

Annual Noise Monitoring Assessment 2019

Dunmore Quarry, Dunmore, NSW
July 2019.



Document Information

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Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180747-01RP1	Final	30 July 2019	Rod Linnett		Oliver Muller	

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1 Introduction

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

The monitoring has been conducted in accordance with the Dunmore Quarry Noise Management Plan (NMP, December 2017) for the period ending July 2019 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; and
- Australian Standard 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	Evening	Night		Morning Shoulder	
	(7am - 6pm)	(6pm - 10pm)	(10pm - 7am)		(6am - 7am)	
	dB, LAeq(15min)	dB, LAeq(15min)	dB, LAeq(15min)	dB, LA1(1min)	dB, LAeq(15min)	dB, LA1(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

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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 monitoring locations 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, LAeq(15min)	dB, LAeq(15min)	dB, LAeq(15min)	dB, LA1(1min)	dB, LAeq(15min)	dB, LA1(1min)
	Location K Stocker						
NM1	40 Swamp Road Dunmore	49	44	38	48	47	55
	Location S						
NM2	86 Croome Vale Road, Croom	37	37	37	45	37	45
	Location T						
NM3	1338 Jamberoo Road Croom	36	36	36	45	36	45
	Location G ²						
NM4	316 Croome Road Croom	40	40	40	45	40	45
	Location F ³						
NM5	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 north western residences F, AA, AB.

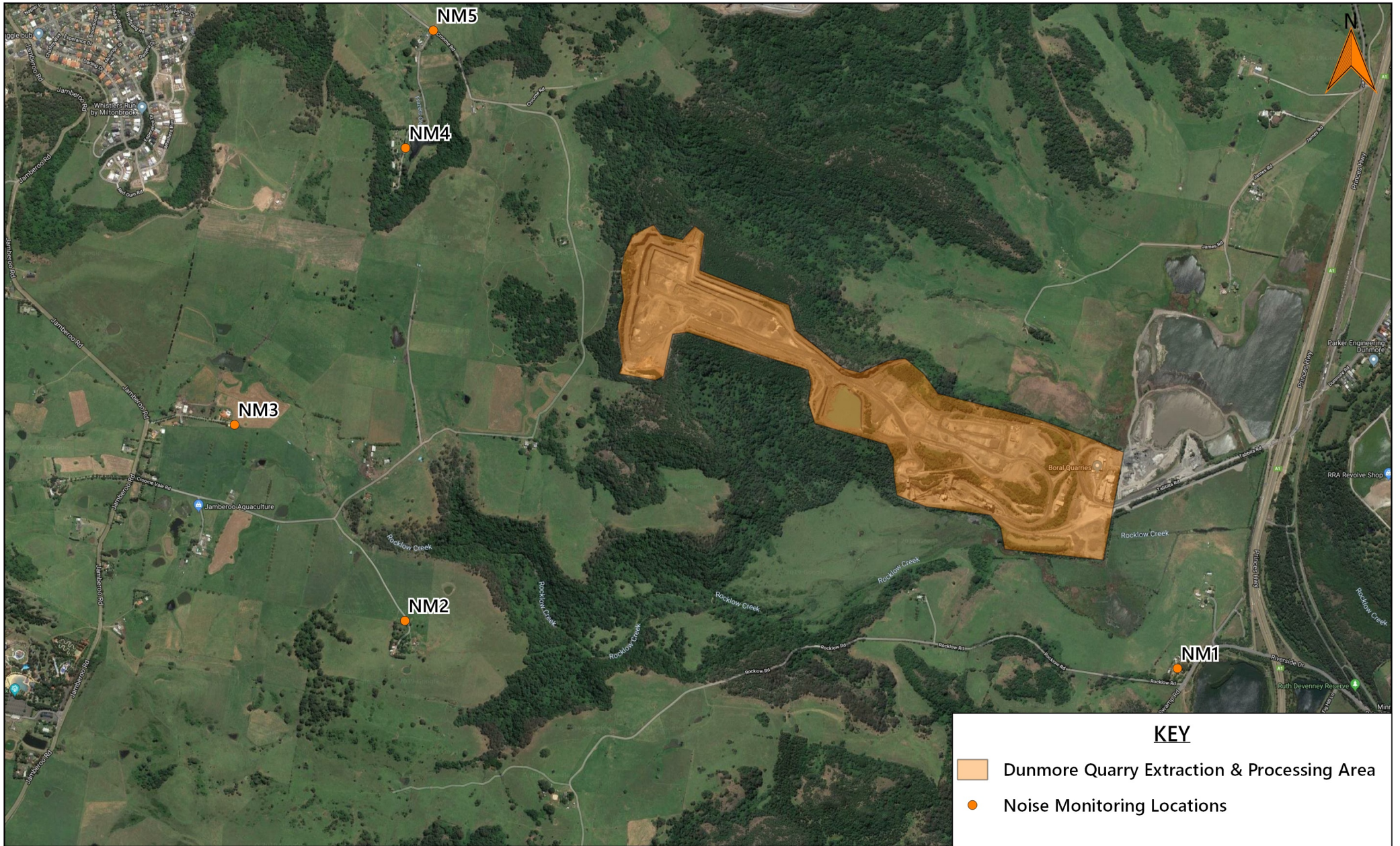
3.2 Assessment Methodology

The attended noise measurements were conducted in general accordance with the procedures described in Australian Standard 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 Monday 22 July 2019 and Wednesday 24 July 2019 to satisfy the requirements of the NMP. The acoustic instrumentation used carries current NATA calibration and complies with AS 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 ± 0.5 dBA.

To understand meteorological conditions during the evening period of Monday 22 July 2019 and the morning shoulder period of Tuesday 23 July 2019, direct measurement of temperature profile was undertaken at NM1 Location K (Stocker) at 2m above ground level and at 50m above ground level using a weather balloon. Similarly, temperature measurements were taken at NM5 Location F (Croom) during the morning shoulder period of Wednesday 24 July 2019. 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 on site 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 $L_{Aeq}(15min)$ 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.



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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 2.0m and 50.0m 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 LAeq(15min) and LA90(15min) in dBA re 20 µPa.
- Quarry LAeq(15min) and LA1(1min) noise level contribution.
- Noise Limit LAeq(15min) and LA1(1min).

Results of the attended noise survey identified that the quarry was audible for short durations during the measurements, however extraneous sources such as distant traffic, insects, cattle and dogs barking were audible during the survey period and dominated the results. Temperature data indicated that inversion strengths calculated from on-site measurements during the evening period of Monday 22 July 2019 and the morning shoulder period of Tuesday 23 July 2019 were outside the development consent conditions (ie greater than 3°C/100m), although quarry noise contribution was compliant with the noise limits. Data indicated that conditions were within the development consent conditions (ie less than 3°C/100m) during the morning shoulder period of Wednesday 24 July 2019 and quarry noise contributions were within the noise limits.

Table 3 NM1 Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp	Descriptor		EPL Limits 15min/ 1min	Observed Meteorology						Description and SPL, dBA	
			LAeq	LA90		WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²		Stability Class ¹
23/07/2019 Morning Shoulder	06:05	0.5m/s S 8°C	58	54	47/55	1.7	WSW	4	13	9	19	F	Highway Traffic 53-63 Local Vehicles 56-62 Train 58-61 Quarry truck 50
Quarry Contribution												<47dB LAeq(15min) <55dB LA1(1min)	
22/07/2019 Day	17:36	Calm 18°C	55	52	49	0.7	WSW	N/A	N/A	N/A	N/A	N/A	Highway Traffic 48-60 Local Traffic 52-56 People 52-54 Insects 52-54 Quarry not audible
Quarry Contribution												<45dB LAeq(15min)	
22/07/2019 Evening	21:00	Calm 10°C	50	45	44	1.9	W	7	15	8	17	E	Highway Traffic 40-56 People 40-52 Train 52 Quarry trucks 32-34
Quarry Contribution												<41dB LAeq(15min)	

Note 1: Data from on-site weather station.

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

Table 4 NM2 Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp	Descriptor		EPL Limits 15min/ 1min	Observed Meteorology						Description and SPL, dBA	
			LAeq	LA90		WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²		Stability Class ¹
24/07/2019 Morning Shoulder	06:00	1-1.5m/s W 14°C	41	33	37/45	1.1	SSW	10	10	0	0	F	Insects 37-40 Cows 38-40 Birds 54 Quarry trucks 30-32
Quarry Contribution												<32dB LAeq(15min) <40dB LA1(1min)	
23/07/2019 Day	08:48	Calm 18°C	42	31.9	37	1.4	WSW	N/A	N/A	N/A	N/A	N/A	Birds 33-44 Local Traffic 34-67 Quarry not audible
Quarry Contribution												<33dB LAeq(15min)	
22/07/2019 Evening	21:38	Calm 14°C	37	28	37	2.2	WSW	7	15	8	17	E	Quarry trucks 27-34 Cows 36-50 Insects 30-36
Quarry Contribution												<30dB LAeq(15min)	

Note 1: Data from on-site weather station.

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

Table 5 NM3 Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp	Descriptor		EPL Limits 15min/ 1min	Observed Meteorology						Description and SPL, dBA	
			LAeq	LA90		WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²		Stability Class ¹
24/07/2019 Morning Shoulder	06:28	1.0m/s W 14°C	36	27	36/45	1.1	SSW	9	9	0	0	F	Birds 34-38 Cows 34-36 Local Vehicles 32-35 Quarry rock noise (5 sec) 37
Quarry Contribution												<35dB LAeq(1min) <40dB LA1(1min)	
23/07/2019 Day	09:13	1.0m/s NW 14°C	41	33	36	0.8	W	N/A	N/A	N/A	N/A	N/A	Birds 31-40 Local Traffic 33-40 Quarry not audible
Quarry Contribution												<32dB LAeq(15min)	
22/07/2019 Evening	21:57	Calm 14°C	34	31	36	1.9	W	7	16	9	18	E	Birds 53 Cows 32-35 Running Water 32-34 Quarry not audible
Quarry Contribution												<30dB LAeq(15min)	

Note 1: Data from on-site weather station.

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

Table 6 NM4 Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp	Descriptor		EPL Limits 15min/ 1min	Observed Meteorology						Description and SPL, dBA	
			LAeq	LA90		WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²		Stability Class ¹
24/07/2019 Morning Shoulder	06:00	1.0m/s SE 13°C	41	33	40/45	1.1	SSW	10	10	0	0	F	Insects 30-51 Roosters 42 -46 Birds 40-57 Quarry not audible
Quarry Contribution												<31dB LAeq(15min) <40 dB LA1(1min)	
23/07/2019 Day	07:50	1.0m/s NW 12°C	43	35	40	1.5	WNW	N/A	N/A	N/A	N/A	N/A	Birds 35-48 Distant Traffic 30-33 Dogs 38-40 Quarry not audible
Quarry Contribution												<33dB LAeq(15min)	
22/07/2019 Evening	20:47	Calm 15°C	36	29	40	1.9	W	8	13	5	10	E	Insects 30-42 Quarry30
Quarry Contribution												30dB LAeq(15min)	

Note 1: Data from on-site weather station.

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

Table 7 NM5 Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp	Descriptor		EPL Limits 15min/ 1min	Observed Meteorology						Description and SPL, dBA	
			LAeq	LA90		WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²		Stability Class ¹
24/07/2019 Morning Shoulder	06:20	0.5m/s SE 13°C	44	31	40/45	1.1	SSW	9	9	0	0	F	Insects 30-40 Birds 36-45 Local Traffic 40-68 Dogs 38-42 Quarry not audible
Quarry Contribution												<34dB LAeq(15min) <40dB LA1(1min)	
23/07/2019 Day	08:10	1.0m/s NE 12°C	54	36	40	1.5	WNW	N/A	N/A	N/A	N/A	N/A	Birds 36-42 Distant Traffic 33-35 Aircraft 33 Quarry not audible
Quarry Contribution												<35dB LAeq(15min)	
22/07/2019 Evening	21:10	Calm 14°C	34	27	40	1.9	W	8	15	7	16	E	Dogs 40-45 Insects 30-35 Distant Traffic 34-36 Quarry not audible
Quarry Contribution												<30dB LAeq(15min)	

Note 1: Data from on-site weather station.

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

5 Discussion and Compliance Assessment

The compliance assessment summary for each monitoring location are 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 haul trucks were just audible during the morning shoulder period for short periods. The contributions were calculated to be at or below the relevant noise criteria for all periods. Extraneous sources audible during the survey included rail noise, insects, local residential activity and birds.

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. Occasional local traffic on Jamberoo Road, approximately 350m to the west was audible for short periods. During the survey quarry haul trucks were just audible during the morning shoulder period at low levels for short periods. The contributions were calculated to be below the relevant noise criteria for all periods.

5.3 Discussion of Results - Location NM3

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 1km to the west was audible for short periods. During the survey quarry noise was just audible during the morning shoulder period at low levels for short periods. The contributions were calculated to be below the relevant noise criteria for all periods.

5.4 Discussion of Results - Location NM4 and NM5

The noise monitoring survey identified that the acoustic environment at these locations are 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 was barely audible during the morning shoulder period and at low levels for short periods. The 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	
			LAeq(15min)	LA1(1min)			LAeq(15min)	LA1(1min)			LAeq(15min)	LA1(1min)
NM1	<45	<41	<47	<55	49	44	47	55	Yes	Yes	Yes	Yes
NM2	<33	<30	<32	<40	37	37	37	45	Yes	Yes	Yes	Yes
NM3	<32	<30	<35	<40	36	36	36	45	Yes	Yes	Yes	Yes
NM4	<33	30	<31	<40	40	40	40	45	Yes	Yes	Yes	Yes
NM5	<35	<30	<34	<40	40	40	40	45	Yes	Yes	Yes	Yes

Note 1: All levels are dBA.

7 Conclusion

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

Attended noise monitoring was undertaken between Monday 22 July 2019 and Wednesday 24 July 2019 at five representative monitoring locations. The assessment has identified that noise emissions generated by Dunmore Quarry were generally not audible during the day and evening periods and just audible for short durations during the morning shoulder period. 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

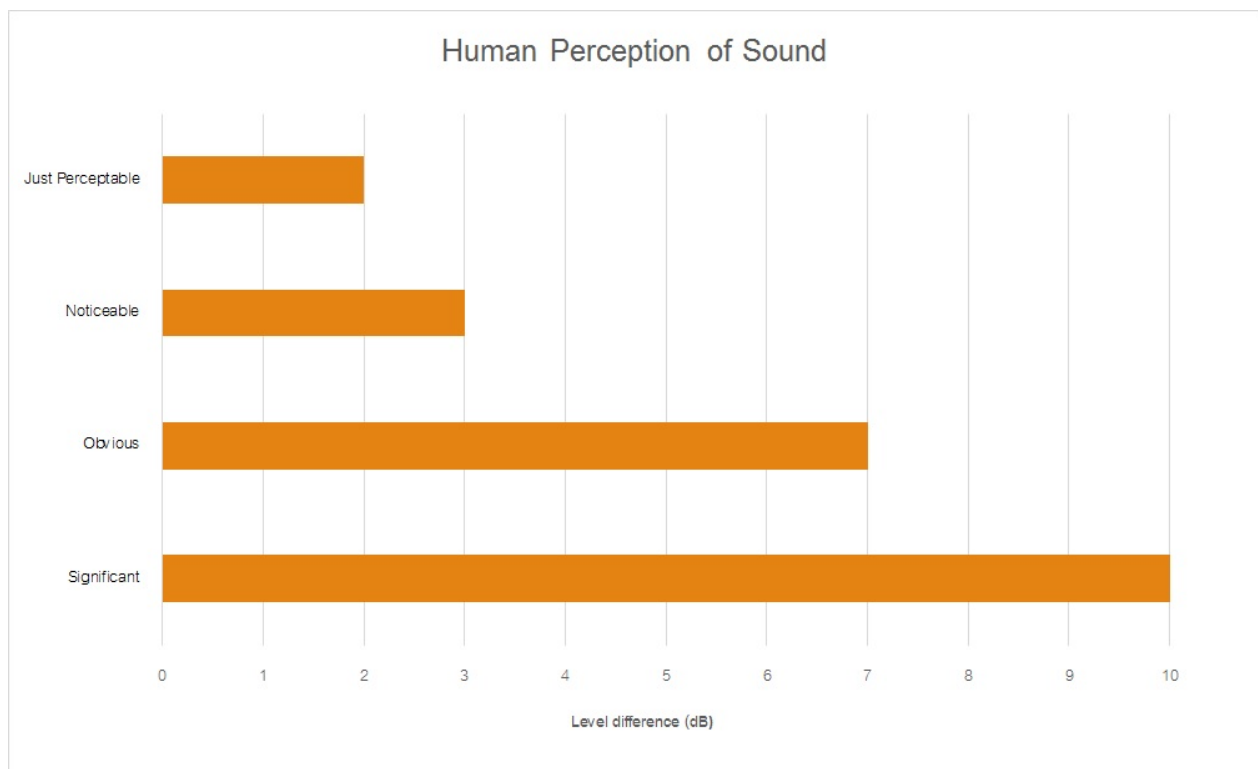
Table A1 provides a number of technical terms have been used in this report.

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.
LAm _{ax}	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 : $= 10 \cdot \log_{10} (W/W_0)$ Where : W is the sound power in watts and W ₀ 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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