Noise Monitoring Assessment

Hera Gold Mine
Nymagee, NSW
April 2023

Prepared for: Aurelia Metals Limited
May 2023
MAC190976-01RP5

Muller Acoustic Consulting

Document Information

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Prepared for: Aurelia Metals Limited

Prepared by: Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

Document ID	Date	Prepared By	Signed	Reviewed By	Signed
MAC190976-01RP5	19 May 2023	Kristian Allen		Oliver Muller	

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Aurelia Metals Ltd (AM) to complete a Noise Monitoring Assessment (NMA) for Hera Gold Mine (HGM), Nymagee, NSW.

The NMA included quantifying the noise contribution of the HGM by direct attended measurements to determine mining noise emissions.

The assessment has been conducted in accordance with the following documents:

- Department of Planning and Environment (DPE), Project Approval 10_0191 (PA), modified on September 2016;
- Aurelia Metals Limited, Noise Management Plan (NMP), approved on 19 August 2013;
- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- NSW Environment Protection Authority (EPA's), Approved methods for the measurement and analysis of environmental noise in NSW, 2022;
- NSW Environment Protection Authority (EPA), Environment Protection Licence EPL #20179 (EPL); and
- Australian Standard AS 1055:2018 - Acoustics - Description and measurement of environmental noise - General Procedures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A.**

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2 Noise Criteria

2.1 Operational Noise Criteria

The Hera Gold Mine (HGM) is located at Nymagee, NSW approximately 6km south of the town centre. Receivers in the locality surrounding the HGM are primarily rural residential. Four residential receivers included in this assessment are located on Burthong Road.

2.2 Noise Monitoring Locations

Monitoring locations that are representative of all assessment locations were selected in accordance with the EPL and Project Approval and are representative of the nearest noise sensitive receivers to the HGM. Three monitoring locations have been selected as part of the NMA and are presented in **Table 1**.

Table 1 Noise Monitoring Locations

Monitoring Location	Receivers	Address	MGA 55 Easting, m	MGA 55 Northing, m
NM1	R1, R2	688 Burthong Road, Nymagee	434382	6444403
NM2	R3	224 Burthong Road, Nymagee	434809	6448336
NM3	R4	39 Burthong Road, Nymagee	435200	6450737

The relevant noise criteria for each noise catchment outlined in the EPL is presented in **Table 2**. **Figure 1** presents a visual representation of the assessed receivers.

Table 2 Noise Criteria, dBA

Receivers	Day[1,2]	Evening[1,2]	Night[1,2]	
	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{A1(1min)}$
R1, R2, R3, R4 Burthong Road Nymagee, NSW	35	35	35	45

Note 1: Noise criteria in accordance with L4.1 of the EPL and the Project Approval.

Note 2: Day - the period from 7am to 6pm Monday to Friday; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Conditions L4.2 to L4.8 of the EPL set out the conditions under which the noise limits apply and are reproduced below.

L4.2 For the purpose of condition L4.1:

- *Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and Public Holidays;*
- *Evening is defined as the period 6pm to 10pm;*
- *Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and Public Holidays;*
- *LAeq (15 minute) is defined as the continuous 'A' weighted sound pressure level-the energy average of the noise measured over a 15 minute period; and*
- *LA1 (1 minute) is defined as the sound pressure level exceeded for one percent of a 1-minute measurement period.*

L4.3 The noise limits set out in condition L4.1 apply under all meteorological conditions except for the following:

- *wind speeds greater than 3m/second at 10 metres above ground level; and*
- *stability category G temperature inversion conditions and wind speeds greater than 2m/second at 10 metres above ground level.*

L4.4 For the purposes of condition L4.3:

- *the meteorological data to be used for determining meteorological conditions is the data recorded by the on-site meteorological weather station at the Hera project site at Nymagee; and*
- *temperature inversion will be assessed by use of the sigma-theta process as outlined in Appendix E4 of the NSW Industrial Noise Policy (INP).*

L4.5 For the purpose of determining the noise generated at the premises Class 1 or 2 noise monitoring equipment as defined by AS IEC61672.1-2004 and AS IEC61672.2-2004, or other noise monitoring equipment accepted by the EPA in writing, must be used.

L4.6 To determine compliance:

a) With the $LA_{eq(15min)}$ noise limits in condition L4.1, the noise measurement equipment must be located:

- *within 30 metres of a dwelling façade, but not closer than 3 metres, where any dwelling on the property is situated more than 30 metres from the property boundary that is closest to the premises;*
- *approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; and*
- *within approximately 50 metres of the boundary of a National Park or a Nature Reserve.*

b) With the $LA_{1(1\ minute)}$ noise limits in condition L4.1; the noise monitoring equipment must be located within 1 metre of a dwelling façade.

c) The noise monitoring equipment must be located in a position that is:

- *at the most affected point at a location where there is no dwelling at the location; or*
- *at the most affected point within an area at a location prescribed by conditions L4.6(a) or L4.6(b).*

L4.7 A breach of this Environmental Protection License will still occur where noise generated from the premises in excess of the appropriate limit specified in the condition L4.1 is detected:

- *at a location other than an area prescribed by conditions L4.6(a) and L4.6(b); and/or*
- *at a point other than the most affected point at a location.*

L4.8 For the purposes of determining the noise generated at the premises the modification factors in Section 4 of the NSW Industrial Noise Policy (INP) must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

2.3 Low Frequency Noise Criteria

Section L4.8 of the EPL states that modifying factor adjustments outlined in Fact Sheet C of the NPI requires an assessment of low frequency (LF) noise generated by HGM to be quantified. The LF requirement is reproduced below along with one third octave $LZ_{eq(15min)}$ thresholds presented in Table 3.

Measure/assess C and A weighted Leq,T levels over the same time period. Where the C minus A level is 15dB or more and:

- *where any of the 1/3 octave noise levels in Table 4-1 are exceeded by up to 5dB and cannot be mitigated, a 2 dB(A) positive adjustment to measured/predicted A weighted levels applies for the evening/night period; and*
- *where any of the 1/3 octave noise levels in Table 4-1 are exceeded by more than 5dB and cannot be mitigated, a 5 dB(A) positive adjustment to measured/predicted A weighted levels applies for the evening/night period and a 2dB positive adjustment applies for the daytime period.*

Table 3 One-third octave low frequency noise thresholds

Hz/dB(Z)	*One-third octave LZeq 15minute threshold level*												
Frequency (Hz)	*10*	*12.5*	*16*	*20*	*25*	*31.5*	*40*	*50*	*63*	*80*	*100*	*125*	*160*
dB(Z)	*92*	*89*	*86*	*77*	*69*	*61*	*54*	*50*	*50*	*48*	*48*	*46*	*44*

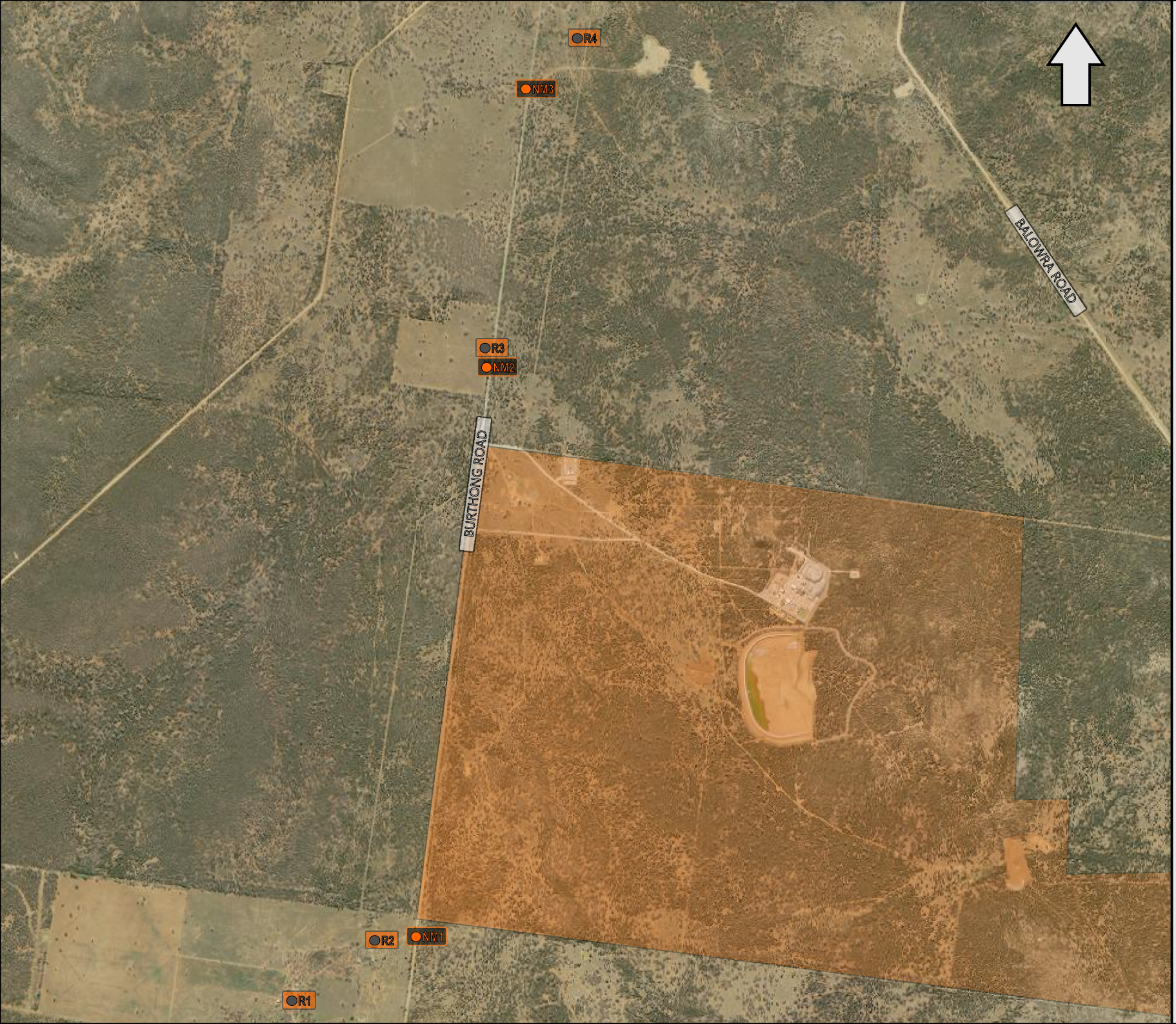

FIGURE 1

LOCALITY PLAN

REF: MAC190976

0 1.5 km

KEY

- R1 RECEIVER LOCATION
- NM1 NOISE MONITORING LOCATION
- SITE LOCATION

MAC
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*Imagery Source : SIX Maps

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3 Methodology

Noise monitoring consisted of operator attended monitoring during the daytime, evening and night-time periods.

3.1 Attended Noise Monitoring

Operator attended noise monitoring was conducted in general accordance with the procedures described in Australian Standard AS 1055:2018. All measurements were carried out using a Svantek Type 1, 977 noise analyser on Tuesday 18 April 2023 and Wednesday 19 April 2023. All acoustic instrumentation used carries appropriate and current NATA (or manufacturer) calibration certificates with records of all calibrations maintained by MAC as per Approved methods for the measurement and analysis of environmental noise in NSW (EPA, 2022) and complies with AS/NZS IEC 61672.1-2019-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

Attended noise monitoring included one 15-minute measurement during daytime, evening and night-time periods. Where possible, throughout each measurement the operator quantified the contribution of each significant noise source.

Extraneous sources were excluded from the analysis to determine the $LA_{eq(15min)}$ HGM noise contribution for comparison against the relevant criteria.

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4 Results

4.1 Meteorological Conditions

As prescribed in Condition L4.4 of the EPL (EPL #20179) weather data for the noise assessment period was sourced from onsite weather station to determine prevailing meteorological conditions at the time of the attended measurements. Results are presented in **Table 4** to **Table 6**. The data shows that wind speeds at 10m above ground level were compliant at levels where the EPL criteria are applicable. Additionally, the observed wind speeds at ground level were less than 3m/s during all measurements, meeting the requirements of AS1055.

Table 4 Prevailing Meteorological Conditions – Day Period

Date	Time	Onsite Weather Station (10mAGL)		
		Wind Direction	Wind (m/s)	Stability Class
19/04/2023	08:30	SW	1.0	B
19/04/2023	08:40	SSE	0.9	A
19/04/2023	08:50	ENE	1.9	D
19/04/2023	09:00	E	1.8	C
19/04/2023	09:10	E	1.6	B
19/04/2023	09:20	ESE	1.1	A
19/04/2023	09:30	ESE	1.3	A
19/04/2023	09:40	SE	1.5	A
19/04/2023	09:50	ESE	1.5	B
19/04/2023	10:00	SE	1.4	A
19/04/2023	10:10	S	1.8	C
19/04/2023	10:20	S	2.2	C
19/04/2023	10:30	SE	2.1	B
19/04/2023	10:40	S	1.6	A
19/04/2023	10:50	S	2.4	A
19/04/2023	11:00	SSE	2.5	A

Note: Day - the period from 7am to 6pm Monday to Saturday, 8am to 6pm Sundays and public holidays.

Table 5 Prevailing Meteorological Conditions - Evening Period

Date	Time	Onsite Weather Station (10mAGL)		
		Wind Direction	Wind (m/s)	Stability Class
18/04/2023	18:00	SSW	1.2	D
18/04/2023	18:10	SSW	1.1	D
18/04/2023	18:20	SSW	0.9	E
18/04/2023	18:30	SSW	0.9	E
18/04/2023	18:40	SSW	0.8	E
18/04/2023	18:50	S	0.3	E
18/04/2023	19:00	ESE	0.1	F
18/04/2023	19:10	SE	0.2	D
18/04/2023	19:20	S	0.1	F
18/04/2023	19:30	S	0.0	F
18/04/2023	19:40	SSW	0.3	E
18/04/2023	19:50	SSW	0.5	D
18/04/2023	20:00	SW	0.7	E
18/04/2023	20:10	S	0.6	E
18/04/2023	20:20	S	1.0	E
18/04/2023	20:30	S	0.7	D

Note: Evening - the period from 6pm to 10pm Monday to Sunday.

Table 6 Prevailing Meteorological Conditions - Night Period

Date	Time	Onsite Weather Station (10mAGL)		
		Wind Direction	Wind (m/s)	Stability Class
19/04/2023	04:30	SSE	0.8	E
19/04/2023	04:40	SSE	0.7	E
19/04/2023	04:50	SSE	0.7	D
19/04/2023	05:00	S	0.8	E
19/04/2023	05:10	SSE	1.0	E
19/04/2023	05:20	SSE	1.1	E
19/04/2023	05:30	SSE	0.9	E
19/04/2023	05:40	SSE	0.8	D
19/04/2023	05:50	S	1.0	D
19/04/2023	06:00	S	1.2	D
19/04/2023	06:10	S	1.1	D
19/04/2023	06:20	SSE	1.0	D
19/04/2023	06:30	SSE	1.0	D
19/04/2023	06:40	S	1.0	E
19/04/2023	06:50	S	0.9	E

Note: Night - the period from 10pm to 7am Monday to Saturday, 10pm to 8am Sundays and public holidays.

4.2 Attended Assessment Results

4.2.1 Attended Assessment Results - Location NM1

The monitored noise level contributions and observed meteorological conditions for each assessment period at location NM1 for the NMA are presented in **Table 7**.

Table 7 Operator-Attended Noise Survey Results – Location NM1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)				Meteorology[1]	Description and SPL, dBA
		L_{Amax}	L_{A1}	L_{Aeq}	L_{A90}		
19/04/2023	09:20 (Day)	48	40	29	22	WD: NE WS: <0.5m/s Rain: Nil	Birds 21-41 Traffic 25-48 Aircraft 25-36 Site Inaudible
		HGM $L_{Aeq(15min)}$ Contribution					<30
18/04/2023	18:36 (Evening)	75	56	47	28	WD: NW WS: 0.1m/s Rain: Nil	Insects 24-34 Aircraft 30-38 Traffic 25-75 Site Inaudible
		HGM $L_{Aeq(15min)}$ Contribution					<30
19/04/2023	04:59 (Night)	37	32	28	26	WD: W WS: <0.1m/s Rain: Nil	Insects <25 Birds 25-37 Site – Generators 24-30 (audible throughout measurement) Site – Vehicles 24-30 (multiple short durations)
		HGM $L_{Aeq(15min)}$ Contribution					26
		HGM $L_{A(1min)}$ Contribution					<40

Note: Day - the period from 7am to 6pm Monday to Friday; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 1: At operator position as per AS1055.

4.2.2 Attended Assessment Results - Location NM2

The monitored noise level contributions and observed meteorological conditions for each assessment period at location NM2 for the NMA are presented in **Table 8**.

Table 8 Operator-Attended Noise Survey Results – Location NM2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)				Meteorology[1]	Description and SPL, dBA
		L_{Amax}	L_{A1}	L_{Aeq}	L_{A90}		
19/04/2023	10:02 (Day)	49	42	33	26	WD: SE WS: 1.0m/s Rain: Nil	Wind 24-44 Birds 25-49 Traffic 25-35 Site – Generators <25 (Barely audible throughout measurement)
		HGM $L_{Aeq(15min)}$ Contribution					<25
18/04/2023	19:31 (Evening)	38	34	30	28	WD: NW WS: 0.1m/s Rain: Nil	Insects 24-31 Aircraft 30-38 Site – Generators 26-31 (audible throughout measurements)
		HGM $L_{Aeq(15min)}$ Contribution					28
19/04/2023	05:45 (Night)	79	56	51	27	WD: W WS: 0.1m/s Rain: Nil	Livestock 35-41 Birds 25-41 Traffic 25-79 Site – Generators 26-30 (audible throughout measurement) Site – Vehicles 25-34 (multiple short durations)
		HGM $L_{Aeq(15min)}$ Contribution					27
		HGM $L_{A(1min)}$ Contribution					<40

Note: Day - the period from 7am to 6pm Monday to Friday; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 1: At operator position as per AS1055.

4.2.3 Attended Assessment Results - Location NM3

The monitored noise level contributions and observed meteorological conditions for each assessment period at location NM3 for the NMA are presented in **Table 9**.

Table 9 Operator-Attended Noise Survey Results – Location NM3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)				Meteorology[1]	Description and SPL, Dba
		L_{Amax}	L_{A1}	L_{Aeq}	L_{A90}		
19/04/2023	09:42 (Day)	45	35	26	22	WD: NE WS: <0.5m/s Rain: Nil	Birds 21-45 Aircraft 25-40 Site Inaudible
		HGM $L_{Aeq(15min)}$ Contribution					<25
18/04/2023	19:01 (Evening)	71	61	47	21	WD: NW WS: 0.1m/s Rain: Nil	Insects 20-31 Traffic 25-71 Site Inaudible
		HGM $L_{Aeq(15min)}$ Contribution					<25
19/04/2023	05:23 (Night)	34	25	21	20	WD: W WS: 0.1m/s Rain: Nil	Birds 20-31 MAC Operator 25-34 Site – Generators <20 (barely audible throughout measurement)
		HGM $L_{Aeq(15min)}$ Contribution					<25
		HGM $L_{A(1min)}$ Contribution					<40

Note: Day - the period from 7am to 6pm Monday to Friday; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 1: At operator position as per AS1055.

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5 Low Frequency Noise Assessment

The low-frequency assessment summary for each monitoring location NM1 to NM3 are presented in Table 10 to Table 12 for each assessment period.

Table 10 Daytime Low Frequency Compliance Assessment

Receiver No.	dB $LC_{eq(15min)}$	dB $LA_{eq(15min)}$	Difference	Mitigation Trigger
NM1	42	29	13	×
NM2	52	33	19	✓
NM3	35	26	9	×

Note: Day - the period from 7am to 6pm Monday to Saturday, 8am to 6pm Sundays and public holidays.

Table 11 Evening Low Frequency Compliance Assessment

Receiver No.	dB $LC_{eq(15min)}$	dB $LA_{eq(15min)}$	Difference	Mitigation Trigger
NM1	54	47	7	×
NM2	50	30	20	✓
NM3	54	47	7	×

Note: Evening - the period from 6pm to 10pm Monday to Sunday.

Table 12 Night Low Frequency Compliance Assessment

Receiver No.	dB $LC_{eq(15min)}$	dB $LA_{eq(15min)}$	Difference	Mitigation Trigger
NM1	41	28	13	×
NM2	54	51	3	×
NM3	34	21	13	×

Note: Night - the period from 10pm to 7am Monday to Saturday, 10pm to 8am Sundays and public holidays.

5.1 Low Frequency Noise Assessment Discussion

The $LC_{eq(15min)}$ exceeded the $LA_{eq(15min)}$ (referred to as 'C-A') by 15dB or more on two occasions during the NMA and are discussed below.

At Location NM2, the site was audible during day and evening period measurements. The C-A value of 19dB and 20dB respectively, were above the low frequency criteria during these measurements, therefore further analysis is required. The measured third octave data has been compared against the low frequency octave criteria outlined in the EPL in **Table 13**. HGM did not exceed relevant third octave criteria for all measurements, and therefore no further mitigation measures are required.

Table 13 One-third octave $LZ_{eq(15min)}$ threshold

Criteria	Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
	dB (Z)	**92**	**89**	**86**	**77**	**69**	**61**	**54**	**50**	**50**	**48**	**48**	**46**	**44**
NM2 19/04/2023 10:02 Day		58	55	52	49	45	42	37	38	35	29	27	25	23
NM2 18/04/2023 19:31 Evening		34	35	37	35	37	31	32	50	36	34	33	34	35

6 Discussion of Results

6.1 Discussion of Results - Location NM1

HGM noise emissions were inaudible during daytime and evening measurements and audible throughout night measurements conducted on Tuesday 18 April 2023 and Wednesday 19 April 2023, however HGM noise emissions remained below the relevant noise limit of 35dB $LA_{eq(15min)}$ at NM1.

HGM noise sources included generator noise and vehicle movements, Extraneous noise sources included birds, traffic, insects and passing aircraft.

6.2 Discussion of Results - Location NM2

HGM noise emissions were audible during all measurements conducted on Tuesday 18 April 2023 and Wednesday 19 April 2023, however HGM noise emissions remained below the relevant noise limit of 35dB $LA_{eq(15min)}$ at NM2.

HGM noise sources included generator noise and vehicle movements. Extraneous noise sources included wind in trees, birds, traffic, insects, livestock, and passing aircraft.

6.3 Discussion of Results - Location NM3

HGM noise emissions were inaudible during daytime and evening and barely audible throughout night measurements conducted on Tuesday 18 April 2023 and Wednesday 19 April 2023, however HGM noise emissions remained below the relevant noise limit of 35dB $LA_{eq(15min)}$ at NM3.

HGM noise sources generator noise. Extraneous noise sources included birds, traffic, insects, and MAC operator noise.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Aurelia Metals Limited for the Hera Gold Mine (HGM), at Nymagee, NSW. The assessment was completed to assess compliance with the relevant noise criteria for EPL #20179.

Attended noise monitoring was completed on Tuesday 18 April 2023 and Wednesday 19 April 2023 at three representative monitoring locations. The assessment has identified that noise emissions generated by HGM were audible at all receiver locations, however the noise emissions from HGM remained below relevant noise limits.

An assessment of low frequency noise was also completed and identified compliance with the relevant criteria.

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Appendix A - Glossary of Terms

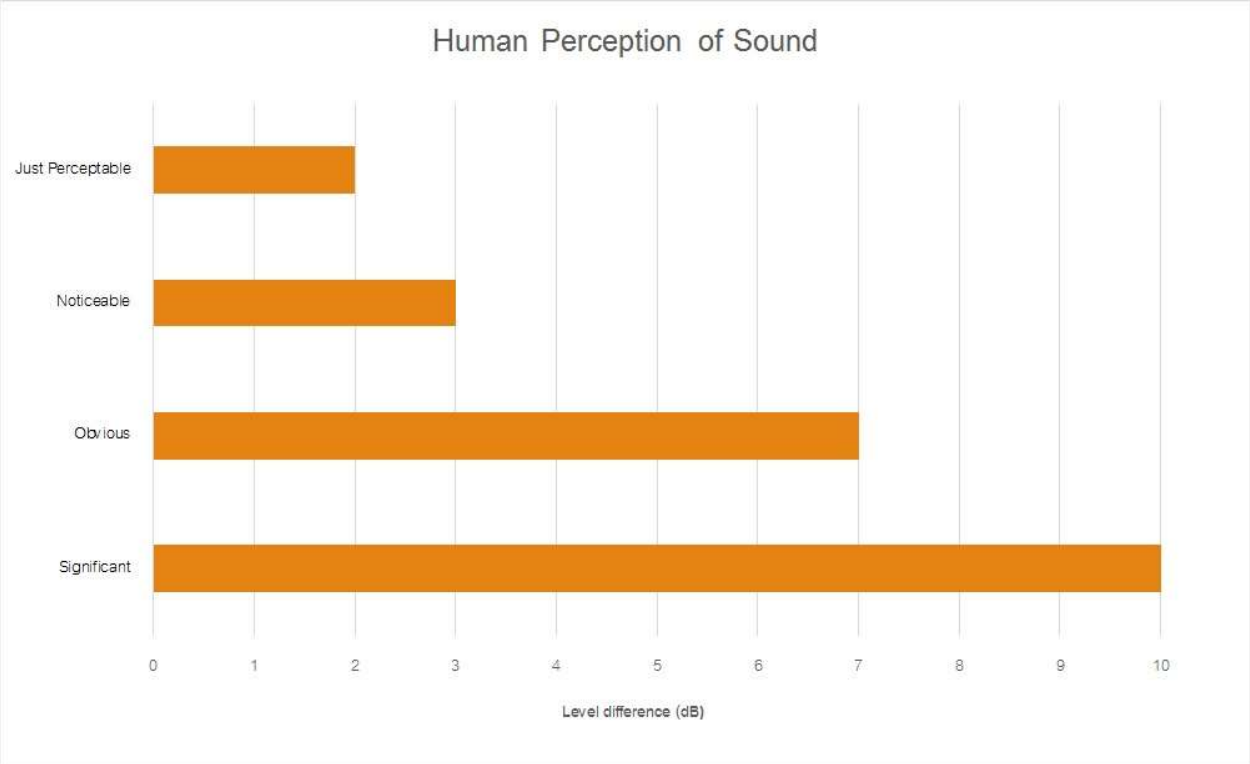
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by: = 10.log10 (W/Wo) Where: W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
Ph: +61 2 4920 1833
www.mulleracoustic.com

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Muller Acoustic Consulting