b>              | biological oxygen demand                                                 |
| <b>BoM</b>              | Australian Bureau of Meteorology                                         |
| <b>CCC</b>              | Community Consultative Committee                                         |
| <b>CCL</b>              | Consolidated Coal Lease                                                  |
| <b>CEECs</b>            | critically endangered ecological communities                             |
| <b>CLC</b>              | Community Liaison Committee                                              |
| <b>CO<sub>2</sub>-e</b> | carbon dioxide equivalent                                                |
| <b>CRD</b>              | cumulative rainfall deficit                                              |
| <b>CSIRO</b>            | Australia's Commonwealth Scientific and Industrial Research Organisation |
| <b>dB</b>               | decibel                                                                  |
| <b>DEC</b>              | NSW Department of Environment and Conservation                           |
| <b>DECCW</b>            | NSW Department of Environment, Climate Change, and Water                 |
| <b>DEWHA</b>            | Australian Department of Environment, Water, Heritage and the Arts       |
| <b>DGRs</b>             | Director-General's requirements                                          |
| <b>DgS</b>              | Ditton Geotechnical Services Pty Limited                                 |
| <b>DII</b>              | NSW Department of Industry and Investment                                |
| <b>DoP</b>              | NSW Department of Planning                                               |
| <b>DoPI</b>             | NSW Department of Planning and Infrastructure                            |
| <b>DOS</b>              | degree of saturation                                                     |

## Acronyms

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|                               |                                                                               |
|-------------------------------|-------------------------------------------------------------------------------|
| <b>DTIRIS</b>                 | NSW Department of Trade and Investment, Regional Infrastructures and Services |
| <b>EA</b>                     | Environmental Assessment                                                      |
| <b>ECRTN</b>                  | EPA's Environmental Criteria for Road Traffic Noise 1999                      |
| <b>EECs</b>                   | endangered ecological communities                                             |
| <b>EETMM</b>                  | Emission Estimation Technique Manual for Mining, Version 2.3                  |
| <b>EMM</b>                    | EMGA Mitchell McLennan Pty Limited                                            |
| <b>EP&amp;A Act</b>           | Environmental Planning and Assessment Act 1979 (NSW)                          |
| <b>EP&amp;A Regulations</b>   | Environmental Planning and Assessment Regulations 2000 (NSW)                  |
| <b>EPA</b>                    | Environment Protection Authority                                              |
| <b>EPBC Act</b>               | Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)  |
| <b>EPIs</b>                   | Environmental Planning Instruments                                            |
| <b>EPL</b>                    | Environment Protection Licence                                                |
| <b>ESD</b>                    | Ecologically Sustainable Development                                          |
| <b>FTA</b>                    | full tributary area                                                           |
| <b>GHG</b>                    | greenhouse gases                                                              |
| <b>Gt</b>                     | gigatonnes                                                                    |
| <b>ha</b>                     | hectare                                                                       |
| <b>Hawkesbury-Nepean CMA</b>  | Hawkesbury-Nepean Catchment Management Area                                   |
| <b>hr</b>                     | hour                                                                          |
| <b>INP</b>                    | EPA's Industrial Noise Policy 2000                                            |
| <b>KEJ</b>                    | Korewal Elouera Jerrungarugh                                                  |
| <b>km</b>                     | kilometre                                                                     |
| <b>KTPs</b>                   | key threatening processes                                                     |
| <b>L</b>                      | litre                                                                         |
| <b>L/s</b>                    | litres per second                                                             |
| <b>LEP</b>                    | Local Environmental Plan                                                      |
| <b>LGA</b>                    | local government area                                                         |
| <b>LOS</b>                    | level of service                                                              |
| <b>m</b>                      | metre                                                                         |
| <b>m<sup>2</sup></b>          | metres squared                                                                |
| <b>m<sup>3</sup></b>          | cubic metre                                                                   |
| <b>m/s</b>                    | metres per second                                                             |
| <b>Major Development SEPP</b> | State Environmental Planning Policy (Major Development) 2005                  |

## Acronyms

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|                    |                                                                                                   |
|--------------------|---------------------------------------------------------------------------------------------------|
| <b>MBLS</b>        | Mobile Breaker Line Supports                                                                      |
| <b>mg/L</b>        | milligrams per litre                                                                              |
| <b>ML</b>          | mega litre                                                                                        |
| <b>ML/day</b>      | mega litres per day                                                                               |
| <b>Mining SEPP</b> | State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 |
| <b>mm</b>          | millimetre                                                                                        |
| <b>MOP</b>         | Mining Operations Plan                                                                            |
| <b>MSB</b>         | Mine Subsidence Board (Picton Office)                                                             |
| <b>Mt</b>          | megatonnes                                                                                        |
| <b>Mtpa</b>        | million tonnes per annum                                                                          |
| <b>NEPC</b>        | National Environmental Protection Council                                                         |
| <b>NEPM</b>        | NEPC's National Environmental Protection Measures 1999                                            |
| <b>NES</b>         | National Environmental Significance                                                               |
| <b>NHMRC</b>       | National Health and Medical Research Council                                                      |
| <b>NMP</b>         | Noise Management Plan                                                                             |
| <b>NOW</b>         | NSW Office of Water                                                                               |
| <b>NPI</b>         | National Pollution Inventory                                                                      |
| <b>NSW</b>         | New South Wales                                                                                   |
| <b>OEH</b>         | NSW Office of Environment and Heritage                                                            |
| <b>PEA</b>         | Preliminary Environmental Assessment                                                              |
| <b>PFM</b>         | planning focus meeting                                                                            |
| <b>POEO Act</b>    | Protection of the Environment Operations Act 1997 (NSW)                                           |
| <b>RBL</b>         | rating background level                                                                           |
| <b>ROM</b>         | run of mine                                                                                       |
| <b>ROTAP</b>       | CSIRO's Rare or Threatened Australian Plants 1995                                                 |
| <b>RTA</b>         | NSW Roads and Traffic Authority                                                                   |
| <b>s</b>           | seconds                                                                                           |
| <b>SCA</b>         | Sydney Catchment Authority                                                                        |
| <b>SEPP</b>        | State Environmental Planning Policy                                                               |
| <b>SEPP 44</b>     | State Environmental Planning Policy No.44 - Koala Habitat Protection                              |
| <b>SMP</b>         | Subsidence Management Plan                                                                        |
| <b>SPZ</b>         | Subsidence Protection Zone                                                                        |
| <b>SW1</b>         | South West 1 Extraction Panel                                                                     |
| <b>SWMP</b>        | Surface Water Management Plan                                                                     |

## Acronyms

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|                |                                                |
|----------------|------------------------------------------------|
| <b>t</b>       | tonnes                                         |
| <b>TDS</b>     | total dissolved solids                         |
| <b>tpa</b>     | tonnes per annum                               |
| <b>TPO</b>     | tree preservation order                        |
| <b>TSC Act</b> | Threatened Species Conservation Act 1995 (NSW) |
| <b>TSP</b>     | total suspended particulate                    |
| <b>TSS</b>     | total suspended solids                         |
| <b>USEPA</b>   | United States Environmental Protection Agency  |
| <b>VECs</b>    | vulnerable ecological communities              |
| <b>WLEP</b>    | Wingecarribee Local Environmental Plan 2010    |
| <b>WQOs</b>    | water quality objectives                       |
| <b>WSC</b>     | Wingecarribee Shire Council                    |

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