

Intended for

Holcim (Australia) Pty Ltd

Document type

Report

Date

May 2024

Teven Quarry Quarterly Noise Monitoring Assessment

Quarter 1 2024



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Teven Quarry Quarterly Noise Monitoring Assessment

Quarter 1 2024

Project name **NSW Environmental Monitoring 2023-2024**
Project no. **318001799**
Recipient **Matt Kelly**
Document type **Report**
Version **1**
Date **06/05/2024**
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Description **Data collected on 10 January for Teven Quarry during Quarter 1 2024 in Teven, NSW, as part of the noise monitoring program**

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Appendix 1

Sound Exposure Level and Noise Emission Level Calculations

Abbreviations and Definitions

Ambient Noise	The all-encompassing noise within a given environment. It is the composite of sounds from many sources, both near and far.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the LA90 descriptor (see below).
dB	Abbreviation for decibel, a measure of sound equivalent to 20 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure, and 10 times the logarithm of a given sound power to a reference power.
dB(A)	A measure of A-weighted sound levels. A Weighting is an adjustment made to the sound level measurement to approximate the response of the human ear.
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods. Normal daily traffic is not extraneous noise.
LA1	The noise level, measured in dB(A), which is exceeded for 1 per cent of the measurement period.
LA1(1min)	The noise level, measured in dB(A), which is exceeded for 1 per cent of the time over a 1-minute measurement period, i.e., is exceeded for 0.6 seconds. This measure can approximate to the maximum noise level but may be less if there is more than 1 noise event during this 0.6 second period.
LA10	The noise level, measured in dB(A), which is exceeded for 10 per cent of the time.
LA90	The noise level, measured in dB(A), which is exceeded for 90 per cent of the time, referred to as the background noise level. This is considered to represent the background noise (see above).
LAeq	The level of noise equivalent to the energy average of noise levels occurring over a defined measurement period.
LAeq (period)	The average equivalent noise level, measured in dB(A), during a measurement period (e.g., 15-minute, day, evening, or night).
LAm_{ax}	The A-weighted sound pressure level that represents the maximum noise level measured over the time that a given sound is measured.
NMA	Noise Monitoring Assessment
NMP	Noise Management Plan
SPL	The Sound Pressure Level. Sound pressure is the fluctuation in air pressure, from the steady atmospheric pressure, created by sound. The sound pressure level is the sound pressure expressed on a decibel scale.

Source: Noise Guide for Local Government (NSW EPA, 2023)

1. Overview

1.1 Project Driver

Ramboll Australia Pty Ltd (Ramboll) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Teven Quarry (“the quarry”) at Teven, NSW.

This NMA was done in accordance with the following documents:

- Noise Policy for Industry (NPfI) (NSW EPA, 2017).
- Teven Quarry Noise Management Plan (NMP) (Holcim Australia, 2021).
- Environment Protection Licence (EPL) number 3293 (NSW EPA, 2021).
- Development Consent Application Number SSD_6422 (Minister for Planning and Environment, 2015).
- Australian Standard AS 1055:2018 Acoustics—Description and measurement of environmental noise (Standards Australia, 2018).
- IEC 60942 Ed. 3.0 b:2003 Electroacoustics - Sound calibrators (Standards Australia, 2003).

This NMA has been undertaken in accordance with the NMP for the quarterly period January to March 2024 and forms part of the monitoring program to determine compliance with conditions of the Development Consent.

1.2 Site Location and Sensitive Receivers

The quarry is in Teven, NSW, approximately 7 km west of Ballina. Sensitive receivers surrounding the quarry are primarily rural and residential properties in coastal bushland with elevated and undulating topography. Five monitoring locations have been selected as part of the NMA and in accordance with the EPL and Development Consent and are shown in **Table 1-1**.

Table 1-1: Monitoring locations locality and sensitive receptors

Monitoring Locations	Nearest Receiver	Locality and Sensitive Receivers
NM1	R7	West of the quarry situated at a rural residential property at the end of Leadbeatters Lane
NM2	R3/R4	East of the quarry situated at a rural residential property on Teven Road
NM3	R2	South of the quarry situated at a rural residential property at the end of Wellers Road
NM4	R10	North of the quarry situated at a rural residential property adjacent the site off Stokers Lane
NM5	R14	Northeast of the quarry situated at a rural residential property of Teven Road

The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.



Legend

- Noise monitoring location
- Residential receiver location

Figure 1: Noise monitoring locations at Teven Quarry



2. Noise Criteria

Table 2-1 summaries the applicable onsite noise criteria outlined in the NMP and Development Consent for residential receivers (NM1, NM2, NM3, NM4, NM5) surrounding the quarry.

Table 2-1: Monitoring locations and noise criteria

Receivers	Monitoring Locations	Day ¹	Evening ²
		L _{Aeq} (15min)	L _{Aeq} (15min)
		dB(A)	
R3, R4, R13, R15, R16, R17, R18, R20	NM2	38	35
All other receivers	NM1, NM3, NM4, NM5	37	35
¹ 7 am–6 pm Monday to Saturday and 8 am–6 pm Sunday and public holidays ² 6 pm–10 pm Monday to Sunday			

3. Methodology

The monitoring program was developed in accordance with the procedures described in *Australian Standard AS 1055:2018* and the Approval Documents referenced in Section 1. The measurements were completed using a RION Sound Level Meter NL-52 on Wednesday 10 January 2024. The acoustic instrumentation used carries current NATA calibration and complies with *AS/NZS IEC 61672-1:2013/2002 Class 1*. Calibration of all instrumentation was checked prior to and following measurements using a Pulsar Acoustic Calibrator 105 which also carried a current NATA calibration and complies with IEC 60942:2003. Drift in calibration did not exceed ± 0.3 dBA.

Attended noise monitoring was conducted for 15-minute periods at each location over one day. As per the NMP, two sets of measurements were completed during the day, and two sets of measurements were completed during the evening, at each monitoring location. It is noted that the quarry was not operational during the evening periods, however, monitoring was conducted as per requirements of the EPL.

Where the quarry was not distinctly audible during the attended monitoring, the quarry contribution is estimated to be at least 10 dBA below the ambient noise level, as determined by the LA90.

3.1 Meteorological conditions

Meteorology has an important influence on noise monitoring assessment. Where an onsite meteorological station with data recorded at 10m height has not been available, the nearest Bureau of Meteorology data has been adopted to inform this assessment and modelled using The Air Pollution Model (TAPM) to determine the atmospheric stability category as outline in **Table 3-1**.

Table 3-1: Classification of Atmospheric Stability (NSW EPA, 2014)

Stability Classification	Pasquill Stability Category	Ambient temperature change with height ($^{\circ}\text{C}/100\text{m}$)
Extremely unstable	A	$\Delta T \leq -1.9$
Moderately unstable	B	$-1.9 < \Delta T \leq -1.7$
Slightly unstable	C	$-1.7 < \Delta T \leq -1.5$
Neutral	D	$-1.5 < \Delta T \leq -0.5$
Slightly stable	E	$-0.5 < \Delta T \leq 1.5$
Moderately stable	F	$1.5 < \Delta T \leq 4.0$
Extremely stable	G	$\Delta T > 4.0$

As stated in the Development Consent, the noise criteria in Table 2-1 applies under all meteorological conditions except the following:

- Wind speeds greater than 3m/s at 10m above ground level
- Temperature inversion conditions between 1.5 $^{\circ}\text{C}$ and 3 $^{\circ}\text{C}/100\text{m}$ and wind speed greater than 2m/s at 10m above ground level
- Temperature inversion conditions greater than 3 $^{\circ}\text{C}/100\text{m}$.

Appendix 5 of the Development Consent also specifies that except for wind speed at microphone height, the data to be used for determining meteorological conditions shall be that recorded by a suitable meteorological station operating in the vicinity of the site.

4. Results and Discussion

4.1 Location NM1

Noise monitoring at location NM1 conducted on Wednesday 10 January 2024 resulted in audible quarry noise during the day. Holcim heavy machinery equipment were observed and measured during both day monitoring periods, however, are below the 15min LAeq criteria using sound level exposure calculations included in **Appendix 1**. The quarry was not operational during the evening. Ambient noise sources measured included insects, wind/rustling leaves, passing cars and a ride on mower. These results meet the established noise criteria and indicate that noise emissions from Teven Quarry did not contribute to noise nuisance. The results and observations taken during the monitoring events at Location NM1 are presented in **Table 4-1**.

Table 4-1: Noise survey results and observations for Location NM1

Date	Time	Descriptor (dBA)			Meteorology (handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry LAeq(15min) Contribution	LAeq(15min) Criteria (dBA)
		LAmx	LAeq	LA90					
10-01-24	10:26am to 10:31am (Day)	64.5	58.2	52.1	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Insects (sporadic) 57-64 Ride on mower 58-64 Holcim machinery <47 (dozen times for several seconds) Quarry audible	<35 ³	37
10-01-24	10:47am to 11:02am (Day)	62.1	54.8	47.8	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Insects (sporadic) 51-62 Holcim machinery <46 (15 times for several seconds) Quarry audible	<35 ³	37
10-01-24	6:01pm to 6:16pm (Evening)	65.2	55.0	44.5	WD: 140° WS: 0.9 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Insects (sporadic) 44-62 Passing car 46 Wind/rustling leaves 45-47 Quarry not operational	n/a ²	35
10-01-24	6:18pm to 6:33pm (Evening)	61.7	47.7	36.1	WD: 140° WS: 0.6 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Insects (sporadic) 43-61 Wind/rustling leaves 40-45 Quarry not operational	n/a ²	35

¹ Temperature data used from BOM (Station ID 94596) to undertake modelling using TAPM to determine Stability Category.

² Quarry not operational.

³ Value estimated based on sound exposure level calculation in **Appendix 1**.

4.2 Location NM2

Noise monitoring at location NM2 was completed on Wednesday 10 January 2024. The quarry was inaudible during the day and was not operational during the evening period. The ambient noise environment was dominated by passing cars on Teven Road, birds, insects, a ride on mower and a whipper snipper. These results indicate that noise emissions from Teven Quarry did not contribute to noise nuisance. The results and observations taken during the monitoring events at Location NM2 are presented in **Table 4-2**.

Table 4-2: Noise survey results and observations for Location NM2

Date	Time	Descriptor (dBA)			Meteorology (handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry LAeq(15min) Contribution	LAeq(15min) Criteria (dBA)
		LAm _{ax}	LA _{eq}	LA ₉₀					
10-01-24	12:01pm to 12:16pm (Day)	82.3	61.2	45.4	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Ride on mower (sporadic) 55-67 Passing cars on Teven road <82 Birds (occasionally) 42-72 Quarry inaudible	<35	38
10-01-24	12:29pm to 12:44pm (Day)	88.0	67.1	51.7	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Whipper snipper (occasional) 53-56 Passing cars (occasional) <89 Insects (sporadic) 61-62 Quarry inaudible	<42 ³	38
10-01-24	8:00pm to 8:15pm (Evening)	77.4	55.6	44.8	WD: n/a WS: 0 m/s Rain: Nil	WD: S WS: 0.4 m/s Rain: nil Stability Category: E ¹	Insects (sporadic) 44-53 Passing cars (occasional) 57-75 Quarry not operational	n/a ²	35
10-01-24	8:17pm to 8:32pm (Evening)	78.9	54.7	43.5	WD: n/a WS: 0 m/s Rain: Nil	WD: S WS: 0.2 m/s Rain: nil Stability Category: E ¹	Insects (sporadic) 41-47 Passing cars (occasional) <78 Quarry not operational	n/a ²	35

¹ Temperature data used from BOM (Station ID 94596) to undertake modelling using TAPM to determine Stability Category.

² Quarry not operational.

³ LA90 value of 52 dBA was dominated by background noise so unable to estimate contribution for quarry at the assessment location.

4.3 Location NM3

Noise monitoring at location NM3 was completed on Wednesday 10 January 2024. The quarry was inaudible during the day and was not operational during the evening period. The ambient noise environment consisted of insects, aircraft, and a passing car. These results indicate that noise emissions from Teven Quarry did not contribute to noise nuisance. The results and observations taken during the monitoring events at Location NM3 are presented in **Table 4-3**.

Table 4-3: Noise survey results and observations for Location NM3

Date	Time	Descriptor (dBA)			Meteorology (handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry LAeq(15min) Contribution	LAeq(15min) Criteria (dBA)
		L _{Amax}	L _{Aeq}	L _{A90}					
10-01-24	11:21am to 11:36am (Day)	73.6	57.5	52.3	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Insects (sporadic) 46-65 Aircraft (few seconds) <74 Quarry inaudible	<36 ³	37
10-01-24	11:37am to 11:52am (Day)	77.4	57.4	51.2	WD: 0° WS: 0.6 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Insects (sporadic) 46-61 Car passing 69 Aircraft (10 seconds) <63 Quarry inaudible	<36 ³	37
10-01-24	8:38pm to 8:53pm (Evening)	59.5	54.2	51.1	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: E ¹	Insects 47-56 Quarry not operational	n/a ²	35
10-01-24	8:56pm to 9:11pm (Evening)	64.3	53.4	50.2	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: E ¹	Insects 48-58 Aircraft (10 seconds) <64 Quarry not operational	n/a ²	35

¹ Temperature data used from BOM (Station ID 94596) to undertake modelling using TAPM to determine Stability Category.

² Quarry not operational.

³ Estimated based on observed background noise (insects) using LAeq.

4.4 Location NM4

Noise monitoring at location NM4 was completed on Wednesday 10 January 2024. The quarry was audible during both monitored day periods. One piece of Holcim heavy machinery equipment was observed and measured during each day monitoring period, however, noise emission from each is below the 15min L_{Aeq} criteria using sound level exposure calculations also included in **Appendix 1**. It should be noted that the monitoring was completed close to Stokers Lane at the entrance to the residence as to not disturb the resident, which places the attended noise monitoring location in direct line-of-sight of the quarry rather than near the sensitive receptor, i.e., the resident. Subsequently the results from the sound exposure level calculation results for both monitored day periods were adopted for distance correction to receiver using noise emission level calculations in **Appendix 1**. The quarry was not operating during the evening period. The ambient noise environment consisted of birds, insects, aircraft, and a passing car. The results and observations taken during the monitoring events at Location NM4 are presented in **Table 4-4** These results indicate that noise emissions from Teven Quarry did not contribute to noise nuisance.

Table 4-4: Noise survey results and observations for Location NM4

Date	Time	Descriptor (dBA)			Meteorology (handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry L_{Aeq} (15min) Contribution	L_{Aeq} (15min) Criteria (dBA)
		L_{Amax}	L_{Aeq}	L_{A90}					
10-01-24	1:23pm to 1:38pm (Day)	83.4	53.4	46.7	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: C ¹	Holcim HME 47-52 (several times for few seconds) Aircraft 54 (once for 10 seconds) Insects (sporadic) 47-54 Passing car 56 Quarry audible	<28 ³	37
10-01-24	1:39pm to 1:54pm (Day)	77.3	50.9	39.4	WD: 0° WS: 0.4 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: C ¹	Holcim HME 45-51 (several times for few seconds) Insects (sporadic) 49-54 Quarry audible	<27 ³	37
10-01-24	7:22pm to 7:37pm (Evening)	62.2	40.5	37.5	WD: n/a WS: 0 m/s Rain: Nil	WD: S WS: 2.0 m/s Rain: nil Stability Category: D ¹	Insects (sporadic) 37-62 Birds 39-40 Quarry not operational	n/a ²	35
10-01-24	7:38pm to 7:53pm (Evening)	60.8	42.5	39.7	WD: n/a WS: 0 m/s Rain: Nil	WD: S WS: 1.8 m/s Rain: nil Stability Category: D ¹	Insects (sporadic) 41-60 Birds 40-42 Quarry not operational	n/a ²	35

¹ Temperature data used from BOM (Station ID 94596) to undertake modelling using TAPM to determine Stability Category.

² Quarry not operational

³ Value estimated based on distance correction to receiver location in calculation in **Appendix 1**.

4.5 Location NM5

Noise monitoring at location NM5 was completed on Wednesday 10 January 2024. The quarry was inaudible during any monitored period during the day and evening. Noise sources measured included birds, insects, and passing cars. These results indicate that noise emissions from Teven Quarry did not contribute to noise nuisance during this time. The results and observations taken during the monitoring events at Location NM5 are presented in **Table 4-5**.

Table 4-5: Noise survey results and observations for Location NM5

Date	Time (hrs)	Descriptor (dBA)			Meteorology (Handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry LAeq(15min) Contribution	LAeq(15min) Criteria
		LAmx	LAeq	LA90					
10-01-24	12:47pm to 1:02pm (Day)	67.1	48.3	36.8	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D/C ¹	Birds (occasional) 39-50 Passing cars (occasional) 57-65 Insects 45 Quarry inaudible	<27	37
10-01-24	1:04pm to 1:19pm (Day)	78.3	48.8	39.9	WD: n/a WS: 0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: C ¹	Birds (occasional) 40 Passing cars (occasional) 62-78 Insects 41-46 Quarry inaudible	<30	37
10-01-24	6:46pm to 7:01pm (Evening)	70.9	46.0	37.8	WD: 60° WS: 1.1 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Passing cars (occasional) 49-72 Insects (sporadic) 37-46 Bird 44 Quarry not operational	n/a ²	35
10-01-24	7:03pm to 7:18pm (Evening)	63.0	45.0	34.2	WD: 60° WS: 1.0 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: D ¹	Passing cars (occasional) 49-63 Insects (sporadic) 37-48 Bird 47-54 Quarry not operational	n/a ²	35

¹ Temperature data used from BOM (Station ID 94596) to undertake modelling using TAPM to determine Stability Category.

² Quarry not operational

5. Conclusion

This NMA completed by Ramboll at the Holcim Teven Quarry, Teven, NSW as a quarterly requirement of the NMP. Noise monitoring was completed on Wednesday 10 January 2024 at five locations selected as representative to the sensitive receptors at the surroundings to Teven Quarry.

Audible noise identified as emitted from the quarry was recorded during the day at location NM1 and NM4. The results presented in this NMA show compliance with the relevant noise criteria at the Holcim Teven Quarry, Teven, NSW.

6. References

Holcim Australia (2021) *Teven Quarry, Noise Management Plan*.

Minister for Planning and Environment (2015) 'Development Consent SSD_6422, Teven Quarry Project'.

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Standards Australia (2003) *AS 60942:2003 Electroacoustics - Sound calibrators*. Australian Standard.

Appendix 1 Sound Exposure Level and Noise Emission Level Calculations

NM1 day monitoring period (10:26AM - 10:31AM)

Noise source	Holcim machinery
Meas. Dist from source (m)	-
Meas. Time (s)	5
Meas. LAeq dB	47
Calc Sel dB	54
No. Events in 15min	12
Total LAeq (15min)	35

NM1 day monitoring period (10:47AM - 11:02AM)

Noise source	Holcim machinery
Meas. Dist from source (m)	-
Meas. Time (s)	5
Meas. LAeq dB	46
Calc Sel dB	53
No. Events in 15min	15
Total LAeq (15min)	35

NM4 day monitoring period (1:23PM - 1:38PM)

Noise source	Holcim HME
Meas. Dist from source (m)	-
Meas. Time (s)	3
Meas. LAeq dB	52
Calc Sel dB	57
No. Events in 15min	5
Total LAeq (15min)	34

NM4 day monitoring period (1:39PM - 1:54PM)

Noise source	Holcim HME
Meas. Dist from source (m)	-
Meas. Time (s)	3
Meas. LAeq dB	51
Calc Sel dB	56
No. Events in 15min	5
Total LAeq (15min)	33

NM4 day monitoring period (1:23PM - 1:38PM)

Site contribution corrected for distance from monitoring location to receiver

Noise source	Holcim crusher/ screening equipment
Estimated site contribution (LAeq) at monitoring location (dBA)	34.2
Approx. distance from monitoring location to site (m)	315
Approx. distance from site to receiver (m)	500
Distance corrected site contribution at receiver (LAeq dBA)	30.2
Estimated additional attenuation (vegetation)	2
Estimated site contribution at receiver (dBA)	28.2

NM4 day monitoring period (1:39PM - 1:54PM)

Site contribution corrected for distance from monitoring location to receiver

Noise source	Holcim crusher/ screening equipment
Estimated site contribution (LAeq) at monitoring location (dBA)	33.2
Approx. distance from monitoring location to site (m)	315
Approx. distance from site to receiver (m)	500
Distance corrected site contribution at receiver (LAeq dBA)	29.2
Estimated additional attenuation (vegetation)	2
Estimated site contribution at receiver (dBA)	27.2

Intended for
Holcim (Australia) Pty Ltd

Document type
Report

Date
July 2024

Teven Quarry Quarterly Noise Monitoring Assessment

Quarter 2 2024



Bright ideas.
Sustainable change.

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Quarter 2 2024

Project name **NSW Environmental Monitoring 2023-2024**
Project no. **318001799**
Recipient **Matt Kelly**
Document type **Report**
Version **1**
Date **12/07/2024**
Prepared by **Jake Bourke, Matilda Englert**
Checked by **Arnold Cho**
Approved by **Gavan Butterfield**
Description **Data collected on 6 May 2024 and 7 May 2024 for Teven Quarry during Quarter 2 2024 in Teven, NSW, as part of the noise monitoring program**

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Sound Exposure Level and Noise Emission Level Calculations

Abbreviations and Definitions

Ambient Noise	The all-encompassing noise within a given environment. It is the composite of sounds from many sources, both near and far.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the LA90 descriptor (see below).
dB	Abbreviation for decibel, a measure of sound equivalent to 20 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure, and 10 times the logarithm of a given sound power to a reference power.
dB(A)	A measure of A-weighted sound levels. A Weighting is an adjustment made to the sound level measurement to approximate the response of the human ear.
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods. Normal daily traffic is not extraneous noise.
LA1	The noise level, measured in dB(A), which is exceeded for 1 per cent of the measurement period.
LA1(1min)	The noise level, measured in dB(A), which is exceeded for 1 per cent of the time over a 1-minute measurement period, i.e., is exceeded for 0.6 seconds. This measure can approximate to the maximum noise level but may be less if there is more than 1 noise event during this 0.6 second period.
LA10	The noise level, measured in dB(A), which is exceeded for 10 per cent of the time.
LA90	The noise level, measured in dB(A), which is exceeded for 90 per cent of the time, referred to as the background noise level. This is considered to represent the background noise (see above).
LAeq	The level of noise equivalent to the energy average of noise levels occurring over a defined measurement period.
LAeq (period)	The average equivalent noise level, measured in dB(A), during a measurement period (e.g., 15-minute, day, evening, or night).
LAm_{ax}	The A-weighted sound pressure level that represents the maximum noise level measured over the time that a given sound is measured.
NMA	Noise Monitoring Assessment
NMP	Noise Management Plan
SPL	The Sound Pressure Level. Sound pressure is the fluctuation in air pressure, from the steady atmospheric pressure, created by sound. The sound pressure level is the sound pressure expressed on a decibel scale.

Source: Noise Guide for Local Government (NSW EPA, 2023)

1. Overview

1.1 Project Driver

Ramboll Australia Pty Ltd (Ramboll) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Teven Quarry (“the quarry”) at Teven, NSW.

This NMA was done in accordance with the following documents:

- Noise Policy for Industry (NPfI) (NSW EPA, 2017).
- Teven Quarry Noise Management Plan (NMP) (Holcim Australia, 2021).
- Environment Protection Licence (EPL) number 3293 (NSW EPA, 2021).
- Development Consent Application Number SSD_6422 (Minister for Planning and Environment, 2015).
- Australian Standard AS 1055:2018 Acoustics—Description and measurement of environmental noise (Standards Australia, 2018).
- Australian Standard AS/NZS IEC 61672.1:2019 Electroacoustics – Sound level meters, Part 1: Specifications (Standards Australia and Standards New Zealand, 2019)
- IEC 60942:2017 Electroacoustics - Electroacoustics – Sound calibrators (International Standard, 2017).

This NMA has been undertaken in accordance with the NMP for the quarterly period April to June 2024 and forms part of the monitoring program to determine compliance with conditions of the Development Consent.

1.2 Site Location and Sensitive Receivers

The quarry is in Teven, NSW, approximately 7 km west of Ballina. Sensitive receivers surrounding the quarry are primarily rural and residential properties in coastal bushland with elevated and undulating topography. Five monitoring locations have been selected as part of the NMA and in accordance with the EPL and Development Consent and are shown in **Table 1-1**.

Table 1-1: Monitoring locations locality and sensitive receptors

Monitoring Locations	Nearest Receiver	Locality and Sensitive Receivers
NM1	R7	West of the quarry situated at a rural residential property at the end of Leadbeatters Lane
NM2	R3/R4	East of the quarry situated at a rural residential property on Teven Road
NM3	R2	South of the quarry situated at a rural residential property at the end of Wellers Road
NM4	R10	North of the quarry situated at a rural residential property adjacent the site off Stokers Lane
NM5	R14	Northeast of the quarry situated at a rural residential property of Teven Road

The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.



Legend

- Noise monitoring location
- Residential receiver location



Figure 1: Noise monitoring locations at Teven Quarry

2. Noise Criteria

Table 2-1 summaries the applicable onsite noise criteria outlined in the NMP and Development Consent for residential receivers (NM1, NM2, NM3, NM4, NM5) surrounding the quarry.

Table 2-1: Monitoring locations and noise criteria

Receivers	Monitoring Locations	Day ¹	Evening ²
		L _{Aeq} (15min)	L _{Aeq} (15min)
		dB(A)	
R3, R4, R13, R15, R16, R17, R18, R20	NM2	38	35
All other receivers	NM1, NM3, NM4, NM5	37	35
¹ 7 am–6 pm Monday to Saturday and 8 am–6 pm Sunday and public holidays ² 6 pm–10 pm Monday to Sunday			

3. Methodology

The monitoring program was developed in accordance with the procedures described in *Australian Standard AS 1055:2018* and the Approval Documents referenced in Section 1. The measurements were completed using a RION Sound Level Meter NL-52 on Monday 6 May and Tuesday 7 May 2024. The acoustic instrumentation used carries current NATA calibration and complies with *AS/NZS IEC 61672-1:2019 Class 1*. Calibration of all instrumentation was checked prior to and following measurements using a Pulsar Acoustic Calibrator 105 which also carried a current NATA calibration and complies with IEC 60942:2017. Drift in calibration did not exceed ± 0.3 dBA.

Attended noise monitoring was conducted for 15-minute periods at each monitoring location over two days. As per the NMP, two sets of measurements were completed during the day, and two sets of measurements were completed during the evening, at each monitoring location. It is noted that the quarry was not operational during the evening periods, however, monitoring was conducted as per requirements of the EPL.

Where the quarry was not distinctly audible during the attended monitoring, the quarry contribution is estimated to be at least 10 dBA below the ambient noise level, as determined by the LA90.

3.1 Meteorological conditions

Meteorology has an important influence on noise monitoring assessment. Where an onsite meteorological station with data recorded at 10m height has not been available, the nearest Bureau of Meteorology data has been adopted to inform this assessment and modelled using The Air Pollution Model (TAPM) to determine the atmospheric stability category as outline in **Table 3-1**.

Table 3-1: Classification of Atmospheric Stability (NSW EPA, 2014)

Stability Classification	Pasquill Stability Category	Ambient temperature change with height ($^{\circ}\text{C}/100\text{m}$)
Extremely unstable	A	$\Delta T \leq -1.9$
Moderately unstable	B	$-1.9 < \Delta T \leq -1.7$
Slightly unstable	C	$-1.7 < \Delta T \leq -1.5$
Neutral	D	$-1.5 < \Delta T \leq -0.5$
Slightly stable	E	$-0.5 < \Delta T \leq 1.5$
Moderately stable	F	$1.5 < \Delta T \leq 4.0$
Extremely stable	G	$\Delta T > 4.0$

As stated in the Development Consent, the noise criteria in Table 2-1 applies under all meteorological conditions except the following:

- Wind speeds greater than 3m/s at 10m above ground level.
- Temperature inversion conditions between 1.5 $^{\circ}\text{C}$ and 3 $^{\circ}\text{C}/100\text{m}$ and wind speed greater than 2m/s at 10m above ground level.
- Temperature inversion conditions greater than 3 $^{\circ}\text{C}/100\text{m}$.

Appendix 5 of the Development Consent also specifies that except for wind speed at microphone height, the data to be used for determining meteorological conditions shall be that recorded by a suitable meteorological station operating in the vicinity of the site.

4. Results and Discussion

4.1 Location NM1

Noise monitoring at location NM1 conducted on Tuesday 7 May 2024 resulted in inaudible quarry noise during the day. The quarry was not operational during the evening. For one day period there was a negligible exceedance of the criteria (<2 dBA). Ambient noise sources measured included insects, wind/rustling leaves, and birds. These results meet the established noise criteria and indicate that noise emissions from Teven Quarry did not contribute to noise nuisance. The results and observations taken during the monitoring events at Location NM1 are presented in **Table 4-1**.

Table 4-1: Noise survey results and observations for Location NM1

Date	Time	Descriptor (dBA)			Meteorology (handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry L _{Aeq} (15min) Contribution	L _{Aeq} (15min) Criteria (dBA)
		L _{Amax}	L _{Aeq}	L _{A90}					
7-05-24	10:05am to 10:20am (Day)	62.8	51.8	46.4	WD: 310° WS: 0.5 m/s Rain: Nil	WD: W WS: 4 m/s Rain: nil Stability Category: E ¹	Background trees/wind/birds 40-62 Quarry inaudible	<36	37
7-05-24	10:20am to 10:35am (Day)	66.5	56.2	49.0	WD: 310° WS: 0.5 m/s Rain: Nil	WD: W WS: 4 m/s Rain: nil Stability Category: E ¹	Background trees/wind/birds 43-60 Car passing 59-64 Quarry inaudible	<39 ³	37
7-05-24	6:33pm to 6:48pm (Evening)	57.0	48.5	46.8	WD: n/a WS: 0 m/s Rain: Nil	WD: W WS: 1.8 m/s Rain: nil Stability Category: E ¹	Background trees/wind/birds 44-50 Quarry not operational	n/a ²	35
7-05-24	6:50pm to 7:05pm (Evening)	59.2	48.6	44.9	WD: 310° WS: 0.9 m/s Rain: Nil	WD: W WS: 2 m/s Rain: nil Stability Category: E ¹	Background wind/trees/birds 44-48 Quarry not operational	n/a ²	35

¹ Modelled using TAPM to determine Stability Category.

² Quarry not operational.

³ Negligible exceedance (NPfI 2017 – Table 4.1 and Table 4.2)

4.2 Location NM2

Noise monitoring at location NM2 was completed on Tuesday 7 May 2024. Offsite quarry vehicles were audible during the day and the site was not operational during the evening period. Two Holcim trucks were observed and measured during one monitored day period, however as this was an offsite vehicle movement it doesn't constitute as a contributor to the quarry contribution. The ambient noise environment was dominated by wind, trees, motorway hum, and passing cars on Teven Road. These results indicate that noise emissions from Teven Quarry did not contribute to noise nuisance. The results and observations taken during the monitoring events at Location NM2 are presented in **Table 4-2**.

Table 4-2: Noise survey results and observations for Location NM2

Date	Time	Descriptor (dBA)			Meteorology (handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry LAeq(15min) Contribution	LAeq(15min) Criteria (dBA)
		L _{Amax}	L _{Aeq}	L _{A90}					
7-05-24	9:20am to 9:35am (Day)	86.4	65.8	44.6	WD: 310° WS: 1.4 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: E ¹	Background wind/trees/motorway 44-48 Cars passing on Teven Rd 55-75 Holcim trucks on Teven Rd 60-85 (occurred twice for 7-10 seconds each) Quarry vehicles audible	<35	38
7-05-24	9:35am to 9:50am (Day)	84.1	61.9	41.1	WD: 310° WS: 1.4 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: E ¹	Background wind/trees/motorway 37-55 Cars passing on Teven Rd 58-81 Quarry inaudible	<31	38
7-05-24	7:54pm to 8:09pm (Evening)	83.8	58.0	37.7	WD: n/a WS: 0 m/s Rain: Nil	WD: W WS: 2 m/s Rain: nil Stability Category: E ¹	Background wind/trees/motorway 35-38 Cars passing on Teven Rd 83 Quarry not operational	n/a ²	35
7-05-24	8:11pm to 8:26pm (Evening)	85.9	57.0	38.3	WD: n/a WS: 0 m/s Rain: Nil	WD: W WS: 2.2 m/s Rain: nil Stability Category: E ¹	Background wind/trees/motorway 35-38 Cars passing on Teven Rd 43-86 Quarry not operational	n/a ²	35

¹ Modelled using TAPM to determine Stability Category.

² Quarry not operational.

4.3 Location NM3

Noise monitoring at location NM3 was completed on Monday 6 May 2024 and Tuesday 7 May 2024. The quarry was inaudible during the day and was not operational during the evening period. The ambient noise environment consisted of insects, frogs, birds, trees, aircraft, and motorway hum. These results indicate that noise emissions from Teven Quarry did not contribute to noise nuisance. The results and observations taken during the monitoring events at Location NM3 are presented in **Table 4-3**.

Table 4-3: Noise survey results and observations for Location NM3

Date	Time	Descriptor (dBA)			Meteorology (handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry LAeq(15min) Contribution	LAeq(15min) Criteria (dBA)
		L _{Amax}	L _{Aeq}	L _{A90}					
7-05-24	7:57am to 8:12am (Day)	64.5	44.6	38.0	WD: 306° WS: 1.8 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: E ¹	Background trees/frogs 36-42 Birds 38-41 Aircraft 44-62 (occurred once) Quarry inaudible	<28	37
7-05-24	8:13am to 8:27am (Day)	48.9	38.5	36.6	WD: 306° WS: 1.8 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: E ¹	Background trees/frogs 34-40 Birds 48 Quarry inaudible	<27	37
6-05-24	6:00pm to 6:15pm (Evening)	48.7	42.5	40.4	WD: n/a WS: 0 m/s Rain: Nil	WD: NW WS: 3.1 m/s Rain: nil Stability Category: E ¹	Background insects/motorway hum 40-42 Quarry not operational	n/a ²	35
6-05-24	6:15pm to 6:30pm (Evening)	54.5	44.1	42.9	WD: n/a WS: 0 m/s Rain: Nil	WD: NW WS: 3.1 m/s Rain: nil Stability Category: E ¹	Background insects/motorway hum 40-42 Aircraft 44-54 Birds 42-45 Quarry not operational	n/a ²	35

¹ Modelled using TAPM to determine Stability Category.

² Quarry not operational.

4.4 Location NM4

Noise monitoring at location NM4 was completed on Monday 6 May 2024 and Tuesday 7 May 2024. The quarry was audible during both monitored day periods. Continuous site background noise and reverse squawkers were measured for the first day period and sound exposure calculations (SEL) included in **Appendix 1** showed an exceedance of the criteria by 6 dBA. Reverse squeakers were measured during the second day period and SEL calculations included in **Appendix 1** showed an exceedance of the criteria by 3 dBA. It should be noted that the monitoring was completed close to Stokers Lane at the entrance to the residence as to not disturb the resident, which places the attended noise monitoring location in direct line-of-sight of the quarry rather than near the sensitive receptor, i.e., the resident. Subsequently the results from the SEL calculations were adopted for distance correction to receiver using noise emission level calculations (NEL) in **Appendix 1**. Following NEL calculations the first day monitored period still showed an exceedance of the criteria by 6 dBA when factoring in the background noise also observed from the site. NEL calculations showed the second monitored day period did not exceed the criteria. Holcim vehicles entering and exiting the site were observed and measured four times for up to 12 seconds each time during the day. As these were offsite vehicle movements they don't constitute as a contributor to the quarry contribution. The quarry was not operating during the evening period. The ambient noise environment consisted of birds, insects, and aircraft. The results and observations taken during the monitoring events at Location NM4 are presented in **Table 4-4**. These results indicate that noise emissions from Teven Quarry did contribute to noise nuisance during the day.

Table 4-4: Noise survey results and observations for Location NM4

Date	Time	Descriptor (dBA)			Meteorology (handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry LAeq (15min) Contribution	LAeq (15min) Criteria (dBA)
		LAmx	LAeq	LA90					
7-05-24	8:43am to 8:58am (Day)	81.2	59.8	45.8	WD: 310° WS: 1.3 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: E ¹	Background site noise (unsure of noise source) 48-51 Holcim trucks entering/exiting quarry 55-80 (occurred twice for 10-12 secs each) Reverse squawkers 46-59 (occurred 11 times for 5-7 secs each) Cars passing on Stoker's Lane 48-73 Birds 45-50 Quarry audible	<43 ^{3,4}	37

Date	Time	Descriptor (dBA)			Meteorology (handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry LAeq (15min) Contribution	LAeq (15min) Criteria (dBA)
		L _{Amax}	L _{Aeq}	L _{A90}					
7-05-24	9:00am to 9:15am (Day)	80.3	57.7	42.8	WD: 310° WS: 1.3 m/s Rain: Nil	WD: n/a WS: 0 m/s Rain: nil Stability Category: E ¹	Reverse squawkers 45-57 (occurred 6 times for 5-10 secs each) Hammering 44-46 (occurred once) Holcim trucks entering/exiting quarry 52-80 (occurred twice for 10-12 secs each) Birds 47-49 Quarry audible	<31 ³	37
7-05-24	6:00pm to 6:15pm (Evening)	54.6	47.5	46.8	WD: n/a WS: 0 m/s Rain: Nil	WD: W WS: 1.3 m/s Rain: nil Stability Category: E ¹	Background insects/motorway hum 45-47 Quarry not operational	n/a ²	35
6-05-24	6:40pm to 6:55pm (Evening)	51.4	40.6	39.4	WD: n/a WS: 0 m/s Rain: Nil	WD: NW WS: 2.2 m/s Rain: nil Stability Category: E ¹	Background insects/motorway hum 39-40 Birds 51 Quarry not operational	n/a ²	35

¹ Modelled using TAPM to determine Stability Category.

² Quarry not operational

³ Value estimated based on SEL and distance correction to receiver location calculations in **Appendix 1**.

⁴ Moderate exceedance (NPFI 2017 – Table 4.1 and Table 4.2)

4.5 Location NM5

Noise monitoring at location NM5 was completed on Tuesday 7 May 2024. The quarry was inaudible during any monitored period during the day and evening. Noise sources measured included wind, trees, motorway hum, aircraft, birds, insects, and passing cars on Teven Road. These results indicate that noise emissions from Teven Quarry did not contribute to noise nuisance during this time. The results and observations taken during the monitoring events at Location NM5 are presented in **Table 4-5**.

Table 4-5: Noise survey results and observations for Location NM5

Date	Time (hrs)	Descriptor (dBA)			Meteorology (Handheld at microphone height)	Onsite Met Station (10m height)	Apparent Noise Source, Description and SPL (dBA)	Teven Quarry LAeq(15min) Contribution	LAeq(15min) Criteria
		LAm _{ax}	LA _{eq}	LA ₉₀					
7-05-24	10:51am to 11:06am (Day)	62.9	45.6	38.7	WD: 310° WS: 0.4 m/s Rain: Nil	WD: W WS: 4 m/s Rain: nil Stability Category: E ¹	Background wind/trees/motorway hum 36-47 Cars passing 40-62 Quarry inaudible	<29	37
7-05-24	11:07am to 11:22am (Day)	65.0	47.1	38.6	WD: 310° WS: 0.4 m/s Rain: Nil	WD: W WS: 4 m/s Rain: nil Stability Category: E ¹	Background wind/trees/motorway hum 36-45 Cars passing 40-62 Aircraft 42-45 Quarry inaudible	<29	37
7-05-24	7:19pm to 7:34pm (Evening)	53.5	42.5	41.1	WD: n/a WS: 0 m/s Rain: Nil	WD: W WS: 2 m/s Rain: nil Stability Category: E ¹	Background wind/trees/motorway hum 39-41 Quarry not operational	n/a ²	35
7-05-24	7:35pm to 7:50pm (Evening)	70.7	50.1	41.8	WD: n/a WS: 0 m/s Rain: Nil	WD: W WS: 1.8 m/s Rain: nil Stability Category: E ¹	Background wind/trees/motorway hum 39-41 Cars passing on Teven Road 70 Quarry not operational	n/a ²	35

¹ Temperature data used from BOM (Station ID 94596) to undertake modelling using TAPM to determine Stability Category.

² Quarry not operational

5. Recommendations and Conclusion

This NMA completed by Ramboll at the Holcim Teven Quarry, Teven, NSW as a quarterly requirement of the NMP. Noise monitoring was completed on Monday 6 May 2024 and Tuesday 7 May 2024 at five locations selected as representative to the sensitive receptors at the surroundings to Teven Quarry.

Audible noise identified as emitted from the quarry was recorded during the day at locations NM2 and NM4. The results presented in this NMA show compliance with the relevant noise criteria at the Holcim Teven Quarry, Teven, NSW, except for NM4 which exceeded the criteria by 6 dBA for one day period.

While the exceedance of the noise criteria is considered "moderate", and no exceedance of the noise criteria has been recorded since the third quarter of 2023, it is recommended that the following 'best management practice' (BMP) be considered to reduce noise emissions from quarry operations in the future.

- using the quieter plant that can do the job.
- restricting movement of trucks on ridgelines and exposed haul routes where their noise can propagate over a wide area, especially at night.
- scheduling the use of noisy equipment at the least-sensitive time of day.
- siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
- where there are several noisy pieces of equipment, scheduling operations so they are used separately rather than concurrently.
- keeping equipment well-maintained and operating it in a proper and efficient manner
- employing 'quiet' practices when operating equipment, for example, positioning idling trucks in appropriate areas.
- running staff-education programs and regular toolbox talks on the effects of noise and the use of quiet work practices.

When BMP is not effective to achieve the required noise reduction by itself, the 'best available technology economically achievable' (BATEA) approach can then be considered. Examples of uses of BATEA include:

- using equipment with efficient muffler design.
- using quieter engines, such as electric instead of internal combustion.
- fitting and maintaining noise reduction packages on plant and equipment.
- using efficient enclosures for noise sources.
- using high-pressure hydraulic systems to split rock, instead of hydraulic or pneumatic hammers.
- damping or lining metal trays or bins.

Ramboll will verify exceedances of the noise criteria in the next round of noise monitoring and discuss further with Holcim in case of significant exceedances of the noise criteria being recorded.

6. References

Holcim Australia (2021) *Teven Quarry, Noise Management Plan*.

International Electrotechnical Commission *IEC 60942:2017 Electroacoustics – Sound calibrators*

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Appendix 1 Sound Exposure Level and Noise Emission Level Calculations

NM4 day monitoring period (8:43AM - 8:58AM)

Noise source	Reverse squawkers
Meas. Dist from source (m)	-
Meas. Time (s)	7
Meas. LAeq dB	54
Calc Sel dB	62
No. Events in 15min	11
Total LAeq (15min)	43

NM4 day monitoring period (9:00AM - 9:15AM)

Noise source	Reverse squawkers
Meas. Dist from source (m)	-
Meas. Time (s)	10
Meas. LAeq dB	52
Calc Sel dB	62
No. Events in 15min	6
Total LAeq (15min)	40

NM4 day monitoring period (8:43AM - 8:58AM)

Site contribution corrected for distance from monitoring location to receiver

Noise source	Holcim background noise
Estimated site contribution (LAeq) at monitoring location (dBA)	51.0
Approx. distance from monitoring location to site (m)	310
Approx. distance from site to receiver (m)	500
Distance corrected site contribution at receiver (LAeq dBA)	46.8
Estimated additional attenuation (vegetation & ground absorption)	5
Estimated site contribution at receiver (dBA)	41.8

Noise source	Reverse Squawkers
Estimated site contribution (LAeq) at monitoring location (dBA)	43.3
Approx. distance from monitoring location to site (m)	310
Approx. distance from site to receiver (m)	500
Distance corrected site contribution at receiver (LAeq dBA)	39.2
Estimated additional attenuation (vegetation & ground absorption)	5
Estimated site contribution at receiver (dBA)	34.2

Cumulative NEL of Holcim reverse squawkers and background noise	42.5
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NM4 day monitoring period (9:00AM - 9:15AM)

Site contribution corrected for distance from monitoring location to receiver

Noise source	Reverse Squawkers
Estimated site contribution (LAeq) at monitoring location (dBA)	40.2
Approx. distance from monitoring location to site (m)	310
Approx. distance from site to receiver (m)	500
Distance corrected site contribution at receiver (LAeq dBA)	36.1
Estimated additional attenuation (vegetation & ground absorption)	5
Estimated site contribution at receiver (dBA)	31.1