Noise Impact Assessment Report

Knauf Glass Wool Manufacturing Plant at Steel River Site, NSW

26 JUNE 2009

Prepared for

Crown Project Services

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Executive Summary

URS Australia Pty Ltd (URS) has been commissioned by Crown Project Services (CPS) to undertake a noise and vibration impact assessment for the proposed Knauf Glass Wool Manufacturing Plant to be located at Steel River Industrial Estate in Newcastle, NSW. This report forms part of the Environmental Assessment (EA) which supports the Project Application lodged for the proposal.

Potential noise issues related to the proposed development include noise associated with the construction and operation of the facility. The proposed plant would operate 24 hours a day, 7 days a week, thus an assessment of sleep disturbance for the nearest potentially affected noise sensitive receptors has also been considered in this study.

The nearest potentially affected noise sensitive receptor locations have been identified and the predicted noise impacts of the proposed construction and operation on these locations have been assessed with consideration of the following relevant state guidelines:

- NSW Department of Environment and Climate Change (DECC) Industrial Noise Policy (INP, EPA 1999) for the assessment of the operational noise of the proposed development;
- NSW DECC Environmental Criteria for Road Traffic Noise (ECRTN, EPA 1999) for the assessment of the off-site traffic noise on public roads;
- NSW DECC Environmental Noise Control Manual (ENCM, EPA 1994) and Draft Construction Noise Guidelines (DECC, 2008) for the assessment of the noise from construction of the proposed development; and
- NSW DECC Environmental Noise Management - Assessing Vibration: A Technical Guideline (2006) for the assessment of the vibration due to the proposed construction.

The noise and vibration limits have been established in accordance with the above guidelines and the results of the background noise monitoring.

Noise levels resulting from the proposed construction and operation have been predicted using an acoustic computer model created in SoundPLAN Version 6.5. Details of the area's topography, receptor locations and sound power levels of the noise sources have been incorporated into the noise model. Typical and 'worst-case' scenarios have been taken into consideration throughout the noise modelling.

This study has found that the noise criteria can be achieved with the proposed noise mitigation measures and the standard noise management practices detailed in this report.

On the basis of this assessment, it is concluded that noise impacts of the proposed construction and operation of the plant are not expected to degrade the existing acoustic environment nor create annoyance to the community surrounding the plant.

1

Introduction

URS Australia Pty Ltd (URS) has undertaken a noise and vibration impact assessment for the proposed Knauf Glass Wool Manufacturing Plant to be located at a site within the Steel River Industrial Estate in Newcastle, NSW.

This noise study forms part of the Environmental Assessment (EA) which supports the Project Application for the facility.

Potential noise impacts associated with the proposed construction and operational activities are assessed:

- in accordance with the relevant guidelines set out in the NSW Department of Environment and Climate Change (DECC), and
- with consideration of the Stategic Impact Assessment Study (SIAS) concerning Land at Tourle Street and Industrial Drive, Mayfield – The Steel River Project (Newcastle City Council, 1998).

Noise impacts associated with the proposed construction activities are assessed against the guidelines set out in the DECC Environmental Noise Control Manual (ENCM, NSW EPA 1994) with consideration of the Draft Construction Noise Guidelines (DECC, 2008)

Vibration impacts associated with the proposed construction are assessed in accordance with the relevant DECC guidelines.

Potential for sleep disturbance is also assessed as the plant proposes to operate 24 hours a day, 7 days a week.

1.1 Scope of Assessment

The scope of this assessment is to:

- Provide a description of the existing acoustic environment and the proposed development;
- Assess the existing acoustic environment and establish appropriate project-specific noise levels (PSNL);
- Predict potential noise impacts by means of noise modelling and calculations;
- Assess predicted noise levels against the established noise criteria (PSNL);
- Provide recommendations for appropriate noise mitigation measures and noise management practices where required;
- Provide a statement of potential noise impacts; and
- Report the findings of the assessment.

2

Site Locality and Project Description

2.1 Site Location

The proposed plant is to be located within Steel River Industrial Estate which is on the south bank of the Hunter River and is bounded by Maitland Road (Pacific Highway), the Kooragang Goods Railway and Hunter River. The site is currently accessed via Channel Road, Steel River Boulevard and Industrial Drive.

Figure 2-1 illustrates the location of the site. The site is zoned 4(c) Industrial under the Newcastle Local Environmental Plan 2003 and is currently vacant.

The site itself is relatively flat, and the landform rises towards the south and south-west from the site boundary to Maitland Road (Pacific Highway) where this ridgeline would provide shielding to residential receptors in Mayfield West. A number of commercial premises are located on Maitland Road to the south of the site which would also provide shielding to the residential receptors.

2.2 Project Description

2.2.1 Plant Capacity

The design capacity of the furnace is 200 tonnes of molten glass per day and 60,000 tonnes per year. The maximum capacity of the molten glass line is 80,000 tonne per year. This maximum capacity will only be produced during limited time frames corresponding with market conditions. Depending on market conditions, the plant would produce between 100 and 200 tonnes per day. The line will be designed to support a product range of glass wool and white wool that can vary between the following limits (in tonnes of molten glass per day):

- 200 tonnes of glass wool
- 160 tonnes of glass wool and 40 tonnes of white wool.

Knauf Insulation does not intend to produce white wool product at this stage, and bringing this product to Australia will be determined by market conditions. For the purpose of this noise impact assessment, the production of white wool has been included in case the white wool line is introduced to the plant in the future. The output of the plant is assumed at maximum capacity of 200 tonnes per day.

2.2.2 Production Overview

The process involves the following key steps:

- For the production of glass wool:

a) Unloading, storing, weighing, mixing, dosing all mineral raw materials,
b) Melting materials to transform them to glass,
c) From liquid glass to fibre glass through the fibreisers,
d) Spray of binder and water to cool the fibres,
e) Forming of the glass fibre mat,
f) Curing oven,
g) Cooling section and X-ray detection, and
h) Cutting and packaging

- For the production of white wool:

a) Unloading, storing, weighing, mixing, dosing all mineral raw materials,

b) Melting the materials to transform them to glass,
c) From liquid glass to fibre glass through the fiberisers,
d) Spray of silicone,
e) Crushing of the fibres,
f) Spray of oil and antistatic materials, and
g) Packaging

The proposed facility would operate continuously 24 hours a day and 7 days a week.

2.3 Noise Sensitive Receptors

The nearest potentially affected noise sensitive receptor locations have been identified from examination of aerial photographs using Google Earth and a site inspection conducted in May 2009 as shown in Table 2-1. Individual receptors were grouped according to their location (generally by street).

Table 2-1 Noise Sensitive Receptors

Receptor	Address	Approx Closest Distance from Centre of Site (m)	Land Use[1]	Note
A	Decora Crescent, Warabrook	170	2(a) 1 Residential Zone[2]	Nearest residential SW to the site
B	O'Learia Crescent, Warabrook	250	2(a) 1 Residential Zone[2]	Nearest residential group S to the site
C	Stevenson Avenue, Travers Avenue, Norris Avenue and Thorton Avenue, Mayfield West	520	2(a) Residential Zone	Nearest residential group SE to the site
D	Mabellae Place, Decora Crescent[3], Angophora Drive and Bakeri Crescent, Warabrook	430	2(a) Residential Zone	Residential group – inner Warabrook
E	Mangrove Road & Maitland Road, Sandgate	320	4(a) Urban Services Zone	Nearest residential group NW to the site
F	Commercial Premises at Maitland Road (Pacific Highway)	80	4(a) Urban Services Zone	Nearest commercial premises S/SW to the site
G	Industrial Premises at Pacific Highway	130	Steel River Zone	Nearest industrial premises S to the site
H	Stevenson Park	850	6(a) Open Space and Recreation Zone	Nearest active recreation area SE to the site

Notes: 1. According to the Newcastle Local Environmental Plan 2003
2. According to the SIAS, this zone is the first row of residences in zones 2(a) which are adjacent to Industrial Drive or Pacific Highway.
3. Dwellings that are distant from Maitland Road

Figure 2-1 shows the location of these receptors described above, together with a reference one kilometre radius circle from the centre of the site.

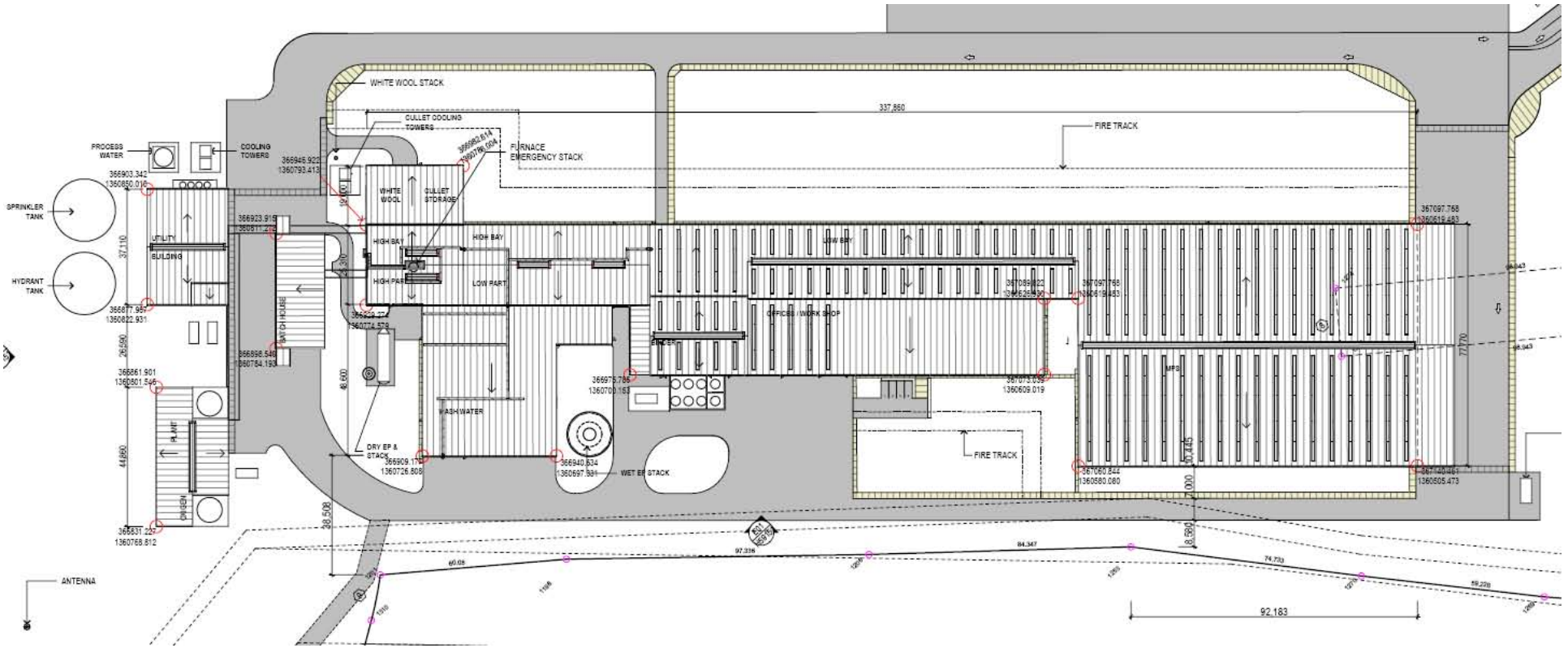
2 Site Locality and Project Description

Figure 2-1 Site and Receptor Locations

Source: Aerial image from Google Earth (URS Copyright, Google Earth 2009)

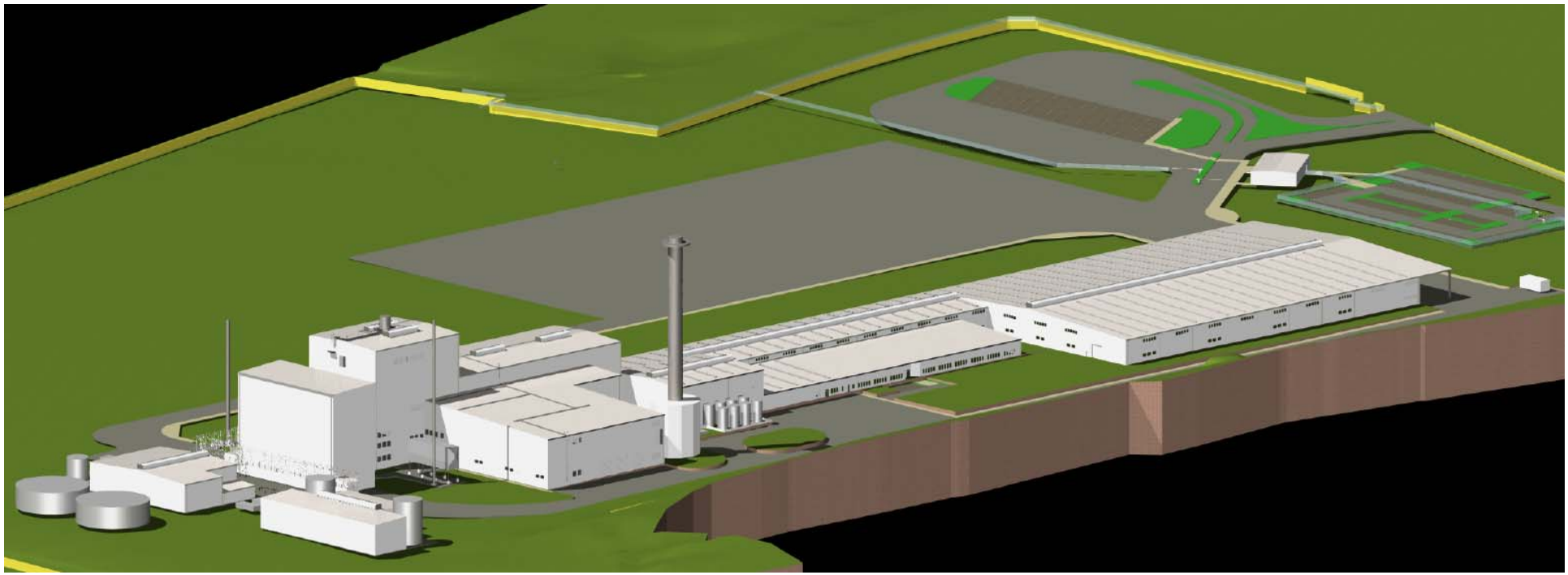
2 Site Locality and Project Description

Figure 2-2 Proposed Site Layout



2 Site Locality and Project Description

Figure 2-3 Knauf insulation plant in 3-D Model



3

Existing Acoustic Environment

3.1 Noise Measurement Methodology

Noise measurements have been conducted by long-term unattended monitoring and short-term attended monitoring at selected noise sensitive receptors.

All the noise measurements were undertaken in accordance with AS1055:1997 “Acoustics – Description and Measurement of Environmental Noise”

The long-term noise monitoring was undertaken using Acoustic Research Laboratories (ARL) Environmental Noise Loggers, models EL-315 and EL-316. These instruments comply with AS IEC 61672.1 – 2004 “Electroacoustics – Sound level meters – Specifications” and are designated as Type 2 and Type 1 instruments respectively, both suitable for field use. The noise loggers were positioned with the microphones at 1.2 metres above ground level and were set to statistically process and store the measured noise levels every 15 minutes for the whole monitoring period. The noise loggers were calibrated before logging and the calibration was checked after logging using an acoustic calibrator consistent with AS IEC 61672 requirements. No significant discrepancies (greater than 0.5 dB) were noticed in the reference calibration sound signals pre and post measurements.

To analyse the measured long-term noise levels, meteorological data provided by the nearest Bureau of Meteorology Automatic Weather Station (AWS), Newcastle Nobbys (AWS ID: 61055) to the site have been reviewed. Any noise monitoring periods affected by adverse weather conditions (rain and wind) were excluded from the final data analysis. The height difference between the AWS (10 metres above the ground level) and the sound level meter (1.2 metres above the ground level) was taken into consideration with a correction factor to modify wind speed used for the data analysis. This method complies with the guidelines specified in Section 4.2.5.1 of the AS 1170.2:2002 “Structural design actions – Wind actions”

The short-term attended noise monitoring was undertaken using a SVANTEK SVAN959 sound level meter which complies with AS IEC 61672.1 – 2004 “Electroacoustics – Sound level meters – Specifications” and is designated as a Type 1 instrument suitable for field and laboratory use. The sound level meter was positioned for each measurement with the microphone approximately 1.2 metres above ground level. The sound level meter was calibrated using an acoustic calibrator before measurement sessions and the calibration was checked at the end of measurement sessions. No significant discrepancies (greater than 0.5 dB) were noted in the reference calibration sound signals pre and post measurements.

The short-term noise monitoring was conducted on a cool day with slight wind gusts (average speed of less than 3 m/s) and partial cloud cover. The weather conditions during the measurement periods would not have adversely affected the results.

All the instrumentation used was calibrated by a NATA accredited acoustic laboratory within two years prior to the measurement period.

3.2 Noise Measurement Locations

Noise monitoring locations were chosen after examination of satellite imagery of the locality and a site inspection. Consideration was given to selecting the monitoring locations to enable unattended long-term noise monitoring to establish the representative noise trend at the nearest receptors. The locations were also chosen so that the noise loggers would not have been affected by extraneous noise which could result in unrepresentative elevated background noise levels.

3 Existing Acoustic Environment

Three noise sensitive receptor locations were selected for the long-term noise monitoring, and several short-term attended locations were also chosen to supplement the long-term noise monitoring. These locations are considered representative of the most potentially affected noise sensitive receptor locations near the site.

A brief description of each measurement location is given below:

- Location A: At the backyard of 79 Decora Crescent, Warabrook - located approximately 170 metres to the south-west of the site. This location was used for long-term unattended noise monitoring to obtain background noise levels representative of the residential group adjacent to Maitland Road (Location A: Decora Crescent, Location B: O'Learia Crescent and Cassia Close). Location E (Mangrove Road and Maitland Road in Sandgate) has been included in this group as the location is also affected by continuous traffic flows on Maitland Road and has a set back distance from the Maitland Road similar to that of Location A.

  The predominant noise source at this location was heavy and continuous road traffic flows during the day, evening and night-time period. Noise from the neighbouring industrial premises was not audible at this location.

  Short-term attended noise measurements were also conducted at this location to supplement the long-term noise monitoring.

- Location C: At the backyard of 63 Stevenson Avenue, Mayfield West, located approximately 520 metres to the south-east of the site. This location was utilised for long-term unattended noise monitoring to obtain background noise levels representative of the south-eastern residential group (Travers Avenue, Norris Avenue, Thorton Avenue and some dwellings at Stevenson Avenue) located in Mayfield West area that are distant from Maitland Road and Industrial Drive.

  The predominant noise sources at this location were distant traffic noise from Industrial Drive and Maitland Road during the day, evening and night-time period. No industry was audible at this location. Noise from people playing at the nearby soccer field was occasionally noticed during the evening period.

  Short-term attended noise measurements were also conducted at this location to supplement the long-term noise monitoring.

- Location D: At the backyard of 8 Mabellae Place, Warabrook, located approximately 430 metres to the south-west of the site. This location was utilised for long-term unattended noise monitoring to obtain background noise levels representative of the south-western and southern residential group (Decora Crescent, Angophora Drive and Bakeri Crescent) located in Warabrook area that are distant from Maitland Road.

  The predominant noise sources at this location were distant traffic noise from Maitland Road, intermittent train noise and local fauna (crickets and birds) during the day, evening and night-time period. No industry noise was noticed at this location.

  Short-term attended noise measurements were also conducted at this location to supplement the long-term noise monitoring.

  Table 3-1 provides a summary of the background monitoring locations and the receivers they represent.

Table 3-1 Summary of Noise Sensitive Receptors

Receptor	Address	Representative Background Monitoring Location
A	Decora Crescent	Location A / Location D
B	O'Learia Crescent & Cassia Close	Location A
C	Stevenson Avenue, Travers Avenue, Norris Avenue, Thorton Avenue	Location C
D	Mabellae Place, Decora Crescent, Angophora Drive & Bakeri Crescent	Location D
E	Mangrove Road & Maitland Road	Location A
F	Commercial Premises at Maitland Road (Pacific Highway)	Background noise monitoring not required as only Amenity Criteria apply to these receptors
G	Industrial Premises at Pacific Highway	
H	Stevenson Park	

3.3 Noise Measurement Results

The results of the long-term noise monitoring are summarised in Table 3-2,

Table 3-3,

3 Existing Acoustic Environment

Table 3-4 and Table 3-5. Any 15-minute period affected by adverse weather conditions or likely extraneous noise were excluded from calculation.

For the purpose of INP assessment, the following time of day is defined:

- Day: 7.00am – 6.00pm, Monday to Saturday; or 8.00am – 6.00pm on Sundays and public holidays
- Evening: 6.00pm – 10.00pm, all days
- Night: 10.00pm – 7.00am, Monday to Saturday; or 10.00pm – 8.00am on Sundays and public holidays

The noise monitoring data is considered representative of the area's acoustic environment, and therefore suitable for this assessment. Daily noise monitoring plots are provided in Appendix D of this report.

Table 3-2 Measured Noise Levels – 79 Decora Crescent, Warabrook (Location A)

Date	Assessment Background Level L_{A90} dB(A)			Ambient Noise Level L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Monday, 11 May 2009	51	46	42	58	56	55
Tuesday, 12 May 2009	51	48	42	59	56	55
Wednesday, 13 May 2009	51	48	40	59	56	55
Thursday, 14 May 2009	52	47	41	59	56	55
Friday, 15 May 2009	53	46	39	59	55	53
Saturday, 16 May 2009	50	44	36	58	53	50
Sunday, 17 May 2009	46	42	41	55	53	54
Monday, 18 May 2009	52	47	41	60	56	55
Tuesday, 19 May 2009	52	-	-	60	-	-
Representative Level[1]	**51**	**46**	**41**	**59**	**55**	**54**
Notes:	"-" noise logger collected during the daytime. 1. Represents median value for L_{A90}, and logarithmic average for L_{Aeq}.					

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Table 3-3 Measured Noise Levels – 63 Stevenson Avenue, Mayfield West (Location C)

Date	Assessment Background Level L_{A90} dB(A)			Ambient Noise Level L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Monday, 11 May 2009	44	43	39	55	53	50
Tuesday, 12 May 2009	40	43	38	53	49	49
Wednesday, 13 May 2009	42	43	37	53	49	48
Thursday, 14 May 2009	46	-	-	56	-	-
Representative Level[1]	**43**	**43**	**38**	**54**	**51**	**49**
Notes:	"-" noise logger collected during the daytime. 1. Represents median value for L_{A90}, and logarithmic average for L_{Aeq}..					

3 Existing Acoustic Environment

Table 3-4 Measured Noise Levels – 8 Mabellae Place, Warabrook (Location D)

Date	Assessment Background Level L_{A90} dB(A)			Ambient Noise Level L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Monday, 11 May 2009	-	39	38	-	47	45
Tuesday, 12 May 2009	33	38	35	50	47	46
Wednesday, 13 May 2009	35	38	35	48	45	44
Thursday, 14 May 2009	40	36	35	50	42	44
Friday, 15 May 2009	42	39	35	53	45	45
Saturday, 16 May 2009	42	35	32	52	44	43
Sunday, 17 May 2009	33	37	39	48	46	47
Monday, 18 May 2009	41	*	*	54	*	*
Tuesday, 19 May 2009	40	-	-	48	-	-
Representative Level[1]	**40**	**38**	**35**	**51**	**45**	**45**

Notes:
- Periods showing * have been affected by extraneous noise.

"-" noise logger collected during the daytime.

1. Represents median value for L_{A90}, and logarithmic average for L_{Aeq}.

The daily noise logging results generally show consistent daily noise levels throughout each period at all the monitoring locations.

The noise logging at Location C stopped after 3 days due to an equipment problem. However, the 3-day logging results showed consistent daily noise levels for each period and have been considered suitable for this assessment.

In the three tables above, an overall representative ambient noise level is determined by logarithmic averaging of each assessment period for the entire monitoring period, whereas the Rating Background Level (RBL) is determined by taking the median value of each assessment period for the entire monitoring period.

Table 3-5 presents a summary of overall ambient and background noise levels at each monitoring location.

Table 3-5 Summary of Measured Noise Levels – All Monitoring Locations

Location	Rating Background Level (RBL) L_{A90} dB(A)			Ambient Noise Level L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
A: Decora Crescent, Warabrook	51	46	41	59	55	54
C: Stevenson Avenue, Mayfield West	43	43	38	54	51	49
D: Mabellae Place, Warabrook	40	38	35	51	45	45

3 Existing Acoustic Environment

The RBLs presented were used to derive day, evening and night-time noise limits for this noise impact assessment of the proposed construction and operation of the plant.

As described in Section 3.2 of this report, noise limits for each assessment location were established by:

- Adopting the RBL obtained at Location A to derive noise limits for residential group adjacent to Maitland Road (Decora Crescent, O'Learia Crescent, Mangrove Road) and Maitland Road in Sandgate Locations A, B and E;
- Adopting the RBL obtained at Location C to derive noise limits for residential group located in Mayfield West (Travers Avenue, Norris Avenue, Thorton Avenue and some dwellings at Stevenson Avenue); and
- Adopting the RBL obtained at Location D to derive noise limits for residential group located in Warabrook area that are distant from Maitland Road (Decora Crescent, Angophora Drive and Bakeri Crescent).

4

Project Acoustic Criteria

4.1 Legislation and Guidelines

The potential noise impacts of the site were assessed in accordance with the following documents:

- DECC Industrial Noise Policy (INP, EPA 1999) for operational noise assessment including Application Notes to the INP (July 2006);
- DECC Environmental Criteria for Road Traffic Noise (ECRTN, EPA 1999) for site associated road traffic noise assessment;
- Environmental Noise Control Manual (ENCM, EPA 1994) for construction noise and sleep disturbance assessment, also with consideration of DECC Draft Construction Noise Guideline (August 2008); and
- DECC Assessing Vibration: A technical guideline (DEC, 2006)

The relevance of these guidelines is outlined in the following sections.

4.2 Operational Noise Criteria

4.2.1 Industrial Noise Policy (INP)

The INP provides the framework and process for deriving noise limit conditions for consents and licences that enables the DECC to regulate premises that are scheduled under the Protection of the Environment Operations Act 1997 (POEO Act). This policy seeks to promote environmental well-being through preventing and minimising noise.

Section 1.1 of the INP states the specific policy objectives as following:

- To establish noise criteria what would protect the community from excessive intrusive noise and preserve amenity for specific land uses;
- To use the criteria as the basis for deriving project specific noise levels;
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects;
- To outline a range of mitigation measures that could be used to minimise noise impacts;
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development; and
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the POEO Act.

The policy sets out two criteria (intrusiveness criterion and amenity criterion) to assess potential noise impacts of industrial sources. The first criterion is used to control intrusive noise impacts in the short-term for residences, and the second criterion is used to maintain noise level amenity for particular land uses for residences and other land uses.

Intrusive Noise Impacts

The intrusiveness criterion is summarised as follows:

h) $L_{Aeq,15\ minute} \leq$ rating background level (RBL, L_{A90}) + 5 dB(A)

where:

- $L_{Aeq,15minute}$ represents the equivalent continuous A-weighted sound pressure level of the source over 15 minutes, unless other descriptors are specified as more appropriate to characterise the source;
- This is to be assessed at the most affected point on or within the residential property boundary or if that is more than 30m from the residence, then at the most affected point within 30m of the residence.

Protecting Noise Amenity

The amenity criterion is established to limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in the INP. Table 4-1 is a summary of the noise levels from the INP showing amenity criteria for different type of receptors and areas within the study area.

Table 4-1 Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receptor	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level, dB(A)	
			Acceptable (ANL)	Recommended Maximum
Residence	Suburban	Day	**55**	60
		Evening	**45**	50
		Night	**40**	45
	Urban	Day	**60**	65
		Evening	**50**	55
		Night	**45**	50
Active recreation area (e.g. school playground, golf course)	All	When in use	**55**	60
Commercial premises	All	When in use	**65**	70
Industrial premises	All	When in use	**70**	75
Notes:	• Shaded Noise Levels represent the Amenity Criteria applicable to this assessment.			

For the receptor locations considered in this assessment, the following amenity areas have been adopted for the purpose of establishing the project-specific noise levels.

- Residential group adjacent to Maitland Road (A, B and E): Urban. This area has through traffic with characteristically heavy and continuous traffic flows during peak periods;
- Residential group distant from Maitland Road and Industrial Drive (C and D): Suburban. This area has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry;
- Active recreation area at Stevenson Park, south-east of the site;
- Commercial premises at Maitland Road, south of the site; and
- Industrial premises at Maitland Road, south-east of the site

In addition, the INP specifies that modification is to be implemented where the existing noise level from industrial noise sources is close to the acceptable noise level (ANL) or already exceeds the ANL for the area in question.

Adjustments are to be applied to the source noise level received at the assessment point, before comparison with the amenity criterion, where the noise source contains characteristics such as prominent tonal components, impulsiveness, intermittency, irregularity and dominant low frequency content as there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. The maximum correction to be applied to the criteria or the measured level is 10 dB(A) where the noise contains two or more modifying factors.

Modification to Acceptable Noise Level (ANL) is not required for the residential locations assessed in this assessment as the L_{Aeq} noise levels obtained for these locations were dominated by road traffic noise and were not affected by industrial sources, as discussed in Section 3.2 of this report.

Project-Specific Noise Levels (PSNL)

The PSNL reflect the most stringent noise level requirement from the criteria derived from both the intrusive and amenity criteria to ensure that intrusive noise is limited and amenity is protected.

Table 4-2 summarises the noise criteria applicable to the operation of the plant.

Table 4-2 Project-Specific Noise Levels (PSNL)

Receptor Location	Intrusiveness Criterion $L_{Aeq,15min}$ dB(A)			Amenity Criterion $L_{Aeq,period}$ dB(A)		
	Day	Evening	Night	Day	Evening	Night
A: Decora Crescent, Warabrook	**56**	51	46	60	**50**	**45**
B: O'Learia Crescent, Warabrook	**56**	51	46	60	**50**	**45**
C: Stevenson Avenue, Mayfield West	**48**	48	43	55	**45**	**40**
D: Mabellae Place, Warabrook	**45**	**43**	**40**	55	45	40
E: Mangrove Road, Sandgate	**56**	51	46	60	**50**	**45**
F: Commercial Premises at Maitland Road (Pacific Highway)[1]	n/a	n/a	n/a	**65**	**65**	**65**
G: Industrial Premises at Maitland Road[1]	n/a	n/a	n/a	**70**	**70**	**70**
H: Stevenson Park[1]	n/a	n/a	n/a	**55**	**55**	**55**

Notes:
1. When in use
- Shaded results represent the PSNL applicable to the each assessment location for day / evening / night.
- Where the predicted amenity noise level is lower than the intrusive level, both levels are to be satisfied.

As the proposed operations are 24 hours a day, the controlling noise criteria is the night-time criteria. For the purpose of this assessment, the night-time criteria are considered because compliance with the target leads to compliance at all other times.

4.2.2 Sleep Disturbance Criteria

In addition to the criteria in 4.2.1, an assessment of sleep disturbance for the potentially affected noise sensitive receptors has also been considered in this study. Where there exists the possibility that instantaneous, short-duration, high-level noise events may occur during night-time hours (10.00pm – 7.00am), consideration should be given to the potential for the disturbance of sleep within residences.

The INP does not specifically address sleep disturbance from high noise level events. DECC however, reviewed research on sleep disturbance in the ECRTN and recognised that the current sleep disturbance criterion, of an $L_{A1,1min}$ not exceeding the $L_{A90,15min}$ by more than 15 dB(A), is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace that criterion, it is understood that DECC will continue to use it as a guide to identify the likelihood of sleep disturbance.

Table 4-3 summarises the sleep disturbance criteria that are applied to the nominated residential receptors.

Table 4-3 Sleep Disturbance Criteria

Receptor	Night-time Background Noise Level ($L_{A90,15min}$) dB(A)	Criterion ($L_{A1,1min}$) dB(A)
A: Decora Crescent, Warabrook	41	41 + 15 = **56**
B: O'Learia Crescent, Warabrook	41	41 + 15 = **56**
C: Stevenson Avenue, Mayfield West	38	38 + 15 = **53**
D: Mabellae Place, Warabrook	35	35 + 15 = **50**
E: Mangrove Road, Sandgate	41	41 + 15 = **56**

These levels are assessed outdoors at the most exposed facade of residential premises. Sleep disturbance thresholds are also determined by factors including noise character and pitch, perceived personal danger, degree of habituation, age, illness or fatigue and the point in time when the noise occurs during the sleep period. For example, noisy events are generally less disturbing to people if confined to the earlier period of the evening when it is still possible to retrieve deep sleep.

The $L_{A1,1min}$ descriptor is meant to represent a maximum noise level measured under 'fast' time response. DECC accepts analysis based on either $L_{A1,1min}$ or L_{AFmax}.

4.2.3 Environmental Envelope

The Newcastle Local Environmental Plan (LEP) refers to a defined environmental envelope, consisting of quantitative and qualitative standards and objectives to guide developments on the estate. Collectively, these criteria define the total impact the estate would have on the local environment. These have been documented in the Strategic Impact Assessment Study (SIAS) concerning land at Tourle Street and Industrial Drive, Mayfield – "The Steel River Project" (Newcastle City Council, February 1998).

The environmental envelope relates to the areas of noise emissions in Section 8.4, Part D of the SIAS as following:

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Table 4-4 Noise Limits – SIAS Environmental Envelope

Zone	Daytime, dB(A)	Night-time, dB(A)
2(a) 1 Residential on a main road or near an industrial area	L_{A10} = 48	L_{A10} = 30 L_{A1} = 55[1]
2(a) Residential	L_{A10} = 42	L_{A10} = 30 L_{A1} = 49[1]
4(b) General Industrial	L_{A10} = 65	L_{A10} = 65
5(a) Special Uses (Church, School)	L_{A10} = 48	n/a
5(b), (c) and (e) (Rail, Road)	L_{A10} = 65	L_{A10} = 65
6(a) Open Space and Recreation	L_{A10} = 50	L_{A10} = 40 L_{A1} = 50[1]
3(d) Commercial	L_{A10} = 50	L_{A10} = 40 L_{A1} = 50[1]
Notes:	• Daytime: 7.00am to 10.00pm Monday to Saturday and 8.00am to 10.00pm on Sundays and public holidays. • Night-time: 10.00pm to 7.00am Monday to Saturday and 10.00pm to 8.00am on Sundays and public holidays. 1. Sleep disturbance criteria	

Table 4-5 summarises the comparison of the noise limits based on the DECC guidelines and SIAC environmental envelope.

Table 4-5 Comparison of Noise Limits – DECC Guidelines and SIAS Environmental Envelope

Receptor	Daytime (L_{Aeq}), dB(A)		Night-time (L_{Aeq}), dB(A)		Sleep Disturbance ($L_{A1,1min}$), dB(A)	
	INP	SIAS[1]	INP	SIAS[1]	ECRTN	SIAS[1]
A: Decora Crescent, Warabrook	56	48	45	30	56	55
B: O'Learia Crescent, Warabrook	56	48	45	30	56	55
C: Stevenson Avenue, Mayfield West	48	42	40	30	53	49
D: Mabellae Place, Warabrook	45	42	40	30	50	49
E: Mangrove Road, Sandgate	56	48	45	30	56	55
F: Commercial Premises at Maitland Road (Pacific Highway)	65	50	65	40	65	40
G: Industrial Premises at Maitland Road	70	65	70	65	70	n/a
H: Stevenson Park	55	50	55	50	55	40
Notes:	• 1. Considering the plant would generate steady industrial noise, no correction has been applied to L_{Aeq} as the variation between L_{Aeq} and L_{A10}. descriptors would be within 1 dB.					

The noise limits presented in Table 4-5 show that the SIAS daytime noise limits are lower than the INP limits by in the order of 10 dB at residential receptors, 8 dB at active recreation area and industrial premises and 14 dB at commercial premises.

It can also be seen that the SIAS night-time noise limits are much stricter than the INP limits by more than 10 dB. The SIAS sleep disturbance criteria are generally similar to ECRTN criteria.

The difference in daytime noise limits between the INP limits and SIAS limits are not considered further as the night-time noise limits will be applied to all assessment period as discussed in Section 4.2.1.

An assessment and discussion of predicted noise impacts against the both DECC guidelines and SIAS environmental envelope for the night-time period is presented in Section 5.3.4.

4.3 Construction Noise Criteria

The noise criteria specified in Chapter 171 of the DECC Environmental Noise Control Manual (ENCM) are usually applied when assessing construction noise. However, the ENCM only considers construction periods of up to 26 weeks.

As the total construction period is expected to be over 26 weeks, a reference has been made to the DECC Draft Construction Noise Guideline. This guideline is not yet mandatory however, it will be used to assist DECC in setting statutory conditions in licences or other regulatory instruments for construction noise.

Table 4-6 summarises the construction noise criteria.

Table 4-6 Construction Noise Criteria – Residences and other sensitive land uses

Construction Period	Time of Day	Management Level[1] $L_{Aeq\ (15min)}$
Greater than 1 week	Recommended standard hours — Monday to Friday: 7.00am to 6.00pm — Saturday 8.00am to 1.00pm — No work on Sundays or public holidays	RBL + 10 dB
	Outside recommended standard hours	RBL + 5 dB
Notes:	• 1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.	

For commercial and industrial premises, the following external construction noise levels should be assessed at the most affected occupied point of the premises:

- Industrial premises: external $L_{Aeq(15min)}$ 75 dB(A); and
- Offices, retail outlets: external $L_{Aeq(15min)}$ 70 dB(A)

In accordance with the above guideline, the following construction noise criteria are applicable for each receptor location.

Table 4-7 Project-specific Construction Noise Criteria

Receptor Location	Rating Background Level L_{A90} dB(A)	Criterion $L_{Aeq,\ 15\ min}$ dB(A)
A: Decora Crescent, Warabrook	51	51 + 10 = **61**
B: O'Learia Crescent, Warabrook	51	51 + 10 = **61**
C: Stevenson Avenue, Mayfield West	43	43 + 10 = **53**
D: Mabellae Place, Warabrook	40	40 + 10 = **50**
E: Mangrove Road, Sandgate	51	51 + 10 = **61**
F: Commercial Premises at Maitland Road (Pacific Highway)1	n/a	**65**
G: Industrial Premises at Maitland Road1	n/a	**70**

The draft construction noise guideline does not include any criteria to assess off-site traffic noise associated with the construction. The off-site traffic noise has therefore been assessed under the ECRTN. Noise from traffic associated with the proposed construction is minimised as much as is practically possible by limitations on construction hours, and Australian Design Rules which apply to road-registered vehicles.

4.4 Off-Site Traffic Noise Criteria

4.4.1 Environmental Criteria for Road Traffic Noise (ECRTN)

Criteria for off site road traffic noise are specified in the DECC Environmental Criteria for Road Traffic Noise (ECRTN). The criteria applicable are summarised in Table 4-8. The site falls under the ECRTN category of 'Land use developments with potential to create additional traffic on existing freeways/arterials'.

Regular vehicle movement within the facility is considered as an industrial noise source and thus, is to be assessed in accordance with the INP.

Table 4-8 Environmental Criteria for Road Traffic Noise

Type of Development	Day $L_{Aeq,15hr}$, dB(A)	Night $L_{Aeq,9hr}$, dB(A)	Where criteria are already exceeded
Land use developments with potential to create additional traffic on existing freeways/arterials	**60**	**55**	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating time of use; using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.
Notes:	• Day: 7.00am – 10.00pm • Night: 10.00pm – 7apm		

4.5 Vibration Criteria

The effect of vibration is generally considered and evaluated in terms of human disturbance and structural damage.

To assess potential vibration impacts from the proposed construction activities including concrete or steel piling, vibration criteria have been adopted from the DECC Environmental Noise Management - Assessing Vibration: A Technical Guideline (2006). This guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. It does not however address motion sickness, occupational vibration, blasting vibration effects or vibration-induced damage to buildings or structures. No blasting operation is proposed during the proposed construction.

There are no Australian Standards that provide criteria against which the potentials for building damage from ground vibration can be assessed. British Standard *BS 7385: Part 2-1993 "Evaluation*

and measurement for vibration in buildings Part 2" is an internationally recognised standard which is one of the more recent vibration standards and is based on a comprehensive review of international standards and guidelines. The standard also takes into consideration the frequency of the vibration which is significant in the assessment of potential building damage.

Vibration and its associated effects are usually classified as Continuous, Impulsive, or Intermittent as follows:

Table 4-9 Examples of Types of Vibration

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

4.5.1 Human Disturbance

The most relevant criteria for the proposed piling operations are presented in the following Table 4-10.

Table 4-10 Acceptable Vibration Dose Values for Intermittent Vibration (m/s$^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60
Notes:	1. Daytime : 7.00am to 10.00pm / Night time: 10.00pm to 7.00am. 2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be need to assess intermittent values against the continuous or impulsive criteria for critical areas. • Source: BS 6472 – 2008			

4.5.2 Structural Damage

British Standard 7385: Part 2 "Evaluation and measurement of vibration in buildings" provides levels at which 'cosmetic', 'minor' and 'major' categories of damage may occur. BS 7385 recommends that the peak particle velocity is used to quantify vibration and specifies damage criteria for frequencies within the range 4Hz to 250Hz, which is the range usually encountered in buildings. At frequencies below 4Hz, a maximum displacement value is recommended.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and heavy commercial / industrial buildings are presented in Table 4-11.

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Table 4-11 Transient Vibration Guide Values

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse, mm/s	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

5

Assessment of Potential Acoustic Impacts

5.1 Calculation Methodology

Noise levels due to the proposed construction and the operation of the plant at the identified noise sensitive receptor locations have been predicted using an acoustic computer model created in SoundPLAN Version 6.5. This program is used and recognised internationally.

The noise model was developed to allow the prediction of cumulative noise levels from the plant and construction site by calculating the contribution of each noise source. The noise model takes into account:

- sound power levels of each source;
- receptor locations;
- digital terrain map with 0.5m height interval;
- screening effects due to topography;
- meteorological effects and attenuation due to distance; and
- ground and atmospheric absorption

The noise calculations have been carried out using the L_{Aeq} and L_{AFmax} descriptors to assess the operational and construction noise impacts.

The program allows the use of various noise prediction algorithms. To calculate noise emission levels under neutral and prevailing meteorological conditions, the CONCAWE algorithm which is designed for industrial sites has been used. The effects of meteorological conditions are explained in more detail in Section 5.2 below.

5.2 Meteorological Conditions

Adverse meteorological conditions have the potential to increase noise levels at a receptor. Such phenomena generally occur during temperature inversions and where there is a wind gradient with wind direction from the source to the receptor. It is known that these meteorological effects typically increase noise levels by 5 to 10 dB, and even higher than 10 dB in extreme conditions.

Temperature inversions generally occur during the night-time and early morning periods during the winter season, thus the most significant meteorological effect during the daytime period is wind.

The prevailing meteorological conditions for the site were assessed using meteorological data collected from a BOM weather station located in Newcastle Nobbys (AWS ID: 61055) in 2004 and incorporated into an air dispersion program, TAPM (V4). The wind rose data used in the assessment are presented in Appendix B.

The results of the meteorological analysis are presented in Table 5-1:

Table 5-1 Prevailing Meteorological Conditions

Time of Day	Pasquill Stability Class	Wind Speed (m/s)	Wind Direction
Day (7.00am – 6.00pm)	D	3	North-westerly
Evening & Night (6.00pm – 7.00am)	F	2	North-westerly

5.3 Operational Noise

5.3.1 Sound Power Levels

Table 5-2 presents the sound power levels of equipment that has been identified as the primary on-site noise sources. Sound power levels of these sources have been provided by Knauf Insulation in octave frequency bands except for minor noise sources which have been taken as single band (500Hz) sources in the noise model. Sound power levels of other sources have been referenced from generic data and library. The data was found to be valid and suitable for the noise modelling.

Table 5-2 Sound Power Levels - Operational Equipment

Building	Operational Noise Source	Estimated Overall Sound Power Level	
		dB(Lin)	dB(A)
High Bay	Furnace	112	108
	Fibrators	121	118
	Motors	107	103
	Fans 1	108	102
	Fans 2	110	105
	Fans 3	107	102
Wash Water	Motors	107	101
White Wool	Primary cyclone	111	109
	Secondary cyclone	106	98
	Fan house	106	99
	Fine filter	112	103
	Formats	111	105
	Hydraulic motor	105	97
	Motor	111	103
	Fan	116	107
	Weighing bowler	111	104
Low Bay	Motors and Fans	113	108
	Furnace fans and motors 1	112	103
	Furnace fans and motors 2	112	103
	Saw 1	117	109
	Saw 2	109	104
MPS	General operation 1	110	102
	General operation 2	105	97
	Chopper 1	105	103
	Chopper 2	105	103
	Blower	106	98
	Packer	104	97
	Palletiser 1	87	83
	Palletiser 2	87	83
Utility	Compressors	109	104

Building	Operational Noise Source	Estimated Overall Sound Power Level	
		dB(Lin)	dB(A)
Oxygen Plant	Source	104	100
External Sources	Cooling tower (pumps and fans)	110	102
	Forklift manoeuvring	117	107
	Forklift working	110	100
	Truck loading / unloading	94	90

5.3.2 Noise Modelling Scenarios

Potential noise impacts have been predicted separately for each of the following meteorological conditions. Table 5-3 provides a summary of each meteorological scenario.

Table 5-3 Meteorological Conditions used in Noise Modelling

Met. Scenario	Meteorological Condition				
	Temperature (°C)	Relative Humidity (%)	Pasquill Stability Class	Wind Speed (m/s)	Wind Direction
A: Daytime Operation – Neutral Met. Conditions	20	70	D	0	n/a
B: Evening & Night-time Operation – Neutral Met Conditions	12	60	D	0	n/a
C: Daytime Operation – Prevailing Met. Conditions	20	70	F	3	North-westerly wind
D: Evening & Night Operation – Prevailing Met. Conditions	12	60	F	2	North-westerly wind

5.3.3 Assumptions Made in Noise Modelling

The noise modelling is based on likely maximum operating conditions. All sources are conservatively positioned within designated operating areas.

The following assumptions were made to assess the cumulative noise impacts of the proposed operation of the plant:

- Each noise generating equipment operates continuously;
- All the equipment listed operates simultaneously;
- External walls of the plant buildings: 0.48mm thick Colorbond steel cladding wall;
- Roof of the plant buildings: 0.48mm thick Colorbond steel sheeting;
- No noise attenuation through roof and wall ventilations; and
- Roller shutter doors kept open.

5.3.4 Predicted Operational Noise Levels

DECC Noise Limits

The noise modelling results using neutral and prevailing meteorological conditions as compared to the DECC Noise Limits are presented in Table 5-4.

Table 5-4 Predicted Operational Noise Levels – DECC Noise Limits

Receptor Location	Predicted Noise Levels (L_{Aeq}) dB(A)		Criterion (L_{Aeq}) dB(A)		Exceedance (dB)
	Neutral Met Conditions (Scenario A & B)	Prevailing Met Conditions (Scenario C & D)	Day (Scenario A & C)	Evening/ Night (Scenario B & D)	
A	**47**	**47**	56	50 / 45	~2 (Night)
B	35	36	56	50 / 45	No
C	32	34	48	45 / 40	No
D	39	39	45	43 / 40	No
E	40	40	56	50 / 45	No
F	54	54	65	65	No
G	50	50	70	70	No
H	35	37	55	55	No

Notes: • Results in bold represent the exceedance of the respective noise limit.

The results presented in Table 5-4 show that the noise levels generated by the proposed operation would generally be within the established noise limits at all receptor locations under all conditions except for at Location A (first row of residences at Decora Crescent, Warabrook which are adjacent to Industrial Drive or Pacific Highway)

A marginal exceedance of the noise limit during the night-time period is predicted to occur at Location A under all meteorological conditions due to its proximity to the site. It is noted that the predicted exceedance is up to 2 dB which is not considered significant and would not be noticeable as the existing road traffic noise level during the night-time period at this locations is 54 dB(A). Nonetheless, noise mitigation measures to meet the noise criteria have been provided in Section 6.1 in order to prevent background creep, i.e. the progressive increase in background noise levels as new noise emitting activities are located in the area.

Modelling also predicted that there would be insignificant difference in noise levels between neutral and enhanced meteorological conditions at all receptor locations. This results from the direction of the prevailing wind which does not greatly increase the noise at the nearest receptors.

Based on the data provided by Knauf Insulation, it is considered that the noise sources would not have characteristics such as prominent tonal components, impulsiveness or dominant low frequency content.

SIAS Environmental Envelope

Table 5-5 presents the assessment of the predicted noise levels against the noise limits set out in the SIAS.

Table 5-5 Predicted Operational Noise Levels – SIAS Noise Limits

Receptor Location	Predicted Night-time Noise Levels (L_{Aeq}) dB(A)		Criterion (L_{Aeq}), dB(A)	Exceedance (dB)
	Neutral Met Conditions (Scenario B)	Enhanced Met Conditions (Scenario D)	Night (B & D)	
A	**47**	**47**	30	~17
B	**35**	**36**	30	~ 6
C	32	**34**	30	~ 4
D	**39**	**39**	30	~ 9
E	**40**	**40**	30	~ 10
F	**54**	**54**	40	~ 14
G	50	50	65	No
H	35	37	40	No

Notes:
- Night-time: 10.00pm to 7.00am Monday to Saturday and 10.00pm to 8.00am on Sundays and public holidays.
- Results in bold represent the exceedance of the respective noise limit.

The results presented in Table 5-5 show that exceedances of the SIAS environmental envelope noise limits during the night-time are predicted to occur at all the assessed residential receptors and commercial receptor by 4 dB to 17 dB.

It should be noted that the SIAS noise limits have been established using L_{A10} descriptor in accordance with ENCM (NSW EPA, 1994). It was based on the background noise levels measured (41 – 49 dB(A) during the daytime and 36 – 44 dB(A) during the night-time period) at selected nearby residential locations to the Steel River site during the night-time period in 1997. The Industrial Noise Policy (INP) was published by NSW EPA in 1999 and superseded the ENCM for the purpose of assessment of industrial noise.

The background noise survey conducted in May 2009 provided noise levels of 40 – 51 dB(A) and 35 – 41 dB(A) during the daytime and night-time period, respectively. The survey results show that the background noise in the area has not been significantly increased since 1997, therefore the measured background noise levels used to establish the project-specific noise levels (PSNL) for this project are considered valid and suitable.

As discussed in Section 4.2.1, when setting the amenity noise criteria, modification is to be implemented where the existing noise level from industrial noise sources is close to the acceptable noise level (ANL) or already exceeds the ANL for the area in question to prevent background creep. Modification to amenity noise criteria was not required for the residential locations assessed in this assessment as no industrial noise was audible at the background noise monitoring locations as discussed in Section 3.2. The primary noise sources at these locations were the road traffic noise from Maitland Road and Industrial Drive.

Therefore, URS considers that the noise limits presented in Table 4-2 have been conservatively established in accordance with the INP requirements and are more appropriate for the purpose of this noise assessment than the noise limits stipulated in the SIAS Environmental Envelope, which were based on a superseded assessment technique.

A predicted noise contour map for the enhanced night-time meteorological conditions is presented in Appendix C. It should be noted that these noise contours are indicative only due to interpolation within the calculation grid, and the results of the point-to-point calculations presented in Table 5-4 are more accurate for a specific receptor.

5.3.5 Assessment of Sleep Disturbance

Table 5-6 presents the predicted maximum noise levels due to the proposed plant operation and the criterion applicable to each residential receptor:

Table 5-6 Predicted Maximum Noise Levels

Receptor	ECRTN Criterion ($L_{A1,1min}$) dB(A)	SIAS Criterion ($L_{A1,1min}$) dB(A)	Predicted Maximum Noise Level (L_{Amax}) dB(A)	Exceedance
A	56	55	53	No
B	56	55	44	No
C	53	49	42	No
D	50	49	47	No
E	56	55	48	No

The predicted noise levels are within the sleep disturbance noise limits established in accordance with both ECRTN and SIAS environmental envelope, therefore noise impact during the night-time period would not be expected for the receptors.

5.4 Construction Noise

The total construction period is expected to be approximately fifteen (15) months. The main construction activities include removing the layer of vegetation and site levelling, installing drainage, roadways and building construction, followed by installation of equipment and machinery.

5.4.1 Construction Equipment

Typical construction equipment expected on this construction site and corresponding noise levels are summarised in Table 5-7. The sound power levels of these items have been taken from Appendix D of AS 2436-1981: “Guide to noise control on construction, maintenance and demolition sites” and library data.

The sound power levels presented in the table are indicative and should be used only as a guide.

Table 5-7 Sound Power Levels - Construction Equipment

Scenario	Proposed Activities	Equipment / Plant Item	Sound Power Level L_{Aeq} dB(A)
1	Site preparation & Earthworks	Excavator	110
		Bulldozer	110
		Grader	116
		Roller	108
		Loader	108
		Steel/Concrete piling rigs & piling	116
		Dump truck	105
2	Concrete Foundation Works	Concrete truck	108
		Concrete mixer	110
		Compactor	114
		Mobile crane	104
3	Building Construction & Equipment Installation	Mobile crane	104
		Delivery trucks	106
		Pneumatic tools	112
		Electric tools	102
		Power generators	102
		Hammers	108

5.4.2 Predicted Construction Noise Levels

The noise levels generated by the construction activities listed above have been predicted at each receptor location. Noise emissions will vary as construction progresses. The noise modelling has been carried out considering the prevailing meteorological conditions. The results are presented in Table 5-8.

Table 5-8 Predicted Construction Noise Levels

Receptor	Predicted Noise Level $L_{Aeq,15min}$ dB(A)	Daytime Noise Criterion $L_{Aeq,15min}$ dB(A)	Exceedance
A	53 – 58	61	No
B	50 – 55	61	No
C	43 – 48	53	No
D	41 – 46	50	No
E	48 – 53	61	No
F (Commercial)	62 – **67**	65	~ 2dB
G (Industrial)	60 – 65	70	No

The predicted construction noise levels presented in Table 5-8 show that no exceedance of the noise limit is expected at any residential locations. A marginal exceedance is predicted at the nearest commercial premises (Location F) which is not considered significant. This exceedance would only occur for a limited duration during the earthworks.

It should be noted that the predicted noise levels presented above result from a conservative noise modelling approach where it has been assumed that all equipment would operate continuously and simultaneously during the assessment period. With more realistic operational patterns, it is predicted that the construction noise levels would be within the noise limit at all locations.

Physical construction noise mitigation measures are not considered necessary. However, adoption of noise management strategies implementing good industry practice is required to minimise noise emissions from the proposed construction works. Noise management strategies are provided in Section 0.

5.5 Off-Site Traffic Noise

The potential off-site traffic noise impact associated with the proposed construction and operation has been assessed based on the URS Traffic Study undertaken for the development.

It is expected that the most potentially affected residences would be the dwellings adjacent to Maitland Road (Pacific Highway). The nearest RTA count station is located west of Maud Street, and has an Annual Average Daily Traffic (AADT) count of 22,902 vehicles (RTA, 2004). The traffic volumes in this road have not changed significantly since 2004.

5.5.1 Construction

The construction of the plant is likely to generate up to 209 light vehicle movements and 8 heavy vehicle movements within the morning and evening peak hour. This equates to a daily volume of 418 light vehicle movements and 16 heavy vehicle movements.

The main impacts from construction are likely to occur:

- During the morning peak between 7.00am and 9.00am when construction staff and early delivery vehicles coincide with morning traffic along Maitland Road, Industrial Drive and Steel River Boulevard;
- Through regular daily traffic generated by delivery trucks for equipment, plant and materials with intermittent peaks associated with works; and
- Outside of peak periods, through delivery of large equipment and facility components from the port to the construction site, that would only occur once.

The predicted increase in road traffic noise levels from Maitland Road is negligible (less than 0.2 dB above the existing levels) at the most potentially affected dwellings. The legislation and guidelines listed in Section Table 4-6 do not include any criteria to assess off-site traffic noise associated with construction. It is assumed that off-site traffic noise with the proposed construction is minimised as much as is practically possible by limitations on construction hours to 7am to 6pm, and Australian Design Rules which apply to road-registered vehicles.

5.5.2 Operation

The operation of the plant is assumed to generate regular daily vehicle trips of up to 226 light vehicle movements and 108 heavy vehicle movements. This translates up to 76 light vehicles per hours and 14 heavy vehicles per hour within the peak periods. The daily heavy vehicle movements are associated with the delivery of raw materials and distribution of the final product.

The traffic volumes generated by the proposed plant operation would be not increase the traffic noise levels greater than 0.3 dB above the existing levels, therefore satisfying the off-site traffic noise criteria.

5.6 Construction Vibration

5.6.1 Vibration sources

Vibration impacts of construction activities can cause human annoyance or damage to buildings. The intensity, duration, frequency components and number of occurrences of vibration are important aspects in both the annoyance caused and strains induced in structures.

Vibration caused by construction activities may be intermittent or continuous in nature depending on the source, and the magnitude of effect created by vibration depends on the nature of the ground transmitting the vibration and the distance from the source to the nearest building.

Vibration would result from the following construction activities:

- Steel/concrete piling operations;
- Jackhammers;
- Use of heavy construction equipment/plant; and
- Use of vibratory rollers.

Typical peak particle velocity ground vibration levels from jackhammers and heavy plant such as bulldozers are from 2.5 mm/s to 4 mm/s at a distance of 10 metres. At a distance greater than 20 metres, the typical vibration levels are below 0.2 mm/s. Levels of ground vibration caused by vibratory rollers can range up to 6 mm/s at a distance of 10 metres.[1] The highest levels of vibration usually occur when the roller is brought to rest, therefore, the plant should not be brought to rest to a location that is in the vicinity of sensitive receptors.

The typical peak particle velocity ground vibration levels from pile driving range from 12 mm/s to 30 mm/s at distances of 10 metres depending on the ground conditions and the equipment used.[1]

Table 5-9 presents the minimum 'buffer' distances recommended for some common construction equipment which have been predicted based on the typical ground vibration levels of the equipment and the criteria set out in Section 4.5 and which are set to avoid human discomfort and cosmetic damage during construction hours.

Table 5-9 Recommended Minimum Vibration Buffer Distances

Construction Equipment/Plant	Recommended Minimum Buffer Distance	
	Human Comfort	Cosmetic Damage
Piling Operations	80 – 100 m	20 – 40 m
Bulldozers	5 m	n/a
Front End Loaders	5 m	n/a
Jackhammers	5 m	n/a
Heavy Vibratory Rollers	20 – 25 m	n/a

[1] Source: NSW Roads and Traffic Authority – Environmental Noise Management Manual

Construction Equipment/Plant	Recommended Minimum Buffer Distance	
	Human Comfort	Cosmetic Damage
Truck Movements	10 – 15 m	n/a

5.6.2 Predicted Construction Vibration Impacts

As shown in Table 5-9, it is anticipated that the primary source of ground vibration is associated with potential steel or concrete piling operations.

The nearest dwelling is located approximately 170 metres from the site, therefore the expected ground vibration levels from the proposed construction activities would be significantly lower than the vibration limits for both human disturbance and structural damage.

The nearest commercial premises is located within 100 metres from the site, the ground-borne vibration may occasionally be slightly perceptible. However, cosmetic damage due to the proposed piling operation is not expected to occur. Vibration monitoring would be conducted during the piling operations should any piling be any closer to this receptor.

Based on typical vibration levels and 'buffer distances', no mitigation measures are required to reduce vibration levels. The principles of best vibration management practice are provided in Section 6.3.

5.7 Summary of Potential Acoustic Impacts

The following provides a summary of the outcomes of the assessment of potential acoustic impacts:

- Operation (with respect to DECC Criteria):
  - Noise levels generated by the proposed operation would generally be within the established noise limits at all receptor locations under all conditions except for at Location A.
  - A marginal exceedance of the noise limit during the night-time period is predicted to occur at Location A under all meteorological conditions due to its proximity to the site. It is noted that the predicted exceedance is up to 2 dB which is not considered significant and would not be noticeable as the existing road traffic noise level during the night-time period at this locations is 54 dB(A).
- Operation (with respect to SIAS Criteria):
  - Exceedances of the SIAS environmental envelope noise limits during the night-time are predicted to occur at all the assessed residential receptors.
  - It should be noted that the SIAS noise limits have been established using L_{A10} descriptor in accordance with ENCM (NSW EPA, 1994). The Industrial Noise Policy (INP) was published by NSW EPA in 1999 and superseded the ENCM for the purpose of assessment of industrial noise.
- Sleep Disturbance:
  - Predicted noise levels are within the sleep disturbance noise limits established in accordance with both ECRTN and SIAS environmental envelope.
- Construction Noise:

  - No exceedance of the noise limit is expected at any residential locations. A marginal exceedance is predicted at the nearest commercial premises (Location F) which is not considered significant. This exceedance would only occur for a limited duration during the earthworks.

- Off-Site Traffic Noise;
  - Construction: The predicted increase in road traffic noise levels from Maitland Road is negligible (less than 0.2 dB above the existing levels) at the most potentially affected dwellings.
  - The traffic volumes generated by the proposed plant operation would be not increase the traffic noise levels greater than 0.3 dB above the existing levels, therefore satisfy the off-site traffic noise criteria.
- Construction Vibration:
  - The expected ground vibration levels for the nearest dwelling from the proposed construction activities would be significantly lower than the vibration limits for both human disturbance and structural damage.
  - The expected ground vibration levels at the nearest commercial premises may occasionally be slightly perceptible. Based on typical vibration levels and ‘buffer distances’, no mitigation measures are required to reduce vibration levels. The principles of best vibration management practice are provided in Section 6.3

6

Noise and Vibration Mitigation Measures

6.1 Operational Noise

The marginal exceedance of the night-time noise limit at Location A is primarily due to higher noise emission levels predicted from the High Bay Low Part building.

The following wall treatment on the south-western and south-eastern facades of the High Bay Low Part building would be required in order to meet the project-specific noise levels:

- Replace the proposed 0.48 mm thick Colorbond steel cladding wall with a minimum of 0.80 mm thick Colorbond steel cladding wall; or
- Apply internal lining to the proposed 0.48mm thick Colorbond steel cladding wall with glasswool insulation with a minimum thickness of 50mm and a density of 14 kg/m^3 equivalent to Knauf Insulation's sound control batts 'EarthWoll'.

With the implementation of one of the mitigation measures above, operational noise would comply with the INP noise criteria.

6.2 Construction Noise

While the proposed construction activities have limited potential for impact on the local ambient noise environment, the following noise management strategies can be applied which would further reduce the potential for noise issues during the proposed construction period:

- Preparing construction noise and vibration management plan;
- Carrying out all noisy construction works during the standard daytime construction hours (Table 4-6);
- Scheduling construction to minimise multiple use of the noisiest equipment or plant items near noise sensitive receptors;
- Strategic positioning of plant items to reduce the noise emission to noise sensitive receptors, where possible;
- Carrying out maintenance work away from noise sensitive receptors, where practicable;
- Ensuring engine covers are closed, maintenance of silencers and mechanical condition. Regular maintenance and noise testing for major items of construction equipment that are significant contributors to construction noise levels;
- Awareness training for staff and contractors in environmental noise issues including;
- Minimising the use of horn signals and maintaining to a low volume. Alternative methods of communication should be considered;
- Avoiding any unnecessary noise when carrying out manual operations and when operating plant;
- Switching off any equipment not in use for extended periods during construction work;
- Minimising heavy vehicles' entry to site and departure from site outside the nominated construction hours;
- Where noise level exceedances cannot be avoided, consideration should be given to applying time restrictions and/or providing quiet periods for nearby residents;
- Community consultation with local residents and building owners to assist in the alleviation of community concerns. Previous experience on similar projects has demonstrated that affected noise sensitive receptors may be willing to endure higher construction noise levels for a shorter duration if they have been provided with sufficient warning in the place of intermittent but extended periods of construction noise at lower levels; and

- Maintaining a suitable complaint register. Should noise complaints be received, undertake noise monitoring at the locations concerned. Reasonable and feasible measures would need to be implemented to reduce noise impacts.

With the implementation of the mitigation measures above, construction noise at all receptor locations is expected to comply with the noise limits.

6.3 Construction Vibration

The DECC Environmental Management - Noise Assessing Vibration: A Technical Guideline (2006) sets out mitigation strategies for vibration controls. A construction noise and vibration management plant would be prepared to implement the following principles to minimise the vibration:

- Choosing alternative, lower-impact equipment or methods wherever possible;
- Scheduling the use of vibration-causing equipment such as jackhammers, at the least sensitive time of day;
- Routing, operating or locating high vibration sources as far away from sensitive areas as possible;
- Sequencing operations so that vibration-causing activities do not occur simultaneously;
- Isolating the equipment causing the vibration on resilient mounts;
- Keeping equipment well maintained;
- Informing neighbours about the nature of the construction stages and the vibration generating activities – e.g. excavation and rock breaking;
- Organising demolition, earthmoving and ground-impacting operations so as not to occur in the same time period;
- Restricting vibration generating activities to the nominated construction hours to minimise impact on residential receivers;
- Placing as much distance as possible between the plant / equipment and the receivers;
- Selecting demolition methods not involving impact where possible (e.g. hydraulic rock splitters rather than rock breakers);
- Should complaints be received regarding vibration, undertake monitoring at sensitive areas to establish compliance with the set vibration limits;
- Occasionally, managing vibration at the source may require a short-term increase in vibration levels beyond the limits which would be caused by piling, demolition or abnormal operations due to unforeseen breakdown or maintenance requirements. In this case, the mitigation strategies suggested above may be impractical for such short-term events, and the following options can be considered;
- Confining vibration-generating operations to the least vibration-sensitive part of the day, e.g. when the background noise level is the highest;
- Determining an upper level for vibration impact also considering feasible and reasonable mitigation options; and
- Consulting with the community regarding the proposed events.

7

Conclusion

URS has completed a noise impact assessment for the proposed glass wool insulation manufacturing plant within the Steel River site in Newcastle, NSW. This assessment has been prepared to support the Environmental Assessment (EA) of the proposed development.

The assessment of potential noise impacts of the proposed construction and operation of the facility, on surrounding noise sensitive receptor locations, has been carried out in accordance with relevant NSW noise guidelines. Throughout the assessment, typical and 'worst-case' factors have been taken into consideration.

The assessment found that the adopted noise limits can generally be achieved with the recommended mitigation measures. The proposed operation of the facility is not expected to significantly degrade the existing acoustic environment nor generate community annoyance.

The predicted noise levels should be verified during commissioning, and in the unlikely event of any significant discrepancies from this assessment, there is scope to provide additional attenuation through measures such as acoustic enclosures and silencers.

8

References

- Industrial Noise Policy, NSW Environment Protection Authority, 1999
- Environmental Criteria for Road Traffic Noise, NSW Environment Protection Authority, 1999
- Environmental Noise Control Manual, NSW Environment Protection Authority, 1994
- Draft Construction Noise Guidelines, NSW DECC, 2008
- Australian Standard 2004, Electroacoustics – Sound level meters – Specifications, AS IEC 61672.1:2004
- Standards Australian/New Zealand 2002, Structural design actions – Wind actions, AS/NZS 1170.2:2002
- Australian Standard 1997, Acoustics – Description and measurement of environmental noise, AS 1055:1997
- Climate Statistics for Albury Airport AWS (072160), Bureau of Meteorology 2008 (Available at: http://www.bom.gov.au/climate/averages/tables/cw_072160.html)
- NSW DECC's Environmental Noise Management - Assessing Vibration: A Technical Guideline (2006)
- British Standard 2008, Guide to evaluation of human exposure to vibration in buildings (1 – 80 Hz), BS 6472:2008
- British Standard 1993, Evaluation and measurement for vibration in buildings Part 2, BS 7385:Part 2

9

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Crown Project Services (CPS) and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 16 April 2009.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between May and June 2009 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

A

Appendix A Glossary of Acoustic Terminology

A wide range of acoustic parameters and technical terms are used in this report. To assist in understanding the technical contents, a brief description of the acoustic terms is provided in this section.

Typical Noise Levels: Compared to the static air pressure (10^5 Pa), the audible sound pressure variations are very small ranging from about 20 µPa ($20x10^{-6}$ Pa), which is called "threshold of hearing" to 100 Pa. A sound pressure of approximately 100 Pa is so loud that it causes pain and is therefore called "threshold of pain".

dB (Decibel): A unit of sound level measurement. The human ear responds to sound logarithmically rather than linearly, so it is convenient to deal in logarithmic units in expressing sound levels. To avoid a scale which is too compressed, a factor of 10 is introduced, giving rise to the decibel. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

Perception of Sound: The number of sound pressure variation per second is called the frequency of sound, and is measured in Hertz (Hz). The normal hearing for a healthy young person ranges from approximately 20 Hz to 20 kHz. In terms of sound pressure levels, audible sound ranges from the threshold of hearing at 0 dB to the threshold of pain at 130 dB and over. A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to small but noticeable change in loudness. An increase of about 8 – 10 dB is required before the sound subjectively appears to be significantly louder.

Sound Pressure (SPL): Sound pressure is the measure of the level or loudness of sound. Like sound power level, it is measured in logarithmic units. The symbol used for sound pressure level is SPL, and it is generally specified in dB. 0 dB is taken as the threshold of human hearing.

Sound Pressure Levels of Some Common Sources		
Sound Pressure Level (dB)	Sound Source	Typical Subjective Description
140	Propeller aircraft; artillery fire, gunner's position	Intolerable
120	Riveter; rock concert, close to speakers; ship's engine room	
110	Grinding; sawing	
100	Punch press and wood planers, at operator's position; pneumatic hammer or drilling (at 2 m)	Very noisy
80	Kerbside of busy highway; shouting; Loud radio or TV	Noisy
70	Kerbside of busy traffic	
60	Department store, restaurant, conversational speech	
50	General office	Moderate
40	Private office; Quiet residential area	Quiet
30	Unoccupied theatre; quiet bedroom at night	
20	Unoccupied recording studio; Leaves rustling	Very quiet
10	Hearing threshold, good ears at frequency of maximum sensitivity	
0	Hearing threshold, excellent ears at frequency maximum response	

Sound Power (SWL): Sound power is the energy radiated from a sound source. This power is essentially independent of the surroundings, while the sound pressure depends on the surroundings (e.g. reflecting surfaces) and distance to the receptor. If the sound power is known, the sound

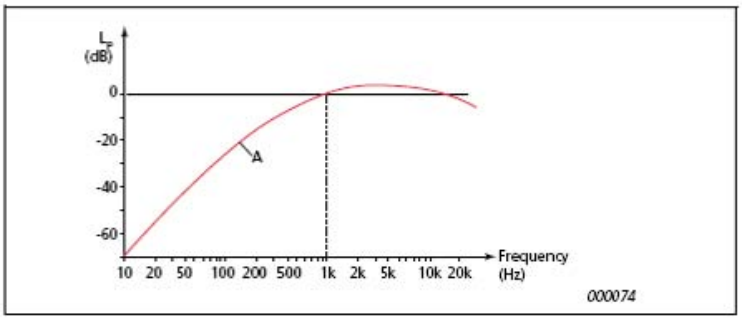
Appendix A

pressure at a point can be calculated. Sound power is also measured in logarithmic units, 0 dB sound power level corresponding to 1 pW (10^{-12} W). The symbol used for sound power level is SWL or Lw, and it is specified in dB.

Frequency: Frequency is synonymous to pitch and is measured in units of Hz.

Frequency Spectrum: In environmental noise investigations, it is often found that the single-number indices, such as L_{Aeq}, do not fully represent the characteristics of the noise. If the source generates noise with distinct frequency components, then it is useful to measure the frequency content in octave or one-third octave frequency bands. For calculating noise levels, octave spectra are often used to account for the frequency characteristics of propagation.

"A" Frequency Weighting: The method of frequency weighting the electrical signal with a noise measuring instrument to simulate the way the human ear responds to a range of acoustic frequencies. It is based on the 40 dB equal loudness contour. The symbols for the noise parameters often include the letter "A" (e.g. L_{Aeq}) to indicate that frequency weighting has been included in the measurement.



Adverse Weather: Weather effects (wind and temperature inversions) that enhance noise. The prescribed conditions are for wind occurring more than 30 % of the time in any assessment period in any season and/or for temperature inversions occurring more than 30 % of the nights in winter.

Assessment Period: The period in a day over which assessments are made: day (7.00am – 6.00pm, Monday to Saturday; or 8.00am – 6.00pm on Sundays and public holidays), evening (6.00pm – 10.00pm, all days) or night (10.00pm – 7.00am, Monday to Saturday; or 10.00pm – 8.00am on Sundays and public holidays).

Ambient Noise: The all-encompassing sound at a site comprising all sources such as industry, traffic, domestic, and natural noises. This is represented as the L_{Aeq} noise level in environmental noise assessment. (See also L_{Aeq})

Background Noise: Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is measured statistically as the A-weighted noise level exceed for ninety per cent of a sample period. This is represented as the L_{A90} noise level (See also L_{A90}).

Assessment Background Level (ABL): A single number representing the typical background noise level during each assessment period (day, evening and night) for each day. The ABLs measured on all the monitoring days are used to determine the overall RBL at a site. (See RBL)

Rating Background Level (RBL): A single number representing the median value of the ABL values of each assessment period over all of the monitoring days.

Appendix A

Free Field: An environment in which a sound wave may propagate in all directions without obstructions or reflections. Free field noise measurements are carried out outdoors at least 3.5 m from any acoustic reflecting structures other than the ground.

Extraneous Noise: Noise resulting from activities that are not typical of the area. Untypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.

Impulsive Noise: Noise having a high peak of short duration or a sequence of such peaks. Noise from impacts or explosions, e.g., from a pile driver, punch press or gunshot, is called impulsive noise. It is brief and abrupt, and its startling effect causes greater annoyance than would be expected from a simple measurement of the sound pressure level.

Intermittent Noise: Noise with a level that abruptly drops to the level of or below the background noise several times during the period of observation. The time during which the level remains at a constant value different from that of the ambient being of the order of 1 s or more.

Meteorological Conditions/Effects: Wind and temperature inversion conditions.

Noise Barrier: Solid walls or partitions, solid fences, earth mounds, earth berms, buildings. Etc used to reduce noise without eliminating it.

Project-Specific Noise Levels (PSNL): PSNL are target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive criteria or amenity criteria. The most stringent criteria is determined by measuring the level and nature of existing noise in the area surrounding the actual or proposed noise generating facility.

Temperature Inversion: An atmospheric condition in which temperature increases with height above the ground.

Tonality: Noise containing a prominent frequency and characterised by a definite pitch.

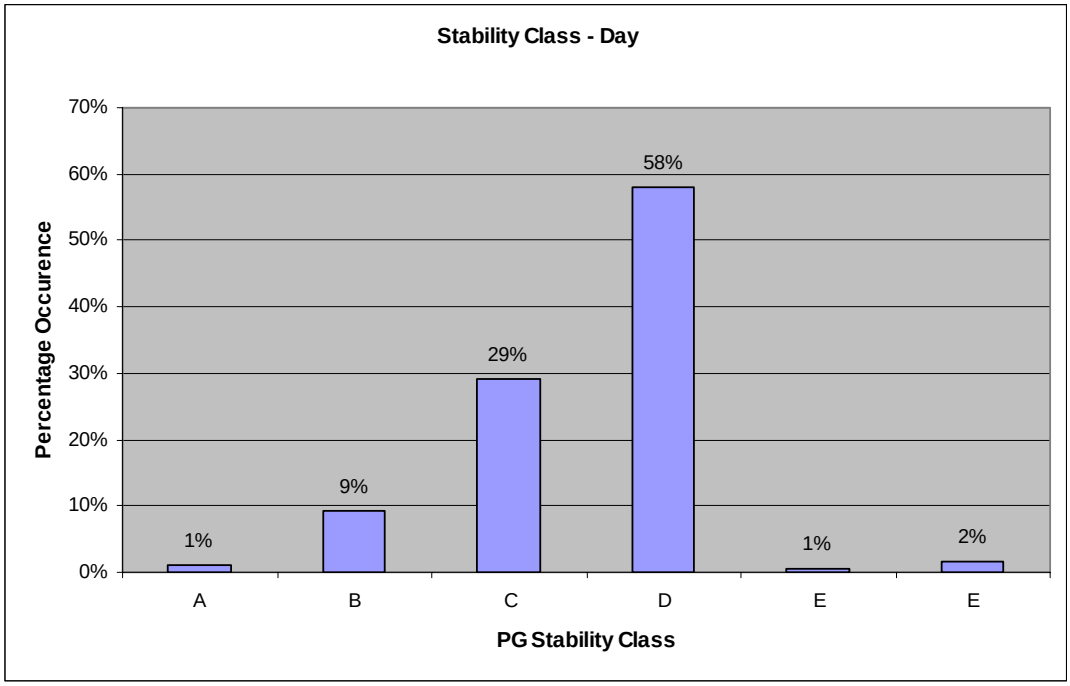
L_{Aeq}: A-weighted equivalent continuous noise level. This parameter is widely used and is the constant level of noise that would have the same energy content as the varying noise signal being measured. The letter “A” denotes that the A-weighting has been included and “eq” indicates that an equivalent level has been calculated. This is referred to as the ambient noise level. (See Ambient Noise)

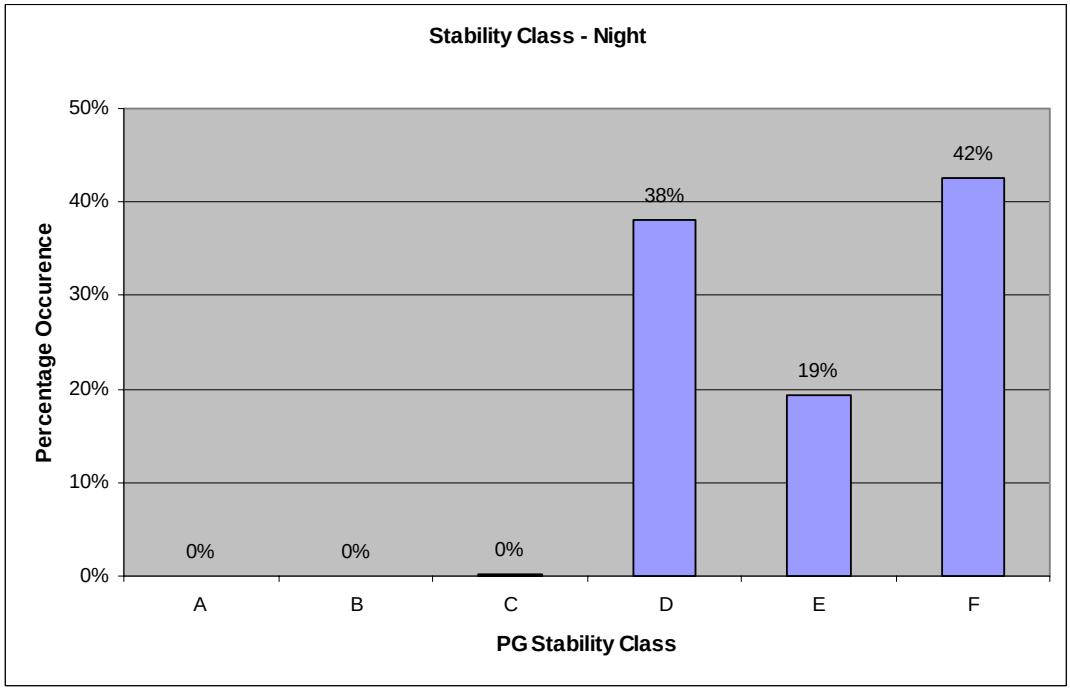
L_{A90}: The A-weighted sound pressure level which is exceeded for 90 % of the measurement period. It is determined by calculating the 90^{th} percentile (lowest 10 %) noise level of the period. This is referred to as the background noise level. (See Background Noise)

B

Appendix B Analysis of Meteorological Data

Calculated Stability Categories from Met Data using Cloud Cover

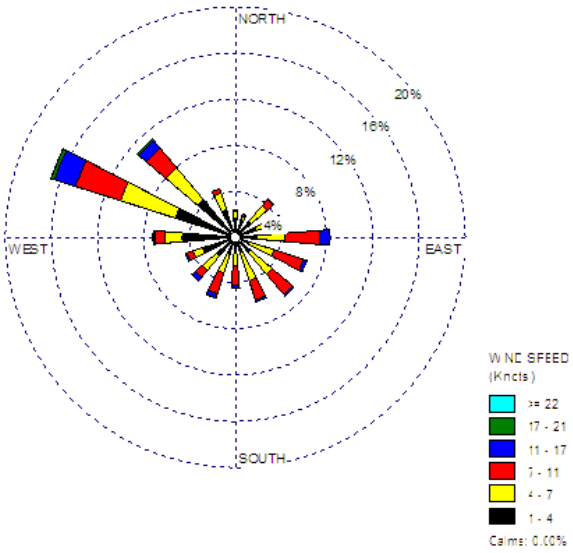


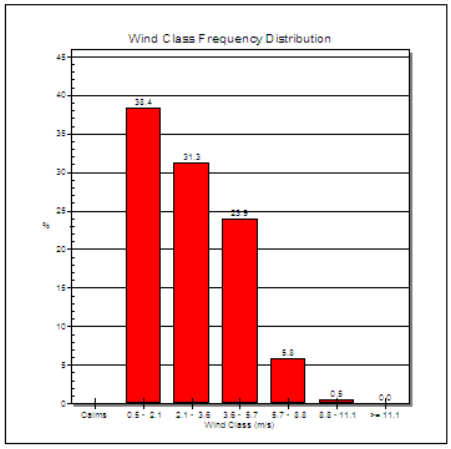


Appendix B

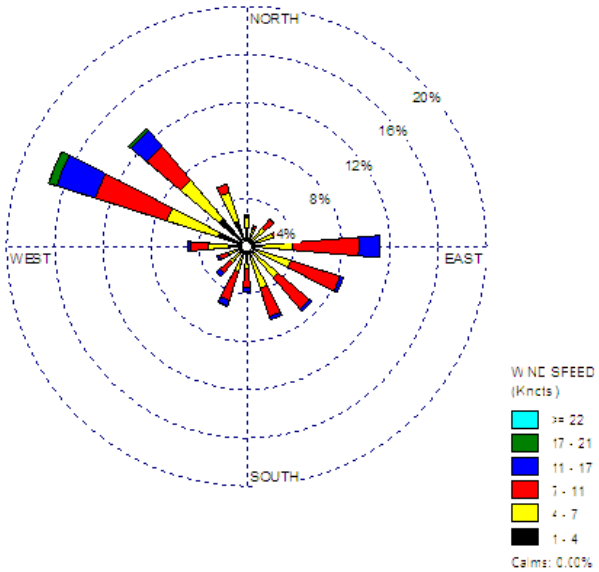
Wind Rose Analysis

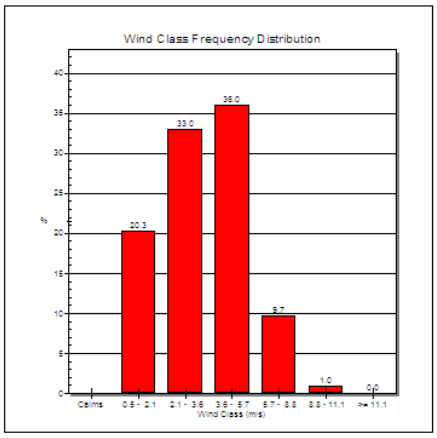
All Seasons



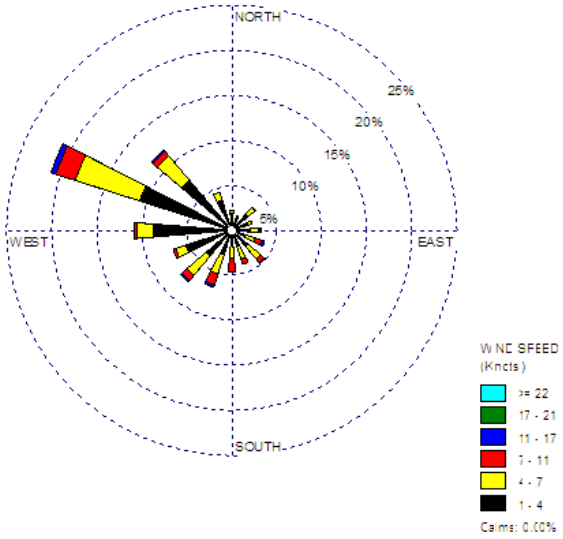


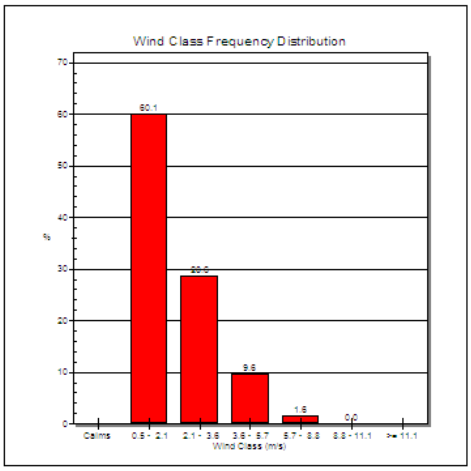
Daytime (7.00am – 6.00pm)



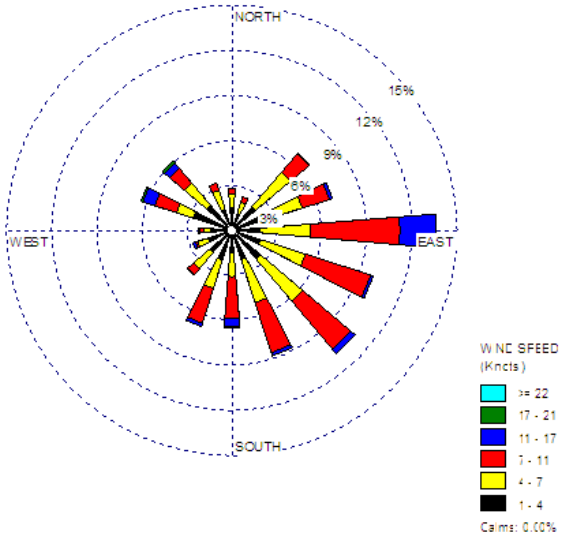


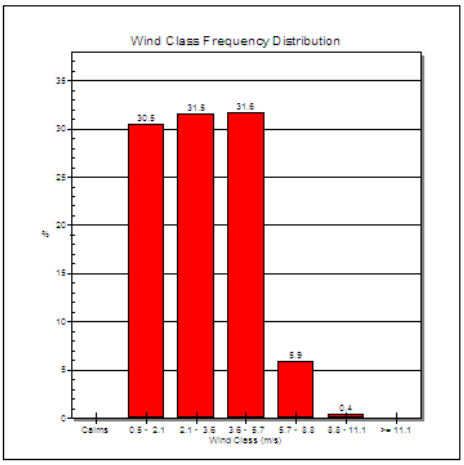
Evening & Night-time (6.00pm – 7.00am)





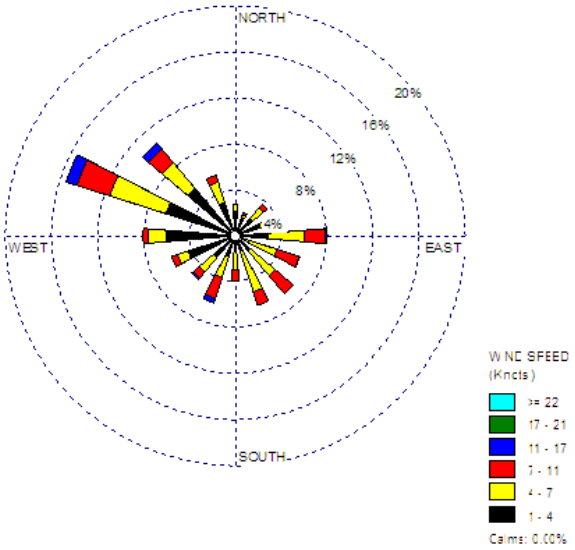
Summer (December – February)

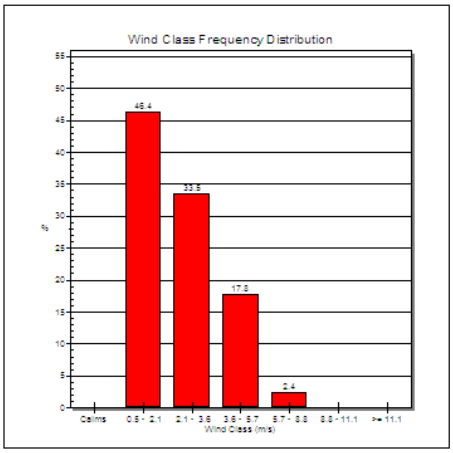




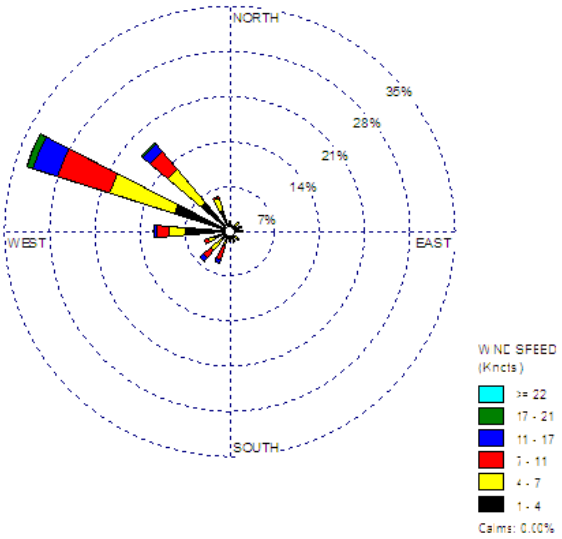
Appendix B

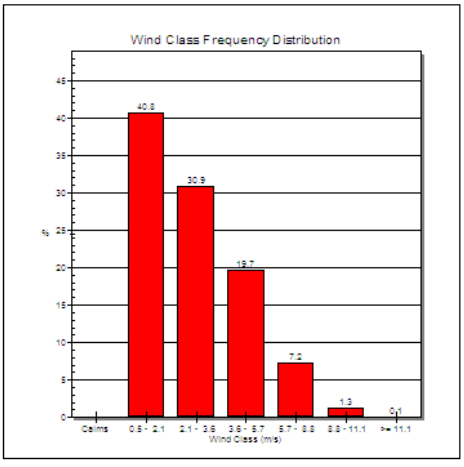
Autumn (March – May)



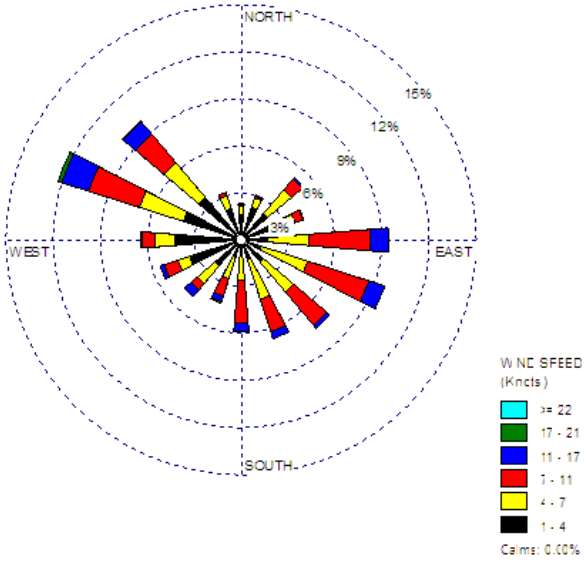


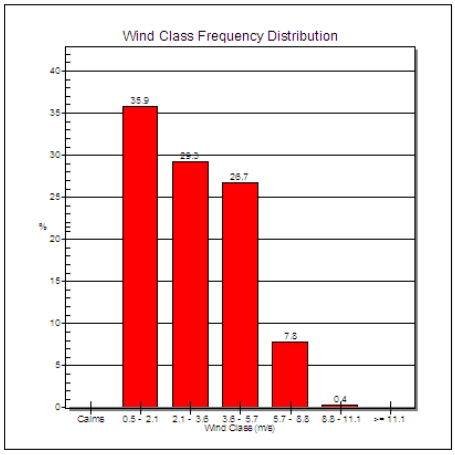
Winter (June – August)





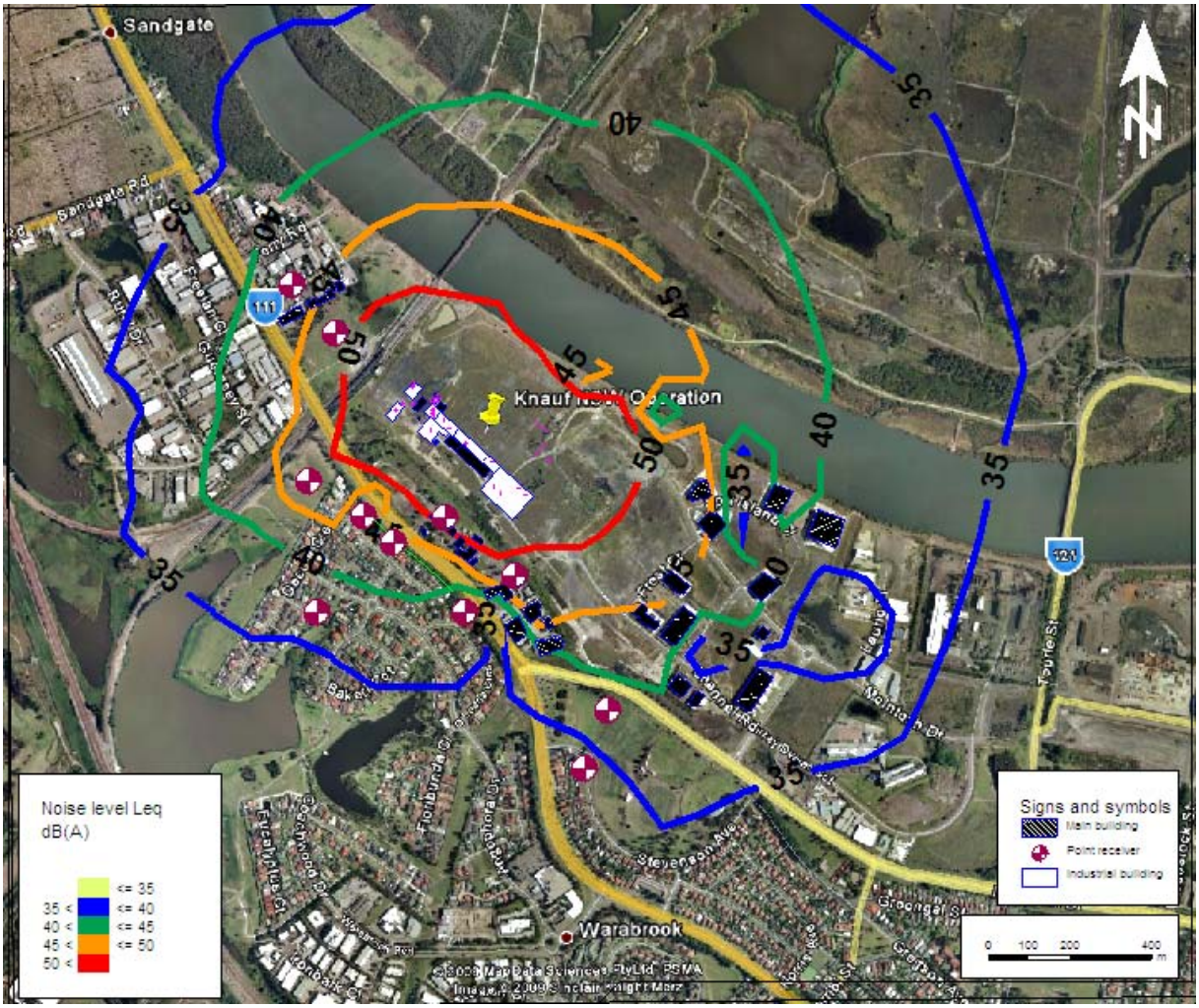
Spring (September – November)





C

Appendix C Noise Contours



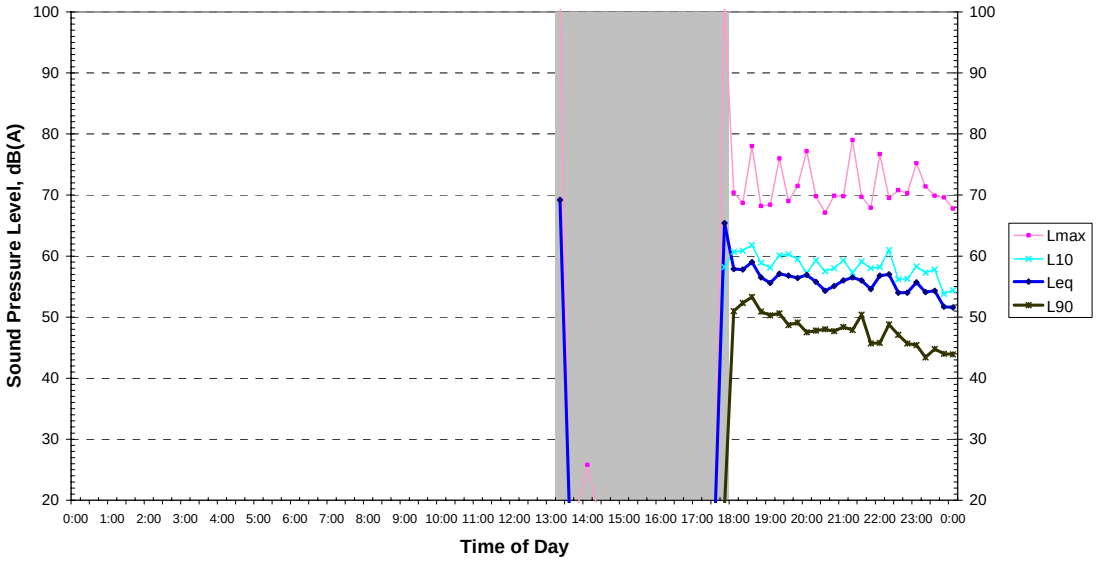
D

Appendix D Daily Noise Monitoring Plots

Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

Monday 11 May 2009



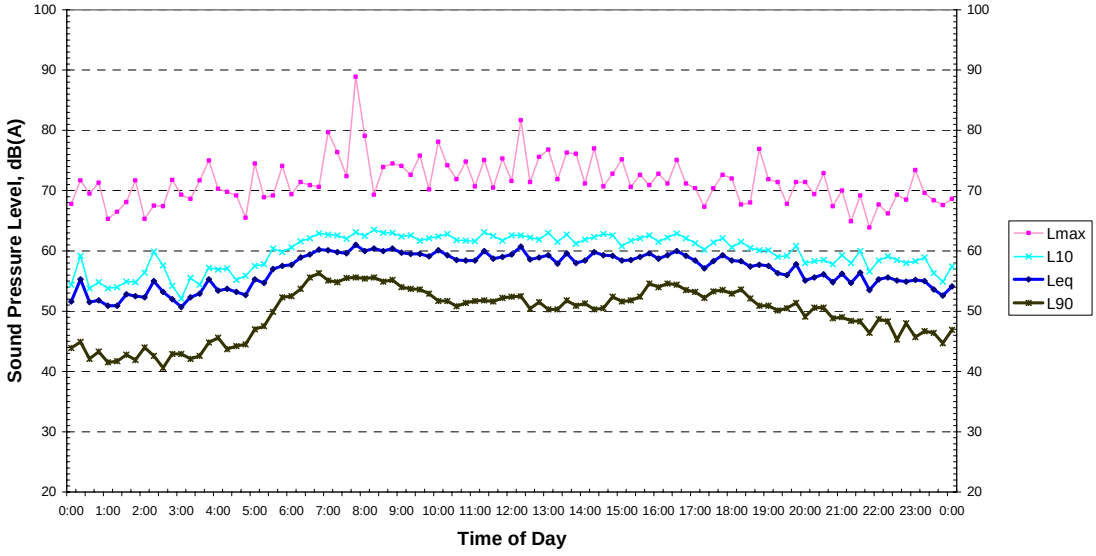
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

Tuesday 12 May 2009



Note:

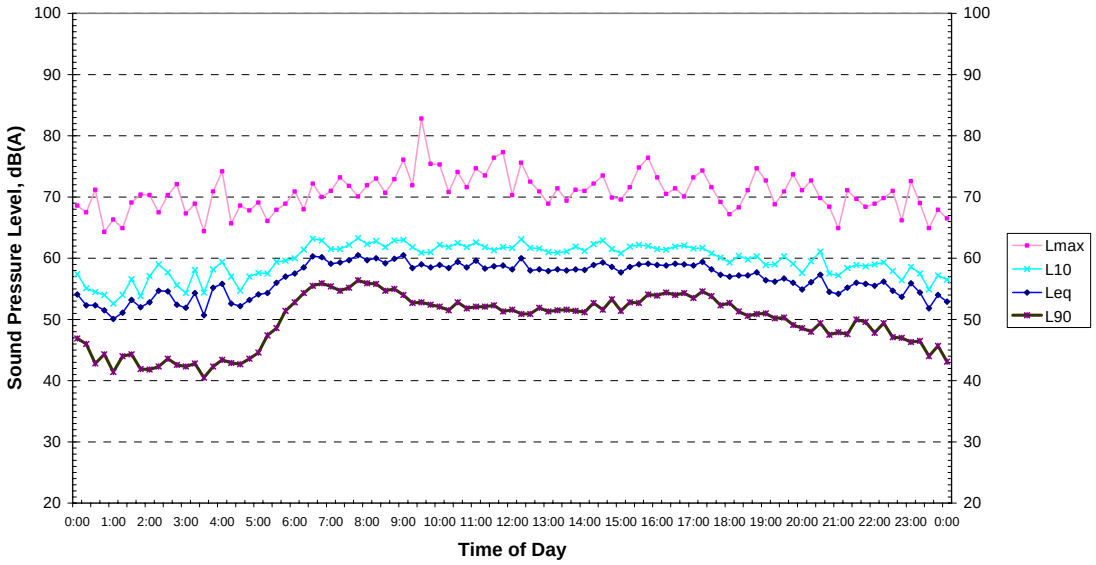
Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D

Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

Wednesday 13 May 2009



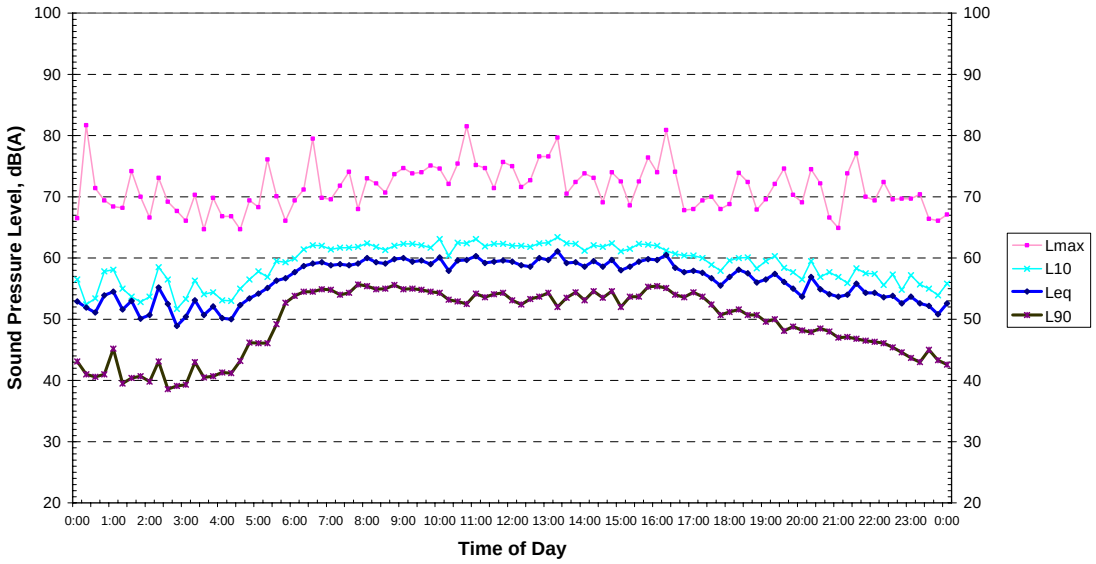
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

Thursday 14 May 2009



Note:

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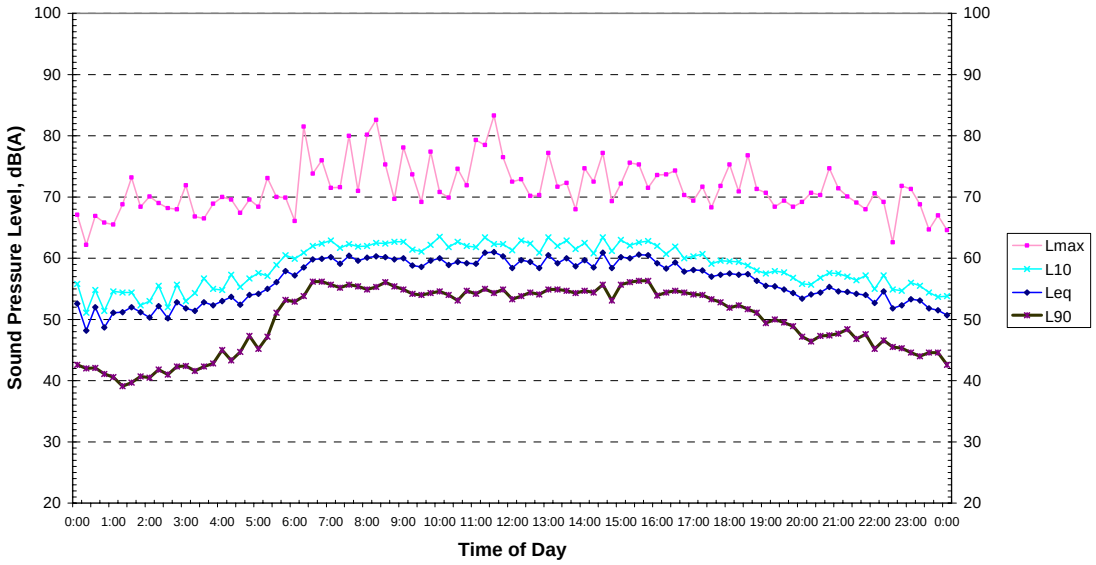
Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

Friday 15 May 2009



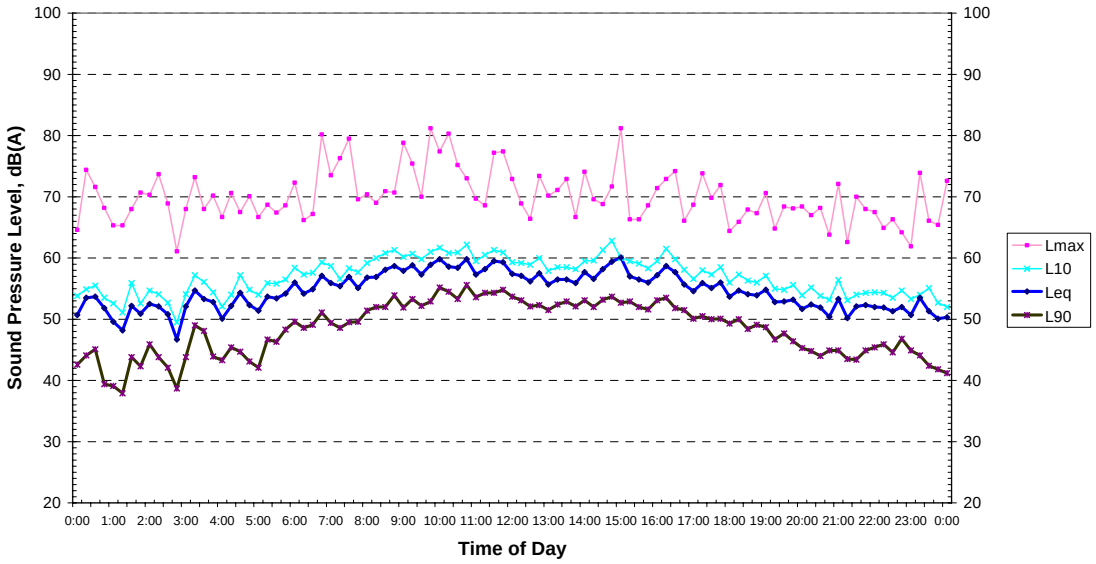
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

Saturday 16 May 2009



Note:

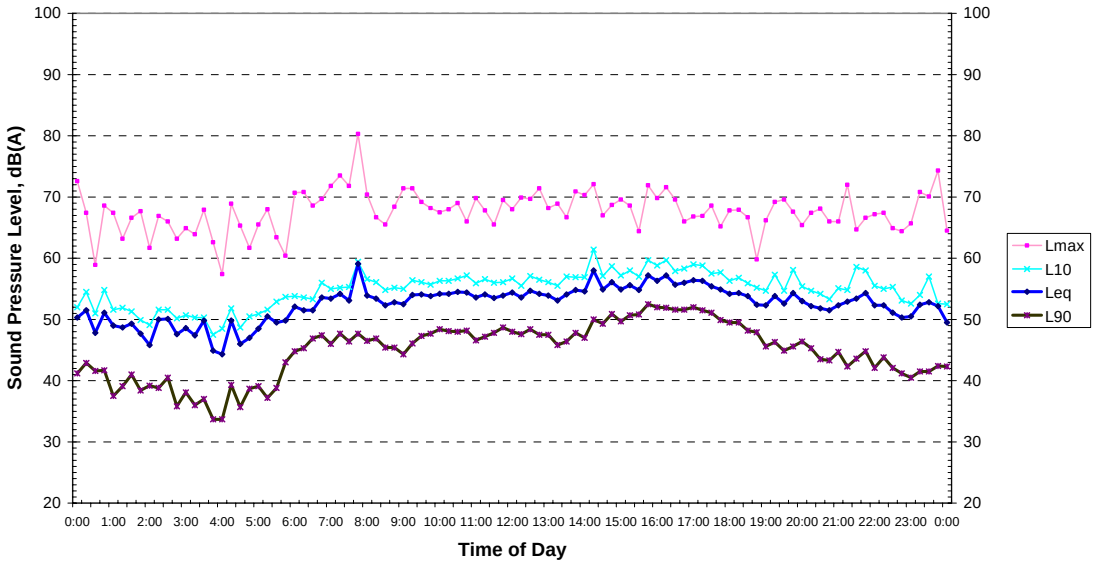
Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D

Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

Sunday 17 May 2009



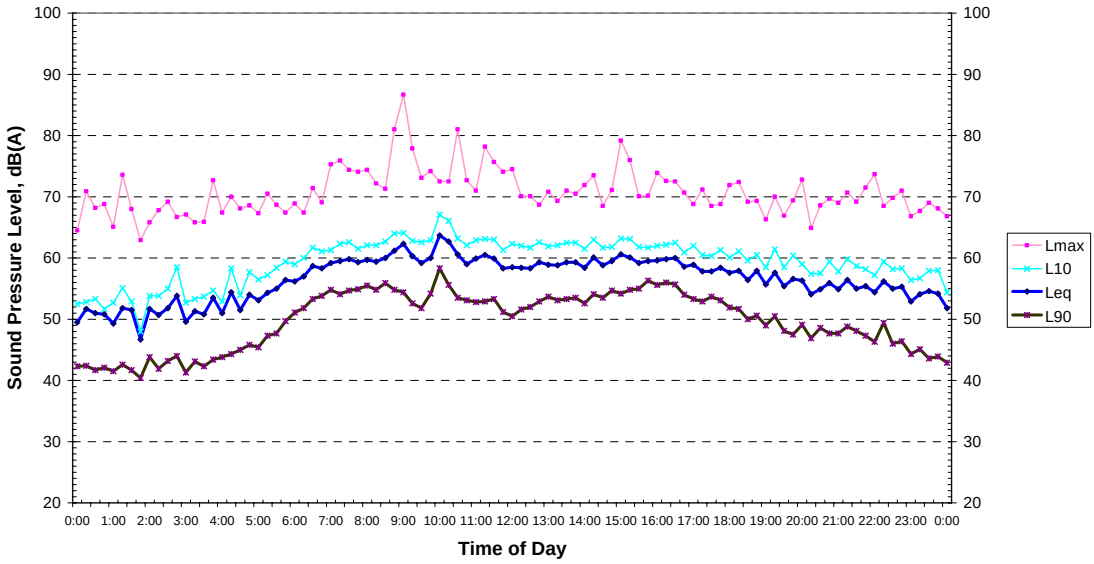
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

Monday 18 May 2009



Note:

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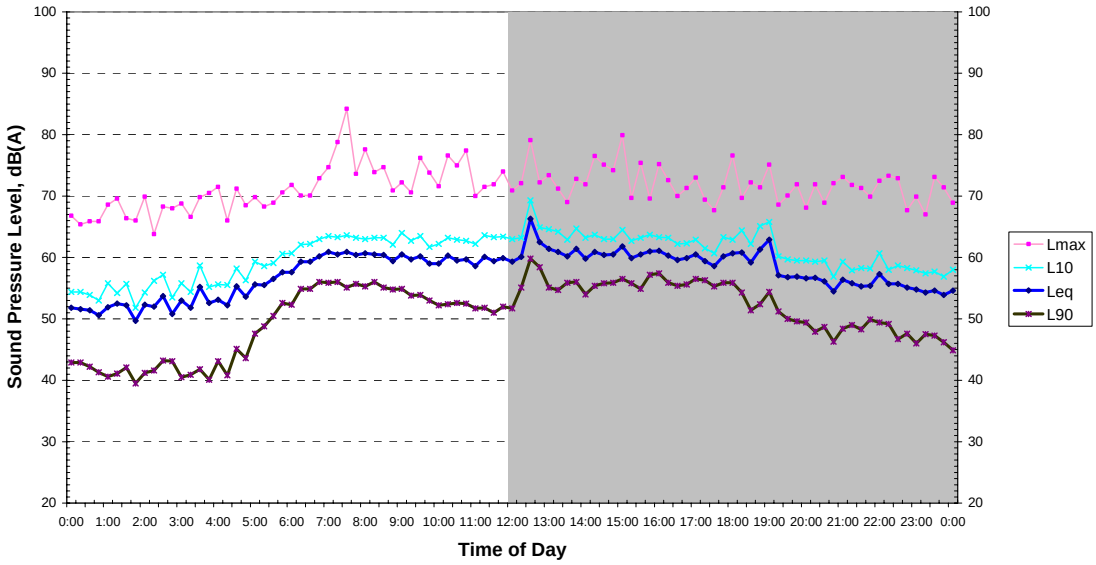
Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

Tuesday 19 May 2009



Note:

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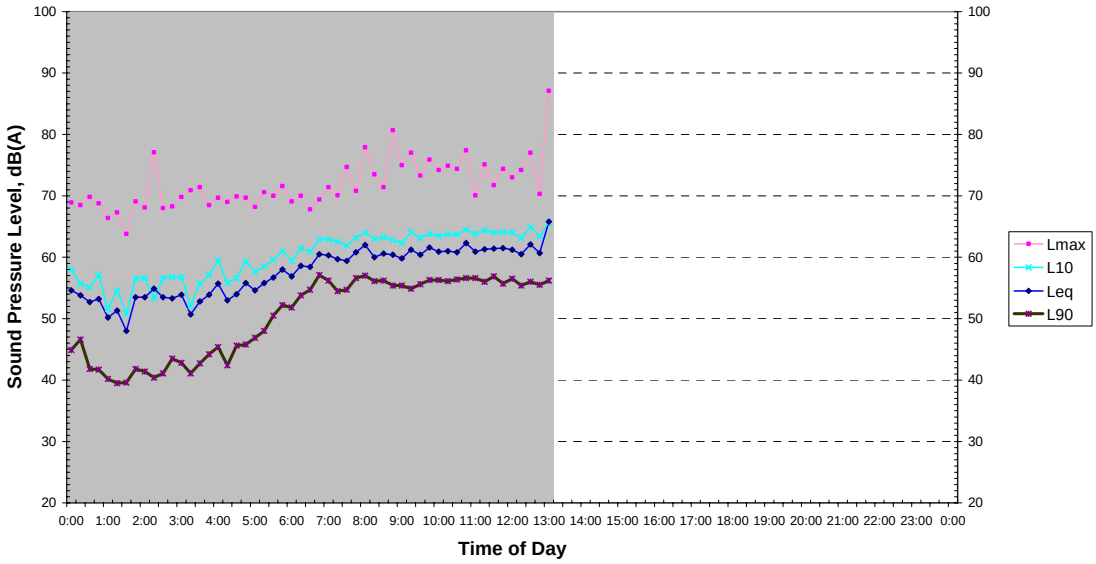
Daily Noise Monitoring Results

Decora Crescent, Warabrook, NSW

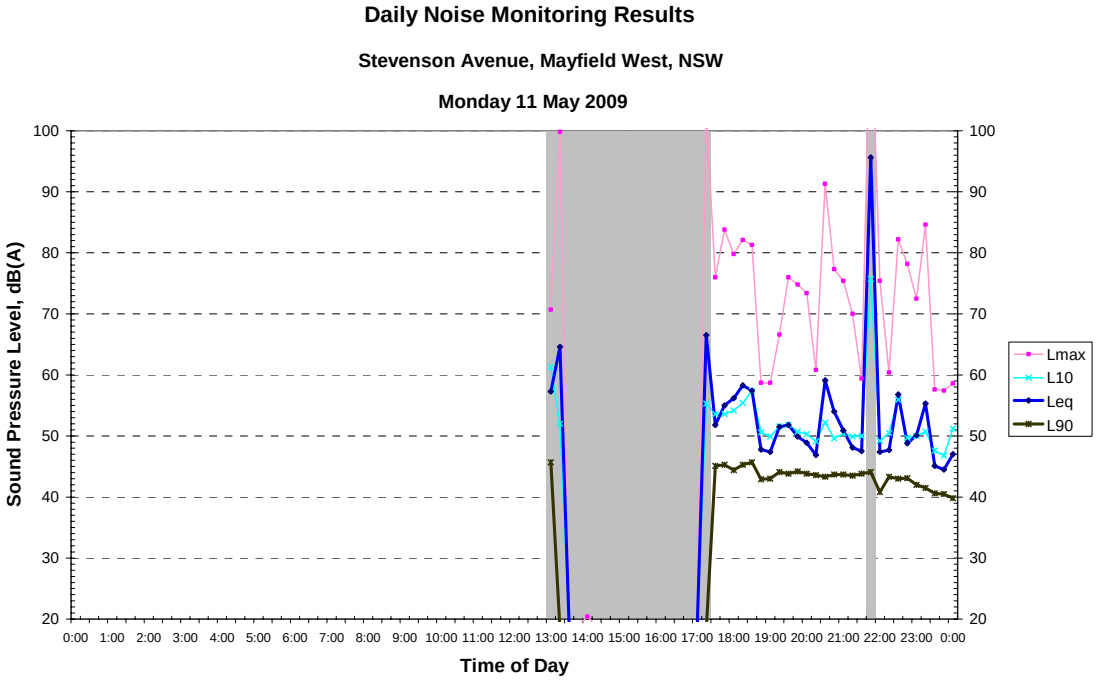
Wednesday 20 May 2009



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D



Note:

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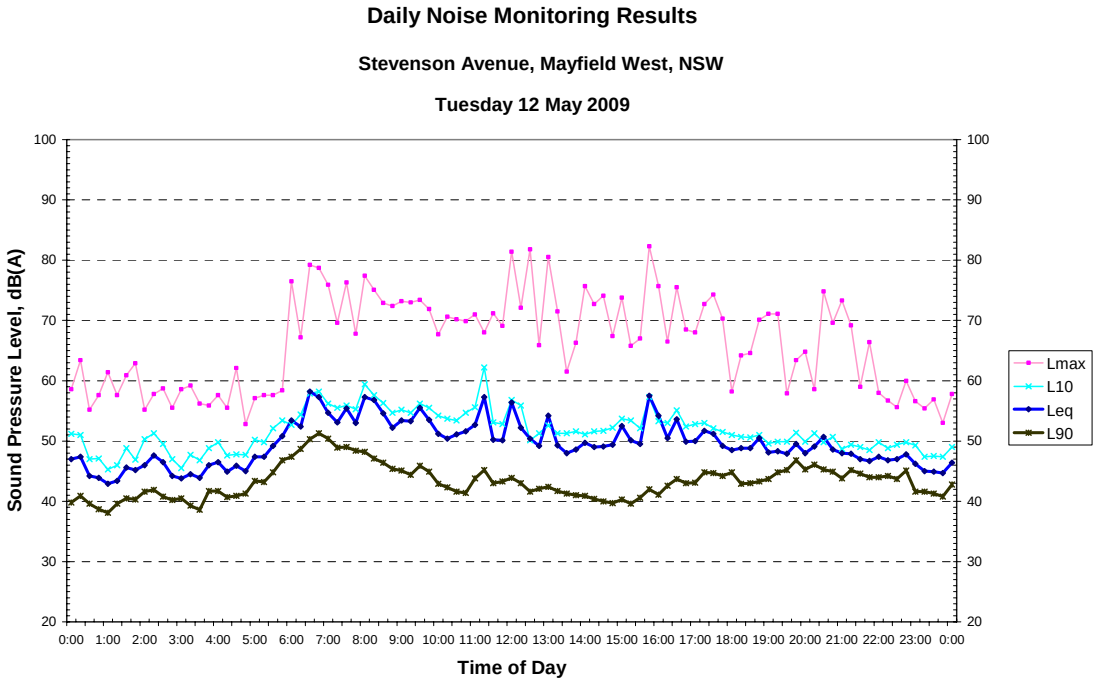

Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
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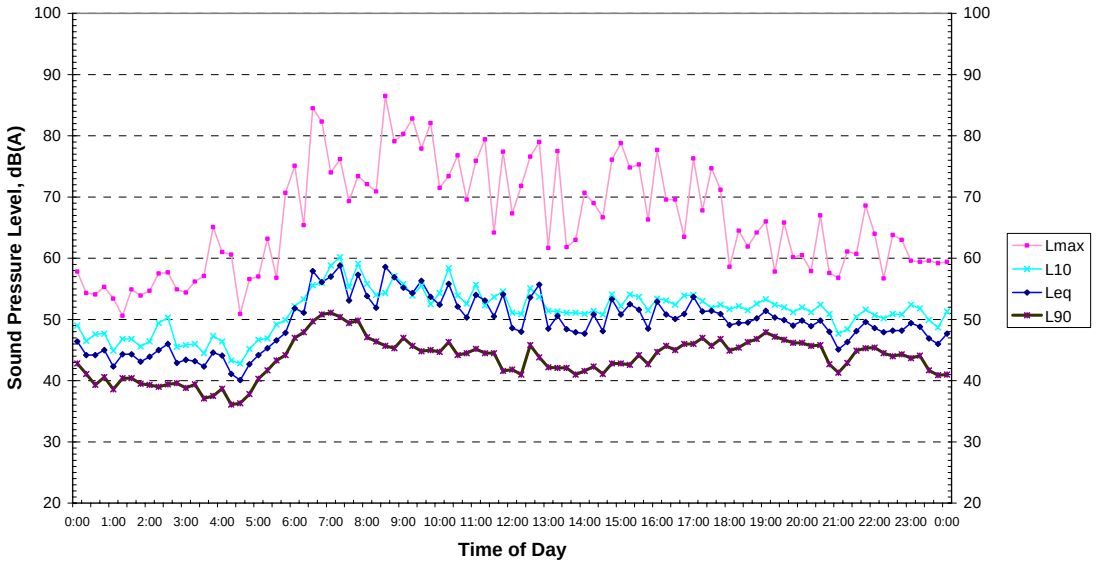
Daily Noise Monitoring Results

Stevenson Avenue, Mayfield West, NSW

Wednesday 13 May 2009



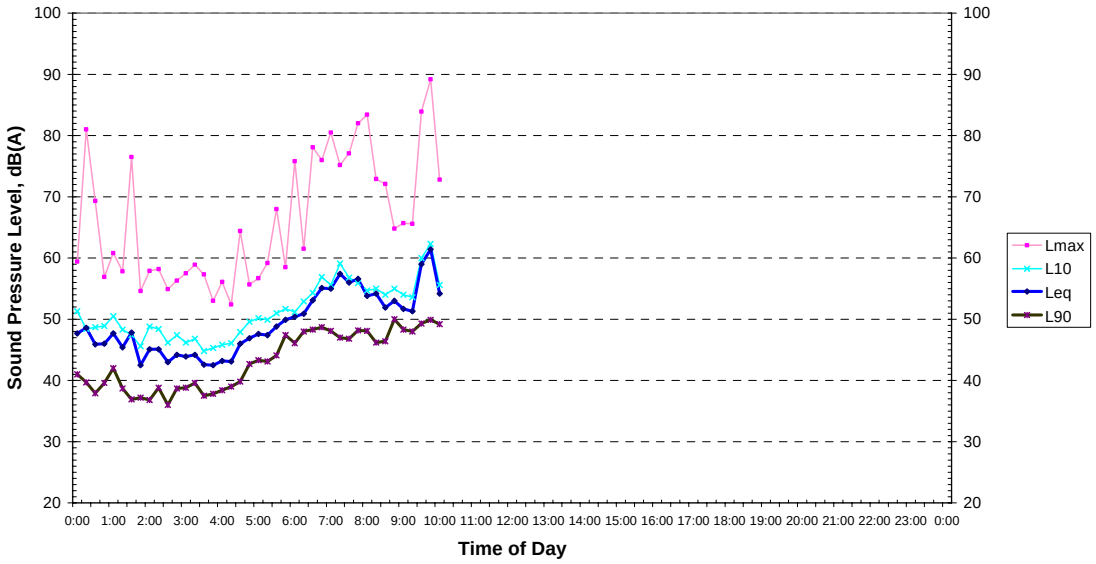
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

Stevenson Avenue, Mayfield West, NSW

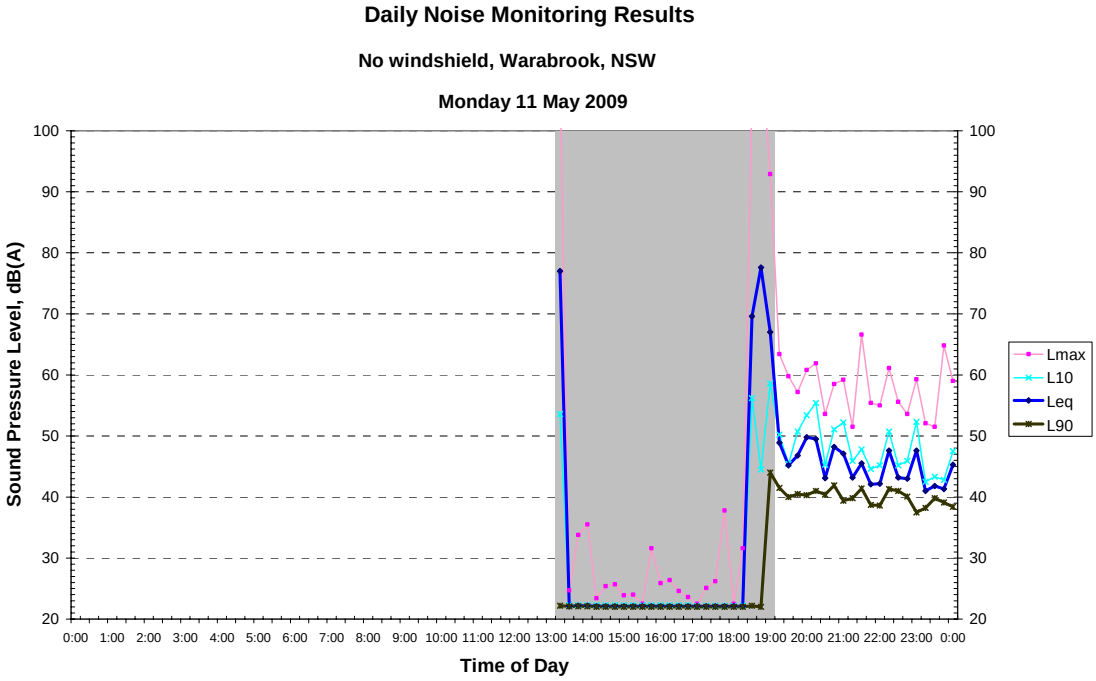
Thursday 14 May 2009



Note:

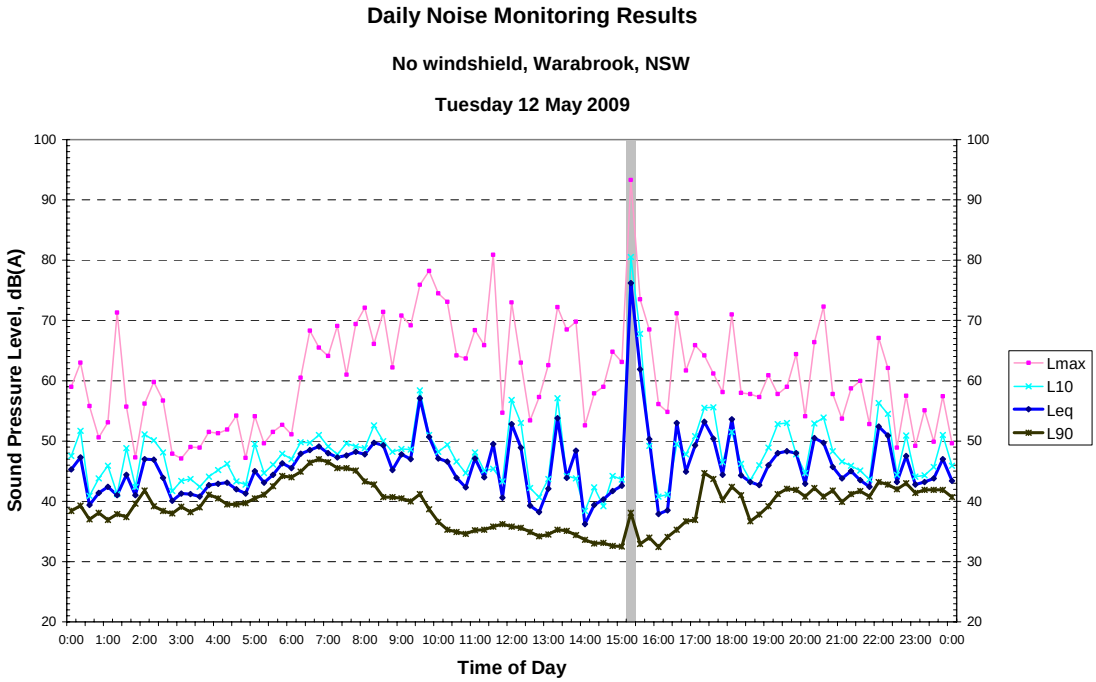
Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous
Measured data during these periods were excluded from calculation of noise levels averaged for the period.



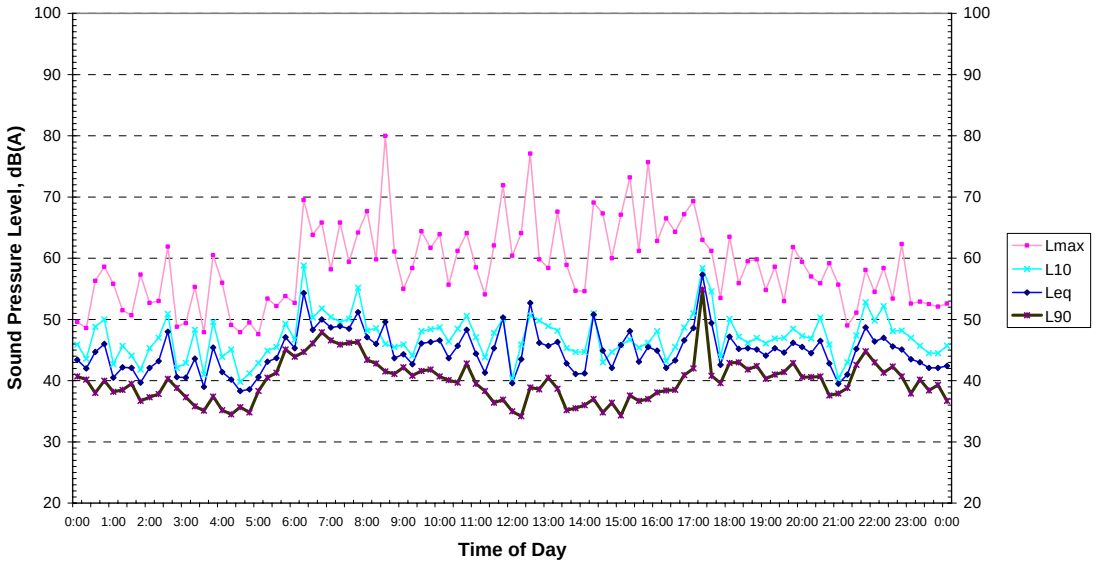
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

No windshield, Warabrook, NSW

Wednesday 13 May 2009



Note:

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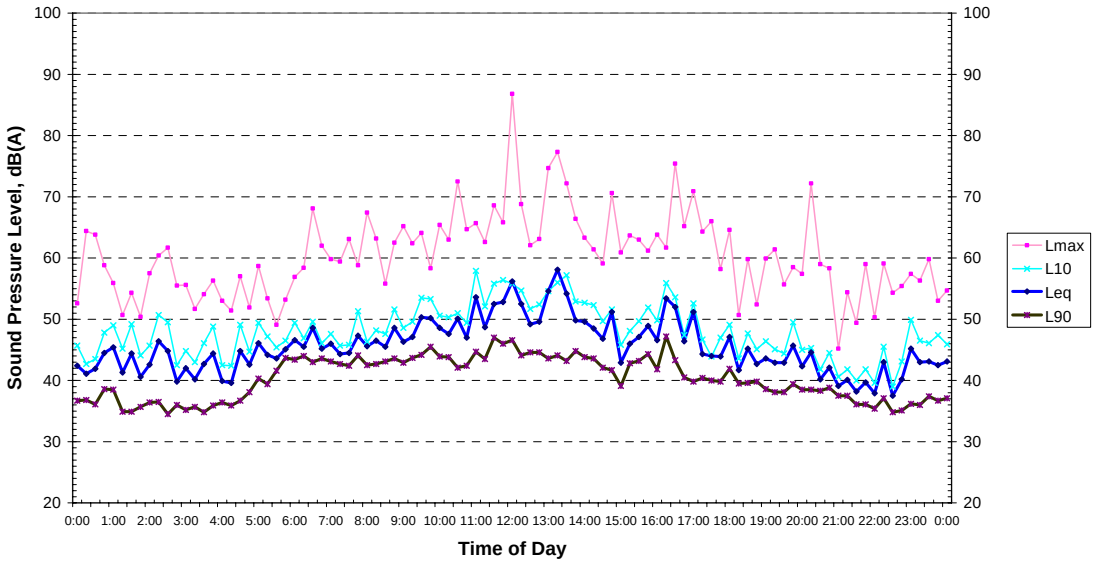
Daily Noise Monitoring Results

No windshield, Warabrook, NSW

Thursday 14 May 2009



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
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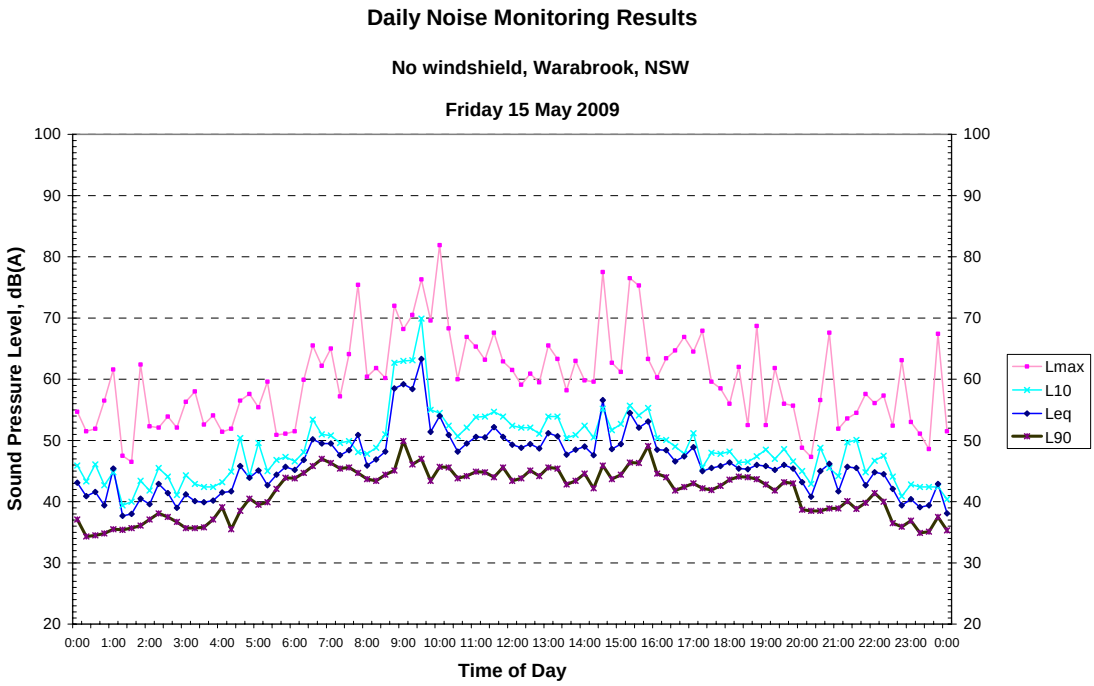
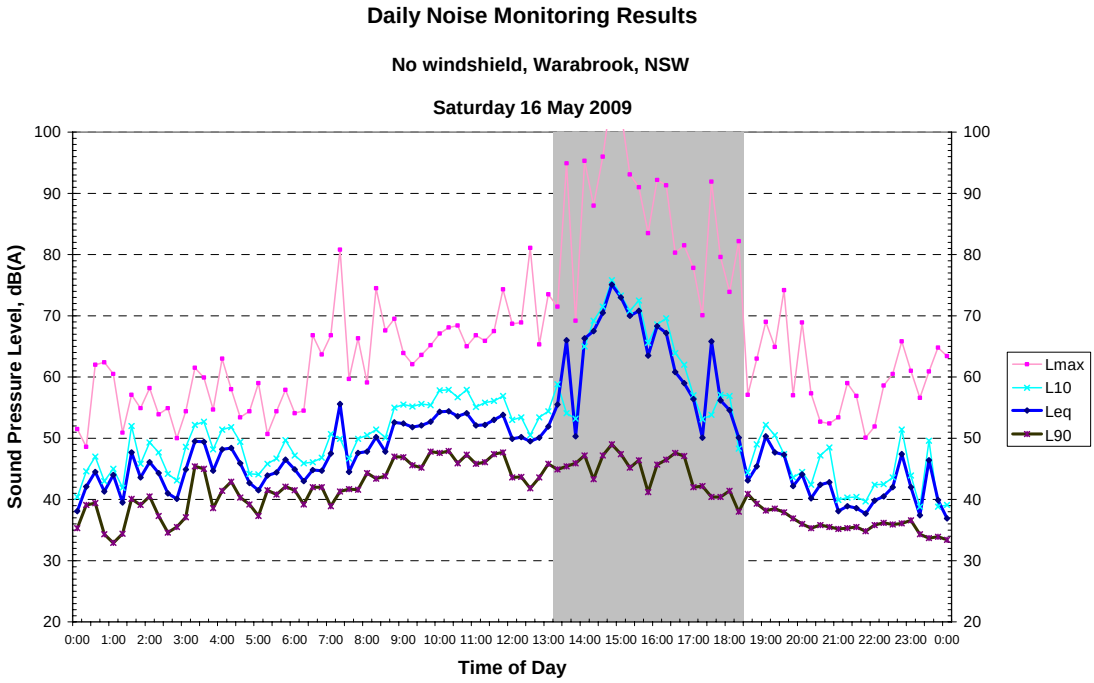
Appendix D



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.



Note:

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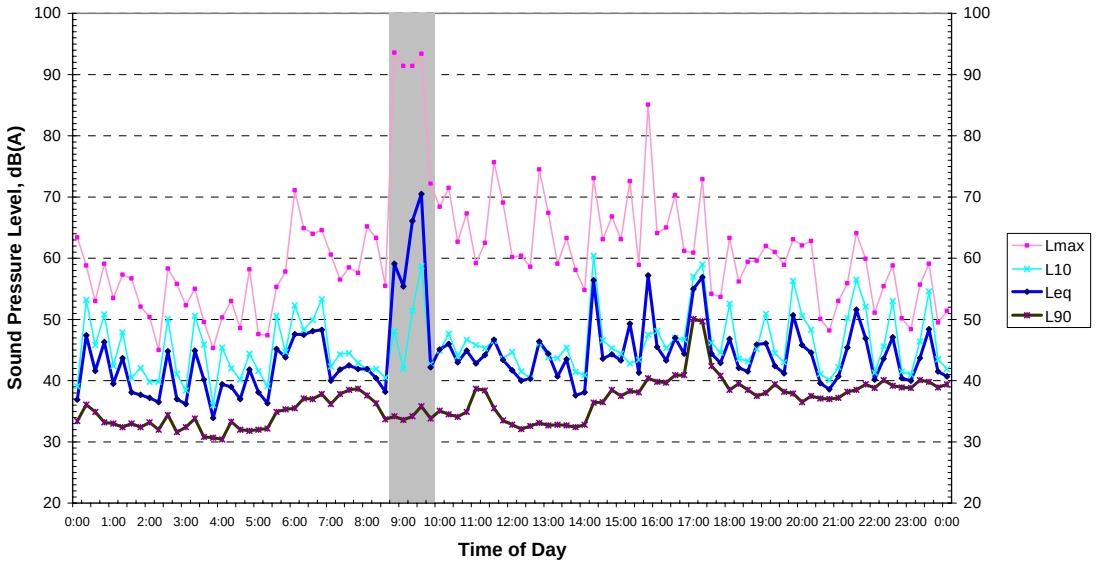
Daily Noise Monitoring Results

No windshield, Warabrook, NSW

Sunday 17 May 2009



Note:

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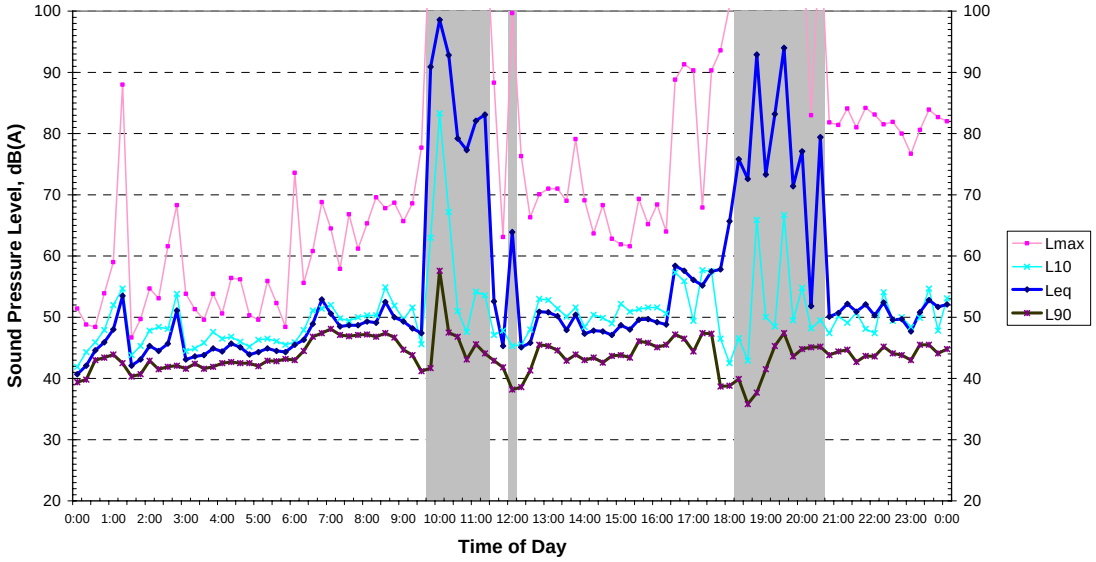
Daily Noise Monitoring Results

No windshield, Warabrook, NSW

Monday 18 May 2009



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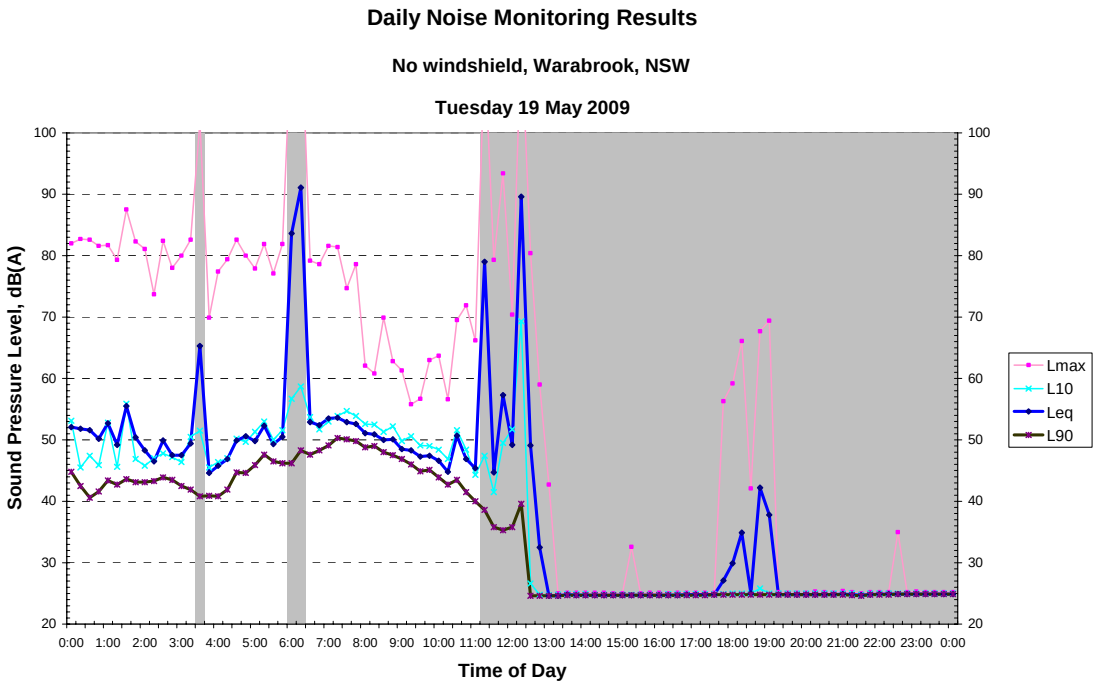
Appendix D



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