Appendix 12

Ardmore Park Quarry – Modification 3

Noise Compliance Reports

- 7 March 2018
- 21 June 2018
- 21 September 2018

prepared by

Benbow Environmental Pty Ltd

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NOISE COMPLIANCE REPORT FOR MULTIQUIP AGGREGATES 5152 OALLEN FORD ROAD, BUNGONIA

Prepared for: Alexander Cox, Environmental Officer
Multiquip Aggregates

Prepared by: Peter Gangemi, Acoustic Engineer
R T Benbow, Principal Consultant

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Benbow
ENVIRONMENTAL

Engineering a Sustainable Future for Our Environment

Head Office: 13 Daking Street North Parramatta NSW 2151 AUSTRALIA
Tel: 61 2 9890 5099 Fax: 61 2 9890 5399
Email: admin@benbowenviro.com.au
Visit our website: www.benbowenviro.com.au

DOCUMENT CONTROL

Prepared by:	Position:	Signature:	Date:
Peter Gangemi	Senior Acoustic Engineer		11 April 2018

Reviewed by:	Position:	Signature:	Date:
Emma Hansma	Acoustic Engineer		11 April 2018

Approved by:	Position:	Signature:	Date:
R T Benbow	Principal Consultant		11 April 2018

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Benbow ENVIRONMENTAL

Head Office:
13 Daking Street North Parramatta NSW 2151 Australia
P.O. Box 687 Parramatta NSW 2124 Australia
Telephone: +61 2 9890 5099 Facsimile: +61 2 9890 5399
E-mail: admin@benbowenviro.com.au
Visit our Website at www.benbowenviro.com.au

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1. INTRODUCTION

Benbow Environmental was engaged to undertake a noise compliance assessment of the Multiquip Aggregates facility at 5152 Oallen Ford Road, Bungonia. The noise impacts of the facility are assessed against the noise limits in the Mod 2 approval.

As part of the assessment, attended noise monitoring was conducted at numerous points along the site boundary. Road traffic monitoring was conducted along Oallen Ford Road and Jerrara Road.

The assessment was conducted during sand washing and rock crushing activities to measure a worst case site scenario.

1.1 SCOPE OF WORKS

The scope of works for this study was to undertake a noise compliance assessment for the Multiquip Aggregates site.

The scope of the study was limited to the following:

- Attended noise monitoring at the site boundaries adjoining the nearest potentially affected receivers;
- Attended noise monitoring of road traffic noise at residential properties along Oallen Ford Road and Jerrara Road;
- Analysis of all noise data and determination of noise contribution from the site and whether it complies with the noise limits;
- Preparation of a report compiling results; and
- Statement of current environmental noise compliance.

Supporting documentation has been included within the Attachments section of this report.

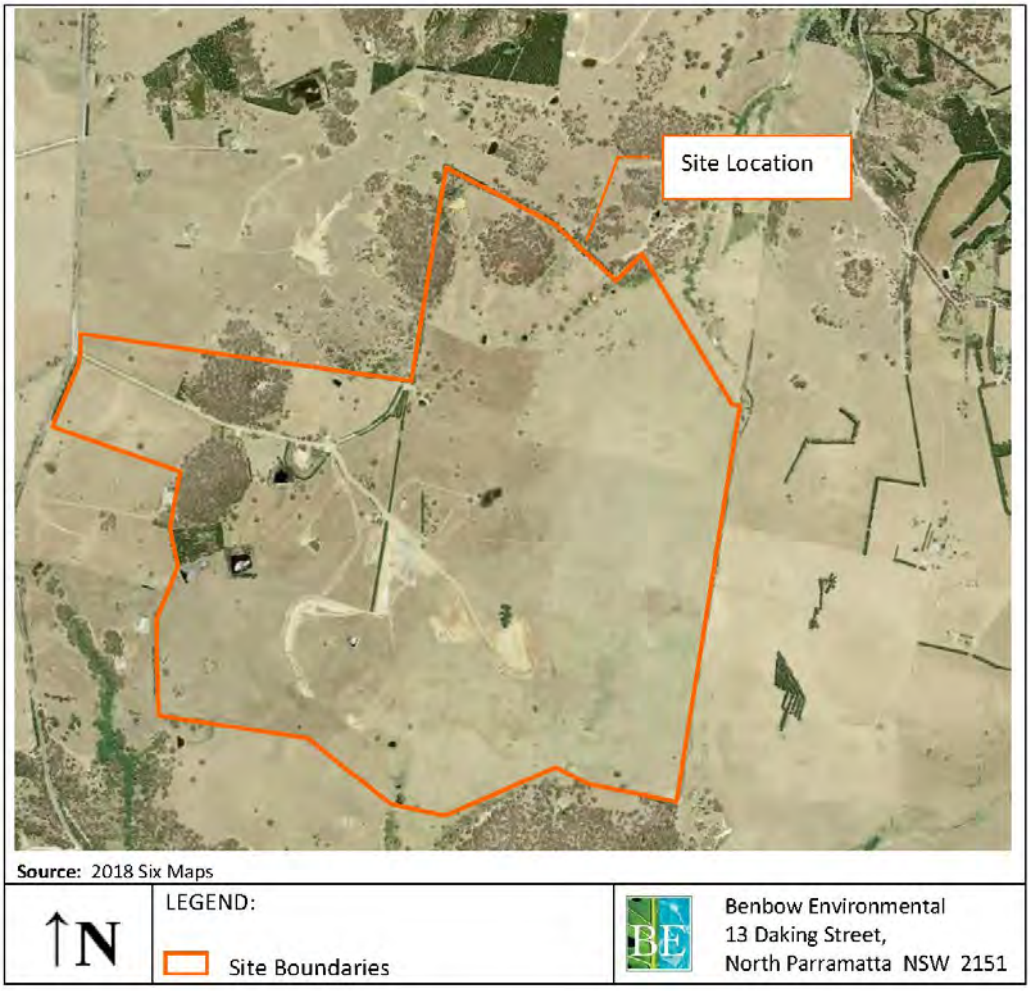
A glossary of the terminology utilised within this report has been provided in Attachment 1.

2. SITE IDENTIFICATION

2.1 SITE LOCATION

The subject site is located on Lot 24 in DP 1001312, 5152 Oallen Ford Road, Bungonia. The site location is shown in Figure 2-1.

Figure 2-1: Site Location



3. NEAREST SENSITIVE RECEPTORS

The nearest sensitive receptors are listed in Table 3-1 and their location is shown in Figure 3-1 and Figure 3-2. These receptors are considered to represent the primary receptors likely to be affected by noise emissions associated with the quarry, and the numbering corresponds to the list in Appendix 3 of the Mod 2 Project Approval (as shown in Figure 3-1).

Table 3-1: Nearest Sensitive Receptors

Receptors	Address	Approximate Distance from house to nearest boundary (m)	Direction	Description
R1	346 Inverary Road, Bungonia	300	NE	Residential
R2	590 Inverary Road, Bungonia	870	E	Residential
R3	550 Inverary Road, Bungonia	700	E	Residential
R4	5025 Oallen Ford, Bungonia	670	SW	Residential
R5	5028 Oallen Ford, Bungonia	290	SW	Residential
R6	5046 Oallen Ford, Bungonia	35	W	Residential
R7	5100 Oallen Ford, Bungonia	35	W	Residential
R8	*Receiver no longer considered*	-	-	-
R9	5194 Oallen Ford, Bungonia	350	NW	Residential

Figure 3-1: Nearest Sensitive Residential Receptors – Diagram

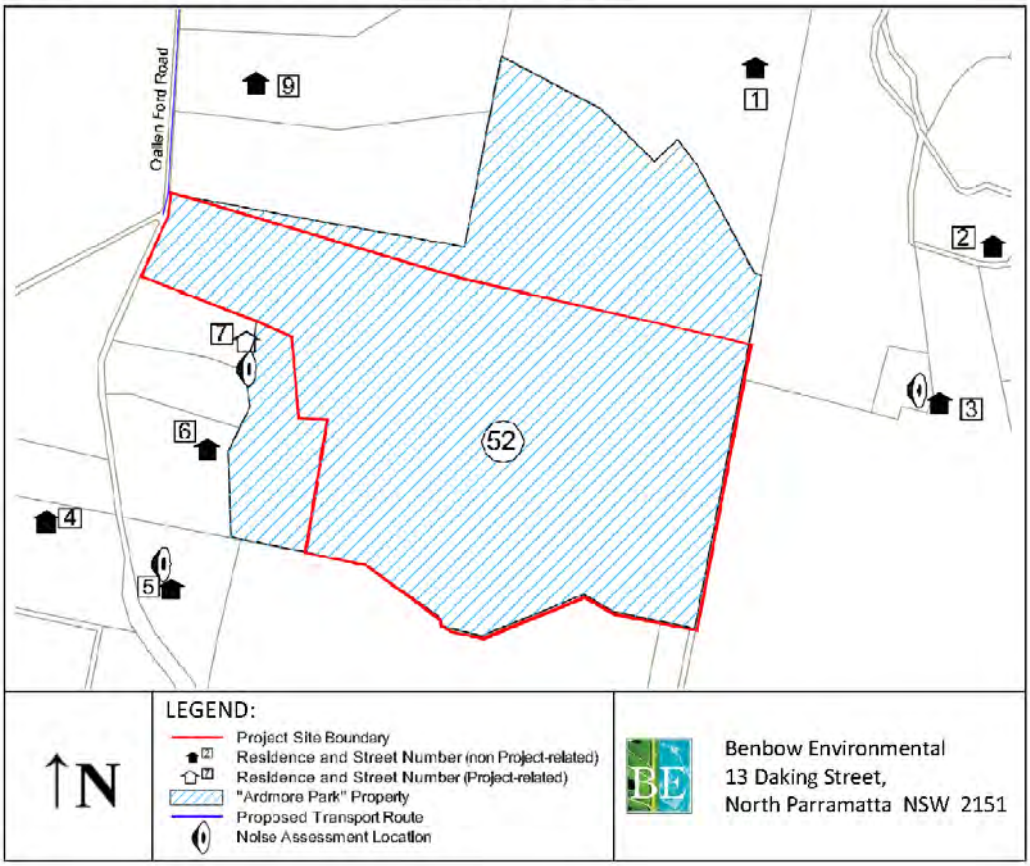
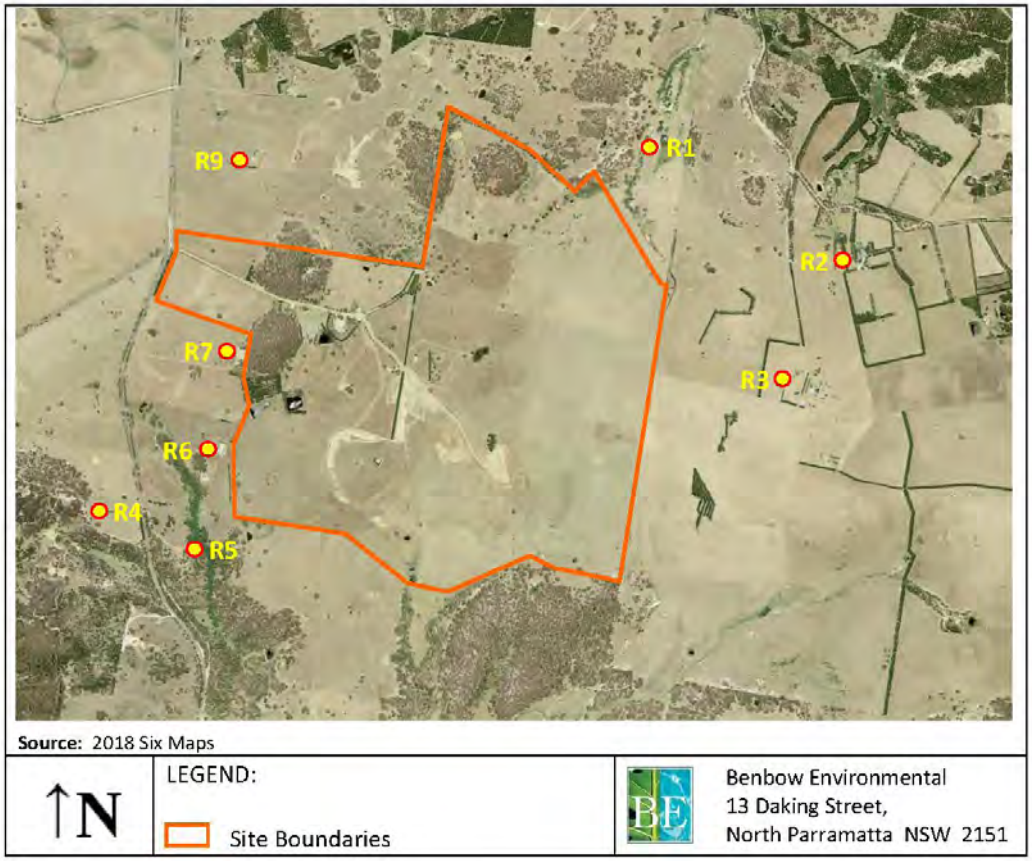


Figure 3-2: Nearest Sensitive Residential Receptors – Satellite



4. RELEVANT ACOUSTIC CRITERIA

The noise emissions from the operations and road traffic generation are required to satisfy the conditions of the Mod 2 approval as follows:

Operational Noise Impact Assessment Criteria

The Proponent shall ensure that the noise generated by the project, including the bypass road, does not exceed the noise impact assessment criteria in Table 1 at any residence or on more than 25 per cent of any privately-owned land.

Table 1: Noise Impact Assessment Criteria

Location	$L_{Aeq(15\ minutes)}$
Residence 1	35
Residence 2	35
Residence 3	35
Residence 4	35
Residence 5	35
Residence 6	36
Residence 8	35
Residence 9	36
Residence R1	35
Residence R2	35
Residence R3	36
Residence R4	35
Residence V1	38
Residence V2	36

Notes:
To interpret the locations referred to Table 1, see the figures in Appendix 3.
Noise generated by the project is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy.
The noise limits do not apply if the Proponent has an agreement with the relevant owner/s of these residences/land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement.

Traffic Noise Impact Assessment Criteria
3. The Proponent shall take all reasonable and feasible measures to ensure that the traffic noise generated by the project (after commencement of quarrying operations) does not exceed the traffic noise impact assessment criteria in Table 2.

Table 2: Noise Impact Assessment Criteria

Roads	Day/evening
Oallen Ford Road	55
Mountain Ash Road	55
Jerrara Road	55
Tarago Road	55
Windellama Road	55

Notes: Traffic noise generated by the project is to be measured in accordance with the relevant procedures in the EPA's Environmental Criteria for Road Traffic Noise.

5. NOISE MONITORING

Compliance noise monitoring was undertaken using attended noise measurements. By utilising attended noise measurements, contributions from the site, as well as from background noise sources such as birds and insects could be quantified. Details of the methodology and measured results have been detailed below.

5.1 INSTRUMENTATION

The attended noise level measurements were carried out using a Svantek SVAN957 Type 1 Precision Sound Level Meter (short-term monitoring). The instrument set was calibrated by a NATA accredited laboratory within two years of the measurement period and comply with AS IEC 61672.1–2004.

The instrument was set on A-weighted, fast response and logged noise levels over fifteen minute statistical intervals. The microphone was positioned between 1.2 and 1.5 m above ground level and was fitted with a windsock. The instrument was calibrated using a Rion NC-73 acoustic calibrator before and after the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations.

QA/QC procedures as applied to the measurement and analysis of noise levels are presented in the Attachments section of this report as well as instrument calibration certificates.

5.2 SITE ATTENDED NOISE MEASUREMENTS

Attended measurements were taken at the boundaries with nearby residential receivers as shown in Figure 5-1. Observations from site showed that the background and ambient noise levels were dominated by a variety of noise sources including birds, insects, grasshoppers, aeroplanes and light winds through vegetation. Noise levels of the site contribution were audible during numerous of the attended measurements.

Attended noise measurements were taken on the site on Wednesday 7th March 2018 and Thursday 8th March 2018. For attended measurements during 7th March 2018 and the morning of 8th March 2018, the sand washing equipment was operational. During attended measurements of the afternoon of 8th March 2018, the sand washing equipment and rock crushing equipment was operational. The list of equipment operational in each day is shown in Table 5-1. Wind was blowing from the east and east-south-east directions on both days.

Table 5-1: Operational Equipment

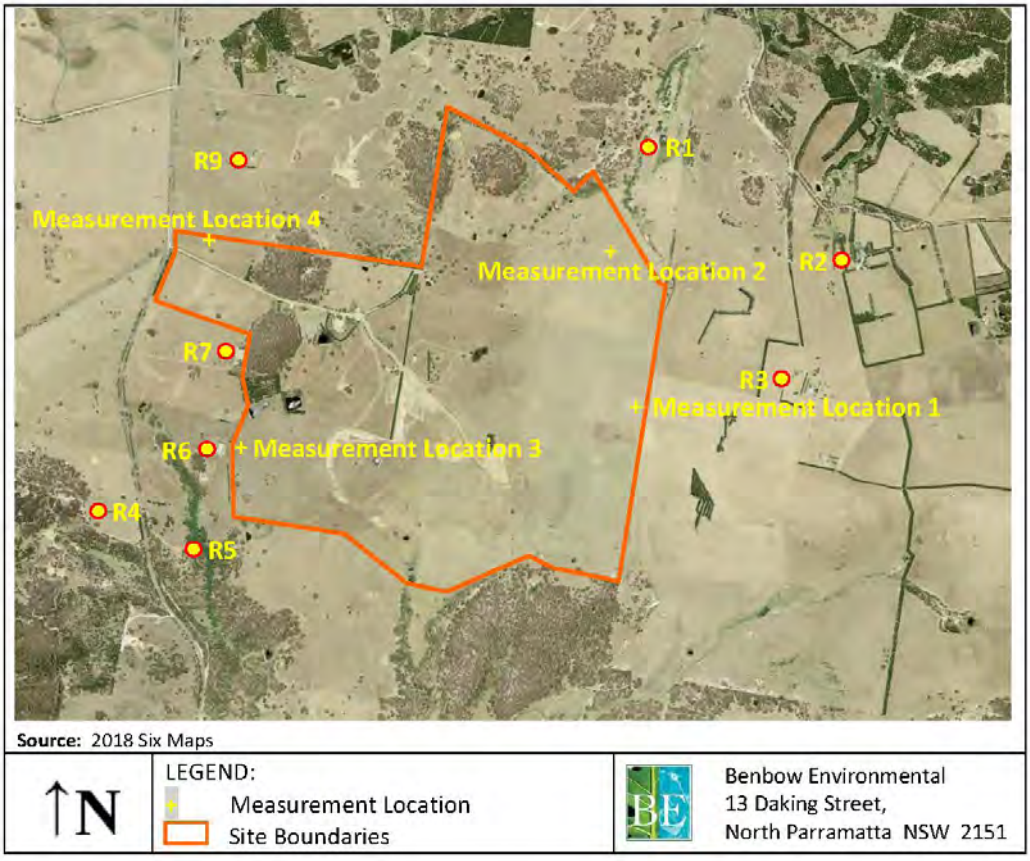
Equipment	7/3/18 and 8/3/18 morning measurements	8/3/18 afternoon measurements
'Evowash 151' Sand Wash Plant x 1	✓	✓
Commander Screen and Feeder x 1	✓	✓
Precision Screen Stacker x 1	✓	✓
Hyundai HL770 Front End Loader x 1	✓	✓
20T Excavator	✓	✓
40T Dump Trucks x 2	✓	✓
Cat D9 Dozer	✓	✓
CAT 637 Scraper	✓	✓
CAT 336 Excavator (Rock Hammering Wednesday Only)	✓	✗
Komatsu WA470 Front End Loader x 1	✓	✓
50000L Water Cart	✓	✓
Kenworth 610 Trucks x 2	✓	✓
45T Excavator	✗	✓
Sandvik Scalper	✗	✓
Tesjab Jaw Crusher	✗	✓
Sandvik Cone Crusher	✗	✓
Sandvik Screen	✗	✓
Precision Screen Stacker x 1	✗	✓
Komatsu WA430 Front End Loader x 1	✗	✓

The results of the short-term attended noise monitoring on site are displayed in Table 5-2. The table displays the Leq, L90, L10 and L1 levels from the noise measurements. These descriptors refer to the total noise measurement, including all noise sources such as birds, insects, dogs, aeroplanes and grasshoppers as well as site noise. For more details, refer to the glossary in attachment 1.

Each attended measurement includes an "Estimated L_{Aeq} Site at monitoring point". This descriptor refers to the equivalent continuous sound level of the site noise sources alone. The estimations are derived using the numerical results of the total measurements, by taking into account all audible noise sources during the measurement and noting sound pressure levels when key noise sources are audible or non-audible. The estimated L_{Aeq} level from the site is either equal to, or less than the total measured L_{Aeq} noise level.

The *"Estimated L_{Aeq} Site at monitoring point"* is the estimated site L_{Aeq} contribution at the measurement location. The *"Estimated L_{Aeq} Site at compliance point"* is the estimated site L_{Aeq} contribution at the least affected point on the most affected 25% area of the nearest residential property as per section 4 of Mod 2.

Figure 5-1: Attended Measurement Locations



Source: 2018 Six Maps

↑N

LEGEND:
Measurement Location
Site Boundaries

Benbow Environmental
13 Daking Street,
North Parramatta NSW 2151

Table 5-2: Operator Attended Noise Measurements, dB(A)

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Measurement Location 1 Wednesday 07/03/2018 9:36	41	34	44	49	Sand washing equipment operational, rock crushing equipment not operational Birds < 51 dB(A) Cattle < 37 dB(A) Insects < 35 dB(A) Light winds through trees < 50 dB(A) Site noise inaudible **Estimated L_{Aeq} Site at monitoring point < 20 dB(A)** **Estimated L_{Aeq} Site at compliance point < 16 dB(A)**
Measurement Location 2 Wednesday 07/03/2018 10:02	35	28	37	44	Sand washing equipment operational, rock crushing equipment not operational Birds < 58 dB(A) Dog < 36 dB(A) Insects < 34 dB(A) Light winds through trees < 38 dB(A) Single mechanical impulse noise < 33 dB(A) Other than impulse, mechanical noise inaudible **Estimated L_{Aeq} Site at monitoring point < 18 dB(A)** **Estimated L_{Aeq} Site at compliance point < 15 dB(A)**
Measurement Location 3 Wednesday 07/03/2018 10:41	43	39	45	49	Sand washing equipment operational, rock crushing equipment not operational Birds < 57 dB(A) Insects < 35 dB(A) Light winds through trees < 49 dB(A) Mechanical caterpillar revving < 47 dB(A) Hydraulic hammer < 47 dB(A) **Estimated L_{Aeq} Site at monitoring point < 37 dB(A)** **Estimated L_{Aeq} Site at compliance point < 36 dB(A)**
Measurement Location 3 Wednesday 07/03/2018 11:03	43	40	46	48	Sand washing equipment operational, rock crushing equipment not operational Birds < 60 dB(A) Insects < 37 dB(A) Light winds through trees < 47 dB(A) Grasshoppers < 43 dB(A) Mechanical caterpillar revving < 48 dB(A) Hydraulic hammer < 50 dB(A) **Estimated L_{Aeq} Site at monitoring point < 36 dB(A)** **Estimated L_{Aeq} Site at compliance point < 35 dB(A)**

Table 5-2: Operator Attended Noise Measurements, dB(A)

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Measurement Location 4 Wednesday 07/03/2018 11:30	43	37	49	51	Sand washing equipment operational, rock crushing equipment not operational Insects < 48 dB(A) Light winds through trees < 45 dB(A) Mechanical caterpillar revving < 42 dB(A) Trucks driving to/from site < 54 dB(A) **Estimated L_{Aeq} Site at monitoring point < 32 dB(A)** **Estimated L_{Aeq} Site at compliance point < 31 dB(A)**
Measurement Location 3 Thursday 08/03/2018 11:05	41	35	44	49	Sand washing equipment operational, rock crushing equipment not operational Birds < 49 dB(A) Insects < 39 dB(A) Light winds through trees < 40 dB(A) Mechanical caterpillar < 48 dB(A) **Estimated L_{Aeq} Site at monitoring point < 35 dB(A)** **Estimated L_{Aeq} Site at compliance point < 34 dB(A)**
Measurement Location 1 Thursday 08/03/2018 13:00	38	33	41	45	Sand washing equipment operational, rock crushing equipment not operational Birds < 44 dB(A) Grasshoppers < 36 dB(A) Insects < 36 dB(A) Light winds through trees < 49 dB(A) Site noise inaudible **Estimated L_{Aeq} Site at monitoring point < 19 dB(A)** **Estimated L_{Aeq} Site at compliance point < 15 dB(A)**
Measurement Location 2 Thursday 08/03/2018 13:25	34	30	37	42	Sand washing equipment operational, rock crushing equipment not operational Birds < 48 dB(A) Grasshoppers < 41 dB(A) Insects < 35 dB(A) Light winds through trees < 51 dB(A) Aeroplane < 43 dB(A) Site noise inaudible **Estimated L_{Aeq} Site at monitoring point < 18 dB(A)** **Estimated L_{Aeq} Site at compliance point < 15 dB(A)**

Table 5-2: Operator Attended Noise Measurements, dB(A)

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Measurement Location 3 Thursday 08/03/2018 14:00	44	40	47	50	Sand washing equipment and rock crushing equipment operational Birds < 48 dB(A) Insects < 39 dB(A) Light winds through trees < 47 dB(A) Crusher < 52 dB(A) **Estimated L_{Aeq} Site at monitoring point < 37 dB(A)** **Estimated L_{Aeq} Site at compliance point < 36 dB(A)**
Measurement Location 1 Thursday 08/03/2018 14:26	41	36	44	50	Sand washing equipment and rock crushing equipment operational Birds < 54 dB(A) Grasshoppers < 36 dB(A) Insects < 40 dB(A) Light winds through trees < 49 dB(A) Crusher < 27 dB(A) **Estimated L_{Aeq} Site at monitoring point < 24 dB(A)** **Estimated L_{Aeq} Site at compliance point < 20 dB(A)**
Measurement Location 2 Thursday 08/03/2018 14:48	37	32	39	45	Sand washing equipment and rock crushing equipment operational Birds < 54 dB(A) Grasshoppers < 48 dB(A) Insects < 37 dB(A) Light winds through trees < 51 dB(A) Crusher < 27 dB(A) **Estimated L_{Aeq} Site at monitoring point < 23 dB(A)** **Estimated L_{Aeq} Site at compliance point < 20 dB(A)**
Measurement Location 4 Thursday 08/03/2018 15:16	43	39	44	48	Sand washing equipment and rock crushing equipment operational Birds < 38 dB(A) Grasshoppers < 48 dB(A) Insects < 40 dB(A) Light winds through trees < 50 dB(A) Crusher < 45 dB(A) **Estimated L_{Aeq} Site at monitoring point < 32 dB(A)** **Estimated L_{Aeq} Site at compliance point < 31 dB(A)**

From the attended site results in Table 5-2, it can be seen that compliance with the criteria was easily achieved at measurement points 1, 2 and 4 within the site. When it is considered that the compliance points are actually further from the site boundary on the property in question, the contribution noise levels are predicted to be even lower.

The 36 dB(A) criteria at location 3 was met exactly during three attended measurements. During the two measurements on Wednesday 7th March, an excavator with a hydraulic hammer was operating in a particularly close location to measurement point 3. During the fourth attended measurement at point 3, the crusher was operating to provide a worst case operational scenario. For all four measurements at point 3, the wind was from an easterly or east-south-easterly direction, providing a worst case scenario of blowing towards the receiver.

Analysis of yearly wind roses from the Goulburn Airport AWS 070330, shows that winds are predominately from the west during the day period for all seasons. Under these conditions, compliance is expected to be more readily achieved at location 3 (receiver 6).

5.3 Road Traffic Attended Noise Measurements

Attended noise measurements of road traffic noise were taken at two locations on Wednesday 7th March 2018. The locations of the two measurements on Oallen Ford Road and Jerrara Road are shown in Figure 5-2 and Figure 5-3. The results of the short-term attended noise monitoring are displayed in Table 5-3.

Figure 5-2: Road Traffic Measurement Location – 5454 Oallen Ford Road

Figure 5-3: Road Traffic Measurement Location – 19 Forest Close

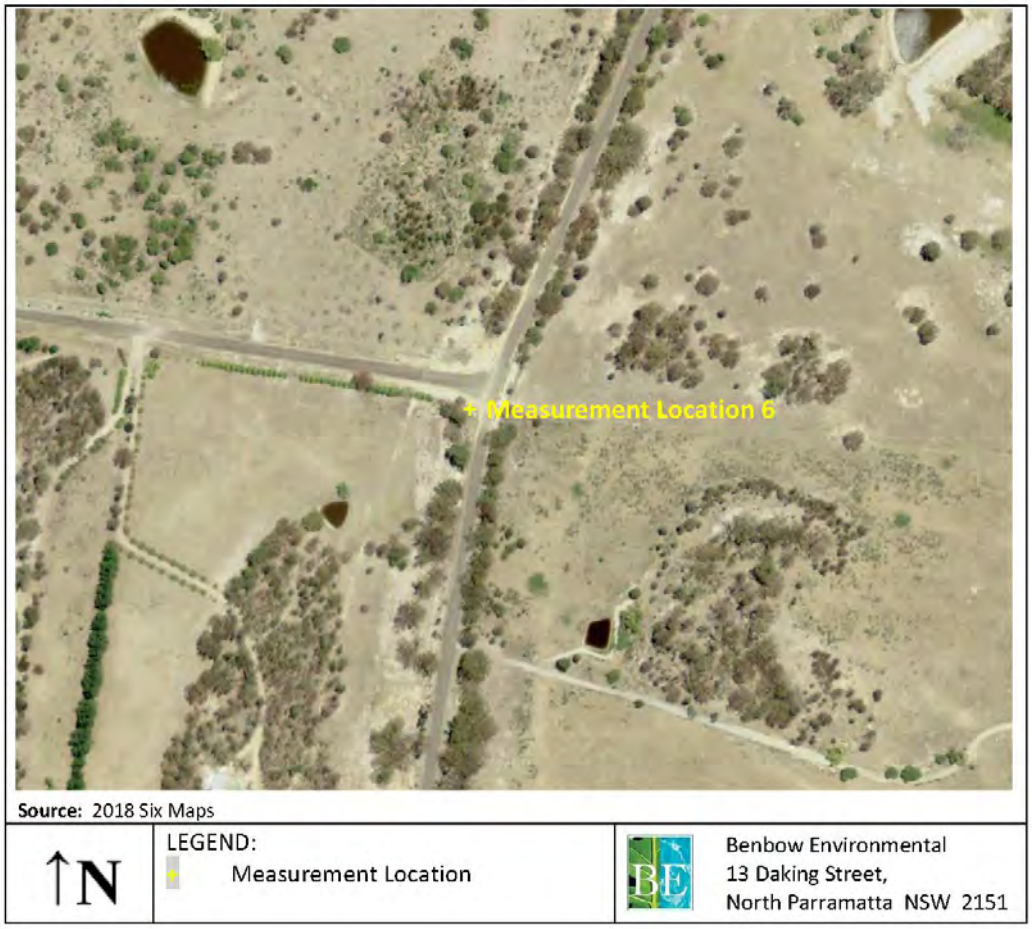


Table 5-3: Operator Attended Noise Measurements, dB(A)

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
5454 Oallen Ford Road, Bungonia Wednesday 07/03/2018 12:11	56	35	46	70	0:49 <79 dB(A), car northbound 3:20 <78 dB(A), truck southbound 4:30 <71 dB(A), car southbound 7:20 <70 dB(A), car northbound 10:23 <74 dB(A), car northbound 13:23 <74 dB(A), car northbound 14:18 <67 dB(A), cars x 2 northbound No light or heavy vehicles to/from site **Estimated Road Noise L_{Aeq} at Measurement Point = 56 dB(A)** **Estimated Road Noise L_{Aeq} at Closest Residential Dwelling (5477 Oallen Ford Road) = 41 dB(A)**
19 Forest Close, Marulan Wednesday 07/03/2018 12:44	59	34	59	73	1:16 <76 dB(A), cars x 2 southbound **1:20 <76 dB(A), trucks x 2 to site, southbound** **2:20 <77 dB(A), truck from site, northbound** 3:56 <67 dB(A), car northbound 5:35 <78 dB(A), car northbound 6:20 <74 dB(A), truck southbound 6:25 <72 dB(A), car southbound 8:33 <70 dB(A), car southbound 9:10 <72 dB(A), car southbound 9:16 <68 dB(A), car northbound 11:03 <68 dB(A), car northbound **11:12 <60 dB(A), car to site southbound** 11:25 <71 dB(A), car northbound 12:25 <73 dB(A), car southbound 13:01 <70 dB(A), car northbound One light vehicle and two heavy vehicles to/from site **Estimated Road Noise L_{Aeq} at Measurement Point = 59 dB(A)** **Estimated Road Noise L_{Aeq} at Closest Residential Dwelling = 50 dB(A)**

The measurement point at 5454 Oallen Ford Road was 13 m from the centre of the road. The residential receiver closest to Oallen Ford Road between Bungonia and the site is at 5477 Oallen Ford Road, with the front façade located 72 m from the centre of the road.

The measurement point at 19 Forest Close was 14 m from the centre of Jerrara Road. The residential receiver closest to Jerrara Road is at 328 Jerrara Road, with the front façade located 40 m from the centre of the road.

Measurements at 5454 Oallen Ford Road and 19 Forest Close were taken in safe locations close to the road, to ensure that the noise contributions were from road traffic noise. Back calculations of these measurements to the nearest residential receivers to the road show that the estimated L_{Aeq} noise contribution from all road traffic noise sources is 41 dB(A) at 5477 Oallen Ford Road and 50 dB(A) at 328 Jerrara Road. The road traffic contributions from all vehicles on these roads is below the L_{Aeq} criteria of 55 dB(A), with the contribution just from site vehicles being even lower than the total road traffic contributions.

6. CONCLUDING REMARKS

Benbow Environmental was engaged to undertake a noise compliance assessment of the Multiquip Aggregates facility at 5152 Oallen Ford Road, Bungonia. Noise impacts of the site and road traffic activities are assessed against the noise limits in the Mod 2 approval.

As part of the assessment, the noise criteria and nearest receptors were identified. Attended noise monitoring was conducted at numerous points along the site boundaries during sand washing and rock crushing activities. Compliance with the site criteria was found during all measured site activities.

Road traffic noise monitoring was conducted along Oallen Ford Road and Jerrara Road. Measurements of all road traffic noise sources were found to be well inside the noise criteria; measurements of simply site vehicles would have generated even lower noise contributions.

The site complied with the criteria set out in the mod 2 approval during all attended noise measurements.

This concludes the report.

Peter Gangemi
Senior Acoustic Engineer

R T Benbow
Principal Consultant

7. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of Multiquip Aggregates, as per our agreement for providing environmental services. Only Multiquip Aggregates is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by Multiquip Aggregates for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

Attachment 1: Glossary of Noise Terminology

'A' FREQUENCY WEIGHTING

The 'A' frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child's scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The 'A' weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.

AMBIENT NOISE

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period 'T' (L_{Aeq},T).

AUDIBLE

Audible refers to a sound that can be heard. There are a range of audibility grades, varying from "barely audible", "just audible" to "clearly audible" and "prominent".

BACKGROUND NOISE LEVEL

Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period 'T' (L_{A90}, T). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15 minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.

'C' FREQUENCY WEIGHTING

The 'C' frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

DECIBEL

The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from 10 $\log_{10}$ ($10^{(50/10)}$ + $10^{(50/10)}$) and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, LAeq

Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the LAeq level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

'F'(FAST) TIME WEIGHTING

Sound level meter design-goal time constant which is 0.125 seconds.

FREQUENCY

The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

IMPULSE NOISE

An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

MAXIMUM NOISE LEVEL, LAFmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.

NOISE

Noise is unwanted, harmful or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid or solid. Noise usually includes vibration as well as sound.

OFFENSIVE NOISE

Reference: Dictionary of the NSW Protection of the Environment Operations Act (1997). "Offensive Noise means noise:
(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

SOUND ATTENUATION

A reduction of sound due to distance, enclosure or some other device. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.

SOUND PRESSURE

The rms sound pressure measured in pascals (Pa). A pascal is a unit equivalent to a newton per square metre (N/m^2).

SOUND PRESSURE LEVEL, Lp

The level of sound measured on a sound level meter and expressed in decibels (dB). Where $L_P = 10 \log_{10} (Pa/Po)^2$ dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20×10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.

SOUND POWER

The rms sound power measured in watts (W). The watt is a unit defined as one joule per second. A measures the rate of energy flow, conversion or transfer.

SOUND POWER LEVEL, Lw

The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. $Lw = Lp + 10 \log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

STATISTICAL NOISE LEVELS, Ln.

Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example:-

- The noise level, in decibels, exceeded for 1 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF1}, T. This may be used for describing short-term noise levels such as could cause sleep arousal during the night.
- The noise level, in decibels, exceeded for 10 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF10}, T. In most countries the LAF10, T is measured over periods of 15 minutes, and is used to describe the average maximum noise level.
- The noise level, in decibels, exceeded for 90 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF90}, T. In most countries the LAF90, T is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

STEADY NOISE

Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1–1997).

Attachment 2: QA/QC Procedures

CALIBRATION OF SOUND LEVEL METERS

A sound level meter requires regular calibration to ensure its measurement performance remains within specification. Benbow Environmental sound level meters are calibrated by a National Association of Testing Authority (NATA) registered laboratory or a laboratory approved by the NSW Environment Protection Authority (EPA) every two years and after each major repair, in accordance with AS 1259–1990.

The calibration of the sound level meter was checked immediately before and after each series of measurements using an acoustic calibrator. The acoustic calibrator provides a known sound pressure level, which the meter indicates when the calibrator is activated while positioned on the meter microphone.

The sound level meters also incorporate an internal calibrator for use in setting up. This provides a check of the electrical calibration of the meter, but does not check the performance of the microphone. Acoustical calibration checks the entire instrument including the microphone. Calibration certificates for the instrument sets used have been included as Attachment 3.

CARE AND MAINTENANCE OF SOUND LEVEL METERS

Noise measuring equipment contains delicate components and therefore must be handled accordingly. The equipment is manufactured to comply with international and national standards and is checked periodically for compliance. The technical specifications for sound level meters used in Australia are defined in Australian Standard AS 1259 – 1990 *Sound Level Meters*.

The sound level meters and associated accessories are protected during storage, measurement and transportation against dirt, corrosion, rapid changes of temperature, humidity, rain, wind, vibration, electric and magnetic fields. Microphone cables and adaptors are always connected and disconnected with the power turned off. Batteries are removed (with the instrument turned off) if the instrument is not to be used for some time.

INVESTIGATION PROCEDURES

All investigative procedures were conducted in accordance with AS 1055.1–1997 *Acoustics – Description and Measurement of Environmental Noise* Part 1: *General Procedures*.

The following information was recorded and kept for reference purposes:

- type of instrumentation used and measurement procedure conducted;
- description of the time aspect of the measurements, ie. measurement time intervals; and
- positions of measurements and the time and date were noted.

As per AS 1055.1–1997, all measurements were carried out at least 3.5 m from any reflecting structure other than the ground. The preferred measurement height of 1.2 m above the ground was utilised. A sketch of the area was made identifying positions of measurement and the approximate location of the noise source and distances in meters (approx.).

ATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

The attended short-term noise monitoring was carried out using a SVANTEK SVAN957 Class 1 Precision Sound Level Meter. The instrument was calibrated by a NATA accredited laboratory within two years of the measurement period. The instrument sets comply with AS 1259 and was set on A-weighted, fast response.

The microphone was positioned at 1.2 to 1.5 metres above ground level and was fitted with windsocks. The instrument was calibrated using a B&K 4230 sound level calibrator prior and subsequent to the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 3.

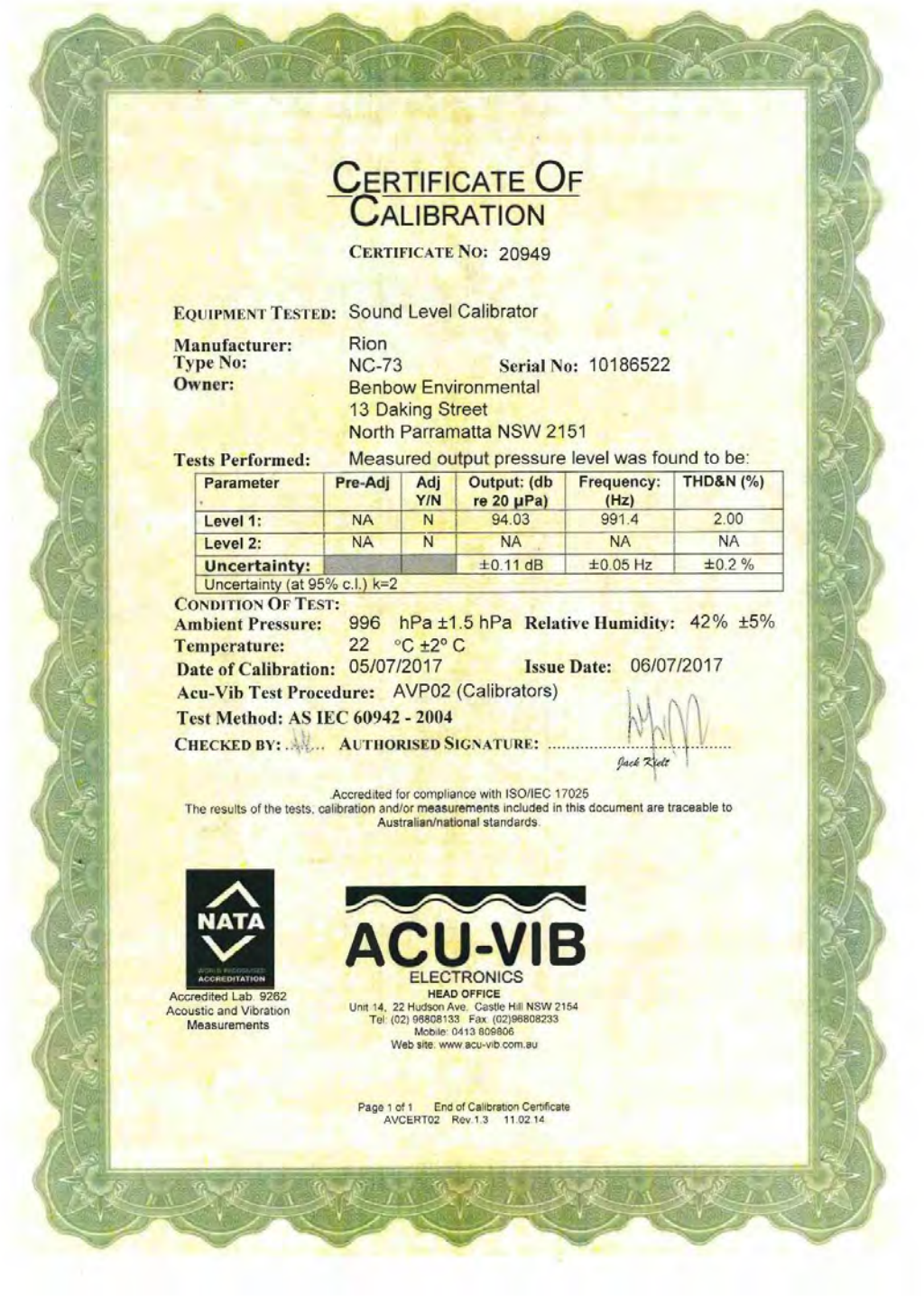
WEATHER CONDITIONS

During the monitoring period, weather was predominantly clear and calm.

METHODOLOGY

The attended noise measurements were carried out generally in accordance with Australian Standard AS 1055–1997 *Acoustics – Description and Measurement of Environmental Noise*.

Attachment 3: Calibration Certificates



CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 20949

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-73 **Serial No:** 10186522
Owner: Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

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	94.03	991.4	2.00
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05 Hz	±0.2 %
Uncertainty (at 95% c.l.) k=2					

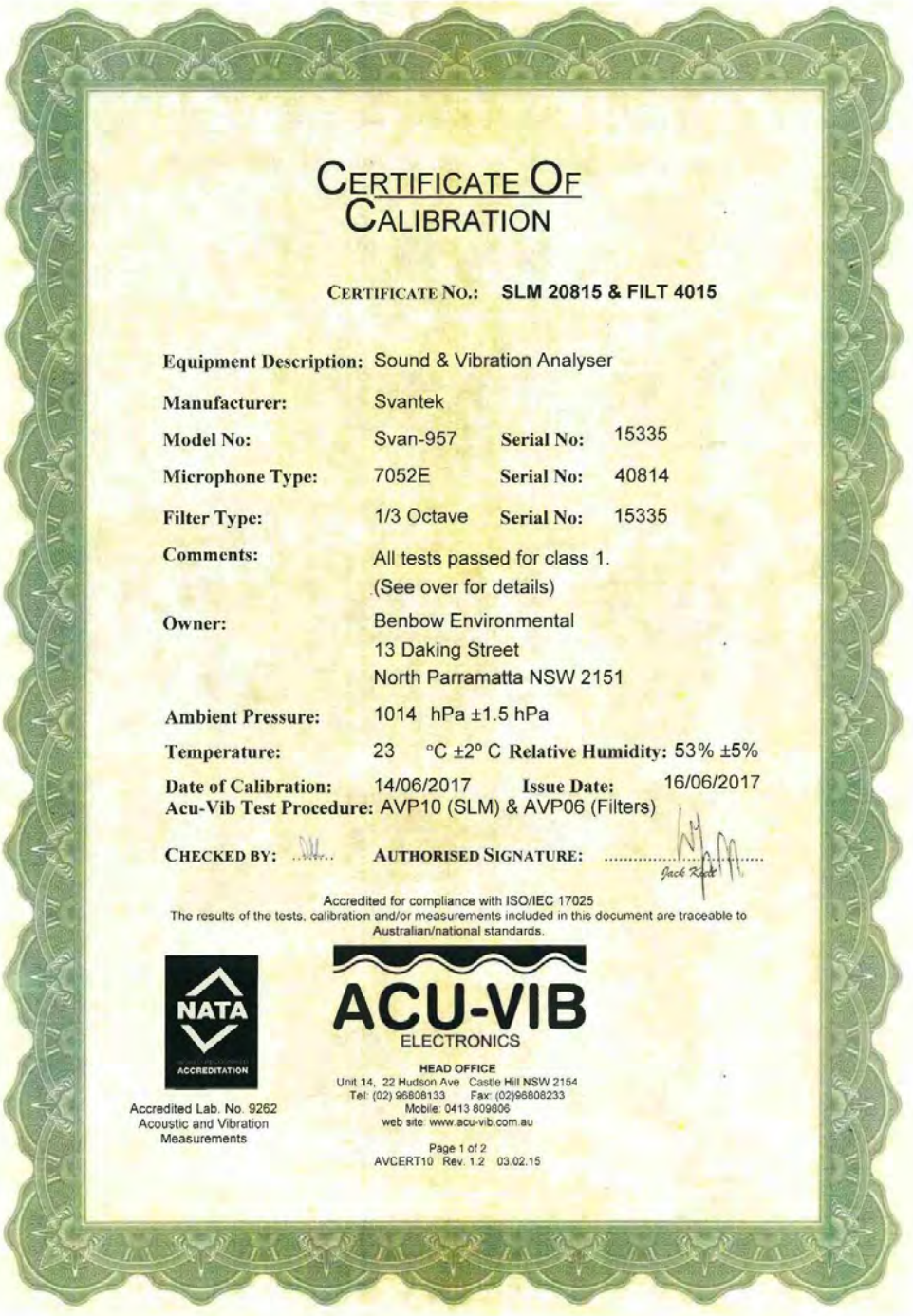
CONDITION OF TEST:
Ambient Pressure: 996 hPa ±1.5 hPa **Relative Humidity:** 42% ±5%
Temperature: 22 °C ±2° C
Date of Calibration: 05/07/2017 **Issue Date:** 06/07/2017
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004
CHECKED BY: ... **AUTHORISED SIGNATURE:** .....
Jack Rieth

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.

NATA ACCREDITATION
Accredited Lab. 9262
Acoustic and Vibration Measurements

ACU-VIB ELECTRONICS
HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
Web site: www.acu-vib.com.au

Page 1 of 1 End of Calibration Certificate
AVCERT02 Rev.1.3 11.02.14



CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 20815 & FILT 4015**

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15335
Microphone Type:	7052E	**Serial No:**	40814
Filter Type:	1/3 Octave	**Serial No:**	15335
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Benbow Environmental 13 Daking Street North Parramatta NSW 2151		
Ambient Pressure:	1014 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	53% ±5%
Date of Calibration:	14/06/2017	**Issue Date:**	16/06/2017
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....
Jack Rock

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.

NATA
ACCREDITATION

Accredited Lab. No. 9262
Acoustic and Vibration
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ACU-VIB
ELECTRONICS

HEAD OFFICE
Unit 14, 22 Hudson Ave Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
web site: www.acu-vib.com.au

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NOISE COMPLIANCE REPORT FOR MULTIQUIP AGGREGATES 5152 OALLEN FORD ROAD, BUNGONIA

Prepared for: Alexander Cox, Environmental Officer
Multiquip Aggregates

Prepared by: Peter Gangemi, Senior Acoustic Engineer
R T Benbow, Principal Consultant

Report No: 181023-02_Noise_Rev3
August 2018
(Released: 6 August 2018)

Benbow
ENVIRONMENTAL

Engineering a Sustainable Future for Our Environment

Head Office: 25-27 Sherwood Street Northmead NSW 2152 AUSTRALIA
Tel: 61 2 9896 0399 Fax: 61 2 9896 0544
Email: admin@benbowenviro.com.au
Visit our website: www.benbowenviro.com.au

DOCUMENT CONTROL

Prepared by:	Position:	Signature:	Date:
Peter Gangemi	Senior Acoustic Engineer		06 August 2018

Reviewed by:	Position:	Signature:	Date:
Emma Hansma	Senior Engineer		06 August 2018

Approved by:	Position:	Signature:	Date:
R T Benbow	Principal Consultant		06 August 2018

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Benbow
ENVIRONMENTAL
A.B.N. 17 160 013 641

Head Office:
25-27 Sherwood Street Northmead NSW 2152 Australia
P.O. Box 687 Parramatta NSW 2124 Australia
Telephone: +61 2 9896 0399 Facsimile: +61 2 9896 0544
E-mail: admin@benbowenviro.com.au
Visit our Website at www.benbowenviro.com.au

Contents

Tables

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1. INTRODUCTION

Benbow Environmental was engaged to undertake the June 2018 noise compliance assessment of the Multiquip Aggregates facility at 5152 Oallen Ford Road, Bungonia. This compliance assessment follows on from the March 2018 noise compliance assessment (181023_Noise_Rev4). Compared to the March 2018 assessment, there were slight variations to the operational equipment on site as rock processing equipment was not operating.

As part of the assessment, attended noise monitoring was conducted at three points along the site boundary and at a residential property 550 Inverary Road, Bungonia. The noise impacts of the facility at these points were assessed against the noise limits in the Mod 2 approval.

1.1 SCOPE OF WORKS

The scope of works for this study was to undertake a noise compliance assessment for the Multiquip Aggregates site.

The scope of the study was limited to the following:

- Attended noise monitoring at the site boundaries adjoining the nearest potentially affected receivers;
- Attended noise monitoring at 550 Inverary Road, Bungonia;
- Analysis of all noise data and determination of noise contribution from the site and whether it complies with the noise limits;
- Preparation of a report compiling results; and
- Statement of current environmental noise compliance.

Supporting documentation has been included within the Attachments section of this report.

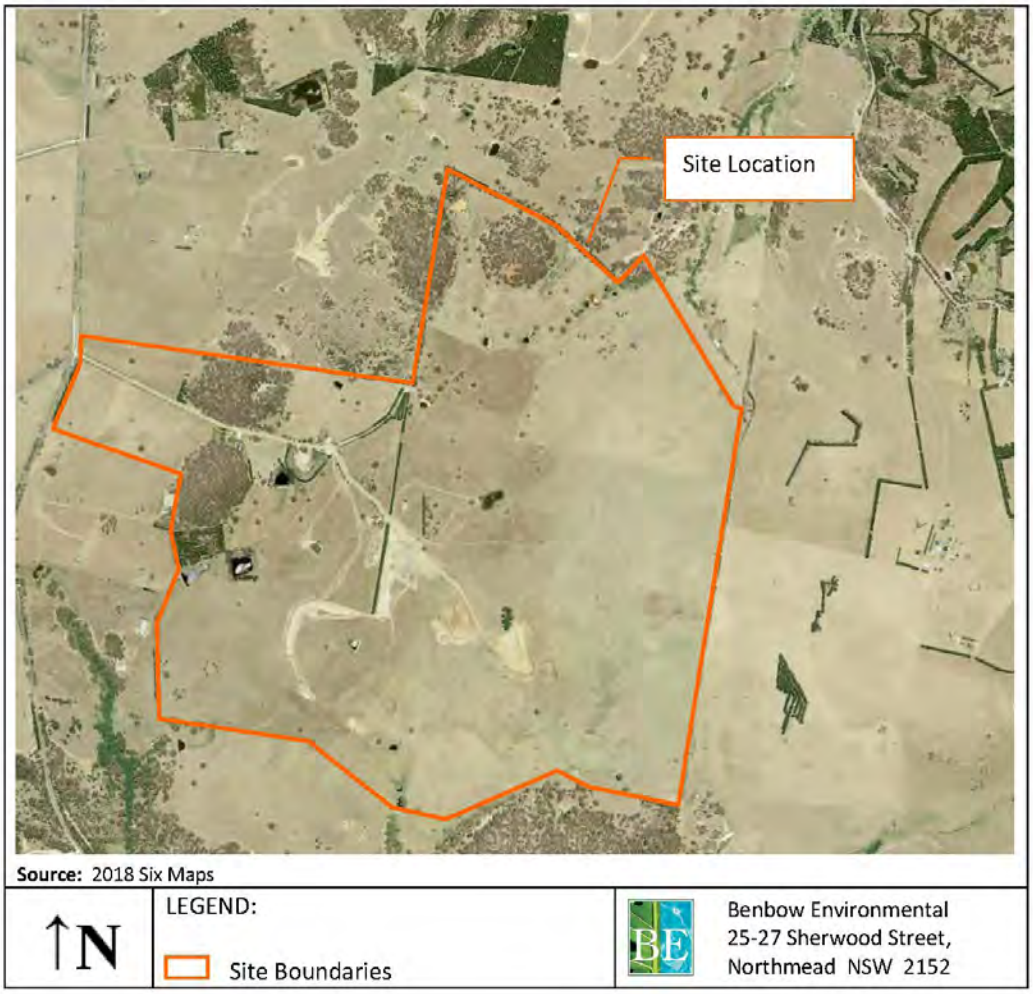
A glossary of the terminology utilised within this report has been provided in Attachment 1.

2. SITE IDENTIFICATION

2.1 SITE LOCATION

The Multiquip Aggregates facility is located on Lot 24 in DP 1001312, 5152 Oallen Ford Road, Bungonia. The site location is shown in Figure 2-1.

Figure 2-1: Site Location



3. NEAREST SENSITIVE RECEPTORS

The nearest sensitive receptors are listed in Table 3-1 and their location is shown in Figure 3-1 and Figure 3-2. These receptors are considered to represent the primary receptors likely to be affected by noise emissions associated with the quarry, and the numbering corresponds to the list in Appendix 3 of the Mod 2 Project Approval (as shown in Figure 3-1).

Table 3-1: Nearest Sensitive Receptors

Receptors	Address	Approximate Distance from house to nearest boundary (m)	Direction	Description
R1	346 Inverary Road, Bungonia	300	NE	Residential
R2	590 Inverary Road, Bungonia	870	E	Residential
R3	550 Inverary Road, Bungonia	700	E	Residential
R4	5025 Oallen Ford, Bungonia	670	SW	Residential
R5	5028 Oallen Ford, Bungonia	290	SW	Residential
R6	5046 Oallen Ford, Bungonia	35	W	Residential
R7	5100 Oallen Ford, Bungonia	35	W	Residential
R8	*Receiver no longer considered*	-	-	-
R9	5194 Oallen Ford, Bungonia	350	NW	Residential

Figure 3-1: Nearest Sensitive Residential Receptors – Diagram

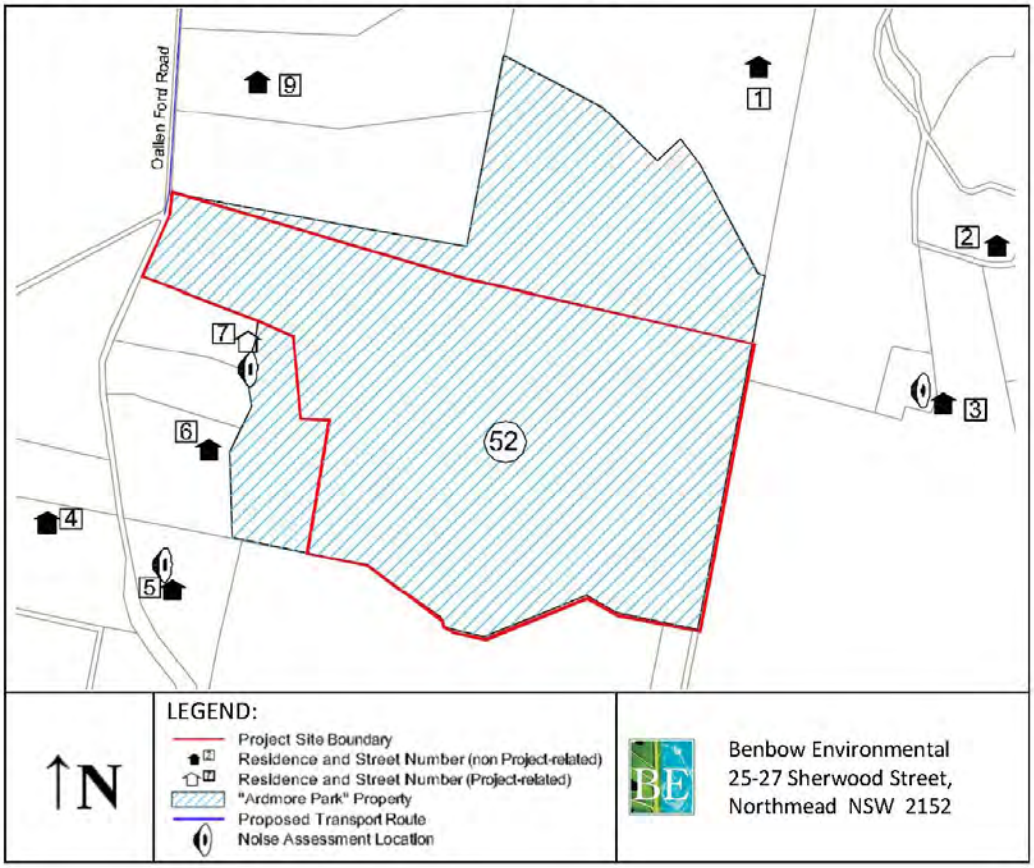
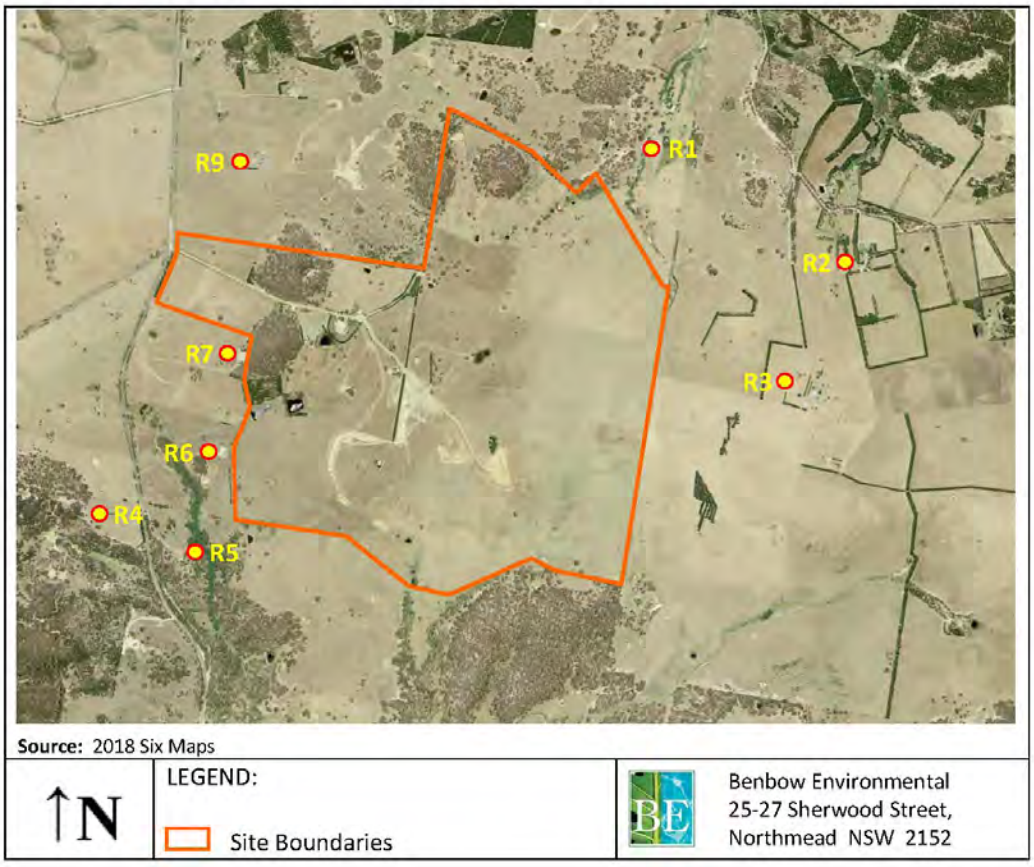


Figure 3-2: Nearest Sensitive Residential Receptors – Satellite



4. RELEVANT ACOUSTIC CRITERIA

The noise emissions from the operations and road traffic generation are required to satisfy the conditions of the Mod 2 approval as follows:

Operational Noise Impact Assessment Criteria

The Proponent shall ensure that the noise generated by the project, including the bypass road, does not exceed the noise impact assessment criteria in Table 1 at any residence or on more than 25 per cent of any privately-owned land.

Table 1: Noise Impact Assessment Criteria

Location	$L_{Aeq(15\ minutes)}$
Residence 1	35
Residence 2	35
Residence 3	35
Residence 4	35
Residence 5	35
Residence 6	36
Residence 8	35
Residence 9	36
Residence R1	35
Residence R2	35
Residence R3	36
Residence R4	35
Residence V1	38
Residence V2	36

Notes:
To interpret the locations referred to Table 1, see the figures in Appendix 3.
Noise generated by the project is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy.
The noise limits do not apply if the Proponent has an agreement with the relevant owner/s of these residences/land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement.

Traffic Noise Impact Assessment Criteria
3. The Proponent shall take all reasonable and feasible measures to ensure that the traffic noise generated by the project (after commencement of quarrying operations) does not exceed the traffic noise impact assessment criteria in Table 2.

Table 2: Noise Impact Assessment Criteria

Roads	Day/evening
Oallen Ford Road	55
Mountain Ash Road	55
Jerrara Road	55
Tarago Road	55
Windellama Road	55

Notes: Traffic noise generated by the project is to be measured in accordance with the relevant procedures in the EPA's Environmental Criteria for Road Traffic Noise.

5. NOISE MONITORING

Compliance noise monitoring was undertaken using attended noise measurements. By utilising attended noise measurements, contributions from the site, as well as from background noise sources such as birds and insects could be quantified. Details of the methodology and measured results have been detailed below.

5.1 INSTRUMENTATION

The attended noise level measurements were carried out using a Svantek SVAN957 Type 1 Precision Sound Level Meter (short-term monitoring). The instrument set was calibrated by a NATA accredited laboratory within two years of the measurement period and comply with AS IEC 61672.1–2004.

The instrument was set on A-weighted, fast response and logged noise levels over fifteen minute statistical intervals. The microphone was positioned between 1.2 and 1.5 m above ground level and was fitted with a windsock. The instrument was calibrated using a Rion NC-73 acoustic calibrator before and after the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations.

QA/QC procedures as applied to the measurement and analysis of noise levels are presented in the Attachments section of this report as well as instrument calibration certificates.

5.2 SITE ATTENDED NOISE MEASUREMENTS

Attended measurements were taken at the boundaries with nearby residential receivers and at 550 Inverary Road, Bungonia as shown in Figure 5-1. Observations from the site showed that the background and ambient noise levels received contributions from noise sources including birds, insects, aeroplanes, distant road traffic and light winds through vegetation. Noise levels of the site contribution were audible during some of the attended measurements.

Attended noise measurements were taken on the site on Thursday 21st June 2018. On this morning, from observations on site and weather and temperature data, Benbow Environmental believes a temperature inversion was taking place before 10am. Weather data from the day is displayed in the appendix while measurements after 10am have been displayed in this report.

For several months, the rock crushing equipment or hard rock processing equipment has not been operational. Sand extraction activities have continued, with production peaking at 1000 T/day. During all attended measurements conducted on the 21st of June 2018, sand washing and extraction were occurring, while rock crushing equipment was not operational. The list of equipment operational is shown in Table 5-1. Wind was less than 5 m/s throughout the attended measurements.

Table 5-1: Operational Equipment

Equipment	21/6/18 measurements
CDE 'Ecowash 151' Sand Wash Plant x 1	✓
Commander Screen and Feeder x 1	✓
Hyundai HL770 Front End Loader x 1	✓
20T Excavator x 1	✓
40T Dump Trucks x 3	✓
D85 Bulldozer	✓
Komatsu WA470 Front End Loader x 1	✓
50000L Water Cart	✓
Kenworth 610 Trucks x 2	✓
45T Excavator x 1	✓
Precision screen tracked stacker x 1	✓
8 inch water pump	✓
130 Kva Diesel Generator	✓
Concrete Pump	✓
2-3 Concrete Agitator Trucks	✓
Fuel Truck	✓
1 x Farm Tractor	✓

✓Operating
×Not Operating

5.3 MEASUREMENT RESULTS

The results of the short-term attended noise monitoring on site are displayed in Table 5-2. The table displays the Leq, L90, L10 and L1 levels from the noise measurements. These descriptors refer to the total noise measurement, including all noise sources such as birds, insects, dogs, aeroplanes and road traffic as well as site noise. For more details, refer to the glossary in attachment 1.

Each attended measurement includes an "Estimated L_{Aeq} Site at monitoring point". This descriptor refers to the equivalent continuous sound level of the site noise sources alone. As per Section 7 of the Noise Policy for Industry, "A noise limit applies to the noise from a particular development/activity and not to general ambient noise". The estimations are derived using the numerical results of the total measurements, by taking into account all audible noise sources during the measurement and noting sound pressure levels when key noise sources are audible or non-audible. The estimated L_{Aeq} level from the site is either equal to, or less than the total measured L_{Aeq} noise level.

The "*Estimated L_{Aeq} Site at monitoring point*" is the estimated site L_{Aeq} contribution at the measurement location. The "*Estimated L_{Aeq} Site at compliance point*" is the estimated site L_{Aeq} contribution at the least affected point on the most affected 25% area of the nearest residential property as per section 4 of Mod 2.

Figure 5-1: Attended Measurement Locations

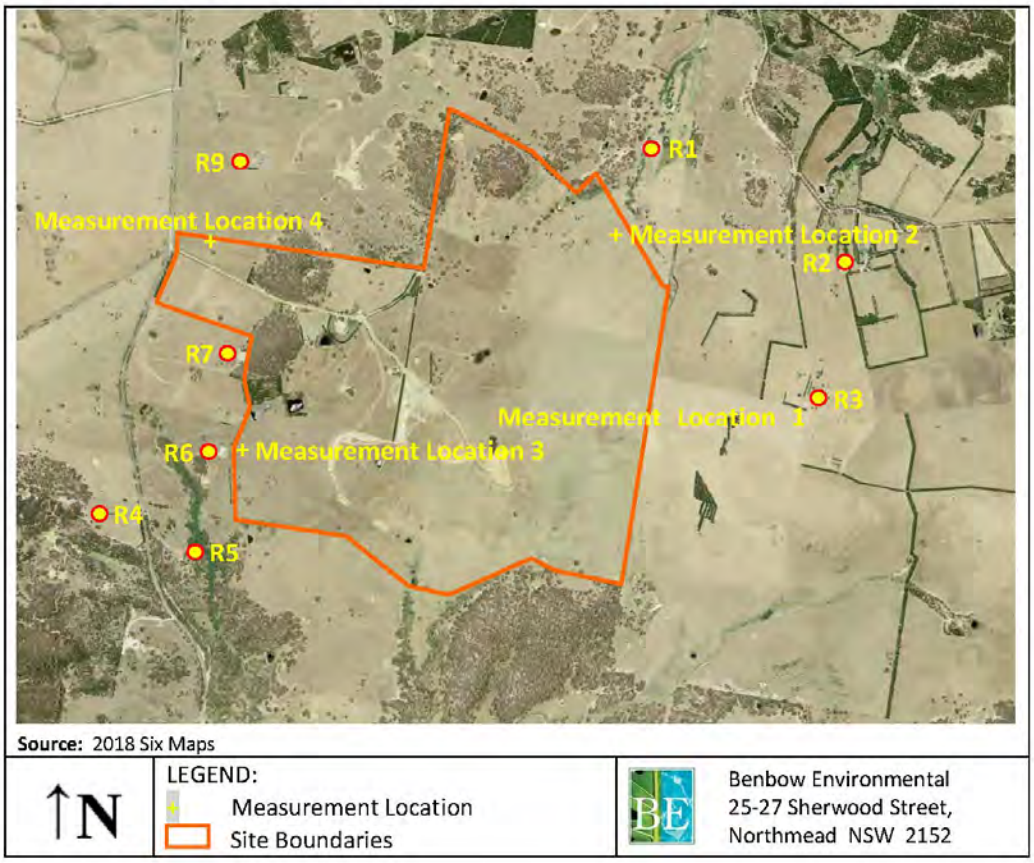


Table 5-2: Operator Attended Noise Measurements, dB(A)

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Measurement Location 1 Thursday 21/06/2018 9:38	44	38	46	52	Birds < 57 dB(A) **Water pump, constant noise < 49 dB(A)** **Excavator, scraping < 51 dB(A)** **Truck revving < 43 dB(A)** **Reverse alarm < 42 dB(A)** **Estimated L_{Aeq} Site at monitoring point < 42 dB(A)** **Estimated L_{Aeq} Site at compliance point < 42 dB(A)**
Measurement Location 2 Thursday 21/06/2018 10:12	42	29	46	53	Birds < 58 dB(A) Insects < 30 dB(A) **Distant water pump constant noise, only heard occasionally, < 30 dB(A)** **Estimated L_{Aeq} Site at monitoring point < 26 dB(A)** **Estimated L_{Aeq} Site at compliance point < 23 dB(A)**
Measurement Location 3 Thursday 21/06/2018 10:48	33	27	34	41	Birds < 57 dB(A) Insects < 30 dB(A) Cow < 35 dB(A) Off-site crushing noise < 35 dB(A) Distant road traffic < 42 dB(A) **Water pump, fairly constant noise < 32 dB(A)** **Dump Truck < 32 dB(A)** **Reverse alarm < 23 dB(A)** **Estimated L_{Aeq} Site at monitoring point < 27 dB(A)** **Estimated L_{Aeq} Site at compliance point < 26 dB(A)**
Measurement Location 4 Thursday 21/06/2018 11:16	40	33	43	51	Birds < 58 dB(A) Insects < 38 dB(A) Sheep < 37 dB(A) Distant road traffic < 50 dB(A) **Water pump, constant noise, but only heard occasionally < 27 dB(A)** **Trucks driving to/from site < 49 dB(A)** **Estimated L_{Aeq} Site at monitoring point < 32 dB(A)** **Estimated L_{Aeq} Site at compliance point < 31 dB(A)**
Measurement Location 1 Thursday 21/06/2018 11:46	37	31	40	45	Birds < 58 dB(A) Rooster < 38 dB(A) Insects < 34 dB(A) Aeroplane < 42 dB(A) Light wind gust < 34 dB(A) **Water pump, constant noise < 39 dB(A)** **Reverse alarm < 39 dB(A)** **Estimated L_{Aeq} Site at monitoring point < 34 dB(A)** **Estimated L_{Aeq} Site at compliance point < 34 dB(A)**

Table 5-2: Operator Attended Noise Measurements, dB(A)

Location &	L_{eq}	L_{90}	L_{10}	L_1	Comments
Measurement Location 1 Thursday 21/06/2018 13:10	48	29	52	58	All site equipment non-operational. Birds < 64 dB(A) Road Traffic < 38 dB(A) Aeroplane < 43 dB(A) Light wind gust < 38 dB(A) **Estimated L_{Aeq} Site at monitoring point - inaudible** **Estimated L_{Aeq} Site at compliance point - inaudible**

From the attended site results in Table 5-2, it can be seen that compliance with the criteria was easily achieved at measurement points 2, 3 and 4 on the site boundaries. When it is considered that the compliance points are actually further from the site boundary on the property in question, the contribution noise levels are predicted to be even lower.

The 35 dB(A) criteria at location 1 was met during the 11:46am late morning attended measurement. i.e. the estimated L_{Aeq} site at the monitoring point was < 34 dB(A), compared to the criteria of 35 dB(A). During the 9:38am early morning measurement, the estimated L_{Aeq} site contribution was determined to be < 42 dB(A).

As mentioned in section 5.2, Benbow Environmental believes a temperature inversion was taking place on the morning of 21 June 2018 up until 10:00am. Benbow Environmental believes that the result of the compliance measurement at 9:38am was primarily due to meteorological factors and should not be considered an exceedance of the noise limits at that receiver in both the Project Approval and EPL. We base this conclusion on our observations that a temperature inversion was likely taking place, and that surveys conducted later in the day at all sites demonstrated clear compliance. This is despite the fact that for all subsequent surveys (with the exception of the 1:30pm survey) the same plant and machinery were undertaking the same activities. We note this includes the follow up survey at 11:30am at receiver 3 (monitoring point 1), again with all plant active. It is therefore the opinion of Benbow Environmental that the 9:30am measurement cannot be considered representative and therefore should be discounted.

6. CONCLUDING REMARKS

Benbow Environmental was engaged to undertake the June 2018 noise compliance assessment of the Multiquip Aggregates facility at 5152 Oallen Ford Road, Bungonia. This compliance assessment follows on from the March 2018 noise compliance assessment (181023_Noise_Rev4). Noise impacts from the site were assessed against the noise limits in the Mod 2 approval.

As part of the assessment, attended noise monitoring was conducted at three points along the site boundary and at a residential property 550 Inverary Road, Bungonia. Compliance with the site criteria was achieved at all representative measurements at the three measurement points on site and at measurement location 1.

This concludes the report.

Peter Gangemi
Senior Acoustic Engineer

R T Benbow
Principal Consultant

7. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of Multiquip Aggregates, as per our agreement for providing environmental services. Only Multiquip Aggregates is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by Multiquip Aggregates for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

Attachment 1: Glossary of Noise Terminology

'A' FREQUENCY WEIGHTING

The 'A' frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child's scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The 'A' weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.

AMBIENT NOISE

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period 'T' (L_{Aeq},T).

AUDIBLE

Audible refers to a sound that can be heard. There are a range of audibility grades, varying from "barely audible", "just audible" to "clearly audible" and "prominent".

BACKGROUND NOISE LEVEL

Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period 'T' (L_{A90}, T). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15 minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.

'C' FREQUENCY WEIGHTING

The 'C' frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

DECIBEL

The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from $10 \log_{10} (10^{(50/10)} + 10^{(50/10)})$ and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, LAeq

Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the LAeq level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

'F'(FAST) TIME WEIGHTING

Sound level meter design-goal time constant which is 0.125 seconds.

FREQUENCY

The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

IMPULSE NOISE

An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

MAXIMUM NOISE LEVEL, LAFmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.

NOISE

Noise is unwanted, harmful or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid or solid. Noise usually includes vibration as well as sound.

OFFENSIVE NOISE

Reference: Dictionary of the NSW Protection of the Environment Operations Act (1997). "Offensive Noise means noise:
(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

SOUND ATTENUATION

A reduction of sound due to distance, enclosure or some other device. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.

SOUND PRESSURE

The rms sound pressure measured in pascals (Pa). A pascal is a unit equivalent to a newton per square metre (N/m^2).

SOUND PRESSURE LEVEL, Lp

The level of sound measured on a sound level meter and expressed in decibels (dB). Where $L_P = 10 \log_{10} (Pa/Po)^2$ dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20×10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.

SOUND POWER

The rms sound power measured in watts (W). The watt is a unit defined as one joule per second. A measures the rate of energy flow, conversion or transfer.

SOUND POWER LEVEL, Lw

The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. $Lw = Lp + 10 \log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

STATISTICAL NOISE LEVELS, Ln.

Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example:-

- The noise level, in decibels, exceeded for 1 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF1}, T. This may be used for describing short-term noise levels such as could cause sleep arousal during the night.
- The noise level, in decibels, exceeded for 10 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF10}, T. In most countries the LAF10, T is measured over periods of 15 minutes, and is used to describe the average maximum noise level.
- The noise level, in decibels, exceeded for 90 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF90}, T. In most countries the LAF90, T is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

STEADY NOISE

Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1–1997).

Attachment 2: QA/QC Procedures

CALIBRATION OF SOUND LEVEL METERS

A sound level meter requires regular calibration to ensure its measurement performance remains within specification. Benbow Environmental sound level meters are calibrated by a National Association of Testing Authority (NATA) registered laboratory or a laboratory approved by the NSW Environment Protection Authority (EPA) every two years and after each major repair, in accordance with AS 1259–1990.

The calibration of the sound level meter was checked immediately before and after each series of measurements using an acoustic calibrator. The acoustic calibrator provides a known sound pressure level, which the meter indicates when the calibrator is activated while positioned on the meter microphone.

The sound level meters also incorporate an internal calibrator for use in setting up. This provides a check of the electrical calibration of the meter, but does not check the performance of the microphone. Acoustical calibration checks the entire instrument including the microphone. Calibration certificates for the instrument sets used have been included as Attachment 3.

CARE AND MAINTENANCE OF SOUND LEVEL METERS

Noise measuring equipment contains delicate components and therefore must be handled accordingly. The equipment is manufactured to comply with international and national standards and is checked periodically for compliance. The technical specifications for sound level meters used in Australia are defined in Australian Standard AS 1259 – 1990 *Sound Level Meters*.

The sound level meters and associated accessories are protected during storage, measurement and transportation against dirt, corrosion, rapid changes of temperature, humidity, rain, wind, vibration, electric and magnetic fields. Microphone cables and adaptors are always connected and disconnected with the power turned off. Batteries are removed (with the instrument turned off) if the instrument is not to be used for some time.

INVESTIGATION PROCEDURES

All investigative procedures were conducted in accordance with AS 1055.1–1997 *Acoustics – Description and Measurement of Environmental Noise* Part 1: *General Procedures*.

The following information was recorded and kept for reference purposes:

- type of instrumentation used and measurement procedure conducted;
- description of the time aspect of the measurements, ie. measurement time intervals; and
- positions of measurements and the time and date were noted.

As per AS 1055.1–1997, all measurements were carried out at least 3.5 m from any reflecting structure other than the ground. The preferred measurement height of 1.2 m above the ground was utilised. A sketch of the area was made identifying positions of measurement and the approximate location of the noise source and distances in meters (approx.).

ATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

The attended short-term noise monitoring was carried out using a SVANTEK SVAN957 Class 1 Precision Sound Level Meter. The instrument was calibrated by a NATA accredited laboratory within two years of the measurement period. The instrument sets comply with AS 1259 and was set on A-weighted, fast response.

The microphone was positioned at 1.2 to 1.5 metres above ground level and was fitted with windsocks. The instrument was calibrated using a B&K 4230 sound level calibrator prior and subsequent to the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 3.

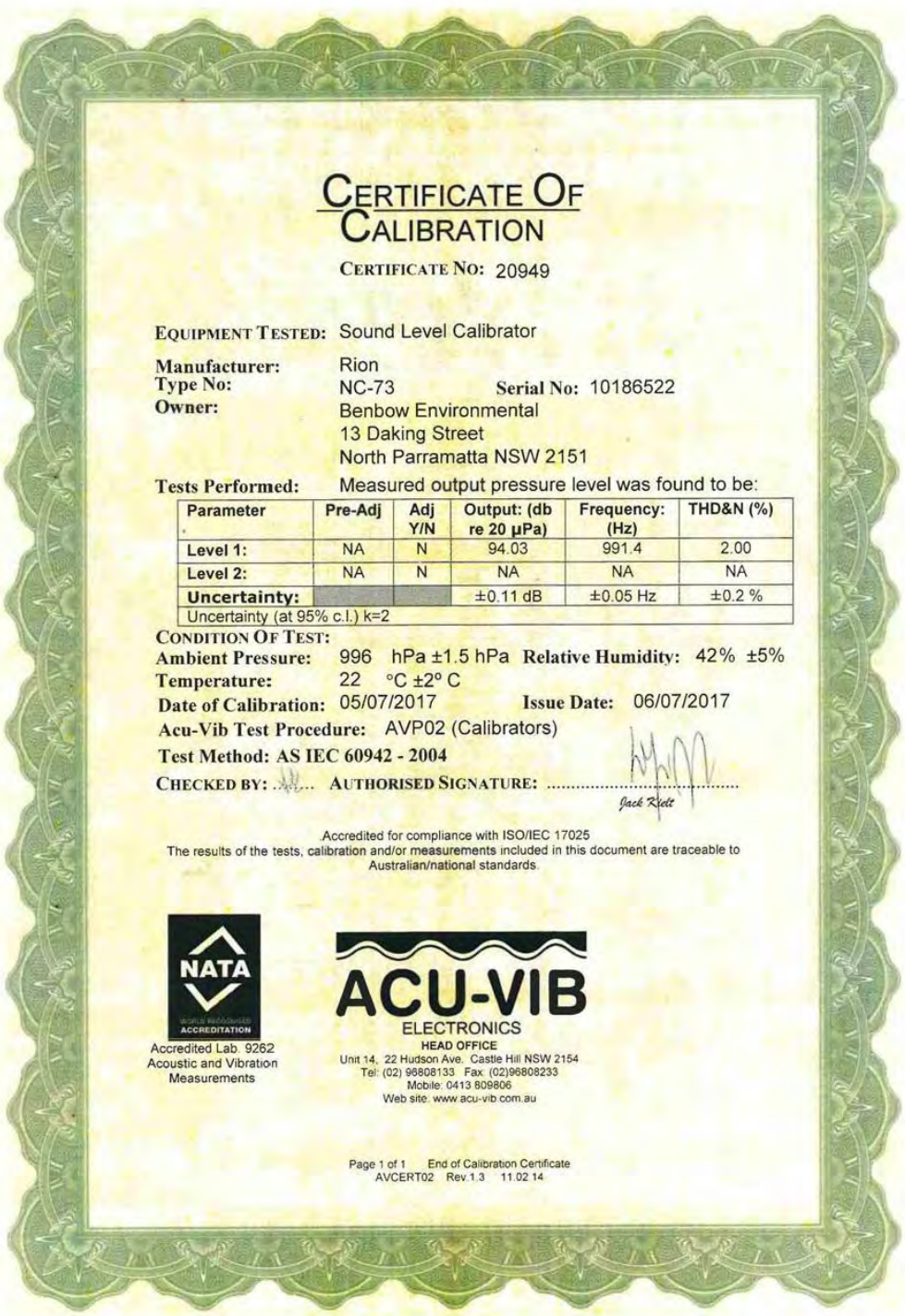
WEATHER CONDITIONS

During the monitoring period, weather was predominantly clear and calm.

METHODOLOGY

The attended noise measurements were carried out generally in accordance with Australian Standard AS 1055–1997 *Acoustics – Description and Measurement of Environmental Noise.*

Attachment 3: Calibration Certificates



CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 20949

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-73 **Serial No:** 10186522
Owner: Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

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	94.03	991.4	2.00
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: 996 hPa ±1.5 hPa **Relative Humidity:** 42% ±5%
Temperature: 22 °C ±2° C
Date of Calibration: 05/07/2017 **Issue Date:** 06/07/2017
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004
CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....
Jack Rielt

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.

NATA
ACCREDITATION
Accredited Lab. 9262
Acoustic and Vibration Measurements

ACU-VIB
ELECTRONICS
HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
Web site: www.acu-vib.com.au

Page 1 of 1 End of Calibration Certificate
AVCERT02 Rev 1.3 11.02.14

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 20815 & FILT 4015

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15335
Microphone Type:	7052E	**Serial No:**	40814
Filter Type:	1/3 Octave	**Serial No:**	15335
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Benbow Environmental 13 Daking Street North Parramatta NSW 2151		
Ambient Pressure:	1014 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	53% ±5%
Date of Calibration:	14/06/2017	**Issue Date:**	16/06/2017
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....
Jack Rich

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.

NATA ACCREDITATION

Accredited Lab. No. 9262
Acoustic and Vibration Measurements

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HEAD OFFICE
Unit 14, 22 Hudson Ave Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
web site: www.acu-vib.com.au

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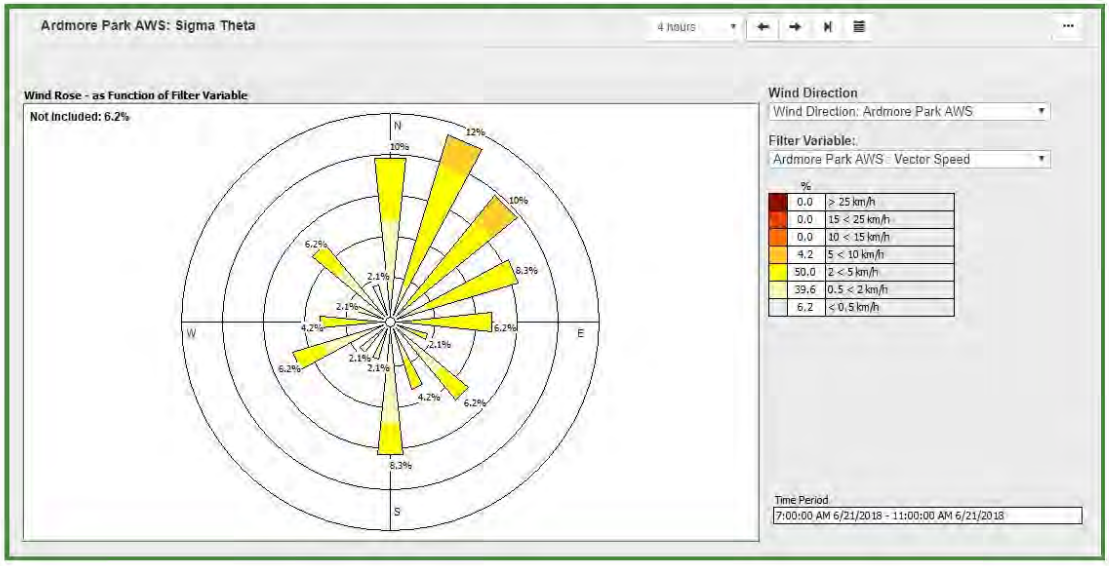
Attachment 4: Weather Observations

Table 1: Weather observations from Ardmore Park AWS 21/6/2018

Time	Temperature 2 m (°C)	Temperature 10 m (°C)	Vector Angle	Vector Speed km/h	Wind Direction (°)	Wind Speed km/h
0:00	2.5	3.18	212	3.92	210	3.83
1:00	2.88	3.49	229	3.15	228.5	3.31
2:00	1.2	2.27	31.6	3.11	31.75	3.15
3:00	-0.1	0.48	131	4.12	100.5	4.32
4:00	-0.3	0.32	24.8	5.04	25.9	5.11
5:00	-1.05	0.067	17.7	3.7	19.9	3.62
6:00	-1.25	0.28	224	2.79	223	2.84
7:00	-0.52	0.58	206	2.17	170	2.47
8:00	0.3	0.9	155	2.22	191.25	2.07
9:00	3.25	3.67	154	1.03	167	1.34
10:00	6.93	6.8	44.8	3.03	70.7	3.82
11:00	8.9	8.61	69.7	4.25	62.25	6.06
12:00	11.5	10.5	84.6	15.2	80.8	15.3
13:00	12	11	93.7	12.2	102	12.1
14:00	12.3	11.4	82.3	11.6	75.9	11.6

Figure 1: Wind observations from Ardmore Park AWS 21/6/2018



BUNGONIA BY-PASS ROAD NOISE COMPLIANCE REPORT FOR MULTIQUIP AGGREGATES 5152 OALLEN FORD ROAD, BUNGONIA

Prepared for: Alexander Cox, Environmental Officer
Multiquip Aggregates

Prepared by: Peter Gangemi, Senior Acoustic Engineer
R T Benbow, Principal Consultant

Report No: 181023-06_Rev4
October 2018
(Released: 31 October 2018)

Benbow
ENVIRONMENTAL

Engineering a Sustainable Future for Our Environment

Head Office: 25-27 Sherwood Street Northmead NSW 2152 AUSTRALIA
Tel: 61 2 9896 0399 Fax: 61 2 9896 0544
Email: admin@benbowenviro.com.au
Visit our website: www.benbowenviro.com.au

DOCUMENT CONTROL

Prepared by:	Position:	Signature:	Date:
Peter Gangemi	Senior Acoustic Engineer		31 October 2018

Reviewed by:	Position:	Signature:	Date:
Emma Hansma	Senior Engineer		31 October 2018

Approved by:	Position:	Signature:	Date:
R T Benbow	Principal Consultant		31 October 2018

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Benbow
ENVIRONMENTAL
A.B.N. 17 160 013 641

Head Office:
25-27 Sherwood Street Northmead NSW 2152 Australia
P.O. Box 687 Parramatta NSW 2124 Australia
Telephone: +61 2 9896 0399 Facsimile: +61 2 9896 0544
E-mail: admin@benbowenviro.com.au
Visit our Website at www.benbowenviro.com.au

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Attachment 1: Glossary of Noise Terminology
Attachment 2: QA/QC Procedures
Attachment 3: Calibration Certificates

1. INTRODUCTION

Benbow Environmental was engaged to undertake a noise compliance assessment of the private by-pass road around the village of Bungonia which provides access to and from the Multiquip Aggregates facility for material deliveries and staff vehicles. The by-pass is located at 2222 Mountain Ash Road, Bungonia and 5513 Oallen Ford Road, Bungonia. Noise monitoring was conducted on 21 September 2018.

As part of the assessment, attended noise monitoring was conducted at three locations along the by-pass road, in the vicinity of the nearest receiver. The noise impacts of the by-pass road are assessed against the project criteria.

1.1 SCOPE OF WORKS

The scope of works for this study was to undertake a noise compliance assessment for the Multiquip Aggregates by-pass road.

The scope of the study was limited to the following:

- Attended noise monitoring along the by-pass road adjoining the nearest potentially affected receivers;
- Analysis of all noise data and determination of noise contribution from the road and whether it complies with the noise limits;
- Preparation of a report compiling results; and
- Statement of current environmental noise compliance.

Supporting documentation has been included within the Attachments section of this report.

A glossary of the terminology utilised within this report has been provided in Attachment 1.

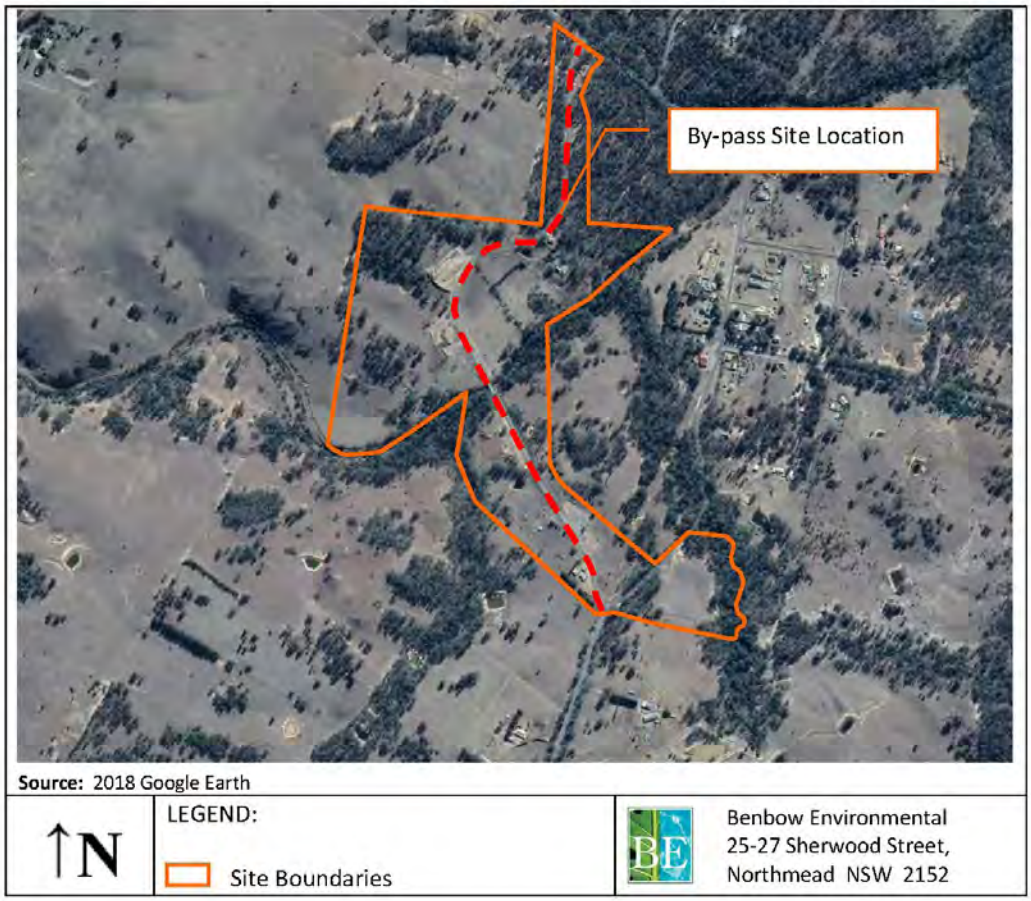
2. SITE IDENTIFICATION

2.1 BUNGONIA BY-PASS ROAD LOCATION

Multiquip Quarries operates the Ardmore Park Quarry. The approved product delivery route from the quarry to the Hume Highway includes a by-pass of the Bungonia Village referred to as the "Bungonia by-pass road". A copy of the land owned by Multiquip Quarries and the route of the by-pass road is displayed in Figure 2-1.

The by-pass road is located at 2222 Mountain Ash Road, Bungonia and 5513 Oallen Ford Road, Bungonia.

Figure 2-1: Site Location



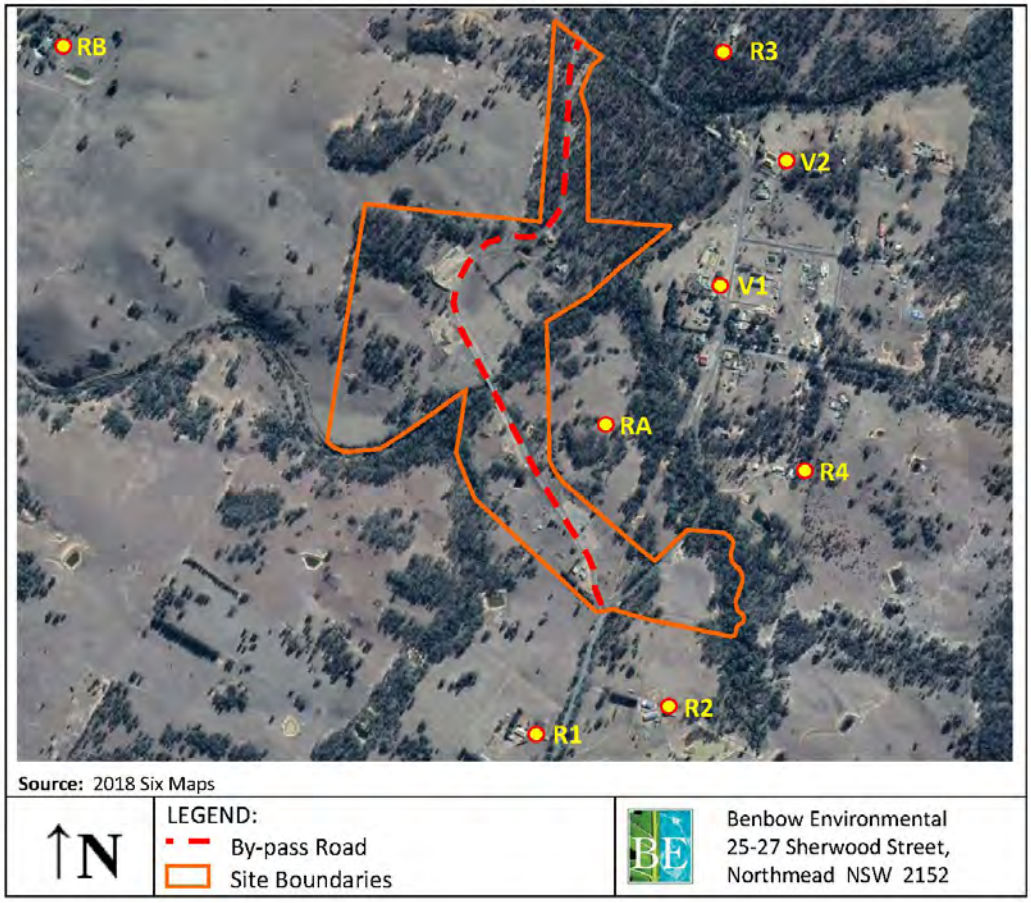
3. NEAREST SENSITIVE RECEPTORS

The nearest sensitive receptors are listed in Table 3-1 and their location is shown in Figure 3-1. These receptors are considered to represent the primary receptors likely to be affected by noise emissions associated with the by-pass. The numbering of receivers R1-R4 and V1-V2 corresponds to the list in Appendix 3 of the Mod 2 Project Approval. RA and RB did not feature in the Mod 2 Project Approval, but have been included here to provide additional reporting information.

Table 3-1: Nearest Sensitive Receptors

Receptors	Address	Closest Distance from house to by-pass road (m)	Direction	Description
R1	5477 Oallen Ford Road, Bungonia	330	S	Residential
R2	5492 Oallen Ford Road, Bungonia	260	SE	Residential
R3	1455 Jerrara Road, Bungonia	270	NE	Residential
R4	5544 Oallen Ford, Bungonia	470	E	Residential
V1	28-30 King Street, Bungonia	370	E	Residential
V2	1 Eliza Champion Street, Bungonia	430	E	Residential
RA	2108 Mountain Ash Road, Bungonia	1020	E	Residential
RB	5522 Oallen Ford, Bungonia	130	NW	Residential

Figure 3-1: Nearest Sensitive Residential Receptors



4. RELEVANT ACOUSTIC CRITERIA

The noise emissions from the traffic by-pass are required to satisfy the conditions of the Mod 2 approval as follows:

Operational Noise Impact Assessment Criteria

The Proponent shall ensure that the noise generated by the project, including the by-pass road, does not exceed the noise impact assessment criteria in Table 1 at any residence or on more than 25 per cent of any privately-owned land.

Table 1: Noise Impact Assessment Criteria

Location	$L_{Aeq(15\ minutes)}$
Residence 1	35
Residence 2	35
Residence 3	35
Residence 4	35
Residence 5	35
Residence 6	36
Residence 8	35
Residence 9	36
Residence R1	35
Residence R2	35
Residence R3	36
Residence R4	35
Residence V1	38
Residence V2	36

Notes:
To interpret the locations referred to Table 1, see the figures in Appendix 3.
Noise generated by the project is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy.
The noise limits do not apply if the Proponent has an agreement with the relevant owner/s of these residences/land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement.

5. NOISE MONITORING

Compliance of the quarry related traffic travelling along the by-pass road was determined using attended noise measurements of truck pass by events along the road. Details of the methodology and measured results have been detailed below.

5.1 INSTRUMENTATION

The attended noise level measurements were carried out using a Svantek SVAN957 Type 1 Precision Sound Level Meter (short-term monitoring). The instrument set was calibrated by a NATA accredited laboratory within two years of the measurement period and comply with AS IEC 61672.1–2004.

The instrument was set on A-weighted and fast response settings. The microphone was positioned between 1.2 and 1.5 m above ground level and was fitted with a windsock. The instrument was calibrated using a Rion NC-73 acoustic calibrator before and after the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations.

QA/QC procedures as applied to the measurement and analysis of noise levels are presented in the Attachments section of this report as well as instrument calibration certificates.

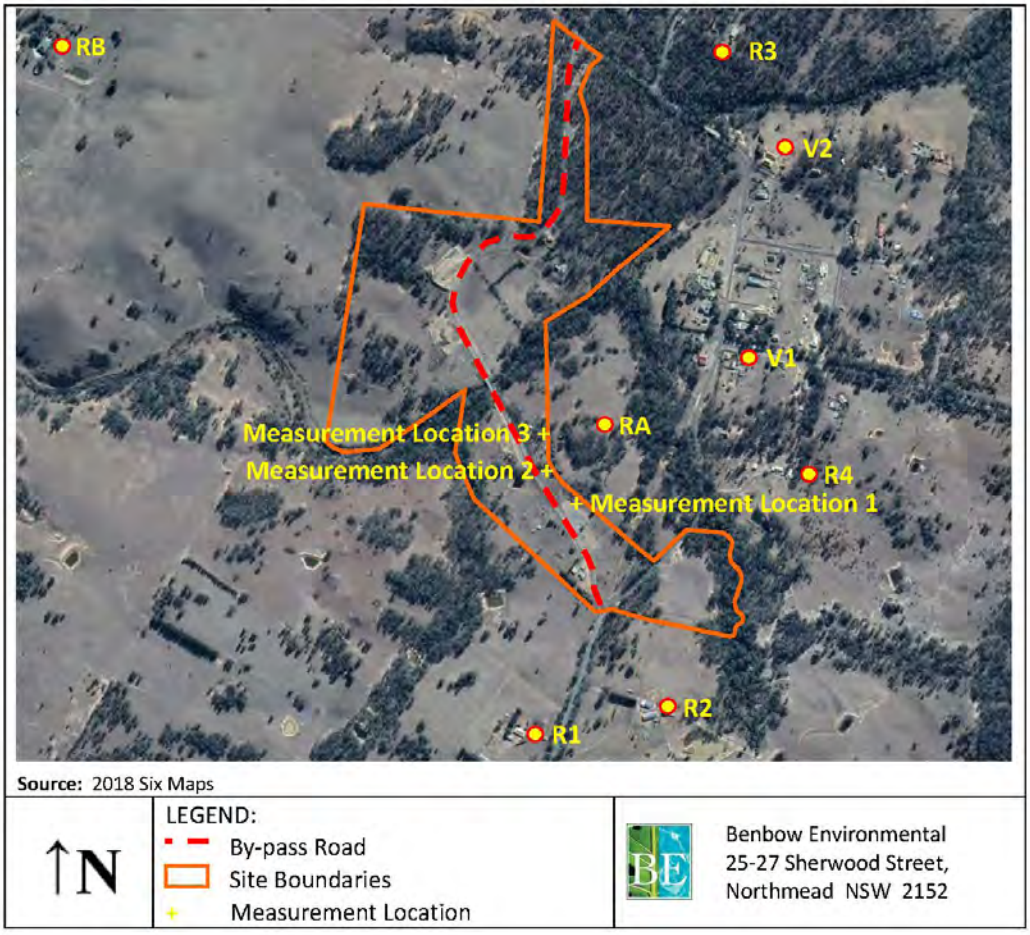
5.2 SITE ATTENDED NOISE MEASUREMENTS

Attended measurements were taken at three points along the by-pass road. A total of five attended measurements were conducted, encompassing northbound and southbound truck directions, and three measurement locations.

5.3 MEASUREMENT RESULTS

The results of the short-term attended noise monitoring on site are displayed in Table 5-1. The table displays the L_{Aeq} and L_{AMax} noise levels for the measurements. Measurements captured the 30 seconds during each truck pass by. The 30 second measurements ensured that the noise contributions captured were from passing vehicles and not from extraneous sources.

Figure 5-1: Attended Measurement Locations



Source: 2018 Six Maps

↑N

LEGEND:
By-pass Road
Site Boundaries
Measurement Location

Benbow Environmental
25-27 Sherwood Street,
Northmead NSW 2152

Table 5-1: Operator Attended Noise Measurements, dB(A)

Location & Date/Time	L_{Aeq}	L_{AMax}	Duration	Comments
Measurement Location 1 Friday 21/09/2018 14:31	57	64	30 seconds	Truck travelling southbound, uphill
Measurement Location 1 Friday 21/09/2018 14:39	54	62	30 seconds	Truck travelling northbound, downhill
Measurement Location 2 Friday 21/09/2018 14:57	56	66	30 seconds	Truck travelling southbound, uphill
Measurement Location 3 Friday 21/09/2018 15:19	47	52	30 seconds	Truck travelling southbound, uphill
Measurement Location 2 Friday 21/09/2018 15:42	54	62	30 seconds	Truck travelling northbound, downhill

6. NOISE IMPACT ASSESSMENT

Attended measurements alongside the by-pass road gave accurate noise contributions from the by-pass at those points. However, compliance measurements could not be conducted at all considered receivers due to the number of receivers involved, access constraints and background noise contributions at those receivers.

An operational noise model was therefore created, with the sound power levels of the trucks inserted, based on the attended measurements carried out in section 5.3.

An outline of the predictive noise modelling methodology and operational noise modelling scenarios has been provided in this section of the report.

6.1 MODELLING METHODOLOGY

Predictive Noise Modelling was carried out using the ISO9613-2 algorithm within SoundPLAN v7.3. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for numerous sites, and is recognised by regulatory authorities throughout Australia.

Inputs into the noise model include topographical features of the area, ground absorption and predicted noise sources. Receivers were included to predict the noise emissions of the proposed development at the nearest potentially affected residences.

The modelling scenario has been carried out using the L_{Aeq} descriptor. Using the model, noise levels were predicted at the potentially most affected receivers to determine the noise impact against the noise criteria.

6.2 NOISE SOURCES

The sound power levels for the identified noise sources associated with the by-pass have been taken from on-site measurements carried out in section 5.3.

6.2.1 Modelling Scenario

One scenario was modelled for operational noise emissions. The scenario considers two heavy vehicle movements northbound and two heavy vehicle movements occurring southbound in a worst case 15 minute scenario.

Table 6-1: Modelled Noise Sources

Scenario	Description
Scenario 1	The scenario includes the following per worst-case 15 minute period: • Two heavy vehicle movements southbound; and • Two heavy vehicle movements northbound.

Figure 6-1 shows the locations of the noise sources for the operational scenarios.

Figure 6-1: Scenarios 1 – By-pass Route

6.2.2 Modelling Assumptions

The relevant assessment period for operational noise emissions is 15 minutes; therefore noise source durations detailed throughout the following assumptions section should be considered per 15 minute period in view of potential noise impacts under worst-case scenarios. Each assessment-specific assumption has been detailed below:

- Off-site topographical information has been obtained from Google Earth and implemented in SoundPLAN v.7.3.
- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled considering different ground factors ranging from 0 to 1. The surrounding grasslands and bushland areas have been modelled with an absorption factor of 1.0.
- Two heavy vehicles are assumed to travel northbound, and two heavy vehicles are assumed to travel southbound during a single 15 minute period. Vehicles are assumed to travel at 50 km/hr.
- All residential receivers were modelled at 1.5 m above ground level at the most noise-affected point within 30 m of the residential dwelling.

6.3 PREDICTED NOISE LEVELS – BY-PASS ROUTE

Noise levels at the nearest receptors have been calculated and results of the predictive noise modelling are shown in Table 6-2.

Table 6-2: Predicted Noise Levels – By-pass Route dB(A)

Receptor	Project Criteria $L_{eq(15\ minute)}$	Predicted Noise Level
R1	35	31 ✓
R2	35	32 ✓
R3	36	33 ✓
R4	35	31 ✓
V1	38	34 ✓
V2	36	32 ✓
RA	N/A	38
RB	N/A	24

✓Complies ✖ Non-compliance

The modelled scenarios are predicted to comply with the noise criteria at all receptors considered in the Mod 2 Project Approval. Noise levels are predicted to be 38 dB(A) at receiver RA, which is not a permanent dwelling; it is a caravan that has been parked at that spot and is seldom occupied. Noise levels are predicted to be 24 dB(A) at receiver RB.

7. CONCLUDING REMARKS

Benbow Environmental was engaged to undertake a noise compliance assessment of the private by-pass road around the village of Bungonia. The by-pass is located at 2222 Mountain Ash Road, Bungonia and 5513 Oallen Ford Road, Bungonia.

As part of the assessment, attended noise monitoring was conducted at three locations along the by-pass road, in the vicinity of the nearest receivers. The noise impacts of the by-pass road are assessed against the project criteria.

Compliance with the criteria for the by-pass road was achieved at all receivers considered in the Mod 2 Project Approval.

This concludes the report.

Peter Gangemi
Senior Acoustic Engineer

R T Benbow
Principal Consultant

8. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of Multiquip Aggregates, as per our agreement for providing environmental services. Only Multiquip Aggregates is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by Multiquip Aggregates for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

Attachment 1: Glossary of Noise Terminology

'A' FREQUENCY WEIGHTING

The 'A' frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child's scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The 'A' weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.

AMBIENT NOISE

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period 'T' (L_{Aeq},T).

AUDIBLE

Audible refers to a sound that can be heard. There are a range of audibility grades, varying from "barely audible", "just audible" to "clearly audible" and "prominent".

BACKGROUND NOISE LEVEL

Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period 'T' (L_{A90}, T). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15 minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.

'C' FREQUENCY WEIGHTING

The 'C' frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

DECIBEL

The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from 10 $\log_{10}$ ($10^{(50/10)}$ + $10^{(50/10)}$) and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, LAeq

Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the LAeq level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

'F'(FAST) TIME WEIGHTING

Sound level meter design-goal time constant which is 0.125 seconds.

FREQUENCY

The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

IMPULSE NOISE

An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

MAXIMUM NOISE LEVEL, LAFmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.

NOISE

Noise is unwanted, harmful or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid or solid. Noise usually includes vibration as well as sound.

OFFENSIVE NOISE

Reference: Dictionary of the NSW Protection of the Environment Operations Act (1997). "Offensive Noise means noise:
(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

SOUND ATTENUATION

A reduction of sound due to distance, enclosure or some other device. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.

SOUND PRESSURE

The rms sound pressure measured in pascals (Pa). A pascal is a unit equivalent to a newton per square metre (N/m^2).

SOUND PRESSURE LEVEL, Lp

The level of sound measured on a sound level meter and expressed in decibels (dB). Where $L_P = 10 \log_{10} (Pa/Po)^2$ dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20×10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.

SOUND POWER

The rms sound power measured in watts (W). The watt is a unit defined as one joule per second. A measures the rate of energy flow, conversion or transfer.

SOUND POWER LEVEL, Lw

The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. $Lw = Lp + 10 \log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

STATISTICAL NOISE LEVELS, Ln.

Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example:-

- The noise level, in decibels, exceeded for 1 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF1}, T. This may be used for describing short-term noise levels such as could cause sleep arousal during the night.
- The noise level, in decibels, exceeded for 10 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF10}, T. In most countries the LAF10, T is measured over periods of 15 minutes, and is used to describe the average maximum noise level.
- The noise level, in decibels, exceeded for 90 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF90}, T. In most countries the LAF90, T is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

STEADY NOISE

Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1–1997).

Attachment 2: QA/QC Procedures

CALIBRATION OF SOUND LEVEL METERS

A sound level meter requires regular calibration to ensure its measurement performance remains within specification. Benbow Environmental sound level meters are calibrated by a National Association of Testing Authority (NATA) registered laboratory or a laboratory approved by the NSW Environment Protection Authority (EPA) every two years and after each major repair, in accordance with AS 1259–1990.

The calibration of the sound level meter was checked immediately before and after each series of measurements using an acoustic calibrator. The acoustic calibrator provides a known sound pressure level, which the meter indicates when the calibrator is activated while positioned on the meter microphone.

The sound level meters also incorporate an internal calibrator for use in setting up. This provides a check of the electrical calibration of the meter, but does not check the performance of the microphone. Acoustical calibration checks the entire instrument including the microphone. Calibration certificates for the instrument sets used have been included as Attachment 3.

CARE AND MAINTENANCE OF SOUND LEVEL METERS

Noise measuring equipment contains delicate components and therefore must be handled accordingly. The equipment is manufactured to comply with international and national standards and is checked periodically for compliance. The technical specifications for sound level meters used in Australia are defined in Australian Standard AS 1259 – 1990 *Sound Level Meters*.

The sound level meters and associated accessories are protected during storage, measurement and transportation against dirt, corrosion, rapid changes of temperature, humidity, rain, wind, vibration, electric and magnetic fields. Microphone cables and adaptors are always connected and disconnected with the power turned off. Batteries are removed (with the instrument turned off) if the instrument is not to be used for some time.

INVESTIGATION PROCEDURES

All investigative procedures were conducted in accordance with AS 1055.1–1997 *Acoustics – Description and Measurement of Environmental Noise* Part 1: *General Procedures*.

The following information was recorded and kept for reference purposes:

- type of instrumentation used and measurement procedure conducted;
- description of the time aspect of the measurements, ie. measurement time intervals; and
- positions of measurements and the time and date were noted.

As per AS 1055.1–1997, all measurements were carried out at least 3.5 m from any reflecting structure other than the ground. The preferred measurement height of 1.2 m above the ground was utilised. A sketch of the area was made identifying positions of measurement and the approximate location of the noise source and distances in meters (approx.).

ATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

The attended short-term noise monitoring was carried out using a SVANTEK SVAN957 Class 1 Precision Sound Level Meter. The instrument was calibrated by a NATA accredited laboratory within two years of the measurement period. The instrument sets comply with AS 1259 and was set on A-weighted, fast response.

The microphone was positioned at 1.2 to 1.5 metres above ground level and was fitted with windsocks. The instrument was calibrated using a B&K 4230 sound level calibrator prior and subsequent to the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 3.

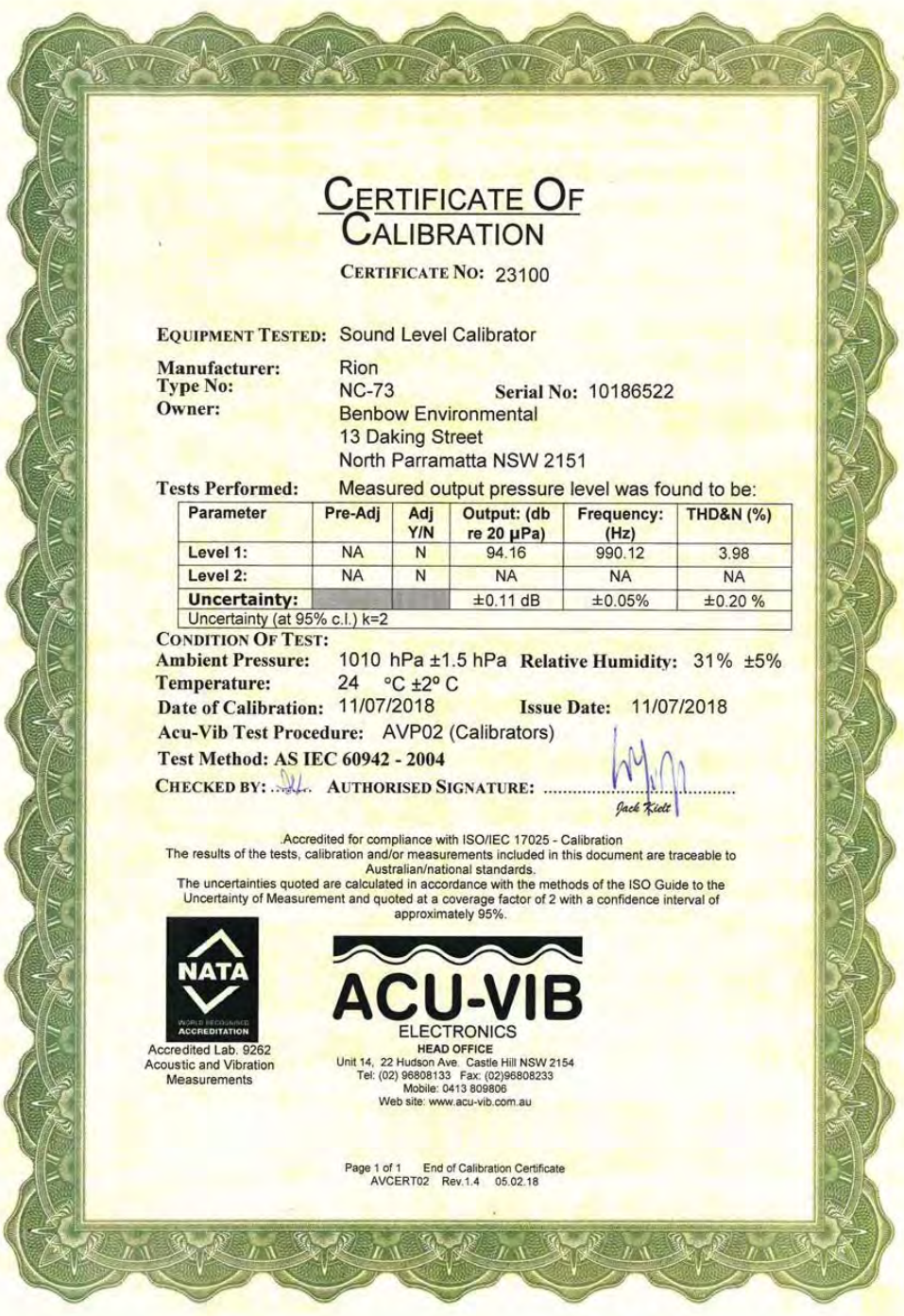
WEATHER CONDITIONS

During the monitoring period, weather was predominantly clear and calm.

METHODOLOGY

The attended noise measurements were carried out generally in accordance with Australian Standard AS 1055–1997 *Acoustics – Description and Measurement of Environmental Noise*.

Attachment 3: Calibration Certificates



CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 23100

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-73 **Serial No:** 10186522
Owner: Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

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	94.16	990.12	3.98
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:
Ambient Pressure: 1010 hPa ±1.5 hPa **Relative Humidity:** 31% ±5%
Temperature: 24 °C ±2° C
Date of Calibration: 11/07/2018 **Issue Date:** 11/07/2018
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004
CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....
Jack Kiett

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.
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
HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 98808133 Fax: (02)96808233
Mobile: 0413 809806
Web site: www.acu-vib.com.au

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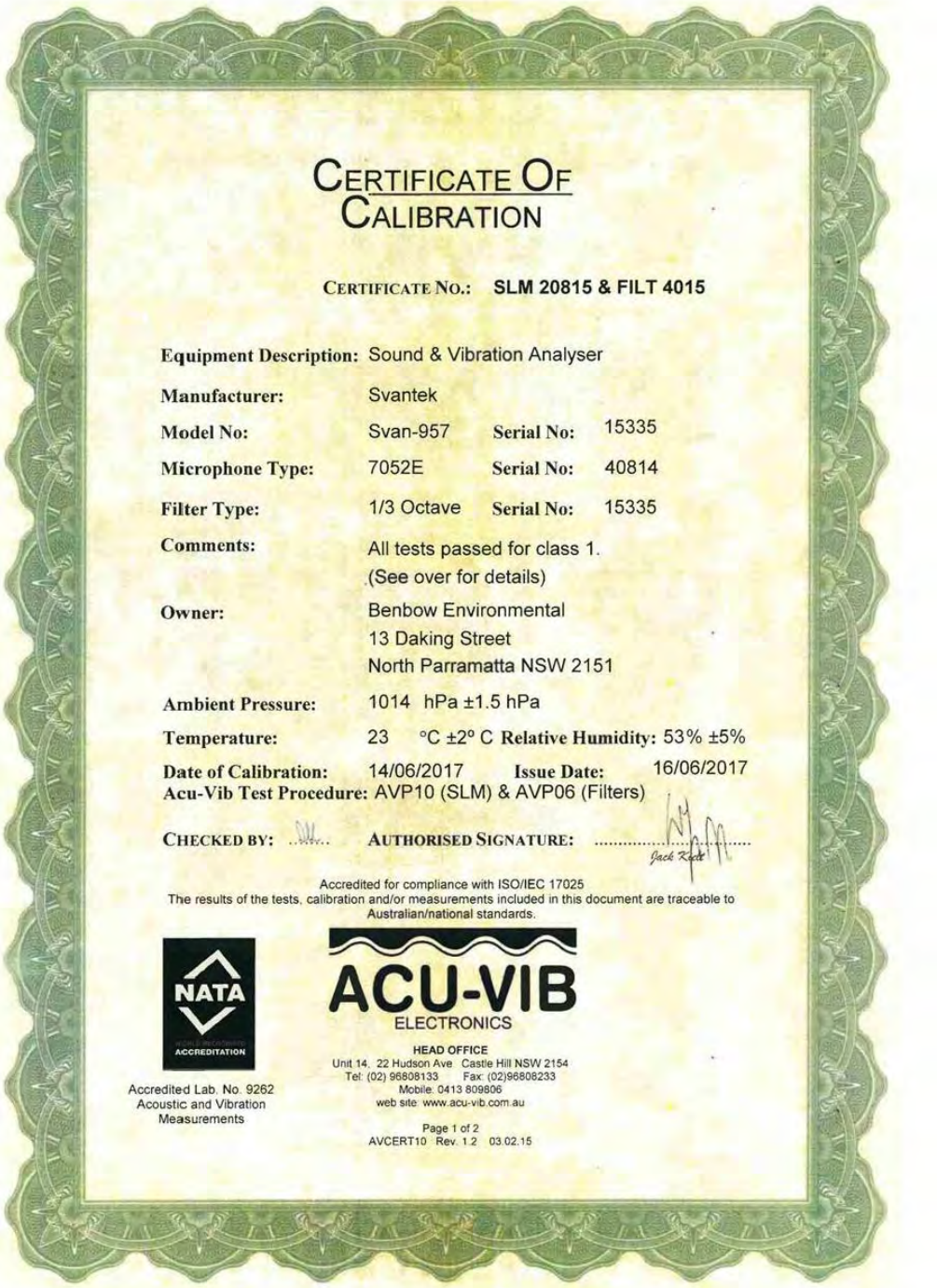

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 20815 & FILT 4015**

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15335
Microphone Type:	7052E	**Serial No:**	40814
Filter Type:	1/3 Octave	**Serial No:**	15335
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Benbow Environmental 13 Daking Street North Parramatta NSW 2151		
Ambient Pressure:	1014 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	53% ±5%
Date of Calibration:	14/06/2017	**Issue Date:**	16/06/2017
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

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

NATA
ACCREDITATION
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Acoustic and Vibration Measurements

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web site: www.acu-vib.com.au

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