Appendix D Noise Impact Assessment

Newman Quarrying Pty Ltd

Noise Impact Assessment

Proposed Quarry Expansion at Lot 2 DP 1055044, Tullymorgan-Jackybulbin Road, Mororo

April 2015

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Glossary

Term	Description
dB	Decibel, which is 10 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a unit of sound.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels.
INP	Industrial Noise Policy
$L_{Aeq\ (period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. This is the level used for assessment purposes. The NSW INP states that where the measured RBL is less than 30 dB(A), the RBL is considered to be 30 dB(A).
$L_{A1\ (period)}$	The sound pressure level that is exceeded for 1% of the measurement period.
$L_{A10\ (period)}$	The sound pressure level that is exceeded for 10% of the measurement period.
$L_{A90\ (period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
L_{Amax}	The maximum sound level recorded during the measurement period.
L_{Amin}	The minimum sound level recorded during the measurement period.
Mitigation	Reduction in severity.
Peak Particle Velocity	Current practice for assessments of the risk of structural damage to buildings use measurements of Peak Particle Velocity (PPV) ground vibration (v_p), which is the maximum vector sum of three orthogonal time-synchronized velocity components. When not directly measured by an instrument, PPV may be determined by: $v_p = \sqrt{(v_x^2 + v_y^2 + v_z^2)}$ Where v_x, v_y, v_z are the instantaneous components of particle velocity of the x, y, z primary axes, respectively.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. This is the level used for assessment purposes.
Receiver	A noise modelling term used to describe a map reference point where noise is predicted. A sensitive receiver would be a home, work place, church, school or other place where people spend time.
RNP	Road Noise Policy
Sound Pressure Level (SPL)	Sound pressure level 20 times the logarithm to the base 10 of the ratio of the root mean square (RMS) sound pressure level to the reference sound pressure level of 20 micropascals.
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).

1. Introduction

1.1 Purpose of this report

GHD Pty Ltd (GHD) was engaged by Newman Quarrying Pty Ltd (Newman Quarrying) to prepare a Noise Impact Assessment (NIA) report to address the potential noise impacts from the proposed expansion of a sandstone quarry at Lot 2 DP 1055044, Tullymorgan-Jackybulbin Road, Mororo, known as Slys Quarry.

The proposal involves the expansion of the existing sandstone quarry by 11.1 hectares and an increase in the extraction rate up to 500,000 tonnes per annum. The primary purpose of the quarry would be to supply substantial quantities of quarry materials required for current and proposed Pacific Highway works, and for supply to Clarence Valley Council (CVC) and local contractors.

It is estimated that the quarry would have an available resource of about 7 million tonnes which would allow extraction for a period of between 30 and 40 years, depending on demand.

1.2 Scope

The scope of work to conduct the Noise Impact Assessment involved:

- A review of the surrounding study area to gain an understanding of local site features and the location and nature of potential sensitive receivers.
- A review of existing environmental studies, as applicable.
- Undertaking noise monitoring at two noise sensitive receiver locations indicative of the local ambient noise environment.
- Establishing project specific noise and vibration goals for the proposal with consideration to the following New South Wales (NSW) Office of Environment and Heritage (OEH) publications:
  - Industrial Noise Policy (OEH, 2000) (INP).
  - Road Noise Policy (OEH, 2011) (RNP).
- A review of site operations to identify principal noise sources during operation and their corresponding sound power levels.
- Undertake two operational noise modelling scenarios using Computer Aided Noise Abatement (CadnaA) software to predict sound pressure levels emanating from the site based on current quarry configuration and after expansion. For each scenario, off-site noise levels resulting from typical extraction rate and peak extraction rate will be investigated.
- Undertaking a desktop assessment of potential road traffic noise impacts from heavy vehicles entering/exiting the site on public roads.
- Providing a summary of the predicted results and outlining recommendations for in-principle noise mitigation measures, where exceedances are predicted.

1.3 Limitations

This report: has been prepared by GHD for Newman Quarrying Pty Ltd and may only be used and relied on by Newman Quarrying Pty Ltd for the purpose agreed between GHD and Newman Quarrying Pty Ltd as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Newman Quarrying Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer to Section 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Newman Quarrying Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.4 Assumptions

The following assumptions were made in this assessment:

- Quarry operating hours would be:
  - Weekdays - 6:30 am to 6.00 pm.
  - Saturdays - 6:30 am - 4.00 pm.
  - Sundays or public holidays - No work.
- Excavation, crushing or loading would not commence until after 7:00 am. Blasting, on an ad-hoc basis, would only occur on weekdays between the hours of 10:00 am and 4:00 pm.
- The operational equipment used on site would be limited to those assessed in this report.

1.5 Secretary’s environmental assessment requirements

1.5.1 Overview

Approval under Part 4.1 of the *Environmental Planning and Assessment Act 1979* (the EP&A Act) is being sought for the project.

The Secretary’s environmental assessment requirements (SEARs) for the project were issued on 21 August 2014. The SEARs have informed the preparation of the noise impact assessment. The SEARs include a requirement noise impact assessment to address the following:

- An assessment of the likely operational noise impacts of the development under the NSW Industrial Noise Policy, paying particular attention to the obligations in Chapters 8 and 9 of the policy.
- An assessment of the likely road noise impacts of the development under the NSW Road Noise Policy.
- An assessment of the likely blasting impacts of the development on people, animals, buildings and infrastructure, and significant natural features, having regard to the relevant ANZEC guidelines.

Table 1-1 outlines where the requirements of the SEARs that have been addressed within this report.

Table 1-1 Secretary's environmental assessment requirements

SEAR reference	Report section
Clarence Valley Council recommendations: Noise issues – noise will be a major consideration. Noise from drilling, blasting, trucks, crushing, transport and machinery etc.	Section 5
RMS recommendations: Impacts of road traffic noise and dust generated along the primary haulage route.	Section 5
An assessment of the likely blasting impacts of the development on people, animals, buildings and infrastructure, and significant natural features, having regard to the relevant ANZEC guidelines.	Section 6 Blast impacts to animals are covered in Slys Quarry Environmental Impact Statement, Biodiversity Assessment Report.

2. Existing environment

2.1 Site location

The existing quarry is located off Jackybulbin Road, Mororo, approximately 17 km north of Maclean. The quarry is located 1.5 km west of the Pacific Highway. The site is surrounded by bushland.

2.2 Existing noise sensitive receivers

Eleven potential sensitive receivers in the vicinity of the quarry have been identified from aerial imagery. Aerial imagery available does not clearly identify whether R3 and R6 are in fact residential receivers, but have been included in this assessment as a conservative measure.

The nearest identified sensitive receiver is located approximately 1.5 km from the quarry boundary.

Sensitive receivers identified in the vicinity of the site are detailed in Table 2-1. Figure 1 shows a site aerial image and the location of identified noise sensitive receivers. These receivers have been identified to represent those with the greatest potential for adverse noise impact. Figure 1 identifies the nearest residential receivers to Slys Quarry.

Table 2-1 Identified noise sensitive receivers

Receiver	Receiver type	Approximate distance to nearest boundary[1] (m)
R1	Residential	1600
R2	Residential	1700
R3	Residential	1500
R4	Residential	2600
R5	Residential	2700
R6	Residential	2800
R7	Residential	3200
R8	Residential	3600
R9	Residential	3300
R10	Residential	3500
R11	Residential	3000

1. Distance measured to the nearest boundary of operations for stage 1 configuration

2.2.1 Potential future sensitive receivers

This assessment has considered existing sensitive receivers only. GHD is not aware of plans for future development in the area, however, acknowledges that future development may occur. The potential for noise and vibration impacts on future development in the area would need to be assessed on a case-by-case basis.

Section 5.5.1 and Section 6.4.3 provides further discussion around potential impacts on future sensitive receivers.

Figure 1 Site location and noise sensitive receivers

2.3 Existing noise environment

Background noise monitoring was undertaken by GHD at two locations between 13 November 2014 and 21 November 2014. These locations were considered to represent the existing ambient noise environment in the area and were identified by GHD in consultation with the client as being a safe and secure place for equipment, minimising the risk of theft or vandalism. Logger locations are shown in Figure 2.

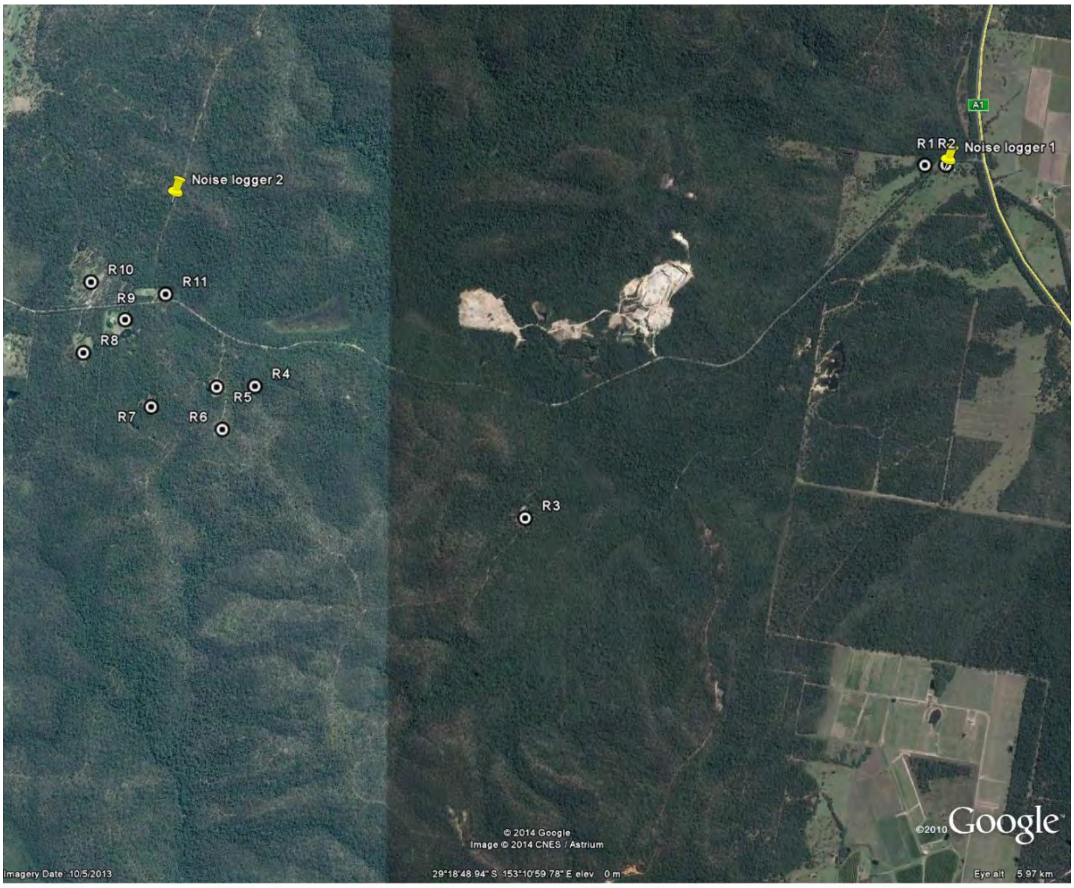

Figure 2 Unattended logger locations

The noise loggers were programmed to accumulate L_{A90}, L_{A10}, L_{Aeq} and L_{Amax} noise descriptors continuously over sampling periods of 15 minutes for the entire monitoring period. Logger calibration was checked before and after measurements using a Bruel and Kjaer 4231 Sound Level Calibrator (serial number 2542101).

The data collected by the loggers was downloaded and analysed, and any invalid data removed. Invalid data generally refers to periods of time where average wind speeds were greater than 5 m/s[1], or when rainfall occurred. Concurrent 15 minute weather data were sourced from the Bureau of Meteorology's (BoM) Yamba automatic weather station (AWS) (22 km south east of the site).

Details of the noise loggers and monitoring locations are provided in Table 2-2.

All sampling activities were undertaken with consideration of the specifications outlined in the AS 1055 (1997) '*Description and Measurement of Environmental Noise'* and the NSW INP.

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[1] Wind speed measurements are taken at 10 m height. Noise logger microphones are located at 1.5 m height. To account for the vertical wind profile from 10 m down to 1.5 m (microphone height), noise data was filtered based on 7 m/s wind speeds.

Table 2-2 Background noise monitoring details

Noise logger	Logger 1	Logger 2
Monitoring location	Lot 100 Jackybulbin Rd (representative of receivers 1 and 2.)	Funnels Rd (representative of receivers 3 to 11)
Logger type	Svan 955	SVAN 955
Logger serial no.	27623	27622
Measurement started	13/11/14 9:45	13/13/14 13:20
Measurement ceased	21/11/14 11:00	21/11/14 10:00
Pre measurement calibration check (94.0 dB at 1 kHz)	94.0 dB	94.0 dB
Post measurement calibration check (94.0 dB at 1 kHz)	93.9 dB	93.9 dB
Frequency weighting	A	A
Time response	Fast	Fast

2.3.1 Summary of noise monitoring results

Unattended noise monitoring results

A summary of calculated background L_{A90} and ambient L_{Aeq} (day, evening and night) noise levels for the monitoring periods are provided in Table 2-3 and Table 2-4 for Logger 1 and Logger 2 respectively. Daily charts of the monitoring results and weather data are presented in Appendix A.

Site observations at the monitoring locations indicated that the primary noise sources in the area were as follows:

- Road traffic on the Pacific Highway at Logger 1.
- Natural noise sources such as insects, birds and wind noise in foliage at Logger 2.

No quarry activities were audible during the deployment of the loggers.

Table 2-3 Summary of noise monitoring results – Logger 1, dB(A)

Date	Background L_{90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Thursday 13/11/14	42	42	38	52	50	50
Friday 14/11/14	40	42	40	49	50	52
Saturday 15/11/14	36	37	37	52	48	51
Sunday 16/11/14	39	40	40	54	50	52
Monday 17/11/14	40	40	39	51	50	51
Tuesday 18/11/14	39	41	38	53	51	51
Wednesday 9/11/14	43	41	39	52	51	51
Thursday 20/11/14	39	43	43	50	53	53
RBL and LAeq Overall	40	41	39	52	51	52

Table 2-4 Summary of noise monitoring results - Logger 2, dB(A)

Date	Background L_{90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Thursday 13/11/14	28	23	19	40	36	40
Friday 14/11/14	31	24	29	43	36	41
Saturday 15/11/14	27	25	20	40	38	40
Sunday 16/11/14	27	25	21	45	37	39
Monday 17/11/14	29	25	22	43	37	43
Tuesday 18/11/14	30	25	22	44	40	40
Wednesday 9/11/14	31	25	21	44	42	46
Thursday 20/11/14	25	32	23	43	43	41
RBL and LAeq Overall	29	25	22	43	39	42

Attended noise monitoring results

A summary of the attended noise monitoring results are provided in Table 2-5.

Table 2-5 Summary of attended noise monitoring results dB(A)

Monitoring location	Date	Measurement time		Measured noise levels dB(A)			Observations (instantaneous dB(A))
		Start	Stop	L_{Aeq}	L_{A90}	L_{A10}	
Logger 1	13/11/2014	12:22	12:37	50	42	51	• Quarry inaudible. • No audible industry noise • Pacific Hwy dominant noise source. • Birds and insects noted. • Three instances of quarry traffic passby noted, LAmax approximately 66 – 69 dB(A). • Slight breeze SE-ESE, 23 degrees, cloudy.
Logger 2	21/11/2014	10:15	10:30	40	36	43	• Quarry inaudible. • No audible industry noise. • Mostly natural noise sources, wind in foliage, birds and insects. • Three instances of aircraft flyover noted. • Still to 2 m/s NE wind speed, 29 – 33 degrees, 3/8 cloud coverage.

3. Project description

3.1 Proposed site operations

The proposal is for the expansion of the existing quarry to extract a maximum of 500,000 tonnes per annum (tpa). The existing quarry is shown in Figure 3.

Figure 3 Typical quarry crushing operations and existing pit area

The site currently has a partially formed quarry wall and pit working area. The current floor of the quarry is approximately 44 m Australian Height Datum (AHD) with a second level to the east at approximately 58 m AHD. The centre of the existing quarry has active faces to the north, east and west, as shown in Figure 3.

Proposed quarry operations would be carried out in three stages and in response to demand. The extraction is proposed to move north and east initially, to the extent of the currently approved quarry. The eastern extent of the excavation would remain 10 m from the road reserve located along the eastern boundary. The excavation would be to the current floor level of 44 m AHD. Proposed expansion plans are shown in Appendix B.

Stage 1 would cover an area of 6.9 hectares and extract approximately 2.3 million tonnes.

Stage 2 would involve expanding the quarry to the north and south and to a depth of 44 m AHD. This would expand the quarry by 5.7 hectares and involve the extraction of approximately 2.8 million tonnes of material.

Stage 3 would be the final stage and would expand the quarry further north and south. Stage 3 would involve an expansion of 5.4 hectares to a depth of 44 m AHD. This would involve extracting approximately 1.8 million tonnes of material.

Material extraction would typically be undertaken using anexcavator. Blasting would be undertaken on a periodic basis depending upon demand for the resource and when manual extraction becomes too difficult or dangerous.

Extracted material would then be crushed, screened and where necessary blended with other materials from the quarry, or material imported to the quarry. The materials would be stockpiled on the quarry floor in numbered stockpiles of approximately 4,000 tonnes each. This material would be loaded onto trucks as required for transportation off-site.

All material processing, size reduction and screening into different grades would occur on-site unless requested otherwise.

The proposed sequence of operations for each stage would generally be:

- Establish the sediment and erosion control measures and other environmental safeguards.
- Clearing vegetation, if necessary. The bulk of cleared vegetative waste would be piled in a suitable location, clear of adjacent vegetated areas and mulched for future revegetation works.
- Topsoil would be stripped, stockpiled and protected against erosion for use in revegetation works.
- Excavation of the weathered rock material, where possible, the deeper layers would be excavated in a similar manner but would also include blasting. Blasting is anticipated to be carried out at a frequency of between two blasts per month to one blast per year, depending on demand and the material encountered. The blasting would be undertaken by a specialist contractor in accordance with regulatory requirements. Drilling would be required as part of blasting operations to allow for down-hole placement of explosives.
- Rock hammering may be required to break large rocks.
- The rock is collected by an excavator and fed into a jaw crusher. The crusher produces an output of various sizes of fill or aggregate which are separated by a screening machine into various piles based on aggregate size. Sand is also produced in this process. The crusher and screener are moved around the quarry floor as necessary to be close to the quarry face and accumulated, excavated stone.
- Loading of the material directly from the stockpile onto trucks for removal from site.
- The excavation continues, as described above, within each stage until it reaches the ultimate depth of 44 m AHD. During the excavation, 10 m high by 10 m wide benches are established at the quarry face.
- Once the extraction is complete, topsoil would be respread on the disturbed areas and revegetated, where possible.

3.2 Extraction rate

To service the demand from the Pacific Highway upgrade works it may be necessary to extract and process up to 500,000 tpa, although this rate of extraction is expected to be uncommon. It is more likely that the annual extraction rate during the upgrade of the Pacific Highway would be around 250,000 to 300,000 tpa. After the Highway upgrade is complete, the annual extraction rate is anticipated to reduce to about 100,000 to 150,000 tpa.

Based on the assessment of the underpinning demand, and allowing for downtime from wet weather etc (about 40%), it is realistic to project a maximum daily extraction and haul rate of about 4,000 tonnes with an average daily win and haul of about 1,500 tonnes. At the other extreme, there will be periods when no materials are extracted or transported from the site. The average daily win and haul rate would reduce significantly following the completion of the highway upgrade.

3.3 Hours of operation

The hours of operation would depend on demand with some periods of high activity and other times when activity is limited to the occasional loading of haulage trucks. The proposed hours of operation are:

- Quarry operating hours would be:
  - Weekdays - 6:30 am to 6.00 pm.
  - Saturdays - 6:30 am - 4.00 pm.
  - Sundays or public holidays - No work.
- Excavation, crushing or loading would not commence until after 7:00am. Blasting, on an ad-hoc basis, would only occur on weekdays between the hours of 10:00am and 4:00pm.

3.4 Quarry equipment

Table 3-1 lists the plant and equipment that would operate on site.

Table 3-1 Quarry equipment

Type	Typical make/model	Approximate number	Typical frequency of use	Description
Excavators	Komatsu PC350 – 8	2	12- 40 hrs/ week	Excavating material and stockpiling. Clearing and grubbing of vegetation and stripping of topsoil.
	Komatsu PC710-5	1		
Front-end Loader	Komatsu WA400-3	1	10 hrs/week	Loading material onto the haul trucks and stockpiling material within the pit floor.
	Komatsu WA470-3	1	30 hrs/week	
	Kawazaki 90ZV	1	45 hrs/week	
Crusher	McCloskey J50	1	20 – 40 hrs/ week	Crushing rock main jaw crusher.
	Komatsu BR380JG-1	1		Crushing rock spare jaw crusher.
Screen	Sandvik GE440	1	20 – 40 hrs/ week	Only for aggregate/gravel production and overburden screening.
	Sandvik GA340	1		
Haul Trucks	Truck and dog Contractors	Up to 125/day	Up to 125/day	Delivery of materials to customers and stockpiling in pit if needed and carting unsuitable material to rehabilitation areas.
Water Cart	Isuzu	1	10 hrs/week	To water haul roads and stockpiles.
Water Pump	Honda	3	10 hrs/week	To dewater excavation/basin and to fill water cart from standpipe. To water stockpiles and put moisture in products.
Generator	Cummins	1	5 hrs/week	Provide electricity to wash plant and dam pump.
	Able	1	9 hrs/day	Provide power to weighbridge and fuel pump.
Hand tools	Various	5	2 hrs/week	General activities maintaining plant.

It is anticipated that not all of the equipment listed above would be operational on-site at any one time.

3.5 Access and traffic generation

The majority of traffic to and from the quarry would access the site from the Pacific Highway and Tullymorgan-Jackybulbin Road via an existing, formed gravel access road that runs to the quarry pit. The layout of the quarry provides a loop that allows trucks and machinery to enter the quarry, load and exit, all while travelling in a forward direction.

Less than 10 deliveries per year would be to the west of the quarry along Tullymorgan-Jackybulbin Road.

Truck and dog trailer combinations have a capacity of about 32 tonnes. At an average daily production, which would generate a win and haul rate of approximately 1,500 tonnes per day, the quarry is expected to generate about 50 truck and dog loads (100 movements) per day. At its peak, the quarry is expected to win and haul about 4,000 tonnes per day which would require about 125 truck and dog loads (250 truck movements) per day. At other times there would be periods when no trucks would be generated by the quarry.

The quarry workforce is expected to generate about 24 light vehicle movements per day.

4. Noise criteria

4.1 Operational noise

Operational industrial noise criteria are derived from the NSW INP.

The INP provides non mandatory industrial noise criteria to aid in the assessment of industrial noise sources scheduled under the *Protection of the Environment Operations Act 1997*. The policy sets two separate noise criteria to meet environmental noise objectives, one to account for intrusiveness and the other to protect the amenity of particular land uses.

Intrusiveness is assessed by determining the background noise level, where the equivalent continuous noise level from quarry operations should not be more than 5 decibels (dB) above the measured background level. The amenity criterion is based on noise criteria specific to the land use and associated activities. The project specific level is the more stringent of the intrusive and amenity criteria.

The intrusive, amenity and project specific levels are shown Table 4-1. The sensitive receivers in the vicinity of the quarry have been identified from aerial imagery. Aerial imagery available does not clearly identify whether R3 and R6 are in fact residential receivers, but have been included in this assessment as a conservative measure.

The nearest identified receiver is located approximately 1.5 km from the quarry boundary. Sensitive receivers identified in the vicinity of the site are detailed in Table 2-1. Figure 1 shows a site aerial image and the location of identified noise sensitive receivers. These receivers have been identified to represent those with the greatest potential for adverse noise impact.

The INP rural residential category has been adopted for all identified receivers to determine the applicable amenity criteria.

Table 4-1 Project specific operational noise criteria – daytime dB(A)

Criterion	Logger 1 (Lot 100 Jackybulbin Rd)	Logger 2 (Funnels Rd)
Rating background level, LA90(Period)	40	29[1]
Intrusiveness criteria, LAeq(15min)	45	35
Amenity criteria (rural), LAeq(period)	50	50
Project specific criterion, LAeq (15min)	**45**	**35**

Note 1: The NSW INP notes that “where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A).

The NSW INP requires that the noise level at residences be assessed at the most affected point on or within the residential boundary or, if this is more than 30 m from the residence, at the most-affected point within 30 m of the residence.

In selecting the appropriate noise criteria for each receiver, the following methodology was used:

- The noise criterion of 45 dB(A) $L_{eq(15\ min)}$ derived from Logger 1 was adopted at receivers located close to the Pacific Highway.
- The noise criterion of 35 dB(A) $L_{eq(15\ min)}$ derived from Logger 2 was adopted at all other receivers.

The adopted criterion for individual receivers is shown in Table 5-2.

4.2 Traffic on public roads

GHD understand that rock material would be hauled from the site along Jackybulbin Road. Therefore, the quarry has the potential to create additional traffic noise on Jackybulbin Road.

Given the quarry access road is located on the site and is not a public road, noise from the access road is assessed under the INP.

The NSW *Road Noise Policy* (OEH, 2011) (RNP) provides non-mandatory road traffic noise target levels for land use developments with potential to create additional traffic on public roads.

Jackybulbin Road has been considered a local road. The road traffic noise target levels are presented in Table 4-2.

Table 4-2 RNP traffic noise target levels at residential receivers – dB(A)

Type of development	Day (7 am – 10 pm)	Night (10 pm – 7 am)
Existing residences affected by additional traffic on existing local roads generated by land use developments.	$LAeq_{(1\ hour)}$ 55 (external)	$LAeq_{(1\ hour)}$ 50 (external)

5. Noise impact assessment

5.1 Noise modelling methodology

The noise emissions from the operation have been assessed through noise modelling using Computer Aided Noise Abatement (CadnaA v4.4) to predict sound pressure levels at the nearest identified noise sensitive receivers.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to ISO 9613-2, *Acoustics – Attenuation of sound during propagation outdoors*. Propagation calculations take into account sound intensity losses due to hemispherical spreading, atmospheric absorption and ground absorption.

The ISO 9613-2 algorithm also takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or downwind conditions which are favourable to sound propagation. As a result, predicted received noise levels are expected to represent a worst case scenario.

5.2 Noise generating equipment

Table 5-1 displays a list of identified noise generating equipment used during site operations and their corresponding sound power levels.

Table 5-1 Noise sources and sound power levels

Noise source	Octave centre frequency (Hz) dB(lin)								Lw dB(A)	Source of data
	63	125	250	500	1k	2k	4k	8k		
Excavator Komatsu pc350-8	79	86	90	95	96	95	89	81	101	A
Excavator Komatsu pc350-8 with rock hammer attachment	89	99	106	106	110	112	110	104	117	A
Excavator Komatsu pc710-5	92	96	99	100	105	101	94	86	108	A
Front End Loader Kowazaki 90ZV	73	93	96	101	100	100	95	87	106	A
Front End Loader Komatsu WA400-3	73	93	96	101	100	100	95	87	106	D
Front End Loader Komatsu WA470-3	73	93	96	101	100	100	95	87	106	D
Crusher McCloskey J50	90	103	106	103	109	107	103	93	114	A
Crusher Komatsu BR380JG-1	90	103	106	103	109	107	103	93	114	D
Screen Sandvik GE440	91	97	103	110	112	110	105	95	116	A
Screen Sandvik GA340	84	90	96	100	103	100	96	89	107	A
Haul trucks	85	95	96	98	100	97	91	83	105	D
Water cart Isuzu	85	85	87	85	87	84	81	74	94	A
Generator Cummins	70	79	88	89	85	75	73	66	93	A
Generator Able	68	77	79	80	79	80	74	69	86	A

1. Excavator pc350-8 with rock hammer attachment was measured while breaking rocks. This sample was considered representative of typical operations, and thus the LAeq was used to calculate the sound power of the operation. A 3 dB(A) penalty has been applied due to the impulsive nature of the noise, as recommended by the NSW INP.

A. On site noise measurement.

B. BS 5228.1 – 2009.

C. Engineering Noise Control, Third Edition, A. Bies and H. Hanson, 1998.

D. Previous noise measurement data undertaken by GHD of similar plant.

E. UK Department for Environment, Food and Rural Affairs.

F. Australian Standard AS 2436-2010.

G. Adopted from Sandvik QJ 341 crusher.

5.3 Modifying factor corrections

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency or dominant low-frequency content, it can cause greater levels of annoyance than other noise sources at the same noise level. The INP provides correction factors which are to be applied to the predicted noise levels for when such sources exist.

A review of site noise sources has been undertaken, based on the observations made on site as well as noise data taken on site. No on-site noise sources were found to contain low frequency or tonal characteristics. Intermittency characteristics need only be assessed where the noise source occurs during the night period. Since Slys Quarry does not operate during the night time period, intermittency was not assessed.

On-site measurement of an excavator breaking rocks with a rock hammer attachment was found to be impulsive in nature. This noise source received a 3 dB(A) adjustment as recommended by the NSW INP.

5.4 Model configuration

As the quarry progresses throughout its lifetime, the shape of the working area would change. For example, the pit walls would become larger and the location of the working area would move throughout various stages. It would be impracticable to attempt to model all stages of the quarry life. Therefore, the following two operational scenarios have been modelled and assessed.

- **Scenario 1**: Proposed operations with current quarry shape (considered to represent a worst-case scenario as equipment would be most exposed to sensitive receivers).
- **Scenario 2**: Proposed operations with final quarry shape.

For both Scenario 1 and Scenario 2, the noise impact of the quarry on surrounding receivers has been assessed at:

- Average daily production, which is expected to generate about 50 truck and dog loads (100 movements) per day.
- Peak daily production, which would require about 125 truck and dog loads (250 truck movements) per day.

The following assumptions were made with regard to the model configuration:

- A general ground absorption coefficient of 1.0 was used throughout the model, representing the surrounding vegetation and land uses.
- Sound propagation is calculated according to the ISO 9613-2 algorithm, with noise enhancing meteorological conditions such as a moderate temperature inversion or light breeze in the direction of the receiver.
- Modelling is based on atmospheric conditions of 10˚C and 70% humidity.

The noise modelling assumptions are as follows:

- All modelled equipment was assumed to be operating simultaneously at full sound power.
- There were assumed to be 24 light vehicle movements per day for staff (12 in / 12 out).
- Noise source heights above ground level were modelled as follows:
  - Excavator: 2.5 m.
  - Screening plant: 3 m.
  - Front End Loader: 2 m.
  - Crusher: 3 m.
  - Haul truck: 3 m.
  - Light vehicles: 0.5 m.
  - Generator and pump: 1 m.
- Blast hole drilling was not assessed in this noise model since this is not a regular activity.
- Single storey receivers were modelled at a height of 1.5 m above ground.

5.5 Operational noise model results

Noise levels were predicted for future operation based on the operating conditions outlined in Section 3. The predicted noise levels for daytime site operations are shown in Table 5-2.

Model results indicate that noise levels generated from quarry operations are predicted to comply with the INP daytime noise criteria at all sensitive receivers. It is noted that off-site noise levels at R3 are close to the criteria, and the use of the rock hammer during peak daily production may cause an exceedance depending on the location of equipment.

Predictions under Scenario 2 indicate that the changing quarry shape will make little difference to the receiver levels.

This assessment is considered conservative as it has not considered the potential screening benefits of equipment operating behind stockpiles.

An assessment of noise mitigation measures has been provided in Section 7.1. It should be noted that the noise modelling is based on worst case operating conditions with conservative assumptions regarding site operations and equipment sound power levels. This conservative approach is likely to result in predicted operational noise levels being slightly higher than actual noise levels.

Figure 4 to Figure 9 shows the predicted operational noise contour plots for Scenario 1 and Scenario 2.

5.5.1 Potential future sensitive receivers

Predicted operational noise impacts indicate that the most stringent day time noise criterion of 35 dB(A) is typically confined to within a few hundred metres of the quarry pit, except for under peak production and when the rock hammer is in use. Under these scenarios, the noise criterion contour extends further, primarily to the south.

To the east, the noise criterion contour is mostly confined within the site boundaries under all operating scenarios.

All land encompasses by the noise criterion contour line is currently heavily vegetated and unlikely to be developed into a sensitive land use.

Predicted results should be used as a guide, indicating the land area surrounding the site which has potential to be adversely affected by noise. Local authorities could use this information for planning purposes in assessing the suitability of land for potential development.

Table 5-2 Predicted operational noise levels

Sensitive Receiver	Noise criterion Leq dB(A)	Predicted noise level Leq dB(A)							
		Scenario 1 – Existing quarry configuration				Scenario 2 – Final quarry configuration			
		Average daily production without rock breaking	Average daily production with rock breaking	Peak daily production without rock breaking	Peak daily production with rock breaking	Average daily production without rock breaking	Average daily production with rock breaking	Peak daily production without rock breaking	Peak daily production with rock breaking
R1	45	26	26	28	28	26	26	28	29
R2	45	25	26	27	28	26	26	28	28
R3	35	32	33	34	35	30	31	32	33
R4	35	23	25	25	26	21	22	23	24
R5	35	23	24	25	25	20	21	22	23
R6	35	22	23	24	25	20	21	22	23
R7	35	21	22	22	23	18	19	21	21
R8	35	19	20	21	22	17	18	19	20
R9	35	20	21	22	23	18	18	20	21
R10	35	20	21	21	22	17	18	19	20
R11	35	21	22	23	24	19	20	21	22

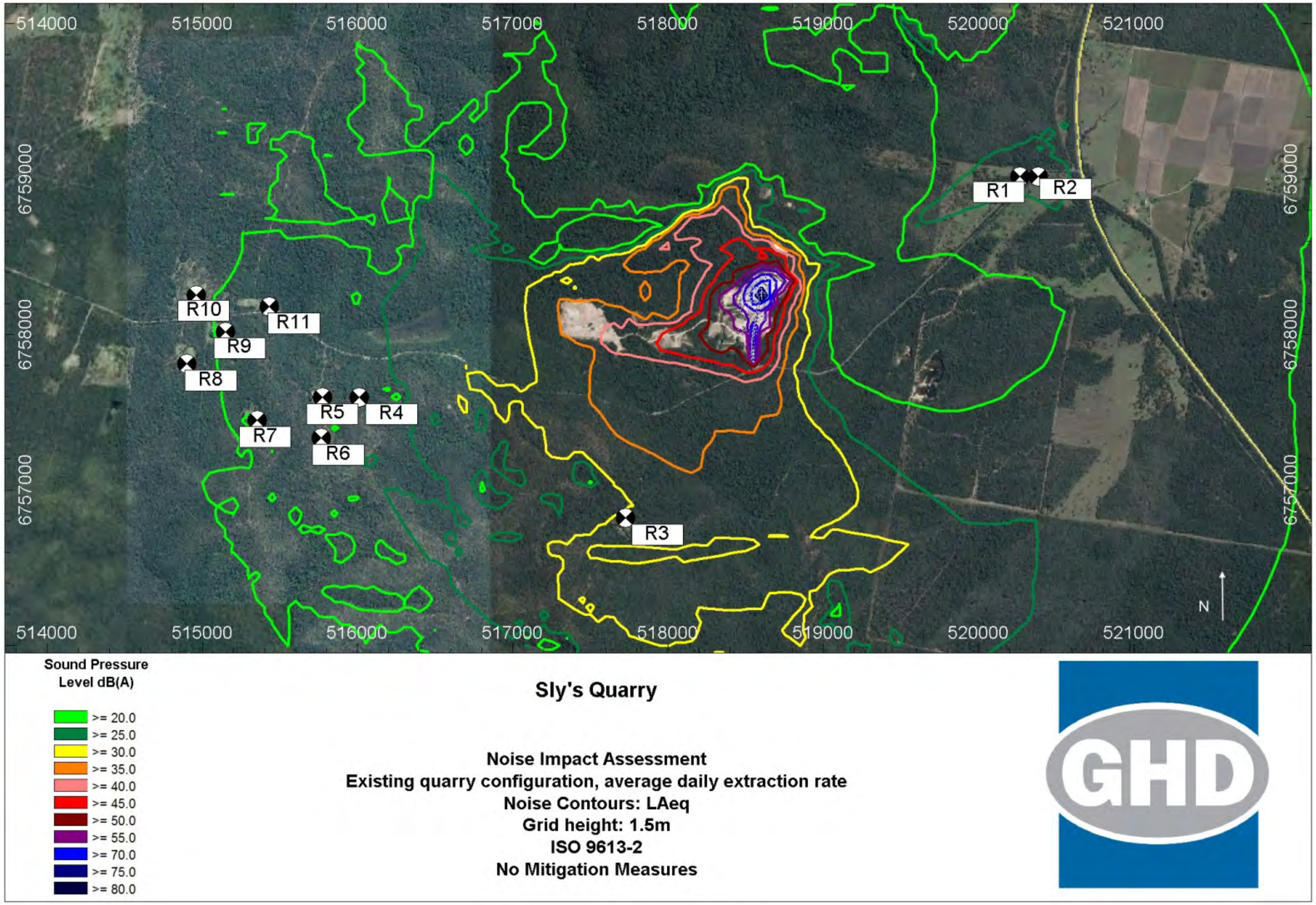


Figure 4 Predicted operational noise levels – Scenario 1 – Average daily production

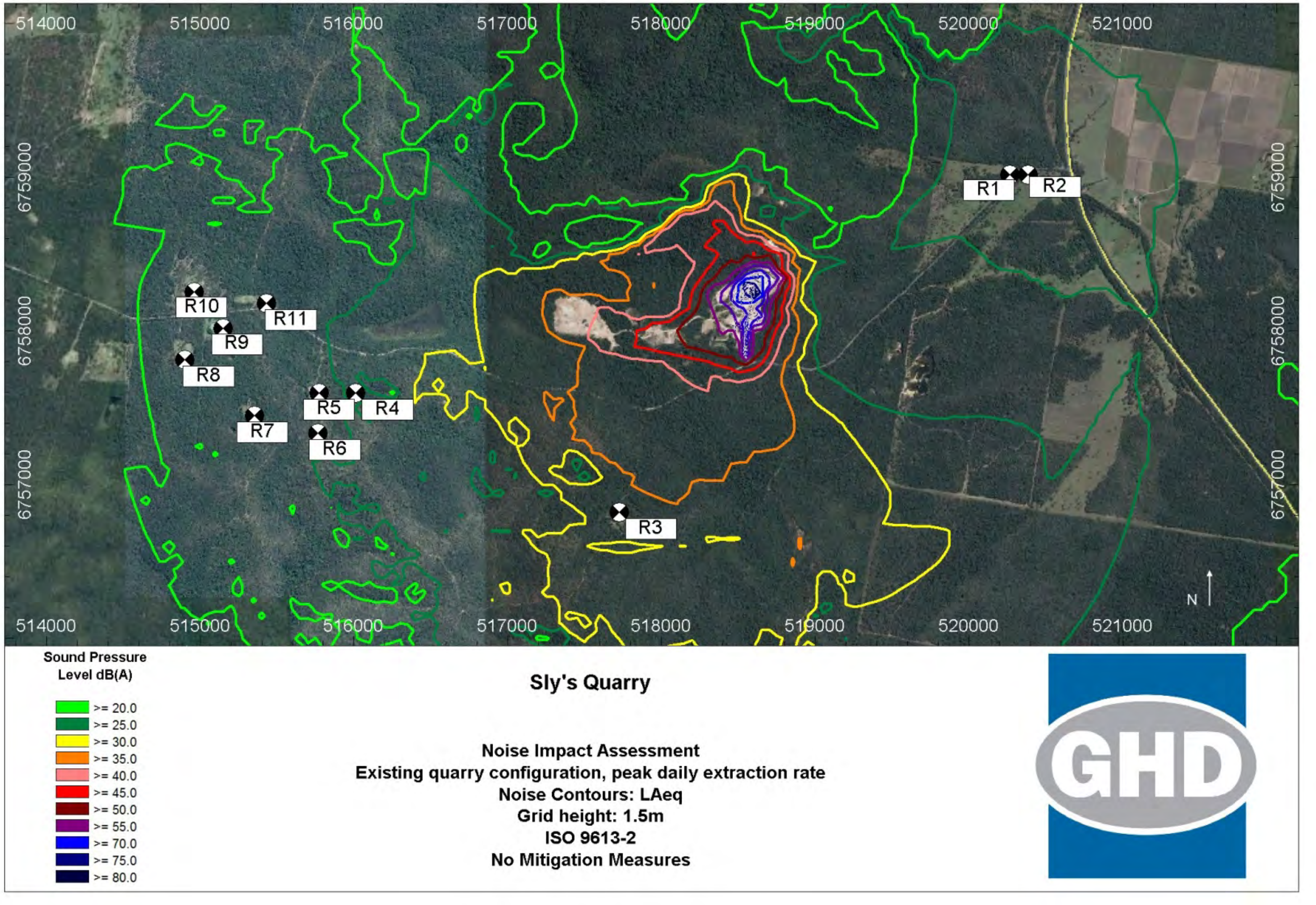


Figure 5 Predicted operational noise levels – Scenario 1 – Peak daily production

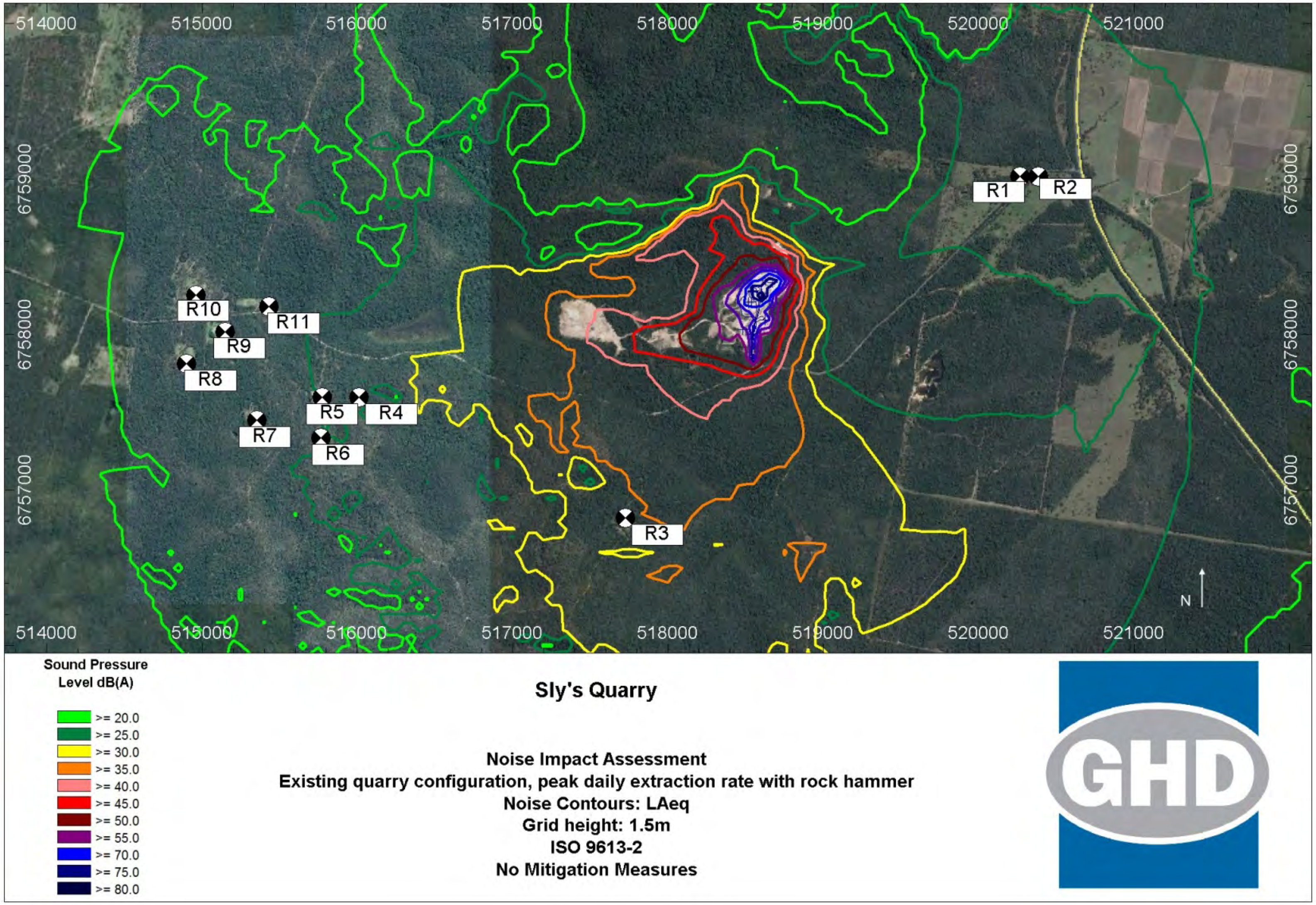


Figure 6 Predicted operational noise levels – Scenario 1 – Peak daily production with rock hammer

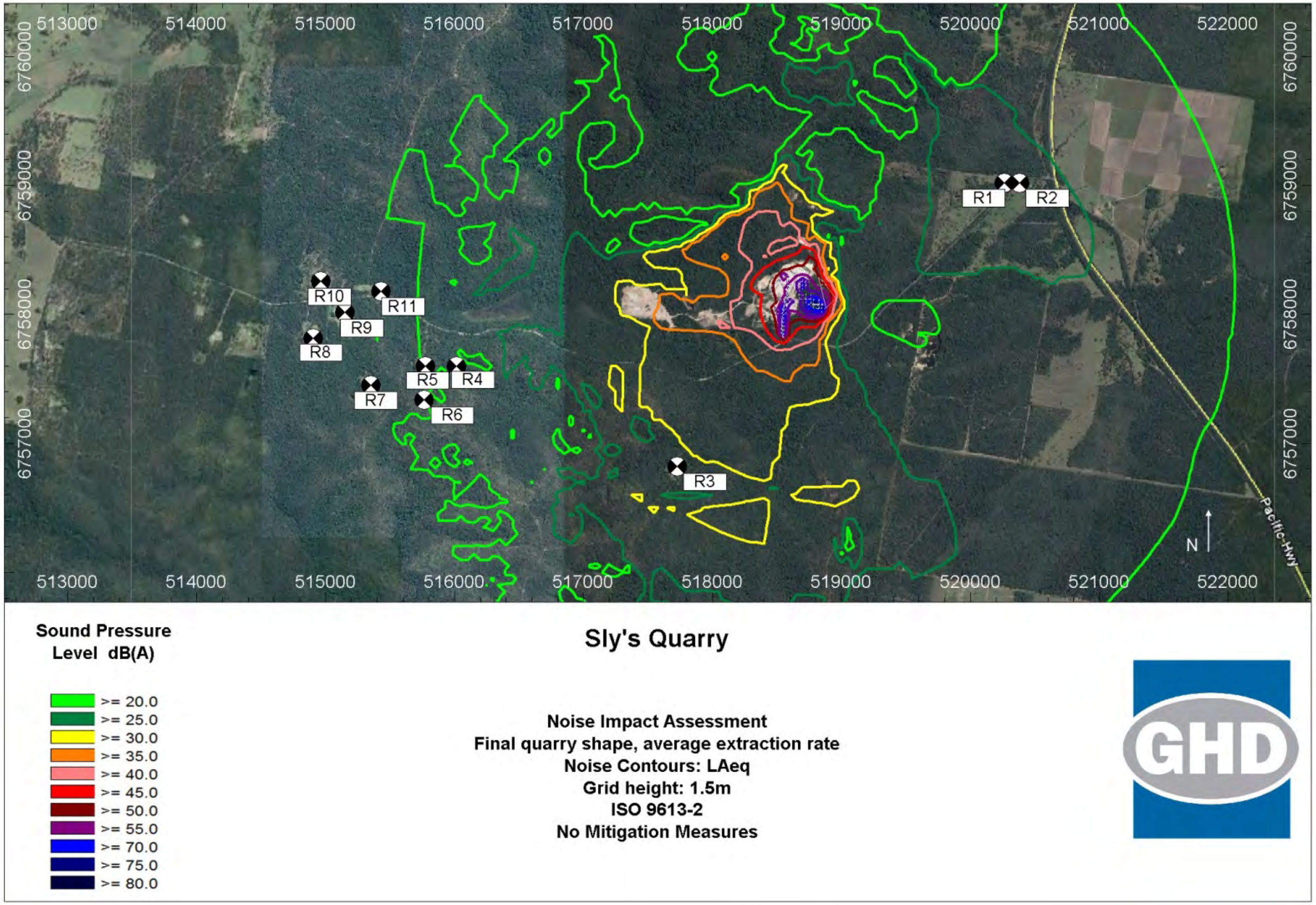


Figure 7 Predicted operational noise levels – Scenario 2 – Average daily production

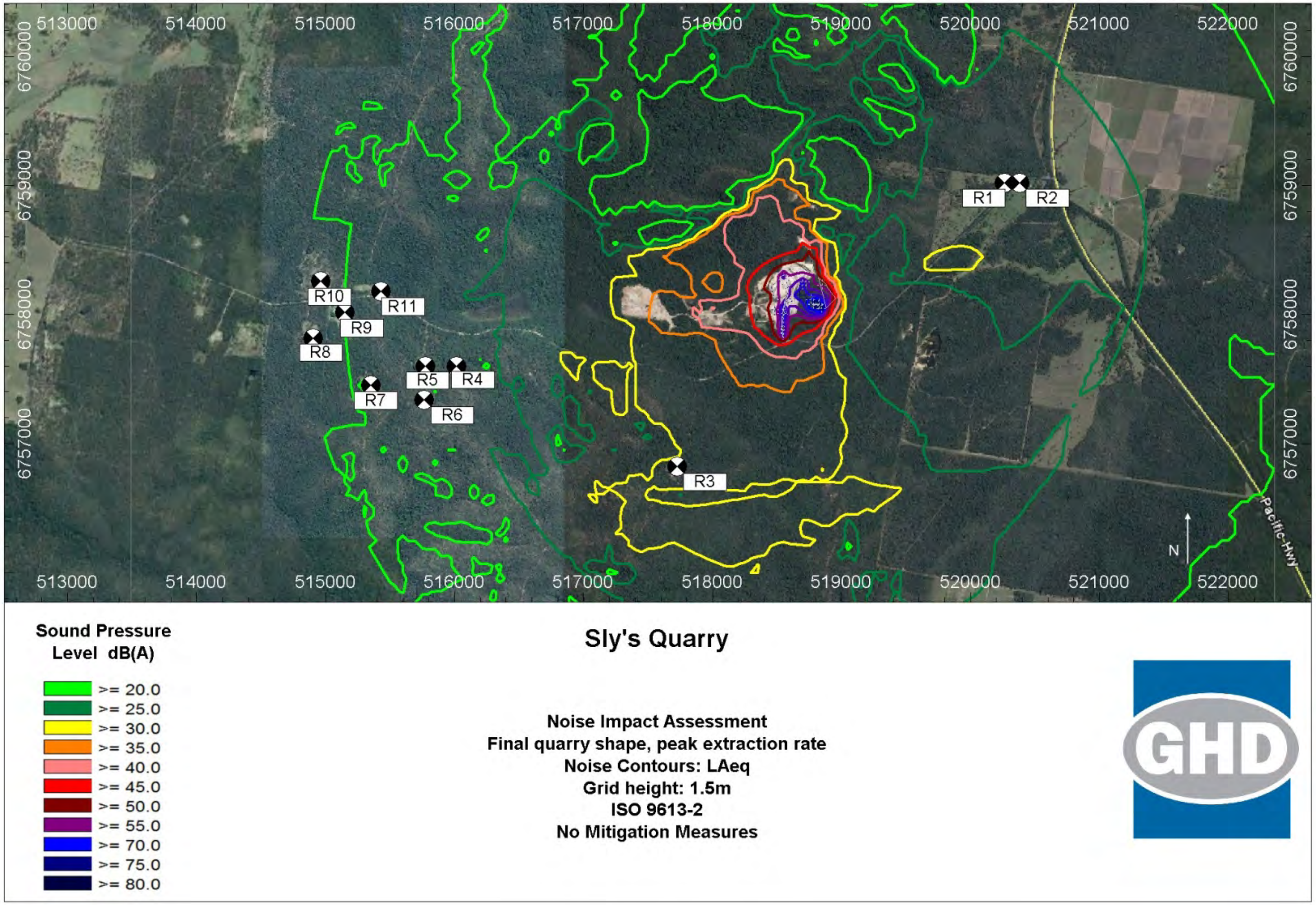


Figure 8 Predicted operational noise levels – Scenario 2 – Peak daily production

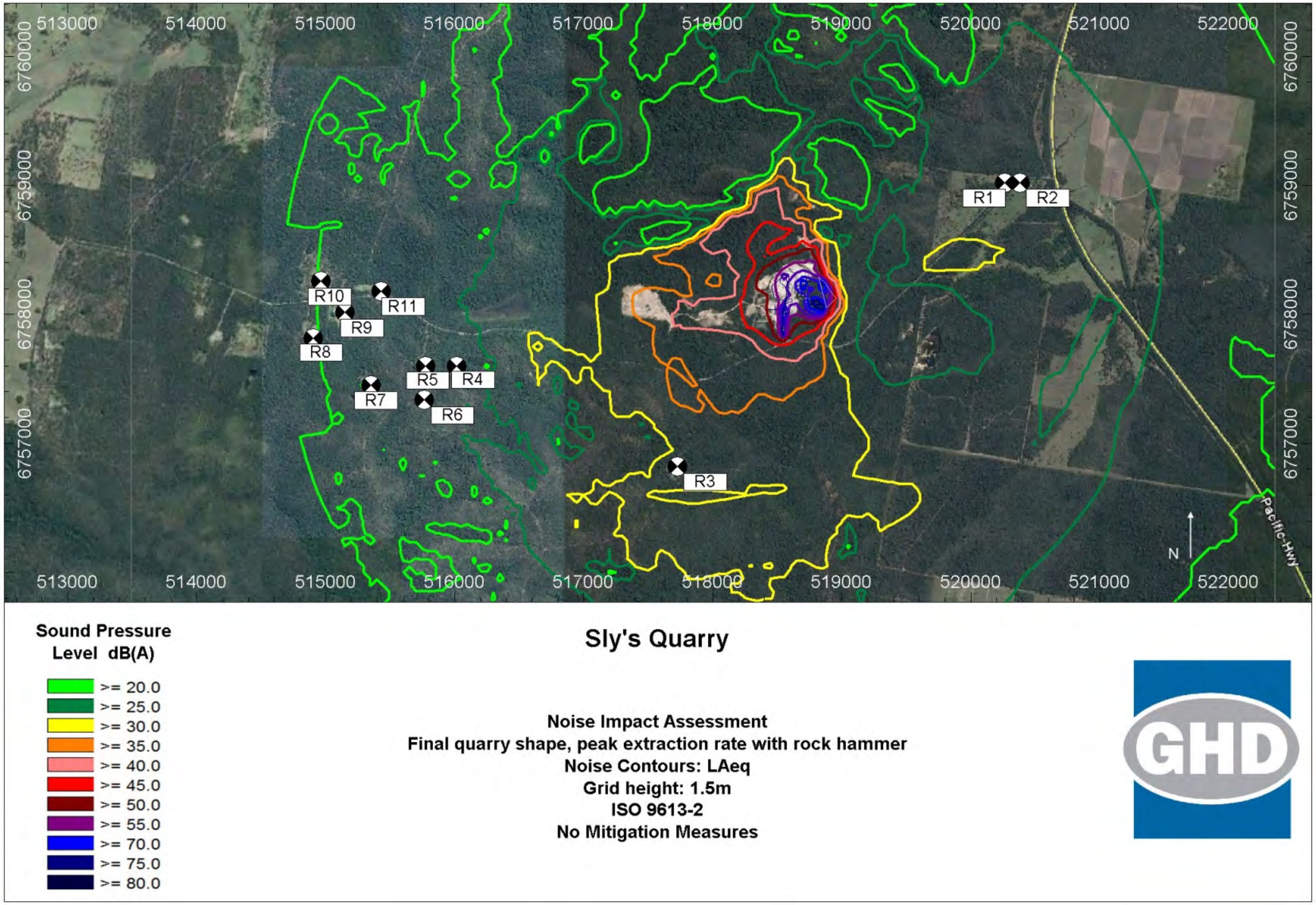


Figure 9 Predicted operational noise levels – Scenario 2 – Peak daily production with rock hammer

5.6 Road traffic noise

Continuous traffic flow related noise is typically calculated using the United Kingdom Calculation of Road Traffic Noise (CoRTN) algorithm, however due to the non-continuous nature of the heavy vehicle movements to and from the site, the United States EPA's Intermittent Traffic Noise guidelines has been utilised to determine potential impacts. The following equation outlines the mathematical formula used in calculating the $L_{eq,T}$ noise level for intermittent traffic noise.

$$L_{eq},T = L_b + 10\log\left[1 + \frac{ND}{T}\left(\frac{10^{(L_{max}-L_b)/10} - 1}{2.3} - \frac{(L_{max} - L_b)}{10}\right)\right]$$

Where:

L_b is background noise level, dB(A).

L_{max} is vehicle maximum noise level, dB(A).

T is the time for each group of vehicles (min).

N is number of vehicle trips.

D is duration of noise of each vehicle (min).

The parameters above were determined as follows:

- Background noise levels are based on the unattended noise monitoring conducted at Location 1.
- The heavy vehicle maximum noise level was measured at Logger 1.
- The duration of each vehicle passby was 10.8 seconds.
- The time for each group of vehicles was 60 minutes.

Table 5-3 summarises the predicted road traffic noise level for when the quarry is operating at peak daily production, and compares this against the RNP criteria.

Table 5-3 Predicted road traffic noise level during peak daily production

Roadway	Generated heavy vehicle movements per day (average daily production)	Generated heavy vehicle movements per day (peak daily production)	RNP criteria Day (7 am – 10 pm)	Predicted road noise level	
				Average daily production $LAeq_{(1\ hour)}$ dB(A)	Peak daily production $LAeq_{(1\ hour)}$ dB(A)
Jackybulbin Rd	100 (50 loads)	250 (125 loads)	$L_{Aeq(1\ hour)}$ 55 (external)	49	52

1. Predicted results have received a 2.5 dB(A) façade correction

Table 5-3 shows that using this algorithm, road traffic noise along Jackybulbin Road due to an increase in heavy vehicles during peak daily production is expected to comply with the RNP criteria.

However, the increase in heavy vehicle traffic is expected to be noticeable to receivers R1 and R2, and have the potential to generate annoyance. In particular, bumps, pot holes or other irregularities in the roadway can cause short-term increased noise during vehicle passbys. Recommendations for noise mitigation measures are provided in Section 7. Note that receivers R3 to R11 are situated west of the quarry access road, and would not be affected by heavy vehicle road noise.

6. Blast impact assessment

6.1 Criteria

6.1.1 Environment Protection Licence (EPL)

The current EPL No 11649 relating to the existing quarry operations indicates the following:

L4 Blasting

L4.1 Blasting at the premises is limited to 1 blast on each day on which the blasting is permitted.

L4.2 The airblast overpressure level from blasting operations in or on the premises must not exceed:

a) 115 dB (Lin Peak) for more than 5% of the total number of blasts during each reporting period; and

b) 120 dB (Lin Peak) at any time.

At the most affected residence or noise sensitive location that is not owned by the licensee or subject to a private agreement between the owner of the residence or noise sensitive location and the licensee as to an alternative overpressure level.

L4.3 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed:

a) 5mm/s for more than 5% of total number of blasts carried out on the premises during each reporting period; and

b) 10mm/s at any time.

At most affected residence or noise sensitive location that is not owned by the licensee or subject to a private agreement between the owner of the residence or noise sensitive location and the licensee as to an alternative overpressure level.

It should be noted that the last paragraph refers to overpressure, which is believed to be a typographical error and should refer to ground vibration peak particle velocity.

6.1.2 ANZECC

The ANZECC Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration has been adopted for assessment of blasting noise and vibration impacts in this report. This guideline specifies recommended human comfort criteria for blasting activities.

The ANZECC recommended maximum level for airblast overpressure is 115 dB(L) peak. This level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the airblast overpressure must not exceed 120 dB(L) peak for any blast.

Ground-borne vibration level should not exceed 5 mm/sec Peak Particle Velocity (PPV). The recommended PPV level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the level should not exceed 10 mm/sec at any time.

ANZECC guideline recommends that blasting should only be permitted during the following hours:

- Monday to Saturday, 9am to 5pm.
- No blasting on Sundays or Public Holidays.

The frequency of blasting should not take place more than once per day. This requirement does not apply to minor blasts.

The abovementioned restrictions on times and frequency of blasting do not apply to premises where the effects of the blasting are not perceived at noise sensitive sites.

When a temperature inversion is known to exist, blasting should be avoided if practicable.

Reference to the above criteria indicates the EPL airblast overpressure and ground vibration levels are the same as the ANZECC criteria.

6.2 Blast monitoring

Blast monitoring was conducted during a blast event at Slys Quarry on the 13 November 2014. The aim of the monitoring was to measure ground vibration and overpressure results during a typical blast event and determine site constants for the area which can be used for blast predictions.

Blast monitoring was conducted by GHD at one location in the vicinity of residential sensitive receptor R2 during the blast event and supplemented with monitoring conducted by the blasting contractor. The blasting contractor recorded overpressure and ground vibration levels at two locations as shown on Figure 10 below.

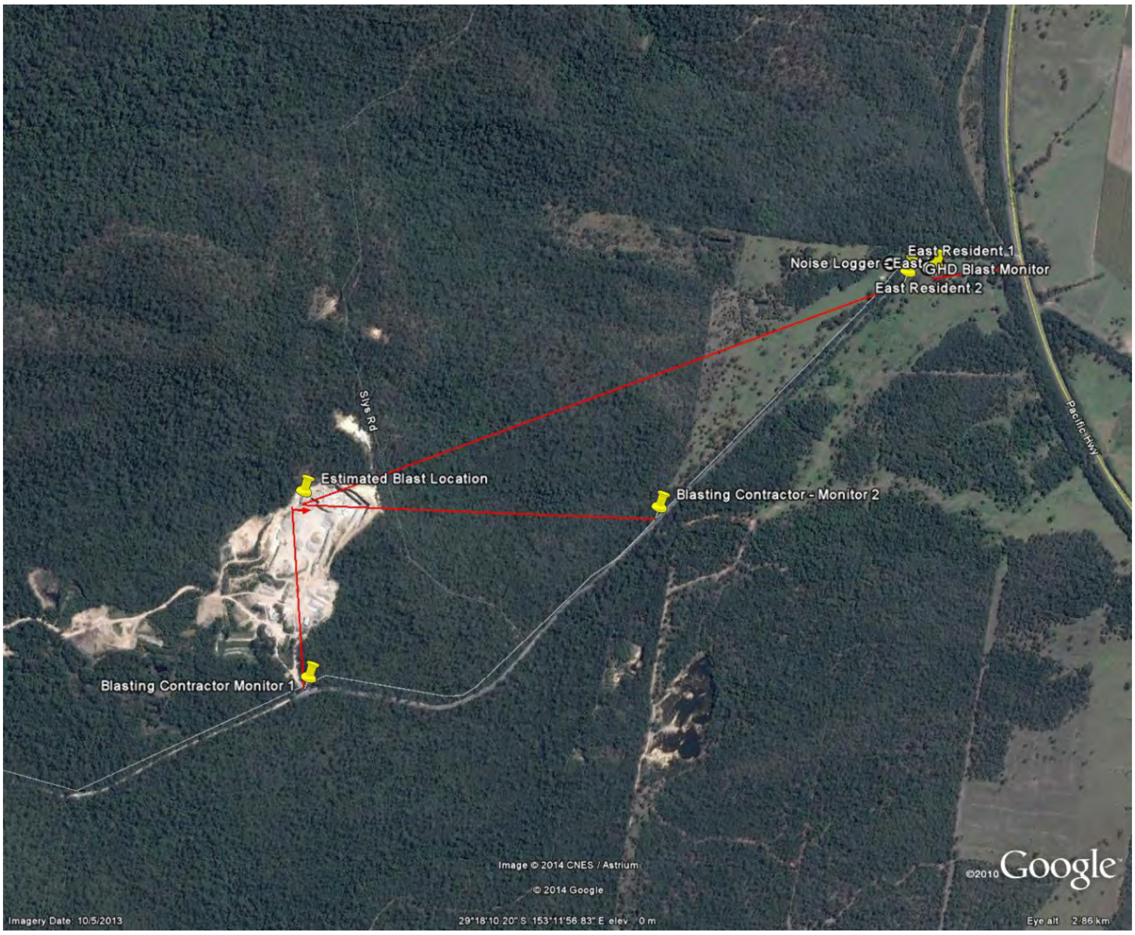


Figure 10 Blast monitoring locations

The monitoring position at R2 was prepared by removing the top layer of grass or loose soil and firmly securing the vibration monitor geophone on the exposed surface using ground-spikes. The microphone was setup facing the blast location at a height of 1.2 metres above ground level.

The vibration monitor was set to record peak vibration levels as a 10-second interval histogram recording. Additionally, a waveform recording trigger was set to 1.5 mm/s to enable identification and further analysis of significant vibration events. The trigger was set at 1.5 mm/s to minimise risk of triggering due to extraneous events such as vehicle passbys on Jackbulbin Road.

6.2.1 Instrumentation details

The vibration monitoring described in this report was completed using an Instantel® Minimate Plus™ vibration monitor, as pictured in Figure 11.

Figure 11 Instantel® Minimate Plus™ vibration monitor and geophone

The Minimate Plus uses a tri-axial geophone to monitor ground vibration peak particle velocity (PPV) in each axial direction and has an inbuilt data logger, downloadable to PC where analysis can be performed using Blastware software. The peak vector sum (PVS) of each measurement is resolved from the acquired data using Blastware.

Equipment setup and specification are presented in Table 6-1.

Table 6-1 Equipment register and setup

Equipment	Serial Number	Calibration Due Date	Recording Mode	Range (mm/s)	Sample Rate (per second)
Instantel Minimate Plus	BE 12721	5 March 2015 (Saros Pty Ltd)	Histogram Combo	31.7mm/s	2048

6.2.2 Blast configuration

The blasting contractor provided the blast monitoring results for their monitors along with the configuration parameters for the blast setup. A summary of the site blast design and site parameters is provided below in Table 6-2.

The blast design and evaluation report can be found in Appendix C

Table 6-2 Blast design parameters and configuration

Parameter	Value
Blast hole diameter	89 mm
Stemming length	1.0 m
Number of holes	28
Average depth of holes	14.16 m
Bench height	7.5 m
Bench area	14.16 m x 7.5 m x 23.33 m
Maximum charge mass per hole	116 kg
Maximum instantaneous charge (MIC)	5487 kg
Blast pattern	2.5 m x 2.5 m
No of holes per delay	1

6.2.3 Blast monitoring results

A summary of the vibration measurement results recorded at the site are presented in Table 6-3.

Table 6-3 Blast monitoring results

Parameter	Approximate distance and direction to blast source	PPV (mm/s) Criteria: 5mm/s	Overpressure dB(L) Criteria: 115 dBL
Location 1 (Blasting Contractor monitor near gate to quarry)	530 metres North	0.78	88[a]
Location 2 (Blasting Contractor monitor near Jackbulbin Road)	1030 metres West	0.17	112
Location 3 (GHD monitor near sensitive receiver R2)	1860 metres West-southwest	0.13	101

[a] This result is not considered valid as it is the noise floor of the instrument, therefore has not been used in this assessment.

The above results indicate the criteria are met at all monitoring locations for both ground vibration and airblast overpressure.

6.3 Blast prediction methodology

GHD have adopted the above blast monitoring results to use in predictions of the ground vibration and airblast overpressure over varying distances on the assumption that the blast parameters would be representative of the conditions at Slys Quarry for future blasting. GHD has adopted this information assuming that the blast procedure and vibration monitoring were undertaken with consideration to the relevant publications and standards, including:

- Australian and New Zealand Environment Conservation Council (ANZECC), "*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*" (1990).
- Australian Standard AS 2187.2 – 2006, "Explosives – Storage, transport and use. Part 2: Use of explosives".

Estimations for ground vibration and airblast overpressure during blasting have been made with consideration to Australian Standard AS2187.2-2006.

6.3.1 Airblast calculations

Airblast radiates outwards from the blast site and attenuates with distance.

Airblast levels have been estimated using the following cube root scaling formula:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a \qquad \textbf{Equation (1)}$$

Table 6-4 summarises the constants in Equation (1) and the values that have been assumed to estimate airblast levels, based on the provided monitoring results.

Table 6-4 Airblast parameters and assumptions

Parameter	Definition	Assumed value
P	Pressure (kPa)	N/A
Q	Explosive charge mass per hole (kg)	116.0 (1)
R	Distance from charge (m)	Range: 530 to 1864
a	Site exponent	-1.70
Ka	Site constant	55.1 (2)

1. Charge mass has been adopted from the blast design and evaluation report provided in Appendix C.

2. Ka site constant has been determined by using the known airblast pressure level, site exponent, charge mass and distance from the blasting contractor and GHD monitoring results provided.

6.3.2 Ground vibration calculations

Ground vibration radiates outwards from the blast site and gradually reduces in magnitude with distance from the blast.

Factors that affect the level of ground vibration arriving at a point from a blast typically include:

- Charge mass fired per hole.
- Distance.
- Ground transmission characteristics.

Ground vibration levels have been estimated using the following formula.

$$V = K_g \left(\frac{R}{Q^{1/2}} \right)^{-B} \qquad \textbf{Equation (2)}$$

Table 6-5 summarises the constants in Equation (2) and the values that have been assumed to estimate ground vibration levels, based on the provided monitoring results.

Table 6-5 Ground vibration parameters and assumptions

Parameter	Definition	Assumed value
V	Ground vibration in Vector Peak Particle Velocity (VPPV) (m/s)	N/A
R	Distance from charge (m)	Range: 530 to 1864
Q	Maximum charge mass (kg)	116.0 (1)
Kg, B	Constants related to site and rock properties for estimation purposes	Kg = 1389 (2) B = 1.8

1. Charge mass has been adopted from the blast design and evaluation attached as Appendix C

2. Kg site constant has been determined by using the known ground vibration level, site exponent, charge mass and distance.

6.4 Predicted results

Figure 12 displays a plot of airblast overpressure and ground vibration against distance from the blast. These plots have been based on the assumptions and values outlined above in Table 6-4 and Table 6-5.

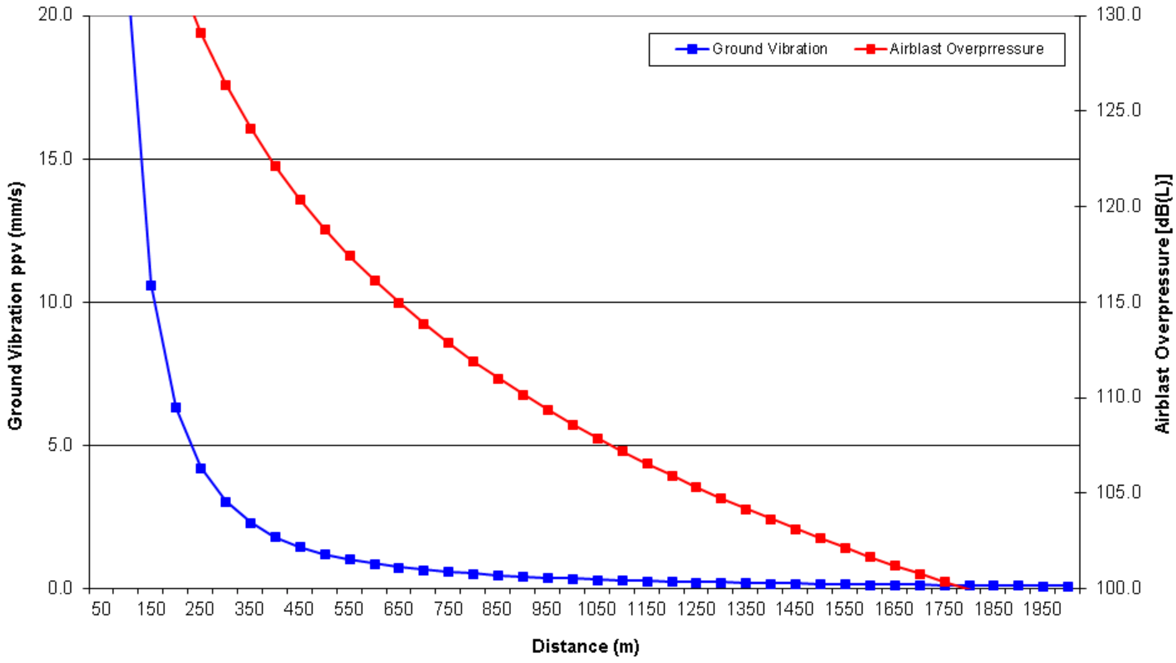


Figure 12 Estimated ground vibration and airblast overpressure levels from blasting

Based on the assumptions outlined above, estimated ground vibration and airblast levels from blasting suggest that, on average, the recommended limits of 5 mm/s and 115 dB(L) would be achieved at a minimum distance of approximately 250 m and 650 m respectively from the blast location. The nearest receivers are located approximately 1500 m from potential blasting locations. Therefore, based on assumptions above, it is expected that the blasting guidelines should be met at all receivers if blasting techniques are similar to those used during the blast in which measurement data was recorded at Slys Quarry on 13 November 2014.

However, due to variability in blasting impacts, it is recommended that the blasting contractor continues to conduct monitoring during blasts at the site to confirm predictions and assess compliance with the ground vibration and airblast overpressure limits.

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods, therefore should not affect blasting during the recommended standard operating hours. Prevailing winds can vary throughout the year and on a day-to-day basis. To assist in the reduction of airblast overpressure propagation, blasting should not be conducted when the prevailing winds are blowing towards the nearest residential receivers.

6.4.1 Predicted blasting buffer distances

Air blast overpressure and ground vibration has been predicted for a range of charge masses and are shown in Figure 13 and Figure 14 for varying distances and assuming average blasting parameters. The distance to comply with the *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZECC, 1990) are also shown.

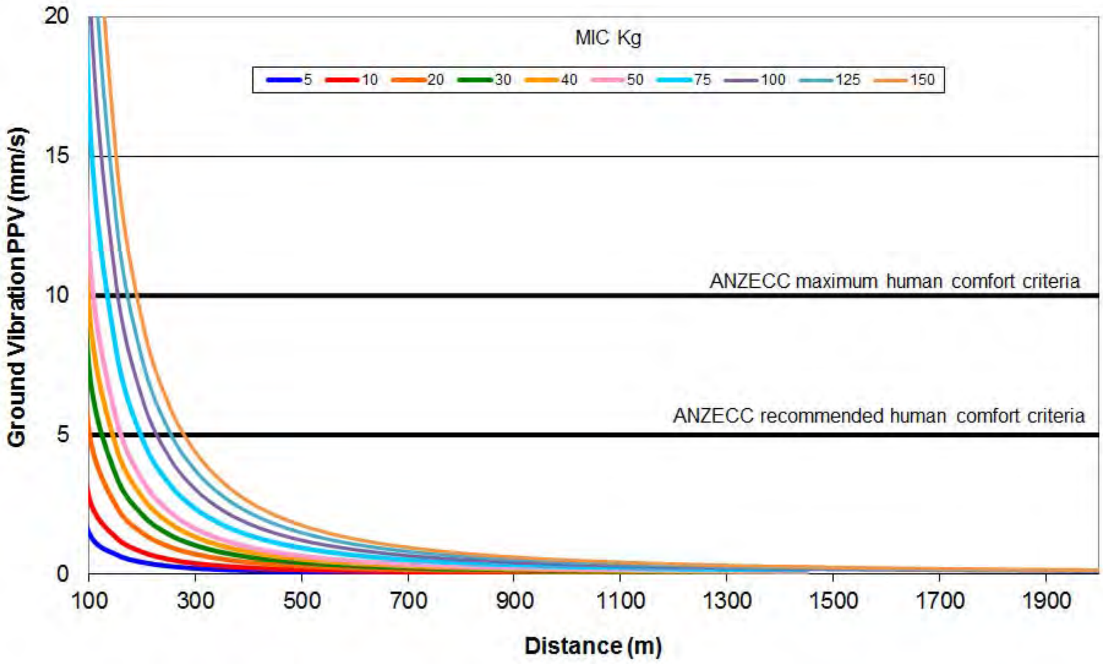


Figure 13 Ground vibration predictions for different charge masses and distances

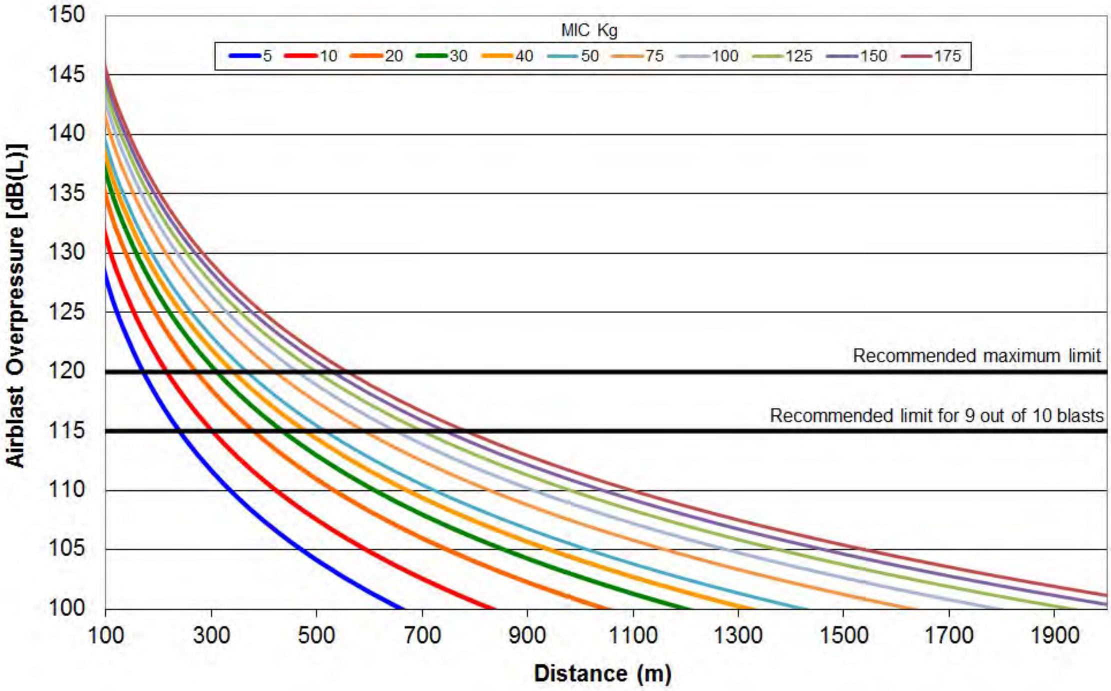


Figure 14 Air blast overpressure predictions for different charge masses and distances

6.4.2 Assessment of blasting impacts

The predicted results shown in Figure 13 and Figure 14 indicate that blasting would be restricted by the air blast overpressure rather than the ground vibration levels.

Although the exact location of blasting is not known at this stage of the project, if it were to occur it would most likely be located in areas moving further away from sensitive receptors than currently experienced. The nearest sensitive receivers are over 1,500 metres away, therefore blasting impacts based on the above parameters are expected to comply with the blasting criteria.

Although blasting impacts are not anticipated, mitigation such as reduced maximum instantaneous charge may be employed to minimised potential airblast overpressure impacts. Further methods to reduce the impact of airblast overpressure are provided in Section 7.2.

It is recognised that the design of blast would be up to the blast contractor and that the above information has been assumed for this assessment only, in the absence of specific information regarding future blasting at the proposed site.

Once the exact location and details of blasting is known, the distance to the receiver should be used for the charge mass estimate. Blast monitoring should then be undertaken to assess compliance, determine the site specific blast parameters and confirm the predictions.

6.4.3 Potential future sensitive receivers

Based on the assessment of current blast activities, the recommended limits of 5 mm/s and 115 dB(L) would be achieved at a minimum distance of approximately 250 m and 650 m respectively from the blast location. The nearest existing receivers are located approximately 1500 m from potential blasting locations. Future sensitive receivers located beyond 650 m from the blast location are unlikely to experience adverse impacts from blast events. If future sensitive receivers are located within 650 m of blast locations, further assessment would be required. Coordination with the blasting contractor may also be required to limit the MIC per blast.

7. Mitigation measures

7.1 Specific noise mitigation measures

Noise modelling predictions indicate marginal compliance of the operational noise criteria at receiver R3 when the rock hammer is used during peak daily production.

Noise predictions have been based on a number of conservative assumptions and model configurations, such as peak production rate and haul truck movements. For these reasons, it is likely that actual site noise on a day-to-day basis would be lower than the predicted values. Therefore, it is recommended that compliance noise monitoring be undertaken to verify the predicted noise levels. Compliance noise monitoring is discussed further in Section 7.5.

The following discussion around potential noise mitigation measures is provided to demonstrate how compliance with the adopted noise goals can be achieved. The requirements for noise mitigation have been based on operating Scenario 1, peak daily production while also operating the rock hammer. Table 7-1 provides a breakdown of the individual contributions to the total noise levels the most affected receivers for peak daily production respectively. Note that individual contributions will depend on the working location of each machine.

The results of Table 7-1 can be used to identify where noise mitigation would be most efficient at reducing total noise levels from site operations. Analysis of operational noise levels indicates that crushers, rock hammering and screens are the primary noise sources.

Due to the availability of material within the quarry, one of the most effective and practical measures of mitigating noise levels from the crushing and screening plants during average and peak daily production is to construct and maintain earth mounds around the processing areas, thus providing shielding effects to noise propagation off site. Earth mounds should be located to intersect the line-of-sight between the noise source and the receivers. An alternative method of shielding the crushing and screening plant would be to use shipping containers. It is recommended to stack two shipping containers on top of each other in the direction of the most exposed sensitive receivers to achieve the required height for effective shielding.

Additionally, an acoustic screen could be erected around the working area of the excavator during rock hammering operations. This acoustic screen would be positioned to intersect the line-of-sight between the noise source and the receivers. This would be particularly beneficial during times where rock hammering activities are being conducted while two crushers are operating.

Table 7-1 Partial noise levels (Scenario 1) – peak daily production with rock hammer operating

Source	Individual noise contribution L_{eq} dB(A)										
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11
Screen QE440	22	22	29	21	20	20	18	16	17	17	19
Crusher Komatsu	21	21	27	19	18	17	16	14	15	14	15
Rock hammer	16	16	27	18	17	17	15	14	15	14	16
Crusher McCloskeyj50	21	21	27	18	17	17	16	14	15	15	16
Komatsu pc710-5	12	13	23	8	12	12	8	9	9	9	10
Screen QA340	13	13	20	12	11	10	9	7	7	7	7
FEL KOMATSU WA400	9	9	18	10	9	9	7	6	7	6	8
FEL KOMATSU WA470	16	15	18	11	10	9	8	6	7	6	8
FEL 90zv	16	15	18	10	10	9	8	6	7	6	8
Dog and trailers	12	12	18	8	8	7	6	4	5	4	6
Excavator pc350-8	8	8	14	6	5	5	3	1	2	1	2
Excavator pc350-8	6	7	14	6	5	4	3	1	2	1	3
Light vehicles	6	6	8	2	1	0	0	0	0	0	0
Generator Cummins	0	0	4	0	0	0	0	0	0	0	0
Water cart	0	0	2.4	0	0	0	0	0	0	0	0
Generator Able	0	0	0.3	0	0	0	0	0	0	0	0
Total	**28**	**28**	**35**	**26**	**25**	**25**	**23**	**22**	**23**	**22**	**24**

7.2 Blasting mitigation measures

It is recommended that all sensitive receivers be informed when blasting is to be undertaken. Reducing charge mass and increasing distance is the most effective way of reducing blasting impacts. Blasting should only occur from 10 am to 4 pm, Monday to Friday and should not generally take place more than once per day.

Once the exact location and details of blasting is known, the distance to the receiver should be used for the charge mass estimate.

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods, particularly during winter periods and therefore should not affect blasting during the recommended standard hours.

Due to variability in blasting impacts, it is recommended that monitoring be undertaken during initial blasts at the site to confirm predictions and assess compliance with the ground vibration and airblast overpressure limits.

7.3 Work ethics

All site workers would be sensitised to the potential for noise impacts on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities. This would include:

- Where practical, machines would be operated at low speed or power and switched off when not being used rather than left idling for prolonged periods.
- Keep truck drivers informed of designated vehicle routes, parking locations and delivery hours.
- Avoid dropping materials from height and avoid metal to metal contact on material.
- All engine covers would be kept closed while equipment is operating.

7.4 Community relations

Consultation and cooperation with the neighbours to the site would assist in minimising uncertainty, misconceptions and adverse reactions to noise. It is recommended the following community relation measures be implemented:

- The quarry manager would erect a sign at the entrance of the quarry with a phone number and permanent site contact so that noise complaints can be received and addressed in a timely manner.
- Upon receipt of a noise complaint, noise monitoring would be undertaken and reported as soon as possible. If exceedances are detected, the situation would be reviewed in order to identify means to attempt to reduce the impact to acceptable levels (i.e. 45 dB(A) or 35 dB(A), depending on the receiver location).

7.5 Compliance noise monitoring

Noise measurements could not be taken of all quarrying equipment during visits to the site. In addition the shape of the quarry and precise location of noise sources relative to the pit wall would also affect the propagation of noise from the site. This creates a level of uncertainty in noise model predictions, which is common in most predictive assessments. Due to the marginal level of compliance at R3, it is recommended that compliance noise monitoring be undertaken during quarry operations to verify noise model predictions and confirm compliance with the adopted noise criterion. Compliance noise monitoring should also be undertaken following receipt of a complaint relating to noise emissions from the site.

The results of compliance noise monitoring would be used to determine the requirement to implement or increase noise mitigation measures such as earth mounds/shipping containers. Noise monitoring would be undertaken with consideration to the NSW INP.

Noise monitoring should be conducted following any change in operating conditions that are likely to increase noise emissions from the site (such as a sudden increase in production rate or heavy vehicle movements) or move noise sources significantly closer to noise sensitive receivers.

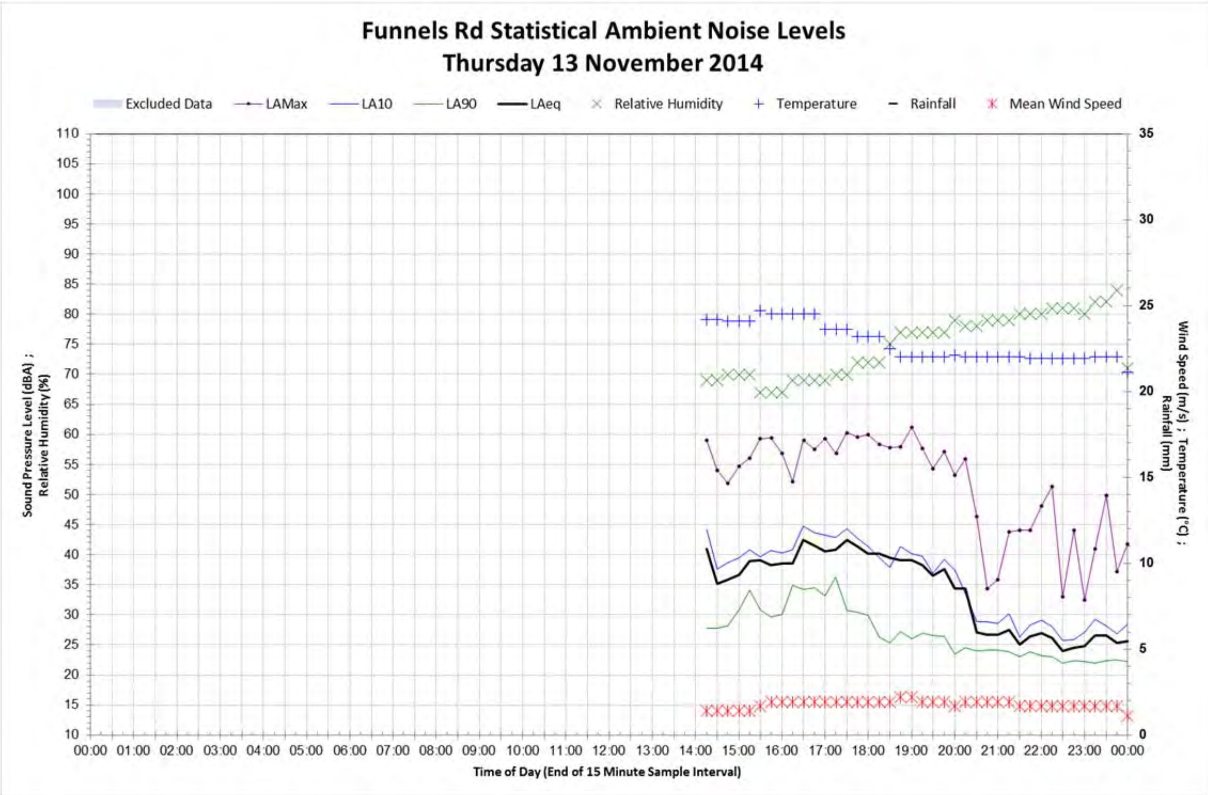
8. Conclusion

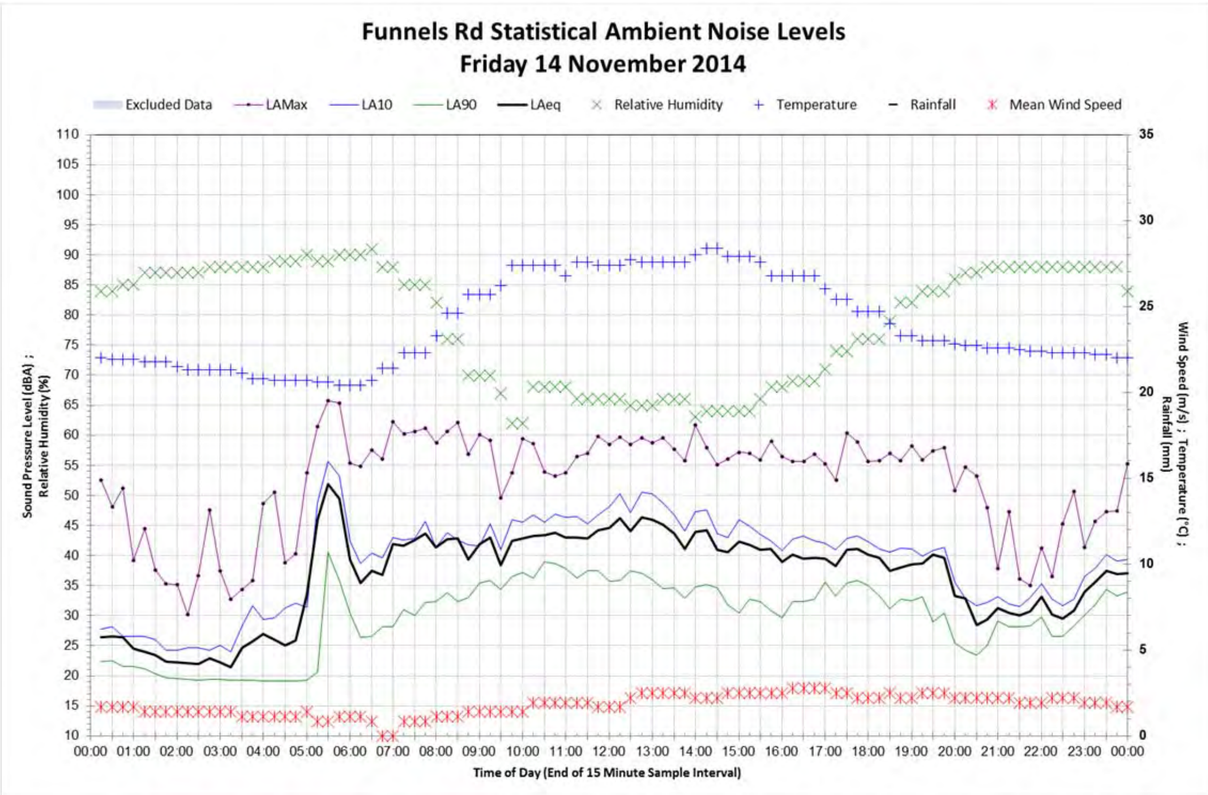
An assessment of the potential noise impacts from current and future operations at Slys Quarry has been undertaken. This assessment has led to the following conclusions, which are subject to the limitations outlined in Section 1.3:

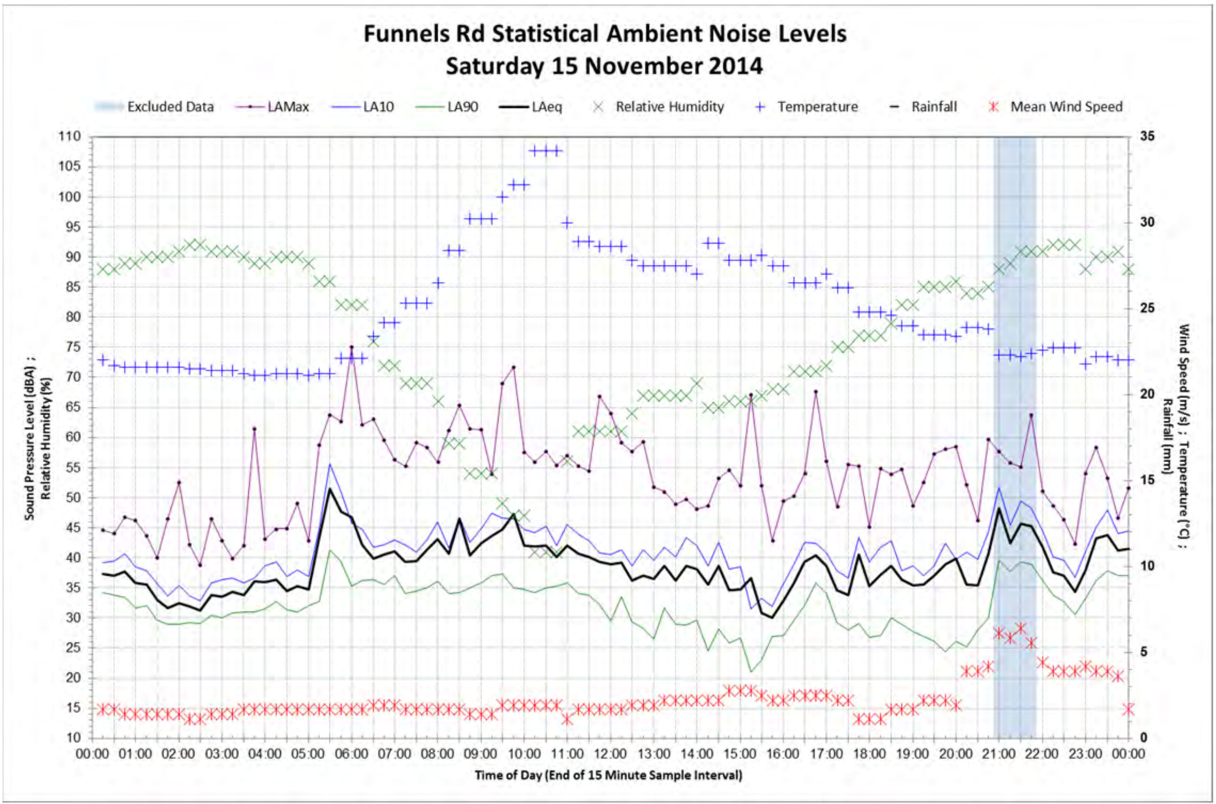
- Existing noise levels in the area surrounding the site are low and typical of a rural environment. Receivers R1 and R2 are much closer to the Pacific Highway than the other receivers, and as such, background levels measured here were dominated by road noise.
- An operational noise criterion of 45 dB(A) $L_{eq(15\ min)}$ derived from Logger 1 was adopted at receivers located close to the Pacific Highway.
- An operational noise criterion of 35 dB(A) $L_{eq(15\ min)}$ derived from Logger 2 was adopted at all other receivers.
- The operational noise assessment has been undertaken based on a worst-case operating scenario, with all equipment operating at maximum sound power levels.
- The noise assessment indicates that the noise levels due to operation of the quarry are expected to meet the adopted noise criteria at all identified sensitive receivers with the rock hammer operating. The noise assessment indicates that undertaking rock hammering during peak daily production will result in marginal compliance at receiver R3. Compliance monitoring is recommended to confirm predictions.
- An analysis of noise mitigation requirements to achieve compliance at all identified receivers has been undertaken. The crushers, screens and rock hammering activities were identified as being the primary noise sources, and thus mitigation measures should target these activities for greatest affect. Using quarry material or other structures to block the line-of-sight between these activities and receivers would be the most effective and practical mitigation measures to implement.
- The predicted growth in quarry traffic along Jackybulbin Rd due to peak production operations was investigated using the United States EPA's Intermittent Traffic Noise guidelines. This model indicated road noise along Jackybulbin Road would comply with the RNP criteria at all assessed sensitive receivers However, the increase in heavy vehicle traffic is expected to be noticeable to receivers R1 and R2, and may cause annoyance.
- Based on the blast data taken at Slys Quarry noise and vibration impacts from blasting are expected to, on average, comply with the adopted criterion at all receivers, providing the distance to the nearest receiver is used to determine charge mass. It is recommended that a blasting contractor be engaged to continue monitoring to confirm compliance.
- Further recommendations have been provided in Section 7 to assist in minimising potential noise impacts.

Appendices

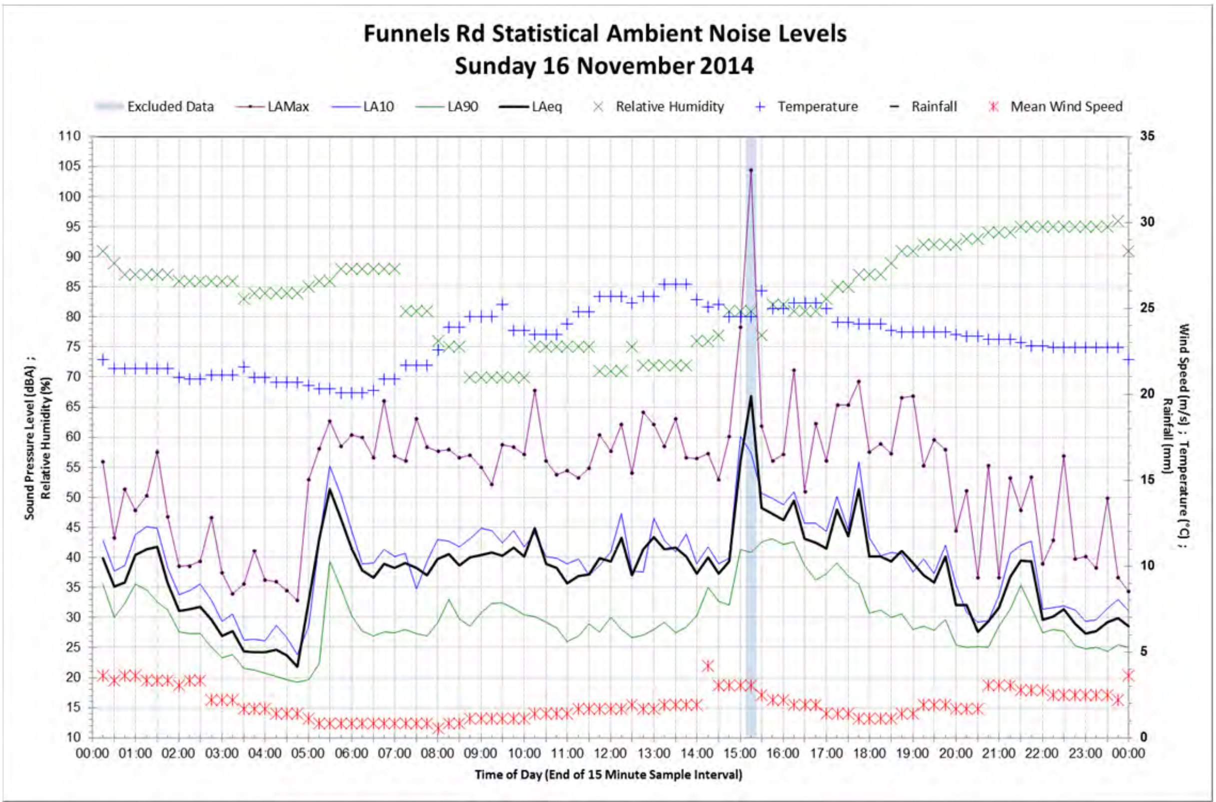
Appendix A – Unattended noise monitoring charts







Funnels Rd Statistical Ambient Noise Levels
Saturday 15 November 2014
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)



Funnels Rd Statistical Ambient Noise Levels
Sunday 16 November 2014
Excluded Data
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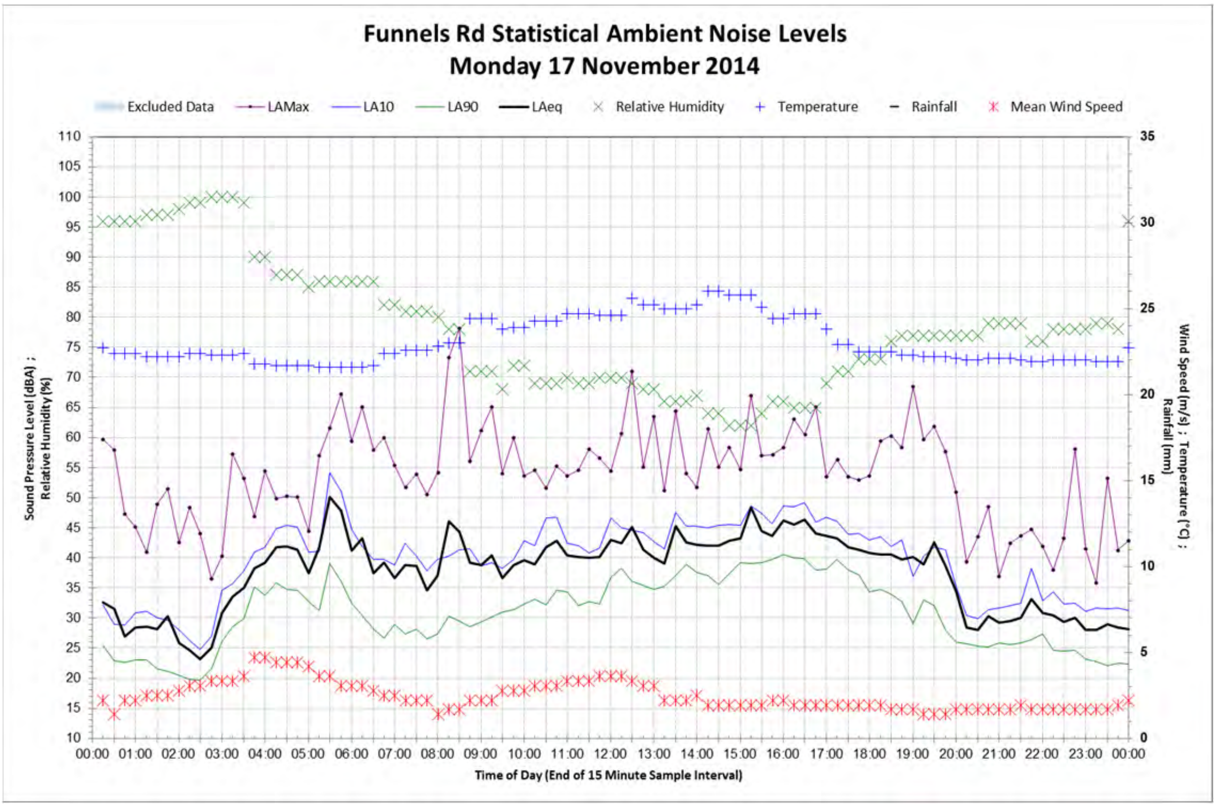
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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LA90
LAeq
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Temperature
Rainfall
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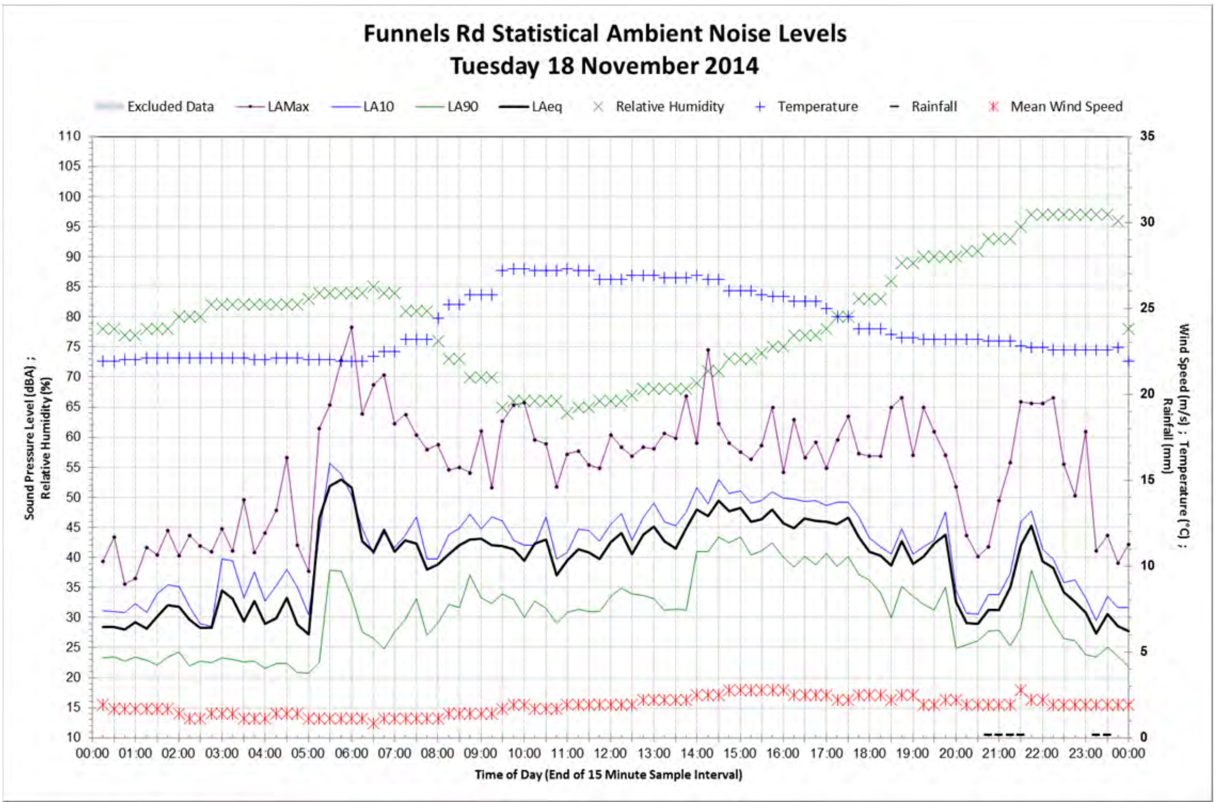
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Tuesday 18 November 2014
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LA90
LAeq
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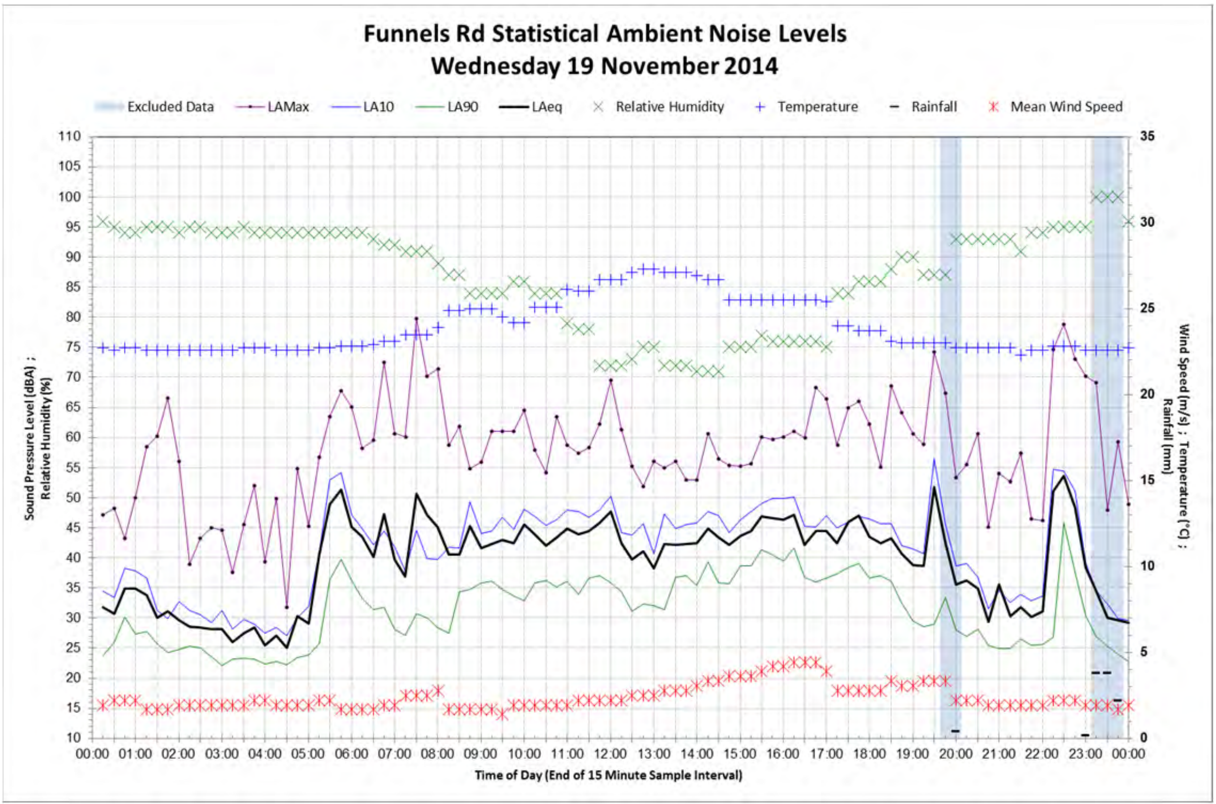
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Wednesday 19 November 2014
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LAeq
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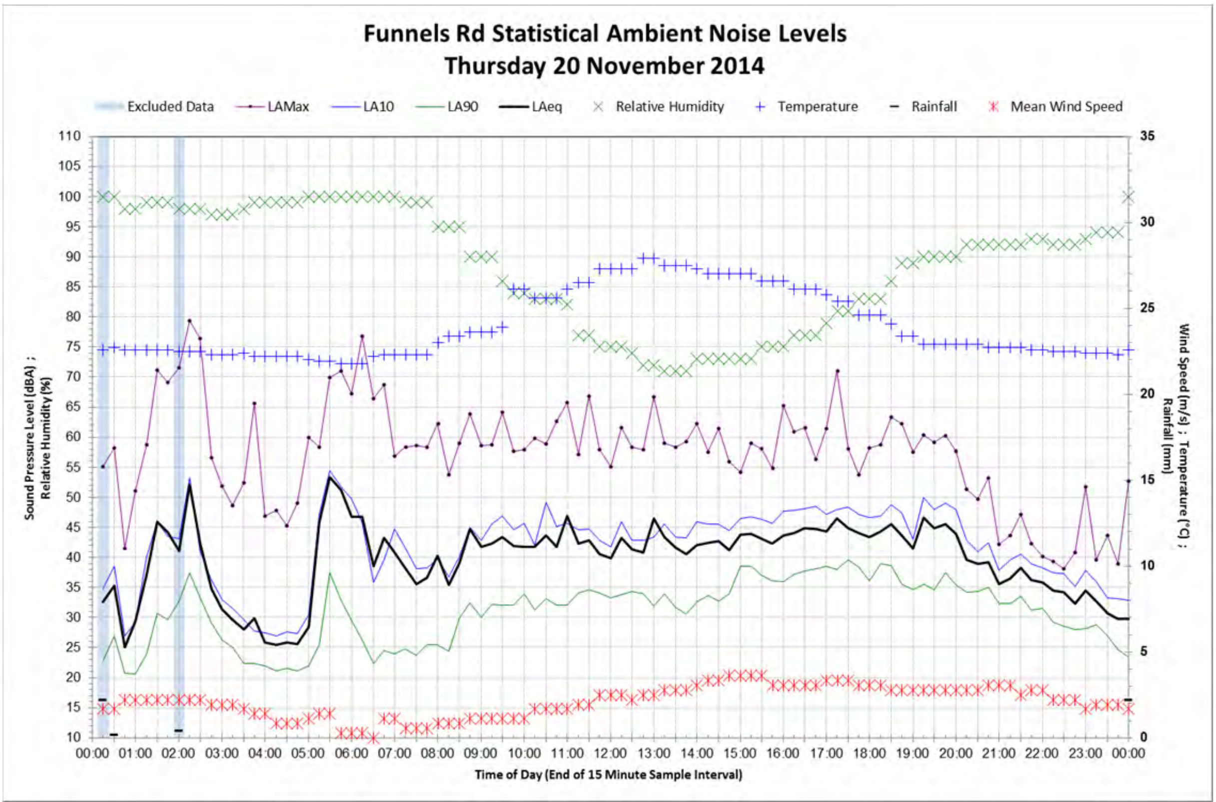
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Thursday 20 November 2014
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LA90
LAeq
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Temperature
Rainfall
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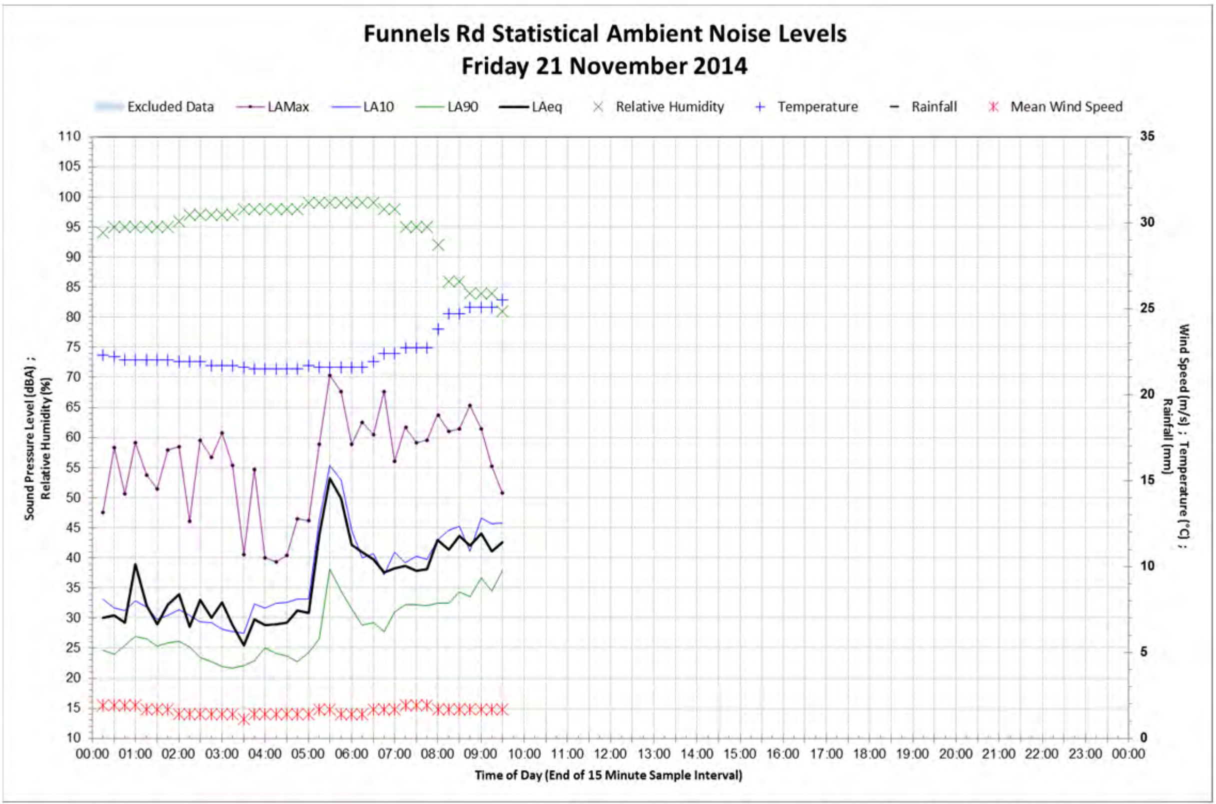
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)



Funnels Rd Statistical Ambient Noise Levels
Friday 21 November 2014
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LA90
LAeq
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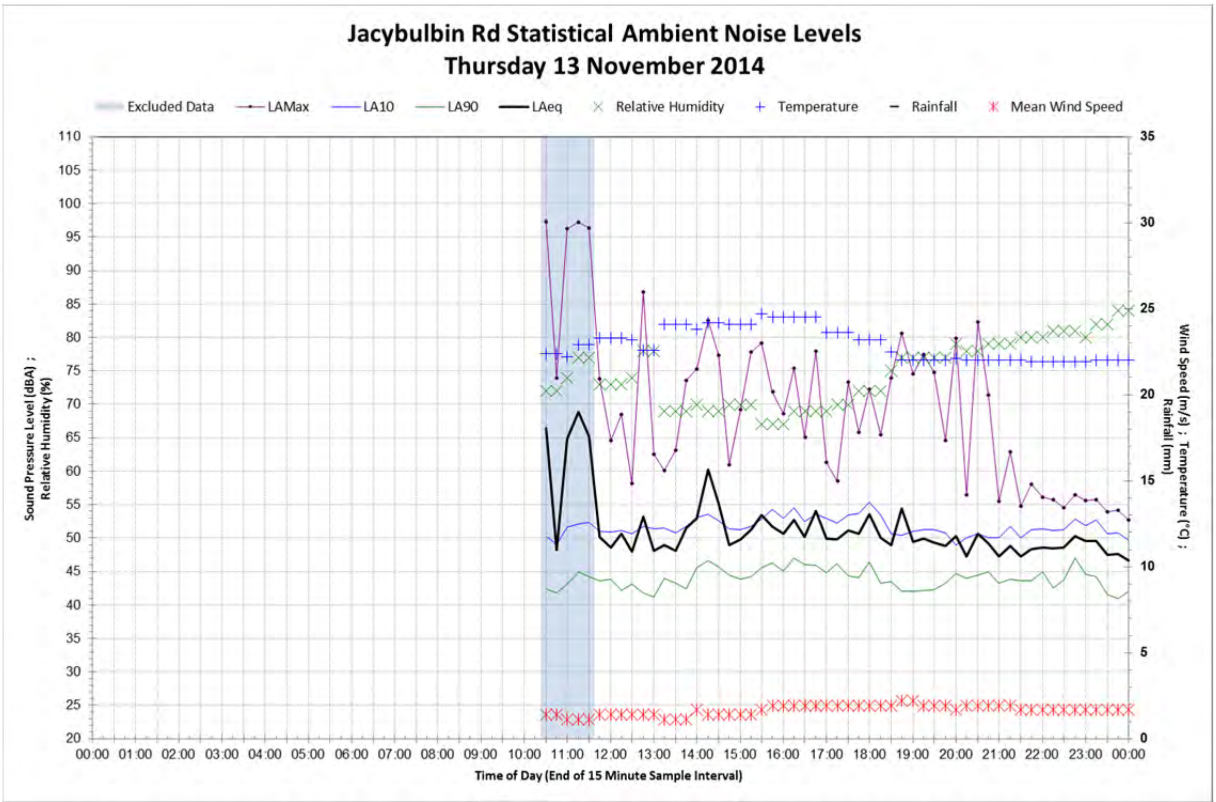
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)



Jacybulbin Rd Statistical Ambient Noise Levels
Thursday 13 November 2014
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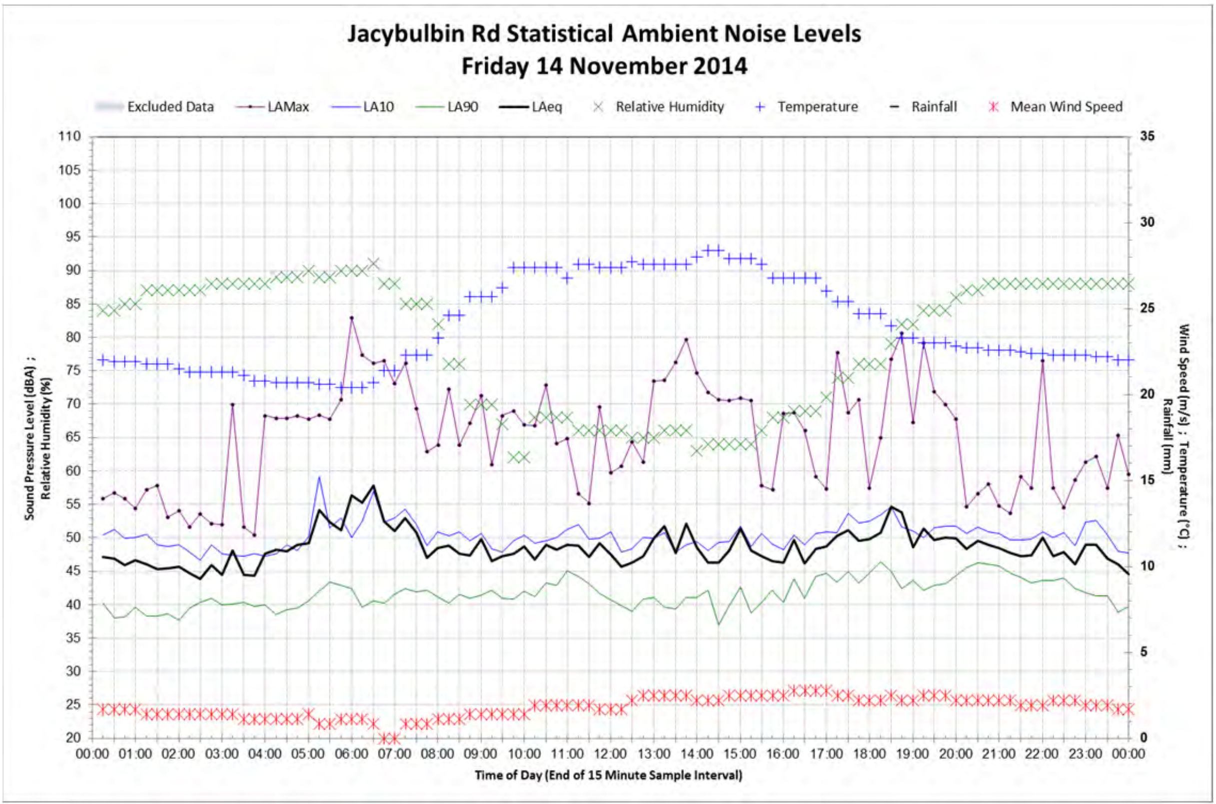
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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LAeq
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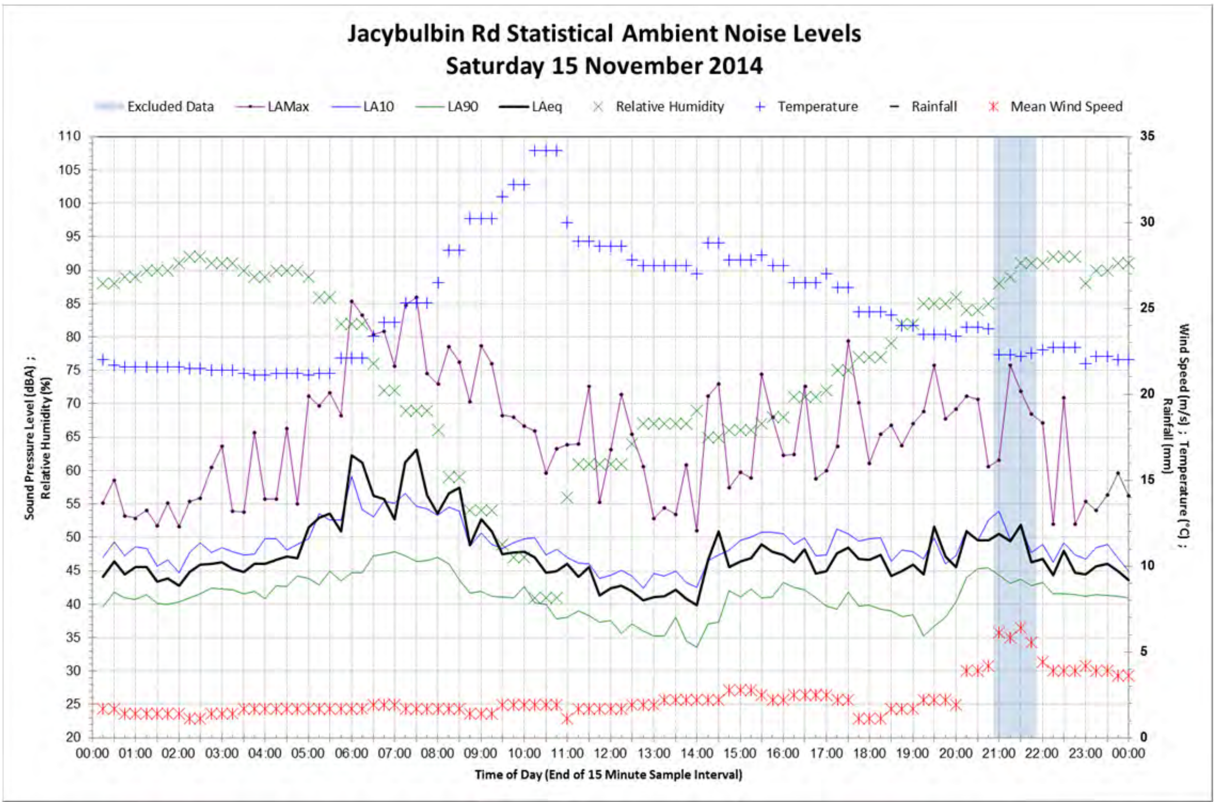
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Saturday 15 November 2014
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LA90
LAeq
Relative Humidity
Temperature
Rainfall
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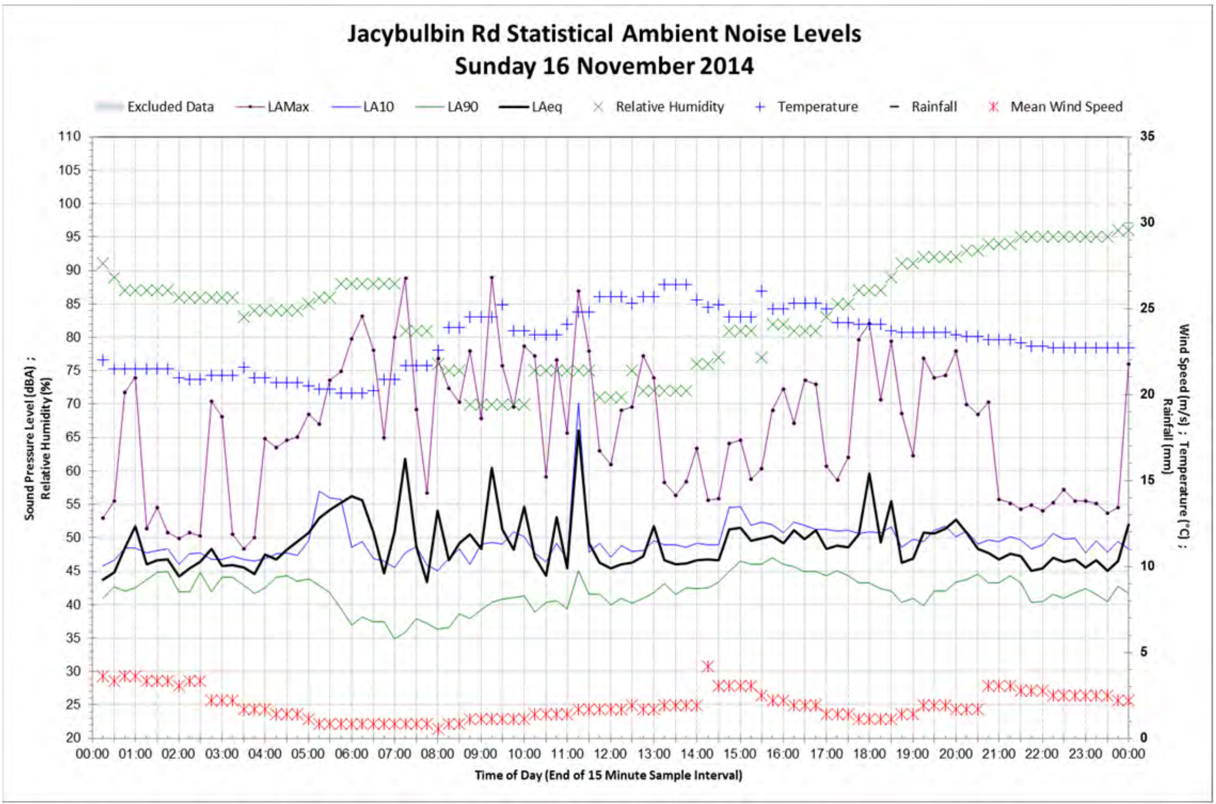
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)



Jacybulbin Rd Statistical Ambient Noise Levels
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LAeq
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Temperature
Rainfall
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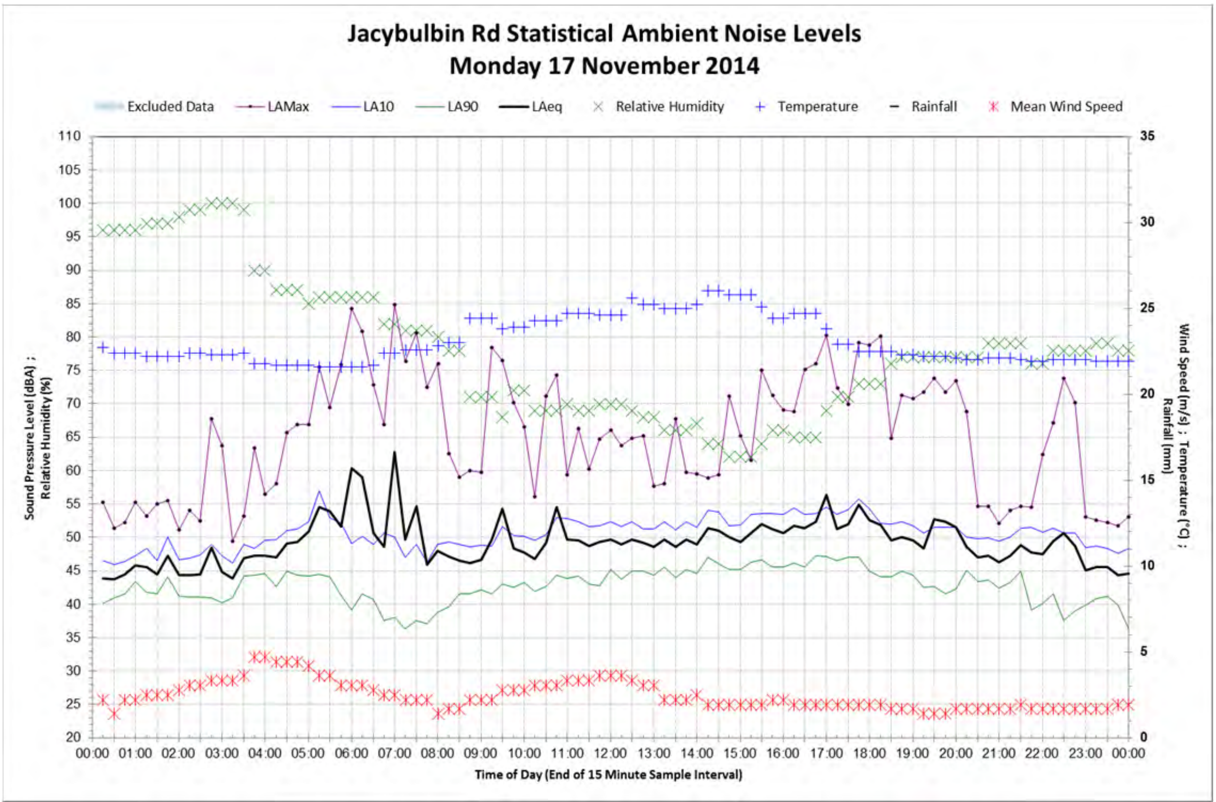
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)



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LAeq
Relative Humidity
Temperature
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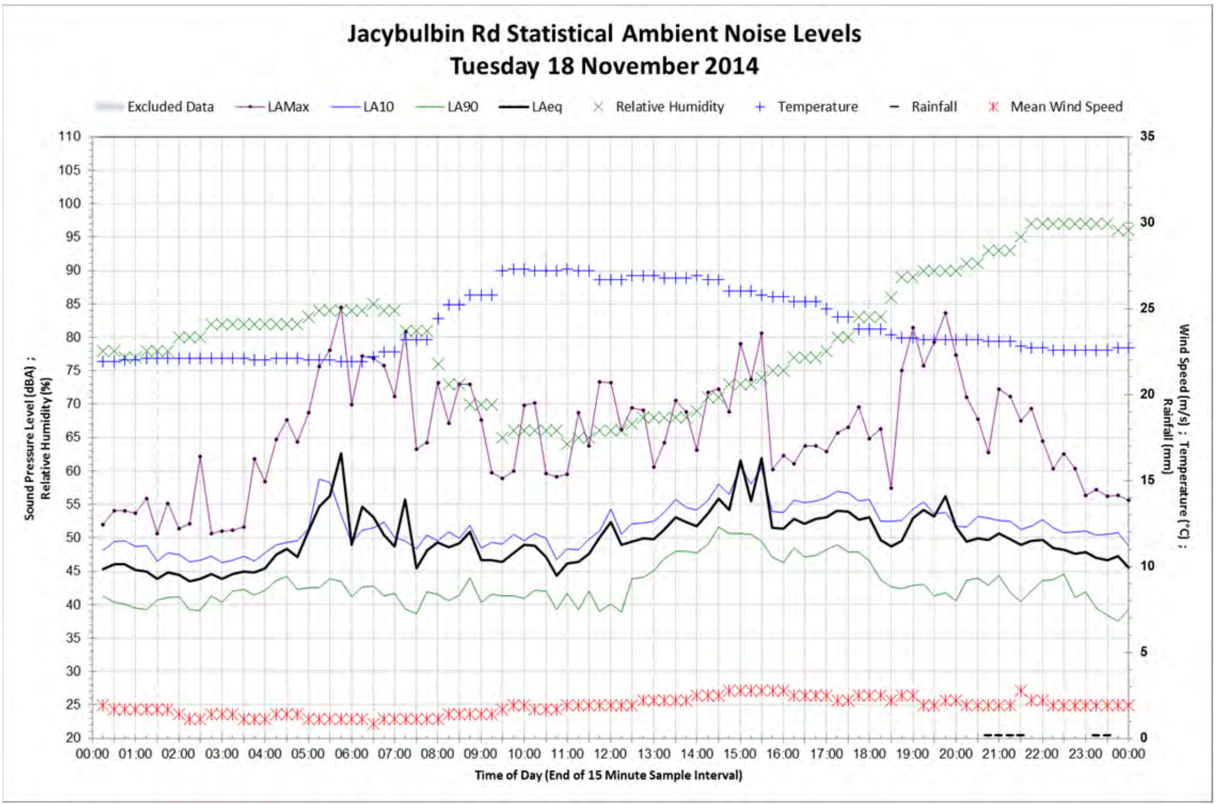
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)



Jacybulbin Rd Statistical Ambient Noise Levels
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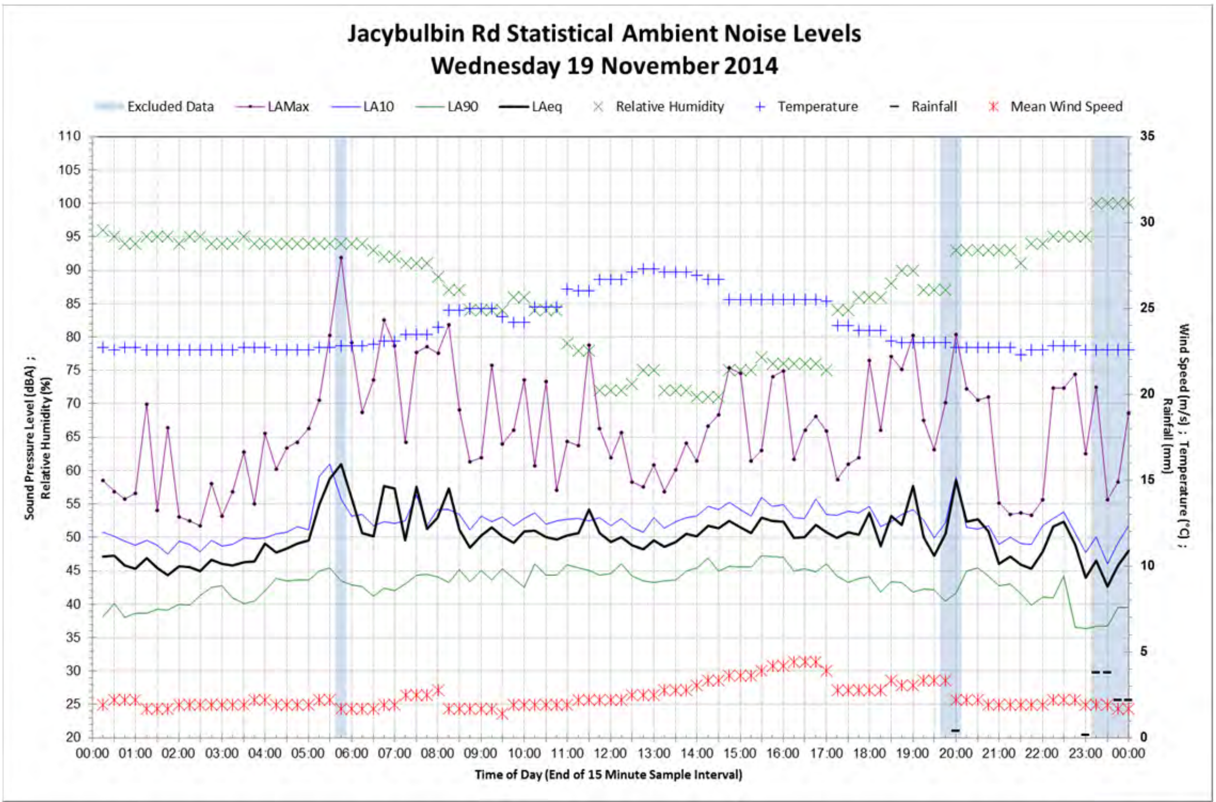

Jacybulbin Rd Statistical Ambient Noise Levels
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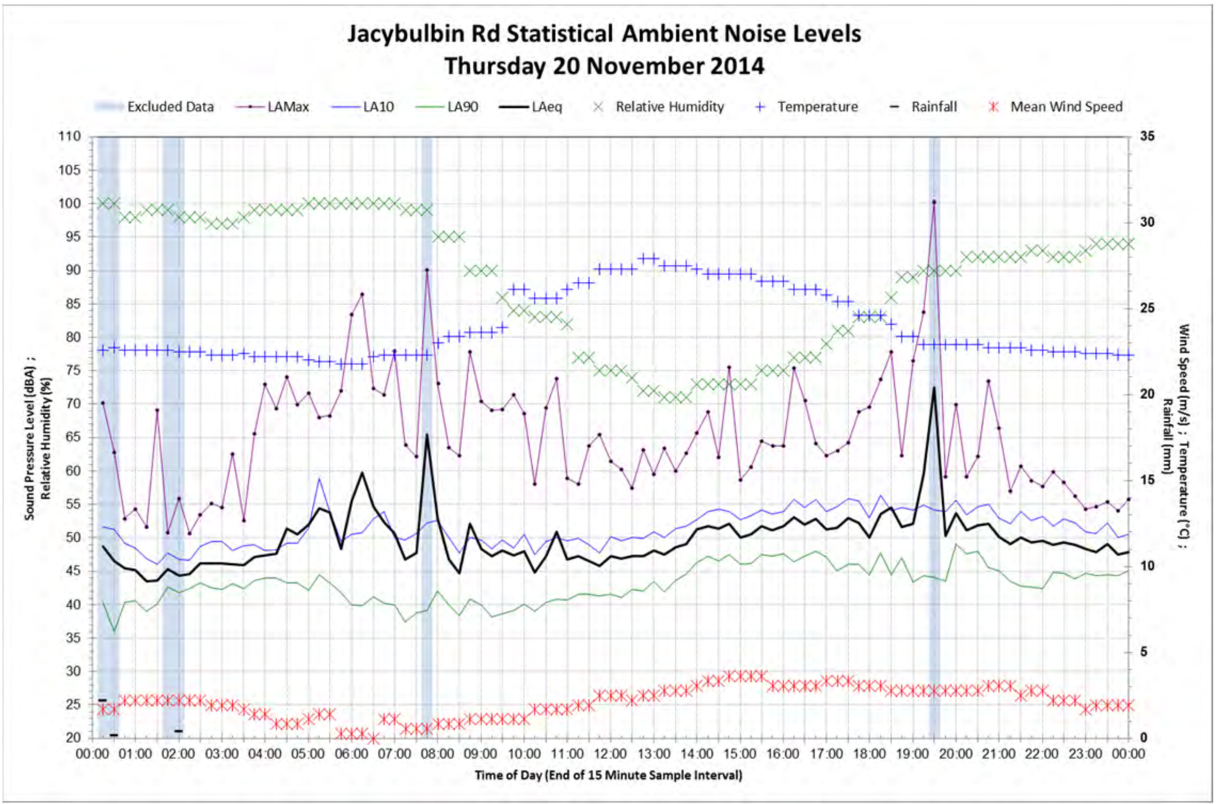
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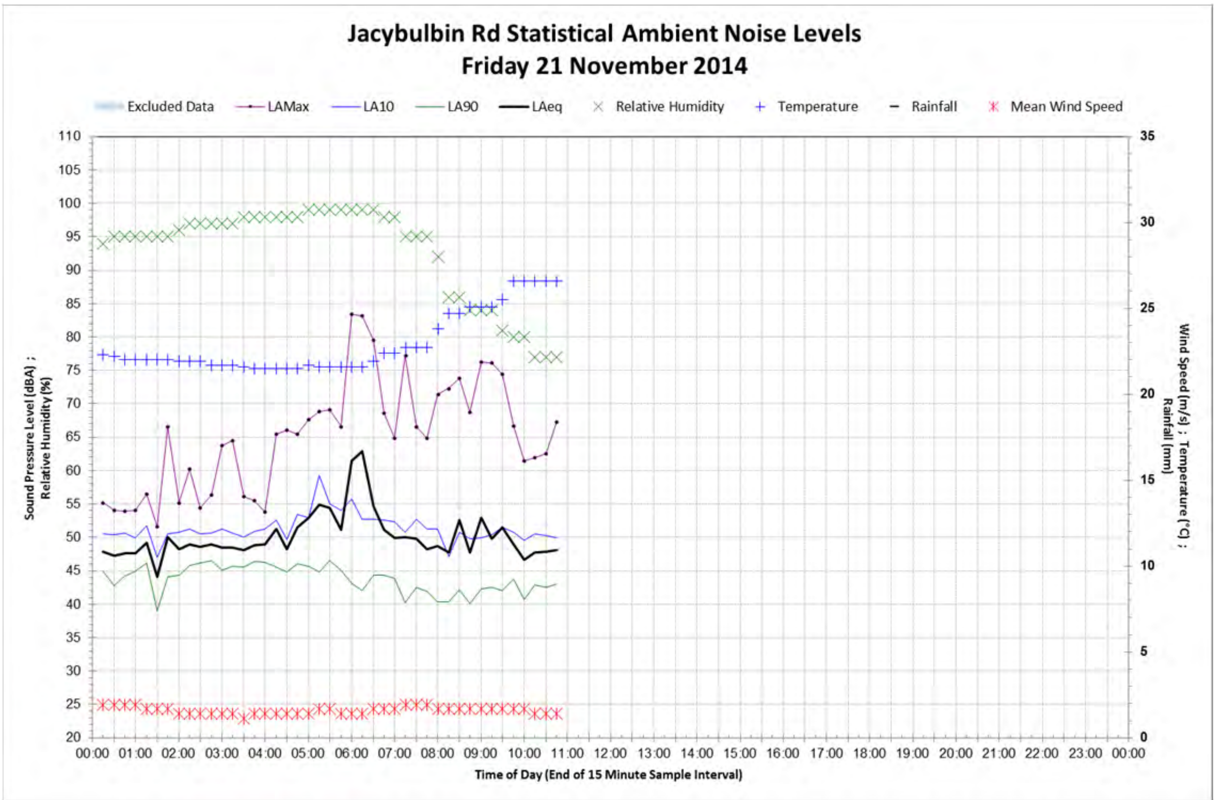
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Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Appendix B – Proposed expansion plans

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date

GHD
Level 8, 180 Lonsdale Street, Melbourne VIC 3000 Australia
T 61 3 8687 8000 F 61 3 8687 8111
E melmail@ghd.com.au W www.ghd.com

DO NOT SCALE

Drawn	S. Verhellen	Designer	
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client: **Newman Quarrying**
Project: **Slys Quarry**
Title: **Proposed Quarry Expansion**

Original Size A1 | Drawing No: **22-17528-001** | Rev:

Appendix C – Contractor blast design and evaluation report

G:\22\1752803\Technical\Noise and vibration\Slys quarry blasting\Blasting sheet_contractor

G:\22\1752803\Technical\Noise and vibration\Slys quarry blasting\Blasting Contractor Monitoring Results

RON SOUTHON PTY LTD
Drilling and Blasting Contractors

PO Box 48
ALSTONVILLE NSW 2477

ABN: 81 067 549 339

Ph: 02 6628 0477
Fax: 02 6628 1756
Mobile: 0407 752 003
Email: shot2@hotkey.net.au

BLAST SUMMARY RECORD

Customer: NEWMANS QUARRY

Date: 13 / 11 / 14 Time: 1.30pm

Quarry: TULLYMORGAN Position in Quarry: MIDDLE BENCH

Weather Condition: FINE

Elect: INITIATION Nonel Delay Nos: 17's & 42's

No of Holes per Delay: 1 Mic: 116kg

Total Exp: 2600kg P.F: 1.04 p/t

Stemming Height: 1m Stemming Material: 10mm AGGREGATE

Pattern: 2.5m X 2.5m

Hole Size: 89mm

No of Holes: 28 Sub Drill: 0.5m

Avg. Depth of Holes: 14.16m Total Lin.Metres: 396.5 L/m

Measurements (m^3): 14.16m X 7.5m X 23.33m

Total CubicMetres: 2477.6 m^3

Payment: Lineal ☐ Cubic ☒

Extra Cost: Wet Products: EZIPUMP EMULSION

EXPLOSIVES	
Explosive Type	Total Explosives Used (kg)
Dry	Dry
Wet EZIPUMP EMULSION	Wet 2600 kg
	Total 2600 kg
GROUND AND AIR VIBRATION	
Peak Particla Velocity (mm/s)	0.783 mm/s & 0.17 mm/s
Air Overpressure (dBL)	88 dBL & 112 dBL
Distance to Geophone (m)	

Compiled by:	NICK CHILCOTT

Gate.

Instantel®

INSTANTEL BlastMate III

Serial Number	BA10184 V 10.20-8.17
Trigger Source	Geo 0.510 mm/s
	Mic 105.0 dB(L)
Geo Range	254.0 mm/s
Record Time	1.0 s at 1024 sps
newmans quarry	tullymorgan
front gate	
RON SOUTHON P/L	
General:	
Extended Notes	

Trigger Long at 12:09:07 Nov 13 14

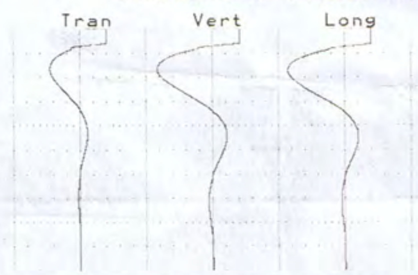
	Tran	Vert	Long	
PPV	0.635	0.635	0.635	mm/s
ZC Freq	19	27	15	Hz
Time	0.125	0.354	0.201	sec
Accel	0.0265	0.0265	0.0265	g
Pk Disp	0.00707	0.00484	0.00831	mm

PVS 0.783 mm/s at 0.211 Sec

PSPL 88.0 dB(L) at 0.352 Sec
>100 Hz

2.00 mm/s/div 5.00 pa.(L)/div

SENSORCHECK CALIBRATION



FT=7.7 OT=3.8 FV=7.5 OV=3.7
FL=7.5 OL=4.0 FM=19.7 PM=528
Tran, Vert, Long, MicL Passed
Battery Level: 6.2 Volts

Calibration Name	Standards & Testing
Calibration	October 21, 2014

Format Copyrighted 1996-2010 Instantel

Half Way.

INSTANTEL DS477 BLASTMATE

SERIAL #	3106 V 5.51		
CLIENT	newmans quarry tully morgan		
LOCATION			
USER			
TRIG SOURCE	geo	or	mic
TRIG LEVEL	1.97 mm/s		110 dB(L)
RECORD TIME	1 s		
NOTES:			

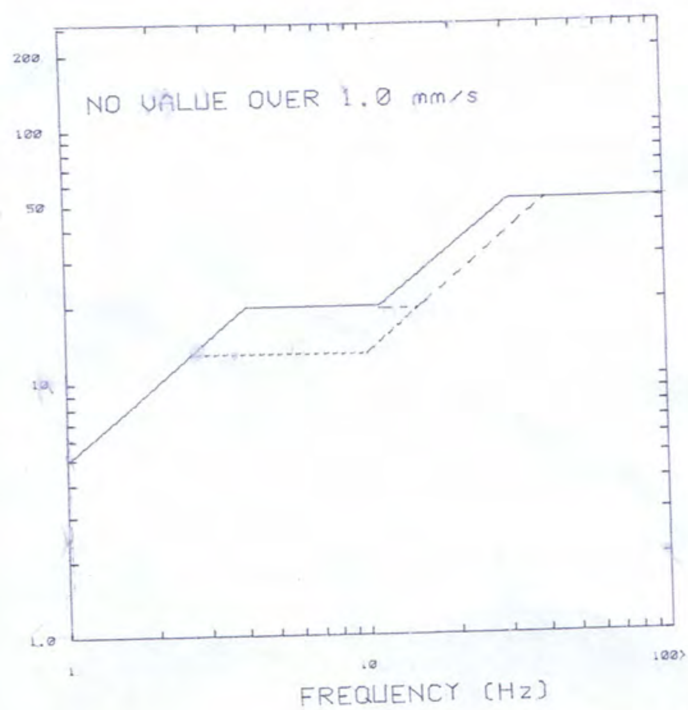
TRIGGERED mic. at 12:10:25
13 Nov. 2014

	TRAN	VERT	LONG	
PPV	0.00	0.13	0.13	mm/s
FREQ	N/A	N/A	N/A	
TIME	2	-94	-1	ms
ACCEL	0.00	0.01	0.01	g
PK DISP:	0.000	0.000	0.000	mm

PVS 0.17 mm/s at 154 ms

PK AIR O/P 112 dB(L) at 120 ms
FREQ N/A

USBM RI8507 AND OSMRE ANALYSIS
ALL GROUND CHANNELS(mm/s)



GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	A Rees	C Evenden		S Lawer		18/03/2015
1	A Rees	C Evenden		S Lawer		24/04/2015

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