Wambo Coal Mine and Rail Spur

Environmental Noise Monitoring

June 2017

Prepared for

Wambo Coal Pty Limited

Global Acoustics

Noise and Vibration Analysis and Solutions

Global Acoustics Pty Ltd
PO Box 3115 | Thornton NSW 2322
Telephone +61 2 4966 4333
Email global@globalacoustics.com.au
ABN 94 094 985 734

Wambo Coal Mine and Rail Spur

Environmental Noise Monitoring
June 2017

Reference: 17234_R02
Report date: 4 August 2017

Prepared for

Wambo Coal Pty Limited
PMB 1
Singleton NSW 2330

Prepared by

Global Acoustics Pty Ltd
PO Box 3115
Thornton NSW 2322

Prepared:	Michael Swanson Acoustics Technician	QA Review:	Katie Weekes Environmental Scientist (Acoustics)

Global Acoustics Pty Ltd ~ Environmental noise modelling and impact assessment ~ Sound power testing ~ Noise control advice ~ Noise and vibration monitoring ~ OHS noise monitoring and advice ~ Expert evidence in Land and Environment and Compensation Courts ~ Architectural acoustics ~ Blasting assessments and monitoring ~ Noise management plans (NMP) ~ Sound level meter and noise logger sales and hire

EXECUTIVE SUMMARY

Global Acoustics were engaged by Wambo Coal (WC) to conduct a noise survey around the Wambo Coal Mine (WCM), and the Wambo Coal Rail Spur (WCRS).

A noise survey around both the WCM and the WCRS is required monthly as a condition of their current development consents (relevant extracts from both are provided in the following report sections).

Environmental noise monitoring described in this report was undertaken during the nights of 13 and 15 June 2017. Attended noise monitoring was conducted at a total of four locations for WCM and the WCRS (see Figure 1).

The survey purpose is to quantify and describe the existing acoustic environment around the WCM and WCRS and compare results with relevant development consent conditions or modelled EIS noise levels.

Attended monitoring was conducted during the night period in accordance with the EPA 'Industrial Noise Policy' (INP) guidelines and Australian Standard AS 1055 'Acoustics, Description and Measurement of Environmental Noise'. The duration of each measurement was 15 minutes.

Operational Noise Assessment

Noise levels from WCM complied with the $L_{Aeq,15minute}$ and $L_{A1,1minute}$ development consent criteria at all monitoring locations during the June 2017 survey, with the exception of N16.

On 13 June 2017 at 22:40, WCM exceeded the relevant impact assessment criterion by 1 dB. An exhaust, engine and fan continuum from WCM was audible during the measurement, generating a site only L_{Aeq} of 41 dB. A surge in engine noise generated the $L_{A1,1minute}$ of 49 dB.

An exceedance of up to 2 dB is not considered significant as the INP deems a development to be in non-compliance only when "*the monitored noise level is more than 2 dB above the statutory noise limit specified in the consent or licence condition.*" This is based on the fact that 2 dB is less than that change in loudness, 3 dB, where the difference is just perceptible to the normal ear (Bies and Hansen, 1988).

The OCE was contacted at the completion of this measurement and advised of elevated levels. The OCE advised that an excavator working in an exposed area had ceased operation. A remeasure was then undertaken with resulting levels below the relevant limits.

Low Frequency Assessment

WCM complied with the relevant limits using the Broner method of assessing low frequency noise at all monitoring locations.

Results were above the relevant INP low frequency modifying factor trigger during the remeasure at N16 and measurement at N23.

The measurement at N23 also triggered the threshold value using the dING method of assessing low frequency.

Global Acoustics Pty Ltd

Table of Contents

Appendices

1 INTRODUCTION

1.1 Background

Global Acoustics were engaged by Wambo Coal (WC) to conduct a noise survey around the Wambo Coal Mine (WCM), and the Wambo Coal Rail Spur (WCRS). The mine and spur operate under separate development consents and have been monitored separately. Reporting, however, has been combined in this document.

Wambo Coal operates both open cut and underground mining operations from their mine at Warkworth, NSW. The open cut operations include use of heavy mobile equipment in open cut pits, on haul roads and on waste rock emplacements. The underground operations have surface facilities. Both operations utilise a coal handling and preparation plant (CHPP) including conveyors, bins and other material-handling infrastructure.

The WCRS is located between Mt Thorley and Warkworth Village, NSW (as shown in Figure 1) and includes the following components:

- a product coal stockpile and reclaim area, product coal conveyor, train loadout bin, rail loop and a rail spur from the Wambo Coal Mine to Mount Thorley;
- rail transport of product coal to the market, an intermittent activity that can take place at any time; and
- a locomotive refuelling facility.

A noise survey around both the WCM and the WCRS is required monthly as detailed in the Noise Management Plan (NMP).

Environmental noise monitoring described in this report was undertaken on the night of 13 and 15 June 2017.

The survey purpose is to quantify and describe the existing acoustic environment around WCM and WCRS and compare results with relevant limits.

1.2 Monitoring Locations and Frequency

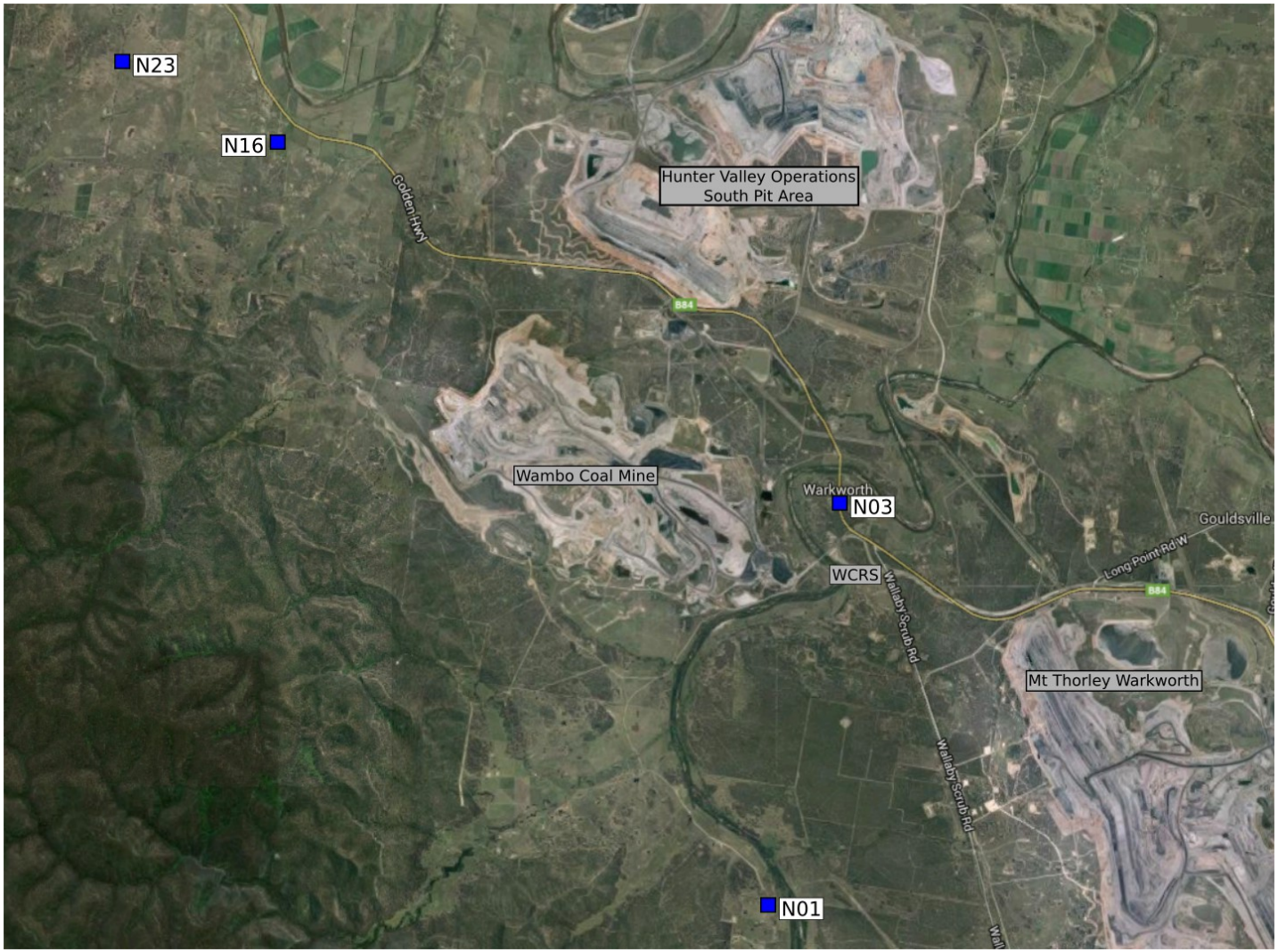
Attended noise monitoring was conducted at a total of four locations for WCM and the WCRS. Table 1.1 outlines the monitor type and frequency for the noise monitoring locations shown in Figure 1.

Table 1.1: WAMBO COAL MONITORING LOCATIONS AND FREQUENCY[1]

Site Reference	Site Location[2]	Monitor Type	Consent Requirements	Frequency
N01	*Lambkin Residence*	Attended	Mine Development Consent	Monthly
N03	*Kelly Residence*	Real-time & Attended	Mine and Rail Spur Development Consents	Continuous & Monthly
N16	*Muller Residence*	Real-time & Attended	Mine Development Consent	Continuous & Monthly
N20	Thelander Residence	Real-time	Mine Development Consent	Continuous
N21	Wambo South Residence	Real-time	Mine Development Consent	Continuous
N23	*Redmanvale Road*	Attended	Mine Development Consent	Monthly

Notes:

1. *Sourced from the Wambo Coal Noise Monitoring Plan – EMP008, February 2014; and*
2. *Monthly attended monitoring locations are shown in italics.*



Source: Google Maps

Figure 1: WCM Attended Noise Monitoring Locations

1.3 Terminology & Abbreviations

Some definitions of terms and abbreviations, which may be used in this report, are provided in Table 1.2.

Table 1.2: TERMINOLOGY & ABBREVIATIONS

Descriptor	Definition
L_A	The A-weighted root mean squared (RMS) noise level at any instant
L_{Amax}	The maximum A-weighted noise level over a time period or for an event
L_{A1}	The noise level which is exceeded for 1 per cent of the time
L_{A10}	The noise level which is exceeded for 10 percent of the time, which is approximately the average of the maximum noise levels
L_{A50}	The noise level which is exceeded for 50 per cent of the time
L_{A90}	The level exceeded for 90 percent of the time, which is approximately the average of the minimum noise levels. The L_{A90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes
L_{Amin}	The minimum A-weighted noise level over a time period or for an event
L_{Aeq}	The average noise energy during a measurement period
dB(A)	Noise level measurement units are decibels (dB). The "A" weighting scale is used to describe human response to noise
SPL	Sound pressure level (SPL), fluctuations in pressure measured as 10 times a logarithmic scale, the reference pressure being 20 micropascals
SEL	Sound exposure level (SEL), the A-weighted noise energy during a measurement period normalised to one second
Hertz (Hz)	Cycles per second, the frequency of fluctuations in pressure, sound is usually a combination of many frequencies together
VTG	Vertical temperature gradient in degrees Celsius per 100 metres altitude. Estimated from wind speed and sigma theta data
SC	Stability Class. Estimated from wind speed and sigma theta data
Day	This is the period 7:00am to 6:00pm
Evening	This is the period 6:00pm to 10:00pm
Night	This is the period 10:00pm to 7:00am

2 PROJECT CONSENT AND CRITERIA

2.1 Wambo Coal Mine Development Consent and Environmental Protection Licence

WCM was granted consent (DA 305-7-2003) in February 2004, which enables the extension of current open cut and underground mining operations. The latest modification to this consent was approved in October 2016. The relevant sections of this modification are reproduced in Appendix A.

The *Wambo Coal Environmental Management System, Noise Management Plan* (EMP008, February 2014) was prepared in accordance with Schedule 4. The Noise Management Plan (NMP) indicates that monitoring will be conducted for WCM activities, and the noise levels to be used for assessment. Monitoring for noise from mining activities is undertaken at the properties numbered N01, N03, N16 and N23.

It should be noted that properties N01 and N03 are subject to acquisition upon request, as detailed in Schedule 4, Condition 1 of DA 305-7-2003. As such, there are no operational noise goals that apply directly to these properties.

Environment protection licence (EPL) number 529 applies to the site with the noise section of the current version reproduced in Appendix A.

Table 2.1 summarises relevant noise assessment criteria for WCM.

Table 2.1: WAMBO COAL MINE NOISE CRITERIA

Location	Day $L_{Aeq,15minute}$ dB	Evening and Night $L_{Aeq,15minute}$ dB	Night $L_{A1,1minute}$ dB
N01[1]	NA	NA	NA
N03[1]	NA	NA	NA
N162	35	40	50
N23[2]	35	38	50

Notes:

1. *N01 and N03 are acquisition upon request and criteria are NA 'not applicable'; and*
2. *Criteria from modified development consent DA 305-7-2003.*

In accordance with the consent and EPL, the noise limits identified in Table 2.1 only apply under the following meteorological conditions:

- wind speeds of up to 3 m/s at 10 metres above ground level; or
- temperature inversion conditions of up to 3ºC/100 metres, and wind speeds of up to 2 m/s at 10 metres above ground level.

2.2 Wambo Coal Rail Spur Development Consent

The WCRS consists of two Development Applications (DA's):

- The Wambo Rail Loop (DA 177-8-2004), modified in February 2012 to include a rail refuelling facility; and
- The Wambo Rail Line (DA 235/97).

The *Wambo Coal Environmental Management System*, *Noise Management Plan* (EMP008, February 2014) was prepared in accordance with Schedule 4. The NMP indicates that monitoring will be conducted for WCRS activities, and the noise levels to be used for assessment. The relevant section of the consent is reproduced in Appendix A.

Monitoring for noise from rail activities has previously been undertaken at properties numbered N01, N24 and N25 for rail pass-by noise. Locations N24 and N25 have been removed from the monitoring program following long-term demonstrated compliance. Monitoring is still undertaken at N01 as part of the mine consent, however, monitoring of the rail activities is no longer required. As detailed in the NMP, monitoring at these locations will recommence following any complaints or change in rolling stock.

It should be noted that properties at N01 are subject to acquisition upon request, as detailed in Schedule 4, Condition 1 of DA 305-7-2003. As such, there are no operational noise targets that apply directly to this property.

Quarterly monitoring of the rail loading facility is no longer undertaken at N03, due to a demonstrated history of compliance. Should anything change with the procedure for refuelling or a resident complaint be received, further monitoring will be undertaken to determine changes to received noise levels.

2.3 Industrial Noise Policy Modifying Factors

Noise monitoring and reporting is carried out generally in accordance with the Environment Protection Authority (EPA) 'Industrial Noise Policy' (INP). Chapter 4 of the INP deals specifically with modifying factors that may apply to industrial noise. The most common modifying factors are addressed in detail below.

As detailed in L4.3 of the EPL:

> *The modification factors in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise levels where applicable.*

2.3.1 Tonality, Intermittent and Impulsive Noise

As defined in the INP:

> *Tonal noise contains a prominent frequency and is characterised by a definite pitch.*
>
> *Impulsive noise has high peaks of short duration and a sequence of such peaks.*
>
> *Intermittent noise is characterised by the level suddenly dropping to the background noise levels several times during a measurement, with a noticeable change in noise level of at least 5 dB. Intermittent noise applies to night-time only.*

Years of monitoring have indicated that noise levels from mining operations, particularly those levels measured at significant distances from the source are relatively continuous. Given this, noise levels from WCM at the monitoring locations are unlikely to be intermittent. In addition, there is no equipment on site that is likely to generate tonal or impulsive noise as defined in the INP.

2.3.2 Low Frequency Noise

INP Method

As defined in the INP:

> *Low frequency noise contains major components within the low frequency range (20 Hz to 250 Hz) of the frequency spectrum.*

As detailed in Chapter 4 of the INP, low frequency noise should be assessed by measuring the site only C- weighted and site only A-weighted level over the same time period. The correction/penalty of 5 dB is applied *if the difference between the two levels is 15 dB or more*.

Broner Method

Low frequency noise can also be assessed using the method specified in the paper *"A Simple Method for Low Frequency Noise Emission Assessment"* (Broner JLFNV Vol29-1 pp1-14 2010). If the site only C-weighted noise level at a receptor exceeds the relevant modifying factor trigger, a 5 dB penalty (modifying factor) is added to predicted levels. This method is included to provide a comparison with the INP method.

Low Frequency Assessment Methods

Low frequency assessment methods are detailed in Table 2.2.

Table 2.2: LOW FREQUENCY ASSESSMENT METHODS AND MODIFYING FACTOR TRIGGERS

Method	Calculation Method	Night Period Modifying Factor Trigger	Day Period Modifying Factor Trigger
Broner, 2010	Site only L_{Ceq}	>60	>65
INP, total	Site only L_{Ceq} minus site only L_{Aeq}	>=15	>=15

The EPA is currently undertaking a review of the assessment of low frequency noise. While a Draft Industrial Noise Guideline (ING) was released in September 2015, low frequency noise results from WCM have been compared to the assessment methods and modifying factor triggers presented above. The applicability of these triggers has been considered when applying low frequency modifying factor corrections.

3 METHODOLOGY

3.1 Overview

Noise monitoring was conducted at the nearest residences in accordance with the EPA INP guidelines and Australian Standard AS 1055 'Acoustics, Description and Measurement of Environmental Noise'. WCM was in operation during all monitoring.

A measurement of $L_{A1,1minute}$ corresponds to the highest noise level generated for 0.6 second during one minute. In practical terms this is the highest noise level emitted from the Wambo Coal noise source during the entire measurement period (i.e. the highest level of the worst minute during the 15-minute measurement).

As indicated in the consent conditions, the $L_{A1,1minute}$ measurement should be undertaken at 1 metre from the dwelling façade and the $L_{Aeq,15minute}$ measurement within 30 metres of the dwelling. However, the direct measurement of noise at 1 metre from the façade is not practical during monitoring for this project. In most cases, this is due to barking dogs or issues with obtaining access. In all cases, measurements for this survey were undertaken at a suitable, representative location.

Weather forecasts of predicted wind speeds and rainfall are always previewed prior to commencement of monitoring. Approval to undertake monitoring is then sought from the client. This procedure gives the best chance of monitoring during suitable atmospheric conditions. However, forecasts are computer models generated for a general area based on a number of atmospheric variables. These models are often generated 12 to 24 hours prior to commencement of monitoring and are only as accurate as the model inputs.

3.2 Attended Noise Monitoring

Attended noise monitoring was conducted at all locations during the night period. The duration of all measurements was 15 minutes.

Attended monitoring is preferred to the use of loggers when determining compliance with prescribed limits; it allows an accurate determination of the contribution, if any, to measured noise levels by the source of interest (in this case WCM).

If the exact contribution of the source of interest cannot be established, due to masking by other noise sources in a similar frequency range, but site noise levels are observed to be well below (more than 5 dB lower than) any relevant criterion, a maximum estimate of the potential contribution of the site might be made based on other measured site-only noise levels, for example, L_{A10}, L_{A50} or L_{A90}. This is generally expressed as a 'less than' quantity, such as <20 dB or <30 dB.

The terms 'Inaudible' (IA) or 'Not Measurable' (NM) may also be used in this report. When site noise is noted as IA, no site noise was audible at the monitoring location. When site noise is noted as NM, this means some noise was audible but could not be quantified. If site noise was NM due to masking but estimated to be significant in relation to a relevant criterion, we would employ methods as per the Industrial Noise Policy (e.g. measure closer and back calculate) to determine a value for reporting.

All sites noted as NM in this report are due to one or more of the following reasons:

- site noise levels were extremely low and unlikely, in many cases, to be even noticed;
- site noise levels were masked by another relatively loud noise source that is characteristic of the environment (e.g. breeze in foliage or continuous road traffic noise) that cannot be eliminated by moving closer; and/or
- it was not feasible, nor reasonable to employ INP methods such as move closer and back calculate. Cases may include, but are not limited to, rough terrain preventing closer measurement, addition/removal of significant source to receiver shielding caused by moving closer, and meteorological conditions where back calculation may not be accurate.

3.3 Meteorological Data

Meteorological data was obtained from the Wambo meteorological station. Atmospheric parameters include wind speed, wind direction, rainfall and sigma theta. This data allowed correlation of atmospheric parameters and measured noise levels. Meteorological data was available in 5 minute intervals.

When meteorological data is provided in less than 15-minute intervals, an analysis must be conducted to determine the meteorological conditions present for the majority of the measurement period and whether those conditions relate to noise criteria being applicable. In order to accurately compare 5-minute meteorological data to 15-minute noise level measurement periods, a rolling 15-minute meteorological interval was produced by converting each 5-minute meteorological interval into an average of the preceding three 5-minute intervals. The rolling 15-minute meteorological interval which most closely matched the 15-minute noise level measurement period was then adopted as the predominant meteorological conditions for that measurement period.

Where rolling averages could not be used (such as for VTG and stability class), the predominant condition, corresponding with the majority of 5-minute meteorological intervals, was adopted.

3.4 Weather Conditions

Weather conditions were recorded at each location during each noise level measurement. Although the consent is not specific as to where the meteorological data should be sourced, information from WCM has been used as it is measured with an elevated anemometer as is required by the consent. The anemometer at WCM is not overly distant from the monitoring locations and is considered to be representative of the general area. Wind speeds measured at 10 metres above ground are usually higher than those measured closer to ground level. In accordance with consent conditions, noise criteria only apply in wind speeds up to 3 metres per second.

3.5 Attended Noise Monitoring Equipment

Equipment used to measure environmental noise levels are listed in Table 3.1. Calibration certificates are provided in Appendix B.

Table 3.1: ATTENDED NOISE MONITORING EQUIPMENT

Model	Serial Number	Calibration Due Date
Rion NA-28 sound level analyser	00370304	16/11/2018
Rion NA-28 sound level analyser	00704124	05/06/2019
Larson Davis Cal150 acoustic calibrator	3333	30/09/2018
Pulsar 106 acoustic calibrator	74813	25/07/2018

4 RESULTS

4.1 Monitoring Locations

There were a total of four attended noise monitoring locations during this survey as listed in Table 4.1 and shown in Figure 1.

Table 4.1: WAMBO ATTENDED NOISE MONITORING LOCATIONS

Descriptor	Monitoring Location
N01	367 Wambo Road, Bulga
N03	1071 Jerrys Plains Road, Warkworth
N16	Rear of 'Kilburnie', Golden Highway, Jerrys Plains
N23	207 Redmanvale Road, Jerrys Plains

4.2 Plant Locations

During monitoring undertaken on 13 June 2017 between 22:00 and 00:00, equipment in operation was as follows:

- EX14 ME/02/WMAO conventional bench working to the west, all loads to the RL120 dump. Lost time for electrical fault;
- EX18 ME/02/WMA – ME/02/WMBO started shift on the last of the Wambo coal to the washery then top loading the partings, all waste to the RL110 dump;
- EX15 MP/23/WMAO double benching waste to the Ryder "C" floor, all waste to the RL30 dump;
- EX17 MP/23/WMAO lost time at start of shift with slow hydraulics, then conventional bench working waste to the west, all loads to the RL30 dump;
- EX12 GM/01/WH0 – GM/01/WH1 started shift on partings with loads going to the reject road, then on coal when EX18 finished. All the loads to the washery, walking 15 minutes; and
- EX11 ME/03/WWAO walked at start of shift to new location, then removing waste to uncover drill roof, all loads to the RL120 dump.

4.3 Attended Noise Monitoring

Noise levels measured at each location during attended 15 minute surveys are provided in Table 4.2; discussion as to the noise sources responsible for these measured levels is provided in Chapter 5 of this report.

Table 4.2: MEASURED NOISE LEVELS – JUNE 2017[1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{A50} dB	L_{Aeq} dB	L_{A90} dB	L_{Amin} dB	L_{Ceq} dB
N01	15/06/2017 22:20	51	42	40	37	38	36	34	55
N03	13/06/2017 23:32	52	47	44	41	42	38	36	63
N16	13/06/2017 22:40	50	46	43	40	41	38	35	56
N16[2]	13/06/2017 23:12	42	39	37	34	35	32	30	54
N23	13/06/2017 22:08	46	40	36	34	35	33	30	55

Notes:

1. *Levels in this table are not necessarily the result of activity at WCM or WCRS; and*
2. *Remeasure.*

4.3.1 Wambo Coal Mine Noise

Noise levels generated by activity at WCM are shown in Table 4.3 and Table 4.4, where comparison of measured $L_{Aeq,15minute}$ and $L_{A1,1minute}$ levels for WCM is made with relevant noise criteria.

Table 4.3: $L_{Aeq,15minute}$ GENERATED BY WCM AGAINST NOISE CRITERIA – JUNE 2017

Location	Start Date and Time	Wind Speed m/s	VTG °C/100m[7]	Criterion $L_{Aeq,15min}$ dB [1]	Criterion Applies? [3,9]	WCM $L_{Aeq,15min}$ dB [4,5]	Exceedance[6,8]
N01[2]	15/06/2017 22:20	0.1	0.5	NA	NA	<30	NA
N03[2]	13/06/2017 23:32	1.0	0.5	NA	NA	38	NA
N16	13/06/2017 22:40	1.8	0.5	40	Yes	41	**1**
N16[10]	13/06/2017 23:12	1.3	-1.0	40	Yes	33	Nil
N23	13/06/2017 22:08	2.1	-1.0	38	Yes	33	Nil

Notes:

1. *Development consent criterion;*
2. *Monitoring location is within Zone of Affectation, criterion not applicable (NA);*
3. *Noise emission limits identified in the above table apply under meteorological conditions of eind speeds of up to 3 m/s at 10 metres above ground level, or temperature inversion conditions of up to 3°C/100m, and wind speeds of up to 2 m/s at 10 metres above ground level;*
4. *Estimated or measured $L_{Aeq,15minute}$ attributed to WCM;*
5. *NM denotes WCM audible but not measurable, IA denotes inaudible;*
6. *NA in exceedance column means atmospheric conditions outside conditions specified in development consent and so criterion is not applicable, or, there is no applicable criterion;*
7. *Vertical temperature gradient (VTG) calculated using sigma theta values according to INP procedures;*
8. *Bold and red text indicate an exceedance of relevant criterion;*
9. *Criterion may or may not apply due to rounding of meteorological data values; and*
10. *Remeasure.*

Table 4.4: $L_{A1,1minute}$ GENERATED BY WCM AGAINST NOISE CRITERIA – JUNE 2017

Location	Start Date and Time	Wind Speed m/s	VTG °C/100m[7]	Criterion $L_{A1,1min}$ dB [1]	Criterion Applies? [3,9]	WCM $L_{A1,1min}$ dB [4,5]	Exceedance[6,8]
N01[2]	15/06/2017 22:20	0.1	0.5	NA	NA	<30	NA
N03[2]	13/06/2017 23:32	1.0	0.5	NA	NA	42	NA
N16	13/06/2017 22:40	1.8	0.5	50	Yes	49	Nil
N16[10]	13/06/2017 23:12	1.3	-1.0	50	Yes	38	Nil
N23	13/06/2017 22:08	2.1	-1.0	50	Yes	41	Nil

Notes:

1. *Development consent criterion;*
2. *Monitoring location is within Zone of Affectation, criterion not applicable (NA);*
3. *The noise emission limits identified in the above table apply under meteorological conditions of wind speeds of up to 3 m/s at 10 metres above ground level; or temperature inversion conditions of up to 3°C/100m, and wind speeds of up to 2 m/s at 10 metres above ground level;*
4. *Estimated or measured $L_{A1,1minute}$ attributed to WCM;*
5. *NM denotes WCM audible but not measurable, IA denotes inaudible;*
6. *NA in exceedance column means atmospheric conditions outside conditions specified in development consent and so criterion is not applicable, or, there is no applicable criterion;*
7. *Vertical temperature gradient (VTG) calculated using sigma theta values according to INP procedures;*
8. *Bold and red text indicate an exceedance of relevant criterion; and*
9. *Criterion may or may not apply due to rounding of meteorological data values; and*
10. *Remeasure*

4.3.2 Low Frequency Assessment

Low frequency results for each monitoring location are presented in Table 4.5. Where the results in Table 4.5 are greater than the INP or Broner low frequency modifying factor trigger due to activities at WCM a 5 dB modifying factor correction is applied to the measured noise level (if applicable).

Applicability of the low frequency correction is determined by a number of factors including whether or not WCM was measurable (not "inaudible", "not measurable" or less than a maximum cut-off value of 30 dB), was within 5 dB of the relevant criterion, and where meteorological conditions resulted in criteria applying (in accordance with the EPL and project approval). Where a modifying factor is triggered and the criterion apply, further information is provided in Table 4.6.

Table 4.5: LOW FREQUENCY NOISE MODIFYING FACTOR ASSESSMENT – JUNE 2017

Location	Start Date and Time	INP		Broner		dING	
		Result[1] $L_{Ceq} - L_{Aeq}$ dB	Penalty dB	Result[2] L_{Ceq} dB	Penalty dB	Result[3] Max exceedance of ref spectrum dB	Penalty dB
N01	15/06/2017 22:20	NA	0	NA	0	NA	NA
N03	13/06/2017 23:32	NA	0	NA	0	NA	NA
N16	13/06/2017 22:40	14	0	54	0	NA	NA
N16[6]	13/06/2017 23:12	**17**	5	51	0	Nil	0
N23	13/06/2017 22:08	**19**	5	53	0	**0.2**	2

Notes:

1. *Low frequency modifying factor trigger is $L_{Ceq} - L_{Aeq}$ >= 15 dB as per the INP;*
2. *Night L_{Ceq} modifying factor trigger is L_{Ceq} 60 dB as per Broner (2010);*
3. *Low frequency modifying factor trigger is comparison of measured spectrum against a reference spectrum as per the dING;*
4. *Bold results and penalties in red are where the relevant modifying factor trigger was exceeded;*
5. *Where it is not possible to determine the site only result due to the presence of other low frequency noise sources occurring during the measurement, this is noted as NA (not available) and no further assessment has been undertaken; and*
6. *Remeasure.*

Where the results in Table 4.5 are greater than the INP, Broner or dING low frequency modifying factor trigger due to activities at WCM a 5 dB modifying factor correction is applied to the measured noise level. See Table 4.6 below for more detail.

Table 4.6: MEASURED NOISE LEVELS FOR WCM AND LOW FREQUENCY NOISE PENALTY ADJUSTMENTS WHERE APPLICABLE – JUNE 2017

Location	Start Date and Time	WCM only L_{Aeq} dB	With INP penalty (if applicable) L_{Aeq} dB[1]	With Broner penalty (if applicable) L_{Aeq} dB[1]	With dING penalty (if applicable) L_{Aeq} dB[1]
N16[2]	13/06/2017 23:12	33	38	33	33
N23	13/06/2017 22:08	33	38	33	35

Notes:

1. *Bolded results in red indicate exceedance of the relevant criterion; and*
2. *Remeasure.*

As detailed in Table 4.6, the site only L_{Ceq} minus L_{Aeq} exceeded 15 dB during two measurements. In order to assess low frequency noise against the dING (as described in Section 2.3), the third-octave results for these measurement were investigated in more detail.

The dING 80 Hz threshold value was reached during July 2017 monitoring at N23, resulting in a 2 dB low frequency noise modifying factor correction.

4.4 Atmospheric Conditions

Atmospheric condition data measured at each location are shown in Table 4.7. Data is routinely recorded on a site-by-site basis to show conditions during the monitoring period. Monitoring is not undertaken during periods of rain or hail. Data obtained concurrently by the meteorological station and used for compliance assessment is provided in Appendix C.

Table 4.7: MEASURED ATMOSPHERIC CONDITIONS – JUNE 2017

Location	Start Date and Time	Temperature degrees	Wind Speed m/s	Wind Direction MN	Cloud Cover eighths
N01	15/06/2017 22:20	12	0.0	-	1
N03	13/06/2017 23:32	12	0.6	200	3
N16	13/06/2017 22:40	14	0.0	-	5
N16	13/06/2017 23:12	14	0.7	150	5
N23	13/06/2017 22:08	13	0.0	-	6

Notes:

1. *Wind speed and direction measured at 1.8 metres; and*
2. *'-' indicates calm conditions.*

5 DISCUSSION

5.1 Noted Noise Sources

Table 4.2 presents data gathered during attended monitoring. These noise levels are the result of many sounds reaching the sound level meter microphone during monitoring. Received levels from various noise sources were noted during attended monitoring and particular attention was paid to the contribution of WCM, if any, to measured levels. At each receptor location, the $L_{Aeq,15minute}$ and $L_{A1,1minute}$ (night-time only) for the WCM (in the absence of any other noise) was, where possible, measured directly, or, determined by frequency analysis. These levels are summarised in Table 4.3 and Table 4.4. Time variations of noise sources in each measurement, their temporal characteristics, are taken into account via statistical descriptors.

From these observations summaries have been derived for each location. The following chapter sections provide these summaries. Statistical 1/3 octave band analysis of environmental noise was undertaken, and Figure 3 to Figure 7 display the frequency ranges for various noise sources at each location for L_{A1}, L_{A10}, L_{A90}, and L_{Aeq}. These figures also provide, graphically, statistical information for these noise levels.

An example is provided as Figure 2 where it can be seen that frogs and insects are generating noise at frequencies above 1000 Hz; mining noise is at frequencies less than 1000 Hz (this is typical). Adding levels at frequencies that relate to mining only allows separate statistical results to be calculated. This analysis cannot always be performed if there are significant levels of other noise at the same frequencies as mining; this can be dogs, cows, or, most commonly, road traffic.

It should be noted that the method of summing statistical values up to a cut-off frequency can overstate the L_{A1} result by a small margin but is entirely accurate for L_{Aeq}.

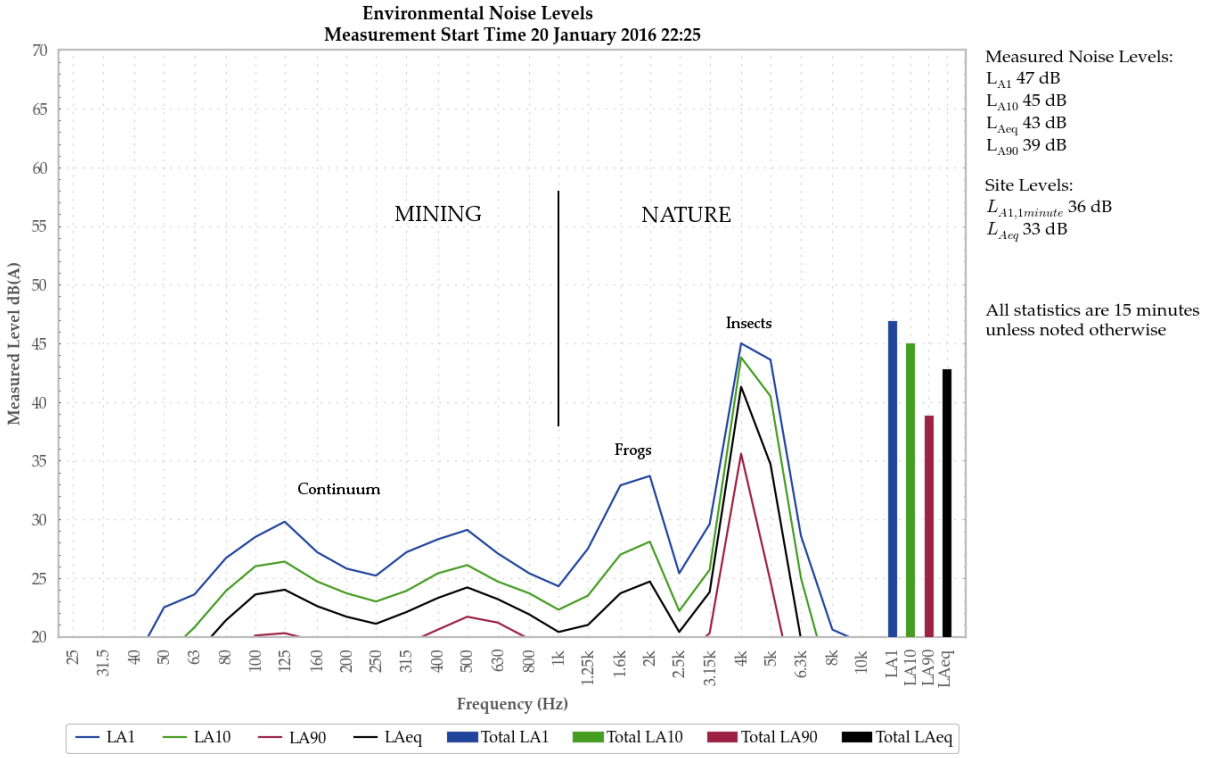


Figure 2: Sample graph (see Section 6.1 for explanatory note)

5.1.1 N01 – 15 June 2017

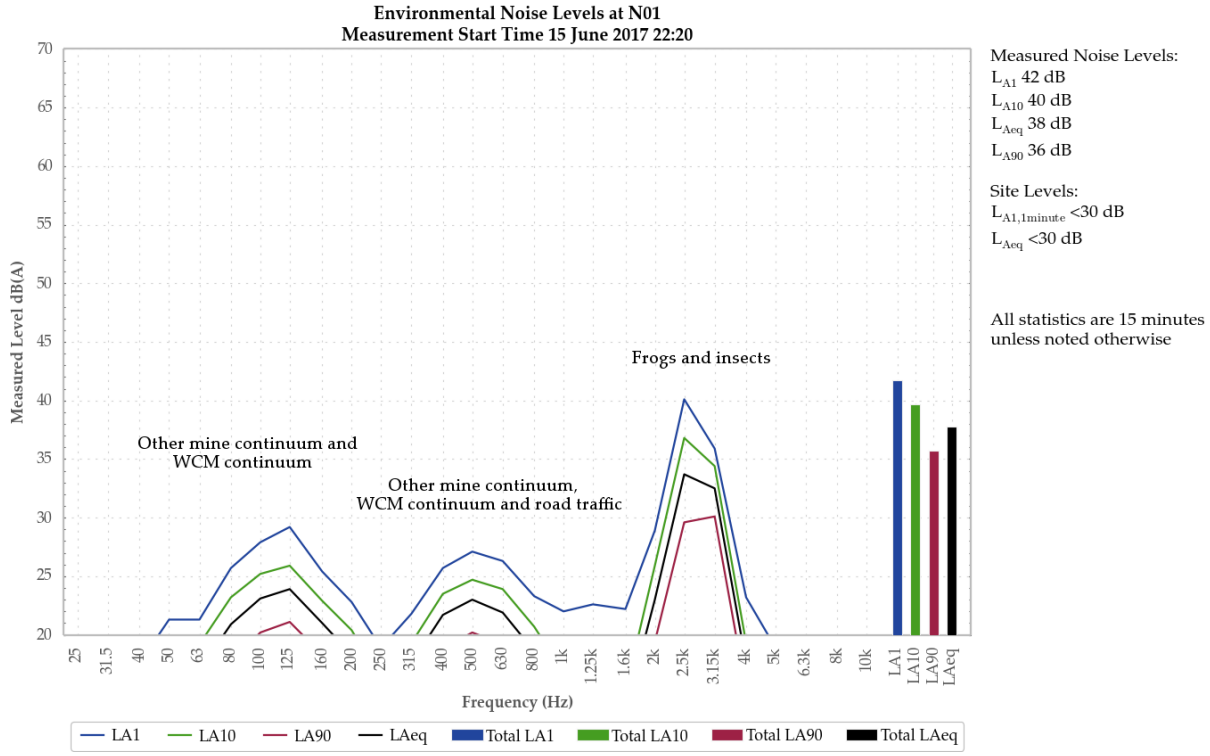


Figure 3: Environmental Noise Levels, N01 - Lambkin

A continuum from WCM was audible throughout the measurement, generating a site only L_{Aeq} and $L_{A1,1minute}$ of less than 30 dB.

Frogs and insects primarily generated the measured L_{A1} and L_{A90} and contributed to the measured L_{A10} and L_{Aeq}. A continuum from another mine and road traffic were minor contributors to the measured L_{A10} and L_{Aeq}.

Sheep and dogs were also noted.

5.1.2 N03 – 13 June 2017

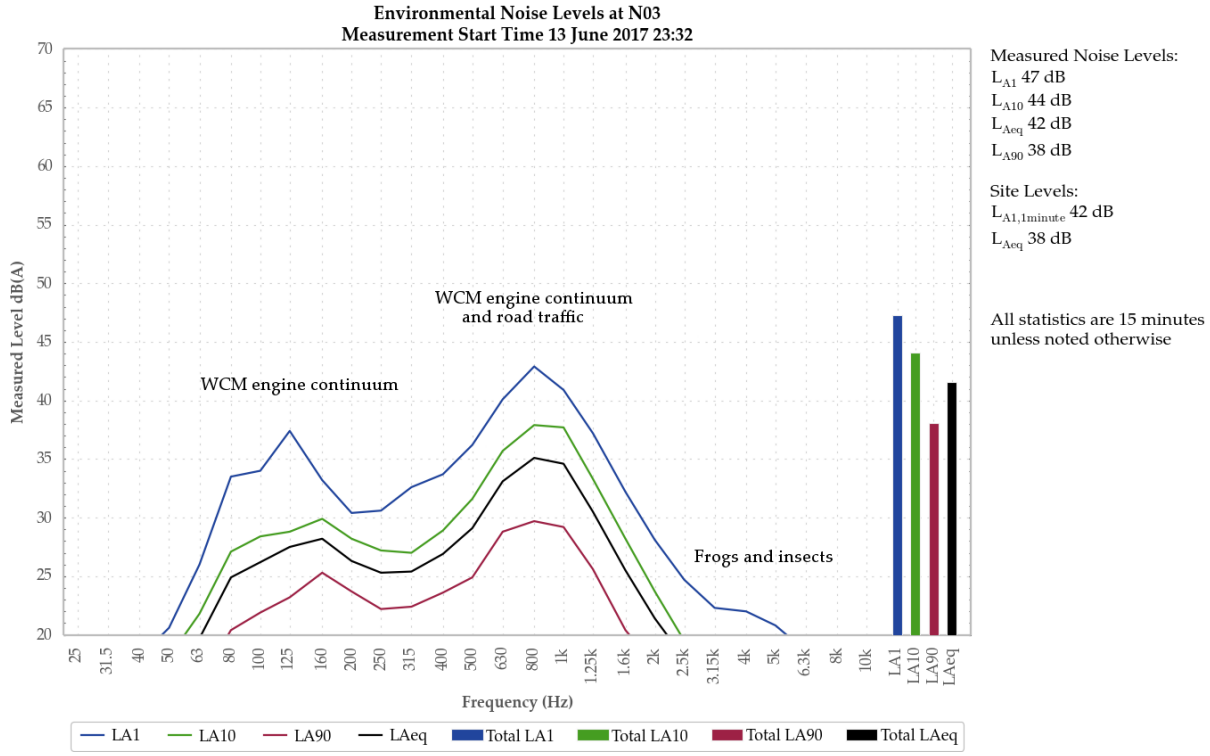


Figure 4: Environmental Noise Levels, N03 - Kelly

An engine continuum from WCM was audible throughout the measurement, generating a site only L_{Aeq} of 38 dB. Surges in the continuum generated the $L_{A1,1minute}$ of 42 dB.

A combination of the continuum from WCM and road traffic noise were responsible for measured L_{A1}, L_{A10}, and L_{Aeq} levels. The WCM continuum was responsible for the L_{A90}.

Kangaroos, insects, and frogs were also noted at low levels.

5.1.3 N16 - 13 June 2017

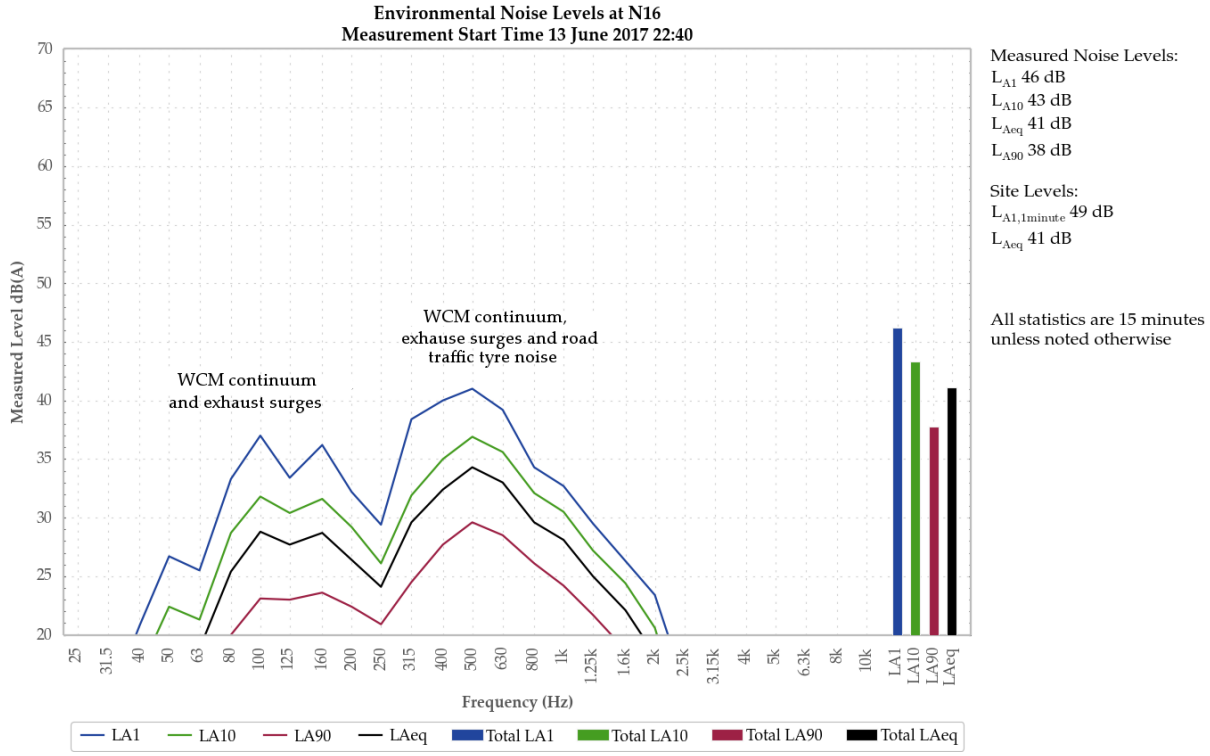


Figure 5: Environmental Noise Levels, N16 - Muller

An exhaust, engine and fan continuum from WCM was audible during the measurement, generating a site only L_{Aeq} of 41 dB. A surge in engine noise generated the $L_{A1,1minute}$ of 49 dB.

WCM was responsible for all measured levels.

Road traffic tyre noise and sheep were also noted.

The OCE was contacted at the completion of this measurement and advised of elevated levels. The OCE advised that an excavator working in an exposed area had ceased operation. A remeasure was then undertaken with resulting levels below the relevant limits.

5.1.4 N16 - 13 June 2017, Remeasure

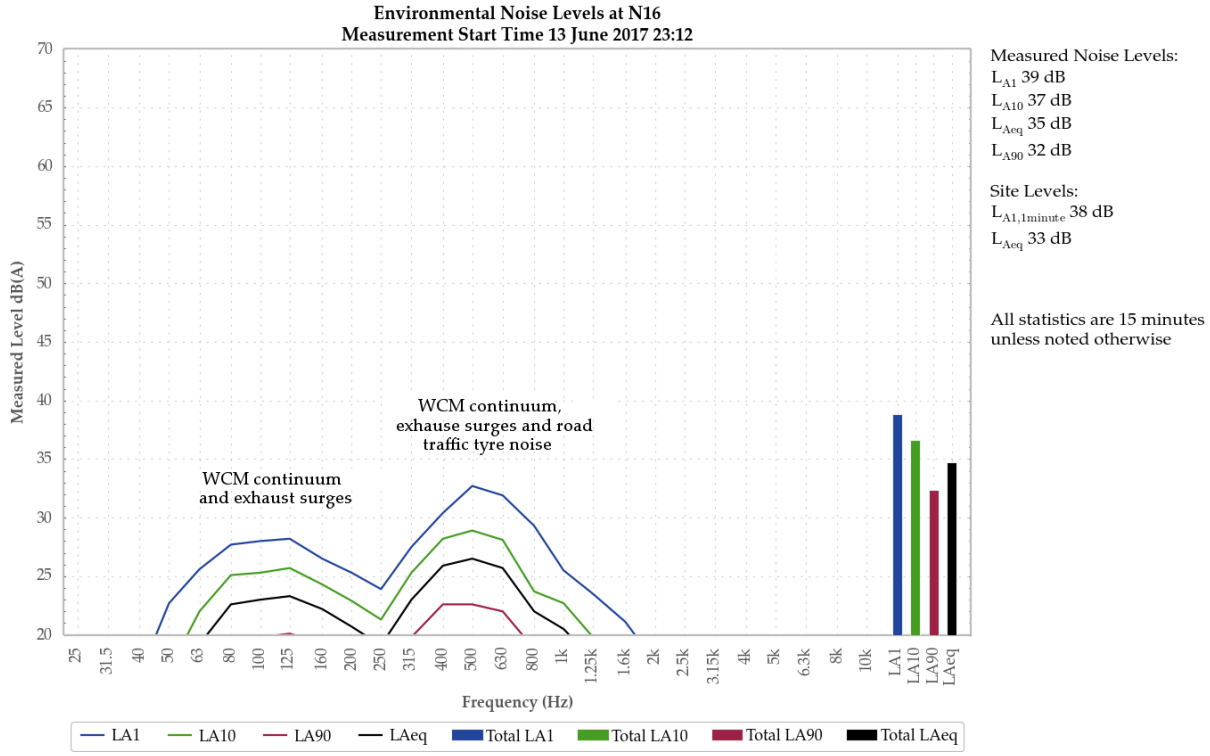


Figure 6: Environmental Noise Levels, N16 - Muller

A continuum from WCM was audible during the measurement, generating a site only L_{Aeq} of 33 dB. A surge in engine noise generated the $L_{A1,1minute}$ of 38 dB.

WCM combined with road traffic tyre noise to generate measured levels.

Breeze in foliage was also noted.

5.1.5 N23 – 13 June 2017

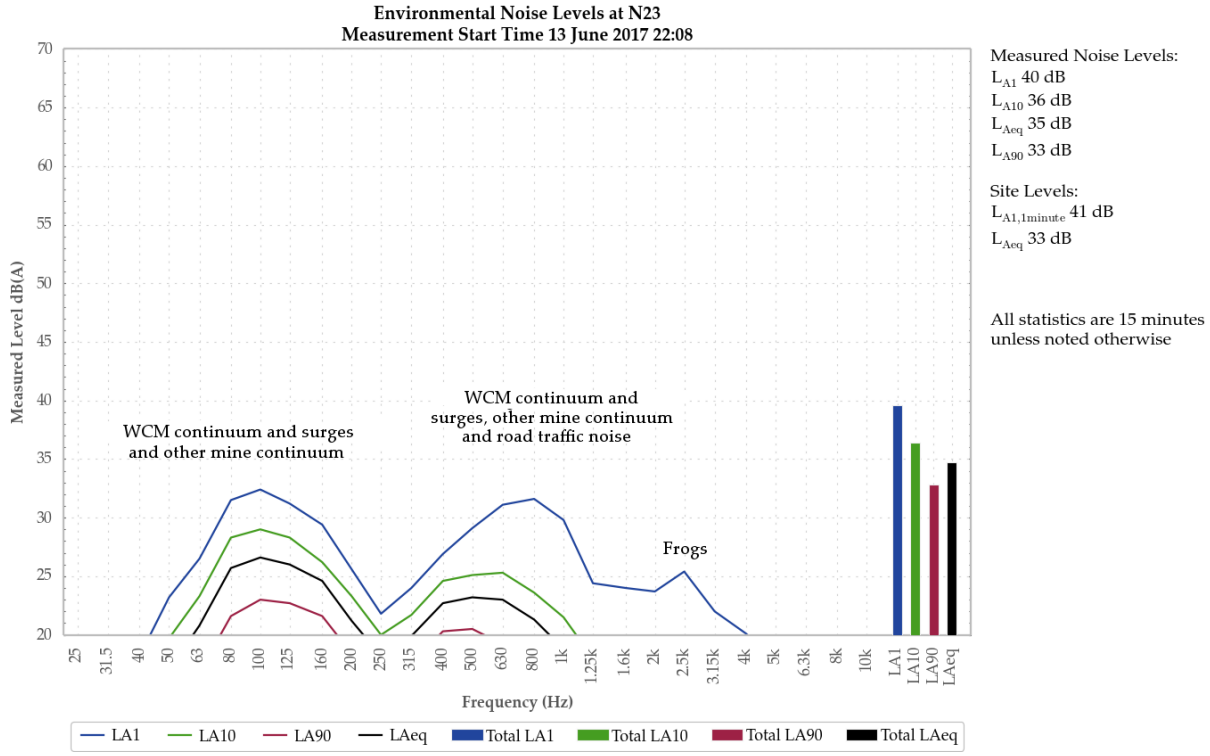


Figure 7: Environmental Noise Levels, N23 - Carter

A continuum from WCM was audible during the measurement, generating a site only L_{Aeq} of 33 dB. A surge in engine noise generated the $L_{A1,1minute}$ of 41 dB.

The continuum from WCM, a continuum from another mine and road traffic tyre noise were primarily responsible for measured levels.

Frogs, birds and cows were also noted.

6 SUMMARY

Environmental noise monitoring described in this report was undertaken during the night of 13 and 15 June 2017.

6.1 Operational Noise Assessment

Noise levels from WCM complied with the $L_{Aeq,15minute}$ and $L_{A1,1minute}$ development consent criteria at all monitoring locations during the June 2017 survey, with the exception of N16.

On 13 June 2017 at 22:40, WCM exceeded the relevant impact assessment criterion by 1 dB. An exhaust, engine and fan continuum from WCM was audible during the measurement, generating a site only L_{Aeq} of 41 dB. A surge in engine noise generated the $L_{A1,1minute}$ of 49 dB.

An exceedance of up to 2 dB is not considered significant as the INP deems a development to be in non-compliance only when "*the monitored noise level is more than 2 dB above the statutory noise limit specified in the consent or licence condition.*" This is based on the fact that 2 dB is less than that change in loudness, 3 dB, where the difference is just perceptible to the normal ear (Bies and Hansen, 1988).

The OCE was contacted at the completion of this measurement and advised of elevated levels. The OCE advised that an excavator working in an exposed area had ceased operation. A remeasure was then undertaken with resulting levels below the relevant limits.

6.2 Low Frequency Assessment

WCM complied with the relevant limits using the Broner method of assessing low frequency noise at all monitoring locations.

Results were above the relevant INP low frequency modifying factor trigger during the remeasure at N16 and measurement at N23.

The measurement at N23 also triggered the threshold value using the dING method of assessing low frequency.

Global Acoustics Pty Ltd

APPENDIX

A DEVELOPMENT CONSENT AND EPL

A.1 WAMBO COAL MINE DEVELOPMENT CONSENT

A.1.1 Relevant Wambo Coal Mine Development Consent Conditions

The relevant sections of the October 2016 modified conditions are reproduced below:

SCHEDULE 4
SPECIFIC ENVIRONMENTAL CONDITIONS

ACQUISITION UPON REQUEST

1. Upon receiving a written request for acquisition from the landowner of the land listed in Table 1, the Applicant must acquire the land in accordance with the procedures in conditions 9-11 of schedule 5:

Table 1: Land subject to acquisition upon request

2 – Lambkin	23A & B - Kannar
13C - Skinner	31A,B,C & D - Fisher
19A & B – Kelly	51 – Hawkes
22 – Henderson	56 - Haynes

Note: For more information on the numbering and identification of properties used in this consent, see Attachment 1 of the EIS for the Wambo Development Project. Lands titled 23A & B – Kannar, 31A,B,C & D – Fisher, 51 – Hawkes and 56 – Haynes have been acquired and are now mine-owned.

[1]NOISE

Noise Impact Assessment Criteria

6. The Applicant must ensure that the noise generated by the Wambo Mining Complex does not exceed the noise impact assessment criteria presented in Table 9.

Table 9: Noise impact assessment criteria dB(A))

Day $L_{Aeq(15\ minute)}$	Evening/Night $L_{Aeq(15\ minute)}$	Night $L_{A1(1\ minute)}$	Land Number
35	41	50	94 – Curlewis
			3 – Birrell

[1] Incorporates EPA GTAs

Day $L_{Aeq(15\ minute)}$	Evening/Night $L_{Aeq(15\ minute)}$	Night $L_{A1(1\ minute)}$	Land Number
35	40	50	4B – Circosta
			15B - McGowen/Caslick
			16 – Cooper
			23C – Kannar
			25 – Fenwick
			28A & B – Garland
			33 -Thelander/O'Neill
			39 – Northcote
			40 – Muller
			254A – Algie
35	39	50	5 – Strachan
			6 - Merrick
			7 - Maizey
			37 - Lawry
			48 - Ponder
35	38	50	1 - Brosi
			17 - Carter
			18 - Denney
			38 - Williams
			49 - Oliver
			63 - Abrocuff
			75 - Barnes
			91 - Bailey
35	37	50	27 - Birralee
			43 - Carmody
			137 - Woodruff
			163 - Rodger/Williams
			246 - Bailey
35	36	50	13B - Skinner
			178 - Smith
			188 - Fuller
			262A, B & C - Moses
35	35	50	All other residential or sensitive receptors, excluding the receptors listed in condition 1 above

Notes:

- Noise generated by the Wambo Mining Complex is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy

Land Acquisition Criteria

7. If the noise generated by the Wambo Mining Complex exceeds the criteria in Table 10, the Applicant must, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures in conditions 9-11 of schedule 5.

Table 10: Land acquisition criteria dB(A)

Day/Evening/Night $L_{Aeq(15\ minute)}$	***Property***
43	*94 - Curlewis*
	23C – Kannar
	254A - Algie
40	*All other residential or sensitive receptor, excluding the receptors listed in condition 1 above*

Note: Noise generated by the Wambo Mining Complex is to be measured in accordance with the notes presented below Table 9 above. Property 23C – Kannar has been acquired and is now mine-owned.

Operating Conditions

8. The Applicant must:
   (a) implement best management practice to minimise the operational, low frequency and traffic noise of the Wambo Mining Complex;
   (b) operate a comprehensive noise management system for the Wambo Mining Complex that uses a combination of predictive meteorological forecasting and real-time noise monitoring data to guide the day to day planning of mining operations and the implementation of both proactive and reactive noise mitigation measures to ensure compliance with the relevant conditions of this consent;
   (c) maintain the effectiveness of noise suppression equipment (if fitted) on plant at all times and ensure defective plant is not used operationally until fully repaired;
   (d) ensure that noise attenuated plant (if used) is deployed preferentially in locations relevant to sensitive receivers;
   (e) minimise the noise impacts of the Wambo Mining Complex during meteorological conditions when the noise limits in this consent do not apply;
   (f) co-ordinate the noise management for the Wambo Mining Complex with the noise management at nearby mines (including HVO South, HVO North and Mt Thorley Warkworth mines) to minimise the cumulative noise impacts of these mines and the Wambo Mining Complex,

   to the satisfaction of the Secretary.

Noise Management Plan

9. The Applicant must prepare a Noise Management Plan for the Wambo Mining Complex to the satisfaction of the Secretary. This plan must:
   (a) be prepared in consultation with the EPA, and submitted to the Secretary for approval by the end of June 2013;
   (b) describe the measures that would be implemented to ensure:
      - best management practice is being employed;
      - the noise impacts of the Wambo Mining Complex are minimised during meteorological conditions when the noise limits in this consent do not apply; and
      - compliance with the relevant conditions of this consent;
   (c) describe the proposed noise management system in detail;
   (d) include a monitoring program that:
      - uses a combination of real-time and supplementary attended monitoring measures to evaluate the performance of the Wambo Mining Complex;
      - adequately supports the proactive and reactive noise management system for the Wambo Mining Complex;
      - includes a protocol for determining exceedances of the relevant conditions in this consent;
      - evaluates and reports on the effectiveness of the noise management system for the Wambo Mining Complex;
      - provides for the annual validation of the noise model for the Wambo Mining Complex; and
   (e) include a protocol that has been prepared in consultation with the owners of nearby mines (including HVO South, HVO North and Mount Thorley Warkworth mines) to minimise the cumulative noise impacts of these mines and the Wambo Mining Complex.

The Applicant must implement the approved management plan as approved from time to time by the Secretary.

A.2 WAMBO RAIL SPUR DEVELOPMENT CONSENT

The relevant sections of the February 2012 modified conditions for the rail spur are reproduced below:

SCHEDULE 4
GENERAL ENVIRONMENTAL CONDITIONS

ACQUISITION UPON REQUEST

1. Upon receiving a written request for acquisition from the landowner of the land listed in Table 1, the Applicant shall acquire the land in accordance with the procedures in conditions 1-3 of schedule 5.

Table 1: Land subject to acquisition upon request

19 - L Kelly	55 - E & C Burley

Note: For more information on the numbering and identification of properties used in this consent, see Attachment 1A and Attachment 1B of the SEE for the Alterations to the Wambo Development Project – Rail and Train Loading Infrastructure.

2. While the land listed in Table 1 is privately owned, the Applicant shall implement all practicable measures to ensure that the impacts of the development comply with the predictions in the SEE, and the relevant conditions in this consent, at any residence on this land, to the satisfaction of the Director-General.

[1]NOISE

Noise Impact Assessment Criteria

3. The Applicant shall ensure that noise generated by the development, combined with noise generated by any development in the Wambo Mining Complex, does not exceed the noise criteria provided in Table 2, unless higher noise criteria are specified in the consent for the Wambo Coal Mine (DA 305-7-2003).

Table 2: Noise impact assessment criteria dB(A)

Day $L_{Aeq(15\ minute)}$	Evening/Night $L_{Aeq(15\ minute)}$	Night $L_{A1(1\ minute)}$	Land Number
35	35	50	All private residential or sensitive receptors, excluding the receptors listed in Table 1

Notes:
- *Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy.*
- *For this condition to apply, the exceedance of the criteria must be systemic.*

Construction Hours

4. The Applicant shall ensure that all construction work is carried out from 7 am to 6 pm Monday to Saturday (inclusive) and 8 am to 6 pm Sundays and Public Holidays.

Operating Hours

5. The Applicant shall:
   (a) take all practicable measures to minimise train movements at the development on Friday evening (6 pm-9 pm) and Sunday morning (9 am-12 am);
   (b) report on the implementation and effectiveness of these measures,
   to the satisfaction of the Director-General.

Rail Noise

6. The Applicant shall seek to ensure that its rail spur is only accessed by locomotives that are approved to operate on the NSW rail network in accordance with noise limits L6.1 to L6.4 in RailCorp's EPL (No. 12208) and ARTC's EPL (No. 3142) or a Pollution Control Approval issued under the former *Pollution Control Act 1970*.

Noise Monitoring

7. The Applicant shall monitor the noise generated by the development, and noise generated by the Wambo Mine, in general accordance with the Noise Management Plan for the Wambo Mining Complex and the *NSW Industrial Noise Policy*.

7A. By 31 May 2012, the Applicant shall review and update the Noise Management Plan for the Wambo Mining Complex, including a noise monitoring protocol for evaluating compliance with the criteria in condition 3 above.

7B. During the first 12 months of operation of the Rail Refuelling Facility, the Applicant must conduct attended noise monitoring at the nearest private receptor during refuelling events, no less often than every three months.

A.3 WAMBO RAIL LINE DEVELOPMENT CONSENT

The relevant sections of the 1998 conditions for the rail line are reproduced below:

Operational Noise

8. The Applicant shall ensure noise emissions from the operations of the railway line when measured at any residence along the railway line corridor shall not exceed the following EPA criteria:

   (a) planning level of $L_{Aeq\ 24hr}$ 55dBA; and

   (b) maximum passby level of L_{Amax} 85dBA

   The noise criteria levels shall be measured under prevailing weather conditions in accordance with EPA requirements and to be consistent with EPA's requirements as applied to the New South Wales coal industry, or otherwise agreed to by the EPA.

9. Prior to the commencement of operations, the Applicant shall prepare in consultation with the EPA and Singleton Shire Council an Operational Noise Management Plan. The Operation Noise Management Plan shall demonstrate that all practical design and noise mitigation methods have been undertaken to achieve the noise levels specified in Condition 8.

A.4 WAMBO ENVIRONMENT PROTECTION LICENCE NUMBER 529

The relevant sections of the EPL are reproduced below:

L4 Noise limits

L4.1 Noise generated at the premises must not exceed the noise limits presented in the table below. The noise limits in the table below represent the noise contribution from the premises.

Noise Limits dB(A)

Receiver Land Number	Day LAeq(15 minute)	Evening LAeq(15 minute)	Night LAeq(15 minute)	Night LA1(1 minute)
94 - Curlewis	35	41	41	50
3 - Birrell 4B - Circosta 15 - McGowen/ Caslick 16 - Cooper 25 - Fenwick 28 - Garland 33 - Thelander/ O'Neill 39 - Northcote 40 - Muller 254 - Algie	35	40	40	50
5 - Strachan 6 - Merrick 7 - Maizey 37 - Lawry 48 - Ponder	35	39	39	50
1 - Brosi 17 - Carter 18 - Denney 30 - Williams 49 - Oliver 63 - Abrocuff 75 - Barnes 91 - Bailey	35	38	38	50
27 - Birralee 43 - Carmody 137 - Woodruff 163 - Rodger/ Williams 246 - Bailey	35	37	37	50
13B - Skinner 178 - Smith 188 - Fuller 262 - Moses	35	36	36	50
All other residential or sensitive receptors excluding the receptors listed above and also excluding those listed in Table 1 of Schedule 4 of the Wambo Coal Mine Development Consent (DA 305-7-2003).	35	35	35	50

L4.2 For the purpose of Condition L4.1:
a) Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays,
b) Evening is defined as the period from 6pm to 10pm
c) Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays
d) The Receiver Land Owner locations are as detailed in the Environmental Impact Statement titled "*Wambo Development Project*", Volumes 1-5 dated July 2003 and prepared by Resource Strategies Pty Ltd.

L4.3 Noise from the premises is to be measured at the most affected point or within the residential boundary or at the most affected point within 30m of the dwelling (rural situations) where the dwelling is more than 30m from the boundary to determine compliance with the LAeq(15 minute) noise limits in condition L4.1.

Where it can be demonstrated that direct measurement of noise from the premises is impractical, the EPA may accept alternative means of determining compliance. See Chapter 11 of the NSW Industrial Noise Policy.

The modification factors presented in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise levels where applicable.

L4.4 Noise from the premises is to be measured at 1m from the dwelling façade to determine compliance with the LA1(1minute) noise limit in condition L4.1.

L4.5 The noise emission limits identified in condition L4.1 apply under meteorological conditions of:

a) Wind speeds of up to 3m/s at 10 metres above the ground level; or
b) Temperature inversion conditions of up to 30C/100m and wind speeds of up to 2m/s at 10 metres above the ground.

APPENDIX

B CALIBRATION CERTIFICATES

Acoustic Research Labs Pty Ltd
Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2006

Calibration Certificate

Calibration Number C16643

Client Details Global Acoustics Pty Ltd
12/16 Huntingdale Drive
Thornton NSW 2322

Equipment Tested/ Model Number : Rion NA-28
Instrument Serial Number : 00370304
Microphone Serial Number : 10421
Pre-amplifier Serial Number : 60313

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	22.2°C	**Ambient Temperature :**	22.4°C
Relative Humidity :	46.6%	**Relative Humidity :**	44.5%
Barometric Pressure :	99.95kPa	**Barometric Pressure :**	99.95kPa

Calibration Technician : Vicky Jaiswal
Secondary Check: Sandra Minto
Calibration Date : 16/11/2016
Report Issue Date : 17/11/2016

Approved Signatory : Juan Aguero

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10: Self-generated noise	*Pass*	14: Level linearity on the reference level range	*Pass*
11: Acoustical tests of a frequency weighting	*Pass*	15: Level linearity incl. the level range control	*Pass*
12: Electrical tests of frequency weightings	*Pass*	16: Toneburst response	*Pass*
13: Frequency and time weightings at 1 kHz	*Pass*	17: Peak C sound level	*Pass*
		18: Overload Indication	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.12dB*	*Temperature*	*±0.05°C*
12.5kHz	*±0.18dB*	*Relative Humidity*	*±0.46%*
16kHz	*±0.31dB*	*Barometric Pressure*	*±0.017kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

NATA
WORLD RECOGNISED ACCREDITATION

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

PAGE 1 OF 2

Acoustic Research Labs Pty Ltd
Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C17248

Client Details	Global Acoustics Pty Ltd 12/16 Huntingdale Drive Thornton NSW 2322
Equipment Tested/ Model Number :	Rion NA-28
Instrument Serial Number :	00701424
Microphone Serial Number :	01916
Pre-amplifier Serial Number :	01463

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	24.3°C	**Ambient Temperature :**	24.4°C
Relative Humidity :	40%	**Relative Humidity :**	39.5%
Barometric Pressure :	100.05kPa	**Barometric Pressure :**	100kPa

Calibration Technician :	Vicky Jaiswal	**Secondary Check:**	Nick Williams
Calibration Date :	05/06/2017	**Report Issue Date :**	06/06/2017

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.16dB*	*Temperature*	*±0.05°C*
12.5kHz	*±0.2dB*	*Relative Humidity*	*±0.46%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.017kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

NATA
WORLD RECOGNISED ACCREDITATION

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

PAGE 1 OF 1

Acoustic Research Labs Pty Ltd
Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Calibrator
IEC 60942-2004

Calibration Certificate

Calibration Number C16526

Client Details Global Acoustics Pty Ltd
12/16 Huntingdale Drive
Thornton NSW 2322

Equipment Tested/ Model Number : LarsonDavis Cal150
Instrument Serial Number : 3333

Atmospheric Conditions
Ambient Temperature : 21.8°C
Relative Humidity : 38.1%
Barometric Pressure : 97.74kPa

Calibration Technician : Vicky Jaiswal
Calibration Date : 30/09/2016
Secondary Check: Riley Cooper
Report Issue Date : 04/10/2016
Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
5.2.2: Generated Sound Pressure Level	*Pass*	5.3.2: Frequency Generated	*Pass*
5.2.3: Short Term Fluctuation	*Pass*	5.5: Total Distortion	*Pass*

	Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
Measured Output	94.0	1000.0	94.1	1000.04
Measured Output	114.0	1000.0	113.9	1000.05

The sound calibrator has been shown to conform to the class 2 requirements for periodic testing, described in Annex B of IEC 60942:2004 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

Least Uncertainties of Measurement -

Specific Tests

Generated SPL	*±0.09dB*
Short Term Fluct.	*±0.02dB*
Frequency	*±0.01%*
Distortion	*±0.5%*

Environmental Conditions

Temperature	*±0.05°C*
Relative Humidity	*±0.46%*
Barometric Pressure	*±0.017kPa*

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

NATA
WORLD RECOGNISED ACCREDITATION

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

PAGE 1 OF 1

Acoustic Research Labs Pty Ltd
Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Calibrator

IEC 60942-2004

Calibration Certificate

Calibration Number C16383

Client Details Global Acoustics Pty Ltd
12/16 Huntingdale Drive
THORNTON NSW 2322

Equipment Tested/ Model Number : Pulsar 106
Instrument Serial Number : 74813

Atmospheric Conditions
Ambient Temperature : 20.9°C
Relative Humidity : 39.8%
Barometric Pressure : 99.08kPa

Calibration Technician : Dennis Kim
Calibration Date : 25/07/2016
Secondary Check: Sandra Minto
Report Issue Date : 25/07/2016

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
5.2.2: Generated Sound Pressure Level	*Pass*	5.3.2: Frequency Generated	*Pass*
5.2.3: Short Term Fluctuation	*Pass*	5.5: Total Distortion	*Pass*

	Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
Measured Output	94.0	1000.0	93.8	1000.34

The sound calibrator has been shown to conform to the class 2 requirements for periodic testing, described in Annex B of IEC 60942:2004 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.09dB*	*Temperature*	*±0.05°C*
Short Term Fluct.	*±0.02dB*	*Relative Humidity*	*±0.46%*
Frequency	*±0.01%*	*Barometric Pressure*	*±0.017kPa*
Distortion	*±0.51%*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

NATA
WORLD RECOGNISED ACCREDITATION

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

PAGE 1 OF 1

APPENDIX

C METEOROLOGICAL DATA

METEOROLOGICAL DATA FROM WAMBO WEATHER STATION

End Date and Time	Wind Speed Average m/s	Wind Direction Average Degrees	Sigma Theta
13/06/17 21:00	2.4	169	6.1
13/06/17 21:05	2.6	172	7.8
13/06/17 21:10	2.7	174	7.6
13/06/17 21:15	3.0	170	9.2
13/06/17 21:20	2.3	168	6.4
13/06/17 21:25	2.5	169	8.0
13/06/17 21:30	2.8	171	9.4
13/06/17 21:35	2.7	170	9.6
13/06/17 21:40	3.0	169	8.3
13/06/17 21:45	2.8	168	8.7
13/06/17 21:50	3.0	172	11.2
13/06/17 21:55	2.6	177	9.4
13/06/17 22:00	2.9	166	10.2
13/06/17 22:05	2.2	167	12.8
13/06/17 22:10	2.7	168	13.9
13/06/17 22:15	2.5	159	13.8
13/06/17 22:20	2.3	158	15.5
13/06/17 22:25	1.6	146	13.4
13/06/17 22:30	2.1	159	12.2
13/06/17 22:35	2.9	158	12.6
13/06/17 22:40	2.7	159	13.4
13/06/17 22:45	2.3	152	13.5
13/06/17 22:50	1.8	147	14.0
13/06/17 22:55	1.4	144	12.3
13/06/17 23:00	1.6	145	12.2
13/06/17 23:05	1.6	156	9.8
13/06/17 23:10	1.4	161	6.9
13/06/17 23:15	1.4	158	6.7
13/06/17 23:20	1.1	156	8.3
13/06/17 23:25	1.6	166	10.4
13/06/17 23:30	1.7	178	7.2
13/06/17 23:35	1.4	182	6.3
13/06/17 23:40	0.9	197	9.8
13/06/17 23:45	0.9	197	0.4
13/06/17 23:50	0.8	206	4.3

End Date and Time	Wind Speed Average m/s	Wind Direction Average Degrees	Sigma Theta
13/06/17 23:55	0.9	198	5.8
15/06/17 21:00	0.7	210	0.2
15/06/17 21:05	0.6	213	1.6
15/06/17 21:10	0.7	214	0.4
15/06/17 21:15	0.5	214	0.5
15/06/17 21:20	0.0	214	0.0
15/06/17 21:25	0.0	NA	0.1
15/06/17 21:30	0.0	NA	0.0
15/06/17 21:35	0.4	214	0.1
15/06/17 21:40	0.3	214	0.0
15/06/17 21:45	0.0	214	0.0
15/06/17 21:50	0.1	214	0.1
15/06/17 21:55	0.7	215	0.3
15/06/17 22:00	0.7	214	0.7
15/06/17 22:05	0.7	206	5.8
15/06/17 22:10	0.3	194	0.0
15/06/17 22:15	0.0	NA	0.0
15/06/17 22:20	0.0	NA	0.0
15/06/17 22:25	0.0	NA	0.1
15/06/17 22:30	0.0	NA	0.0
15/06/17 22:35	0.2	194	0.2
15/06/17 22:40	0.4	194	0.0
15/06/17 22:45	0.4	194	0.0
15/06/17 22:50	0.2	194	0.0
15/06/17 22:55	0.0	NA	0.0
15/06/17 23:00	0.0	NA	0.0
15/06/17 23:05	0.0	NA	0.0
15/06/17 23:10	0.0	NA	0.1
15/06/17 23:15	0.0	NA	0.0
15/06/17 23:20	0.0	NA	0.0
15/06/17 23:25	0.0	NA	0.0
15/06/17 23:30	0.0	NA	0.0
15/06/17 23:35	0.1	194	0.0
15/06/17 23:40	0.0	NA	0.0
15/06/17 23:45	0.0	NA	0.0
15/06/17 23:50	0.0	NA	0.0

End Date and Time	Wind Speed Average m/s	Wind Direction Average Degrees	Sigma Theta
15/06/17 23:55	0.4	194	0.0

Notes - "NA" indicates data was not available or not applicable.