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Environmental Noise Compliance Assessment Bass Point Quarry 2022 – Quarter Two

1 Bass Point Quarry Road,
Shell Cove, NSW 2529

Prepared for:-

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Harwood Acoustics Pty. Ltd. was engaged by Hanson Construction Materials Pty Ltd to carry out quarterly noise compliance testing for its Bass Point Quarry at 1 Bass Point Quarry Road, Shell Cove, NSW. This assessment relates to Quarter Two of 2022 and noise compliance testing was conducted in June 2022.

Accordingly, Harwood Acoustics Pty. Ltd. has prepared this report for the exclusive use of the Client identified on the title page. The report is prepared in accordance with the brief and scope of works agreed between the Client and Harwood Acoustics Pty. Ltd. and may not be suitable for use beyond that scope.

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TABLE OF CONTENTS

1. INTRODUCTION AND SUMMARY.....	4
2. SITE AND DEVELOPMENT DESCRIPTION.....	5
2.1 Site Description.....	5
2.2 Development Description.....	6
3. NOISE CRITERIA.....	6
3.1 Acceptable Noise Limits	6
3.2 Noise Compliance Assessment Methodology	7
4. MODIFYING FACTOR ADJUSTMENTS.....	8
5. MEASURED NOISE LEVELS	8
6. CONCLUSION	14

1. INTRODUCTION AND SUMMARY

Hanson Construction Materials Pty Ltd (Hanson) currently operates the Bass Point Quarry at 1 Bass Point Quarry Road, Shell Cove, NSW (the Quarry).

The Quarry is located at the eastern end of Bass Point Quarry Road adjacent to the Killalea State Park. The nearest residences are located toward the north west and west in the village of Shell Cove as shown in Figure 1.

The Quarry operates 24 hours per day, seven days per week under Project Approval 08_0143 issued by the Minister for Planning and Infrastructure on 28 January 2014 (the Approval).

It was previously a requirement of the Approval that monthly environmental noise compliance monitoring be undertaken. Since late 2017 environmental noise compliance monitoring became a quarterly requirement.

Schedule 3 of the Approval provides specific noise criteria that must be met at specifically identified receptor locations whilst the Quarry is operating. Appendix 6 of the Approval provides guidelines and requirements in relation to compliance noise monitoring methodology.

The specific acoustical parameters that are required to be assessed under the Project Approval are the $L_{eq, 15 \text{ min}}$ parameter (being the energy average sound pressure level measured over a period of 15 minutes) and the $L_{1,1 \text{ minute}}$ which is the noise level that is exceeded for 1% percent of 1 minute, which is essentially close to the maximum noise level).

This report addresses those requirements as well as the requirements of Hanson's Management Plan. Hanson's Management Plan requires several additional acoustical parameters to be recorded during noise compliance testing, being the: L_{max} , L_{min} , L_{10} , L_{50} , L_{90} and L_{99} in order to describe the ambient acoustical environment.

The author visited the site and all residential receptors on Wednesday 15 June 2022 to undertake attended noise compliance monitoring.

Noise measurements were taken in accordance with the requirements of the Approval and the Management Plan and the level of noise emission from the operation of the Quarry was found to be well below acceptable noise limits at all receptor locations as detailed in this Report.

The ambient acoustical environment at all receptor locations is dominated by either neighbourhood noise, passing traffic, insects, weather or surf noise from the ocean.

2. SITE AND DEVELOPMENT DESCRIPTION

2.1 Site Description

The Quarry is located adjacent to the Killalea State Park at the eastern end of Bass Point Quarry Road as shown in Figure 1 below.

The closest receptors to the site are in Shell Cove to the north west and west of the Quarry. Those identified in the Approval are receptors R4 through to R12 inclusive as detailed below.

All receptors are shown in Figure 1 and as follows:-

R4 – Sloop Avenue (cnr Cutter Parade)	R5 – Apollo Drive (cnr Clipper Avenue)
R6 – 1 Makaha Way	R7 – 44 Mystics Drive
R8 – 29 Hinchinbrook Drive	R9 – 23 Magnetic Ridge
R11 – 7 Joondalup Parkway	R12 – 3 Ranfurlie Parkway

Noise monitoring was also undertaken at an additional receptor – A1 – along Harbour Boulevard, in response to the substantial recent residential development in Shell Cove.



Figure 1. Location Plan – Bass Point Quarry, Shell Cove, NSW

(source: www.metromap.com.au image date 11/09/2022)

2.2 Development Description

Hanson's Bass Point Quarry is an extractive industry (hard rock quarry) supplying a range of products for projects such as building railways, roads, bridges, dams, airports, etc.

Primary activities at the site include the extraction, crushing, sorting and despatching of construction aggregates and this involves the use of the following plant and equipment:-

- Operation of the primary crusher
- Final product load out (dump trucks)¹
- Load and haul pit operations (front end loader and two dump trucks)²
- Wash plant operations (generator, pump, wash plant and loader)⁴
- Operation of the secondary crusher
- Operation of the tertiary crusher
- Sales operations (loading product into road trucks for dispatch – loaders & trucks)³

Notes:-

1. CAT 777 and Komatsu 325 dump trucks
2. Komatsu WA 800 loader and CAT 777 dump trucks
3. Komatsu WA 500 loader, Volvo L 250 loader and various trucks, and
4. CAT 980 loader.

The above listed plant and machinery typically operates up until approximately 10 pm and constitutes full operation of the site. Normally, from approximately 10 pm the majority of operations cease with the exception of the secondary crushing plant and despatch loaders and trucks. On occasion, due to increased demand for aggregates, operating hours are regularly extended.

3. NOISE CRITERIA

Project specific noise limits and compliance testing conditions and methodology are derived from the Approval, and are as follows.

3.1 Acceptable Noise Limits

Schedule 3, Clause 3, Table 2 of the Approval sets noise criteria for each receptor location. Table 2 of the Approval is replicated in Table 1 below.

Table 1 Noise Criteria (Project Approval, Schedule 3 - Table 2)

Location	Day / Evening	Night	
	(L _{Aeq} , 15 min)	(L _{Aeq} , 15 min)	(L _{A1} , 1 min)
R4	44	44	54
R5	45	45	55
R6	42	42	52
R7	41	41	51
R8	35	35	45
R9	35	35	45
R11	45	45	55
R12	45	45	55
Any residential property within the Shell Harbour Marina Precinct (refer A1)	48	48	58
Shell Cove Primary School (when in use)	L _{Aeq} , 1 hour 40 (internal)	Not Applicable	

“Notes:

Noise generated by the project is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy. Appendix 6 sets out the meteorological conditions under which these criteria apply, and the requirements for evaluating compliance with these criteria.

However, these criteria do not apply if the Proponent has a written agreement with the relevant landowner to exceed the criteria, and the Proponent has advised the Department in writing of the terms of this agreement.”

3.2 Noise Compliance Assessment Methodology

Appendix 6 of the Approval provides conditions and assessment methodology that is to be adhered to during noise compliance monitoring, and states:-

“Applicable Meteorological Conditions

1. The noise criteria in Table 1 of the conditions are to apply under all meteorological conditions except the following:

- (a) during periods of rain or hail,*
- (b) average wind speed at microphone height exceeds 5m/s,*
- (c) wind speeds greater than 3 m/s measured at 10 m above ground level, or*
- (d) temperature inversion conditions greater than 3°C/100 m.*

Determination of Meteorological Conditions

2. Except for wind speed at microphone height, the data to be used for determining meteorological conditions shall be that recorded by the meteorological station on or in the vicinity of the site.

Compliance Monitoring

3. Unless otherwise agreed, this monitoring is to be carried out in accordance with the relevant requirements for reviewing performance set out in the NSW Industrial Noise Policy (as amended from time to time), in particular the requirements relating to:

- (a) monitoring locations for the collection of representative noise data;*
- (b) meteorological conditions during which collection of noise data is not appropriate;*
- (c) equipment used to collect noise data, and conformity with Australian Standards relevant to such equipment; and*
- (d) modifications to noise data collected including for the exclusion of extraneous noise and/or penalties for modifying factors apart from adjustments for duration.”*

3.2 Hanson Construction Materials’ Management Plan

Hanson operates its Bass Point Quarry under a Management Plan, which in relation to acoustical compliance testing, in Section 4.2, states:-

Operator attended noise measurements and recordings will be conducted to quantify the intrusive noise emissions from quarrying and processing operations as well as the overall level of ambient noise.

The operator will quantify and characterise the maximum (L_{Amax}) and the average ($L_{Aeq(15\text{ minute})}$) intrusive noise level from quarrying and processing operations over a

15 minute measurement period. In addition, the operator must quantify and characterise the overall levels of ambient noise (i.e. L_{Amax} , L_{A1} , L_{A10} , L_{A50} , L_{A90} , L_{A99} , L_{Amin}) over the 15 minute measurement interval.

4. MODIFYING FACTOR ADJUSTMENTS

Where a noise source contains certain characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration.

Fact Sheet C of the Noise Policy for Industry 2017 outlines the correction factors to be applied to the source noise level at the receiver before comparison with the project noise trigger levels, to account for the additional annoyance caused by these modifying factors.

The modifying factor corrections should be applied having regard to:

- the contribution noise level from the premises when assessed/measured at a receiver location, and
- the nature of the noise source and its characteristics (as set out in this fact sheet).

Table C1 sets out the corrections to be applied. The corrections specified for tonal, intermittent and low-frequency noise are to be added to the measured or predicted noise levels at the receiver before comparison with the project noise trigger levels. The adjustments for duration are to be applied to the criterion.

Table C1 of Fact Sheet C is replicated in the attached Appendix B.

In this instance the measured noise levels at all receptor locations during the evening and night time periods did not display characteristics requiring modifying factor adjustments.

5. MEASURED NOISE LEVELS

5.1 Noise Measurement Results

The author visited the Quarry and each of the receptor locations to carry out attended noise measurements during the evening and night time periods on Wednesday 15 June 2022. Noise measurements were undertaken at each receptor location shown in Figure 1, between the hours of approximately 6.45 pm and 11.00 pm. During the noise survey, the weather was mild to cool with temperatures of approximately 16 to 18 degrees Celsius. Skies were clear and conditions were calm (still) with wind speeds well below 5 m/s at microphone height throughout the entire survey. However, care was taken to avoid taking noise measurements, or pausing the sound level meter during wind gusts when necessary and as far as was reasonably practicable as is often the case in Shell Cove, particularly near Killalea State Park.

The Quarry was in full operation throughout the entire noise survey. All measurements were also paused as trucks passed along the Haul Road, whenever this was practicable.

All measurements were carried out in accordance with Australian Standard AS 1055-1997 '*Acoustics - Description and measurement of environmental noise*' and the instrumentation used during the noise survey is shown in the attached Appendix A.

The results of the survey are shown in Tables 2, 3 and 4 below, where:-

- Table 2 shows the measured and predicted $L_{eq, 15 \text{ minute}}$ noise levels for assessment against the Intrusiveness criteria as required by the Project Approval,
- Table 3 shows the measured and predicted $L_{1, 1 \text{ minute}}$ noise levels for assessment against the Sleep Disturbance criteria as required by the Project Approval, and
- Table 4 shows the measurement parameters required to be recorded under the Management Plan.

Table 2 Measured & Estimated $L_{eq, 15 \text{ minute}}$ Noise Levels – 15 June 2022

Location / Time / Description	Noise Level (dBA)				Complies
	Measured Noise Level	Typical Extraneous Noise Sound Pressure Level	Estimated Quarry Noise Level $L_{eq, 15 \text{ minute}}$	Acceptable Noise Limit $L_{eq, 15 \text{ minute}}$ Day, Evening & Night	
R4 – Sloop Avenue (9.25 – 9.40 pm) Quarry not audible	43	Traffic and Neighbourhood noise 40 - 45 Lulls 37 / 38	<40	44	Yes
R5 – Apollo Drive (8.55 to 9.20 pm) ¹ Quarry not audible	49	Water treatment 49 Lulls 38 ¹	<38	45	Yes
R6 – 1 Makaha Way (7.40 to 7.55 pm) Quarry not audible	43	Neighbourhood noise 40 - 45 Lulls 38	<38	42	Yes
R7 – 44 Mystics Drive (8.00 to 8.15 pm) Quarry not audible	43	Traffic 42 – 45 Lulls 34	<35	41	Yes
R8 – 29 Hinchinbrook Drive (8.25 to 8.40 pm) Quarry not audible	39	Distant traffic > 40 Lulls 35	<35	35	Yes
R9 – 23 Magnetic Ridge (9.50 to 10.05 pm) Quarry not audible	35	Lulls 34	<34	35	Yes
R11 – 7 Joondalup Parkway ² (7.15 pm to 7.30 pm) Quarry not audible	39	Insects & Traffic 39 / 40 Lulls 37 / 38	<37	45	Yes
R12 – 3 Ranfurlie Parkway (10.15 to 10.30 pm) Quarry faintly audible	32	Lulls <30	<30	45	Yes
A1 – Harbour Boulevard (6.50 to 7.05) Quarry not audible ³	56	Traffic 50 – 55 Surf & lulls 46	46	48	Yes

Notes:-

1. *This location as specifically identified in the Approval is adjacent to a water treatment plant and the motor noise from the pump dominates the noise measurements. A full 15 minute noise measurement was taken at this location in spite of the pump noise, in accordance with the requirements of the approval, however additional short-term measurements were taken further from the pump to estimate the level of quarry noise in the absence of the treatment plant. Quarry noise was not audible or measurable in either location.*
2. *Appendix A shows a photograph of the measurement location at this receptor and also includes a small garden water feature, the noise from which often contributes to the measured noise levels at this receptor. Despite the measured noise level being below the noise limit, the level of quarry noise is considerably lower still.*
3. *Noise measurements were taken near to the closest residential receptor to the quarry (as the crow flies), as indicated in Figure 1 (A1) which for the Quarter 2 assessment was chosen to be 235 Harbour Boulevard.*

This location is within the new Shell Harbour Marina Precinct and the appropriate acceptable noise limits for this area are derived from the Approval, which are shown in Table 2 in schedule 3 of the Project Approval, which are reiterated in Table 1 of this report.

Measured L_{eq} noise levels at this location were dominated almost exclusively by passing traffic which it was not practicable to avoid. Underlying noise levels are dominated by surf and the measured level of 56 dBA is in no way reflective of the quarry.

Table 3 Measured & Calculated $L_{1, 1 \text{ minute}}$ Noise Levels – 15 June 2022

Location / Description	Noise Level (dBA)				Complies
	Measured Noise Level $L_{1, 1 \text{ minute}}$	Typical Extraneous Noise Sound Pressure Level	Estimated Quarry Noise Level $L_{1, 1 \text{ minute}}$	Acceptable Noise Limit $L_{1, 1 \text{ minute}}$ at night	
R4 – Sloop Avenue (10.50 pm) not audible	41	neighbourhood	<41	54	Yes
R5 – Apollo Drive (10.47 pm) not audible	46	Water treatment plant	<46	55	Yes
R6 – 1 Makaha Way (11.00 pm) not audible	43	neighbourhood	<43	52	Yes
R7 – 44 Mystics Drive (11.03 pm) not audible	44	neighbourhood	<44	51	Yes
R8 – 29 Hinchinbrook Drive (11.10 pm) not audible	43	neighbourhood	<43	45	Yes
R9 – 23 Magnetic Ridge (10.40 pm) not audible	40	neighbourhood	<40	45	Yes
R11 – 7 Joondalup Parkway (10.34 pm) not audible	43	Surf / water feature	<43	55	Yes
R12 – 3 Ranfurly Parkway (10.31 pm) faintly audible	37	Quarry*	<37	55	Yes
A1 – Harbour Boulevard (10.55) not audible	52	Surf noise / distant traffic	<52	58	Yes

* At no time was the quarry audible during the $L_{1, 1 \text{ minute}}$ measurements after 10 pm with the exception of receptor R12, where a distant hum could be heard (and light seen over the rise at the eastern end of Killalea State Park). Even in this instance it is likely that the measured noise levels are still affected, if not dominated, by extraneous noise.

All other measured noise levels in Table 3 are dominated by extraneous noise.

Table 4 below shows the measured noise levels at each receptor location during the 15 minute measurements including each of the acoustical parameters prescribed in the Management Plan.

Table 4 Measured Noise Levels – 16 June 2022 (Additional Parameters)

Location / Description	Noise Level (dBA) L_x , 15 minute							
	L_{max}	L_{eq}	L_1	L_{10}	L_{50}	L_{90}	L_{99}	L_{min}
R4 – Sloop Avenue (9.25 – 9.40 pm) Quarry not audible	58	43	46	44	43	41	40	38
R5 – Apollo Drive (8.55 to 9.20 pm)	75	49	59	47	43	41	39	38
R6 – 1 Makaha Way (7.40 to 7.55 pm)	56	43	48	45	42	41	40	38
R7 – 44 Mystics Drive (8.00 to 8.15 pm)	65	43	53	45	41	39	37	36
R8 – 29 Hinchinbrook Drive (8.25 to 8.40 pm)	63	39	43	42	38	36	35	35
R9 – 23 Magnetic Ridge (9.50 to 10.05 pm)	49	35	43	38	34	32	31	30
R11 – 7 Joondalup Parkway (7.15 pm to 7.30 pm)	58	39	47	42	38	37	36	35
R12 – 3 Ranfurly Parkway (10.15 to 10.30 pm)	43	35	41	36	34	33	33	32
A1 – Harbour Boulevard (6.50 to 7.05)	79	56	67	54	51	49	48	47

5.2 Noise Assessment and Discussion

Tables 2 and 3 – Assessment of $L_{eq, 15 \text{ minute}}$ and $L_1, 1 \text{ minute}$ noise levels.

The contribution of Quarry noise emission to the measured levels in Table 2 has been estimated based on observations of the sound pressure level during lulls in extraneous and ambient noise, whilst the Quarry was operating, and the subjective audibility of the Quarry. In each instance these estimated levels are still considered to be conservatively high.

Sound pressure levels of extraneous noise are excluded from column 3 in Table 3 as the measured $L_1, 1 \text{ minute}$ noise level is so far below the acceptable noise limit at each location, in every instance, irrespective of the contribution of Quarry noise.

During the 2022 quarter 2 survey, at no time was noise emission from the quarry audible at any receptor location with the exception of location R12 where noise from the quarry was faintly audible. At approximately 10.30 pm the ambient neighbourhood noise was very low, such that noise from the Quarry was an audible hum in the distance where lights could be seen above the earth mound / rise at the eastern end of Killalea State Park. Whilst audible the measured noise levels at receptor R12 were well below the noise limits (refer Tables 2 and 3 for R12).

Noise measurements are dominated by extraneous noise and consequently the contribution of noise from the Quarry to the actual measured noise levels is likely to be lower still, often considerably, than those levels estimated in Tables 2 and 3.

Compliance with the acceptable intrusiveness noise limits during the full operation of the quarry in the evening prior to 10 pm, also demonstrates compliance during the night time,

with the same intrusive noise limits set during either the same or reduced operations as the night goes on.

Measurements and predictions therefore show that the level of noise emission from the operation of the Quarry during the noise survey was below the Project Approval noise limits at all receptor locations, at all times.

Table 4 – Assessment of additional acoustical parameters.

During this particular survey on Wednesday 16 June 2022, extraneous noise consisted of distant traffic on Shellharbour Road, significant (on occasion) neighbourhood noise as well as passing cars, insects and surf noise. Noise emission from the marina precinct was not subjectively noticeable during this survey. Noise levels at receptor A1 along Harbour Boulevard were dominated exclusively by surf noise and passing traffic.

Noise emission from the water treatment plant (sewage plant) was dominant at receptor R5 in Apollo Avenue which is not always the case.

Table 4 shows the measured noise levels for each of the parameters required to be assessed under the Management Plan.

The noise levels represent various ambient and extraneous noise events, for example:-

- **L_{max}** noise levels are dominated by passing traffic, neighbourhood noise such as garage doors closing, bin lids closing, dogs barking, etc,
- **L_{eq}** noise levels are the energy average noise levels measured and provided in Table 2 and used to predict the contribution (if at all) of Quarry noise,
- **L₁** noise levels are affected by neighbourhood noise similar to that which dominates the maximum levels listed above. The **L_{1, 15 minute}** noise levels are different to the **L_{1, 1 minute}** noise levels provided in Table 3, as these are assessed over a different duration – for example the **L_{1, 1 minute}** noise level is essentially the noise level that is exceeded for 1 % of 60 seconds (i.e. 0.6 seconds), whereas the **L_{1, 15 minute}** is the noise level that is exceeded for 1 % of 15 minutes (i.e. 9 seconds),
- **L₁₀** noise levels are typically dominated by passing and distant road traffic, depending upon the measurement location and activity on local roads at the time of the measurements as well as insects in the summer months,
- **L₅₀** noise levels represent the statistically average level of measured noise, being the median value of the fluctuating noise levels over the measurement period (15 minutes in this instance). If quarry activity was a contributing factor to the acoustical environment at any receptor, then this would be reflected in the **L₅₀** noise level. It can be seen that the **L₅₀** noise level is often also below the **L_{eq}** noise limits at all receptors even if it did contain contributions of Quarry noise,
- **L₉₀** noise levels represent the “background” noise level, being the noise level that is exceeded for 90 % of the time (i.e. the quietest 10 % of noise in 15 minutes). In Shell Cove, the background noise level is dominated by insects, surf noise or the rustling of wind in trees, depending on the measurement location and time of year. It is perhaps useful in describing quarry noise contributions if it is the case that the quarry was operating at a steady state for a minimum period of 15 minutes. For example, if the primary crusher was operating for at least 15 minutes and the noise level from the crusher did not vary significantly over that 15 minute period, then the measured **L₉₀** noise level could be considered representative of quarry noise emission. Again, if this

were the case on any occasion, then it can be seen that the $L_{90, 15 \text{ minute}}$ noise levels are at or below the noise limits with the exception of receptor R8 where the measured $L_{90 (15 \text{ minute})}$ noise level was 36 dBA and the noise limit is 35 dBA. The $L_{90, 15 \text{ minute}}$ noise level at this receptor during this particular noise survey however is dominated by distant traffic and neighbourhood hum and not quarry noise, as evidenced by observations of the sound pressure level, inaudibility and subjective assessment,

- L_{99} noise levels are essentially the opposite to the L_1 noise level and represent the noise level that is exceeded for 99 % of the time (i.e. the quietest 1 % of noise in 15 minutes) and is similar to the minimum noise level.
- L_{min} is the minimum noise level during the measurement period and represents the quietest noise level in the absence of any extraneous noise.

6. CONCLUSION

Environmental Noise Compliance testing has been undertaken at Hanson's Bass Point Quarry in accordance with the requirements of the Project Approval 08_0143.

The level of noise emission from the Quarry was found to be below the Project Approval noise limits at all times, at all receptor locations.



Matthew Harwood, MAAS

Director & Principal Consultant

Harwood Acoustics Pty. Ltd.

Attachments:-

Important Note

Appendix A – Noise Survey Instrumentation

Appendix B – Modifying Factor Corrections (EPA NPI 2017)

Appendix C – Photograph of Receptor R11 during noise measurement 15/06/2022

Important Note

All products and materials suggested by Harwood Acoustics Pty Ltd are selected for their acoustical properties only.

*Recommendations made in this report are intended to resolve acoustical problems only, therefore all other properties such as aesthetics, air flows, chemical, corrosion, combustion, construction details, decomposition, expansion, fire rating, fumes, grout or tile cracking, loading, shrinkage, smoke, ventilation etc. are outside Harwood Acoustic's fields of expertise and **must** be checked with the supplier or suitably qualified specialist before purchase.*

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Noise Survey Instrumentation	Appendix A
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The instrumentation used during the noise survey consisted of the following:-

Description	Model No.	Serial No.
Bruel and Kjaer Sound Level Meter	2250	3009198
Bruel and Kjaer Acoustical Calibrator	4321	3003242

The sound level meter conforms to Australian Standards AS IEC 61672.1-2004 : 'Electroacoustics - Sound level meters – Specifications' as a Class 1 precision sound level meter.

The calibration of the meter was checked before and after the measurement period. No significant system drift occurred over the measurement period. The sound level meter and calibrator have been checked, adjusted and aligned to conform to the factory specifications and issued with conformance certificates.

Modifying Factor Corrections (EPA 2017)	Appendix B
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Table C1 Modifying Factor Corrections (from Table C.1 of the NSW Noise Policy for Industry 2017)

Factor	Assessment/ Measurement	When to Apply	Correction	Comments
Tonal Noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method (<i>ISO1996.2-2007 – Annex D</i>).	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: <ul style="list-style-type: none"> • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz. 	5 dB	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. Note: Narrow-band analysis using the reference method in <i>ISO1996-2:2007, Annex C</i> may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.
Low Frequency Noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz	Measure/assess source contribution C- and A-weighted Leq,T levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: <ul style="list-style-type: none"> • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2-dB(A) positive adjustment applies for the daytime period. 	2 or 5 dB	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

Table C1 Modifying Factor Corrections (from Table C.1 of the NSW Noise Policy for Industry 2017) *Cont...*

Factor	Assessment/ Measurement	When to Apply	Correction	Comments
Intermittent Noise	Subjectively Assessed but should be assisted with measurement to gauge the extent of change in noise level.	The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.	5 dB	Adjustment to be applied for night-time only .
Duration	Single-event noise duration may range from 1.5 m to 2.5 h	One event in any 24-hour period	0 to -20dBA	The acceptable noise trigger level may be increased by an adjustment depending on duration of noise (see Table C.3)
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10 dBA ² (excluding duration correction)	

Notes:

1. Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.
2. Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.
3. Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

Photograph of Measurement Location – Receptor R11	Appendix C
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