Appendix 4

Noise and Blasting Assessment

prepared by

Muller Acoustic Consulting Pty Ltd

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Noise Impact Assessment

Tomingley Gold Mine - Modification 5
Tomingley, NSW

Prepared for: RW Corkery and Co Pty Limited
November 2020
MAC160282-02RP1V1

Muller Acoustic Consulting

Document Information

Noise Impact Assessment

Tomingley Gold Operations - Modification 5

Tomingley, NSW

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CONTENTS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by RW Corkery & Co Pty Limited (RWC) on behalf of Tomingley Gold Operations Pty Ltd (TGO) to complete a Noise Impact Assessment (NIA) for a modification (MOD 5) of the existing Tomingley Gold Mine (the 'Mine') Project Approval (MP 09_0155).

The NIA has been undertaken to quantify potential acoustic impacts associated with MOD 5 within the surrounding community and has been prepared to support and accompany the Environmental Assessment (EA) that is being prepared by RWC.

This NIA has also considered and applied the following policy, guidelines and standards where relevant:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI) 2017;
- Tomingley Gold Project, Noise and Blasting Assessment (SLR, 2011);
- Tomingley Gold Mine, Environmental Assessment, Modification 2. Appendix 1 - Noise Bund Assessment (Noise and Sound Service, 2014);
- Noise Compliance Report, (Noise and Sound Service, 2015);
- Noise and Blasting Assessment, Tomingley Gold Mine, Modification 3 (Muller Acoustic Consulting Pty Ltd, 2015);
- Noise Impact Assessment, Tomingley Gold Mine, Modification 4 (Muller Acoustic Consulting Pty Ltd, 2019); and
- Tomingley Gold Project, Consolidated Project Approval (Department of Planning Industry and Environment, May 2020).

This report has not included an assessment of road traffic noise or blasting, as there are no proposed changes to existing off-site traffic flows or blast locations as a result of the modification.

A glossary of terms, definitions and abbreviations used in this report, along with a list of common noise sources and their typical sound level is provided in **Appendix A.**

1.1 Background

The Mine is located immediately to the south of the village of Tomingley in central western NSW (see Figure 1). The Mine is operated by Tomingley Gold Operations Pty Ltd, a wholly owned subsidiary of Alkane Resources Ltd. PA 09_0155 has been amended on four occasions previously as follows.

- Modification 1 (MOD 1) (November 2013) – to adjust a range of commitments made during the original application which were no longer appropriate.
- Modification 2 (MOD 2) (April 2015) – to permit enhancement of the approved and constructed amenity bund and a cut back of the approved Caloma 1 Open Cut (Cal1).
- Modification 3 (MOD 3) (July 2016) – establishment of Caloma Two Open Cut (Cal2), construction of a portal and decline from the Cal1 Open Cut to enable the development and mining of underground resources below the Cal1, Cal2 Open Cuts.
- Modification 4 (MOD 4) (October 2016) – in pit Residue Storage Operations and modifications to the Waste Rock Emplacement (WRE).

1.2 Project Description

MOD 5 proposes to increase the residue storage capacity of TGO through the construction of Stage 1 and Stage 2 of a second Residue Storage Facility (RSF2), together with the associated extension of the approved TGO Mine Site.

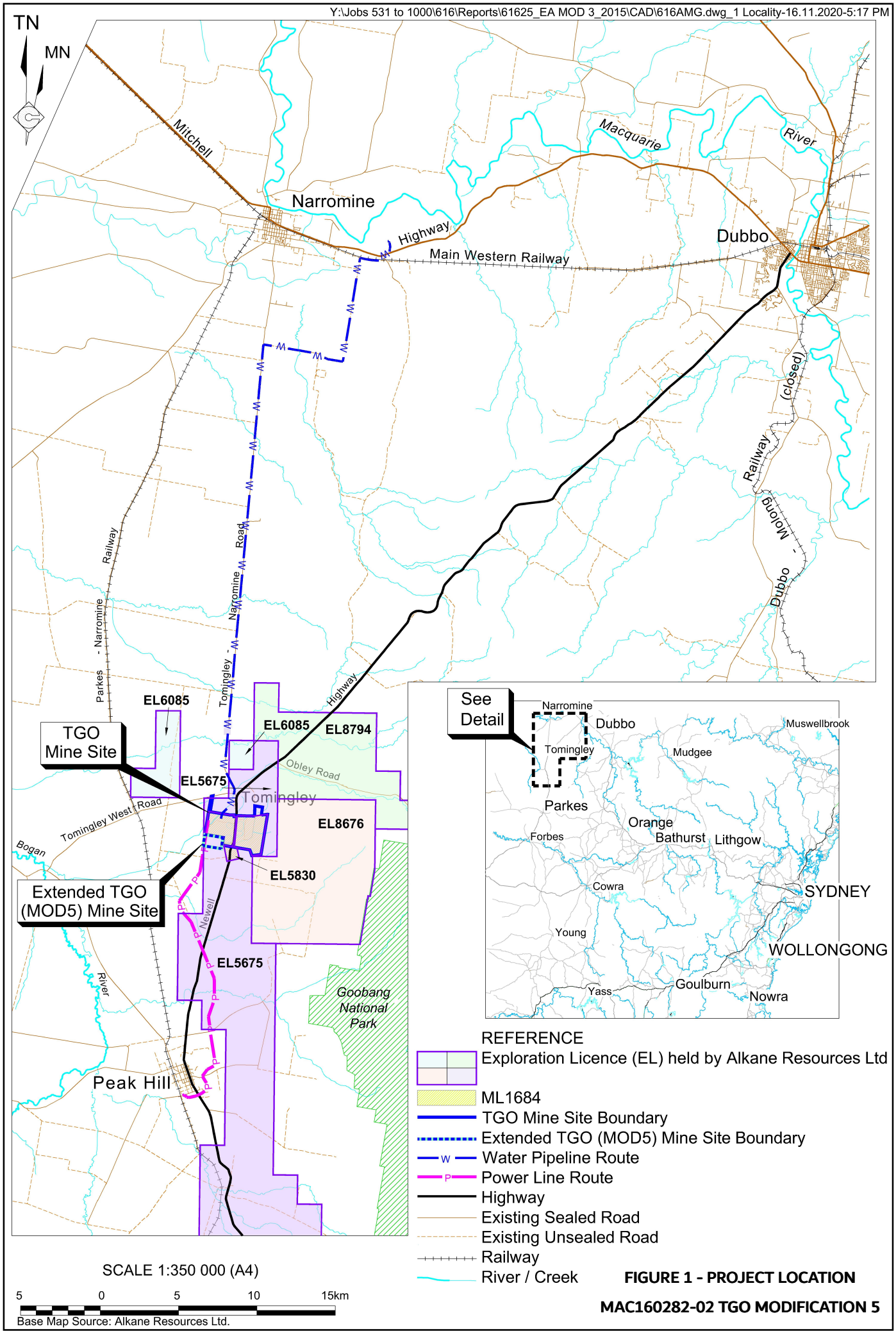
The Proposed Modification seeks consent for the following.

- Construction and use of Stages 1 and 2 of RSF2;
- An extension of Mine Life from 31 December 2022 to 31 December 2025; and
- Extension of the Mine Site boundary to incorporate RSF2.

For the purposes of this assessment, the most significant noise generating activities would be construction of the Stage 2 embankment at an elevation of approximately 7m above the natural ground surface.

Current evening and night time operations are unchanged and are not assessed as the proposed RSF2 construction is only proposed for the daytime period 7am to 6pm.

Figure 2 presents the mine site layout and location of proposed modifications to operations.



Source: RW Corkery Pty Ltd

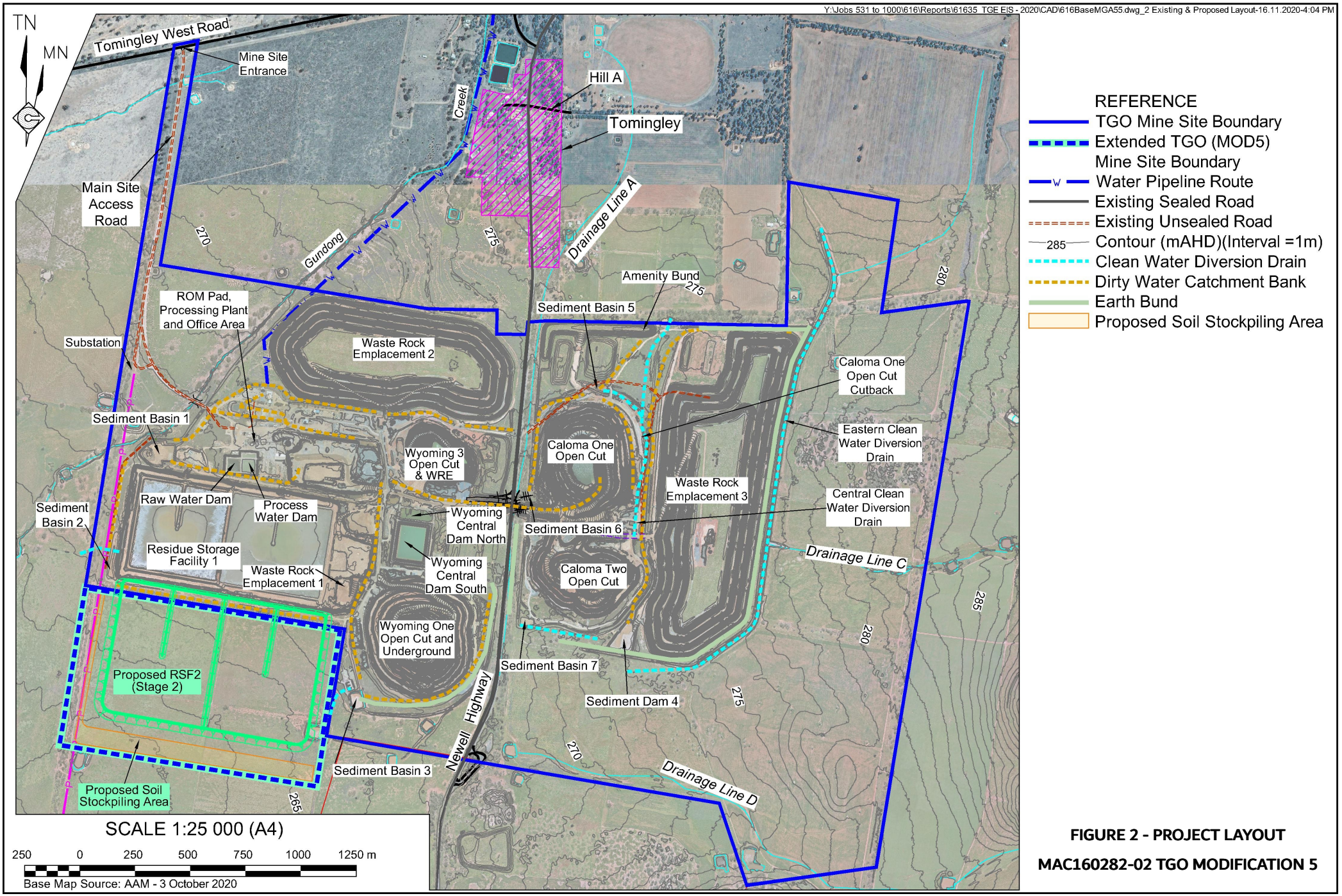


FIGURE 2 - PROJECT LAYOUT

MAC160282-02 TGO MODIFICATION 5

Source: RW Corkery Pty Ltd

2 Criteria

2.1 Current Noise Criteria

Condition 3 of Schedule 3 of PA 09_0155 includes operational noise limits for surrounding receivers. The operational noise criteria have been adopted as the primary criteria for this assessment. Relevant sections of Schedule 3 of PA 09_0155 pertaining to this assessment are summarised below. It is noted that from historic assessments, receivers are allocated into Noise Assessment Groups (NAGs) or noise catchments. Each NAG has been derived according to the relevant background environment that receivers are situated within.

This ranges from relatively quiet rural background levels for NAG A and B, to environments that are controlled by ambient road traffic such as NAG C and D, from which higher noise criteria were derived.

Condition 3A states that from 30 June 2019, unless agreed otherwise by the Secretary, the Proponent shall ensure that the noise generated by the project does not exceed the criteria at any residence on privately-owned land as per **Table 1.**

Table 1 Noise Criteria

Noise Assessment Group	Receivers	Day	Evening	Night	
		dB $LA_{eq(15min)}$	dB $LA_{eq(15min)}$	dB $LA_{eq(15min)}$	dB $LA_{1(1min)}$
NAG A	All receivers	35	35	35	45
NAG B	All receivers	36	35	35	45
NAG C	All receivers	45	35	35	45
NAG D	All receivers	43	38	36	45
All other residential receivers		35	35	35	45

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Additionally, Appendix 7 of MP 09_0155 states that the noise criteria in Table 2 of schedule 3 are to apply under all meteorological conditions except the following applicable meteorological conditions:

1 *The noise criteria in Table 2 of schedule 3 are to apply under all meteorological conditions except the following:*

   a) *Wind speeds greater than 3 m/s at 10 m above ground level; or*

   b) *Stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 m above ground level; or*

   c) *Stability category G temperature inversion conditions.*

The historic assessment (SLR, 2011) identified that prevailing winds (less than 3m/s) were not a feature of the area. However, the Consent Conditions require the project to meet the criteria for any wind under 3m/s in contradiction to the meteorological conditions used assessment.

2.2 NPI Noise Enhancing Conditions

Noise emissions can be significantly influenced by prevailing weather conditions. Light stable winds (<3m/s) and temperature inversions have the potential to increase noise at a receiver.

Fact Sheet D of the NPI provides two options when considering meteorological effects:

- adopt the noise enhancing conditions for all assessment periods without an assessment of how often the conditions occur – a conservative approach that considers a source to receiver winds for all receivers and F class temperature inversions with wind speeds up to 2m/s at night; or
- determine the significance of noise enhancing conditions. This requires assessing the significance of temperature inversions (F and G Class stability categories) for the night time period and the significance of light winds up to 3m/s for all assessment periods during stability categories other than E, F or G.

Standard meteorological conditions and noise-enhancing meteorological conditions as defined in Table D1of the NPI are reproduced in **Table 2**.

Table 2 Standard and Noise-Enhancing Meteorological Conditions

Meteorological Conditions	Meteorological Parameters
Standard Meteorological Conditions	Day/evening/night: stability categories A–D with wind speed up to 0.5m/s at 10m AGL.
Noise Enhancing Meteorological Conditions	Daytime/evening: stability categories A–D with light winds (up to 3 m/s at 10m AGL). Night-time: stability categories A–D with light winds (up to 3m/s at 10m AGL) and/or stability category F with winds up to 2m/s at 10 m AGL.

The existing Project Approval and Consent Conditions are based on the historic assessment (SLR, 2011) completed in accordance with the NSW Industrial Noise Policy (INP, 200). The historic assessment identified that prevailing winds (less than 3m/s) were not a feature of the area, however, the occurrence of temperature inversions (F and G Class Stability) were significant (>30%) and are to be considered in the assessment.

The methodology used in the historic noise assessment (SLR, 2011) to determine the occurrence of noise-enhancing meteorological conditions is generally unchanged to that required by NPI (refer **Appendix B)**. Therefore, the historic assessment of prevailing winds and temperature inversions is considered valid for the determination of the occurrence of noise-enhancing meteorological conditions in accordance with Table D1 of the NPI.

For this assessment, as the occurrence prevailing winds are not significant, standard meteorological conditions have been adopted for the daytime and evening periods. However, the occurrence of temperature inversions is significant and noise enhancing meteorological conditions are adopted for the night time period.

2.2.1 NPI Very Noise Enhancing Conditions

Fact Sheet D of the NPI also states:

'Noise limits derived for consents and licences will apply under the meteorological conditions used in the environmental assessment process, that is, standard or noise-enhancing meteorological conditions. For 'very noise-enhancing meteorological conditions' (see glossary[1]) a limit is set based on the limit derived under standard or noise-enhancing conditions (whichever is adopted in the assessment) plus 5dB. In this way a development is subject to noise limits under all meteorological conditions.'

Essentially, this means a limiting criterion of PNTL +5dB is applicable for meteorological conditions outside that adopted in the assessment. In the context of TGO, this means that the operation would need to comply with PNTL +5dB for any prevailing wind or temperature inversion conditions.

2.3 Differences Between INP and NPI Noise Assessment Criteria

The most significant difference in noise assessment criteria from the implementation of the NPI is the change to the minimum applicable daytime Rating background Level (RBL) of 30dB $L_{A90(daytime)}$ in the INP is now 35dB $L_{A90(daytime)}$. This results in the minimum applicable Project Intrusiveness Noise Level (PINL) of 40dB $L_{Aeq(15min)}$.

[1] Meteorological conditions outside of the range of either standard or noise-enhancing meteorological conditions as adopted in the noise impact assessment following the procedures in Fact Sheet D.

2.4 Proposed Contemporary Criteria

In consideration of the preceding discussion of noise enhancing meteorological conditions and contemporary noise criteria, the revised contemporary noise criteria in **Table 3** are proposed to be incorporated into this and future assessments for TGO.

Table 3 Noise Criteria

Noise Assessment Group	Receivers	Day[1]	Evening[1]	Night[1]	
		dB $L_{Aeq(15min)}$	dB $L_{Aeq(15min)}$	dB $L_{Aeq(15min)}$	dB $L_{A1(1min)}$
Assessment meteorological conditions[2]					
NAG A	All receivers	40	35	35	45
NAG B	All receivers	40	35	35	45
NAG C	All receivers	45	35	35	45
NAG D	All receivers	43	38	36	45
All other residential receivers		40	35	35	45
Very enhancing[3]					
NAG A	All receivers	45	40	40	N/A
NAG B	All receivers	45	40	40	N/A
NAG C	All receivers	50	40	40	N/A
NAG D	All receivers	48	43	41	N/A
All other residential receivers		45	35	40	N/A

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Standard meteorological conditions(Daytime and Evening) and noise enhancing meteorological conditions (night time) as per **Table 2.**

Note 3: All other meteorological conditions.

3 Receiver Review

The Mine is located to the south of the village of Tomingley NSW. Receivers in the locality surrounding the Mine are primarily rural/residential and for consistency the naming convention for each receiver has been retained from historic noise assessments. **Figure 3** provides a locality plan identifying the position of receivers in relation to the Mine. The receiver IDs, MGA(55) coordinates, relevant Noise Assessment Group (NAG) and approximate distance to the project are summarised in **Table 4**.

Table 4 Receiver Locations

Receivers	NAG	Coordinates (GDA94/MGA55)		Approximate Distance to Mine[1], m
		Easting, m	Northing, m	
R1	A	614370	6396168	1755
R2	B	611373	6395459	2300
R3	C	614697	6395283	1350
R4	A	617146	6393348	3850
R5	A	614220	6390481	4200
R6	A	611773	6392345	2870
R8	A	612512	6398172	3675
R9	A	614081	6398014	3425
R10	A	615157	6396770	2695
R11	A	615523	6396855	2990
R12	A	616534	6397951	4485
R13	C	614425	6396318	1912
R16	D	614591	6395927	1680
R17	D	614541	6395905	1630
R18	C	614684	6395856	1690
R19	C	614661	6395797	1630
R21	C	614666	6395742	1595
R22	D	614591	6395675	1495
R23	D	614520	6395615	1400
R24	D	614585	6395604	1440
R25	C	614685	6395661	1555
R26	C	614676	6395632	1530
R27	C	614679	6395520	1460
R28	C	614701	6395382	1400
R29	C	614686	6395297	1345
R32	D	614893	6395401	1575
R33	C	614764	6395450	1490
R35	C	614726	6395772	1660
R37	D	614874	6395819	1800
R40	C	614682	6395720	1595
R41	C	614587	6395520	1390
R42	C	614625	6395893	1678
R99	A	617326	6390563	5500

Note 1: Distance measured from residence to TGM Administration Office at x: 613488, y: 6394619

Figure 3 - Receiver Locations

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4 Noise Assessment Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers for typical construction activities and operations. DGMR (iNoise, Version 2020.0) noise modelling software was used to quantify noise emissions from typical construction activities and operations. iNoise is a new intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics – Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors. Part 2: General method of calculation' including corrections for meteorological conditions using CONCAWE[2]. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

4.1 Operational Noise Modelling Parameters

The model incorporated three-dimensional digitised ground contours for the Mine, as derived from the current mine layout (including the modified open cuts and WREs where relevant) for MOD 4, MOD 3, the MOD 2 noise barrier and the surrounding land base topography, superimposed on each other. Plant and equipment were modelled at various locations and heights, representative of proposed operating conditions for the proposed MOD 5 scenario. The processing plant was modelled within a semi-enclosed building consistent with the current Mine layout.

[2] Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

The noise model predicts LA_{eq} noise levels. It should be noted that this assessment has assumed all plant and equipment operate simultaneously. In practice, such an operating scenario would be unlikely to occur and the results should therefore be considered conservatively high. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

4.1.1 Meteorological Analysis

Historic noise assessment (SLR, 2011) for the Mine determined the prevailing conditions in accordance with Table D1 of the NPI and for consistency these parameters have been adopted for this assessment. The prevailing conditions used in modelling of each assessment scenario is presented in **Table 5**.

Table 5 Modelled Meteorological Parameters

Assessment Condition[1]	Temperature	Wind Speed[2]/ Direction	Relative Humidity	Stability Class[2]
Day	20°C	0 m/s	50%	D

Note 1: Day 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening 6pm to 10pm; Night - the remaining periods.

Note 2: Implemented using CONCAWE meteorological corrections.

4.2 Modelling Scenarios

A representative modelling scenario was adopted in this assessment to represent noise emissions for proposed MOD 5 operations.

Current Operations

- 120t excavator (CL1 East) & D10 dozer (CL2 backfill at 250m RL);
- Currently approved ROM & processing operations;
- 3 x CAT 777 haul trucks hauling from eastern side of CL1 to CL2, backfilling 20m below surface level;
- Ore haulage from WY1 portal by 3 x AD55 CAT underground mine trucks to ROM; and
- Support from 16G Grader / D10 dozer / watercart.

Proposed Operations – Current Operation plus second lift RSF2 (daytime only 7am – 6pm)

- RSF2 Stage 2a Construction – Bulk Earthworks:
  - load and haul waste from WRE1 for embankment material - 70t Excavator and 4 x 45t articulated dump trucks;
  - D7/D8 dozer pushing out embankment material on RSF2 lift;
  - Padfoot 18t roller compacting embankment; and
  - M12/M14 Grader conditioning embankment material with support from articulated dump trucks 35kl watercart for dust suppression.

- RSF2 Stage 2b Construction – Final Trim:
  - 1 x 18t flat drum roller on embankment;
  - trim 20t excavator.

Final Trim construction activities occur in the absence of excavator and trucks used for Bulk Earthworks.

4.2.1 Sound Power Levels

Mobile plant noise emissions used in modelling for this assessment were obtained via direct measurement of onsite plant or the MAC database of sources. The noise emission levels used in modelling are summarised in **Table 6**. **Appendix C** provides the octave sound power data, modelled plant and equipment locations for the operational scenarios.

Table 6 Equipment Sound Power Levels

Area	Item	Utilisation	Operating hrs[1]	Location	Sound Power Level (SWL), dBA
Operations	Excavator 120t (x1)	80%	Daytime	Caloma1	116
	D10 Dozer	80%	Daytime	Caloma2	113
	CAT 777 Haul truck (x3)	6/15min[2]	Daytime	Caloma1 – Caloma2	114
	AD55 Underground Mine Truck (x1)	2/15min[2]	Daytime	Wyoming1 - ROM	114
	CAT 16G Grader (x1)	50%	Daytime	Pit/Haul Roads	114
	35kl Water Cart	50%	Daytime	Pit/Haul Roads	108
	Vent Fan (x2)	100%	24/7	Wyoming1	90
Processing	WA 700 FEL (x1)	80%	24/7	ROM	113
	Ball mill (x1)	100%	24/7	Plant	112
	Primary/Secondary Crusher (x1)	100%	24/7	Plant	115
RSF2 Stage 2a	Excavator 70t (x1)	80%	Daytime	WRE1	113
	40t Articulated Dump Truck (x4)	6/15min[2]	Daytime	WRE1 – RSF2	108
	D8 Dozer (x1)	80%	Daytime	RSF2	108
	18t Padfoot Roller (x1)	80%	Daytime	RSF2	108
	35kl Water Cart	50%	Daytime	RSF2	108
RSF2 Stage 2b	Excavator 20t (x1)	80%	Daytime	RSF2	105
	18t Drum Roller (x1)	80%	Daytime	RSF2	108
	35kl Water Cart	50%	Daytime	RSF2	108

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Truck movements per 15 minute period from pit.

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5 Noise Modelling Results and Discussion

5.1 Operational Noise Results

The predicted noise levels at each assessed receiver for the meteorologic conditions (refer **Table 5**) for proposed MOD 5 operations are provided in **Table 7** along with predicted noise levels for TGO current operations. **Appendix D** presents the noise contours for this scenario. Results of modelling identify the MOD 5 operations will satisfy relevant criteria at all assessed receivers.

Table 7 Predicted MOD 5 Operational Noise Levels (by receiver), dB $L_{Aeq(15min)}$

Receiver	NAG	MOD4	Current Operations	Proposed RSF2 Stage 2a	Proposed RSF2 Stage 2b	Day Criteria dB $L_{Aeq(15min)}$
R1	A	<30	30	32	30	40
R2	B	<30	27	34	<30	40
R3	C	35	34	36	35	45
R4	A	<30	26	32	<30	40
R5	A	<30	25	<30	<30	40
R6	A	30	27	35	31	40
R8	A	<30	23	<30	<30	40
R9	A	<30	24	<30	<30	40
R10	A	<30	27	<30	<30	40
R11	A	<30	27	<30	<30	40
R12	A	<30	23	<30	<30	40
R13	C	<30	29	31	30	45
R16	D	30	31	33	31	43
R17	D	30	31	33	32	43
R18	C	31	31	33	32	45
R19	C	31	31	34	32	45
R21	C	31	32	34	32	45
R22	D	32	32	35	33	43
R23	D	32	33	35	33	43
R24	D	32	33	35	33	43
R25	C	32	32	35	33	45
R26	C	32	32	35	33	45
R27	C	33	33	35	34	45
R28	C	34	34	36	34	45
R29	C	34	34	36	35	45
R32	D	34	33	35	34	43
R33	C	34	33	35	34	45
R35	C	31	32	34	32	45

Table 7 Predicted MOD 5 Operational Noise Levels (by receiver), dB LAeq(15min)						
Receiver	NAG	MOD4	Current Operations	Proposed RSF2 Stage 2a	Proposed RSF2 Stage 2b	Day Criteria dB LAeq(15min)
R37	D	31	31	33	32	43
R40	C	32	32	34	33	45
R41	C	33	33	35	34	45
R42	C	30	31	33	32	45
R99	A	<30	23	<30	<30	40

It is noted that predicted noise levels under the NPI's 'standard meteorological conditions' are within the proposed contemporary criteria presented in **Table 3**.

Table 8 presents a summary of operational noise levels for each scenario for each Noise Assessment Group.

Table 8 Predicted MOD 5 Operational Noise Levels (by NAG), dB LAeq(15min)			
Noise Assessment Group	Mod4	RSF2a	RSF2b
NAG A	<25	24 - 35	21 - 31
NAG B	<25	<34	<29
NAG C	25 - 35	31 -36	30 - 35
NAG D	30 - 34	33 - 35	31 -34

It is noted that predicted noise levels are within +5dB of the proposed contemporary criteria for 'very enhancing noise conditions' presented in **Table 3**.

5.2 Noise Monitoring Results

A review of regular noise monitoring completed for TGO has been completed and indicates that operational noise from the project is generally inaudible or at ambient noise levels of 30dBA or less in NAG A. Processing noise is audible in NAG B and NAG C at ambient noise levels of 30dBA. Hence, predicted noise levels for current operational are supported by in field observations and attended noise monitoring.

6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has conducted a Noise Impact Assessment (NIA) of potential impacts associated with the proposed modification (MOD 5) of the existing Tomingley Gold Mine (TGM) Project Approval (MP 09_0155).

The assessment has undertaken a review of the current consent conditions and recommended the adoption of contemporary noise criteria and associated meteorological conditions to be considered in the NIA.

The results of the NIA demonstrate that proposed MOD 5 operations will satisfy relevant daytime criteria at all assessed receivers.

Based on the NIA results, there are no noise related issues which would prevent the approval of the modification. The results of the assessment show compliance with the relevant operational criteria without ameliorative measures being required.

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Appendix A – Glossary of Terms

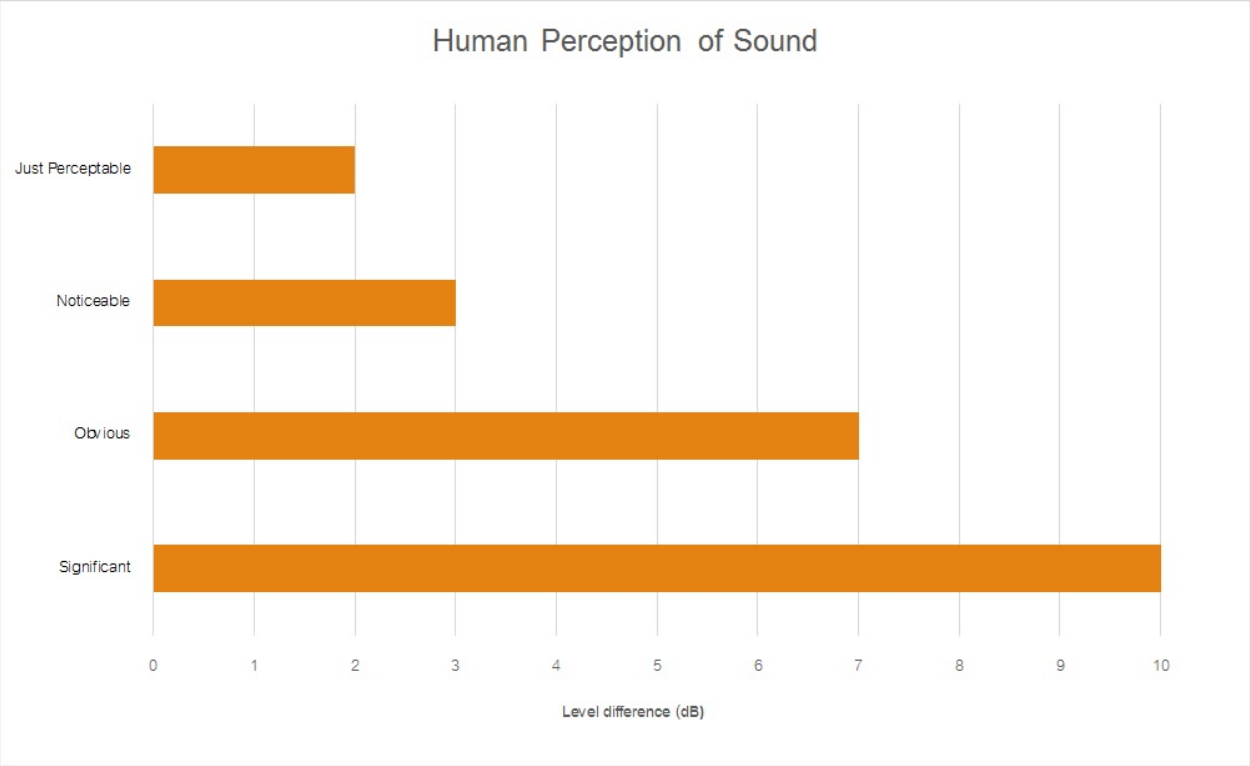
Table A1 provides a number of technical terms have been used in this report.

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



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Appendix B – Historic Assessment of Noise Enhancing Conditions

Within the periods selected as being representative of the background noise level, noise data during periods of any rainfall and/or wind speeds in excess of 5m/s (approximately 9 knots) were discarded.

The unattended ambient noise logger data from each monitoring location, together with the on-site weather conditions, are presented graphically on a daily basis in **Appendices A1** to **A6**.

The ambient noise data have been processed in accordance with the requirements of the INP in order to derive the Monday to Sunday ambient noise levels and are presented in **Table 10**.

Review of the graphs presented in **Appendix A** indicates that only a small percentage of the noise data was discarded during processing, i.e. data corresponding to wind speeds above 5m/s and/or rainfall above 0.5mm per 15 minute period.

Table 10
Unattended Ambient Noise Environment (dB(A) re 20µPa)

NAG	Residence	Survey Period	Ambient ($L_{A90(15minute)}$) Level All Noise Sources		
			Day	Evening	Night
A	R1	30 April, 1 May, 13 May to 15 May 2009	29	26	24
B	R2	29 April to 6 May 2009	31	33	35
C	R3	1 October to 8 October 2009	40	30	28
A	R4	29 April to 1 May, 12 May to 15 May 2009	29	24	23
A	R5	29 April to 6 May 2009	30	25	25
A	R6	29 April to 6 May 2009	28	24	23
D	R23	1 October to 8 October 2009	38	33	31

4.2 Operator-attended Noise Surveys

In order to supplement the unattended noise logger measurements and to assist in identifying the character and duration of the ambient noise sources, operator-attended night-time noise surveys were conducted. **Table 11** lists the results of the operator-attended noise measurements, undertaken in accordance with the INP.

4.3 Rating Background Noise Level

Based on the observations made during the operator-attended noise monitoring, it is concluded that the ambient ($L_{A90(15minute)}$) Rating Background Levels (RBLs) presented in **Table 12** are representative of the background noise environment in the absence of noise emissions from the Project at Residences 1 to 6 and Residence 23.

5 INP ASSESSMENT OF PREVAILING WEATHER CONDITIONS

5.1 Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the noise source. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Table 11
Operator-attended Ambient Noise Survey Results – 29 May to 30 May 2009

Residence Date / Time Meteorological Conditions						Primary Noise Descriptor (dB(A) re 20µPa)					Description of Noise Emissions and Typical Maximum Levels – dB(A) (LAmax)
Res.	Time	Cloud Cover (Octa)	Wind	Temp	Relative Humidity	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}	
R1	11.44pm	0	<1m/s	5°C	70%	42	50	47	37	32	Distant Traffic 30-34 Local Heavy Traffic 48-51
R2[1]	12.45am	0	<1m/s	3°C	81%	37	49	38	25	25	Distant Traffic 20-25 Drilling Rig to East <24
R3	1.05am	0	<1m/s	3°C	75%	65	79	56	35	30	Local Heavy Traffic 70-86 Distant Traffic 30-33 Trucks at Rest Stop (idle) 25-30 Dog Barks (distant) 40
R4	2.36am	0	<1m/s	3°C	81%	25	48	35	25	25	Distant Traffic 30-34 Sheep (distant) <25
R5	3.06am	0	<1m/s	1°C	87%	44	56	47	32	26	Distant Traffic 28-57

Note 1: As access to the private road leading to the residence was not available at this monitoring location, the operator attended noise survey was conducted on Tomingley West Road at the front gate of the private road approximately 330m north-northeast of the unattended noise logger.

Table 12
Summary of Existing L_{A90} Rating Background Levels (RBLs) (dB(A) re 20µPa)

Residence	Rating Background Level[1] ($L_{A90(15minute)}$) Level All Noise Sources		
	Day	Evening	Night
R1	30	30	30
R2	31	30[2]	30[2]
R3	40	30	30
R4	30	30	30
R5	30	30	30
R6	30	30	30
R23	38	33	31

Note 1: Rating Background Level (RBL) determined in accordance with the procedures specified in the Industrial Noise Policy, 2000 (INP).

Note 2: It has been determined from the attended noise monitoring results that the L_{A90} noise levels measured by the unattended noise logger were controlled by local domestic activity at Residence 2. The evening and night-time RBLs at this receptor have been adjusted accordingly.

Wind effects need to be considered when wind is a feature of the area under consideration. Where the source to receiver wind component at speeds of up to 3m/s occur for 30% or more of the time in any seasonal period (during the day, evening or night), then wind is considered to be a feature of the area and noise level predictions must be made under these conditions,

The NSW INP Section 5.3, Wind Effects, states:

> *"Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source to receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30 percent of the time or more in any assessment period in any season."*

An assessment of existing wind conditions for the Project Site has been prepared from the on-site meteorological data recorded at the Peak Hill Gold Mine located approximately 15km to the south of the Project Site for the period January 2003 to December 2003. The data, corrected for the height of the anemometer mast, was analysed in order to determine the frequency of occurrence of wind speeds up to 3m/s in each season.

The dominant seasonal wind speeds and directions are presented in **Table 13**, **Table 14** and **Table 15** for the daytime (7.00am to 6.00pm), evening (6.00pm to 10.00pm) and night-time (10.00pm to 7.00am) periods respectively.

Table 13
Seasonal Frequency of occurrence Wind Speed Intervals - Daytime

Period	Calm (<0.5m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2m/s	2 to 3m/s	0.5 to 3m/s
Summer	7.5%	ENE	5.3%	4.4%	9.7%
Autumn	28.5%	S	13.6%	3.3%	16.8%
Winter	33.9%	SSW	11.6%	3.8%	15.4%
Spring	11.6%	S	5.4%	3.0%	8.4%

Table 14
Seasonal Frequency of occurrence Wind Speed Intervals - Evening

Period	Calm (<0.5m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2m/s	2 to 3m/s	0.5 to 3m/s
Summer	1.0%	ESE	4.4%	3.4%	7.8%
Autumn	0.4%	E	11.7%	5.8%	17.5%
Winter	1.1%	NW	8.0%	12.2%	20.2%
Spring	1.5%	NW	1.7%	3.9%	5.7%

Table 15
Seasonal Frequency of occurrence Wind Speed Intervals - Night-Time

Period	Calm (<0.5m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2m/s	2 to 3m/s	0.5 to 3m/s
Summer	7.5%	ENE	6.5%	5.2%	11.7%
Autumn	18.7%	E	11.9%	6.1%	18.0%
Winter	23.8%	SSW	10.2%	5.1%	15.4%
Spring	14.9%	SSE	7.1%	3.8%	10.8%

There are no prevailing winds of velocity less than (or equal to) 3m/s, with a frequency of occurrence greater than (or equal to) 30% of the time. Assessment of specific wind direction is not considered to be relevant to the site in accordance with the NSW INP.

5.2 Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for 30% or more of the total evening and night-time period during winter or about two nights per week.

However, the INP states that temperature inversions need only be considered for the night-time noise assessment period ie 10.00pm to 7.00am. The OEH accepts three methods for estimating the strength of temperature inversions:

1. Direct measurement of the temperature lapse rate over a 50m height interval range.

2. Cloud cover, wind speed and solar radiation which are used to determine the rate of atmospheric heat loss (i.e. rate of cooling).

3. Sigma-theta (standard deviation of wind direction) and wind speed which are used to determine atmospheric stability and the corresponding atmospheric stability category.

Using Sigma-theta (Method 3) is the most commonly employed method for estimating the temperature inversion strength.

The INP contains a detailed procedure for determining the night-time Pasquill-Gifford stability category for a given sigma-theta and wind speed (ranging from A-Class to G-Class). The INP then sets default temperature inversion strengths for each stability category.

An assessment of existing atmospheric stability conditions has been prepared from the Peak Hill Gold Mine meteorological data recorded on site for the period January 2003 to December 2003. The frequency of occurrence of each stability class is presented in **Appendix B** for evening/night-times (6.00pm to 7.00am) during each season, where stability classes F and G indicate the occurrence of noise enhancing temperature inversions. **Table 16** presents a summary of this data during the winter season only.

Table 16
Frequency of Occurrence of Each Stability Class Winter Evening/Night-time Period Peak Hill – January 2003 to December 2004

Stability Class	Winter Evening/Night-time
A	0.0%
B	0.0%
C	0.0%
D	23.8%
E	19.2%
F	43.9%
G	13.0%
F+G	56.9%

The assessment shows that the cumulative frequency of occurrence of F and G stability class is greater than (or equal to) 30% during the winter evening/night-time period. Therefore, temperature inversions are considered to be relevant to the site in accordance with the INP. Further, it is appropriate to cater for the presence moderate (F class, 3˚C/100m - refer to the INP Section 5.2 and INP Appendix F) temperature inversions in the assessment of winter night-time noise emissions from the Project.

5.3 Drainage Flow Winds

The INP identifies that a default wind drainage value be applied where sources are situated at a higher altitude than receivers with no intervening topography.

The drainage-flow wind does not apply to this Project as the topography of the area is relatively flat.

5.4 Summary of Prevailing Weather Conditions

Temperature inversions are considered to be a feature of the area during the night-time in all seasons. However, in accordance with the INP, temperature inversions are only required to be assessed during the winter period.

6 ASSESSMENT CRITERIA

6.1 Operational Noise Criteria and Management Measures

6.1.1 Introduction

The NSW Industrial Noise Policy prescribes detailed calculation routines for establishing "project specific" $L_{Aeq(15minute)}$ intrusive and $L_{Aeq(period)}$ amenity noise criteria for a development at potentially affected receivers.

6.1.2 Background Noise Levels for Project Assessment Purposes

Based on the background noise monitoring data presented in **Table 10**, **Table 17** presents the Rating Background Levels (RBLs) determined in accordance with the INP. The RBLs adopted for assessment purposes are representative of the background noise environment at the respective noise assessment groups.

Existing industrial amenity noise levels from other industrial operations in the locality are not significant (i.e. greater than 6dB(A) lower than the acceptable amenity noise level nominated in INP) at the surrounding residences.

6.1.3 Assessment Criteria

The INP-based intrusiveness and amenity noise assessment criteria for each assessment group is presented in **Table 18**. The criteria are nominated for the purposes of assessing the potential operational noise impacts from the Project and are based on a review of the unattended and attended noise monitoring results. It is noteworthy that the $L_{Aeq(15minute)}$ intrusive criteria are the controlling noise criteria at all residential receivers.

Appendix C – Sound Power Data & Equipment Locations

Table C1 $LA_{eq(15min)}$ Sound Power Level Spectra

Noise Source	Octave Band Centre Frequency (Hz), dBA								Total
	63	125	250	500	1000	2000	4000	8000	dB(A)
Excavator 120t	102	103	104	106	110	111	106	100	116
Dozer	86	103	102	105	108	107	101	94	113
CAT 777 Haul truck	97	101	105	109	106	108	101	98	114
AD55 Underground Mine Truck	97	101	105	109	106	108	101	98	114
CAT 16G Grader	78	94	101	105	110	107	103	98	113
35kl Water Cart	92	96	102	102	103	100	93	84	108
Vent Fan	66	74	84	87	81	79	71	56	90
FEL	94	99	104	107	105	107	105	93	113
Ball mill	91	102	105	111	108	108	101	88	115
Primary/Secondary Crusher	91	101	104	111	113	114	109	98	118
Excavator 70t	107	100	101	103	105	107	103	97	113
40t Articulated Dump Truck	92	96	102	102	103	100	93	84	108
D8 Dozer	81	98	97	100	103	102	96	89	108
18t Padfoot Roller	92	96	96	106	101	97	94	88	108
Excavator 20t	99	92	93	95	97	99	95	89	105
18t Drum Roller	92	96	96	106	101	97	94	88	108

TGO Current Operations

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RSF2 Stage2a Bulk Earthworks
Plant & Equipment Locations

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RSF2 Stage2b Final Trim
Plant & Equipment Locations

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Appendix D – Noise Contours

TGO Current Operations

Predicted Noise Levels - dB LAeq(15min)

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RSF2 Stage2a Bulk Earthworks
Predicted Noise Levels - dB LAeq(15min)

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Industrial noise - ISO 9613.1/2, [REF/SEE - RSF2 Stage2a Bulk Earthworks] , iNoise V2020.0 Enterprise. Licensed to Muller Acoustic Consulting Pty Ltd - Australia

RSF2 Stage2b Final Trim
Predicted Noise Levels - dB LAeq(15min)

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Industrial noise - ISO 9613.1/2, [REF/SEE - RSF2 Stage2b Final Trim] , iNoise V2020.0 Enterprise. Licensed to Muller Acoustic Consulting Pty Ltd - Australia

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