Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW
Quarter 1 Ending March 2019.

Prepared for: Holcim (Australia) Pty Ltd
February 2019
MAC180611-02RP3

Muller Acoustic Consulting

Document Information

Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW

Quarter 1 Ending March 2019

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CONTENTS

1 INTRODUCTION 5

2 NOISE CRITERIA 7

3 METHODOLOGY 9

3.1 LOCALITY 9

3.2 ASSESSMENT METHODOLOGY 9

4 RESULTS 13

4.1 ASSESSMENT RESULTS - LOCATION N1 13

4.2 ASSESSMENT RESULTS - LOCATION N2 13

4.3 ASSESSMENT RESULTS - LOCATION N3 14

4.4 ASSESSMENT RESULTS - LOCATION N4 15

5 NOISE COMPLIANCE ASSESSMENT 17

6 DISCUSSION 19

6.1 DISCUSSION OF RESULTS - LOCATION N1 19

6.2 DISCUSSION OF RESULTS - LOCATION N2 19

6.3 DISCUSSION OF RESULTS - LOCATION N3 19

6.4 DISCUSSION OF RESULTS - LOCATION N4 19

7 CONCLUSION 21

APPENDIX A - GLOSSARY OF TERMS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Lynwood Quarry (the 'quarry'), Marulan, NSW.

The monitoring has been conducted in accordance with the Lynwood Noise Management Plan (NMP) and in general accordance with the Noise Policy for Industry (NPI), at four representative monitoring locations. This assessment has been undertaken for the Quarterly period ending March 2019, and forms part of the annual noise monitoring program to address conditions outlined in the Development Consent.

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

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Lynwood Quarry Noise Management Plan (NMP), 2016;
- Lynwood Quarry Environmental Protection Licence (EPL), 2013 (12939);
- Lynwood Quarry, Development Consent, 2005 (DA128-5-2005); 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 Lynwood Quarry Noise Management Plan (NMP), outlines the applicable noise criteria for residential receivers L1 – L16 surrounding the quarry, and are presented in **Table 1.**

Table 1 Noise Criteria[1]

Location	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)	
	dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	dB, $L_{A1(1min)}$
L1	35	35	35	45
L2	35	35	35	45
L3	35	35	35	45
L4	35	37	35	46
L5	35	35	35	46
L6	35	37	36	46
L7	38	38	35	55
L8	39	38	36	55
L9	39	39	37	56
L10	42	42	40	53
L11	35	35	35[1]	47
L12	37	37	36	47
L13	40	38	37	47
L14	35	35	35	47
L15	35	35	35	47
L16	35	35	35	45

Note 1: Noise criteria adopted from the EPL.

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3 Methodology

3.1 Locality

The quarry is located near Marulan, NSW approximately 4km west of the town centre. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Hume Highway situated to the east and south of the site. Highway traffic is a dominant noise source in the area along with rural noise. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan in **Figure 1** and presented in **Table 2.**

Table 2 Monitoring Location Addresses

Location	NMP ID	Address	Criteria		
			Day	Evening	Night
N1	L1	South Eastern Boundary of 1114 Carrick Road, Marulan[1]	35	35	35
N2	L6	End of Maclura Drive, Marulan	35	37	36
N3	L11	Northern Boundary, 16038 Hume Highway, Marulan[1]	35	35	35[2]
N4	L12	Corner of Dorsett and Suffolk Road, Marulan	37	37	36

Note: 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.

Note 1: Intermediate noise monitoring point.

Note 2: Noise criteria adopted from the EPL.

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 Lynwood Quarry EPL. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Wednesday 30 January 2019. The acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2004-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

Noise measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Measurements were conducted at four locations (N1-N4) on Wednesday 30 January 2019 to satisfy the requirements of the NMP.

Extraneous noise sources were excluded from the analysis to determine the $LA_{eq(15min)}$ 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.

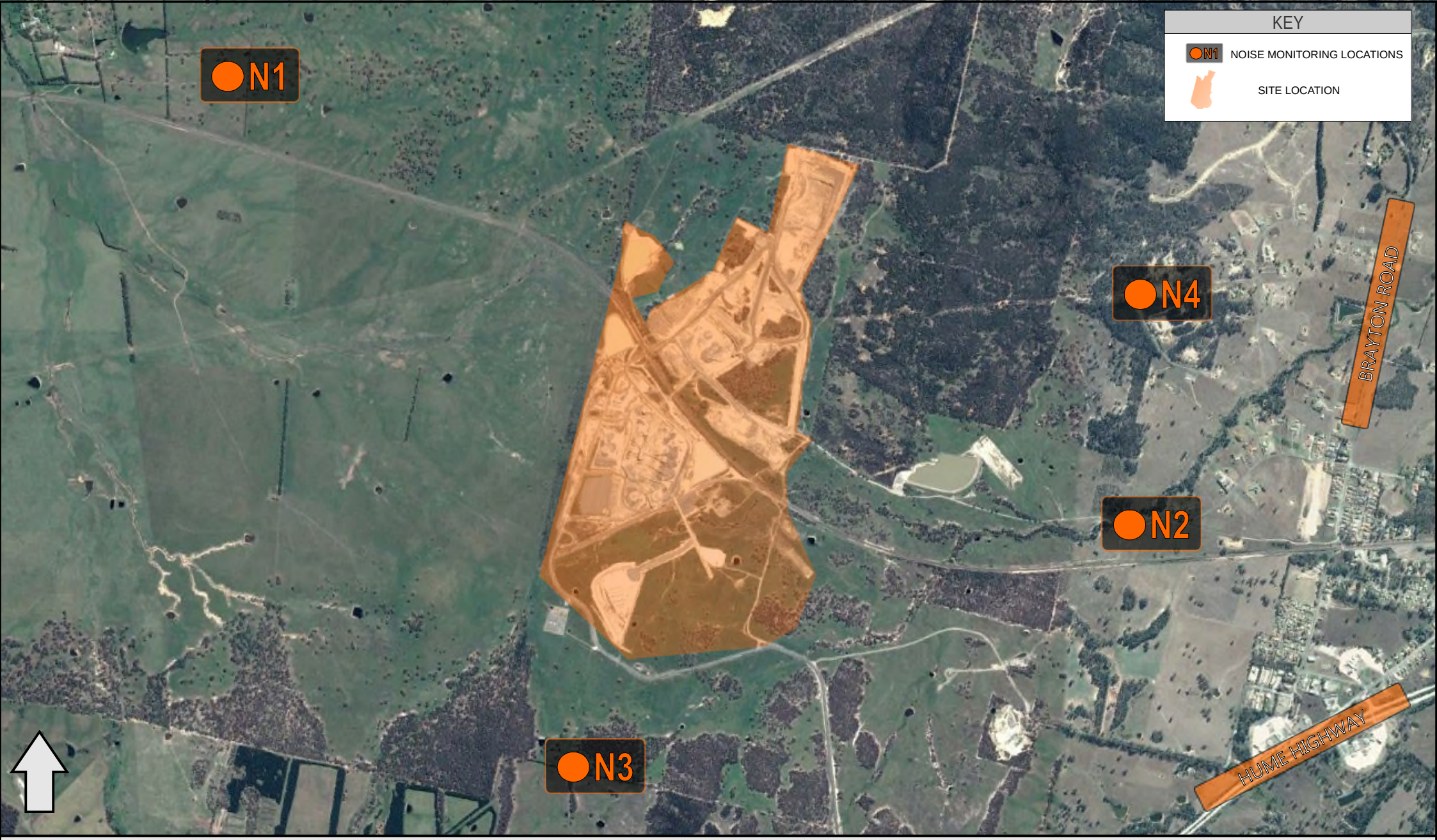

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FIGURE 1

LOCALITY PLAN

REF: MAC180611-02

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4 Results

4.1 Assessment Results - Location N1

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N1 for the NMA are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location N1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
30/01/19	21:34 (Evening)	59	36	33	WD: WNW WS: 2m/s Rain: Nil	Insects <30 Wind in trees 30-35 Train 38-59
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<23
30/01/19	22:01 (Night)	52	36	31	WD: WNW WS: 2m/s Rain: Nil	Insects <30 Aircraft 31-49 Wind in trees 30-34
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<21

Note: 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.

4.2 Assessment Results - Location N2

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N2 for the NMA are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location N2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
30/01/19	19:24 (Evening)	53	39	36	WD: WNW WS: Calm Rain: Nil	Insects <38 Birds 38-40 Distant traffic 38-53 Dog bark <38
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<26
30/01/19	23:00 (Night)	60	42	35	WD: WNW WS: Calm Rain: Nil	Insects <32 Highway traffic 32-40 Holcim haul trucks and reverse alarms 32-34 Train 36-60
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						34

Note: 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.

4.3 Assessment Results - Location N3

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N3 for the NMA are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location N3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
30/01/19	19:49 (Evening)	54	40	36	WD: NNW WS: 2.5m/s Rain: Nil	Insects 37-42 Wind 38-52 Birds 36-41 Holcim haul trucks and reverse alarms 33-37 Train 38-45
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						35
30/01/19	23:34 (Night)	49	39	37	WD: WNW WS: Calm Rain: Nil	Insects <36 Distant highway traffic 36-40 Holcim haul trucks and reverse alarms 33-38
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						35

Note: 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.

4.4 Assessment Results - Location N4

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N4 for the NMA are presented in **Table 6**.

Table 6 Operator-Attended Noise Survey Results – Location N4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
30/01/19	20:49 (Evening)	60	41	39	WD: NNW WS: Calm Rain: Nil	Highway traffic 36-42 Insects 36-39 Local residential noise <36 Train 37-40 Local traffic 37-59
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<29
30/01/19	22:36 (Night)	53	32	30	WD: WNW WS: Calm Rain: Nil	Insects <30 Distant traffic 30-36 Holcim haul trucks and reverse alarms 29-32
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						31

Note: 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.

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5 Noise Compliance Assessment

The compliance assessment summary for each monitoring location N1 to N4 are presented in **Table 7** and **Table 8** for the two assessment periods.

Table 7 Round 1 Noise Compliance Assessment Summary

Location No.	Period	Quarry Contribution	Criteria	Compliant
		dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	
N1	Evening	<23	35	✓
N2	Evening	<26	35	✓
N3	Evening	35	35	✓
N4	Evening	<29	37	✓

Note: 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.

Table 8 Round 2 Noise Compliance Assessment Summary

Location No.	Period	Quarry Contribution	Criteria	Compliant
		dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	
N1	Night	<21	35	✓
N2	Night	34	35	✓
N3	Night	35	35	✓
N4	Night	31	37	✓

Note: 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.

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6 Discussion

6.1 Discussion of Results - Location N1

Monitoring on Wednesday 30 January 2019 identified that the quarry noise contribution remained inaudible, although contributions were calculated at between <21dBA and <23dBA respectively which satisfies the relevant noise criteria. Extraneous sources audible during the survey included insects, wind in trees, train pass by and aircraft noise.

6.2 Discussion of Results - Location N2

Quarry noise emissions were audible during the night measurement on Wednesday 30 January 2019. Quarry noise emissions were estimated to be 34dBA, satisfying the relevant noise criteria for both measurements. Audible onsite operations included haul truck movements and reverse alarms. Extraneous sources measured include insects, birds, highway traffic, dog bark and train pass by.

6.3 Discussion of Results - Location N3

Quarry noise was audible during both evening and night measurements conducted on Wednesday 30 January 2019. Quarry noise emissions were estimated to be 35dBA for each measurement respectively, therefore satisfying relevant noise limits. Audible onsite operations included haul truck movements and reverse alarms. Non-quarrying noise sources included insects, wind, birds, train pass by, and distant highway traffic.

6.4 Discussion of Results - Location N4

Quarry noise was audible during the night measurement conducted on Wednesday 30 January 2019. Quarry noise emissions were estimated to be 31dBA, therefore satisfying relevant noise limits. Audible onsite operations included haul truck movements and reverse alarms. Non-quarrying sources included highway traffic, insects, local residential noise, train pass by and local traffic.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for Holcim (Australia) Pty Ltd at the Lynwood Quarry, Marulan, NSW. The assessment was completed to assess the quarry's compliance with the relevant noise criteria during Quarter 1 March 2019.

Attended noise monitoring was undertaken on Wednesday 30 January 2019 at four representative monitoring locations. The assessment has identified that noise emissions generated by Lynwood Quarry were audible during measurements at location N2, N3 and N4, however quarry noise emissions were below the relevant noise criteria. Operational noise was inaudible during all other attended noise measurements thus satisfying the applicable noise criteria.

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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

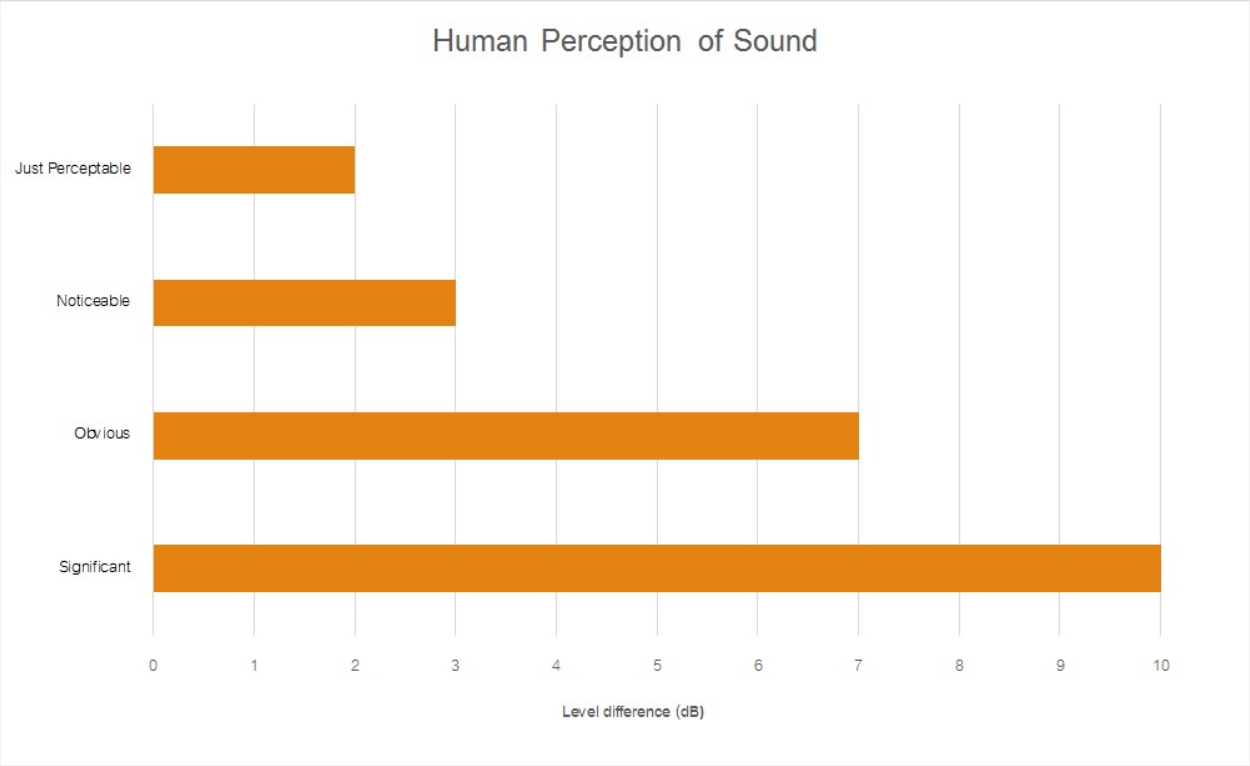
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for 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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Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW
Quarter 2 Ending June 2019.

Prepared for: Holcim (Australia) Pty Ltd
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CONTENTS

1 INTRODUCTION 5

2 NOISE CRITERIA 7

3 METHODOLOGY 9

3.1 LOCALITY 9

3.2 ASSESSMENT METHODOLOGY 9

4 RESULTS 13

4.1 ASSESSMENT RESULTS - LOCATION N1 13

4.2 ASSESSMENT RESULTS - LOCATION N2 13

4.3 ASSESSMENT RESULTS - LOCATION N3 14

4.4 ASSESSMENT RESULTS - LOCATION N4 14

5 NOISE COMPLIANCE ASSESSMENT 15

6 DISCUSSION 17

6.1 DISCUSSION OF RESULTS - LOCATION N1 17

6.2 DISCUSSION OF RESULTS - LOCATION N2 17

6.3 DISCUSSION OF RESULTS - LOCATION N3 17

6.4 DISCUSSION OF RESULTS - LOCATION N4 17

7 CONCLUSION 19

APPENDIX A - GLOSSARY OF TERMS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Lynwood Quarry (the 'quarry'), Marulan, NSW.

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

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Lynwood Quarry Noise Management Plan (NMP), 2016;
- Lynwood Quarry Environmental Protection Licence (EPL), 2013 (12939);
- Lynwood Quarry, Development Consent, 2005 (DA128-5-2005); 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 Lynwood Quarry Noise Management Plan (NMP), outlines the applicable noise criteria for residential receivers L1 – L16 surrounding the quarry, and are presented in **Table 1.**

Table 1 Noise Criteria[1]

Location	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)	
	dB, $LA_{eq(15min)}$	dB, $LA_{eq(15min)}$	dB, $LA_{eq(15min)}$	dB, $LA_{1(1min)}$
L1	35	35	35	45
L2	35	35	35	45
L3	35	35	35	45
L4	35	37	35	46
L5	35	35	35	46
L6	35	37	36	46
L7	38	38	35	55
L8	39	38	36	55
L9	39	39	37	56
L10	42	42	40	53
L11	35	35	35[1]	47
L12	37	37	36	47
L13	40	38	37	47
L14	35	35	35	47
L15	35	35	35	47
L16	35	35	35	45

Note 1: Noise criteria adopted from the EPL.

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3 Methodology

3.1 Locality

The quarry is located near Marulan, NSW approximately 4km west of the town centre. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Hume Highway situated to the east and south of the site. Highway traffic is a dominant noise source in the area along with rural noise. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan in **Figure 1** and presented in **Table 2.**

Table 2 Monitoring Location Addresses

Location	NMP ID	Address	Criteria		
			Day	Evening	Night
N1	L1	South Eastern Boundary of 1114 Carrick Road, Marulan[1]	35	35	35
N2	L6	End of Maclura Drive, Marulan	35	37	36
N3	L11	Northern Boundary, 16038 Hume Highway, Marulan[1]	35	35	35[2]
N4	L12	Corner of Dorsett and Suffolk Road, Marulan	37	37	36

Note: 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.

Note 1: Intermediate noise monitoring point.

Note 2: Noise criteria adopted from the EPL.

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 Lynwood Quarry EPL. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Wednesday 22 May 2019 and Thursday 23 May 2019. 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 ±0.5dBA.

Noise measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Measurements were conducted at four locations (N1-N4) on Wednesday 22 May 2019 and Thursday 23 May 2019 to satisfy the requirements of the NMP.

Extraneous noise sources were excluded from the analysis to determine the $LA_{eq(15min)}$ 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.

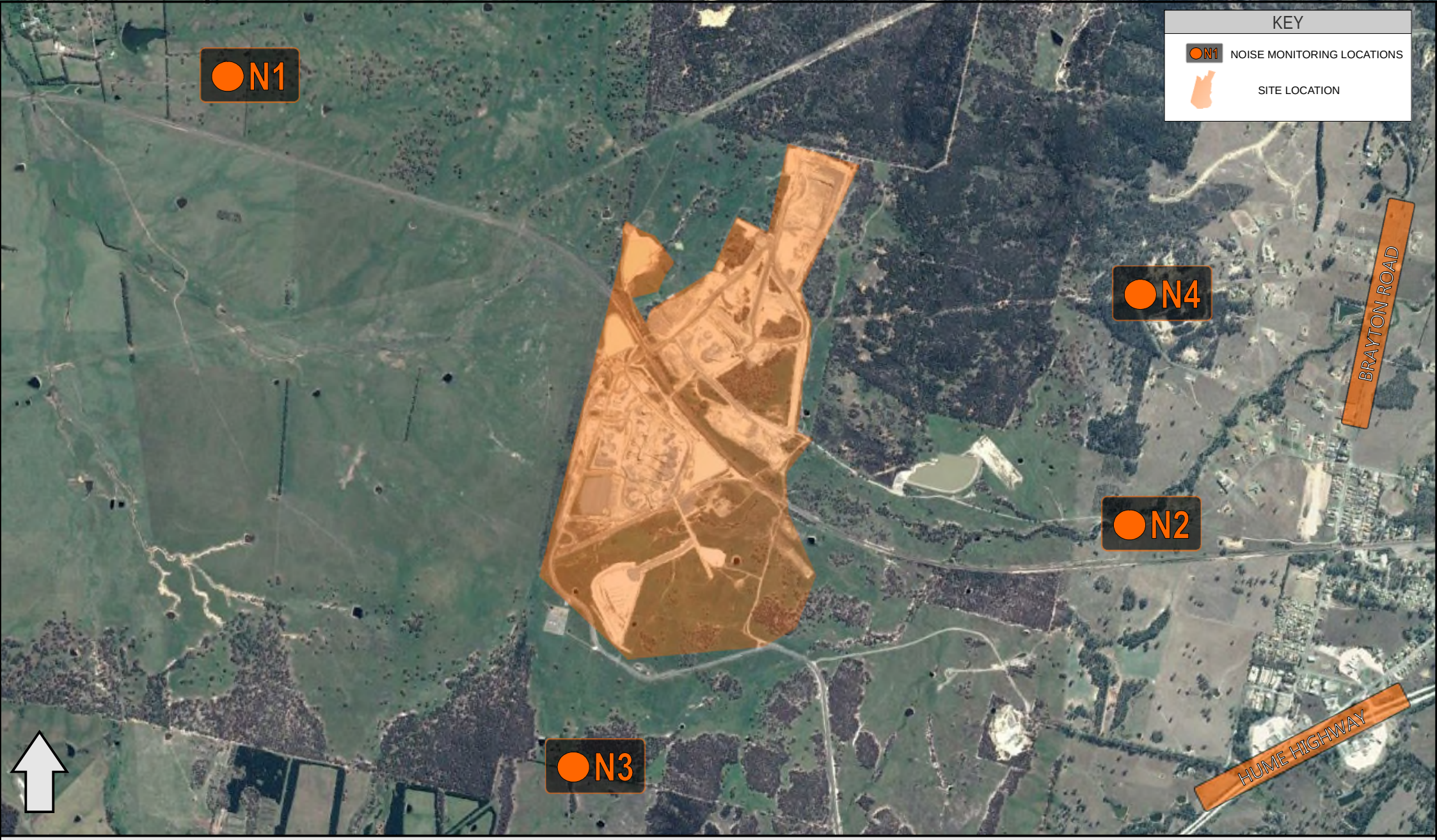

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FIGURE 1

LOCALITY PLAN

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4 Results

4.1 Assessment Results - Location N1

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N1 for the NMA are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location N1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
22/05/19	19:07 (Evening)	47	41	39	WD: NE WS: 1m/s Rain: Nil	Highway traffic 30-40 Holcim site <35
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35
23/05/19	08:18 (Day)	63	37	33	WD: NNW WS: <1m/s Rain: Nil	Birds 32-34 Holcim site 30-36
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35

Note: 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.

4.2 Assessment Results - Location N2

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N2 for the NMA are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location N2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
22/05/19	20:58 (Evening)	61	38	39	WD: NE WS: 1m/s Rain: Nil	Highway traffic 32-38 Train 30-67 Site inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
23/05/19	10:10 (Day)	69	40	31	WD: NW WS: 1m/s Rain: Nil	Birds 33-36 Highway traffic 28-30 Site inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30

Note: 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.

4.3 Assessment Results - Location N3

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N3 for the NMA are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location N3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
22/05/19	21:55 (Evening)	67	40	25	WD: NE WS: 1m/s Rain: Nil	Train 40-58 Holcim haul truck 33 Holcim site noise 26-33
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						29
23/05/19	09:15 (Day)	49	39	37	WD: NW WS: <1m/s Rain: Nil	Livestock 36-45 Train 40-63 Site inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30

Note: 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.

4.4 Assessment Results - Location N4

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N4 for the NMA are presented in **Table 6**.

Table 6 Operator-Attended Noise Survey Results – Location N4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
22/05/19	20:36 (Evening)	77	52	38	WD: NE WS: 1m/s Rain: Nil	Highway traffic 32-38 Local car 80 Dogs 42 Site inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
23/05/19	09:48 (Day)	53	32	30	WD: NNW WS: 1m/s Rain: Nil	Birds 30-34 Distant traffic <30 Site inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<20

Note: 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.

5 Noise Compliance Assessment

The compliance assessment summary for each monitoring location N1 to N4 are presented in **Table 7** and **Table 8** for the two assessment periods.

Table 7 Round 1 Noise Compliance Assessment Summary

Location No.	Period	Quarry Contribution	Criteria	Compliant
		dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	
N1	Evening	<35	35	✓
N2	Evening	<30	37	✓
N3	Evening	29	35	✓
N4	Evening	<30	37	✓

Note: 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.

Table 8 Round 2 Noise Compliance Assessment Summary

Location No.	Period	Quarry Contribution	Criteria	Compliant
		dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	
N1	Day	<35	35	✓
N2	Day	<30	35	✓
N3	Day	<30	35	✓
N4	Day	<20	37	✓

Note: 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.

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6 Discussion

6.1 Discussion of Results - Location N1

Monitoring on Wednesday 22 May 2019 and Thursday 23 May 2019 identified that the quarry noise contribution was audible throughout the survey, although contributions were calculated below 35dBA which satisfies the relevant noise criteria. Extraneous sources audible during the survey included traffic and birds.

6.2 Discussion of Results - Location N2

Quarry noise emissions were inaudible during the measurements on Wednesday 22 May 2019 and Thursday 23 May 2019. Quarry noise emissions were estimated to be <30dBA for the evening period and <30dBA for the day period, satisfying the relevant noise criteria for both measurements. Extraneous sources measured include highway traffic, train pass by and birds.

6.3 Discussion of Results - Location N3

Quarry noise was audible during the evening measurement conducted on Wednesday 22 May 2019 and however remained inaudible during the daytime measurement on Thursday 23 May 2019. Quarry noise emissions were estimated to be <30dBA for each measurement respectively, therefore satisfying relevant noise limits. Audible onsite operations included haul truck movements and reverse alarms. Non-quarrying noise sources included train pass by and livestock.

6.4 Discussion of Results - Location N4

Quarry noise was inaudible during the measurements conducted on Wednesday 22 May 2019 and Thursday 23 May 2019. Quarry noise emissions were estimated to be <30dBA, therefore satisfying relevant noise limits. Non-quarrying sources included birds, highway traffic, local residential noise, and local traffic.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for Holcim (Australia) Pty Ltd at the Lynwood Quarry, Marulan, NSW. The assessment was completed to assess the quarry's compliance with the relevant noise criteria during Quarter 2 June 2019.

Attended noise monitoring was undertaken on Wednesday 22 May 2019 and Thursday 23 May 2019 at four representative monitoring locations. The assessment has identified that noise emissions generated by Lynwood Quarry were audible during both evening and daytime measurements at location N1 and during the evening measurement at N3, however quarry noise emissions were below the relevant noise criteria. Operational noise was inaudible during all other attended noise measurements thus satisfying the applicable noise criteria.

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Appendix A - Glossary of Terms

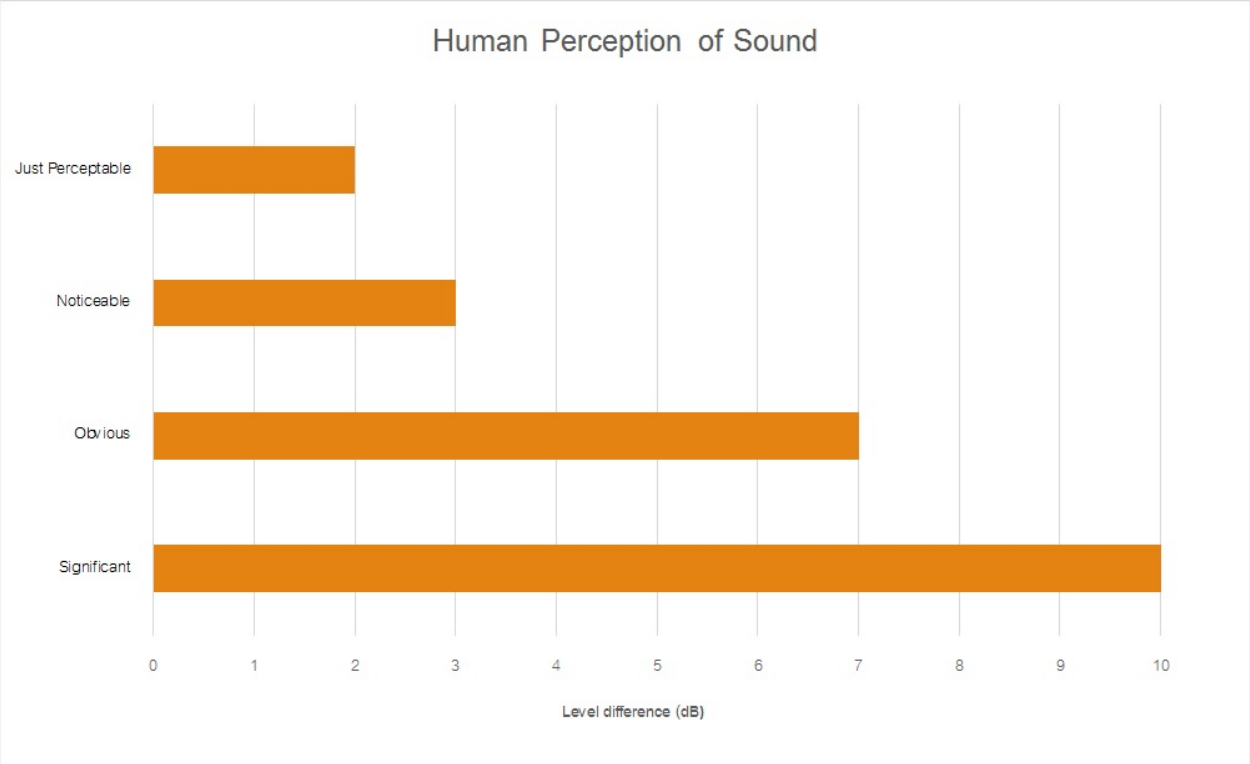
Table A1 provides a number of technical terms have been used in this report.

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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Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW
Quarter 3 Ending September 2019.

Prepared for: Holcim (Australia) Pty Ltd
September 2019
MAC180611-02RP5

Muller Acoustic Consulting

Document Information

Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW

Quarter 3 Ending September 2019

Prepared for: Holcim (Australia) Pty Ltd

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CONTENTS

1 INTRODUCTION 5

2 NOISE CRITERIA 7

3 METHODOLOGY 9

3.1 LOCALITY 9

3.2 ASSESSMENT METHODOLOGY 9

4 RESULTS 13

4.1 ASSESSMENT RESULTS - LOCATION N1 13

4.2 ASSESSMENT RESULTS - LOCATION N2 13

4.3 ASSESSMENT RESULTS - LOCATION N3 14

4.4 ASSESSMENT RESULTS - LOCATION N4 14

5 NOISE COMPLIANCE ASSESSMENT 15

6 DISCUSSION 17

6.1 DISCUSSION OF RESULTS - LOCATION N1 17

6.2 DISCUSSION OF RESULTS - LOCATION N2 17

6.3 DISCUSSION OF RESULTS - LOCATION N3 17

6.4 DISCUSSION OF RESULTS - LOCATION N4 17

7 CONCLUSION 19

APPENDIX A - GLOSSARY OF TERMS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Lynwood Quarry (the 'quarry'), Marulan, NSW.

The monitoring has been conducted in accordance with the Lynwood Noise Management Plan (NMP) and in general accordance with the Noise Policy for Industry (NPI), at four representative monitoring locations. This assessment has been undertaken for the Quarterly period ending September 2019, and forms part of the annual noise monitoring program to address conditions outlined in the Development Consent.

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

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Lynwood Quarry Noise Management Plan (NMP), 2016;
- Lynwood Quarry Environmental Protection Licence (EPL), 2013 (12939);
- Lynwood Quarry, Development Consent, 2005 (DA128-5-2005); 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 Lynwood Quarry Noise Management Plan (NMP), outlines the applicable noise criteria for residential receivers L1 – L16 surrounding the quarry, and are presented in **Table 1.**

Table 1 Noise Criteria[1]

Location	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)	
	dB, $LA_{eq(15min)}$	dB, $LA_{eq(15min)}$	dB, $LA_{eq(15min)}$	dB, $LA_{1(1min)}$
L1	35	35	35	45
L2	35	35	35	45
L3	35	35	35	45
L4	35	37	35	46
L5	35	35	35	46
L6	35	37	36	46
L7	38	38	35	55
L8	39	38	36	55
L9	39	39	37	56
L10	42	42	40	53
L11	35	35	35[1]	47
L12	37	37	36	47
L13	40	38	37	47
L14	35	35	35	47
L15	35	35	35	47
L16	35	35	35	45

Note 1: Noise criteria adopted from the EPL.

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3 Methodology

3.1 Locality

The quarry is located near Marulan, NSW approximately 4km west of the town centre. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Hume Highway situated to the east and south of the site. Highway traffic is a dominant noise source in the area along with rural noise. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan in **Figure 1** and presented in **Table 2.**

Table 2 Monitoring Location Addresses

Location	NMP ID	Address	Criteria		
			Day	Evening	Night
N1	L1	South Eastern Boundary of 1114 Carrick Road, Marulan[1]	35	35	35
N2	L6	End of Maclura Drive, Marulan	35	37	36
N3	L11	Northern Boundary, 16038 Hume Highway, Marulan[1]	35	35	35[2]
N4	L12	Corner of Dorsett and Suffolk Road, Marulan	37	37	36

Note: 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.

Note 1: Intermediate noise monitoring point.

Note 2: Noise criteria adopted from the EPL.

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 Lynwood Quarry EPL. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Tuesday 10 September 2019 and Wednesday 11 September 2019. 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 ±0.5dBA.

Noise measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Measurements were conducted at four locations (N1-N4) on Tuesday 10 September 2019 and Wednesday 11 September 2019 to satisfy the requirements of the NMP.

Extraneous noise sources were excluded from the analysis to determine the $LA_{eq(15min)}$ 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.

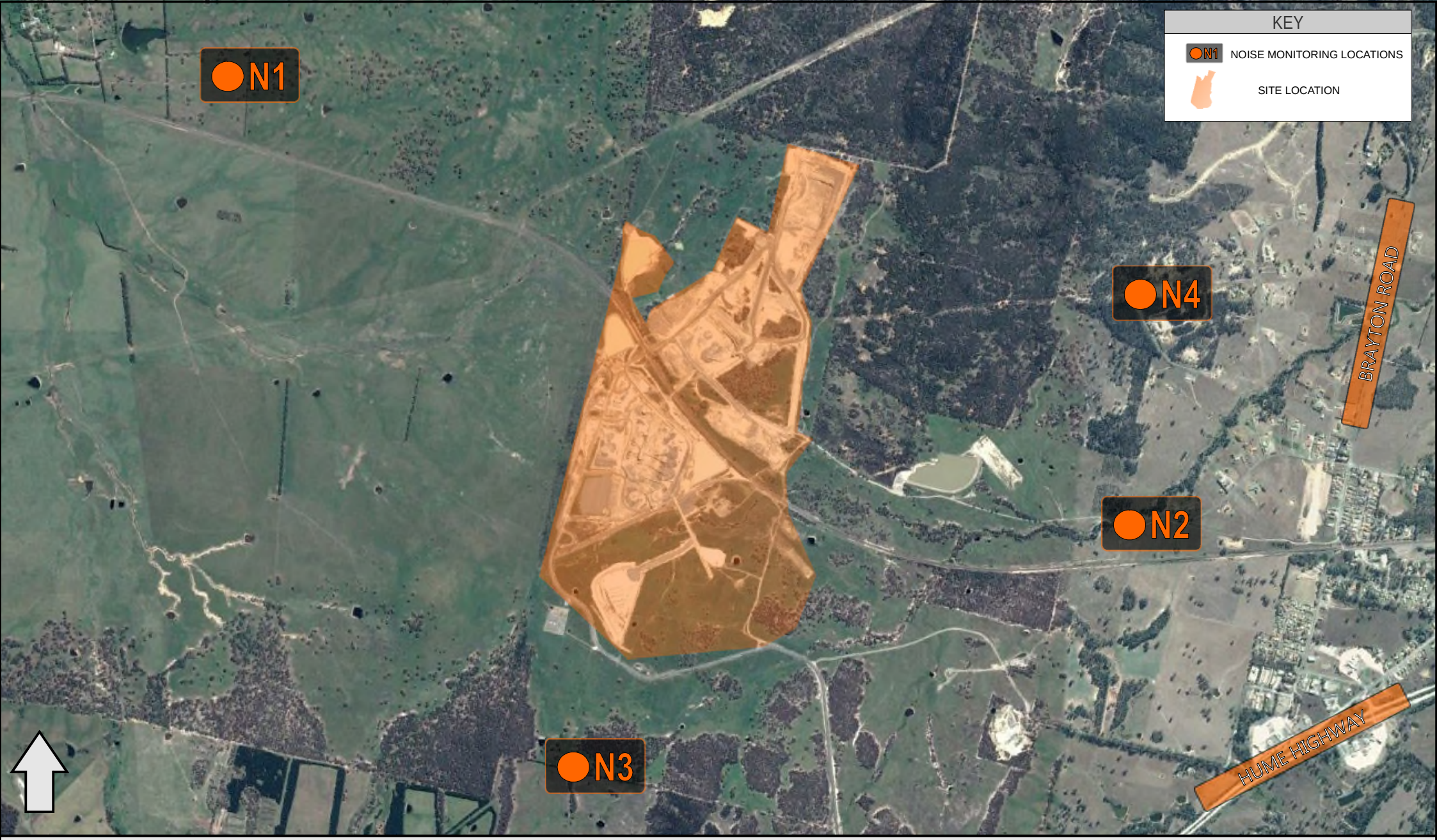

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FIGURE 1

LOCALITY PLAN

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4 Results

4.1 Assessment Results - Location N1

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N1 for the NMA are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location N1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
10/09/2019	17:48 (Day)	60	40	34	WD: SE WS: 2-3m/s Rain: Nil	Highway Traffic 33-38 Wind 36-44 Livestock 33-44 Birds 33-60 Holcim Site 36-44
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
11/09/2019	05:52 (Night)	57	41	35	WD: W WS: <0.1m/s Rain: Nil	Livestock 30-36 Birds 34-56 Quarry (not site) 37-45 Holcim Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30

Note: 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.

4.2 Assessment Results - Location N2

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N2 for the NMA are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location N2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
10/09/2019	16:49 (Day)	57	44	41	WD: SE WS: 1-2m/s Rain: Nil	Highway traffic 38-45 Birds 38-45 Wind 38-45 Aircraft 42-57 Holcim Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
11/09/2019	06:48 (Night)	75	56	42	WD: N WS: <0.2m/s Rain: Nil	Birds to 48 Highway Traffic 42-46 Train 42-76 Holcim Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35

Note: 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.

4.3 Assessment Results - Location N3

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N3 for the NMA are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location N3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
10/09/2019	16:12 (Day)	61	41	31	WD: SE WS: 1-2m/s Rain: Nil	Highway Traffic 30-39 Birds 30-39 Aircraft 30-62 Local Traffic 32-38 Holcim Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<25
11/09/2019	05:00 (Night)	65	47	42	WD: W WS: <0.1m/s Rain: Nil	Highway Traffic 40-46 Train 38-44 Birds 43-48 Local Traffic 44-56 Holcim Reverse Alarms 44-46 Holcim Loading/Alarms 42-46
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35

Note: 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.

4.4 Assessment Results - Location N4

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N4 for the NMA are presented in **Table 6**.

Table 6 Operator-Attended Noise Survey Results – Location N4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
10/09/2019	17:12 (Day)	58	42	37	WD: SE WS: 2-3m/s Rain: Nil	Highway Traffic 37-40 Wind 37-43 Aircraft 40-58 Birds 37-52 Holcim Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
11/09/2019	06:27 (Night)	64	45	37	WD: SW WS: <0.1m/s Rain: Nil	Birds 36-59 Highway Traffic 36-44 Holcim Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30

Note: 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.

5 Noise Compliance Assessment

The compliance assessment summary for each monitoring location N1 to N4 are presented in **Table 7** and **Table 8** for the two assessment periods.

Table 7 Round 1 Noise Compliance Assessment Summary

Location No.	Period	Quarry Contribution	Criteria	Compliant
		dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	
N1	Day	<30	35	✓
N2	Day	<30	37	✓
N3	Day	<25	35	✓
N4	Day	<30	37	✓

Note: 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.

Table 8 Round 2 Noise Compliance Assessment Summary

Location No.	Period	Quarry Contribution	Criteria	Compliant
		dB, $L_{Aeq(15min)}$	dB, $L_{Aeq(15min)}$	
N1	Night	<30	35	✓
N2	Night	<35	35	✓
N3	Night	<35	35	✓
N4	Night	<30	37	✓

Note: 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.

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6 Discussion

6.1 Discussion of Results - Location N1

Monitoring on Tuesday 10 September 2019 identified that the quarry noise was audible during the daytime survey with contributions below 30dBA. On Wednesday 11 September 2019 quarry noise was inaudible during the night-time period with noise emissions estimated to be <30dBA, therefore satisfying the relevant noise criteria for both periods. Quarry noise sources audible during the survey included loading activities and extraneous sources included wind, highway traffic, livestock, and birds.

6.2 Discussion of Results - Location N2

Quarry noise emissions were inaudible during the measurements on Tuesday 10 September 2019 and Wednesday 11 September 2019. Quarry noise emissions were estimated to be <30dBA for the daytime period and <35dBA for the night-time period, therefore satisfying the relevant noise criteria for both periods. Extraneous sources measured include train, wind, highway traffic, aircraft and birds.

6.3 Discussion of Results - Location N3

Quarry noise was inaudible during measurements on Tuesday 10 September 2019 with quarry noise emissions estimated to be <25dBA. Quarry noise was audible on Wednesday 10 September 2019 night-time period measurement with contributions estimated to be <35dBA, therefore satisfying relevant noise criteria for both periods. Quarry noise sources audible during the survey included loading activities and reverse alarms. Extraneous noise sources included train pass by, aircraft noise, birds, highway and local traffic.

6.4 Discussion of Results - Location N4

Quarry noise was inaudible during the measurements conducted on Tuesday 10 September 2019 and Wednesday 11 September 2019. Quarry noise emissions were estimated to be <30dBA for both daytime and night-time periods, therefore satisfying relevant noise criteria for both measurements. Non-quarrying sources included birds, highway traffic, wind and aircraft.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for Holcim (Australia) Pty Ltd at the Lynwood Quarry, Marulan, NSW. The assessment was completed to assess the quarry's compliance with the relevant noise criteria during Quarter 3 September 2019.

Attended noise monitoring was undertaken on Tuesday 10 September 2019 and Wednesday 11 September 2019 at four representative monitoring locations. The assessment has identified that noise emissions generated by Lynwood Quarry were audible during daytime measurements at location N1 and during the night-time measurement at N3, however quarry noise emissions were below the relevant noise criteria. Operational noise was inaudible during all other attended noise measurements, satisfying the applicable noise criteria.

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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.
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dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
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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.
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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.

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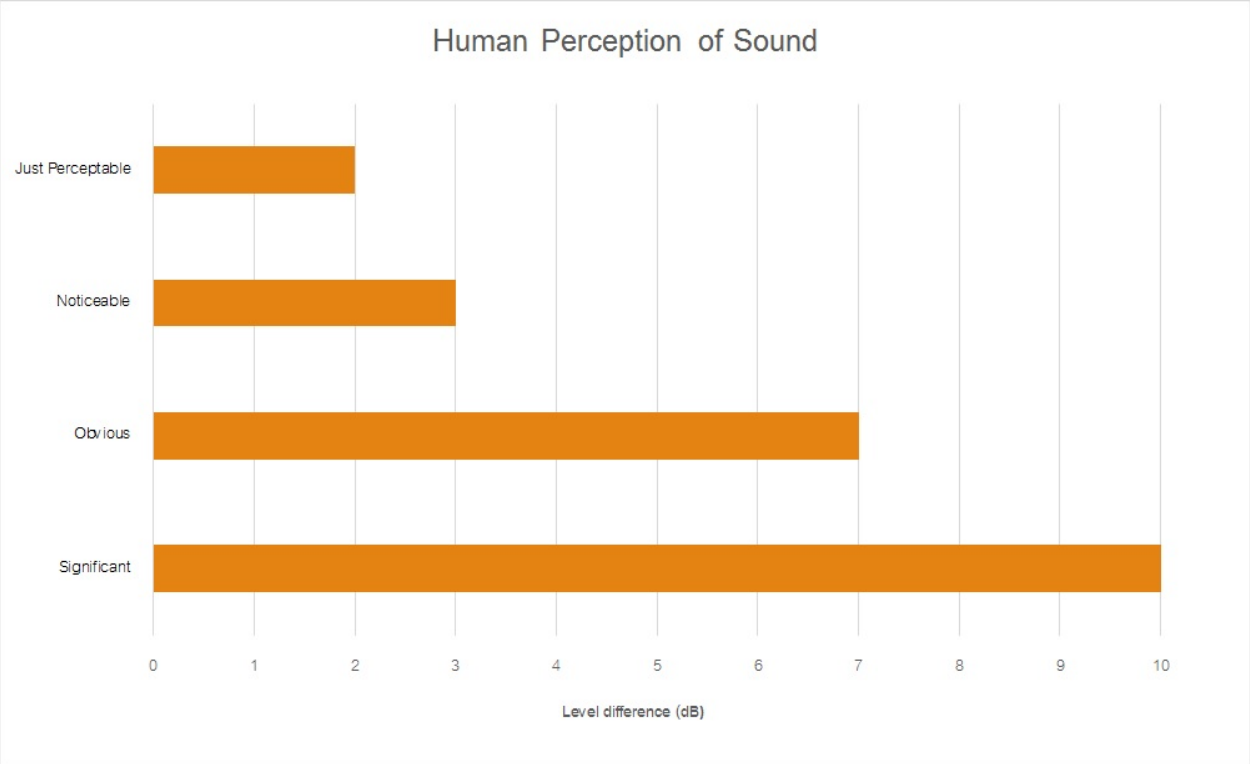
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW
Quarter 4 Ending December 2019.

Prepared for: Holcim (Australia) Pty Ltd
November 2019
MAC180611-02RP6

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Document Information

Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW

Quarter 4 Ending December 2019

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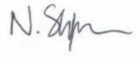
MAC180611-02RP6	Final	25 November 2019	Nicholas Shipman		Rod Linnett	

CONTENTS

1 INTRODUCTION 5

2 NOISE CRITERIA 7

3 METHODOLOGY 9

3.1 LOCALITY 9

3.2 ASSESSMENT METHODOLOGY 9

4 RESULTS 13

4.1 ASSESSMENT RESULTS - LOCATION N1 13

4.2 ASSESSMENT RESULTS - LOCATION N2 13

4.3 ASSESSMENT RESULTS - LOCATION N3 14

4.4 ASSESSMENT RESULTS - LOCATION N4 14

5 DISCUSSION 15

5.1 DISCUSSION OF RESULTS - LOCATION N1 15

5.2 DISCUSSION OF RESULTS - LOCATION N2 15

5.3 DISCUSSION OF RESULTS - LOCATION N3 15

5.4 DISCUSSION OF RESULTS - LOCATION N4 15

6 CONCLUSION 17

APPENDIX A - GLOSSARY OF TERMS

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

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2 Noise Criteria

The Lynwood Quarry Noise Management Plan (NMP), outlines the applicable noise criteria for residential receivers L1 – L16 surrounding the quarry, and are presented in **Table 1**.

Table 1 Noise Criteria[1]

Location	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)	
	dB LAeq(15min)	dB LAeq(15min)	dB LAeq(15min)	dB LA1(1min)
L1	35	35	35	45
L2	35	35	35	45
L3	35	35	35	45
L4	35	37	35	46
L5	35	35	35	46
L6	35	37	36	46
L7	38	38	35	55
L8	39	38	36	55
L9	39	39	37	56
L10	42	42	40	53
L11	35	35	35[1]	47
L12	37	37	36	47
L13	40	38	37	47
L14	35	35	35	47
L15	35	35	35	47
L16	35	35	35	45

Note 1: Noise criteria adopted from the EPL.

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3 Methodology

3.1 Locality

The quarry is located near Marulan, NSW approximately 4km west of the town centre. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Hume Highway situated to the east and south of the site. Highway traffic is a dominant noise source in the area along with rural noise. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan in **Figure 1** and presented in **Table 2.**

Table 2 Monitoring Location Addresses

Location	NMP ID	Address	Criteria		
			Day	Evening	Night
N1	L1	South Eastern Boundary of 1114 Carrick Road, Marulan[1]	35	35	35
N2	L6	End of Maclura Drive, Marulan	35	37	36
N3	L11	Northern Boundary, 16038 Hume Highway, Marulan[1]	35	35	35[2]
N4	L12	Corner of Dorsett and Suffolk Road, Marulan	37	37	36

Note: 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.

Note 1: Intermediate noise monitoring point.

Note 2: Noise criteria adopted from the EPL.

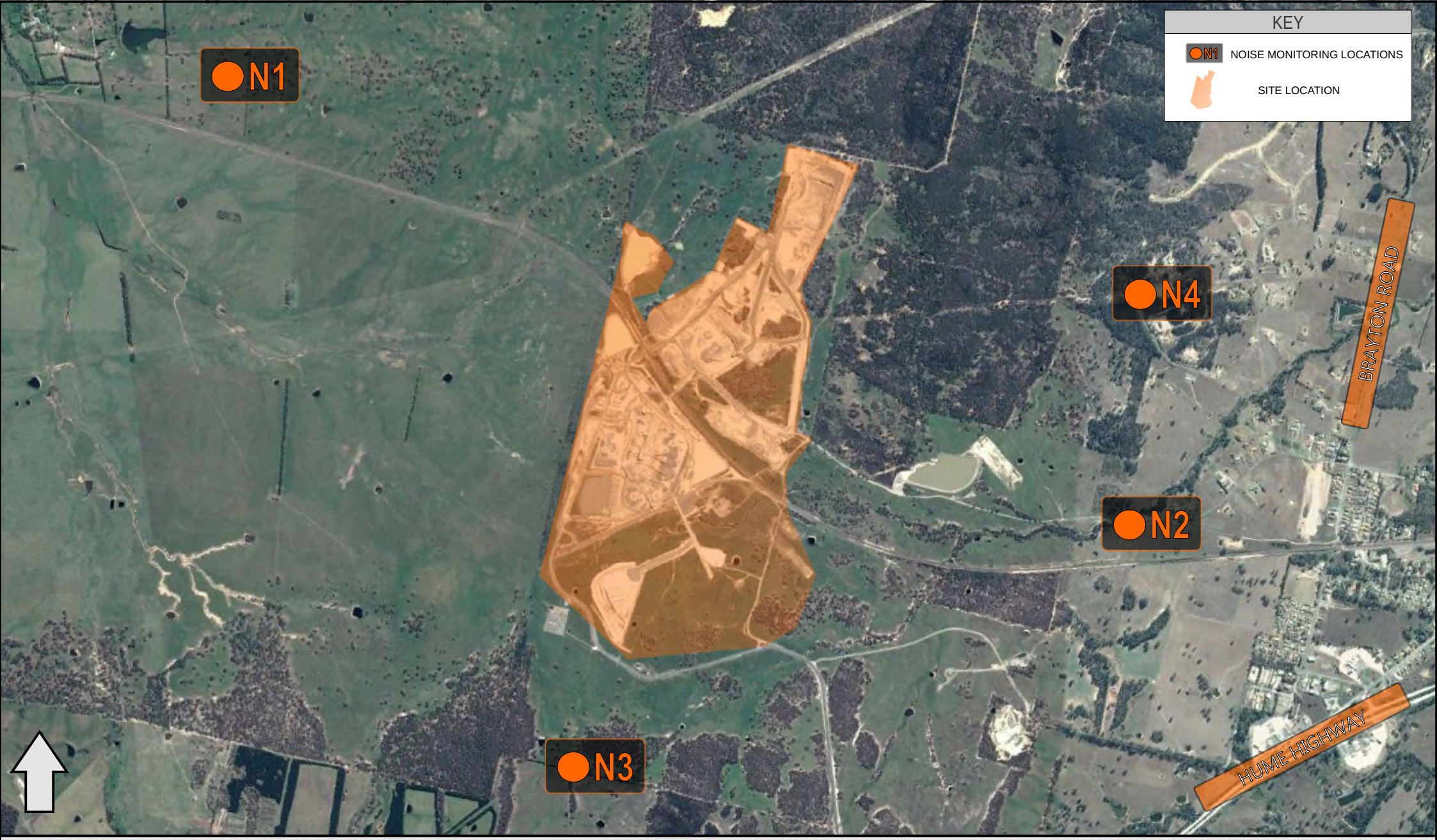
3.2 Assessment Methodology

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 Lynwood Quarry EPL. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Tuesday 19 November 2019 and Thursday 21 November 2019. 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 ±0.5dBA.

Noise measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Measurements were conducted at four locations (N1-N4) on Tuesday 19 November 2019 and Thursday 21 November 2019 to satisfy the requirements of the NMP.

Extraneous noise sources were excluded from the analysis to determine the $LA_{eq(15min)}$ 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.



MAC
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FIGURE 1

LOCALITY PLAN

REF: MAC180611-02

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4 Results

4.1 Assessment Results - Location N1

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N1 for the NMA are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location N1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
19/11/2019	15:51 (Day)	64	49	43	WD: W WS: 3m/s Rain: Nil	Wind 38-56 Birds 40-45 Aircraft <45 Holcim Site Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
21/11/2019	11:07 (Day)	65	50	43	WD: NW WS: 2m/s Rain: Nil	Wind 40-61 Livestock 45-51 Birds 41-45 Holcim Site Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30

Note: 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.

4.2 Assessment Results - Location N2

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N2 for the NMA are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location N2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
19/11/2019	14:43 (Day)	72	47	42	WD: W WS: 2.5m/s Rain: Nil	Wind 39-55 Birds <40 Aircraft 40-45 Holcim Site Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
21/11/2019	10:05 (Day)	53	38	34	WD: N WS: 1.5m/s Rain: Nil	Wind 34-43 Birds 40-42 Insects <38 Aircraft 37-44 Holcim Site Vehicle <33
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<33

Note: 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.

4.3 Assessment Results - Location N3

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N3 for the NMA are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location N3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
19/11/2019	16:58 (Day)	67	46	38	WD: W WS: 2.5m/s Rain: Nil	Wind 37-50 Birds 44-50 Traffic <40 Aircraft <40 Holcim Site Vehicle <35
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35
21/11/2019	09:17 (Day)	56	43	39	WD: N WS: 2m/s Rain: Nil	Birds 40-45 Wind 40-53 Aircraft 42-55 Traffic 38-44 Holcim Site Vehicles <36 Holcim Site Hum 34-36
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						35

Note: 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.

4.4 Assessment Results - Location N4

The monitored noise level contributions and observed meteorological conditions for each assessment period at location N4 for the NMA are presented in **Table 6**.

Table 6 Operator-Attended Noise Survey Results – Location N4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
19/11/2019	15:07 (Day)	73	53	42	WD: NW WS: 2.8m/s Rain: Nil	Wind 40-62 Birds 40-46 Traffic 45-64 Holcim Site Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
21/11/2019	10:27 (Day)	65	41	38	WD: NW WS: 1.6m/s Rain: Nil	Wind 36-47 Birds 36-41 Traffic 36-38 Holcim Site Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30

Note: 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.

5 Discussion

5.1 Discussion of Results - Location N1

Monitoring on Tuesday 19 November 2019 and Thursday 21 November 2019 identified that the quarry noise was inaudible during both daytime surveys with contributions estimated to be below 30dBA on both occasions therefore, satisfying the relevant noise criteria for both periods. Extraneous sources included wind, birds, aircraft, and livestock.

5.2 Discussion of Results - Location N2

Quarry noise emissions were inaudible on the Tuesday 19 November 2019 and therefore the quarry contribution was estimated to be <30dBA. Quarry noise emissions were audible on Thursday 21 November 2019 with Holcim site vehicles measured at <33dBA during the measurement, therefore satisfying the relevant noise criteria for both measurements. Extraneous sources measured included wind, birds, aircraft and insects.

5.3 Discussion of Results - Location N3

Quarry noise was audible during measurements on Tuesday 19 November 2019 and Thursday 21 November 2019 with quarry noise emissions estimated to be 35dBA, or less, therefore satisfying relevant noise criteria for both periods. Quarry noise sources audible during the survey included Holcim site vehicles and quarry hum. Extraneous noise sources included wind, birds, traffic and aircraft noise.

5.4 Discussion of Results - Location N4

Quarry noise was inaudible during the measurements conducted on Tuesday 19 November 2019 and Thursday 21 November 2019. Quarry noise emissions were estimated to be <30dBA for both daytime periods, therefore satisfying relevant noise criteria for both measurements. Non-quarrying sources included wind, birds and traffic.

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6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for Holcim (Australia) Pty Ltd at the Lynwood Quarry, Marulan, NSW. The assessment was completed to assess the quarry's compliance with the relevant noise criteria during Quarter 4 (ending December 2019).

Attended noise monitoring was undertaken on Tuesday 19 November 2019 and Thursday 21 November 2019 at four representative monitoring locations. The assessment has identified that noise emissions generated by Lynwood Quarry were occasionally audible, however quarry noise emissions were below the relevant noise criteria, satisfying the applicable noise criteria throughout the survey period.

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Appendix A - Glossary of Terms

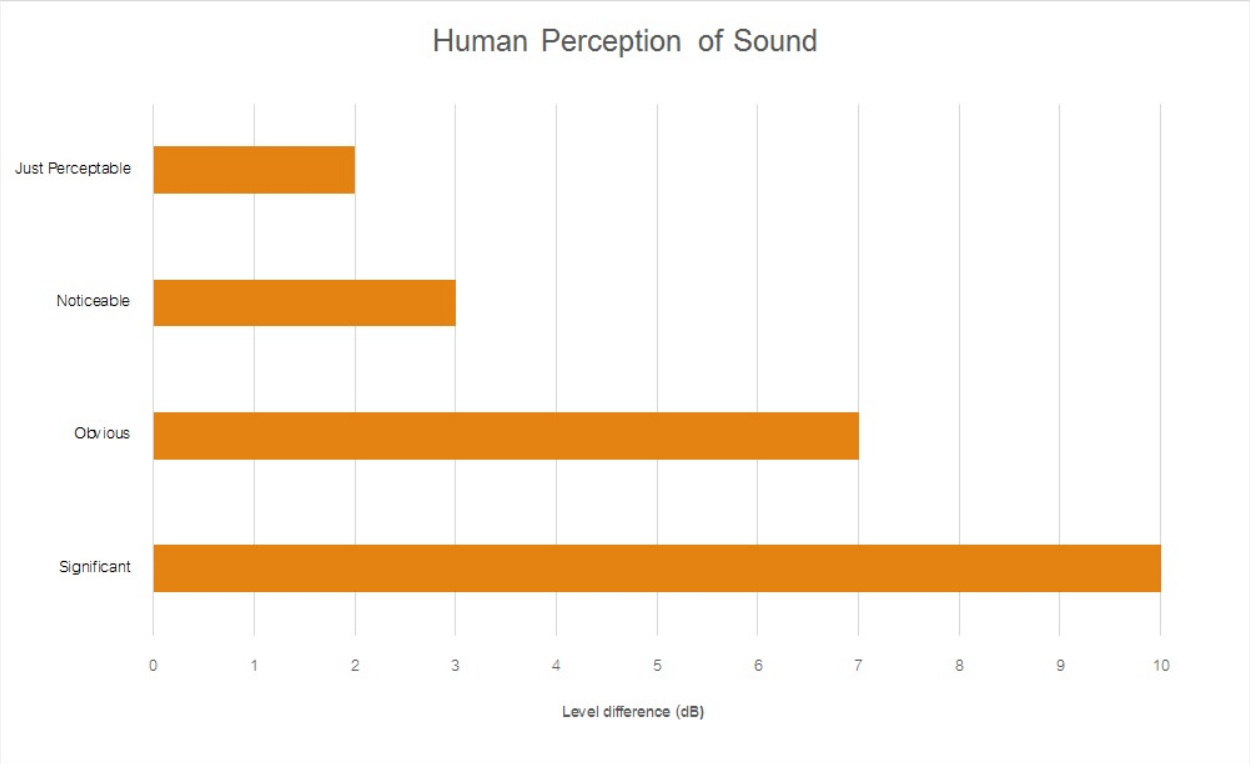
Table A1 provides a number of technical terms have been used in this report.

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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