4B.5 HERITAGE

The heritage assessment was undertaken by Archaeological Surveys & Reports Pty Ltd. The full assessment is presented in Part 9 of the *Specialist Consultant Studies Compendium* (AS&R, 2010). Information from the assessment has been summarised in the following subsections.

4B.5.1 Introduction

Based on the risk analysis undertaken by R.W. Corkery & Co Pty Limited for the proposed Yarraboldy Extension (see Section 3.3 and **Table 3.7**), the potential environmental impacts related to Aboriginal heritage requiring assessment and their unmitigated risk rating are as follows.

- Destruction of a minor Aboriginal site or artefact (low risk).
- Destruction of a significant Aboriginal site or artefact (medium risk).
- Loss of archaeological knowledge (low risk).

In addition, the Director-General's Requirements issued by DoP require that the assessment of Aboriginal heritage refer to the draft *Guidelines of Aboriginal Cultural Heritage Assessment and Community Consultation* (DEC, 2005).

The Director-General's Requirements also identified "Heritage" as one of the key issues that requires assessment at the Project Site. The assessment of impacts on Aboriginal and European heritage is required to address the following.

- Provide a description of the existing heritage environment for the Project using sufficient baseline data.
- Provide an assessment of the potential impacts of the Project, including any cumulative impacts taking into consideration any relevant guidelines, policies, plans and statutory provisions.
- Provide 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 managing any significant risks to the environment.
- Consider the cumulative impact of the Project in a regional context by assessing the cumulative impact to cultural heritage of proposed and approved developments throughout the region.

The following subsections present the objectives of the assessment, methodology employed, a review of results from the heritage surveys undertaken, the proposed management of identified sites and assessment of the significance of any Project impacts on these sites.

4B.5.2 Method of Investigation

4B.5.2.1 Introduction

The identification and extent of impacts on cultural heritage values within the Project Site, the significance of the sites identified and assessments of significance of Project impacts were conducted systematically through a number of procedures including review of the archaeological records, consultations with the stakeholders, development of a predictive model for the distribution of archaeological material, and field surveys.

4B.5.2.2 Review of the Archaeological Record

A search was made of the Aboriginal Heritage Information Management System (AHIMS) Site Register maintained by the Culture and Heritage Division, DECCW, for all sites within a 56km^2 area centred on the Project Site. The search resulted in a listing of 33 sites. None of the sites occur in the Yarraboldy Extension area. No details of the sites have been included in this report on instruction from the Culture and Heritage Division in the interests of site security.

Of the 33 sites listed, 19 are open artefact scatters, one is a stone arrangement, one is a group of axe-grinding grooves and there is one restricted site. The other 11 are shelter sites. Of the shelter sites, six contained occupation deposits, two had both art and axe-grinding grooves, two contained axe-grinding grooves, and one contained art. Of particular significance, only nine sites on the listing from the Culture and Heritage Division were recorded in cleared areas. Nine sites occur along the cliff-line scarp above Pipers Flat Creek and the 12 sites associated with Lamberts Creek to the south appear to have been associated with a natural route between the northern valley sites and the sites above Pipers Flat Creek.

Three open sites have been recorded adjacent to the road west of old Wallerawang Colliery, and two sites to the west of Long Swamp. Of relevance to this investigation, one of the sites recorded to the west of Long Swamp is in Lot 39, in the northern part of Coxs River.

Of the four archaeological sites recorded during the 2010 site investigation, two were just inside the original boundary of the proposed Yarraboldy Extension area, but it was decided to avoid the two sites by amending the Project Site boundary. The two sites, both open artefact scatters, occur on cleared spur tops overlooking the Neubecks Creek (also known as Wangcol Creek) valley and their management will be addressed if required in the future by the Proponent, if disturbance of these sites is proposed.

The only remaining European heritage feature or structure that has survived within the Project Site is the entrance to the old Wallerawang Colliery underground workings and as this was in itself no heritage significance, it was determined that no assessment of the European Heritage in the Yarraboldy Extension area was required.

4B.5.2.3 Consultation

The consultation process was conducted in accordance with the DECCW guideline document *Guidelines of Aboriginal Cultural Heritage Assessment and Community Consultation* (DEC, 2005). This process is documented in the specialist consultant report (AS&R, 2010). Copies of correspondence with all stakeholders including responses and recommendations received from them after fieldwork and newspaper advertisement of the proposed Project Approval application for the site in *Lithgow Mercury* are included as appendices in AS&R, 2010.

Out of the 19 stakeholders or groups identified and invited to take part in the assessment, only six stakeholder groups participated in the field surveys and provided reports for inclusion in the specialist consultant report (AS&R, 2010).

The stakeholder groups involved in the assessment were:

- Warrabinga Native Title Claimants Aboriginal Corporation;
- Wiradjuri Traditional Owners Central West Aboriginal Corporation;
- Bathurst Local Aboriginal Land Council;
- Gundungurra Tribal Council;
- Tocomwall – A Division of Yarrawalk Aboriginal Corporation; and
- North East Wiradjuri Co Ltd.

Reports and recommendations received from the above stakeholders are attached as Appendices xii – xvi in the specialist report. A joint report was received from North East Wiradjuri Co. Ltd and Warrabinga Native Title Claimants Aboriginal Corporation.

4B.5.2.4 Development of a Predictive Model for the Distribution of Archaeological Material

A model for site distribution was proposed for the Project Site, based on a lack of reliable water source, no exposures of sandstone bedrock, no rock overhangs and the unlikely occurrences of potential archaeological deposits (PADS) due to the absence of both water and shelter. The model had the following components.

- Isolated artefacts may be present and visible in erosion features on ridges, spur tops or along creek banks.
- Low-density artefact scatters may be present and visible in erosion features on ridges, spur tops or along creek banks, but it is unlikely that any debitage will be visible.
- There is a potential for trees more than 150 years old to exhibit scarred surfaces.
- There is a potential for any trees more than 150 years old to exhibit carved surfaces.
- There will be no engravings and/or grinding grooves.
- There are unlikely to be any PADs.
- In the absence of shelters or overhangs there is no potential for shelters to exist and therefore no potential for art sites and therefore no potential for undisturbed occupation deposits.
- There will be no stone quarries.
- There will be no shell middens.

- There will be no visible evidence of burials.
- There will be no surviving Bora rings.
- There will be no stone arrangements.
- There are no known cultural associations with the area.

The model was based on the expected distribution of archaeological material which might be realistically expected to not only be present, but also detectable. The underlying factors considered to affect distribution or materials, in terms of site types and their locations, were the places where the Aboriginal people are most likely to have been, where they would most likely leave evidence of their activities, and lastly the degree to which that evidence is observable in the present record.

4B.5.2.5 Field Surveys and Results

The strategy of the field surveys was to detect any erosion features or soil exposures and identify any mature trees that might be scarred or exhibit a carved surface.

Field surveys were conducted over a two-week period from 6-15 April 2010. A roster was prepared to accommodate the high number of stakeholders who had indicated interest in being part of the survey groups (see Appendix viii, AS&R (2010)). Surveys were conducted from approximately 9.30 am till 3.30 pm each day. The conditions were generally dry and sunny.

Field observations of topography and vegetation cover were recorded as photographs and have been included in AS&R, (2010). Site locations were recorded by a GPS, and the details of archaeological artefacts identified, their dimensions and features were recorded in a field log.

Two open scatters were recorded on spurs upslope of the Yarraboldy Extension area and an isolated artefact was found on a vehicle track in the north-western corner just outside the Project Site. In addition, another site containing two artefacts was recorded immediately outside the western boundary of the Project Site. Site Recording Forms will be lodged with DECCW for listing on the AHIMS Site Register.

No sites of European significance were recorded during the survey. No sites or places of indigenous cultural significance were found within the Project Site. No locations of Potential Archaeological Deposits (PADs) were identified either. This finding reflects the disturbed nature of the site. It also reflects the absence of useful and reliable resources available at the site that would have attracted the Aboriginal people to occupy the area for any length of time and leave evidence of their presence.

4B.5.3 Significance Assessment

4B.5.3.1 Cultural Significance

The cultural significance of the artefacts and scatters identified were assessed by the stakeholders from the Aboriginal Community. While nearly all of the stakeholders considered the two artefact scatters found just outside the Project Site to be of cultural significance, none expressed any concern or interest in any cultural issues in the Yarraboldy Extension area (see to

the Appendices xii to xvi in AS&R, (2010). It should be noted, that since receiving the reports from the stakeholders the Proponent has revised the Project Site boundary and now excludes the two artefact scatters mentioned above. Therefore the references in the stakeholders' reports to the two artefact scatters within the Project Site are no longer relevant to the Project.

4B.5.3.2 Scientific Significance

In the absence of any archaeological sites identified, the Project Site is assessed to be of no research potential.

4B.5.4 Design and Operational Safeguards

Since no artefacts of cultural or scientific values have been identified at the Project Site the Proponent does not need to implement any special design or operational safeguards to minimise impacts. However, in the unlikely event that some artefacts are identified during the Project all works would be stopped and DECCW would be advised of the findings. Appropriate actions and mitigation measures after discussions with DECCW, would be implemented if this were to occur.

4B.5.5 Assessment of Impacts

Since no artefacts of cultural or scientific significance have been identified within the Project Site the Project will have no impacts on the Aboriginal or European heritage values of the site.

4B.6 TRANSPORTATION ASPECTS

The traffic and transport assessment for the Project was undertaken by Barnson Pty Ltd (Barnson, 2010). The full assessment is presented as Part 8 of the *Specialist Consultant Studies Compendium*. Relevant information from the assessment is summarised in the following subsections.

4B.6.1 Introduction

A risk analysis undertaken for the Project in Section 3 did not identify any potential impacts relating to traffic and transport associated with the Project. Nevertheless, the Director-General's Requirements issued by the DoP identified some areas relating to "Traffic and Transport" requiring assessment for the Project. The assessment of impacts relating to traffic and transport is required to include the following.

- A description of the existing traffic environment and describe the proposed traffic and transport regime associated with the Project including any proposed waterway crossings, vehicle types, movements and volumes.
- An accurate estimate of any Project-related impacts relating to traffic and transport including impacts on the safety and performance of the road network.
- A detailed description of the measures that would be implemented to avoid or mitigate traffic and transport related impacts.

The traffic assessment was undertaken in accordance with the relevant guideline documents and planning policies.

The following sub-sections describe and assess the existing traffic and transport environment, identify traffic and transport management issues, proposed controls, safeguards and mitigation measures associated with the Project.

4B.6.2 Existing Transport Network and Traffic Levels

4B.6.2.1 Existing Pine Dale Coal Mine Traffic

The existing Pine Dale Coal Mine is located approximately 2.6 km south of the Castlereagh Highway and the Boulder Road intersection in an area known as Blackmans Flat. Pine Dale Coal Mine currently supplies coal to customers via the Castlereagh Highway. At the current production level of 350 000tpa, the average traffic levels range between 60 to 80 truck loads despatched per day on a campaign basis on an average of 10 days per month. This equates to 120 to 160 truck movements along Castlereagh Highway during a busy day, i.e. 7 to 9 trucks per hour in one or both directions.

The majority of product is currently hauled to the north of the Pine Dale Coal Mine site. As such, the majority of heavy vehicle movements are left-in, right out of the Pine Dale Coal Mine heavy vehicle intersection.

Current light vehicle movements are approximately 19 to 22 trips per day during peak times and utilise the light vehicle entrance (see Figure 2).

4B.6.2.2 Existing Castlereagh Highway Traffic Volumes

Traffic volume information to 2002 from the intersection of the Castlereagh Highway and Western Main Colliery, which was provided by the Roads and Traffic Authority (RTA) – Parkes and the RTA website was used to extrapolate traffic volumes for the present. Barnson calculates that existing traffic volumes on the Castlereagh Highway for 2010 in the vicinity of the Project Site are approximately 3630 light vehicles per day and 545 heavy vehicles per day.

4B.6.2.3 Existing Road Pavement

The existing road pavement at the intersection of the Pine Dale Coal Mine and the Castlereagh Highway is a granular pavement with a bitumen seal. The pavement is currently in good condition with no potholes or visible deformation. No loose aggregate or other debris was noted surrounding the intersection.

4B.6.2.4 Traffic Safety Associated with the Existing Pine Dale Coal Mine

There has been no occasion where a complaint has been made by any person about coal transport along the Castlereagh Highway associated with the existing Pine Dale Coal Mine. No incidents have occurred associated with the transport of cola from the existing Pine Dale Coal Mine along the Castlereagh Highway.

Accident history in the area of the intersection of the Pine Dale Coal Mine and the Castlereagh Highway provided shows that there have been five (5) recorded accidents in the area, from 2005 - 2009. The previous recorded accident numbers for the five year period (prior to 2005) was ten (10). The majority of the recorded accidents were approximately 500m north of the intersection in an area known as Blackman's curve. This curve was upgraded by the RTA in 2008, which has improved safety. An accident map is shown in **Figure 4B.19**.

4B.6.2.5 Current Pine Dale Coal Mine Intersection Designs

Site Entry

The heavy vehicle intersection at present has a designated left turn lane into the site for all vehicles coming from the west. This lane is approximately 200m long, which exceeds the RTA requirements for a 'BAL' (BAsic Left Turn) type layout. For vehicles entering the site through the heavy vehicle intersection via a right turn from the east, there is an inside through lane for continuity. This intersection meets the RTA requirements for an 'AUR' (AUxiliary Right turn) type layout.

The light vehicle entry meets the RTA requirements for a 'BAR' (BAsic Right turn) type layout for vehicles entering the site from the east and BAL type layout from the east.

Site Exit

The heavy vehicle intersection has a designated right turn acceleration lane out of the site, which also exceeds the RTA requirements for a 'BAL' type layout. There is also an inside through lane for continuity for vehicles exiting the site via a right hand turn towards the west. This intersection meets the RTA requirements for an 'AUL' type layout.

The light vehicle entry meets the RTA requirements for a 'BAL' type layout where the side road 'AADT is less than 50 for vehicles exiting the site to the east and a 'BAR' type layout to the east.

4B.6.2.6 Other Existing Intersection Features

At the intersection of the heavy vehicle intersection and the Castlereagh Highway, sight distance of over 500m is available to the west, while sight distance of around 200m is currently available to the east. A large improvement in sight distance to the east could be achieved if a willow tree and scrub were removed. The site distances for the light vehicles intersection are in excess of 250m in both directions.

Located 100m to the west of the Pine Dale Coal Mine heavy vehicle intersection is the entrance for the Western Main Colliery and the proposed Lithgow City Council Waste Management Facility. There are no other major intersections in the vicinity of the heavy or light vehicle entrances to the mine.

A bus stop is located on the southern side of the Castlereagh Highway, opposite the light vehicle entrance to the Pine Dale Coal Mine.

The type of product trucks currently utilising the public road network typically consist of semi-trailers, rigid-bodied tip trucks and truck and dog trailers with average pay loads in the order of 30t to 35t.

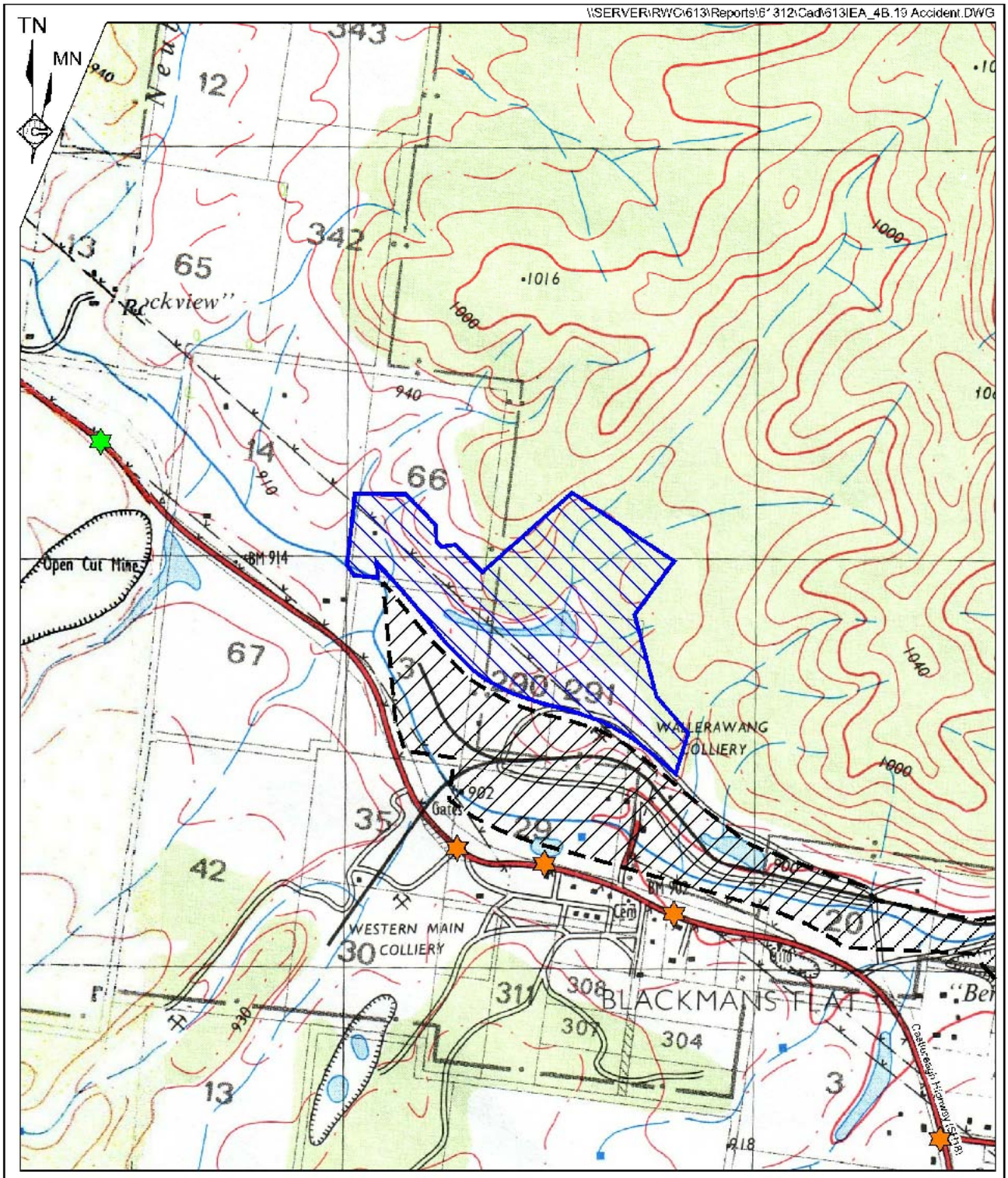


Figure 4B.19
VEHICLE ACCIDENT MAP NEAR THE PROJECT SITE

4B.6.3 Changes to Existing Network and Traffic Levels

4B.6.3.1 Proposed Coal Transport Regime

It is proposed that the volume of material transported on the Castlereagh Highway associated with the Project will be reduced from 350 000tpa to 150 000tpa. Of this, 100 000tpa would consist of product coal transported to local customers, with the remaining 50 000tpa consisting of boiler ash from the Oberon Timberworks transported to the Project Site for use in rehabilitation.

To ensure that product coal can still be transported on a campaign basis on the Castlereagh Highway, it is proposed that daily and hourly transport rates for the Yarraboldy Extension remain the same as what is currently approved for the Pine Dale Coal Mine. That is up to 100 truck loads per day (200 movements) and up to 10 trucks per hour (20 movements). It is estimated that there would remain approximately 10 days per month when product coal was transported on the Castlereagh Highway. Transportation of coal would remain during the same hours which are currently approved being from 7.00am to 8.00pm, Monday to Saturday.

There would be no change to the existing public transport network or intersections needed as a result of the Project.

The type of product trucks utilising the public road network would remain similar to the existing truck configurations, typically consisting of semi-trailers, rigid-bodied tip trucks and truck and dog trailers with average pay loads in the order of 30t to 35t.

4B.6.3.2 Projected Future Highway Traffic Growth

Barnson utilised a linear regression traffic projection spreadsheet, provided by the RTA design section in Lithgow, was used to calculate AADT to give an approximation of the future highway traffic volumes near the intersections of the Castlereagh Highway and the existing Pine Dale Coal Mine.

The traffic projection spreadsheet suggests a growth in traffic volumes of 1.7% per annum along the Castlereagh Highway at Blackmans Flat. It has also been projected that in 2014 the approximate final year of operation of the Yarraboldy Extension that there would be approximately 3850 light vehicles and 578 heavy vehicles per day utilising the Castlereagh Highway in the vicinity of the Project Site.

4B.6.4 Operational Safeguards and Ongoing Maintenance

Following a previous site visit with RTA representatives, it was previously recommended that the following measures be implemented to facilitate the transport of the currently approved 350 000tpa from the Pine Dale Coal Mine.

- Installation of truck turning signs in accordance with RTA requirements.
- Installation of guide posts at both the heavy vehicle and light vehicle entrance to delineate the entrance and highlight the bus stop at the light vehicle intersection to the Pine Dale Coal Mine.

- Removal of a willow tree and scrub to the east of the heavy vehicle intersection to the Pine Dale Coal Mine to improve sight distance.
- Continued implementation of a the 'Surface Transport Management Plan' incorporating safety and behaviour protocols for product truck drivers including the need to tarp all loads and minimise the potential of material spillage.

In addition, in accordance with the current consent, heavy vehicle one-way-in movements from the Pine Dale Coal Mine have been limited to ten (10) per hour. An RTA approved traffic counter on the heavy vehicle entry monitored vehicle movements over a 3 month period to ensure this limit was not breached of their consent.

The majority of the above measures have been successfully implemented. It is recommended that the willow tree and scrub to the east of the heavy vehicle intersection as noted above still be removed to improve site distance at this intersection.

The current light vehicle entry configuration and location is suitable for the design traffic flows.

4B.6.5 Assessment of Impacts

4B.6.5.1 Traffic Associated with the Project

The Proponent does not plan to increase production beyond the current approval of 350 000 tpa. The total number of truck despatches from the Project Site would not increase and the utilisation of the Private Coal Haul Road to transport coal to customers would reduce the transportation of coal and ash associated with the Pine Dale Coal Mine – Yarraboldy Extension along the Castlereagh Highway from 350 000tpa to 150 000tpa.

Based on the projected traffic movement at the end of the Project life (approximately 2014), and the proposed transport regime described above, Barnson determined that the existing heavy vehicle intersection would be suitable for the 150 000 tonnes per annum of material transported to and from the Pine Dale Coal Mine – Yarraboldy Extension onto the Castlereagh Highway. It was also assessed that no additional upgrade to either existing the heavy vehicle or light vehicle intersection would be required as a result of the Project.

4B.6.5.2 Cumulative Impacts

Barnson assessed the cumulative effect on highway traffic volumes due to heavy vehicles associated with the Pine Dale Coal Mine – Yarraboldy Extension, the coal washing facility at the Western Main Colliery and general traffic and heavy vehicles using the proposed Lithgow City Council Waste Management Facility.

It was assessed that the cumulative traffic volumes on the Castlereagh Highway associated with the above operations, would increase overall traffic volumes to 4272 total vehicles per day and heavy vehicles to 696 vehicles per day. As stated previously, these are maximum rates per day but there is a reduction in heavy vehicles per annum from the proposed Yarraboldy Extension as it is proposed that annual tonnages transported along the highway would decrease from the current 350 000tpa to 150 000tpa, which has not been factored into this analysis. Due to the localised increase in heavy vehicles it could be expected that highway traffic would experience slower journeys through the Blackmans Flat area until suitable overtaking opportunities are available. However, the forecasted volumes of traffic are below the design and capacity of the Castlereagh Highway.

Assuming that the Western Main Colliery/Lithgow Council Waste Management Facility operate at full capacity it would be expected that there would be some difficulty with coordinating heavy vehicles which leave the Pine Dale Coal Mine – Yarraboldy Extension travelling to the west and heavy or light vehicles leaving the Lithgow Council Waste Management Facility, travelling to the east to Lithgow.

It is understood that a four way (or cross intersection) has been considered for the site, which would require the heavy vehicle entry into the Pine Dale Coal Mine to be moved opposite the current Western Main Colliery entry. This proposal has been reviewed by Barnson and has been rejected as a solution due to future safety concerns and the adequacy of the existing intersection.

The current light vehicle entry configuration and location is suitable for the design traffic flows.

4B.7 NOISE

The noise and vibration assessment for the Project was undertaken by Heggies Pty Ltd (Heggies, 2010b). The full assessment is presented as Part 7 of the *Specialist Consultant Studies Compendium*. Relevant information from the assessment is summarised in the following subsections.

4B.7.1 Introduction

Based on the risk analysis undertaken by R.W. Corkery & Co Pty Limited for the Project (Section 3.3 and **Table 3.7**) the potential impacts relating to noise and vibration requiring assessment and their unmitigated risk rating are as follows.

- Reduction of amenity within the surrounding local area (high).
- Human health related issues and sleep deprivation relating to noise emissions (high).
- Noise related impacts on livestock (low).

In addition, the Director-General's Requirements issued by the DoP identified "Noise and Vibration" as one of the key issues that requires assessment at the Project Site. The assessment of impacts on noise and vibration is required to include the following.

- An assessment of the potential noise and blasting impacts associated with the Project, including cumulative impacts.
- A detailed description of the measures that would be implemented to avoid or mitigate impacts relating to noise and vibration.

The noise assessment was undertaken in accordance with the *NSW Industrial Noise Policy* (2000) (INP) and other relevant guideline documents and planning policies as referred to in the assessment report.

The following sub-sections describe and assess the existing noise and vibration environment, identify the potential noise and vibration impacts relating to the Project, identify noise and vibration management issues, proposed controls, safeguards and mitigation measures.

4B.7.2 Existing Noise Environment

Ten non-Project related residences were identified (R1 – R10) as being representative sensitive receptors within the immediate vicinity of the Project Site (**Figure 4B.20**). Sensitive receptors range from 400m to 2.5km from the Project Site.

Background noise monitoring was conducted at three locations considered to be representative of the nearest potentially affected residential receivers for the Project (**Figure 4B.21)** from 5 November 2009 to 16 November 2009 to determine the existing noise environment.

The existing LAeq noise levels in the vicinity of the Project Site are dominated by traffic with some influence from existing mining activity. The amenity criteria have been established using the results of ambient noise measurements.

The existing acoustical environment is primarily rural in nature with some influence from existing mining operations and the Castlereagh Highway). Therefore, the residences in the general area have been assessed as "rural" receiver types.

4B.7.3 Environmental Noise Criteria

4B.7.3.1 Introduction

The assessment of impacts of the Project on the local noise climate has been undertaken by calculating likely noise levels during both the construction and operational stages of the Project and comparing those noise levels against the noise criteria established through reference to:

- the *Industrial Noise Policy* (INP) - for site operational noise (EPA, 2000);
- NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999); and

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

For the purposes of defining relevant criteria, the DECCW nominate the following times relevant to daytime, evening, night-time periods, i.e. for Monday to Saturday.

- Daytime – 7.00am to 6.00pm
- Evening – 6.00pm to 10.00pm
- Night-time – 10.00pm to 7.00am

For Sundays and public holidays, night-time extends from 10.00pm to 8.00am.

Noise criteria for the Project were developed in accordance with the INP using the background noise monitoring information and existing meteorological records from the Pine Dale Coal Mine weather station.

Figure 4B.20
SENSITIVE NOISE RECEIVERS

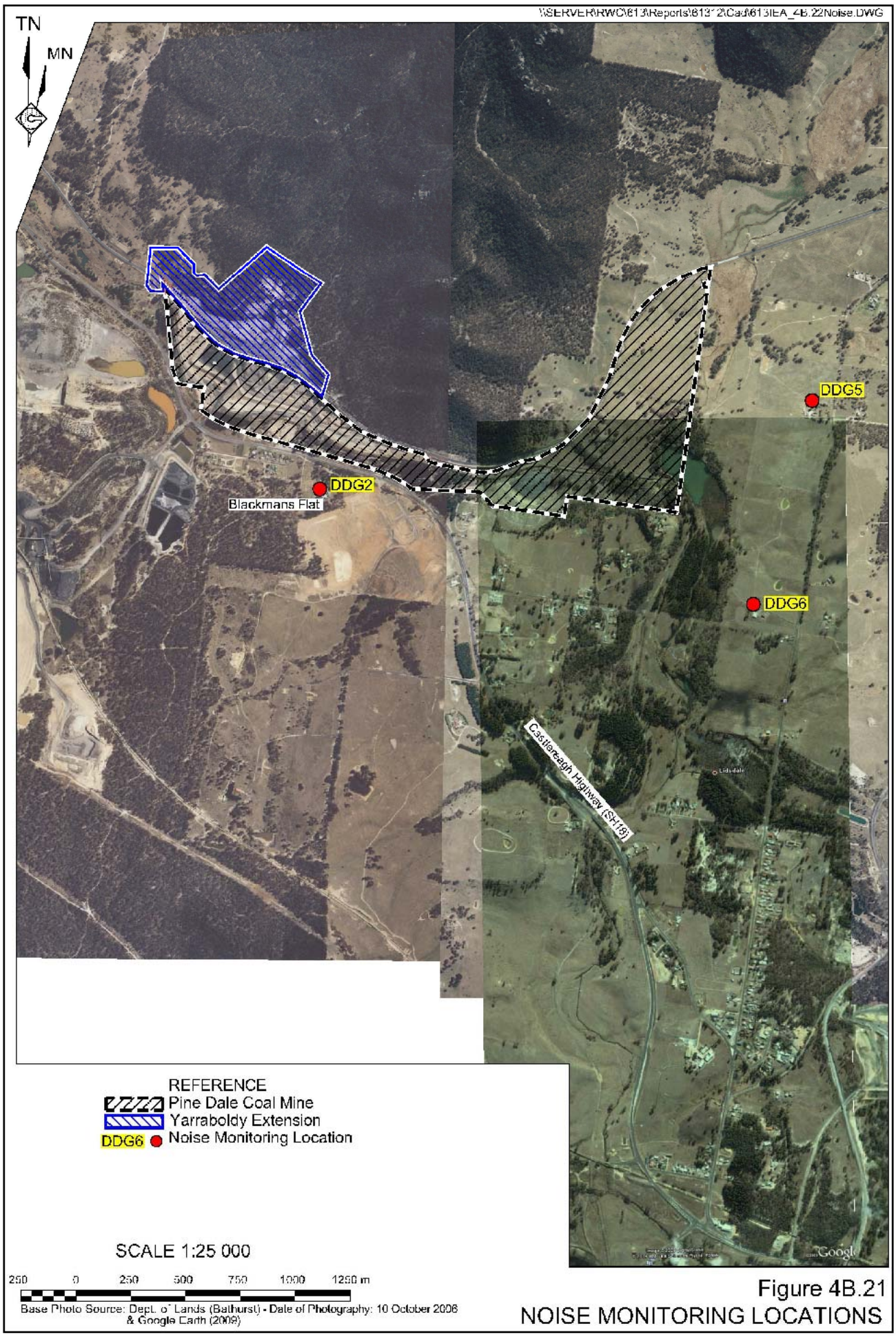


Figure 4B.21
NOISE MONITORING LOCATIONS

4B.7.3.2 Operational Noise Criteria

The INP specifies two noise criteria:

- an *intrusiveness criterion* which limits L_{Aeq} noise levels from the industrial source to a value of 'background plus 5dB(A)';and
- an *amenity criterion* which aims to protect against excessive noise levels where an area is becoming increasingly developed.

The operational Project specific noise criteria developed for the Yarraboldy Extension are shown in **Table 4B.14** for locations 1 and 2 in **Figure 4B.21**.

Table 4B.14
Project Specific Noise Criteria – Monitoring Locations

Location	Period	Intrusiveness Criteria $L_{Aeq(15minute)}$ dB(A)	Amenity Criteria $L_{Aeq(15minute)}$ dB(A)	Project Specific Noise Criteria $L_{Aeq(15minute)}$ dB(A)
Location 1				
	Day	41	50	**41**
	Evening	35	45	**35**
	Night	35	40	**35**
Location 2				
	Day	37	50	**37**
	Evening	35	45	**35**
	Night	35	40	**35**
Source: Heggies (2010b) – Table 19				

Table 4B.15 presents the adopted Project specific noise goals for receivers (see **Figure 4B.20)** surrounding the proposed Yarraboldy Extension area.

Table 4B.15
Project Specific Noise Goals – All Receivers

Assigned Residential Location Number (as per Figure 4B.20)	Period	Project Specific Noise Criteria $L_{Aeq(15minute)}$ dB(A)
1,2,3,4	Day	41
	Evening	35
	Night	35
5,6,7,8,9,10	Day	37
	Evening	35
	Night	35
Source: Heggies (2010b) – Table 20		

4B.7.3.3 Construction Noise Criteria

The DECCW has prepared a new draft guideline covering construction noise. The NSW Construction Noise Guideline sets out noise criteria applicable to construction site noise for the purpose of defining intrusive noise impacts. **Table 4B.16** sets out the noise management levels and how they are to be applied. The approach is intended to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

Table 4B.16
Construction Noise Management

Time of Day	Management Level $L_{Aeq,(15mins)}$ *	How to Apply
Recommended standard hours: Monday to Friday 7:00am to 6:00pm Saturday 8:00am to 6:00pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,(15mins)}$ is greater than the noise affected level, the Proponent should apply all feasible and reasonable work practices to minimise noise. The Proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dB(A)	The highly affected noise level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the Proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise below this level. If no quieter work method is feasible and reasonable and the works proceed, the Proponent should communicate with the impacted residents by clearly explaining the duration and noise levels of the works and by describing any respite periods that will be provided.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The Proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.

Source: Heggies (2010b) – Table 11

The Project specific construction noise goals outlined in above would apply to the construction period of the proposed noise amenity bund at the nearest potentially affected residential locations.

Similar to the intrusive Project specific noise goals, the adopted Project specific noise goal for construction activities is background plus 10dB(A) (LA90 + 10dB(A)). **Table 4B.17** presents the noise goals for construction of the noise amenity bund.

Table 4B.17
Construction Noise Goals

Assigned Residential Location Number (as per Figure 4B.7.1)	Period	Project Specific Noise Criteria $L_{Aeq(15minute)}$ dB(A)
1,2,3,4	Day	46
5,6,7,8,9,10		42
Construction may only occur between the hours of 7.00 am and 6.00 pm Monday to Friday. For all other times construction noise must be inaudible at the receiver. No construction work is to take place on Sundays or Public Holidays.		
Source: Heggies (2010b) – Table 21		

4B.7.3.4 Sleep Disturbance Criteria

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

To avoid the likelihood of sleep disturbance, the ENCM recommends that the LA1(1minute) noise level of the source under consideration should not exceed the background noise level (LA90) by more than 15dB(A) when measured outside the bedroom window of the receiver during the night-time hours (10:00 pm to 7:00 am). For the Yarraboldy extension, the sleep disturbance criteria would be 45dB(A).

4B.7.3.5 Road Traffic Noise Criteria

Vehicle noise associated with the transportation of product coal and ash to and from the Project Site along the Castlereagh Highway is considered to be road traffic noise. Therefore the noise criterion set out in the ECRTN applies to emissions from road traffic associated with the Project.

4B.7.4 Design and Operational Safeguards

A preliminary acoustic assessment identified that some activities undertaken during construction, operation and the transportation of product coal to the Castlereagh Highway intersection would likely generate noise levels above the Project's noise criteria. In order to minimise the potential for any such noise exceedance, the following controls would be adopted.

- All acoustically significant plant and equipment operates simultaneously.
- Before the drill rig operates in a particular area, the dozer would push up the weathered material to form a bund in the order of 3m in height along the southern edge of the amenity bund footprint. This smaller bund would then be effectively incorporated into the main amenity bund as it is constructed.
- Equipment supplying overburden to the amenity bund would be predominantly working behind the bund rather than working in advance of it and hauling back.

- A D9 bulldozer would be working on the amenity bund.
- The pump would be operating behind a suitable high noise barrier.
- A maximum of 10 trucks (20 movements) per hour would be occurring on the mine access route to the Castlereagh Highway.
- The crusher would be oriented such that the open side is facing north.
- The pump would not be operating in the evening or night-time periods.
- The existing crushing plant within the Pine Dale Coal Mine may operate during the site establishment phase of the Project. If this was to occur, then the crusher within the Yarraboldy Extension area would not be operated in tandem with the existing crusher. Other activities during such times would be managed to ensure compliance with noise criteria.

4B.7.5 Assessment of Impacts

4B.7.5.1 Noise Assessment Methodology

The noise impacts of proposed Yarraboldy Extension have been established by Heggies using SoundPLAN software, developed by Braunstein and Berndt Gmbh in Germany. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model used this map, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

The model was then constructed by placing the various noise generating equipment in four scenarios that would be typical of construction of the amenity bund, operation of the mine, transport of product coal to the Castlereagh Highway and night time maintenance activities. Prediction of noise emission levels was carried out under calm and prevailing atmospheric conditions as outlined in the noise assessment report. This information was then used to determine estimated noise levels at each of the surrounding residences for the four scenarios. The four scenarios modelled are outlined as follows.

- Scenario 1 – Site Establishment (Construction and Operation)
- Scenario 2 – Mining Operations
- Scenario 3 – Evening Product Transport
- Scenario 4 – Night-time Maintenance Activities

Details of each scenario are outlined in the noise assessment report.

4B.7.5.2 Noise Assessment Results

Noise levels resulting from the four modelling the scenarios described above predicted at the nearest potentially affected residential locations are provided in **Table 4B.18** to **Table 4B.21**. Potential exceedances of the Project specific noise criteria are highlighted in bold within the tables.

Scenario 1

Table 4B.18 presents the results of noise modelling under calm conditions for Scenario 1, site establishment. Results are presented for the operational and construction components of Scenario 1 and have been assessed against the appropriate criteria.

Table 4B.18
Predicted Noise Levels – Scenario 1

Receiver Location (see Figure 4B.20)	Project Specific Noise Criteria dB(A)	Construction Noise Criteria ($L_{Aeq,15min}$) dB(A)	Daytime Calm LAeq(15minute) dB(A)		
			Operational Activities	Construction Activities	Cumulative Noise Levels
R1	41	46	41	42	45
R2			38	44	45
R3			34	37	39
R4			33	38	39
R5	37	n/a[1]	<30	31	34
R6			<30	<30	<30
R7			35	<30	35
R8			**39**	<30	**39**
R9			36	<30	36
R10			**38**	<30	**38**

1 – Given that operational noise levels dominate at receivers R5 to R10, it is not appropriate to assess these locations to the construction noise criteria.

Source: Heggies (2010b) – Table 24

The results of noise modelling indicate that with the proposed noise mitigation and management strategies in place as outlined in Section 4B.7.4, construction noise levels would be in compliance with the construction noise criteria at all locations. Furthermore, the cumulative impact of construction and operational activities are predicted to be below the construction noise criteria at the nearest affected residential receivers (i.e. R1 to R4).

Operational noise levels are predicted to meet the Project specific noise criteria at all locations with the exception of a 2dB(A) exceedance at Residence 8 and a 1dB(A) exceedance at Residence 10. These exceedances are attributed to the shaping of the final landform in Mining Area C and will be of relatively short duration.

The elevated noise levels at Residence 8 and Residence 10 represent a marginal noise level increase which would not be noticeable by most people. Notwithstanding this, the noise levels are predicted to be within the noise management zone. Therefore, in order to limit the impact on these residences, Heggies recommend that the following management procedures be implemented.

- Prompt response to any community issues of concern.
- Noise monitoring on site and within the community. If noise monitoring identifies actual exceedances of the noise criteria, either noise mitigation should be installed on the bulldozers, or one of the bulldozers should be removed from the area.

- Consideration of acoustical mitigation at receivers.
- Consideration of negotiated agreements with property owners for the short duration exceedances may occur.

Scenario 2

Table **4B.19** presents the results of noise modelling under calm conditions for Scenario 2, mining operations.

Table 4B.19
Predicted Noise Levels – Scenario 2

Receiver Location (see Figure 4B.20)	Project Specific Noise Criteria dB(A)	Daytime Calm LAeq(15minute) dB(A)
R1	41	41
R2		38
R3		32
R4		39
R5	37	34
R6		31
R7		34
R8		<30
R9		<30
R10		<30
Source: Heggies (2010b) – Table 25		

Results presented in **Table 4B.19** indicate that with the proposed noise amenity bund in place, noise levels emitted from the Project Site are predicted to meet the Project specific noise criteria at all residential locations during Scenario 2 operations.

Scenario 3

Table 4B.20 presents the results of noise modelling under calm and prevailing conditions for Scenario 3, product transport within the Project Site to the intersection with the Castlereagh Highway during the evening.

As indicated in **Table 4B.20,** product transport within the Project Site to the intersection of the Castlereagh Highway during the evening period between 6:00pm and 8:00pm is predicted to comply with the Project specific noise criteria at all locations during calm and prevailing meteorological conditions with the exception of Receiver 1 where exceedances of up to 4dB(A) are predicted and Receiver 2 where a 2dB(A) exceedance is predicted under prevailing WNW winds.

It should be noted that, while evening noise levels from product transport are predicted to exceed the Project specific noise criteria based on the INP, noise levels are predicted to meet the road traffic noise criteria when travelling on the Castlereagh Highway. Furthermore, predicted noise levels from onsite truck movements are significantly below existing road traffic noise levels at the nearest residence and it is therefore considered unlikely that on-site truck movements would be distinguishable from existing road traffic movements.

Table 4B.20
Predicted Noise Levels – Scenario 3

Receiver Location (see Figure 4B.20)	Project Specific Noise Criteria dB(A)	Evening $L_{Aeq(15minute)}$ dB(A)					
		Calm	ENE	E	ESE	SE	WNW
R1	35	**39**	**42**	**40**	36	34	**42**
R2		<30	<30	<30	<30	<30	34
R3		<30	<30	<30	<30	<30	<30
R4		<30	<30	<30	<30	<30	<30
R5		<30	<30	<30	<30	<30	<30
R6		<30	<30	<30	<30	<30	<30
R7		<30	<30	<30	<30	<30	<30
R8		<30	<30	<30	<30	<30	<30
R9		<30	<30	<30	<30	<30	<30
R10		<30	<30	<30	<30	<30	<30
Source: Heggies (2010b) – Table 26							

It should also be noted, that product transport at the Pine Dale Coal Mine is currently approved to operate at the proposed rates (10 trucks (20 movements) per hour) and no complaints have been received.

Notwithstanding this, if complaints regarding noise emissions between 6.00pm and 8.00pm from the transport of product within the Project Site to the Castlereagh Highway intersection arise, it is proposed that the following management procedures be considered.

- Prompt response to any complaint.
- Noise monitoring on site at the point of the complaint.
- Installation/refinement of on-site noise mitigation measures and mine operating procedures where practical.
- Consideration of acoustical mitigation at receivers.

Scenario 4

Table 4B.21 presents the results of noise modelling under calm and prevailing conditions for Scenario 4, night time maintenance activities.

The results presented in **Table 4B.21** indicate that operational noise levels from maintenance activities during the night-time period are predicted to meet the Project specific noise criteria at all considered residential locations under calm and prevailing weather conditions with the recommended noise mitigation and management strategies outlined in Section 4B.7.4 implemented.

Table 4B.21
Predicted Noise Levels – Scenario 4

Receiver Location (see Figure 4B.20)	Project Specific Noise Criteria dB(A)	Evening $L_{Aeq(15minute)}$ dB(A)				
		Calm	E	ESE	SE	Temperature Inversion
R1	35	31	<30	<30	<30	35
R2		<30	<30	<30	<30	<30
R3		<30	<30	<30	<30	<30
R4		<30	<30	<30	<30	<30
R5		<30	<30	<30	<30	<30
R6		<30	<30	<30	<30	<30
R7		<30	<30	<30	<30	<30
R8		<30	<30	<30	<30	<30
R9		<30	<30	<30	<30	<30
R10		<30	<30	<30	<30	<30
Source: Heggies (2010b) – Table 27						

4B.7.5.3 Cumulative Impact

Potential sources of noise surrounding the Project Site have been identified as the Wallerawang Power Station, the Mt Piper Power Station, the Angus Place underground coal mine and the associated haul road to Mt Piper Power Station and the Springvale Coal Mine. The cumulative impacts of these other potential noise sources surrounding the project Site were assessed during the noise monitoring that was conducted in November 2009. Results of the monitoring determined that the cumulative noise impacts of the Project Site with existing industrial noise sources would be within amenity levels.

4B.7.5.4 Road Traffic Noise Assessment Parameters

The following parameters were used to assess the impact of road traffic noise associated with the Project.

- A peak of 200 heavy vehicle movements per day (100 loads) when product transport is occurring which is in accordance with current consent conditions. This has been assumed to be an increase of 100 truck movements to the existing road traffic flows during times when product transport is occurring onto the Castlereagh Highway.
- A worst case scenario has been calculated, based upon all of the trucks passing the residences at Blackmans Flat, simulating 100% of vehicle traffic travelling to Wallerawang Power Station. This is considered to be a worst-case transport scenario.
- Compression braking was assumed not to occur.
- Truck noise levels were taken from Heggies measurements of road truck pass-bys on the Castlereagh Highway.

- It was assumed that the existing Pine Dale Coal Mine contributes on average 100 vehicle movements per day to the existing road traffic volume when product transport is occurring, which is half the level of traffic movements that are approved under the existing consent.
- The road traffic noise modelling was based upon the peak of 200 heavy vehicle movements per day (100 loads) when product transport is occurring which is in accordance with current consent conditions. This has been assumed to be an increase of 100 truck movements to the existing road traffic flows during times when product transport is occurring onto the Castlereagh Highway.
- In addition to the heavy vehicle movements it was estimated there would be 19 to 22 light vehicle trips (38 to 44 movements) per day associated with the Project.
- A nominal 22m offset distance from the road was set in the model.
- The modelling includes a notional 0.8dB(A) façade reflection component.

4B.7.5.5 Road Traffic Noise Assessment Results

The modelling results for the road traffic noise assessment are presented in **Table 4B.22**.

Table 4B.22
Road Traffic Noise Levels – Blackmans Flat

Primary Noise Descriptor	Existing Noise Level at 22m (dB(A) re 20µPa)[1]	Predicted Increased Project Contribution at 22m (dB(A) re 20µPa)	Predicted Future Noise Level at 22m (dB(A) re 20µPa)	Predicted Noise Level change (dB(A) re 20µPa)
LAeq(15hour) (7:00am to 10:00pm)	59	53	60	1
LAeq(9hour) (10:00pm to 7:00am)	55	No Mine Vehicles	55	No Change
1 – Road traffic noise levels interpolated to 22m from measured road traffic noise levels at Location 1.				
Source: Heggies (2010b) – Table 29				

The results of the road traffic noise modelling for the Project presented in **Table 4B.22** indicate that predicted future road traffic noise levels associated with the Project are likely to meet the road traffic noise criteria. Furthermore, the likely increase in road traffic noise levels if the proposed 200 truck movements in a day (100 loads) is utilised for the Project, is predicted to be less than 1dB(A) which is a negligible increase in road traffic noise levels.

4B.7.6 Monitoring

Noise impact from the Project would continue to be monitored on a quarterly basis at the potentially affected receiver locations outlined in the current Pine Dale Coal Mine Noise Monitoring Program.

4B.8 BLASTING

The assessment of the proposed blasting practices within the Yarraboldy Extension has been undertaken by Enviro Strata Consulting Pty Ltd (ESC). Their assessment is presented in full in this section based largely upon the considerable experience gained to date at the Pine Dale Coal Mine.

4B.8.1 Introduction

Based on the risk analysis undertaken by R.W. Corkery & Co Pty Limited for the Project (Section 3.3 and **Table 3.7**), the potential impacts relating to blasting and their unmitigated risk rating are as follows.

- Damage to buildings or structures (medium).
- Nuisance/amenity impacts to surrounding landowners (low).

In addition, the Director-General's Requirements issued by the DoP identified impacts from blasting as one of the key issues that requires assessment at the Project Site. The assessment of impacts related to blasting is required to include the following.

- Provide a description of the existing vibration environment.
- Provide a quantitative assessment of the potential impacts relating to blasting.
- A description of the measures that would be implemented to avoid or mitigate impacts relating to blasting.

In determining the likely impacts related to blasting, reference was made to the Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (ANZECC 1990).

The potential direct impacts relating to blasting that may occur as a result of the proposed Yarraboldy Extension have been assessed through reference to:

- historical blasting records and site laws established for the existing Pine Dale Coal Mine; and
- predictions of blasting impacts using predictive modelling.

Due to the close proximity of blasting operations within the existing Pine Dale Coal Mine to some receptors, the Proponent and its blasting adviser Enviro Strata Consulting Pty Ltd have paid particular attention to the design of the blasts to ensure both ground vibration and airblast overpressure levels comply with all relevant criteria at residential properties. The features of the blast design are summarised in Section 4B.10.4. All recorded blast monitoring results for the Pine Dale Coal Mine have recorded a ground vibration of less than 5mm/s at the closest residence (430m).

4B.8.2 Potential Blast Receptors

Table 4B.23 lists three representative residential receptors within Blackmans Flat and their respective distance to the closest boundary of the proposed Yarraboldy Extension. Also listed are the locations of four more distant residences that have in fact been closer to the existing Pine Dale Mine. Regular blast monitoring has been undertaken at two of the four residences throughout the life of the Pine Dale Coal Mine. The locations of these residences are displayed on **Figure 4B.20**.

Table 4B.23
Representative Receptors to Blasting Operations at the Proposed Yarraboldy Extension

Location[@]	Elevation (m)	Estimated Minimum Distance (m)	Direction from Yarraboldy Extension
R1	907	500	South
R2	902	400	South
R3	901	450	South
R4*	896	800	Southeast
R5	913	1500	Southeast
R6	905	1500	Southeast
R7*	908	1600	Southeast

* Blast monitoring currently conducted at these residences
[@] See **Figure 4B.20**

4B.8.3 Blast Assessment Criteria

Impacts associated with blasting are assessed based on the ANZECC criteria which are routinely specified in environment protection licences for open cut coal mines.

- The recommended maximum airblast overpressure level for blasting is 115dB (Linear).
- The level of 115dB (Linear) may be exceeded for up to 5% of the total number of blasts over a 12 month period, but should not exceed 120dB (Linear) at any time.
- The recommended maximum ground vibration velocity for blasting is 5mm/s Peak Vector Sum (PVS).
- The PVS level of 5mm/s may be exceeded for up to 5% of the total number of blasts over a 12 month period, but should not exceed 10mm/s at any time.
- Blasting is only permitted during the hours of 9:00am to 5:00pm Monday to Saturday, and should not take place on Sundays and Public Holidays (note: the proposed hours for blasting are well within this range - see **Table 2.5**).
- Blasting occurs no more than once per day.

4B.8.4 Design and Operational Safeguards

The design and operational safeguards to be adopted for the proposed Yarraboldy Extension would be consistent with those already adopted for the existing Pine Dale Coal Mine. The principal safeguards are as follows.

- Application of deck charges to minimise the ground vibration impacts for critical blasts.
- Application of electronic detonator technology to minimise the impact of vibration (via the elimination of initiation scatter).
- Improvement in air vibration control via introduction of changes to stemming material and stemming column and developing appropriate control procedures.
- Optimisation of the initiation sequence to minimise the impact on the generated air and ground vibration levels.

The blasting assessment assumes that the above safeguards would be adopted for the Project.

4B.8.5 Approach to Predicted Blast Emissions

The predicted blast emissions for the Yarraboldy Extension have been undertaken through a detailed analysis of the blast monitoring data compiled for the Pine Dale Coal Mine. In addition, the monitoring data, blast design parameters such as blast locations, blast type and instantaneous charge mass were utilised to develop comparative vibration predictive models. The analysis also assumed that a similar vibration transfer mechanism would be encountered for the Yarraboldy Extension as is currently encountered at the existing Pine Dale Coal Mine.

The evaluation of the monitoring data involved:

- an analysis of the ground vibration site law;
- an analysis of the air vibration-sonics decay law; and
- the results of single hole trials.

Details of these evaluations are set out as follows.

Ground Vibration Site Law Analysis

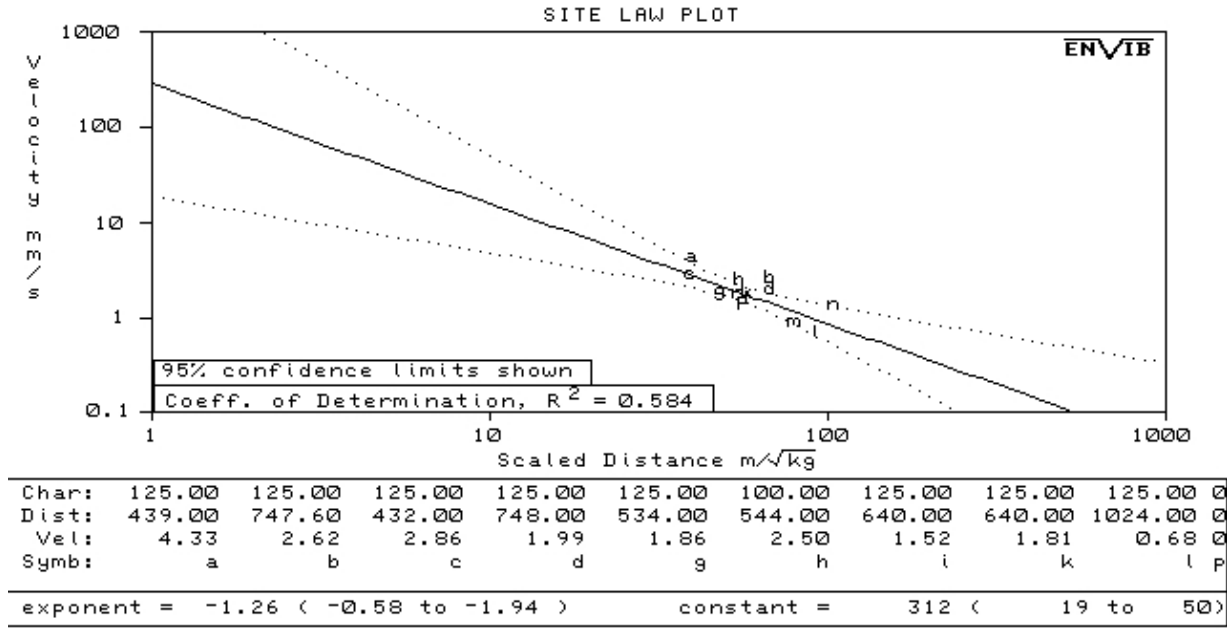
ESC used the following site law formula for ground vibration.

$$\mathbf{V} = \mathbf{k}\left(\frac{D}{\sqrt{m}}\right)^{a}$$

Where:

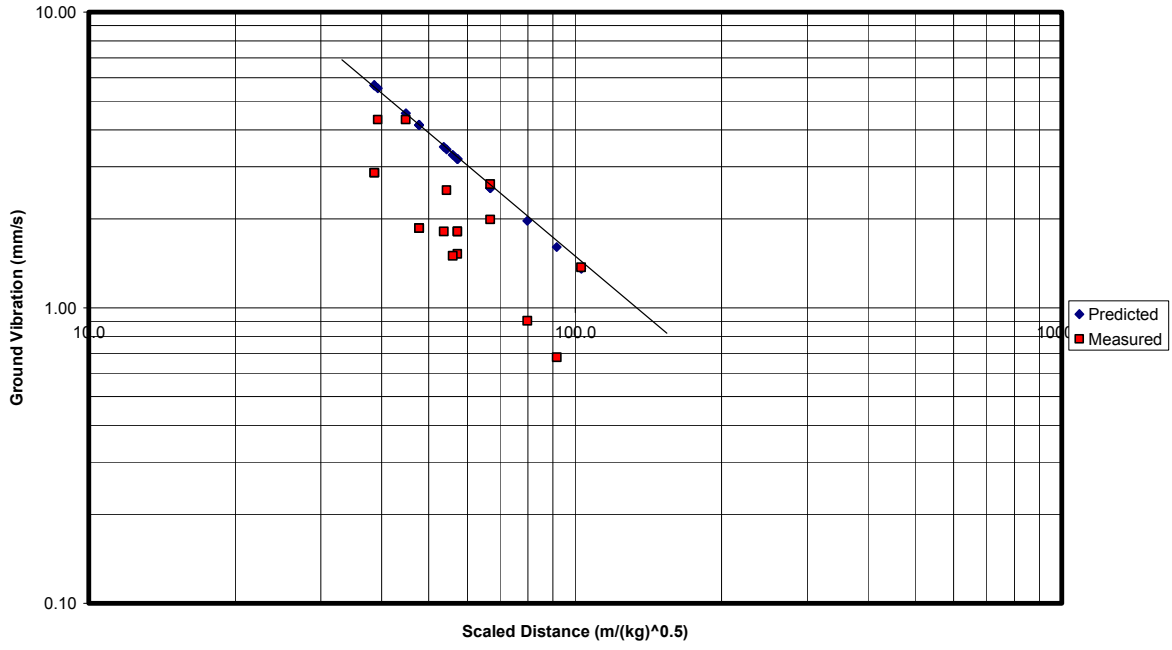
V	=	Peak Particle Velocity (mm/s)
D	=	Distance from blast (m)
m	=	Charge mass per delay (kg)
a	=	Site exponent
k	=	Site constant

The results of the ground vibration analysis are presented in **Figure 4B.22** together with a 95% confidence limit line. The results have also been analysed and include the outer data envelope (see **Figure 4B.23)**. Each of the diagrams also includes estimated formulas.



Source: T. Lewandowski

Figure 4B.22
SITE LAW ANALYSIS For GROUND VIBRATION



Source: T. Lewandowski

Figure 4B.23
SITE DECAY ANALYSIS – OUTER DATA ENVELOPE

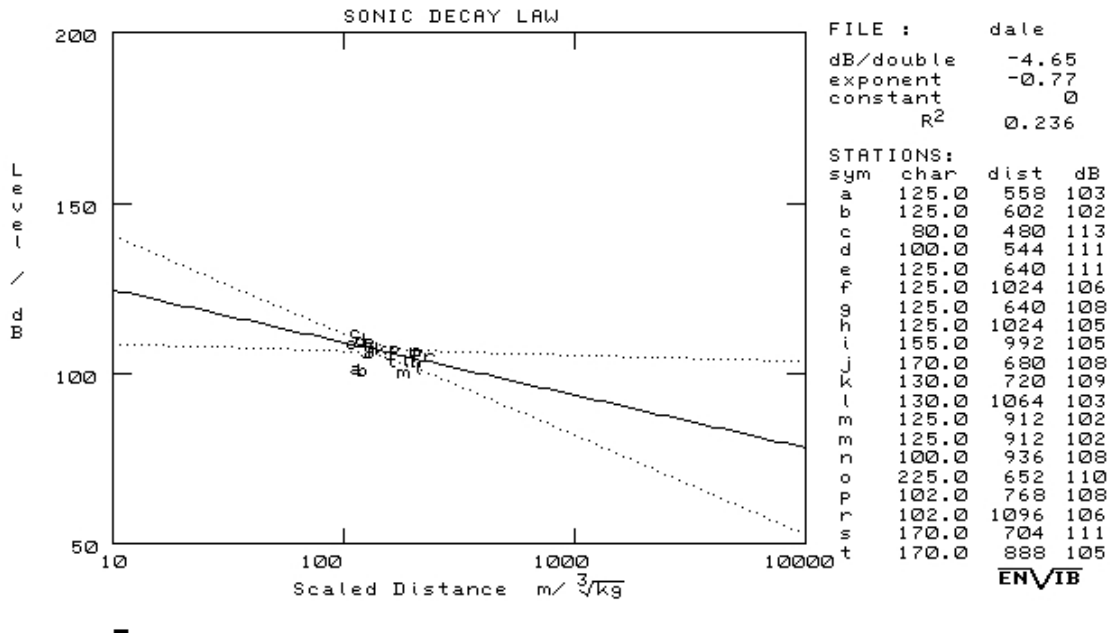
Air Vibration – Sonic Decay Law Analysis

ESC used the following sonic decay formula to predict the airblast overpressure levels arising from blasts in the Yarraboldy Extension area.

$$P = A\left(\frac{D}{\sqrt[3]{W}}\right)^{a}$$

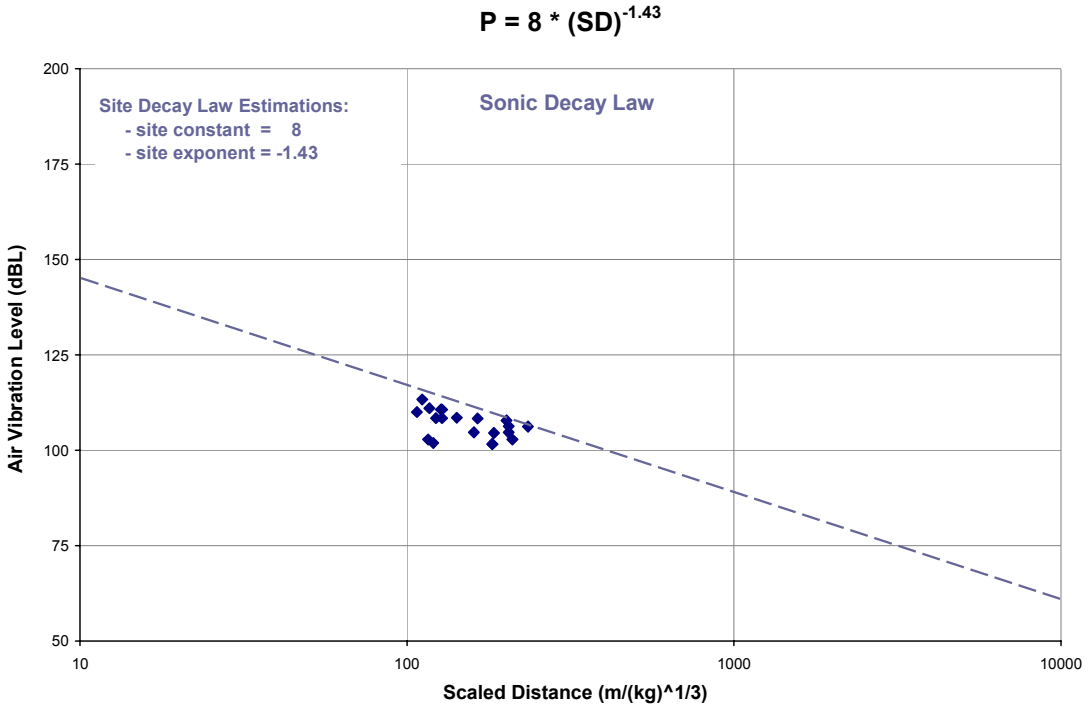
Where:
- P = Peak Pressure in kPa
- A = Site Constant
- a = Site Exponent
- D = Distance from blast (m)
- W = Charge mass per delay (kg)

Figure 4B.24 shows the results of the sonic decay law analysis, including a 95% confidence limit and **Figure 4B 25** incorporates the outer data envelope for the sonic decay analysis. An estimated formula is also shown.



Source: T. Lewandowski

Figure 4B.24
SONIC DECAY ANALYSIS FOR AIR VIBRATION



Source: T. Lewandowski

Figure 4B.25
SONIC DECAY ANALYSIS – OUTER DATA ENVELOPE

ESC notes that the sonic decay law analysis method is rather inaccurate and the results of the modelling may appear to be overestimated as the analysis is based on only charge mass and distance. ESC lists the following factors which should be taken into account when analysing the results of sonic decay law analysis.

- The emission of an airblast is not uniform but rather similar to an elliptical shape (Moore and Richards 2004), where the highest airblast emission is in front of the face and the lowest airblast emission at the back of the face (due to shielding). However, it is noted that the sonic decay law analysis is based on a uniform noise distribution from the source.
- The atmospheric conditions play a major role in potential sound level amplification i.e. collected air vibration data is not assessed for the impact of weather. Therefore the analysis using sonic decay, without assessing each measurement for atmospheric input, introduces a significant error into the whole analysis, as some of the results are affected by wind, wind shear, inversion and other factors.
- The stemming column is completely disregarded in the sonic law equation, which is one of the most important parameters.

Single Hole Trial Results

In 2008, a single hole trial was undertaken for the existing Pine Dale Coal Mine to determine if blasting operations could occur within close proximity to receptors, without exceeding relevant blasting criteria.

ESC notes that the trial revealed that the air vibration level generated by a single hole emission was in the range of 100 – 107 dBL for the closest residence located at approximately 430m from the trial area. Considering the highest air vibration emission from the single hole trial, it was concluded that it should be possible to maintain the level of air vibration from the main blast below 115 dBL for receptors located within 400m to 500m from a blast.

The trial assumed that the above air vibration levels could only be achieved if there was full control of the following.

- Stemming height and stemming material – no stemming ejection allowed.
- Face conditions – no face burst allowed.
- Environmental conditions.

4B.8.6 Predicted Blast Emissions and Assessment of Impacts

Table 4B.24 summarises the ground vibration and airblast overpressure levels predicted from blasting operations within the Yarraboldy Extension area.

The predictions have been assembled for three scenarios involving increasing quantities for the maximum instantaneous charge (MIC).

Table 4B.24
Estimation of Air and Ground Vibration Levels - Various Scenarios

Location[@]	Distance (m)	Ground Vibration (mm/s)	Air Vibration (dBL)	Comments
MIC – 80 kg – Minimum Distance Case				
R1	500	3.3	113.0	
R2	400	4.6	115.8	Critical residence, vibration acceptable as model overestimated
R3	450	3.9	114.3	
R4*	800	1.7	107.2	
R 5	1500	0.7	99.3	Negligible impact
R6	1500	0.7	99.3	Negligible impact
R7*	1600	0.6	98.5	Negligible impact
MIC - 110 kg and blasting moved by 50				
R1	550	3.6	113.1	
R2	450	4.9	115.6	Critical residence, vibration acceptable as model overestimated
R3	500	4.2	114.3	
R4*	850	1.9	107.7	
R 5	1550	0.8	100.3	Negligible impact
R6	1550	0.8	100.3	Negligible impact
R7*	1650	0.7	99.5	Negligible impact
MIC - 140 kg and blasting moved by 100 metres				
R1	600	3.8	113.0	
R 2	500	5.0	115.3	Critical residence, vibration acceptable as model overestimated
R3	550	4.3	114.1	
R4*	900	2.1	108.0	
R5	1600	0.9	100.9	Negligible impact
R6	1600	0.9	100.9	Negligible impact
R7*	1700	0.8	100.1	Negligible impact

* Blast monitoring currently conducted at these residences [@] See **Figure 4B.20**

Based upon the predicted levels in **Table 4B.24**, it is assessed that the blasting criteria set out in Section 4.6.3 will be satisfied principally by limiting the MIC whilst maintaining the Proponent's standard blasting and well proven practices.

The Proponent would have the opportunity to further assess blasting impacts at the most critical residence (Residence 2) well before blasting is undertaken near the closest boundary of the Yarraboldy Extension area. This will be possible as blasting will commence at the northwestern side of the mine extension at least 750m from the residence. Blast monitoring would assist to ensure all blasting criteria are satisfied.

4B.9 AIR QUALITY

The air quality assessment was undertaken by Heggies Pty Ltd. As part of this assessment the greenhouse gas emission sources were identified and quantified. The full assessment is presented in Part 6 of the *Specialist Consultant Studies Compendium (Heggies, 2010a).* This section summarises the assessment of overall air emissions from the Project Site.

4B.9.1 Introduction

Based on the risk analysis undertaken by R.W. Corkery & Co Pty Limited for the project (see Section 3.3 and **Table 3.7**), the potential air quality impacts requiring assessment and their **unmitigated** risk ratings are as follows.

- Increased deposited dust levels and suspended particulate matter concentration (extreme risk).
- The release of sulphur dioxide and its associated odour relating to a spontaneous combustion outbreak (low risk).
- Reduced local amenity due to the production of nitrogen oxide from blasting operations (low risk).
- Greenhouse and other gas emissions (extreme risk).
- Minor health impacts associated with emissions of sulfur dioxide and nitrogen oxide (low risk).

The Director-General's Requirements issued by the DoP identified air quality as one of the key issues that requires assessment at the Project Site. The assessment is required to include:

- a quantitative assessment of potential air quality impacts;
- a qualitative assessment of the potential scope 1, 2 and 3 greenhouse gas emissions of the project; and
- an assessment of all reasonable and feasible measures that could be implemented on site to minimise greenhouse gas emissions and ensure the project is energy efficient.

The assessment of air quality was undertaken in accordance with *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005).

The air quality issues addressed in this section relate to the following.

- Generation of dust by both construction, operational and rehabilitation activities throughout the Project Site and in the surrounding areas.
- Emissions of greenhouse gases – principally carbon dioxide (CO_2) and methane (CH_4) during and following the mining of the coal.

The following subsections describe the existing air quality environment surrounding the Project Site, air quality criteria used to assess the Project impacts on the environment, proposed operational safeguards and mitigation measures, and an assessment of the residual impacts following the implementation of these safeguards and mitigation measures.

4B.9.2 Existing Air Quality

4B.9.2.1 Introduction

Air quality impacts provided in this section were assessed against all the relevant air quality guidelines and goals. The description of the existing air quality at the Project Site was derived from site-specific air quality data, acquired as part of the Pine Dale Coal Mine ambient air quality monitoring network. The network comprises six dust deposition gauges (DDG1 – DDG6) and two high volume air samplers (HVAS), the locations of which are shown in **Figure 4B.26.** The average values reported in this assessment have been derived from data measured over a 3.5 year period from December 2005 to July 2009.

4B.9.2.2 Suspended Particulate

The annual average total suspended particulate (TSP) concentrations, comprising airborne particles greater than 10µm but less than 35µm in aerodynamic diameter, measured in the area south of the current mining operations have been approximately 30 to 40µg/m^3 over the 3.5 year period of data acquisition. The values are well below DECCW ambient air quality guideline value of 90µg/m^3.

The annual average PM_{10} concentrations, comprising airborne particulate matter with less than 10µm aerodynamic diameter, measured by the HVAS were also well below the DECCW ambient air quality guideline for PM_{10} of 30µg/m^3. Other than a noticeable decrease in ambient PM_{10} levels in the period May 2007 to April 2008, the rolling annual average concentrations have consistently been below 15µg/m^3 since the beginning of 2008.

The measured 24-hour average PM_{10} concentrations have also been compliant with the DECCW 24-hour average ambient air quality guideline of 50 µg/m^3, except for a slight exceedance recorded in May 2006.

4B.9.2.3 Dust Deposition

Particles that have an aerodynamic sufficiently large so as not to be suspended in air (typically >35µm) are referred to as deposited dust. Dust deposition data acquired from deposition gauges DDG1 – DDG6 over the 3.5 years of monitoring showed the annual average dust deposition rate (based on the insoluble solids component) in the area surrounding the current mining operations ranges between 1 and 2g/m^2/month, and has been consistently below the DECCW ambient air quality guideline average of 4g/m^2/month. Only three monthly samples recorded values above the guideline value which appeared to be isolated events associated with local dust sources near the gauges, rather than the ongoing activities at the Pine Dale Coal Mine site.

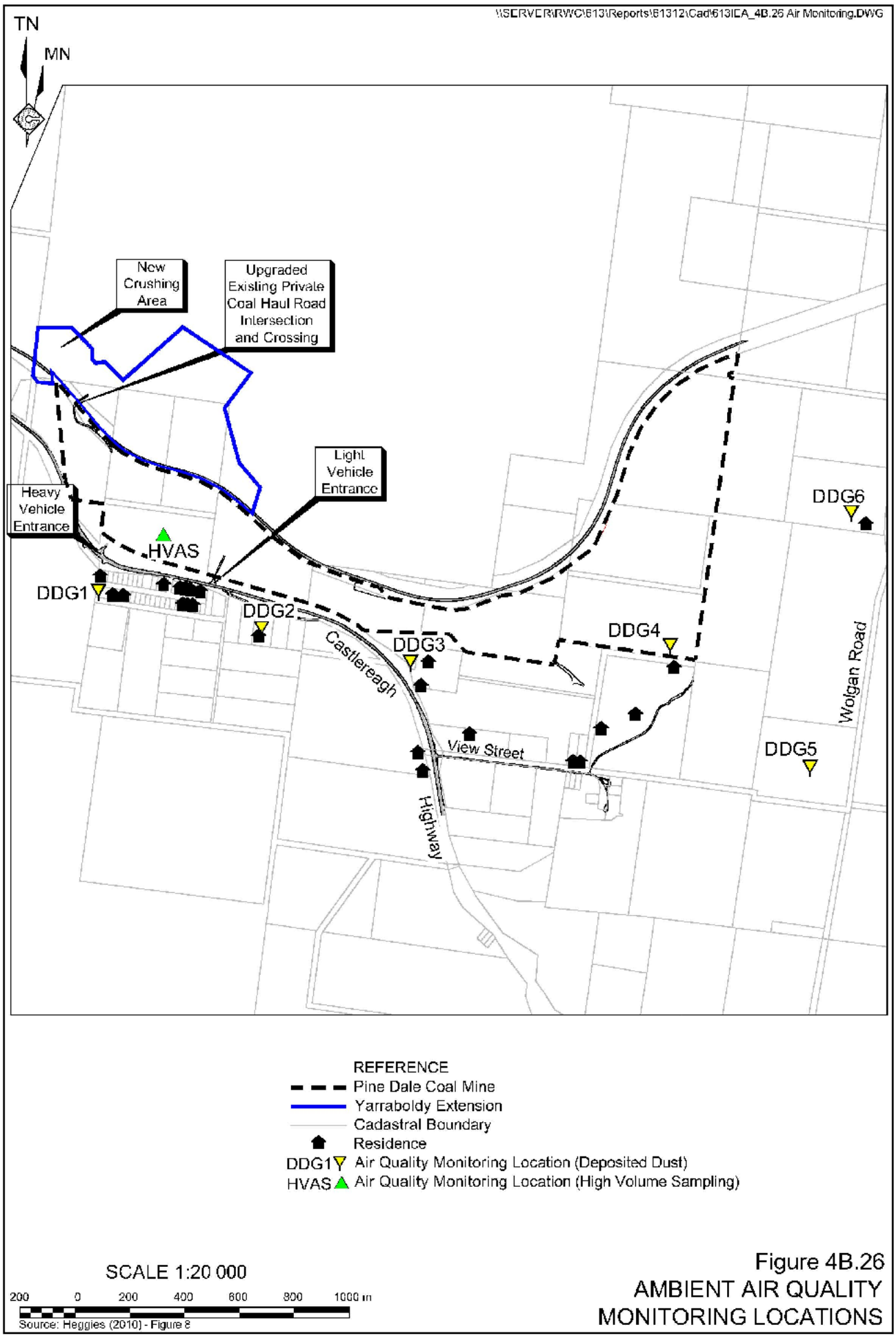


Figure 4B.26
AMBIENT AIR QUALITY MONITORING LOCATIONS

4B.9.2.4 Oxides of Nitrogen and Sulfur

Existing background concentrations of sulphur dioxide (SO_2) and nitrogen oxides (NO_x), pollutants generated through the combustion of fuels in vehicles, would be small from Yarraboldy Extension area, and the resulting concentrations at the nearest receptors would be negligible.

4B.9.2.5 Carbon-containing Gaseous Pollutants

Existing background concentrations of volatile organic compounds (VOCs), carbon monoxide and fugitive emissions from coal seams would be small from Yarraboldy Extension area, and the resulting concentrations at the nearest receptors would be negligible.

4B.9.2.6 Summary of Existing Air Quality

Table 4B.25 provides a summary of the background concentrations of PM_{10}, TSP and dust deposition that have been used in modelling assessments of potential air quality impacts of the Project.

Table 4B.25
Background Air Quality Data used in Modelling Assessment

Air Quality Parameter	Averaging Period	Concentration
PM_{10}	24-hours	Daily varying file based on 2006 monitoring data from Bathurst (DECCW)
	Annual	15µg/m^3
TSP	Annual	40µg/m^3
Dust Deposition	Annual	2g/m^2/month
Source: Heggies (2010a) – Table 7		

4B.9.3 Potential Sources of Air Pollutants

4B.9.3.1 Particulate Emissions

Project activities that would contribute to the particulate emissions inventory from the Yarraboldy Extension are related to specific site establishment and construction activities, operational and on-site transportation components as given below. The particulate emission sources are indicated for each activity.

- Topsoil stripping
  - Topsoil removal by excavator
  - Transport of topsoil to stockpiles by haul truck
  - Dumping of topsoil to stockpiles
  - Stockpile management by dozer

- Blasting
  - Drilling of blast holes
  - Blasting
- Overburden management
  - Overburden to haul truck by excavator
  - Transport to waste rock dump by haul truck
  - Dumping of overburden to waste rock dump
  - Overburden management by dozer
- Coal management
  - Coal to haul truck by excavator
  - Transport to ROM stockpile/coal loader
  - Dumping of coal to ROM stockpile/coal loader
  - Movement of coal from ROM to hopper by front-end loader
  - Crushing and screening of coal
  - Stacking of product coal onto the product stockpile
- Haul route management
  - Grader on haul routes
- Gravel extraction
  - Gravel extraction by excavator
  - Transport to stockpile by haul truck
- Stockpiles and open areas
  - Wind erosion of stockpiles and open areas
- Product management
  - Movement of coal from product stockpile to product trucks by front-end loader
  - Transport of product to Castlereagh Highway or to Private Coal Haul Road

4B.9.3.2 Greenhouse Gas Emissions

Sources of greenhouse gas emissions (carbon dioxide, methane, water vapour) are anticipated to be the following.

- Combustion of diesel during mining and ancillary activities
- Transportation of coal off site and distribution of coal products.
- Fugitive emissions from coal seams.
- Use of explosives.
- The use of purchased electricity within the Project Site.
- End use of coal products.

4B.9.4 Operational Air Quality Controls

4B.9.4.1 Introduction

The Proponent would apply a wide range of air pollution control measures to ensure air quality standards are not compromised by the Project activities. These operational controls have been categorised as either dust control measures, controls for other air contaminants, and greenhouse gas mitigation measures.

4B.9.4.2 Dust Control Measures

Appropriate dust control measures would be implemented within the Project Site to minimise dust emissions from a number of sources. The individual potential sources of dust and proposed controls are listed in **Table 4B.26.**

Table 4B.26
Dust Control Measures for Project Site Activities

Dust Emission Source	Operational Controls
Vegetation Clearing	• Cleared trees and branches would be retained on the margins of cleared areas for use in stabilising disturbed areas once they are no longer required.
Soil Stripping	• Where practicable, soil stripping would be undertaken at a time when there is sufficient soil moisture to prevent significant lift-off of dust. • The Proponent would avoid stripping soil in periods of high winds • Dust suppression by water application would be used to increase soil moisture, if required.
Coal Transfer, Crushing and Screening	• Notwithstanding the moist nature of the ROM coal, water would be applied to the coal at the feed hopper, crusher and at all conveyor transfer and discharge points. • All conveyors would be fitted with appropriate cleaning and collection devices to minimise the amount of material falling from the return conveyor belts. • The crusher would be enclosed. • All surface conveyors would be partly enclosed to minimise dust lift off. • Some flexibility would exist to temporarily cease operation in the event of protracted dry periods, high winds, and significant dust generation and dispersal towards the surrounding residences.
Wind Erosion from Exposed Surfaces and Stockpiles	• Minimising the extent of clearing/site preparation during site establishment and preparation of operational sites across the Project Site. • Clear definition of all site roads and the restriction of vehicles and equipment to those roads. • Progressive rehabilitation of areas of disturbance including topsoil and subsoil stockpiles. • Routine application of water sprayed onto stockpiles and hardstand areas. • Maintenance of the perimeter amenity bund and windbreaks.
Coal Loading onto Trucks	• The coal loaded onto trucks would be watered as required to maintain sufficient moisture content to prevent dust lift-off during loading. The loads would be covered during transport off site and delivery to final destinations.

4B.9.4.3 Controls for Other Potential Air Contaminants

Earthmoving equipment and on-site vehicles would be fitted with exhaust controls which satisfy the DECCW emission requirements. All equipment would be properly maintained to ensure no unacceptable exhaust emissions occur. The Proponent would commit to the removal of any vehicle or item of mobile equipment from the site deemed not to be complying with DECCW guidelines. The exhausts of all equipment would be directed upwards or to the side so as not to impinge on the ground and cause dust lift-off.

The Proponent would pro-actively minimise the use of diesel to minimise diesel fume generation by:

- optimising and scheduling vehicle operations;
- maintaining engines according to manufacturers' guidelines and keeping tyres at optimum pressure;
- minimising vehicle idling time; and
- possible use of alternative fuels with a reduced carbon content.

The above control measures relating to diesel fumes are also relevant to controlling odour arising from the mobile equipment fleet. The generation of odour on either the ROM coal pad or product coal storage pad (arising from localised spontaneous combustion) would be avoided and / or minimised through constant monitoring of each pad. In the unlikely event localised spontaneous combustion is detected on either pad, the Proponent would isolate the affected coal, drench the coal with water and either process or despatch the subject coal as quickly as possible.

4B.9.4.4 Greenhouse Gas Mitigation Measures

The Proponent is currently implementing a number of measures to minimise the emissions of greenhouse gases from the Project. Mitigation measures being undertaken are described below.

- Maximising energy efficiency as a key consideration in the development of the Mine Plan.
- Additional measures that would be implemented to achieve reductions in greenhouse gas emissions would include:
  - the implementation of cost effective measures to improve energy efficiency;
  - regular maintenance of plant and equipment to minimise fuel consumption; and
  - consideration of energy efficiency in the plant and equipment selection/phase.

4B.9.5 Assessments of Impacts

4B.9.5.1 Introduction

The assessment of Project impacts was undertaken for both dust generating activities and greenhouse gas (GHG) emissions. In the case of the impacts of the dust generating activities this was primarily undertaken through computer modelling to establish likely concentrations of PM_{10}, TSP and deposited dust generated within the Project Site. In the case of the impacts of greenhouse emissions a quantitative assessment was undertaken, and the estimates from the Project Site were compared with the National and State GHG emissions.

Dust emissions from the proposed Yarraboldy Extension were modelled using the US EPA's CALPUFF (Version 6.267) modelling system. CALPUFF is a transport and dispersion model that advects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes. Input data required for this modelling were sourced from modelling to predict three-dimensional meteorological data and air pollution concentrations. The Air Pollution Model (TAPM) was used for predictions of wind speed and direction, temperature, pressure, water vapour, cloud rain water and turbulence. CALMET was used to develop wind and temperature fields on a three-dimensional modelling domain.

Details of the modelling methodology employed for impact predictions, and the pollutant sources and emission data used in the modelling are provided in Section 7 of Heggies (2010a).

Prior to modelling predictions of TSP and PM_{10} concentrations and dust deposition rates attributable to the proposed Yarraboldy Extension, inventories of all emission sources along with the emission estimates were determined for two operational scenarios: site establishment and Year 2 operations.

The emission inventories determined for the two scenarios are presented in Section 4B.9.5.2 while the dispersion modelling results are presented in Section 4B.9.5.3.

Please note: Both dust inventories are to be reviewed during the adequacy assessment period given the scenarios proposed are possibly un-realistic / achievable.

4B.9.5.2 Emission Inventories and Assessments of Operational Scenarios

The particulate generating activities have been quantified for the Project and are given below. The estimates for TSP and PM_{10} to be used for dispersion modelling were derived based on two operational scenarios.

- Scenario 1 – Site Establishment
- Scenario 2 – Year 2 Operations

It should be noted that emissions from existing activities at the Pine Dale Coal Mine were not included and modelled, as these activities would cease by the time the Yarraboldy Extension becomes operational.

Scenario 1 – Site Establishment

The Site Establishment phase is expected to occur over approximately six months and would involve:

- commencement of mining within the Yarraboldy Extension area;
- construction of the amenity bund utilising approximately 175 000 m^3 of overburden and interburden above the current ground surface;
- construction and operation of a new crushing plant north of the Private Coal Haul Road and transport of coal products (via the existing public road intersection;
- operation (if required) of the existing crushing plant within the existing Pine Dale Cola Mine footprint. However, this plant would not operate concurrently with the new crushing plant located within the proposed Yarraboldy Extension;

- final landform shaping of rehabilitated areas of the existing Pine Dale Coal Mine; and
- pumping of water (if needed) for use in dust suppression.

Details of the calculations conducted, specific activities that were considered in preparing the emissions inventory, and the emission factors used for Scenario 1 are given in Section 6.2 of the air assessment report (Heggies, 2010a).

Table 4B.27 presents the summary of the estimated TSP and PM_{10} emissions for Scenario 1. Given that Scenario 1 represents only the first six months of the Project the annual estimates for Scenario 1 have been calculated by multiplication with the appropriate factor, and are not based on actual estimates.

Table 4B.27
Estimated TSP and PM_{10} Emissions – Scenario 1 (Site Establishment)

Page 1 of 2

Emission Source	Estimated Daily Emissions (kg/hr)		Estimated Annual Emissions (kg/year)	
	TSP	PM_{10}	TSP	PM_{10}
Open Cut				
Drilling	0.4	0.4	1 381	1 378
Blasting [1]	102.2	53.2	5 317	2 765
Excavator	0.2	0.2	715	654
Two Dozers (Mining Area C)	3.3	0.6	10 219	2 016
Hauling from pit to ROM	0.2	0.1	636	172
Grader (internal haul road)	1.0	0.4	2 965	1 326
Processing Area				
Run-of-Mine stockpile loading	1.6	0.7	4 992	2 122
Front end loader at crusher	5.7	2.7	8 928	4 235
Crusher	4.0	1.6	6 240	2 496
Product stockpile loading	1.6	0.7	2 496	1 061
Truck loading	5.7	2.8	8 242	3 962
Hauling product off-site	3.5	0.8	5 074	1 166
Bund Construction				
Truck unloading	2.4	0.9	7 636	2 736
Excavator	5.1	2.4	15 909	7 636
Dozer	1.6	0.3	5 110	1 008
Hauling to bund	0.7	0.2	2 088	564
Stockpiles and Exposed Areas				
Exposed area – Open cut	2.1	1.0	3 319	1 660
Exposed area – Amenity bund	1.0	0.5	1 590	795
ROM stockpile	0.1	0.04	140	70
Product stockpile	0.1	0.04	140	70
TOTAL SITE EMISSIONS	**142.54**	**69.58**	**93 136**	**37 891**

[1] Annual emissions assume 52 blasts/year

Source Heggies (2010a) Table 12

Scenario 2 – Year 2 Operations

The mining operations (following construction of the amenity bund to final elevation of 935 m AHD and completion of final landform shaping within the rehabilitated Pine Dale Coal Mine Mining Area C) considered for Scenario 2 included:

- ongoing mining of the Yarraboldy Extension area;
- operation of the crushing plant within the Yarraboldy Extension area and transportation of coal products via the Private Coal Haul Road and public road; and
- dewatering of the underground workings.

Details of the calculations conducted, specific activities that were considered in preparing the emissions inventory, and the emission factors used for Scenario 1 are given in Section 6.2 of the air assessment report (Heggies, 2010a). It was assumed that approximately 250 000 tonnes per annum (tpa) of coal would be transported via the Private Haul and 100 000tpa would continue to be transported via the Castlereagh Highway. Of the trucks transporting coal via the Castlereagh Highway, up to 30 000tpa may turn left out onto the highway to travel eastwards.

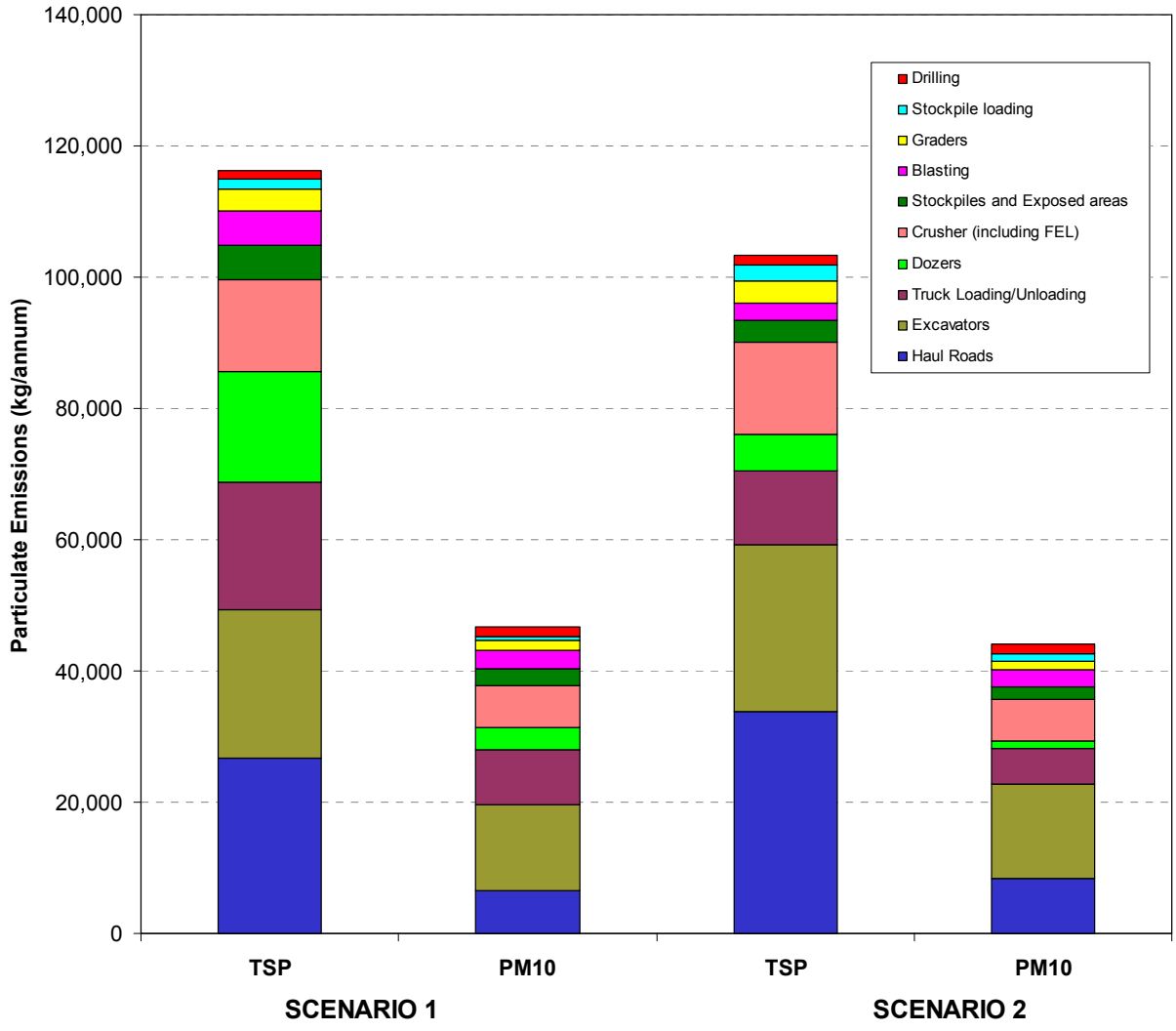
Table 4B.28 presents the summary of the estimated TSP and PM_{10} emissions for Scenario 2.

Table 4B.28
Estimated TSP and PM_{10} Emissions – Scenario 2 (Year 2 Operations)

Emission Source	Estimated Daily Emissions (kg/hr)		Estimated Annual Emissions (kg/year)	
	TSP	PM_{10}	TSP	PM_{10}
Pine Dale Open Cut				
Drilling	0.4	0.4	1 255	1 253
Blasting [1]	51.1	50.5	2 658	2 627
Excavator	0.2	0.2	715	645
Dozer	2.3	0.5	7 186	1 456
Grader	1.0	0.4	2 965	1 326
Hauling from pit to ROM	0.2	0.1	580	157
Hauling overburden/interburden	0.9	0.2	2 837	766
Excavator	2.9	1.4	9 105	4 319
Processing Area				
ROM stockpile loading	1.6	0.7	4 992	2 122
Front end loader at crusher	5.7	2.7	8 928	4 235
Crusher	4.0	1.6	6 240	2 496
Product stockpile loading	1.6	0.7	1 920	816
Truck loading	5.7	2.7	8 242	3 909
Hauling product off-site	5.9	1.3	8 457	1 943
Stockpiles and Exposed Areas				
Exposed area – Open cut	2.1	1.0	3 319	1 660
ROM and product stockpile	0.03	0.02	55	28
ROM and product stockpile	0.03	0.02	55	28
TOTAL SITE EMISSIONS	**86**	**64**	**69 511**	**29 784**
[1] Annual emissions assume 52 blasts/year				
Source Heggies (2010a) Table 13				

A comparison of inventories presented in **Table 4B.27** and **Table 4B.28** show a slight decrease in total emissions of TSP and PM_{10} for Scenario 2 (Year 2 Operations) compared to Scenario 1 (Site Establishment).

Figure 4B.27 presents the relative contributions of each source activity type to the total estimated annual TSP and PM_{10} emissions for both Scenarios. This figure shows that the processing area, including crushing, truck loading/unloading and excavators, are predicted to be the main aggregate source of TSP emissions. Together with dozers, these four sources account for 59% – 67% of the TSP and PM_{10} emissions for the two scenarios.



Source: Heggies (2010a) Figure 15

Figure 4B.27
CONTRIBUTIONS OF PROJECT SITE ACTIVITIES TO TOTAL ESTIMATED TSP AND PM_{10} EMISSIONS

4B.9.5.3 Dispersion Modelling Results

Dispersion modelling predictions of TSP and PM_{10} concentrations and dust deposition rates attributable to the proposed Yarraboldy Extension are given below for the two scenarios assessed.

Particulate Matter as TSP

Based upon the input data and assumptions of the modelling study, the modelling results indicate that the off-site annual average TSP concentrations will be substantially lower than the DECCW guideline at all nearby receptors. **Table 4B.29** presents a summary of the predicted ground-level annual average TSP concentrations at the nearby sensitive receptors.

Table 4B.29
Predicted TSP Concentrations - Annual Averages

Location	Annual Average TSP Concentrations (µg/m^3)			
	Background	**Predicted Impact**	**Cumulative Impact**	**Assessment Criterion**
Scenario 1				
Worst-affected residential receptor	**40**	**6**	**46**	90
Scenario 2				
Worst-affected residential receptor	**40**	**5**	**45**	90
Source: Heggies Modified after (2010a) Table 15				

Particulate Matter as PM_{10}

Based upon the input data and assumptions of the modelling study, **Table 4B.30** presents a summary of the predicted ground-level annual average PM_{10} concentrations, and **Table 4B.31** presents a summary of the predicted ground-level 24-hour average PM_{10} concentrations (6^{th} highest prediction).

Table 4B.30
Predicted PM_{10} Concentrations - Annual Averages

Location	Annual Average PM_{10} Concentrations (µg/m^3)			
	Background	**Predicted Impact**	**Cumulative Impact**	**Assessment Criterion**
Scenario 1				
Worst-affected residential receptor	**15**	**1.6**	**16.6**	**30**
Scenario 2				
Worst-affected residential receptor	**15**	**3**	**18**	**30**
Source: Heggies (2010a) Table 16				

Table 4B.31
Predicted PM10 Concentrations – 24-Hour Averages

Location	24 Hour Average PM_{10} Concentrations (µg/m^3)			
	Background	**Predicted Impact**	**Cumulative Impact**	**Assessment Criterion**
Scenario 1				
Worst-affected residential receptor	**Daily Varying**	**13.6**	**47.6**	**50**
Scenario 2				
Worst-affected residential receptor	**Daily Varying**	**8.6**	**45.7**	**50**
Source: Heggies (2010a) Table 17				

Dust Deposition

Based upon the input data and assumptions of the modelling study, **Table 4B.32** presents a summary of the predicted ground-level annual average dust deposition rates.

Table 4B.32
Predicted Dust Deposition Rates - Annual Averages

Location	Annual Average Dust Deposition Rates (g/m^2/month)			
	Background	**Predicted Impact**	**Cumulative Impact**	**Assessment Criterion**
Scenario 1				
Worst-affected residential receptor	**2**	**1.6**	**3.6**	**4**
Scenario 2				
Worst-affected residential receptor	**2**	**1.2**	**3.2**	**4**
Source: Heggies (2010a) - Table 18				

4B.9.5.4 Greenhouse Gas Assessment

The greenhouse gas emissions were calculated in accordance with the appropriate guidelines and protocols. Details of the methodology employed can be found in Heggies (2010a). These calculations were based on the anticipated operational activities within the Project Site, which are summarised in **Table 4B.33**.

Table 4B.33
Summary of Project-Related Activity Data Relevant to GHG Emissions

Activity	Quantity
Annual ROM production	350 000t
Annual Electricity Consumption	70 080kWh
Annual Diesel Consumption	1 500 000L
Annual Explosive Usage	576t
Solid Waste to Landfill	*
Employee Vehicle Movements	22
Source: Heggies (2010a) - Table 21	
* Data not available	

A summary of the Scope 1, Scope 2 and Scope 3 emission point sources from the Project Site is given in **Table 4B.34**.

Table 4B.34
Summary of Potential Project Greenhouse Gas Emissions

Page 1 of 2

Point Source	Direct Emissions	Indirect Emissions	
	Scope 1	**Scope 2**	**Scope 3**
Explosives	Emissions from the release of GHG as a result of explosive usage.	NA	NA
Fugitive Emissions	Emissions from the release of coal bed methane and carbon dioxide as a result of extraction activities.	NA	NA

Table 4B.34 (Cont'd)
Summary of Potential Project Greenhouse Gas Emissions

Point Source	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
Diesel	Emissions from the combustion of diesel at the Project in both mobile and fixed plant and equipment (Includes ROM coal Transport by Proponent owned vehicles)	NA	Estimated emissions attributable to the extraction, production and transport of diesel consumed at the Project Site.
Electricity	NA	Emissions associated with the consumption of purchased electricity at the Project Site.	Estimated emissions from the extraction, production and transport of fuel burned for the generation of electricity consumed at the Project Site and the electricity lost in delivery in the transmission and distribution network.
Combustion of Coal	NA	NA	Emissions from the combustion of coal from the Project.
Source: Heggies (2010a) Table 22			

Calculated Scope 1, Scope 2 and Scope 3 emissions of greenhouse gas resulting from the emissions sources outlined above for the Project (based on a 350 000 tpa ROM extraction rate) are presented in **Table 4B.35**.

The main contributor to the estimated Scope 1 emissions is fugitive emissions of coal seam methane. Data from borehole measurements on-site (limited to date) indicate that site-specific emissions of CO_2-e are significantly lower than the default NGA factors, and as such the assessment may be considered to be conservative in the assessment of Scope 1 emissions.

Table 4B.35
Summary of Greenhouse Gas Emissions from the Project Site

Point Source Scope	Emission Source	Activity Data	Activity Rate	Emission Factor (CO_2-e)			Total Emissions (t CO_2-e/ year)
				Emission Factor	Units	Source	
Scope 1	Fugitive Emissions (Default NGA Factor)	350,000	t/year	0.045	t CO_2-e/t ROM	Table 8 NGA Factors	15 750
	Diesel Combustion	1.5	ML/year	69.9[1]	kg CO_2-e /GJ	Table 4 NGA Factors	4 047
	Explosives	576	t/year	0.17	t CO_2-e/t explosive	Feb 2008 NGA Factors	98
	Sub Total Scope 1						**19 895**

Table 4B.35
Summary of Greenhouse Gas Emissions from the Project Site

Point Source Scope	Emission Source	Activity Data	Activity Rate	Emission Factor (CO_2-e)			Total Emissions (t CO_2-e/ year)
				Emission Factor	Units	Source	
Scope 2	Electricity Consumption	70,080	kWh/year	0.89	kg CO_2-e /kWh	Table 5 NGA Factors	62
	Sub-total Scope 2						**62**
Scope 3	Diesel Combustion	1.5	ML/year	5.31[1]	kg CO_2-e /GJ	Appendix 4 Table 38 NGA Factors	307
	Electricity Consumption	70,080	kWh/year	0.18	kg CO_2-e /kWh	Appendix 4 Table 39 NGA Factors	13
	Coal Combustion in Power Stations	350,000	t/year	8.7[2]	kg CO_2-e /GJ	Table 1 NGA Factors (January 2008)	82 215
	Sub-total Scope 3						**82 535**
Scope 1, 2 & 3	**TOTAL**						**102 493**

Note 1: Diesel Fuel assumed to have an energy content of 38.6 GJ/kL as per Table 4 of the NGA Factors
Note 2: Black Coal used in electricity generation assumed to have an energy content of 27 GJ/t as per Table 1 of the NGA Factors
Source: Heggies (2010a) Table 23

Comparisons of the total GHG emissions arising from the Project with NSW and Australia emission totals are presented in **Table 4B.36**.

Table 4B.36
Comparison of the Project GHG Emissions with State and National Totals for 2007

Emission Scope	Estimated Project Emissions (t CO_{2-e}/year)	Percentage of NSW 2007 GHG Emission Total	Percentage of Australian 2007 GHG Emission Total
Scope 1	19 895	0.01%	0.003%
TOTAL (1, 2 and 3)	**102 493**	**0.06%**	**0.02%**

Source: Heggies (2010a) Table 25

Key findings of the greenhouse gas assessment were as follows.

- Direct (Scope 1) emissions resulting from the Project are estimated to be 19 895 tonnes CO2-e per year, attributable mainly (79.2%) to fugitive CH_4 emissions. The remaining Scope 1 emissions are due to diesel (20.3%) and explosive (0.5%) use as part of the Project operation.
- Indirect (Scope 2) emissions are estimated to be 62.4 tonnes CO2-e per year.

- Indirect (Scope 3) GHG emissions are estimated to be 82 535 tonnes CO2-e per year. These emissions are due primarily to Scope 3 coal combustion (81%), diesel (19%) and electricity (<0.01%) use as part of the Project.
- The Direct (Scope 1) emissions estimated for the Project represent 0.01% of the NSW GHG total emission inventory for 2007, and 0.003% of the Australian national emissions for 2007.
- The total GHG emissions for the Project (Scope 1, 2 and 3 emissions) represent 0.06% of the NSW GHG total emission inventory for 2007, and 0.02% of the Australian national emissions for 2007.

4B.9.5.5 Summary of Impact Assessment

Impacts from Dust Emissions

Quantification of the identified particulate (TSP and PM_{10}) generating activities associated with the Project for two operational scenarios and the subsequent dispersion modelling of these emissions have indicated that cumulative off-site, annual average TSP, PM_{10} and dust deposition levels and 24-hour average PM_{10} concentrations predicted to occur as a result of the Project would comply with relevant DECCW ambient air quality criteria at the nearest sensitive receptors. Therefore, it is unlikely that the site establishment and operational activities within the Project Site would have any significant impact on the air quality.

Impacts from Greenhouse Gas Emissions

The total GHG emissions for the Project (Scope 1, 2 and 3 emissions) at 0.06% of the NSW GHG total emission inventory for 2007, and 0.02% of the Australian national emissions for 2007 are small. As such it is unlikely that GHG emissions during the course of the Project activities would have any significant impact on the air quality, or make a significant contribution to greenhouse gas emissions and global warming.

4B.9.6 Monitoring

Based on the above modelling results, no additional mitigation measures would be required to ensure depositional dust or the annual averages for TSP and PM_{10} remained below specified criteria as a result of the Project. Additionally it was determined in the air quality assessment that the existing dust monitoring network being utilised for the Pine Dale Coal Mine would also be sufficient to monitor dust deposition from the proposed Yarraboldy Extension.

However, in order to ensure that the 24 hour average for PM_{10} remains below the relevant criteria, the following measures would be implemented.

- Ongoing monitoring of PM_{10} at the existing monitoring site would be undertaken. This monitoring site is representative of PM_{10} levels at the potentially worst affected receptor.
- The frequency of the PM_{10} sampling would be increased (from once every 6 days to once every 3 days, for example) should elevated PM_{10} concentrations begin to be measured, which may be attributable to mine operations

- In the event that it is determined that dust levels become elevated, extra mitigation measures would be implemented. This would include but not limited to more road watering and modification of site activities during windy conditions.

The Energy Savings Action Plan of the Pine Dale Coal Mine would be reviewed to allow for the Yarraboldy Extension operations.

4B.10 VISIBILITY

4B.10.1 Introduction

Although not specifically raised within the Director-General's Requirements, visual amenity has been identified by the Proponent as a key issue requiring assessment. The visibility of the future operations was also not directly raised during consultation (see Section 3.2.2), however, preference for 'greening' of existing bunding was raised by one resident. Based on the environmental risk analysis undertaken for the Project (see Section 3.3 and **Table 3.7**), the **unmitigated** risk rating for potential impacts on visual amenity was considered moderate to high.

This subsection outlines the existing visibility of the Project Site experienced by surrounding residents / landowners, proposed safeguards and mitigation measures and an assessment of the likely impact to the visual amenity.

4B.10.2 Existing Visual Amenity

The existing visual character of the Project Site and surrounds is a combination of a rural landscape including grazing and State Forest and mining and energy-related industries. In particular, the Mt Piper Power Station and its associated ash dam are highly visible from a number of vantage points surrounding the Project Site.

The existing Pine Dale Coal Mine operations are also visible to varying degrees from surrounding vantage points. However, the Yarraboldy Extension area is shielded to the north, east and partly to the west by intervening topography and forest areas. The principal area of potential visibility is to the southeast, south and southwest.

Plates 4.1 to **4.5** show the existing visual character and land uses within and surrounding the Project Site. **Figure 4B.28** displays the location/direction of each plate.

Plate 4.1 View Southeast from Yarraboldy Extension area towards Lidsdale (Ref: E613J-016 & 017)

Plate 4.2 View Southwards from Yarraboldy Extension area towards Blackmans Flat (Ref: E613J-015)

Plate 4.3 View Northwards from Blackmans Flat. Yarraboldy Extension area (background) Existing Pine Dale Coal Mine (mid-ground) Castlereagh Highway (foreground).

Plate 4.4 View Northwards from Blackmans Flat to Existing Office Area

Plate 4.5 View Southwest from Yarraboldy Extension area to Mt Piper Power Station Ash Dam

4B.10.3 Visual Controls

The following visual controls would be implemented to reduce potential adverse impacts upon visual amenity.

- Construction of the Amenity Bund to an elevation of 935m AHD and grassing to provide a visual barrier of the Yarraboldy Extension area.
- The Project Site would be progressively rehabilitated, where possible, so that non-vegetated areas would be minimised.
- The Project Site would be maintained in a clean and tidy condition at all times.
- Air quality controls would be implemented (see Section 4B.9) to reduce visible dust.
- Floodlights or other required lighting would be positioned and directed so as to minimise off-site light emissions. When lighting is not required at any given time it would not be used.

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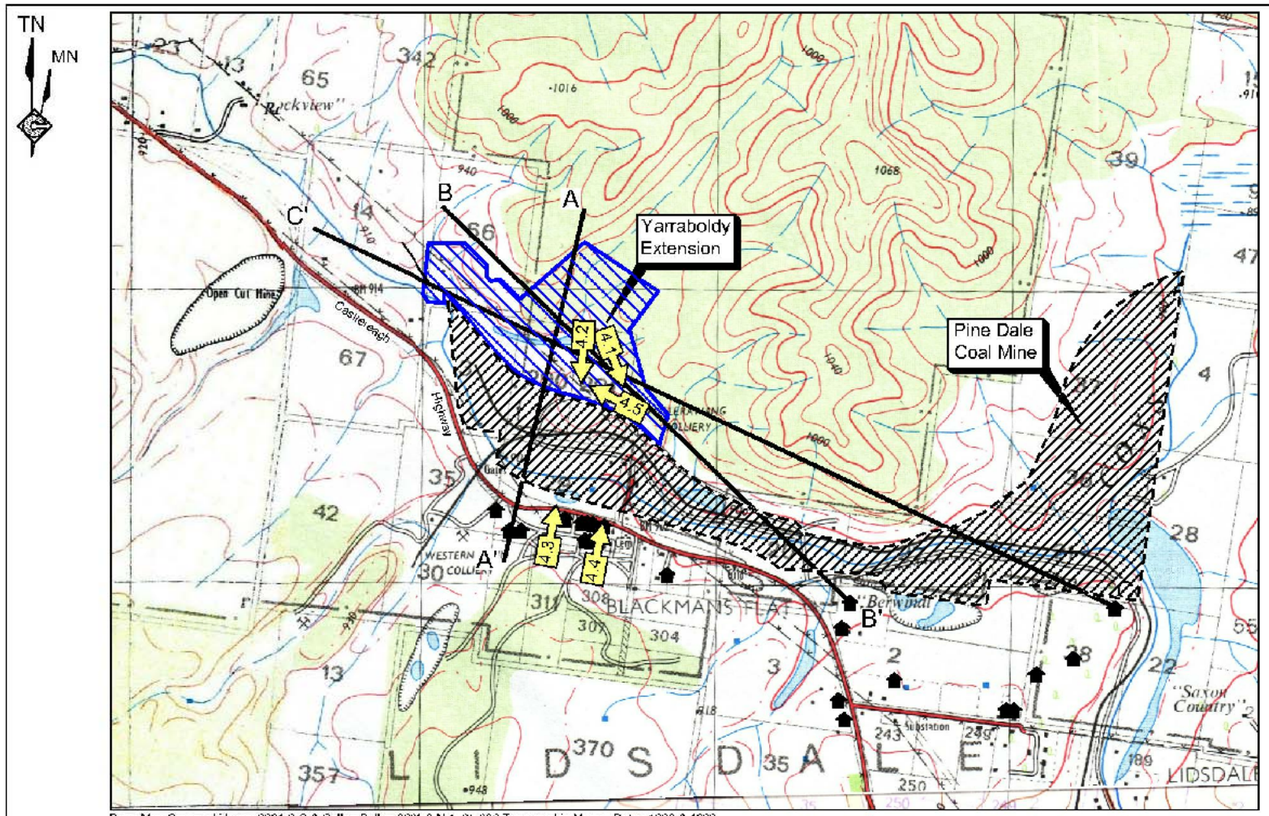
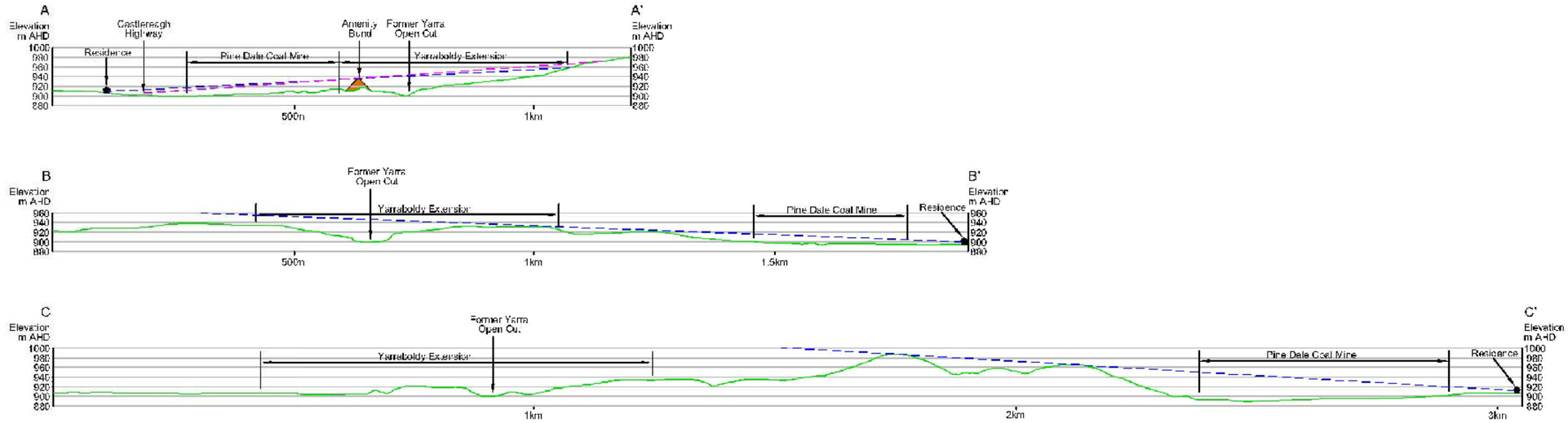


Base Map Source: Lithgow 8931-3-S & Cullen Bullen 8931-3-N 1: 25 000 Topographic Maps - Dates 1988 & 1989

REFERENCE
Pine Dale Coal Mine
Yarraboldy Extension
Sight Line from Residence
Sight Line from Castlereagh Highway
Residence

SCALE 1:20 000
200 0 200 400 600 800 1000 m

Mine Drainage Discharge Location
Amenity Bund
Interim Haul Road
Surface Water Monitoring Location
Underground Discharge Point
EPL Discharge Point
Point Location and Reference
Colour Location and Reference



SECTION SCALE 1:10 000
100 0 100 200 300 400 500 m

Figure 4B.28
VISIBILITY SECTIONS

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4B.10.4 Assessment of Impacts

Based upon the available topographic information, observations from surrounding vantage points and the proposed mitigation measures, it is considered that the operations within the Yarraboldy Extension area would generally not be visible from surrounding residences except during the construction of the amenity bund and in the very late stage of the Project (see **Figure 4B.28**).

The principal components / activities that would continue to be visible would be the existing site office (**Plate 4.4**) and vehicle movements on the heavy vehicle access road. It is considered that these components / activities would not be inconsistent with the existing visual amenity and that, with the use of the Private Coal Haul Road, the 'visual intensity' of product transportation activities would decrease from those currently experienced. It is also noted that the visual amenity of the current mining areas would continue to improve as rehabilitation and revegetation activities are completed and vegetation establishes.

Overall, it is assessed that the nature and scale of the proposed activities would generally be consistent with the scale and character of developments in the local area. Furthermore, following the completion of the Project and rehabilitation activities, it is considered that the visual character of the landscape would in fact improve with the return of the former Yarraboldy Open Cut Mine to a forested landscape.

4B.11 SOILS, LAND CAPABILITY AND AGRICULTURAL SUITABILITY

The soils, land capability and agricultural suitability assessment for the Project was undertaken by Geoff Cunningham Natural Resource Consultants Pty Ltd (GCNRC, 2010a). The full assessment is presented as Part 3 of the *Specialist Consultant Studies Compendium*. Relevant information from the assessment is summarised in the following subsections.

4B.11.1 Introduction

Based on the risk analysis undertaken by R.W. Corkery & Co Pty Limited for the Project (Section 3.3, **Table 3.7**) the potential impacts on soils, land capability and agricultural suitability requiring assessment and their **unmitigated** risk rating are as follows.

- Reduced opportunity to relinquish rehabilitated land (high risk).
- Loss of soil resource (moderate risk).
- Reduced rehabilitation success (moderate risk).
- Reduced land stability (low risk).
- Decreased land and agricultural capability in final landform (medium risk).
- Increased sediment load in surface water due to soil erosion (high risk).
- Degradation of aquatic ecosystems due to soil erosion (medium risk).

The Director-General's Requirements issued by the DoP identified "Soils and Land Capability" as one of the key issues that requires assessment at the Project Site. The assessment of impacts on soils and land capability is required to address the following.

- Provide a description of the existing soil and land capability environment for the Project using sufficient baseline data.
- Provide an assessment of the potential impacts of the Project, including any cumulative impacts taking into consideration any relevant guidelines, policies, plans and statutory provisions.
- Provide 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 managing any significant risks to the environment.
- Consider the following documentation in the assessment:
  - Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC).
  - Rural Land capability Mapping (DECCW formerly DLWC).
  - Agricultural Land Classification (I&I NSW formerly DPI).

The following is a summary of the soils, land capability and agricultural suitability assessment. It describes the soils within the Project Site that would be disturbed, identifies the soil and land management issues associated with the Project and the proposed soil-related controls, safeguards and mitigation measures. An assessment of the suitability of the proposed final rehabilitated landform is also presented.

4B.11.2 Soil Occurrences

4B.11.2.1 Regional Setting

The proposed Yarraboldy Extension lies within the Cullen Bullen Soil Landscape as mapped by King (1993).The landscape is described as comprising of rolling low hills and rises on the Illawarra Coal Measures and Berry Formation. The slopes vary between 10 and 25% with local relief of <50m. Localised rock outcrops occur as small isolated scarps (<5m). Four general landforms occur within the Cullen Bullen soil landscape:

- **Crests** – Soils are usually < 100cm deep and generally comprise 0-20cm dark reddish brown sandy loam material overlying hard-setting bleached massive fine sandy clay loam. There is a clear boundary to <50cm of either bright brown moderately pedal clay or bedrock.
- **Upper Slopes and Mid-slopes** – Total soil depth is usually <30-40cm. Soils usually comprise up to 25cm of dark reddish brown sandy loam material overlying <30cm of hard-setting bleached massive fine sandy clay loam. A clear boundary gives way to <80cm of bright brown moderately pedal clay. The soils are often stony.

- **Lower Slopes and Narrow Drainage Lines** – Soil depth is generally <130cm. Soils comprise up to 25cm of dark reddish brown sandy loam material overlying <30cm of hard-setting bleached massive fine sandy clay loam. A clear or abrupt boundary then gives way to <80cm of bright brown moderately pedal clay.
- **Low Scarps** – Resistant layers of conglomerate and sandstone form small scarps occasionally on the upper slopes and mid-slopes. Soils on the shoulders of scarps consist of <20cm of dark reddish brown sandy loam material overlying <30cm of hard-setting bleached massive fine sandy clay loam.

4B.11.2.2 Project Site Soils

Prior to field investigations, the Project Site was subjected to an airphoto interpretation to ascertain the nature of the landforms present within the Project Site and to develop a broad appreciation of the landform units that would require sampling.

Field sampling involved the complete description of three profiles to bedrock at all sites. The sampling site locations within the Project Site are shown in **Figure 4B.29** along with the soil mapping unit boundaries. Note that no effort was made to test soils from areas of the Project Site that are already disturbed by open cut mining because of the variable nature of the soil resulting from these previous mining activities.

Data was acquired from three pits (Pit 1, Pit 29, Pit 30). Soil profiles at each pit location were fully described for their physical attributes in terms of texture, fabric, structure, consistence, boundary sharpness, colour (moist and dry), gravel / stone occurrence, pH and presence of roots, lime and manganese. Two Soil Mapping Units (SMU) were identified within the Project Site from the information obtained.

Chemical analyses was conducted either in the field (pH) or at the Land and Property Management Authority [Soil Conservation Service Division] which is a NATA – accredited soil testing laboratory for particle size analysis, % dispersion, coherence (Emerson Aggregate Test) and electrical conductivity. A total of 11 samples from three soil profiles (Pits 1, 29 and 30) were analysed.

4B.11.3 Soil Physical Attributes

The two Soil Mapping Units (SMUs) that were identified within the Project Site area referred to as Soil Mapping Unit 1 and Soil Mapping Unit 2. Note that SMU1 has been determined from one test pit data (#1) and observations while SMU2 has been determined from data and observations from two test pits (#29, #30).

4B.11.3.1 Soil Mapping Unit 1 – Soils of the Lower Slopes, Mid-Slopes and Upper Slopes, Low Crests

The Australian Soil Classification Name of soils in this SMU is Brown Kurosols. SMU1 has been described as follows.

- Surface Condition – soft to firm, surface stone absent.
- Soil - excavated to a maximum of 137cm depth but generally much less in low crest locations; surface condition soft to firm; surface stone absent.

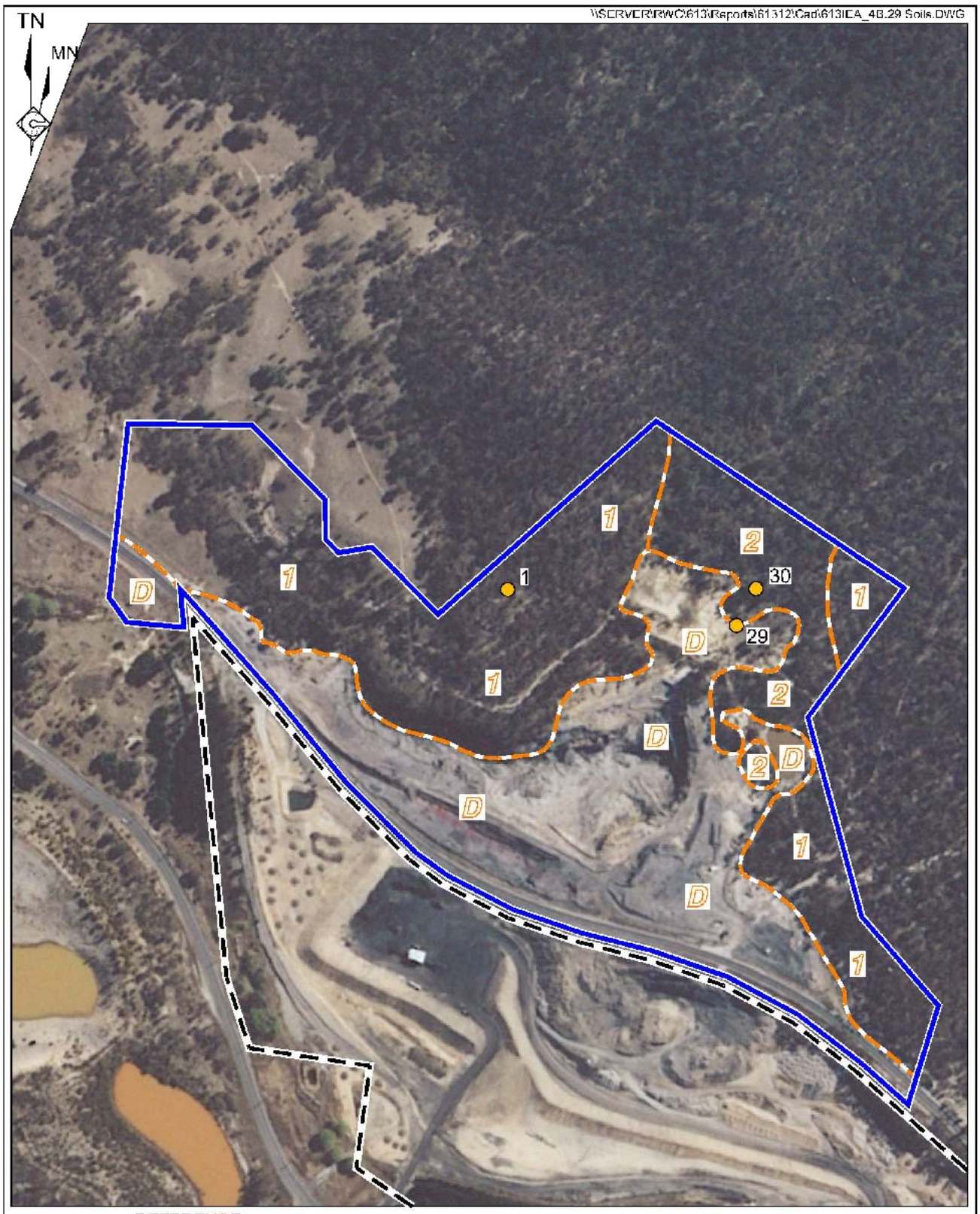

Figure 4B.29
SOIL SAMPLING LOCATIONS AND SOIL MAPPING UNIT BOUNDARIES

- Topsoil - of a single layer - silty clay loam; roots common; no lime present; no manganese present; pH 6.0; some flat angular gravel to 3cm; not mottled; not bleached; light brownish grey [10YR6/2] dry, brown [7.5R4/3] moist; peds rough-faced, highly pedal [100%], polyhedral.5-10mm in size; very firm consistence dry; slightly hydrophobic.
- Subsoil – four subsoil horizons identified; texture generally clayey; many roots in the upper sections but few at depth; recorded pH 5.5; gravel present in varying amounts; whole coloured pale brown; commonly well structured; slightly hydrophobic.

A full technical description of SMU1 is provided in the assessment report (CGNRC, 2010b).

Layer 1 material (0-15cm) from SMU1 is suitable as topsoil on the basis of the stripping suitability assessment conducted on it in accordance with Elliot and Veness (1981). It contains valuable seeds of native plants, organic matter and nutrient reserves required for rehabilitation.

Layer 2 (15cm – bedrock or decomposing rock) of SMU1 is suitable for use as subsoil on the basis of the stripping suitability assessment conducted on it in accordance with Elliot and Veness (1981).

4B.11.3.2 Soil Mapping Unit 2 – Soils of the Drainage Depressions and Associated Terraces

The Australian Soil Classification Name of soils in this SMU is Brown Kurosols. SMU2 has been described in layman's terms as follows.

- Surface Condition –firm, surface stone absent.
- Soil - excavated to a maximum of 46cm depth (test pit #29) and 250cm (test pit 30) surface condition loose to firm; surface stone absent or some angular surface stone to 1-2cm present.
- Topsoil –a sandy clay loam to sandy clay; roots common to many; no lime present; no manganese present; pH 6.5 to 7.0; some to much flat angular gravel 5mm to 4cm along with angular sandstone fragments to 10cm; not mottled; not bleached; light grey to brown dry, light olive brown to very dark brown moist; peds rough- faced, moderately [50%] to highly [100%] structured, sometimes hydrophobic.
- Subsoil – comprised of up to three layers over bedrock or to depth of excavation; medium to heavy clay, sandy clay or clayey sand; roots absent to few; pH 6.0 to 6.5; gravel and stones usually present – sometimes large stones present; not mottled, not bleached; white to very pale brown coloured; usually well structured sometimes massive; not hydrophobic.

A full technical description of SMU2 is provided in the assessment report.

As for SMU1, SMU2 topsoil (0-15cm) material is suitable as topsoil on the basis of the stripping suitability assessment conducted on it in accordance with Elliott and Veness (1981). It contains valuable seeds of native plants, organic matter and nutrient reserves required for rehabilitation.

Layer 2 material (15cm – bedrock or decomposing rock) of SMU2 is suitable for use as subsoil on the basis of the stripping suitability assessment conducted on it in accordance with Elliott and Veness (1981).

4B.11.3.3 Particle Size Analysis

Table 4B.37 presents the particle size analysis conducted on samples collected from both SMU1 and SMU2. Layer 1 represents the topsoil while all other layers represent sub-soils. Data shows that most soils analysed contain variable but sometimes moderate levels of gravel.

Table 4B.37
Physical Laboratory Analysis Data for Selected Soil Profiles – Part 1
[Whole Soil Particle Size Analysis]

SMU / Pit No.	Layer	Texture [fine earth]#	Depth [cm]	PSA % Clay	PSA % Silt	PSA % Fine Sand	PSA% Coarse Sand	PSA % Total Sand	PSA % Gravel
SMU 1 Pit 1	1	silt loam	0-17	23	24	21	23	44	9
	2	silty clay loam	17-31	28	22	13	17	30	20
	3	clay	31-46	41	13	20	22	42	4
	4	silty clay loam	46-90	39	31	19	10	29	1
	5	clay	90-157	46	22	16	9	25	7
SMU 2 Pit 29	1	loamy sand / loam	0-14	10	13	22	40	62	15
	2	loam / clay loam	14-36	23	17	13	38	51	9
SMU 2 Pit 30	1	loam	0-20	18	16	17	34	51	15
	2	clay loam	20-62	29	17	18	32	50	4
	3	loam	62-110	16	9	13	37	50	25
	4	sandy loam	110-250	10	4	17	44	61	25

PSA = Particle Size Analysis
# texture based on laboratory measurements

Source: GCNRC (2010a) – Table 3

4B.11.3.4 Dispersion Percentage

The Dispersion Percentage (D%) test indicates the proportion of the soil material less than 0.005 mm in size that will disperse on wetting. In **Table 4B.38** the D% values are given for all soil samples analysed, along with the level of dispersion described as either slight, moderate or high in accordance with the dispersion ratings of Hazelton and Murphy (2007).

Table 4B.38
Physical Laboratory Analysis Data for Selected Soil Profiles – Part 2
[Whole Soil Particle Size Analysis]

SMU / Pit No.	Layer	Texture [fine earth]#	Depth [cm]	D%	D% Level of Dispersion	EAT	EAT Level of Dispersion
SMU 1 Pit 1	1	silt loam	0-17	24	slight	5	Slight
	2	silty clay loam	17-31	46	moderate	5	Slight
	3	clay	31-46	47	moderate	5	Slight
	4	silty clay loam	46-90	25	slight	3[2]	Slight
	5	clay	90-157	51	high	2[1]	high to moderate
SMU 2 **Pit 29**	1	loamy sand / loam	0-14	37	moderate	3[1]	Slight
	2	loam / clay loam	14-36	57	high	5	Slight
SMU 2 **Pit 30**	1	loam	0-20	17	slight	5	Slight
	2	clay loam	20-62	21	slight	5	Slight
	3	loam	62-110	48	moderate	5	Slight
	4	sandy loam	110-250	41	moderate	2[1]	high to moderate
# texture based on laboratory measurements							
Source: Source GCNRC (2010a) – Table 4							

The D% values when correlated with the dispersion ratings indicate that the topsoils of both SMUs show generally slight dispersibility but some of the subsoils exhibit moderate to high dispersibility. Many of the subsoils in the samples tested contain moderate to high levels of clay which may make them more naturally dispersive than analyses data indicate.

From the dispersion percentage results it can be concluded that the erosion potential of soils within the Project Site would generally be low for any topsoil stockpiles and moderate for any subsoil stockpiles as well as for any areas of exposed subsoil. This conclusion is based solely on the D% test. Accordingly, appropriate measures would need to be taken to protect the stockpiles and exposed areas within the Project Site at all times. In particular, the soil stockpiles would need to be rapidly stabilised with a living permanent pasture cover to prevent erosion.

4B.11.3.5 Emerson Aggregate Test

This test provides a measure of the coherence of soil aggregates when they are immersed in water in terms of the Emerson Class Number. In this classification, the degree of soil aggregate stability generally increases from Class 1 through to Class 8. Classes 2 and 3 have a number of subclasses based on the degree of dispersion. Aggregates in Classes 1 and 2 are generally regarded as being unstable while those in Classes 4 to 8 are considered to be stable.

The Emerson Aggregate Test (EAT) results for the soil samples analysed are given in **Table 4B.37**. The EAT class numbers have been converted into levels of dispersibility in qualitative terms. The results show that topsoils within the Project Site generally have a low dispersibility, which is inconsistent with the D% values which indicate that some the subsoils are relatively dispersible. However, the dispersibility levels suggest the erosion potential within the Project Site would be generally slight for the topsoil stockpiles and slight to moderate to high for subsoil stockpiles. Consequently, appropriate measures would need to be taken to protect the stockpiles and exposed areas within the Project Site all times. The stockpiles in particular would need to be rapidly stabilised with a living permanent pasture cover to prevent erosion.

4B.11.4 Soil Chemical Attributes

The pH and electrical conductivity values obtained from all soil samples analysed are given in **Table 4B.39.**

Table 4B.39
Chemical Analyses Laboratory Analysis Data for Selected Soil Profiles

SMU / Pit No.	Layer	Texture [fine earth]#	Depth [cm]	pH+	Measured Electrical Conductivity [dS/m]	Multiplier Factor @	*Saturated Electrical Conductivity [dS/m]	Soil Salinity Status
SMU 1 Pit 1	1	silt loam	0-17	6.0	0.12	9.5	1.14	non-saline
	2	silty clay loam	17-31	5.5	<0.01	8.6	<0.086	non-saline
	3	clay	31-46	5.5	<0.01	7.5	<0.075	non-saline
	4	silty clay loam	46-90	5.5	<0.01	8.6	<0.086	non-saline
	5	clay	90-157	5.5	0.01	7.5	0.075	non-saline
SMU 2 Pit 29	1	loamy sand / loam	0-14	6.5	<0.01	23	<0.23	non-saline
	2	loam / clay loam	14-36	6.5	<0.01	8.6	<0.086	non-saline
SMU 2 Pit 30	1	loam	0-20	7.0	0.01	9.5	0.095	non-saline
	2	clay loam	20-62	6.0	<0.01	8.6	<0.086	non-saline
	3	loam	62-110	6.0	<0.01	9.5	<0.095	non-saline
	4	sandy loam	110-250	6.0	<0.01	14	<0.14	non-saline

texture based on laboratory measurements
\+ Raupach field measurement
∗ Calculated by multiplying measured values with an appropriate multiplier factor (Hazelton and Murphy, 2007) based on the estimated water holding capacity of the soil sample
@ (Hazelton and Murphy, 2007)

Source: GCNRC (2010a) – Table 4

The pH data indicate that all of the topsoils and subsoils tested within the Project Site have pH values between 5.5 and 7.0, indicating slightly acidic to neutral soils. The values are well within the 4.0 to 8.5 range associated with the suitability of soils for plant growth, that is, the soils are neither too acidic nor basic. These results indicate that there would not be any problems associated with soil pH when soils from the Project Site are used for rehabilitation purposes.

The measured electrical conductivity values are extremely low. The saturated electrical conductivity values, calculated by multiplying the measured values with the appropriate multiplier factor that accounts for the water holding capacity of soils, are also extremely low, indicating that all topsoils and sub-soils of both SMUs within the Project Site are non-saline. A consequence of this observation is that there would not be any limitations due to soil salinity on using these soils for rehabilitation purposes.

4B.11.5 Contamination Issues

The Project Site is not listed as a contaminated site.

4B.11.6 Erosion Potential and Erosion Hazard

The dispersion percentage and EAT values indicate that the erosion potential for topsoils within the Project Site would be low, with the erosion potential for subsoils being moderate to high. Erosion hazard analysis of the soils involving calculations of their erodibility values (K) using the SOILOSS Program (Rosewell and Edwards, 1988; Rosewell, 1993) which takes into account the physical characteristics of soils including particle size analysis data, concluded that soils at the Project Site were of moderate erodibility.

The findings suggest that soil disturbance within the Project Site would require appropriate management of soils from both SMUs during stripping and rehabilitation stages to ensure that soil structure damage is minimal and that they are suitably protected by vegetation or other mediums while the soils are stockpiled and after they are used in rehabilitation.

4B.11.7 Soil Management

The Project would require the disturbance of soils from the undisturbed areas of the Project Site. A consequence of this disturbance would be an increase in the erosion potential. However, appropriate measures would be implemented to protect stockpiled soil and exposed areas within the Project Site. Soil stockpiles in particular would be rapidly stabilised with a living permanent pasture cover to prevent erosion.

Soils from the currently undisturbed or largely undisturbed area of the Project Site would be used for rehabilitation purposes. Soils from the already disturbed areas of the Project Site are too contaminated with coal and other mining-related residues to be used. As such, all topsoil and subsoils down to the bedrock would be stripped from areas within the Project Site that have not been previously disturbed by open cut mining. The soils would either be directly emplaced onto reprofiled landforms or stockpiled to provide soil covering for the final rehabilitated surface of the Project Site.

The following soil management procedures have been developed and would be adhered to for stripping, handling and stockpiling both topsoils and subsoils within the Project Site.

- All soils would be handled as little as possible to minimise their structural damage to by ensuring the areas for stripping and stockpiling are clearly identified.
- Soils would not be stripped or replaced during wet conditions.
- Machinery used for stripping operations would dump their loads neatly and uniformly so that the stockpile does not require further forming prior to establishment of vegetation cover.
- Driving of machinery on the topsoil and subsoil stockpiles would be prohibited once the stockpiles are created to minimise compaction and further degradation of soil structure.
- Topsoil stockpiles would not exceed 2m in height, while the subsoil stockpiles would not exceed 3m in height.
- Upslope water diversion banks and the perimeter amenity bund would direct overland surface water flow away from the soil stockpiles.
- Downslope sedimentation controls would be implemented as required, until such time as the surface of the soil stockpiles is appropriately stabilised using groundcover species.
- The formed soil stockpile surfaces would have a generally uneven surface that is as 'rough' as possible, in a micro-sense, to assist in surface water runoff control and seed retention and germination.
- Soil stockpiles would be sown with stabilising groundcover species as soon as possible after placement and watered if necessary to speed up establishment. The vegetation would help stabilise the surface and minimise erosion and sedimentation.
- Stabilisation measures would be taken to minimise loss of soil materials from the stockpiles prior to the establishment of stabilising ground cover. Stabilisation measures would include the use of geotextile “silt fences” or lines of straw bales.

Further management procedures would be developed, if warranted, using best industry practice guidelines as the stripping and stockpiling operations progress.

4B.11.8 Assessment of Impacts

The soils (both topsoils and subsoils) would show a low to moderate propensity for erosion when disturbed. This conclusion is based on the physical attributes of the Project Site soils described by the texture (deduced from particle size analysis data), dispersibility from D% and EAT values, and erodibility values.

However, adherence to the recommended soil stripping, windrowing, handling and storage procedures, described in the assessment, would result in a minimal impact at the Project Site from a soils and land capability viewpoint.

4B.11.9 Land Capability and Agricultural Land Suitability

4B.11.9.1 Existing Land Capability

The 1:100 000 scale Land Capability Mapping Program data (DECCW) did not extend into State Forests and so much of the Yarraboldy Extension area has not been mapped as part of this Program. The remaining section of the proposed extension area has been disturbed to varying degrees by mining related activity.

Field assessments were used to classify the land capability for the Project Site in accordance with the land capability classification system used in New South Wales as described by Emery (un-dated). This classification is a modification of the system devised and used by the former USDA Soil Conservation Service in the United States of America and is an eight-class system based on the management and protection needs of different types of land ranging from land needing no special soil conservation works or practices (**Class I**) through to land that is unsuitable for agricultural or pastoral production (**Class VIII**). Two other land capability classes exist and relate to Mining and Urban land use.

In the Project Site, the heavily disturbed lands would be classified as **Class M** (Mining and Quarrying Areas) while the lesser disturbed areas (mainly within Ben Bullen State Forest) would be classified as **Class VII** lands.

Class VII lands described as "land best protected by green timber" and generally comprise areas of steep slopes, shallow soils and/or rock outcrop. In this type of land adequate ground protection must be maintained by limiting grazing and minimising damage by fire. While destruction of trees is not generally recommended, partial clearing for grazing purposes under strict management controls can be practised on small areas of low erosion hazard. Where clearing of these lands as occurred in the past, unstable soil and terrain sites should be returned to timber cover.

Field observations and assessments made on the Project Site confirm the **Class M** and **Class VII** classification for existing land capability. More details are given in Figure 3 of GCNRC (2010a).

4B.11.9.2 Existing Agricultural Land Suitability

NSW Industry and Investment - Agriculture (formerly NSW Department of Primary Industries (Agriculture)) has indicated that land within Ben Bullen State Forest has not been mapped under its Agricultural Land Suitability Classification Mapping Program described by Cunningham *et al* [undated] and Hulme *et al* [2002]. The remaining land associated with the disturbed areas affected by previous mining related activity would be classed as **Class 5** land with a notation indicating its past disturbance. **Class 5** land is "land unsuitable for agriculture or at best suited only to light grazing. Agricultural production is very low to zero as a result of severe constraints, including economic factors, which preclude improvement".

Field observations and assessments made on the Project Site confirm the **Class 5** classification. More details are given in Figure 4 of GCNRC (2010a).

4B.11.9.3 Assessment of Impacts

Disturbance to lands with a **Class VII** land capability classification would occur as a result of the Project. However, upon cessation of mining, rehabilitation of the mined areas would aim to recreate a landform with the **Class VII** land capability and one that would support the development of native woodlands and forests and thus habitat for native fauna.

In a similar vein, the **Class 5** Agricultural Land Suitability classification for the undisturbed areas would be disturbed due to the Project activities. However, following the cessation of mining, the rehabilitation of the mined areas would aim to recreate a landform with **Class 5** agricultural land capability that can provide habitat for native fauna.

4B.12 SOCIO-ECONOMIC SETTING

4B.12.1 Existing Socio-economic Setting

4B.12.1.1 Introduction

Information presented in the following subsections has been obtained from census data produced by the Australian Bureau of Statistics from the 2006 Census. The Project Site is located within the Lithgow City Local Government Area LGA 14870 (4566.7 km^2) and more specifically within Collection Districts 1142203 (953.3km^2), which encompasses the Ben Bullen State Forest, and 1142205 (8.2km^2) which encompasses the Lidsdale and Wallerawang townships. The community of Blackmans Flat south of the Castlereagh Highway is located within Collection District 1142210 (67.8km^2).

4B.12.1.2 Population and Population Growth

Table 4B.40 presents a summary of the 2006 population statistics for the Lithgow LGA, Collection Districts surrounding the Project Site and for NSW as a whole.

The Census data indicates that within the Lithgow LGA and Collection Districts surrounding the Project Site, the proportion of persons aged 55 to 64 years (14% to 22%) was higher than for NSW as a whole (11%) and generally slightly lower for persons aged between 15 and 34 years (8% to 12% and 13% respectively). However, overall, there does not appear to be a significant difference in the age distribution between Lithgow City LGA and surrounding Collection Districts compared to NSW as a whole.

Table 4B.40
2006 Census Population Statistics

		LGA		CD 1142203		CD 1142205		CD 1142210		NSW	
	Age Groups	**Persons**	**%**	**Persons**	**%**	**Persons**	**%**	**Persons**	**%**	**Persons**	**%**
Children	0-4 years	1,135	6	29	8	36	7	7	4	420,431	6
	5-14 years	2,725	14	48	14	84	15	18	10	878,483	13
Studying or Working	15-24 years	2,344	12	27	8	52	10	15	9	871,717	13
	25-54 years	7,806	40	124	35	238	44	72	41	2,753,219	42
Approaching Retirement or Retired	55-64 years	2,703	14	79	22	75	14	32	18	719,551	11
	65 years and over	3,042	15	45	13	58	11	31	18	905,778	14
	Total Persons	**19,755**		**352**		**543**		**175**		**6,549,178**	
Source: Australian Bureau of Statistics – 2006 Census											

4B.12.1.3 Employment, Occupation and Industries

Table 4B.41 presents the employment statistics from the 2006 Census. This data indicates that the unemployment rate in Lithgow LGA and the Collection Districts surrounding the Project Site on the date of the census was substantially higher (8.5% to 14.5%) than NSW as a whole (5.9%). Labour force participation is also lower in Lithgow LGA and the Collection Districts except for Collection District CD 1142205 (incorporating the townships of Lidsdale and Wallerawang) which has a participation rate of 61.1% which is above that for NSW as a whole (58.9%).

Table 4B.41
2006 Census Employment Statistics

	LGA		CD 1142203		CD 1142205		CD 1142210		NSW	
	Persons	**%**	**Persons**	**%**	**Persons**	**%**	**Persons**	**%**	**Persons**	**%**
Employed										
Full-time(a)	4,826	57.2	63	55.8	151	59.0	39	51.3	1,879,628	61.0
Part-time	2,404	28.5	23	20.4	67	26.2	23	30.3	842,713	27.0
Employed, away from work(b)	287	3.4	3	2.7	0	0.0	0	0.0	187,103	6.0
Total	7,517	89.1	89	78.8	218	85.2	62	81.6	2,909,444	94.0
Unemployed, looking for work										
Full-time work	511	6.1	6	5.3	22	8.6	8	10.5	115,165	4.0
Part-time work	205	2.4	6	5.3	7	2.7	3	3.9	67,994	2.0
Total	716	8.5	12	10.6	29	11.3	11	14.5	183,159	5.9
Labour Force Participation										
Total labour force	8434		113		256		76		3,092,603	
Total Persons	15897		279		419		143		5,250,261	
Labour force participation	53.1%		40.5%		61.1%		53.1%		58.9%	
Source: Australian Bureau of Statistics - 2006 Census										

Table 4B.42 presents a summary of the 2006 Census statistics relating to industry of employment. This data indicates that, within the Lithgow LGA, "Retail trade" (11%), "Mining" (10%) and "Health care & social assistance" (10%) are the leading industries of employment (12.6%). Leading industries of employment in the surrounding Collection Districts included "Agriculture, forestry & fishing", "Mining", "Construction", "Retail Trade" and "Transport, postal and warehousing".

State-wide, "Manufacturing" and "Construction" were the principal industries (employing 13% and 12% of the workforce respectively) followed by "Retail trade" (9%).

These trends reflect the generally broad industries of employment within the Lithgow LGA for which mining plays an essential component.

Table 4B.42
Industry Employment Statistics

	LGA		CD 1142203		CD 1142205		CD 1142210		NSW	
	No*	**%**	**Persons**	**%**	**Persons**	**%**	**Persons**	**%**	**Persons**	**%**
Agriculture, forestry & fishing	261	3	30	30	3	1	3	5	55 532	4
Mining	774	10	10	10	29	13	0	0	18 322	1
Manufacturing	631	8	4	4	22	10	5	9	202 434	13
Electricity, gas, water & waste services	392	5	3	3	20	9	0	0	23 079	2
Construction	475	6	6	6	9	4	10	17	183 998	12
Wholesale trade	142	2	3	3	0	0	0	0	87 166	6
Retail trade	865	11	3	3	21	9	8	14	140 058	9
Accommodation & food services	676	9	7	7	11	5	0	0	86 433	6
Transport, postal & warehousing	406	5	0	0	25	11	15	26	111 898	7
Information media & telecommunications	56	1	0	0	0	0	0	0	40 119	3
Financial & insurance services	142	2	0	0	7	3	0	0	68 253	4
Rental, hiring & real estate services	86	1	0	0	0	0	0	0	25 360	2
Professional, scientific & technical services	217	3	3	3	3	1	3	5	115 503	7
Administrative & support services	243	3	0	0	7	3	0	0	43 167	3
Public administration & safety	637	8	7	7	19	8	4	7	103 620	7
Education & training	464	6	8	8	12	5	0	0	67 250	4
Health care & social assistance	765	10	7	7	22	10	6	10	67 856	4
Arts & recreation services	74	1	0	0	6	3	0	0	21 311	1
Other services	260	3	3	3	11	5	0	0	63 176	4
Inadequately described/Not stated	151	2	6	6	3	1	4	7	45 913	3
Total	**7,717**		**100**		**230**		**58**		**1 570 448**	
Source: Australian Bureau of Statistics - 2006 Census									*No of Persons	

4B.12.1.4 Income

Table 4B.43 presents income statistics provided in the 2006 Census. That data indicates that median individual, family and household incomes in the Lithgow LGA were substantially lower than NSW as a whole (between 19% and 42% lower).

This difference is likely to be attributed to the fact that there are proportionally fewer people working (ie. higher unemployment) in Lithgow LGA and the Collection Districts surrounding the Project Site than in NSW as a whole. Also, typically, wages and salaries available for workers in rural areas are lower than other areas within the State. However, it is noted that Collection District 1142205 which incorporates the Lidsdale and Wallerawang townships has a proportionally higher income than the Lithgow LGA and the other Collection Districts.

Table 4B.43
Income Statistics 2006

	LGA	CD 1142203	CD 1142205	CD 1142210	NSW
Median individual income ($/weekly)	353	290	374	334	461
Median family income ($/weekly)	1,026	833	1,109	875	1,181
Median household income ($/weekly)	738	601	850	636	1,036
Source: Australian Bureau of Statistics - 2006 Census					

4B.12.1.5 Housing

Table 4B.44 presents a summary of the housing cost statistics for the Lithgow LGA, Collection Districts surrounding the Project Site and NSW as a whole. The data indicates that the median monthly loan repayment is generally between $410 and $217 less than the NSW median. Similarly, median rental costs are between $75 and $135 less than the NSW median.

The average household size was marginally lower for the Lithgow LGA and Collection Districts than for NSW as a whole although the average number of people per bedroom was the same.

Table 4B.44
Cost of Housing and Household Size Statistics - 2006

	LGA	CD 1142203	CD 1142205	CD 1142210	NSW
Median housing loan repayment ($/monthly)	1,107	1,203	1,100	1,300	1 517
Median rent ($/weekly)	135	75	130	118	210
Average number of persons per bedroom	1.1	1.1	1.1	1.0	1.1
Average household size	2.4	2.3	2.5	2.4	2.6
Source: Australian Bureau of Statistics - 2006 Census					

4B.12.2 Safeguards

In addition to the mitigation measures and management procedures relating to amenity aspects such as noise, air quality, visibility, transportation etc, described previously in Section 4B, the Proponent would implement the following management and mitigation measures to ensure that Project-related benefits for the community surrounding the Project Site are maximised and adverse impacts are minimised.

- Proactively consult throughout the Project life with those residents who could potentially be adversely impacted by the Project.
- Continued participation in the Community Consultative Committee meetings, when called and provision of secretarial and reporting services for the committee.
- Continue to engage the community surrounding the Project through the use of an "open door" policy for any member of the community who wishes to discuss any aspect of the Project.

- Continued maintenance of a community complaints response system.
- Encourage the involvement of the Aboriginal community in the workforce.
- Continued preference, where practicable, to suppliers of equipment, services or consumables located within the Lithgow City LGA.
- Ongoing financial and in-kind support for local schools, community events and progress associations.

4B.12.3 Assessment of Impacts

Since commencement of mining operations in the area during 1998, the Proponent has been an active member in the community including through donations to local schools, community events and progress associations. The operations have also resulted in a total expenditure of approximately $56 million in capital and operating costs, over $2.5 million in wages and approximately $5 million in royalties and levies.

The Project would continue to result in a range of socio-economic benefits to the local and wider community including the following.

- Continued direct employment (full-time equivalent) for approximately 12 people on site and 7 truck drivers during operation of the Project.
- Injection of approximately $2.2 million into the local and regional economy through purchase of consumables and payment of wages etc, with an additional approximately $2.9 million into the State economy through royalties (based on the recovery of 800 000t of coal). This expenditure is likely to generate additional economic activity and flow on effects, providing further employment opportunities.
- Ongoing support for training and education of employees.
- Continued positive support and involvement in the local community.
- Rehabilitation of the disturbance associated with the former Yarraboldy Open Cut Mine and return of the area to State Forest.

It is acknowledged that a limited number of surrounding residents would be aware of site activities as noise levels approach the nominated criteria. However, the Proponent notes that it has taken all reasonable and feasible measures to minimise those impacts and would continue to proactively monitor and implement further measures, as necessary.

Considering the relatively short term and / or minor nature of impacts on local amenity, the socio-economic benefits of the Project are considered to exceed the actual and perceived adverse impacts. It is also considered that the benefits to Forests NSW would also outweigh the impacts to Ben Bullen State Forest with the return of the area, including 10ha of currently bare earth and coaly residue, back to State Forest capability.

Overall, the Proponent is looking forward to the opportunity to continue its involvement in the Blackmans Flat area over the next 3 years as it has over the past 10 years.

4B.13 EUROPEAN HERITAGE

The survey undertaken by Mr John Appleton of Archaeological Surveys and Reports Pty Ltd did not identify any component or site within the Yarraboldy Extension area which had any heritage significance, from a European Heritage perspective.

4B.14 BUSHFIRE HAZARD

4B.14.1 Introduction

As the Project Site is partially within the Ben Bullen State Forest, the Director-General's Requirements require an assessment of how bushfire hazard would be managed so that if a fire starts within an uncleared area of the Project Site that it could be managed without it spreading into the wider Ben Bullen State Forest or potentially impact residences in the Blackmans Flat area.

4B.14.2 Managing Bushfire Hazard

It is recognised that even after vegetation is cleared from the Project Site, that the area is directly adjacent to the heavily wooded Ben Bullen State Forest. Therefore the threat of bushfire both within the Project Site and adjacent to the Project Site would be high if management measures are not adopted to mitigate this risk. As such, a Bushfire Management Plan would be developed in consultation with the local Rural Fire Service and State Forests to ensure that the appropriate management and response procedures are implemented to reduce the risk of bushfire hazard and subsequently the potential safety risk to employees and the local community as well as the potential loss of timber resource within the wider Ben Bullen State Forest.

The Proponent has considered the relevant guidelines and would also adopt the following controls and safeguards.

- All equipment on site would be equipped with adequate and fully operational fire suppression equipment in accordance with AS 1841 and AS 1851.
- All employees would be trained in the proper use of fire fighting equipment held on site.
- Water especially set aside for fire fighting on site and a water cart made available for fire fighting purposes.
- A protocol would be developed similar to that adopted for State Forests for restricting work in forested areas during high fire danger periods of the bushfire season.
- Consult with Forests NSW and the local Rural Fire Service prior to each bushfire season.
- Mine site fire fighting equipment would be made available to the local Rural Fire Service and/or State Forests if required in the event of a bushfire in the land surrounding the Project Site.
- Firebreaks would be developed and maintained at the edge of forested areas within the Project Site.

With the proposed safeguards and controls, it is considered that the bushfire hazard associated with the Project would be acceptable and that the proposed Yarraboldy Extension would not significantly contribute to raising the local bushfire hazard.