Noise and Blasting Assessment

Appendix 12

ANVIL HILL PROJECT

NOISE & VIBRATION ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 03222
VERSION E

WILKINSON MURRAY

ANVIL HILL PROJECT

NOISE & VIBRATION ASSESSMENT

REPORT NO. 03222
VERSION E

AUGUST 2006

PREPARED FOR

UMWELT (AUSTRALIA) PTY LIMITED
PO BOX 838
TORONTO NSW 2283

Wilkinson Murray Pty Limited
ABN 41 192 548 112 • Level 1, 123 Willoughby Road, Crows Nest NSW 2065, Australia • **Asian Office: Hong Kong**
t +61 2 9437 4611 • f +61 2 9437 4393 • e acoustics@wilkinsonmurray.com.au • w www.wilkinsonmurray.com.au

TABLE OF CONTENTS

ACOUSTICS AND AIR

1 INTRODUCTION

Centennial Hunter Pty Limited (Centennial) proposes to establish an open cut coal mine and ancillary facilities including a Coal Preparation Plant (CPP) and rail loop in the Wybong area, 20km west of Muswellbrook and approximately 10km north of the township of Denman. The proposal, known as the Anvil Hill Project, is based on a large, undeveloped coal reserve of approximately 150 million tonnes (Mt) that is suitable for production of thermal coal for both domestic and export markets.

The proposal includes open cut coal mining over a 21 year period using a "truck and shovel" method. Up to four separate pits are proposed for the extraction of coal, however at any time there would only be one pit where coal is mined. An excavator would load coal onto trucks for transportation to a preparation plant. Coal would then be transported by conveyer to a rail loading facility, where it would be loaded onto trains for transport to domestic and export markets. Overburden would also be moved using a "truck and shovel" method and transported around various parts of the site. It is proposed that overburden be moved from any three of the four pits simultaneously. The landform would be progressively rehabilitated.

This report addresses potential noise and vibration impacts associated with all aspects of the proposal, including construction of the infrastructure, access road and rail loop; mining and rehabilitation activities; blasting; and transportation activities.

Noise from mining and transport activities onsite has been assessed in accordance with the NSW Department of Environment & Conservation's (DEC) *NSW Industrial Noise Policy (INP).* In addition, the DEC's *Environmental Criteria for Road Traffic Noise (ECRTN)* has been employed in the assessment of road traffic noise impacts.

2 PROJECT DESCRIPTION AND CONTEXT

2.1 The Anvil Hill Project

The Anvil Hill Project comprises the design, construction and operation of:

- An open cut coal mine;
- Coal handling and crushing facilities, a preparation plant (washery) and stockpile areas;
- Water management, supply and distribution infrastructure;
- Handling and placement of overburden (rock);
- Mine access road including a new intersection on Wybong Road, internal access roads and haul roads;
- Infrastructure including offices, staff amenities, workshop, conveyors, and ancillary services; and
- A rail spur, rail loop and rail loading infrastructure for the transport of all product coal.

The proposal covers a 21 year project life. Detailed mine and project planning has been undertaken to develop a conceptual mine plan, with indicative stages modelled at years 2, 5, 10, 15 and 20 as well as the construction phase.

2.2 The Surrounding Area

The Anvil Hill Project is located in the Upper Hunter Valley, on the margin of the valley floor. The proposed disturbance boundary covers an area of approximately 2238 hectares.

The project area has been extensively used for agriculture since the 1800s and is dominated by rolling grazing land with remnant and regrowth woodland. The locality immediately surrounding the project area consists of mostly smaller rural holdings, dominated by rural residential land use, but also includes more intensive agricultural land uses such as vineyards, irrigation for lucerne and dairies.

The topography of the proposed disturbance area varies from lower slopes towards the Hunter River, through undulating and hilly lands to rocky outcrops. A notable topographical feature within this area is Anvil Hill itself which rises approximately 70m above the surrounding area at its highest point. It is located at the centre of the proposed mining area and consists of two hills connected by a saddle. Anvil Hill is not proposed to be mined. The lower sections of the proposed disturbance area are currently used for pastoral grazing, and a 500kV TransGrid power line crosses the site in a southeast / northwest direction.

The area surrounding the proposed disturbance area is dominated by a row of hills to the west and south. The hills to the west are not named, although they are known locally as "Wallaby Rocks". Wallaby Rocks rise to a height of 264m AHD, being approximately 100m above the surrounding area and contain a visually dominant escarpment along the western side. The rocky area to the south known as Limb of Addy Hill rises to a height of 302m AHD, which is also approximately 100m above the surrounding area.

There are several other mine sites within 20km of the Anvil Hill Project including Mount Arthur North, Bengalla, Drayton and the approved Mount Pleasant mine. As such, to protect residential amenity, assessment of noise impacts from the Anvil Hill Project needs to consider not only impacts from the project itself, but also the potential for cumulative impacts with other existing and approved operations.

2.3 Types of Noise & Vibration Impacts

A number of activities associated with the proposal have potential to cause noise impacts at nearby residential receivers. These are of typical nature to similar operations in the area.

Operational noise levels would be dominated by the transportation of overburden and coal around the site. The majority of noise would result from the movement of haul trucks and, to a lesser extent, the operation of dozers on overburden emplacements. Adverse meteorological conditions would increase noise levels at receivers from equipment, particularly at night time, as temperature inversions are a common feature in the local area at night. Noise levels would often be higher in the surrounding area at night time than during the daytime as a result. Much of the other operational equipment is contained within pits, and this plant would not contribute as much to the overall noise environment, however it would still be perceivable at times.

Another noise source would be vehicles travelling to and from the proposed mine when shifts are changing. These impacts would generally last for an hour at a time and would be of the same character as existing road traffic.

Typically, noise from infrastructure and rail loading and movement would be audible at residences close to these facilities but barely audible or inaudible at most residences surrounding the proposal.

Finally, noise from construction of the proposal would be audible during the 12 months that it would take to build the facilities. These noise levels would vary week to week depending on what activities were taking place. However, as a worst case the noise levels at residences during construction would be less than during normal operations.

2.4 Noise Controls

Several types of noise control measures are proposed as outlined below. Information on how these controls have been incorporated into the noise modelling procedures is discussed further in Section 6.2.4.

2.4.1 Restriction of Night Time Operations

Given that the greatest noise impacts are predicted to occur during the night time period, it is appropriate to consider methods of controlling operations at night, where feasible. Noise impacts are dominated by noise from the operation of haul trucks around the site, and hence maximum benefit would be obtained by restricting their operation. Therefore, at night trucks would be restricted to operate below the maximum elevation of the overburden emplacement areas. This is considered both practical and economically viable and was found to have a more significant impact than construction of bunding on top of overburden emplacement areas (see below). Further, dozers involved in the distribution of overburden would also be restricted to the same working elevation.

2.4.2 Control of noise from Infrastructure

- All infrastructure and coal handling plant would be located in topographically shielded positions on the site, which are specifically located to reduce noise impacts to adjacent residences.
- The coal preparation plant, rejects bin and crushing stations including the roof / ceiling, would be enclosed with cladding.
- All conveyors used in the plant would incorporate shielding close to the belt on the side closest to residential receivers.

2.4.3 Control of Noise from Rail Spur

The location of the rail loop requires part of the track to be positioned in a substantial degree of cutting as a result of the natural topography at the northern end of the loop. This in itself provides surrounding residences with a high degree of shielding from rail noise. As the track progresses south and out of the loop it is proposed to construct a barrier (fence) to a height of 4 metres above the track on the eastern side. This barrier will continue to where the spur joins the main Muswellbrook to Ulan line. A second barrier is proposed to be constructed on the opposite side of the track, from the intersection with the main line to where the track turns to the north, to provide shielding to those properties to the south of the rail spur.

2.4.4 Real-time Noise Monitoring

It is proposed to monitor operational noise levels from the Anvil Hill Project with a real-time monitoring system. The commitment to use such a system goes beyond normal DEC monitoring requirements and has proved effective to assist in noise management at several other sites in NSW.

This real time system would not be utilised as a substitution for compliance monitoring which generally involves attended noise monitoring at various residential locations around the proposal.

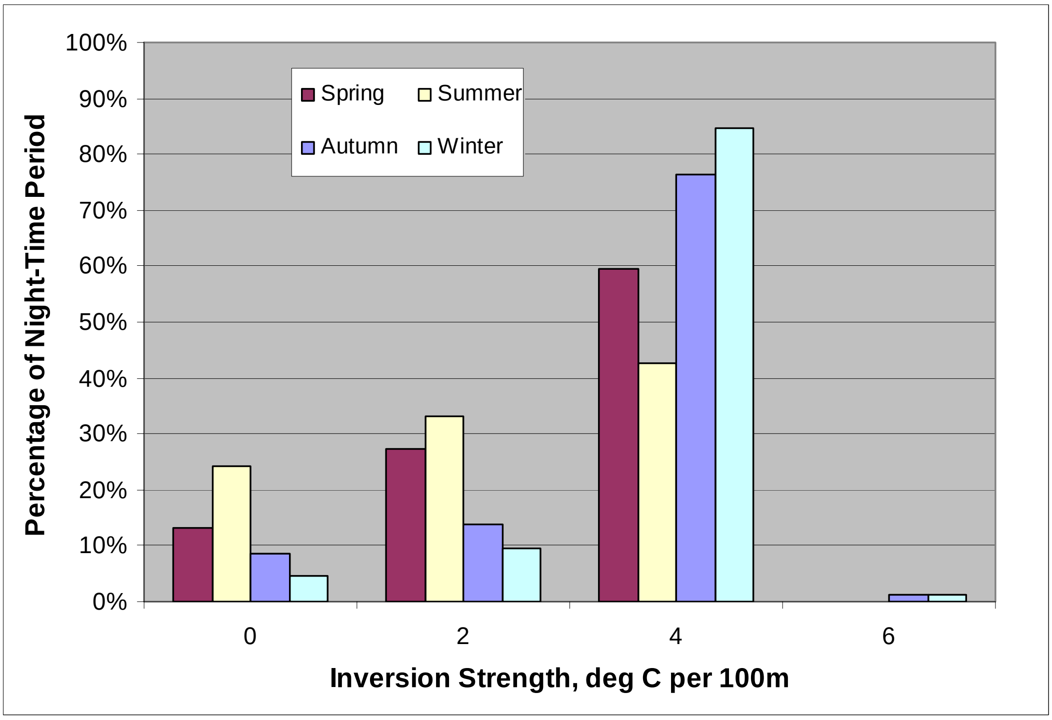
2.4.5 Other Noise Control Measures

Several other noise control measures have been considered in the preparation of this assessment, but are not considered to be appropriate for the proposal. They include the following.

Restriction of operations under adverse meteorological conditions

Consideration was given to restricting or stopping operations at night under adverse meteorological conditions. Potential noise impacts are greatest under strong temperature inversions. However, investigation of the occurrence of temperature inversions at Anvil Hill showed a very high frequency of such strong temperature inversions. Figure 2-1 shows the occurrence as a percentage of the night time period for each season. It is noted that inversion strengths of 4°/100m are prevalent, with occurrences of between 42.8% of the time during summer nights and up to 84.8% of the time during winter nights. The proponent has advised that not operating for this amount of time would not be financially viable for the proposal.

Figure 2-1 Temperature Inversion probabilities at Anvil Hill



Use of Trolley Assist System

Trolley assist systems allow haul trucks to use power from fixed overhead wiring, with the diesel engine operating at idle speed only. However such systems are only viable where there is a major haul route through the site. There is no scope for such a system for the Anvil Hill Project.

Use of Bunding on overburden emplacement areas

Bunding at the top of the overburden emplacement areas was modelled under night time conditions. While the bunding would greatly reduce the noise levels at residences due to dozers operating at the top of the emplacements, there was negligible reduction in the noise level from haul trucks, and therefore the overall noise levels at residences were only marginally affected. It was found to be more effective to put controls on the operating elevations of haul trucks and dozers as discussed in Section 2.4.1 above.

3 NOISE LEVEL CRITERIA

This section discusses the various noise and vibration criteria and guidelines set out by the NSW Government with regard to different types of activity from the proposal that have potential to impact on the surrounding area.

3.1 Operational Noise Criteria

The *NSW Industrial Noise Policy (INP)* sets out two forms of noise criterion. In assessing noise levels at residences, the criteria should be assessed at the most-affected point on or within the residential property boundary or, if this is more than 30m from the residence, at the most-affected point within 30m of the residence. The two criteria are described below.

3.1.1 Intrusiveness Criterion

The intrusiveness criterion specifies that the L_{Aeq} noise level from the proposed source should not exceed the RBL by more than 5dBA. The RBL is defined as the overall single-figure background level representing each measurement period (day, evening and night) over the whole monitoring period. The RBL is the level used for assessment purposes. Where the RBL is found to be less than 30dBA, it is to be set to 30dBA.

In the present case, the application of modifying factors may be relevant for certain specific noise sources, notably an adjustment for tonality and an adjustment for impulsiveness. These sources are assessed separately below in terms of their potential to cause sleep disturbance. However, the overall noise at any residence due to all mining activities would be dominated by continuous or quasi-continuous sources such as haul trucks, and would be unlikely to attract such adjustments. Hence, the criterion noise level is set equal to the RBL + 5dBA, for the relevant time period.

This criterion should be assessed under specific meteorological conditions, which are detailed in the *INP.* Definition of appropriate meteorological conditions is discussed in detail in Chapter 5.

3.1.2 Amenity Criterion

The second type of criterion is an amenity criterion, and is intended to ensure that the total L_{Aeq} noise level from all industrial sources does not exceed specified levels. For rural residences, the relevant recommended "acceptable" levels are:

- Daytime (7.00am-6.00pm) 50dBA L_{Aeq}
- Evening (6.00pm-10.00pm) 45dBA L_{Aeq}
- Night Time (10.00pm-7.00am) 40dBA L_{Aeq}

(These time periods are as defined above for calculation of the RBL, with the exception that for the purpose of the amenity criterion only, the "night" period extends to 8.00am, rather than 7.00am, on Sundays and public holidays.)

The amenity criterion represents the cumulative impact of all existing and potential industrial noise sources affecting a location, and the appropriate criterion for a new source depends on the existing and future noise levels from other existing or approved industrial sources. The Policy specifies explicitly how the above values should be reduced if the existing noise level from other industrial sources is known. Surveys have not identified any existing industrial noise at potentially affected residences, and hence the values above represent the amenity criterion for noise from the project. There are no approved industrial developments that influence the criteria for this project.

3.1.3 Operational Noise Levels at Places of Worship

Two churches have been identified near the proposal, namely a Catholic Church on Wybong Road and an Anglican Church on Castlerock Road. There are no specific criteria in the *NSW Industrial Noise Policy (INP)* for places of worship, however in respect of such premises, Australian Standard 2107:2000 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors* recommends a maximum internal level of L_{Aeq} 35dBA for places of worship without speech amplification systems. Internal noise levels are generally 10dBA below external noise levels with windows open to a normal extent. The above Australian Standard would therefore imply a recommended external noise level of L_{Aeq} 45dBA at the churches.

3.1.4 Summary of Operational Noise Criteria

The operational noise criteria for the Anvil Hill Project are summarised in Table 3-1. All criteria apply under specific meteorological conditions which are described in detail in Section 5. These criteria are the same for each of the identified residences surrounding the proposal.

Table 3-1 Summary of Operational Noise Criteria

Location	Period	RBL (dBA)	Criterion (dBA)	
			Intrusiveness	Amenity
ALL	Day	30	35	50
	Evening	30	35	45
	Night	30	35	40

For the Anvil Hill Project, the intrusiveness criterion is the more stringent criterion in all time periods, and is the adopted criterion for this assessment.

3.1.5 Exceedance of Criteria

In cases where the criteria set out in Section 3.1.4 are exceeded, the *INP* sets out a range of responses, including:

- Application of "feasible and reasonable" mitigation measures to reduce noise levels;
- Negotiation with relevant government bodies and/or the affected community to determine reasonable levels based on the extent of any residual impacts and other factors such as social and economic benefits derived from the noise source; and
- In extreme cases, acquisition of affected properties. Recent Department of Planning (DOP) approach for major projects would suggest acquisition of properties where the operational noise level, under meteorological conditions as defined in Section 5, exceeds the RBL by more than 10dBA.

In particular, the Policy indicates:

> *The industrial noise source criteria … are best regarded as planning tools. They are not mandatory, and an application for a noise-producing development is not determined purely on the basis of compliance or otherwise with the noise criteria. Numerous other factors need to be taken into account in the determination. These factors include economic consequences, other environmental effects and the social worth of the development. The criteria help to determine consent/licence conditions because they provide information on the likely effect of any environmental noise associated with the development.*

3.2 Construction Noise Criteria

There are no criteria within either document for construction activities that are expected to last for longer than 26 weeks, as is the case with the Anvil Hill Project, where the period of construction works is expected to last for up to 12 months. It is therefore considered reasonable to assess long-term construction activities as being a phase of the general operations for the project. As such it is proposed that the criteria for operational noise outlined in Section 3.1 should also be used to assess construction noise. This methodology has proved acceptable to the DEC on similar projects.

3.3 Road Traffic Noise Criteria

Criteria for assessment of noise from traffic on public roads are set out in the *Environmental Criteria for Road Traffic Noise (ECRTN)*. The relevant criteria are set out in Table 3-2. In terms of the *ECRTN* road classifications, Denman Road would be considered a "collector" road and both Wybong and the Bengalla Link roads considered "local" roads.

Table 3-2 Criteria for Traffic Noise – Residences

Type of Development	Noise Level Criterion		Where Criteria are already Exceeded
	Daytime (7.00am-10.00pm)	Night Time (10.00pm-7.00am)	
Land use developments with potential to create additional traffic on collector roads	$L_{Aeq,5hr}$ 60dBA	$L_{Aeq,1hr}$ 55dBA	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2dB. Where feasible & reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies…
Land use developments with potential to create additional traffic on local roads	$L_{Aeq,5hr}$ 55dBA	$L_{Aeq,1hr}$ 50dBA	

3.4 Blasting Assessment Criteria

3.4.1 Annoyance & Discomfort

For assessment of annoyance due to blasting, the DEC (and most similar authorities in Australia) adopt guidelines produced by the Australian and New Zealand Environment and Conservation Council (ANZECC). The fundamental criteria are that at any residence or other sensitive location:

- The maximum overpressure due to blasting should not exceed 115dB for more than 5% of blasts in any year, and should not exceed 120dB for any blast; and
- The maximum peak particle ground velocity should not exceed 5mm/sec for more than 5% of blasts in any year, and should not exceed 10mm/sec for any blast.

3.4.2 Structural Damage

At sufficiently high levels, blast overpressure may in itself cause structural damage to some building elements such as windows. However, this occurs at peak overpressure levels of about 133dB and above, well in excess of criteria for annoyance.

For assessment of damage due to ground vibration, Australian Standard *AS2187.2-1993 Explosives – Storage, Transport and Use* contains an appendix specifying recommended levels for peak particle vibration velocity to protect typical buildings from damage. These are:

- "Structures that may be particularly susceptible to ground vibration" – 5mm/sec
- "Houses and low-rise residential buildings; commercial buildings not included below" – 10mm/sec
- "Commercial and industrial buildings or structures of reinforced concrete or steel construction" – 25mm/sec

The Standard notes that there may be special cases including high-rise buildings, reservoirs and buildings housing sensitive equipment where alternative criteria may be appropriate. No such structure has been identified in the vicinity of the Anvil Hill Project.

A number of heritage sites have been identified surrounding the proposal. These sites have been inspected by a historic architect and one assessed as being susceptible to damage from vibration from blasting. At this site the 5mm/sec criterion has been adopted. Other heritage sites that are not particularly susceptible to damage from vibration adopt the 10mm/sec building damage criterion.

3.4.3 Mount Piper 500kV Power Transmission Line

A 500kV power transmission line runs through the project area and has been subject of discussions between the proponent and Transgrid. The following comments have been offered by Transgrid in relation to blasting near the transmission line.

- Vibration effects at the transmission line structures should be limited to levels of 50mm/sec. Predictions of the effects of blasting on the structures should be provided prior to works commencing. Monitoring of vibration levels at the line structures should be carried out throughout the blasting and the results made available to Transgrid on a regular basis. Where predicted and/or actual levels exceed 50mm/sec, blasting shall not proceed until the effects are assessed by Transgrid and the necessary action taken to protect the transmission line.
- Flyrock from blasting operations could damage the transmission line, in particular the conductors, insulators and structures.

3.4.4 Rock Shelters

A number of rock shelters and rock formations are located within the Project Area. While historically and culturally significant, it is unlikely that these structures are particularly susceptible to ground vibration and as such the 5mm/sec criterion is not considered appropriate in this case. RCA Australia has surveyed these structures, and advised appropriate levels to protect their structural integrity, and this report is included as another Appendix to the EA.

3.5 Low Frequency Noise Criteria

No criteria exist in NSW with regard to exposure to low frequency noise at residences. This topic has, however, been highlighted by a few local landholders as being of concern. A recent technical paper produced by the University of Salford, UK, proposes a criterion to assist in determining whether a low frequency disturbance exists.

A measurement of L_{Aeq}, L_{10} and L_{90} is taken in third octave bands between 10Hz and 160Hz. If the L_{Aeq} taken over a time when the noise is said to be present exceeds the reference curve in Table 3-3, it may indicate a source of low frequency noise that could cause disturbance. The character of the sound should be checked if possible by playing back an audio recording at an amplified level.

Table 3-3 Proposed Reference Curve

Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB, L_{eq}	92	87	83	74	64	56	49	43	42	40	38	36	34

If the noise occurs only during the day then a 5dB relaxation may be applied to all third octave bands. If the noise is steady then a 5dB relaxation may be applied to all third octave bands. A noise is considered steady if either of the conditions below is met:

- $L_{10} - L_{90}$ <5dB
- The rate of change of sound pressure level (fast time weighting) is less than 10dB per second.

The above parameters are evaluated in the third octave band which exceeds the reference curve by the greatest margin.

3.6 Rail Noise Criteria

Australian Rail Track Corporation (ARTC) operates the Gulgong - Sandy Hollow, Merriwa and Main Northern railways. Noise emissions from railways operated by the ARTC are regulated via ARTC's EPL 3142. The EPL Section L6 does not nominate specific environmental noise limits but notes that:

> *"It is an objective of this licence to progressively reduce noise levels of railway operations to appropriate goals through the implementation of Pollution Reduction Programs (PRPs)."*

At present the Gulgong - Sandy Hollow and Main Northern railways are not subject to a PRP (Pollution Reduction Program). However, EPL 3142 provides that "In developing the PRPs, the licensee must work towards the goals of 65 dBA L_{Aeq}, (daytime), 60 dBA L_{Aeq}, (night time) and 85 dBA (24hr) max pass-by noise, at one metre from the facade of affected residential properties".

Based on the above guideline noise assessment goals, the following noise criteria have been adopted for the Anvil Hill Project:

- $L_{Aeq,9hr}$ = 60dBA
- $L_{Aeq,15hr}$ = 65dBA
- L_{Amax} = 85dBA

4 EXISTING NOISE ENVIRONMENT

The existing ambient noise environment around the proposal has been monitored on several occasions, both by means of unattended noise logging, and by attended measurements.

4.1 Unattended Noise Measurements

Four unattended noise surveys were carried out by HLA Envirosciences Pty Ltd in 2002 and 2003. The surveys involved establishing environmental noise loggers at eight representative residential locations surrounding the project application area. These residences N1 to N8 are listed in Table 4-1 and illustrated in Figure 4-1.

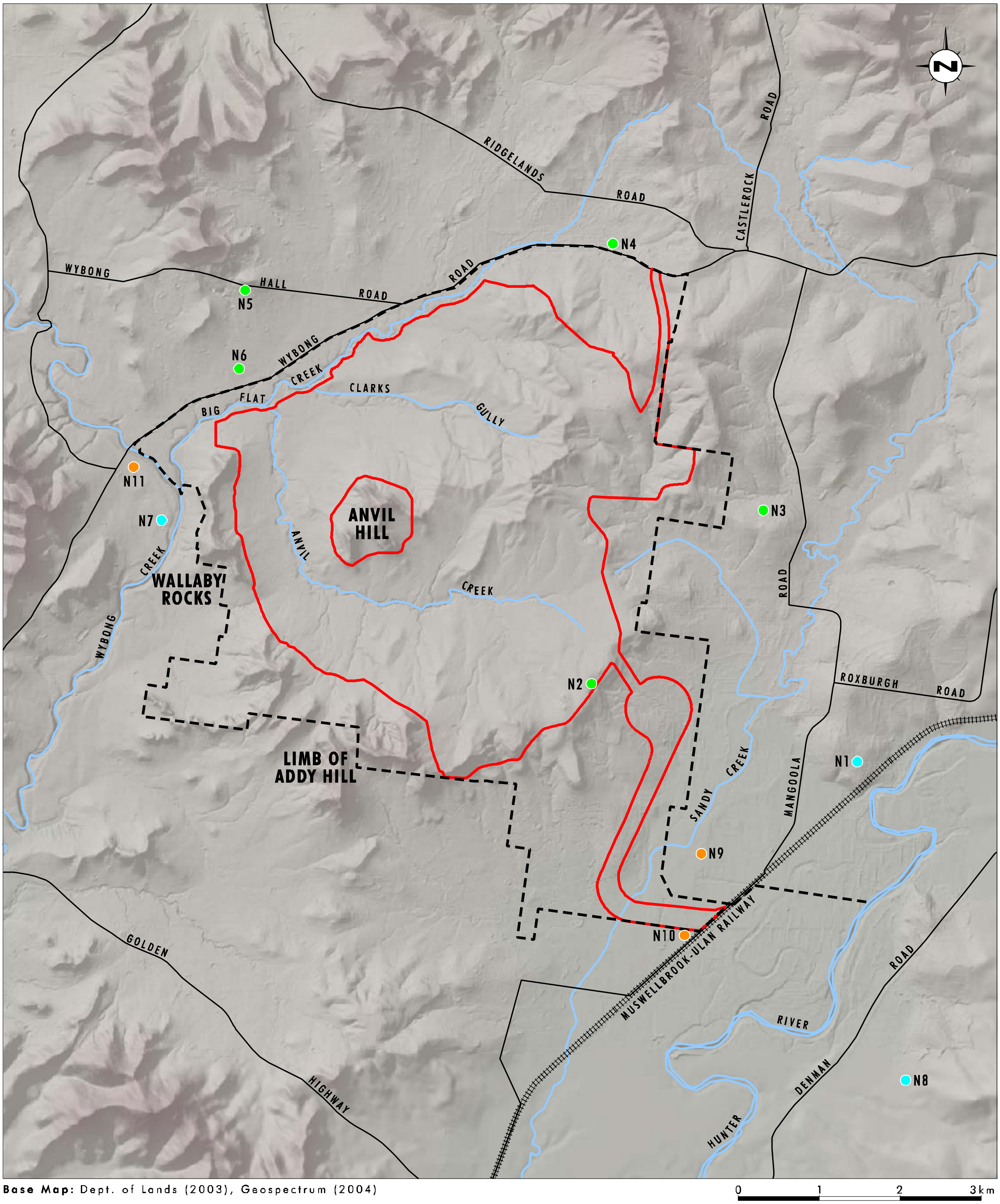
The loggers were set to A-Weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later analysis. The equipment calibration was checked before and after the survey and no significant drift occurred.

The noise logger enables the calculation of an Assessed Background Level (ABL), i.e. the single figure background level representing each assessment period (day, evening and night), for each day. The ABL is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period, as described in Appendix A. Over the whole measurement survey period the Rating Background Level (RBL), which is the median value of the ABL values for the period over all measurement days, is determined. The RBL value is the appropriate background noise level recommended to be used by the *INP*.

Results from the four surveys are shown in Figure 4-2 to Figure 4-4 for daytime (7.00am-6.00pm), evening (6.00-10.00pm) and night time (10.00pm-7.00am) assessment periods. Those periods in which wind speed at microphone level was greater than 5m/s or when it was raining were excluded from analysis in accordance with the *INP*.

Table 4-1 Unattended Noise Measurement Locations

Site No.	Property No.	Nearest Road	Measurement Location
N1	CH 0079	Mangoola Road	Inside house yard, near sheds
N2	CH 0255	Coolabah Road	Met station compound
N3	CH 0286	Mangoola Road	House yard in front of house
N4	CH 0276	Wybong Road	At dust gauge DG 10
N5	CH 0031	Wybong Hall Road	At dust gauge DG 11
N6	CH 0304	Wybong Road	On fenceline, east of house
N7	CH 0123	Wybong Road	House yard, in front of pool
N8	CH 1358	Denman Road	Back of paddock, 200m from road



Base Map: Dept. of Lands (2003), Geospectrum (2004)

Legend
- Proposed Disturbance Area
- Project Area
- Attended Noise Monitoring Location
- Unattended Noise Monitoring Location
- Attended and Unattended Noise Monitoring Location

FIGURE 4.1

Noise Monitoring Locations

Figure 4-2 Measured Daytime Background Noise Levels

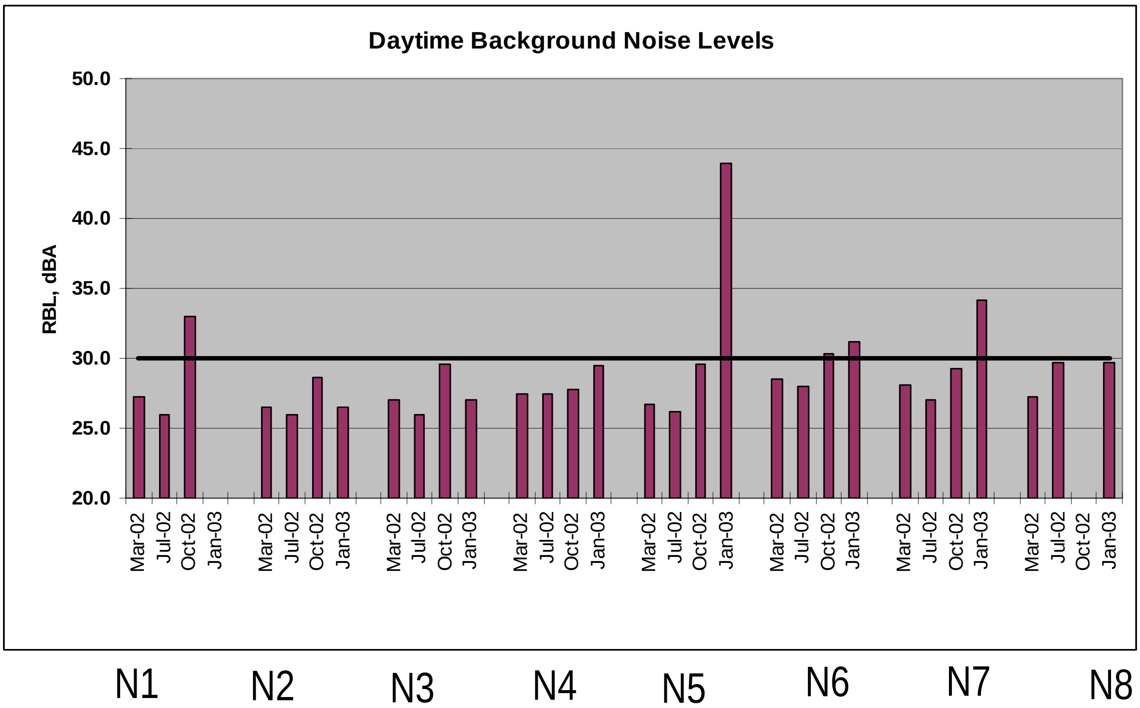


Figure 4-3 Measured Evening Background Noise Levels

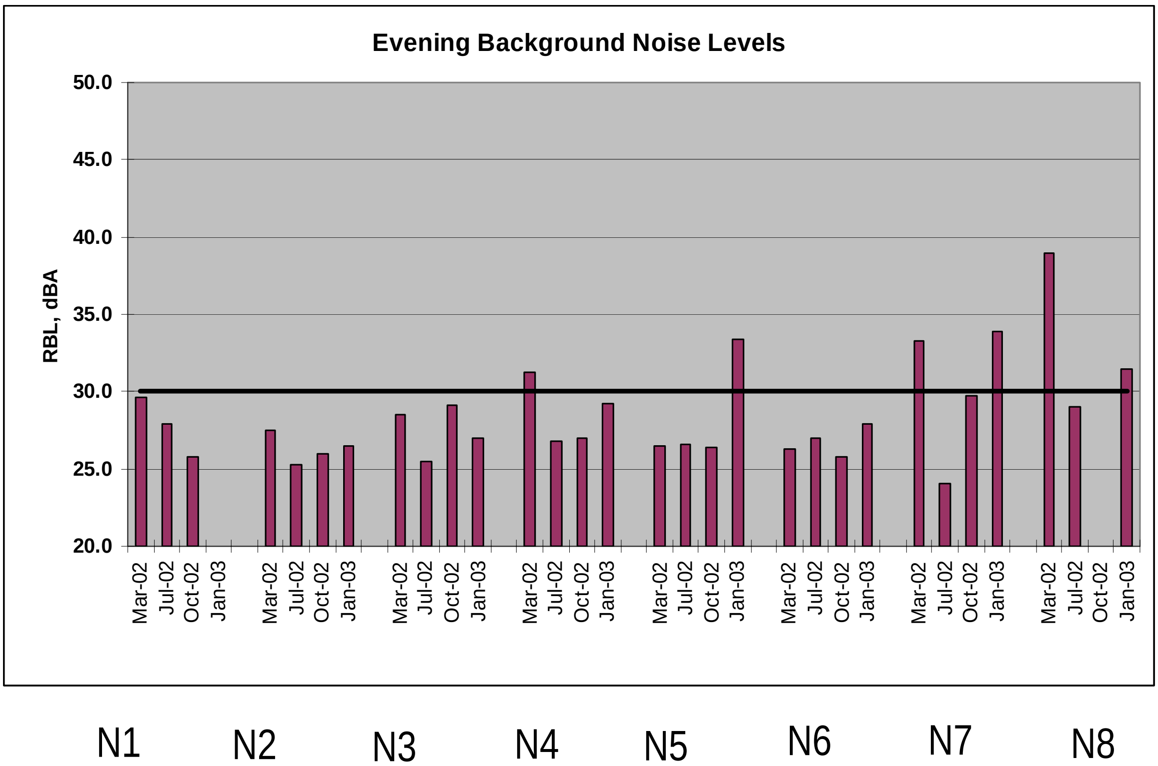
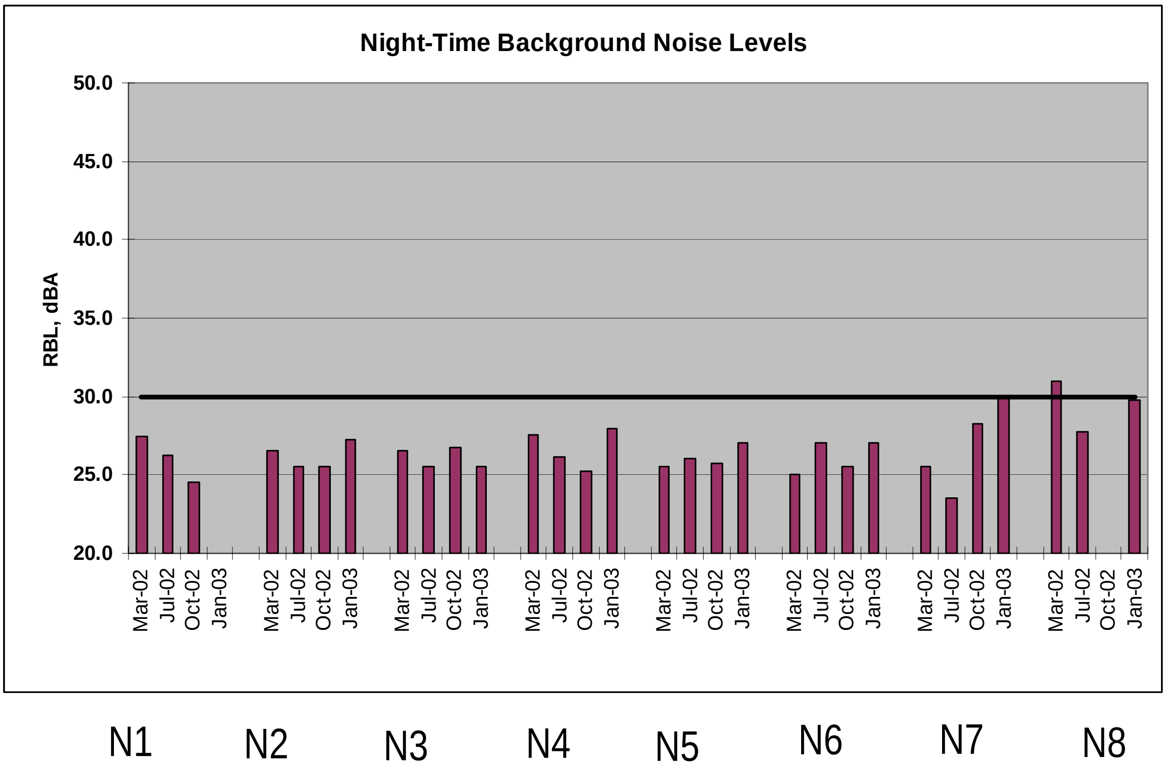


Figure 4-4 Measured Night Time Background Noise Levels



Although some sites have missing data due to logger failure, it is clear that the RBL background levels are generally below 30dBA for day, evening and night. There are some locations which show dramatic increases in RBL noise levels in the summer and autumn months, but this is most likely due to localised insect noise.

4.2 Attended Noise Measurements

Further attended noise measurements were conducted by Wilkinson Murray in December 2004. The purpose of these measurements was to establish whether there was any existing industrial noise in the area. Eight residences were chosen for short-term attended noise monitoring. Five of these residences were the same as those at which unattended monitoring was carried out. A full list of monitoring locations is shown in Table 4-2 and their locations illustrated in Figure 4-1. Monitoring was carried out at the roadside boundary of all residences.

Table 4-2 Attended Noise Measurement Locations

Site No.	Property No.	Nearest Road
N2	CH 0255	Coolabah Road
N3	CH 0286	Mangoola Road
N4	CH 0276	Wybong Road
N5	CH 0031	Wybong Hall Road
N6	CH 0304	Wybong Road
N9	CH 0307	Mangoola Road
N10	CH 0310	Wybong Road
N11	CH 0151	Mangoola Road

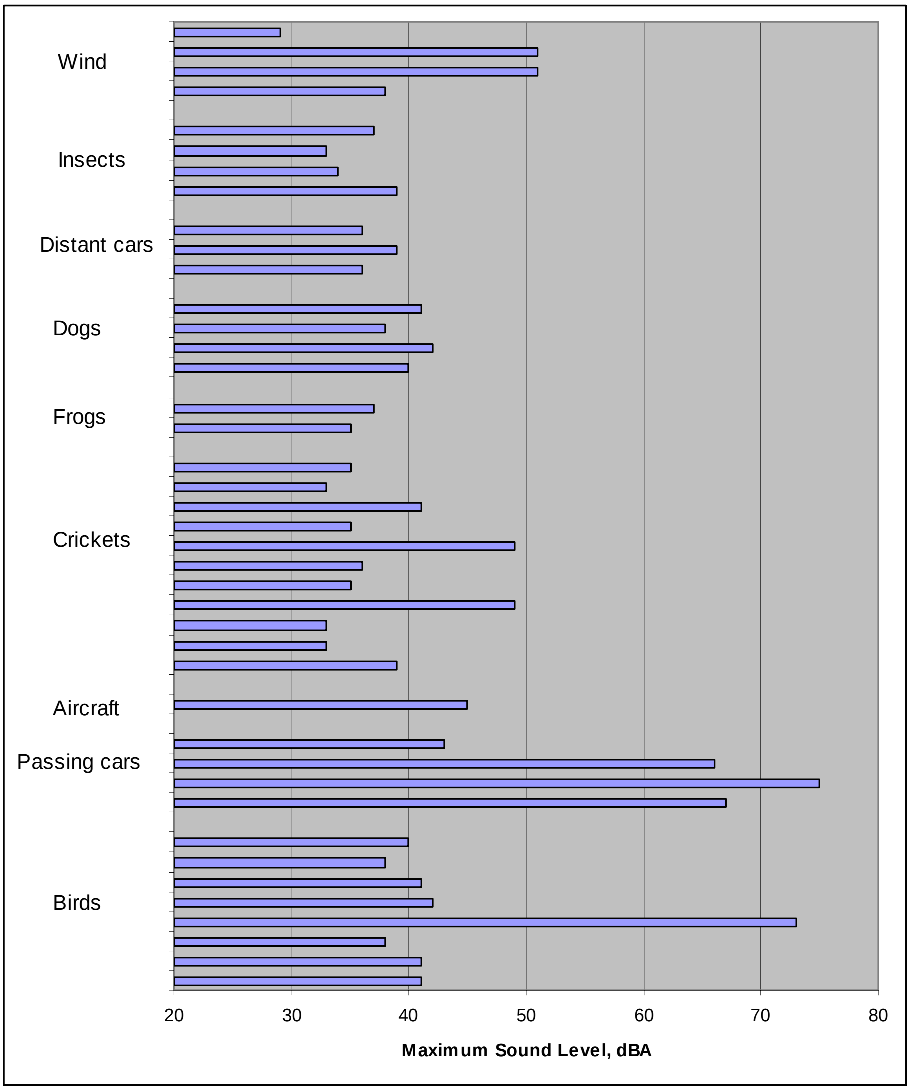
Attended measurements of ambient noise levels were taken at all residential locations on Wednesday, 1 December 2004 and again on Wednesday, 22 December 2004. Noise levels were measured with a CEL 593 Sound Level Meter. This Sound Level Meter conforms to Australian Standard 1259 "Acoustics – Sound Level Meters" as Type 1 Precision Sound Level Meter which has an accuracy suitable for laboratory use.

The A-Weighting filter of the meter was selected and the time weighting was set to "Fast". The meter was then field calibrated both before and after the measurements with a Sound Level Calibrator Type CEL 284/2. No significant system drift was noted. The CEL 593 and the CEL 284/2 have been laboratory calibrated within the previous two years in accordance with Wilkinson Murray Quality Assurance procedures.

During the measurement periods no industrial noise sources were observed at any time.

Figure 4-5 illustrates examples of noise levels at the eight residences over the two monitoring periods.

Figure 4-5 Examples of Maximum Noise Levels during monitoring surveys



5 METEOROLOGICAL FACTORS

Noise levels experienced by a receiver at relatively large distances from a source can vary considerably under different meteorological conditions, particularly at night. Prevailing wind and air temperature gradients will change over the course of the night time period, and hence noise levels at receivers will change, even when the noise source level is constant.

The *INP* identifies the Hunter Valley as a region where occurrence of temperature inversions is frequent and as such the effect of metrological conditions must be addressed in the prediction of noise levels from the proposal.

The *INP* generally directs the use of a single set of adverse meteorological data to use in the assessment of noise impacts; however Wilkinson Murray has adopted a more rigorous approach in past assessments where noise levels at residences are calculated under a varied set of existing meteorological conditions. Measured statistical occurrences of these conditions over a period of one year are then applied to the results, and a 10^{th} percentile exceedance level calculated, which is then compared with relevant criteria. This approach is generally more conservative than one using a single set of meteorological data as it accounts for the directional distribution of prevailing winds for each residence surrounding the proposal.

This alternative assessment procedure involves significantly greater computational complexity than the use of a single set of meteorological conditions, but provides a much more direct and comprehensible description of noise impacts at a receiver. This approach of using the 10^{th} percentile calculated noise level as a measure of noise impacts on residences has been considered acceptable by the DEC for previous similar assessments. Due to the relatively large number of residences in the area surrounding the Anvil Hill Project, this alternative procedure is considered appropriate and has been adopted.

5.1 Measured Meteorological Data

Three sets of meteorological data were available for this assessment:

- A weather station at Coolabah Road just within the southern project application boundary has recorded conditions from 2002-2005. This station provided data on wind speed and wind direction.
- A weather station at Wybong Road, a few hundred metres north of the northern project application boundary, has recorded conditions from 2002-2005. This station provided data on wind speed and wind direction, and also data on standard deviation of wind direction (sigma-theta).

Given that the above stations do not have the capacity to measure temperature gradients, a methodology needs to be formulated to calculate temperature inversion strengths at the project site. A third data set was therefore incorporated in this analysis - data from a mast in the Bengalla mining lease area. This monitoring station provides direct, high-quality measurements of temperature gradient. The full methodology of calculation of temperature inversion strengths for the proposal can be found in Appendix B.

6 OPERATIONAL NOISE IMPACTS

This section outlines potential noise impacts at residences as a result of general operations at the proposal. This includes noise from mobile plant such as haul trucks, drills and dozers, and also potential impacts from infrastructure plant associated with the preparation of coal. Assessment of potential impacts from the proposed rail loadout facility and the impacts associated with the movement of trains on the proposed rail loop are also addressed in this section.

6.1 Noise Modelling Methodology

Operational noise levels at residences are calculated using the ENM prediction model. This model has been endorsed by the DEC for environmental noise assessment. The ENM model takes account of noise attenuation due to geometric spreading, atmospheric absorption, shielding and the effect of acoustically soft ground. It can also be used to predict noise levels under various meteorological conditions, defined by a combination of temperature gradient, wind speed and wind direction.

Calculations were undertaken for six progressive operational scenarios, namely a construction scenario and years 2, 5, 10, 15 and 20 of the proposal. For each year a representative "worst-case" scenario was modelled. Where plant could be operating in more than one position around the proposal, noise levels were calculated at various positions relative to the surrounding residences, and the highest noise level used as the worst-case.

Because different operating procedures are proposed for daytime (7.00am-10.00pm) and night-time (10.00pm-7.00am), two scenarios (day and night time) were modelled for each of the operating years.

Calculations were performed under a variety of meteorological conditions using the methodology outlined in Section 5. Noise levels were calculated under a total of 41 conditions for the 10 operational scenarios (day and night) at a total of 282 residences up to 8km surrounding the proposal. A summary of the inputs used in noise modelling is shown in Table 6-1. The following sections outline the calculation of noise levels in more detail.

Table 6-1 Noise Modelling Inputs

Modelling Inputs	
Residential receivers	From surveys undertaken locally and aerial photography.
Topography	Disturbed contours for operational years in accordance with the Conceptual Mine Plan & local topography at residences provided by the NSW Lands Department & Aerial Digital Terrain DTM model from photogrammetry undertaken by Geospectrum.
Noise Source Levels	From measurements of similar plant at other sites.
Meteorological data	From measurements at Wybong Road and Bengalla weather stations (see Section 5)

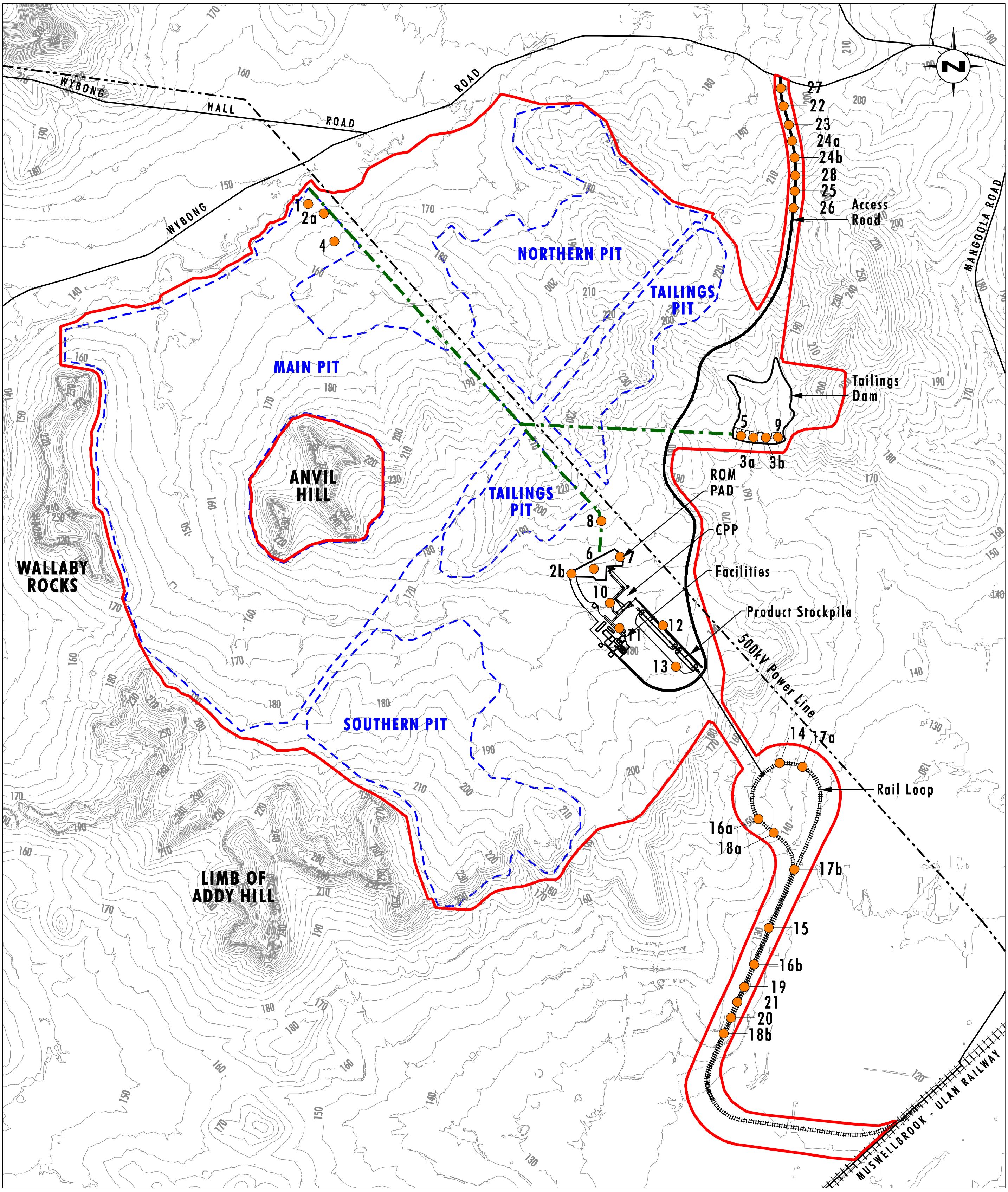
6.2 Noise Modelling Procedures

6.2.1 Construction Operations

Construction of the project infrastructure is proposed for a period of in the order of one year. Noise impacts have been modelled on construction hours of generally 7.00am-7.00pm seven days per week. Construction activities include:

- Box cut and haul roads;
- Coal preparation plant, ROM pad, washery, crushers, conveyers and rail loadout bin and site roads;
- Facilities including office buildings;
- Tailings dam;
- A new access road from Wybong Road to the facilities; and
- A rail loop and spur running from the rail loadout bin to the main Muswellbrook to Ulan line.

Sound Power Levels have been modelled for items of plant typically utilised in construction of a mine site and are shown in Table 6-2. Plant locations are shown in Figure 6-1.



Base Map: Dept. of Lands (2003), Mine Consult (2005), Geospectrum (2004)

0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Construction Haul Road
- Plant Location

FIGURE 6.1

Modelled Plant Locations Construction Phase

Table 6-2 Modelled Equipment Sound Power Levels

Figure Ref.	Equipment	No. Operating Simultaneously	Sound Power Level L_{Aeq} (dBA)
Box Cut, ROM pad & Tailings dam construction			
1	Front end loader	1	110
2a, 2b	Dump Truck	2	114
3a, 3b	Dump Truck	2	114
4	Diesel drill	1	114
5	Dozer	1	118
6	Dozer	1	118
7	Grader	1	109
8	Watercart	1	114
9	Plate Compactor	1	115
CPP & Mine Facilities Construction			
10	Crane	1	100
11	Mobile Crane	1	105
Coal Handling Infrastructure construction			
12	Crane	1	100
13	Mobile Crane	1	105
Rail Spur and loop construction			
14	Crane	1	100
15	Mobile Crane	1	105
16a, 16b	Delivery Truck	2	111
17	Dozer	1	110
18	Excavator	1	110
19	Plate Compactor	1	115
20	Tamper	1	118
21	Regulator	1	110
Mine Access Road Construction			
22	Dozer	1	110
23	Grader	1	109
24a, 24b	Trucks	2	108
25	Water cart (small)	1	110
26	Compactor (vibrating)	1	114
27	Asphalt Spreader	1	98
28	Rubber tyred roller	1	101

Note: The above plant and associated sound power levels are indicative of typical construction operations

Given the length of the construction period, it is appropriate to assess potential impacts under daytime meteorological conditions using the ENM noise model. Plant locations were selected as "worst-case", positioned at points where they have the greatest potential for noise impacts for nearby residences. In particular the track laying equipment for the rail loop (tamper and regulator) was positioned at the point where it is on an embankment rather than at the loop where the track is in considerable depth of cutting which would shield noise from track laying operations. The equipment involved in the construction of the mine access road was similarly modelled in the worst-case location, at the intersection with Wybong Road.

6.2.2 Operational Noise Source Levels

Noise sources associated with plant and infrastructure operating around the proposal, and their typical L_{Aeq} noise levels, are shown in Table 6-3. These levels are based on measurements conducted at a number of similar operations. In regard to haul trucks, noise levels can vary considerably depending on the manufacturer and the degree of retrofitted noise attenuation measures. Typical trucks range from 111-117dBA in practice, with some older-style vehicles measured at up to 121dBA. As the manufacturer of trucks at the proposal is not yet known, a figure of 114dBA has been adopted in the noise modelling. This figure is considered to be reliably achievable either with new trucks, or in some cases older trucks with some degree of noise attenuation.

Table 6-3 Modelled Equipment Sound Power Levels

Equipment	Assumed L_{Aeq} Sound Power Level (dBA)	Comments
Haul Truck	114	
Drill	114	
Excavator	118	
Dozer	118	
Water cart	114	
Grader	109	
Lighting Rig	107	Night time only
Rehabilitation (various plant)	119	Day time only
Conveyers	79 per metre	shielded near belt
Conveyer Drive	97	
Coal Prep Plant	110	acoustic building design
Crushers	110	enclosed
Rail Loadout Bin	116	
Class 81 Locomotives	80 per metre	Based on 2 locos at 10kph
Wagons	75 per metre	Based on 1280m 10kph train

6.2.3 Operational Methodology & Fleet Numbers

Scenarios were modelled to represent years 2, 5, 10, 15 and 20, for both daytime (7.00am-6.00pm) and night time (10.00pm-7.00am) operations. Proposed evening (6.00pm-10.00pm) and daytime operations are equivalent in terms of plant locations and numbers.

Table 6-4 outlines the maximum numbers of plant that have been modelled for each of the years advised by the proponent. The table separates the various components of operation, namely:

- **Coal Activities** – up to four separate pits are proposed for the extraction of coal, namely the Main Pit, Southern Pit, Tailings Pit and Northern Pit. The modelling assumes that at any time there would only be one pit where coal is mined. In order to calculate worst-case noise levels, noise levels from extraction and haulage of coal for each pit are calculated, and the worst-case pit assigned to each residence assessed.
- **Overburden Activities** – the maximum number of trucks allows for operation of a maximum of three pits simultaneously. Noise levels were again calculated separately for each of the four pits above, and the three highest noise levels combined for each residence as a worst case.
- **Blast push activities** – modelling assumes a maximum of two dozers are available, and that these would not generally operate in the same pit together, with the exception of year 20. Again, noise levels were calculated for operation of one dozer in each pit, and the worst two combined for each residence. In year 2, however, only one dozer would be available. No blast push dozers operate in the Tailings Pit at any stage of the proposal.
- **Rehabilitation Activities** – one team of a dozer and several smaller items of plant will operate at various locations around the proposal. Noise levels were calculated for each location and the worst case level assigned to each residence.
- **Infrastructure** – this component of the overall noise environment would remain constant throughout the life of the proposal. It is composed of noise from all plant involved in the preparation of coal and subsequent movement to the rail loader.
- **Rail Noise** – the rail loop has the capacity for two trains moving simultaneously which in turn allows for three possible operational scenarios:
  - One train arriving at coal loading bin as another departs
  - One train arriving at coal loading bin whilst another is being loaded
  - One train departing coal loading bin whilst another is being loaded.

Again each scenario is modelled and the worst case noise level assigned to respective receivers. The above components are then added to produce a final worst-case noise level for each residence. This figure is inherently conservative as it is unlikely that the items of plant above would all be in the worst-case position at the same time.

Table 6-4 Modelled Fleet Numbers by Year

Equipment	Year 2	Year 5	Year 10	Year 15	Year 20
Coal					
Diesel Drill	1	1	1	1	1
Excavator	1	1	1	1	1
Dozer	1	1	1	1	1
Haul Trucks	3	4	4	4	4
Overburden					
Diesel Drill	1	1	1	1	1
Excavator	2	3	3	3	2
Dozer	3	4	4	4	4
Haul Trucks	4	9	10	10	6
Blast Push Dozer	1	2	2	2	2
Rehabilitation					
Dozer	0	1	1	1	1
Front end Loader	0	1	1	1	1
Dump Truck	0	2	2	2	1
Shared Plant					
Grader	1	2	2	2	2
Watercart	2	4	4	4	4

6.2.4 Modelling Assumptions

The following assumptions concerning plant operation have been made in modelling the proposal.

Noise Emission from Mobile Plant

Specific manufacturers of the various components of mobile plant are not known at this stage, however the proponent has committed to use of low-noise haul trucks with an energy average sound power level not greater than 114dBA, unless it can be demonstrated that noise levels can be achieved at nearest private residences with use of other noise control mechanisms that may become available in the future.

In addition to the procedures outlined in Section 6.2.3, the following assumptions are made for the six operational scenarios:

- **Construction Phase** – construction of infrastructure including preparation plant, rail loop, access roads and tailings dam. Work is confined to daylight hours only.
- **Year 2** – mining will have started at each of the four pits; however fleet numbers dictate that only one pit will be removing overburden at any one time with only one blast push dozer in operation; working in the same pit as the overburden fleet as a worst case. A maximum of three trucks have been modelled hauling coal. No rehabilitation work has started at this stage of the project.
- **Year 5** – fleet numbers allow for overburden to be mined from three pits simultaneously with three trucks on each overburden route, with two blast push dozers in operation in separate pits. Rehabilitation work has begun during the day.
- **Year 10** – operational fleet is now at full scale. An extra haul truck is available for overburden and will be involved in haulage from the main pit. A second overburden dozer will also be available in the main pit.
- **Year 15** – fleet numbers are the same as for Year 10; however work has now finished in the Northern Pit.
- **Year 20** – only the main pit is now active, with all remaining fleet working forward on that location.

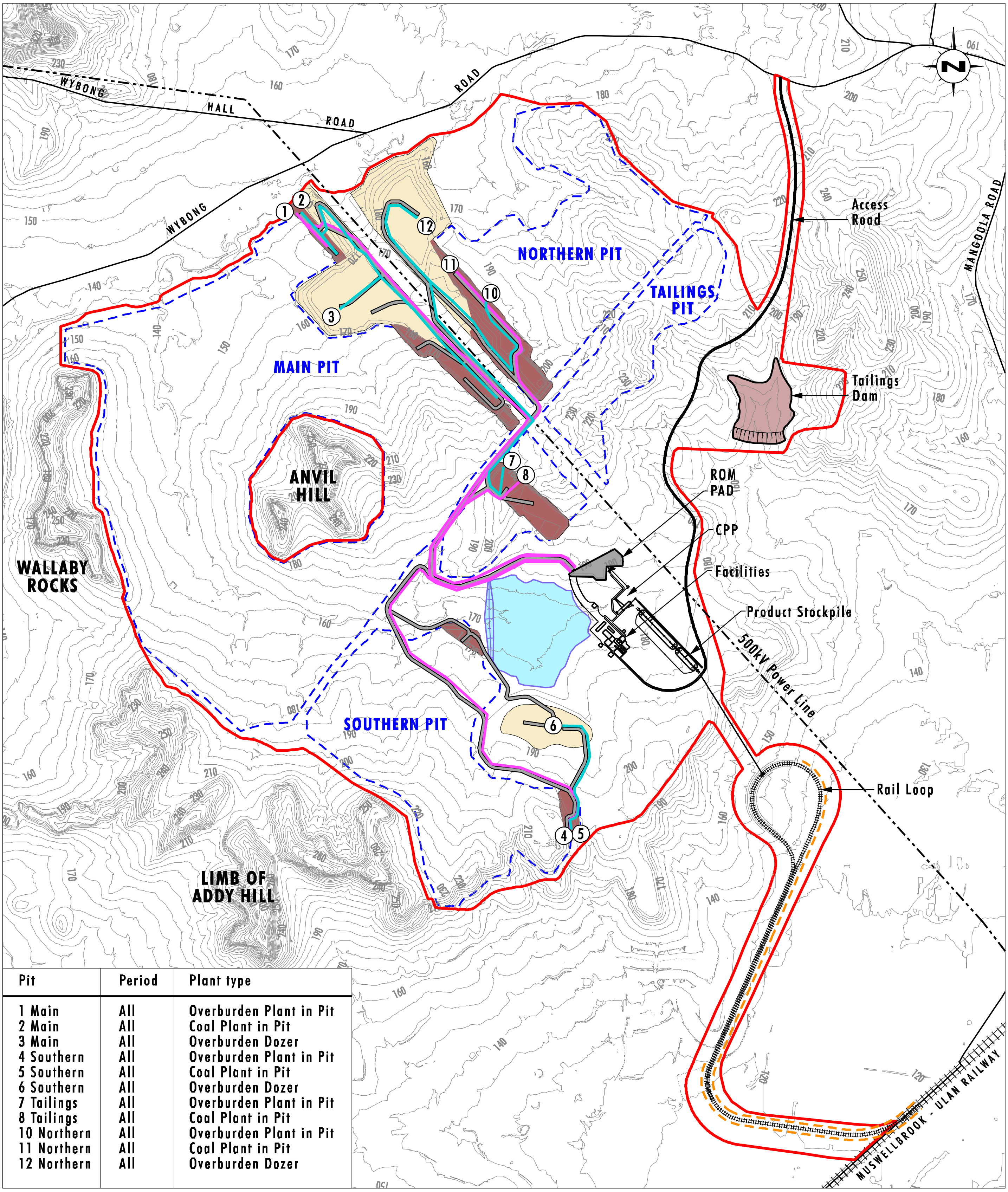
During the operational scenarios, and with the exception of rehabilitation activities, there is no difference between numbers of plant operating during the day and the night; rather the modelled operating locations are different. For daytime and evening operations, haul trucks would move overburden from pits to the tops of overburden dumps, with a dozer operating at the top of each dump. At night the haul trucks and dozers would be restricted to operating below the maximum elevation of the overburden emplacement areas.

6.2.5 Calculation Details

Plant that operates in the same vicinity for long periods, such as dozers and excavators, and all infrastructure items were modelled as point sources. Items involved in transport of materials such as haul trucks, watercarts, graders, trains and conveyers were modelled with source points at 40-50m intervals along the routes. The effective sound power level for each source point was assigned based on the number of items of plant using the route and the number of source points. The contributions of graders and watercarts were spread evenly over all coal and overburden routes for all scenarios. The locations of all items of plant over the six operational scenarios are shown in Figures 6-1 to 6-6. These figures indicate possible positions of all plant, although only a proportion would be operating at the same time, as shown in Table 6-4.

Noise levels were calculated using the ENM model for each of the scenarios under a total of 41 meteorological conditions. A statistical data set representing the proportional occurrence of these conditions at the Wybong Road weather station over a year was then applied to the calculated noise levels. The noise level exceeded for 10% during each of the day, evening and night time periods was then calculated.

For night time operations, 10^{th} percentile exceedance noise levels were calculated using statistical meteorological data for the winter period only, as conditions are more adverse than other seasons, with the greatest occurrence of strong temperature inversions. Data from all seasons was used to calculate 10^{th} percentile exceedance levels during the daytime and evening periods. The particular season that generated the highest noise level at each of the respective residences was then used as a worst-case for each residence.



Pit	Period	Plant type
1 Main	All	Overburden Plant in Pit
2 Main	All	Coal Plant in Pit
3 Main	All	Overburden Dozer
4 Southern	All	Overburden Plant in Pit
5 Southern	All	Coal Plant in Pit
6 Southern	All	Overburden Dozer
7 Tailings	All	Overburden Plant in Pit
8 Tailings	All	Coal Plant in Pit
10 Northern	All	Overburden Plant in Pit
11 Northern	All	Coal Plant in Pit
12 Northern	All	Overburden Dozer

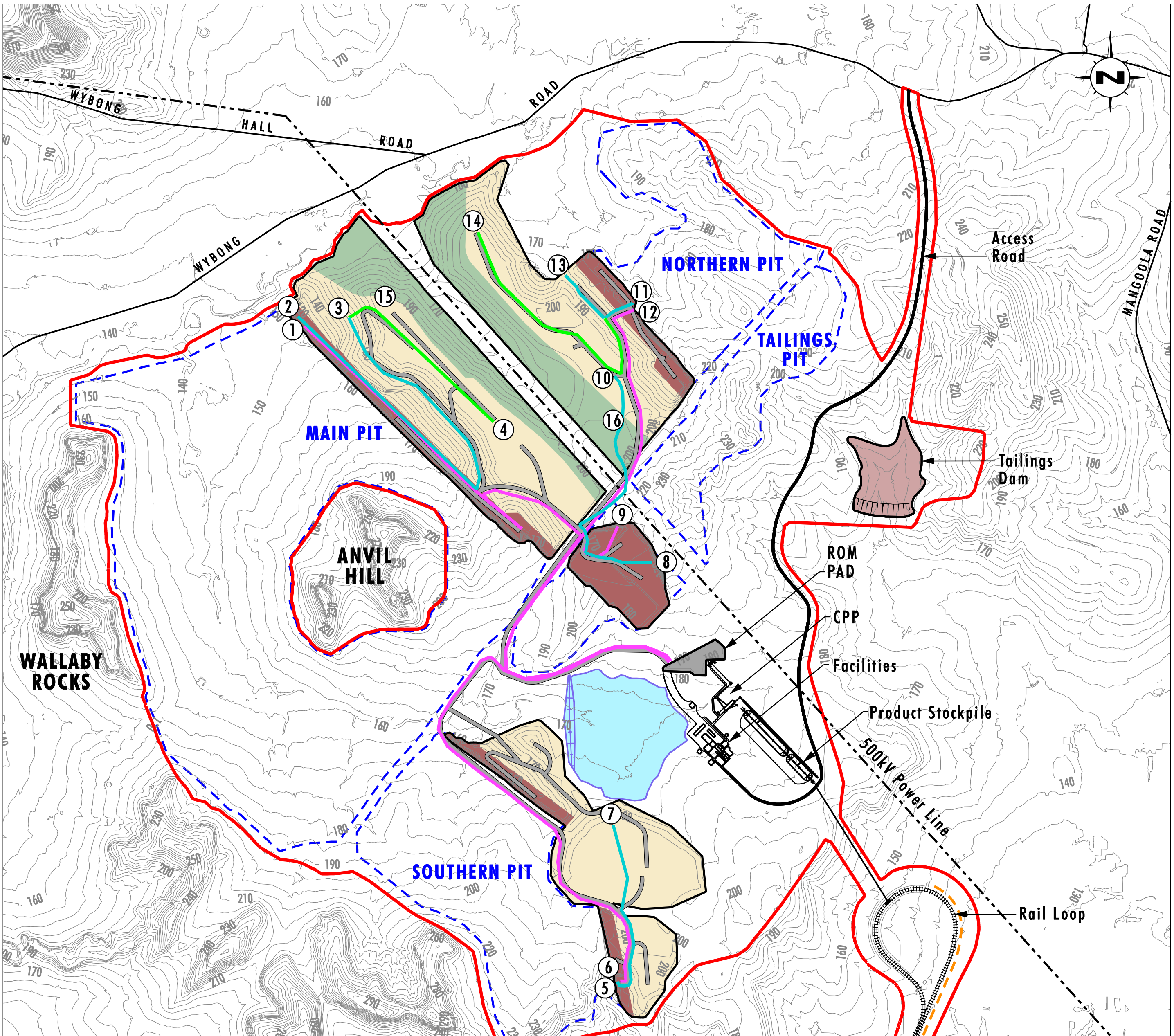
Source: Mine Consult 2005
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: 1. Contour Interval 5m
2. Please refer to Section 6-2 for detailed information on plant in pits and trucks on haulage routes

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Main Dam
- Overburden Haulage Route - All
- Coal Haulage Route - All
- ① Equipment Location
- Noise Barrier

FIGURE 6.2

Modelled Plant Locations Year 2



Pit	Period	Plant type
1 Main	All	Overburden Plant in Pit
2 Main	All	Coal Plant in Pit
3 Main	Night	Overburden Dozer
4 Main	Day Time	Overburden Dozer
5 Southern	All	Overburden Plant in Pit
6 Southern	All	Coal Plant in Pit
7 Southern	All	Overburden Dozer
8 Tailings	All	Overburden Plant in Pit
9 Tailings	All	Coal Plant in Pit
10 Tailings	All	Overburden Dozer
11 Northern	All	Overburden Plant in Pit
12 Northern	All	Coal Plant in Pit
13 Northern	Night	Overburden Dozer
14 Northern	Day Time	Overburden Dozer
15 Main	Day Time	Rehabilitation Plant
16 Northern	Day Time	Rehabilitation Plant

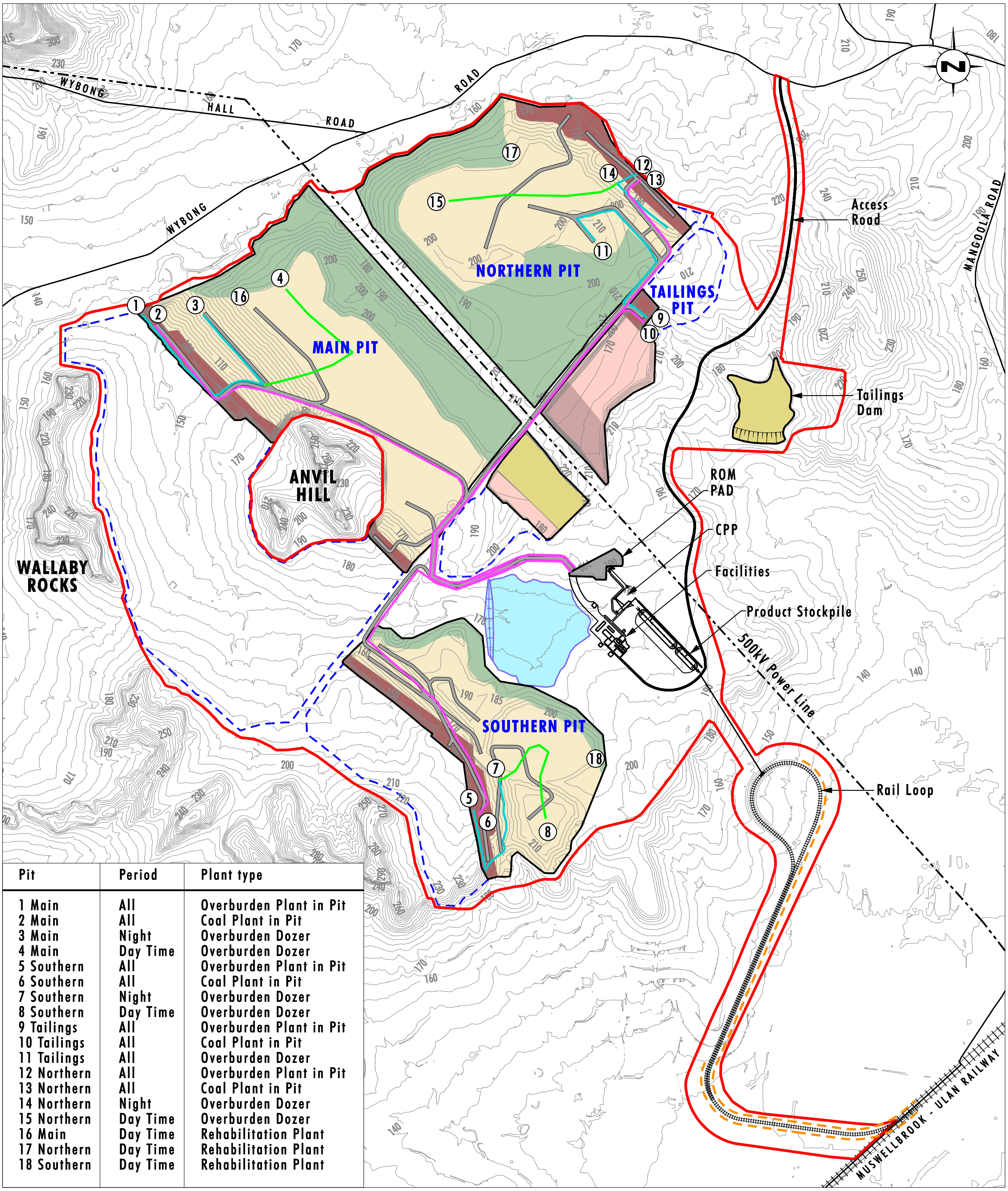
Source: Mine Consult 2005
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: 1. Contour Interval 5m
2. Please refer to Section 6-2 for detailed information on plant in pits and trucks on haulage routes

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Rehabilitation
- Main Dam
- Overburden Haulage Route - All
- Overburden Haulage Route - Daytime
- Coal Haulage Route - All
- ① Equipment Location
- Noise Barrier

FIGURE 6.3

Modelled Plant Locations Year 5



Pit	Period	Plant type
1 Main	All	Overburden Plant in Pit
2 Main	All	Coal Plant in Pit
3 Main	Night	Overburden Dozer
4 Main	Day Time	Overburden Dozer
5 Southern	All	Overburden Plant in Pit
6 Southern	All	Coal Plant in Pit
7 Southern	Night	Overburden Dozer
8 Southern	Day Time	Overburden Dozer
9 Tailings	All	Overburden Plant in Pit
10 Tailings	All	Coal Plant in Pit
11 Tailings	All	Overburden Dozer
12 Northern	All	Overburden Plant in Pit
13 Northern	All	Coal Plant in Pit
14 Northern	Night	Overburden Dozer
15 Northern	Day Time	Overburden Dozer
16 Main	Day Time	Rehabilitation Plant
17 Northern	Day Time	Rehabilitation Plant
18 Southern	Day Time	Rehabilitation Plant

Source: Mine Consult 2005
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: 1. Contour Interval 5m
2. Please refer to Section 6-2 for detailed information on plant in pits and trucks on haulage routes

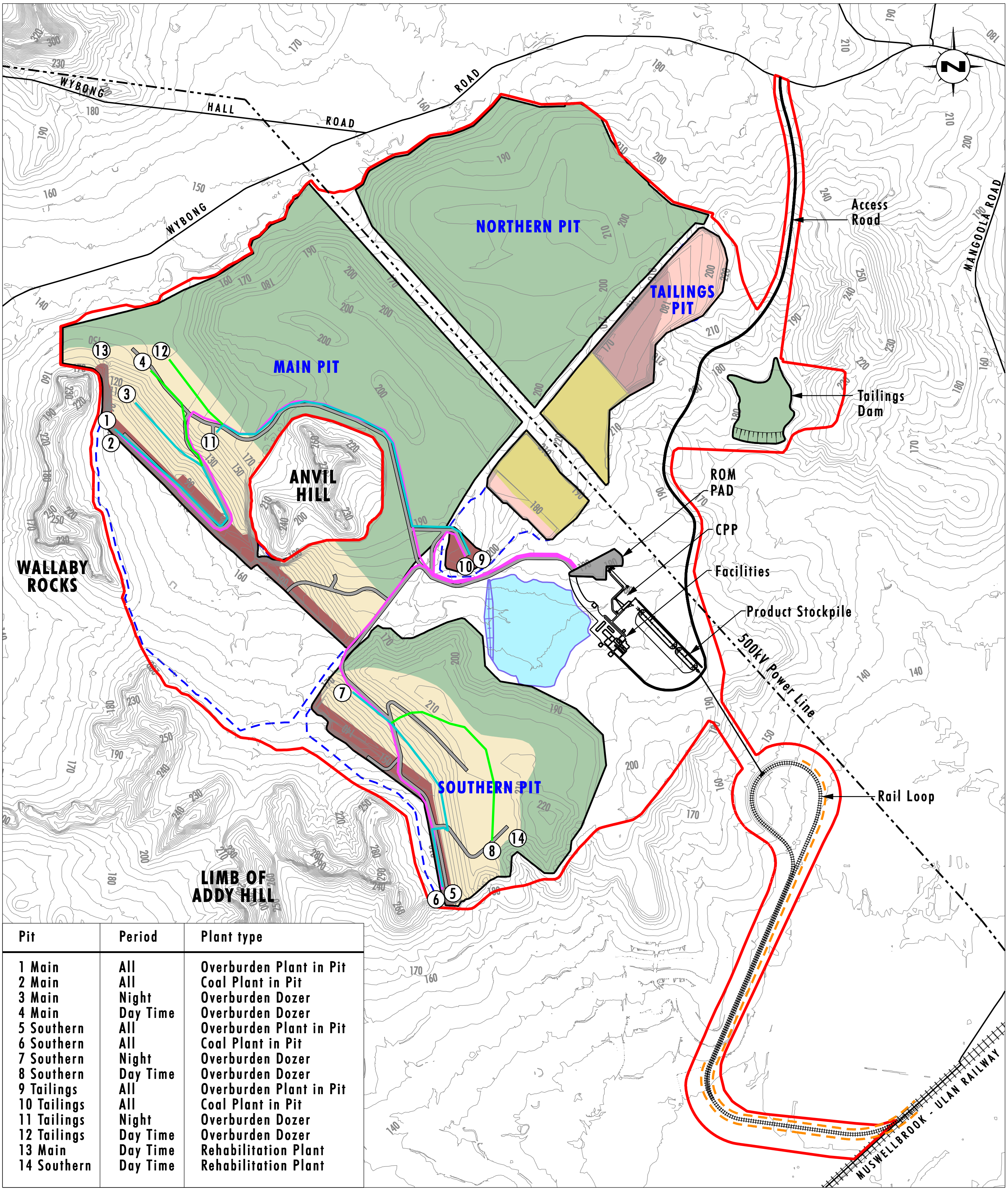
0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Inactive Tailings
- Pit Floor
- Rehabilitation
- Main Dam
- Overburden Haulage Route - All
- Overburden Haulage Route - Daytime
- Coal Haulage Route - All
- ① Equipment Location
- Noise Barrier

FIGURE 6.4

Modelled Plant Locations Year 10



Pit	Period	Plant type
1 Main	All	Overburden Plant in Pit
2 Main	All	Coal Plant in Pit
3 Main	Night	Overburden Dozer
4 Main	Day Time	Overburden Dozer
5 Southern	All	Overburden Plant in Pit
6 Southern	All	Coal Plant in Pit
7 Southern	Night	Overburden Dozer
8 Southern	Day Time	Overburden Dozer
9 Tailings	All	Overburden Plant in Pit
10 Tailings	All	Coal Plant in Pit
11 Tailings	Night	Overburden Dozer
12 Tailings	Day Time	Overburden Dozer
13 Main	Day Time	Rehabilitation Plant
14 Southern	Day Time	Rehabilitation Plant

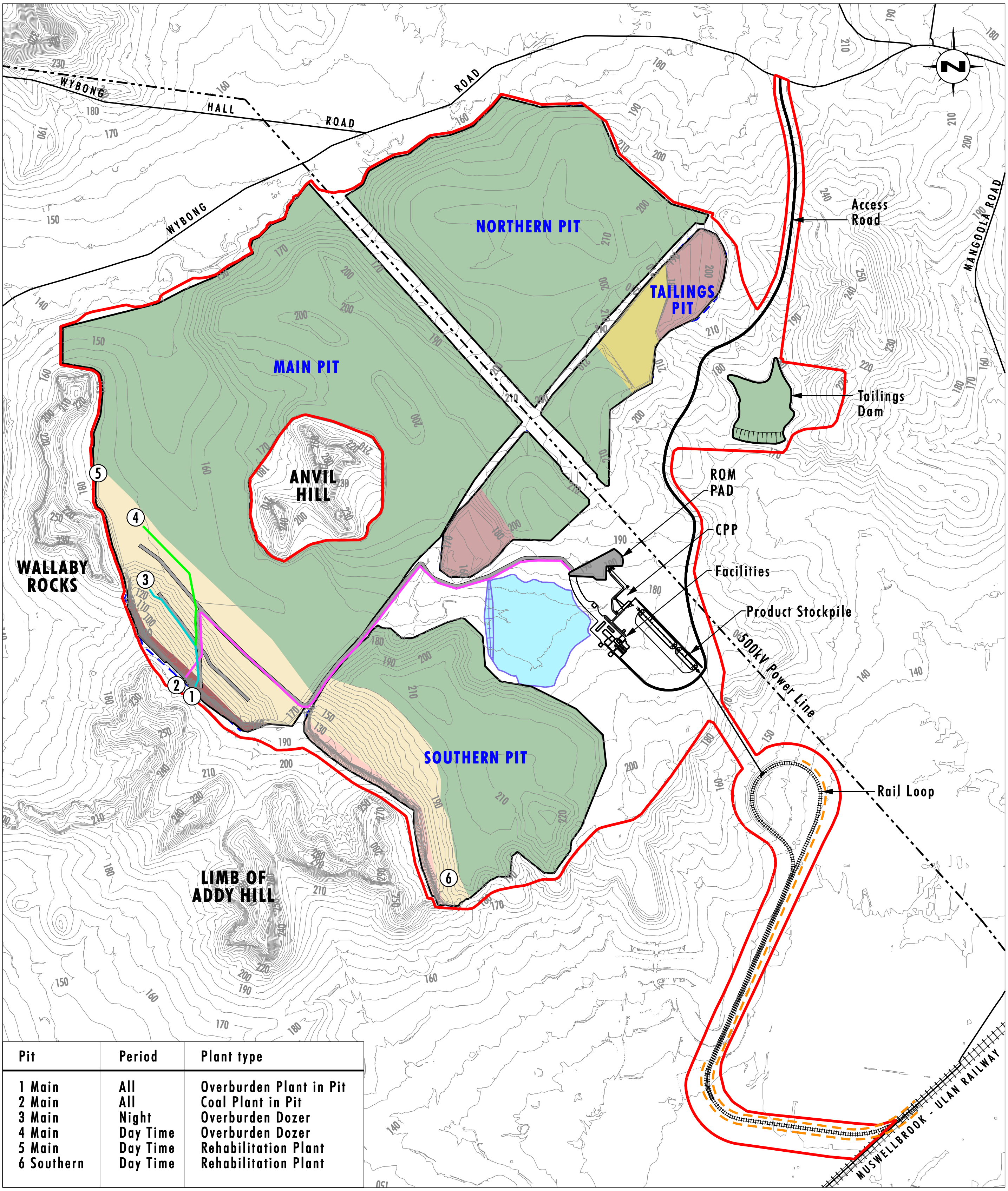
Source: Mine Consult 2005
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: 1. Contour Interval 5m
2. Please refer to Section 6-2 for detailed information on plant in pits and trucks on haulage routes

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Inactive Tailings
- Pit Flooor
- Rehabilitation
- Main Dam
- Overburden Haulage Route - All
- Overburden Haulage Route - Daytime
- Coal Haulage Route - All
- ① Equipment Location
- Noise Barrier

FIGURE 6.5

Modelled Plant Locations Year 15



Pit	Period	Plant type
1 Main	All	Overburden Plant in Pit
2 Main	All	Coal Plant in Pit
3 Main	Night	Overburden Dozer
4 Main	Day Time	Overburden Dozer
5 Main	Day Time	Rehabilitation Plant
6 Southern	Day Time	Rehabilitation Plant

0 0.5 1.0 2km

Source: Mine Consult 2005
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: 1. Contour Interval 5m
2. Please refer to Section 6-2 for detailed information on plant in pits and trucks on haulage routes

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Inactive Tailings
- Pit Floor
- Rehabilitation
- Main Dam
- Overburden Haulage Route - All
- Overburden Haulage Route - Daytime
- Coal Haulage Route - All
- ① Equipment Location
- Noise Barrier

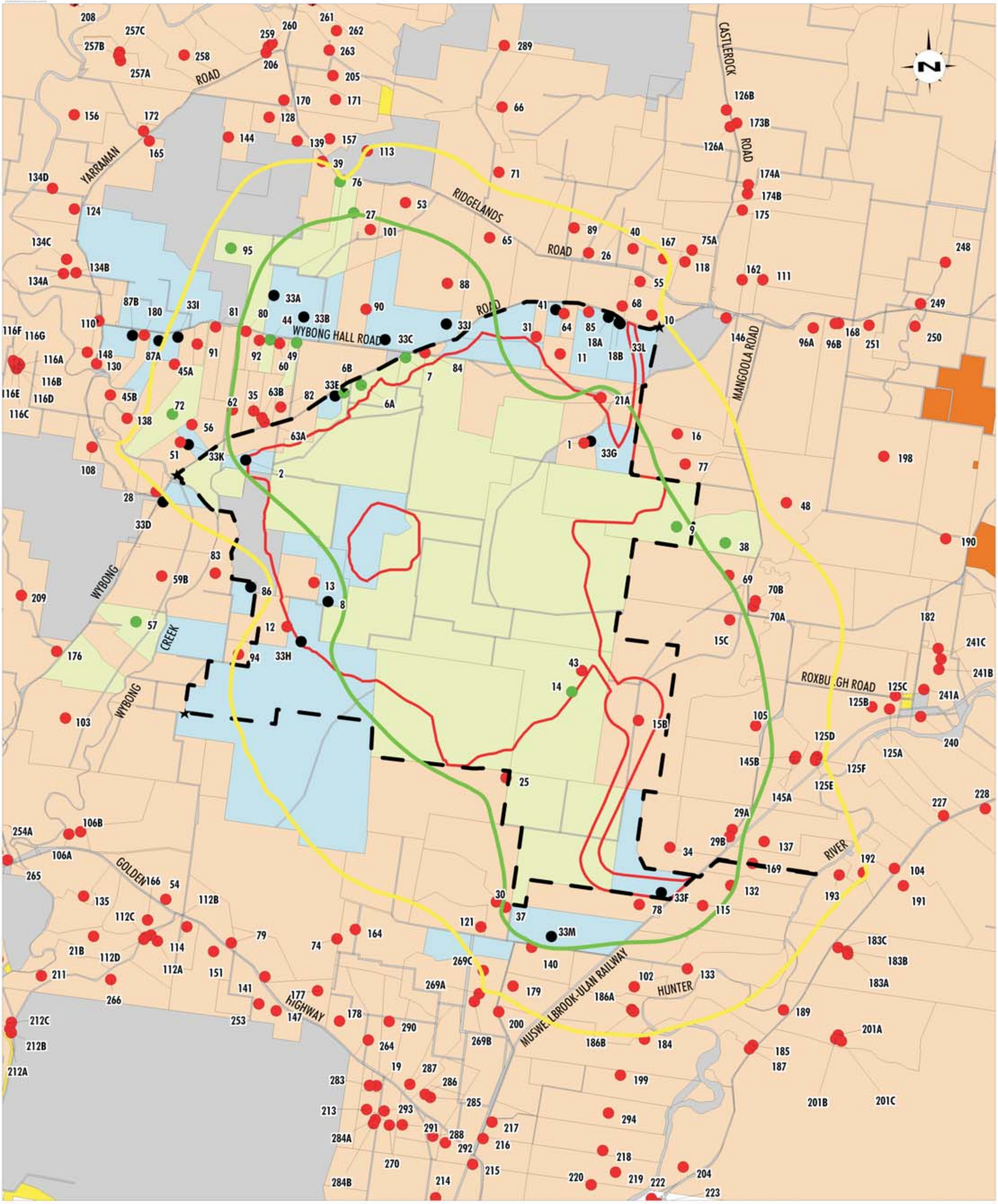
FIGURE 6.6

Modelled Plant Locations Year 20

It should be noted that the calculations described above rely on predictions produced by the ENM model. This model is based on simple assumed vertical profiles of temperature and wind speed, and does not accurately model more complex situations. In particular, there are times when a combination of non-linear vertical temperature and wind speed profiles can result in "focussing" of noise in a small area. In these events, increases in noise level of 10-20dBA can occur over periods of minutes to hours. The frequency of these events, and the level of noise enhancement occurring, cannot be accurately predicted using ENM or any other known model. However, recent validation of measured noise levels from similar nearby operations has shown good correlation with predicted noise levels as a 10^{th} percentile exceedance level.

6.2.6 Predicted Noise Levels at Residences

Worst-case 10^{th} percentile noise levels for each of the identified 282 residences surrounding the proposal were calculated for proposed typical day, evening and night time operations for years 2, 5, 10, 15 and 20. These results are summarised in Table 6-5. Detailed results for each residence are shown in Appendix C, where calculated noise levels have been rounded to the nearest whole number. Noise contours have also been provided for all operational scenarios. Contours indicating 35dBA and 40dBA noise levels corresponding with the derived operational noise criteria are shown in Figures 6-7 to 6-16.



Source: Dept of Lands (2003) , Wilkinson Murray Pty Limited (2006)

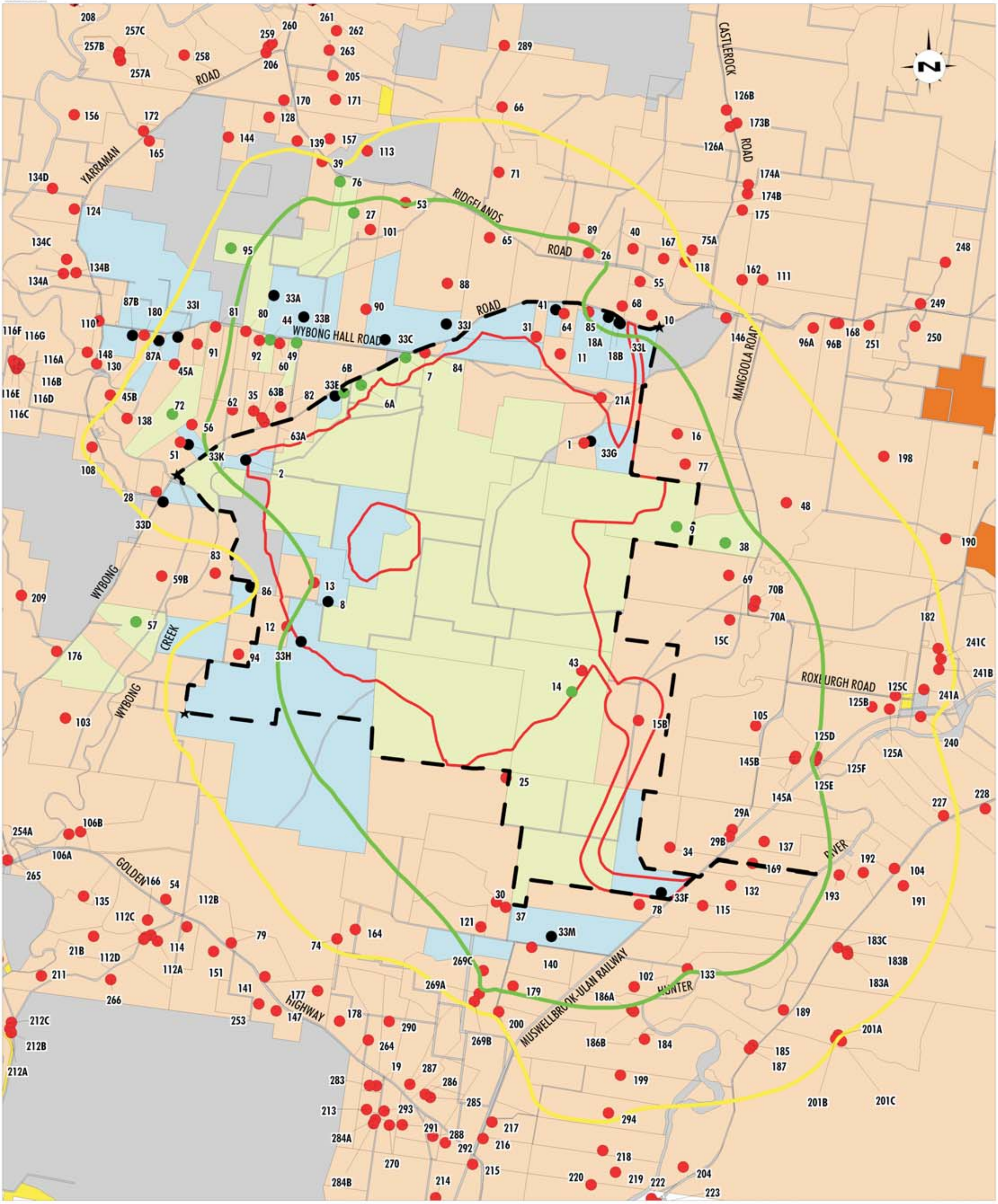
0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.7

Year 2 Daytime Noise Contours



Source: Dept of Lands (2003), Wilkinson Murray Pty Limited (2006)

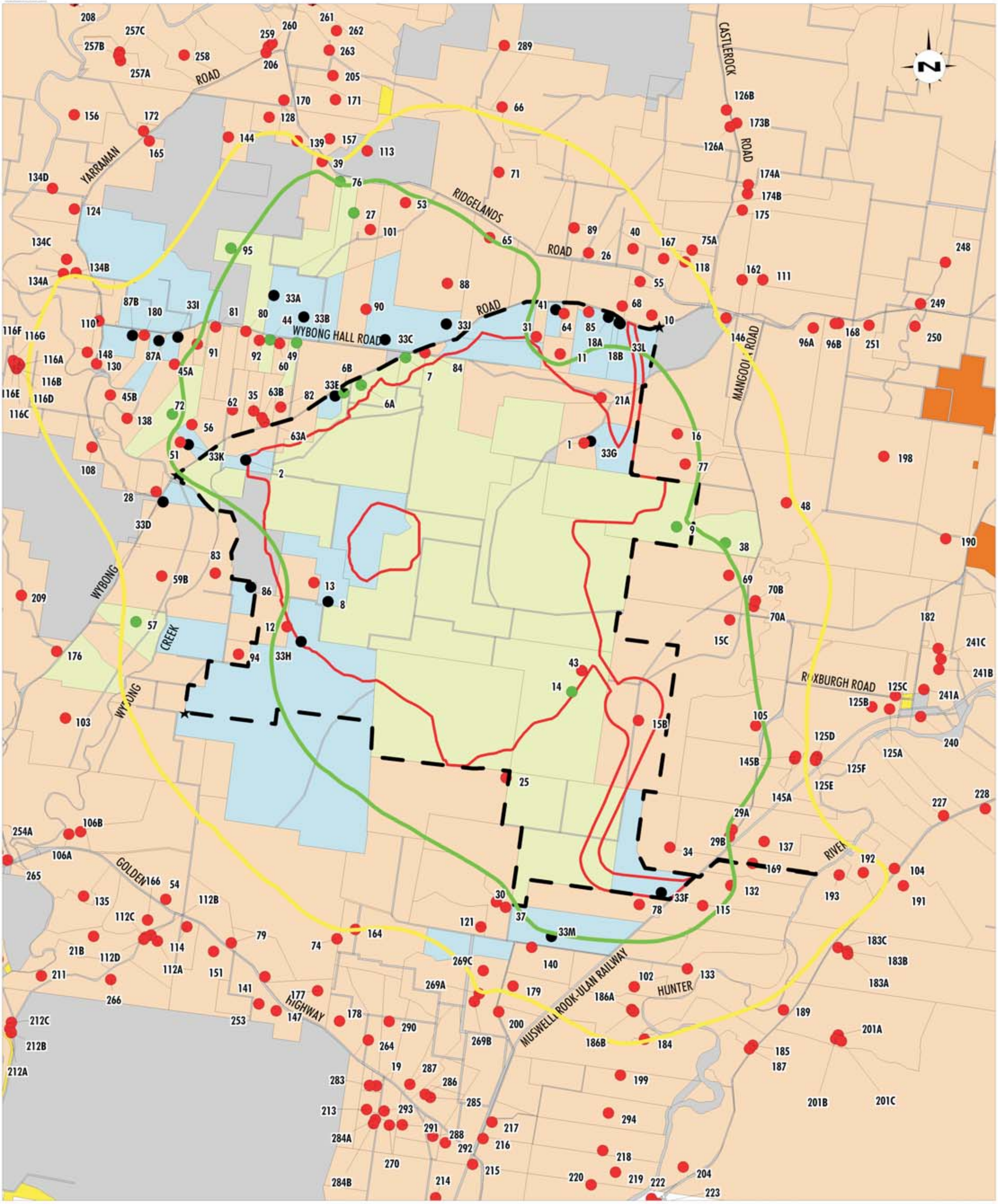
0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.8

Year 2 Night Time Noise Contours



Source: Dept of Lands (2003), Wilkinson Murray Pty Limited (2006)

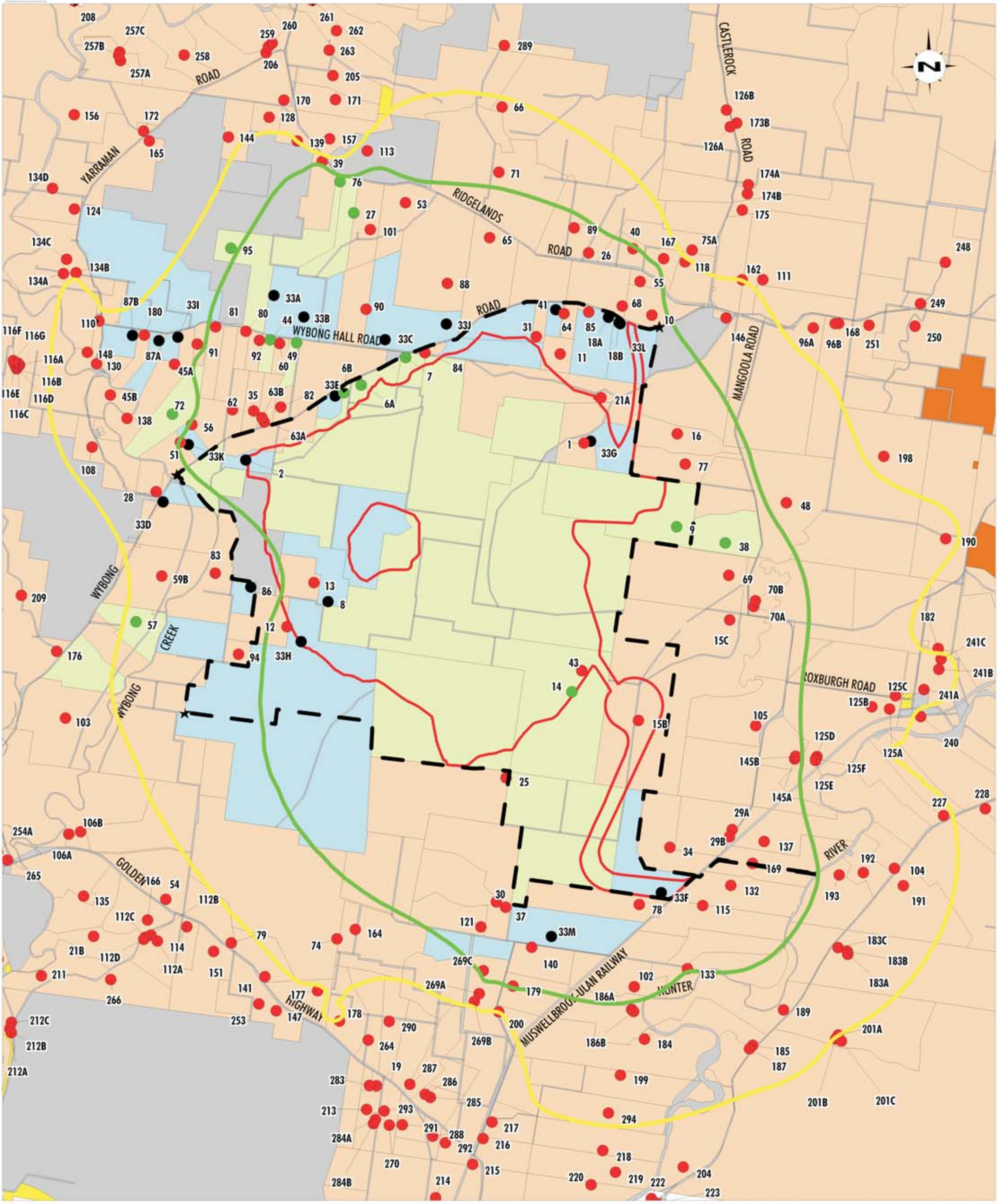
0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.9

Year 5 Daytime Noise Contours



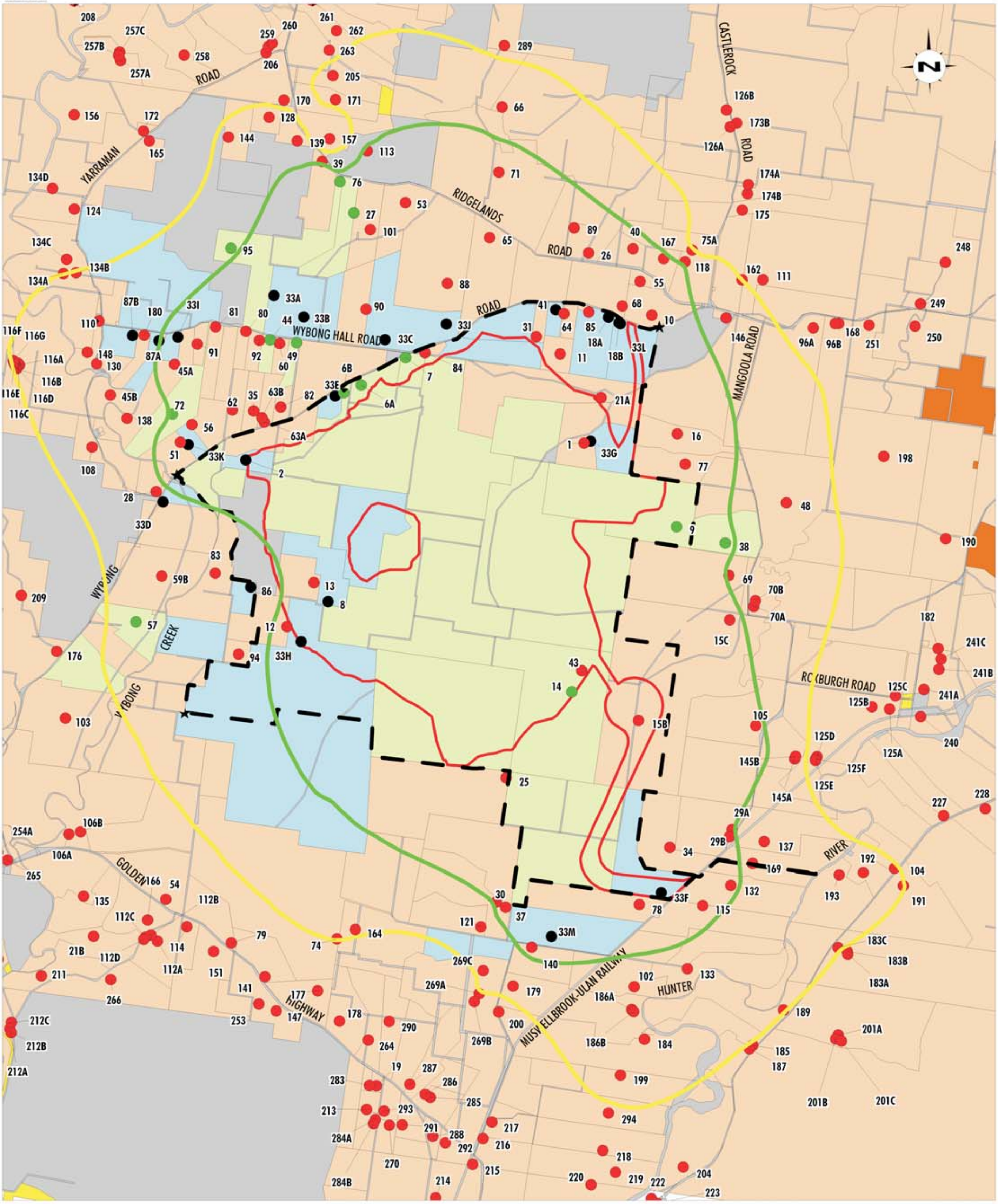
Source: Dept of Lands (2003), Wilkinson Murray Pty Limited (2006)

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.10

Year 5 Night Time Noise Contours



Source: Dept of Lands (2003), Wilkinson Murray Pty Limited (2006)

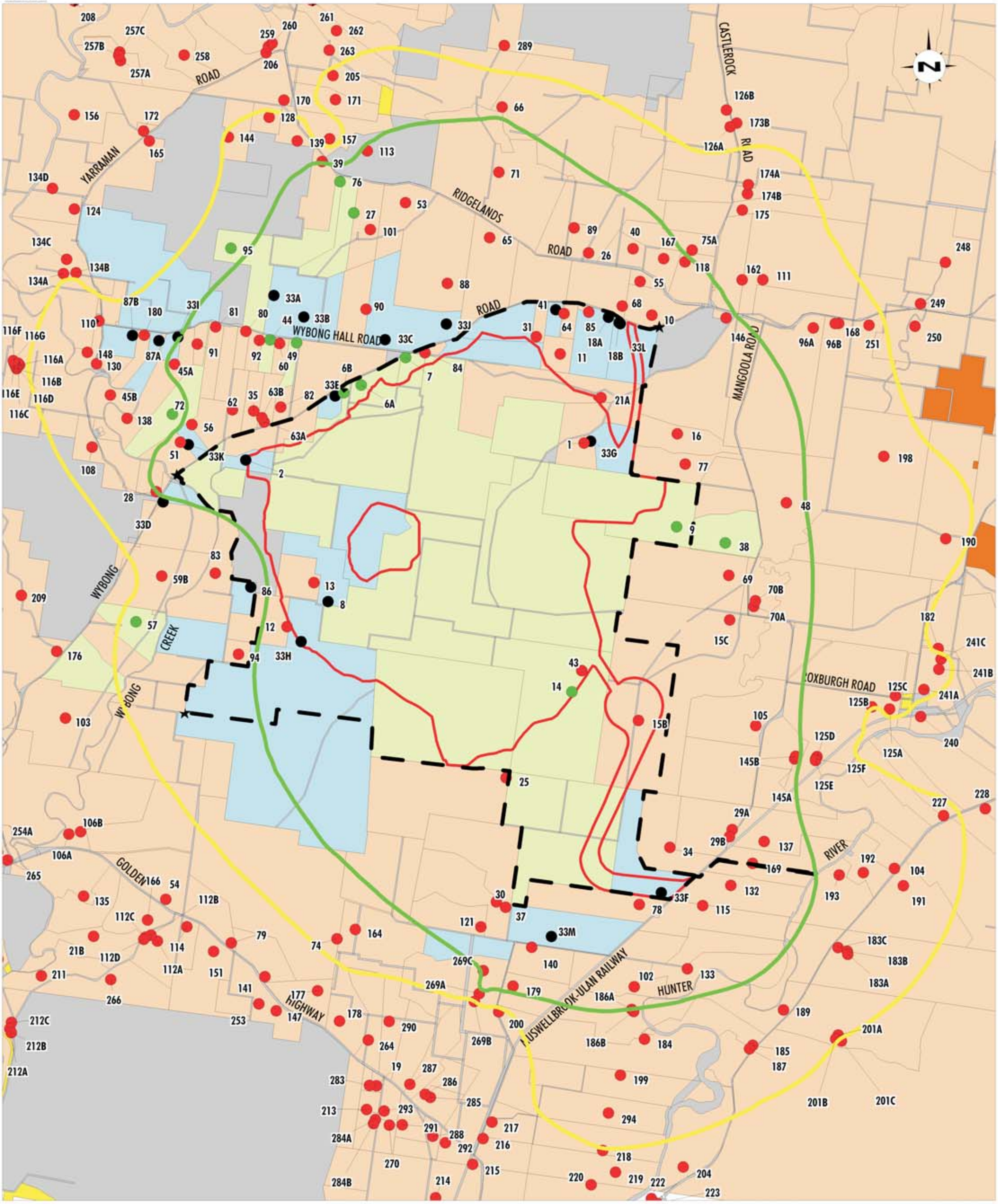
0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.11

Year 10 Daytime Noise Contours



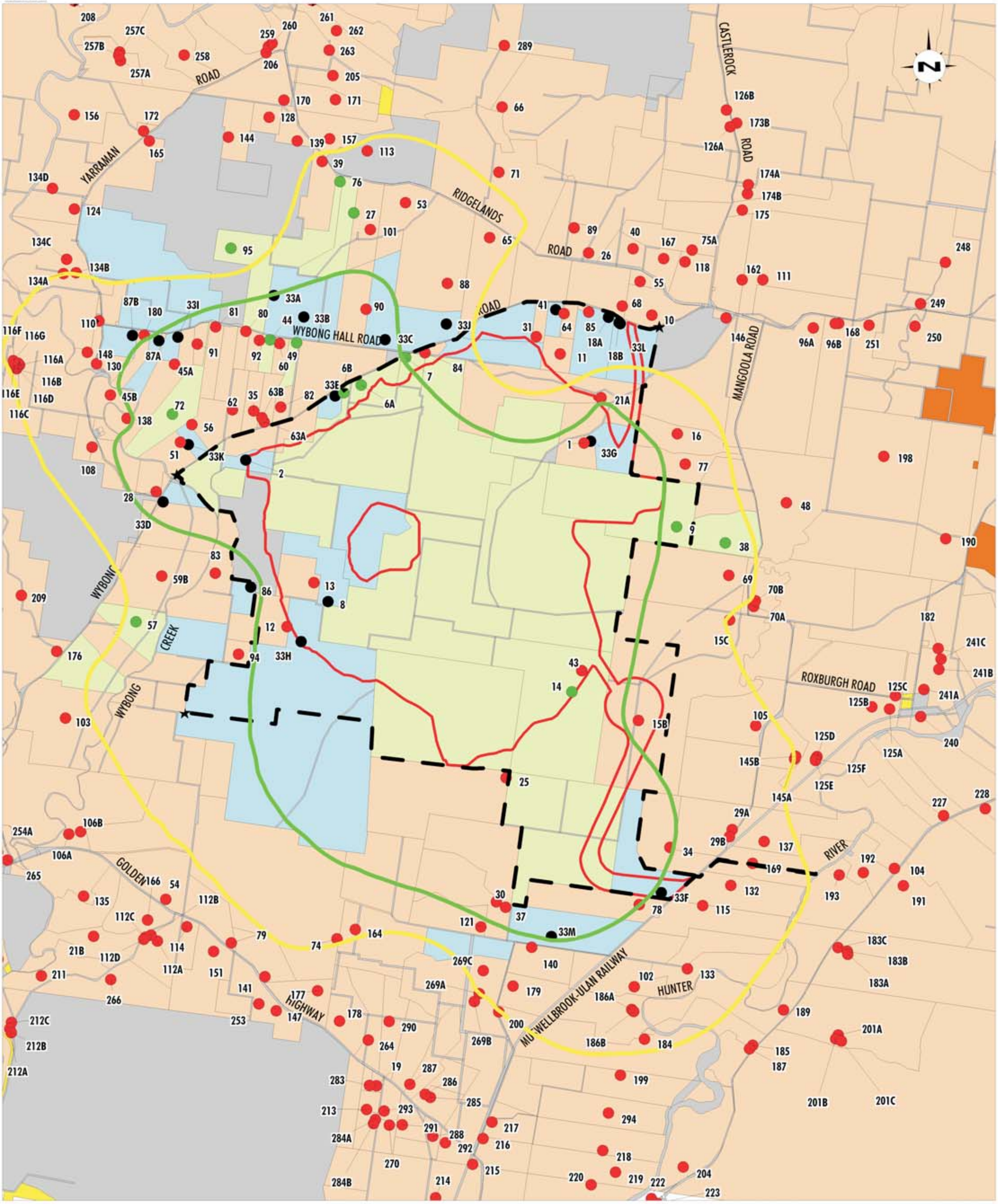
Source: Dept of Lands (2003), Wilkinson Murray Pty Limited (2006)

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.12

Year 10 Night Time Noise Contours



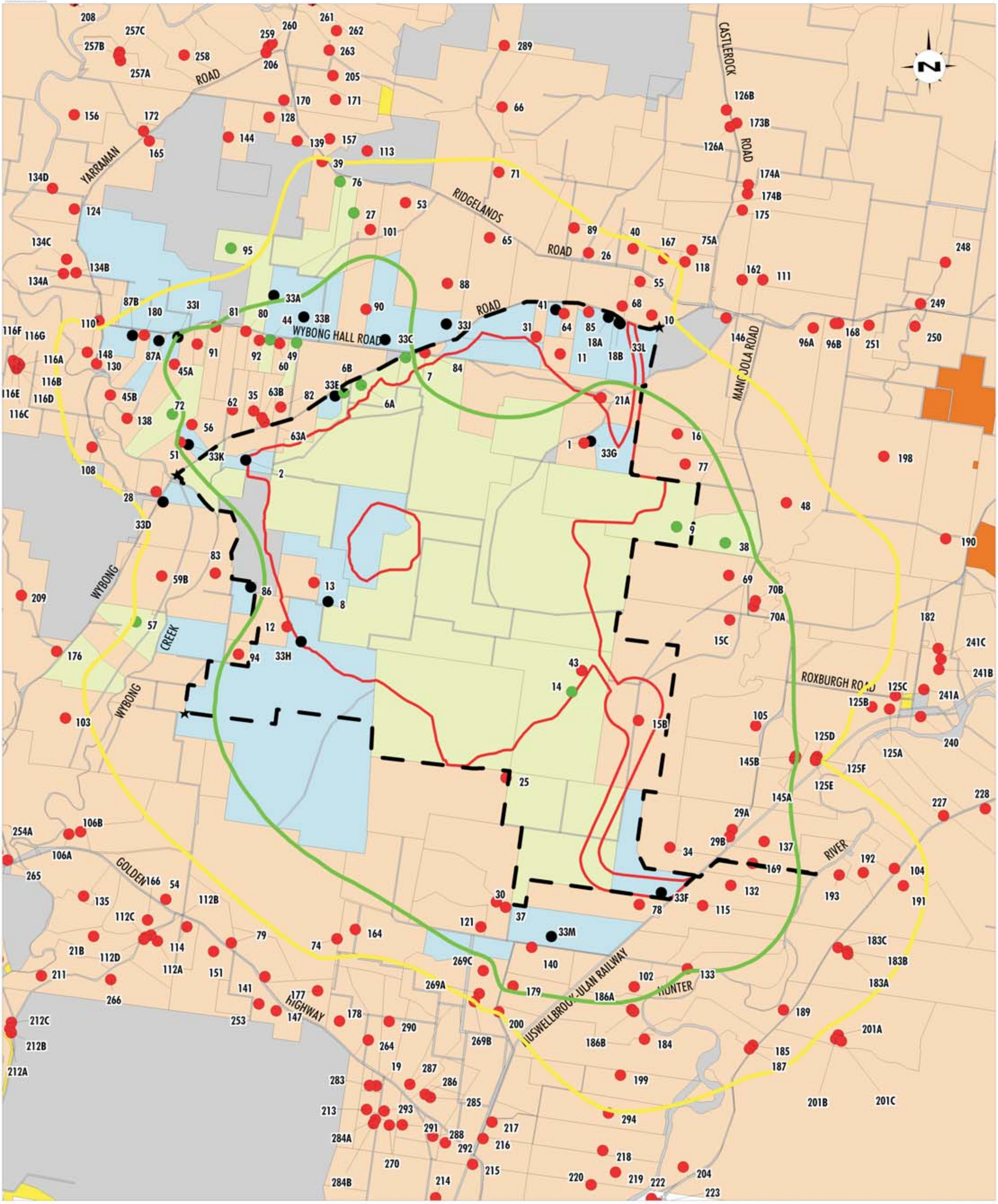
Source: Dept of Lands (2003), Wilkinson Murray Pty Limited (2006)

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.13

Year 15 Daytime Noise Contours



Source: Dept of Lands (2003), Wilkinson Murray Pty Limited (2006)

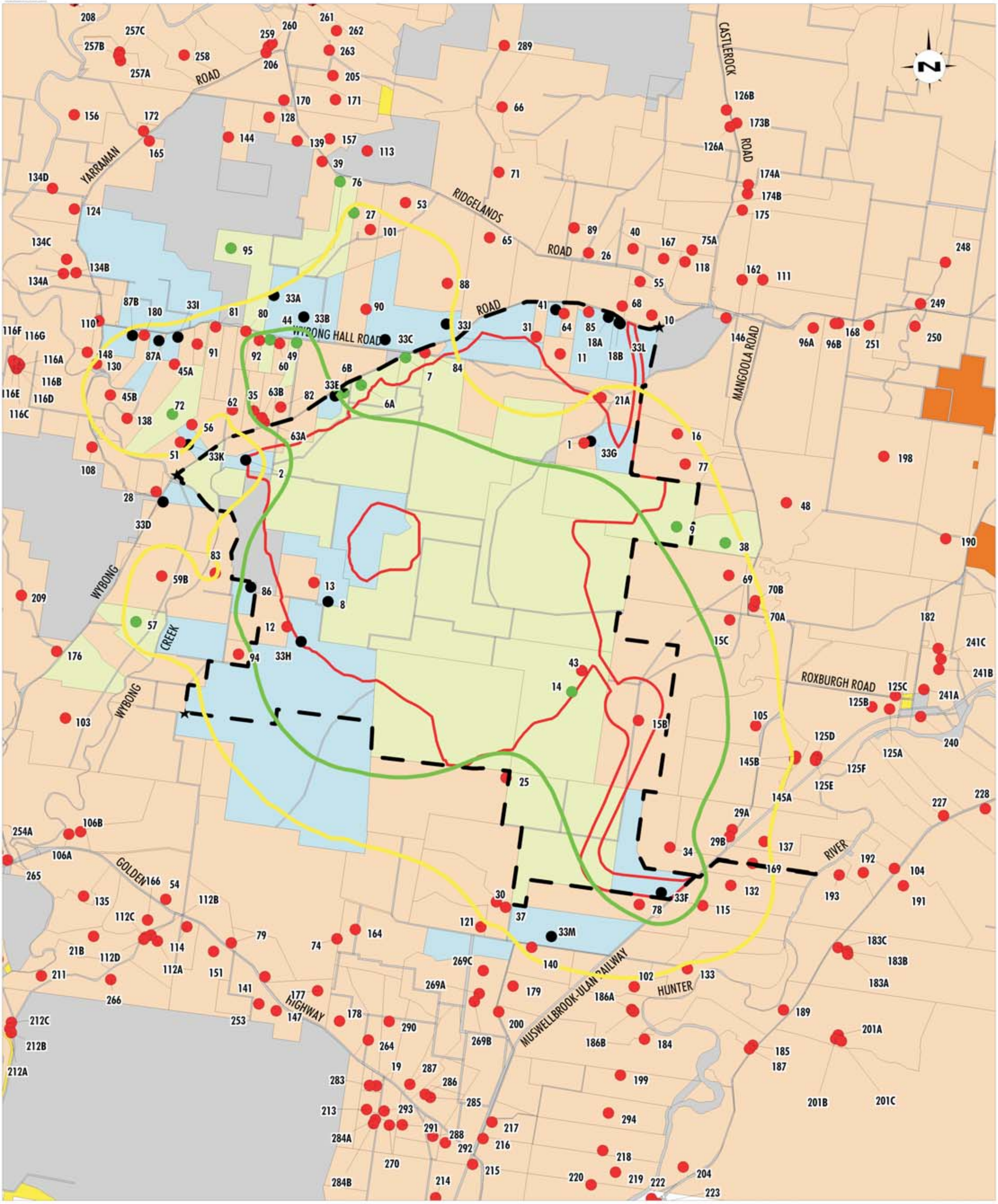
0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.14

Year 15 Night Time Noise Contours



Source: Dept of Lands (2003), Wilkinson Murray Pty Limited (2006)

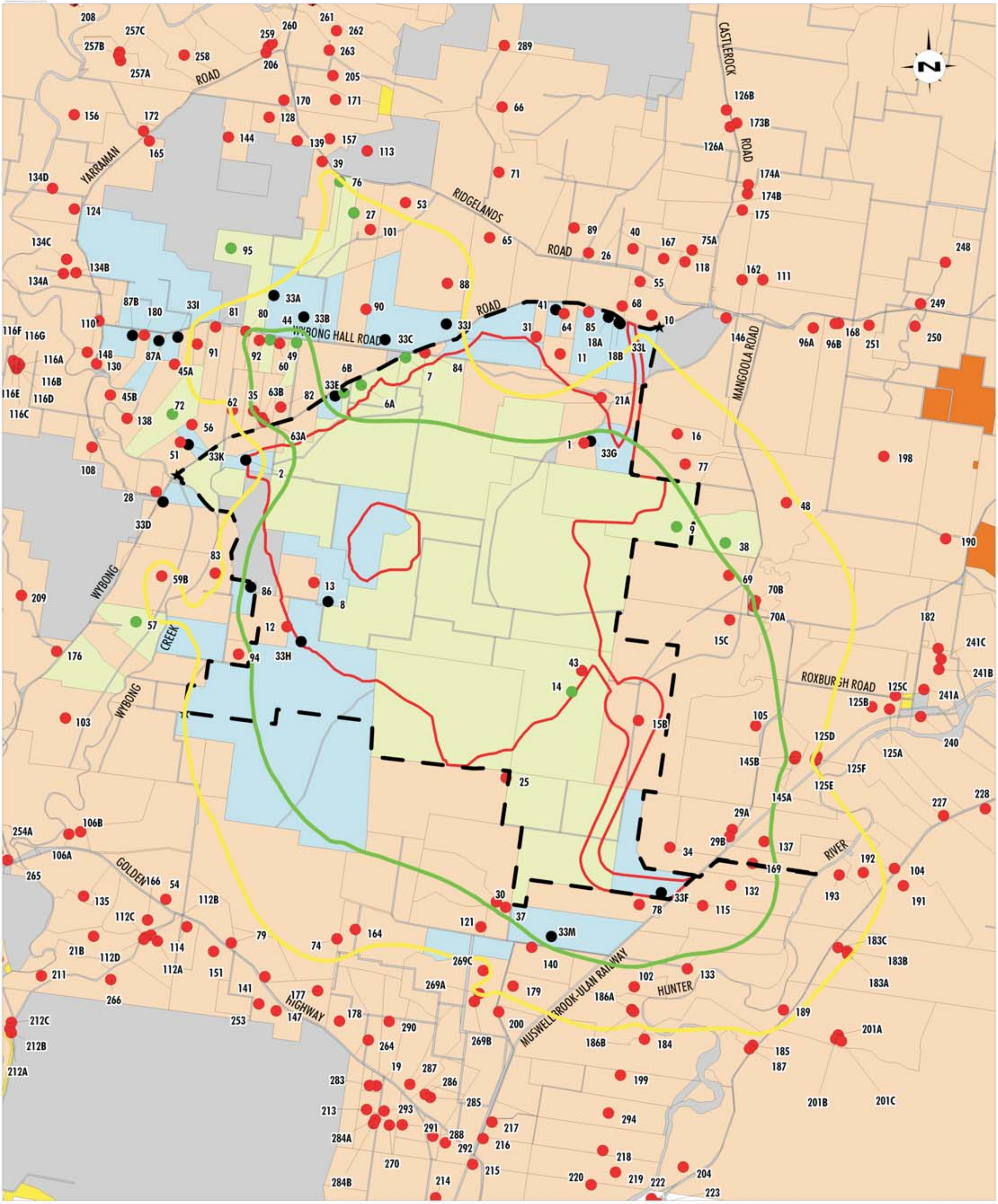
0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.15

Year 20 Daytime Noise Contours



Source: Dept of Lands (2003), Wilkinson Murray Pty Limited (2006)

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 6.16

Year 20 Night Time Noise Contours

Table 6-5 Summary of Operational Noise Impacts

Operational Year	No. of Private Residences with Predicted Noise Levels Exceeding Criteria	
	> 40dBA	35-40dBA
Construction Phase		
Daytime	21	26
Year 2		
Daytime	26	46
Evening	27	41
Night	47	61
Year 5		
Daytime	32	55
Evening	32	54
Night	59	55
Year 10		
Daytime	53	55
Evening	53	55
Night	69	59
Year 15		
Daytime	25	52
Evening	24	52
Night	46	44
Year 20		
Daytime	12	38
Evening	12	37
Night	27	33

Table 6-6 summarises impacts at private residences of the operational life of the proposal, showing numbers of residences predicted to have operational noise levels exceeding the criteria at any stage.

Table 6-6 Summary of Operational Noise Impacts over all years

All Years	No. of Private Residences with Predicted Noise Levels Exceeding Criteria	
	> 40dBA	35-40 dBA
	71	71

6.2.7 Predicted Noise Levels at Places of Worship

Noise levels at the two churches near the proposal are estimated from the worst-case 10^{th} percentile noise contours. The relevant noise level was taken as the maximum of the levels from daytime and evening contours at these locations. Table 6-7 compares this level with the adopted external noise level criterion derived in Section 3.1.3.

Table 6-7 External Noise Levels at Places of Worship

Location	Predicted Worst-Case Daytime Noise Level (dBA)	Adopted External Criteria (dBA)
Anglican Church, Castlerock Road	38	45
Catholic Church, Wybong Road	37	45

Both places of worship have predicted worst-case noise levels within the adopted external noise level criterion, ensuring compliance with the recommended internal noise level.

6.3 Potential for Sleep Disturbance

Although the *NSW Industrial Noise Policy (INP)* does not specifically address sleep disturbance, the NSW Department of Environment & Conservation (DEC) have published a Noise Guide for Local Government which states:

> *Where sleep disturbance is being assessed, $L_{A1,60\ seconds}$ or L_{Amax} noise level is most appropriate, and the measurement position might be outside the bedroom window. Sleep may be disturbed if the source noise level exceeds the background noise by more than 15dBA.*

Based on the adopted night time RBL for the proposal, the sleep disturbance criterion is shown in Table 6-8 below.

Table 6-8 Sleep Disturbance Criterion, L_{Amax}

Descriptor	Night Time(10.00pm-7.00am)
L_{Amax}	45dBA

However the maximum instantaneous sound pressure level for typical plant around the proposal would be less than 5dBA above the sound power level used in noise modelling. On this basis, any properties with potential to experience noise levels above the L_{Amax} criteria will also experience noise levels above the 40dBA operational criterion.

6.4 Cumulative Noise Impacts

No existing industrial noise sources were identified at residences during attended measurements near the proposed disturbance boundary. However, it is possible that some of the residences considered in this study may be affected by noise from other mining operations, particularly those residences on the eastern boundary of the area considered. Given the distance to nearest mining operations (approximately 12km to the east), any residences affected by noise from other mines can be expected to have L_{Aeq} noise levels from Anvil Hill which are significantly below the relevant amenity criterion of 40dBA. In this case, exceedance of the amenity criterion would require that noise from these other mines was the dominant noise source, and probably that noise from the other mines would exceed their own relevant noise criteria.

In most cases, no direct information is available on predicted noise levels from other mines at residences potentially affected by noise from Anvil Hill. However, one receiver point to the extreme east of the proposal was found to also be included in the Mount Arthur North (MAN) Environmental Impact Statement. This residence, 273B, is referred to in the MAN EIS as "Denman Road West". The maximum calculated night time noise level at this residence due to the proposal is 30dBA, whereas the MAN EIS indicates a maximum level of approximately 36dBA. These noise levels are unlikely to occur simultaneously, but if they do the total noise level at this residence would be approximately 37dBA, which remains within the relevant amenity criterion.

The same residence is potentially affected by noise from other mines, notably Bengalla and Mount Pleasant. However, as noted in the MAN EIS, with these sources included the total noise level is unlikely to exceed 40dBA L_{Aeq}. In any case, the Anvil Hill project, at 30dBA, would make a negligible contribution to the total industrial noise level at this location.

Although information on noise levels from other mines is not available for other residences, the same assessment would apply to residences close to residence 273B. At other residences closer to the Anvil Hill Project, where calculated noise levels from Anvil Hill approach the amenity criterion of 40dBA L_{Aeq}, approximate calculations indicate that noise from the other mines would make a negligible contribution to the total noise level, and the assessment can consider Anvil Hill alone, as above.

6.5 Low Frequency Noise Impacts

Potential sources of low frequency noise are unknown at this stage and experience suggests that such impacts have only occasionally been noted at similar operations. These impacts may be as a result of low frequency noise and or vibration from processing equipment. It is not possible to predict such impacts at the planning stage, however if such noise is found to occur at levels similar to those referred to in Section 3.5, the Environmental Management Plan for the proposal will specify methods of investigation to allow appropriate treatment methods to be devised. This may include specific structural monitoring and treatment.

7 OFF-SITE TRANSPORTATION NOISE IMPACTS

This section addresses potential noise impacts from vehicles using the local road and rail networks. Traffic noise impacts include car and truck movements to and from the proposal. Rail noise impacts are from train movements associated with the transportation of coal on the Muswellbrook to Ulan line. Rail noise impacts from trains on the proposed Anvil Hill rail spur are considered part of the overall operational noise impact and are assessed in Section 6 of this report.

7.1 Road Traffic Noise Impacts

The Anvil Hill Project has potential to generate additional traffic on public roads as a result of staff arrivals and departures, and also from heavy vehicle deliveries of supplies. Potential noise impacts at residences from two scenarios have been addressed in this assessment:

- Impacts during the infrastructure construction period; and
- Impacts during the peak operational period of the proposal.

The approved Bengalla Link Road will extend the existing Bengalla Link Road to Wybong Road west of the Roxburgh Road intersection. A mine access road is also proposed approximately 7km west of the new Bengalla Link Road. Traffic entering and leaving the mine via the access road will be directed to use Wybong Road and the Bengalla Link Road to join Denman Road, from where traffic can access the major road network. A traffic report by TPK & Associates Pty Ltd has indicated that at the Bengalla Link Road and Denman Road intersection, less than 10% of traffic generated by the proposal would turn towards Denman, the vast majority continuing toward Muswellbrook.

Two 12 hours shifts are proposed from 7.30am-7.30pm and vice versa. It is likely that traffic noise levels in one hour could be impacted by both vehicles arriving on site and also by vehicles departing from the previous shift. The number of workers required will vary over the life of the proposal and as such employee traffic numbers have been based on the peak operational year.

A mine at Mount Pleasant was approved in 1999 and traffic from that mine is proposed to share some of the road network with traffic generated by the Anvil Hill proposal. The Environmental Impact Statement for Mount Pleasant did not specify shift start and finish times, rather nominating a window between 6.00-8.00am or 6.00-8.00pm for the two shifts. It is possible that shifts at Mount Pleasant would coincide with those proposed for the Anvil Hill Project, and consequently traffic from the two operations would share the road network at the same time. As a result the following analysis examines potential road traffic noise impacts for the Anvil Hill Project and also potential cumulative noise impact from both operations having the same shift cycles.

Given the proposed 7.30am start time, it is likely that cars arriving for that shift would be on the local road network between 7.00-7.30am. Similarly cars going home from the night shift would be on local roads between 7.30-8.00pm. The following analysis assesses road traffic noise impacts against the *ECRTN* criteria derived in Section 4.

7.1.1 Existing Traffic Flows

Existing traffic movements on the local road network have been taken from counts provided in a transport study undertaken by TPK & Associates Pty Ltd. Table 7-1 outlines the measured traffic flows on Wybong Road from Wednesday, 7 December 2005 to Tuesday, 13 December 2005. The total traffic volume for each hour is provided as a seven day average. The counter did not distinguish between light and heavy vehicles. A second survey was conducted at the intersection of Wybong Road and Kayuga Road on Wednesday, 8 February 2006 between 6.45-9.30am and again between 2.45-5.30pm, where vehicles were classified into light and heavy vehicles. TPK & Associates has advised that the proportion of heavy vehicles on Wybong Road to be used in assessment of traffic noise levels is 10%.

Table 7-1 Existing Traffic Volumes on Wybong Road, Vehicles Per Hour

Start Time	7 day Average	
	North-Bound	South-Bound
midnight	0.1	0.4
1.00am	0.7	0.1
2.00am	0.3	0.0
3.00am	0.1	0.4
4.00am	1.0	0.9
5.00am	5.9	2.1
6.00am	6.6	3.4
7.00am	9.4	8.1
8.00am	16.9	8.6
9.00am	14.1	7.3
10.00am	12.0	9.3
11.00am	q	10.0
12.00pm	9.4	10.3
1.00pm	10.0	10.1
2.00pm	8.0	15.7
3.00pm	8.4	12.4
4.00pm	8.4	12.3
5.00pm	9.0	11.1
6.00pm	8.4	10.9
7.00pm	5.0	7.7
8.00pm	2.3	3.9
9.00pm	1.9	2.1
10.00pm	1.0	2.0
11.00pm	0.6	0.7

No weekly traffic count data is available for existing traffic on Denman Road; however counts of existing am and pm peak intersection traffic have been undertaken at the junction of Denman Road and Bengalla Road. These counts are shown in Table 7-2 and Table 7-3.

Table 7-2 Existing Traffic Volumes on Denman Road AM Peak

Time	ALL	Light Vehicles	Heavy Vehicles
6.45am	121	109	12
7.00am	83	79	4
7.15am	62	47	15
7.30am	73	60	13
7.45am	71	51	20
8.00am	74	65	9
8.15am	72	56	16
8.30am	58	45	13
8.45am	65	56	9
9.00am	61	52	9
9.15am	65	53	12
9.30am	64	57	7

Table 7-3 Existing Traffic Volumes on Denman Road PM Peak

Time	ALL	Light Vehicles	Heavy Vehicles
2.45pm	50	45	5
3.00pm	60	52	8
3.15pm	62	57	5
3.30pm	80	70	10
3.45pm	77	61	16
4.00pm	84	66	18
4.15pm	93	84	9
4.30pm	83	73	10
4.45pm	74	66	8
5.00pm	63	60	3
5.15pm	78	72	6
5.30pm	83	79	4

In addition to the above peak counts, TPK & Associates Pty Ltd has advised that the total AADT at this intersection would be in the order of 3,500 vehicles per day with the flows split over the relevant periods for assessment as shown in Table 7-4. This analysis is based on a permanent RTA counting station at Denman. The new Bengalla Link Road has not been opened at the time of writing and it is assumed that the existing flow on this road would be equivalent to existing flows on Wybong Road.

Table 7-4 Existing Traffic Volumes on Denman Road at Bengalla Link Road

Time Period	Number of Vehicles
7.00-8.00am	277
7.00-8.00pm	250

7.1.2 Operational Traffic Noise Impacts

Future peak predicted traffic movements for early morning and evening arrivals and departures are shown in Table 7-5 and Table 7-6 respectively. The following assumptions have been made with regard to potential traffic flows during shift changeover.

- Administrative staff arrivals have been combined with shift-worker movements for 7.30am arrivals. They are likely to depart separately although it is reasonable that up to four may depart at the same time as shift workers (7.30pm). The potential impact of separate administrative staff departures at 5.00pm would be negligible and has not been assessed.
- Half of all visitor arrivals coincide with the 7.30am shift change. It is likely that visitor movements would be distributed evenly over the day.
- Shift workers are divided into four groups, with two active every day.
- Half of all heavy vehicle movement arrivals coincide with each shift change. It is likely that heavy vehicle movements would be distributed more evenly over the day.
- A conservative level of car sharing has been adopted resulting in a high car usage rate of between 80% and 85%. This is consistent with similar operations in the area and has been applied to shift workers and administrative staff only.

Table 7-5 Predicted Peak Operational Traffic Movements – AM shift change

Peak Anvil Hill Project AM Movements (7.00-8.00am)						
Activity	**Total Employees**	**No. on Site per Day**	**Sharing Adjustment**	**Movements in Worst-Case Hour**		
				Arrivals	**Departures**	**Total**
Shift Employees	227	118	0.825	49	49	98
Day Employees	13	13	0.825	11	0	11
Visitors		20		10	0	10
Heavy Vehicles		10		5	1	6
Total	**240**	**161**		**75**	**50**	**125**

Table 7-6 Predicted Peak Operational Traffic Movements – PM shift change

Peak Anvil Hill Project PM Movements (7.00-8.00pm)						
Activity	**Total Employees**	**No. on Site per day**	**Sharing Adjustment**	**Movements in Worst-Case Hour**		
				Arrivals	**Departures**	**Total**
Shift Employees	227	118	0.825	49	49	98
Day Employees	13	13	0.825	0	4	4
Visitors		20		0	1	1
Heavy Vehicles		10		1	2	3
Total	**240**	**161**		**50**	**56**	**106**

Table 7-7 shows the increase in noise levels due to operational traffic during the specified shift changeover periods on Wybong Road, Bengalla Link Road and Denman Road.

Table 7-7 Maximum Increase in Traffic Noise Levels

Location	**Increase in Traffic Noise Levels (dBA)**	
	7.00-8.00am	**7.00-8.00pm**
Wybong Road / Bengalla Link Road	7	11
Denman Road (towards Muswellbrook)	1	1

The increase in noise levels due to traffic generated by the proposal is within the *ECRTN* allowance criterion for residences on Denman Road at all times. As 90% of traffic would turn left at Denman Road towards Muswellbrook, the impact of vehicles turning right towards Denman has not been assessed but would clearly have negligible impact. The predicted increase in traffic noise levels of between 7-11dBA on Wybong Road and Bengalla Link Road is significant and as such, further detailed investigation of traffic noise levels on these roads is warranted and is addressed in Section 7.1.3.

7.1.3 Prediction of Traffic Noise Levels on Wybong Road / Bengalla Link Road

Noise levels from both the existing and proposed traffic were calculated at individual residences using procedures based on the CoRTN (Calculation of Road Traffic Noise UK DoE Traffic Noise Prediction Method 1988) prediction algorithms. The standard prediction procedures were modified in the following ways.

- L_{Aeq} values were calculated from the L_{A10} values predicted by the CoRTN algorithms using the well-validated approximation $L_{Aeq,1hr} = L_{A10,1hr} - 3$.
- Noise source heights were set at 0.5m for cars and heavy vehicle tyres, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representing typical values for Australian vehicles. Noise from a heavy vehicle exhaust was assessed as 8dBA lower than the noise from the engine.

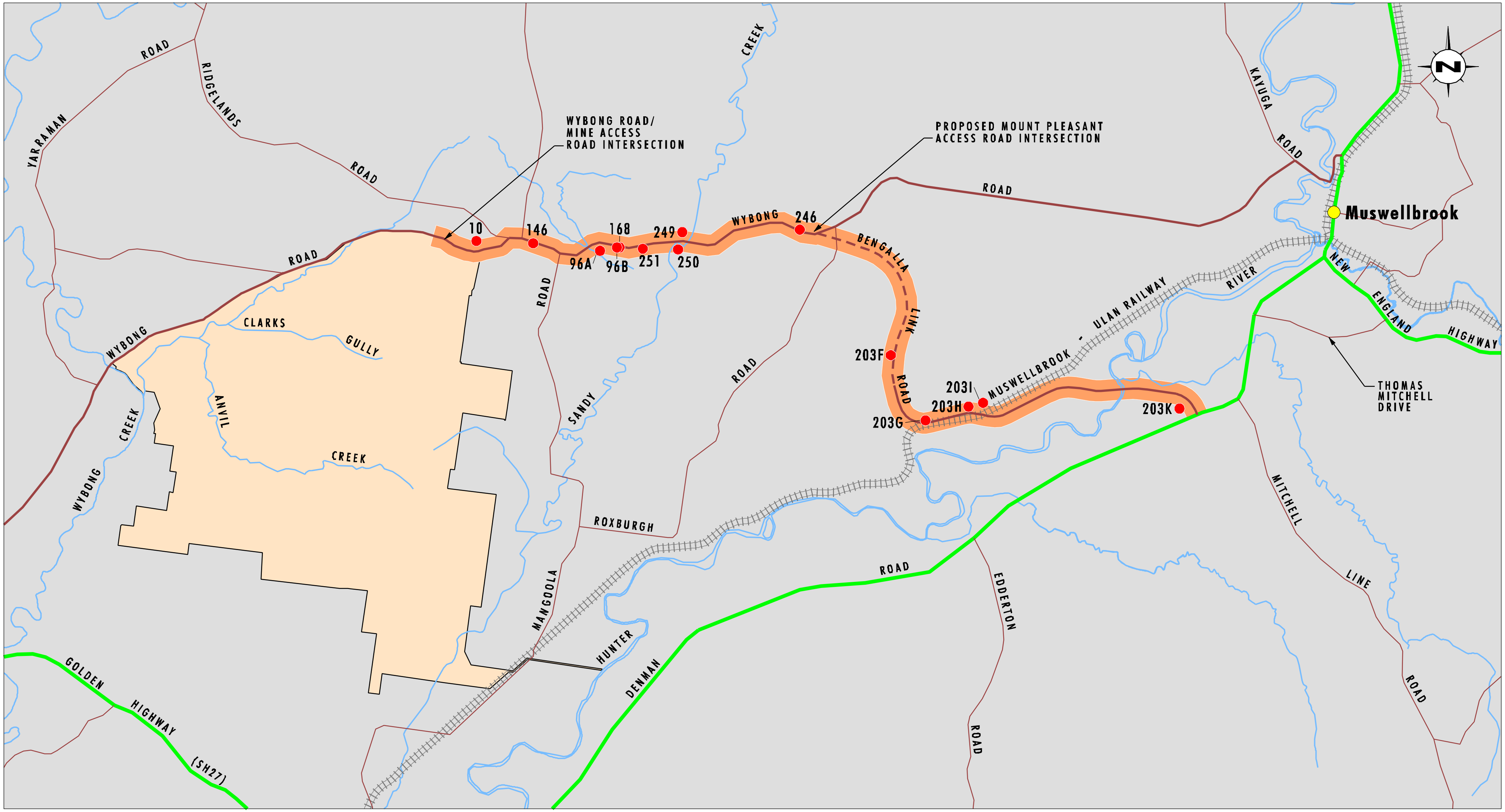
The models were implemented using *ROADent* software, based on road points at 10m intervals along Wybong Road and Bengalla Link Road. Where there are no barriers present, ground was taken to be 50% soft. This has previously been found to give a good correlation with measured noise levels in similar situations. With barriers, hard ground is assumed, as required under the CoRTN procedures.

The existing road surface is modelled as chipseal with a CoRTN correction of 2.5dBA, with speeds of both light and heavy vehicles modelled at 100 kph which is consistent with the existing speed limit in the area. Speed limits on Bengalla Link Road are not yet known and traffic is modelled at the likely limit of 80kph.

Table 7-8 and Table 7-9 show the predicted existing and future noise levels for houses within 250m of either road between the proposed mine access road and the intersection with Denman Road. These residences are shown in Figure 7-1. The calculated noise levels are then compared with the appropriate *ECRTN* criteria.

Table 7-8 Calculated Traffic Noise Levels – 7.00-8.00am

Residence	Nearest Road	Distance from Road (m)	$L_{Aeq, 1hr}$ Noise Level (dBA)		
			Existing	Future	Criterion
10	Wybong	175	45.5	52	55
146	Wybong	100	48.5	55	55
168	Wybong	80	49.5	56.5	55
246	Wybong	75	49.5	56	55
249	Wybong	80	49.5	55.5	55
250	Wybong	250	44	50.5	55
251	Wybong	120	46.5	53	55
96A	Wybong	200	46.5	53	55
96B	Wybong	90	49.5	56	55
203F	Bengalla Link	65	48	54.5	55
203G	Bengalla Link	50	50	56.5	55
203H	Bengalla Link	120	44.5	51.5	55
203I	Bengalla Link	220	42.5	49	55
203K	Bengalla Link	210	42	49	55



Source: TPK & Associates Pty Ltd (2006), Dept. of Lands (2003)

Legend

- Project Area
- Major Road
- Proposed Road
- Modelled Section of Road

FIGURE 7.1

Residences and Roads Modelled for Road Traffic Noise

The calculated noise levels show marginal exceedances of the *ECRTN* criterion at four residences on Wybong Road of between 0.5-1.5dBA for the period 7.00-8.00am. One residence on Bengalla Link Road has an exceedance of 1.5dBA.

Table 7-9 Calculated Traffic Noise Levels – 7.00-8.00pm

Residence	Nearest Road	Distance from Road (m)	$L_{Aeq, 1hr}$ Noise Level (dBA)		
			Existing	Future	Criterion
10	Wybong	175	39.5	50.5	55
146	Wybong	100	42.5	53.5	55
168	Wybong	80	44	54.5	55
246	Wybong	75	43.5	54	55
249	Wybong	80	43	54	55
250	Wybong	250	38	49	55
251	Wybong	120	40.5	51.5	55
96A	Wybong	200	40	51	55
96B	Wybong	90	43.5	54	55
203F	Bengalla Link	65	42.5	53.5	55
203G	Bengalla Link	50	44.5	55	55
203H	Bengalla Link	120	39	50	55
203I	Bengalla Link	220	37	48	55
203K	Bengalla Link	210	36.5	47.5	55

During the period 7.00-8.00pm all residences have calculated noise levels that meet the *ECRTN* criterion. The early morning period of 7.00-8.00am is the only time where there are predicted exceedances of the *ECRTN* criteria. In terms of impacts at residences, there would be a noticeable change in the acoustic environment for that hour and monitoring of traffic noise levels at these residences should be conducted to ensure compliance with the appropriate criteria.

If measured noise levels are found to exceed *ECRTN* criteria, then appropriate noise mitigation measures would be offered to residents. Potential noise mitigation measures include the provision of air conditioning or mechanical ventilation to allow windows to be kept closed.

7.1.4 Construction Traffic Impacts

Whilst there are no specific criteria that govern noise levels associated with traffic involved in short term activities such as the construction of the project infrastructure and facilities, guidance must be taken from the *ECRTN* criteria for operational traffic noise.

Initial estimates of the labour force required in construction activities indicate a total workforce of 500 contractors over the course of the one year construction period. The expected peak total traffic numbers during the construction period are shown in **Table 7-10**.

Table 7-10 Predicted Daily Peak Construction Traffic Movements

Activity	Peak No. on Site per Day	No. of Movements Worst-Case Hour
Contractors	200	165
Visitors	20	20
Heavy Vehicles	12	6
Total	232	191

Heavy vehicle arrivals and departures are likely to be distributed evenly throughout the day; however as a worst case it is assumed that 50% of all movements could happen in the same hour as the arrival and / or departure of contractors and visitors. In addition, a conservative level of car sharing has been adopted resulting in a high car usage rate of between 80% and 85%.

Based on overall traffic volumes, the highest traffic noise levels at residences during the construction period would be expected to be 2-3dBA higher than the highest hourly daytime operational traffic noise levels, as shown in Table 7-10. They would therefore exceed the daytime criterion for operational traffic noise by a maximum of 4.5dBA. However construction traffic is likely to be at a peak for only 2-3 months during the 12 month construction period and any impacts at residences can be considered short-term. Under these circumstances these noise impacts are considered acceptable.

7.1.5 Maximum Noise Levels during Vehicle Passbys

Noise levels from individual vehicle passbys during the night time period have the potential to cause sleep disturbance. Given that shifts start at 7.30am, traffic would not generally be passing residences during the period that is defined as night in the *ECRTN*. However there would be a possibility of infrequent out-of-hours deliveries occurring during the night time period and it is appropriate to assess possible impacts at residences on Wybong Road and Bengalla Link Road.

Procedures based on the FHWA (US Federal Highways Administration) traffic noise model methodology were used to calculate maximum noise levels at the closest identified residences from a typical heavy vehicle passby.

Calculated maximum noise levels are shown in Table 7-11. The maximum internal noise level within a bedroom, with windows open to provide adequate ventilation, is approximately 10dBA below the external noise level.

Table 7-11 Calculated Maximum Noise Levels from Heavy Vehicle Passbys at Residences

Residence	L_{Amax} Noise Level (dBA) External	L_{Amax} Noise Level (dBA) Internal
10	57-67	47-57
146	64-69	54-59
168	65-70	55-60
246	67-72	57-62
249	64-69	54-59
250	53-58	53-58
251	60-65	50-55
96A	56-61	46-51
96B	64-69	54-59
203F	64-69	54-59
203G	67-72	57-62
203H	58-63	48-53
203I	53-58	43-53
203K	53-58	43-53

Whilst there are no specific criteria to deal with maximum night time traffic noise levels, the *ECRTN* offers the following guidance:

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

Based on this guidance, whist there may be a possibility of adverse reaction to maximum levels from traffic noise the predicted levels are not considered high enough to affect health and wellbeing significantly. Internal maximum levels will be the same as existing maximum levels from trucks passing on Wybong Road and Bengalla Link Road.

7.2 Cumulative Traffic Noise Impacts

As discussed in Section 7.1, there is a possibility of the approved Mount Pleasant operation having the same shift cycle as the Anvil Hill project. Consequently cumulative traffic noise impacts need to be examined. Traffic will access the Mount Pleasant site via a number of link roads. The western link road will join the Bengalla Link Road near the Roxburgh Road intersection at which point the majority of traffic will turn left towards Denman Road. A small amount of traffic will turn right on to Wybong Road. The Mount Pleasant EIS outlines the distribution of mine traffic as shown in Table 7-12. Those routes relevant to the assessment of cumulative noise impacts are in italics.

Table 7-12 Mount Pleasant Traffic Distribution

Direction	Proportion	Approach Route (to/from)
South via Bengalla Link Road	*38%*	*Muswellbrook via Denman Road (E)*
	25%	*Via Thomas Mitchell Drive (S)*
	3%	*Edderton Road via Denman Road (W)*
North via Mount Pleasant Western Link Road	7%	Scone via Blairmore Lane
	5%	Scone via Dartbrook Road
	9%	Aberdeen via Dartbrook Link Road
	3%	Local rural areas via Dartbrook Link Road
	3%	Local rural areas via Kayuga Road
West via Wybong Road	4%	Denman via Roxburgh Road
	3%	*Sandy Hollow via Wybong Road (W)*

The Mount Pleasant EIS details likely operational traffic numbers including staff, heavy vehicle movements and visitors. Using similar assumptions with regard to shift cycles and car sharing as outlined in Section 7.1.2 of this report, the traffic flows for Mount Pleasant AM and PM shift changes are shown in Table 7-13 and. Table 7-14.

Table 7-13 Predicted Peak Operational Traffic Movements – AM shift change

Peak Mount Pleasant Mine AM Movements (7.00-8.00am)						
Activity	**Total Employees**	**No. on Site per day**	**Sharing Adjustment**	**Movements in Worst Case Hour**		
				Arrivals	**Departures**	**Total**
Shift Employees	350	176	0.825	73	73	146
Day Employees	30	25	0.825	21	0	21
Visitors		20		10	0	10
Heavy Vehicles		10		5	1	6
Total	**380**	**199**		**109**	**74**	**183**

Table 7-14 Predicted Peak Operational Traffic Movements – PM shift change

Peak Mount Pleasant Mine PM Movements (7.00-8.00pm)						
Activity	**Total Employees**	**No. on Site per day**	**Sharing Adjustment**	**Movements in Worst Case Hour**		
				Arrivals	**Departures**	**Total**
Shift Employees	350	176	0.825	73	73	146
Day Employees	30	25	0.825	0	8	8
Visitors		20		0	1	1
Heavy Vehicles		10		1	2	3
Total	**380**	**199**		**74**	**84**	**158**

The Mount Pleasant Mine proposal was approved in December 1999 and it has been assumed to start operations before the Anvil Hill Project. Operational traffic from Mount Pleasant would therefore be regarded as existing traffic. Using the traffic count data from Section 7.1.1 and the predicted peak hour traffic flows for the Anvil Hill Project, the cumulative noise impact of both mines operating with the same shift cycle can be addressed. Table 7-15 shows the increase in noise levels due to operational traffic during the specified shift changeover periods on Wybong Road, Bengalla Link Road and Denman Road.

Table 7-15 Maximum Increase in Traffic Noise Levels

Location	**Increase in Traffic Noise Levels (dBA)**	
	7.00-8.00am	**7.00-8.00pm**
Wybong Road / Bengalla Link Road	6.5	9.5
Bengalla Link Road	2	2.5
Denman Road (towards Muswellbrook)	0.5	1

The above cumulative increases in traffic noise levels are lower than those increases calculated in Section 7.1.3. This is as a result of the Mount Pleasant operational traffic being considered as part of the existing traffic flow. The impacts of additional traffic from the Anvil Hill Proposal would therefore show a lower net increase in noise levels when considered in isolation; however the overall noise level at residences would be higher due to all combined traffic.

The predicted increase in traffic noise levels of between 6.5-9.5dBA on Wybong Road and 2-2.5dBA on Bengalla Link Road is significant and as such, further detailed investigation of cumulative traffic noise levels on these roads is warranted and is addressed in Section 7.3.

7.3 Predicted Cumulative Noise Levels

The traffic noise model defined in Section 7.1.3 is now used to calculate the cumulative noise level resulting from both operations operating with the same shift cycle. Table 7-16 and Table 7-17 show the predicted existing and future noise levels for houses within 250m of either road between the proposed Anvil Hill access road and the intersection with Denman Road. The calculated noise levels are then compared with the appropriate *ECRTN* criteria. An allowance criterion is adopted where existing levels already exceed the base criterion and is indicated in brackets where relevant.

Table 7-16 Calculated Cumulative Traffic Noise Levels – 7.00-8.00am

Residence	Nearest Road	Distance from Road (m)	$L_{Aeq, 1hr}$ Noise Level (dBA)		
			Existing	Future	Criterion (Allowance)
10	Wybong	175	45.5	52	55
146	Wybong	100	48.5	55	55
168	Wybong	80	50	56.5	55
246	Wybong	75	49.5	56	55
249	Wybong	80	49.5	55.5	55
250	Wybong	250	44	50.5	55
251	Wybong	120	46.5	53	55
96A	Wybong	200	46.5	53	55
96B	Wybong	90	49.5	56	55
203F	Bengalla Link	65	55.5	58	(57.5)
203G	Bengalla Link	50	58	60	(60)
203H	Bengalla Link	120	52.5	54.5	55
203I	Bengalla Link	220	50	52.5	55
203K	Bengalla Link	210	50	52	55

Table 7-17 Calculated Cumulative Traffic Noise Levels – 7.00-8.00pm

Residence	Nearest Road	Distance from Road (m)	$L_{Aeq, 1hr}$ Noise Level (dBA)		
			Existing	Future	Criterion
10	Wybong	175	41	51.5	55
146	Wybong	100	44	53.5	55
168	Wybong	80	45.5	54.5	55
246	Wybong	75	45	54.5	55
249	Wybong	80	45	54	55
250	Wybong	250	39.5	49	55
251	Wybong	120	42	51.5	55
96A	Wybong	200	41.5	51	55
96B	Wybong	90	45	54	55
203F	Bengalla Link	65	54	56.5	(56)
203G	Bengalla Link	50	56.5	58.5	(58.5)
203H	Bengalla Link	120	51	53	55
203I	Bengalla Link	220	48.5	51	55
203K	Bengalla Link	210	48.5	51	55

Future traffic noise levels on Wybong Road are generally the same as those calculated in Section 7.1.3. Noise levels on Bengalla Link Road increase by up to 3.5dBA from those levels calculated in Section 7.1.3, however higher existing noise levels mean that some residences have an *ECRTN* allowance criteria.

7.4 Summary of Operational Traffic Noise Impacts

Calculated noise levels from operational traffic associated with the Anvil Hill Project generally meet or marginally exceed the *ECRTN* noise level criterion for daytime when considered in isolation, and also when cumulative impacts from the Mount Pleasant Mine are considered. The maximum predicted exceedance of any criterion under either scenario is 1.5dBA.

7.5 Rail Noise Impacts – Muswellbrook to Ulan line

The proposed development has the potential to generate additional rail movements on the Muswellbrook to Ulan line. This line is currently used for transportation of coal and other resources from the following industrial facilities:

- Cobar Mine
- Ulan Mine
- Bengalla Mine

In addition, the following developments have been approved and are assumed to be operational at the same time as the Anvil Hill Project:

- Wilpinjong Coal Project
- Mount Pleasant Coal Mine

7.5.1 Predicted Increase in Rail Noise Levels

With regard to L_{Amax} levels at residences; there will be no change in levels as freight trains already run on the Muswellbrook to Ulan line.

In order to assess increases in noise levels at residences, it is necessary to consider three distinct sections of the line:

- Anvil Hill Project rail spur to Mount Pleasant rail spur;
- Mount Pleasant rail spur to Bengalla rail spur; and
- Bengalla rail spur to Muswellbrook

Figure 7.2 shows the orientation of the various operations under consideration.

Figure 7-2 Rail Network under Assessment

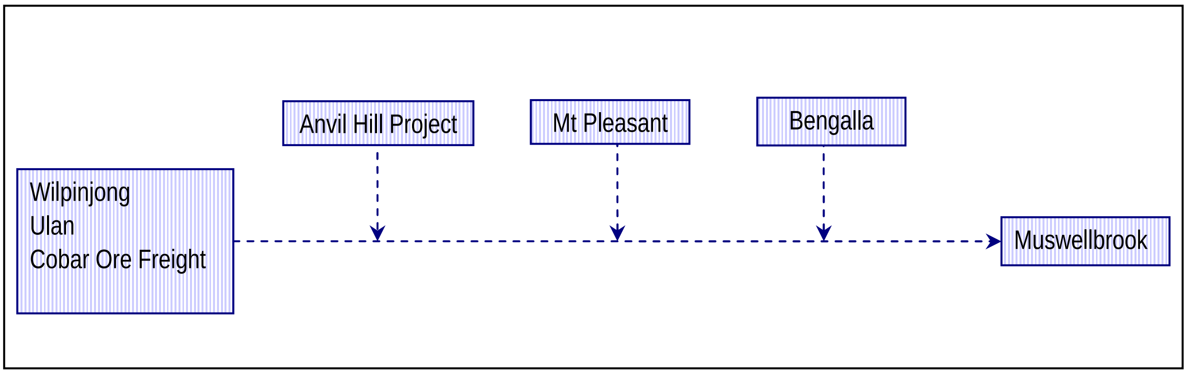


Table 7-18 displays the average existing and approved rail movements from trains on the line from Ulan to the Mount Pleasant rail spur with parameters used in calculations. Where there are different train lengths for different operations the arithmetic mean length has been calculated. Predicted movements for facilities that are not included in this document have been sourced from the appropriate environmental documentation. The proposed rail movements from the Anvil Hill Project are shown, with the associated cumulative future average movements from all operations. It is conservatively assumed that maximum daily existing movements from the proposal are equal to the average daily value.

Table 7-18 Freight Train Movements and Configurations

Operation	Status	Number of Movements		Length (m)	Audible Wheel Defects	Speed (Kph)
		Daytime (7am-10pm)	Night time (10pm-7am)			
Cobar Ore Freight	Existing	3 #	1 #	634	Medium	60
Ulan Coal	Existing	8 #	4 #	1319	Medium	60
Wilpinjong Coal Project	Consented	6 #	2 #	1500	Medium	60
Mt Pleasant Mine	Consented	4 @	2 @	1500	Medium	60
Bengalla Mine	Existing	4 ^	2 ^	1500	Medium	60
Anvil Hill Project (Peak)	Proposed	6	4	1500	Medium	60
Cumulative Movements		**31**	**15**			

Notes: # Source from Richard Heggie & Associates 2005, Wilpinjong Coal Project Construction, Operation and Transportation Noise & Source from Richard Heggie & Associates 2005, Wilpinjong Coal Project Construction, Operation and Transportation Noise Impact and Blasting Assessment
@ Source from ERM Mitchell McCotter 1997, Mt Pleasant Mine Environmental Impact Statement Volume 1
^ Source from Envirosciences 1993, Bengalla Coal Mine Environmental Impact Statement Volume 1

Using the above data on freight movements, it is possible to calculate the distance from residences at which ARTC criteria are exceeded using predicted energy average L_{Aeq} and SEL noise levels from the Railcorp NSW standard rail noise database for both locomotives and freight wagons. The database levels are adjusted for speed, number of locomotives, length of trains and audible wheel defects, with no allowance for shielding. A façade correction of 2dBA is also applied.

Distances at which the ARTC criteria are exceeded for both existing and proposed peak movements for appropriate sections of track are illustrated in Table 7-19 to Table 7-21, rounded to the nearest 5m. In addition the number of private residences where the criteria would be exceeded, both for existing and proposed operations is shown.

Table 7-19 Exceedances of ARTC Criteria: Anvil Hill Project to Mount Pleasant

Period	Criterion (dBA)	Existing Freight Movements		Proposed Freight Movements	
		Distance from Track (m)	Number of residences criterion exceeded	Distance from Track (m)	Additional residences criterion exceeded
L_{Aeq}, Daytime (7am -10pm)	65	35	0	40	N/A
L_{Aeq}, Night time (10pm-7am)	60	50	1	70	1
L_{Amax}, Passby Noise (24Hrs)	85	45	1	45	N/A

Table 7-20 Exceedances of ARTC Criteria: Mount Pleasant to Bengalla

Period	Criterion (dBA)	Existing Freight Movements		Proposed Freight Movements	
		Distance from Track (m)	Number of residences criterion exceeded	Distance from Track (m)	Additional residences criterion exceeded
Daytime (7am -10pm)	65	40	0	45	N/A
Night time (10pm-7am)	60	60	0	80	0
Maximum Passby Noise (24Hrs)	85	45	0	45	N/A

Table 7-21 Exceedances of ARTC Criteria: Bengalla to Muswellbrook

Period	Criterion (dBA)	Existing Freight Movements		Proposed Freight Movements	
		Distance from Track (m)	Number of residences criterion exceeded	Distance from Track (m)	Additional residences criterion exceeded
Daytime (7am -10pm)	65	45	2	50	N/A
Night time (10pm-7am)	60	70	3	85	1
Maximum Passby Noise (24Hrs)	85	35	2	35	N/A

The maximum increase in distance from the track to meet the ARTC criteria as a result of proposed Anvil Hill freight movements on any part of the Muswellbrook to Ulan line is 5m for daytime peak operations and 20m for peak operations at night. For each section of track under consideration, the noise footprint for daytime $L_{Aeq,15\ hr}$ and maximum passby noise for proposed operations are wholly contained within the existing night time noise footprint. As such the only relevant time period for assessment of future additional exceedances is the night time period. The proposed night time freight movements result in an additional two residences having noise levels that exceed the criteria.

8 BLASTING IMPACTS

8.1 Prediction of Noise and Vibration Levels

Airblast overpressure and ground vibration levels from blasting are related to the "scaled distance" from the blast, which is defined as

Scaled distance = $D/W^{(1/3)}$ for airblast overpressure, and
Scaled distance = $D/W^{(1/2)}$ for ground vibration,

where D is the distance from the blast in metres and W is the maximum instantaneous charge of explosive, in kg Ammonium Nitrate Fuel Oil (ANFO) equivalent.

Standard predictive curves relating scaled distance to overpressure and ground vibration levels have been derived from measurements conducted at numerous sites. However, it is recognised that the exact relationship varies from site to site, and hence it is generally preferable to use data gathered close to the proposed blasting site in making predictions.

For this assessment, blast measurements performed at the Bayswater No. 3 Mine between 1996 and 1999 were used in predictions. Ground vibration data for 193 blasts, and overpressure data for 171 blasts, were available for analysis. Figure 8-1 shows the best-fit line and 95% confidence limit derived from the measured vibration levels. The figure also indicates the predicted vibration level using the method outlined in Australian Standard 2187.2-1993: "Explosives – Storage, Transport and Use" for both normal and hard rock.

Figure 8-2 shows measured airblast overpressure values. As for most blast measurement data, overpressure levels show much higher variability than vibration levels.

Figure 8-1 Measured Peak Particle Ground Velocity & Scaled Distance

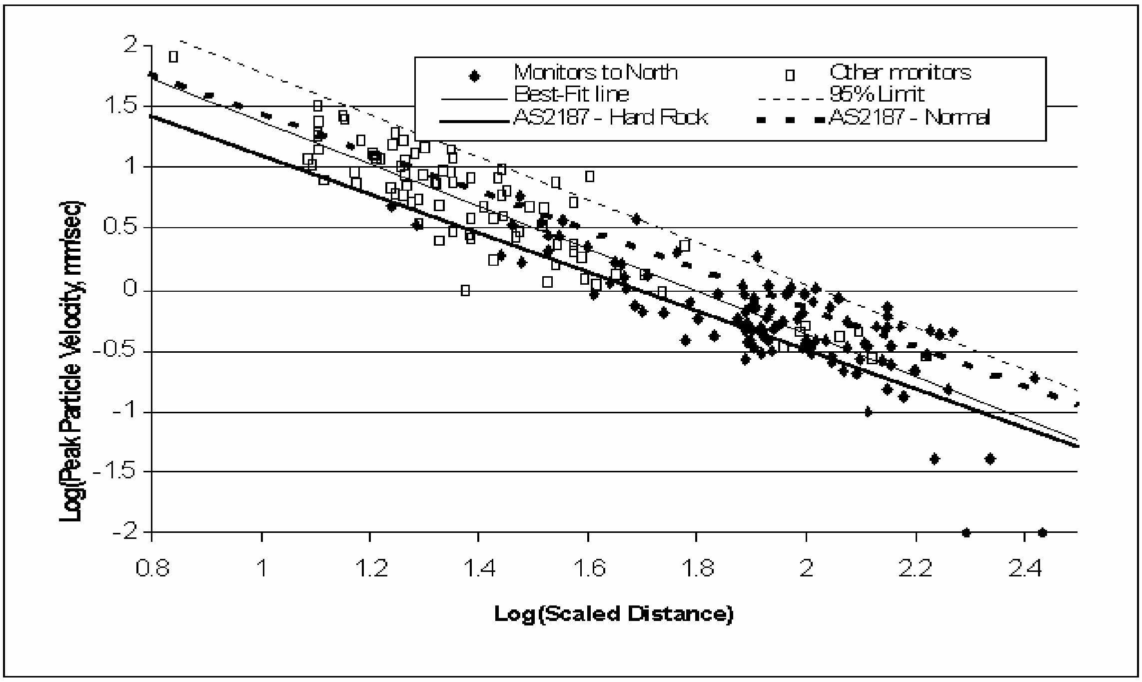
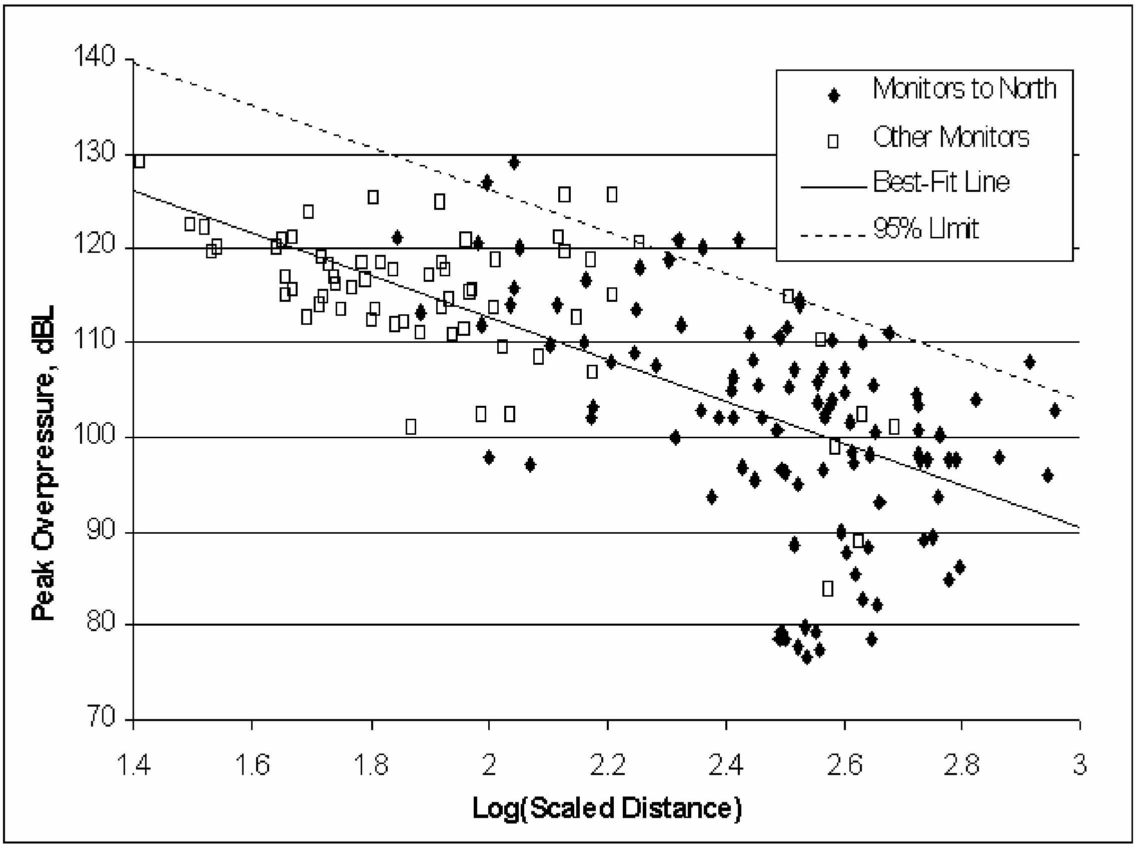


Figure 8-2 Measured Blast Overpressure & Scaled Distance



8.2 Conceptual Blast Designs

A range of standard blast designs is proposed for the Anvil Hill Project, depending on whether coal or overburden is being blasted.

Table 8-1 shows the standard conceptual blast designs over the modelled stages of the project life, listing various blasting parameters including the Maximum Instantaneous Charge (MIC).

Table 8-1 Conceptual Blast Designs

Operational Year	Y2	Y5	Y10	Y15	Y20
Coal					
Bench Height (m)	8	8	8	8	8
Burden (m)	6.5	6.5	6.5	6.5	6.5
Spacing (m)	6	6	6	6	6
MIC (kg)	67	67	67	67	67
Blasts per Year	58	190	153	126	71
Overburden					
Bench Height (m)	35	35	35	35	35
Burden (m)	7.5	7.5	7.5	7.5	7.5
Spacing (m)	9	9	9	9	9
MIC (kg)	1,585	1,937	2,524	3,111	3,698
Blasts per Year	15	37	46	40	37

8.3 Predicted Residential Overpressure and Vibration Levels

The distance from blasts at which vibration and overpressure levels meet the ANZECC guidelines can be calculated using:

- The proposed pit locations;
- The blasting parameters from Section 8.2; and
- Predictive equations.

With regard to annoyance and human discomfort, initial investigations of overpressure levels using the 95th percentile level indicated a significant number of exceedances of the annoyance criterion, and as such control measures need to be implemented. Necessary best-practice measures will include:

- Strict control of stemming for blast holes;
- Ensuring adequate timing sequences for all blasts; and
- Restriction of blasting under adverse weather conditions.

Development of these procedures will require ongoing refinement of blast design in conjunction with monitoring. With such measures in place it is considered that overpressure and vibration levels equivalent to the best-fit lines in Figure 8-1 and Figure 8-2 are appropriate to use for this assessment. The contours representing the annoyance criteria for overpressure and vibration levels are calculated using the blast parameters outlined in Table 8-1. For vibration it is reasonable to assume that if 95% of all blasts are within 5mm/sec, then 100% of blasts will be within 10mm/sec. The contour for compliance with the annoyance criterion is therefore equivalent to the contour for compliance with the building damage criterion.

Blast overpressure and vibration contours were calculated on the above basis for each of the five operational scenarios over the life of the proposal. Finally worst-case contours for vibration and overpressure are generated using the predicted results for each year. These contours are displayed in Figure 8-3. For this project, the vibration criterion is predicted to be exceeded to a greater degree than the overpressure criterion, due to the size of the Maximum Instantaneous Charges proposed for the Anvil Hill Project. The number of private residences which are predicted to have vibration levels in exceedance of the criteria is shown in Table 8-2 below.

Table 8-2 Number of Residences where Blast Criteria are exceeded

Criterion	Number of Residences that Exceed Criterion
Vibration	23
Overpressure	21

The contour in Figure 8-3 is wholly contained within the worst-case operational noise and air-quality affectation contours for the proposal and further discussion of blasting impacts at residential receivers is therefore not warranted.

8.4 Predicted Vibration Levels at TransGrid Pylons

The pylon structures supporting the TransGrid 500kV power transmission line are shown in Figure 8-4. The maximum vibration levels at each pylon for each operational year are calculated using the procedure outlined in Section 8.3.

The calculation is repeated for each of the modelled scenarios. Table 8-3 shows the predicted blast PPVs for each pylon expressed in terms of the best-fit equation derived from Figure 8-1. These predicted vibration levels are then compared with the agreed maximum level derived in Section 3.4.3 of 50mm/sec. Those predicted PPVs that exceed the maximum are shaded.

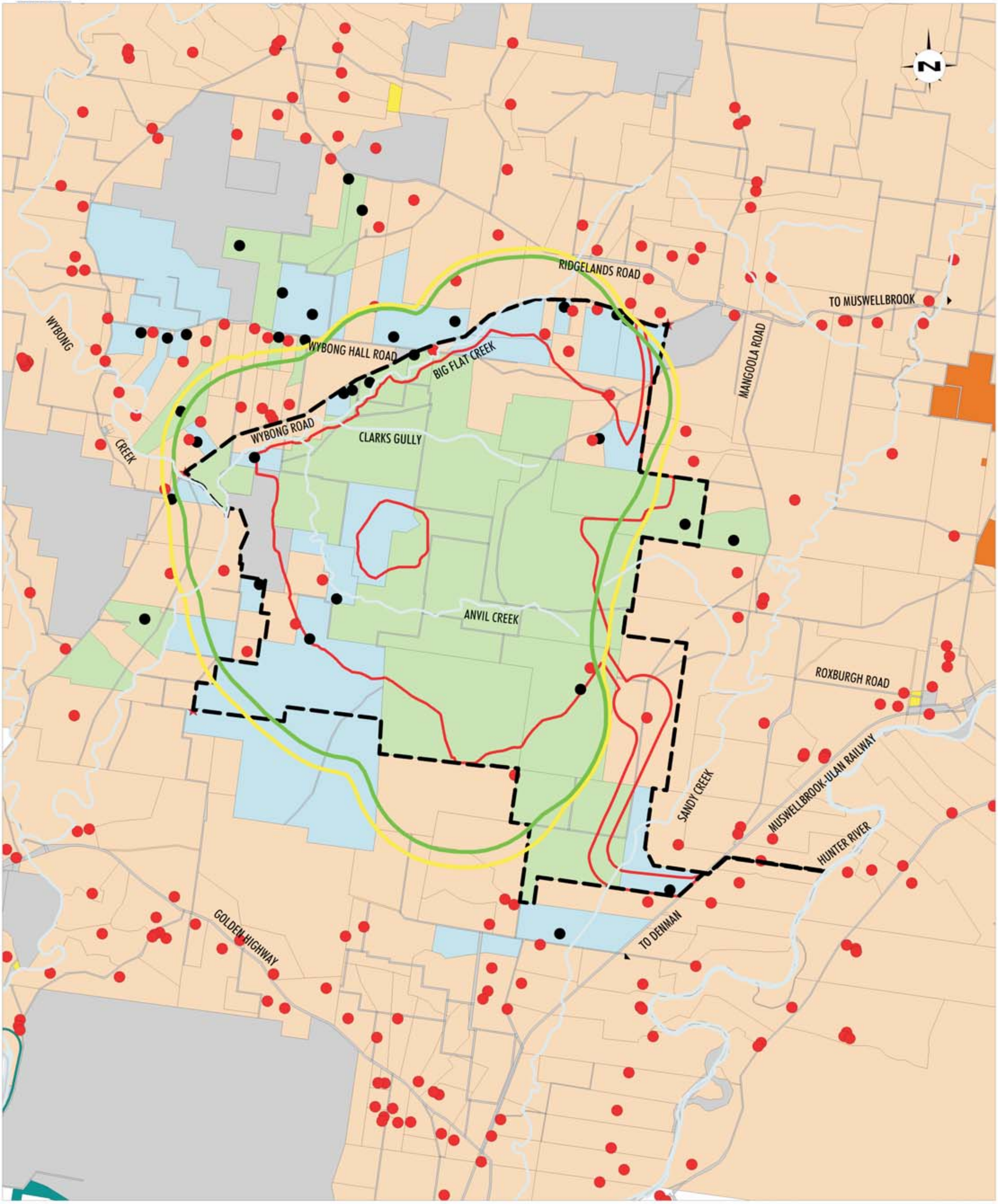
Several of the pylons have predicted blast vibration levels significantly exceeding the proposed maximum level. Some of the calculated levels are high enough to cause serious damage to the pylons under the blasting conditions currently proposed, and hence restrictions will be required concerning the location and/or size of blast conducted near the pylons.

8.5 Predicted Vibration Levels at Rock Shelters

A number of rock shelters and rock formations are located within the Project Area. The location of the rock shelters is shown in Figure 8-4. A geotechnical expert has surveyed the sites and produced an estimated significant damage threshold for each structure. Significant damage is defined as detachment of existing joint blocks and/or roof partings. This analysis is based on a mean blast vibration frequency of 10Hz.

Vibration levels from blasting have been calculated at the shelters as described above. Table 8-3 shows the predicted maximum blast PPVs for each structure expressed in terms of the best-fit equation derived from Figure 8-1.

Predicted vibration levels are generally within the damage threshold for each structure. However in the later stages of the operational cycle exceedances of the damage thresholds are noted, particularly for The Book and Anvil Rock.



Source: Dept. of Lands (2003)

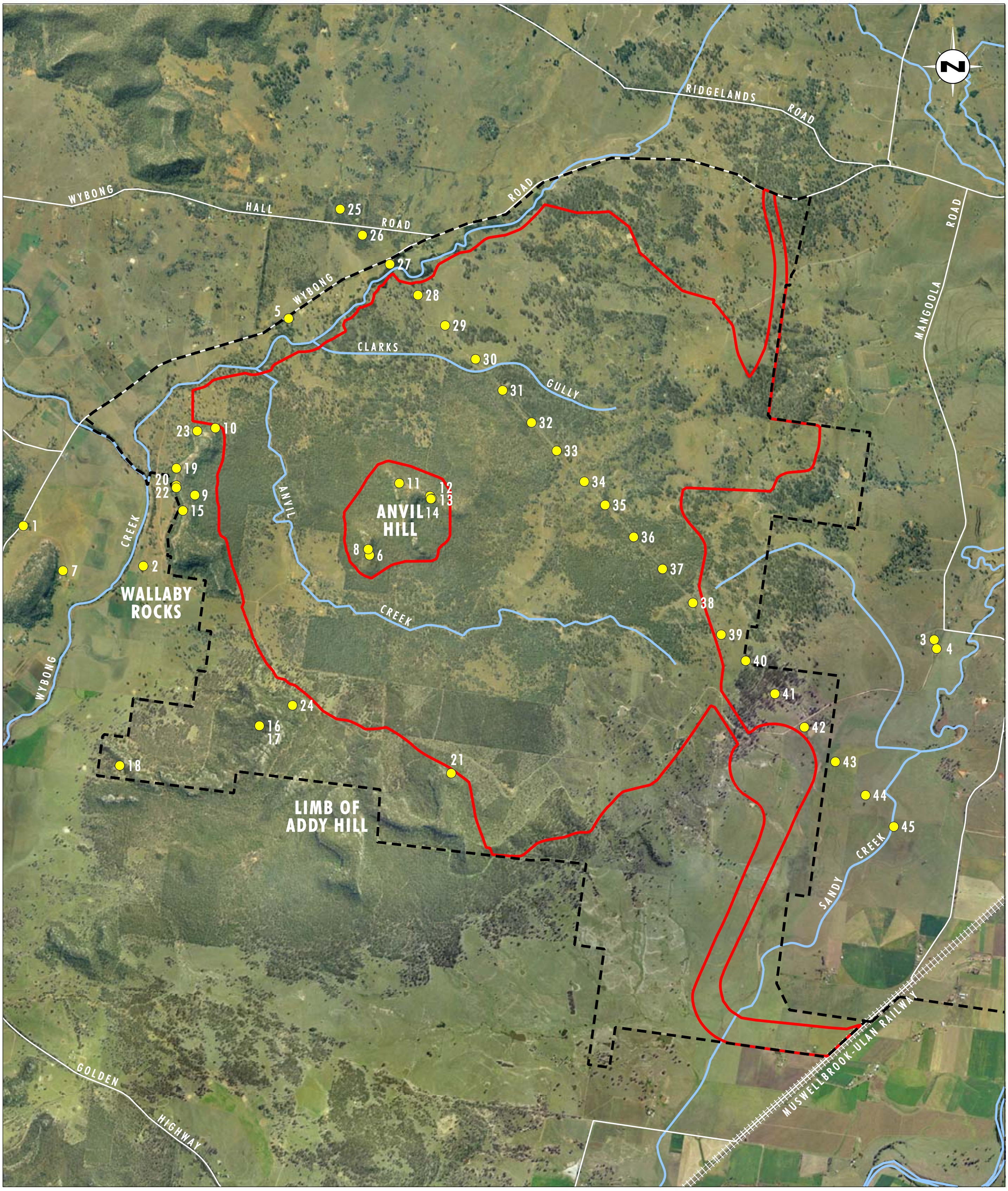
0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- Overpressure (115dB)
- Vibration Level (5mm/s)
- Centennial Owned Or Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Other Mine Owned
- Not Known
- Private

FIGURE 8.3

Blast Vibration and Overpressure Criteria



Base Map: Dept. of Lands (2003), Ortho-rectified by Plateau Images

0 1.0 2.0 2.5km

Legend

Proposed Disturbance Area

Project Area

Transgrid Pylons, Rock Shelters and Heritage Structures

FIGURE 8.4

Location of Modelled Transgrid Pylons, Rock Shelters and Heritage Structures

8.6 Predicted Vibration Levels at Heritage Structures

Several items of historical importance have been identified in the area surrounding the proposal. These items are not considered to be particularly susceptible to damage from vibration and a significant damage threshold has been adopted from a geotechnical analysis. One other heritage site, Castle Hill, has been identified as having susceptibility to vibration damage and the 5mm/sec peak particle velocity criterion has been adopted at this location.

Vibration levels from blasting have been calculated at these sites as before. Table 8-4 shows the predicted maximum blast PPVs for each structure expressed in terms of the best-fit equation derived from Figure 8-1.

Table 8-4 indicates that Castle Hill is predicted to have vibration levels from blasting that exceed the adopted criteria.

8.7 Summary of Vibration Impacts from Blasting

While there are no predicted exceedances of blast criteria at residential locations that are not already impacted by significant noise or dust impacts, one historical site, and several rock shelter sites and TransGrid pylon structures are predicted to have vibration levels in exceedance of their various criteria with the blasting parameters proposed.

The proponent has committed to design and undertake blasts to ensure the relevant vibration and blast overpressure criteria are met at the 500 kV power transmission line, Anvil Rock and rock shelters on Wallaby Rocks, Limb of Addy Hill and Western Rocks that are considered to be of highest Aboriginal cultural value. Remaining heritage structures that are predicted to exceed the vibration criteria will be inspected and recorded by appropriate experts prior to blasting. This will include assessing the structural status and identifying appropriate ameliorative measures, where relevant.

Techniques to minimise blast impacts will be employed as necessary to ensure compliance with relevant criteria. This may include blast initiation using electronic detonation techniques, limiting blast MIC, consideration of wind speed and direction prior to blasting, use of adequate stemming, implementing a delay detonation system, and careful drilling and hole loading to ensure that the required blast design is implemented.

Table 8-3 Predicted Vibration Levels at Rock Shelters and Formations

ID No on Figure 8.4	Label	Criterion PPV, mm/sec	Year 2		Year 5		Year 10		Year 15		Year 20	
			Min distance (m)	Max PPV (mm/sec)	Min distance (m)	Max PPV (mm/sec)	Min distance (m)	Max PPV (mm/sec)	Min distance (m)	Max PPV (mm/sec)	Min distance (m)	Max PPV (mm/sec)
9	AC42	220	2512	1.1	1974	1.7	1120	5.9	391	45.0	247	117.4
10	BFC12	270	1957	1.8	1416	3.1	569	19.4	60	1204.8	387	53.4
11	CG01	220	995	5.7	521	18.0	194	128.4	353	53.8	1034	9.5
12	CG08	270	907	6.8	404	28.1	195	126.3	583	22.4	860	13.2
13	CG09	220	919	6.6	409	27.5	184	140.0	557	24.3	833	14.0
14	CG10	220	926	6.5	417	26.6	193	128.9	555	24.4	838	13.8
15	WC05	270	2693	1.0	2155	1.5	1300	4.6	573	23.0	376	56.1
16	WC25	220	2420	1.2	1990	1.7	1628	3.1	1296	5.5	555	28.4
17	WC26	270	2420	1.2	1990	1.7	1628	3.1	1296	5.5	555	28.4
18	WC33	270	3785	0.6	3346	0.7	2992	1.1	2663	1.6	1754	3.8
19	WC43	220	2480	1.2	1938	1.8	1093	6.2	462	33.6	436	43.3
20	WC45	220	2588	1.1	2043	1.6	1200	5.3	496	29.7	422	45.9
21	AC38	220	1315	3.5	997	5.8	629	16.3	201	144.3	129	364.4
22	WC46	220	2601	1.1	2056	1.6	1212	5.2	504	28.9	420	46.1
23	WC47	220	2109	1.5	1573	2.6	718	12.9	118	367.1	436	43.2
24	WC27	220	2060	1.6	1625	2.5	1268	4.8	957	9.4	212	152.3
6	Anvil Rock	90	1404	3.1	1054	5.2	653	15.3	188	162.1	306	80.3
8	The Book	100	1444	3.0	1104	4.8	626	16.5	204	140.6	348	64.3

Table 8-4 Predicted Vibration Levels at Heritage Sites

ID No on Figure 8.4	Label	Criterion PPV, mm/sec	Year 2		Year 5		Year 10		Year 15		Year 20	
			Min distance (m)	Max PPV (mm/sec)	Min distance (m)	Max PPV (mm/sec)	Min distance (m)	Max PPV (mm/sec)	Min distance (m)	Max PPV (mm/sec)	Min distance (m)	Max PPV (mm/sec)
1	Catholic Church	10	3967	0.5	3438	0.7	2570	1.4	1927	2.8	1882	3.3
2	Castle Hill	5	3321	0.7	2782	1.0	1928	2.3	1207	6.3	828	14.1
3	Yarrawongaö Dairy	10	3288	0.7	3257	0.7	3100	1.0	3800	0.8	3393	1.2
4	Yarrawongaö Feed Shed	10	3322	0.7	3304	0.7	3154	1.0	3836	0.8	3435	1.2
5	Charcoal retorts	10	862	7.4	511	18.6	412	34.2	664	17.8	1525	4.8
7	Hopkins Property (incl Catholic Church, Collareen)	10	3920	0.5	3376	0.7	2534	1.4	1818	3.1	1560	4.6

9 CONCLUSION

Noise and vibration impacts from the proposed Anvil Hill Project have been assessed in accordance with appropriate environmental standards, notably the NSW Department of Environment and Conservation's Industrial Noise Policy (*INP*). Impacts at relevant sensitive receivers such as residential dwellings, heritage structures and items of special cultural significance have been quantified and where possible, measures have been proposed that would reduce these impacts. The major conclusions of this assessment are as follows.

- The existing noise environment around the proposal is typical of a quiet rural area, with little exposure from existing traffic noise and no exposure from any existing industrial noise.
- In keeping with its setting in the Hunter Valley, the Project and its surroundings are often affected by strong night time temperature inversion conditions, which tend to elevate night time noise levels at receivers. The area around the proposal has a high frequency of strong night time temperature inversions, which elevate night time operational noise levels. The assessment of the effect of meteorological conditions on noise levels as used in this report is effectively more conservative than the methodology outlined in the *INP*. Thus the calculated noise levels are higher than would have been predicted using standard *INP* conditions.
- Feasible noise control measures have been considered for the Anvil Hill Project and a number are included in the proposal, where viable. However, a substantial number of residential dwellings are still predicted to have 10th percentile noise levels that exceed the typical acquisition criterion of 40dBA. Real time noise monitoring would be undertaken at representative locations to manage potential noise impacts for residences that are predicted to have 10th percentile noise levels above 35dBA.
- Noise levels at residences during the construction of infrastructure and rail facilities would be lower than those levels predicted for operational noise, and as such no additional impacts are expected.
- Vibration and overpressure levels are predicted to exceed the appropriate building damage and annoyance criteria for some private residences. However, these residences are already impacted by significant noise or dust impacts. Some exceedances have been noted at TranGrid pylon structures and at some culturally significant rock shelters and heritage structures at some stages over the project life. Techniques to ensure compliance with appropriate criteria will be implemented at those sites.
- Road traffic noise from off site vehicles will generally be within the *ECRTN* criteria. The maximum exceedance of the criterion is predicted to be 1.5dBA.
- As a result of the Project, the distance from the Muswellbrook to Ulan rail line at which the ARTC criteria is met has increased by a maximum of 5m for peak daytime freight movements and 20m for peak night time freight movements. These distances correspond to an extra 2 residences that exceed the relevant ARTC criteria.

Note
All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose.

Quality Assurance
We are committed to and have implemented AS/NZS ISO 9001:2000 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC
This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Version	Status	Date	Prepared by	Checked by
A	DRAFT	2 May 2006	Tim Dean	Rob Bullen
B	DRAFT	2 June 2006	Tim Dean	Rob Bullen
C	DRAFT	5 June 2006	Tim Dean	Rob Bullen
D	DRAFT	9 August 2006	Tim Dean	Rob Bullen
E	FINAL	10 August 2006	Tim Dean	Rob Bullen

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

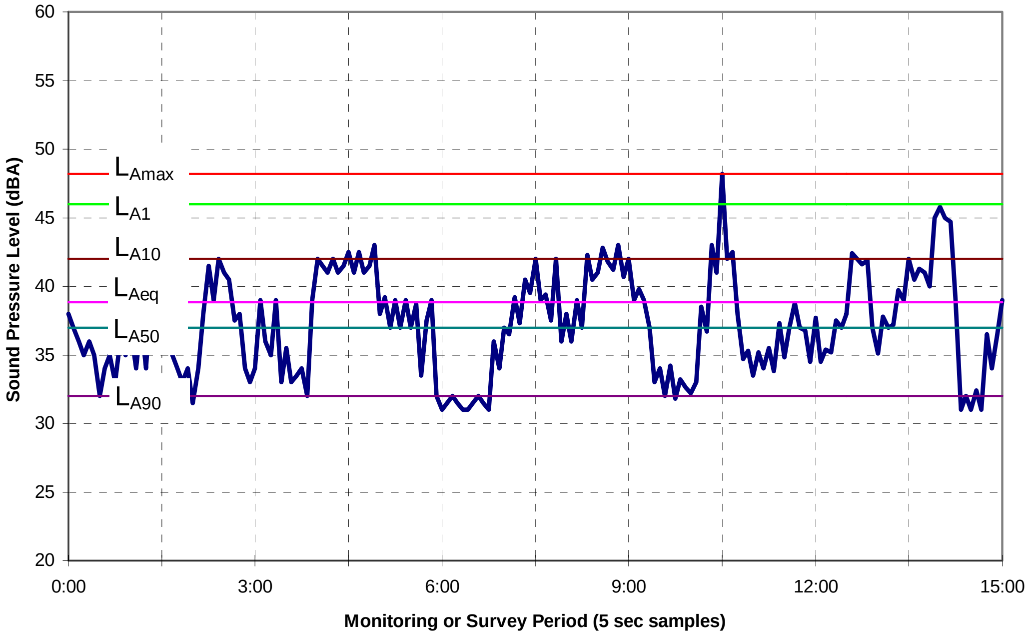
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.



60
55
50
45
40
35
30
25
20
LAmax
LA1
LA10
LAeq
LA50
LA90
Sound Pressure Level (dBA)
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)

APPENDIX B

CALCULATION OF TEMPERATURE INVERSION STRENGTHS METHODOLOGY

A temperature inversion is said to occur when temperature increases with height above the ground. Inversions are typically found during the night and early morning periods, and are most common in winter. Under these conditions, noise which would otherwise propagate away from the ground can be refracted downwards, increasing the noise level as heard on the ground. This effect can dramatically reduce the effectiveness of barriers and shielding in controlling noise.

Temperature gradients may be determined either by direct measurement or by other indirect methods. The *INP* outlines several alternative methods of calculating temperature gradients where direct measured data is not available. These indirect methods allow the susceptibility of an area to inversions to be determined through the use of the relationship developed by the US Atomic Energy Commission between atmospheric stability categories and inversions. The relationship shown in Table 1 outlines the range of temperature gradients that can be expected within each stability category. Hence, if a stability category is known, then the range of possible temperature gradients may be inferred.

Table 1 Range of Temperature Gradients °C per 100m, By Stability Category (from US Atomic Energy Commission)

Stability Class	Range of Vertical Temperature Gradients (DT/DZ)
A	Temperature Gradient <-1.9
B	-1.9 < D Temperature Gradient < - 1.7
C	-1.7 < Temperature Gradient < - 1.5
D	-1.5 < Temperature Gradient < - 0.5
E	-0.5 < Temperature Gradient < 1.5
F	1.5 < Temperature Gradient < 4.0
G	4.0 < Temperature Gradient

One of the methods outlined in the *INP* for calculating stability category, and hence temperature inversion, in non-arid areas is the use of sigma-theta data. This measure of the standard deviation of the horizontal wind direction fluctuations can be related to atmospheric stability categories as shown in Table 2.

Table 2 Wind Fluctuation Criteria for Estimating Stability Categories

Stability Class	Range of Sigma-Theta Values (σ_A)
A	$\sigma_A >= 22.5°$
B	$17.5° <= \sigma_A < 22.5°$
C	$12.5° <= \sigma_A < 17.5°$
D	$7.5° <= \sigma_A < 12.5°$
E	$3.8° <= \sigma_A < 7.5°$
F	$2.1° <= \sigma_A < 3.8°$
G	$\sigma_A < 2.1°$

Using Tables 1 and 2, and sigma-theta data from the Wybong Road weather station, it is possible to estimate the prevalence of temperature inversions of various strengths in the project area. However, utilizing data from the Bengalla mast allows a more accurate assessment by deriving a relationship between sigma theta and temperature inversion strength at the proposal.

It is possible to derive a relationship between stability category (based on sigma-theta levels), and temperature inversion strength at different wind speeds using the data from the Bengalla mast measured during winter 1999. This relationship is illustrated in Table 3. The derived relationship between stability class and inversion strength at Bengalla is considered to be more appropriate than the US Atomic Energy Commission relationship from Table 1 as it uses localised data and includes inversion strengths at different wind speeds.

Table 3 Mean Measured Temperature Inversion Strengths at Bengalla under different Stability Categories during Winter Nights 1999, °C Per 100m

Wind Speed, m/sec	Stabililty Class						
	A	B	C	D	E	F	G
0	4	4	4	4	4	6	6
1	4	4	4	4	6	6	4
2	4	4	4	4	4	6	4
3	4	2	4	2	2	4	6
4	2	2	2	0	2	4	4
5	2	2	0	0	2	4	4
6	0	2	2	0	2	4	0
7	0	0	0	0	0	2	0
8	0	2	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	2	0	0	0

Table 3, in conjunction with wind speed and sigma-theta data from the Wybong Road weather station, was used to calculate the prevalence and strength of temperature inversions in the project area. This approach uses measured inversion strengths at Bengalla to estimate inversion strengths for the same wind speed and sigma-theta values in the project area. This is a more conservative approach than using Table 1 for this purpose, as the overall estimated prevalence and strength of inversions is higher than would have been derived from Table 1.

APPENDIX C

CALCULATED 10TH PERCENTILE OPERATIONAL NOISE LEVELS

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
1	45	48	42	42	50	45	45	61	56	56	45	42	41	41	39	36	61
10	54	40	36	35	41	39	38	47	44	43	36	33	31	35	33	31	47
11	45	43	36	35	43	39	38	50	47	47	34	30	29	31	26	25	50
12	33	40	38	38	43	42	41	43	42	42	47	46	46	55	55	55	55
13	30	40	38	38	44	43	43	47	44	44	52	49	49	61	62	61	62
16	42	42	39	39	45	42	41	51	45	45	42	39	38	39	36	36	51
26	40	41	37	35	42	40	38	45	43	43	36	35	34	34	33	32	45
28	31	37	35	35	38	39	39	41	40	40	36	43	43	33	34	34	43
29A	40	46	41	41	45	40	40	45	40	41	44	39	39	43	38	38	46
30	38	44	39	39	45	39	40	46	41	41	46	42	42	41	36	37	46
31	43	41	37	36	44	39	39	49	49	49	30	28	27	28	25	23	49
34	48	48	44	44	48	43	43	48	43	43	47	41	41	45	41	41	48
35	38	43	42	42	45	46	46	49	49	49	45	51	51	41	42	42	51
37	39	46	42	43	45	40	40	47	42	42	46	42	42	41	36	37	47
39	32	40	37	38	41	40	40	41	41	41	37	37	37	36	34	34	41
40	43	40	37	35	41	38	38	44	42	42	36	35	34	33	32	31	44
43	44	58	53	52	55	51	51	54	53	53	54	44	44	52	50	50	58
48	33	38	34	33	39	36	35	41	37	37	37	30	29	36	32	32	41
51	34	40	38	38	41	41	41	43	42	42	41	44	44	35	36	37	44
53	34	40	38	39	41	41	41	45	45	45	38	38	38	35	35	34	45
54	24	31	30	29	34	32	32	32	33	32	33	33	33	31	28	28	34
55	49	40	36	35	41	39	37	46	43	42	36	35	33	34	32	32	46

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
56	35	40	39	39	41	42	42	44	43	43	42	48	48	36	36	37	48
60	40	44	43	43	47	47	47	47	47	48	44	46	46	41	41	41	48
62	37	42	41	41	43	44	44	47	46	46	44	48	49	35	36	36	49
64	45	42	38	37	44	40	37	47	47	46	35	31	30	33	29	25	47
65	35	41	38	38	43	40	40	48	47	47	38	37	36	35	34	34	48
66	31	35	33	33	36	35	35	40	40	40	33	34	33	29	29	28	40
68	53	40	37	36	42	39	38	48	45	44	37	33	31	34	33	31	48
69	39	44	40	40	45	41	41	44	40	40	41	37	36	41	37	36	45
71	34	39	35	34	40	38	37	44	42	42	36	35	35	34	33	33	44
74	27	36	34	34	38	35	35	37	36	36	36	36	36	37	30	31	38
77	42	42	39	38	45	41	41	50	45	45	43	39	39	39	37	36	50
78	42	47	43	44	47	43	43	47	43	43	46	41	41	45	41	42	47
79	23	33	31	31	35	33	33	32	33	33	34	34	34	34	29	30	35
80	37	42	41	41	45	45	45	46	46	46	43	45	45	41	40	40	46
81	35	39	38	38	41	41	41	44	43	43	41	43	44	38	38	39	44
82	41	45	44	44	47	48	48	53	52	53	47	51	52	43	43	44	53
83	18	34	33	33	34	33	33	32	32	32	32	34	34	34	35	35	35
84	44	52	47	45	52	51	51	50	52	52	39	39	36	38	38	34	52
85	45	40	35	34	43	40	36	48	45	43	36	31	30	32	27	25	48
88	38	49	44	44	47	45	45	51	51	51	40	39	39	37	36	36	51
89	40	40	36	36	41	40	39	44	43	42	36	36	35	33	33	32	44
90	42	48	47	47	49	48	48	48	48	48	42	42	42	38	37	37	49

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
91	34	38	37	37	40	40	40	42	42	42	42	43	44	36	37	38	44
92	39	43	42	42	46	46	46	47	46	46	44	46	46	41	41	41	47
94	29	38	36	36	38	38	38	39	38	38	42	39	39	37	37	37	42
101	36	44	42	42	45	44	44	45	45	45	40	39	39	37	36	36	45
102	33	42	37	37	42	38	38	42	39	39	42	38	38	39	35	35	42
103	26	32	31	31	34	34	34	34	34	34	35	35	35	31	32	32	35
104	30	38	35	35	38	35	35	38	36	36	37	34	34	35	33	33	38
105	37	46	42	41	45	41	41	45	41	41	44	37	37	43	38	38	46
108	30	36	36	36	37	38	38	38	38	38	37	40	40	32	35	35	40
110	29	34	33	33	36	36	36	36	38	38	35	37	37	33	35	35	38
111	32	33	31	31	35	34	32	39	35	34	32	29	27	29	26	24	39
112A	25	31	29	29	33	32	32	31	32	32	32	33	33	31	29	29	33
113	33	38	36	37	39	39	39	42	42	42	34	36	36	31	33	33	42
114	24	31	30	30	34	32	32	32	33	33	33	34	34	32	29	29	34
115	38	46	42	42	46	41	42	46	42	42	46	38	38	45	40	40	46
118	40	36	34	33	38	37	36	43	41	40	35	34	33	33	32	31	43
269A	32	41	35	36	40	36	37	41	36	36	41	37	37	37	33	34	41
121	36	43	37	38	43	38	39	44	38	39	45	40	40	40	35	36	45
124	20	19	21	21	25	27	28	26	32	32	30	31	32	21	21	22	32
128	26	31	30	30	34	34	34	36	37	37	28	28	29	30	25	26	37
130	30	34	33	33	36	37	37	37	38	38	37	39	39	33	36	36	39
132	38	46	41	41	46	41	41	46	41	41	45	38	38	44	39	39	46

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
133	32	40	38	38	40	38	38	42	39	39	40	37	37	39	35	35	42
135	20	29	28	27	31	30	30	29	31	31	30	32	31	26	25	25	32
137	36	44	39	39	43	39	39	43	39	39	42	37	37	41	36	36	44
138	31	36	35	35	38	38	38	39	39	39	38	40	40	34	37	38	40
139	30	34	32	33	36	36	36	38	38	39	33	32	32	31	32	32	39
140	36	44	40	41	43	40	40	45	41	42	43	40	40	40	36	37	45
141	25	33	31	31	35	33	33	33	33	33	34	34	34	34	29	30	35
144	26	34	33	34	35	35	35	36	37	37	31	31	31	26	28	29	37
145A	35	43	39	39	43	39	39	42	39	39	42	36	36	40	36	36	43
146	37	37	33	32	37	35	34	41	38	37	33	29	26	29	26	24	41
147	25	33	31	31	35	33	33	33	33	33	34	34	34	33	29	30	35
148	29	34	33	33	37	37	37	37	38	38	37	39	39	33	35	35	39
151	24	32	31	31	34	33	33	32	33	33	33	33	34	34	29	30	34
156	25	31	30	30	31	32	32	33	34	34	29	31	31	21	21	21	34
157	20	21	19	20	23	22	22	32	29	29	29	33	33	29	31	31	33
162	32	33	32	32	36	34	33	39	35	34	32	27	25	30	25	24	39
164	29	37	34	34	39	36	36	37	36	36	37	36	37	36	31	31	39
165	21	24	26	30	26	29	31	26	28	31	27	27	28	23	24	24	31
166	24	31	29	29	33	32	32	31	32	32	32	32	32	30	28	28	33
167	44	39	37	35	40	38	37	44	41	41	36	35	34	34	32	32	44
168	30	33	31	31	34	33	33	38	34	34	33	29	28	31	28	26	38
169	36	44	40	40	44	39	39	44	40	40	43	37	37	42	37	37	44

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
170	27	32	30	31	33	33	34	34	35	35	31	31	31	30	31	31	35
171	26	31	30	30	33	32	33	37	37	37	31	34	34	26	30	30	37
172	23	29	30	30	30	32	33	29	31	33	28	29	29	23	24	24	33
174B	32	31	30	30	33	32	31	36	35	34	31	28	27	26	25	23	36
175	32	32	30	30	34	32	32	36	35	34	32	29	27	26	25	24	36
176	27	32	32	32	34	34	33	33	34	34	35	34	34	32	33	33	35
177	26	33	32	32	35	33	33	34	34	34	35	34	34	34	30	31	35
178	27	35	32	32	36	34	34	36	34	34	35	34	34	34	31	32	36
179	33	42	38	39	41	37	37	42	38	38	42	38	38	38	33	33	42
180	31	35	34	34	36	38	38	36	39	39	37	40	40	35	36	37	40
182	28	36	33	33	34	32	32	35	32	32	34	30	30	33	31	31	36
184	28	38	35	35	38	36	36	39	37	37	38	36	36	35	32	32	39
185	28	38	34	34	38	34	35	38	35	36	37	34	35	35	32	32	38
186A	30	40	37	37	40	36	37	40	38	38	40	38	38	37	33	34	40
187	28	37	34	34	37	34	34	37	35	35	36	34	35	34	32	32	37
189	29	39	34	34	39	35	35	39	36	36	38	34	34	36	32	33	39
190	30	35	33	33	36	34	34	37	35	35	35	33	33	33	31	31	37
191	30	37	35	35	37	35	35	37	36	36	36	33	33	35	33	33	37
192	31	39	36	36	39	36	36	39	36	36	38	34	34	36	34	34	39
193	31	40	36	36	40	36	36	40	36	36	39	35	35	37	33	33	40
194	26	33	31	31	33	32	32	33	32	32	32	31	31	31	30	30	33
195	24	31	30	29	32	31	31	33	32	32	30	29	29	27	27	26	33

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
198	29	35	32	32	35	32	31	37	34	34	34	31	31	32	30	29	37
199	25	36	33	33	37	35	35	38	37	37	37	35	35	34	31	32	38
200	29	36	32	32	35	31	31	34	33	33	35	36	36	31	28	28	36
201A	27	36	33	33	35	33	33	36	34	34	35	33	33	33	31	31	36
202	27	29	28	28	31	30	30	32	31	31	30	29	29	29	28	28	32
203A	27	29	28	28	30	30	29	32	31	31	30	29	29	28	28	27	32
205	27	31	30	30	34	33	34	36	37	37	31	33	33	29	30	30	37
206	24	29	28	29	31	31	31	30	32	32	30	32	32	29	30	30	32
207	25	29	28	28	32	32	32	33	33	33	28	29	29	28	28	29	33
208	23	28	28	28	30	30	30	31	32	32	27	29	29	24	25	26	32
209	14	27	27	27	27	27	27	24	27	27	24	25	25	22	23	23	27
210	5	16	16	15	17	16	16	17	17	17	16	14	14	16	16	16	17
211	20	27	26	26	27	27	27	29	29	29	29	28	28	26	25	25	29
212A	16	23	22	22	23	24	24	25	24	24	26	25	25	25	22	22	26
213	24	31	28	28	33	30	31	32	30	31	31	31	31	29	27	27	33
214	20	30	28	28	30	27	28	31	28	29	29	30	31	26	22	22	31
215	21	33	30	30	33	30	30	32	30	30	30	31	31	26	23	24	33
216	21	34	32	32	34	32	32	32	30	31	31	31	32	28	25	25	34
217	22	35	33	33	35	32	33	35	32	33	32	32	32	30	25	25	35
218	24	35	33	33	35	33	33	35	35	35	34	33	33	32	29	29	35
219	23	33	30	30	34	32	33	35	34	34	33	32	32	31	28	28	35
220	22	33	31	32	34	32	32	34	33	34	33	32	32	30	28	28	34

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
204	25	34	31	32	34	32	32	35	33	33	33	33	33	31	29	29	35
222	22	33	31	31	33	32	32	34	33	33	33	32	32	30	28	28	34
223	23	32	30	30	33	32	32	34	33	33	32	32	32	30	28	28	34
227	26	36	33	33	36	34	34	36	34	34	34	32	32	33	30	30	36
228	25	34	32	32	34	32	32	35	33	33	34	32	32	31	30	30	35
230	23	33	31	31	33	31	31	33	32	32	32	30	30	31	29	29	33
231	23	33	31	31	33	31	31	33	32	32	32	30	30	30	29	29	33
232A	22	32	30	30	32	30	30	32	32	32	31	30	30	29	28	28	32
232B	22	32	30	30	32	30	30	32	32	32	31	30	30	29	27	27	32
233	22	31	30	30	32	30	30	32	32	31	31	30	29	29	27	27	32
232C	22	31	29	29	32	30	30	32	32	32	31	29	29	29	27	27	32
235A	22	31	29	29	31	29	29	32	31	31	31	29	29	28	26	26	32
236A	21	31	29	29	31	28	28	32	31	31	30	29	29	28	26	26	32
237	25	33	31	31	33	29	29	34	33	33	32	31	30	30	28	28	34
238	24	33	29	29	33	30	30	34	32	32	31	30	30	29	27	27	34
229B	24	32	29	29	32	29	29	34	32	32	30	29	29	29	27	27	34
240	28	36	32	32	35	31	31	34	31	31	34	32	32	32	27	27	36
242	21	31	29	29	30	28	28	29	29	29	28	22	22	29	25	25	31
243	28	32	31	30	33	32	32	34	33	32	32	31	31	31	30	29	34
244	21	29	28	27	28	27	27	28	28	28	27	23	23	26	25	24	29
246	26	29	28	28	30	29	29	32	31	31	29	28	28	27	27	26	32
247	24	26	25	25	27	27	26	30	29	28	27	27	26	26	25	25	30

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
248	22	29	28	27	29	27	27	31	28	27	29	26	24	26	23	22	31
249	24	30	29	29	30	29	28	32	30	29	28	25	23	26	23	22	32
250	24	31	29	27	31	31	30	33	31	31	30	27	25	29	27	26	33
251	30	33	31	30	34	33	33	37	35	35	33	30	29	31	29	27	37
252A	25	29	28	28	30	29	29	32	31	31	29	28	28	27	26	26	32
253	25	33	31	31	35	32	33	33	33	33	33	33	33	33	29	30	35
255	20	27	26	26	28	28	28	27	28	28	27	25	24	24	24	23	28
256	23	30	29	29	30	31	30	31	32	32	31	30	30	28	27	27	32
257A	20	25	26	26	26	28	29	24	26	27	25	26	27	21	22	22	29
258	23	30	29	30	32	32	33	32	33	34	28	28	28	25	24	24	34
259	24	29	27	28	30	30	30	33	33	34	30	32	32	28	30	30	34
260	24	28	27	28	31	31	31	34	35	35	30	32	32	28	30	30	35
261	26	30	29	29	32	32	32	34	34	34	30	32	32	28	29	29	34
262	27	30	28	29	32	32	32	34	35	35	29	31	32	27	28	28	35
263	27	30	29	29	33	33	33	33	34	35	31	32	32	28	29	29	35
264	26	30	28	28	32	29	29	31	30	30	30	27	28	29	28	28	32
265	23	29	28	28	31	31	31	30	31	31	31	31	31	27	28	28	31
266	17	23	20	20	24	25	25	25	26	26	26	25	25	20	20	20	26
269B	31	36	32	33	36	33	33	34	33	33	35	30	30	34	32	32	36
269C	31	41	35	36	41	36	36	40	36	36	38	37	38	34	30	30	41
285	21	31	26	27	33	29	30	31	29	29	31	31	31	28	25	25	33
287	23	32	28	29	33	29	30	33	30	30	32	31	31	30	27	27	33

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
286	22	31	27	27	33	29	30	31	29	30	31	30	31	28	25	25	33
288	20	30	27	27	32	28	28	29	28	28	30	31	31	26	23	23	32
289	28	30	29	29	33	33	33	32	34	34	29	31	31	26	28	28	34
290	22	29	26	25	31	26	26	32	27	26	29	21	22	29	26	25	32
291	25	32	29	29	33	30	30	32	30	30	31	31	31	29	26	27	33
292	22	31	27	28	32	28	28	29	28	29	29	31	31	26	22	23	32
293	25	31	28	28	33	30	31	32	30	31	31	31	31	29	27	28	33
294	25	36	34	34	36	34	34	36	35	35	35	34	34	32	30	30	36
106A	24	31	29	29	32	32	32	32	32	32	33	33	33	29	28	28	33
106B	24	31	29	29	32	32	32	32	32	32	33	33	33	29	29	28	33
116A	27	33	33	33	34	35	35	35	36	36	34	36	36	31	34	34	36
116B	27	33	33	33	34	35	35	35	36	36	34	36	36	30	34	34	36
125A	29	38	35	35	38	35	35	38	36	35	36	33	33	34	32	31	38
125B	27	37	33	32	34	29	29	35	30	30	35	29	29	33	27	27	37
125C	29	38	34	34	36	33	33	37	35	34	35	33	33	34	31	31	38
126A	21	28	23	21	30	30	26	32	32	29	24	23	21	20	18	17	32
126B	21	27	23	23	28	27	25	32	29	28	24	21	21	20	19	18	32
134A	28	32	32	32	35	35	35	35	36	36	36	36	36	32	33	34	36
134B	28	33	32	32	35	36	36	35	36	36	34	36	36	32	34	34	36
134D	23	27	29	30	30	32	32	30	34	34	29	32	32	24	24	25	34
134C	22	25	25	25	26	29	29	30	32	32	31	31	32	23	23	23	32
15B	44	56	51	51	54	49	49	53	49	49	53	39	39	52	49	48	56

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
15C	38	45	41	41	46	42	41	45	41	41	44	35	34	42	38	38	46
174A	33	31	30	29	32	31	30	36	35	34	29	28	26	26	23	22	36
173B	21	28	26	26	29	29	26	32	33	29	25	24	22	22	19	18	33
173C	24	27	25	25	29	29	29	31	31	31	27	26	25	26	25	25	31
183A	29	38	34	34	38	35	35	38	35	35	37	34	34	36	32	32	38
183B	29	38	34	34	38	35	35	38	35	35	37	34	34	36	32	32	38
183C	29	38	34	34	38	35	35	38	36	36	38	34	34	36	32	32	38
21A	42	46	42	41	48	45	44	59	53	53	43	41	39	39	37	34	59
21B	14	24	22	22	22	23	23	28	22	22	25	20	20	19	19	19	28
224A	23	32	30	31	32	31	31	33	32	32	32	32	32	29	28	28	33
224B	24	33	31	31	33	31	31	33	32	32	33	30	31	31	29	29	33
229A	26	32	30	30	33	31	31	33	32	32	31	30	30	30	29	29	33
229B	24	31	29	29	31	30	30	32	31	31	30	29	29	29	28	28	32
229C	24	31	30	30	32	30	30	32	31	31	31	29	29	29	28	28	32
241A	28	37	34	34	37	34	34	36	34	34	34	32	32	33	31	31	37
241B	27	36	33	33	37	34	34	36	35	34	35	32	32	33	30	30	37
241C	28	36	33	33	36	34	34	36	35	34	35	33	33	32	30	30	36
245B	22	28	27	27	29	28	27	30	29	29	27	24	24	26	26	26	30
254A	23	28	28	28	31	31	31	31	31	31	31	31	31	27	28	28	31
45A	33	38	37	37	40	40	40	42	42	42	42	43	44	35	37	37	44
45B	30	35	34	34	38	39	39	38	39	39	37	40	40	33	36	37	40
59B	28	35	34	34	37	37	37	36	39	38	37	37	37	37	38	38	39

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
63A	40	43	43	43	45	47	47	51	50	50	46	53	54	41	42	42	54
63B	40	43	43	43	45	46	46	50	50	50	47	53	53	41	42	42	53
70A	35	44	40	40	45	40	40	44	40	39	43	35	35	40	36	36	45
70B	35	44	40	39	44	40	40	44	39	39	43	35	35	41	36	36	44
75A	28	34	29	29	31	30	28	38	34	32	26	22	22	24	22	22	38
19	23	31	28	28	33	29	30	32	30	31	32	31	31	29	27	27	33
25	41	46	41	41	51	45	45	54	48	48	57	54	54	45	38	38	57
270	25	32	28	29	33	30	31	32	30	30	31	31	31	29	27	28	33
275	21	30	28	28	30	28	28	31	30	30	29	28	28	27	26	26	31
283	24	31	28	28	33	29	30	32	30	31	31	31	31	29	27	27	33
295	21	30	27	27	29	28	27	29	28	28	28	23	23	27	25	25	30
112B	24	31	29	29	33	32	32	31	32	32	32	33	33	31	28	28	33
112C	24	31	29	29	33	32	32	31	32	32	31	33	33	30	28	28	33
112D	23	31	29	29	33	32	32	31	32	32	31	32	32	30	28	28	33
116C	27	33	33	33	34	35	35	35	36	36	34	36	36	31	34	34	36
116D	27	33	33	33	35	35	35	35	36	36	34	36	36	30	34	34	36
116E	27	33	33	33	35	35	35	35	36	36	34	36	36	31	34	34	36
116F	27	33	33	33	35	35	35	35	36	36	34	36	36	31	34	34	36
116G	27	33	33	33	34	35	35	35	36	36	34	36	36	31	34	34	36
125E	32	40	36	36	36	32	32	36	33	32	35	27	27	35	30	30	40
145B	35	43	39	39	43	39	39	42	39	39	42	36	36	40	36	36	43
186B	29	40	37	37	40	36	36	40	38	38	40	38	38	36	33	33	40

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	
188A	20	27	26	26	27	24	24	28	27	27	25	23	23	25	20	20	28
188B	22	29	27	27	30	29	29	30	29	29	28	28	28	27	27	27	30
201B	27	36	33	33	36	34	34	36	34	34	35	33	33	33	31	31	36
203B	22	30	28	28	30	29	29	32	30	30	27	26	25	25	23	23	32
203C	18	24	23	22	24	25	24	23	25	24	21	19	18	21	20	19	25
203D	22	30	29	28	29	28	27	30	29	29	29	26	26	28	26	26	30
203E	20	28	27	27	28	26	26	28	27	27	28	24	24	26	26	25	28
212B	13	21	18	18	19	21	20	21	21	21	21	18	18	17	17	16	21
212C	19	25	24	24	27	26	26	28	27	27	28	27	27	26	24	24	28
235B	21	31	29	29	31	29	29	32	31	31	30	29	29	28	26	26	32
235C	21	31	29	29	31	29	29	32	31	31	30	29	28	28	26	26	32
236B	21	31	29	29	31	29	29	32	31	31	30	29	29	28	26	26	32
236C	21	30	29	28	30	28	28	31	31	31	29	28	28	27	26	26	31
252B	24	27	26	26	28	28	28	30	30	29	28	27	27	26	25	25	30
273A	21	29	28	28	29	28	28	30	30	29	29	28	28	26	25	25	30
273B	21	29	28	28	29	28	28	30	29	29	29	28	28	27	25	25	30
273C	21	29	28	28	30	28	28	31	30	30	29	28	27	26	25	25	31
281A	19	24	23	23	25	25	24	25	25	25	25	24	24	22	22	22	25
281B	19	23	22	22	25	23	24	26	25	25	23	15	15	22	21	21	26
284A	25	31	28	29	33	30	31	32	30	30	31	31	31	29	27	28	33
284B	24	29	28	28	30	28	29	31	29	29	29	26	27	28	27	27	31
29B	40	45	41	41	45	40	40	45	41	41	44	39	39	42	38	38	45
96A	30	33	31	30	34	33	31	38	34	33	32	28	27	31	28	26	38

Residence	Const	Y2			Y5			Y10			Y15			Y20			Worst-Case All Operational Years
	Day	**Night**	**Day**	**Eve**	**Night**	**Day**	**Eve**	**Night**	**Day**	**Eve**	**Night**	**Day**	**Eve**	**Night**	**Day**	**Eve**	
96B	30	33	32	31	34	33	32	38	34	34	33	29	28	31	28	26	38

Centennial Hunter Pty Limited

Centennial Hunter Pty Limited
Anvil Hill Project Office
Shop 14
Campbells Corner Building
Brook Street
Muswellbrook NSW 2333
Tel: (61-2) 6543 2800

Umwelt
Environmental Consultants

Umwelt (Australia) Pty Limited
2/20 The Boulevarde
PO Box 838
Toronto NSW 2283
Ph. 02 4950 5322
Fax 02 4950 5737
www.umwelt.com.au