

NARRABRI MINE NOISE MONITORING

**Quarter Ending March 2020
Summary Noise Report**

Prepared for:

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18063-R08-v1.0	27 April 2020	Adam Sirianni	Martin Davenport	Martin Davenport

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1 Introduction

Narrabri Coal Operations Pty Ltd has commissioned SLR Consulting Australia Pty Ltd (SLR) to conduct operational noise monitoring for the Narrabri Mine located near Narrabri, New South Wales (NSW) in accordance with the approved Noise Management Plan (NMP) dated June 2018, the Narrabri Mine Project Approval (PA) 08_0144 and the Environment Protection Licence 12789 dated 19 January 2017 (EPL 12789).

The objectives of the noise monitoring programme for this operating period were as follows:

- Conduct operator attended noise surveys at 6 locations (as listed in **Section 3.3**) surrounding the mine during the day, evening and night-time periods.
- Quantify all sources of noise within each of the attended noise surveys, including their measured and/or estimated contribution and maximum level of individual noise sources.
- Assess the noise emissions of Narrabri Mine and determine compliance with respect to the limits contained in Section 2 of the NMP and the relevant approvals.

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 PERFORMANCE ASSESSMENT AND DISCUSSION

The following provides a summary of the attended noise measurements undertaken at each monitoring location. Further details are provided for each location in **Section 5** of this report.

Table 1 Performance Assessment – Operations

EPL ID	Location	Date	Narrabri Mine Contribution dBA				Noise Criteria ²	Measurement Periods	Weather Compliant			Compliant			
			LAeq 15 min Day	LAeq 15 min Evening	LAeq 15 min Night	LA1 (1 min) Night			Day	Evening	Night				
N5	Oakleigh ³	24/03/2020	I/A	25	25	27	Day, Evening and Night – LAeq(15minute) 35 dBA Night LA1(1minute) – 45 dBA	Day - 1.5 hrs	Y	Y	Y	Y			
		25/03/2020	31	I/A	N/M	N/M			Evening - 0.5 hrs	Y	Y	Y	Y		
		26/03/2020	I/A	I/A	I/A	I/A			Night – 1hrs	Y	N	N	Y		
N6	Newhaven	24/03/2020	27	N/M	I/A	I/A		Night LA1(1minute) – 45 dBA	Day - 1.5 hrs	N	Y	Y	Y		
		25/03/2020	N/M	N/M	26	30				Evening - 0.5 hrs	Y	Y	N	Y	
		26/03/2020	25	N/M	N/M	N/M				Night – 1hrs	Y	N	N	Y	
N8	Haylin View ³	24/03/2020	26	<25	27	28			Night LA1(1minute) – 45 dBA	Day - 1.5 hrs	Y	Y	Y	Y	
		25/03/2020	27	34 ¹	30	33					Evening - 0.5 hrs	Y	Y	Y	Y
		26/03/2020	<25	I/A	I/A	I/A					Night – 1hrs	N	N	N	Y
N9	High Range	24/03/2020	<25	I/A	N/M	N/M	Night LA1(1minute) – 45 dBA			Day - 1.5 hrs	N	Y	Y	Y	
		25/03/2020	I/A	27	27	29					Evening - 0.5 hrs	Y	Y	N	Y
		26/03/2020	27	25	<25	26					Night – 1hrs	N	N	N	Y
N1	Bow Hills ²	24/03/2020	I/A	25	28	30		Night LA1(1minute) – 45 dBA		Day 15 min	N	Y	Y	Y	
N3	Ardmona	24/03/2020	I/A	25	26	30				Evening 15 min	N	Y	Y	Y	
N7	Merriman ³	24/03/2020	I/A	I/A	I/A	I/A				Night 15 min	N	Y	Y	Y	
N8	Matilda ³	24/03/2020	28	<25	<25	25			Night 15 min	N	Y	Y	Y		

I/A = Inaudible, N/M = Not Measurable

Note 1: 2dB modifying factor correction for low frequency noise has been applied in accordance with the NPfI.

Note 2: A private agreement between NCOPL and the residents of N1 Bow Hills of 50 dBA LAeq(15minute) is in place. This new level of 50 dBA LAeq(15minute) replaces the levels identified in Conditions 1-3, Schedule 4 of PA 08_0144 Mod 2 and the identical limits contained in condition L3 of Environment Protection Licence No 12789

Note 3: Property is owned by Narrabri Coal Operations.

3 Noise Criteria

3.1 Project Approval, EPL and NMP

Noise monitoring at the Narrabri Mine was conducted in accordance with EPL 12789, the PA requirements and the NMP. The site specific EPL and PA noise limits are summarised in Section 2 of the NMP and are reproduced in **Table 2**.

Table 2 Project Approval and EPL Noise Criteria

Location	Day	Emergency Day	Night	
	LAeq(15minute)	LAeq(15minute)	LAeq(15minute)	LA1(1minute)
All Privately owned Residences	35	35	35	45

3.2 Non-compliances & Exemptions

In accordance with Section 11.1.3 of the NSW Industrial Noise Policy (INP) a development is deemed to be in non-compliance with a noise consent or licence condition if the monitored noise level is more than 2 dB above the statutory noise limit specified in the consent or licence. This may occur for two reasons:

- The noise from the Narrabri Mine is excessive, in which case Narrabri Mine will be not complying with its consent or licence condition.
- The noise was increased by extreme, non-standard weather effects—in which case the Narrabri Mine is not considered to be in noncompliance with its consent or licence condition.

In this latter case, further monitoring at a later date is required to determine compliance under “normal” meteorological conditions.

The INP states in Section 9.2 that *“it is not practicable to meet the noise limit under all inversion events; hence exceedances under extreme temperature inversions are not considered to be a non-compliance with consent or licence conditions.”*

Non-standard weather effects include:

- Wind speeds greater than 3 m/s at 10m above ground level; or
- Stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level; or
- Stability category G temperature inversion conditions

As stated in EPL 12789 *“Data recorded by the meteorological station identified as EPA Identification Point(s) W1 must be used to determine meteorological conditions and temperature inversion conditions (stability category) are to be determined by direct measurement over a minimum 50m height interval as referred to in Part E2 of Appendix E of the “New South Wales Industrial Noise Policy” dated January 2000 ISBN 0 7313 2715 2.”*

Weather and Temperature inversion monitoring is undertaken continuously in accordance with EPL 12789 with monitoring locations displayed in **Figure 1**. Monitoring Location W1 records wind speed and direction at 10m above ground level. Temperature inversion monitoring is undertaken continuously by directly measuring temperature at two elevations 50m apart (10m & 60m from ground level) at monitoring location W2. All weather data reported in **Table 5** to **Table 20** have been recorded at these monitoring locations.

3.3 Attended Monitoring

Attended Noise monitoring is to be undertaken on a quarterly basis at residential areas. The attended monitoring will take place at the following locations:

EPL Monitoring Locations

- N5 Oakleigh – 16293 Kamilaroi Highway Baan Baa
- N6 Newhaven – 184 Greylands Road Turrawan
- N8 Haylin View – 791 Mayfield Road Baan Baa
- N9 High Range – 92 Davis Road Turrawan

EPL also requires monitoring at N8 Haylin View to be conducted quarterly when surface activities approach the eastern end of the southern longwall panels. Monitoring at N8 Haylin View has been undertaken during this period, however as no works are currently being undertaken over the eastern end of the southern longwall panels future monitoring will be ceased until required.

It is noted that the Narrabri Mine own the properties Oakleigh (N5) and Haylin View (N9).

NMP Monitoring Locations

- N1 Bow Hills – 16652 Kamilaroi Highway Baan Baa
- N3 Ardmona – 16462 Kamilaroi Highway Baan Baa
- N7 Merriman – 16896 Kamilaroi Highway Baan Baa
- N8 Matilda – 773 Mayfield Road Baan Baa

It is noted that the Narrabri Mine owns the properties Merriman (N7) and Matilda (N8), and has a private agreement with the landholder of Bow Hills (N1) for increased noise limits.

The following details the requirements of the monitoring:

EPL Monitoring Requirements

- At each one of the monitoring locations N5, N6, N8 and N9;
- Occur quarterly in a reporting period;
- Occur during each day, evening and night period as defined in the NSW Industrial Noise Policy for a minimum of:
 - i) 1.5 hours during the day;
 - ii) 30 minutes during the evening; and
 - iii) 1 hour during the night.

- Occur for three consecutive operating days.

NMP Monitoring Requirements

- At each one of the monitoring locations N1, N3, N7 and N8
- Occur quarterly in a reporting period; and
- Occur during a day, evening and night period as defined in the NSW Industrial Noise Policy for a minimum 15 minutes.

4 Operational Noise Monitoring Methodology

4.1 General Requirements

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672.1 – 2004 *Electroacoustics—Sound level meters – Specifications*, AS IEC 61672.2-2004, AS IEC 61672.3-2004 and carried current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ± 0.5 dBA. Calibration certificates for all instruments employed during the monitoring campaign are presented in **Appendix B**.

4.2 Methodology - Operator Attended Noise Monitoring

Operator attended noise measurements were conducted during the day, evening and night-time periods for a minimum of 1.5 hours during the day; 30 minutes during the evening and 1 hour during the night at the four EPL nominated noise monitoring locations and for 15 minutes during the day, evening and night at each of the NMP nominated noise monitoring location representing the most affected receiver locations, listed in **Table 3** and shown in **Figure 1**. During the operator attended noise measurements, the character and relative contribution of ambient noise sources and mine contributions were determined.

Table 3 Noise Monitoring Locations

Monitoring Location	Monitoring Requirements	Receiver Type	Address	Monitoring Location - MGA Zone 55	
				Easting (m)	Northing (m)
N5 ^{1,2}	EPL	Residence	Oakleigh – 16293 Kamilaroi Highway Baan Baa	779526	6617751
N6 ^{1,2}	EPL	Residence	Newhaven – 184 Greylands Road Turrawan	776564	6624643
N8 ¹	EPL	Residence	Haylin View - 791 Mayfield Road Baan Baa	777428	6617316
N9 ¹	EPL	Residence	High Range – 92 Davis Road Turrawan	775879	6625895
N1	NMP	Residence	Bow Hills – 16652 Kamilaroi Highway Baan Baa	780114	6620641
N3 ²	NMP	Residence	Ardmona – 16462 Kamilaroi Highway Baan Baa	780233	6618836
N7 ²	NMP	Residence	Merriman – 16896 Kamilaroi Highway Baan Baa	779290	6623143
N8 ²	NMP	Residence	Matilda – 773 Mayfield Road Baan Baa	777815	6617045

Note: 1. EPL monitoring locations
 2. NMP monitoring locations

The objective of the operator attended noise monitoring was to measure the (LA_{1(1minute)}) and the LA_{eq(15minute)} noise level contribution from the Narrabri Mine at the nearest potentially affected receptors in order to determine the noise contribution of operational activities associated with Narrabri Mine over each 15 minute measurement period. In addition, the operator quantifies and characterises the overall levels of ambient noise in the area (i.e. LA_{max}, LA₁, LA₁₀, LA₉₀, and LA_{eq}) over the 15 minute measurement interval.

Operator attended noise measurements were conducted using one-third octave integrating Brüel & Kjær Type 2250 and 2270 sound level meters (s/n 3006994 and s/n 3027586 respectively). Attended noise measurements were undertaken by SLR staff Adam Sirianni and Jordan McMahon.

Figure 1 Attended Noise Monitoring Locations

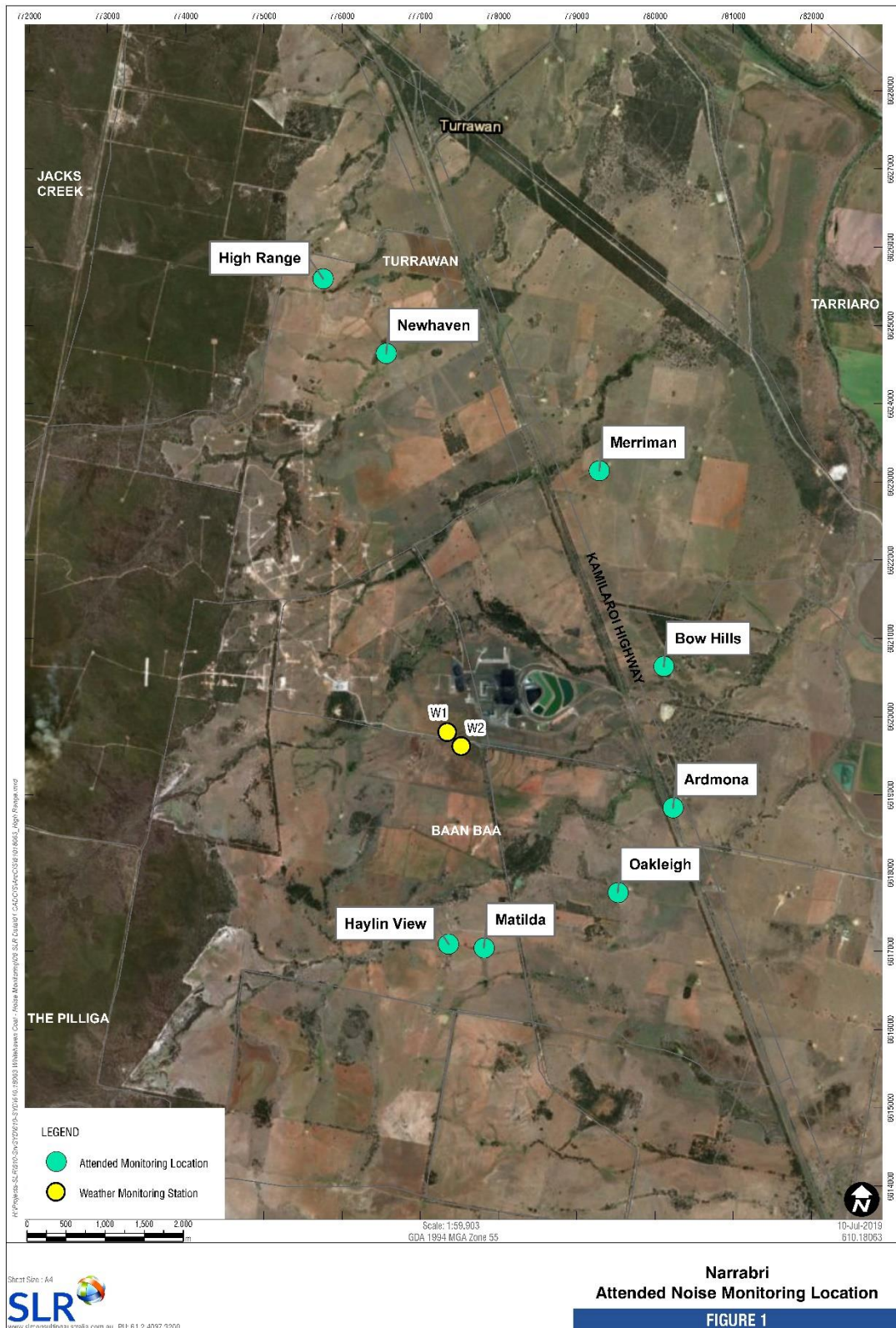


Table 4 presents a summary of which days of the week the quarterly monitoring was conducted, in accordance with condition M7.4 of EPL 12789 and Section 5 of the NMP.

Table 4 Days of the Week Quarterly EPL Monitoring was Conducted – Q1 2020

Period	Day of the Week (Excluding Weekends and Public Holidays)				
	Monday	Tuesday	Wednesday	Thursday	Friday
Day		24 th March 2020	25 th March 2020	26 th March 2020	
Evening		24 th March 2020	25 th March 2020	26 th March 2020	
Night ¹		24 th March 2020	25 th March 2020	26 th March 2020	

Note 1: Taken to mean the night time period from 10:00 pm on the stated day to 7:00 am the following day.

5 Results and Discussion

5.1 Results of Operator Attended Monitoring

Results of the operator attended noise surveys at N5, N6, N8_(EPL), N9, N1, N3, N7 and N8_(NML) are provided **Table 5** to **Table 20**.

Ambient noise levels presented include all noise sources such as transport (roads, rail and aircraft), fauna (insects, frogs, birds and bats), the natural environment (wind in trees), domestic noises, other industrial operations as well as Narrabri Mine noise emissions.

Weather data during the monitoring period has been obtained from the weather station located on the Narrabri Mine site and observed conditions.

The tables also provide the following information:

- Date and start time, operator and equipment details.
- Monitoring location.
- Wind velocity (m/s) and temperature (°C) at weather station W1, as detailed in **Section 3.2**.
- Typical maximum (L_{Amax}) and contributed L_{Aeq(15minute)} noise levels.

5.1.1 Operator Attended Noise Survey Results – EPL Monitoring Location N5

Results of the operator attended noise surveys at N5 are provided in **Table 5**, **Table 6** and **Table 7**. Monitoring location N5 represents residential receptors located to the southeast of the site in Oakleigh.

Table 5 Operator Attended EPL Noise Survey Results – N5 – Oakleigh (Day 1)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 1 24/03/2020 10:00 0.6 – 3.2 m/s W/SE 23-27 °C 3006994	35 dBA L _{Aeq} (15minute)	1	D	52	43	36	27	33	26	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 30-48 Birds 36-59
		2	C	58	46	38	28	36	25	I/A	
		3	A	59	49	38	27	37	25	I/A	
		4	A	56	44	33	26	33	25	I/A	
		5	A	51	42	34	27	32	25	I/A	
		6	A	52	43	36	27	33	24	I/A	
Evening 1 24/03/2020 21:19 0 – 1.2 m/s W/WNW 21 °C 3006994	35 dBA L _{Aeq} (15minute)	1	-	46	44	39	30	36	26	N/M	Site Related Noise Events: General activity 23-26 Other Noise Events: Traffic 35-50
		2	F	50	46	43	30	38	26	25 L _{Aeq}	

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Night 1 24/03/2020 22:01 0 – 1.8 m/s WSW 21 °C 3006994	35 dBA LA _{eq} (15minute) 45 dBA LA ₁ (1minute)	1	-	49	44	39	31	37	28	25 LA _{eq} 27 LA ₁	Site Related Noise Events: Dozer operations 24-27 General activity 21-25 Other Noise Events: Traffic 33-51 Insects 30-33 Aircraft 40-51
		2	-	51	46	41	28	37	26	<25 LA _{eq} 25 LA ₁	
		3	F	52	46	41	30	38	27	<25 LA _{eq} <25 LA ₁	
		4	E	51	47	38	30	36	27	24 LA _{eq} 25 LA ₁	

Note: N/M = Not Measurable, I/A = Inaudible

Table 6 Operator Attended EPL Noise Survey Results – N5 – Oakleigh (Day 2)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Day 1 25/03/2020 07:07 0 – 1.5 m/s SW/NW 19 - 22 °C 3006994	35 dBA LA _{eq} (15minute)	1	E	59	51	42	30	40	26	N/M	Site Related Noise Events: General activity 27-36 Engine noise 30-32 Other Noise Events: Traffic 35-46 Birds 35-65
		2	D	55	49	41	30	38	26	30 LA _{eq}	
		3	A	61	51	40	30	39	28	30 LA _{eq}	
		4	A	53	45	38	29	35	27	29 LA _{eq}	
		5	Z	54	46	39	31	37	28	31 LA _{eq}	
		6	A	65	47	40	33	39	29	28 LA _{eq}	
Evening 1 25/03/2020 20:50 2.9 – 3.2 m/s E/ESE 18 °C 3006994	35 dBA LA _{eq} (15minute)	1	E	48	42	38	25	33	23	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 35-55 Animals 35-38
		2	D	55	46	40	24	36	22	I/A	
Night 1 25/03/2020 22:00 2 – 3.6 m/s SE/ESE 18 °C 3006994	35 dBA LA _{eq} (15minute) 45 dBA LA ₁ (1minute)	1	E	55	49	44	26	40	22	I/A	Site Related Noise Events: Generally Inaudible with faint site activity audible at times Other Noise Events: Traffic 37-46 Bats 45-59 Aircraft 40-49
		2	E	49	43	38	21	33	20	N/M	
		3	E	59	45	41	25	37	23	I/A	
		4	D	53	49	47	38	43	35	I/A	

Note: N/M = Not Measurable, I/A = Inaudible

Table 7 Operator Attended EPL Noise Survey Results – N5 – Oakleigh (Day 3)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Day 3 26/03/2020 08:54 2.9 – 3.8 m/s SE/ESE 18-20 °C 3006994	35 dBA LA _{eq} (15minute)	1	D	52	45	36	28	34	24	I/A	Site Related Noise Events: Inaudible Other Noise Events: Birds 39-60 Traffic 32-44
		2	D	57	47	36	26	35	22	I/A	
		3	D	48	40	35	27	32	25	I/A	
		4	D	60	46	38	28	36	24	I/A	
		5	D	59	49	39	29	37	26	I/A	
		6	D	54	45	39	29	36	26	I/A	
Evening 3 26/03/2020 20:45 5.5 – 6.1 m/s ESE 20 °C 3006994	35 dBA LA _{eq} (15minute)	1	D	58	50	46	39	43	36	I/A	Site Related Noise Events: Inaudible Other Noise Events: Wind 40-58 Traffic 40-48
		2	D	54	48	45	38	42	34	I/A	
Night 3 26/03/2020 22:00 4.7 – 5.3 m/s ESE 18-19 °C 3006994	35 dBA LA _{eq} (15minute) 45 dBA LA ₁ (1minute)	1	D	55	47	44	37	41	33	I/A	Site Related Noise Events: Inaudible Other Noise Events: Wind 40-55 Traffic 35-49
		2	D	53	44	41	35	38	32	I/A	
		3	E	48	44	40	32	37	29	I/A	
		4	D	52	42	38	33	36	30	I/A	

Note: N/M = Not Measurable, I/A = Inaudible

5.1.2 Operator Attended Noise Survey Results – EPL Monitoring Location N6

Results of the operator attended noise surveys at N6 are provided in **Table 8**, **Table 9** and **Table 10**. Monitoring location N6 represents residential receptors located to the northwest of the site in Newhaven.

Table 8 Operator Attended EPL Noise Survey Results – N6 – Newhaven (Day 1)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 1 24/03/2020 07:26 3.1 – 4.3 m/s SE/SSE 19-21 °C 3027586	35 dBA L _{Aeq} (15minute)	1	E	64	53	45	31	42	26	<25 L _{Aeq}	Site Related Noise Events: General mine activity 25-29 Other Noise Events: Birds 40-70 Road Traffic 30-40
		2	D	58	50	41	30	39	26	27 L _{Aeq}	
		3	D	70	55	42	31	43	27	26 L _{Aeq}	
		4	D	63	49	41	30	38	26	25 L _{Aeq}	
		5	D	54	44	38	29	35	25	N/M	
		6	D	51	44	38	28	35	25	<25 L _{Aeq}	
Evening 1 24/03/2020 20:07 0 - 1 m/s SW/WSW 22-23 °C 3027586	35 dBA L _{Aeq} (15minute)	1	-	55	42	38	24	33	22	N/M	Site Related Noise Events: Mine barely audible Other Noise Events: Insects 30-45 Road Traffic 28-43 Animals 40-55
		2	E	48	44	40	25	35	22	I/A	

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Night 1 25/03/2020 00:27 1.1 – 2.5 m/s W/WSW 21-22 °C 3027586	35 dBA L _{Aeq} (15minute)	1	F	40	32	29	23	26	21	I/A	Site Related Noise Events: Mine inaudible Other Noise Events: Insects 30-40 Wind 25-30 Road Traffic 30 Animals 25-45
		2	F	45	33	28	20	25	19	I/A	
	45 dBA L _{A1} (1minute)	3	D	42	35	29	20	25	18	I/A	
		4	D	43	33	28	20	25	19	I/A	

Note: N/M = Not Measurable, I/A = Inaudible

Table 9 Operator Attended EPL Noise Survey Results – N6 – Newhaven (Day 2)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 2 25/03/2020 07:05 0 – 1.5 m/s SW/NW 19-22 °C 3027586	35 dBA L _{Aeq} (15minute)	1	D	59	52	44	30	41	24	N/M	Site Related Noise Events: Mine barely audible Other Noise Events: Birds 40-70 Road Traffic 40-46 Aircraft 30-35
		2	E	57	52	48	31	44	25	I/A	
		3	D	59	50	43	30	40	25	I/A	
		4	A	70	55	41	27	44	24	N/M	
		5	A	68	50	40	25	41	22	I/A	
		6	-	64	52	40	26	39	23	I/A	
Evening 2 25/03/2020 20:05 2.9 – 3.8 m/s E/ESE 18 °C 3027586	35 dBA L _{Aeq} (15minute)	1	D	47	45	43	36	40	33	I/A	Site Related Noise Events: Mine barely audible Other Noise Events: Insects 30-45 Wind 33-47 Road Traffic 35-45 Vehicle on resident's property 40
		2	D	48	44	40	30	37	28	N/M	
Night 2 25/03/2020 23:34 3.1 – 3.6 m/s SE/ESE 18 °C 3027586	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	D	51	43	40	32	37	29	25 L _{Aeq} 30 L _{A1}	Site Related Noise Events: General mine activity 25-30 Other Noise Events: Wind / Rain 25-40 Road Traffic 25-42 Operator 56
		2	D	56	38	36	29	33	27	26 L _{Aeq} 27 L _{A1}	
		3	E	52	40	37	31	35	28	26 L _{Aeq} 27 L _{A1}	
		4	E	47	40	37	30	34	28	25 L _{Aeq} 28 L _{A1}	

Note: N/M = Not Measurable, I/A = Inaudible

Table 10 Operator Attended EPL Noise Survey Results – N6 – Newhaven (Day 3)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 3 26/03/2020 09:16 2.9 – 3.8 m/s SE/ESE 18-21 °C 3027586	35 dBA L _{Aeq} (15minute)	1	D	58	52	45	30	41	28	25 L _{Aeq}	Site Related Noise Events: General mine activity 25-27 Other Noise Events: Birds 40-75 Road Traffic 30-45 Aircraft 35-50
		2	D	59	50	41	29	39	27	25 L _{Aeq}	
		3	D	55	47	39	28	36	26	<25 L _{Aeq}	
		4	D	58	51	42	29	39	25	N/M	
		5	D	75	64	47	28	50	25	N/M	
		6	D	54	47	39	30	37	26	<25 L _{Aeq}	
Evening 3 26/03/2020 20:01 6.2 – 6.7 m/s ESE 20 °C 3027586	35 dBA L _{Aeq} (15minute)	1	D	49	46	43	38	41	35	N/M	Site Related Noise Events: Mine barely audible Other Noise Events: Wind 30-45 Road Traffic 35-48 Aircraft 40-42
		2	D	53	46	44	37	41	35	N/M	
Night 3 26/03/2020 23:29 4 – 4.9 m/s ESE 17 °C 3027586	35 dBA L _{Aeq} (15minute)	1	E	46	44	40	35	38	34	N/M	Site Related Noise Events: Mine barely audible Other Noise Events: Insects 30-40 Wind 35-45 Road Traffic 40-50
		2	E	45	43	40	35	38	32	N/M	
	45 dBA L _{A1} (1minute)	3	E	51	47	45	40	43	38	N/M	
		4	E	60	48	46	40	43	37	N/M	

Note: N/M = Not Measurable, I/A = Inaudible

5.1.3 Operator Attended Noise Survey Results – EPL Monitoring Location N8

Results of the operator attended noise surveys at N8 are provided in **Table 11**, **Table 12** and **Table 13**. Monitoring location N8 represents residential receptors located to the southwest of the site in Haylin View.

Table 11 Operator Attended EPL Noise Survey Results – N8 – Haylin View (Day 1)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 1 24/03/2020 09:55 0.6 – 3.1 m/s SE/WNW 22-27 °C 3027586	35 dBA L _{Aeq} (15minute)	1	D	61	45	38	28	36	25	26 L _{Aeq}	Site Related Noise Events: General mine activity 25-29 Other Noise Events: Birds 30-61 Road Traffic 30-34 Aircraft 30-35
		2	C	59	50	37	28	37	25	26 L _{Aeq}	
		3	A	56	48	39	27	36	25	25 L _{Aeq}	
		4	A	54	47	40	28	36	25	25 L _{Aeq}	
		5	A	51	44	37	26	33	24	25 L _{Aeq}	
		6	A	51	44	36	27	33	24	<25 L _{Aeq}	
Evening 1 24/03/2020 21:34 0 – 1.2 m/s WSW 21 °C 3027586	35 dBA L _{Aeq} (15minute)	1	-	42	36	34	27	32	25	<25 L _{Aeq}	Site Related Noise Events: Mine barely audible Other Noise Events: Insects 30-42 Road Traffic 21-34
		2	F	38	36	32	27	30	25	<25 L _{Aeq}	

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Night 1 24/03/2020 22:27 1.3 – 2.2 m/s W/WSW 21 °C 3027586	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	F	54	35	30	26	29	24	<25 L _{Aeq} 24 L _{A1}	Site Related Noise Events: General mine activity 25-28 Other Noise Events: Insects 25-35 Road Traffic 25-30 Animals 40-58
		2	E	49	33	29	26	28	24	<25 L _{Aeq} 23 L _{A1}	
		3	D	58	34	30	26	29	24	<25 L _{Aeq} 26 L _{A1}	
		4	D	47	35	31	28	30	25	27 L _{Aeq} 28 L _{A1}	

Note: N/M = Not Measurable, I/A = Inaudible

Table 12 Operator Attended EPL Noise Survey Results – N8 – Haylin View (Day 2)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 2 25/03/2020 09:09 0 – 8.3 m/s WNW/NW 23-25 °C 3027586	35 dBA L _{Aeq} (15minute)	1	D	54	45	38	30	35	27	27 L _{Aeq}	Site Related Noise Events: General mine activity 26-30 Other Noise Events: Birds 30-64 Road Traffic 30-39 Wind 30-60
		2	D	64	50	46	35	42	32	27 L _{Aeq}	
		3	D	59	54	50	40	47	34	N/M	
		4	D	58	54	51	41	47	36	I/A	
		5	-	60	55	51	41	48	37	I/A	
		6	D	58	54	51	41	47	35	I/A	
Evening 2 25/03/2020 21:11 2.9 - 3 m/s E/ESE 18 °C 3027586	35 dBA L _{Aeq} (15minute)	1	D	66	42	38	29	36	26	34 L _{Aeq} ¹	Site Related Noise Events: General mine activity 28-34 Dozer 30-35 Other Noise Events: Road Traffic 30-46 Wind / Rain 25-30 Operator 66
		2	D	63	45	38	33	37	30	30 L _{Aeq}	
Night 2 25/03/2020 22:00 2 – 3.6 m/s SE/ESE 18 °C 3027586	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	E	42	38	36	32	34	30	30 L _{Aeq} 33 L _{A1}	Site Related Noise Events: General mine activity 28-32 Dozer 30-33 Other Noise Events: Road Traffic 25-40 Wind / Rain 25-50 Car 65-69
		2	E	46	39	34	27	32	25	28 L _{Aeq} 31 L _{A1}	
		3	E	54	44	42	33	39	30	N/M	
		4	D	69	55	52	41	49	38	N/M	

Note: N/M = Not Measurable, I/A = Inaudible

Note 1: 2dB modifying factor correction for low frequency noise has been applied in accordance with the NPfl.

Table 13 Operator Attended EPL Noise Survey Results – N8 – Haylin View (Day 3)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 3 26/03/2020 07:15 3.2 – 3.8 m/s SE/ESE 17-18 °C 3027586	35 dBA L _{Aeq} (15minute)	1	D	56	44	38	30	36	26	I/A	Site Related Noise Events: Mine barely audible Other Noise Events: Birds 30-62 Road Traffic 30-40
		2	E	60	53	42	30	41	24	I/A	
		3	D	57	47	38	29	36	25	I/A	
		4	D	53	43	37	29	35	25	<25 L _{Aeq}	
		5	D	62	55	48	29	44	25	<25 L _{Aeq}	
		6	D	58	53	45	28	41	24	<25 L _{Aeq}	
Evening 3 26/03/2020 20:59 5.2 – 5.6 m/s ESE 20 °C 3027586	35 dBA L _{Aeq} (15minute)	1	D	49	46	44	38	41	35	I/A	Site Related Noise Events: Mine inaudible Other Noise Events: Road Traffic 30-37 Wind 40-49
		2	D	45	43	40	34	38	30	I/A	
Night 3 26/03/2020 22:01 4.7 – 5.3 m/s ESE 18-19 °C 3027586	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	D	52	41	37	31	35	28	I/A	Site Related Noise Events: Mine inaudible Other Noise Events: Road Traffic 30-40 Wind 25-50 Animals 40-54
		2	D	45	40	36	27	32	26	I/A	
		3	E	51	43	39	34	37	31	I/A	
		4	D	54	42	39	34	37	32	I/A	

Note: N/M = Not Measurable, I/A = Inaudible

5.1.4 Operator Attended Noise Survey Results – EPL Monitoring Location N9

Results of the operator attended noise surveys at N9 are provided in **Table 14**, **Table 15** and **Table 16**. Monitoring location N9 represents residential receptors located to the northwest of the site in High Range.

Table 14 Operator Attended EPL Noise Survey Results – N9 – High Range (Day 1)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Day 1 24/03/2020 07:16 3.1 – 4.3 m/s SE/ESE 19-21 °C 3006994	35 dBA LA _{eq} (15minute)	1	E	57	48	40	31	38	26	N/M	Site Related Noise Events: Exhaust vents 27-29 at times but generally barely audible Other Noise Events: Traffic 30-47 Birds 40-59 Animals 35-45
		2	E	56	45	38	29	36	26	I/A	
		3	D	58	51	45	32	41	27	I/A	
		4	D	52	44	38	30	35	26	N/M	
		5	D	54	44	38	29	35	26	N/M	
		6	D	53	40	34	28	32	25	<25 LA _{eq}	
Evening 1 24/03/2020 19:41 0 m/s 23-25 °C 3006994	35 dBA LA _{eq} (15minute)	1	-	49	36	32	25	29	22	I/A	Site Related Noise Events: Inaudible Other Noise Events: Residence MV 28-30 Dog 34-49 Traffic 27-32 Birds 30-36
		2	-	46	37	35	28	33	25	I/A	

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Night 1 25/03/2020 00:08 1.1 – 2.1 m/s S/WSW 21-22 °C 3006994	35 dBA LA _{eq} (15minute)	1	D	53	44	34	25	32	22	N/M	Site Related Noise Events: Exhaust vent barely audible Other Noise Events: Traffic 30-53 Bat 42-47
		2	F	46	33	28	24	27	22	N/M	
	45 dBA LA ₁ (1minute)	3	F	47	34	29	24	27	22	N/M	
		4	F	38	31	27	22	25	21	N/M	

Note: N/M = Not Measurable, I/A = Inaudible

Table 15 Operator Attended EPL Noise Survey Results – N9 – High Range (Day 2)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Day 2 25/03/2020 09:04 0 – 8.3 m/s WNW/NW 23-25 °C 3006994	35 dBA LA _{eq} (15minute)	1	D	54	49	42	30	39	26	I/A	Site Related Noise Events: Inaudible Other Noise Events: Wind 33-65 Birds 41-61 Traffic 34-41
		2	D	62	48	43	33	40	28	I/A	
		3	D	58	52	46	36	43	33	I/A	
		4	D	61	49	42	34	40	31	I/A	
		5	-	60	52	47	35	44	32	I/A	
		6	D	65	55	50	38	47	35	I/A	
Evening 2 25/03/2020 19:57 2.9 – 3.8 m/s E/ENE 18 °C 3006994	35 dBA LA _{eq} (15minute)	1	D	50	42	39	32	36	30	25 LA _{eq}	Site Related Noise Events: Exhaust vent 27-31 Other Noise Events: Traffic 30-45 Wind 30-35
		2	D	45	40	38	29	34	26	27 LA _{eq}	
Night 2 25/03/2020 23:24 3.3 – 3.6 m/s ESE 18 °C 3006994	35 dBA LA _{eq} (15minute) 45 dBA LA ₁ (1minute)	1	D	52	41	38	28	35	25	<25 LA _{eq} 25 LA ₁	Site Related Noise Events: Exhaust vent 20-29 Other Noise Events: Traffic 33-42 Animals 40-52 Slight Rain 40-57
		2	D	57	45	43	26	38	23	27 LA _{eq} 29 LA ₁	
		3	E	42	35	30	24	28	22	24 LA _{eq} 29 LA ₁	
		4	E	49	40	34	27	32	24	N/M	

Note: N/M = Not Measurable, I/A = Inaudible

Table 16 Operator Attended EPL Noise Survey Results – N9 – High Range (Day 3)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Day 3 26/03/2020 07:00 3.2 – 3.8 m/s SE/ESE 17-18 °C 3006994	35 dBA LA _{eq} (15minute)	1	D	64	57	48	33	45	28	N/M	Site Related Noise Events: Exhaust vent 23-29 Other Noise Events: Horn 46-52 Traffic 30-43 Local traffic 50-64 Birds 45-67
		2	D	62	51	40	32	40	29	<25 LA _{eq}	
		3	E	63	52	39	33	40	30	25 LA _{eq}	
		4	D	67	60	49	35	48	30	<25 LA _{eq}	
		5	D	54	47	42	33	39	29	27 LA _{eq}	
		6	D	53	48	43	32	39	28	<25 LA _{eq}	
Evening 3 26/03/2020 19:55 6.2 – 6.7 m/s ESE 20 °C 3006994	35 dBA LA _{eq} (15minute)	1	D	53	42	39	33	36	31	<25 LA _{eq}	Site Related Noise Events: Exhaust vent 20-34 Other Noise Events: Traffic 32-42 Wind 30-36 Bat 46-53
		2	D	51	44	38	33	36	31	25 LA _{eq}	
Night 3 26/03/2020 23:22 4.4 – 5.2 m/s ESE 17-18 °C 3006994	35 dBA LA _{eq} (15minute) 45 dBA LA ₁ (1minute)	1	D	46	36	34	31	33	30	N/M	Site Related Noise Events: Exhaust vents 20-26 Other Noise Events: Traffic 30-50 Wind 35-45
		2	D	46	36	33	30	32	29	<25 LA _{eq} 26 LA ₁	
		3	D	43	37	36	33	34	29	<25 LA _{eq} 24 LA ₁	
		4	D	50	43	40	35	37	33	N/M	

Note: N/M = Not Measurable, I/A = Inaudible

5.1.5 Operator Attended Noise Survey Results – NMP Monitoring Location N1

Results of the operator attended noise surveys at N1 are provided in **Table 17**. Monitoring location N1 represents residential receptors located to the east of the site in Bow Hills.

Table 17 Operator Attended NMP Noise Survey Results – N1 – Bow Hills

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Day 24/03/2020 09:30 3.3 m/s SE 22 °C 3006994	35 dBA LA _{eq} (15minute)	1	D	60	50	45	33	41	30	I/A	Site Related Noise Events: Inaudible Other Noise Events: Train Horn 60 Traffic 35-57
Evening 24/03/2020 20:29 1 m/s SW 22 °C 3006994	35 dBA LA _{eq} (15minute)	1	E	52	50	47	36	42	34	25 LA _{eq}	Site Related Noise Events: Dozer operations 25-28 Other Noise Events: Traffic 40-52 Insects 35-37
Night 24/03/2020 23:38 2.2 m/s W 21 °C 3006994	35 dBA LA _{eq} (15minute) 45 dBA LA ₁ (1minute)	1	D	54	44	37	31	35	28	28 LA _{eq} 30 LA ₁	Site Related Noise Events: Dozer operations 23-30 General activity 23-27 Other Noise Events: Traffic 40-54 Animals 32-37

Note: N/M = Not Measurable, I/A = Inaudible

Note 1: A private agreement between NCOPL and the residents of N1 Bow Hills of 50 dBA LA_{eq}(15minute) is in place. This new level of 50 dBA LA_{eq}(15minute) replaces the levels identified in Conditions 1-3, Schedule 4 of PA 08_0144 Mod 2 and the identical limits contained in condition L3 of Environment Protection Licence No 1278

5.1.6 Operator Attended Noise Survey Results – NMP Monitoring Location N3

Results of the operator attended noise surveys at N3 are provided in **Table 18**. Monitoring location N3 represents residential receptors located to the southeast of the site in Ardmona.

Table 18 Operator Attended NMP Noise Survey Results – N3 – Ardmona

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 24/03/2020 11:50 3.4 m/s W/WNW 27 °C 3006994	35 dBA L _{Aeq} (15minute)	1	C	93	84	68	31	70	27	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 50-93
Evening 24/03/2020 20:54 0.5 m/s WSW 22 °C 3006994	35 dBA L _{Aeq} (15minute)	1	D	94	81	60	29	68	27	25 L _{Aeq}	Site Related Noise Events: Dozer operations 22-28 Other Noise Events: Insects 30-33 Traffic 45-94
Night 24/03/2020 23:15 2.2 m/s W 21 °C 3006994	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	D	92	78	57	29	66	27	26 L _{Aeq} 30 L _{A1}	Site Related Noise Events: Dozer operations 24-30 General activity 25-27 Other Noise Events: Traffic 50-92 Dog 31

Note: N/M = Not Measurable, I/A = Inaudible

5.1.7 Operator Attended Noise Survey Results – NMP Monitoring Location N7

Results of the operator attended noise surveys at N7 are provided in **Table 19**. Monitoring location N7 represents residential receptors located to the northeast of the site in Merriman.

Table 19 Operator Attended NMP Noise Survey Results – N7 – Merriman

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Day 24/03/2020 11:58 3.4 m/s WNW 27 °C 3027586	35 dBA LA _{eq} (15minute)	1	C	54	45	40	28	37	25	I/A	Site Related Noise Events: Mine inaudible Other Noise Events: Birds 40-54 Road Traffic 30-42 Wind 30-37
Evening 24/03/2020 20:52 0.5 m/s WSW 22 °C 3027586	35 dBA LA _{eq} (15minute)	1	D	45	41	37	28	34	27	I/A	Site Related Noise Events: Mine inaudible Other Noise Events: Insects 30-45 Road Traffic 30-42
Night 24/03/2020 23:54 1.8 m/s S 21 °C 3027586	35 dBA LA _{eq} (15minute) 45 dBA LA ₁ (1minute)	1	D	49	44	40	27	36	23	I/A	Site Related Noise Events: Mine inaudible Other Noise Events: Insects 30-44 Road Traffic 28-49 Animals 32

Note: N/M = Not Measurable, I/A = Inaudible

5.1.8 Operator Attended Noise Survey Results – NMP Monitoring Location N8

Results of the operator attended noise surveys at N8 are provided in **Table 20**. Monitoring location N8 represents residential receptors located to the south of the site in Matilda.

Table 20 Operator Attended NMP Noise Survey Results – N8 – Matilda

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAm _{ax} (dB)	LA ₁ (dB)	LA ₁₀ (dB)	LA ₉₀ (dB)	LA _{eq} (dB)	LA _{min} (dB)		
Day 24/03/2020 09:38 3.2 m/s SSE 22 °C 3027586	35 dBA LA _{eq} (15minute)	1	D	62	50	38	30	38	26	28 LA _{eq}	Site Related Noise Events: General mine activity 25-30 Other Noise Events: Birds 30-62 Road Traffic 25-35 Aircraft 30-35
Evening 24/03/2020 21:19 0 m/s 21 °C 3027586	35 dBA LA _{eq} (15minute)	1	-	68	46	34	28	36	25	<25 LA _{eq}	Site Related Noise Events: Mine barely audible Other Noise Events: Insects 25-35 Animals 40-68
Night 24/03/2020 22:08 0 m/s 21 °C 3027586	35 dBA LA _{eq} (15minute) 45 dBA LA ₁ (1minute)	1	-	55	47	35	27	35	25	<25 LA _{eq} 25 LA ₁	Site Related Noise Events: General mine activity 20-25 Other Noise Events: Insects 25-35 Road Traffic 23-35 Animals 40-55 Aircraft 30-50

Note: N/M = Not Measurable, I/A = Inaudible

6 Conclusion

SLR was engaged by Narrabri Coal Operations Pty Ltd to conduct attended noise monitoring for the Narrabri Mine in accordance with the Narrabri Mines' Noise Management Plan, Environment Protection Licence and Project Approval.

Operator attended noise monitoring was conducted at 8 locations in order to determine the noise performance of the Narrabri Mine, with compliance achieved at all locations during all time periods.

APPENDIX A

Acoustic Terminology

Sound Level or Noise Level

The terms “sound” and “noise” are almost interchangeable, except that in common usage “noise” is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2 “A” Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an “A-weighting” filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as “linear”, and the units are expressed as dB(lin) or dB.

3 Sound Power Level

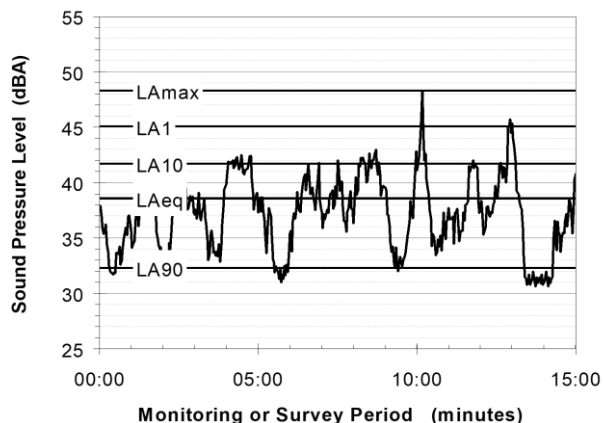
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

- LA1 The noise level exceeded for 1% of the 15 minute interval.
- LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- LAeq The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the “repeatable minimum” LA90 noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or “average” levels representative of the other descriptors (LAeq, LA10, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than “broad band” noise. 7. Impulsiveness

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

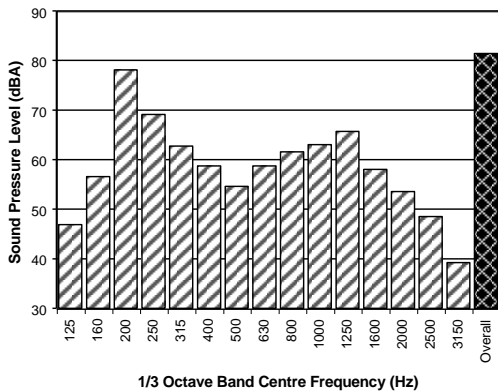
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of “peak” velocity or “rms” velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as “peak particle velocity”, or PPV. The latter incorporates “root mean squared” averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V , expressed in mm/s can be converted to decibels by the formula $20 \log (V/V_0)$, where V_0 is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organizations.

9 Human Perception of Vibration

People are able to “feel” vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual’s perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as “normal” in a car, bus or train is considerably higher than what is perceived as “normal” in a shop, office or dwelling.

10 Over-pressure

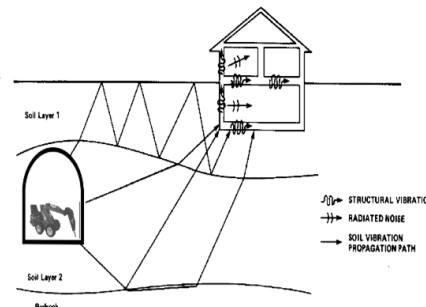
The term “over-pressure” is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed “structure-borne noise”, “ground-borne noise” or “regenerated noise”. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term “regenerated noise” is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

APPENDIX B

Calibration Certificates

CERTIFICATE OF CALIBRATION

CERTIFICATE No.: **SLM 26583 & FILT 5697**

Equipment Description: Sound Level Meter

Manufacturer: B & K

Model No: 2250 **Serial No:** 3006994

Microphone Type: 4952 **Serial No:** 3017903

Preamplifier Type: - **Serial No:** -

Filter Type: 1/3 Octave **Serial No:** 3006994

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

Owner: SLR Consulting Australia Pty Ltd
120 High Street
North Sydney, NSW 2060

Ambient Pressure: 1009 hPa \pm 1.5 hPa

Temperature: 24 °C \pm 2° C **Relative Humidity:** 57% \pm 5%

Date of Calibration: 18/03/2020 **Issue Date:** 19/03/2020

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

CHECKED BY: *KB* **AUTHORISED SIGNATURE:** *Hein See*

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.



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Accredited Lab. No. 9262
Acoustic and Vibration
Measurements

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AVCERT10 Rev. 1.3 15.05.18

CERTIFICATE NO.: SLM 26583 & FILT 5697

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

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

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

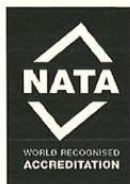
This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 1260: 1995 and AS/NZS 4476 - 1997 and were conducted to test the following performance characteristics:

1. Relative attenuation clause 5.3

Date of Calibration: 18/03/2020 **Issue Date:** 19/03/2020

Checked by: *JRB*

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.



Accredited Lab. No. 9262
Acoustic and Vibration
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MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2270--D01-** Serial No. **3027586** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to national or international standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 04-nov-2019



Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please go to www.bksv.com/service.

BA 028 - 20

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