Specialist Consultant Studies

East Boggabri Joint Venture

Proposed East Boggabri Coal Mine

Noise and Vibration Assessment

Prepared by

Spectrum Acoustics Pty Ltd

May, 2005

Specialist Consultant Studies Compendium
Part 7

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Noise and Vibration Assessment

of the

Proposed East Boggabri Coal Mine

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EXECUTIVE SUMMARY

An assessment has been conducted to determine the noise and vibration impact of the proposed East Boggabri coal mine project. Noise monitoring in the area has revealed a generally quiet rural environment and an operational noise limit of 35 dB(A),$L_{eq(15\ minute)}$ was established for all non-mine owned residences within the acoustic study area. This criterion applies to all periods (day, evening and night) and represents the lowest industrial noise criterion that can be established under NSW Department of Environment and Conservation (DEC) guidelines.

Noise modelling was conducted using the Environmental Noise Model (ENM, version 3.06) for several construction and operational scenarios throughout the life of the proposed mine. Modelling results showed minor (1dB) noise level exceedances at the two nearest residential locations ("Templemore" and "Bollol Creek Station") under noise-enhancing atmospheric conditions, when considering the cumulative noise impact from both the proposed East Boggabri Coal Mine and the approved Boggabri Coal Mine to the north of the study area.

Recommendations have been made with regard to managing noise emissions from the Proposal. These include noise barriers in the form of earth bunds and operational management of noise emissions under adverse weather conditions by having more than one active emplacement area. For example, when the southern emplacement area is being used, it was found that emplacement occurring behind a 15m high earth bund under adverse meteorological conditions would result in compliant noise levels. The bund would be formed during the day or under favourable (ie noise-reducing) conditions. Night-time overburden emplacement could be conducted-in-pit until completion of the protective bund.

The nearest residences to the proposed mine are to the southeast ("Templemore" and "Bollol Creek Station") and are therefore adversely affected more by winds from the northwest than from any other direction. Analysis of wind data from the Whitehaven Mine has shown that northwesterly winds are not predominant in the area thereby reducing the occurrence of meteorological conditions under which noise impacts may actually occur. Notwithstanding this, noise levels were predicted under northwesterly winds to present a worst case scenario for the management of noise emissions.

Lower noise levels were predicted for the northern emplacement than for the southern emplacement. Since the northern emplacement would be commenced first, there would be a significant period of time to gather information about actual noise emissions and local meteorological conditions before commencement of activities on the southern emplacement. This would enable the formulation of a reliable plan to effectively manage noise emissions from the southern emplacement.

No exceedance of blast overpressure limits have been predicted during any stage of mining. No exceedances of adopted noise limits for road transport of coal have been predicted. Recommendations have been presented regarding noise and vibration compliance monitoring procedures.

We conclude that the proposal could operate without adversely impacting upon the acoustical amenity of any non-project related residential receiver, after implementation of noise control recommendations given in this report.

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1 INTRODUCTION

1.1 Scope

The East Boggabri Joint Venture (the "Proponent") is seeking to establish a coal mine 15km northeast of Boggabri, NSW. The proposed development is State significant development and therefore the Minister for Infrastructure and Planning is the consent authority. Accordingly, a Noise and Vibration Impact Assessment (NVIS) has been conducted in accordance with the Department of Conservation (DEC) *NSW Industrial Noise Policy* (INP) for reference in the Environmental Impact Statement (EIS) for the proposal.

1.1.1 Study Area

The proposed East Boggabri Coal Mine is located within a 726ha Project Site centred on the "Thuin", "Nagero" and "Forest View" properties, approximately 15km northeast of Boggabri, 10km north of the Whitehaven Coal Mine and south of, and adjacent to, the approved Boggabri Coal Project (**Figure 1**). The Project Site is surrounded to the south, west and east by relatively flat agricultural land with six non project-related residences within a 3km radius of the boundary of the Project Site. The study area for the noise assessment and nearby residential receivers are discussed in Section 3.2.

1.1.2 Proposed Operations

The proposed East Boggabri Coal Mine would involve the following activities coal mining by open cut methods over an area of approximately 160ha (the open cut area), within which surface drilling has identified 8 coal seams amenable to mining by open cut methods, namely the:

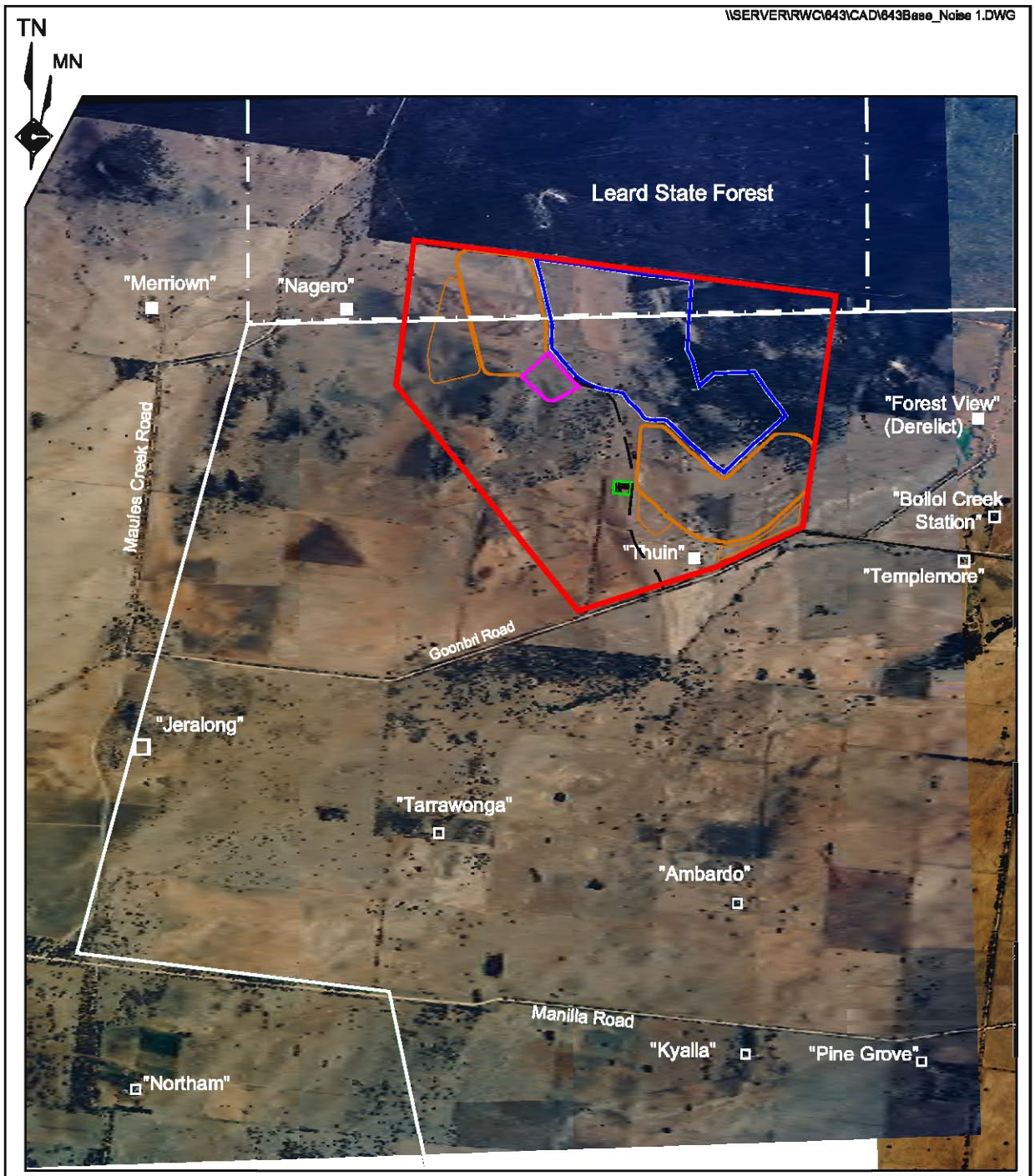
- Braymont Seam
- Bollol Creek Seam
- Jeralong Seam
- Jeralong (lower)
- Merriown Seam
- Merriown (lower)
- Velyama Seam
- Nagero Seam

Additional coal seams lie at depths below the Nagero Seam and though not amenable to open cut mining, these seams may have potential for future underground development. Any such development would be subject to future applications to the relevant authorities.

A total of approximately 12.4Mt Run-of-Mine (ROM) coal would be produced at an average stripping ratio of 7.2 bank cubic metres (bcm) overburden to 1 tonne coal. Under current economic circumstances, it is considered that mining beyond this average stripping ratio is not viable.

The floor of the open cut would range from approximately 20m below the natural surface at its western extremity to approximately 120m in the south-east.

Open cut mining would be by the conventional truck and shovel haulback method involving the sequential removal of soil and overburden / interburden materials above and between the coal seams, coal removal, and progressive backfilling and rehabilitation of the mined-out areas. Blasting would be required from the outset of mining.



REFERENCE
- EL 5967 / CL 368 Boundary (White)
- CL 368 Boundary (White)
- Project Site Boundary
- Open Cut Area
- Out-of-Pit Emplacement
- Coal Processing Area
- Mine Access Road
- Property Boundary
- Project Related Residence
- Non-Project Related Residence

SCALE 1:50 000

0.5 0 0.5 1.0 1.5 2.0 2.5 km

Base Photo Source: Geo-Spectrum (Australia) Pty Ltd - Date of Photograph: 12 February 2003

Figure 1
LOCAL ENVIRONMENT

The proposal if approved would incorporate the following activities.

- Construction of a mine entrance on Goonbri Road and a mine access road from Goonbri Road to the coal processing area.
- Coal mining by open cut mining methods over an area of approximately 160ha referred to as the "open cut area". The open cut area has been defined by drilling and a review of economic, geological and environmental considerations.
- Programmed placement of overburden and interburden materials from the open cut area to a combination of out-of-pit and in-pit overburden emplacements.
- On-site crushing and temporary stockpiling of the mined coal within a defined coal processing area southwest of the open cut area.
- Establishment of a transport route between the Project Site and the Whitehaven CHPP and rail loading facility with the importation of road construction materials from the Whitehaven Coal Mine.
- Transportation of coal from the Project Site to the Whitehaven CHPP for washing and/or despatch to export markets via rail to the Port of Newcastle.
- Backloading of coarse reject material from the Whitehaven CHPP for placement in the mined out areas of the proposed East Boggabri Coal Mine.
- Installation of a range of services, structures and transportable buildings.
- Progressive shaping and rehabilitation of the mine area and other areas of disturbance.

Figure 2 presents the proposed Project Site activities and **Figures 3(a)** and **3(b)** present the proposed transport route which would incorporate a northern section between the Project Site and the Whitehaven Coal Mine and a southern section between the Whitehaven Coal Mine and the Whitehaven CHPP. The northern section would require the construction of private roads and upgrading of existing public roads where as the southern section would utilise the existing coal haulage route of the Whitehaven Coal Mine. The proposed transport route incorporates the following private and public roads as identified on **Figures 3(a)** and **3(b)**.

Northern Section

Section 1: (Private Road)

A 3.4km length of road to be constructed between Goonbri Road and Manilla Road.

Stop signs would be erected on the approaches to Goonbri and Manilla Roads providing priority to local traffic travelling on these public roads. This section of the proposed transport route requires the crossing of Bollol Creek and would be aligned to minimise disturbance to native vegetation either side of the Goonbri Road and Bollol Creek crossing, and avoid several Aboriginal heritage sites. This section of the route would traverse the "Thuin" and "Tarrawonga" properties with the road aligned parallel to an existing fenceline on the "Tarrawonga" property.

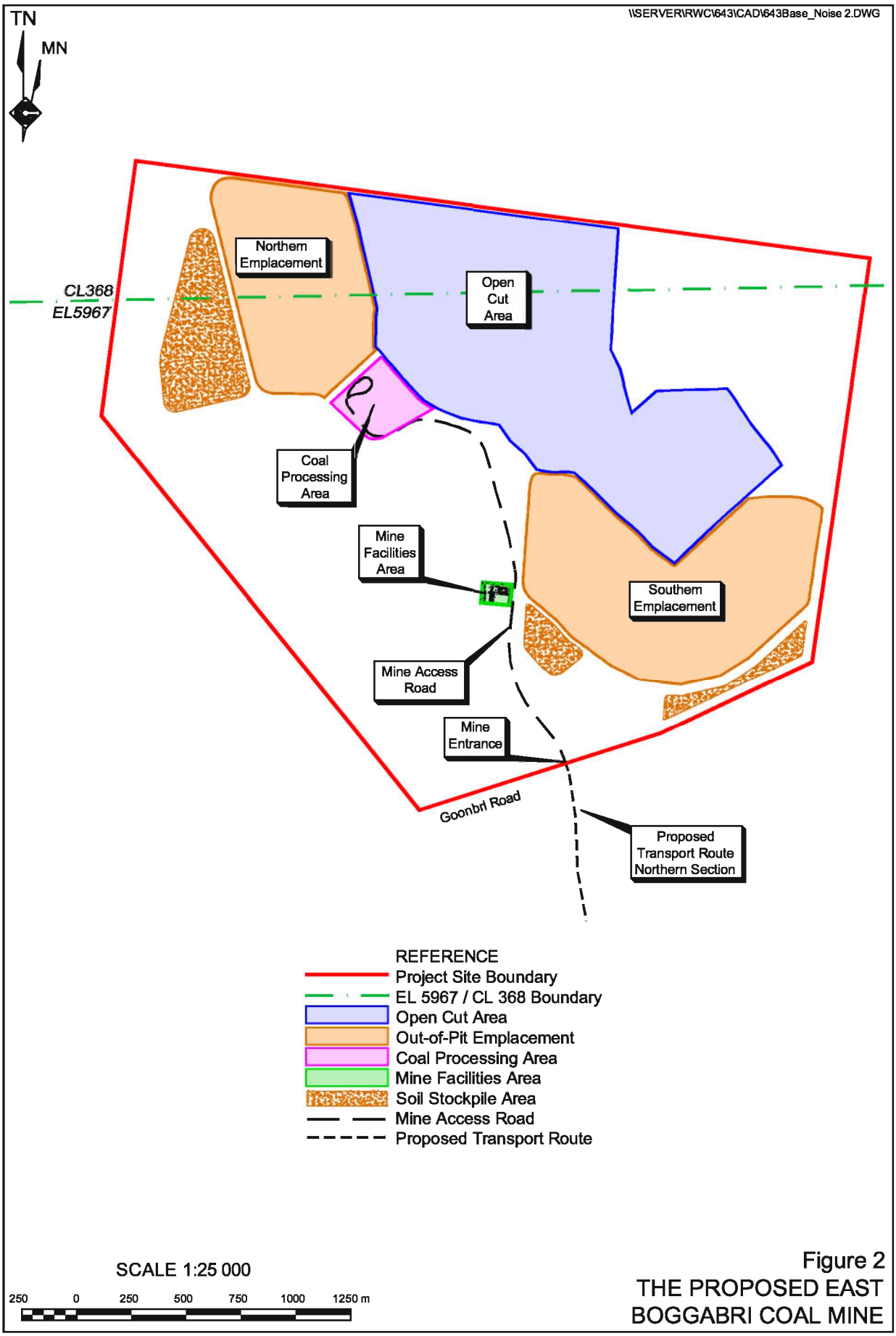


Figure 2
THE PROPOSED EAST BOGGABRI COAL MINE

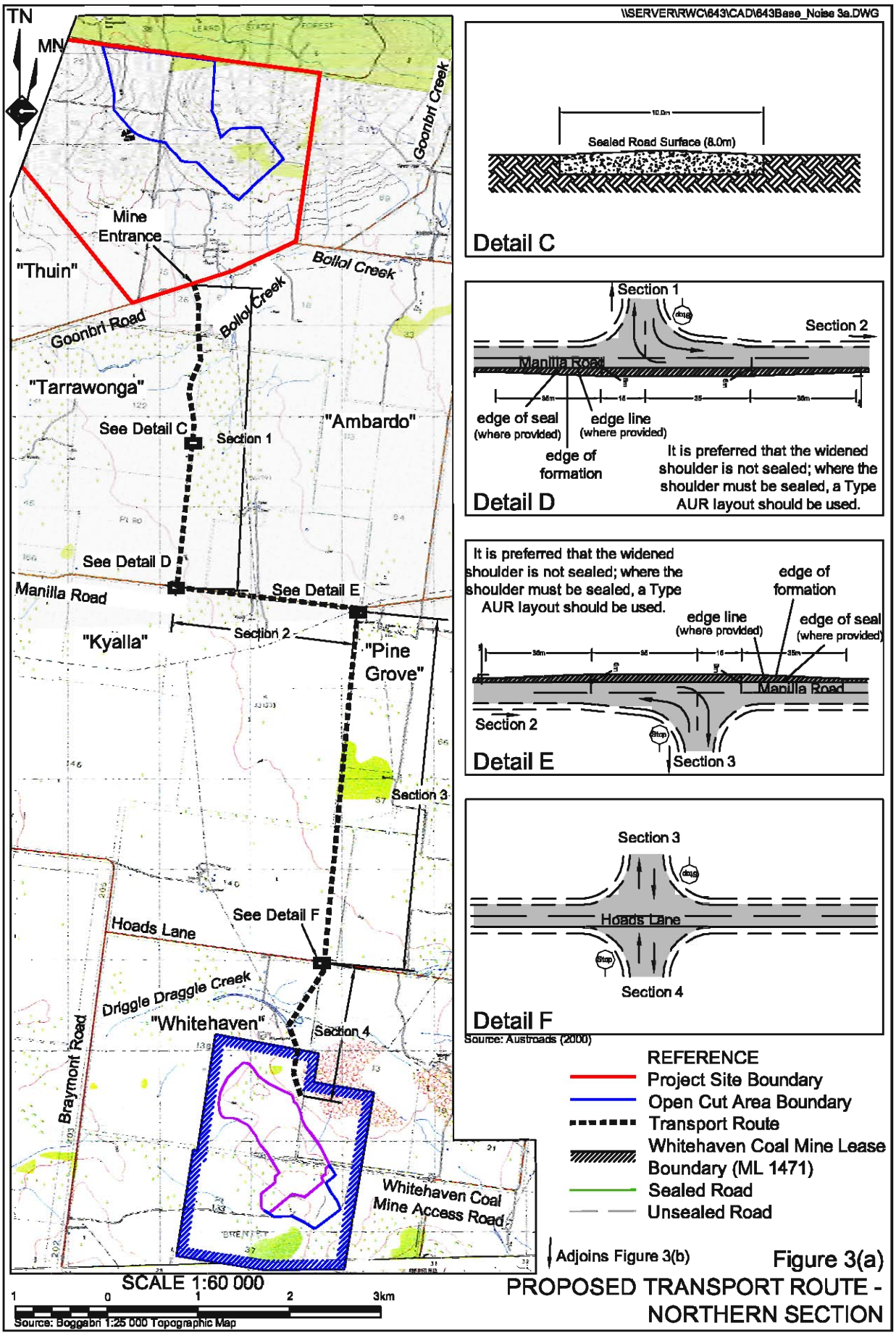


Figure 3(a)
PROPOSED TRANSPORT ROUTE - NORTHERN SECTION

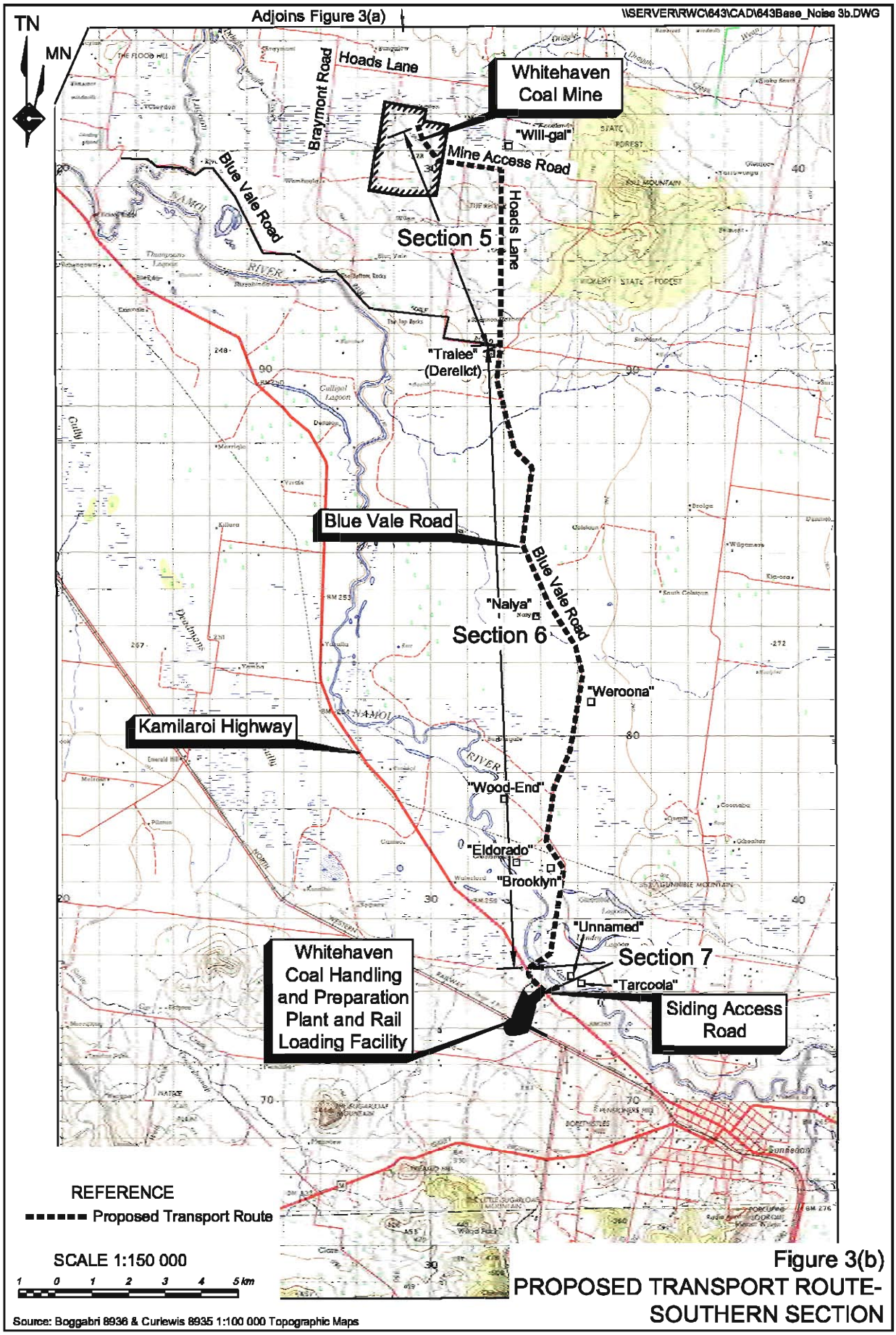


Figure 3(b)
PROPOSED TRANSPORT ROUTE-SOUTHERN SECTION

Section 2: (Public Road)

A 2.0km length of Manilla Road, an existing public road.

Manilla Road is an unsealed regional main road (No. 357) with wide gravel shoulders. Sight distance is at least 250m in both directions from the proposed intersection with Section 1 due to the naturally flat topography, straight road orientation and minimal roadside vegetation.

Section 2 would terminate approximately 750m west of its intersection with Blair Athol Lane at an intersection with Section 3 of the northern route.

Section 3: (Private Road)

A 3.9km length of road to be constructed between Manilla Road and Hoads Lane.

No natural water bodies would require crossing along this section and it is not anticipated that any native vegetation would require clearing. The northern 2.9km of this section would be constructed on the "Kyalla" property, with the remaining 1.0km constructed on WCM's "Bungalow" property.

Section 4: (Private Road)

An additional 1.5km section of this road would be constructed on the "Whitehaven" property to the product coal bin. This section of the road would require the crossing of Driggle Draggle Creek with clearing restricted to agricultural pasture and crop land.

Southern Section

Section 5:

The southern section of the proposed transport route would commence adjacent to the product coal bin at the Whitehaven Coal Mine, exiting the mine via the existing mine access road and incorporating a 5.2km section of Hoads Lane. Hoads Lane is an 8m wide sealed road.

Section 6:

An 18.4km section of Blue Vale Road which links Hoads Lane and the Kamilaroi Highway. This road is also approved for the transportation of coal from the Whitehaven Coal Mine. This section of road is the subject of a maintenance agreement between Whitehaven Coal Mine and Gunnedah Shire Council.

Section 7:

From an intersection specifically designed for the trucks transporting coal to the coal loading facility via Blue Vale Road and the Kamilaroi Highway, and extend 0.5km east on the highway into the specially constructed intersection with the siding access road. The siding access road provides access to both the Whitehaven CHPP and rail loading facility.

2 DESCRIPTION OF TERMS

2.1 Scope

This section of the report aims to convey an understanding of several commonly used acoustical terms. Various terms are explained in plain language and the effects of certain atmospheric phenomena on noise propagation are discussed. Noise level percentiles are explained with the aid of a diagram of a hypothetical noise signal.

The descriptions in this section are not formal definitions of the terms. Formal definitions may be found in AS1633-1985 "Acoustics – Glossary of terms and related symbols".

2.2 General Terms

Sound Power Level

The amount of acoustic energy (per second) emitted by a noise source. Usually written as "Lw" or "SWL", the Sound Power Level is expressed in decibels (dB) and cannot be directly measured. Lw is usually calculated from a measured sound pressure level.

Sound Pressure Level

The "noise level", in decibels (dB), heard by our ears and/or measured with a sound level meter. Written as "SPL", the sound pressure level generally decreases with increasing distance from a source. Noise levels are often written as dB(A) rather than dB. The "A-weighting" is a correction applied to the measured noise signal to account for the ear's ability to hear sound differently at different frequencies. For example, 40dB at 500Hz (speech frequency) is clearly audible but 40dB at 50Hz (very low bass) would be far less audible. The A-weighted sound pressure level therefore represents the measured (or predicted) noise level as it would be heard by the typical human ear.

Temperature Inversion

An atmospheric state in which the air temperature increases with altitude. Sound travels faster in warmer air than in cold air, so that during an inversion the top of a "sound wave" would move faster than the bottom. This bends (refracts) sound back towards the ground just as light bends upon entering and exiting a glass prism. The result is a "trapping" of sound energy near the ground and an increase in noise levels.

Wind Shear

A moving air mass would experience a "friction drag" at the ground in much the same way as a lava flow would flow quickly on top and "roll over" the lava beneath which must drag along the ground. This increasing wind speed with altitude is called "wind shear".

For a sound wave travelling down wind, the top of the wave moves faster than the bottom and the wave bends towards the ground. However, for a wave travelling into the wind the top of the wave is slowed down more than the bottom is and the wave bends upwards. **Figure 4** shows several examples of how atmospheric effects can bend sound waves.

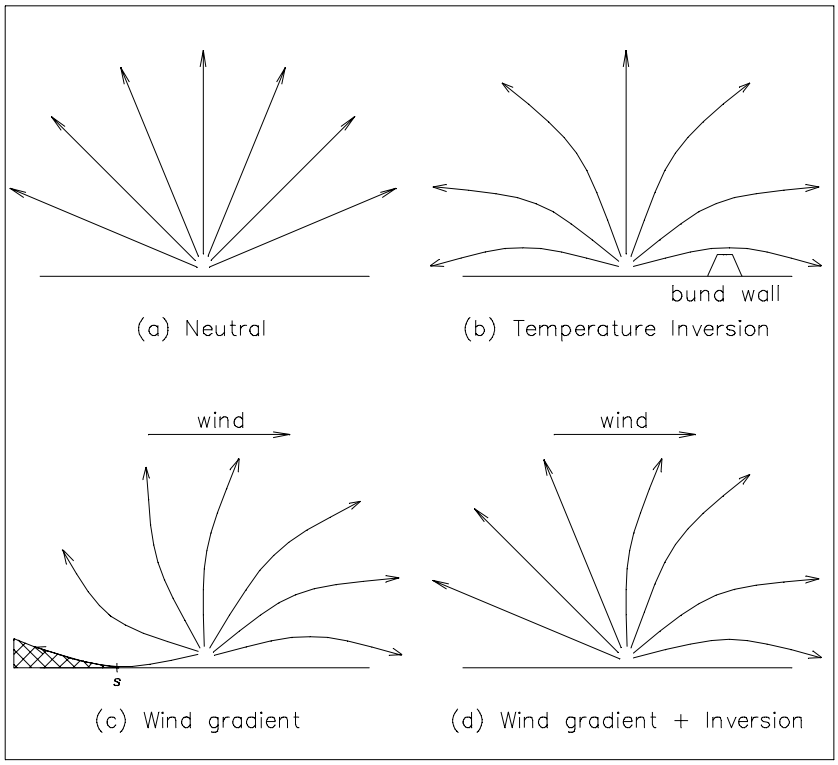


FIGURE 4
Sound refraction under temperature inversions and wind gradients.

Figure 4 shows that sound rays can be refracted over a barrier (usually a bund wall or small hill) during a temperature inversion, increasing noise levels in the 'shadow zone'.

Neutral Atmospheric Conditions

An atmosphere that is at a temperature of approximately 23^0C from ground level to an altitude of 200m or more. There are no fluctuations in density or humidity and no wind. Such conditions rarely occur, as temperature would usually vary with altitude and there is always movement in various directions in different layers of the atmosphere.

Prevailing Atmospheric Conditions

Atmospheric conditions (with regards to potential effects on noise propagation) which are characteristic of the study area. These would typically include seasonal wind directions and velocities. Temperature inversions would be included as prevailing if they occur, on average, for more than 2 nights per week in winter.

Adverse Atmospheric Conditions

Adverse conditions would include simultaneous winds and temperature inversions, even if the inversions occur for less than 2 nights per week in winter. This represents the worst case scenario for potential noise enhancement due to atmospheric effects.

2.2 Noise Levels Percentiles

A noise level percentile (L_n) is the noise level (SPL) in decibels which is exceeded for "n" % of a given monitoring period. Several important L_n percentiles would be explained by considering the hypothetical time signal in **Figure 5**.

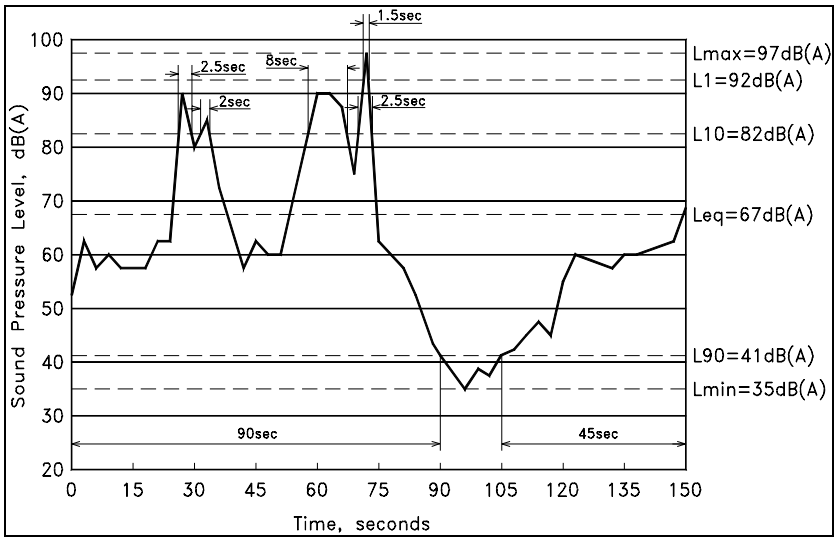


FIGURE 5
Hypothetical time-trace of 150-second sound signal.

The signal in **Figure 5** has a duration of 2.5 minutes (ie. 150 seconds) with noises occurring as follows.

- The person holding the instrument is standing beside a road and hears crickets in nearby grass at a level of around 60dB(A).
- At about the 30 second mark a motorcycle passes on the road, followed by a car.
- At 60 seconds a truck passes.
- After the truck passes it sounds its air horn at the 73 second mark.
- The crickets are frightened into silence and the truck fades into the distance.
- All is quiet until 105 seconds when the crickets slowly start to make noise, reaching full pitch by 120 seconds.
- The measurement stops at 150 seconds, just when an approaching car starts to become audible.

L_1 Noise Level

Near the top of Figure 5, there is a dashed line at 92dB(A). A small spike of 1.5 sec duration extends above this line at around 73 seconds. Since 1.5 sec is 1% of the signal duration (150 seconds), the L_1 (or L_{A1} to signify A-weighting) noise level of this sample is 92dB(A). The L_1 percentile is often called the *average peak noise level* and is used by the NSW Department of Environment and Conservation[1] (DEC) as a measure of potential disturbance to sleep.

L_{10} Noise Level

The dashed line at 82dB(A) is exceeded for four periods of duration 2.5 sec, 2 sec, 8 sec and 2.5 sec, respectively. The total of these is 15 sec, which is 10% of the total sample period. Therefore, the L_{A10} noise level of this sample is 82dB(A). The L_{10} percentile is called the *average maximum noise level* and has been widely used as an indicator of annoyance caused by noise.

[1] Formerly Environment Protection Authority, EPA.

L_{90} Noise Level

In similar fashion to L_1 and L_{10}, Figure 5 shows that the noise level of 41dB(A) is exceeded for 135 seconds (90 + 45 =135). As this is 90% of the total sample period, the L_{A90} noise level of this sample is 41dB(A). The L_{90} percentile is called the *background noise level*.

L_{eq} Noise Level

Equivalent continuous noise level. As the name suggests, the L_{eq} of a fluctuating signal is the continuous noise level which, if occurring for the duration of the signal, would deliver equivalent acoustic energy to the actual signal. L_{eq} can be thought of as a kind of 'average' noise level. Recent research suggests that L_{eq} is the best indicator of annoyance caused by industrial noise and the EPA *NSW Industrial Noise Policy* takes this into consideration.

L_{max} and L_{min} Noise Levels

These are the maximum and minimum SPL values occurring during the sample. Reference to **Figure 5** shows these values to be 97dB(A) and 35dB(A), respectively.

3 THE EXISTING ENVIRONMENT

3.1 Introduction

The existing meteorological and acoustic environments have been studied as part of this EIS. The acoustical climate has been quantified at specific residential locations, whereas the meteorological data are assumed to be consistent over the entire study area.

3.2 Meteorology

The atmospheric conditions most relevant to noise assessments are temperature inversions, gentle winds (indicative of possible wind shear) and relative humidity. From long-term weather monitoring data and more recent continuous data collected at the Whitehaven Coal Mine, the existing environment near this location is well classified.

The following data are the most significant with respect to noise propagation.

- Extremes of relative humidity (RH) are rarely experienced. For modelling purposes, a value of 70% RH was adopted.
- Mild temperature inversions are likely to occur on more than 30% of mornings and evenings in winter, as inferred from Appendix F of the INP. The DEC default value of $+4^{o}$C/100m vertical temperature gradient for non-arid areas (INP, Appendix E) was adopted in the noise models.
- Winds are predominantly southeasterly in summer and northwesterly in winter, although analysis of meteorological data from Whitehaven Mine suggests that northeasterly winds are predominant there. Since the potentially most affected residences are located southeast of the proposed mine only a northwesterly wind was considered to provide a worst-case scenario. A wind speed of 3m/s (at 10m above ground level) was modelled to determine the noise impact under the northwesterly wind.

Typical calm daytime conditions of no wind, 70% RH and -1^{o}C/100m vertical temperature gradient (ie. dry adiabatic lapse rate, DALR) was also modelled to represent typical daytime noise levels.

3.3 Surrounding Residences and Land Uses

The Joint Venture Partners collectively own the freehold land within the Project Site within the properties of "Thuin", "Nagero", and "Forest View". Leard State Forest which is owned by the Crown, is to the immediate north while the "Bollol Creek Station" property, owned by J. Picton, shares a common boundary with the Project Site along the southern section of the eastern Project Site boundary.

Surrounding Residences

Table 1 lists each of the non-project related residences surrounding the Project Site together with the distance to the closest proposed mining or processing activities in Year 1 and Year 6. Of the non-project related residences, "Templemore" would be the closest to mining activities (1 420m during Year 6). It is noted that the residences on "Merriown", "Nagero", Thuin" and "Forest View" are referred to as project-related as they are owned by either WCM or IBC.

Table 1
Proximity of Non-Project-related Residences Surrounding the Project Site

Property Name	Closest distance to mining/processing activity (m)	
	Year 1	Year 6
"Jeralong"	4 200	4 000
"Tarrawonga"	3 650	3 030
"Ambardo"	4 230	2 890
"Templemore"	3 100	1 420
"Bollol Creek Station"	3 100	1 520
"Matong"	5 000	3 320
"Blair Athol School House"	4 100	2 440

The northern section traverses two properties not owned by the Proponent and crosses one road reserve (with a permit), two public roads (Manilla Road and Hoads Lane) and an unformed road. It is noted that the Proponent has an agreement with the owners of the "Tarrawonga" and "Kyalla" properties to allow a section of the proposed transport route to traverse their properties. However, it remains the Proponent's intention to satisfy transport noise criteria at the residences on these properties.

Table 2 lists the five non-project related residences within 2km of the northern section of the proposed transport route. The closest residences to this section of the proposed transport route are "Kyalla" and "Pine Grove" at distances of 200m and 250m respectively.

Table 2
Non-Project Related Residences within 2km of the Proposed Transport Route

Property Name	Distance to Proposed Transport Route (m)
Northern Section	
"Tarrawonga"	1 700
"Ambardo"	720
"Kyalla"	200
"Pine Grove"	250
"Gundawarra"	1 950
Southern Section	
"Will-gai"	280
"Tralee" (Derelict)	100
"Nalya"	600
"Weroona"	330
"Wood-End"	1 340
"Eldorado"	1 230
"Brooklyn"	70
Unnamed	700
"Tarcoola"	1000

A total of eight occupied residences are located within 2km of the southern section of the proposed transport route which is already used for the transportation of coal between the Whitehaven Coal Mine and Whitehaven CHPP and rail loading facility. A further six residences are set back between 2km and 3km from the southern section of the proposed transport route. The distances of each residence from either Hoads Lane or Blue Vale Road are listed in **Table 2**. Residences closer to the Kamilaroi Highway than the proposed transport route have been excluded from **Table 2** given noise levels at those residences would be more influenced by highway traffic noise.

It is noted from **Table 2** that the closest inhabited residences to the southern section of the proposed transport route are "Brooklyn" (70m), "Will-gai" (280m) and "Weroona" (330m).

Surrounding Land Uses

The land uses on each of the properties within and surrounding the Project Site are as follows.

Project Related Properties

- "Thuin" – cattle grazing in rotation with cropping. The property also retains a piggery although this is not a current land use.
- "Forest View" – cattle grazing and some cropping.
- "Nagero" – cattle grazing in rotation with cropping.
- "Merriown" – cattle grazing in rotation with cropping.

Non-Project Related Properties

- "Templemore" – cattle grazing in rotation with cropping.
- "Jeralong" – cattle grazing in rotation with cropping.
- "Tarrawonga" – cattle grazing in rotation with cropping.

- "Pine Grove" – mixed farming
- "Kyalla" – cattle grazing in rotation with cropping.
- "Ambardo" – cattle grazing in rotation with cropping.
- "Northam" – cattle grazing in rotation with cropping.
- "Bollol Creek Station" – cattle grazing in rotation with cropping.

The principal land uses adjacent to the northern section of the proposed transport route are as follows.

Project Related Properties

- "Bungalow" – cattle grazing.
- "Whitehaven" – mining within ML 1471 and cereal/fodder cropping in rotation with sheep production external to ML 1471.

Non-Project Related Properties

- "Pine Grove" – mixed farming
- "Kyalla" – cattle grazing in rotation with cropping.
- "Northam" – cattle grazing in rotation with cropping.

The land uses adjacent to the southern section of the proposed transport route are also predominantly agricultural, although in the vicinity of the Whitehaven Coal Mine, the land within the former Vickery Coal Mine is still predominantly subject to post-mining revegetation. The only non-agricultural use adjacent to Blue Vale Road between the Whitehaven Coal Mine and the Whitehaven CHPP is the Blue Vale Speedway which is used mainly of a weekend.

3.4 Ambient Noise Levels

A noise study was conducted in 1982 by Louis Challis & Associates for the Boggabri Coal Project (LCA, 1982). Noise measurements were taken at several residences on farms in the area around the Boggabri Coal Project area.

The results of LCA (1982) were typical of rural areas away from major roads and industries with daytime background L_{A90} noise levels of around 30dB(A),L_{90} and night-time L_{90} levels as low as 23dB(A). Given that there has been no appreciable change in the acoustic environment in the intervening years, these background levels would remain appropriate and have been adopted for the present assessment.

It is a standard DEC requirement that noise levels below 30dB(A) shall be taken as 30dB(A) for the purposes of assessing industrial noise, so that the **30dB(A),L_{90}** background level would be adopted for all residential receivers during the day, evening and night.

4 NOISE AND VIBRATION CRITERIA

4.1 Introduction

This section of the report presents noise and vibration criteria for potentially affected non-project related residences.

4.2 Construction Noise

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

- Construction period less than 4 weeks:
  L_{A10} level restricted to background (L_{A90}) + 20dB
- Construction period more than 4 weeks but less than 26 weeks:
  L_{A10} level restricted to background (LA_{90}) + 10dB

DEC recommends construction during daytime hours only. For construction periods longer than 26 weeks, the operational criteria presented in Section 4.3 are assumed to apply.

Construction activities are expected to be completed within 6 months and the criterion of 'daytime background level + 10dB' or **40dB(A),L_{10}**, would apply.

4.3 Operational Noise

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';and
- an *amenity criterion* which aims to protect against excessive noise levels where an area is becoming increasingly developed.

Since there is no existing major industry dominating noise levels at any receivers near the proposal, and there is negligible road traffic, only the intrusiveness criteria will be considered for setting project-specific operational noise limits. The proposed intrusiveness criteria will be applied to the cumulative noise impact from the proposal and the Boggabri Coal Project to allow equitable noise contributions from both projects and to aim for minimal noise impact at nearby residences.

Based on the existing background noise level of 30dB(A),L90 the intrusiveness criterion is **35dB(A),$L_{eq(15\text{-}minute)}$** at all non-project related residences.

4.4 Sleep Disturbance

To help protect against people waking from their sleep, the DEC recommends that 1-minute L_{A1} noise levels (effectively, the maximum noise level from impacts, etc) should not exceed the background level by more than 15dB(A) when measured/computed at a building facade. The "sleep disturbance" criterion is only applicable to night-time operations.

The sleep disturbance criterion applicable for this project at each receiver location is equal to the intrusiveness criterion plus 10dB(A), that is, **45dB(A),$L_{1(1\text{-}minute)}$.**

4.5 Traffic Noise

In NSW, noise from vehicle movements associated with an industrial source is assessed in terms of the INP if the vehicles are on the industrial site (the mining lease in this case). If the vehicles are on a public road, the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN) applies. Section 1.1.2 (Figure 2) shows that the road from the proposed East Boggabri Mine to Whitehaven Mine is on both public and private roads (to be constructed).

Given the often remote location of quarries or mines with respect to major product transport facilities, the concept of "principal haulage routes" was proposed in 1997 by the (then) Department of Urban Affairs and Planning's North Coast Extractive Industries Standing Committee. The concept of 'principal haulage routes' is specifically mentioned in Section 2.2 of the ECRTN under the heading Functional Categories of Roads as follows.

> *"Ways of identifying 'principal haulage routes' and managing associated adverse impacts have not yet been fully identified. Where local authorities identify a 'principal haulage route', the noise criteria for the route should match those for collector roads, recognising the intent that they carry a different level and mix of traffic to local roads."* (ECRTN, P5)

Table 3 below shows ECRTN traffic noise criteria for the case where the proposed transport route is considered as a collector road.

Table 3
Road Traffic Noise Criteria

Type of Development	Recommended Criteria – dB(A)		
	Day 7.00am to 10.00pm)	**Evening (6.00pm to 10.00pm**	**Night (10.00pm to 7.00am)**
11. Land use developments with potential to create additional traffic on collector roads.	$L_{Aeq(1hr)}60$	$L_{Aeq(1hr)}60$	$L_{Aeq(1hr)}55$

It is proposed that coal will be transported by road during daytime hours only. Off-site traffic noise from the proposal will therefore be assessed against the ECRTN criterion of **$L_{Aeq(1hr)}$60 (day)** for the entire proposed transport route between the proposed East Boggabri Coal Mine and the existing Whitehaven Coal Mine[2].

4.6 Blasting

4.6.1 Annoyance Criteria

Noise and vibration levels from blasting are assessable against criteria proposed by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication *"Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990"*.

[2] This is consistent with the 60 dB(A) criterion which applies to the existing haul road from Whitehaven Mine to the Whitehaven CHPP and rail loading facility.

These criteria are summarised as follows.

- The recommended maximum overpressure level for blasting is 115dB.
- The level of 115dB may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120dB at any time.
- The recommended maximum 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 should generally only be permitted during the hours of 9am to 5pm Monday to Saturday, and should not take place on Sundays and Public Holidays.
- Blasting should generally take place no more than once per day.

These criteria are typically adopted by the DEC when issuing Environment Protection Licences for projects involving blasting.

4.6.2 Building Damage Criteria

Building damage assessment criteria are nominated in AS 2187.2-1993 *"Explosives – Storage, Transport and Use Part 2: Use of Explosives"* and summarised in **Table 4.**

Table 4
Blasting Criteria to Limit Damage to Buildings (AS 2187)

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

The annoyance (ANZECC) criteria are more stringent than the building damage criteria (**Table 4**) and would be taken as the governing criteria for the proposed East Boggabri Coal Mine.

5 ASSESSMENT METHODOLOGY

5.1 Construction Noise

The proposal would require the following construction works with the potential for noise impact on residential receivers.

- Limited tree clearing and topsoil removal within the footprint of the northern emplacement.
- Construction of the mine entrance and mine access roads.
- Construction of the coal processing area.

For modelling purposes, it was assumed that initial earthworks and construction of surface facilities would take place simultaneously. Noise levels for typical construction machinery have been sourced from our extensive noise database and are shown in **Appendix A**. Assessment of construction noise was conducted using RTA Technology's Environmental Noise Model v3.06 (ENM) with the same atmospheric conditions discussed earlier in the report. Indicative construction noise source locations are shown in **Figure 6**. It is noted that the locations allocated for the tree felling and topsoil removal are outside the footprint of activity during the construction period. However, the activities could be related to construction of surface water management facilities to be located in the general southeastern part of the Project Site albeit for short periods of time. In any event, the positioning of the equipment in this area is recognised to be conservative.

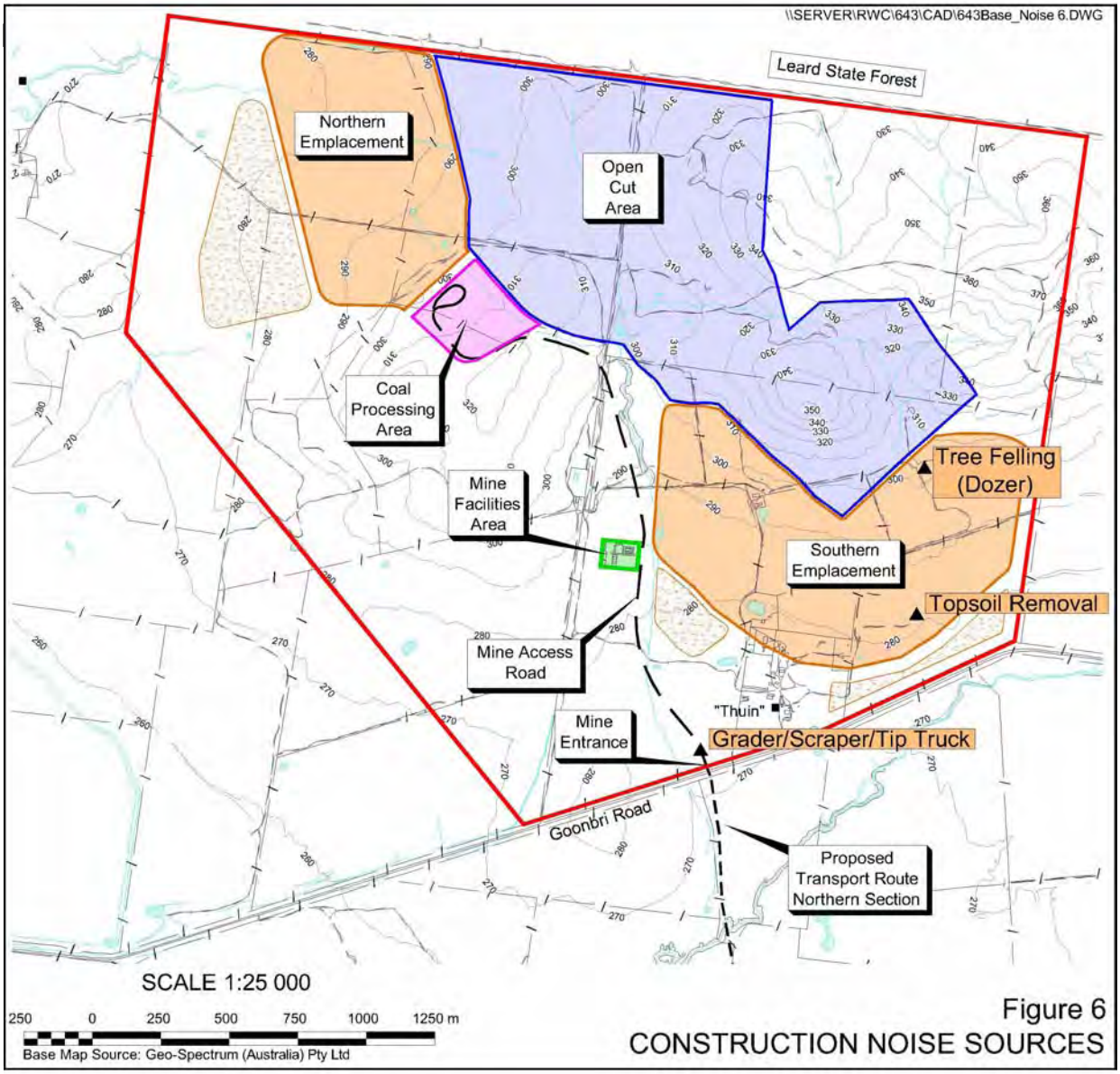


Figure 6
CONSTRUCTION NOISE SOURCES

5.2 Operational Noise

Assessment of operational noise was conducted using the ENM software. The noise sources were modelled at their known (for stationary sources such as the coal processing area) or most exposed (for mobile sources such as dump trucks) positions and noise contours and/or point calculations were generated for the surrounding area.

5.2.1 Noise Sources

Noise data for significant sources associated with the proposal were either provided by the Proponent or obtained from Spectrum Acoustics' extensive database of measured plant items. Where multiple database entries exist for the same plant item, the higher noise levels have been adopted for conservatism. Sound power levels of operational noise sources are shown in **Appendix A**.

5.2.2 Modelled Scenarios

As discussed in Section 3.1, modelling was conducted for the following atmospheric conditions.

- *Daytime lapse* - 20^0C, 70% relative humidity (RH), no wind, -1^oC/100m vertical temperature gradient (dry adiabatic lapse rate, DALR);
- *Inversion* – 10^0C, 70% R.H., +4^oC/100m vertical temperature gradient; and
- *Prevailing wind* – 20^0C, 70% R.H., 3m/s wind from NW.

In addition to the construction scenario, noise models were generated for the following operational (mining) scenarios for each of the above atmospheric conditions.

1. ***Commencement of mining*** (excavation at ground level in the "X" and "N" pits, overburden placement at the northwestern toe of the northern emplacement, on-site coal processing and coal haulage);
2. ***End Year 1*** (excavation 20m below ground level in the "X" and "N" pits, overburden placement on the northern end of the half-completed northern emplacement, on-site coal processing and coal haulage);
3. ***End Year 3*** (excavation 50m below ground level in the "X" and "N" pits, overburden placement on the southern end of the completed northern emplacement, on-site coal processing and coal haulage);
4. ***Start Year 4*** (excavation 50m below ground level in the "X" and "N" pits, overburden placement at ground level at the southeastern toe of the southern emplacement, on-site coal processing and coal haulage);
5. ***End Year 6*** (excavation 40m below ground level in the "C" and "S" pits, overburden placement on eastern edge of the almost-completed southern emplacement, on-site coal processing and coal haulage).

These scenarios are anticipated as the worst cases in terms of potential noise impacts. NOTE: Scenarios 4, 5 and 6 each comprise two scenarios: (a) overburden placement in the open, and (b) placement of overburden behind a 15m high 'leading edge' of overburden formed during favourable weather conditions. **Figures 7** and **8** show noise source locations for scenarios 2 (incorporating northern emplacement) and 5 (incorporating southern emplacement). The road registered trucks transporting product coal on the mine access road have been assessed separately, with results added to predicted noise levels for the above scenarios.

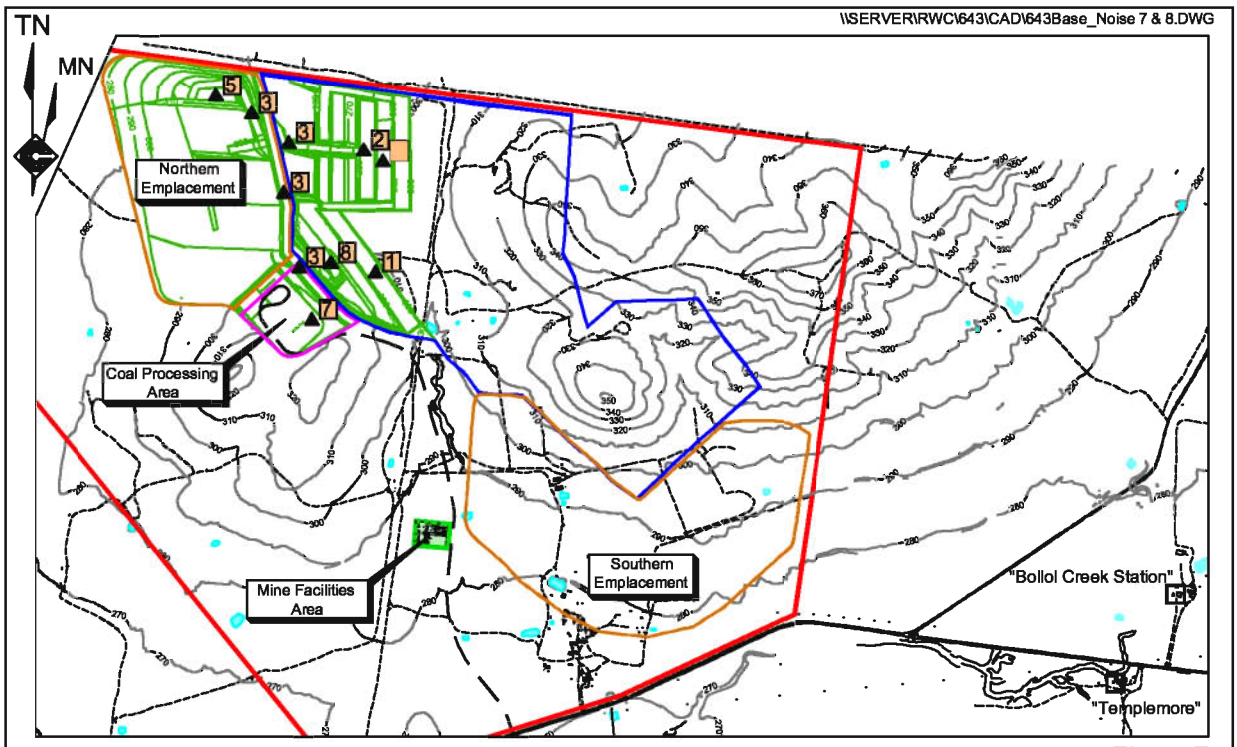


Figure 7
END YEAR 1 NOISE SOURCES

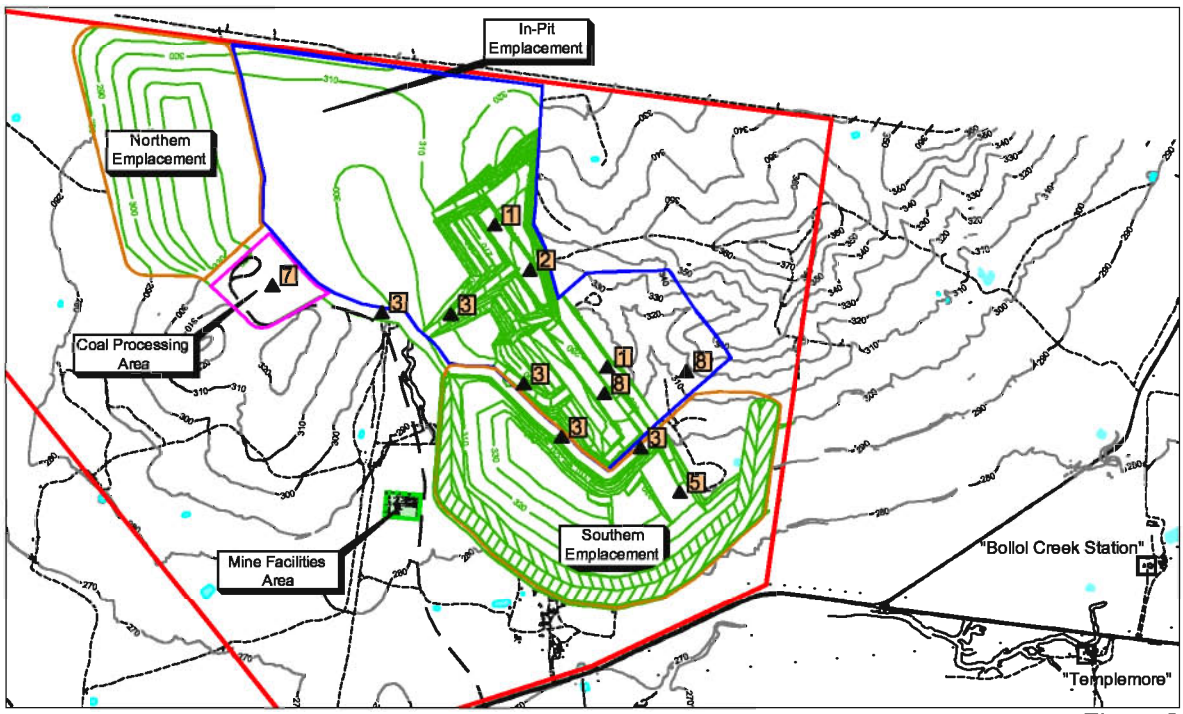


Figure 8
END YEAR 6 NOISE SOURCES

▲ NOISE SOURCE
1 Drill
2 Excavator (3600)
3 Haul Truck
5 Overburden Placement (& Dozer)
7 Crushing Plant (& FEL)
8 Excavator (1900)

REFERENCE
Project Site Boundary
Open Cut Area Boundary
Mine Access Road
Unsealed Road / Track
Building
Contour (Interval = 10m)(m AHD)
Stage Contour (Interval = 10m)(m AHD)
Dam / Water Storage
Initial 15m High Noise Bund

SCALE 1:30 000
500 0 500 1000 1500 m

Source: Spectrum-Acoustics Pty Ltd (2005) - Figures 6 and 8

5.3 Sleep Disturbance

A potential for sleep disturbance would occur during mining operations due to general impact noise from excavation/placement of overburden activities, coal loading into empty trucks and dozer tracks. Sound power levels of modelled L_{Amax} noise sources (as an estimation of L_{A1} levels) are shown in **Appendix A**.

Impact noise was modelled using the ENM program under the noise-enhancing atmospheric conditions discussed in Section 3.2.

5.4 Traffic Noise

Off-site coal transportation would be of an intermittent rather than constant nature, with up to 25 trucks movements per hour passing a given point on the proposed transport route. There are many methods available for calculating the cumulative noise impact arising from intermittent signals of various shapes. The methodology employed in this assessment was sourced from the US Environmental Protection Agency document No. 550/9-74-004 "Information on Levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974".

The document refers to 'triangular' and 'trapezoidal' time signals, which are illustrated in **Figure 9**. A triangular time signal rises from the background level to a peak noise level and then immediately begins to subside. A trapezoidal time signal rises from the background level to a maximum level and sustains that level for a period of time before subsiding.

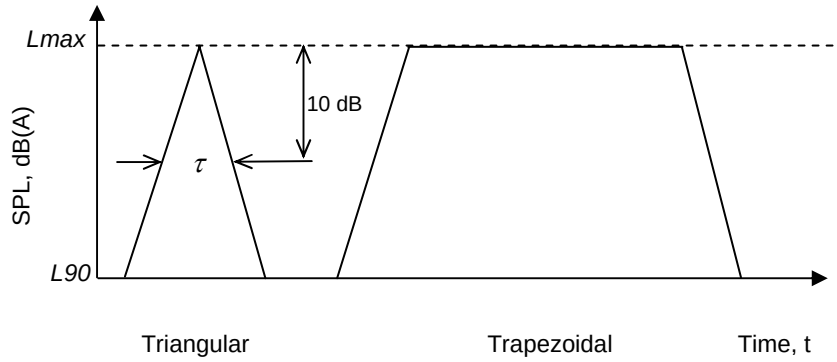


FIGURE 9
Simple time-signal shapes used in the calculation of intermittent noise levels. Passing trucks are approximated by a triangular signal.

The value of $L_{Aeq,T}$ for a series of identical triangular time patterns having maximum levels of L_{Amax} is given by **Equation 1**. A triangular time signal is a good approximation to the SPL signal of a truck as it passes an observation point.

$$L_{eq},T = L_b + 10\log\left[1+\frac{n\tau}{T}\left(\frac{10^{\frac{\Delta L}{10}}-1}{2.3}-\left(\frac{\Delta L}{10}\right)\right)\right] \quad (1)$$

where,

L_{max} = maximum truck noise at residence, dB(A)
L_b = ambient equivalent noise level, dB(A)
ΔL = L_{max} - L_b
T = assessment period (minutes)
τ = "10dB-down" duration per truck (minutes, see **Figure 13**), and
n = number of truck during assessment period.

The ENM program was used to calculate the maximum truck noise level at each assessed receiver along the haul route. Based on the proposed mine productivity, there would be a maximum of 25 truck movements along the haul route per hour (including return trips) so for a 1-hour period, n = 25 and T = 60. The duration per truck, τ, is calculated from the distance between source and receiver, D, and the vehicle speed, v, by $\tau = 0.1D/v$.

5.5 Blasting

The following sections provide standard equations for predicting blast overpressure (ie. noise) and ground vibration levels, sourced from the United States Bureau of Mines and accepted by DEC.

5.5.1 Blast Overpressure

Unweighted airblast overpressure levels, OP, are predicted from **Equation 2** below.

$$OP = 165 - 24(\log_{10}(D) - 0.3 \log_{10}(Q)), \quad \text{dB} \qquad (2)$$

where D is distance from the blast to the assessment point (m), and
Q is the weight of explosive per delay (MIC, kg).

Equation 2 has often been found to underestimate blast overpressure levels by up to 3dB, so 3dB has been added to the predicted levels presented in this report.

5.5.2 Blast Vibration

The basic equations for calculation of peak particle vibration (PPV) levels from blasting are as follows:

$$\text{PPV} = 1140\left(\frac{D}{Q^{0.5}}\right)^{-1.6} \text{, mm/s} \quad \text{(for average ground type)} \qquad (3)$$

$$\text{PPV} = 500\left(\frac{D}{Q^{0.5}}\right)^{-1.6} \text{, mm/s} \quad \text{(for hard rock)} \qquad (4)$$

where D and Q are as defined in Equation 2.

It is noted that the only difference between equations (3) and (4) is the value of the coefficient (either 1140 or 500). Geological data for a site in the Upper Hunter Valley showed that most of the material to be mined contained bands of sandstone, conglomerate and mudstone, all of which are relatively hard materials.

The rocks within the Project Site are similar to the harder materials blasted in Hunter Valley mines. Consequently, a coefficient value of 700 was considered appropriate for use in the equation for prediction of ground vibration levels from blasting. Nevertheless, the value of 1140 (Equation 3) has been used to allow a sizeable margin for error.

6 IMPACT ASSESSMENT

This section of the report presents predicted noise and vibration levels and provides mitigation recommendations where criterion exceedances are predicted. Representative noise contours or various operational scenarios are shown in **Figures 10** to **15** following discussion of each relevant operational scenario[3].

6.1 Construction Noise

6.1.1 Predicted Noise Levels

Predicted noise levels for earthworks (construction/roadworks) during the initial construction period are shown in **Table 5** and results for tree clearing/topsoil removal are shown in **Table 5**. Combined results are summarised in **Table 7**. **Tables 5, 6** and **7** also include the "differentials" between the predicted levels (maximum over all meteorological conditions) and the noise criteria, with criterion exceedances highlighted in bold type.

Table 5
Predicted Noise Levels From Earthworks During Construction of Coal Processing Area and Mine Access Road

	Meteorological Condition				
Location	Lapse	Inversion	NW wind	Criterion	Differential
(1) "Tarrawonga"	<20	<20	<20	40	<-20
(2) "Ambardo"	<20	23	<20	40	-17
(3) "Templemore"	<20	22	21	40	-18
(4) "Bollol Creek Station"	<20	<20	<20	40	<-20
(5) "Matong"	<20	<20	<20	40	<-20

Table 6
Predicted Noise Levels from Tree Clearing and Topsoil Removal During the Construction Phase

	Meteorological Condition				
Location	Lapse	Inversion	NW wind	Criterion	Differential
(1) "Tarrawonga"	<20	23	<20	40	-17
(2) "Ambardo"	<20	28	24	40	-12
(3) "Templemore"	34	40	39	40	0
(4) "Bollol Creek Station"	30	38	36	40	-2
(5) "Matong"	<20	23	21	40	-17

Table 7
Combined Construction Noise Levels from Surface Preparation and Construction Works

	Meteorological Condition				
Location	Lapse	Inversion	NW wind	Criterion	Differential
(1) "Tarrawonga"	<20	24	<20	40	-16
(2) "Ambardo"	21	29	25	40	-11
(3) "Templemore"	34	40	39	40	0
(4) "Bollol Creek Station"	30	38	36	40	-2
(5) "Matong"	<20	24	21	40	-16

[3] Figure 10 relates to noise from the on-site component of the product haul road and is presented after the discussion of initial mining noise levels. Figure 12 relates to noise at the end of year 2 and is presented after the discussion of Year 1 noise levels.

6.1.2 Noise Control Recommendations - Construction

The results in **Table 7** show that only under worst case weather conditions, and with both tree felling and topsoil removal occurring at the nearest points to residences, would the daytime construction noise criterion be approached. Tree felling contributed 38dB(A) and topsoil removal contributed 36dB(A) to the total 40dB(A) predicted at "Templemore" under inversion conditions. Although the criterion is not exceeded at "Templemore" and "Bollol Creek Station", the following measures may be adopted if construction noise were to become an issue at these residences.

Recommended noise minimisation options:

1. Only conduct one of the noisier operations (tree felling or topsoil removal) if it is necessary to work at the closest points to "Templemore" under inversion or northwest wind conditions; or

2. Ensure that simultaneous topsoil removal and tree felling, in the most exposed locations, occurs only under neutral conditions or when wind direction is outside the northwestern quadrant (ie, bearing 0^0 – 270^0).

6.2 Initial Mining Operations

6.2.1 Predicted Noise Levels

After the initial construction period, continuous mining operations would commence. Initial mining operations (excavator, blast hole drill, overburden placement) would occur at natural ground level. Excavation would commence at the western edge of the "X" and "N" pits and overburden placement would occur at the northwestern toe of the northern emplacement. Coal processing and on-site transportation of both ROM and product coal has also been included in the model. Predicted noise levels are summarised in **Table 8**. Any exceedances of the relevant criterion are highlighted in bold.

Table 8
Predicted initial mining noise levels, dB(A), $L_{eq(15\text{-}min)}$. Placing of overburden at ground level on the northwestern edge of the northern emplacement

Location	Meteorological Condition				
	Lapse	Inversion	NW wind	Criterion	Differential
(1) "Tarrawonga"	<20	34	30	35	-1
(2) "Ambardo"	<20	33	31	35	-2
(3) "Templemore"	<20	34	34	35	-1
(4) "Bollol Creek Station"	<20	33	33	35	-2
(5) "Matong"	<20	28	28	35	-7

Table 8 shows no exceedances of the noise criterion during initial mining operations.

6.3 End Year 1 Mining

6.2.1 Predicted Noise Levels

At the end of Year 1, excavations would be approximately 20m below ground level in the "X" and "N" pits and placement of overburden would be occurring at 320m AHD on the half-completed northern emplacement. Coal processing and on-site transportation of both ROM and product coal has also been included in the model. Predicted noise levels are summarised in **Table 9**.

Table 9
Predicted End Year 1 Mining Noise Levels, dB(A),$L_{eq(15\text{-}Min)}$. Placing of Overburden on the Half-Completed Northern Emplacement

Location	Meteorological Condition				
	Lapse	Inversion	NW wind	Criterion	Differential
(1) "Tarrawonga"	23	33	31	35	-2
(2) "Ambardo"	<20	30	31	35	-4
(3) "Templemore"	<20	32	33	35	-2
(4) "Bollol Creek Station"	<20	31	32	35	-2
(5) "Matong"	<20	27	28	35	-7

Table 9 shows no exceedances of the noise criterion for the end of Year 1 mining scenario.

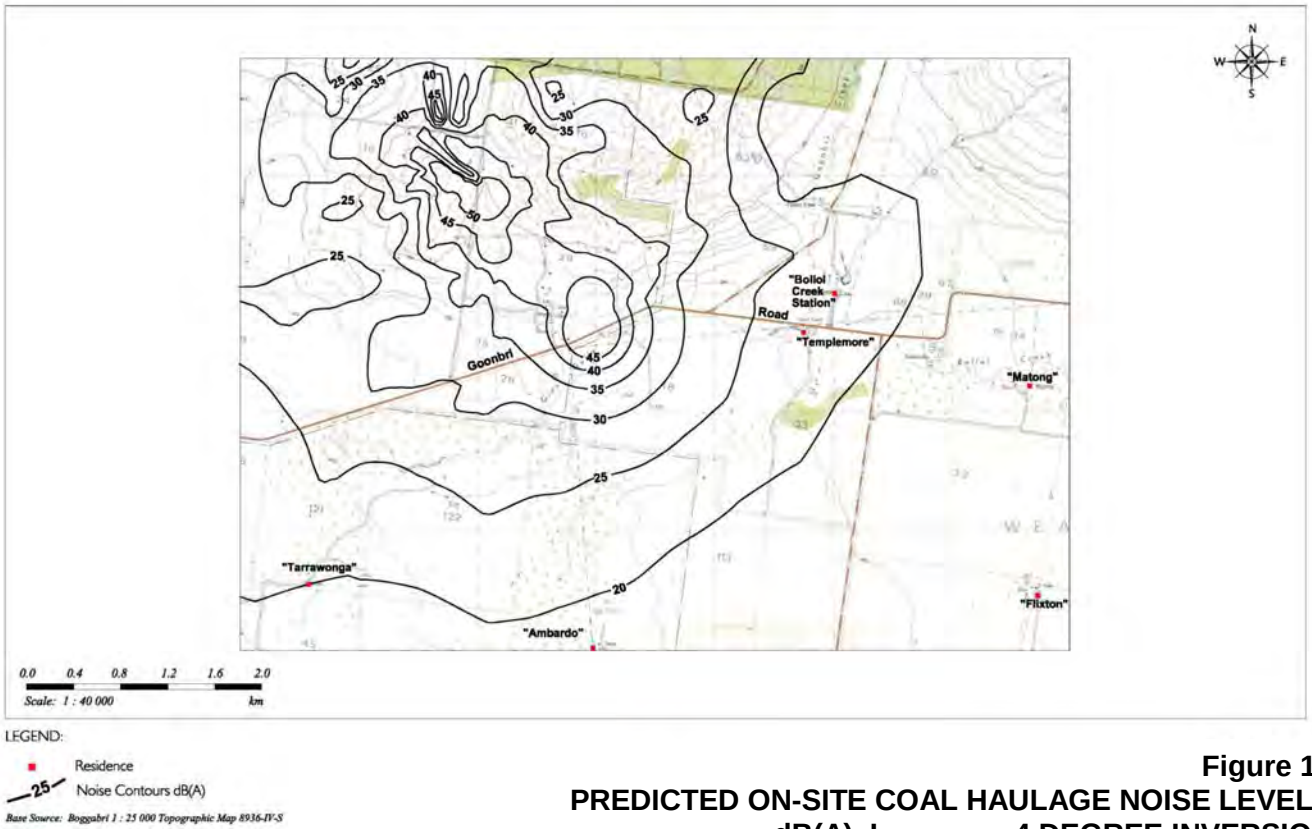
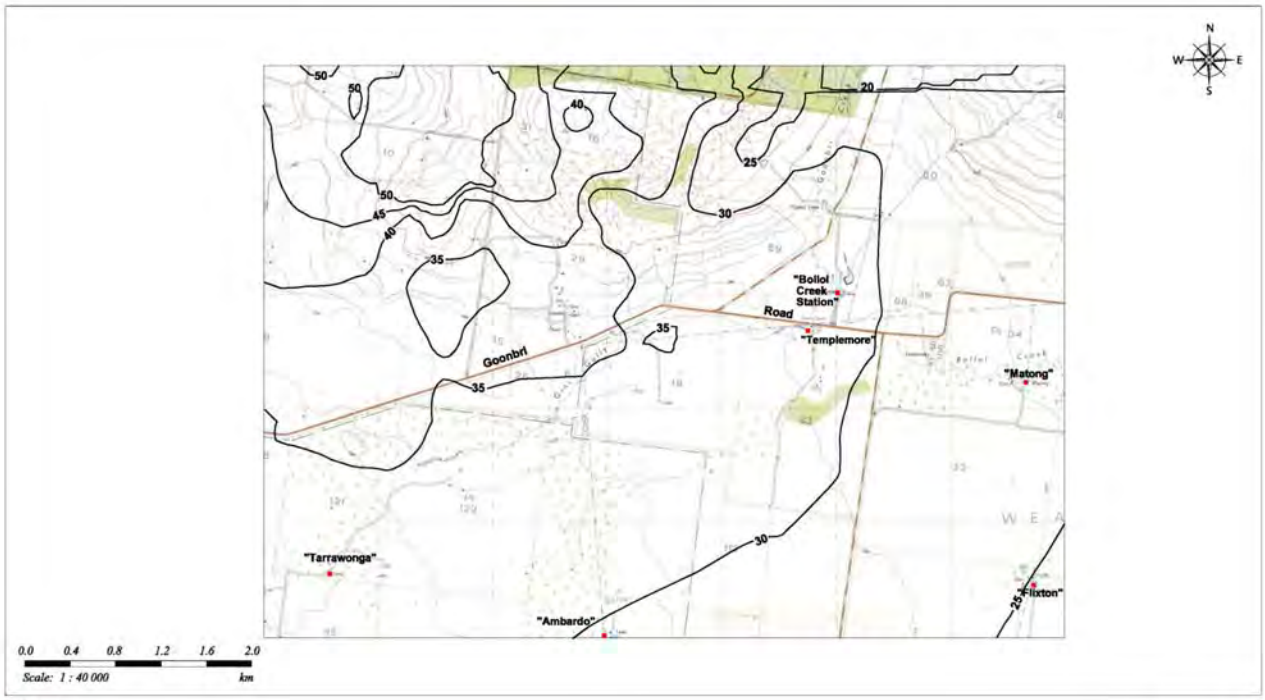


Figure 10
PREDICTED ON-SITE COAL HAULAGE NOISE LEVELS dB(A), $L_{eq(15\ minute)}$ 4 DEGREE INVERSION



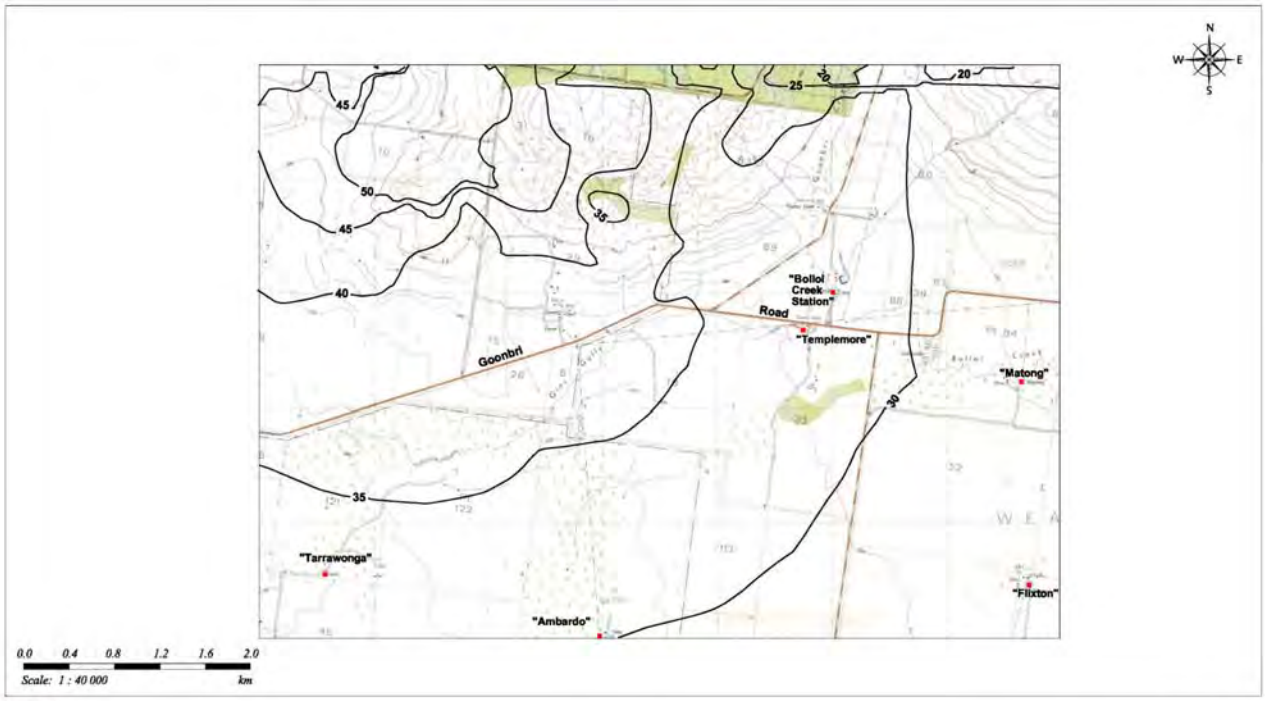
LEGEND:

Residence

25 Noise Contours dB(A)

Base Source: Boggabri 1 : 25 000 Topographic Map 8936-IV-S

Figure 11
PREDICTED INITIAL MINING NOISE LEVELS, dB(A), Leq (15 minute) 4 DEGREE INVERSION



LEGEND:

Residence

25 Noise Contours dB(A)

Base Source: Boggabri 1 : 25 000 Topographic Map 8936-IV-S

Figure 12
PREDICTED END YEAR 2 NOISE LEVELS, dB(A), $L_{eq\ (15\ minute)}$ 4 DEGREE INVERSION

6.4 End Year 3 Mining

6.4.1 Predicted Noise Levels

At the end of Year 3, excavations would be approximately 50m below ground level in the "X" and "N" pits and placement of overburden would be occurring at 340m AHD on the southern edge of the completed northern emplacement. Coal processing and transport of both ROM and product coal has also been included in the model. Predicted noise levels are summarised in **Table 10**.

Table 10
Predicted End Year 3 Mining Noise Levels, dB(A), $L_{eq(15\text{-}min)}$. Placing of Overburden on the Southern Edge of the Completed Northern Emplacement

Location	Meteorological Condition				
	Lapse	Inversion	NW wind	Criterion	Differential
(1) "Tarrawonga"	28	33	31	35	-2
(2) "Ambardo"	22	30	30	35	-5
(3) "Templemore"	23	33	33	35	-2
(4) "Bollol Creek Station"	<20	33	32	35	-2
(5) "Matong"	<20	28	28	35	-7

Table 10 shows no exceedances of the noise criterion for the end of Year 3 mining scenario.

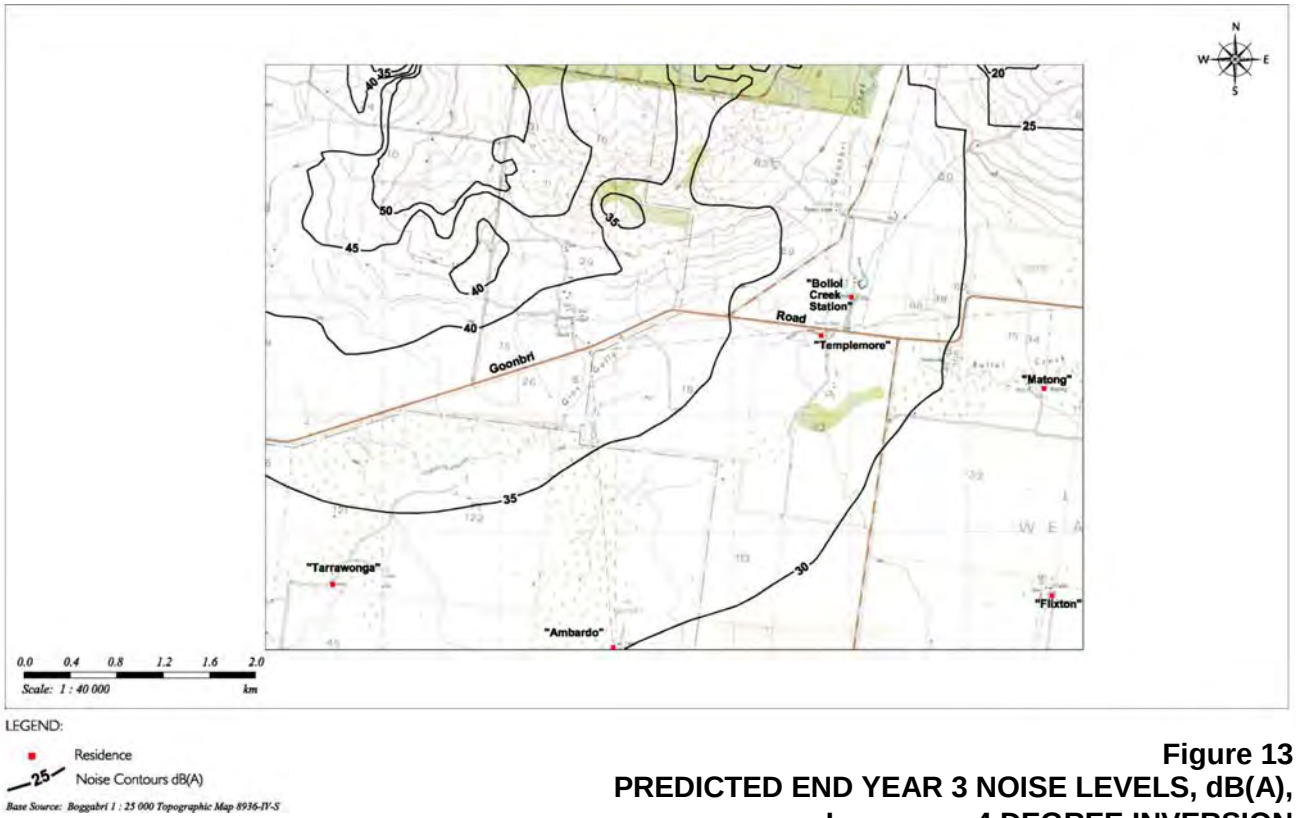


Figure 13
PREDICTED END YEAR 3 NOISE LEVELS, dB(A), $L_{eq\ (15\ minute)}$ 4 DEGREE INVERSION

6.5 Start Year 4 Mining

6.5.1 Predicted Noise Levels

At the start of Year 4, mining activities would be as described for the end of Year 3 (above) except placement of overburden would have commenced on the southern emplacement. Section 2 of the EIS discusses the Proponent's intention to construct the southern/eastern edges of the southern emplacement to a height of 15m before this emplacement area is actually required at the start of Year 4. This reflects the Proponent's desire to avoid a potential noise issue at nearby residences.

The 15m 'bund' would be constructed during calm daytime conditions, or when winds are between northeast and southwest. Modelling shows a maximum level of 34dB(A),$L_{eq(15\text{-}minute)}$ at "Templemore" under calm daytime conditions and lower levels at times when winds are not from source to receiver, ie. not from the northwest.

Predicted noise levels for overburden placement occurring behind the 15 m southern/eastern edge of the southern emplacement are summarised in **Table 11**. Coal processing and transport of both ROM and product coal has also been included in the model.

Table 11
Predicted Start Year 4 Mining Noise Levels, dB(A),$L_{eq(15\text{-}min)}$. Placing of Overburden at the Southeastern Toe of the Southern Emplacement Behind 15m Bund

	Meteorological Condition				
Location	Lapse	Inversion	NW wind	Criterion	Differential
(1) "Tarrawonga"	22	34	29	35	-1
(2) "Ambardo"	22	32	30	35	-3
(3) "Templemore"	25	35	35	35	0
(4) "Bollol Creek Station"	24	34	34	35	-1
(5) "Matong"	<20	28	28	35	-7

Given the predicted compliance at surrounding residences with the 15m bund in place, it is recommended that the southern/eastern edges of each lift of the southern emplacement should be formed during favourable weather conditions so that overburden emplacement during unfavourable conditions would always occur behind a protective bund.

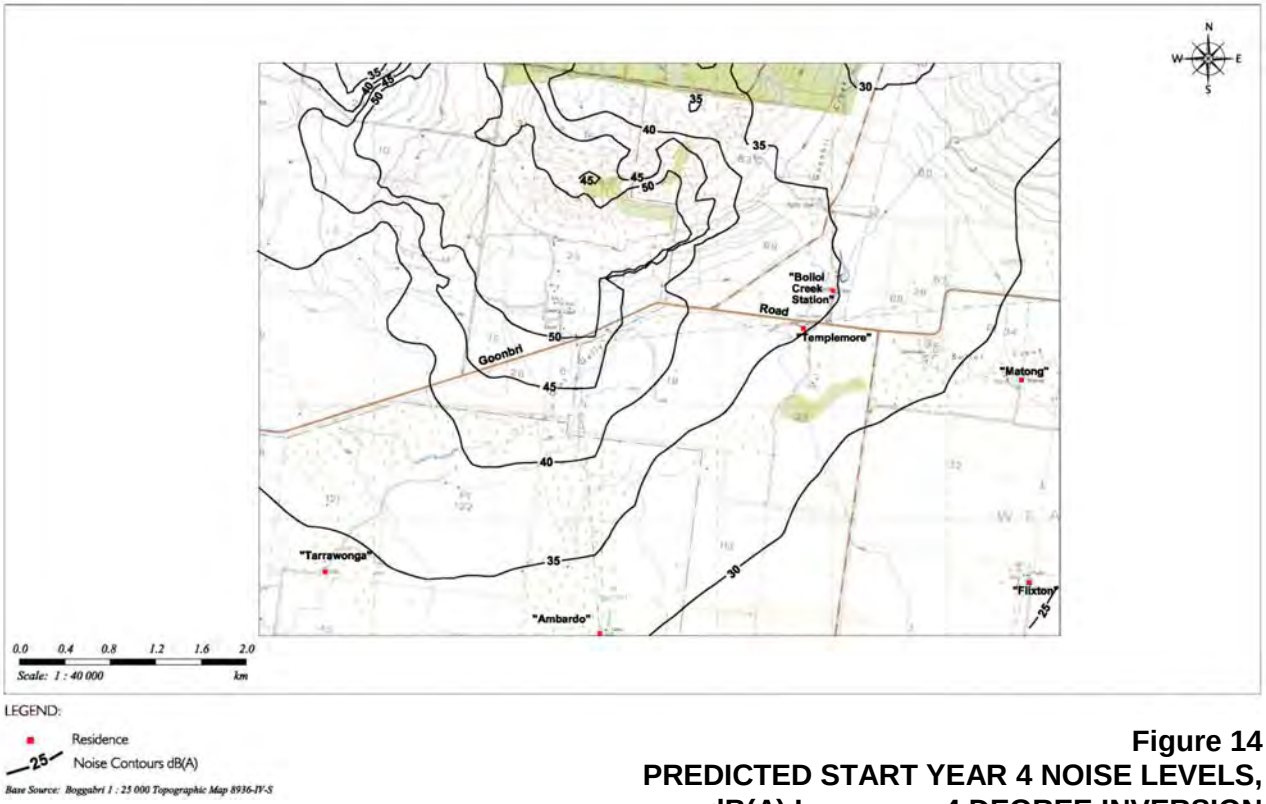


Figure 14
PREDICTED START YEAR 4 NOISE LEVELS, dB(A) $L_{eq\ (15\ minute)}$ 4 DEGREE INVERSION

6.6 End Year 6 Mining

6.6.1 Predicted Noise Levels

For the end of Year 6 scenario, mining would be approximately 40m below ground level in the "C" and "S" pits and overburden placement would occur near the eastern end of the half-completed southern emplacement. Placement of overburden under adverse conditions would only occur with a protective 15m 'bund' in place as described above. Predicted noise levels are summarised in **Table 12**. Coal processing and on-site transportation of both ROM and product coal has also been included in the model.

Table 12
Predicted End Year 6 mining noise levels, dB(A),$L_{eq(15\text{-}min)}$. Placing of overburden on the half-completed southern emplacement behind 15m bund

Location	Meteorological Condition				
	Lapse	Inversion	NW wind	Criterion	Differential
(1) "Tarrawonga"	21	31	28	35	-4
(2) "Ambardo"	20	31	29	35	-4
(3) "Templemore"	21	32	33	35	-2
(4) "Bollol Creek Station"	20	32	32	35	-3
(5) "Matong"	<20	28	28	35	-7

Noise impacts at all stages during formation of the southern emplacement would be minimised by:

- forming the leading (southern/eastern) edges of the southern emplacement to a height of 15m high during calm daytime conditions or when winds are between northeast and southwest (at any time); and
- operating behind the 15m high bund during adverse weather conditions.

Table 12 shows no exceedances of the noise criterion during the end of Year 6 mining operations.

Notwithstanding the predicted compliance, it is recommended that a management plan would be developed to include these recommendations, so that by having two emplacements available (one would be in-pit) at any time and waiting for suitable weather to form the leading edge of lifts on the southern emplacement, the placement of overburden could occur continuously without causing excessive noise impacts.

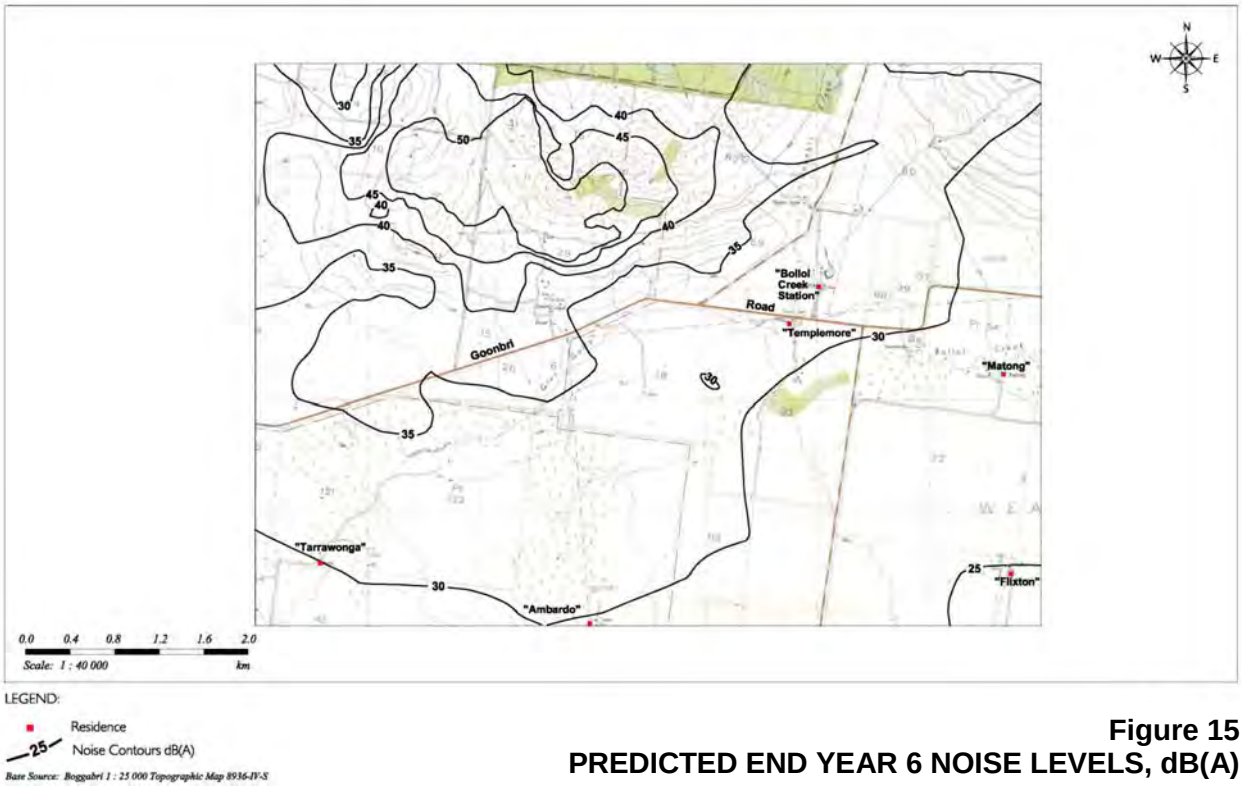


Figure 15
PREDICTED END YEAR 6 NOISE LEVELS, dB(A)
$L_{eq\ (15\ minute)}$ 4 DEGREE INVERSION

6.8 Modifying Factor Corrections

Point calculations for several of the worst case scenarios presented above show a difference between C-weighted and A-weighted noise levels (often referred to as the "(C–A) level") within the range 8 to 15dB at the worst affected receivers ("Tarrawonga" and "Bollol Creek Station"). As this difference is not greater than 15dB, there is no low-frequency correction applicable under the INP. Predicted $L_{Aeq(15\text{-minute})}$ sound pressure levels also did not contain tonal components as defined in the INP above.

For some of the mining scenarios, however, the C-A levels at locations 1, 2, 5 and 6 were up to 22dB. Applying a 5dB correction (ie. penalty) for this low-frequency content results in corrected levels of no more than the 35dB(A) limit. Further, the nature of the low-frequency content is acoustic (100 to 250Hz mine 'hum') and not the sub-audible frequencies of 25 to 40Hz that have been known to emanate from large coal washeries.

6.9 Sleep Disturbance

An assessment of noise impact for operational scenarios (Scenarios 3 and 5 containing the northern and southern emplacements respectively) has been conducted to determine the potential for sleep disturbance during operating hours. In particular, the major potential source of impact noise is the overburden emplacement operation which is proposed to be conducted between the hours 9:00 am to 3:30 am Monday to Friday, with contingency to operate 24 hours. Proposed Saturday operating hours for overburden placement are 7:00 am to 6:00 pm, therefore avoiding the night time period.

6.9.1 End Year 3 mining

Predicted maximum noise levels under neutral or noise reducing conditions for the End Year 3 scenario are shown in **Table 13 (a)** with results under noise enhancing conditions shown in **Table 13 (b)**. Exceedances of the 45dB(A) criterion, if any, are shown in bold type in the following Tables.

Table 13(a)
Predicted End Year 3 Mining Noise Levels, dB(A), L_{max}. Placing of Overburden on the Half-Completed Northern Emplacement (non-enhancing conditions)

Location	Neutral				SE wind			
(Source*)	1	2	3	4	1	2	3	4
(1) "Tarrawonga"	<20	<20	34	35	<20	<20	27	28
(2) "Ambardo"	<20	<20	29	30	<20	<20	25	26
(3) "Templemore"	<20	<20	29	30	<20	<20	26	27
(4) "Bollol Creek Station"	<20	<20	20	20	<20	<20	<20	<20
(5) "Matong"	<20	<20	21	20	<20	<20	<20	<20

*Noise sources included in the L_{Amax} calculations:
1. Filling trucks at coal processing facility;
2. Excavator and haul trucks 10m below ground level in the "N" Pit;
3. Placing overburden at the southern end of the northern emplacement area; and
4. Dozer operating at the emplacement area.

Table 13(b)
Predicted End Year 3 Mining Noise Levels, dB(A), L_{max}. Placing of Overburden on the Half-Completed Northern Emplacement (noise-enhancing conditions)

Location	NW wind				Inversion			
(Source)	1	2	3	4	1	2	3	4
(1) "Tarrawonga"	27	<20	36	36	30	21	38	39
(2) "Ambardo"	25	32	33	34	27	29	35	36
(3) "Templemore"	29	36	36	37	31	24	38	39
(4) "Bollol Creek Station"	28	31	35	36	33	31	37	38
(5) "Matong"	20	29	29	29	23	31	31	31

These results suggest that sleep disturbance would not be an issue when operating within the open cut and/or on the northern emplacement.

6.9.2 End Year 6 mining

Predicted maximum noise levels under neutral or noise reducing conditions for the End Year 6 scenario are shown in **Table 14 (a)** with results under noise enhancing conditions shown in **Table 14 (b)**.

Table 14(a)
Predicted End Year 6 Mining Noise Levels, dB(A),$L_{max.}$ Placing of Overburden on the Half-Completed Southern Emplacement (non-enhancing conditions)

Location	Neutral				SE wind			
(Source*)	1	2	3	4	1	2	3	4
(1) "Tarrawonga"	<20	<20	35	35	<20	<20	34	35
(2) "Ambardo"	<20	<20	36	37	<20	<20	34	35
(3) "Templemore"	<20	<20	47	49	<20	<20	43	45
(4) "Bollol Creek Station"	<20	<20	46	47	<20	<20	42	43
(5) "Matong"	<20	<20	37	37	<20	<20	33	34

*Noise sources included in the L_{Amax} calculations:
1. Filling trucks at coal processing facility;
2. Excavator and haul trucks 10m below ground level in the "C" Pit;
3. Placing overburden at the eastern end of the southern emplacement area; and
4. Dozer operating at the emplacement area.

Table 14(b)
Predicted End Year 6 Mining Noise Levels, dB(A),$L_{max.}$ Placing of Overburden on the Half-Completed Southern Emplacement (noise-enhancing conditions)

Location	NW wind				Inversion			
(Source)	1	2	3	4	1	2	3	4
(1) "Tarrawonga"	22	26	34	35	30	30	37	39
(2) "Ambardo"	25	33	37	38	26	35	40	41
(3) "Templemore"	26	27	51	53	24	30	52	53
(4) "Bollol Creek Station"	26	27	48	50	24	29	49	51
(5) "Matong"	20	31	39	40	22	32	40	41
(6) "Flixton"	<20	28	35	36	<20	29	36	37

The results in **Tables 14(a) and 14(b**) suggest that the night-time sleep disturbance criterion would not be achieved at locations 3 and 4 whenever overburden placement is taking place on the eastern end of the southern emplacement without any protective bund in place, except when the wind is originating from between east and south.

It is recommended that night-time overburden placement should only occur with the protection of a 15m bund and that the initial bund and subsequent lifts are only constructed during the day.

With the 15m bund in place, predicted maximum noise levels for placing of overburden occurring within 30m behind the bund are summarised in **Table 15**, under noise-enhancing conditions only (lower levels would result for the non-enhancing conditions).

Table 15
Predicted End Year 6 Mining Noise Levels, dB(A),L_{max}. Placing of Overburden on the Half-Completed Southern Emplacement with15m Bund in Place

Location	NW wind				Inversion			
(Source*)	1	2	3	4	1	2	3	4
(1) "Tarrawonga"	22	26	<20	<20	30	30	24	24
(2) "Ambardo"	25	33	<20	<20	26	35	21	22
(3) "Templemore"	28	27	31	31	24	30	30	31
(4) "Bollol Creek Station"	27	25	29	30	24	29	30	31
(5) "Matong"	<20	31	24	24	22	32	23	23

*Noise sources included in the L_{Amax} calculations:
1. Filling trucks at coal processing facility;
2. Excavator and haul trucks 10m below ground level in the "C" Pit;
3. Placing overburden at the eastern end of the southern emplacement area; and
4. Dozer operating at the emplacement area.

Table 15 shows that no exceedances of the sleep disturbance criterion are predicted when placing of overburden on the southern emplacement occurs behind a 15 m protective bund.

6.10 Transport Noise on the Proposed Transport Route

The nearest residences to the northern section of the proposed transport route between the proposal and Whitehaven Coal Mine[4] that are not owned by the Proponent or under an agreement with the Proponent regarding are on the "Pine Grove" and "Kyalla" properties. The residence on "Pine Grove" is south of Manilla Road and approximately 250m east of the proposed haul route, near the junction of Sections 2 and 3 (see **Figure 3a**). "Kyalla" is further west along Manilla Road and is 200m south of the road.

The speed limit on Sections 2 and 3 of the proposed transport route would be 80km/hr, although for the purposes of calculating the intermittent traffic noise contribution at "Pine Grove" it was assumed that the trucks would be travelling at only 60km/hr upon their approach to and departure from the intersection with Manilla Road. It was similarly assumed that the use of exhaust brakes near "Pine Grove" would be prohibited.

The A-weighted sound power level of a road-registered truck is typically 108dB(A) when travelling at road speeds over a flat surface. Propagating this level of noise for a distance of 250m over a grassy paddock using the ENM noise model, and applying adverse meteorological conditions of inversions and source-receiver winds, gives a worst case maximum noise level of 46.3dB(A) at "Pine Grove" for each passing truck. The maximum predicted level at "Kyalla" is 48.2dB(A).

Using these values in the procedure detailed in Section 5.4 gives worst case levels of 41dB(A),$L_{eq(1\ hour)}$ at "Pine Grove" and 43dB(A),$L_{eq(1\ hour)}$ at "Kyalla". These levels are well below the adopted criterion of 60dB(A),$L_{eq(1\ hour)}$ and allow a substantial margin for error, such as generated noise from road surface imperfections. Given the predicted noise level at "Kyalla" satisfies the nominated criterion, noise levels at other residences further from the haul road would also satisfy the criterion.

[4] Cumulative noise impacts from coal trucks using the existing haul road south of Whitehaven Mine are assessed in Section 6.12.2.

6.11 Blasting

Blast overpressure and vibration curves for average and maximum proposed charge weights (MIC, 960 kg and 1952 kg respectively) are shown in **Figures 16** and **17**.

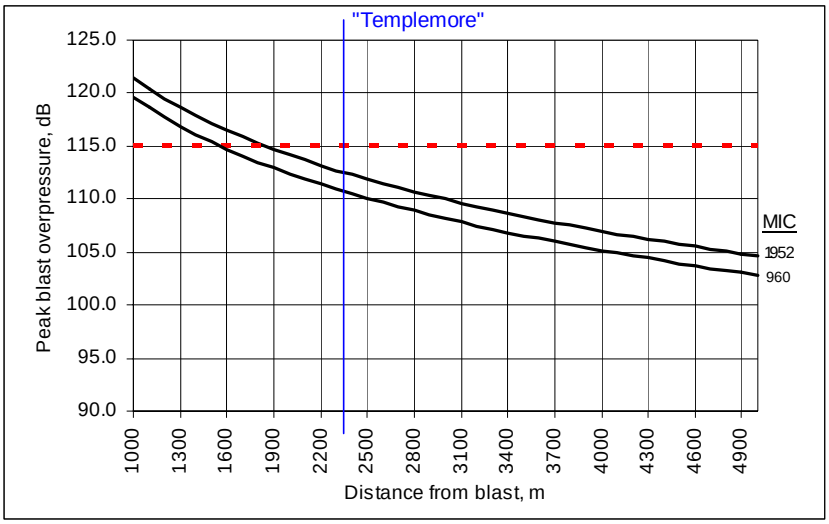


FIGURE 16
Blast overpressure, dB, as a function of distance for various charge weights (MIC). Criterion of 115 dB is shown dotted (red).

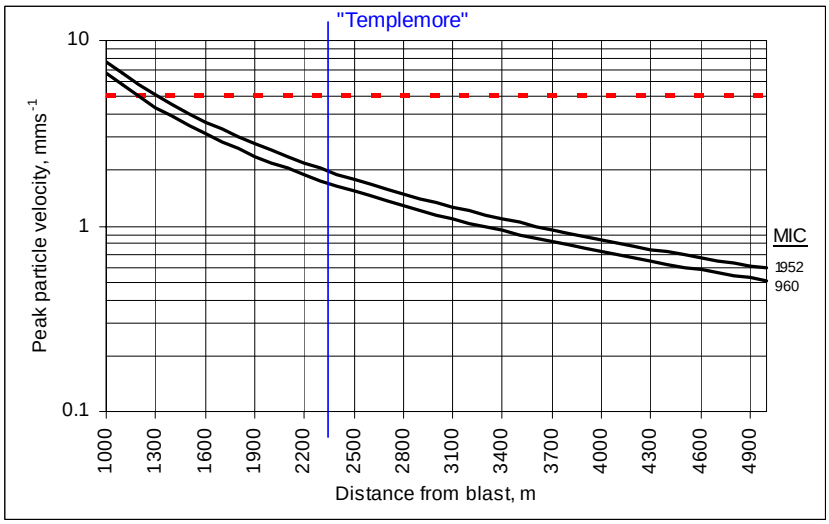


FIGURE 17
Ground vibration levels, mm/s, as a function of distance for various charge weights (MIC). Criterion of 5mm/s is shown dotted.

Figure 16 shows maximum and average blast overpressure levels of 112.5dB and 110.5dB respectively at the nearest residence ("Templemore", 2350 m from closest point of blasting in the "S" Pit) while **Figure 17** shows maximum and average ground vibration levels of 2.0 mm/s and 1.6 mm/s respectively at "Templemore". Since the blasting criteria are satisfied at the nearest residence, they will be satisfied at all assessed residences and no further study of blasting impacts is required.

6.12 Cumulative Noise Impacts

6.12.1 Introduction

A cumulative noise impact assessment has been conducted to assess the total and relative noise contributions from the proposed East Boggabri Coal Mine and Boggabri Coal Projects.

6.12.2 Operational Noise

The cumulative assessment of mining noise considers the worst case in which:

(a) the Boggabri Coal Project and the proposed East Boggabri Coal Mine commence operations at the same time;

(b) the Boggabri Coal Project commences at the southern extent of the approved mining area, rather than the north; and

(c) mining within the Boggabri Coal Project mining area are assumed to occur at ground level.

Although not all details of the Boggabri Coal Project were available to construct a precise model, the following significant noise factors have been used to generate the potential worst case scenarios:

- The initial mine facilities (coal processing) area will be utilised. This is closer to residences than the proposed location of the facilities area at full production (ie, after year 10);

- A dump hopper, rotary breaker, secondary breakers, conveyors and heavy vehicle movements have been placed in the coal processing area. These data were measured by Spectrum Acoustics at a mine with an unattenuated rotary breaker. Total sound power for the Boggabri Coal Project processing area is 116dB(A),$L_{eq(15\text{-}minute)}$;

- Mining activities including excavation, overburden haulage/placement of overburden and product haulage are all occurring at ground level at the southeastern extent of the extraction area (closest to residences) for the initial mining cumulative impact scenario. Total sound power for Boggabri Coal Project mining source is 120dB(A),$L_{eq(15\text{-}minute)}$; and

- For the Year 4 cumulative impact scenario, the Boggabri Coal Project mining activities have been advanced 1.5 km to the northwest, but are still located at natural ground level.

Noise levels for the initial mining (Scenario 1) and Year 4 (Scenario 4) cumulative impact scenarios are summarised in **Tables 16 and 17.**

Table 16
Predicted Initial Mining Noise (Cumulative) Levels, dB(A),$L_{eq(15\text{-}min)}$. East Boggabri Utilising Northern Emplacement, Boggabri at Southern Extent of Extraction Area

Location	Meteorological Condition							
	Inversion			NW wind			Criterion	Differential
	EBC[1]	BCC[2]	Total	EBC	BCC	Total		
(1) "Tarrawonga"	34	25	35	30	22	31	35	0
(2) "Ambardo"	33	25	34	31	25	32	35	-1
(3) "Templemore"	34	32	36	34	32	36	35	1
(4) "Bollol Creek Station"	33	32	36	33	32	36	35	1
(5) "Matong"	28	28	31	28	28	31	35	-4

[1] East Boggabri Coal (values from Table 8)
[2] Boggabri Coal Company.

Table 17
Predicted Year 4 Mining Noise (Cumulative) Levels, dB(A),$L_{eq(15\text{-}min)}$. East Boggabri Commencing Southern Emplacement, Boggabri Moving North Within Extraction Area.

Location	Meteorological Condition							
	Inversion			NW wind			Criterion	Differential
	EBC[1]	BCC[2]	Total	EBC	BCC	Total		
(1) "Tarrawonga"	34	25	35	29	21	30	35	0
(2) "Ambardo"	32	24	33	30	23	31	35	-2
(3) "Templemore"	35	30	36	35	30	36	35	1
(4) "Bollol Creek Station"	34	30	36	34	30	36	35	1
(5) "Matong"	28	25	30	28	26	30	35	-5

[1] East Boggabri Coal (values from Table 11)
[2] Boggabri Coal Company.

These results suggest a very minor (1dB) noise criterion exceedance may occur at "Templemore" or "Bollol Creek Station" under adverse meteorological conditions. It is again noted that the noise sources for Boggabri Coal Project were all assumed to be at ground level and at the nearest point to receivers, whereas in practice the coal mining will occur below ground level for much of the time and sources will be more dispersed. The likelihood of these worst case configurations actually occurring is therefore small and the real potential for the minor exceedance of cumulative noise levels is minimal.

6.12.3 Transportation Noise

Transportation of East Boggabri coal from the Whitehaven Coal Mine to the Whitehaven CHPP will occur on the existing (approved) haulage route along Hoads Lane and Blue Vale Road. This section of road is referred to as the southern section of the proposed transport route for the proposed East Boggabri Coal Mine. At peak periods, additional trucks generated by the proposal may be up to 1.5 times the current number of trucks, increasing the number of coal trucks using the transport route by a factor of up to 1.5. In acoustic terms, a doubling of the number of essentially identical sources travelling on the same route will increase L_{Aeq} levels by 3dB at an assessment point. For a 150% increase as proposed (ie 2.5 times the current truck numbers), the noise level would increase by approximately 4dB.

A noise logger was placed along the Whitehaven CHPP access road during the period 7 - 13 December 2004. The logger was approximately 200m from the Kamilaroi Highway and only 20m from the access road, on the eastern side. Coal trucks were the dominant noise source observed at the logger location. Although much of the monitoring period was affected by rain, it was found that L_{Aeq} levels typically ranged between 54 – 63dB(A) during periods when it was not raining and when it was known that haulage from Whitehaven Coal Mine was occurring. Statistical average L_{Aeq} levels during these periods ranged from 56 – 61dB(A), so a value of 61dB(A),$L_{eq(1\ hour)}$ was adopted as the noise level of existing Whitehaven coal trucks at a distance of 20 m.

As a check on the reliability of this value, propagating it to a distance of 250 m using '6dB per doubling of distance' gives 39.1dB(A). This compares well with the 40.6dB(A) resulting from the theoretical calculation in Section 6.10. Based on 61dB(A) at 20 m, and maximum truck numbers of 2.5 times the current numbers, a cumulative level of 65dB(A),$L_{eq(1\ hour)}$ is predicted at a distance of 20m.

Based on a criterion of 60dB(A),$L_{eq(1\ hour)}$ for road haulage of coal (see Section 4.5), and assuming 3dB per doubling of distance (ie, assuming the traffic is a line source), the criterion will be achieved for the total (cumulative) volume of coal trucks at a distance of approximately 60 m.

Reference to maps covering the existing Whitehaven Coal Mine haul route shows the closest residences to the haul road to be on Blue Vale Road (at 70 m) and the Kamilaroi Highway (at 90m). These are both further from the haul road than 50 m, therefore noise from the additional coal trucks from East Boggabri is not expected to result in an exceedance of the traffic noise criterion.

7 MONITORING PROGRAM

7.1 Introduction

This section of the report sets out a recommended noise and vibration monitoring program sufficient to determine compliance with the relevant criteria. Specific details of measurement, analysis and reporting methods will be included in a Noise Management Plan prepared to assist site personnel should development consent be granted.

7.2 Noise Monitoring

7.2.1 Construction Noise

Construction of roads and infrastructure are only short term daytime activities and no noise goal exceedances were predicted. It is recommended that construction noise monitoring should be conducted once during road construction operations and then in response to complaints only.

7.2.2 Operational Noise

Given the generally low background levels (around 30dB(A) during the day and 25dB(A) at night) it is suggested that noise loggers may be appropriate to determine compliance with the 35dB(A),L_{eq} noise criterion. This will be particularly relevant when night time operations commence. Noise loggers could periodically be installed at two or three locations, nominally "Templemore", "Bollol Creek Station", with data analysis and reporting being conducted by a contractor on a quarterly basis. Alternatively, Mine personnel could receive external training in conducting their own noise surveys.

It is important that the noise monitoring conducted is regularly reviewed to ensure the data being collected are meaningful. The Proponent should keep detailed records of all Project Site activities during the period of monitoring to provide a basis for evaluating compliance and/or identifying potential sources of noise criterion exceedance.

Night time compliance with sleep disturbance limits would need to be determined via an attended monitoring survey in the first instance, and then repeated in the event of any complaints. If the logger option is not desirable or is not acceptable, then quarterly attended 24-hour noise compliance surveys conducted by suitable qualified personnel are recommended.

7.3 Blast Monitoring

A blast vibration / airblast overpressure monitor should be positioned at one of the nearest sensitive receivers, namely "Templemore" or "Bollol Creek Station". Logger data could be accessed by mine personnel for reporting requirements.

8 CONCLUSION

An assessment has been conducted to determine the noise and vibration impact of the proposed East Boggabri coal mine project. Modelling results show minor noise level exceedances at the nearest residential locations under noise-enhancing atmospheric conditions and no exceedance of blast overpressure limits during any stage of mining. No exceedances of noise limits for road transport of coal have been predicted.

Recommendations have been made with regard to managing noise levels. These include noise barriers in the form of earth bunds, and operational management of noise emissions under adverse weather conditions by having more than one active emplacement area. Recommendations have also been presented regarding noise and vibration compliance monitoring procedures.

It will be noted that lower noise levels were predicted for the northern emplacement than for the southern emplacement. Since the northern emplacement would be commenced first, there would be a significant period of time to gather information about actual noise emissions and local meteorological conditions before commencement of activities on the southern emplacement. This would enable the formulation of a reliable plan to effectively manage noise emissions from the southern emplacement.

We conclude that the proposal could operate without adversely impacting upon the acoustical amenity of any non-project related residential receiver, after implementation of noise control recommendations given in this report.

APPENDIX A

Noise Source Sound Power Levels

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Major Construction Noise Sources, dB,L_{10}

Source	dB(A)	Octave band centre frequency, Hz							
		31.5	63	125	250	500	1k	2k	4k
Earth works (grader + scraper)	115	--	110	110	110	111	110	108	104
Tree felling with dozer	116	110	115	116	108	112	112	108	100

Major Operational Noise Sources, dB,$L_{eq(15\text{-}minute)}$

Source	dB(A)	Octave band centre frequency, Hz							
		31.5	63	125	250	500	1k	2k	4k
Coal processing area[1]	113	109	113	112	111	112	109	108	101
Overburden placement[2]	115	118	120	121	119	114	104	105	102
Excavator EX 1900 plus trucks	114	113	103	109	110	111	107	108	103
Excavator EX 3600 plus trucks	116	115	105	111	112	113	109	110	105
CAT 789 trucks hauling on slope[3]	115	118	118	119	112	111	109	110	104
CAT 789 trucks hauling on flat	112	115	115	116	109	108	106	107	101
CAT 785 trucks hauling coal	111	112	115	116	105	108	105	103	98
Blasthole drill	113	109	111	111	110	110	109	106	101

1. Coal crushing plant and front end loader.
2. Four CAT 789 trucks per 15 minutes and D11 dozer.
3. Four uphill and four down hill per 15 minutes.

Major Impact Sources, dB,L_{max}

Source	dB(A)	Octave band centre frequency, Hz							
		31.5	63	125	250	500	1k	2k	4k
Overburden placement (with dozer)	128	--	125	128	130	123	121	120	115
Excavator plus trucks	125	--	127	123	120	121	121	119	114
Overburden haul road (flat section)	118	--	123	125	117	116	111	109	104
Overburden haul road (downhill)	124	116	123	117	114	117	122	117	113

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