

22 March 2018

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Re: Quarter 1 - 2018: East Guyong Quarry noise and blast monitoring

1 Introduction

EMM Consulting Pty Ltd (EMM) has been commissioned by Hanson Construction Materials Pty Ltd (NSW) (Hanson) to complete quarterly noise monitoring for the East Guyong Quarry, as required by the site's approved Noise Management Plan. The quarry is located approximately 22 km southeast of Orange, NSW.

The following material was referenced as part of this assessment:

- Environment Protection Authority (EPA), *Industrial Noise Policy (INP) 2000*;
- Environment Protection Authority (EPA), *Noise Policy for Industry (NPfI) 2017*;
- R. W. Corkery & Co Pty Limited (RWC), *Noise Management Plan for the East Guyong Quarry (NMP) 2013*;
- Department of Planning and Infrastructure (DP&I), *East Guyong Quarry Project Modification (06_0193 MOD 1) approval (PA) 2012*; and
- Australian and New Zealand Environment Council (ANZEC) 1990, *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration*.

Analysis of data from four blast events that occurred on 19 December 2017, 23 January, 13 and 27 February 2018 has also been included in this report.

Several technical terms are discussed in this report and are explained in Appendix A.

2 Methodology

2.1 Site operations

At the time of the attended noise monitoring on Thursday 15 March 2018, the quarry's activities comprised of the following:

- extraction of basalt using standard drill, load and haul techniques;
- processing of extracted basalt and stockpiling of material; and
- transportation of quarry products.

The quarry's approved hours of operation are:

- Monday to Friday (non-daylight savings) from 6 am to 6 pm;
- Monday to Friday (daylight savings) from 6 am to 8 pm; and
- Saturdays from 7 am to 1 pm.

Material crushing and screening currently occurs on site from Monday to Thursday. This restriction to approved hours is an operational decision by the quarry and aids in the planning for maintenance and repairs.

2.2 Noise monitoring

Operator-attended 15 minute noise measurements were conducted at locations N1, N2 and an additional location to the south of the site, as shown in Figure 1, when the quarry was in full operation. The operator quantified the contribution of each significant quarry noise source where possible. Noise monitoring was conducted in general accordance with the INP and Australian Standard AS 1055.1-1997 *Acoustics - Description and Measurement of Environmental Noise - General Procedures*.

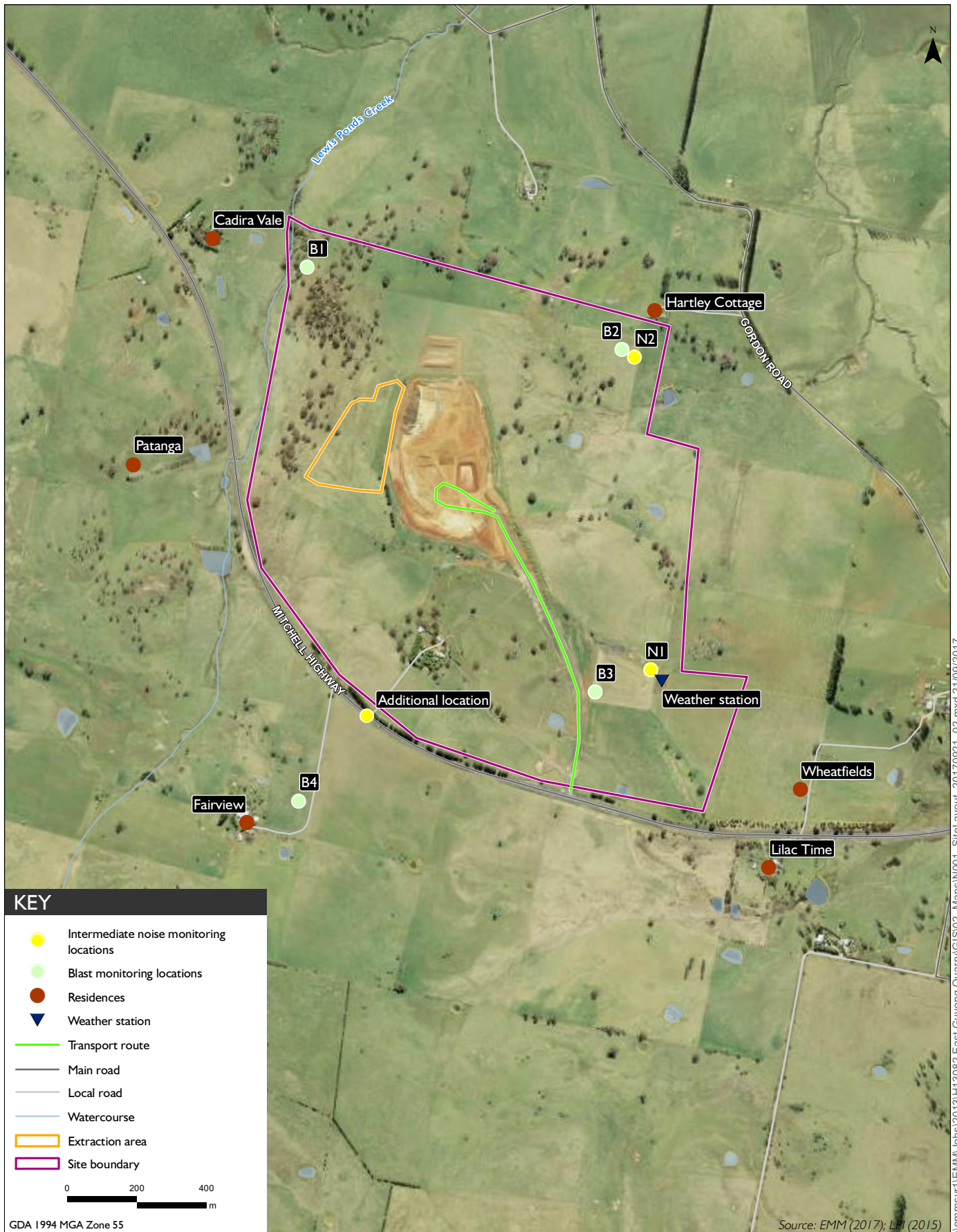
A Svan 957 Type 1 sound analyser (s/n 14572) was used for the noise monitoring. The sound analyser was calibrated before and after the completion of the surveys using a Brüel & Kjær Type 4230 calibrator (s/n 1442144). The instruments were within a current NATA calibration period at the time of the noise monitoring and relevant certificates are provided in Appendix B.

2.3 Assessment locations

The noise monitoring included five 15 minute operator-attended noise measurements during the daytime period on 15 March 2018 to quantify noise emissions from the quarry at locations N1, N2 and an additional location to the south of the site. Noise monitoring was not conducted prior to 7 am as the quarry was not in operation.

Locations N1 and N2 are near the south-east and north-east boundaries of the site, respectively. Location N1 is approximately 500 m from "Wheatfields", the closest residence situated south-east of the quarry. Location N2 is approximately 150 m from "Hartley Cottage", the closest residence situated north-east of the quarry. These monitoring locations were selected so as to not inconvenience residents and are consistent with the approved Noise Management Plan for the East Guyong Quarry (RWC, 2013). Monitoring at these locations, rather than at the residences, also provides a better opportunity to quantify site related noise since they are closer to the operations.

Noise monitoring was completed at an additional location south of the quarry (refer to Figure 1). This location represents the potentially worst affected residence to the south (ie "Fairview") and was selected due to the northerly (ie source to receiver) winds present at the time of the measurements.



Site location and monitoring plan

East Guyong Quarry
East Guyong Quarry noise and blast monitoring

Figure 1

3 Criteria

3.1 Operational noise

Condition 3(5) of PA 06_0193 states that the noise assessment criteria are $L_{Aeq,15 \text{ minute}}$ 35 dB at any residence for all assessment periods. The exception is the "Fairview" residence which has a daytime criterion of $L_{Aeq,15 \text{ minute}}$ 36 dB. In accordance with the PA 06_0193, "Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy."

As per Condition 3(5) of PA_0193, to demonstrate compliance at residential locations, the noise monitoring results are to be assessed against the following (intermediate) noise criteria for monitoring locations N1 and N2:

- N1 - $L_{Aeq,15 \text{ minute}}$ 43 dB; and
- N2 - $L_{Aeq,15 \text{ minute}}$ 50 dB.

It is stated in the NMP that by satisfying criteria at these intermediate locations, quarry noise at neighbouring residences would also satisfy residential criteria. This assumes the presence of soil and product stockpiles, bunding and intervening topography between the site and surrounding residences, which provide some degree of attenuation of site noise.

Further to the above, section 11.1.3 of the INP identifies that a development is deemed to be in non-compliance if the monitored noise levels from the development are more than 2 dB above the statutory limit.

3.2 Low frequency noise criteria

Section 11.2.3 of the NMP states that modification factors in Section 4 of the INP (EPA 2000) should be applied to the measured noise levels where applicable. The INP application notes state that Section 4 of the INP has been withdrawn and the modifying factor adjustments outlined in Fact Sheet C of the NPfl are to be used when assessing the characteristics of a noise source. Fact sheet C of the NPfl (EPA 2017) states that modification factor corrections shall be applied to the measured noise levels.

Fact sheet C of the NPfl (EPA 2017) provides guidelines for applying modifying factor corrections to account for annoying noise characteristics, such as tonal and low frequency noise emissions. The NPfl specifies that for low frequency noise, a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels identifies the potential for an unbalanced spectrum and potential increased annoyance.

Where a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels is identified, the one-third octave noise levels recorded should be compared to the values in Table C2 of the NPfl (EPA 2017), which has been reproduced in Table 1 below.

Table 1 One-third octave low-frequency noise thresholds

HZ/dB(Z)	One-third octave $L_{Zeq,15 \text{ minute}}$ threshold level												
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB (Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

The modifying factor correction to be applied where the site 'C-weighted' and site 'A-weighted' noise emission level is 15 dB or more and:

- where any of the one-third octave noise levels in Table 1 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period; or
- where any of the one-third octave noise levels in Table 1 are exceeded by more than 5 dB and cannot be mitigated, a 5 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2 dB positive adjustment applies for the daytime period.

Hence, where possible throughout each survey the operator has estimated the difference between site 'C-weighted' and site 'A-weighted' noise emission levels by matching audible sounds with the response of the analyser ($L_{Ceq}-L_{Aeq}$). Where this was deemed to be 15 dB or greater, the measured one-third octave frequencies have been compared to the values in Table 1 to identify the relevant modifying factor correction (if applicable). This method has been applied to this assessment as presented in Section 4.

It is of note that the NPfl (EPA 2017) states that low-frequency noise corrections only apply under the standard and/or noise-enhancing (ie applicable) meteorological conditions.

3.3 Blast monitoring

Blast overpressure and vibration monitoring is managed by Hanson for all blast events. Blast overpressure and ground vibration are monitored at three locations within or at the site's boundary as well as a fourth location south of the Mitchell Highway near the Fairview property. Monitoring locations are situated closer to blasting locations than the residential structures (refer to Figure 1), and therefore overpressure and vibration levels would likely be lower at the actual residential dwellings than those measured.

Blast emissions criteria for the quarry apply at any residence on privately-owned land surrounding the site and are presented in Table 2.

Table 2 Blast overpressure and vibration criteria

Location	Airblast overpressure criteria (dB (Linear Peak))	Ground vibration criteria (mm/s (Peak velocity))	Allowable exceedance
Any privately-owned residence surrounding the site.	115	5	5% of the total number of blasts in a 12 month period
	120	10	0%

4 Results

4.1 Noise monitoring results

Noise monitoring results for locations N1 and N2 are presented in Table 3. Data recorded by the site's weather station (shown in Figure 1) was used to identify weather conditions during the monitoring period and to determine the applicability of noise limits. Wind speed and direction observations are presented in Table 3.

Wind speed averages were above 3 m/s (at 10 m above ground) during the last four measurements; hence noise limits were not applicable during these surveys. It is noted that during the final measurement, taken at the additional location, winds were in the direction of source to receiver (ie northerly winds), and therefore would have enhanced site noise levels at this location.

Low frequency noise modifying factors, in accordance with fact sheet C2 of the NPfI (EPA 2017), were not applied to any measurements, as no low frequency noise was measured during the first measurement and noise limits were not applicable during the final four measurements. Low-frequency noise corrections only apply under the standard and/or noise-enhancing (ie applicable) meteorological conditions. It is noted that the crushing plant was in operation for the duration of all measurements.

All quarry contributions measured at locations N1 and N2 satisfied the relevant noise criteria as per the NMP. It is therefore expected that relevant criteria for surrounding residential receivers would also be satisfied.

An additional monitoring location was also chosen to confirm that satisfying relevant criteria at monitoring locations N1 and N2 would satisfy relevant criteria at other surrounding residential locations. This location was south of the quarry and was selected due to the northerly (ie source to receiver) wind present at the time of the survey and little intervening topography between the quarry activity, the monitoring location and the Fairview residence. The measured quarry contribution at the additional location was estimated to be less than $L_{Aeq,15 \text{ minute}} 35 \text{ dB}$. Adopting distance attenuation, the calculated noise level at 'Fairview' based on the measured level at the additional location would also be less than $L_{Aeq,15 \text{ minute}} 35 \text{ dB}$ and therefore satisfy the relevant criterion of $L_{Aeq,15 \text{ minute}} 35 \text{ dB}$.

Based on the preceding information, noise levels from the quarry were expected to satisfy the relevant residential criteria at all assessment locations identified in Condition 3(5) of PA_0193.

Table 3 **Attended noise monitoring summary – 15 March 2018**

Location	Start time	Attended noise monitoring results dB					Criteria dB	Meteorological conditions ¹		Criteria Applies? (Y/N)	Exceedance	Comments
		Total measured			Site contribution			Wind speed (m/s)	Wind direction ²			
		L _{Aeq}	L _{Amax}	L _{A90}	LFN mod. factor	L _{Aeq}						
N1	08:35	42	55	39	Nil	40	43	2.9	336	Y	Nil	Site consistently audible including crushing plant, engine revs and reversing alarms. Other sources include frequent bird noise, wind gusts and occasional livestock and traffic noise from the Mitchell Highway.
N2	08:59	45	67	40	Nil	41	50	7.0	328	N	N/A	Site consistently audible including crushing plant and reversing alarms. Other sources include consistent insects and wind in grass, frequent bird noise and wind gusts and occasional livestock and traffic noise from the Mitchell Highway.
N2	09:14	43	71	39	Nil	40	50	6.4	330	N	N/A	Site consistently audible including crushing plant. Other sources include consistent insects, frequent bird noise and wind gusts/wind in grass and occasional traffic noise from the Mitchell Highway.
N1	09:41	46	74	40	Nil	39	43	8.3	317	N	N/A	Site consistently audible including crushing plant and reversing alarms. Other sources include frequent bird noise and wind gusts/wind in trees and occasional traffic noise from the Mitchell Highway.
Additional location	10:00	70	85	49	Nil	<35	N/A	7.3	334	N/A	N/A	Site audible (crushing plant) in between traffic passbys on the Mitchell Highway. Other sources include consistent wind gusts and wind in trees, frequent bird noise and traffic passbys on the Mitchell Highway. A tractor was audible for approximately one minute.

- Notes:
1. Meteorological data was obtained from the site weather station at a height of 10 m above ground.
 2. Wind direction reported in degrees from north (0°)
 3. N/A = Not Applicable

4.2 Blast overpressure and ground vibration

Four blast events occurred at the quarry since the last quarterly noise monitoring in December 2017. The blast overpressure and vibration monitoring results were provided by Hanson and are presented in Table 4. The monitoring results show the relevant criteria were satisfied at all monitoring locations (refer to Figure 1).

Table 4 Blast emissions monitoring results

Date	Monitoring location	Airblast overpressure level (dB(Linear Peak))		Ground vibration - Peak particle velocity (mm/s)	
		Measured	Criteria ³	Measured	Criteria ³
19/12/17	B1	110.1	115	4.82	5
	B2	84.5	115	0.50	5
	B3 ¹	-	115	-	5
	B4	109.4	115	1.73	5
	B5 ¹	-	115	-	5
23/01/18	B1	102.5	115	3.45	5
	B2	88.0	115	2.84	5
	B3 ¹	-	115	-	5
	B4	107.3	115	1.67	5
	B5	85.8	115	2.65	5
13/02/18	B1	99.4	115	3.92	5
	B2	84.5	115	3.16	5
	B3 ¹	-	115	-	5
	B4	101.6	115	1.54	5
	B5 ²	-	115	-	5
27/02/18	B1	106.5	115	2.82	5
	B2	96.5	115	3.82	5
	B3 ¹	-	115	-	5
	B4	107.6	115	2.50	5
	B5 ¹	-	115	-	5

Notes: 1. There was no trigger for this blasting event.
 2. Not used as approved site personnel was not available.
 3. This criteria applies at the nearest residential location and not at the monitoring location.

5 Conclusion

EMM has completed an assessment of noise and blasting emissions from East Guyong Quarry operations. Noise monitoring was undertaken at locations around the site on 15 March 2018 as required by the site's approved NMP.

The results demonstrated that the received site noise levels at all monitoring locations satisfied the relevant noise criteria as per the PA_0193 and in accordance with the NMP for the East Guyong Quarry.

Therefore, it is concluded that noise levels from quarry operations satisfied the relevant criteria at all assessment locations identified in Condition 3(5) of PA_0193.

The blast overpressure and ground vibration monitoring results satisfied the relevant criteria at all monitoring locations for the four blast events that have been assessed and, hence, the relevant criteria were also achieved at the nearest residences.

Yours sincerely,



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Acoustic Consultant
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Review: Katie Teyhan (21/3/2018)

Appendix A

Glossary of acoustic terms

A number of technical terms are required for the discussion of noise. These are explained in Table A.1.

Table A.1 Glossary of acoustic terms

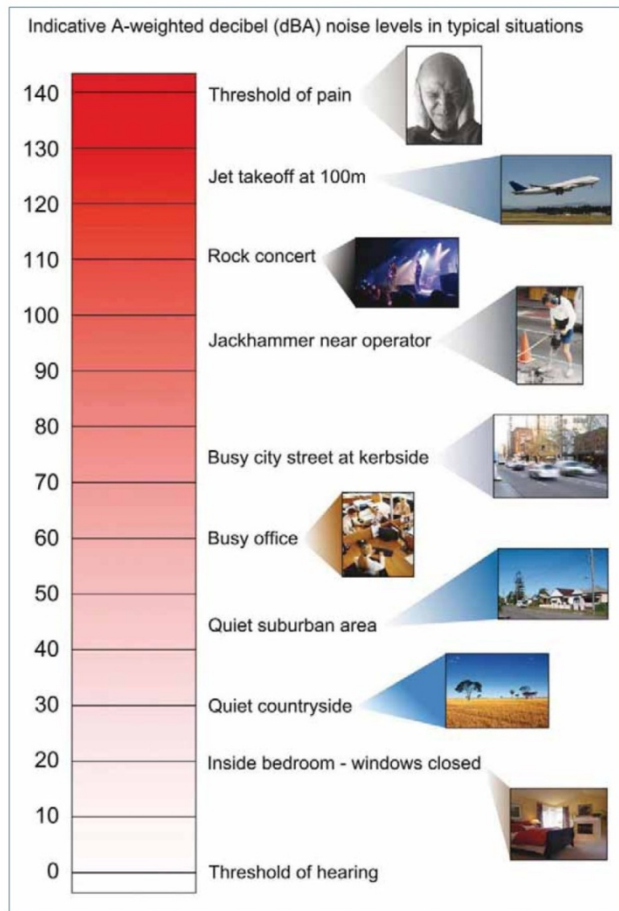
Term	Description
dB	Noise is measured in units called decibels (dB).
A-weighting	There are several scales for describing noise, the most common being the 'A-weighted' scale. This is an adjustment made to sound-level measurement to approximate the response of the human ear.
C-weighting	This is an adjustment made to sound-level measurements which takes account of low-frequency components of noise within the audibility range of humans.
L _{A90}	Commonly referred to as the background noise level. The A-weighted noise level exceeded 90% of the time.
L _{Aeq}	The A-weighted, energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The L _{Aeq(15-min)} descriptor refers to an L _{Aeq} noise level measured over a 15 minute period.
L _{Amax}	The A-weighted maximum root mean squared sound pressure level received during a measuring interval.
Day period	Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 8 am to 6 pm.
Evening period	Monday – Saturday: 6 pm to 10 pm, on Sundays and Public Holidays: 6 pm to 10 pm.
Night period	Monday – Saturday: 10 pm to 7 am, on Sundays and Public Holidays: 10 pm to 8 am.

It is useful to have an appreciation of decibels, the unit of noise measurement. Table A.2 gives an indication as to what an average person perceives about changes in noise levels:

Table A.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
1 to 2	typically indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud

Examples of common noise levels are provided in Figure A.1.



Source: Road Noise Policy (Department of Environment, Climate Change and Water (DECCW) 2011).

Figure A.1 Common noise levels

Appendix B

Calibration certificates

CERTIFICATE OF CALIBRATION

CERTIFICATE No.: **SLM 19473 & FILT 1414**

Equipment Description: Sound & Vibration Analyser

Manufacturer: Svantek

Model No: Svan 957 **Serial No:** 14572

Microphone Type: 7052H **Serial No:** 39852

Filter Type: 1/3 Octave **Serial No:** 14572

Comments: All tests passed for class 1.
(See over for details)

Owner: EMGA
Level 5, 21 Bolton Street
Newcastle, NSW 2300

Ambient Pressure: 1013 hPa \pm 1.5 hPa

Temperature: 22 °C \pm 2° C **Relative Humidity:** 37% \pm 5%

Date of Calibration: 29/08/2016 **Issue Date:** 29/08/2016

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: *IK*

AUTHORISED SIGNATURE:

Jack Reid

Accredited for compliance with ISO/IEC 17025

The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.



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Acoustic and Vibration
Measurements



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AVCERT10 Rev. 1.2 03.02.16

CERTIFICATE NO.: SLM 19473 & FILT 1414

The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

Tests Performed:	Clause	Result
<i>Absolute Calibration</i>	10	Pass
<i>Acoustical Frequency Weighting</i>	12	Pass
<i>Self Generated Noise</i>	11.1	Entered
<i>Electrical Noise</i>	11.2	Entered
<i>Long Term Stability</i>	15	Pass
<i>Electrical Frequency Weightings</i>	13	Pass
<i>Frequency and Time Weightings</i>	14	Pass
<i>Reference Level Linearity</i>	16	Pass
<i>Range Level Linearity</i>	17	Pass
<i>Toneburst</i>	18	Pass
<i>Peak C Sound Level</i>	19	Pass
<i>Overload Indicator</i>	20	Pass
<i>High Level Stability</i>	21	Pass

Statement of Compliance: The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC61672-1:2013. A full technical report is available if required.

This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 1260: 1995 and AS/NZS 4476 - 1997 and were conducted to test the following performance characteristics:

1. Relative attenuation clause 5.3

Least uncertainty for relative attenuation (at 95% c.l.) k=2:
±0.1 dB for attenuation equal to or less than 6 dB
±0.3 dB for RA from above 6 dB to 18 dB
±0.6 dB for RA from above 18 dB to 80 dB

Date of Calibration: 29/08/2016 **Issue Date:** 29/08/2016

Checked by: *[Signature]*

Accredited for compliance with ISO/IEC 17025
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.



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CERTIFICATE OF CALIBRATION

CERTIFICATE No: 20742

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-74 **Serial No:** 34372752
Owner: EMGA Mitchell McLennan
Suite 6, Lev 1, 146 Hunter St
Newcastle NSW 2300

Tests Performed: Measured output pressure level was found to be:

Parameter	Pre-Adj	Adj Y/N	Output: (db re 20 µPa)	Frequency: (Hz)	THD&N (%)
Level 1:	NA	N	94.04	1002.7	1.00
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05 Hz	±0.2 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:

Ambient Pressure: 1018 hPa ±1.5 hPa **Relative Humidity:** 31% ±5%

Temperature: 21 °C ±2° C

Date of Calibration: 01/06/2017

Issue Date: 01/06/2017

Acu-Vib Test Procedure: AVP02 (Calibrators)

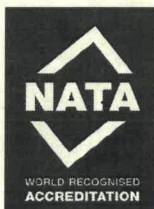
Test Method: AS IEC 60942 - 2004

CHECKED BY: *[Signature]* **AUTHORISED SIGNATURE:** *[Signature]*

Per Jack Kiett

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