Lloyd George Acoustics
PO Box 717
Hillarys WA 6923
T: 0439 987 455 F:9300 4199
E: olivier@lgacoustics.com.au W: www.lgacoustics.com.au

Environmental Noise Assessment

IMD Battler Gold Project

Reference: 15093322-01 draft.docx

Prepared for:
Bioscope Environmental

Report: 15093322-01 draft.docx

Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

PO Box 717
Hillarys WA 6923

T: 9300 4188 / 9401 7770
F: 9300 4199

Contacts	Daniel Lloyd	Terry George	Mike Cake	Matt Moyle	Olivier Mallié
E:	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	mike@lgacoustics.com.au	matt@lgacoustics.com.au	olivier@lgacoustics.com.au
M:	0439 032 844	0400 414 197	0438 201 071	0412 611 330	0439 987 455

Prepared By:	Olivier Mallié 
Position:	Project Director
Date:	24 March 2016

Table of Contents

List of Tables

List of Figures

Appendices

1 INTRODUCTION

The Battler gold mine is located approximately 14 kilometres (km) south-southeast of Southern Cross and 22 km north-northwest of Marvel Loch, Western Australia. The mine has a long history of gold prospecting, exploration, mining and ore processing, and is currently not rehabilitated from these activities. IMD Gold Mines (IMD) is currently obtaining the mine from Black Oak Minerals Ltd (BOK). IMD proposes to:

- Expand the existing open pit to mine up to 165,000 tonnes (t) of gold ore and up to 3,100,000 t of waste rock using conventional drill and blast, load and haul techniques.
- Dewater the mine pit prior to commencement of mining if required to remove any water remaining in the existing void and during mining if required to maintain dry mining conditions. Mine water will be stored on-site for use in dust suppression.
- Crush ore onsite – using an onsite mobile crushing plant.
- Utilise waste rock for site construction purposes, with excess material being disposed of in a Waste Rock Landforms (WRL) to be developed to the west and north east of the pit.
- Develop topsoil and vegetation storage stockpiles.
- Develop supporting mine infrastructure comprising haul roads, site office, crib room and amenities, explosives magazine, generator(s) for power generation, and turkeys nest and/or water dam.
- Transport the gold ore to the a third party for toll processing. No tailings disposal will occur at Battler.

Gazetted public roads provide access to the Project Area. The Southern Cross – Marvel Loch Road provides the main site access route and is accessible via Great Eastern Highway. Both the Southern Cross – Marvel Loch Road and the Great Eastern Highway will be used to transport ore from the Battler Project to Coolgardie for processing. Subject to approval timing, site works are proposed to commence at the end of the second quarter of 2016. Rehabilitation and closure works will be conducted following the cessation of mining.

The Proposal has a ten month operational life, with operations running both day and night, 7 days a week as follows:

- 'Day time' operations which include drilling and blasting, excavation, crushing, movement of waste rock to western dump and transport of ore off-site; and,
- 'Night-time' operations which include only excavation and movement of waste rock to eastern dump.

It is noted population density in the area is sparse with the only noise-sensitive receivers located approximately 550 metres west of the proposed pit.

A map of the Project area is shown in *Figure 1-1* and a preliminary mining schedule is shown in *Appendix A.*

Appendix C contains a description of some of the terminology used throughout this report.

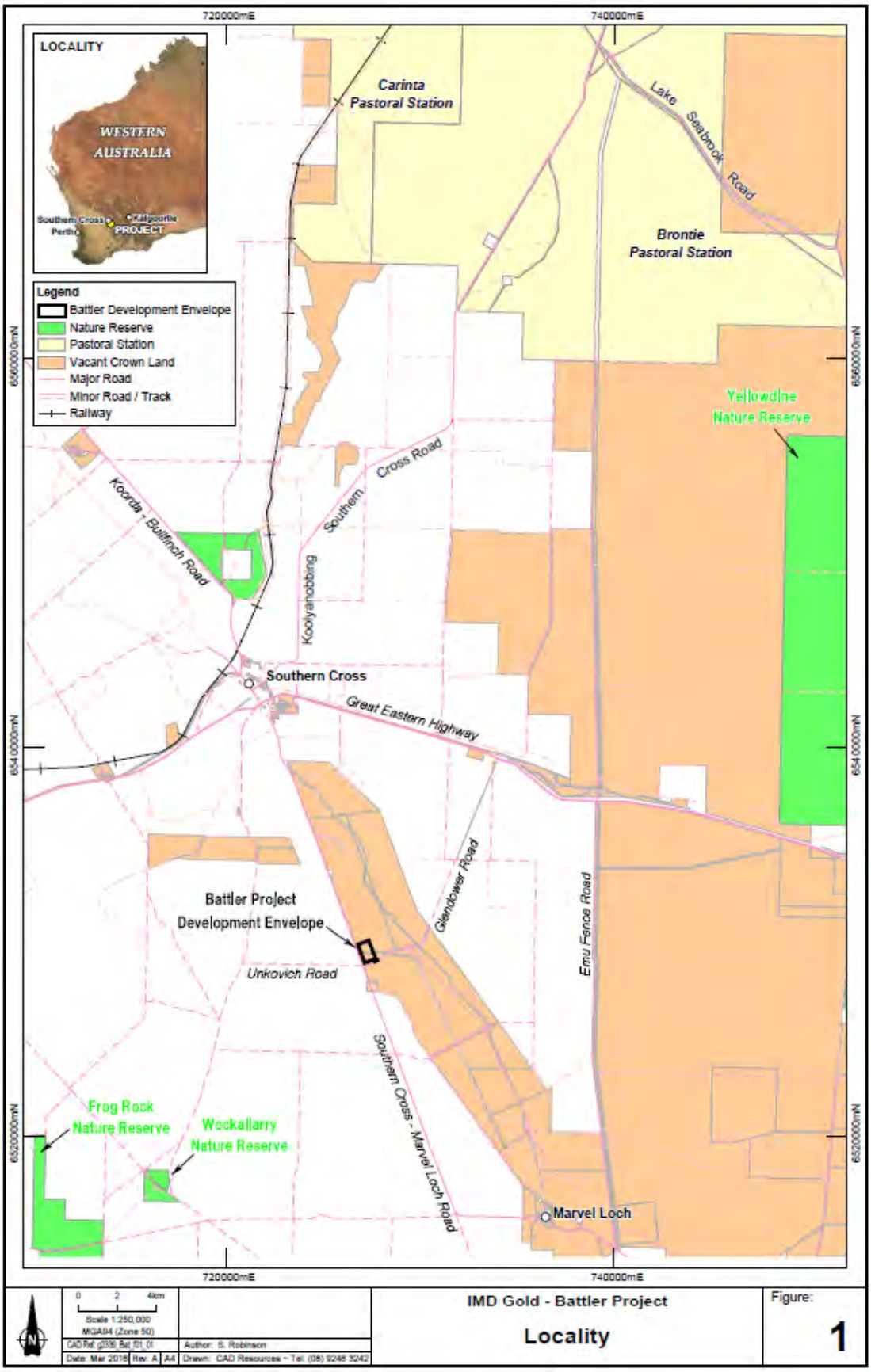


Figure 1-1 Project Area

2 EXISTING NOISE ENVIRONMENT

Ambient noise measurements were carried out between the 15 and 28 April 2011. These dates did not include any activity related to the proposal.

The ambient noise measurements are presented and discussed in Lloyd George Acoustics' report 11021791-01, dated May 2010, which is attached in *Appendix B*.

In summary, the background noise levels, L_{A90}, at the closest residence were determined as being:

- L_{A90} of 26 dB between 0700-1900 hours Monday to Saturday;
- L_{A90} of 32 dB between 1900-2200 hours Monday to Saturday and 0900-2200 hours on Sundays and public holidays; and,
- L_{A90} of 22 dB between 2200-0700 hours Monday to Saturday and 2200-0900 hours on Sundays and public holidays.

3 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

3.1 Operational Noise

Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (1) Noise emitted from any premises or public place when received at other premises –

(a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) Must be free of –

i. Tonality;

ii. Impulsiveness; and

iii. Modulation".

A "…noise emission is taken to *significantly contribute to* a level of noise if the noise emission exceeds a value which is 5 dB below the assigned level…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard after the adjustments of *Table 3-1* are made to the noise emission as measured at the point of reception.

Table 3-1 Adjustments for Intrusive Characteristics

Tonality	Modulation	Impulsiveness
+ 5dB	+ 5dB	+ 10dB

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in *Table 3-2*.

Table 3-2 Baseline Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise Sensitive[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor

1. Applies within 15 metres of a building associated with a noise sensitive use, as defined in Schedule 1, Part C.

The influencing factor applicable at the noise sensitive premises has been calculated as 0 dB as shown in *Table 3-3*.

Table 3-3 Influencing Factor Calculation

Description	Within 100 metre Radius	Within 450 metre Radius	Total
Industrial Land	0 dB 0 %	0 dB 0 %	0 dB
Commercial Land	0 dB 0 %	0 dB 0 %	0 dB
Major Road	*None*	*None*	0 dB
Minor Road	*None*	*None*	0 dB
Total			**0 dB**

Table 3-4 shows the assigned noise levels including the influencing factor at the receiving location.

Table 3-4 Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise Sensitive[1]	0700 to 1900 hours Monday to Saturday (Day)	45	55	65
	0900 to 1900 hours Sunday and public holidays (Sunday)	40	50	65
	1900 to 2200 hours all days (Evening)	40	50	55
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35	45	55

1. Applies within 15metres of a building associated with a noise sensitive use, as defined in Schedule 1, Part C.

It is noted the assigned noise levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as *a period of time of not less than 15 minutes, and not exceeding 4 hours*, which is determined by an *inspector* or *authorised person* to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission. An *inspector* or *authorised person* is a person appointed under Sections 87 & 88 of the *Environmental Protection Act 1986* and include Local Government Environmental Health Officers and Officers from the Department of Environment Regulation. Acoustic consultants or other environmental consultants are not appointed as an *inspector* or *authorised person*. Therefore, whilst this assessment is based on a 4 hours RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.

3.2 Construction Noise

Construction noise is dealt with under regulation 13 of the Regulations, which states the following:

Regulation 7 does not apply to … construction work carried out between 0700 hours and 1900 hours on any day which is not a Sunday or public holiday if the occupier of the premises … shows that –

a) The construction work was carried out in accordance with control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites;

b) The equipment used on the premises was the quietest reasonably available; and

c) If the occupier was required to prepare a noise management plan … in respect of the construction site –

i. The noise management plan was prepared and given in accordance with the requirement, and approved by the Chief Executive Officer; and

ii. The construction work was carried out in accordance with the management plan.

Regulation 7 does not apply to … construction work carried out other than between the [above] hours if the occupier of the premises … shows that –

a) The construction work was carried out in accordance with control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites;

b) The equipment used on the premises was the quietest reasonably available;

c) The construction work was carried out in accordance with a noise management plan in respect of the construction site –

i. Prepared and given to the Chief Executive Officer not later than 7 days before the construction work commenced; and

ii. Approved by the Chief Executive Officer;

d) At least 24 hours before the construction work commenced, the occupier of the construction site gave written notice of the proposed construction work to the occupiers of all premises at which noise emissions received were likely to fail to comply with the standard prescribed under regulation 7; and

e) It was reasonably necessary for the construction work to be carried out at that time.

In relation to the above, and according to regulation 13(1), construction works include the following activities:

a) the construction, erection, installation, alteration, repair, maintenance, cleaning, painting, renewal, removal, excavation, dismantling or demolition of, or addition to, any building or structure, or any work in connection with any of these things, that is done at or adjacent to the place where the building or structure is located; or

b) work on which a hoisting appliance or any scaffold or shoring is used; or

c) work in driving or extracting piles, sheet piles or trench sheet; or

d) work in laying any pipe or work in lining pipe that is done at or adjacent to the place where the pipe is laid or to be laid; or

e) work in sinking or lining or altering, repairing, maintaining, renewing, removing, or dismantling a well or borehole; or

f) reclamation or site works including road works and earth works; or

g) the removal or reinstatement of vegetation or topsoil for the purpose of or in relation to a mining operation; or

h) tunnelling.

3.3 Regulation 3 Exemptions

Under regulation 3, nothing in the Regulations applies to the following noise emissions –

(a) noise emissions from the propulsion and braking systems of motor vehicles operating on a road;

(b) noise emissions from a safety warning device, other than a reversing alarm, fitted to a motor vehicle operating on a road;

(c) noise emissions from trains or aircraft (other than model aircraft and trains operating on railways with a gauge of less than 70cm);

(d) noise emissions from a safety warning device fitted to a train or vessel;

(e) noise emissions from an emergency vehicle as defined in the Road Traffic Code 2000 regulation 3(1);

(f) noise emissions from the propulsion system or the movement through the water of a vessel operating in water other than water on private premises;

(g) noise emissions –

(i) from a device for warning pedestrians installed at a pedestrian crossing on a road; or

(ii) from a device for warning of the passage of a train installed at a level crossing; or

(iii) from a safety warning device fitted to a building as a requirement of the Building Code as defined in the *Building Regulations 2012* regulation 3; or

(iv) for the purpose of giving a warning required under the *Mines Safety and Inspection Regulations 1995* regulation 8.26,

if every reasonable and practicable measure has been taken to reduce the effect of the noise emission consistent with providing an audible warning to people;

(h) noise emissions from –

(i) a reversing alarm fitted to a motor vehicle, mobile plant, or mining or earthmoving equipment; or

(ii) a startup or movement alarm fitted to plant,

if

(iii) it is a requirement under another written law that such an alarm be fitted; and

(iv) it is not practicable to fit an alarm that complies with the written law under which it is required to be fitted and emits noise that complies with these Regulations;

(i) noise emissions from an engine, equipment, machinery or plant on a vessel while the vessel is in a port.

Port is defined in either the *Port Authorities Act 1999* section 3(1) or the *Shipping and Pilotage Act 1967* section 3.

It is considered that reversing alarms fitted to mobile plant e.g. dozers or loaders, are not exempt under the Regulations since they may not specifically be required under another written law. The commonly used fixed noise output tonal reversing alarms also known as 'reversing beeper' emit, by their very nature, tonal and modulating noise at high levels. As such, this type of reversing alarm can result in high level of annoyance and generally cannot comply with the Regulations even at distant receivers.

If deemed to be required, an alternative reversing alarm type should be considered. Such alternative, which can more readily comply with the Regulations, include alarms emitting a broadband signal in-lieu of a tonal 'beep' and which self-adjusts the output signal level based on ambient noise at the time.

4 METHODOLOGY

Computer modelling has been used to support the Project's environmental impact assessment. The advantage of modelling is that it is not affected by background noise sources and can provide the noise level for various weather conditions and operating scenarios if necessary.

The software used was *SoundPLAN 7.4* with the CONCAWE algorithms selected. These algorithms have been selected as they are one of the few that include the influence of wind and atmospheric stability. Input data required in the model are:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and,
- Source sound power levels.

4.1 Meteorological Information

Meteorological information utilised (*Table 4-1)* is based on that specified in the *draft EPA Guidance for the Assessment of Environmental Factors No.8 Environmental Noise* (the EPA Guidance). These conditions are considered the worst-case for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Table 4-1 Modelling Meteorological Conditions

Parameter	Night (1900-0700)	Day (0700-1900)
Temperature (^{o}C)	15	20
Humidity (%)	50	50
Wind Speed (m/s)	3	4
Wind Direction*	All	All
Pasquil Stability Factor	F	E

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

The EPA policy is that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

4.2 Topographical Data

Topographical data was based on that provided by Novo Resources. The selected contours are in 5 metres intervals and cover the Project area including noise sensitive premises of concern.

4.3 Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). In this instance, a value of 0.7 has been used as an average across the study area.

4.4 Proposed Mining Fleet

The mining fleet will nominally comprise the following:

- Mobile Crusher
- 85t Digger Hitachi ZX870LCH-3
- Dozers, Caterpillar D10T and D7R Series 2
- 40t Articulated Tip Trucks
- Grader Caterpillar 140H
- Loaders: Komatsu WA500-6, Caterpillar 966H and IT 930 tyre changer / forklift
- Excavator Caterpillar 336D feeding crusher
- Wheel Water Truck
- Mack Service Truck

4.5 Source Sound Levels

The sound power levels used in the modelling are provided in *Table 4-2*. These levels have been derived from past projects including other gold mining projects as well as sand mining operations in Western Australia.

Table 4-2 Source Sound Power Levels

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)
	31.5	63	125	250	500	1k	2k	4k	
85t Digger Hitachi ZX870	-	107	112	115	113	111	105	100	**115**
Dozer D10	-	115	114	111	112	108	105	99	**113**
40t articulated dump trucks (CAT 740 or similar)	-	103	105	102	102	103	101	96	**107**
Grader	105	112	110	107	109	107	106	101	**112**
Loader Komatsu WA500-6	109	122	107	107	104	105	102	96	**109**
Front-End Loader (CAT 966)	104	102	116	106	106	105	107	100	**112**
Dozer Caterpillar D7R series 2	125	112	111	108	110	103	101	99	**110**
Loader Caterpillar IT 930 tyre changer / forklift	109	122	107	107	104	105	102	96	**109**
Excavator Caterpillar 336D	-	102	114	104	104	106	102	99	**110**
Water truck (CAT 740 based)	-	103	105	102	102	103	101	96	**107**
Service Truck (nominal Lw)	-	103	105	102	102	103	101	96	**107**
Mobile Crusher	-	113	113	110	109	107	105	100	**112**

With regards to the above, please note the following:

- The acoustic centre for all sources was assumed to be 2 metres above local ground level;
- The sound power levels presented represent L_{10} levels for normal operating conditions of machinery and equipment;
- The articulated dump trucks, service truck and water truck were modelled as moving point sources travelling along a set route and at an average speed of 10 km/hr;
- For the purpose of predicting the noise levels from the articulated trucks, 10 trucks per hour were assumed to be dumping material on either waste dumps; and,
- All other sources were modelled as static point sources.

4.6 Mine Site Layout

The mine site layout used in this assessment is shown on *Figure 4-1.*

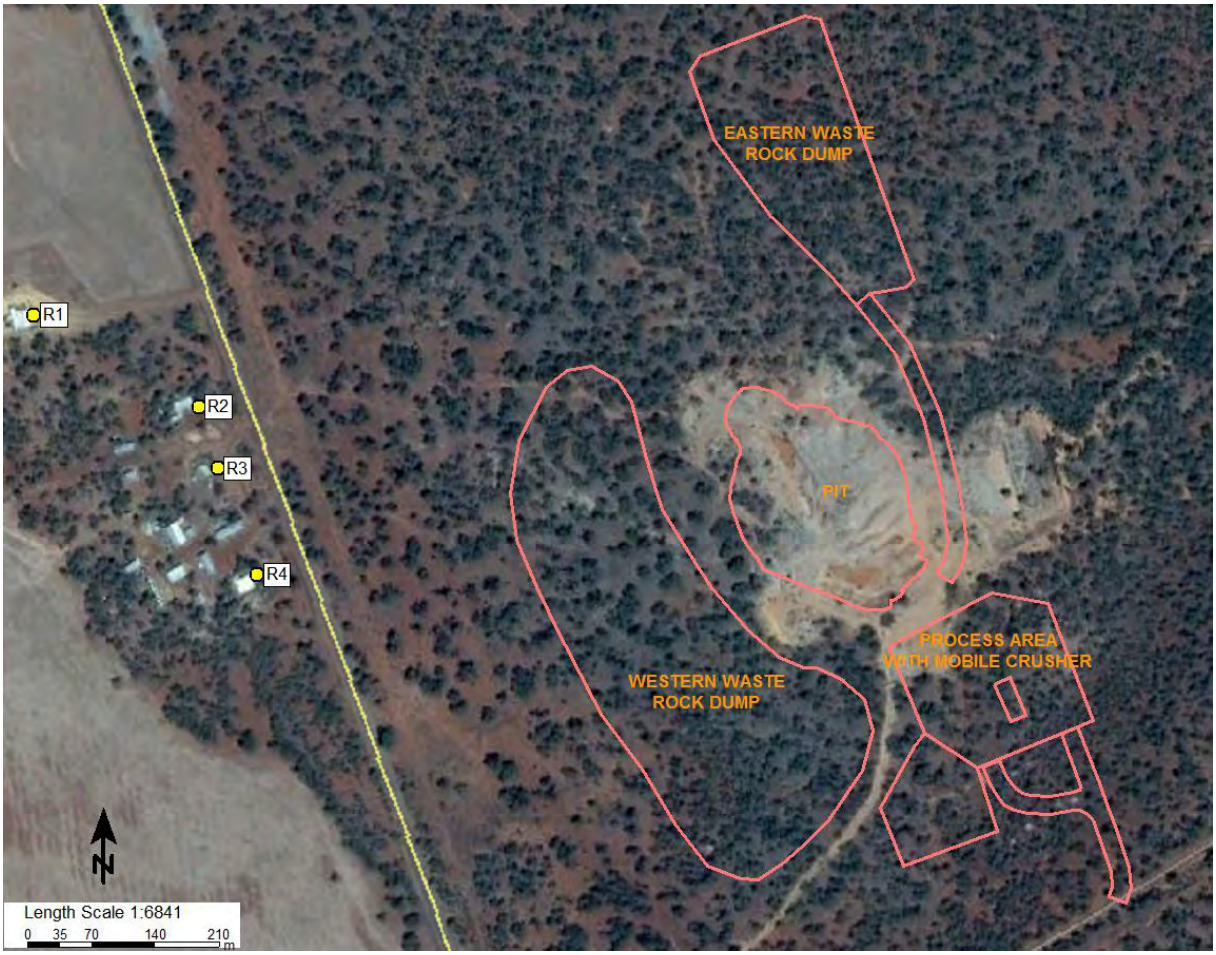


Figure 4-1 Mine Layout

5 RESULTS

This section provides the results of the noise predictions representing the overall noise emissions from proposal at the closest receivers for both the day time and night-time operations phases of the project. As the operation will significantly different between day and night shifts, two operational scenarios were modelled.

5.1 'Daytime Operations'

Daytime operations is to include drilling and blasting, excavation of material from pit, movement of waste rock to the western dump, crushing of ore and transport of ore off-site.

As a worst-case scenario, the following was modelled:

- All machinery and equipment were modelled as operating simultaneously;
- Start of mining where the pit depth is 2 metres below local ground. It is noted that the drill rig will not be used at the start of operations and therefore this source was excluded;
- Dump trucks dumping material on the western waste dump;
- No noise controls in place, that is, no noise bunds or engineering controls on equipment; and,
- Prevailing weather conditions are easterly winds.

Noise predictions were made for both daytime and night-time meteorological conditions (refer *Table 4-1*) since the shift hours are likely to be across both time periods as defined in the Regulations however, it is noted the differences in noise levels is not significant and therefore only the daytime noise levels are presented.

The results of the noise modelling are shown as noise level contour plots in *Figure 5-1* and summarised in *Table 5-1.*

Table 5-1 'Daytime Operations' Predicted Noise Levels

Receiver	Predicted Noise Levels, dB L_{A10}		
	Plant in Pit and Processing Area (including crusher)	Truck Movements to Western Waste Dump	Overall Noise Levels
R1	51	41	51
R2	55	45	55
R3	55	46	55
R4	55	47	56

Table 5-2 presents the individual noise levels from the most significant sources, excluding dump truck noise. The sources were also ranked from 'most significant contributor' to 'least significant contributor'. For example, it can be seen the dozer D7 dominates the overall noise emissions at all receivers with then the D10 dozer or 85t excavator being the second most significant noise source.

Table 5-2 'Daytime Operations' Source Ranking At Each Receiver

R1		R2		R3		R4	
Dozer D7	44.7	Dozer D7	48.9	Dozer D7	49.7	Dozer D7	50.6
Dozer D10T	44.3	Dozer D10T	47.1	Dozer D10T	47.4	85t Excavator	48.2
85t Excavator	43.2	85t Excavator	46.5	85t Excavator	47.2	Dozer D10T	47.7
Loader CAT966H	40.8	Loader CAT966H	44.5	Loader CAT966H	45.2	Loader CAT966H	45.7
Grader 140H	40.2	Grader 140H	42.6	Grader 140H	43	Grader 140H	43.6
Mobile Crusher	38	Mobile Crusher	40.4	Mobile Crusher	41.1	Mobile Crusher	42.4
40t Tip Truck in Pit	37	40t Tip Truck in Pit	39.9	40t Tip Truck in Pit	40.1	40t Tip Truck in Pit	40.7

IMD Goldmines - 'Daytime Operations' With No Noise Mitigation
Battler, Southern Cross

Figure 5-1

Signs and symbols
- Receiver
- Noise Sources
- Site Outline
- Dump Truck Route

N

24 March 2016

Length Scale 1:5248
0 30 60 120 180 m

Lloyd George Acoustics
by Olivier Mallié
olivier@lgacoustics.com.au
0439 987 455

5.2 'Night-time Operations'

Night-time operations will include only limited operations within the pit, no crushing and the movement of waste rock to the eastern dump.

As a worst-case scenario, the following was modelled:

- Selected machinery and equipment were modelled as operating simultaneously;
- Start of mining where the pit depth is 2 metres below local ground;
- Dump trucks dumping material on the eastern waste dump;
- No noise controls in place, that is, no noise bunds or engineering controls on equipment; and,
- Prevailing weather conditions are easterly winds with temperature inversion.

Noise predictions were made for night-time meteorological conditions (refer *Table 4-1*). The results of the noise modelling are shown as noise level contour plots in *Figure 5-2* and summarised in *Table 5-3.*

Table 5-4 presents the individual noise levels from the most significant sources, excluding dump truck noise. The sources were also ranked from 'most significant contributor' to 'least significant contributor'. For example, it can be seen the dozer D7 dominates the overall noise emissions at all receivers with then the D10 dozer or 85t excavator being the second most significant noise source.

Table 5-3 'Night-time Operations' Predicted Noise Levels

Receiver	Predicted Noise Levels, dB L_{A10}		
	Plant in Pit	Truck Movements to Eastern Waste Dump	Overall Noise Levels
R1	47	39	48
R2	50	41	50
R3	50	41	50
R4	51	41	51

Table 5-4 'Night-time Operations' Source Ranking At Each Receiver

R1		R2		R3		R4	
85t Excavator	43.5	85t Excavator	46.6	85t Excavator	47.1	85t Excavator	48.0
Dozer D7	41.2	Loader CAT966H	44.5	Loader CAT966H	45.3	Loader CAT966H	45.7
Loader CAT966H	40.8	Dozer D7	43.0	Dozer D7	42.7	Dozer D7	42.2

IMD Goldmines - 'Night-time Operations' With No Noise Mitigation
Battler, Southern Cross

Figure 5-2

Signs and symbols
- Receiver
- Noise Sources
- Site Outline
- Dump Truck Route

N

24 March 2016

Length Scale 1:4497
0 25 50 100 150 m

Lloyd George Acoustics
by Olivier Mallié
olivier@lgacoustics.com.au
0439 987 455

6 ASSESSMENT

It is noted the Regulations define time periods differently than the traditional 12 hours mining shift of 0600 to 1800 hours. For example, the first hour of a traditional dayshift, 0600 to 0700 hours Monday to Saturday, will be considered the night-time period under the Regulations and, as such, the lowest assigned noise level of 35 dB L_{A10} applies.

Similarly, it is noted Sunday and public holidays have a lower L_{A10} assigned noise levels compared to the Monday to Saturday daytime period, and, the daytime period is defined as starting at 0900 hours instead of 0700 hours. Therefore any work occurring on site before 0900 hours on Sundays or public holidays must comply with the night-time assigned levels.

Tables 6-1 and *6-2* present the assessment of the worst-case overall noise levels from the proposed 'daytime' and 'night-time' operations respectively at all four receivers against the Regulations. It is noted the time periods in the first column of the table correspond to those prescribed in the Regulations (refer *Table 3-2)*.

It is noted the Regulations require noise emissions to be free of annoying characteristics when assessed at the receiver. Given the nature of the equipment used and the relatively short distances between source and receiver, tonality is expected to be present and therefore the predicted noise levels were adjusted accordingly (refer *Table 3-1)*.

Based on *Tables 6-1* and *6-2*, it can be seen that under worst-case meteorological conditions the overall noise emissions from the site, that is mining, processing and dump truck movements noise combined, will exceed the assigned noise levels at all times.

Table 6-1 Assessment of 'Daytime Operations' Noise Levels

Time Periods	Assigned Noise Level[1]	Predicted Noise Level[2]	Assessable Noise Levels	Calculated Exceedance
Receiver R1				
0700-1900 Monday to Saturday	45 dB L_{A10}	51 dB L_{A10}	56 dB L_{A10}	11 dB
0900-1900 Sundays and public holidays	40 dB L_{A10}	51 dB L_{A10}	56 dB L_{A10}	16 dB
1900-2200 Any Days	40 dB L_{A10}	51 dB L_{A10}	56 dB L_{A10}	16 dB
0600-0700 Monday to Saturday	35 dB L_{A10}	51 dB L_{A10}	56 dB L_{A10}	21 dB
0700-0900 Sundays and public holidays	35 dB L_{A10}	51 dB L_{A10}	56 dB L_{A10}	21 dB
Receiver R2 and R3				
0700-1900 Monday to Saturday	45 dB L_{A10}	55 dB L_{A10}	60 dB L_{A10}	15 dB
0900-1900 Sundays and public holidays	40 dB L_{A10}	55 dB L_{A10}	60 dB L_{A10}	20 dB
1900-2200 Any Days	40 dB L_{A10}	55 dB L_{A10}	60 dB L_{A10}	20 dB
0600-0700 Monday to Saturday	35 dB L_{A10}	55 dB L_{A10}	60 dB L_{A10}	25 dB
0700-0900 Sundays and public holidays	35 dB L_{A10}	55 dB L_{A10}	60 dB L_{A10}	25 dB
Receiver R4				
0700-1900 Monday to Saturday	45 dB L_{A10}	56 dB L_{A10}	61 dB L_{A10}	16 dB
0900-1900 Sundays and public holidays	40 dB L_{A10}	56 dB L_{A10}	61 dB L_{A10}	21 dB
1900-2200 Any Days	40 dB L_{A10}	56 dB L_{A10}	61 dB L_{A10}	21 dB
0600-0700 Monday to Saturday	35 dB L_{A10}	56 dB L_{A10}	61 dB L_{A10}	26 dB
0700-0900 Sundays and public holidays	35 dB L_{A10}	56 dB L_{A10}	61 dB L_{A10}	26 dB

Notes:

1. The assigned noise level is as defined in *Table 3-4*.
2. From *Tables 5-1* and *5-2* rounded to the nearest dB.

Table 6-2 Assessment of 'Night-time Operations' Noise Levels

Time Periods	Assigned Noise Level[1]	Predicted Noise Level[2]	Assessable Noise Levels	Calculated Exceedance
Receiver R1				
1900-2200 Any Days	40 dB L_{A10}	48 dB L_{A10}	53 dB L_{A10}	13 dB
2200-0700 Monday to Saturday	35 dB L_{A10}	48 dB L_{A10}	53 dB L_{A10}	18 dB
2200-0900 Sundays and public holidays	35 dB L_{A10}	48 dB L_{A10}	53 dB L_{A10}	18 dB
Receiver R2 and R3				
1900-2200 Any Days	40 dB L_{A10}	50 dB L_{A10}	55 dB L_{A10}	15 dB
2200-0700 Monday to Saturday	35 dB L_{A10}	50 dB L_{A10}	55 dB L_{A10}	20 dB
2200-0900 Sundays and public holidays	35 dB L_{A10}	50 dB L_{A10}	55 dB L_{A10}	20 dB
Receiver R4				
1900-2200 Any Days	40 dB L_{A10}	51 dB L_{A10}	56 dB L_{A10}	16 dB
2200-0700 Monday to Saturday	35 dB L_{A10}	51 dB L_{A10}	56 dB L_{A10}	21 dB
2200-0900 Sundays and public holidays	35 dB L_{A10}	51 dB L_{A10}	56 dB L_{A10}	21 dB

Notes:

1. The assigned noise level is as defined in *Table 3-4*.
2. From *Tables 5-1* and *5-2* rounded to the nearest dB.

7 NOISE MITIGATION MEASURES

This section describes the noise mitigation measures investigated in order to mitigate noise from the overall noise emissions from the site to comply with the Regulations at all times.

7.1 'Daytime Operations'

In order to comply with the daytime assigned noise level of 45 dB L_{A10}, an overall noise reduction of 11 to 16 dB is required. From the model predictions (refer *Table 5-1)* it is noted that dump truck movements to the western dump can significantly contribute to the overall noise levels, and would not comply with the Regulations should they be considered in isolation. Therefore noise control measures to mitigate both the equipment operating in the pit and processing plant, and the truck movements are required. Several noise mitigation options are presented below.

7.1.1 Option 1 - Engineering Noise Controls

Engineering noise controls generally include the modification or upgrade of plant and equipment to reduce their overall noise levels and, where practicable, remove any tonal characteristics. Therefore with engineering noise controls in place, it is expected that tonality will not be present at the receivers.

Based on the predicted noise levels at receiver R4 and presented in *Table 5-1,* the above means that the noise levels from all plant and equipment, including the dump trucks, would need to be reduced by at least 11 dB.

While this level of reduction may be achievable, it would require extensive engineering modifications or upgrades of various parts on the entire mining fleet e.g. exhaust mufflers, engine fan noise treatments, engine casing, rolling elements (tracks), etc. Given the operational life of the mine is only 10 months, such treatments were not considered practicable.

7.1.2 Option 2 - Noise Bunds

Noise bunds were investigated to minimise the noise emissions from plant in the pit, the process area and the dump trucks on site.

A 15 to 20 metres high noise bund (top of bund at RL 405) around the pit at the location of the western waste dump (location and extent shown on *Figure 7-1*) would reduce the overall noise levels at all the receivers by 9 to 11 dB. If tonality is considered to be present, this would still result in exceedances of the daytime 45 dB L_{A10} assigned noise levels of 2 to 5 dB under worst-case meteorological conditions. Therefore further noise controls are required.

While the bund mitigates the noise levels from the dump trucks and equipment in the pit, it is then the mobile plant operating in the crushing area that dominates the noise emissions. The following additional noise controls are therefore required:

- Do not use the Grader 140H under easterly winds or limit its use to less than 24 minutes in any 4 hours period; and,
- Mitigate the noise levels of the Excavator 336D and Loader WA500 by 10 dB.

The 10 dB reduction in noise levels for the excavator and loader may be achieved by retro-fitting engineering noise controls to the equipment such as exhaust silencers and engine cooling fan treatments.

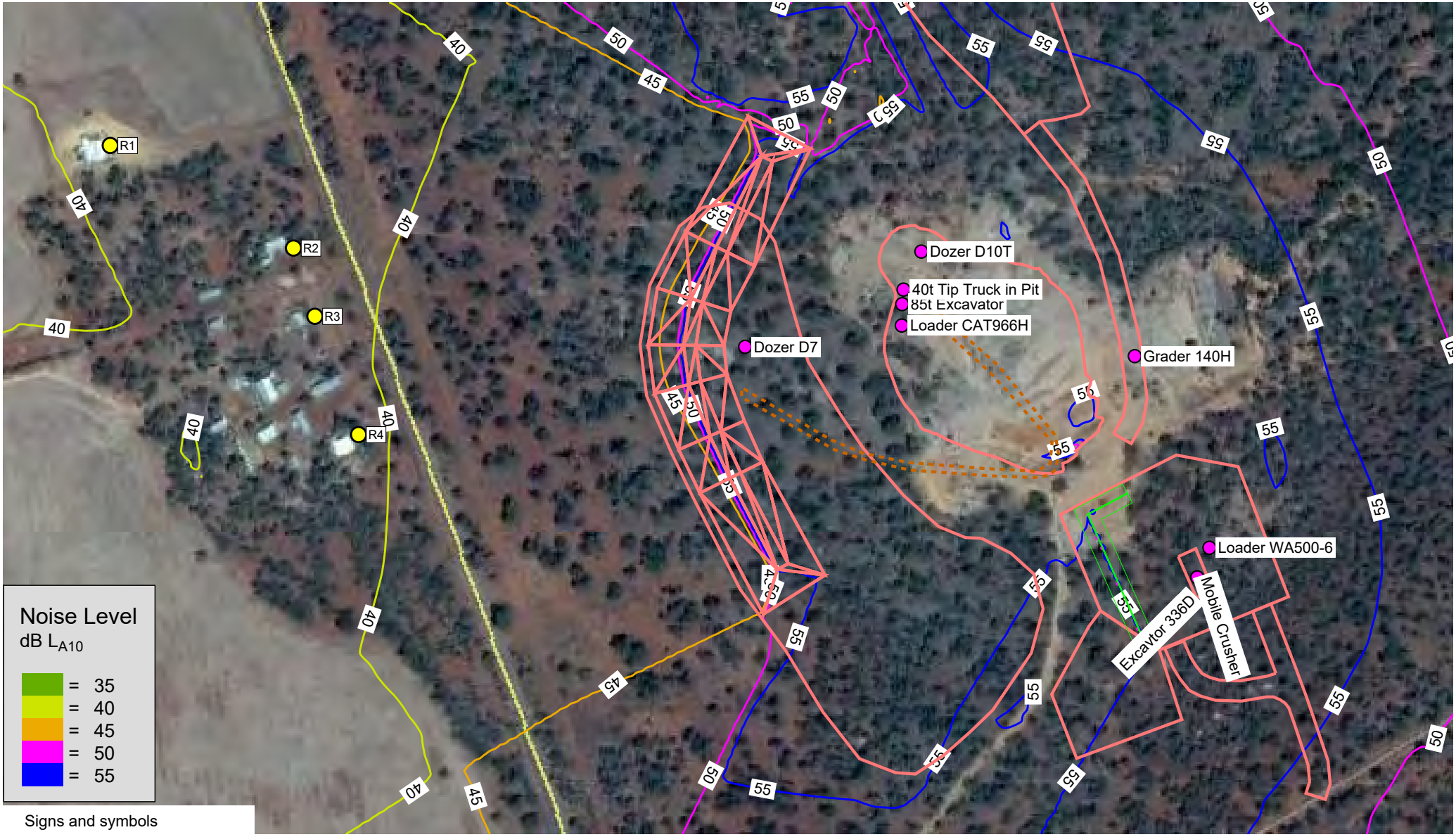
Alternatively to the above, a 10 metres high bund (top of bund at RL 410) could be built around the process plant area.

The mitigated noise levels for 'daytime operations' with noise bunds are shown on *Figure 7-2*.

Figure 7-1 Location and Extent of Bunds

IMD Goldmines - 'Daytime Operations' With Noise Mitigation
Battler, Southern Cross

Figure 7-2



Lloyd George Acoustics
by Olivier Mallié
olivier@lgacoustics.com.au
0439 987 455

7.2 'Night-time Operations'

In order to comply with the night-time assigned noise level of 35 dB L_{A10}, an overall noise reduction of 16 to 21 dB is required. From the model predictions (refer *Table 5-2)* it is noted that dump truck movements to the eastern dump can significantly contribute to the overall noise levels, and would not comply with the Regulations should they be considered in isolation. Therefore noise control measures to mitigate both the equipment operating in the pit and the truck movements are required. Several noise mitigation options are presented below.

7.2.1 Option 1 - Engineering Noise Controls

Similarly to the discussion in *Section 7.1.1*, engineering noise controls could be implemented to reduce overall noise levels and, where practicable, remove any tonal characteristics.

Based on the predicted noise levels at receiver R4 and presented in *Table 5-2,* the above means that the noise levels from all plant and equipment, including the dump trucks, would need to be reduced by at least 16 dB.

This level of reduction is unlikely to be achievable and would require extensive engineering modifications or upgrades of various parts on the entire mining fleet e.g. exhaust mufflers, engine fan noise treatments, engine casing, rolling elements (tracks), etc. Such option was therefore not considered practicable.

7.2.2 Option 2 - Noise Bunds

In determining the requirements for noise controls for the 'night-time operations', it was assumed the 15 to 20 metres high noise bund described in *Section 7.1.1* will already be in place.

A 5 to 15 metres high noise bund (top of bund at RL 395) located just west of the eastern waste dump (location and extent shown on *Figure 7-2*) would reduce the noise levels from the dump trucks going to the eastern bund by 3 to 12 dB. However, the noise levels from the limited equipment operating in the pit then also significantly contribute to the overall noise levels at each receiver.

If tonality is considered to be present, this would still result in exceedances of the night-time 35 dB L_{A10} assigned noise levels of 6 to 8 dB under worst-case meteorological conditions. Therefore further noise controls are required however, given the nature of the operation and its proximity to the receivers, the additional noise reduction required may be hard to achieve. Additional noise controls could include:

- Optimise the design of the noise bund adjacent to the eastern bund to maximise noise barrier effects to trucks travelling to the eastern dump; and,
- Ensure the eastern dump area is flatten to lowest practicable grade to ensure trucks are always below the top of the bund; and,
- Restricting the working area of the plant within the pit to ensure plant operates in location(s) which maximise the noise barrier effects from the noise bund on the western side. It is noted such requirement would only apply until such time the pit is deep enough, at which point the edges of the pit also act as a significant noise barrier.

7.3 Daytime Compliance on Sundays and Public Holidays

For 'daytime operations' occurring between 0900 and 1900 on Sundays and public holidays to comply with the daytime assigned noise level of 40 dB(A) L_{A10} at the receivers, a further reduction of 5 dB in the overall noise levels is required. To achieve such reduction would likely require higher noise bunds as well as engineering noise controls to some of the mining fleet, in particular the equipment operating in the processing area.

Should 'night-time' operations be also scheduled to occur between these hours, a further 1 to 2 dB reduction in the overall noise levels would be required. This level of reduction is practicable and could be achieved by optimising the eastern bund and the truck route to the dump.

7.4 Noise Control At The Receiver

While the assigned levels of the Regulations apply outside the receiving premises, it may be possible to acoustically treat each affected residence in order to achieve acceptable indoor noise levels in various spaces such as bedrooms and living areas. Depending on the nature of the existing properties and given the predicted external noise levels, architectural treatments to each house is likely to involve glazing improvement including window frame replacement, ceiling/roof construction upgrade, acoustic treatments to the eaves and provision of, or upgrade to, air conditioning system.

Acceptable indoor noise levels could be determined based on the guidance provided in Australian Standard AS 2107.

7.5 Noise-Sensitive Receiver Relocation

The assessment presented above is based on the assumption that all four receivers identified are occupied residences, and therefore considered as noise-sensitive premises under the Regulations. Should these residences become un-occupied for the whole, or part(s) of, the duration of the operations at the project site, the premises could then be considered to be either commercial or industrial premises under the Regulations. The applicable assigned noise levels are 60 and 65 dB L_{A10} respectively.

Based on the predicted noise levels at receiver R4 of 56 dB L_{A10}, and assuming the noise emissions are tonal, the overall noise emissions from the site would:

- Comply with the Regulations if the premises are considered industrial, where 65 dB L_{A10} applies; and,
- Result in a marginal exceedance of 1 dB if the premises are considered commercial, where 60 dB L_{A10} applies.

8 CONCLUSIONS

The Battler gold mine is located approximately 14 kilometres (km) south-southeast of Southern Cross and 22 km north-northwest of Marvel Loch, Western Australia. An assessment of the overall noise emissions from the proposal were assessed against the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Based on the assessment of the proposed 'daytime operations' and 'night-time operations', it is concluded that:

- The 'daytime operations' can comply with the Regulations during the daytime period of 0700 to 1900 hours Monday to Saturday provided that noise bunds are built as described in *Section 7.1.2*.
- For the 'daytime operations' to comply with the Regulations during the daytime period of 0900 to 1900 hours on Sundays and public holidays Monday will require additional noise mitigation measures in the form of higher noise bunds and engineering noise controls to some of the mining fleet.
- For the 'night-time operations' to comply with the Regulations during the night-time period (from 2200 to 0700 on a Monday to Saturday, and 0900 on a Sunday or public holiday), the following noise mitigation measures would be required in addition to the western dump earth bund;
    - Increase the length of the proposed noise bund adjacent to the truck route to the eastern dump to include as much of the truck route length as practicable; and,
    - Apply engineering noise controls to some equipment working in the pit; or,
    - Designate a specific work area within the pit the plant can be operated in to maximise noise barrier effects from the western noise bund. This requirement would only apply until such time the pit is deep enough so that the edges of the pit also act as a significant noise barrier.

It is further noted this assessment is based on the assumption that all four receivers identified are occupied residences, and therefore considered as noise-sensitive premises under the Regulations. It is understood the proponent is seeking agreement with the affected residents which could result in these residences to become un-occupied for the whole, or part(s) of, the duration of the operations at the project site. If this was the case, the affected premises could then considered to be either commercial or industrial premises under the Regulations with an applicable assigned noise levels of 60 and 65 dB L_{A10} at all times (day and night). Based on the predicted noise levels the overall noise emissions from the site would:

- Comply with the Regulations if the premises are considered industrial, where 65 dB L_{A10} applies; and,
- Result in a marginal exceedance of 1 dB if the premises are considered commercial, where 60 dB L_{A10} applies.

Appendix A

Preliminary Mining Schedule

	Tonnes				BCM			
Month	ore	g/t	waste	total	ore	waste	total	mRl
-1					Clearing & topsoil			
1	-		444,600	444,600	-	222,300	222,300	385.0
2	201	3.13	447,358	447,559	244	222,056	222,300	380.0
3	1,226	4.83	427,270	428,496	2,647	204,833	207,480	375.0
4	4,397	5.4	449,334	453,731	9,306	198,174	207,480	367.5
5	10,746	3.96	421,517	432,263	13,477	174,243	187,720	360.0
6	20,145	4.04	396,697	416,842	17,921	154,979	172,900	350.0
7	21,739	3.6	274,177	295,916	16,800	101,760	118,560	340.0
8	18,506	3.31	135,194	153,700	11,249	49,551	60,800	332.5
9	24,099	3.45	122,140	146,239	14,667	42,333	57,000	325.0
10	37,222	3.29	63,924	101,146	18,323	19,677	38,000	312.5
11	11,422	4.39	4,533	15,954	5,148	712	5,860	305.0
12					Closure works			
Total	149,704	3.67	3,186,742	3,336,446	109,781	1,390,619	1,500,400	

Appendix B

Background Noise Monitoring

Noise Impact Assessment

Ambient Noise Measurements

Southern Cross Gold
Parker Range Battler Deposit

Prepared For

Southern Cross Gold

May 2010

Reference: 11021791-01

LLOYD GEORGE Acoustics

Report: 11021791-01

Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

PO Box 717
Hillarys WA 6923

Offices:	Ocean Reef	Padbury	Scarborough	Waterford
Phone:	9300 4188	9401 7770	9245 3223	9313 3655
Fax:	9300 4199	9401 7770	9300 4199	9300 4199
Email:	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	mike@lgacoustics.com.au	rebecca@lgacoustics.com.au
Mobile:	0439 032 844	0400 414 197	0438 201 071	0427 388 876

Member of the Association of Australian Acoustical Consultants – (AAAC)

Approved for Issue:	Daniel Lloyd 
Position:	Project Director
Verified	Terry George 
Date:	18 May 2011

CONTENTS

APPENDICES

1 INTRODUCTION

As part of the environmental impact assessment for the Southern Cross Gold, Parker Range Battler Deposit, the existing ambient noise levels at two locations close to the proposed project area were measured.

The purpose of these measurements is to provide baseline noise levels in the surrounding area of the proposal. Once the noise levels of the mining operations are predicted, these will be compared to the baseline noise level results to:

- allow the impact of noise level increases over low ambient noise levels to be assessed/determined;
- allow the likelihood of noise exceedances resulting from the combination of the ambient noise with that of the proposal to be assessed/determined; and
- enable assessment of the likely audibility of any tonal, modulation or impulsive components in the noise from the proposal to be assessed/determined.

Measurements and analysis were conducted in accordance with the *Environmental Protection Authority: Guidance for the Assessment of Environmental Factors - Draft Guidance No. 8: Guidance for Environmental Noise* (Guidance No. 8).

Appendix A contains a description of some of the terminology used throughout this report.

2 MEASUREMENT PROCEDURE

Ambient noise measurements were carried out between the 15 and 28 April 2011. These dates did not include any activity related to the proposal.

The measurements were conducted outdoors with the microphone at least 3 metres from any reflecting surface other than the ground, and at a height of at least 1.2 metres above the ground.

The noise levels were logged continuously over a period of two weeks, which included two weekends, using sample periods of 15 minutes' duration. Measurements were conducted in accordance with Clause 5 of Australian Standard 1055.1-1990 (Standards Australia, 1990).

The measurement locations, detailed below and shown graphically in *Figure 2.1,* were chosen to represent the various conditions (road/bush) within the project area.

- Location 1 Unkovich Farm - Forrestania Southern Cross Road;
- Location 2 East of proposed extraction area.

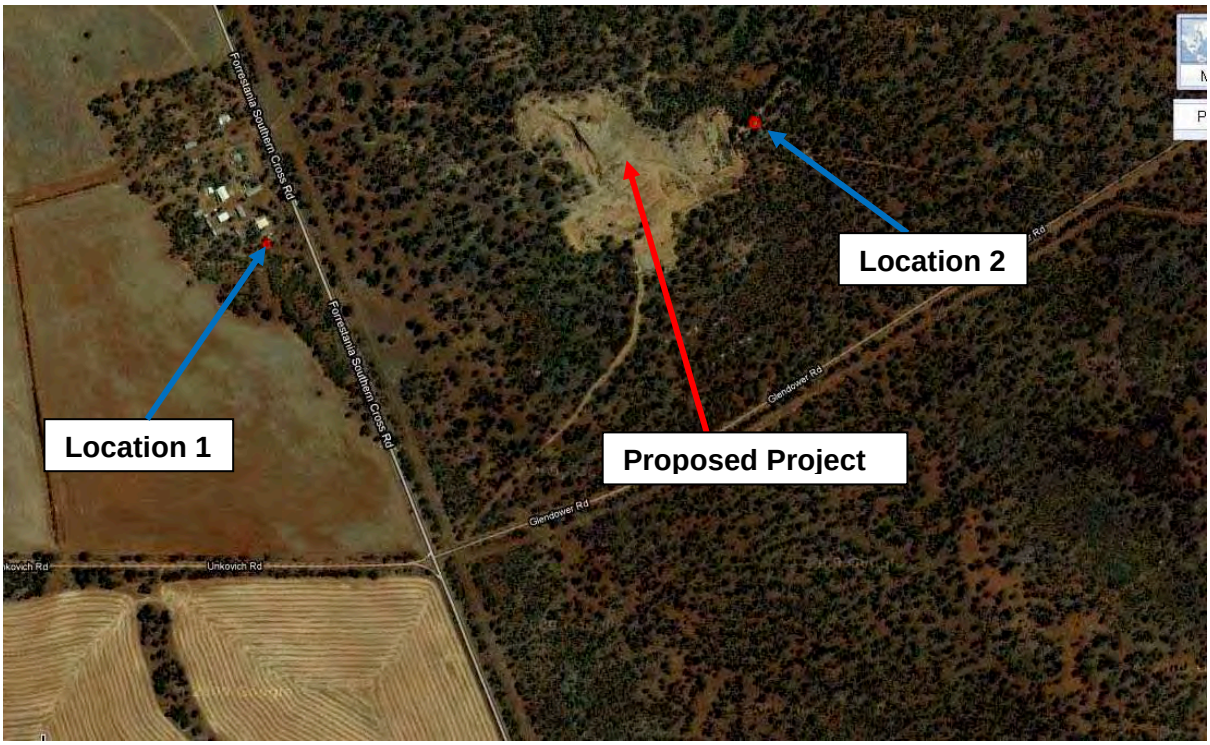


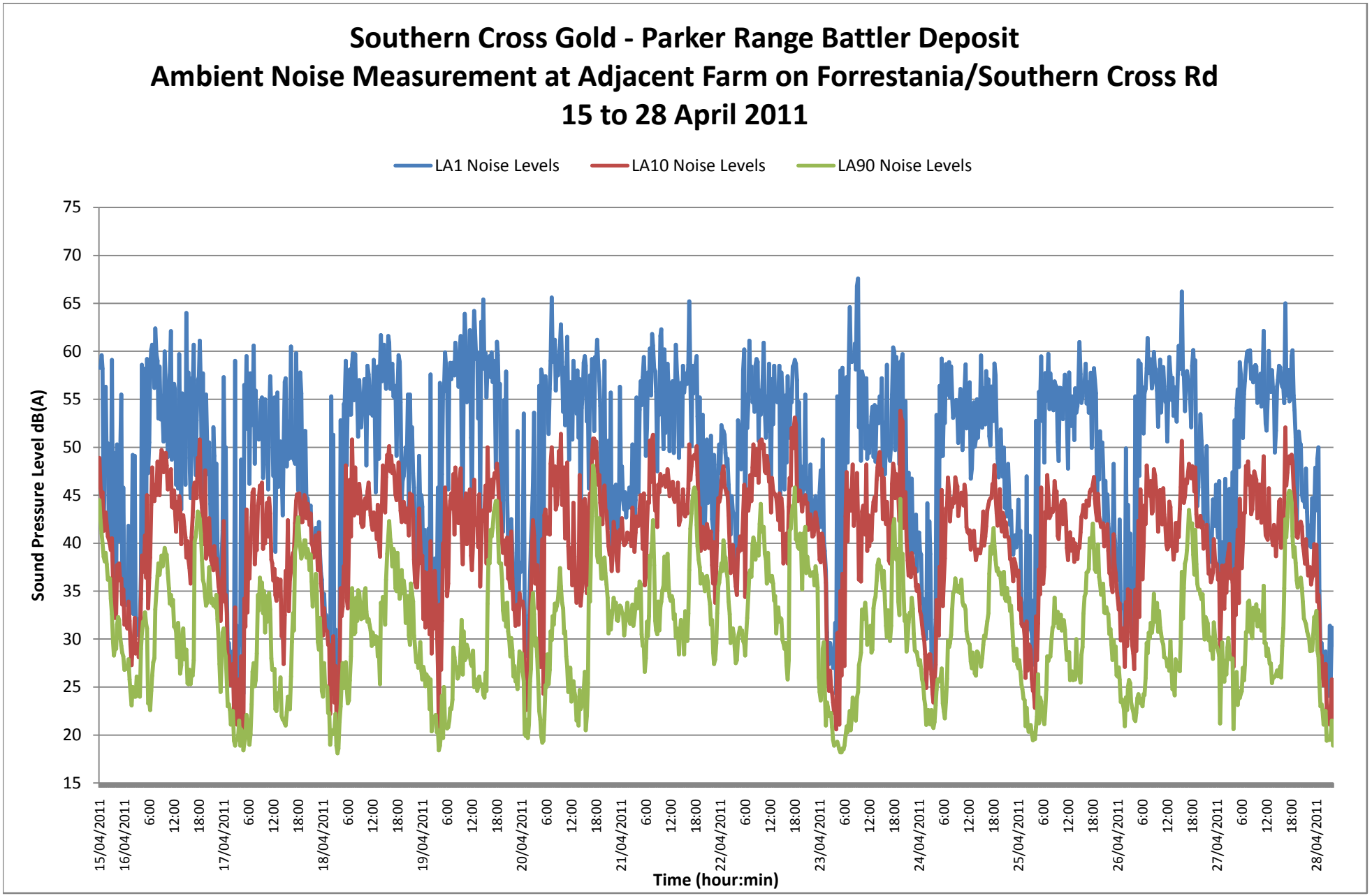
Figure 2.1 Noise Monitoring Locations

3 RESULTS

The noise level data, presented graphically in *Figures 3.1 and 3.2,* shows the L_{A1}, L_{A10} and L_{A90} noise levels.

As described in *Appendix A*:

- An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured;
- An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level; and
- An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.


Southern Cross Gold - Parker Range Battler Deposit
Ambient Noise Measurement at Adjacent Farm on Forrestania/Southern Cross Rd
15 to 28 April 2011
LA1 Noise Levels
LA10 Noise Levels
LA90 Noise Levels
Sound Pressure Level dB(A)
75
70
65
60
55
50
45
40
35
30
25
20
15
15/04/2011
16/04/2011
17/04/2011
18/04/2011
19/04/2011
20/04/2011
21/04/2011
22/04/2011
23/04/2011
24/04/2011
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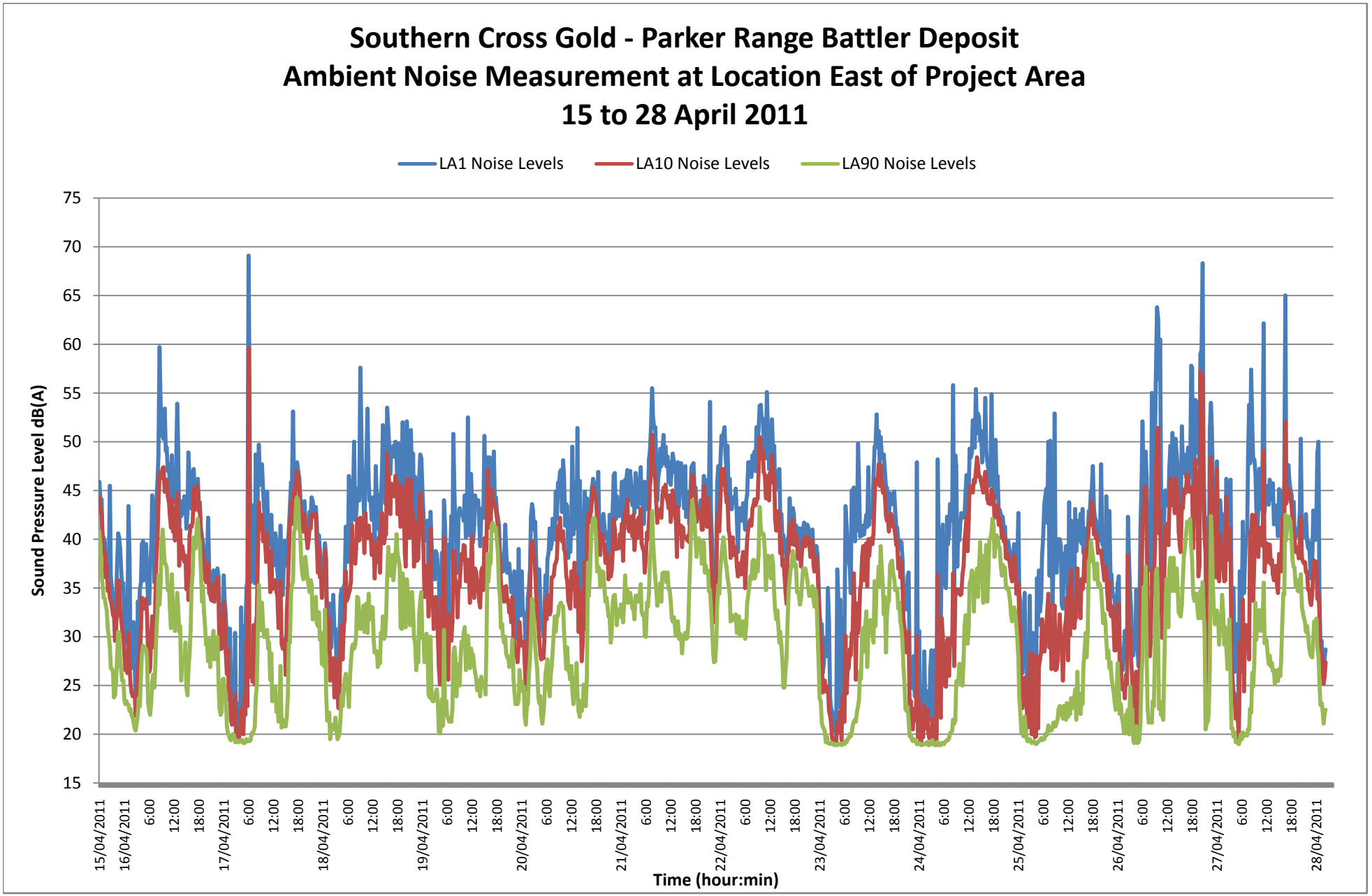
26/04/2011
27/04/2011
28/04/2011
6:00
12:00
18:00
Time (hour:min)


Southern Cross Gold - Parker Range Battler Deposit
Ambient Noise Measurement at Location East of Project Area
15 to 28 April 2011
LA1 Noise Levels
LA10 Noise Levels
LA90 Noise Levels
Sound Pressure Level dB(A)
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50
45
40
35
30
25
20
15
15/04/2011
16/04/2011
17/04/2011
18/04/2011
19/04/2011
20/04/2011
21/04/2011
22/04/2011
23/04/2011
24/04/2011
25/04/2011
26/04/2011
27/04/2011
28/04/2011
6:00
12:00
18:00
Time (hour:min)

As required under Guidance No. 8, background noise levels have been determined by extracting from the full data the "L_{90}" of the L_{A90} noise levels. This is used to determine whether the noise from the project is likely to be audible over the background noise level at a particular receiver location during a particular time period. From analysis of the results the following "L_{90}" of the L_{A90} noise levels have been determined:

Location 1 Unkovich Farm - Forrestania Southern Cross Road

- 0700-1900 hours Monday to Saturday = L_{A90} 26 dB
- 1900-2200 hours Monday to Saturday and 0900-2200 hours on Sundays and public holidays = L_{A90} 32 dB
- 2200-0700 hours Monday to Saturday and 2200-0900 hours on Sundays and public holidays = L_{A90} 22 dB

Location 2 East of proposed extraction area

- 0700-1900 hours Monday to Saturday = L_{A90} 24 dB
- 1900-2200 hours Monday to Saturday and 0900-2200 hours on Sundays and public holidays = L_{A90} 29 dB
- 2200-0700 hours Monday to Saturday and 2200-0900 hours on Sundays and public holidays = L_{A90} 22 dB

The weather observations made by the Bureau of Meteorology Southern Cross station for the measurement period is provided below in *Table 3.1*.

Table 3.1 Weather Observations from the BOM Southern Cross Office

Date	Day	Temps		Rain	9:00 AM				3:00 PM			
		Min	Max		Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
		°C	°C	mm	°C	%		km/h	°C	%		km/h
15	Fr	11.9	27.2	0	19.4	52	NE	24	26.5	28	NE	17
16	Sa	13.1	29.6	0	19.6	51	NNE	33	28.9	24	N	15
17	Su	11.8	32.1	0	22.4	32	N	22	31.3	16	WSW	11
18	Mo	17.6	26	0	19.6	71	SSE	28	25	46	SSE	28
19	Tu	14.5	24	3.6	15.2	97	SE	19	23.2	56	ESE	13
20	We	12.7	26.1	0	15.3	89	E	17	25.4	42	E	11
21	Th	13.9	27.3	0	18.8	56	E	22	26.5	37	ESE	19
22	Fr	14.5	30.8	0	20.5	43	NE	28	30	26	NNE	22
23	Sa	12.9	34.4	0	23.1	37	N	9	33.6	11	NW	26
24	Su	12.1	32.4	0	23.3	36	NNW	11	31.5	23	WNW	24
25	Mo	14.2	29.8	0	20.3	64	SSW	2	29.5	32	NNW	15
26	Tu	16	27.7	2.6	17.5	86	NW	13	27.1	35	NNE	24
27	We	16.2	24.2	5.8	18.3	89	NW	20	22.9	42	WNW	31
28	Th	10.9	19.8	0	14.7	54	SW	19	19.1	31	W	17

4 DISCUSSION

It can be seen that the noise levels vary throughout the day and are influenced by such things as wind in trees, local noise sources (noise from general activities), birds and road traffic. As expected the short-term measurements (L_{A1} and L_{A10}) are influenced by local noise sources much more than the background (L_{A90}) levels.

The most important measurements for this assessment are the background levels (L_{A90}) and these can be seen to vary by approximately 20 to 25 dB during a 24-hour period. The lowest background levels (the "L_{90}" of the L_{A90} noise levels) occur during the night-time period of 2200-0700 and are fairly consistent at both locations at approximately L_{A90} 22 dB. Daytime levels range from L_{A90} 21 to 32 dB and evening from L_{A90} 20 to 37 dB. The higher background levels during the evening is likely to be the result of bird noise.

These results indicate that background noise levels in the area are relatively low, which is consistent with the rural setting. As such, if noise originating from the Battler site exhibits tonal characteristics, which is common for the type of operation proposed, these characteristics would be readily discernible at the nearest noise sensitive receptors (residences at the Unkovich farm).

To ensure compliance with the Environmental Protection (Noise) Regulations 1997, the following noise limits would apply:

- 0700-1900 hours Monday to Saturday = L_{A10} 40 dB[1];
- 1900-2200 hours Monday to Saturday and 0900-2200 hours on Sundays and public holidays = L_{A10} 35 dB[2]; and
- 2200-0700 hours Monday to Saturday and 2200-0900 hours on Sundays and public holidays = L_{A10} 30 dB[3].

Once anticipated noise associated with the proposed mining operation has been predicted, the management measures required to ensure achievement of these limits at the nearby residences will need to be established.

[1] Under the Regulations, a day-time level of L_{A10} 45 dB is allowed, however a 5 dB penalty may be applied if the noise is found to exhibit tonal noise characteristics (see Appendix A).

[2] Under the Regulations, an evening level of L_{A10} 40 dB is allowed, however a 5 dB penalty may be applied if the noise is found to exhibit tonal noise characteristics (see Appendix A).

[3] Under the Regulations, a night-time level of L_{A10} 35 dB is allowed, however a 5 dB penalty may be applied if the noise is found to exhibit tonal noise characteristics (see Appendix A).

APPENDIX A

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)

The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Pressure Level (L_p)

The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}

This is the noise level in decibels, obtained using the A frequency weighting and the S time weighting as specified in AS1259.1-1990. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{Amax}

An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}

An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}

An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}

The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}

An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

Background Noise

Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise

Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise

Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

Tonal Noise

A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between —

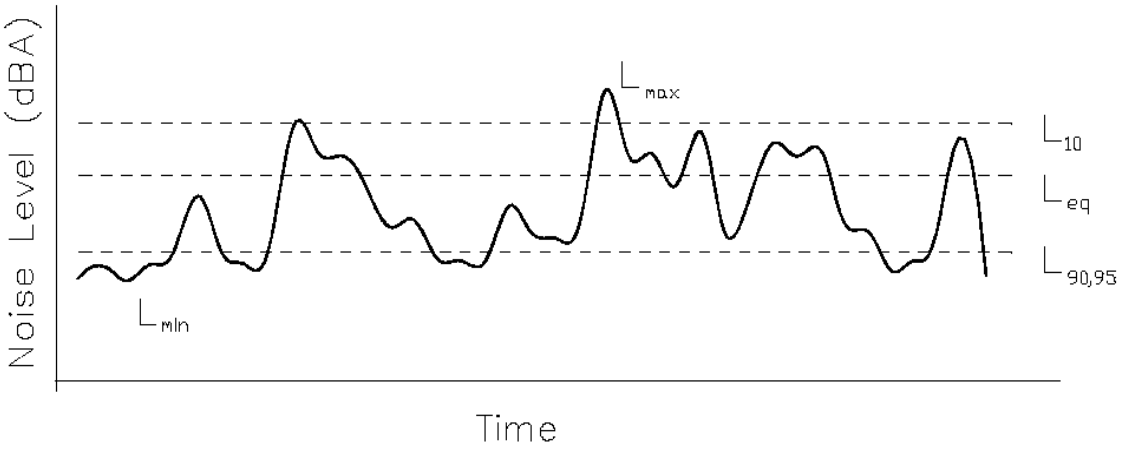
(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

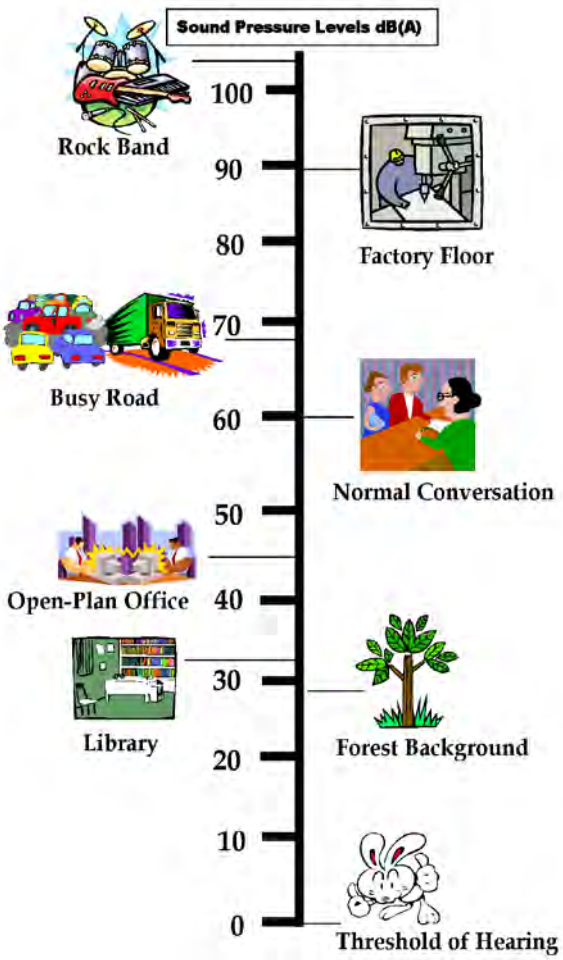
is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Chart of Noise Level Descriptors



Typical Noise Levels



Appendix C

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)
Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)
The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}
This is the noise level in decibels, obtained using the A frequency weighting and the S time weighting as specified in AS1259.1-1990. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}
This is the noise level in decibels, obtained using the A frequency weighting and the F time weighting as specified in AS1259.1-1990. This is used when assessing the presence of modulation only.

L_{APeak}
This is the maximum reading in decibels using the A frequency weighting and P time weighting AS1259.1-1990.

L_{Amax}
An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}
An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}
An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise
An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road
Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road
Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}) + \frac{1}{20}(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450})$$

where :

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a100m radius of the premises receiving the noise

$\%\text{TypeA}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a100m radius of the premises receiving the noise

$\%\text{TypeB}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period
Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise
Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise
Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise
Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

Peak Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

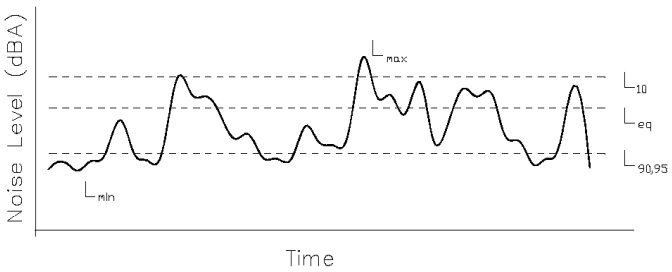
RMS Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Chart of Noise Level Descriptors



Typical Noise Levels