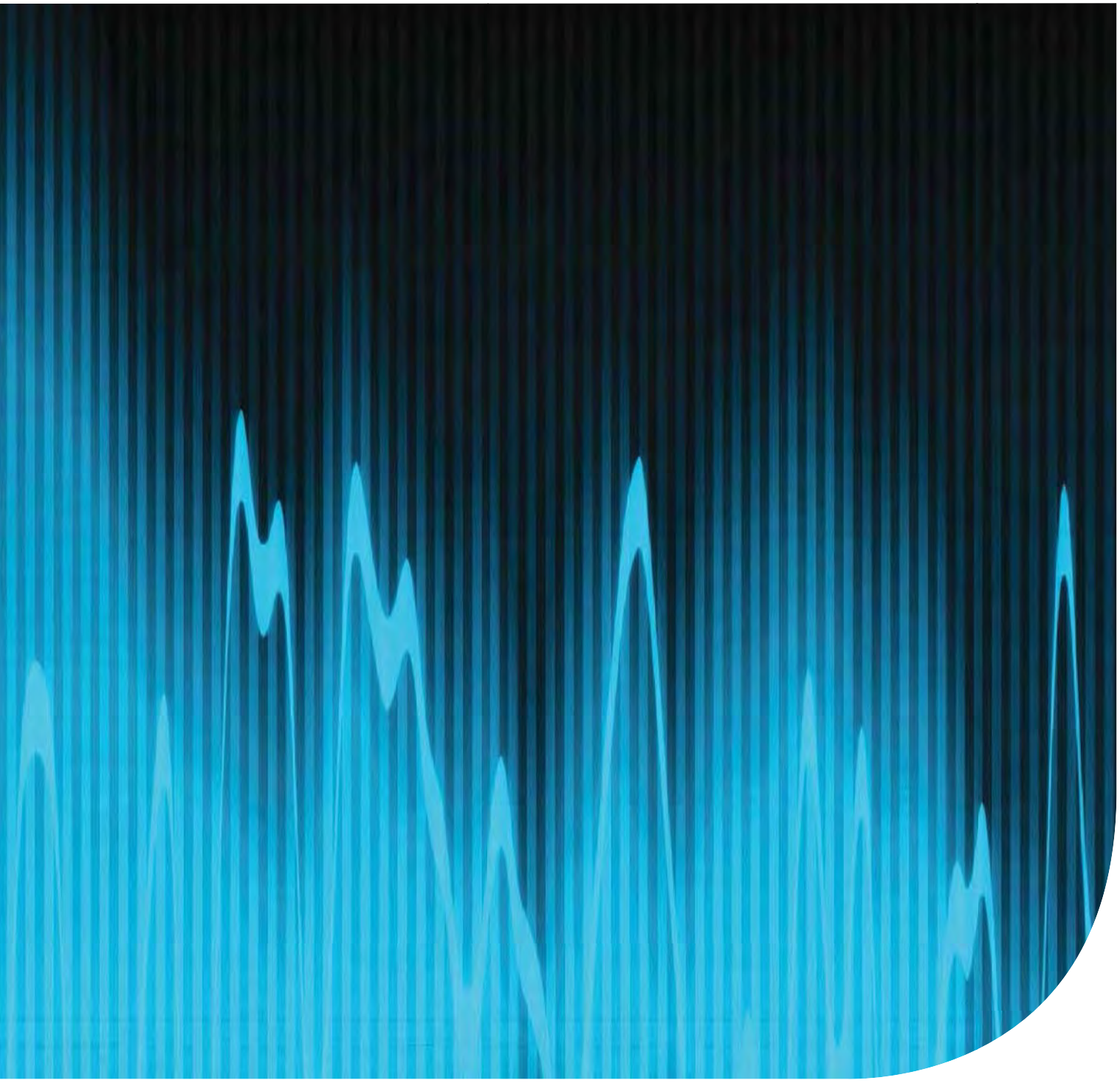
Muswellbrook Coal Continuation Project

Noise and vibration impact assessment

Prepared for Muswellbrook Coal Company Limited | 21 April 2016



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Muswellbrook Coal Continuation Project

Final

Report J16011RP1 | Prepared for Muswellbrook Coal Company Limited | 21 April 2016

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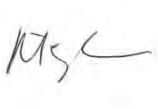
Signatures			Signature	
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1 Introduction

Muswellbrook coal mine (MCM) is an open cut coal mine operated by Muswellbrook Coal Company Limited (MCC). MCM is located on Muscle Creek Road, 3 kilometres (km) north-east of the township of Muswellbrook, in the Muswellbrook local government area (LGA) in New South Wales (NSW) (refer Figure 1.1).

MCC has approval from Muswellbrook Shire Council (MSC) to mine within the No. 1 Open Cut Extension Area (Open Cut 1) (DA 205/2002, as modified), with operations approved to be complete by 2020.

Additional coal resources have been identified within a previously rehabilitated area adjacent to Open Cut 1. While this area is within the development consent boundary, a modification to the existing development consent is required to modify the conceptual mine plan to allow mining of these additional resources, as well as extending the approved mine life and modifying the conceptual final landform (the modification).

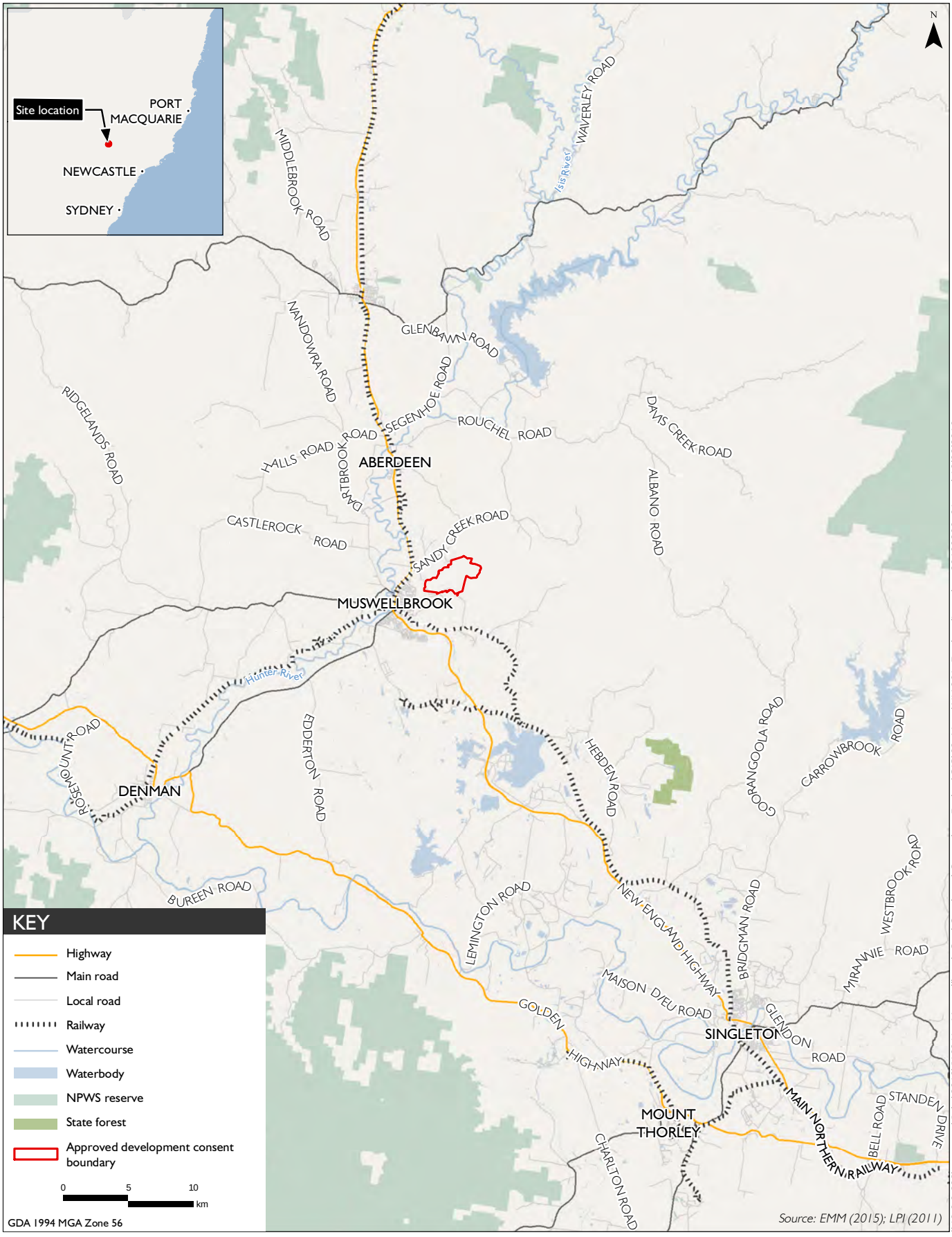
EMM Consulting Pty Limited (EMM) has been engaged by MCC to prepare a noise and vibration impact assessment (NVIA), which forms part of the Statement of Environmental Effects (SEE) prepared to accompany the application for the modification.

The NVIA has been prepared with reference to the following policies, standards and guidelines:

- NSW Environment Protection Authority (EPA) (2000) *NSW Industrial Noise Policy* (INP);
- NSW Department of Environment, Climate Change and Water (DECCW) (2011) *NSW Road Noise Policy* (RNP);
- Australian Standard (AS) 1055-1997, Acoustics - Description and Measurement of Environmental Noise; and
- Australian and New Zealand Environment Council (ANZEC) (1990) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*.

A noise and vibration assessment (HLA-Envirosciences Pty Limited 2002) was prepared as part of the Environmental Impact Statement (EIS) which accompanied the original development application (DA) 205/2002 for mining in Open Cut 1. This assessment was revised and updated for subsequent modification applications. These previous assessments have been referenced as part of this NVIA.

A number of technical terms are required for the discussion of noise and blasting. These are explained in Appendix A.



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Regional context

Muswellbrook Coal Continuation Project
Noise and vibration impact assessment

Figure 1.1

2 Project description

2.1 Project overview

MCC has a long history of mining in the Muswellbrook area, with underground operations commencing at MCM in 1907. Underground operations ceased in the late 1990s; however open cut mining continues. MCC has approval from Muswellbrook Shire Council (MSC) to mine within the No. 1 Open Cut Extension Area (Open Cut 1) (DA 205/2002, as modified), with operations approved to be complete by 2020.

Additional coal resources have been identified within a previously rehabilitated area adjacent to Open Cut 1. While this area is within the development consent boundary, a modification to the existing development consent is required to modify the conceptual mine plan to allow mining of these additional reserves, as well as extending the approved mine life and modifying the conceptual final landform (the modification).

The modification would maximise the recovery of coal resources within ML 1562, ML 1304 and CCL 713 and would enable the recovery of approximately 4.2 million tonnes (Mt) of additional coal resources.

In summary the modification involves:

- extension of open cut mining operations in Open Cut 1;
- extension of the mine life, with operations to cease by the end of 2025;
- changes to the conceptual final landform within the modification area; and
- overburden emplacement in both Open Cut 1 and Open Cut 2, so as to achieve the conceptual final landform.

As the modification involves mining of a previously disturbed area that was used as an overburden dump, there would be no direct impact to previously undisturbed land.

No changes are proposed to the currently approved maximum production rate of 2 Mtpa, mining methods, coal processing, blasting methods, water management, waste management and handling, coal transport, access to site, employee numbers, hazardous substances and dangerous goods management and environmental management.

2.2 Existing site operations

2.2.1 Mining method

MCC current mining operations consist of truck and excavator multi seam-mining within Open Cut 1. This involves extraction of coal remaining from the underground mine workings developed during the 1900s. Operations in Open Cut 1, as approved under DA 2015/2002, began in March 2005. It is noted that no mining operations currently occur in Open Cut 2.

The mining method involves removal of vegetation and stripping of topsoil before drilling and blasting the overburden material. Overburden is removed using excavators and dump trucks, and re-used as fill in old mining areas. Once overburden is removed coal can be extracted from the exposed coal seams.

The open cut mining method used incorporates excavators, front-end loaders and rear dump trucks. Run of Mine (ROM) coal is sent for crushing which takes place in an on-site coal crushing plant, after which the coal is analysed by an ash analyser and sorted into high and low ash. High ash coal is sent to be washed in the Coal Preparation Plant (CPP) while low ash coal only requires crushing. Coal is then stockpiled ready for transport.

MCC has an obligation to undertake rehabilitation works during the life of the MCM. Rehabilitation will be undertaken in accordance with an approved Mining Operations Plan (MOP).

Rehabilitation works include filling voids with overburden material, planting a combination of pasture and native trees so that vegetation is consistent with the local area, establishment of a vegetation corridor, weed control and rehabilitation monitoring. Rehabilitation aims to make the site compatible with the surrounding land, and have safe final voids that are unlikely to experience spontaneous combustion.

2.2.2 Transport

Prepared coal is transported by truck to Ravensworth Coal Terminal, approximately 27 km south-east of MCM. The transport route taken by trucks is via Muscle Creek Road and the New England Highway. Approval is for 2 Mtpa coal transported by road.

Coal is transported from Ravensworth by rail to the Port of Newcastle for export. The coal is stockpiled at both the Port Waratah Coal Service and Newcastle Coal Infrastructure Group holdings terminals ready for export.

2.2.3 Site infrastructure and services

The Mine Infrastructure Area (MIA) was relocated following modification approval in September 2013. The current MIA includes the following:

- site office;
- workshops;
- bath house;
- sealed light vehicle parking area;
- hard stand area for heavy vehicles;
- sealed access road;
- wash down bay;
- fuel storage;
- lube bay; and
- store facilities.

MCM also has a coal crushing plant and CPP that are used to further process high ash content coal.

2.2.4 Hours of operations

Open-cut mining operations at MCM are approved to occur 24 hours a day, seven days a week. Blasting is limited to between 9 am and 5 pm Monday to Friday.

2.2.5 Current noise conditions (DA 205/2002, as modified)

Noise criteria specified in Condition 6.4.1 of the current development consent (DA 205/2002) are reproduced in Table 2.1. These are consistent with the site's Environment Protection Licence (EPL 656) issued by the EPA. Locations referenced in Table 2.1 are shown in Figure 3.1.

Table 2.1 Development consent (DA 205/2002) operational noise criteria

Location	Noise criteria, dB			
	Day	Evening	Night	
	$L_{Aeq(15\text{-}min)}$	$L_{Aeq(15\text{-}min)}$	$L_{Aeq(15\text{-}min)}$	$L_{A1(1\text{-}min)}$
R7	36	36	36	44
R13	40	40	40	51
R15	35	35	35	46
R16	35	35	35	46
R17	35	35	35	46
R20	38	38	38	48

Condition 6.4.3 and 6.4.5 of the current development consent relating to the interpretation of noise levels and the noise management plan requirements are reproduced as follows:

6.4.3 Interpretation of noise levels

a) For the purposes of condition 6.4.1 and 6.4.2:

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays;
- Evening is defined as the period from 6pm to 10pm; and
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.

b) Noise from the Project is to be measured within the residential boundary, or within 30 m of the dwelling (rural stations) where the dwelling is more than 30 m from the boundary to determine compliance with the LAeq(15 minutes) noise limit in Condition 6.4.1. Where it can be demonstrated that direct measurement of noise from the project is impractical, the EPA may accept alternative means of determining compliance. See chapter 11 of the NSW Industrial Noise Policy. The modification factors presented in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise level where practical.

c) Noise from the project is to be measured at 1m (unless otherwise agreed with the property owner) from the dwelling façade, to determine compliance with the LA1(1 minute) noise limits in Condition 6.4.1.

d) The noise emission limits identified in Condition 6.4.1 apply under meteorological conditions of:

- Wind speed up to 3 m/s at 10 metres above ground level; and
- Temperature inversion conditions of up to 3^{o}C/100 m.

6.4.5 Noise Management

The applicant shall prior to the commencement of operations prepare and implement a noise management plan for the project (incorporating construction and operational noise), in consultation with the EPA and to the satisfaction of MSC. The plan shall:

i) Demonstrate consistency in complying with noise criteria limits at the existing MCC operation;

ii) Include details of the conduct of noise investigations at six monthly intervals (unless otherwise agreed by MSC) to evaluate, assess and report the LAeq (15 minute) noise emission levels due to normal operations of the project;

iii) Provide details regarding operating configuration, determining survey intervals, weather conditions and seasonal variations, selecting variations, locations, periods and times of measurements;

iv) Detail management measures where the target noise level criteria of this consent are predicted to be exceeded, or are exceeded during mining operations. These measures should include but not be limited to:

- The selection of representative monitoring locations within the community must be carried out in consultation with MSC;
- Prompt response to any community issues of concern;
- Refinement of on-site noise mitigation measures and mining operating procedures where practical;
- Discussions with relevant property holders to assess concerns;
- Consideration of acoustical mitigation at receivers; and
- Consideration of negotiated agreements with property owners.

v) Outline proactive/predictive and reactive mitigation measures to be employed on the site to limit noise emissions;

vi) Outline measures to reduce the impact of intermittent, low frequency and tonal noise (including truck reversing alarms);

vii) Survey and investigate noise reduction measures from plant and equipment annually, subject to noise monitoring results and/or complaints received, and report in the AEMR at the conclusion of the first 12 months of mining operations and set targets for noise reduction taking into consideration valid noise complaints in the previous year;

viii) Specify the procedures for a noise monitoring program for the purpose of undertaking independent noise investigations;

ix) Outline the procedure to notify property owners and occupiers likely to be affected by noise from the operations;

x) Maintain a protocol for handling noise complaints that include recording, reporting and acting on complaints, particularly where complaints are received and it is demonstrated noise levels are in excess of the criteria contained in this consent;

xi) Record appropriate mechanisms for community consultation; and

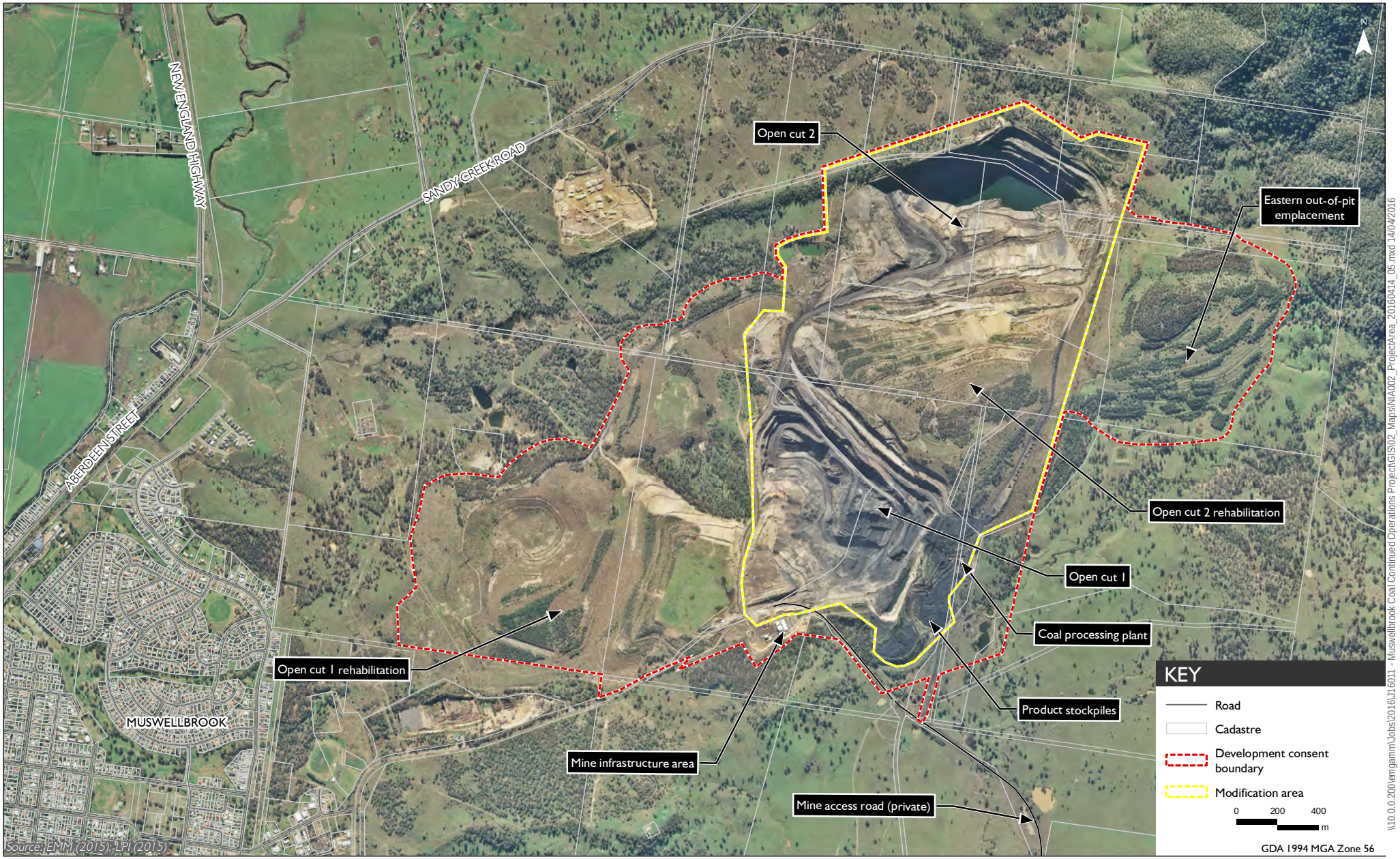
xii) As far as practicable, details of the interrelationship of this plan with the noise management plan of other mines in the vicinity.

2.3 Proposed modification

MCC seeks to modify the conceptual mine plan to allow mining of additional resources, as well as extending the approved mine life and modifying the conceptual final landform.

The approved operations and proposed modification are shown in Figure 2.1.

The modification will involve progression of Open Cut 1 to the north-east and the filling of voids in either Open Cut 1 or Open Cut 2 with overburden and rejects. This has the potential to generate noise emissions higher than currently experienced at potentially sensitive residential receivers, in particular those located to the north of the site. This is mainly due to MCM extracting operations moving north and occurring at higher elevations and in more exposed areas. Existing extracting operations at MCM generally occur within lower benches within Open Cut 1 and thus are less exposed to those northern residential receivers.



Approved and proposed extraction area

Muswellbrook Coal Continuation Project
Noise and vibration impact assessment
Figure 2.1

3 Existing environment

3.1 Site location and noise sensitive receivers

MCM is located in a rural setting and is surrounded by undulating terrain. Elevations within the site boundary range from approximately 80 m to 340 m AHD.

Land uses surrounding the mine include agricultural activities, light industrial land uses and residential areas. Agricultural activities are located on properties surrounding MCM and primarily include grazing of beef cattle. Light industrial land uses include Muswellbrook Quarry to the north-west, St Heliers correctional centre to the north-west and Muswellbrook waste management facility to the south. Muswellbrook township is to the south-west, with other notable rural-residential areas along Sandy Creek Road to the north-west, Woodlands Ridge Estate to the south and along Muscle Creek Road to the south-east.

Other significant features surrounding MCM include the Main Northern Rail Line and the New England Highway, which run to the west through Muswellbrook township and to the south towards Singleton. Numerous other mining operations and power-generating facilities exist between Muswellbrook and Singleton.

Several residences are located within at least 3 km of the site and have been identified for the assessment of noise from the modification. Nearest and potentially most affected sensitive receivers have been adopted as assessment locations for the purpose of this NVIA. Six of these locations are referenced in the current development consent DA 205/2002 and were part of the original environmental assessment prepared by HLA-Envirosciences (2002). The assessment location IDs are consistent with the previous noise and vibration assessments prepared for MCM by Hansen Bailey in 2013, which formed part of the environmental assessment prepared for the last MCM modification. Furthermore, newly identified sensitive receivers have also been adopted for the purpose of this assessment.

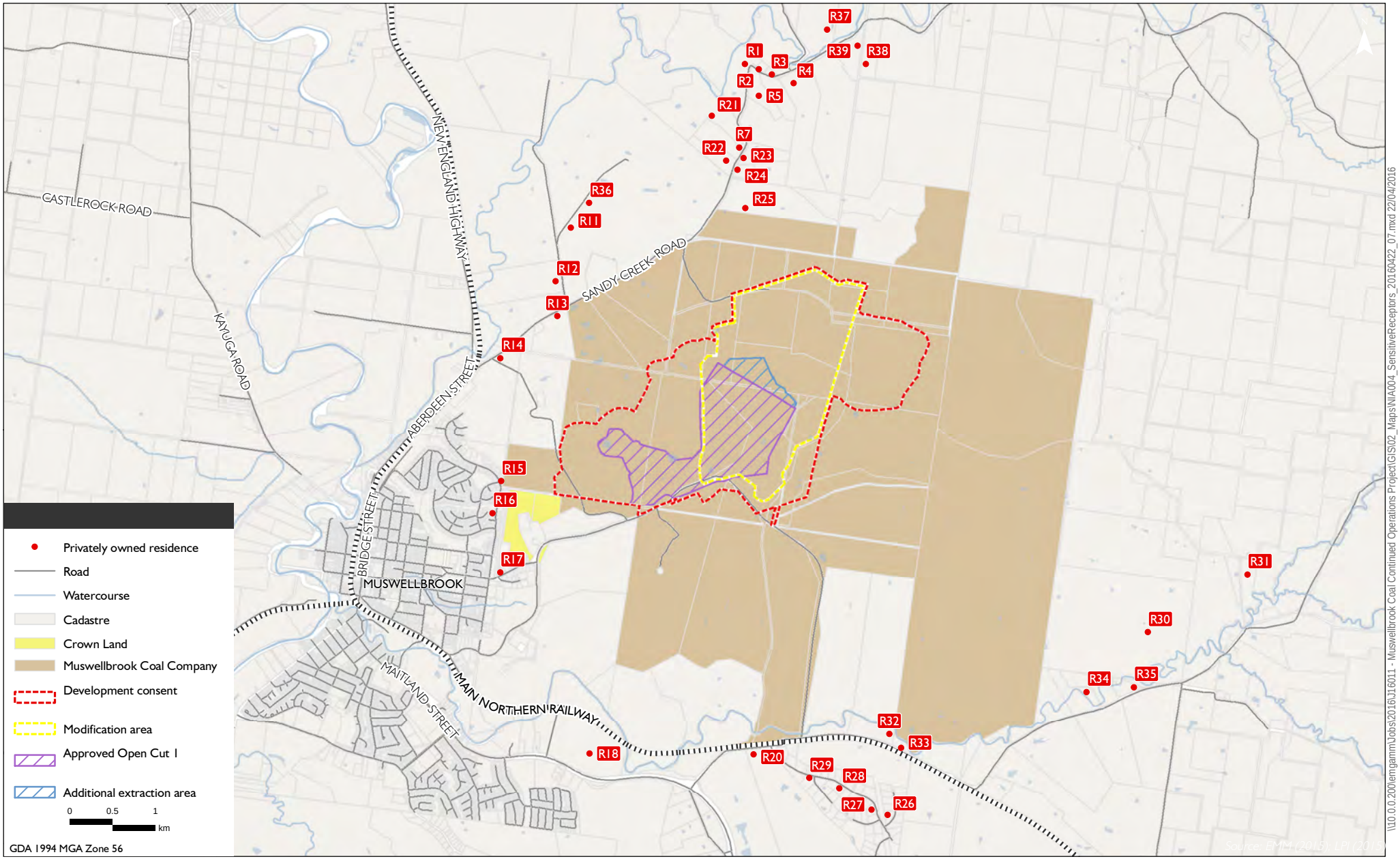
The noise assessment locations are presented in Table 3.1 and shown on Figure 3.1.

Table 3.1 Assessment locations

Assessment location ID	Locality	MGA coordinates	
		Easting	Northing
R1	Sandy Creek Road north	305602	6434379
R2	Sandy Creek Road north	305764	6434314
R3	Sandy Creek Road north	305916	6434254
R4	Sandy Creek Road north	306165	6434153
R5	Sandy Creek Road north	305763	6434008
R7	Sandy Creek Road north	305543	6433411
R11	St Heliers Road	303573	6432471
R12	St Heliers Road	303397	6431849
R13	Sandy Creek Road	303467	6431464
R14	Sandy Creek Road	302757	6430953
R15	Queen Street	302760	6429569
R16	Queen Street	302667	6429160
R17	Queen Street	302699	6428427

Table 3.1 Assessment locations

Assessment location ID	Locality	MGA coordinates	
		Easting	Northing
R18	New England Highway south	303792	6426355
R20	Muscle Creek Road	305683	6426361
R21	Sandy Creek Road north	305213	6433772
R22	Sandy Creek Road north	305400	6433248
R23	Sandy Creek Road north	305580	6433240
R24	Sandy Creek Road north	305545	6433109
R25	Sandy Creek Road north	305596	6432688
R26	Woodland Ridge	307261	6425642
R27	Woodland Ridge	307076	6425699
R28	Woodland Ridge	306700	6425948
R29	Woodland Ridge	306348	6426069
R30	Muscle Creek Road east	310289	6427765
R31	Muscle Creek Road east	307416	6426419
R32	Muscle Creek Road	309577	6427069
R33	Muscle Creek Road	310127	6427126
R34	Muscle Creek Road east	303789	6432760
R35	Muscle Creek Road east	306558	6434778
R36	St Heliers Road	307007	6434376
R37	Sandy Creek Road north	306912	6434588
R38	Sandy Creek Road north	307261	6425642
R39	Sandy Creek Road north	307076	6425699



Noise assessment locations

Muswellbrook Coal Continuation Project
Noise and vibration impact assessment
Figure 3.1

3.2 Existing noise and blasting emissions

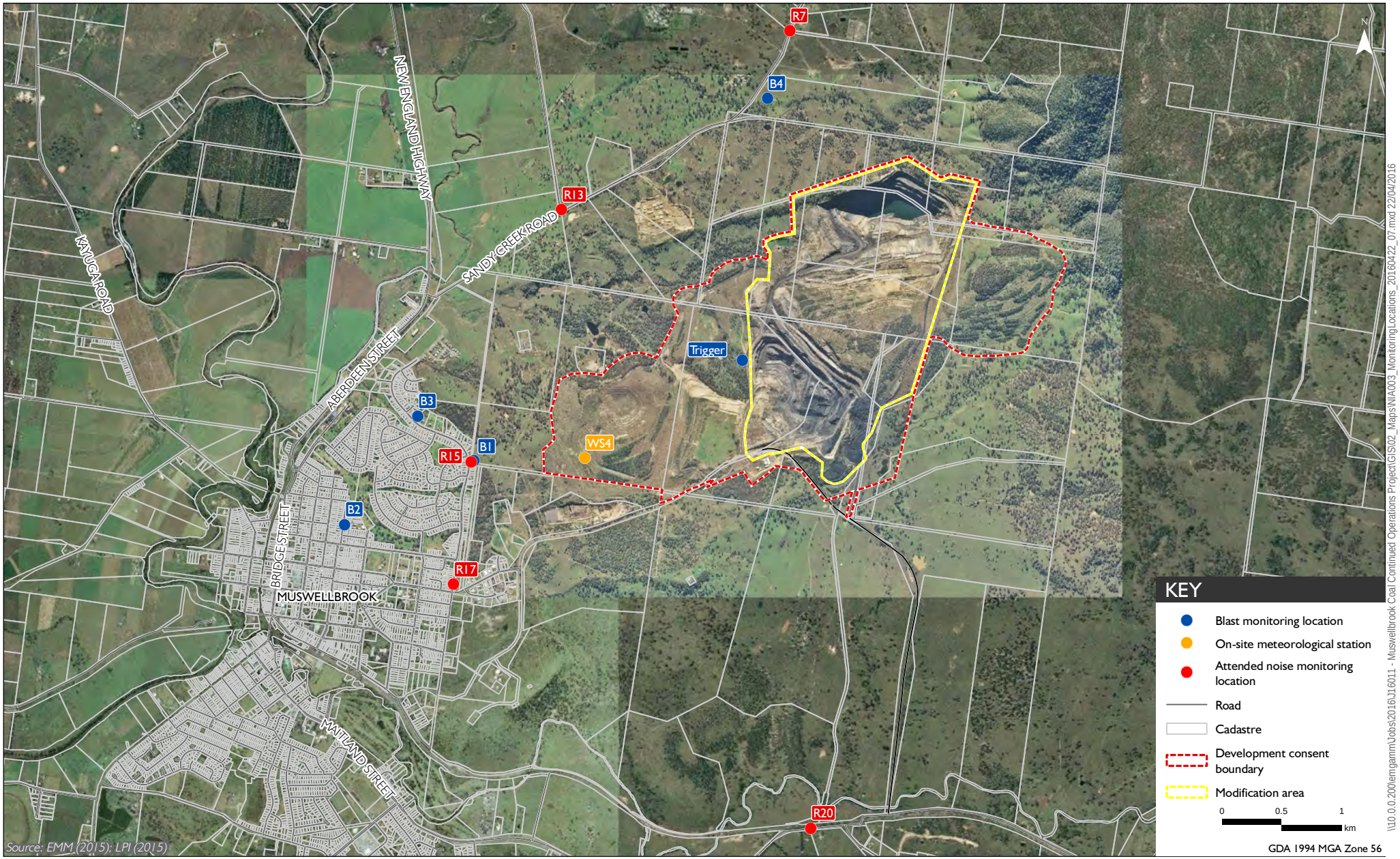
Noise emissions from mining operations at MCM are currently managed in accordance with the approved Noise Management Plan (MCC 2015), which includes operator-attended noise monitoring on a bi-annual (six monthly) basis. A review of historical noise monitoring results showed that noise levels from mining operations generally satisfied the relevant limits specified in the development consent DA 205/2002 at all noise monitoring locations. The exceptions were during the night-time monitoring surveys in June 2012 (at R15) and June 2013 (at R13), where MCM $L_{Aeq(15\text{-}min)}$ noise contributions were marginally above the relevant limits by 2 dB and 1 dB, respectively.

It is noted that very few complaints have been received in relation to noise from MCM since January 2013. Two were received in April 2013 in relation to general mine noise and one on 23 May 2014 relating to dozer tracks and reversing alarms; broadband reversing alarms have subsequently been fitted to relevant plant. Another was received in October 2015 and a subsequent investigation found that the source was unlikely to have been mine related.

Blasting is currently managed in accordance with the approved Blast-Vibration Management Plan (MCC 2015). Noise and blast monitoring locations are shown in Figure 3.2. There have been 85 blasts at MCM between July 2011 and December 2015. Results of blast emissions monitoring during this time are summarised as follows:

- ground vibration levels from blasting were less than the most stringent criteria of 5 mm/s on all occasions at all monitoring locations;
- airblast (overpressure) criterion of 115 dB, Lin Peak was marginally exceeded (up to 2 dB) at location B4 in November 2011, June and October 2013; and
- airblast levels have never been recorded above the upper criterion of 120 dB, Lin Peak.

Based on information supplied by MCC, seven complaints in relation to noise and vibration from blasting at MCC were received since January 2013; 2 April 2013, 9 and 19 September 2013, 6 November 2014, 14 and 16 January 2015 and 30 March 2015. All of these complaints were related to being able to ‘feel’ the blast; it is noted that blast overpressure and ground vibration levels satisfied the relevant criteria during all blast events that were the subject of complaint.



EMM

Noise and blast monitoring locations

Muswellbrook Coal Continuation Project
Noise and vibration impact assessment
Figure 3.2

3.3 Existing ambient noise levels

A key element in assessing environmental noise impact from industry is to quantify the existing background acoustic environment, including any existing industrial noise where present.

Background noise levels referenced in the original noise assessment prepared for MCM (HLA-Envirosciences, 2002) were referenced for the purpose of this assessment (refer Table 3.2). It is anticipated that these background noise levels would have remained the same for the majority of the monitoring locations and therefore are deemed representative of the current background noise environment. It is noted that background noise levels for some of these noise catchments, in particular for those closer to the town of Muswellbrook, may have increased since 2002 and therefore are deemed conservative. This is discussed further in Section 4.1.2 of this report.

Table 3.2 Measured ambient noise levels (HLA-Envirosciences, 2002)

Location (previous ID)	$L_{Aeq(day)}$	$L_{Aeq(evening)}$	$L_{Aeq(night)}$	RBL Day	RBL Evening	RBL Night
R7 (N1)	53	52	45	32	34	33
R15 (N2)	51	54	43	31	34	30
R16 (N3)	47	49	51	32	37	29
R17 (N4)	47	49	45	36	40	37
R20 (N5)	55	55	53	40	33	32

Notes: 1.Day: 7 am to 6 pm (*8 am on Sundays and public holidays), Evening: 6 pm to 10 pm, Night: 10 pm to 7 am* (*8 am on Sundays and public holidays).*

3.4 Meteorology

Noise propagation over distance can be significantly affected by the weather conditions. Of most interest are source to receiver winds, the presence of temperature inversions and drainage flow effects, as these conditions can enhance received noise levels. To account for these phenomena, the INP specifies meteorological analysis procedures to determine the prevalent weather conditions that enhance noise propagation in a particular area, with a view to determining whether they can be described as a feature of the project area.

3.4.1 Wind

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

The INP requires that winds of speeds up to 3 m/s with an occurrence greater than or equal to 30% of the time during any period (day, evening or night) in any season be assessed.

Detailed analysis of winds was undertaken using weather data from the MCM on-site weather station located on the western side of the site.

The prevailing winds analysis was undertaken in accordance with INP methods and considered weather data over a one year period (January 2014 to December 2014). The analysis determined that prevailing winds were present during the day period ranging from the east-south-east to south (112.5° to 180° from north 0°).

3.4.2 Temperature inversions

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions generally occur during the night-time and early morning periods during the winter months. A temperature inversion needs to occur for approximately 30% of the total night-time period during winter, or approximately two nights per week, for it to be a significant characteristic of the area and require consideration in accordance with the INP (EPA 2000).

The frequency of temperature inversions was analysed based on supplied sigma-theta data from the MCM on-site weather station. F or G class temperature inversions were found to occur for greater than 30% of the night-time period and as such, have been considered in the prediction and assessment of noise emissions from the project. This is consistent with past studies undertaken for other projects in the area.

3.4.3 Drainage winds

Topography around MCM is undulating with a gentle uphill slope in most directions. The INP states that a default wind drainage value should be applied where sources are at a higher altitude than the assessment location with no intervening topography. Drainage winds were considered but found to be irrelevant at the project area as assessment locations are higher than the noise sources or there is intervening topography.

3.4.4 Modelled meteorological conditions

Predicted noise levels from MCM at the assessment locations have been calculated based on the meteorological parameters shown in Table 3.3. Prevailing conditions (winds and temperature inversion) based on the detailed weather data analysis described previously have been considered.

Table 3.3 Weather conditions considered in noise modelling

Assessment period	Meteorological condition	Air temperature	Relative humidity	Wind speed[1]	Stability category (temperature gradient)
Day	Calm	20°C	70%	0 m/s	D class
	Wind	20°C	70%	2.6 m/s[2]	D class
Evening/night	Calm	10°C	90%	0 m/s	D class
Night	Temperature inversion	10°C	90%	0 m/s	F class

Notes: 1. Based on the 10th percentile wind speed of all winds present for 30% of the time during the relevant period.

2. Wind directions adopted are 112.5°, 135°, 157.5°, 180° from north (0°) based on data from the MCM on-site weather station.

4 Noise criteria

4.1 Operational noise criteria

4.1.1 INP noise criteria

Industrial sites in NSW are regulated by the local council, Department of Planning and Environment (DP&E) and/or the EPA. Noise limits are normally derived from operational noise criteria applied at assessment locations based on INP guidelines (EPA 2000) or noise levels that can be achieved at a specific site following the application of all feasible and reasonable noise mitigation.

The INP guidelines for assessing industrial facilities have been used for this assessment. With respect to the criteria, the guidelines state:

> 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.

Assessment criteria depend on the existing amenity of areas potentially affected by the subject development. Noise assessment criteria for industry are based on the following objectives:

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

To meet these objectives, the EPA provides two separate criteria: intrusiveness criteria and amenity criteria. A fundamental difference between the intrusiveness and the amenity criteria is the period they relate to:

- intrusiveness criteria — apply over 15 minutes in any period (day, evening or night); and
- amenity criteria — apply to the entire assessment period (day, evening or night).

i Intrusiveness

The intrusiveness criteria require that $L_{Aeq(15\text{-}min)}$ noise levels from site during the relevant operational periods (ie day, evening and night) do not exceed the Rating Background Levels (RBLs) by more than 5 dB. It is noted that where the RBL for the evening or night period is higher than day period RBL, the lower RBL for the day period has been adopted as the evening and night periods RBLs in accordance with the INP Application Notes. The RBLs utilised for determination of the intrusive criteria are based on the background noise monitoring results presented in the original noise and vibration assessment (HLA-Enviroscience 2002) for assessment locations in the vicinity of those monitoring locations. Where assessment locations are distant from the previous monitoring locations, the INP minimum RBL of 30 dB has been adopted for all assessment periods.

Table 4.1 presents the intrusive noise criteria determined from the RBLs for all assessment locations.

Table 4.1 Intrusive noise criteria

Assessment location (previous ID)	Adopted RBL, dB			Intrusive criteria, $L_{Aeq(15\text{-}min)}$, dB		
	Day	Evening	Night	Day	Evening	Night
R1	30	30	30	35	35	35
R2	30	30	30	35	35	35
R3	30	30	30	35	35	35
R4	30	30	30	35	35	35
R5	30	30	30	35	35	35
R7 (N1)	32	32	32	37	37	37
R11	30	30	30	35	35	35
R12	30	30	30	35	35	35
R13	32	32	32	37	37	37
R14	32	32	32	37	37	37
R15 (N2)	31	31	30	36	36	35
R16 (N3)	32	32	30	37	37	35
R17 (N4)	31	31	30	36	36	35
R18	40	33	32	45	38	37
R20 (N5)	40	33	32	45	38	37
R21	30	30	30	35	35	35
R22	32	32	32	37	37	37
R23	32	32	32	37	37	37
R24	32	32	32	37	37	37
R25	32	32	32	37	37	37
R26	30	30	30	35	35	35
R27	30	30	30	35	35	35
R28	30	30	30	35	35	35
R29	30	30	30	35	35	35
R30	30	30	30	35	35	35
R31	30	30	30	35	35	35
R32	30	30	30	35	35	35
R33	30	30	30	35	35	35
R34	30	30	30	35	35	35
R35	30	30	30	35	35	35
R36	30	30	30	35	35	35
R37	30	30	30	35	35	35
R38	30	30	30	35	35	35
R39	30	30	30	35	35	35

Notes: *1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night: all remaining periods.*

2. The INP minimum RBL has been assumed for R1 – R5, R11, R12, R21 and R26 – R39. The RBLs recorded at R20 are assumed to be representative of those at R18. The RBLs recorded at R7 are assumed to be representative of those at R22-R25, R13 and R14.

ii Amenity

The assessment of amenity is based on noise criteria specific to the land use. The criteria relate only to industrial noise and exclude road or rail noise. Where the measured existing industrial noise approaches recommended amenity criteria, it needs to be demonstrated that noise levels from new industry will not contribute to existing industrial noise.

Most residential assessment locations have been categorised in the INP (EPA 2000) rural amenity category in accordance with the INP definition of a rural receiver type, ie an area with an acoustical environment that is dominated by natural sounds, and generally characterised by low background noise levels. The exceptions are assessment locations R15, R16 and R17, which are located on Queen Street, on the outskirts of the town of Muswellbrook. These assessment locations were categorised to be in a suburban amenity area, due to their proximity to built-up residential areas. The corresponding recommended amenity criteria for all assessment locations adopted for the project are given in Table 4.2.

Table 4.2 Amenity criteria

Assessment location	Indicative area	Recommended noise level, $L_{Aeq(period)}$, dB					
		Acceptable			Maximum		
		Day	Evening	Night	Day	Evening	Night
R1	Rural	50	45	40	55	50	45
R2	Rural	50	45	40	55	50	45
R3	Rural	50	45	40	55	50	45
R4	Rural	50	45	40	55	50	45
R5	Rural	50	45	40	55	50	45
R7	Rural	50	45	40	55	50	45
R11	Rural	50	45	40	55	50	45
R12	Rural	50	45	40	55	50	45
R13	Rural	50	45	40	55	50	45
R14	Rural	50	45	40	55	50	45
R15	Suburban	55	45	40	60	50	45
R16	Suburban	55	45	40	60	50	45
R17	Suburban	55	45	40	60	50	45
R18	Rural	50	45	40	55	50	45
R20	Rural	50	45	40	55	50	45
R21	Rural	50	45	40	55	50	45
R22	Rural	50	45	40	55	50	45
R23	Rural	50	45	40	55	50	45
R24	Rural	50	45	40	55	50	45
R25	Rural	50	45	40	55	50	45
R26	Rural	50	45	40	55	50	45
R27	Rural	50	45	40	55	50	45
R28	Rural	50	45	40	55	50	45
R29	Rural	50	45	40	55	50	45
R30	Rural	50	45	40	55	50	45
R31	Rural	50	45	40	55	50	45
R32	Rural	50	45	40	55	50	45
R33	Rural	50	45	40	55	50	45

Table 4.2 Amenity criteria

Assessment location	Indicative area	Recommended noise level, $L_{Aeq(period)}$, dB					
		Acceptable			Maximum		
		Day	Evening	Night	Day	Evening	Night
R34	Rural	50	45	40	55	50	45
R35	Rural	50	45	40	55	50	45
R36	Rural	50	45	40	55	50	45
R37	Rural	50	45	40	55	50	45
R38	Rural	50	45	40	55	50	45
R39	Rural	50	45	40	55	50	45

Notes: 1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night: all remaining periods.

iii Project specific noise levels

The project specific noise levels (PSNLs) are generally the more stringent of either the intrusive or amenity criteria. However, where the amenity criteria is lower than the intrusive criteria it does not automatically follow that the amenity criteria would be more stringent due to the relative time periods over which they apply. Where this situation arises it is necessary to demonstrate that both the amenity and intrusive criteria can be achieved.

The PSNLs determined for the project for all relevant assessment periods are the relevant intrusive criteria and are shown in 'bold' text in Table 4.3.

Table 4.3 Project specific noise levels

Assessment locations	Intrusive criteria, $L_{Aeq(15\text{-}min)}$, dB			Amenity criteria, $L_{Aeq(period)}$, dB		
	Day	Evening	Night	Day	Evening	Night
R1	**35**	**35**	**35**	50	45	40
R2	**35**	**35**	**35**	50	45	40
R3	**35**	**35**	**35**	50	45	40
R4	**35**	**35**	**35**	50	45	40
R5	**35**	**35**	**35**	50	45	40
R7	**37**	**37**	**37**	50	45	40
R11	**35**	**35**	**35**	50	45	40
R12	**35**	**35**	**35**	50	45	40
R13	**37**	**37**	**37**	50	45	40
R14	**37**	**37**	**37**	50	45	40
R15	**36**	**36**	**35**	55	45	40
R16	**37**	**37**	**35**	55	45	40
R17	**36**	**36**	**35**	55	45	40
R18	**45**	**38**	**37**	50	45	40
R20	**45**	**38**	**37**	50	45	40
R21	**35**	**35**	**35**	50	45	40
R22	**37**	**37**	**37**	50	45	40
R23	**37**	**37**	**37**	50	45	40

Table 4.3 Project specific noise levels

Assessment locations	Intrusive criteria, $L_{Aeq(15\text{-}min)}$, dB			Amenity criteria, $L_{Aeq(period)}$, dB		
	Day	Evening	Night	Day	Evening	Night
R24	**37**	**37**	**37**	50	45	40
R25	**37**	**37**	**37**	50	45	40
R26	**35**	**35**	**35**	50	45	40
R27	**35**	**35**	**35**	50	45	40
R28	**35**	**35**	**35**	50	45	40
R29	**35**	**35**	**35**	50	45	40
R30	**35**	**35**	**35**	50	45	40
R31	**35**	**35**	**35**	50	45	40
R32	**35**	**35**	**35**	50	45	40
R33	**35**	**35**	**35**	50	45	40
R34	**35**	**35**	**35**	50	45	40
R35	**35**	**35**	**35**	50	45	40
R36	**35**	**35**	**35**	50	45	40
R37	**35**	**35**	**35**	50	45	40
R38	**35**	**35**	**35**	50	45	40
R39	**35**	**35**	**35**	50	45	40

Notes: 1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night is the remaining periods.

4.1.2 Acquisition criteria

For the project, the acquisition noise criteria for some of the assessment locations have been defined in the development consent DA 205/2002 and are shown in Table 4.4 for the relevant locations. For all assessment locations the acquisition noise criteria were also determined based on guidance provided in the NSW Government's Voluntary Land Acquisition and Mitigation Policy (VLAMP) by adding 5 dB to the relevant PSNLs for all assessment locations, and are shown in Table 4.5. These are higher compared to the current acquisition criteria for R7, R13, R15, R16, R17 and R20 (Table 4.4). It should be noted that acquisition applies if the stated levels are exceeded.

Table 4.4 Development consent (DA 205/2002) acquisition noise criteria

Location	Noise acquisition criteria, dB		
	Day $L_{Aeq(15\text{-}min)}$	Evening $L_{Aeq(15\text{-}min)}$	Night $L_{Aeq(15\text{-}min)}$
R7	41	41	41
R13	45	45	45
R15	40	40	40
R16	40	40	40
R17	40	40	40
R20	43	43	43

Notes: 1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night is the remaining periods.

Table 4.5 Acquisition noise criteria

Location	PSNLs $L_{Aeq(15\text{-}min)}$, dB			Acquisition criteria $L_{Aeq(15\text{-}min)}$, dB		
	Day	Evening	Night	Day	Evening	Night
R1	35	35	35	40	40	40
R2	35	35	35	40	40	40
R3	35	35	35	40	40	40
R4	35	35	35	40	40	40
R5	35	35	35	40	40	40
R7	37	37	37	42	42	42
R11	35	35	35	40	40	40
R12	35	35	35	40	40	40
R13	37	37	37	42	42	42
R14	37	37	37	42	42	42
R15	36	36	35	41	41	40
R16	37	37	35	42	42	40
R17	36	36	35	41	41	40
R18	45	38	37	50	43	42
R20	45	38	37	50	43	42
R21	35	35	35	40	40	40
R22	37	37	37	42	42	42
R23	37	37	37	42	42	42
R24	37	37	37	42	42	42
R25	37	37	37	42	42	42
R26	35	35	35	40	40	40
R27	35	35	35	40	40	40
R28	35	35	35	40	40	40
R29	35	35	35	40	40	40
R30	35	35	35	40	40	40
R31	35	35	35	40	40	40
R32	35	35	35	40	40	40
R33	35	35	35	40	40	40
R34	35	35	35	40	40	40
R35	35	35	35	40	40	40
R36	35	35	35	40	40	40
R37	35	35	35	40	40	40
R38	35	35	35	40	40	40
R39	35	35	35	40	40	40

Notes: 1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night is the remaining periods.

4.1.3 Sleep disturbance

MCM currently operates during the night period and sleep disturbance ($L_{A1(1\text{-}min)}$) noise limits exist in the current development consent DA 205/2002 (Table 2.1). MCM will continue to operate during the night period (from 10 pm to 7 am).

The INP Application Notes recognise that the current sleep disturbance criterion is not ideal. The assessment of potential sleep disturbance is complex and poorly understood and the EPA believes that there is insufficient information to determine a suitable alternative criteria.

In the interim, the INP application notes suggest that the $L_{A1(1\text{-}min)}$ level of 15 dB above the RBL is a suitable screening criteria for sleep disturbance for the night period. Guidance regarding potential for sleep disturbance is also provided in the NSW Road Noise Policy (RNP). The RNP calls upon a number of studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance. However, the RNP provides the following conclusions from the research on sleep disturbance:

- maximum internal noise levels below 50 to 55 dB are unlikely to awaken people from sleep; and
- one or two noise events per night (for example, excavator loading coal or overburden into an empty haul truck tray), with maximum internal noise levels of 65 to 70 dB, are not likely to affect health and wellbeing significantly.

It is commonly accepted by acoustic practitioners and regulatory bodies that a facade including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60 to 65 dB calculated at the facade of a residence are unlikely to cause sleep disturbance affects. Furthermore, the World Health Organisation (WHO) *Guidelines for Community Noise* (WHO 1999) suggests that levels below 45 dB inside homes are unlikely to wake sleeping occupants.

The descriptors L_{Amax} and $L_{A1(1\text{-}min)}$ may be considered interchangeable which is accepted by the EPA.

Sleep disturbance noise goals for all assessment locations have been determined by applying the guidance provided in the INP Application Notes and are presented in Table 4.6. These have been based on the adopted RBLs presented in Table 4.1.

Table 4.6 Sleep disturbance criteria (night time only)[1]

Assessment location	Adopted RBL, dB	Sleep disturbance L_{Amax} criteria, dB	Development consent $L_{A1(1\text{-}min)}$ criteria, dB
R1	30	45	-
R2	30	45	-
R3	30	45	-
R4	30	45	-
R5	30	45	-
R7	32	47	44
R11	30	45	-
R12	30	45	-
R13	32	47	51
R14	32	47	-
R15	30	45	46
R16	30	45	46
R17	30	45	46
R18	32	47	-
R20	32	47	48
R21	30	45	-

Table 4.6 Sleep disturbance criteria (night time only)[1]

Assessment location	Adopted RBL, dB	Sleep disturbance L_{Amax} criteria, dB	Development consent $L_{A1(1\text{-}min)}$ criteria, dB
R22	32	47	-
R23	32	47	-
R24	32	47	-
R25	32	47	-
R26	30	45	-
R27	30	45	-
R28	30	45	-
R29	30	45	-
R30	30	45	-
R31	30	45	-
R32	30	45	-
R33	30	45	-
R34	30	45	-
R35	30	45	-
R36	30	45	-
R37	30	45	-
R38	30	45	-
R39	30	45	-

Notes: 1. Night: 10 pm to 7 am Monday to Saturday; 10 pm to 8 am Sundays and public holidays.

4.2 Applying INP criteria to existing sites

The INP also provides guidance on the application of noise criteria to existing industrial sites such as the MCM:

> The application of the criteria to existing sources of noise would occur where significant modifications (such as to warrant serious and/or ongoing development consent or EPA approval) are made to existing developments or where complaints are received. In applying the policy to existing operations it is acknowledged that the scope for applying reasonable and feasible mitigation measures to existing noise sources is usually far more limited than for new developments. Careful consideration of noise impacts and the feasible and reasonable mitigation measures available at these sites may result in less stringent noise limits than would ideally apply. Sometimes the resultant noise limits will be above the criteria.

The INP Application Notes state that if PSNLs are not achieved from existing operations, a preliminary review of feasible and reasonable mitigation measures should be undertaken to identify potential opportunities to reduce existing operational noise levels.

The INP Application Notes state that if the existing premises cannot achieve PSNLs after the feasible and reasonable noise mitigation review, the proposed modification should not significantly increase the existing noise emissions.

This assessment has adopted the procedures outlined in the INP Application Notes for existing industrial sites.

4.3 Construction noise

Construction noise is assessed under the Interim Construction Noise Guidelines (ICNG), however there is no proposed construction works related to the modification. Noise generated during rehabilitation works (ie filling of voids) will be assessed as operational noise due to the similar type of plant and equipment used for MCM general operations. In EMM's experience, this method is considered suitable and commonly accepted by the EPA.

4.4 Cumulative noise

To limit continuing increases in industrial noise within a particular area, combined industrial noise should not exceed the amenity criteria levels specified in Table 2.1 from Section 2.2 of the INP (EPA 2000).

Three other mines currently operate in the area including Bengalla coal mine, Mt Arthur Coal mine and Drayton Coal mine. It is noted that mining operations at Drayton Coal mine are currently approved until 31 December 2017 after which time rehabilitation activities may still occur. Further, Mt Pleasant coal mine, to the west of MCM, has approval to operate, however mining operations have not yet commenced. Cumulative noise emissions from these operations have the potential to impact the nearest residences, which are located to the west and south of MCM. Cumulative operational noise during the night-time period has been considered and compared against the relevant INP acceptable and recommended maximum amenity criteria levels (as provided in Table 4.2).

4.5 Blasting

The limits adopted by EPA for blasting are provided in the Australian and New Zealand Environment Conservation Council (ANZECC 1990) guidelines, *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*.

The blasting limits address two main effects of blasting:

- airblast noise (overpressure); and
- ground vibration.

It is noted that airblast and ground vibration criteria exist for MCM operations as specified in Condition 6.3 of the current development consent DA 205/2002. These are consistent with the ANZECC (1990) guidelines as discussed in the following sections. Blasting is restricted between 9 am and 5 pm Mondays to Fridays, and currently occurs on average three times a week.

4.5.1 Airblast

The recommended maximum level for airblast is 115 dB linear peak. This level may be exceeded on up to 5% of the total number of blasts over 12 months. However, the level should not exceed 120 dB linear peak at any time. A summary of airblast limits are provided in Table 4.7.

Table 4.7 Airblast (overpressure)

Airblast level dB(L_{peak})	Allowable exceedance
115	5% of the total number of blasts over 12 months
120	0%

4.5.2 Ground vibration

Peak particle velocity (PPV) from ground vibration should not exceed 5 mm/s for more than 5% of the total number of blasts over 12 months. Further, the maximum level should not exceed 10 mm/s at any time. A summary of ground vibration limits are provided in Table 4.8.

Table 4.8 Ground vibration limits

PPV (mm/s)	Allowable exceedance
5	5% of the total number of blasts over 12 months
10	0%

4.6 Road traffic noise

There will be no increase in road traffic as a result of the modification. Hence, road traffic noise has not been considered as part of this assessment.

5 Operational noise modelling and assessment

5.1 Overview

The modification will involve an extension of the mine life, the progression of Open Cut 1 to the north-north-east and the placement of overburden within voids in Open Cut 1 and Open Cut 2. All mining methods and equipment at MCM will remain unchanged. These aspects have the potential to change noise emissions at sensitive receivers. Hence, noise emissions from the project have been quantitatively reviewed to provide a contemporary assessment of approved operations, incorporating the modification.

5.2 Noise modelling methodology

5.2.1 Modelling software and calculation method

This section presents the methods and assumptions used to model noise emissions from MCM, incorporating the relevant elements of the modification.

Noise modelling was based on three-dimensional digitised ground contours of the surrounding land. Noise predictions were carried out using Brüel and Kjær Predictor Version 11 noise prediction software. 'Predictor' calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources. The model has considered factors such as:

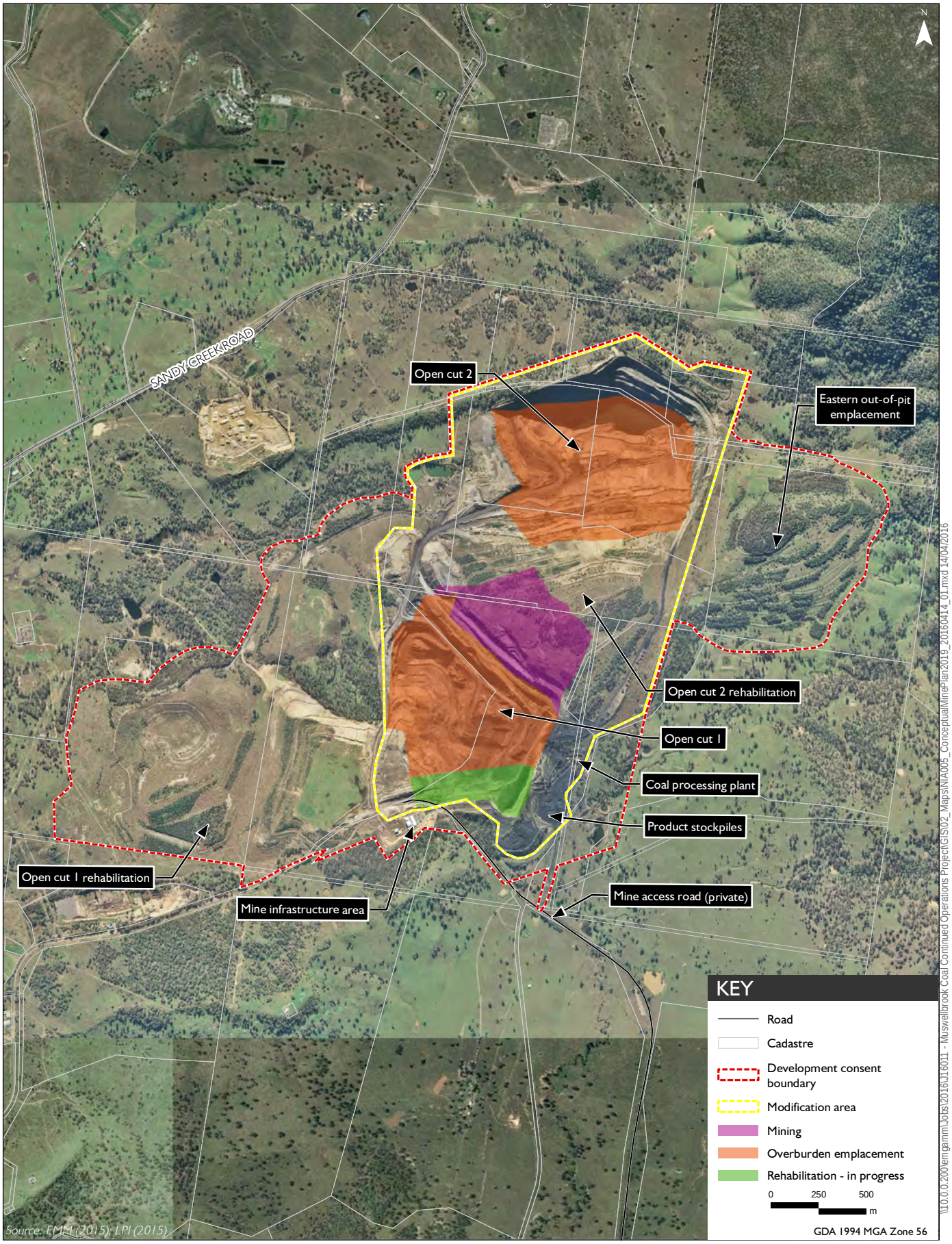
- the lateral and vertical location of plant;
- source to assessment location distances;
- ground effects;
- atmospheric absorption;
- topography of MCM and surrounding area; and
- applicable meteorological conditions.

Validation of the noise model was completed using most recent attended measurements undertaken as part of the noise monitoring program at MCM in November 2015.

5.2.2 Modelling scenarios

The modelling was based on mine plans developed for operations at MCM. A preliminary noise modelling exercise identified that mining activities planned to occur at the start of Year 3 would be representative of worst case noise emissions as a result of the modification. Therefore, Year 3 proposed mining operations were modelled for the purpose of this assessment. Based on information provided by MCC it is anticipated that operations associated with this acoustically worst-case scenario would occur for a period of approximately two months. Noise levels from MCM operations are anticipated to be the same or lower than the predicted noise emissions for Year 3 for the majority of the mine life.

Plant and equipment were modelled at locations and heights representing worst case activities during proposed Year 3 mining operations. The conceptual mine plan for Year 3 is provided in Figure 5.1. Appendix C shows the locations of acoustically significant noise sources assumed in the noise model for Year 3 mining operations. The noise modelling conservatively assumed that all plant and equipment will be operating concurrently and at full power.



Conceptual mine plan - Year 3

Muswellbrook Coal Continued Operations Project
Noise and vibration impact assessment
Figure 5.1

5.2.3 Plant and equipment sound power levels

Sound power levels used in the noise model were referenced from the latest onsite sound power testing survey reports. Sound power testing surveys were completed on-site at MCM in May 2013, June 2014 and most recently in July/October 2015. Sound power levels utilised for the purpose of noise modelling for all operational plant and equipment are provided in Table 5.1. A complete list of sound power levels and single octave spectral data for all plant and equipment used in the noise model is provided in Appendix B.

Table 5.1 Operational plant and equipment sound power levels

Plant and equipment	Typical activities	Location	Quantity	Sound power level (Lw)[1], dB(A)
CPP (washing plant)	Washing/screening coal	CPP area	1	119
Crushing plant	Crushing/screening coal	CPP area	1	116
Graders (CAT 16H)	Trimming haul roads	Haul roads	2	106-108
Track dozers (CAT D10T)	Organising overburden/coal	Pit/dump areas	4	123-126
Haul trucks (Hitachi EH35000)	Hauling overburden/coal	Haul roads	8	116-120
Haul trucks (CAT 777C)	Hauling within clean stockpile area/ Hauling rejects to dump areas	Clean stockpile area/ RoM/haul roads/dump areas	3	116-119
Water truck (CAT 777C)	Watering haul roads	Haul roads	1	117
Water truck (CAT 777D)	Watering haul roads	Haul roads	1	118
Drill (Ingersoll Rand DML)	Drilling blast holes	Pit/higher benches	1	115
Front-end loader (CAT 990H)	Loading/handling coal	RoM area	1	110
Excavator (Hitachi EX3600)	Stripping and loading overburden/coal	Pit/higher benches	1	117
Excavator (Hitachi EX2600-6)	Stripping and loading overburden/coal	Pit/higher benches	1	117

Notes: 1. Obtained from MCM sound power testing survey reports prepared by Global Acoustics (2013- 2015).

5.3 Noise modelling results and discussion

5.3.1 Operational noise levels

Predicted noise emission levels from MCM under the modification at all assessment locations are provided in Table 5.2. Noise levels have been predicted based on the meteorological conditions provided in Table 3.3. Indicative worst case noise contours are shown in Appendix D.

Noise emission levels predicted to be above the PSNLs are indicated by shading, and levels above the current development consent DA 205/2002 limits are indicated by bold text.

Table 5.2 Predicted operational noise levels

Assessment location	Predicted operational $L_{Aeq(15\text{-}min)}$ noise levels, dB				Noise criteria, $L_{Aeq(15\text{-}min)}$, dB					
	Day	Day	Evening/Night	Night	PSNLs			DA 205/2002		
	Calm	Wind	Calm	Inversion[2]	Day	Evening	Night	Day	Evening	Night
R1	31	33	32	34	35	35	35	-	-	-
R2	31	33	32	34	35	35	35	-	-	-
R3	32	34	33	35	35	35	35	-	-	-
R4	32	34	33	35	35	35	35	-	-	-
R5	33	35	34	36	35	35	35	-	-	-
R7	35	**37**	36	**38**	37	37	37	36	36	36
R11	35	37	37	39	35	35	35	-	-	-
R12	36	38	37	39	35	35	35	-	-	-
R13	37	40	38	**41**	37	37	37	40	40	40
R14	34	37	36	38	37	37	37	-	-	-
R15	34	**36**	35	**37**	36	36	35	35	35	35
R16	33	35	34	**36**	37	37	35	35	35	35
R17	31	33	33	35	36	36	35	35	35	35
R18	<30	<30	<30	31	45	38	37	-	-	-
R20	30	<30	32	34	45	38	37	38	38	38
R21	33	36	35	37	35	35	35	-	-	-
R22	35	38	36	39	37	37	37	-	-	-
R23	36	38	37	39	37	37	37	-	-	-
R24	37	39	38	40	37	37	37	-	-	-
R25	39	41	39	42	37	37	37	-	-	-
R26	<30	<30	<30	31	35	35	35	-	-	-
R27	<30	<30	30	31	35	35	35	-	-	-
R28	<30	<30	31	32	35	35	35	-	-	-
R29	30	<30	31	33	35	35	35	-	-	-
R30	<30	<30	<30	<30	35	35	35	-	-	-
R31	<30	<30	<30	<30	35	35	35	-	-	-
R32	<30	<30	31	33	35	35	35	-	-	-
R33	<30	<30	31	33	35	35	35	-	-	-
R34	<30	<30	<30	<30	35	35	35	-	-	-
R35	<30	<30	<30	<30	35	35	35	-	-	-
R36	35	37	36	38	35	35	35	-	-	-
R37	<30	31	31	32	35	35	35	-	-	-
R38	31	32	32	34	35	35	35	-	-	-
R39	30	32	31	33	35	35	35	-	-	-

Notes: 1. Maximum predicted level based on wind speed of 2.6 m/s and wind directions 112.5°, 135°, 157.5°, 180° from north (0°) based on data from the MCM on-site weather station.

2. F class temperature inversion.

Predicted noise levels satisfy the relevant PSNLs at most assessment locations. A discussion of results relevant to the level of impact from the modification is provided as follows:

- noise emissions are predicted to meet the PSNLs at 20 of the 34 assessed locations;
- a negligible impact (up to 2 dB above the PSNLs) is predicted at eight assessment locations;
- a moderate impact (3-5 dB above the PSNLs) is predicted at six assessment locations;
- predicted noise emission levels satisfy the relevant acquisition criteria at all assessment locations; and
- noise emissions are predicted to only marginally exceed the current development consent limit by 1 dB at locations R13 and R16 and 2 dB at locations R7 and R15.

Further discussion is provided in Section 6 regarding consideration of feasible and reasonable mitigation measures.

5.3.2 Sleep disturbance assessment

Predicted L_{Amax} noise levels from the modification at all assessment locations are provided in Table 5.3.

The highest predicted L_{Amax} noise level (from an excavator loading a haul truck or the FEL bucket scraping the ground) was 40 dB during F class temperature inversion at assessment location R24 and R25. This satisfies the adopted sleep disturbance criteria at both locations. The predicted L_{Amax} noise levels at all other assessment locations ranged between <30 dB and 37 dB during F class temperature inversion, and satisfy the EPA's strict background plus 15 dB screening target.

Table 5.3 Predicted night-time L_{Amax} noise levels

Assessment location	Predicted L_{Amax} noise levels, dB	Relevant noise criteria, dB	
	Inversion[1]	L_{Amax}	$L_{A1(1\text{-}min)}$
R1	30	45	-
R2	31	45	-
R3	31	45	-
R4	31	45	-
R5	35	45	-
R7	35	47	44
R11	37	45	-
R12	36	45	-
R13	37	47	51
R14	34	47	-
R15	33	45	46
R16	32	45	46
R17	31	45	46
R18	<30	47	-
R20	35	47	48
R21	36	45	-
R22	36	47	-

Table 5.3 Predicted night-time L_{Amax} noise levels

Assessment location	Predicted L_{Amax} noise levels, dB	Relevant noise criteria, dB	
	Inversion[1]	L_{Amax}	$L_{A1(1\text{-}min)}$
R23	36	47	-
R24	40	47	-
R25	40	47	-
R26	30	45	-
R27	31	45	-
R28	32	45	-
R29	33	45	-
R30	<30	45	-
R31	<30	45	-
R32	32	45	-
R33	34	45	-
R34	<30	45	-
R35	<30	45	-
R36	35	45	-
R37	<30	45	-
R38	30	45	-
R39	<30	45	-

Notes: 1. F class temperature inversion.

5.4 Cumulative noise assessment

Potential cumulative noise impacts from existing and approved developments have been considered.

Three other coal mines currently operate in the area surrounding MCM including Bengalla, Mt Arthur and Drayton. It is noted that Mt Pleasant coal mine to the west of MCM has approval to operate however mining operations have not yet commenced. Cumulative noise from these four operations, together with the MCM, has the potential to impact residences located to the west and south of the MCM.

Potential noise levels from the four other mines in the area have been quantitatively reviewed based on their current approval documentation. The noise limit from each of the other coal mines at residences to the south and west of the MCM is $L_{Aeq,15\text{-}min}$ 35 dB. The highest predicted noise level from MCM including the modification at residences to the west or south of MCM is $L_{Aeq,15\text{-}min}$ 41 dB. Based on our experience at similar sites, the $L_{Aeq,night}$ is at least 4 dB lower than the predicted worst case $L_{Aeq,15\text{-}min}$ during adverse weather. The cumulative noise assessment summary is provided in Table 5.4.

Table 5.4 Cumulative noise assessment

Predicted MCM $L_{Aeq,night}$	Allowable noise emission limit, $L_{Aeq,night}$				Total predicted night amenity level, $L_{Aeq,night}$
	Bengalla	Mt Arthur	Drayton	Mt Pleasant	
37 dB	31	31	31	31	40

As presented in Table 5.4, cumulative noise from the modification and surrounding mines is anticipated to satisfy the night amenity criteria of $L_{Aeq,night}$ 40 dB at all assessment locations.

5.5 Blasting assessment

Blast emission monitoring data relevant to existing MCM operations was supplied to EMM by MCC. This data included blast ID information, maximum instantaneous charge (MIC) and measured vibration and airblast levels at a number of monitoring locations. Blast results between January and December 2015 were used to develop prediction site laws for ground vibration and airblast for this assessment.

Site specific relationships between the level of blast emissions and scaled distances have been developed based on the measured data (refer Figures 5.2 and 5.3).

The scaled distance is determined from the following equation:

$$SD = \frac{D}{\sqrt[3]{MIC}}$$

Where *D* is the distance between the monitoring location and the blast site and *MIC* is the maximum explosive charge mass (kg) detonated in an eight millisecond interval.

It is to be noted that a square-root scaled distance is commonly used for the purpose of open cut mining blast vibration predictions in order to account for the cylindrical dispersion of energy from a blast. Analysis of the supplied data showed a higher degree of correlation (74%) between the cube-root scaled distance and the measured vibration data than the square-root scaled distance (68%). Due to this, the cube-root scaled distance has been utilised for the purpose of assessing the potential blast vibration impacts.

Figure 5.2 Ground vibration monitoring data and site law

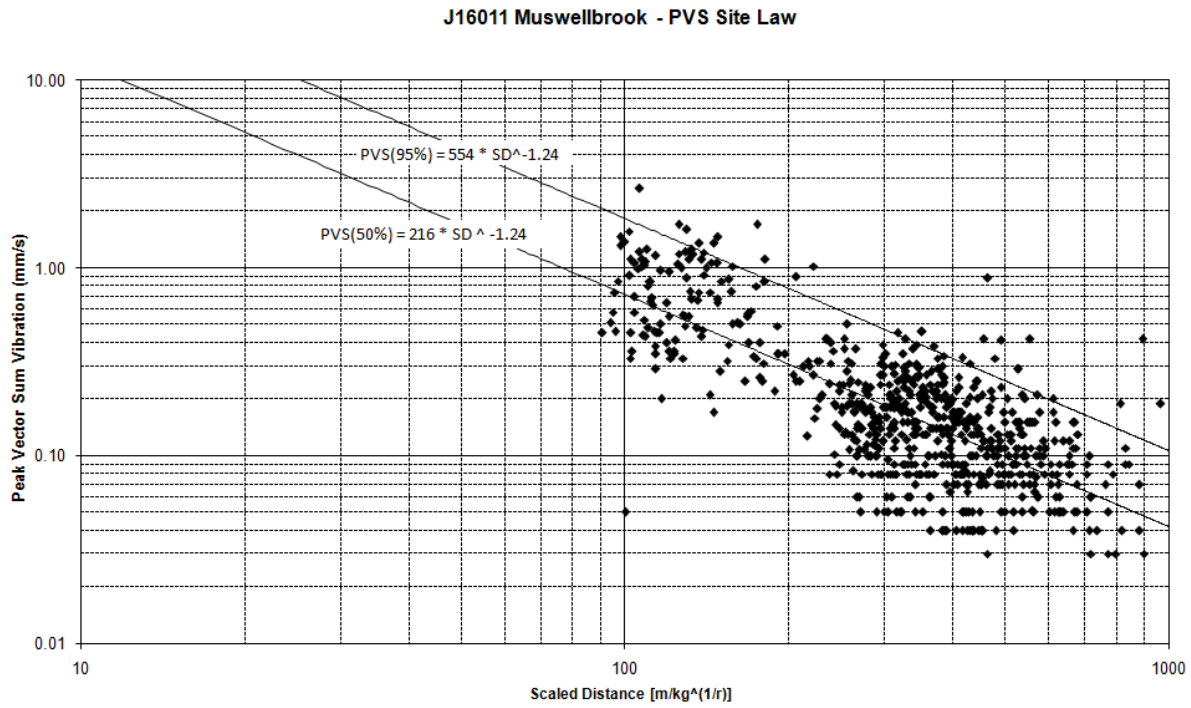
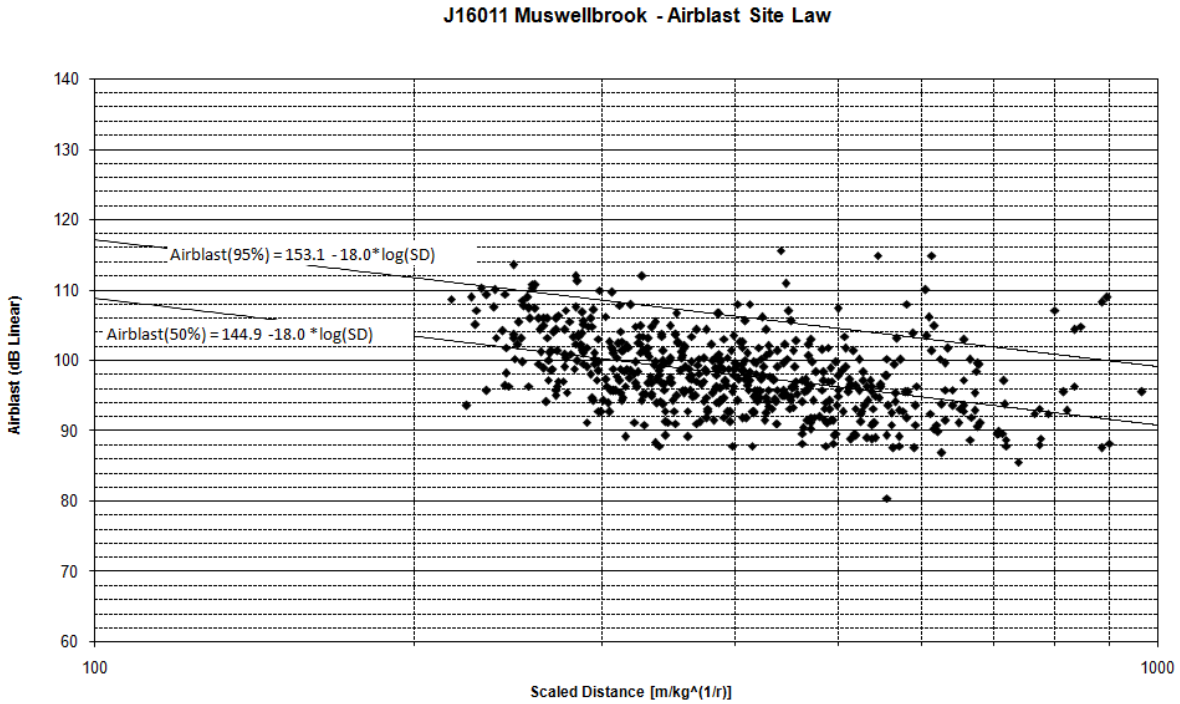


Figure 5.3 Airblast monitoring data and site law



The site laws for ground vibration and airblast emissions have been calculated to be:

$$PVS(95\%) = 554SD^{-1.24}$$

$$Airblast(95\%) = 153.1 - 18\log SD$$

Where *PVS(95%)* and *Airblast(95%)* are the levels of ground vibration (peak vector sum, mm/s) and airblast level (dB Linear), respectively, above which 5% of the total population of data points will lie, assuming that the population has the same statistical distribution as the underlying measured sample.

The purpose of this assessment was to determine the limiting factors to the blast design for the modification with the aim of achieving the relevant criteria outlined in Section 4.4. Calculations were conducted using the respective blast emissions site law equations developed based on measured data, in order to determine the allowable MICs and the resulting potential impacts at surrounding sensitive receptors.

Table 5.5 contains the results of the allowable MIC calculations based on the site laws developed for ground vibration and airblast predictions.

Table 5.5 Ground vibration and airblast results

Assessment location	Airblast criteria (dB(L)peak)	Ground vibration criteria PPV (mm/s)	Approx. distance to potential blasting (m)	Limiting MIC (kg) based on	
				Vibration	Airblast
Nearest residence (R25)	≤115	≤5	1,700	>10,000	2,100

The allowable MIC calculations indicate that there are no significant restrictions to the MIC of blasts at MCM.

Assuming the existing average MIC of 500 kg, the ground vibration and airblast levels predicted at the nearest residence are 0.7 mm/s and 111 dB, respectively.

By maintaining the current approach to blast design and blast emission management, it is anticipated that the blast emissions criteria will continue to be met throughout the life of the modification.

6 Noise and blasting mitigation, monitoring and management

6.1 Feasible and reasonable noise management and mitigation

Results of noise modelling have indicated the combination of excavators, haul truck fleet and dozers to be the main contributors to offsite noise levels at most assessment locations, in particular the most affected locations. Feasible mitigation measures were subsequently investigated including the restriction of certain operational activities to certain areas of the mine (e.g. within pit or at lower benches) during adverse weather or to the less sensitive day-time period. The reduction in total offsite noise levels at the most affected locations was in the order of 1 dB (ie imperceptible change). Such measures were therefore deemed unreasonable and not considered further.

Furthermore, noise benefit from adding noise attenuation kits to the haul truck fleet was considered. The overall reduction in total offsite noise levels with this mitigation in place was in the order of up to 1 dB at some of the assessment locations. This reduction was evaluated along with other economic factors and was deemed unreasonable for the project due to the significant overall cost to implement the measure given the relatively short extension of life (ie 5 years) of the project.

6.2 Noise and blast monitoring

MCC currently undertakes operational noise and blast monitoring in accordance with the approved Noise Management Plan (MCC 2015) and Blast-Vibration Management Plan (MCC 2015). Operator-attended monitoring to quantify noise contribution from MCM at the relevant assessment locations is completed on a bi-annual (six monthly) basis. Attended noise monitoring is undertaken at five locations (ie R7, R13, R15, R17 and R20) and noise data recorded at these locations is used to determine compliance at all other surrounding sensitive receivers.

It is recommended that the frequency of noise monitoring be increased from bi-annual to quarterly (ie every 3 months). It is also recommended that noise monitoring be undertaken at the nearest assessment location to the north of the mine, namely location R25. It is noted that attended noise monitoring for sensitive receivers in this area is currently undertaken at location R7, however this location is no longer the nearest receiver and monitoring at location R25 would replace that currently undertaken at R7.

Blast monitoring is undertaken for all blast events at four residential locations. It is recommended that blast monitoring is continued for the life of the project and that MCC continues to actively manage and monitor blast overpressure and vibration in accordance with the blast management plan.

6.3 Negotiation process

Where noise emissions are predicted to be above the PSNL, the INP and the VLAMP provide guidance regarding a process for negotiation with the relevant regulating authority and/or affected community. Main items for consideration in this process include the following:

- demonstrating that all feasible and reasonable avoidance and/or mitigation measures have been implemented;
- potential broader social and economic benefits of the project;
- the magnitude of predicted noise emission levels and noting that not all exceedances of the PSNLs will equate to unacceptable impacts;

- characteristics of the area and receivers likely to be affected including existing measures of community impact (eg complaints);
- characteristics of the proposal and its noise and vibration emissions; and
- the package of benefits negotiated with potentially affected residences may include installation of glazing, insulation or air-conditioning, payment of compensation or contributions to improve community facilities and infrastructure.

7 Conclusion

EMM has completed a noise and vibration assessment for the proposed Muswellbrook Coal Continuation Project at MCM.

A noise model was developed to assess noise levels from the modification. The model adopted sound power levels of acoustically significant plant and equipment from on-site sound power testing surveys. Potential noise emission levels from the modification have been predicted and compared to both the current approval conditions (where relevant) and the PSNLs.

A discussion of results relevant to the level of impact from the modification is provided as follows:

- noise emissions are predicted to meet the PSNLs at 20 of the 34 assessed locations;
- a negligible impact (up to 2 dB above the PSNLs) is predicted at eight assessment locations;
- a moderate impact (3-5 dB above the PSNLs) is predicted at six assessment locations;
- predicted noise emission levels satisfy the relevant acquisition criteria at all assessment locations; and
- Noise emissions are predicted to only marginally exceed the current development consent limit by 1 dB at locations R13 and R16 and 2 dB at locations R7 and R15.

Noise modelling demonstrated that L_{Amax} noise levels would comply with the relevant sleep disturbance criteria provided in both the current development consent (where relevant) and the PSNLs at all assessment locations.

Cumulative noise from the modification and other existing and approved coal mines in the area is shown to satisfy the relevant amenity criteria.

Blast overpressure and ground vibration levels from the modification are predicted to satisfy relevant EPA guidelines. Notwithstanding, MCC will continue to actively manage and monitor blast overpressure and ground vibration in accordance with MCM's Blast-Vibration Management Plan (MCC 2015).

Attended noise monitoring is currently undertaken in accordance with the approved Noise Management Plan (MCC 2015) and blast emissions are measured and managed in accordance with the Blast-Vibration Management Plan (MCC 2015). Noise and vibration emissions from mining operations at MCM typically satisfy the relevant criteria at all monitoring locations. Furthermore, only a small number of complaints with regard to noise or blasting have been received over the last three years.

Mitigation measures considered have included the restriction of certain operational activities to more acoustically shielded areas (eg within pit or at lower benches) and the addition of noise attenuation kits to the haul truck fleet. The potential noise reduction at the most affected locations was predicted to be in the order of 1 dB (ie imperceptible change). Given the limited noise reduction and the relatively short extension of life (ie 5 years) of the project these options were not considered feasible or reasonable.

It is recommended that the frequency of noise monitoring be increased from bi-annual to quarterly (ie every 3 months). It is also recommended that noise monitoring be undertaken at the nearest assessment location to the north of the mine, namely location R25 (in lieu of the previous monitoring location). It is recommended that blast monitoring is continued for the life of the project and that MCC continue to actively manage and monitor blast overpressure and vibration in accordance with the blast management plan.

Given that operational noise emissions are predicted to be above the PSNLs at some locations, negotiation with the relevant regulating authority and/or affected community is recommended. Guidance has been provided in this report regarding the negotiation process with reference to the INP and VLAMP.

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Environment Protection Authority (EPA) 2000, *NSW Industrial Noise Policy*, NSW Government.

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NSW Government, 2015, *Voluntary Land Acquisition and Mitigation Policy*.

World Health Organization 1999, *Guidelines for Community Noise*.

Appendix A

Acoustic terminology

Several technical terms are discussed in this report. These are explained in Table A.1.

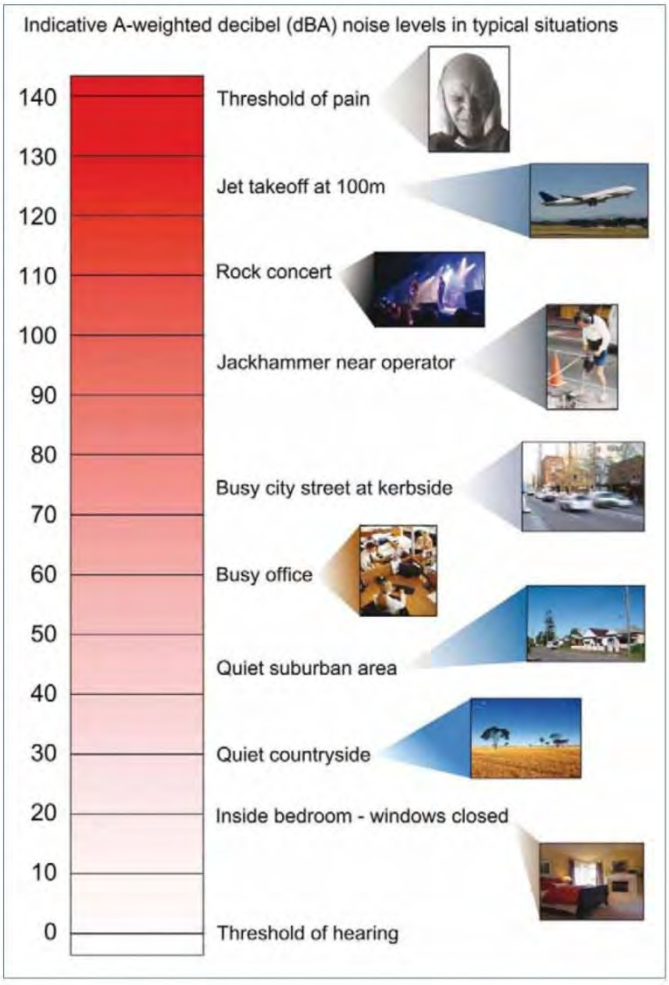
Table A.1 Glossary of acoustic terms

Term	Description
Amenity criteria	The amenity criteria relate to all industrial noise. Where industrial noise approaches base amenity criteria, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise.
ANZECC	Australian and New Zealand Environment Conservation Council.
Day period	Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 8 am to 6 pm.
dB	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
DP&E	Department of Planning and Environment (NSW government).
EA	Environmental assessment.
EPA	NSW Environment Protection Authority.
EP&A Act	Environmental and Planning Assessment Act 1979 (NSW).
Evening period	Monday – Saturday: 6 pm to 10 pm, on Sundays and Public Holidays: 6 pm to 10 pm.
INP	Industrial Noise Policy (NSW EPA 2000).
Intrusive criteria	The intrusive criteria refers to noise that intrudes above the background level by more than 5 dB. The intrusiveness criterion is described in detail in this report.
$L_{A1(1\text{-}min)}$	The 'A-weighted' noise level exceeded for 1% of the specified time period of 1 minute.
L_{A10}	The 'A-weighted' noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise level.
L_{A90}	Commonly referred to as the background noise level. The 'A-weighted' noise level exceeded 90% of the time.
L_{Aeq}	The energy average noise from a source. This is the equivalent continuous 'A-weighted' sound pressure level over a given period. The $L_{Aeq(15\text{-}min)}$ descriptor refers to an L_{Aeq} noise level measured over a 15 minute period.
L_{Amin}	The minimum 'A-weighted' noise level received during a measuring interval.
L_{Amax}	The maximum root mean squared 'A-weighted' sound pressure level (or maximum noise level) received during a measuring interval.
Linear peak	The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.
Night period	Monday – Saturday: 9 pm to 7 am (as per agreement with DP&E), on Sundays and Public Holidays: 10 pm to 8 am.
PSNL	The project-specific noise level (PSNL) are criteria for a particular industrial noise source or industry. The PSNL is the lower of either the intrusive criteria or amenity criteria.
RBL	The Rating Background Level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period.
RNP	Road Noise Policy.
Sound power level (Lw)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Temperature inversion	A positive temperature gradient. A meteorological condition where atmospheric temperature increases with altitude.
Vibration	A motion that can be measured in terms of its displacement, velocity or acceleration. The common unit for velocity is millimetres per second (mm/s).

It is useful to have an appreciation of decibels (dB), the unit of noise measurement. Table A.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure A.1.

Table A.2 Perceived change in noise level

Change in sound level (dB)	Perceived change in noise
1–2	typically indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud



Source: Road Noise Policy (DECCW 2011).

Figure A.1 Common noise levels

Appendix B

Plant and equipment sound power levels

Table B.1 Plant and equipment sound power levels

Plant and equipment (Model)	ID	Sound power level spectrum (Hz), dB(A)									
		31.5	63	125	250	500	1k	2k	4k	8k	Total
CPP (washing plant)	590	91	95	99	107	110	114	115	110	98	119
Crushing plant	568	76	87	95	105	110	111	109	103	91	116
Grader (CAT 16H)	1545	70	86	97	99	101	103	102	94	85	108
Grader (CAT 16H)	1547	66	85	94	98	99	101	100	95	84	106
Track dozer (CAT D10T) - 1st gear	1436	67	84	107	104	109	113	111	103	91	117
Track dozer (CAT D10T) - 2nd gear	1436	74	90	109	110	115	119	119	110	100	124
Track dozer (CAT D10T) - 1st gear	1437	72	85	99	104	110	114	112	104	92	118
Track dozer (CAT D10T) - 2nd gear	1437	75	89	102	110	118	122	122	114	100	126
Track dozer (CAT D10T) - 1st gear	1438	72	83	104	102	106	112	108	100	88	115
Track dozer (CAT D10T) - 2nd gear	1438	74	89	105	110	114	120	118	109	95	123
Track dozer (CAT D10T) - 1st gear	1490	74	87	103	111	117	116	114	107	97	121
Track dozer (CAT D10T) - 2nd gear	1490	75	90	104	114	121	119	119	111	98	125
Haul truck (Hitachi EH35000)	1231	82	96	106	108	112	113	112	107	105	118
Haul truck (Hitachi EH35000)	1232	82	95	105	105	110	110	110	107	105	117
Haul truck (Hitachi EH35000)	1233	84	96	108	109	112	112	110	108	99	118
Haul truck (Hitachi EH35000)	1234	85	94	108	105	109	108	109	107	98	116
Haul truck (Hitachi EH35000)	1235	81	95	106	108	114	114	113	109	104	120
Haul truck (Hitachi EH35000)	1236	81	96	106	106	112	112	111	107	104	118
Haul truck (Hitachi EH35000)	1237	83	97	106	106	111	112	110	107	101	118
Haul truck (Hitachi EH35000)	1238	83	97	104	105	110	112	110	106	102	116
Haul truck (CAT 777C)	1216	76	87	100	105	109	112	112	103	94	116
Haul truck (CAT 777C)	1218	77	91	98	106	110	112	111	104	97	117
Haul truck (CAT 777C)	1219	77	92	104	108	113	114	112	104	95	119
Water truck (CAT 777C)	1115	75	87	101	104	110	112	113	104	97	117
Water truck (CAT 777D)	1117	75	84	100	103	111	114	114	105	97	118
Drill (Ingersoll Rand DML)	450	69	91	103	106	111	109	107	103	104	115
Front-end loader (CAT 990H)	323	68	81	100	100	104	105	104	95	85	110
Excavator (Hitachi EX3600)	211	68	93	100	106	114	111	110	104	94	117
Excavator (Hitachi EX2600-6)	212	74	88	100	103	112	112	110	104	95	117
Excavator (Komatsu PC220-8)	210	66	85	99	94	98	98	94	91	85	104

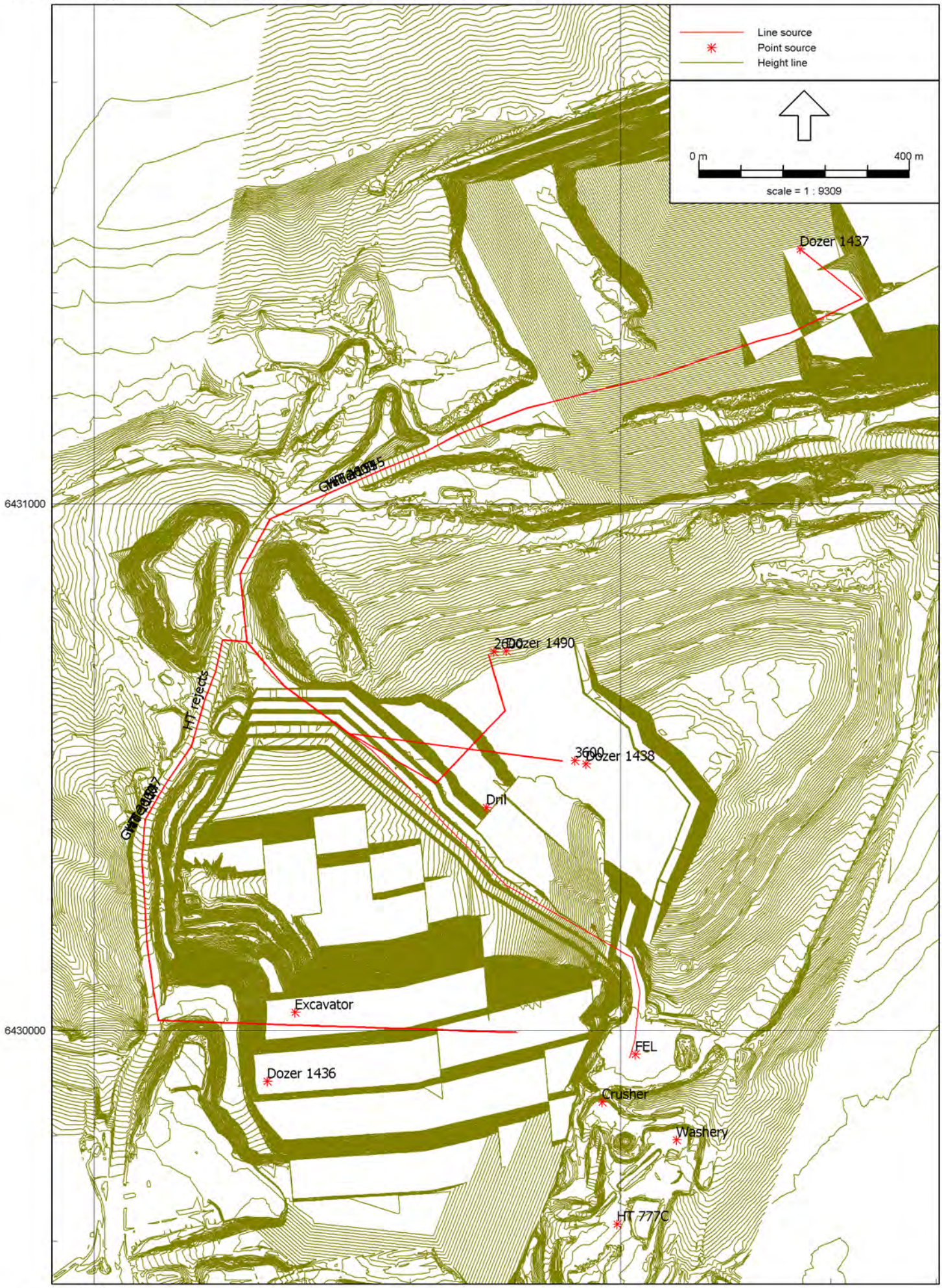
Appendix C

Locations of plant and equipment assumed in noise model

Muswellbrook Coal Continuation Project

EMM Consulting

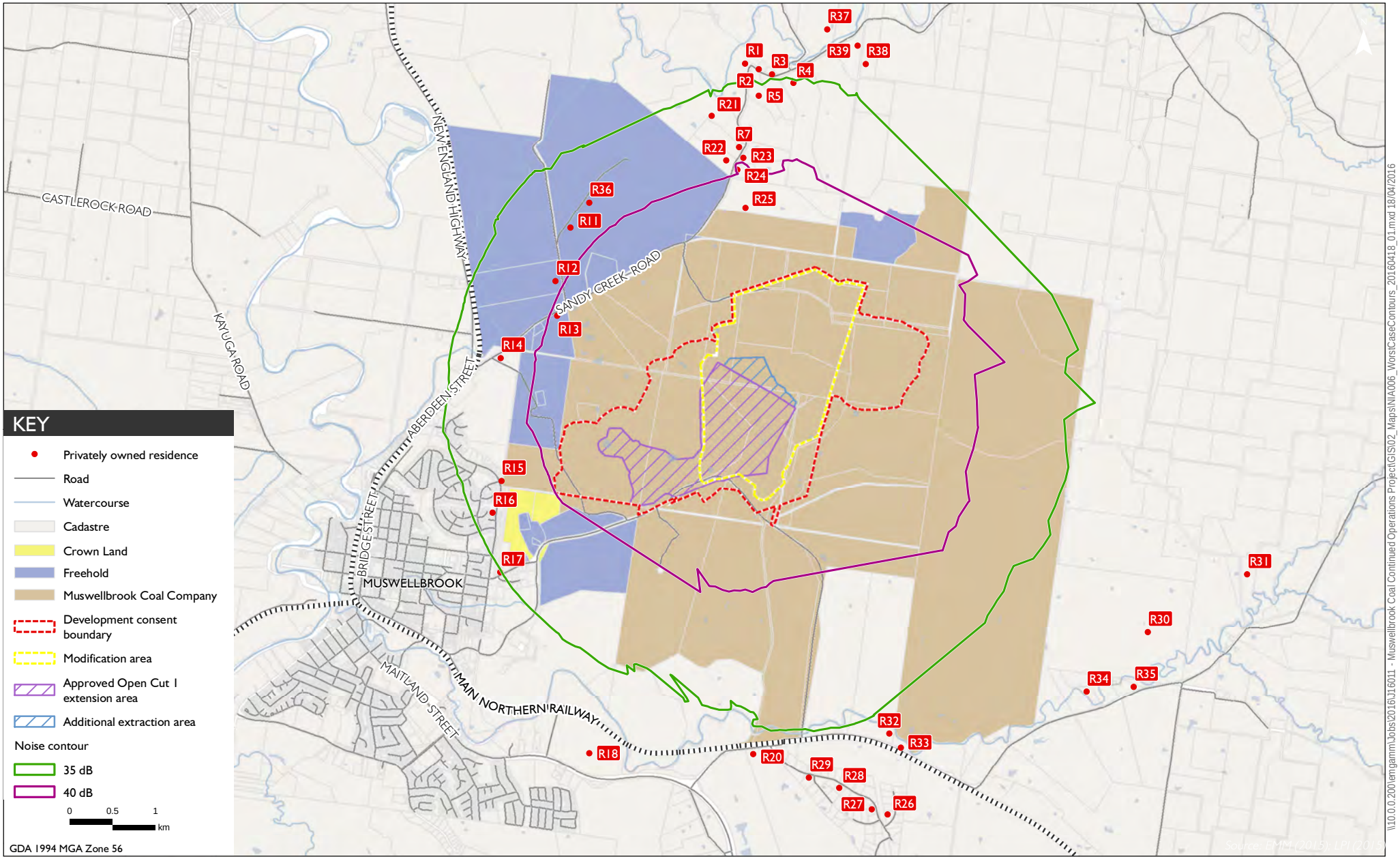
Noise modelling scenario - Year 3_Night-time F class temperature inversion



Industrial noise - ISO 9613.1/2, [MCCP Option 2 alternative route 1 for 2600 fleet (final) - Option 2 - 2019_1_contour v3 night F inv] , Predictor V11.00

Appendix D

Predicted worst-case noise contours



Predicted worst-case noise contours

Muswellbrook Coal Continuation Project
Noise and vibration impact assessment
Figure D1

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