Noise Monitoring Assessment

Wallerawang Quarry
September 2022

Prepared for: Walker Quarries Pty Ltd
September 2022
MAC160392RP12

Muller Acoustic Consulting

Document Information

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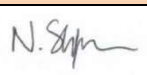
MAC160392RP12	23 September 2022	Nicholas Shipman		Oliver Muller	

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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 2022 (September 2022).

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 four 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);
- Development Consent 344-1-2001 (Mod 3), February 2020;
- Australian Standard 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 (NMP), 2019.

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	43	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 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 north west 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 N4 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
RL1	Reference Location (adjacent to site office)	N/A
N1	139 Gemalong, Marrangaroo, NSW	1200m
N2	987 Great Western Highway, Marrangaroo, NSW	400m
N3	2 Cypress Close, Wallerawang, NSW	550m
N4	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 Australian Standard 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 Wednesday 7 September 2022. The acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672-2019-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

REF: MAC160392

0 200m

KEY

- N1 — RECEIVER/MONITORING LOCATION
- RL1 — REFERENCE LOCATION
- SITE LOCATION

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*Imagery Source : nearmaps

4 Results

4.1 Assessment Results –Reference Location (RL1)

Operational attended noise monitoring was completed at RL1 on Wednesday 7 September 2022. **Table 5** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 5 Operator-Attended Noise Survey Results – Reference Location 1 (RL1)

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			EPL Limit[1]	Meteorology	Comments
		L_{Amax}	L_{Aeq}	L_{A90}			
07/09/2022	09:05	82	65	55	N/A	WS: 0.4m/s WD: E Rain: Nil	Traffic 52-82 Quarry generator 41-57 Quarry water cart 66-71
Quarry Site $L_{Aeq(15min)}$ Contribution							68
07/09/2022	10:15	75	65	55	N/A	WS: 0.2m/s WD: E Rain: Nil	Traffic 62-75 Quarry generator <54 Quarry water cart 61-72 Quarry reverse alarms 62-68
Quarry Site $L_{Aeq(15min)}$ Contribution							66

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

4.2 Assessment Results – Location N1

Operational attended noise monitoring was completed at N1 on Wednesday 7 September 2022. **Table 6** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 6 Operator-Attended Noise Survey Results – Location N1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			EPL Limit	Meteorology	Comments
		L_{Amax}	L_{Aeq}	L_{A90}			
07/09/2022	07:48	77	62	48	43	WS: 0.2m/s WD: E Rain: Nil	Traffic 39-54 Birds 39-59 Roadworks 39-77 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution							<38
07/09/2022	11:58	73	56	44	43	WS: 1.3m/s WD: E Rain: Nil	Traffic 40-73 Birds 40-54 Dog bark <46 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution							<34

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

4.3 Assessment Results – Location N2

Operational attended noise monitoring was completed at N2 on Wednesday 7 September 2022. **Table 7** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 7 Operator-Attended Noise Survey Results – Location N2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			EPL Limit	Meteorology	Comments
		L_{Amax}	L_{Aeq}	L_{A90}			
07/09/2022	09:45	69	45	37	43	WS: 0.2m/s WD: E Rain: Nil	Traffic 34-62 Birds 39-69 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution							<27
07/09/2022	10:55	65	48	41	43	WS: 0.6m/s WD: E Rain: Nil	Traffic 39-58 Birds 38-65 Wind in trees <40 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution							<31

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

4.4 Assessment Results – Location N3

Operational attended noise monitoring was completed at N3 on Wednesday 7 September 2022. **Table 8** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 8 Operator-Attended Noise Survey Results – Location N3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			EPL Limit	Meteorology	Comments
		L_{Amax}	L_{Aeq}	L_{A90}			
07/09/2022	08:10	61	52	42	43	WS: 0.6m/s WD: E Rain: Nil	Traffic 36-61 Birds 36-57 Dog bark 36-44 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution							<32
07/09/2022	11:17	95	73	40	43	WS: 0.2m/s WD: E Rain: Nil	Traffic 35-62 Birds 41-49 Dog bark 48-95 Insects <35 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution							<30

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

4.5 Assessment Results – Location N4

Operational attended noise monitoring was completed at N4 on Wednesday 7 September 2022. **Table 9** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 9 Operator-Attended Noise Survey Results – Location N4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			EPL Limit	Meteorology	Comments
		L_{Amax}	L_{Aeq}	L_{A90}			
07/09/2022	08:34	73	53	47	43	WS: 0.6m/s WD: E Rain: Nil	Traffic 44-62 Birds 45-73 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution							<37
07/09/2022	11:37	65	51	46	43	WS: 1.2m/s WD: E Rain: Nil	Traffic 42-65 Birds 42-51 Quarry inaudible
Quarry Site $L_{Aeq(15min)}$ Contribution							<36

Note 1: Quarry Site LAeq(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. 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, L_{Aeq}

Plant	Octave Band Centre Frequency, Lw Spectrum									Sound Power Lw	Goal[1]
	32	63	125	250	500	1k	2k	4k	8k		
Komatsu WA480 FEL	58	78	89	90	97	94	93	89	79	101	100
Screen and Crusher	79	93	100	105	108	113	114	110	99	118	111
Volvo 6 Wheeled Water Cart	66	82	92	89	96	100	100	96	88	105	101
Wirtgen Kleeman Cone/Sand Plant	76	87	90	97	103	104	103	100	90	109	110
Total Site Sound Power										**118**	**121[2]**

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

Note 2: This is the total SWL of all plant modelled in the EIS / NVIA.

It is noted that the sound power level of the front-end loader, water cart, screen and crusher are above the EIS levels for each item of plant. Notwithstanding, the total emissions from all onsite plant are lower than the total logarithmic sum of the total site criteria as shown in **Table 10**. Hence, the total target sound power levels are satisfied for site.

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 2022.1) 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 (7 September 2022). 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 (RL1)

Noise measurements were conducted on Wednesday 7 September 2022 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 68dB $L_{Aeq(15min)}$ and 66dB $L_{Aeq(15min)}$ respectively. The noise environment at the reference location was primarily dominated crushing activities and weigh bridge operations.

6.2 Discussion of Results – Location N1

Measurements conducted Wednesday 7 September 2022 identified that Wallerawang Quarry noise was inaudible during both measurements conducted at N1 with contributions measured between <38dB $L_{Aeq(15min)}$ and <34dB $L_{Aeq(15min)}$ respectively. and satisfied the relevant noise limits of 43dB $L_{Aeq(15min)}$ for this location. Extraneous non-quarry related sources included highway traffic, roadworks, dog bark and birds, that were significant contributors to the ambient noise environment.

The predicted quarry site contribution at N1, 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 N2

Measurements conducted on Wednesday 7 September 2022 identified that Wallerawang Quarry noise was inaudible during both measurements conducted at N2, with contributions measured between <27dB $L_{Aeq(15min)}$ and <31dB $L_{Aeq(15min)}$ respectively. Therefore, the relevant noise limit of 43dB $L_{Aeq(15min)}$ was satisfied. Extraneous non-quarry related sources included traffic, birds and wind in trees that were significant contributors to the ambient noise environment.

The predicted quarry site contribution at N2, which included distance loss, the surrounding topography and air absorption, was <36dBA, which is generally consistent 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.

6.4 Discussion of Results – Location N3

Measurements conducted on Wednesday 7 September 2022 identified that Wallerawang Quarry noise was inaudible during both measurements conducted at N3, with contributions measured between <30dB $LA_{eq(15min)}$ and <32dB $LA_{eq(15min)}$ respectively. Therefore, the relevant noise limit of 43dB $LA_{eq(15min)}$ was satisfied. Extraneous non-quarry related sources included traffic, birds, dogs barking and insects that were significant contributors to the ambient noise environment.

The predicted quarry site contribution at N3 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.

6.5 Discussion of Results – Location N4

Measurements conducted on Wednesday 7 September 2022 for N4 were dominated by local and highway traffic. Quarry operations were inaudible during all measurements at this location with estimated contributions measured between <36dB $LA_{eq(15min)}$ and <37dB $LA_{eq(15min)}$ 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 and birds that were significant contributors to the ambient noise environment.

The predicted quarry site contribution at N4, which included distance loss, the surrounding topography and air absorption, was <36dBA, 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.

6.6 Discussion of Results – Sound Power Audit

The results of the sound power audit demonstrate that current plant such the front-end loader, water cart, screen and crusher used onsite exceed the relevant mobile and static sound power criteria as outlined in the NVIA. Notwithstanding, the overall emissions from combined plant on site remain below the combined site sound power criteria.

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 Wednesday 7 September 2022, 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 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 front-end loader, water cart, screen and crusher used onsite exceed the individual sound power criteria as outlined in the NVIA. Notwithstanding, the overall emissions from combined plant on site remain below the combined site sound power criteria.

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Appendix A – Glossary of Terms

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

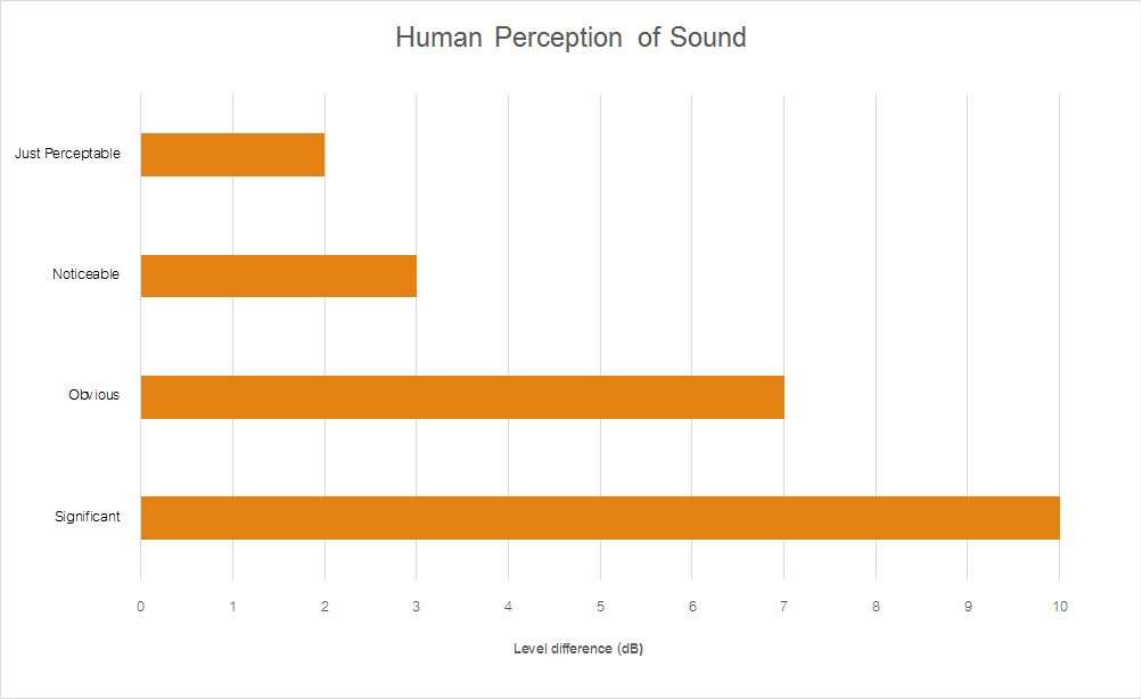
Table A1 Glossary of Terms

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
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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Appendix B – Correspondence Register

Table B1 Correspondence Register			
Date	Contact Between	Phone/Email	Comment
Monday5 September 2022	R Heaton, A Irwin, W Chapman N Shipman	Email	Initial contact to schedule environmental compliance survey and sound power audit in September 2022
Wednesday 7 September 2022	N Shipman	On site	Site check in and survey completed

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