Annual Noise Monitoring Assessment 2024

Dunmore Quarry
Dunmore, NSW
August 2024

Prepared for: Boral Resources (NSW) Pty Ltd
September 2024
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Muller Acoustic Consulting

Document Information

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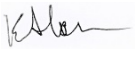
MAC180747-11RP1	16 September 2024	Kristian Allen		Rod Linnett	

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Boral Resources (NSW) Pty Ltd for Dunmore Quarry (the quarry), Tabbita Road, Dunmore, NSW.

The monitoring has been conducted in accordance with the Dunmore Quarry Noise Management Plan (NMP V4, December 2017) during August 2024 and forms the annual noise monitoring program to address conditions outlined in the Development Consent (Ref: 470-11-2003).

This report summarises the operator-attended noise monitoring results measured at five receivers in comparison to the relevant noise limits contained in the Development Consent and NMP.

The assessment has been conducted in general accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunmore Quarry Noise Management Plan V4 (NMP), 2017 (EMM Consulting);
- Discussion Paper - Validation of Inversion Strength Estimation Method (EPA) 2014;
- NSW Environment Protection Authority (EPA's), Approved Methods for the measurement and analysis of environmental noise in NSW, 2022; and
- Standards Australia AS 1055:2018 - Acoustics - Description and measurement of environmental noise.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

The Dunmore Quarry Noise Management Plan (NMP) outlines the applicable noise criteria for residential receivers surrounding the quarry and are presented in **Table 1**.

Table 1 Noise Limits

Description	Day (7am - 6pm)	Evening (6pm - 10pm)	Night (10pm - 7am)		Morning Shoulder (6am - 7am)	
	dB $L_{Aeq(15min)}$	dB $L_{Aeq(15min)}$	dB $L_{Aeq(15min)}$	dB $L_{A1(1min)}$	dB $L_{Aeq(15min)}$	dB $L_{A1(1min)}$
Location K Stocker	49	44	38	48	47	55
Location O Dunmore Lakes	49	44	38	48	47	55
Location J Creagan	Negotiated Agreement in place					
Location AA	38	38	38	45	38	45
Location AB and T	36	36	36	45	36	45
Locations D, F, G and Z	40	40	40	45	40	45
Location S	37	37	37	45	37	45

Source: Table 2 of Dunmore Quarry NMP.

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3 Methodology

3.1 Locality

The quarry is located at Dunmore near Shellharbour, NSW. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Princes Highway situated to the east of the site. Highway traffic is a dominant noise source for those receivers east of the quarry along with rural noise. The representative noise monitoring locations identified in Table 4.1 of the NMP with respect to the quarry are presented in the locality plan in **Figure 1.** **Table 2** presents the noise limits for each receiver as per the EPL.

Table 2 Attended Monitoring Locations and EPL Noise Limits

ID	Description	Day[1]	Evening[1]	Night[1]		Morning Shoulder[1]	
		dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	dB, $L_{A1(1min)}$	dB, $L_{Aeq(15min)}$	dB, $L_{A1(1min)}$
NM1	Location K Stocker 40 Swamp Road Dunmore	49	44	38	48	47	55
NM2	Location S 86 Croome Vale Road Croom	37	37	37	45	37	45
NM3	Location T 1338 Jamberoo Road Croom	36	36	36	45	36	45
NM4	Location G[2] 318 Croome Road Croom	40	40	40	45	40	45
NM5	Location F[3] 316 Croome Road Croom	40	40	40	45	40	45

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods and the morning shoulder period is from 6am to 7am.

Note 2: Representative location for western residences G, D, Z.

Note 3: Representative location for northwestern residences F, AA, AB.

3.2 Assessment Methodology

The attended noise measurements were conducted in general accordance with the procedures described in Standards Australia AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise" and the Dunmore Quarry NMP. Noise measurements of 15-minutes in duration were conducted at five locations (NM1-NM5) using a Svantek Type 1, 971 noise analyser between Tuesday 20 August 2024 and Friday 23 August 2024 to satisfy the requirements of the NMP. All acoustic instrumentation used carries appropriate and current NATA (or manufacturer) calibration certificates with records of all calibrations maintained by MAC as per Approved Methods for the measurement and analysis of environmental noise in NSW (EPA, 2022) and complies with AS/NZS IEC 61672.1-2019- Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

To understand meteorological conditions during calm conditions, direct measurement of temperature profile was undertaken at Trevethan Reserve, Minnamurra on Tuesday 20 August 2024 and at Fuller Drive, Dunmore on Wednesday 21 August 2024, at 2m above ground level and at 50m above ground level using a weather balloon.

The results of the temperature measurements were used to determine the temperature lapse rate in general accordance with the Validation of Inversion Strength Estimation Method (2014). These measurements, in combination with the onsite weather station provide a reference to validate the relevant meteorological conditions under which compliance is assessed.

Extraneous noise sources were excluded from the analysis to determine the dB $LA_{eq(15min)}$ quarry noise contribution for comparison against the relevant criteria. In the event of quarry attributed noise being above criteria, prevailing meteorological conditions for the monitoring period are sourced from the onsite meteorological station and analysed in accordance with Fact Sheet A4 of the NPI to determine the stability category present at the time of each attended measurement.

Where the quarry is inaudible, the contribution is estimated to be at least 10dBA below the ambient noise level.

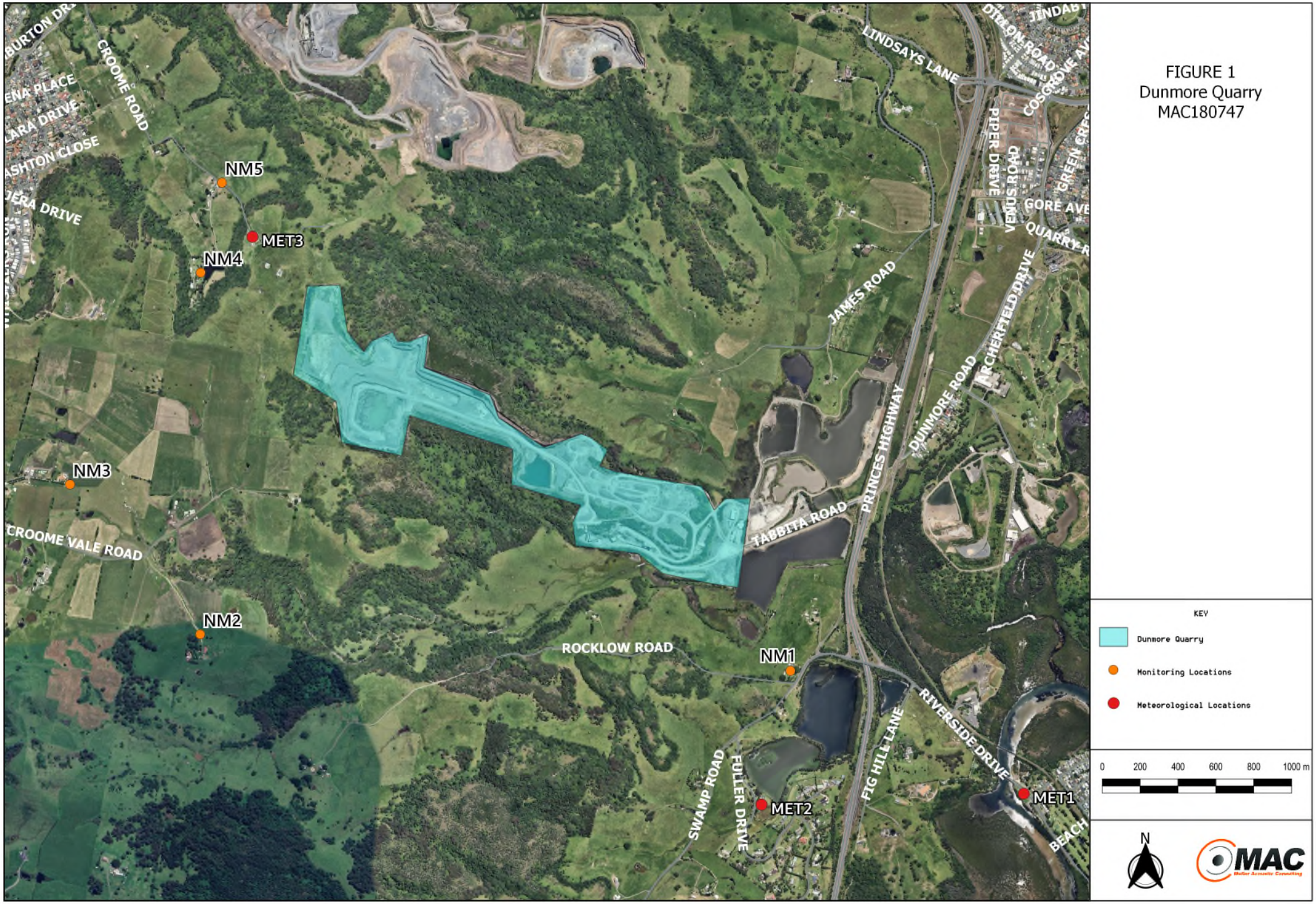
FIGURE 1
Dunmore Quarry
MAC180747
NM5
MET3
NM4
NM3
NM2
NM1
MET2
MET1
CROOME ROAD
LINDSAYS LANE
JAMES ROAD
PRINCES HIGHWAY
DUNMORE ROAD
TABBITA ROAD
CROOME VALE ROAD
ROCKLOW ROAD
SWAMP ROAD
FULLER DRIVE
FIG HILL LANE
RIVERSIDE DRIVE
ARCHERFIELD DRIVE
PIPER DRIVE
GORE AVE
KEY
Dunmore Quarry
Monitoring Locations
Meteorological Locations
0 200 400 600 800 1000 m
N
MAC

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4 Results

A summary of the operator attended measurements at location NM1 to NM5 are presented **Table 3** to **Table 7** and provide the following information:

- Monitoring location;
- Date, time and assessment period;
- Observed Wind Speed (WS, m/s), Wind Direction (WD) and Temperature (Temp) in °C at 1.5m above the ground measured at the monitoring location;
- Measured Temperature (Temp) in °C at 2m and 50m above ground level at a representative location;
- Average Wind Speed (WS, m/s), Wind Direction (WD) and Temperature (Temp) in °C at 10m above ground level at the on-site weather station;
- Atmospheric stability class derived from the on-site weather station;
- Calculated temperature inversion strength;
- Ambient measured noise levels $LA_{eq(15min)}$ and $LA_{90(15min)}$ in dB re 20µPa;
- Quarry $LA_{eq(15min)}$ and $LA_{1(1min)}$ noise level contribution; and
- Noise Limit $LA_{eq(15min)}$ and $LA_{1(1min)}$.

Results of the attended noise survey identified that the quarry was generally inaudible during the measurement periods at all but one location during the morning shoulder measurement period, however extraneous sources such as traffic, insects, aircraft, birds, livestock, dogs barking, and local residential noise were audible during the survey period and dominated the results. Temperature data, from on-site measurements, was unavailable during most measurement periods due to high wind speeds at more than 10m above ground level (AGL).

Table 3 NM1 - Attended Noise Monitoring Summary													
Date & Period	Time (hrs)	1.5m WS WD Temp°C[3]	Descriptor		EPL Limits	Observed Meteorology							Description and SPL, dBA
			L_{Aeq}	L_{A90}	$L_{Aeq\ (15min)}$/ $L_{A1\ (1min)}$	WS (m/s)[1]	WD[1]	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m[2]	Stability Class[1]	
22/08/2024	06:27 (Morning Shoulder)	0.1m/s SW 14°	64	55	47/55	0.9	W	11°	14°	3°	6°	G	Traffic 52-83 Birds 45-60 Quarry – Production <45-50 Quarry – Reverse Alarms <45 Quarry – Truck Movements <45-50
Quarry Contribution													<47dB LAeq(15min) <55dB LA1(1min)
21/08/2024	08:25 (Day)	0.1m/s W 15°	65	48	49	1.4	W	n/a	n/a	n/a	n/a	n/a	Traffic 44-83 Birds 40-62 Quarry Inaudible
Quarry Contribution													<49dB LAeq(15min)
20/08/2024	21:22 (Evening)	0.5m/s N 17°	55	45	44	0.9	ENE	n/a	n/a	n/a	n/a	n/a	Traffic 41-78 Insects <41 Quarry Inaudible
Quarry Contribution													<44dB LAeq(15min)

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

Table 4 NM2 - Attended Noise Monitoring Summary													
Date & Period	Time (hrs)	1.5m WS WD Temp°C[3]	Descriptor		EPL Limits	Observed Meteorology							Description and SPL, dBA
			L_{Aeq}	L_{A90}	$L_{Aeq\ (15min)}$/ $L_{A1\ (1min)}$	WS (m/s)[1]	WD[1]	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m[2]	Stability Class[1]	
23/08/2024	06:31 (Morning Shoulder)	0.1m/s W 14°	41	35	37/45	1.4	SSW	n/a	n/a	n/a	n/a	n/a	Agricultural Noise 32-36 Traffic 30-38 Birds 30-63 Livestock 35-43 Quarry Inaudible
Quarry Contribution													<37dB $L_{Aeq(15min)}$ <45dB $L_{A1(1min)}$
21/08/2024	10:29 (Day)	1.0m/s NE 18°	58	28	37	1.3	NE	n/a	n/a	n/a	n/a	n/a	Traffic 25-86 Birds 26-64 Quarry Inaudible
Quarry Contribution													<37dB $L_{Aeq(15min)}$
20/08/2024	20:31 (Evening)	<0.5m/s SE 15°	36	34	37	1.5	SW	n/a	n/a	n/a	n/a	n/a	Insects 32-38 Traffic 30-39 Dogs Barking 30-42 Aircraft 30-46 Quarry Inaudible
Quarry Contribution													<37dB $L_{Aeq(15min)}$

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

Table 5 NM3 - Attended Noise Monitoring Summary													
Date & Period	Time (hrs)	1.5m WS WD Temp°C[3]	Descriptor		EPL Limits	Observed Meteorology							Description and SPL, dBA
			L_{Aeq}	L_{A90}	$L_{Aeq\ (15min)}$/ $L_{A1\ (1min)}$	WS (m/s)[1]	WD[1]	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m[2]	Stability Class[1]	
23/08/2024	06:05 (Morning Shoulder)	0.1m/s W 14°	60	36	36/45	1.4	SSW	n/a	n/a	n/a	n/a	n/a	Traffic 30-79 Birds 28-60 Insects 30-39 Livestock 35-50 Quarry Inaudible
Quarry Contribution													<36dB $L_{Aeq(15min)}$ <45dB $L_{A1(1min)}$
21/08/2024	10:09 (Day)	<0.5m/s SW 19°	61	38	36	0.9	NW	n/a	n/a	n/a	n/a	n/a	Traffic 27-79 Birds 25-58 Aircraft 30-45 Quarry Inaudible
Quarry Contribution													<36dB $L_{Aeq(15min)}$
20/08/2024	20:10 (Evening)	<0.5m/s SE 15°	61	34	36	1.5	WSW	n/a	n/a	n/a	n/a	n/a	Traffic 30-81 Insects 31-36 Dogs Barking 35-48 Quarry Inaudible
Quarry Contribution													<36dB $L_{Aeq(15min)}$

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

Table 6 NM4 - Attended Noise Monitoring Summary													
Date & Period	Time (hrs)	1.5m WS WD Temp°C[3]	Descriptor		EPL Limits	Observed Meteorology							Description and SPL, dBA
			LA_{eq}	LA_{90}	$LA_{eq\ (15min)}$/ $LA_{1\ (1min)}$	WS (m/s)[1]	WD[1]	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m[2]	Stability Class[1]	
23/08/2024	06:40 (Morning Shoulder)	0.5m/s SW 12°	47	35	40/45	1.8	W	n/a	n/a	n/a	n/a	n/a	Birds 32-65 Traffic 32-36 Residential Noise 36-44 Quarry Inaudible
Quarry Contribution													<40dB $LA_{eq(15min)}$ <45dB $LA_{1(1min)}$
21/08/2024	09:28 (Day)	<0.5m/s W 18°	44	34	40	0.6	NW	n/a	n/a	n/a	n/a	n/a	Birds 30-62 Traffic 31-34 Residential Noise 30-36 Aircraft 30-41 Quarry Inaudible
Quarry Contribution													<40dB $LA_{eq(15min)}$
20/08/2024	19:26 (Evening)	0.5m/s SE 16°	35	33	40	0.5	ESE	n/a	n/a	n/a	n/a	n/a	Insects 30-36 Traffic 32-36 Aircraft 30-42 Quarry Inaudible
Quarry Contribution													<40dB $LA_{eq(15min)}$

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

Table 7 NM5 - Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp°C[3]	Descriptor		EPL Limits	Observed Meteorology							Description and SPL, dBA
			L_{Aeq}	L_{A90}	$L_{Aeq\ (15min)}$/ $L_{A1\ (1min)}$	WS (m/s)[1]	WD[1]	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m[2]	Stability Class[1]	
23/08/2024	06:23 (Morning Shoulder)	0.5m/s S 12°	44	39	40/45	1.6	SSW	n/a	n/a	n/a	n/a	n/a	Birds 36-56 Traffic 36-39 Aircraft 38-44 Quarry Inaudible
Quarry Contribution													<40dB $L_{Aeq(15min)}$ <45dB $L_{A1(1min)}$
21/08/2024	09:10 (Day)	<0.5m/s SW 17°	42	34	40	0.6	W	n/a	n/a	n/a	n/a	n/a	Traffic 31-43 Birds 30-67 Aircraft 30-49 Quarry Inaudible
Quarry Contribution													<40dB $L_{Aeq(15min)}$
20/08/2024	19:46 (Evening)	0.5m/s SE 15°	36	32	40	0.5	ESE	n/a	n/a	n/a	n/a	n/a	Insects <30 Traffic 30-41 Aircraft 30-52 Quarry Inaudible
Quarry Contribution													<40dB $L_{Aeq(15min)}$

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

5 Discussion and Compliance Assessment

The compliance assessment summary for each monitoring location is presented in Table 8 for all assessment periods.

5.1 Discussion of Results - Location NM1

The noise monitoring survey identified that the acoustic environment at this location is dominated by road traffic noise from the Princes Highway, approximately 350m to the east. During the survey, quarry emissions were audible during the morning should period, inaudible during day and evening monitoring periods and quarry noise contributions were calculated (during short breaks in traffic) to be at or below the relevant noise criteria for all periods.

Quarry noise sources included rock processing noise, heavy vehicles movements and machinery reverse alarms. Extraneous sources audible during the survey included traffic, birds, aircraft, and other industrial noise.

5.2 Discussion of Results - Location NM2

The noise monitoring survey identified that the acoustic environment at this location is dominated by natural sounds such as insects and bird noise, and agricultural noise such as livestock. Occasional local traffic on Jamberoo Road, approximately 350m to the west was audible for short periods. During the survey, quarry noise emissions were inaudible, and quarry contributions were calculated to be below the relevant noise criteria for all periods.

5.3 Discussion of Results - Location NM3

Due to access restrictions at the NM3 location, measurements were conducted at the front fence line of the location approximately 300m to the west of the receiver. The noise monitoring survey identified that the acoustic environment at this location is dominated by natural sounds such as insects, and bird noise, and agricultural noise such as livestock. Traffic on Jamberoo Road, to the west was audible for short to medium periods. During the survey, quarry noise emissions were inaudible during all measurement periods. Quarry contributions were calculated to be below the relevant noise criteria for all periods.

5.4 Discussion of Results - Location NM4

The noise monitoring survey identified that the acoustic environment at these locations is dominated by natural sounds such as insects and bird noise, and agricultural noise such as livestock. Occasional distant traffic on the East-West Link Road, approximately 2km to the north was audible for short periods. During the survey, quarry noise emissions were inaudible, and quarry contributions were calculated to be below the relevant noise criteria for all periods.

5.5 Discussion of Results - Location NM5

The noise monitoring survey identified that the acoustic environment at these locations is dominated by natural sounds such as insects and bird noise, and agricultural noise such as livestock. Occasional distant traffic on the East-West Link Road, approximately 2km to the north was audible for short periods. During the survey, quarry noise emissions were inaudible, and quarry contributions were calculated to be below the relevant noise criteria for all periods.

Table 8 Noise Compliance Assessment Summary

Location	Estimated Quarry Noise Contribution[1]				Noise Limit[1]				Demonstrated Compliance			
	Day	Evening	Morning Shoulder		Day	Evening	Morning Shoulder		Day	Evening	Morning Shoulder	
			$LA_{eq(15min)}$	$LA_{1(1min)}$			$LA_{eq(15min)}$	$LA_{1(1min)}$			$LA_{eq(15min)}$	$LA_{1(1min)}$
NM1	<49	<44	<47	<55	49	44	47	55	Yes	Yes	Yes	Yes
NM2	<37	<37	<37	<45	37	37	37	45	Yes	Yes	Yes	Yes
NM3	<36	<36	<36	<45	36	36	36	45	Yes	Yes	Yes	Yes
NM4	<40	<40	<40	<45	40	40	40	45	Yes	Yes	Yes	Yes
NM5	<40	<40	<40	<45	40	40	40	45	Yes	Yes	Yes	Yes

Note 1: All levels are dBA.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Boral Resources (NSW) Pty Ltd for Dunmore Quarry (the quarry), Tabbita Road, Dunmore, NSW.

Attended noise monitoring was undertaken between Tuesday 20 August 2024 and Friday 23 August 2024 at five representative monitoring locations. The assessment has identified that noise emissions generated by Dunmore Quarry were generally just audible throughout the morning shoulder period at NM1. The quarry was inaudible during all other remaining measurements. Quarry contributed noise emissions were below the relevant noise criteria at all locations during all measurement periods, thus satisfying the relevant noise limits.

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Appendix A - Glossary of Terms

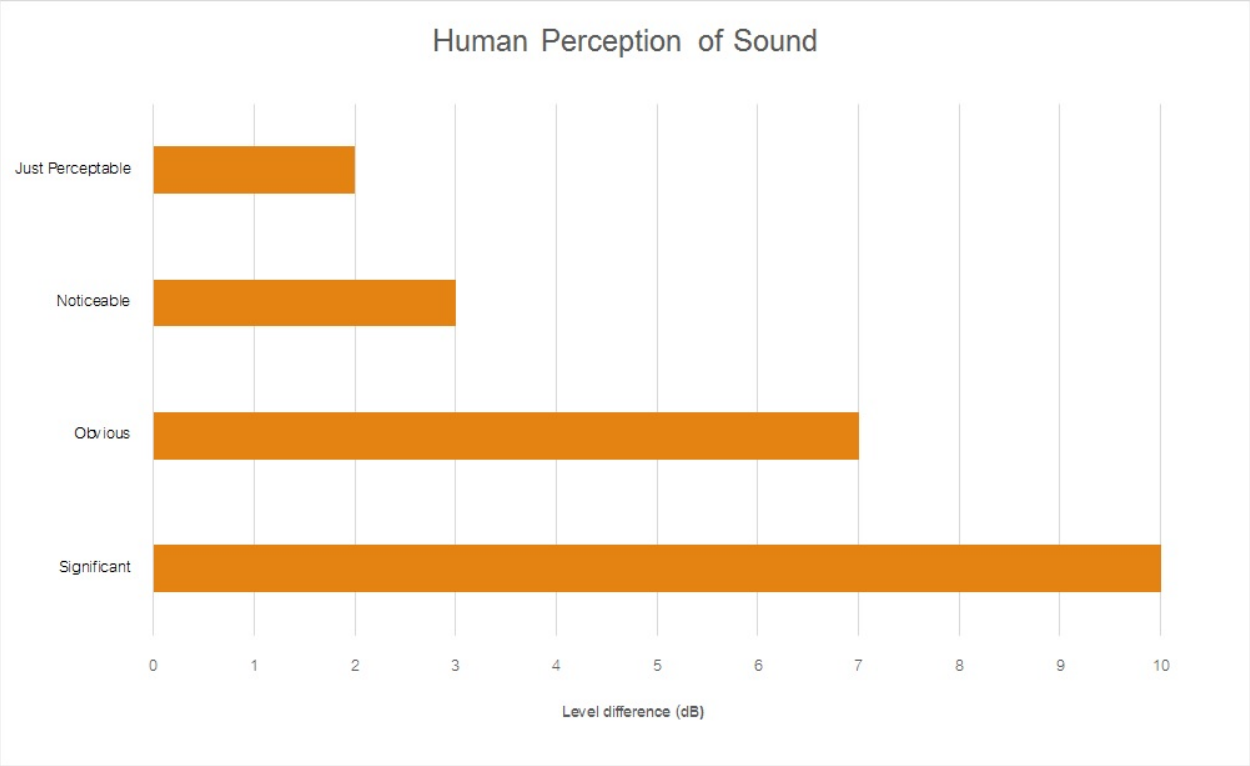
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	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.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
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 location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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