Noise Monitoring Assessment

Wallerawang Quarry
Wallerawang, NSW
August 2023

Prepared for: Walker Quarries Pty Ltd
August 2023
MAC160392RP14

Muller Acoustic Consulting

Document Information

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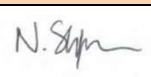
MAC160392RP14	28 August 2023	Nicholas Shipman		Oliver Muller	

CONTENTS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Walker Quarries Pty Ltd to complete a bi-annual Noise Monitoring Assessment (NMA) for Wallerawang Quarry (the quarry). This assessment has been undertaken as the second bi-annual assessment for 2023 (August 2023).

The NMA involved quantifying the noise contribution of the quarry by direct attended measurements to compare quarry emissions against relevant criteria. Monitoring has been conducted at three representative receiver locations in accordance with the Walker Quarry, Noise Management Plan (NMP) and the quarry's Environmental Protection License (ref: 13172). An additional measurement at a nearfield reference location was also conducted to verify the operation of quarry plant and to quantify the noise contribution from site.

The assessment has been conducted in accordance or with reference to the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Environment Protection Licence EPL 13172 (EPL);
- NSW Environment Protection Authority (EPA's), Approved Methods for the measurement and analysis of environmental noise in NSW, 2022;
- Development Consent 344-1-2001 (Mod 3), February 2020;
- Standards Australia AS 1055:2018 - Acoustics - Description and measurement of environmental noise - General Procedures;
- Muller Acoustic Consulting Pty Ltd (MAC), Noise and Vibration Impact Assessment (NVIA), 2019; and
- Umwelt, Wallerawang Quarry Noise Management Plan, Version 4 (NMP), 2021.

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

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2 Noise Criteria

2.1 Environmental Protection License Noise Limits

Table 1 reproduces the noise criteria for the quarry as per Condition L4.1 of EPL 13172.

Table 1 EPL Noise Limits, dBA

Location	Day	Evening	Night
	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$
All privately owned residences	43	43	39

Note: Day Period is 7am to 6pm, Evening Period is 6pm to 10pm, Night Period is 10pm to 7am.

It is noted that Condition L4.3 of EPL 13172 identifies conditions under which the noise criteria do not apply and include:

a) wind speeds greater than 3m/s at 10m above ground level;

b) temperature inversion conditions greater than 3 degrees Celsius / 100m; or

c) under "non-significant weather conditions".

2.2 Development Consent Noise Limits

Schedule 3 of the site's Development Consent (DA344-11-2001) outlines applicable noise criteria for the operation of the quarry. **Table 2** reproduces the criteria as outlined in the development consent.

Table 2 Development Consent Noise Limits, dBA

Location	Day	Evening	Night
	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$
All privately owned residences	43	39	35

Additionally, Condition 3B of Schedule 3 of the Development Consent states, 'The noise criteria in **Table 2** do not apply if the Applicant has an agreement with the owner/s of the relevant residence or land to exceed the noise criteria, and the Applicant has advised the Department in writing of the terms of this agreement.'

2.3 Variance in noise limits

It is noted that the night-time criteria presented in the Development Consent differs from that outlined in the EPL. This is due to the consent being updated to reflect the recent modification for site. Hence, the more conservative criteria outlined in the consent have been adopted for this assessment. Notwithstanding, as the quarry is not operational during the evening and night period, the variance in the applicable noise criteria is inconsequential.

2.4 Quarry Plant Sound Power Noise Limits

Table 15 of the Noise and Vibration Impact Assessment (NVIA) (Muller Acoustic Consulting Pty Ltd, April 2019) prepared for the Environmental Impact Statement (EIS) (Umwelt (Australia)) sets out the noise targets for mobile plant operating at the quarry. The logarithmic site total sound powers are reproduced in **Table 3**.

Table 3 Quarry Plant Sound Power Levels, dBA (re 10^{-12} Watts)

Noise Source/Item	Total dBA
Sandvik Crusher	111
Pugmill	108
Service Vehicle	82
Wirtgen Kleeman Secondary/Tertiary Crusher	111
Wirtgen MR130Z Track Mounted Impact Crusher	113
Wirtgen Kleeman Cone/Sand Plant	110
Wirtgen Kleeman Screen	111
Drill	115
Cat D8 Dozer	111
Komatsu PC450 Excavator	109
Komatsu Loader	99
Komatsu WA500 Loader	105
Komatsu WA480 Wheel Loader	100
Komatsu HM400 Articulated Dump Truck (x3)	106
Volvo 6 Wheeled Water Cart	101
Manitou	96
Standard Road Truck (x3)	102
Total Site Sound Power	**121**

3 Methodology

3.1 Locality

Wallerawang is located approximately 10km to the northwest of Lithgow, NSW. Receivers in the locality surrounding the quarry are primarily rural/residential and for consistency the naming conventions for each receiver has been retained from the NMP. It is noted that N08 has been added to the assessment, although has not been retained from the NMP. The monitoring locations with respect to the quarry are presented in **Table 4** and graphically in the locality plan shown in **Figure 1.**

Table 4 Receiver Locations

ID	Address	Distance to Quarry Boundary
RL01	Reference Location (adjacent to site office)	N/A
N01	139 Gemalong, Marrangaroo, NSW	1200m
N03	2 Cypress Close, Wallerawang, NSW	550m
N08	42 Rocky Waterhole Drive, Wallerawang, NSW	980m

3.2 Environmental Noise Assessment Methodology

The attended noise surveys were conducted in general accordance with the procedures described in Standards Australia AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise", the EPL and NMP. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Thursday 17 August 2023. The 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.

Two daytime measurements of 15-minutes in duration were completed at each monitoring location during standard onsite operations. Where possible, throughout each survey the operator quantified the contribution of each significant noise source. Extraneous noise sources were excluded from the analysis to calculate the $LA_{eq(15min)}$ quarry noise contribution for comparison against the relevant EPL limits.

FIGURE 1

LOCALITY PLAN

MAC160392-01

Wallerawang Quarry,

Wallerawang NSW

KEY

Attended Locations

Project Boundary

0 100 200 300 400 m

N

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4 Results

4.1 Meteorological Conditions

Weather data for the noise assessment period was sourced from Wallerawang Quarry is on-site meteorological station as well as operator measured conditions on site of EPL nominated receiver locations to determine prevailing meteorological conditions at the time of the attended measurements and are presented in **Table 5**.

Table 5 Prevailing Meteorological Conditions

Date & Time	Walker Quarries on-site Meteorological Station		Operator Measured Weather EPL Monitoring Location (1.8m AGL)	
	Wind Direction	Wind (m/s)	Wind Direction	Wind (m/s)
17/08/2023 10:46	NW	1.8	NW	1.9
17/08/2023 11:05	W	1.7	NW	0.5
17/08/2023 11:26	N	1.2	NW	0.8
17/08/2023 11:48	N	1.4	NW	1.6
17/08/2023 12:26	N	1.6	NW	2.0
17/08/2023 14:27	N	1.2	W	2.0
17/08/2023 14:50	N	1.9	W	1.6
17/08/2023 15:12	N	1.6	W	2.0

4.2 Assessment Results –Reference Location (RL01)

Operational attended noise monitoring was completed at RL01 on Thursday 17 August 2023. **Table 6** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 6 Operator-Attended Noise Survey Results – Reference Location 1 (RL01)

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			EPL Limit[1]	Meteorology	Comments
		L_{Amax}	L_{Aeq}	L_{A90}			
17/08/2023	11:48	71	56	51	N/A	WS: 1.6m/s WD: NW Rain: Nil	Traffic 49-64 Wind in vegetation 41-46 Mobile plant (Front end loader, Hall truck) 49-66 Site traffic 50-71
Quarry Site $L_{Aeq(15min)}$ Contribution[1]							56
17/08/2023	12:26	71	56	49	N/A	WS: 2.0 m/s WD: NW Rain: Nil	Traffic 44-65 Wind in trees <44 Mobile plant 54-69 Quarry construction 39-44 Trucks 44-71
Quarry Site $L_{Aeq(15min)}$ Contribution[1]							56

Note 1: EPL not applicable for this onsite reference location.

4.3 Assessment Results – Location N01

Operational attended noise monitoring was completed at N01 on Thursday 17 August 2023. **Table 7** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 7 Operator-Attended Noise Survey Results – Location N01

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			EPL Limit	Meteorology	Comments
		L_{Amax}	L_{Aeq}	L_{A90}			
17/08/2023	10:46	64	51	44	43	WS: 1.9 m/s WD: NW Rain: Nil	Birds 41-48 Traffic 41-64 Insects 34-39 Wind in vegetation 41-46 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution[1]							<34
17/08/2023	15:12	67	52	47	43	WS: 2.0m/s WD: W Rain: Nil	Dog bark 43-58 Traffic 43-67 Insects <43 Wind in vegetation <43 Birds 46-56 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution[1]							<37

Note 1: Quarry Site $L_{Aeq(15min)}$ calculated based on nearfield measurements.

4.4 Assessment Results – Location N03

Operational attended noise monitoring was completed at N03 on Thursday 17 August 2023. **Table 8** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 8 Operator-Attended Noise Survey Results – Location N03

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			EPL Limit	Meteorology	Comments
		L_{Amax}	L_{Aeq}	L_{A90}			
17/08/2023	11:05	61	44	37	43	WS: 0.5m/s WD: NW Rain: Nil	Birds 33-52 Traffic 33-61 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution[1]							<27
17/08/2023	14:27	78	52	43	43	WS: 2m/s WD: W Rain: Nil	Insects <38 Traffic 38-68 Aircraft <40 Dog bark 38-69 Residential noise 40-78 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution[1]							<33

Note 1: Quarry Site LAeq(15min) calculated based on nearfield measurements.

4.5 Assessment Results – Location N08

Operational attended noise monitoring was completed at N08 on Thursday 17 August 2023. **Table 9** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 9 Operator-Attended Noise Survey Results – Location N08

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			EPL Limit	Meteorology	Comments
		L_{Amax}	L_{Aeq}	L_{A90}			
17/08/2023	11:26	70	59	51	43	WS: 0.8m/s WD: NW Rain: Nil	Traffic 45-70 Birds 45-51 Quarry inaudible
		Quarry Site $L_{Aeq(15min)}$ Contribution[1]					<41
17/08/2023	14:51	68	57	51	43	WS: 1.6m/s WD: W Rain: Nil	Traffic 48-68 Birds <48 Wind in vegetation <48 Quarry inaudible
		Quarry Site $L_{Aeq(15min)}$ Contribution[1]					<41

Note 1: Quarry Site $L_{Aeq(15min)}$ calculated based on nearfield measurements.

4.6 Assessment Results – Sound Power Audit

Near field measurements of plant and equipment were also completed to determine their operating Sound Power Levels (SWLs). The measurements were conducted in general accordance with AS 5331:2019 – Acoustics – Determination of sound power levels of noise sources – Guidelines for the use of basic standards. Results of the analysis identify that the overall sound power of items of plant used at the project site are below target Sound Power Levels outlined in the EIS and NVIA and are presented in **Table 10**.

Table 10 Sound Power Levels, LAeq

Plant	Octave Band Centre Frequency, Lw Spectrum									Sound Power Lw	Goal[1]
	32	63	125	250	500	1k	2k	4k	8k		
Komatsu HM400 Articulated Dump Truck	64	76	95	97	95	97	94	86	76	103	106
Komatsu WA500 Loader	58	77	87	97	98	98	97	91	79	104	105

Note 1: These are the SWLs of individual plant modelled in the EIS / NVIA.

Other fixed and mobile plant items were measured during the first round of monitoring for 2023.

5 Noise Verification Modelling Methodology

Due to the high ambient noise levels attributed to passing traffic on the Great Western Highway, site operations are often masked at the noise monitoring locations. To verify the offsite noise levels from the quarry and correlate the established noise contributions from attended noise monitoring, predictive noise modelling was undertaken.

Noise modelling utilised the DGMR (iNoise, Version 2023.1) noise modelling software. iNoise is an intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

The model calculation method used to predict noise levels was in accordance with ISO 9613:1 and ISO 9613:2 including corrections for meteorological conditions using CONCAWE[1]. The ISO 9613 standards are the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

Site mobile and fixed equipment was positioned in locations representative of the areas in which they were operating during the attended noise monitoring survey (17 August 2023). The results of the predictive modelling are presented in **Section 6** and compared to the measured site contribution from the attended monitoring.

1 Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

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6 Discussion

6.1 Discussion of Results – Reference Location (RL01)

Noise measurements were conducted on Thursday 17 August 2023 when Wallerawang Quarry was operating at normal production levels, which included use of crusher train, mobile screen, front-end loader, excavator, road trucks and water cart.

The noise contribution from the quarry at the reference location was 56dB $LA_{eq(15min)}$ for both measurements respectively. The noise environment at the reference location was primarily dominated crushing activities, weigh bridge operations and mobile plant.

6.2 Discussion of Results – Location N01

Measurements conducted Thursday 17 August 2023 identified that Wallerawang Quarry noise was inaudible during both measurements conducted at N01 with contributions measured between <34dB $LA_{eq(15min)}$ and <37dB $LA_{eq(15min)}$ respectively which satisfied the relevant noise limits of 43dB $LA_{eq(15min)}$ for this location. Extraneous non-quarry related sources included highway traffic, birds, insects and wind in vegetation, that were significant contributors to the ambient noise environment.

The predicted quarry site contribution at N01, which included distance loss, the surrounding topography and air absorption, was 32dBA, which is consistent with the site being inaudible at this location during the attended noise monitoring. This level is also significantly lower than the ambient dominant sources which generally masks site noise emissions.

6.3 Discussion of Results – Location N03

Measurements conducted on Thursday 17 August 2023 identified that Wallerawang Quarry noise was inaudible during both measurements conducted at N03, with contributions measured between <27dB $LA_{eq(15min)}$ and <33dB $LA_{eq(15min)}$ respectively. Therefore, the relevant noise limit of 43dB $LA_{eq(15min)}$ was satisfied. Extraneous non-quarry related sources included traffic, birds, insects, aircraft, residential noise and dogs barking that were significant contributors to the ambient noise environment.

The predicted quarry site contribution at N03 which included distance loss, the surrounding topography and air absorption, was 34dBA, which is consistent with the measured site contribution at this location during the attended noise monitoring.

6.4 Discussion of Results – Location N08

Measurements conducted on Thursday 17 August 2023 for N08 were dominated by local and highway traffic. Quarry operations were inaudible during all measurements at this location with estimated contributions measured <41dB $LA_{eq(15min)}$ for both measurements respectively, demonstrating that quarry contributions remained below the relevant criteria of 43dB $LA_{eq(15min)}$ for both measurements conducted at the location. Extraneous non-quarry related sources included traffic, wind in vegetation and birds that were significant contributors to the ambient noise environment.

The predicted quarry site contribution at N08, which included distance loss, the surrounding topography and air absorption, was 35dBA, which correlates with the measured site contribution at this location during the attended noise monitoring. This level is also significantly lower than the ambient dominant sources which generally masks site noise.

6.5 Discussion of Results – Sound Power Audit

The results of the sound power audit demonstrate that the measured mobile plant used onsite comply with the individual plant sound power goal as outlined in the NVIA. Other fixed and mobile plant used on site were assessed and included in the first bi-annual 2023 assessment.

7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment on behalf of Walker Quarries Pty Ltd. The assessment was completed to assess Wallerawang Quarry noise emissions against relevant criteria presented in EPL 13172 and DA 344-11-2001.

Quarry noise remained inaudible at all residential locations conducted on Thursday 17 August 2023, therefore satisfied the specified noise limits in the Noise Management Plan and Environmental Protection Licence at all locations.

All monitoring locations were dominated by extraneous sources such as traffic that predominantly masked quarry operations.

Predictive noise modelling was generally consistent with the findings of the attended noise monitoring, confirming the site complied with the applicable noise criteria at all assessed locations and also confirmed the site was inaudible when compared against extraneous ambient noise sources (ie masked by ambient levels).

The results of the sound power audit demonstrate that the measured mobile plant used onsite comply with the individual sound power goal as outlined in the NVIA.

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Appendix A – Glossary of Terms

Several technical terms have been used in this report and are explained in **Table A1.**

Table A1 Glossary of Terms

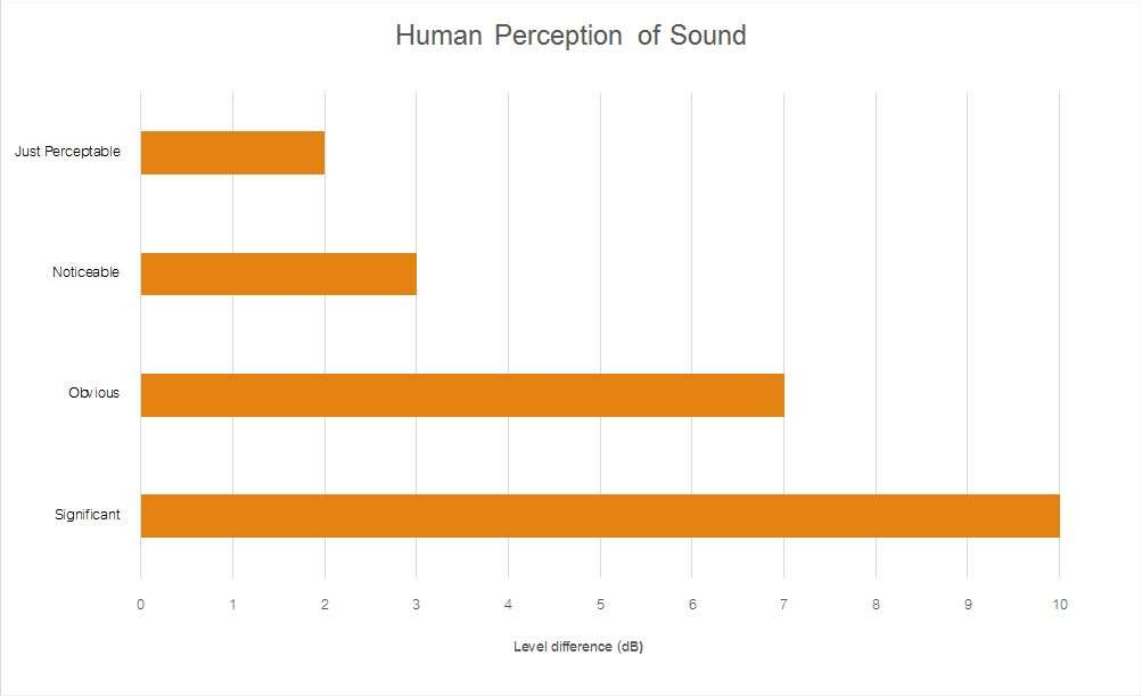
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
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)	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 (SWL)	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
Lawnmower (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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