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11 May 2021

Chris Cooke
Quarry Manager
Hanson Construction Materials Pty Ltd
Level 5, 75 George Street
Parramatta NSW 2150

Re: Quarter 1 - 2021: East Guyong Quarry noise and blast monitoring

Dear Chris,

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. Operator-attended noise monitoring was undertaken on 15 March 2021.

The following material was referenced as part of this assessment:

- Environment Protection Authority (EPA), *Industrial Noise Policy* (INP) 2000;
- Environment Protection Authority (EPA), *Industrial Noise Policy - Application notes* 2017;
- Environment Protection Authority (EPA), *Noise Policy for Industry* (NPfI) 2017;
- Hanson Construction Materials and R. W. Corkery & Co Pty Limited (RWC), *Noise Management Plan for the East Guyong Quarry* (NMP) – Mod 2 Revision, July 2019;
- 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 six blast events that occurred on 10, 11, 17, 18 December 2020, 4 January 2021 and 24 February 2021 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 15 March 2021, the quarry's activities comprised of the following:

- Dump truck and excavator operating in extraction pit;
- Sales front end loader (FEL) operating in stockpile area (980H);
- Maintenance and repairs across site machinery; and
- Heavy vehicle movements/sales.

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

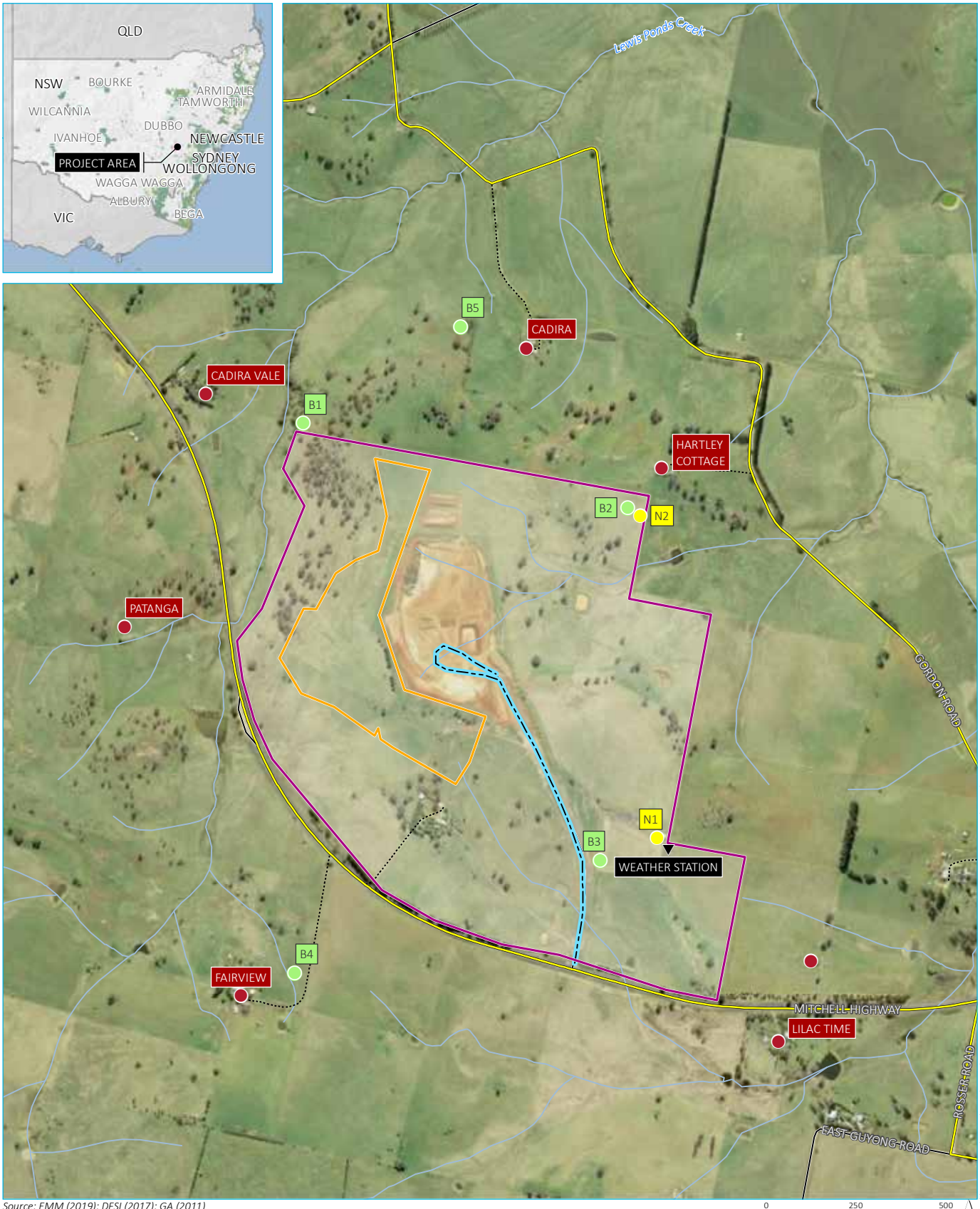
Operator-attended 15-minute noise measurements were conducted at locations N1 and N2, as shown in Figure 1, when the quarry was in full operation. The operator quantified the contribution of each significant quarry noise source where possible. Noise monitoring was conducted in general accordance with the INP and Australian Standard AS 1055-2018 *Acoustics - Description and Measurement of Environmental Noise - General Procedures*.

A Brüel & Kjær 2250 Type 1 sound analyser (s/n 3029363) was used for the noise monitoring. The sound analyser was calibrated before and after the completion of the surveys using a Svantech SV36 calibrator (s/n 106879). 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 four 15-minute operator-attended noise measurements during the daytime period on 15 March 2021 to quantify noise emissions from the quarry at locations N1 and N2. 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 to not inconvenience surrounding residents and are consistent with the approved Noise Management Plan for the East Guyong Quarry (RWC, 2019). 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.



Source: EMM (2019); DFSI (2017); GA (2011)

0 250 500 m

GDA 1994 MGA Zone 55

N

\\EMMSVR1\emm\Jobs\2019\J190114 - East Guyong Quarry Noise Monitoring 2019\8 GIS\02_Maps\G001_MonitoringPlan_20190318_01.mxd 20/03/2019

KEY

- Blast monitoring location
- Residences
- Attended noise monitoring location
- Weather station
- Site boundary
- Extraction area boundary
- Transport route
- Main road
- Local road
- Vehicular track
- Watercourse/drainage line

Site location and monitoring plan

East Guyong Quarry
Noise and blast monitoring
Figure 1

EMM creating opportunities

3 Criteria

3.1 Operational noise

Condition 3(5) of PA 06_0193 states that the noise assessment criteria are $L_{Aeq,15\ minute}$ 35 dB at any residence for all assessment periods. The exception is the "Fairview" residence which has a daytime criterion of $L_{Aeq,15\ minute}$ 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 06_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 - $L_{Aeq,15\ minute}$ 43 dB; and
- N2 - $L_{Aeq,15\ minute}$ 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 NPfI are to be used when assessing the characteristics of a noise source. Fact sheet C of the NPfI (EPA 2017) states that modification factor corrections shall be applied to the measured noise levels where relevant.

Fact sheet C of the NPfI (EPA 2017) provides guidelines for applying modifying factor corrections to account for annoying noise characteristics, such as tonal and low frequency noise emissions. The NPfI 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 NPfI (EPA 2017), which has been reproduced in Table 3.1 below.

Table 3.1 One-third octave low-frequency noise thresholds

	One-third octave $L_{Zeq,15\ minute}$ 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 3.1 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 3.1 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 3.1 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 NPfI (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 two locations outside of the site's boundary (one south of the Mitchell Highway near the Fairview property and one north of the site near the Cadira property). Monitoring locations are situated closer to blasting locations than the residential structures (refer to Figure 2.1), 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 3.2.

Table 3.2 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 4.1. Data recorded by the site's weather station (shown in Figure 2.1) 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 4.1

Wind speed averages were below 3 m/s (at 10 m above ground) and skies were clear (no rain) during all of the measurements at N1 and N2; hence noise limits were applicable during all measurements.

Low frequency noise modifying factors, in accordance with fact sheet C2 of the NPfI (EPA 2017), were not applied to any measured site contribution as measured noise levels did not exceed the relevant LFN thresholds.

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 have been satisfied.

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 4.1 Attended noise monitoring summary – 19 March 2019

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_{90}	L_{Aeq}	L_{Amax}	LFN mod. factor	L_{Aeq}	L_{Aeq}					
N2	11:31am	29	42	63	Nil	32	50	2.3	60	Y	Nil	**Site audible throughout including machinery/truck movements and revs, hammering in workshop, occasional reverse squawker and FEL loading trucks/managing stockpiles.** Ambient noise included birdsong, insects, distant highway traffic and one airplane flyover.
N2	11:48am	29	32	50	Nil	30	50	2.8	313	Y	Nil	**Site audible throughout including machinery/truck movements and revs, hammering in workshop, occasional reverse squawker and FEL loading trucks/managing stockpiles.** Ambient noise included birdsong, insects and distant highway traffic.
N1	12:15pm	32	41	60	Nil	30	43	2.6	164	Y	Nil	**Site audible at times throughout measurement including hammering in workshop shed and occasional truck/machinery movements and revs.** Ambient noise included birdsong, persistent traffic on highway and one helicopter overflight.
N1	12:31pm	32	40	63	Nil	31	43	2.2	175	Y	Nil	**Site audible at times throughout measurement including hammering in workshop and truck/machinery movements and revs.** Ambient noise included persistent traffic on highway, birdsong and one helicopter overflight.

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

Three blast events occurred at the quarry since the last quarterly noise monitoring in November 2020. The blast overpressure and vibration monitoring results were provided by Hanson and are presented in Table 4.2.

Table 4.2 Blast emissions monitoring results

Date	Monitoring location	Airblast overpressure level (dB(Linear Peak))		Ground vibration - Peak particle velocity (mm/s)	
		Measured	Criteria[2]	Measured	Criteria[2]
10/12/2020	B1[1]	0	115	0	5
	B2[1]	0	115	0	5
	B3[1]	0	115	0	5
	B4[1]	0	115	0	5
	B5[1]	0	115	0	5
11/12/2020	B1[1]	0	115	0	5
	B2[1]	0	115	0	5
	B3[1]	0	115	0	5
	B4[1]	0	115	0	5
	B5[1]	0	115	0	5
17/12/20	B1	104.7	115	0.61	5
	B2	102.6	115	0.95	5
	B3	105.6	115	0.73	5
	B4[1]	0	115	0	5
	B5	102.2	115	1.08	5
18/12/20	B1[1]	0	115	0	5
	B2[1]	0	115	0	5
	B3[1]	0	115	0	5
	B4[1]	0	115	0	5
	B5[1]	0	115	0	5
4/1/21	B1[1]	0	115	0	5
	B2	102	115	0.87	5
	B3[1]	0	115	0	5
	B4[1]	0	115	0	5
	B5	104	115	2.2	5
24/2/21	B1	108.8	115	0.16	5
	B2[1]	0	115	0	5
	B3	99	115	0.58	5
	B4	105.8	115	0.55	5
	B5[1]	0	115	0	5

Notes: 1. There was no trigger for this blasting event.
2. Criteria applies at the nearest residential location and not at the monitoring location.

The monitoring results show the relevant criteria were satisfied at all monitoring locations (refer to Figure 2.1).

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 2021 as required by, and in accordance with, the site's approved NMP.

Noise limits were applicable for all measurements. 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 six blast events that have been assessed.

Yours sincerely

Rick Scully
Acoustic Consultant

rscully@emmconsulting.com.au

Review: Katie Teyhan 11/5/2021

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 LAeq(15-min) descriptor refers to an LAeq 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 pm.
L_{peak}	The maximum instantaneous sound pressure during a measurement period or noise event.
PPV	The greatest instantaneous particle velocity during a given time interval.

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.

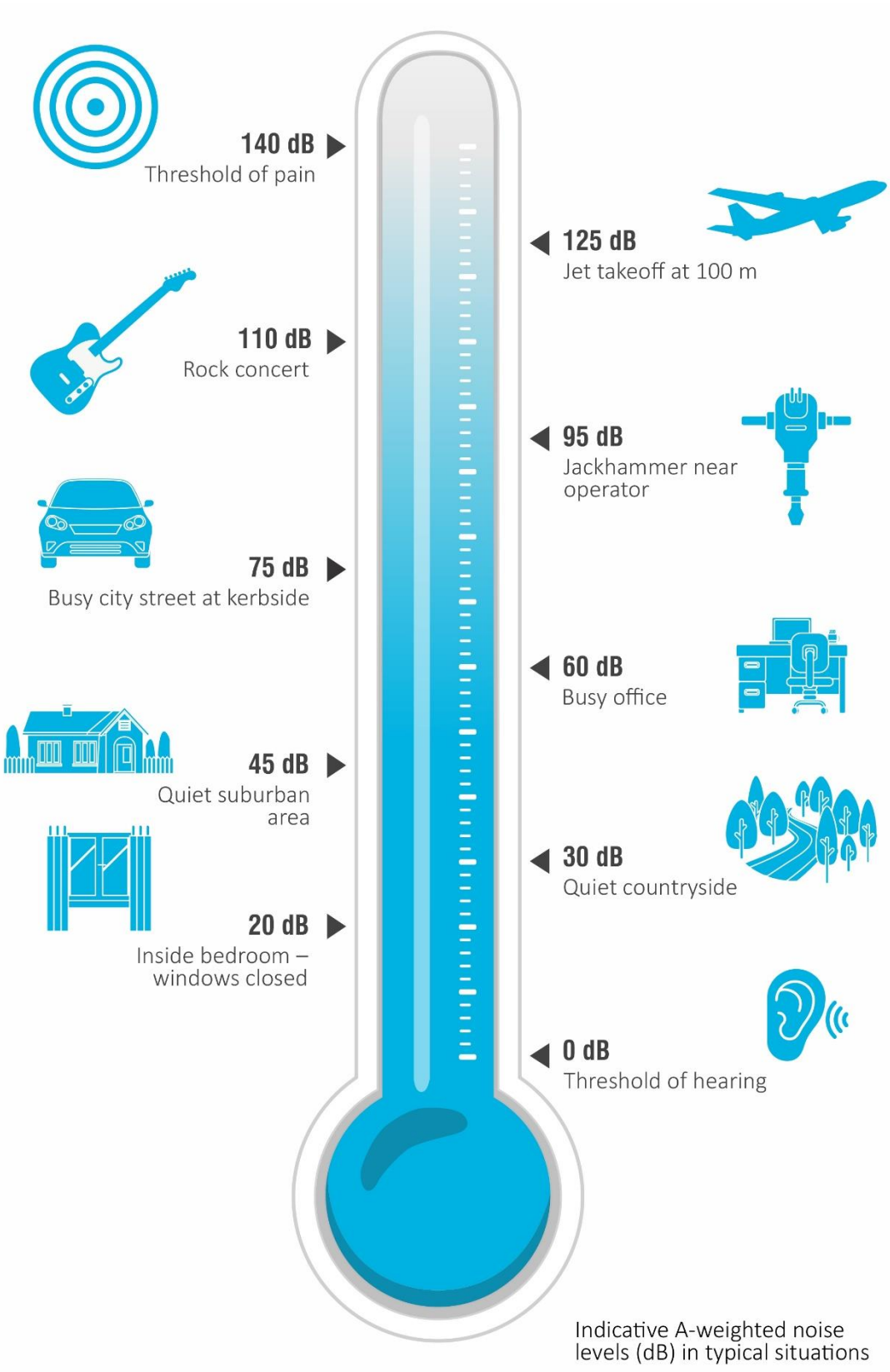


Figure A.1 **Common noise levels**

Appendix B

Calibration certificates

HBK HOTTINGER BRÜEL & KJÆR
The Calibration Laboratory
Skodsborgvej 307, DK-2850 Nærum, Denmark

ilac-MRA

DANAK
CAL Reg.No. 307
Member of EA MLA

CERTIFICATE OF CALIBRATION

No: CDK2007931

CALIBRATION OF

Sound Level Meter:	Brüel & Kjær Type 2250	No: 3029363	Id: -
Microphone:	Brüel & Kjær Type 4189	No: 3260501	
PreAmplifier:	Brüel & Kjær Type ZC-0032	No: 30109	
Supplied Calibrator:	None		
Software version:	BZ7222 Version 4.7.6	Pattern Approval:	-
Instruction manual:	BE1712-22		

CUSTOMER

EMM Consulting
Ground Floor, Suite 1
20 Chandos Street
2065 St Leonards
New South Wales, Australia

CALIBRATION CONDITIONS

Preconditioning: 4 hours at 23°C ± 3°C

Environment conditions: *See actual values in sections.*

SPECIFICATIONS

The Sound Level Meter Brüel & Kjær Type 2250 has been calibrated in accordance with the requirements as specified in IEC 61672-1:2013 class 1. Procedures from IEC 61672-3:2013 were used to perform the periodic tests. The accreditation assures the traceability to the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System 3630 with application software type 7763 (version 8.2 - DB: 8.20) by using procedure B&K proc 2250, 4189 (IEC 61672:2013).

RESULTS

Calibration Mode: **Calibration as received.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of calibration: 2020-11-26

Date of issue: 2020-11-26

Lene Petersen
Calibration Technician

Erik Bruus
Approved Signatory

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: C28814

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Svantek
Type No: SV-36 **Serial No:** 106879
Owner: EMM Consulting
Suite 01, 20 Chandos St
St Leonards NSW 2065

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	94.08	1000.00	1.78
Level 2:	NA	N	114.04	999.98	0.63
Uncertainty:			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

CONDITIONS OF TEST:

Ambient Pressure: 1005 hPa ±1.5 hPa **Relative Humidity:** 54 % ±5%

Temperature: 23 °C ±2° C

Date of Calibration: 15/02/2021 **Issue Date:** 15/02/2021

Acu-Vib Test Procedure: AVP02 (Calibrators)

Test Method: AS IEC 60942 - 2017

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Jack Kielt

.Accredited for compliance with ISO/IEC 17025 – Calibration

Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

NATA
WORLD RECOGNISED ACCREDITATION

Accredited Lab. 9262
Acoustic and Vibration Measurements

ACU-VIB
ELECTRONICS

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