Taroborah Coal Project

Appendix 17 – Noise Impact Assessment

Taroborah Coal Project

Noise Impact Assessment

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Prepared for

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Table of Contents

Table of Figures and Tables

Figures

Tables

1 Introduction

Shenhuo International Group Pty Ltd (Shenhuo) proposes to develop the Taroborah Coal Project (MDL 467), a combined open-cut and underground coal mine. ASK Consulting Engineers Pty Ltd (ASK) was commissioned by AustralAsian Resource Consultants (AARC) to carry out the noise and vibration assessment for the construction and operation of the proposed Taroborah Coal Project. The proposed operation is located approximately 22 kilometres west of the township of Emerald, as shown on **Figure 1.1** (source: Google Earth Pro).

The purpose of this report is as follows:

- Present background noise level data obtained by ASK.
- Determine appropriate noise and vibration criteria for the project.
- Determine the noise emission levels of the proposed fixed and mobile plant.
- Determine vibration levels due to blasting operations.
- Assess operational and construction noise and vibration levels in accordance with the nominated noise and vibration criteria.
- Provide recommendations for inclusion in the EIS.

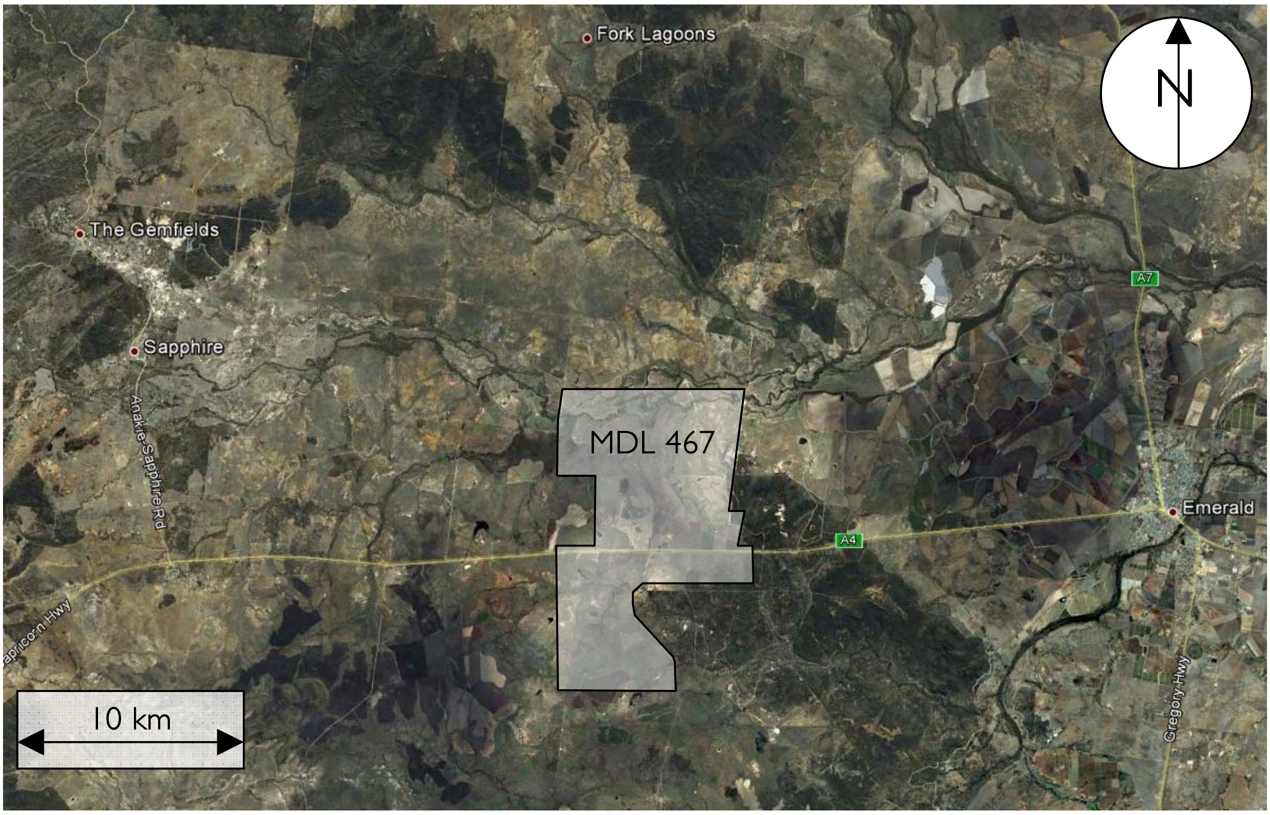


Figure 1.1 Location of Taroborah Coal Project

2 Study Area Description

The Taroborah Coal Project (MDL 467) is located on the western edge of the Bowen Basin in central Queensland, approximately 22 kilometres west of Emerald.

The site location is shown in Figure 2.1 (source: Google Earth Pro). The site is currently vacant, and generally consists of cleared land.

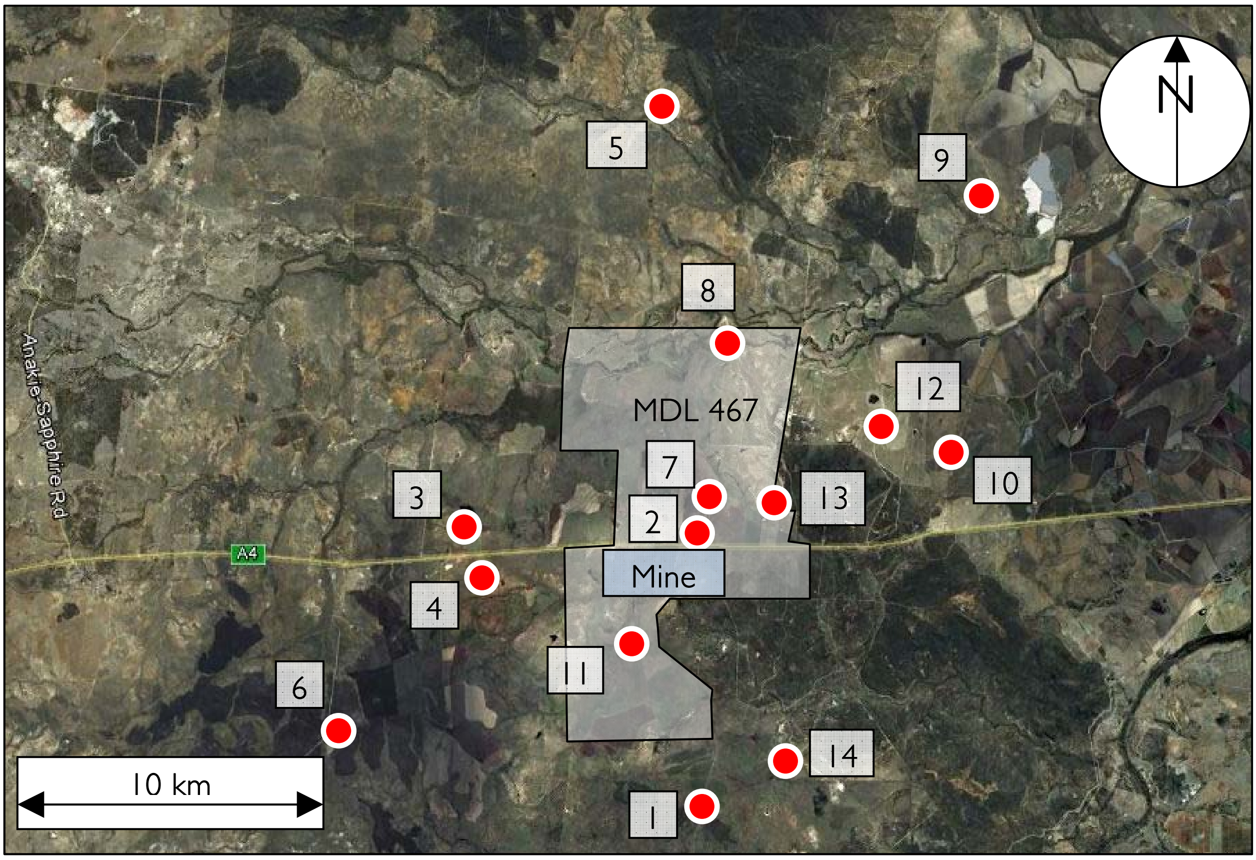


Figure 2.1 Location of MDL 467, Mine and Nearest Sensitive Receivers 1 to 14

The nearest sensitive locations are summarised in Table 2.1 including their northing and easting locations. The receiver locations are included in Figure 2.1. The closest receiver to the above-ground section of the mine (Donnelly, Receiver 2) is approximately 200 metres away from the active mining area to the north-east and is within the MDL 467 tenement area.

Table 2.1 List of Noise Sensitive Receivers and Distance from Proposed Pit and Coal Preparation Plant (CPP)

Receiver	Homestead	Direction From Mine	Approximate Distance (km)		Coordinates (UTM) GDA Zone 55	
			From Proposed Pit	From Coal Preparation Plant	Easting	Northing
1	Airlie	South	6.8	8.2	596588	7387748
2	Donnelly	North	0.2	2.6	596450	7396228
3	Dunloe	West	6.0	5.1	589085	7396597
4	Fairways	West	5.3	4.3	589734	7395104
5	Fork Lagoons	North	14.3	14.9	595365	7410405
6	Glendarriwell	South-West	12.1	11.2	584109	7390151
7	Iona Downs	North	0.7	3.0	596686	7396790
8	Jabiru	North	7.1	8.5	597530	7403116
9	Kingower	North-East	14.2	17.0	606399	7407103
10	Selma	East	8.0	11.5	605237	7398595
11	St Helens	South	2.4	2.4	594379	7393033
12	Sypher	North-East	6.6	10.0	602818	7400147
13	Walther	North-East	2.5	6.0	599728	7397238
14	Wilga Downs	South	5.2	7.9	598993	7389546

3 Project Description

3.1 Project Description

The proposed maximum Run of Mine (ROM) from both open-cut and underground operations is 5.75Mtpa of coal to be mined over a period of 21 years. Mining and processing are planned to operate 7 days a week, 24 hours a day. The layout of the proposed mining operations is included in Figure 3.1.

3.2 Open-Cut Mine Methodology

The open-cut mine will use conventional truck and excavator methodology. The open-cut mining method proposed is described as follows:

- Excavators will load the mined material into haul trucks to be transported from the mining faces to the ROM pad or spoil dumps. The south-east dump will be used in Years 1 to 3, the south-west dump in Year 1 only, and the north-west dump in Years 1 and 2. In-pit dumping will occur from Year 2 onwards, and will be the sole form of dumping from Year 4 onwards.
- A combination of trucks and front end loaders direct tipping into a crusher, will size ROM coal onto a conveyor for transfer into the coal preparation plant (CPP).
- From the CPP, processed coal will be loaded onto product stockpiles via conveyor and radial stacker.
- Product coal will be loaded onto the train load out (TLO) conveyor and bin for eventual transport by train to the Wiggins Island Coal Export Terminal (WICET) at the Port of Gladstone for export.
- Service vehicles and water trucks will operate in the pit and on the haul roads.

3.3 Underground Mine Methodology

The underground mine will use longwall mining methodology. The underground mining method proposed is described as follows:

- Coal will be cut from the mining face by shearer and transported via conveyor from the mining face to the surface via a portal to be located in the north-west corner of the open-cut pit.
- Coal from underground mining will be stockpiled, processed and handled in a similar way to the coal from the open-cut mining.
- Product coal will be loaded onto the train load out (TLO) conveyor and bin for eventual transport by train to the WICET for export.

The majority of equipment will be underground and of no acoustic significance. It is expected that the equipment located above ground for underground operations has a noise output less than that of the open-cut fleet nominated. Two exhaust vent fans have been added to the proposed mine equipment list, although only one would generally be operational at any one time (the other fan functioning as a backup).

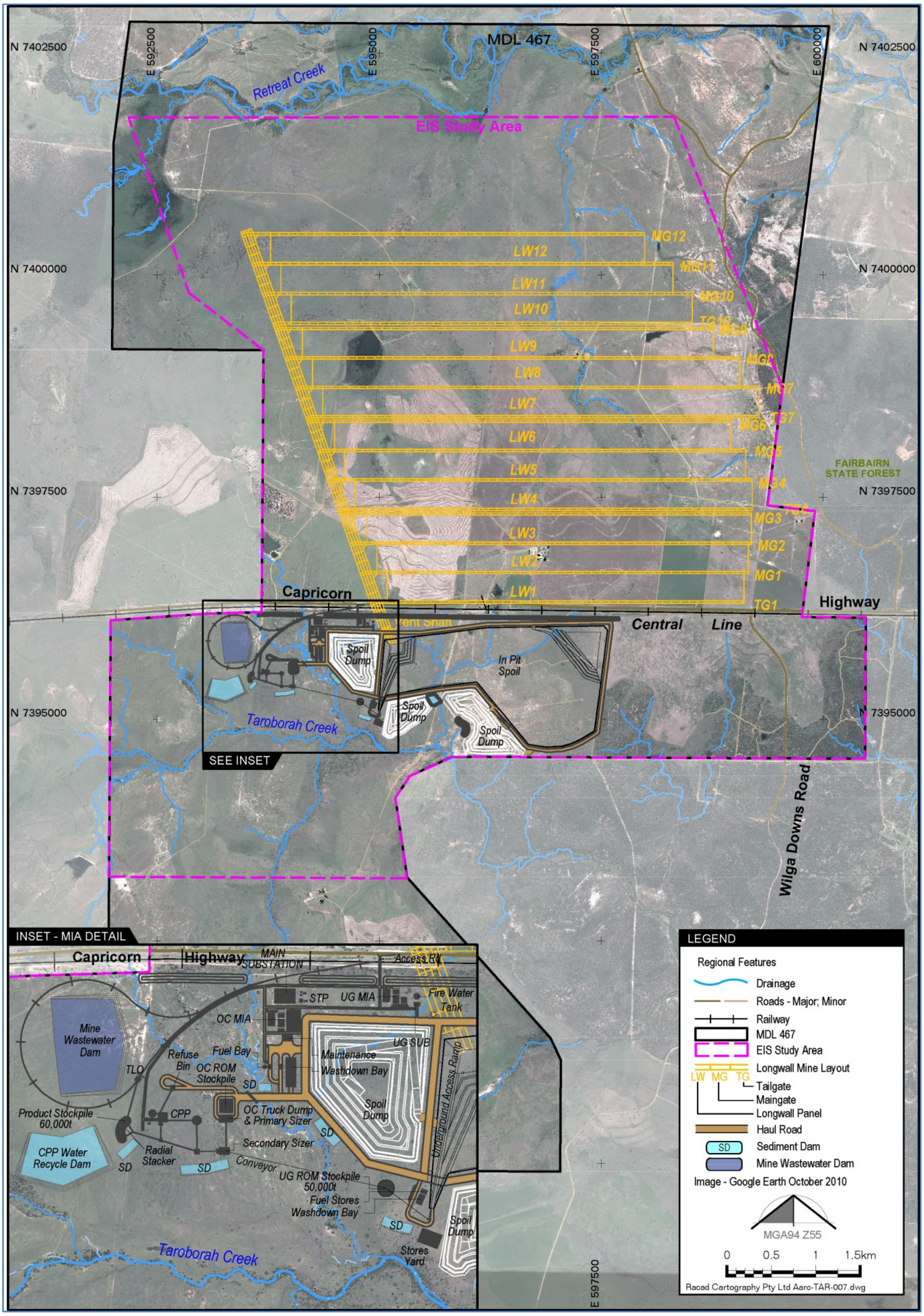


Figure 3.1 Layout of Mining Operations

The proposed surface-based mobile mine equipment is listed in Table 3.1.

Table 3.1 Proposed Surface Based Mobile Mine Equipment

Equipment	Mining Year								
	1	2	3	4	5	6	7	8	9 to 21
Waste Mining									
Hitachi EX5500 Excavator	1	2	3	3	3	3	2	N/A	
Coal Mining									
Komatsu PC1600 Excavator	1	1	1	1	1	1	1	N/A	
CAT 988 Loader	1	1	1	1	1	1	1	N/A	
Waste Haulage									
CAT 789 Truck	6	13	12	14	13	14	12	N/A	
CAT Water Truck	1	1	1	2	2	2	2	N/A	
Coal Haulage									
CAT 777 Truck	2	2	2	2	2	2	2	N/A	
Support Plant									
CAT D11 Track Dozer	1	1	1	1	1	1	1	N/A	
CAT 824C Wheel Dozer	1	1	1	1	1	1	1	N/A	
CAT 16M Grader	1	2	2	3	3	3	3	N/A	
CAT D9 Track Dozer	1	1	1	1	1	1	1	1	1
Loadout									
Trains Per Day	0.3	0.7	0.9	1.1	1.1	1.2	1.8	2.8	2.9

The proposed surface-based fixed equipment includes:

- Coal handling: Comprised of primary sizer (400 tph through to Year 7), secondary sizer (400 tph through to year 6, and 750 tph thereafter), and transfer stations, conveyors, conveyor drives, etc.
- Radial stacker (750 tph).
- CPP: Wash plant (250 tph) operating 8 to 12 hours per day during daylight hours only.
- Underground Vent Fans: Two fans operational from Year 5, of which only one would generally be operational at any one time.
- Rail loadout: Conveyor and train loading bin operating for approximately 2 hours during train loading only.

4 Existing Noise Environment

4.1 Overview

Both attended and un-attended noise monitoring of the existing noise environment were conducted in April 2012.

Environmental noise logging was conducted using four Larson Davis LD831 Environmental Noise Loggers. The instruments were setup for 15 minute intervals as per the Queensland Department of Environment and Heritage Protection (EHP) Noise Measurement Manual.

Attended noise measurements were also undertaken using a Rion NA-27 Sound Level Meter.

A glossary of acoustic terminology is included in Appendix A.

The monitoring was conducted with the noise loggers at four (4) of the closest noise sensitive receivers to the future mining operations as follows (refer Figure 2.1):

- Location A: Located at Lot 14 on RP881318 (Iona Downs property). The coordinates for this site are: (GDA 94) E 596817, N 7396850. Noise monitoring was conducted from the 19/04/12 to the 27/04/12.
- Location B: Located at Lot 4 on PT352 (St Helens property). The coordinates for this site are: (GDA 94) E 594373, N 7393065. Noise monitoring was conducted from the 19/04/12 to the 27/04/12.
- Location C: Located at Lot 24 on DN40201 (Walther property). The coordinates for this site are: (GDA 94) E 599708, N 7397230. Noise monitoring was conducted from the 19/04/12 to the 27/04/12.
- Location D: Located at Lot 76 on PT372 (Jabiru property). The coordinates for this site are: (GDA 94) E 597528, N 7403121. Noise monitoring was conducted from the 19/04/12 to the 27/04/12.

4.2 Unattended Noise Logging Results

Plots of the unattended noise levels are included in Appendix B as Figures B.1, B.2, B.3 and B.4.

The noise levels are expressed in terms of the L_{eq}, L_{10}, and L_{90}. The L_{10} and L_{90} are respectively the A-weighted noise levels which are exceeded 10%, and 90% of the time. The L_{eq} is the A-weighted energy average noise level containing the same acoustic energy as the actual fluctuating noise level.

Plots of the L_{90} noise levels, by time of day, are shown in Appendix B as Figures B.5, B.6, B.7 and B.8.

The ambient L_{eq}, L_{10}, and L_{90} levels measured onsite are included in Table 4.1. The noise levels are expressed in terms of the maximum, minium and average levels, in addition to the highest (top) 10% of noise levels, and the lowest (low) 10% of noise levels. It should be noted that only complete measurement periods have been included within the analysis.

Table 4.1 Summary of Measured Noise Levels

Location	Statistic	L_{10}, dBA			L_{90}, dBA			L_{eq}, dBA		
		Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
A	Max	70	61	88	70	58	70	70	58	80
	Min	31	35	20	26	24	17	28	30	18
	Top 10%	54	52	51	44	48	44	49	49	46
	Low 10%	34	42	28	29	36	19	30	38	24
	Average	45	47	41	37	43	32	41	44	36
B	Max	65	59	52	47	42	36	63	59	45
	Min	34	23	18	27	20	17	30	21	18
	Top 10%	48	46	41	43	34	27	45	40	34
	Low 10%	39	26	19	31	23	18	34	25	19
	Average	44	37	29	38	29	21	40	34	26
C	Max	60	58	85	47	52	74	53	54	91
	Min	36	33	27	29	25	20	31	28	23
	Top 10%	51	54	50	46	50	45	47	50	46
	Low 10%	41	43	35	33	37	27	37	39	30
	Average	46	50	43	39	45	37	42	46	39
D	Max	67	62	52	55	61	43	63	59	55
	Min	29	38	19	23	29	18	26	33	19
	Top 10%	50	56	44	36	46	38	45	48	40
	Low 10%	32	40	21	25	34	19	28	37	21
	Average	41	46	33	29	41	27	36	43	31

The background noise levels have also been calculated using the EHP lowest 10th percentile method (minL_{90} noise levels) for each measured period (day, evening and night) and are listed in **Table 4.2**. These EHP derived background noise levels differ from the 'Low 10%' L_{90} levels in **Table 4.1** as the EHP derived levels represent the specific approach of the EHP lowest 10th percentile method, which determines the lowest 10th percentile for each day and then reports the value corresponding to the median day.

Table 4.2 Measured Background Noise Levels (EHP Lowest 10th Percentile Method)

Location	Background Noise Level, minL_{90}, dBA		
	Day	Evening	Night
A	31	36	20
B	31	24	18
C	33	43	27
D	25	35	19

4.3 Attended Noise Monitoring

Attended noise measurements were conducted on the 19/04/12 and 20/04/12 at noise logger Locations A, B, C and D. Measurements were undertaken to understand the current background noise environment and assist with interpreting the noise logger results. Field notes from attended measurements are summarised in Table 4.3.

Noise measurements were undertaken using a Rion NA27 Type 1 sound level meter with current calibration certification, and which was field calibrated before and after noise measurements.

Table 4.3 Field Notes from Attended Noise Measurements

Date	Time & Duration	Location	Results and Notes
Thursday 19/04/12	2:06pm (15 mins)	A	Fine, Light breeze. Distant Capricorn Highway Traffic 26 – 46 (Truck) dBA Wind through grass 30 - 40 dBA Some insect noise approx 29 dBA Some banging & grinding noise from homestead shed approx 30 dBA Some bird noise. L_{10} 39 dBA, L_{90} 29 dBA
	3:11pm (15 mins)	B	Fine, Light S breeze. Insect noise 30 - 42 dBA Some distant horse noise (no level measurable) L_{10} 39 dBA, L_{90} 29 dBA
	4:31pm (15 mins)	C	Fine. Insect noise 34 - 48 dBA Utility vehicle entering property 40 – 60 dBA Some bird noise. Dogs present on property but not audible during measurement period. L_{10} 46 dBA, L_{90} 36 dBA

Date	Time & Duration	Location	Results and Notes
	5:37pm (15 mins)	D	Fine. Insect noise 29 - 38 dBA Bird noise 35 - 45 dBA Some noise from homestead cows and pigs L_{10} 39 dBA, L_{90} 29 dBA
Friday 20/04/12	1:41am (30 mins)	A	Fine. Truck on Capricorn Highway 39 - 52 dBA Insect noise 21 - 33 dBA Train (slow moving) 37-47dBA Truck and Train together approx 53 dBA Some dog noise 32 - 51 dBA Some cow noise L_{10} 44 dBA, L_{90} 23 dBA
	2:50am (30 mins)	B	Fine. Some bird noise 17 - 26 dBA Truck on Capricorn Highway 19 - 37 dBA Some cow noise 25-39 dBA Some insect noise but not measurable L_{10} 28 dBA, L_{90} 17 dBA
	3:54am (30 mins)	C	Fine. Capricorn Highway Traffic 18 - 45 dBA Mechanical plant noise 26 - 30 dBA (set on a timer, occurred 4 times during measurement period running for approximately 2 minutes each time) Some minor insect noise 20 - 22 dBA Some dog noise 19 - 47 dBA Some bird noise. L_{10} 34 dBA, L_{90} 20 dBA

Date	Time & Duration	Location	Results and Notes
	4:54am (30 mins)	D	Fine. Bird noise 20 - 40 dBA Some insect noise 17 - 23 dBA Distant Capricorn Highway noise 18 - 19 dBA Some horse noise but not measurable Noise from small pump no level recorded (only 2 second duration, occurred once during measurement period) L_{10} 19 dBA, L_{90} 18 dBA

5 Noise and Vibration Criteria

5.1 Overview

Noise and vibration criteria for the project need to address a number of potential noise impacts on existing and future residential receivers.

The assessment was undertaken in accordance with relevant legislation and criteria from the Department of Environment and Heritage Protection (EHP) as follows:

- Environmental Protection Act 1994.
- Environmental Protection (Noise) Policy 2008.
- EcoAccess Guideline "Planning For Noise Control".
- EcoAccess Guideline "Assessment of Low Frequency Noise".
- EcoAccess Guideline "Noise & Vibration from Blasting".

5.2 Environmental Protection Act 1994

In Queensland, the environment is protected under the *Environmental Protection Act 1994*. The object of the Act is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

The Act states a person must not carry out any activity that causes, or is likely to cause, environmental harm, unless the person takes all reasonable and practicable measures to prevent or minimise the harm. This is termed the 'general environmental duty'. Environmental harm is defined as any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value, and includes environmental nuisance. Environmental nuisance is unreasonable interference or likely interference with an environmental value caused by noise or vibration.

The Act describes a number of offences relating to noise standards, including building work, regulated devices (e.g. power tools), pumps, air-conditioning equipment, refrigeration equipment, indoor venues, outdoor events, amplifier devices other than at indoor venue or open-air events, power boat sports in waterways, operating power boat engines at premises, blasting, and outdoor shooting ranges.

The following noise sources are excluded from the Act – audible traffic signals, warning signals for railway crossings, safety signals from reversing vehicle, operating a ship, aircraft, public and state controlled roads, busway, light rail, rail, and non-domestic animals.

This Act refers to the Environmental Protection Policy (further details provided below) as being subordinate legislation to the Act.

5.3 Environmental Protection (Noise) Policy 2008

5.3.1 Overview

In respect of the acoustic environment, the object of the Act is achieved by the Environmental Protection (Noise) Policy 2008 (EPP (Noise)). This policy identifies environmental values to be enhanced or protected, states acoustic quality objectives, and provides a framework for making decisions about the acoustic environment.

5.3.2 Background Creep

The EPP(Noise) contains noise criteria for controlling background creep, which are to be applied "for an activity involving noise". The criteria are as follows:

To the extent that it is reasonable to do so, noise from an activity must not be—

a) *for noise that is continuous noise measured by $L_{A90,T}$—more than nil dBA greater than the existing acoustic environment measured by $L_{A90,T}$; or*
b) *for noise that varies over time measured by $L_{Aeq,adj,T}$—more than 5dBA greater than the existing acoustic environment measured by $L_{A90,T}$.*

The EPP(Noise) does not define "continuous noise", but by definition, "continuous noise" would be required to occur for at least 90% of a measurement period (typically 15 minutes or 60 minutes). Thus this criterion could apply for equipment such as mechanical plant.

The criterion for "noise that varies over time" is appropriate for noise sources operating for less than 90% of a measurement period, and could apply to intermittent events (e.g. vehicles) or mechanical plant that does not run continuously (e.g. air-conditioning).

5.3.3 Acoustic Quality Objectives

The EPP(Noise) contains a range of acoustic quality objectives for a range of receivers. The objectives are in the form of noise levels, and are defined for various periods of the day, and use a number of acoustic parameters.

Schedule 1 of the EPP(Noise) includes the following acoustic quality objectives to be met at residential dwellings:

- Outdoors
  - Daytime and Evening: 50 dBA $L_{Aeq,adj,1hr}$, 55 dBA $L_{A10,adj,1hr}$ and 65 dBA $L_{A1,adj,1hr}$
- Indoors
  - Daytime and Evening: 35 dBA $L_{Aeq,adj,1hr}$, 40 dBA $L_{A10,adj,1hr}$ and 45 dBA $L_{A1,adj,1hr}$
  - Night: 30 dBA $L_{Aeq,adj,1hr}$, 35 dBA $L_{A10,adj,1hr}$ and 40 dBA $L_{A1,adj,1hr}$

In the EHP EcoAccess Guideline "Planning For Noise Control" documentation, it is proposed that the noise reduction provided by a typical residential building façade is 5 to 7 dBA assuming open windows. That is, with an external noise source, a 5 to 7 dBA reduction in noise levels from outside a house to inside a house is expected when windows are fully open. Thus the indoor noise objectives noted above could be considered as the following external objectives (with windows open):

- Daytime and Evening: 40 to 42 dBA $L_{Aeq,adj,1hr}$, 45 to 47 dBA $L_{A10,adj,1hr}$ and 50 to 52 dBA $L_{A1,adj,1hr}$
- Night: 35 to 37 dBA $L_{Aeq,adj,1hr}$, 40 to 42 dBA $L_{A10,adj,1hr}$ and 45 to 47 dBA $L_{A1,adj,1hr}$

A sensitive receiver is defined as *"an area or place where noise is measured"*.

The EPP(Noise) states that the objectives are intended to be progressively achieved over the long term. However, as this project involves the introduction of new noise sources it would seem reasonable that the acoustic quality objectives are achieved upon commencement of operation of the project, and this may be the intent of the policy. Therefore, consideration of achieving these acoustic quality objectives will be included in the design noise limits for the project.

The acoustic quality objectives do not take into consideration of the existing noise environment and therefore, it is considered that they do not necessarily protect or enhance the acoustic amenity of the area surrounding the site as required by the EPP(Noise). Therefore, it is considered that the objectives should not be used as the sole noise limits for a development, and reference should also be made to noise limits which are determined with consideration for the existing noise environment.

5.4 EcoAccess Guidelines

EHP has a number of EcoAccess guidelines relevant to the assessment of noise and vibration. These are summarised as follows.

5.4.1 EcoAccess – Planning for Noise Control

EHP EcoAccess Guideline "Planning For Noise Control" contains procedures and methods that are applicable for setting conditions relating to noise emitted from industrial premises for planning purposes. The guideline is applicable to noise from all sources, individually and in combination, which contribute to the total noise from a site.

5.4.1.1 Control and Prevention of Background Creep

The procedure takes into account three factors: firstly, the control and prevention of background noise creep in the case of a steady noise level from equipment such as that caused by ventilation fans and other continuously operating machinery; secondly, the containment of variable noise levels and short-term noise events such as those caused by forklifts and isolated hand tools to an acceptable level above the background noise level; thirdly, the setting of noise limits that should not be exceeded to avoid sleep disturbance.

5.4.1.2 Sleep Disturbance Criteria

The World Health Organization (WHO) issued its "Night Noise Guidelines for Europe" in 2009. This guideline is written specifically for the European environment and may not be applicable for Australian conditions. However, it has been adopted as it is the most recent WHO publication which addresses sleep disturbance. The WHO guideline states that in regard to sleep disturbance from continuous noise from activities, such as mining operations, the equivalent sound pressure level should not exceed 30 dBA indoors, if negative effects on sleep are to be avoided. The WHO guideline states that the threshold for sleep awakening and sleep disturbance is 42 dBA L_{max} indoors.

The EcoAccess Guideline "Planning for Noise Control", in referring to the World Health Organisation guidelines, makes the following general recommendation regarding short term transient noise events:

> *"As a rule in planning for short-term or transient noise events, for good sleep over eight hours, the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dBA maxL$_{pA}$ more than 10 to 15 times per night."*

For less regular night events, the allowable internal noise level is higher, as follows:

- Approximately 3 events per night: 50 dBA L_{max}.
- Approximately 1 event per night: 65 dBA L_{max}.

Note: For the purpose of this assessment the maxL$_{pA}$ level is defined using the L_{max} descriptor.

As noted previously, EHP propose that the noise reduction provided by a typical residential building façade is 5 to 7 dBA assuming open windows. Thus the indoor noise objectives noted above could be converted to external objectives (with windows open) with the appropriate correction.

Comparison of the nominated noise limits indicates that the WHO criteria for short duration events are more stringent and therefore have been adopted for this assessment. The recommended sleep disturbance noise limits which have been adopted for this assessment are summarised in Table 5.1.

Table 5.1 Summary of WHO Sleep Disturbance and Annoyance Criteria

Descriptor	Number of Noise Events	Indoor Criterion in dBA	Outdoor Criterion, dBA
Sleep Disturbance (Short Duration Events)	Not Specified	L_{max} 42	L_{max} 47 to 49
Sleep Disturbance (Continuous Noise)	Continuous	L_{eq} 30	L_{eq} 35 to 37
Annoyance (Night Time)	Continuous	L_{eq} 35	L_{eq} 40 to 42

Note: The outdoor criteria are based on a EHP EcoAccess nominated outdoor-to-indoor noise reduction of 5 to 7 dBA for open windows.

5.4.2 EcoAccess – Assessment of Low Frequency Noise

EHP EcoAccess Guideline "Assessment of Low Frequency Noise" contains methods and procedures that are applicable to low frequency noise emitted from industrial premises and mining operations for planning purposes. Items such as boilers, pumps, transformers, cooling fans, compressors, oil and gas burners, foundries, wind farms, electrical installations, diesel engines, ventilation and air-conditioning equipment, wind turbulence and large chimney resonance may comprise sources of high level noise having frequency content less than 200 Hz.

These sources may exhibit a spectrum that characteristically shows a general increase in sound pressure level with decrease in frequency. Annoyance due to low frequency noise can be high even though the dBA level measured is relatively low. Typically, annoyance is experienced in the otherwise quiet environments of residences, offices and factories adjacent to or near low frequency noise sources. Generally, low level/low frequency noises become annoying when the masking effect of higher frequencies is absent. This loss of high frequency components may occur as a result of transmission through the fabric of a building, or in propagation over long distances.

Where a noise immission occurs exhibiting an unbalanced frequency spectrum, the overall sound pressure level inside residences should not exceed 50 dB(Linear) to avoid complaints of low frequency noise annoyance. A spectrum is considered unbalanced when the un-weighted overall noise level is more than 15 dB higher than the A-weighted overall noise level.

5.4.3 EcoAccess – Noise & Vibration from Blasting

EHP EcoAccess Guideline "Noise and vibration from blasting" contains criteria and procedures that are applicable to noise and vibration emitted from blasting. It applies to activities such as mining, quarries, construction and other operations which involve the use of explosives for fragmenting rock.

The criteria address human comfort and are below typical limits for prevention of structural damage. The criteria apply at residential and commercial receivers. The criteria are presented in Table 5.2.

Table 5.2 Blasting Vibration and Airblast Criteria

Issue	Criteria
Airblast	Air blast overpressure of 115 dB (linear peak) for nine (9) out of ten (10) consecutive blasts initiated and not greater than 120 dB (linear peak) at any time.
Vibration	5 mm/s peak particle velocity (PPV) for nine (9) out of ten (10) consecutive blasts and not greater than 10 mm/s PPV at any time.

5.5 Proposed Criteria

In keeping with other recent, similar projects and discussions with EHP, it is proposed that an external night-time noise limit of 35 dBA $L_{eq,adj,T}$ is applied to the project for operation 7 days per week and 365 days per year. This limit corresponds to achieving an internal continuous sleep disturbance criterion of 30 dBA L_{eq} (refer: Section 5.4.1.2 and Table 5.1) and an acoustic quality objective of 30 dBA L_{eq} (refer Section 5.3.3), assuming a minimal 5 dBA reduction through a light-weight building façade with open windows.

A limit of 40 dBA $L_{eq,adj,T}$ is recommended for the daytime and evening, as this would be expected to achieve an acoustic quality objective of 35 dBA $L_{eq,adj,T}$ inside a dwelling (refer Section 5.3.3).

An external limit of 47 dBA L_{max} is also recommended for the night-time for sleep disturbance, based on the WHO guideline as discussed in Section 5.4.1.2.

The proposed noise limits are shown in Table 5.3.

Table 5.3 Proposed External Noise Limits

Recommended Noise Limits	Time Period		
	Daytime	Evening	Night-time
$L_{eq,adj,T}$ (T= 15 minutes to 1 hour), dBA*	40	40	35
L_{max} dBA*	N/A	N/A	47

Notes: * To be achieved under the majority of adverse meteorological conditions.

Daytime = (7am to 6pm), Evening = (6pm to 10pm), Night-time = (10pm to 7am).

From ASK's experience, the difference between the average L_{max} noise events and the L_{eq} due to the variable noise from equipment is typically 5 dBA to 8 dBA. Therefore, in compliance with the external 35 dBA L_{eq} criteria, it is predicted that the external 47 dBA L_{max} sleep disturbance limit will also be met.

6 Noise & Vibration Modelling

6.1 Model Description

Noise modelling was carried out using the SoundPLAN computer program using the CONCAWE algorithms, which is considered acceptable to EHP.

The model includes terrain data for the unmined MDL plus the open-cut pit and out-of-pit spoil dumps provided by the Client.

6.2 Meteorology

6.2.1 General

The mining noise levels at residential receivers can vary significantly depending upon the meteorology and the mining activities. Meteorology has a significant effect on the noise levels, particularly due to wind speed and direction, and vertical temperature gradients, which include temperature inversions.

It is possible to measure noise variations of the order of 15 to 20 dBA due to changes in meteorology. This needs to be carefully considered, as compliance with noise limits needs to be achieved under 'most' conditions. There is no strict definition for 'most' conditions, but we would expect that designing to achieve EHP noise limits for adverse night meteorological conditions is an acceptable target.

The SoundPLAN model has been setup to run with a meteorological file with neutral and adverse (temperature inversion) conditions. The conditions are set as follows:

- Neutral
  - Pasquill Stability Class: D
  - Temperature: 25 Degrees Celsius
  - Wind Speed: 0 m/s
  - Relative Humidity: 40%
- Adverse (Temperature Inversion)
  - Pasquill Stability Class: F
  - Temperature: 10 Degrees Celsius
  - Wind Speed: 2m/s
  - Relative Humidity: 40%

6.2.2 Effect of Climate Change

ASK has extracted information on future climate changes effects on the local meteorology, from the document CSIRO 2007: Climate Change in Australia – Observed Changes and Projections. CSIRO and Australian Bureau of Meteorology. CSIRO Climate Change in Australia Technical Report, 2007. The information from that document is summarised as follows:

- By 2050 annual warming over the whole of Australia is predicted to be 0.8 to 1.8°C and by 2070 this warming change increases to 1.0 to 2.5°C with inland Australia in the upper part of these ranges. An increase in the frequency of hot days and warm nights is predicted to accompany this shift in mean temperatures.

- Best estimates suggest a possible 2 - 5% increase in the current spring-time mean 10m high wind speeds in eastern Queensland by 2030. The annual mean 10m wind speed is estimated to increase by the same degree by 2070.

In terms of future noise levels, the changes to temperature, wind and other parameters are unlikely to produce a significant change in the noise levels from the proposed mining operations.

6.3 Noise Sources

The noise impact from plant and mobile equipment has been considered. Table 6.1 lists the sound power levels for the plant and mobile equipment associated with the mine operations.

Table 6.1 Source Sound Power Levels

Source	Octave Sound Power Levels, dBA, $L_{eq,1hr}$								Overall	
	63	125	250	500	1k	2k	4k	8k	dBZ	dBA
Hitachi EX5500 Excavator	96	110	106	109	109	108	103	94	128	116
Hitachi EX3600 Excavator	94	109	105	108	108	107	102	93	127	115
CAT 988 Wheel Loader	77	94	104	106	109	105	99	93	117	113
CAT 789D Haul Truck	89	109	111	115	113	113	105	94	127	119
CAT 777F Water Truck	84	96	101	108	111	110	102	95	118	115
CAT 777G Truck	86	96	101	107	110	110	102	96	119	115
CAT D11T Track Dozer	85	103	108	116	113	115	106	92	124	120
CAT 824C Wheel Dozer	86	104	109	117	114	116	107	93	125	121
CAT 16M Grader	82	99	103	101	104	103	99	89	118	110
CAT D9 Track Dozer	85	103	108	116	113	115	106	92	124	120
CPP*	99	102	105	110	110	108	102	92	127	115
Sizer - ROM	81	92	99	105	108	111	113	106	118	117
Sizer - 2nd Stage	91	96	100	105	108	108	105	102	120	113
Radial Stacker	50	70	85	95	100	98	92	81	104	103
Conveyor (per metre)	63	72	76	78	78	73	68	59	93	83
Rail Loadout Bin	79	86	95	102	105	108	105	94	113	112
Underground Vent Fan & Motor	89	98	101	110	102	99	95	82	120	112

Note: * The CPP will not be operated at night (10pm to 7am).

The data in Table 6.1 is collated from ASK's noise source database.

6.4 Modelling Scenarios

The modelling scenario used to predict noise level emissions from the proposed mine is to be based on Year 3 operations. This is generally considered to be worst-case operations as the operations still include out-of-pit dumping, the majority of mobile equipment is in use, and mining operations generally occur across the extent of the pits. The CPP is included in the day and evening noise level predictions, but is not included in night-time noise level predictions.

The noise emissions will differ during other mining years, with variances due to pit dumping and mining locations. In later years mining will be underground, and therefore above ground vehicle movements will be reduced and overall noise emissions reduced.

The predicted noise levels from Year 3 mining operations include the underground vent fan and motor though this is not in operation until Year 5. Its contribution to the overall noise levels is generally minor given its sound power level, except at close proximity, and its contribution does not result in additional noise limit exceedances.

6.5 Predicted Noise Levels

Noise levels have been calculated for the Mining Year 3 operating scenario under each of the proposed meteorological conditions.

The predicted noise levels at the nearby sensitive receivers due to the modelled open-cut and underground mining operations during Mining Year 3 are shown in Table 6.2. Results which exceed the nominated night-time criteria are presented shaded.

The noise contours for the modelled mining operations under the neutral and adverse meteorological conditions are shown in Appendix C as follows:

- Figure C.1 Mining Year 3 Operations – Day and Evening, neutral meteorological conditions.
- Figure C.2 Mining Year 3 Operations – Night, neutral meteorological conditions.
- Figure C.3 Mining Year 3 Operations – Night, adverse meteorological conditions.

Table 6.2 Predicted Noise Levels (Mining Year 3)

Location		Predicted Noise Level $L_{eq,1hr}$, dBA		
		Day and Evening (Limit 40 dBA)	Night (Limit 35 dBA)	
		Neutral	Neutral	Adverse
1	Airlie	22	22	28
2	Donnelly	47	47	53
3	Dunloe	24	23	30
4	Fairways	27	26	33
5	Fork Lagoons	15	15	18
6	Glendarriwell	16	15	19
7	Iona Downs	44	44	51

Location		Predicted Noise Level $L_{eq,1hr}$, dBA		
		Day and Evening (Limit 40 dBA)	Night (Limit 35 dBA)	
		Neutral	Neutral	Adverse
8	Jabiru	22	22	28
9	Kingower	14	14	17
10	Selma	20	20	24
11	St Helens	37	37	44
12	Sypher	21	21	27
13	Walther	31	31	39
14	Wilga Downs	25	25	31

From **Table 6.2** it can be seen that the night time neutral condition noise levels are up to 1 dBA quieter than the day and evening neutral condition noise levels. The reduction is due to the CPP not operating at night. The influence of the CPP is not particularly significant at receptors due to the higher noise levels from mobile plant, and hence the minor change.

Exceedances of the proposed day and evening (40 dBA) and night (35 dBA) noise limits are noted in **Table 6.2** and thus will be required to be considered further. Exceedances are predicted as follows:

- In the daytime at Donnelly and Iona Downs.
- At night at Donnelly, Iona Downs and St Helens in neutral and adverse conditions, and at Walther in adverse conditions only.

The un-weighted noise levels have been predicted under adverse meteorological conditions at the nearby sensitive receivers. The unweighted (linear) noise levels are used to assess the low-frequency component of the noise emissions. The results are shown in **Table 6.3**. The differences between the un-weighted and A-weighted levels are also shown in **Table 6.3**.

Table 6.3 Predicted Noise Levels for Assessment of Low Frequency Noise (Mining Year 3)

Location		Predicted Noise Levels under Night-Time Adverse Meteorological Conditions			
		Unweighted Noise Level $L_{eq,1hr}$, dB	A-weighted Noise Level $L_{eq,1hr}$, dBA	Difference between Unweighted and A-weighted Level	Exceedance of Criteria
1	Airlie	41	28	13	-
2	Donnelly	61	53	8	-
3	Dunloe	41	30	11	-
4	Fairways	44	33	11	-
5	Fork Lagoons	34	18	16	-

Location		Predicted Noise Levels under Night-Time Adverse Meteorological Conditions			
		Unweighted Noise Level $L_{eq,1hr}$, dB	A-weighted Noise Level $L_{eq,1hr}$, dBA	Difference between Unweighted and A-weighted Level	Exceedance of Criteria
6	Glendarriwell	34	19	15	-
7	Iona Downs	59	51	8	-
8	Jabiru	41	28	13	-
9	Kingower	33	17	16	-
10	Selma	39	24	15	-
11	St Helens	53	44	9	-
12	Sypher	40	27	13	-
13	Walther	49	39	10	-
14	Wilga Downs	44	31	13	-

Note: * Limit is an external level of 55 dB and a spectral difference (between the unweighted and A-weighted levels) of greater than 15 dB, as per EHP EcoAccess Guideline "Assessment of Low Frequency Noise".

Table 6.3 shows that no receivers are predicted to experience noise levels both exceeding the proposed external low frequency noise limit of 55 dB and have a spectral difference (between the unweighted and A-weighted levels) of greater than 15 dB.

7 Blasting

7.1 Overview

Prior to commencing mining, the existing vibration levels around the mine site will generally be negligible, except close to roads, rail lines and near major items of fixed plant. The vibration levels would be well below vibration criteria at nearby residences.

With the operation of the proposed mine, the only vibration source of significance at nearby residences would be blasting. Both ground vibration and airblast from blasting activities have been assessed.

Ground vibration and airblast levels caused by blasting activities have been predicted based on the formulas and methodology of Australian Standard AS2187.2 Explosives - Storage Transport and Use - Use of Explosives, which predicts the peak particles velocity (PPV) in mm/s and the airblast over pressure (peak pressure) in dB.

7.2 Modelling

7.2.1 Ground Vibration

Ground vibration levels are not to exceed 5mm/s (PPV) for nine out of ten blasts and are not to exceed 10mm/s (PPV) at any time. Ground vibration can be calculated at various distances from a blast using the following formula from AS2187.2:

$$V = K \left(R / Q^{1/2}\right)^{-B}$$

where: V = ground vibration as peak particle velocity (mm/s)

K = site constant

R = distance between charge and point of measurement (m)

Q = effective charge mass per delay or maximum instantaneous charge (kg)

B = site exponent or attenuation rate

Ground vibration from blasting generally increases with an increase in charge mass and reduces with distance.

A site exponent (-B) (attenuation rate) of –1.6, and site constant (K) in the range 800 to 1600, have been assumed for the site based on parameters in AS2187.2 and other similar coal projects.

Based on advice from the Client and other similar projects the following typical characteristics for each blast have been assumed:

- Blast hole diameter of 250mm.
- Stemming Height of 4.0m.
- MIC 260 kg.
- 80 holes per blast.

Table 7.1 presents the separation distances from the blast that are required to achieve the nominated ground vibration level limits (PPV)(mm/s).

Table 7.1 Required Separation Distances to Achieve Nominated Ground Vibration Level Limits

PPV (mm/s)	Separation Distance from Mine (km)	
	K = 800	K = 1600
10.0	0.2	0.4
5.0	0.4	0.6
2.0	0.7	1.1
1.0	1.1	1.6
0.5	1.6	2.5

Table 7.1 shows that the 5 mm/s peak particle velocity criterion could be exceeded at distances less than 600m from the blast assuming the higher site constant (K) of 1600. The only sensitive receiver within 600m of the proposed open-cut pit is Donnelly at approximately 200m north of the pit limit. The impact on this residence will need to be addressed prior to the commencement of blasting. Excluding that location, the vibration levels are predicted to be compliant with the nominated blast parameters throughout the mine life for all other sensitive receivers.

7.2.2 Airblasts

Airblast pressure levels are not to exceed 115dB for four out of five blasts and are not to exceed 120dB at any time.

For blasting in an open-cut mine, the distance to the 120 dB L_{peak} contour line from the blast can be calculated using the following formula:

$$D_{120} = (k * h / \text{maximum}(B,S))^{2.5} * m^{1/3}$$

where: D_{120} = distance to the 120 dB L_{peak} contour (m)

k = a site constant determined from the ratio S/B and S/h and requires local calibration

h = hole diameter (mm)

B = burden (mm)

S = stemming height (mm)

m = charge mass (kg)

The site constant, k, has been assumed to be equal to 180 based on other mining projects.

The following indicative blast information has been provided by the Client:

- h = 250 mm
- S = 4000 mm
- B = 7000 mm
- m = 260 kg

Using the above factors and assumptions, the distance to the 120 dB contour line is calculated to be 0.7 km. The distance to the 115 dB contour line can be calculated using the attenuation rate of 9 dB per doubling of distance. Therefore, the 115 dB airblast criteria would be exceeded at a distance of approximately 1 km or less.

As noted previously, Donnelly is located approximately 200m north of the pit limit and is thus in the airblast impact zone. As for vibration, the impact on this residence will need to be addressed prior to the commencement of blasting.

Iona Downs is also potentially impacted from airblast in Years 4 to 7 as it is located 1 km to the north of the pit limit. Blast parameters will need to be designed to ensure that airblast criteria are met at this location.

Aside from Donnelly and Iona Downs, the airblast levels are predicted to be compliant with the nominated blast parameters throughout the mine life for all other sensitive receivers.

8 Construction

The duration of the construction period for a coal mine can often exceed a year and therefore needs to be considered as a permanent noise source. Hence, it is recommended that the noise emissions from construction activities meet the proposed operational noise limits as discussed in Section 5.5.

Construction sound power levels are dependent on the number and type of equipment in use, with typical levels of 123 to 131 dBA measured with major plant items between 8 and 41 in number (Mils, Bridges and Juillerat 2000).

The proposed equipment for construction of Taroborah includes approximately 25 items of mobile equipment, and the proposed fleet of equipment to be utilised during construction will generally be smaller in size than the operational equipment. Therefore, the sound power level of the construction fleet could be estimated by interpolating the number of 25 items from the range of 123 to 131 dBA indicated above. A construction sound power level of 127 dBA is estimated.

Given the construction sound power level is calculated to be less than the operational sound power level, the noise emissions from construction would be lower than that predicted for operational noise, and thus will have lower predicted noise criteria exceedances, if any.

9 Train Noise

Noise impacts from rail movements have been considered for trains associated with the proposed Taroborah Coal Project. Coal transport trains are proposed to travel along the existing Queensland Rail (QR) line to Emerald, and then along the Aurizon Blackwater rail system to the Wiggins Island Coal Export Terminal (WICET) near Gladstone. This assessment of rail noise impacts has given consideration to the existing rail movements and the additional rail movements as a result of the project.

To determine the impact of project related rail movements, the assessment of 24 hour L_{eq} noise levels has been based on rail activity for the QR rail line to Emerald. The Aurizon Blackwater rail system to WICET is an extended rail network which will have varying levels of activity dependent on the location along the rail line. Comparison with the QR rail line to Emerald is considered acceptable to demonstrate the impact of the project.

To assist in the assessment, ASK requested current and future rail activity data for the QR controlled rail line west of Emerald on 3rd September 2014 as follows:

- train types (coal, etc) (for all trains, including private freight)
- train type movements per typical day/week
- locomotive class (class of engine) for each train type
- length of each train type
- number of locomotives per train type
- speed and notch setting (gear) for trains along rail line adjacent project site
- sound exposure level (SEL) data for locomotive and wagon travel.

In response to the information request, two months of historic information (from 30th June to 25th August 2014) was provided. This information included weekly breakdowns of train types, number of movements, the average number of working locomotives per train and the average train length. ASK was advised that QR are unable to supply future rail activity figures as forecast data is currently unavailable. Information regarding speed and notch setting was unable to be provided by QR.

The supplied data indicated that currently an average of two train pass-bys occur per day, with two working locomotives per train. The average train length for existing rail activity was determined to be approximately 287 metres. Train types noted to utilise the rail line included freight and passenger trains, with freight movements more prevalent.

ASK has been advised that for project related rail activity it is proposed to utilise the following locomotive/wagon configuration to haul coal from the mine to WICET:

- 3 x 120 tonne (4000 Class) locomotives
- 90 x 80 tonne wagons.

Based on the above configuration and the anticipated coal extraction rates, the number of trains per day required to take coal from the mine to the port area for each of the relevant project time periods has been advised as follows:

- approximately 1 train per day in Years 1 to 5 (2 train pass-bys, arrival and departure)
- up to 2 trains per day in Years 6 to 7 (4 train pass-bys)
- up to 3 trains per day in Years 8 to 20 (6 train pass-bys).

As future rail activity data was unable to be provided, it has been assumed that future rail movements are similar to current movements of two train pass-bys per day. Based on this assumption, the 24 hour L_{eq} noise level has been predicted for each relevant project time period (Years 1 to 7, Years 6 to 7 and Years 8 to 20) with the anticipated number of project related train movements as noted above. The 24 hour L_{eq} noise levels from train movements, have been predicted using the SEL data provided by QR, assuming a notch setting of two and a train travel speed of 80 km/h, assumptions which are considered appropriate in the absence of the actual data.

A travel speed of 80 km/h could be expected along the rail line in undeveloped areas, however it is expected that travel speed would be limited to between 50 to 60km/h through built up or populated areas such as Emerald. As noise emissions from train movement increase with increases in speed, the application of an 80 km/h travel speed could be considered conservative.

Assuming that future rail activity remains at the current level, it is predicted that the QR 24 hour L_{eq} noise limit of 65 dBA would be exceeded within 5m of the QR rail line for Years 1 to 5 and Years 6 to 7, and within 10m of the rail line for Years 8 – 20. For comparison, the QR 24 hour L_{eq} noise limit of 65 dBA is currently exceeded within 5m of the rail line, based on a total of two rail pass-bys events per day. Meteorological effects have not been considered for the prediction of the 24 hour L_{eq} noise level as meteorological conditions will vary through-out a 24 hour period, and differ through seasons.

The maximum (L_{max}) noise level from train movements has been predicted based on noise measurements previously obtained by ASK for passing coal trains. The coal train pass-by noise levels measured by ASK are assumed to be similar to those from trains associated with the Taroborah Coal Project.

Based on the results of previously obtained noise measurements, train movements associated with the Taroborah Coal Project would exceed the QR L_{max} noise limit of 87 dBA at a distance of approximately 40m or less from the railway under neutral meteorological conditions, or approximately 60m or less under adverse meteorological conditions (e.g. downwind). As the QR Emerald rail line and Aurizon Blackwater rail systems are currently utilised by freight trains, the L_{max} noise levels from rail movements are expected to be consistent with the existing maximum noise levels experienced along the rail line.

Based on the predicted noise levels, the QR 24 hour L_{eq} noise limit is anticipated to be exceeded within 10m of the rail line during Years 8 to 20, with the QR L_{max} noise limit anticipated to be exceeded within 60m of the rail line under adverse (worst-case) meteorological conditions irrespective of the project period. As compliance with the QR noise limits is dependent on the maximum pass-by noise level, which is expected to be consistent with existing maximum pass-by levels, the cumulative impact of the project does not influence the distance at which the QR rail noise criteria are achieved. As the proposed rail activity associated with the project is not anticipated to influence the distance at which the QR noise limits are achieved, no noise mitigation measures are recommended to address rail noise.

10 Noise and Vibration Assessment Summary

10.1 Operational Noise (Mining Year 3)

The predicted noise levels for the Mining Year 3 operations are shown in Table 6.2. An assessment summary of the predicted noise levels is as follows:

- During the day and evening it is predicted that the noise limit (40dBA) will be exceeded at 2 of 14 modelled receiver locations (Donnelly and Iona Downs) by up to 7 dBA and 4 dBA respectively.
- During the night, under neutral meteorological conditions, it is predicted that the night-time noise limit (35dBA) will be exceeded at 3 of 14 modelled receiver locations (Donnelly, Iona Downs, and St Helens) by up to 12 dBA, 9 dBA and 2 dBA respectively.
- During the night, under adverse meteorological conditions, it is predicted that the night-time noise limit (35dBA) will be exceeded at 4 of 14 modelled receiver locations (Donnelly, Iona Downs, St Helens and Walther) by up to 18 dBA, 16 dBA, 9 dBA and 4 dBA respectively.
- All other noise level predictions for modelled receivers comply with the proposed noise limits.

Given the relatively close proximity of receivers Donnelly, Iona Downs and St Helens to the mining operations, it is expected that exceedances would be predicted. The exceedance at Walther is up to 4 dBA, but only at night and under adverse meteorological conditions.

The five major noise sources that contribute to the exceedances at night under adverse conditions are as follows in Table 10.1.

Table 10.1 Major Noise Source Contributors

Receiver	Major Noise Source Contributors			
	Donnelly	Iona Downs	St Helens	Walther
Predicted Exceedance	18	16	9	4
Noise Source #1	CAT D11	CAT 789	CAT D9	CAT 789
Noise Source #2	CAT 777 water truck	CAT 789	CAT 789	CAT 789
Noise Source #3	CAT 789	CAT D11	CAT D11	CAT 789
Noise Source #4	CAT 789	CAT 789	CAT 789	CAT D11
Noise Source #5	CAT 789	CAT 789	CAT 789	CAT 789

It is noted that the major noise items are generally the CAT 789 trucks and CAT D11 dozers.

If the top five noise sources were attenuated by 10 dBA each, the overall reduction at each receiver would be 4 to 5 dBA. To achieve large overall noise reductions at each receiver would require more comprehensive equipment noise reductions.

Given the noise levels under both neutral and adverse conditions exceed the nominated noise limit at the closest receivers, further consideration needs to be given to acquisition of affected properties, noise monitoring and/or noise control measures on the Project site.

10.2 Low Frequency Noise

The predicted linear noise levels under adverse meteorological conditions are shown in Table 6.3. No low frequency exceedances are predicted.

10.3 Blasting

Based on the blasting calculations in Section 7, the ground vibration levels from open-cut operations are predicted to exceed accepted limits at Donnelly due to its very close proximity to mining operations. Airblast levels are also expected to exceed accepted limits at Donnelly, and marginally exceed accepted limits at Iona Downs. Depending on the local site conditions, blast parameters may need to be reviewed in consultation with a Blast Engineer to ensure compliance.

10.4 Construction

Noise during construction phases is expected to be less than that predicted during operation, and thus noise impacts would be reduced compared to during operation.

10.5 Train Noise

Based on the predicted noise levels, the QR 24 hour L_{eq} noise limit is anticipated to be exceeded within 10m of the rail line during Years 8 to 20, with the QR L_{max} noise limit anticipated to be exceeded within 60m of the rail line under adverse (worst-case) meteorological conditions irrespective of the project period. As compliance with the QR noise limits is dependent on the maximum pass-by noise level, which is expected to be consistent with existing maximum pass-by levels, the cumulative impact of the project does not influence the distance at which the QR rail noise criteria are achieved. As the proposed rail activity associated with the project is not anticipated to influence the distance at which the QR noise limits are achieved, no noise mitigation measures are recommended to address rail noise.

11 Discussion and Recommendations

From the summary in Section 10, it is apparent that the predicted noise levels at Donnelly, Iona Downs, St Helens and Walther will exceed the noise limits as proposed in Section 5.5 by up to 18 dBA in the worst instance.

When considering excessive noise impacts from mining operations the following measures are recommended in order to reduce such noise impacts:

- Alternative arrangements with property holders (e.g. property purchases).
- Attenuation of equipment (fixed and mobile plant).
- Alternative (quieter) mining methods.
- Restricting operations during adverse conditions.
- Noise monitoring program.

11.1 Attenuation Methodology

It is noted that the four (4) receivers which exceed the proposed noise criteria are all located within the mining lease area and therefore, may be subject to property purchase by the proponent in the future.

It is not considered feasible to achieve the required noise reductions of 16 to 18 dBA at night-time at Donnelly and Iona Downs. Addressing the modelled exceedance of 9 dBA at St Helens may be feasible but would require attenuation of equipment, alternative mining methodology in the form of re-routing of haul roads, re-allocation of mobile plant, restrictions of dumping, particularly during the night period, and significant bunding in close proximity to all haul routes.

The exceedance of up to 4 dBA at Walther can likely be attenuated using some or all of the above attenuation strategies.

11.2 Noise Monitoring

It is recommended that the proponent conducts noise monitoring, to ensure that mining operations are undertaken in accordance with the prescribed noise criteria. Such monitoring should be conducted at the worst affected sensitive receivers to validate the noise model, and improve its accuracy as required.

It is recommended that the noise monitoring sites and equipment be selected in consultation with an acoustic consultant. The monitoring equipment should record one-third octave band noise levels using the A-weighted L_{eq} parameter of duration 15 to 60 minutes. ASK recommends measurement results be recorded in conjunction with weather data and compared with the nominated noise criteria. Recording operational equipment will enable the noise model to be tailored to suit the as-measured mine condition, and confirm model accuracy. Occasional attended monitoring is also recommended to ensure that interpretation of unattended noise monitoring data is accurate.

If legitimate noise complaints are received from nearby residents as a result of mining activities, then additional attended noise monitoring is recommended, with results from this and the periodic monitoring compared against the noise limits in the Environmental Authority. As noted above, noise measurements are to be conducted using a one-third octave band sound level meter. Care should be taken to ensure that measurement levels are representative of mining noise, and are not dominated by extraneous noise (e.g. wind rustling leaves in trees, rain, animals etc). ASK recommends measurement results be reported in conjunction with weather data.

If noise complaints are received and the noise limits exceeded, then noise mitigation measures are to be investigated. It is recommended that noise mitigation measures be selected in consultation with an acoustic consultant, and be relevant to the complaint, i.e. addressing the equipment of concern and the locality of concern.

It is also recommended that the mine operators conduct vibration and airblast monitoring to ensure that blast parameters result in compliant levels. Blast parameters should be revised if exceedances are recorded.

12 Conclusions

Noise levels from the Project were predicted at the nearest noise sensitive receivers for different meteorological conditions. Predictions were undertaken for mining Year 3 as this is generally expected to generate the highest noise emission levels. The noise and vibration predictions for the Project were assessed against a number of criteria, with the following comments and results:

- Noise criteria for the mine have been proposed in **Section 5.5**, which includes limits of 40 dBA $L_{Aeq,adj,T}$ in the day and evening and 35 dBA $L_{Aeq,adj,T}$ in the night.
- The noise predictions are summarised as follows:
  - During the day and evening it is predicted that the noise limit (40dBA) will be exceeded at 2 of 14 prediction locations (Donnelly and Iona Downs) by up to 7 dBA and 4 dBA respectively.
  - During the night, under neutral meteorological conditions, it is predicted that the night-time noise limit (35dBA) will be exceeded at 3 of 14 prediction locations (Donnelly, Iona Downs, and St Helens) by up to 12 dBA, 9 dBA and 2 dBA respectively.
  - During the night, under adverse meteorological conditions, it is predicted that the night-time noise limit (35dBA) will be exceeded at 4 of 14 prediction locations (Donnelly, Iona Downs, St Helens and Walther) by up to 18 dBA, 16 dBA, 9 dBA and 4 dBA respectively.
  - No exceedances of the low frequency criteria are predicted.
- The noise exceedances are assessed as follows:
  - Given the relatively close proximity of receivers Donnelly, Iona Downs and St Helens to the mining operations, it is expected that exceedances would be predicted at those locations.
  - The exceedance at Walther is up to 4 dBA at night under adverse meteorological conditions.
  - The major noise sources that contribute to the exceedances are the CAT 789 haul trucks and CAT D11 track dozers.
  - Given the noise levels under both neutral and adverse conditions are predicted to exceed the nominated noise limits at Donnelly, Iona and St Helens, further consideration needs to be given to acquisition of these affected properties, noise monitoring and/or noise control measures on the Project site. These strategies are discussed in **Section 11**.
- Based on the blasting calculations in **Section 7**, the ground vibration levels from open-cut operations are predicted to exceed vibration criteria at Donnelly due to its very close proximity to mining operations. Airblast levels are also predicted to exceed airblast criteria at Donnelly, and are marginal at Iona Downs. Depending on the local site conditions, blast parameters may need to be reviewed in consultation with a Blast Engineer to ensure compliance.
- Noise during construction phases is expected to be lower than that predicted during operation.
- For trains associated with the Project, travelling along the existing Queensland Rail (QR) and Aurizon rail systems to WICET, the Queensland Rail noise limit criteria are predicted to be met at approximately 60m or more from the railway lines along the route from the mine to the export terminal, under adverse (worst-case) meteorological conditions, and at 40m or more under more prevalent neutral meteorological conditions.

Please contact the undersigned with any queries on 07 3255 3355.

Yours faithfully

ASK Consulting Engineers Pty Ltd

Mitch Ryan

Engineer

13 References

Australian Bureau of Meteorology, CSIRO (2007), Climate Change in Australia Technical Report, CSIRO, Australia

Environmental Protection Act 1994 (Qld)

Environmental Protection (Noise) Policy 2008 (Qld)

Environmental Protection Agency (2004), EcoAccess Guideline "Planning For Noise Control", available from Department of Environment and Heritage Protection, Queensland

Environmental Protection Agency (2002), EcoAccess Guideline "Assessment of Low Frequency Noise", available from Department of Environment and Heritage Protection, Queensland

Environmental Protection Agency (2006), EcoAccess Guideline "Noise and vibration from blasting", available from Department of Environment and Heritage Protection, Queensland

Mils P., Bridges M. and Juillerat E (2000) Noise Reduction In New Open-Cut Coal Mines, Coal Handling and Preparation Plants, Sedgman Pty Ltd, New South Wales.

Standards Australia (2006) Explosives - Storage Transport and Use - Use of Explosives AS2187.2-2006, Standards Australia, NSW

World Health Organization (2009), Night Noise Guidelines for Europe. World Health Organization.

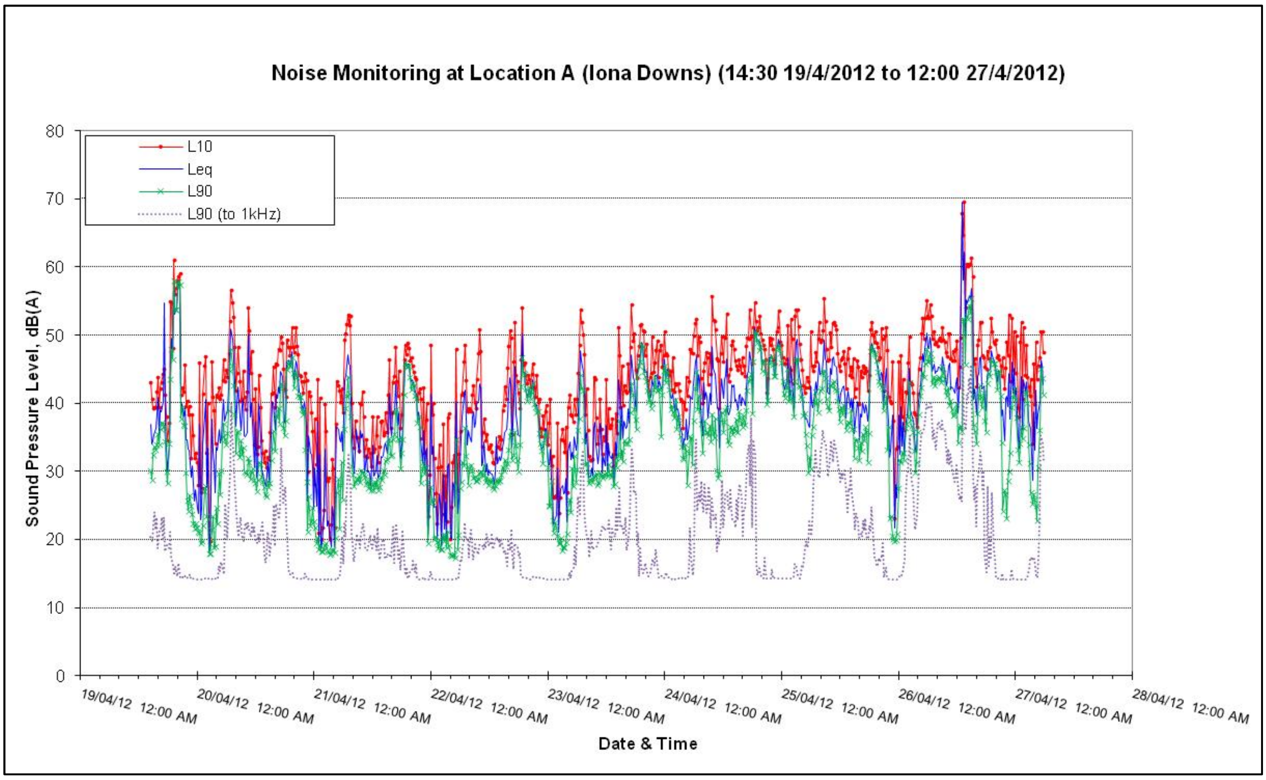
Appendix A Acoustic Terminology

Parameter or Term	Description
Frequency	The number of vibrations, or complete cycles, that take place in one second. Measured in hertz (Hz), where one Hz equals one cycle per second. A young person with normal hearing will be able to perceive frequencies between approximately 20 and 20,000 Hz. With increasing age, the upper frequency limit tends to decrease.
dB	The decibel (dB) is the unit measure of sound. Most noises occur in a range of 20 dB (quiet rural area at night) to 120 dB (nightclub dance floor or concert).
dBA	Noise levels are most commonly expressed in terms of the 'A' weighted decibel scale, dBA. This scale closely approximates the response of the human ear, thus providing a measure of the subjective loudness of noise and enabling the intensity of noises with different frequency characteristics (e.g. pitch and tone) to be compared.
dB, dB(linear) OR dBZ	Noise levels are sometimes expressed in terms of the linear, Z or un-weighted decibel scale – they all take the same meaning. The value has no weighting applied to it and is the same as the dB level.
dBC	Noise levels are sometimes expressed in terms of the 'C' weighted decibel scale, dB(C). This scale is very similar to the dB, dB, dB(linear), dBZ un-weighted scale. The difference being that some negative weighting is applied below 250Hz and above 1kHz. The magnitude of the weighting is significantly less than the dBA scale.
Octave band	Ranges of frequencies where the highest frequency of the band is double the lowest frequency of the band. The band is usually specified by the centre frequency, i.e., 31.5, 63, 125, 250, 500 Hz, etc.
Day	The period between 7am and 6pm.
Evening	The period between 6pm and 10pm.
Night	The period between 10pm and 7am.
Free-field	The description of a noise receiver or source location which is away from any significantly reflective objects (e.g. buildings, walls).
Noise sensitive receiver OR Noise sensitive receptor	The definition can vary depending on the project type or location, but generally defines a building or land area which is sensitive to noise. Generally it includes residential dwellings (e.g. houses, units, caravans, marina), medical buildings (e.g. hospitals, health clinics, medical centres), educational facilities (e.g. schools, universities, colleges),

Parameter or Term	Description
L_p	The instantaneous noise level, which is noted during a noise event.
L_{pA}	As for Lp except the frequency weighting is defined as being the 'A' weighted decibel scale. Often the 'A' is not included in the subscript if the level is reported as being dBA.
L_1	The noise level exceeded for 1% of the measurement period.
L_{10}	The noise level exceeded for 10% of the measurement period. It is sometimes referred to as the average maximum noise level.
L_{90}	The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.
$minL_{90}$	The background noise levels calculated using the 'lowest 10th percentile' of the L90 levels in each period of the day. This 'lowest 10th percentile' method is defined in the Queensland Department of Environment and Heritage Protection (EHP) guidelines.
$minL_{90,1hour}$	As for minL90 except the measurement intervals are defined as 1 hour duration.
L_{eq}	The equivalent continuous sound level, which is the constant sound level over a given time period, which is equivalent in total sound energy to the time-varying sound level, measured over the same time period.
$L_{eq,1hour}$	As for Leq except the measurement intervals are defined as 1 hour duration.
L_{Amax} OR maxLpA	Maximum A-weighted sound pressure level.
$L_{Amax,T}$	Average maximum A-weighted sound pressure level.
$L_{Amax,adj,T}$	Adjusted average maximum A-weighted sound pressure level.
L_{eq}(24 hour)	The average Leq noise level over the 24-hour period from midnight to midnight.
LAr,Tr	The rating noise level, as used by the Queensland Department of Environment and Heritage Protection (EHP) EcoAccess "Planning for Noise Control" guideline document.
PNL	The planning noise level, as used by the Queensland Department of Environment and Heritage Protection (EHP) EcoAccess "Planning for Noise Control" guideline document.

Parameter or Term	Description
Low frequency noise	Noise that occurs in the 10 Hz to 200 Hz frequency range, as defined in the Queensland Department of Environment and Heritage Protection (EHP) EcoAccess "Assessment of Low Frequency Noise" draft guideline document.

Appendix B Graphs of Noise Monitoring Results



4 Figure B.1 Plot of Noise Monitoring Results at Location A

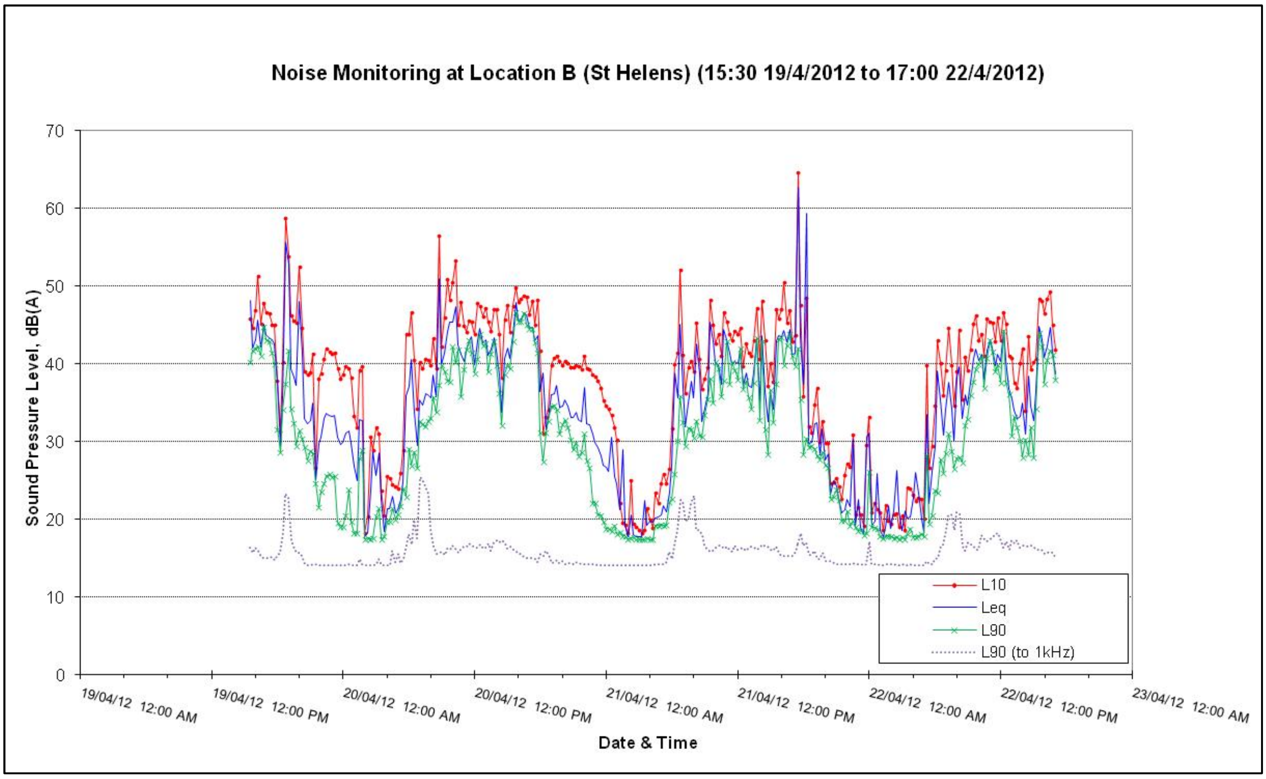


Figure B.2 Plot of Noise Monitoring Results at Location B

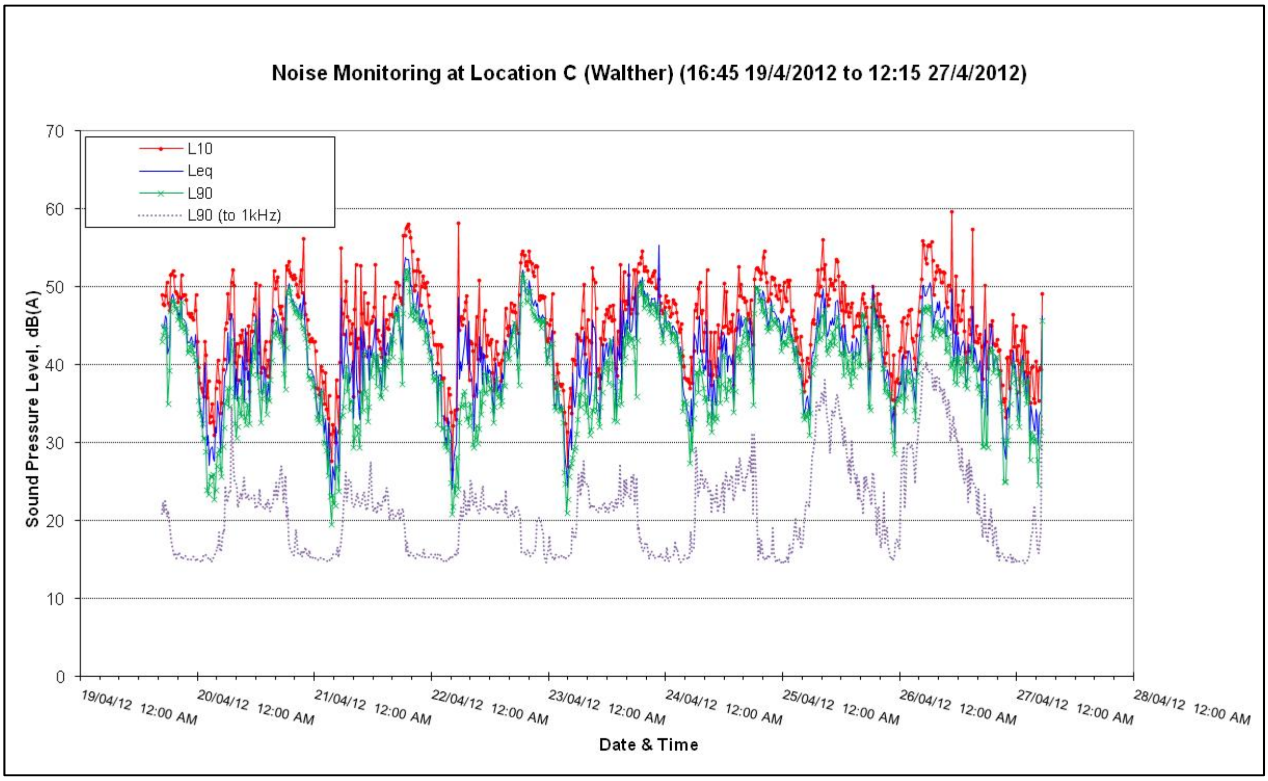


Figure B.3 Plot of Noise Monitoring Results at Location C

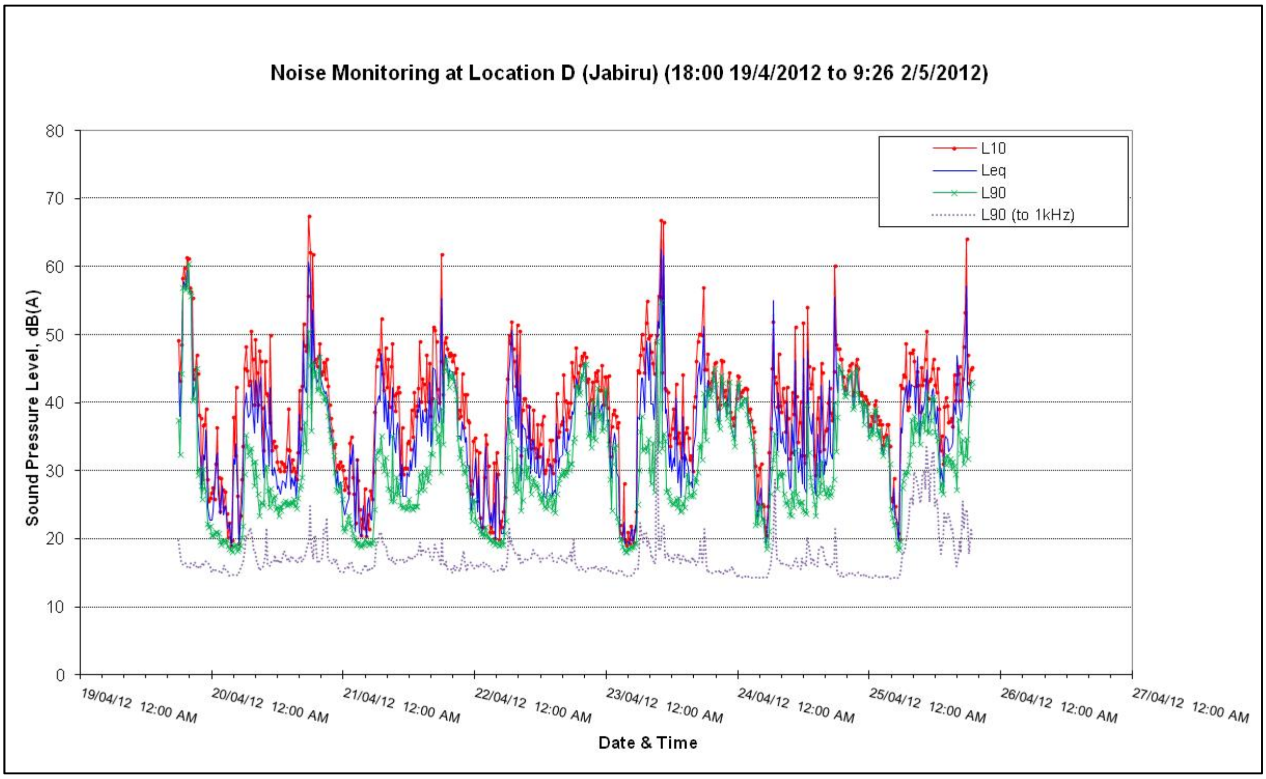


Figure B.4 Plot of Noise Monitoring Results at Location D

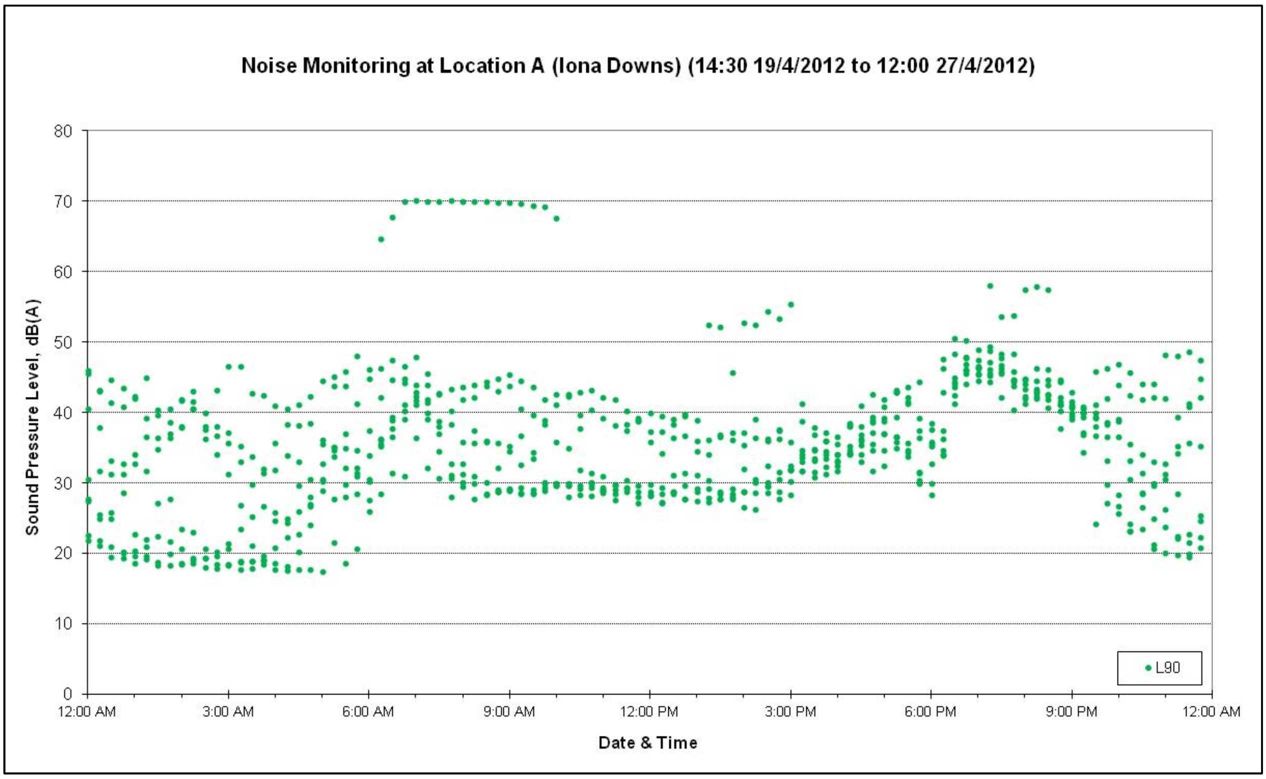


Figure B.5 Plot of Background Noise Monitoring Results at Location A

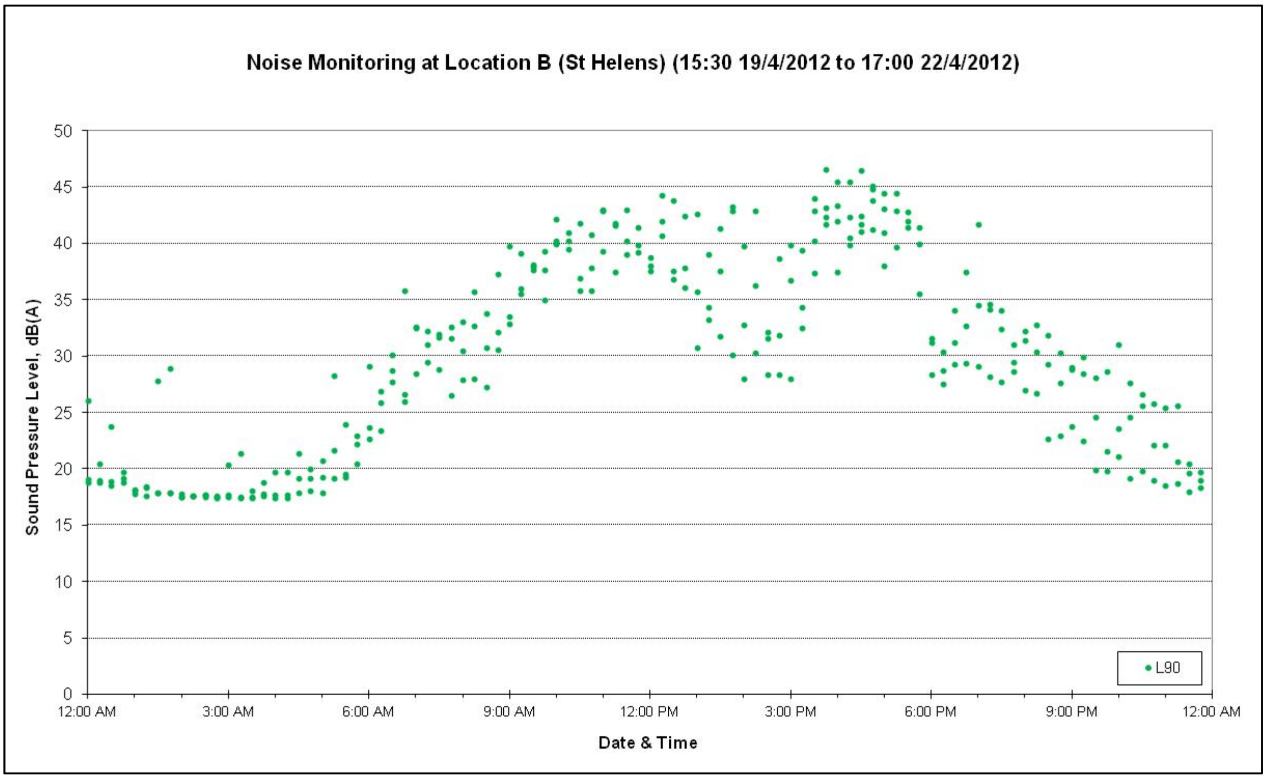


Figure B.6 Plot of Background Noise Monitoring Results at Location B

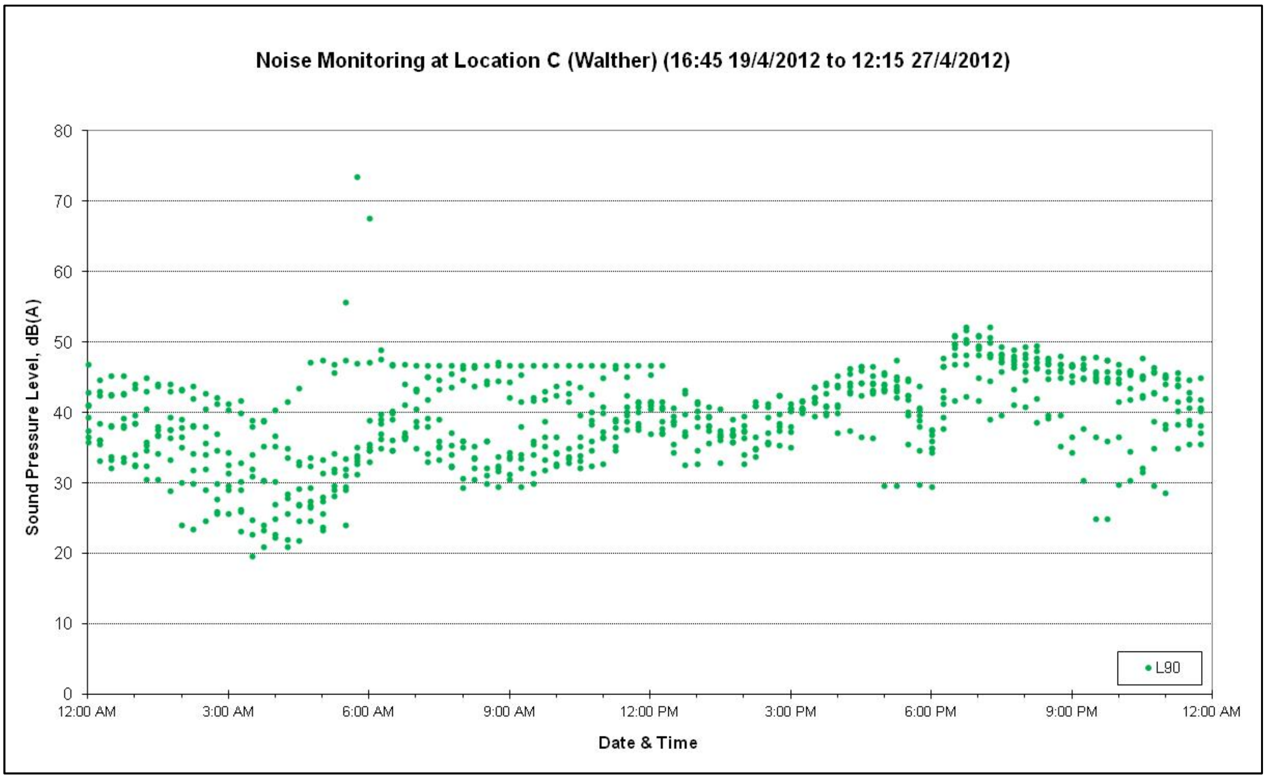


Figure B.7 Plot of Background Noise Monitoring Results at Location C

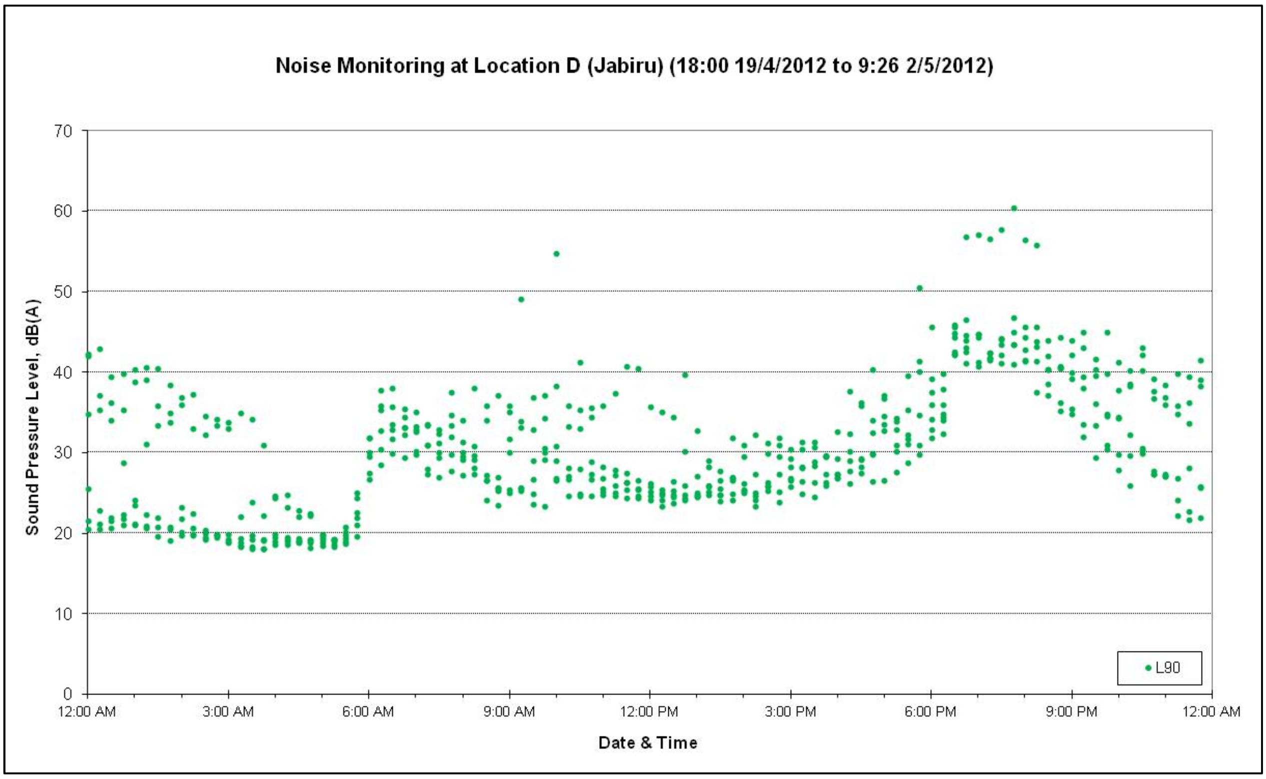


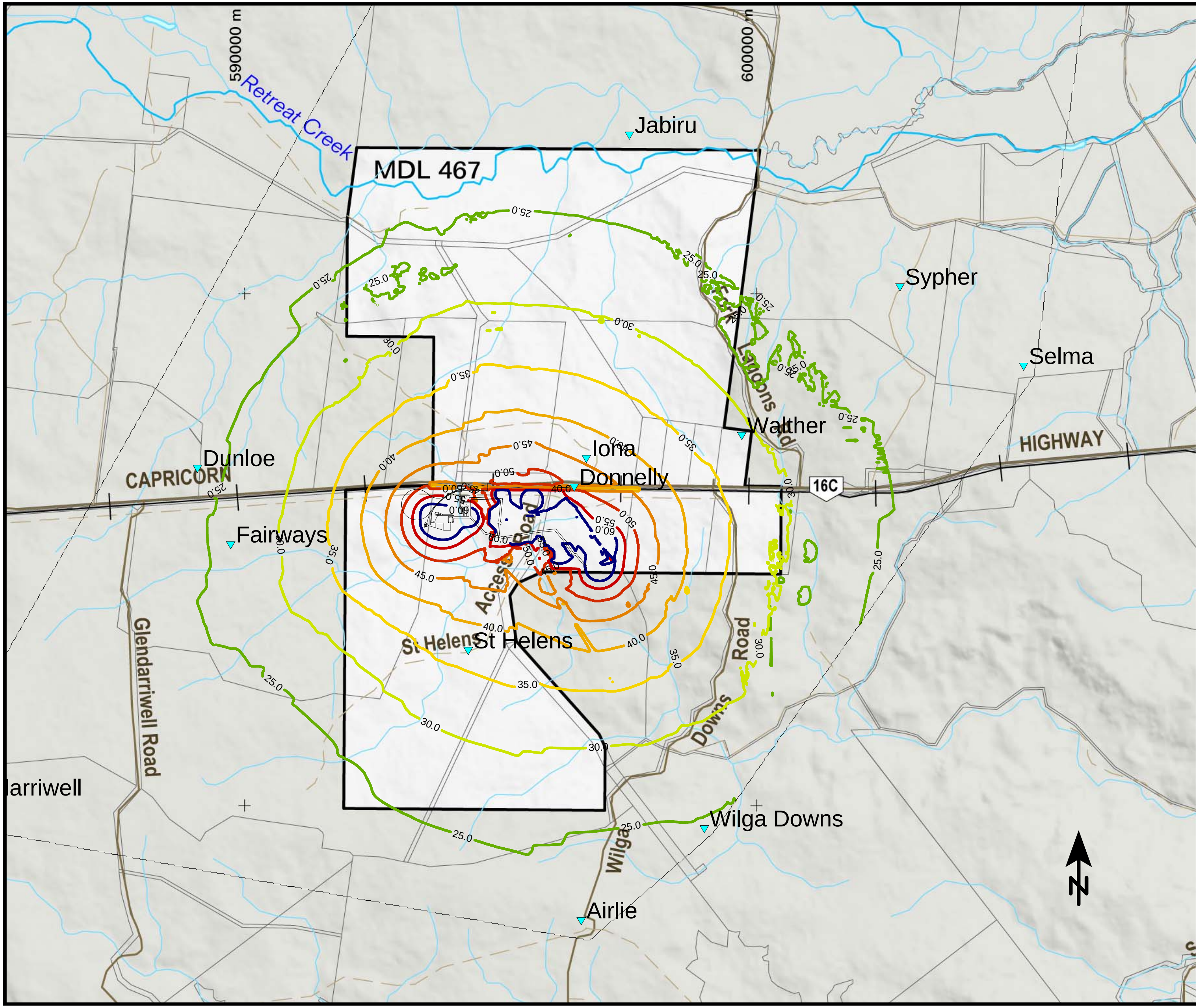
Figure B.8 Plot of Background Noise Monitoring Results at Location D

Appendix C Predicted Mining Noise Figures

Figure C.1 Mining Year 3 Noise Levels from Open-Cut Operations during Day and Evening with Neutral Meteorological Conditions

Figure C.2 Mining Year 3 Noise Levels from Open-Cut Operations during Night with Neutral Meteorological Conditions

Figure C.3 Mining Year 3 Noise levels from Open-Cut Operations during Night with Adverse Meteorological Conditions



Taroborah Coal Project

Year 3 Mining Operations

Day/Evening Equipment
Neutral Meteorological
Conditions

Figure C.1

Signs and symbols
Point receiver

Noise Levels Leq dBA

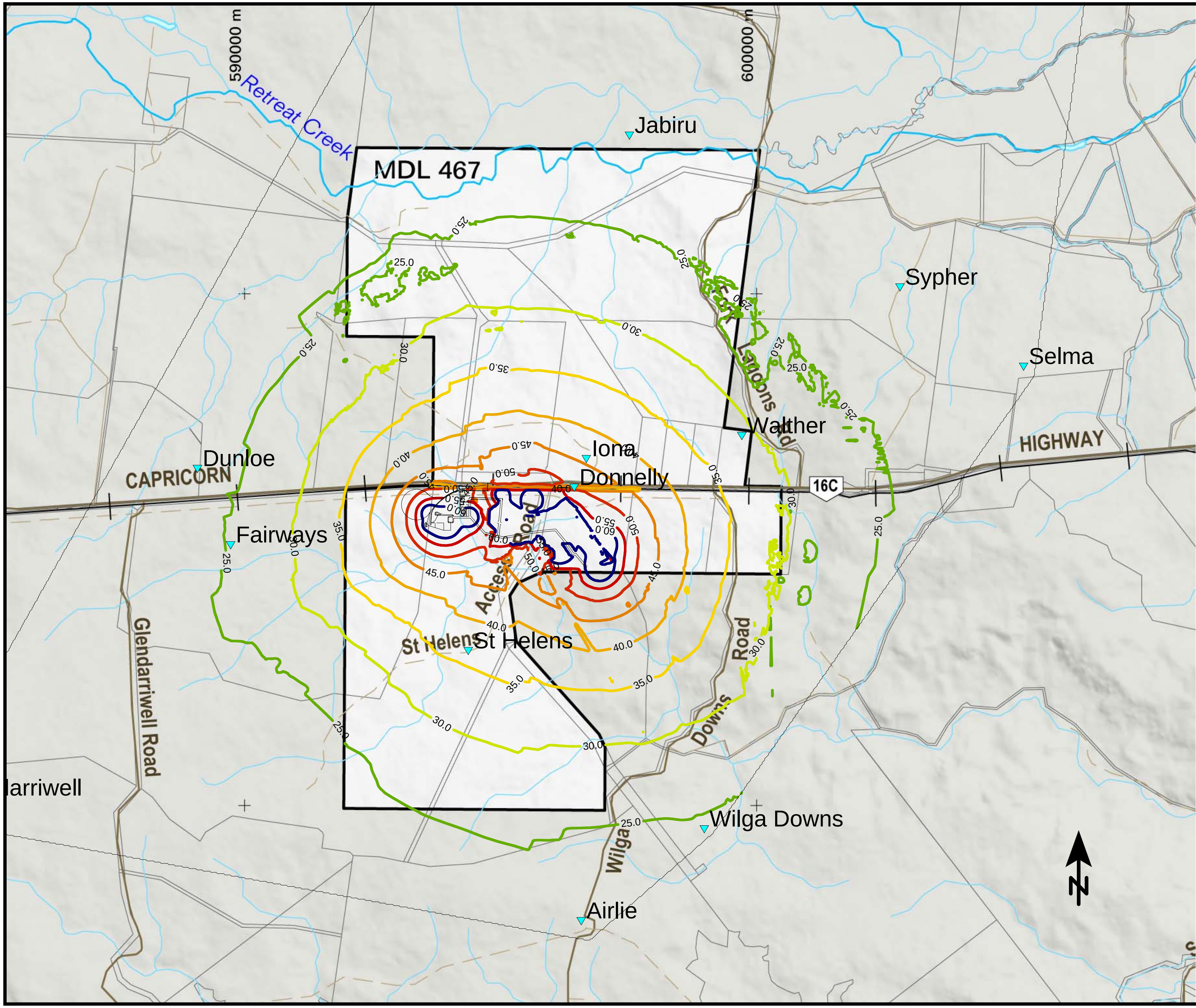
	< 25
25 <=	< 30
30 <=	< 35
35 <=	< 40
40 <=	< 45
45 <=	< 50
50 <=	< 55
55 <=	< 60
60 <=	

Date 16/12/2013

Length Scale 1:108703

0 0.5 1 2 3 4 km

ask ACOUSTICS & AIR QUALITY



Taroborah Coal Project

Year 3 Mining Operations

Night-Time Equipment
Neutral Meteorological
Conditions

Figure C.2

Signs and symbols

Point receiver

Noise Levels Leq dBA

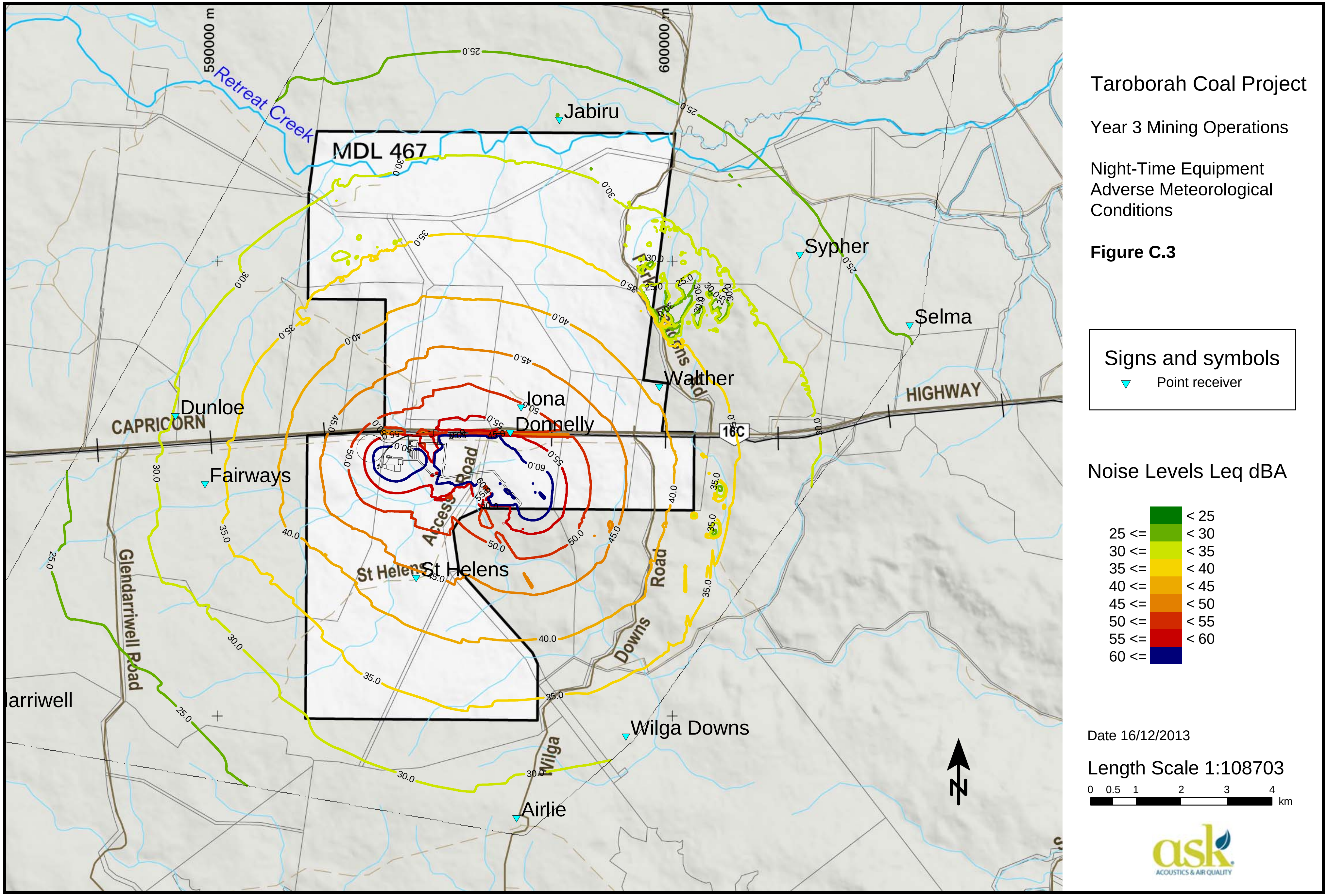
	< 25
25 <=	< 30
30 <=	< 35
35 <=	< 40
40 <=	< 45
45 <=	< 50
50 <=	< 55
55 <=	< 60
60 <=	

Date 16/12/2013

Length Scale 1:108703

0 0.5 1 2 3 4 km

ask ACOUSTICS & AIR QUALITY



Taroborah Coal Project
Year 3 Mining Operations
Night-Time Equipment
Adverse Meteorological
Conditions
Figure C.3
Signs and symbols
Point receiver
Noise Levels Leq dBA
< 25
25 <= < 30
30 <= < 35
35 <= < 40
40 <= < 45
45 <= < 50
50 <= < 55
55 <= < 60
60 <=
Date 16/12/2013
Length Scale 1:108703
0 0.5 1 2 3 4 km
ACOUSTICS & AIR QUALITY
590000 m
600000 m
Retreat Creek
MDL 467
Jabiru
Sypher
Selma
Walther
Iona
Donnelly
Dunloe
Fairways
CAPRICORN
HIGHWAY
16C
St Helens
Access Road
Glendarriwell Road
Downs Road
Wilga Downs
Airlie
N