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Construction Noise and Vibration Management Plan
600 Woodstock Avenue
Glendenning

NOISE MANAGEMENT PLAN




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Project Strategyt
Attn: Stewart Johnson

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1. Executive Summary

The following report is in response to a request by Project Strategy for a construction noise and vibration management plan for the proposed warehouse/industrial development located at 600 Woodstock Avenue, Glendenning. This report provides a noise management plan and recommendations for noise control during earthworks and construction of the proposed development as required by in accordance with Penrith City Council requirements and the NSW Department of Planning and Environment's Secretary's Environmental Assessment Requirements (SEARs) (Application Reference: *SSD-29999239*) which requires the following matters to be addressed:

Table 1: SSD-29999239 SEARS requirements

Condition	CNVMP Section References
§ the identification of impacts associated with construction, site emission and traffic generation at noise affected sensitive receivers, including the provision of operational noise contours and a detailed sleep disturbance assessment;	5,9 Operational noise assessed in separate report (ref: *1021096 R01D 600 Woodstock Avenue Glendenning ENV.docx* dated 20/05/2022)
§ details of noise monitoring survey, background noise levels, noise source inventory and 'worst case' noise emission scenarios;	3,6,7,9
§ consideration of annoying characteristics of noise and prevailing meteorological conditions in the study area;	7,8,9
§ a cumulative impact assessment inclusive of impacts from other developments;	Assessed in a separate report (ref: *1021096 R01D 600 Woodstock Avenue Glendenning ENV.docx* dated 20/05/2022)
§ details and analysis of the effectiveness of proposed management and mitigation measures to adequately manage identified impacts, including a clear identification of residual noise and vibration following application of mitigation these measures and details of any proposed compliance monitoring programs.	12,14.2

2. Introduction

This report is in response to a request by Project Strategy for a construction noise and vibration management plan for a State Significant Development Application for a proposed material recovery facility to be located at 600 Woodstock Avenue, Glendenning. The construction noise assessment was conducted in accordance with Blacktown City Council requirements and the NSW Department of Planning, Industry and Environment's *Secretary's Environmental Assessment Requirements* (SEARs). To facilitate the assessment, unattended noise monitoring was conducted in the vicinity of nearby sensitive receivers to establish the criteria for onsite activities.

3. Site Description

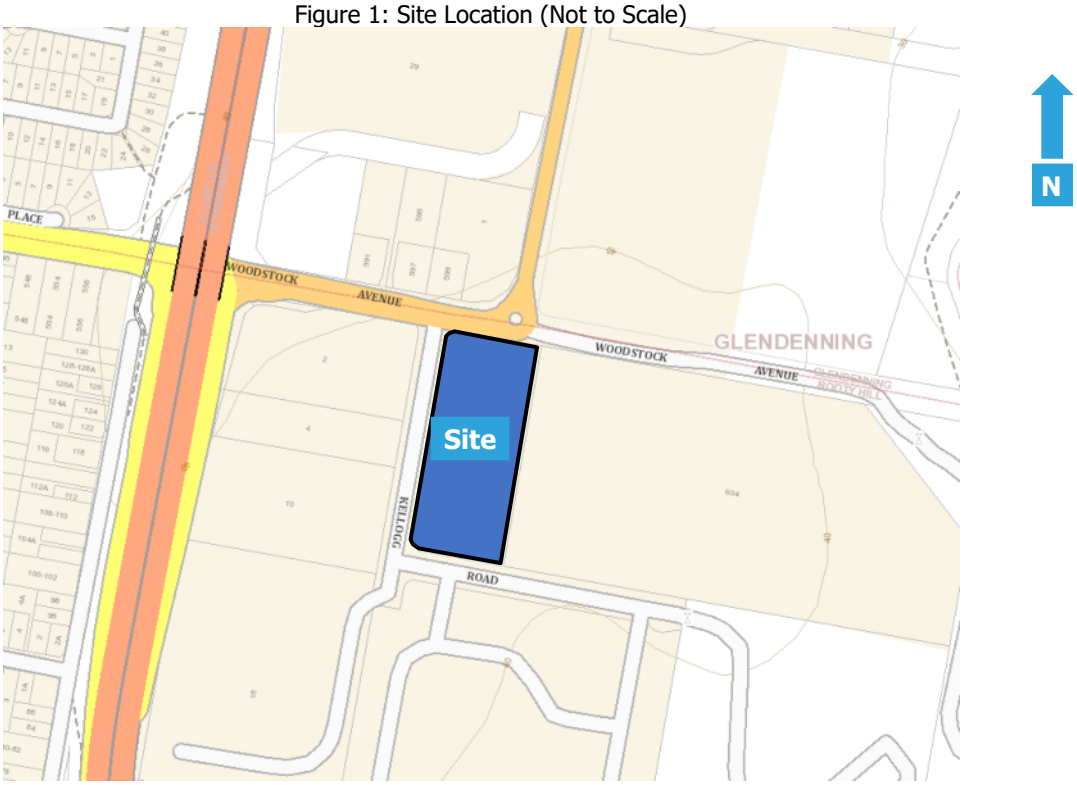
3.1 Site Location

The site is described by the following:

600 Woodstock Avenue, Glendenning
Lot 67 in Deposited Plan DP804292

Refer to Figure 1 for site location.

Figure 1: Site Location (Not to Scale)



A comprehensive site survey was conducted on the 30th August 2021 which identified the following:

- The site is located in IN1 – General Industrial as defined in the Blacktown Local Environmental Plan 2015.
- An industrial premises currently occupies the site and will be demolished to make way for the development.
- The surrounding area consists of industrial land use.
- Residential receivers are located on the western side of the M7.

3.2 Proposal

The State Significant Development Application proposes to demolish existing onsite structures and construct a materials recycling facility.

Charter Hall Holdings Pty Ltd (identified as 'the Proponent') obtained Planning Secretary's Environmental Assessment Requirements (SEARs) on 9 November 2021 from the Department of Planning, Industry and Environment (DPIE) for the 'Rooty Hill Materials Recycling Facility' (ref: SSD-29999239, dated 09/11/2021) comprising the demolition of existing buildings onsite and the construction of a materials recycling facility.

Specifically, the SEARS permits the following development:

> *"Demolition of existing structures, construction and operation of a materials recycling facility processing up to 120,000 tonnes per annum of recyclable wastes."*

3.3 Construction Staging and Activities

Development of the 600 Woodstock Avenue site comprises the demolition of existing buildings and the construction of the proposed materials recycling facility.

3.4 Acoustic Environment

The surrounding area is primarily affected by road traffic noise from the M7, Woodstock Avenue and noise from existing nearby commercial/industrial activities.

4. Conditions of Approval

The requirements for the construction of the proposed development are contained in the SEARs document as follows:

> *"The EIS must address the following specific matters:*
>
> *Noise and Vibration – including:*
> - *A quantitative noise and vibration impact assessment for construction and operation of the development, including traffic noise, undertaken by a suitably qualified person in accordance with the relevant Environment Protection Authority guidelines and Australian Standards which includes:*
> - *The identification of impacts associated with construction site emission and traffic generation at noise affected sensitive receivers, including the provision of operational noise contours and a detailed sleep disturbance assessment.*
> - *Details of noise monitoring survey, background noise levels, noise source inventory, and 'worst-case' noise emission scenarios.*
> - *Consideration of annoying characteristics of noise and prevailing meteorological conditions in the study area.*
> - *A cumulative impact assessment inclusive of impacts from other developments, including the existing development.*
> - *Details and analysis of the effectiveness of proposed management and mitigation measures to adequately manage identified impacts, including a clear identification of residual noise and vibration following application of mitigation these measures and details of any proposed compliance monitoring programs."*|

The SEARs document nominates the following NSW policies and guidelines to be used as a basis for assessment.

Table 2: Policies and Guidelines referenced by SEARs

Aspect	Policy/Methodology
Noise and Vibration	Interim Construction Noise Guideline (DECC, 2009)
	Noise Policy for Industry (EPA, 2017)
	NSW Road Noise Policy (EPA, 2011)
	Environmental Criteria for Road Traffic Noise (EPA, 1999)
	Assessing Vibration: A Technical Guideline (DEC, 2006)
	Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (ANZECC 1990)

A summary of all applicable standards and codes used in this assessment is provided in Section 5.

5. Noise and Vibration Standards and Codes

We provide the following summary of noise and vibration standards and codes that may be applicable to the construction works at the site. This may include;

- Protection of the Environment Operations Act 1997
- Protection of the Environment (Noise Control) Regulation 2008
- NSW Industrial Noise Policy 2000
- Assessing Vibration: A Technical Guideline 2006
- NSW Interim Construction Noise Guideline 2009
- Australian Standard AS2107 – *Acoustics-Recommended Design Sound Levels and Reverberation Times for building interiors*
- Australian Standard AS2436 – *Guide to noise control on construction, maintenance and construction sites*.
- Australian Standard AS 2670.2-1990 *Evaluation of Human Exposure to whole body Vibration Part 2 Continuous and shock induced vibration in buildings (1 to 80 Hz)*
- Australian Standard 2187-1993 *SAA Explosives Code, Part 2 - Use of Explosives*

The application relevance of each of these is summarised as follows;

Table 3: Application of codes and regulations

Code/standard title (abbreviated)	Applicable to construction noise or vibration?	Sets specific noise or vibration goals?	Comments
Protection of the Environment Operations Act 1997	Not mentioned	No	Construction noise and vibration not specifically referenced but may be implied
Protection of the Environment (Noise Control) Regulation 2008	Not mentioned	No	Construction noise and vibration not specifically referenced but may be implied
NSW Industrial Noise Policy 2000	No	No	Construction noise is not dealt with by the INP as described in Section 1.3 of the policy
Assessing Vibration: A Technical Guideline 2006	Noise - No Vibration - Yes	Yes	Continuous, impulsive and intermittent vibration. Based on BS6472-1992
NSW Interim Construction Noise Guideline 2009	Noise - Yes Vibration - No	Noise - Yes Vibration - No	Primarily for noise from construction works that are regulated by the NSW EPA
Australian Standard AS2107	No	Yes	Not relevant to construction noise
Australian Standard AS2436	Noise - Yes	No	Applicable to noise associated with construction
Australian Standard AS2670.2	Noise - No Vibration - Yes	Specific vibration goals	Used for vibration only
Australian Standard AS2187-1993	Noise - No Vibration - Yes	Specific vibration goals	Relevant to demolition

Review of the relevant codes and standards listed above is provided in the following sections of this report.

5.1 Assessing Vibration: A Technical Guideline 2006

5.1.1 Types of vibration

There are three types of vibration as classified in the guide;

- Continuous - vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted rms acceleration values
- Impulsive - rapid build up to a peak followed by a damped decay that may or may not involve several cycles. The duration is short, typically less than 2 seconds. Impulsive vibration (no more than three occurrences in an assessment period) is assessed on the basis of acceleration values.
- Intermittent - interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. Assessed on the basis of vibration dose values.

5.1.2 Acceptable values for continuous and impulsive vibration (1-80Hz)

The relevant criteria for continuous and impulsive vibration are as follows;

Table 4: Preferred weighted RMS vibration acceleration values

Type	Location	Assessment period	Preferred values m/s^2		Maximum values m/s^2	
			z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration	Critical areas	Day or night time	0.005	0.0036	0.01	0.0072
	Residences	Day time	0.01	0.0071	0.02	0.014
		Night time	0.007	0.005	0.014	0.01
	Offices, schools, educational institutions and places of worship	Day or night time	0.02	0.014	0.04	0.028
	Workshops	Day or night time	0.04	0.029	0.08	0.058
Impulsive vibration	Critical areas	Day or night time	0.005	0.0036	0.01	0.0072
	Residences	Day time	0.3	0.21	0.6	0.42
		Night time	0.1	0.071	0.2	0.14
	Offices, schools, educational institutions and places of worship	Day or night time	0.64	0.46	1.28	0.92
	Workshops	Day or night time	0.64	0.46	1.28	0.92

5.1.3 Acceptable values for intermittent vibration

Intermittent vibration is assessed using the vibration dose value (VDV) root-mean-quad method. VDV accumulates the vibration energy received over the daytime and night-time periods. The vibration dose methodology is as per standard BS 6472–1992.

The relevant criteria for vibration dose values are as follows;

Table 5: Vibration dose values for intermittent vibration

Location	Daytime		Night time	
	Preferred value $m/s^{1.75}$	Maximum value $m/s^{1.75}$	Preferred value $m/s^{1.75}$	Maximum value $m/s^{1.75}$
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

5.1.4 Short-term works

Short-term works are works that occur for a duration of approximately one week. In accordance with the guide, the reference to short term works is as follows;

In circumstances where work is short term, feasible and reasonable mitigation measures have been applied, and the project has a demonstrated high level of social worth and broad community benefits, then higher vibration values (above the maximum) may apply. In such cases, best management practices should be used to reduce values as far as practicable, and a comprehensive community consultation program should be instituted. An example of a possible management strategy would be to restrict the times during which high vibration values occur to the least sensitive times of the day. Typical issues covered in a consultation program include a public contact point for handling complaints, and early notification of proposed operations and any significant change to operations.

5.2 NSW Interim Construction Noise Guideline 2009

5.2.1 Hours for construction work

The recommended standard hours for construction work are shown below in Table 6, however they are not mandatory. There are some situations where construction work may need to be undertaken outside of these hours. The likely noise impacts and the ability to undertake works during the recommended standard hours should be considered when scheduling work.

Table 6: Recommended standard hours for construction work

Work type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

* The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.

Work outside of hours may be done under one of the following five categories;

- the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- public infrastructure works that shorten the length of the project and are supported by the affected community
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

5.2.2 Assessment criteria

The quantitative assessment method involves predicting airborne noise levels and comparing them with the levels in the relevant section of the Guideline. The noise criteria for quantitative assessment are shown below.

5.2.2.1 Residential uses

Noise criteria assessed at residential properties is listed in Section 4.1.1 of the guideline. The relevant criteria and associated notes are as follows;

Table 7: Noise criteria for quantitative assessment - Residential

Time of day	Criterion LAeq(15min) *	How to apply
Recommended standard hours	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended hours	Noise affected RBL + 5dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m 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.

5.2.2.2 Other sensitive uses

The following table presents management levels for noise at other sensitive land uses. The proponent should also consult with noise sensitive land use occupants potentially affected by noise from the works, to schedule achieve a reasonable noise outcome.

Table 8: Noise criteria for quantitative assessment - Other uses

Land use	Management level LAeq(15min)	Assessment location
Classrooms at schools and other educational institutions	45dBA	Internal
Hospital wards and operating theatres	45dBA	Internal
Places of worship	45dBA	Internal
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	65dBA	External
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	60dBA	External
Community centres	Depends on the use of the centre. Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.	Internal

5.2.2.3 Commercial and industrial properties

Noise management levels for commercial and industrial premises are contained in Section 4.1.3 of the guideline.

Table 9: Noise criteria - Commercial and industrial premises

Land use	Management level LAeq(15min)	Assessment location
Industrial	75dBA	External, most-affected occupied point of the premises
Offices, retail shops	70dBA	External, most-affected occupied point of the premises
Other businesses e.g. theatre, childcare etc	Depends on the use. Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.	Varies, refer to AS2107

Where noise from construction works is above the 'noise affected' levels presented, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform potentially affected parties of the activities to be carried out, the expected noise impacts and duration.

If any of the following activities are to be undertaken, they should be factored into the quantitative assessment by adding 5 dB to the predicted levels;

- use of 'beeper' style reversing or movement alarms
- use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or
- steel work
- grinding metal, concrete or masonry
- rock drilling
- line drilling
- vibratory rolling
- rail tamping and regulating
- bitumen milling or profiling
- jackhammering, rock hammering or rock breaking
- impact piling.

5.2.3 Ground-borne noise

Noise within dwellings resulting from ground vibration from construction processes would be required to comply with the following criteria;

Table 10: Recommended standard hours for construction work

Time	Criterion LAeq(15min) dB(A)
Evening (6pm to 10pm)	40
Night (10pm to 7am)	35

The criteria only apply to evening and night time construction works.

5.3 Australian Standard AS2107

Australian Standard 2107-2000 *Acoustics-Recommended design sound levels and reverberation times for building interiors* lists the desired noise levels for residential buildings. This standard includes the assessment of building services noise (i.e. mechanical services, hydraulics etc), and building components that exclude noise external to the building (e.g. traffic noise, industrial noise).

Section 2 *Application* - specifically states that the standard is not intended either for the assessment or prescription of acceptable noise levels from transient or variable noises such as construction.

5.4 Australian Standard AS2436

Australian Standard AS2436-2010 *Guide to noise control on construction, maintenance and construction sites* provides guidance in noise control in respect of engineering construction, maintenance and construction works. This includes guidance in investigation and identification of noise sources, measurement of sound and assessment, with a view to appropriate planning of measures for noise control.

AS2436 also contains a table of typical sound levels from construction plant and equipment, and a discussion of the effectiveness of acoustic treatments and acoustic screens and enclosures. Section 1.5 Regulatory Requirements states that the legislation for the control of noise on construction, maintenance and construction sites is generally the responsibility of the relevant State government or local Council body.

5.5 Australian Standard AS2670.2-1990

Definitions of acceptable perceived vibration criteria can be found in AS 2670.2-1990 Evaluation of Human Exposure to whole body Vibration Part 2 Continuous and shock induced vibration in buildings (1 to 80 Hz). This code provides frequency weighted curves for acceptable vibration levels. These relate to a resultant of vibration in all three axis'; more specifically the x, y and z directions. The curves are based on multiples of a single base curve depending on type of receiver.

Table 11: AS2670.2-1990 vibration multiplying factors

Place	Time	Continuous or intermittent vibration	Transient vibration excitation with several occurrences per day
Critical working areas (for example some hospital operating-theatres, some precision laboratories, etc.)	Day & Night	1	1
Residential	Day	2 to 4	30 to 90
	Night	1.4	1.4 to 20
Office	Day & Night	4	60 to 128
Workshop	Day & Night	8	90 to 128

5.6 Australian Standard AS2187-1993

Australian Standard 2187-1993 *SAA Explosives Code, Part 2 - Use of Explosives* specifies acceptable levels of ground vibration to limit the probability of structural damage and human discomfort. The criteria presented in this Standard are summarised below;

Table 12: AS2187-1993 recommended peak particle velocity

Type of building or structure	Particle velocity (Vp) mm/s
Historical buildings and monuments, and buildings of special value and significance	2
House and low rise residential buildings: Commercial buildings not included in item 3 below	10
Commercial and industrial buildings or structures of reinforced concrete or steel construction	25

While the use of explosives is not expected for the site, the values presented in the table would still form an appropriate guide to reducing the risk of potential structural damage due to vibration from construction processes.

5.7 DIN 4150 – 2016 Part 3

German Standard DIN 4150 – 2016, " *Part 3 - Effects of vibration on structures" stipulates in section 5 the acceptable levels of vibration that can occur* levels of ground vibration to limit the probability of structural damage and human discomfort. The criteria presented in this Standard are summarised below.

Table 13 – DIN4150 recommend peak particle velocity

Type of building or structure	Particle velocity (Vp) mm/s
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	10
Dwellings and buildings of similar design and/or occupancy	5
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3-5

6. Noise Monitoring and Receivers

6.1 Receiver Locations

The nearest sensitive receiver locations were identified as follows;

1. The Westlink M7 Motorway separates the site from single and two storey residential dwellings to the north west.
2. The Westlink M7 Motorway separates the site from single and two storey residential dwellings to the west.
3. The Westlink M7 Motorway separates the site from single and two storey residential dwellings to the south west.

A1. Woodstock Avenue separates the site from industrial premises to the north.

B1. Kellogg Road separates the site from industrial premises to the west.

C1. Kellogg Road separates the site from industrial premises to the south.

D1. Industrial premises are located adjacent the eastern site boundary.

These locations were chosen as they are the nearest sensitive receivers to the proposed development. Refer to Figure 2 for these locations.

Figure 2: Receiver and noise monitoring locations

Although multiple dwellings are grouped for receivers 1, 2 and 3, to ensure a conservative assessment all calculation of noise impacts were assessed to the nearest dwelling within the nominated area. The receivers nominated in Figure 2 are the nearest and worst-affected sensitive receivers to the site. The identified industrial receivers in Figure were only assessed for vibration.

6.2 Equipment

The following equipment was used to record noise levels:

- 2x Rion NL42 Environmental Noise Monitors (SN# 00509258 and SN# 01259207)
- Pulsar Model 105 Ltd Sound Calibrator (SN # 57417)

The Environmental Noise Monitors hold current NATA Laboratory Certification and were field calibrated before and after the monitoring period, with no significant drift from the reference signal recorded.

6.3 Unattended Noise Monitoring

Rion NL42 environmental noise monitors were placed at 2 Wolseley Street (Monitor A) and 540 Woodstock Avenue (Monitor B) as shown in Figure 2 to measure ambient and traffic noise levels respectively. These locations were chosen as they were considered representative of the nearest residential receivers. The monitors were located in free field positions with the microphones approximately 1.4 metres above ground surface level. The monitors were set to record noise levels between the 5th to 13th of October 2021.

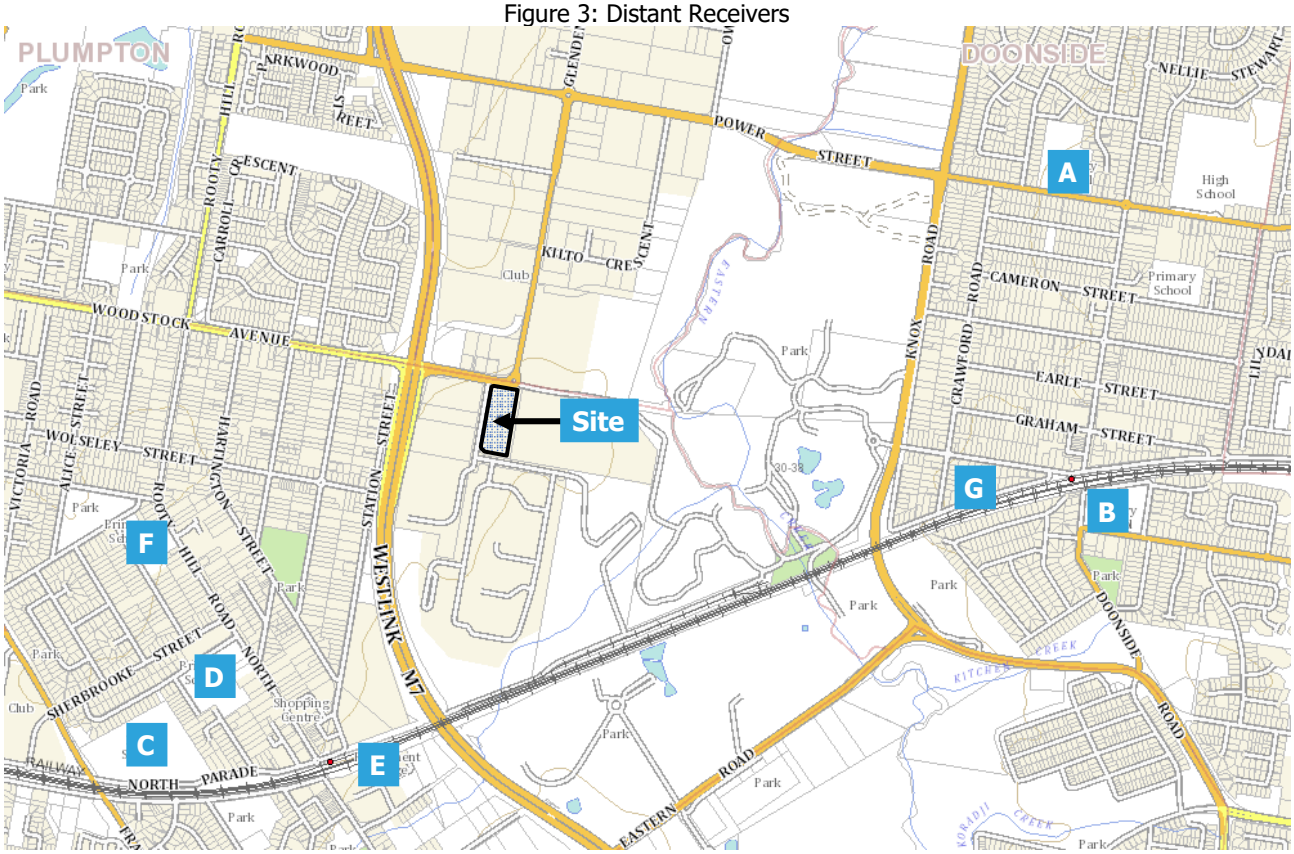
The environmental noise monitors were set to record noise levels in "A" weighting, Fast response using 15 minute statistical intervals. Ambient noise monitoring was conducted in accordance with Australian Standard AS1055:2018 *Acoustics – Description and measurement of environmental noise*. For the unattended noise monitoring locations refer to Figure 2.

6.4 Distant Receivers

Distant sensitive receivers with the potential to be affected by cumulative noise from the site were identified as follows:

A. Crawford Public School is located to the north east of the site.
B. Doonside Public School is located to the east of the site.
C. Rooty Hill High School is located to the south west of the site.
D. Rooty Hill Public School is located to the south west of the site.
E. Melva McDonald Lodge, a retirement village, is located to south of the site.
F. St Aidan's Primary School is located to the west of the site.
G. Doonside Christadelphian Church is located to the east of the site.

Figure 3: Distant Receivers



The above receivers were nominated as the distant receivers with the most potential to be adversely affected by noise impacts from the site. Other receivers not mentioned are predicted to be less affected than those nominated.

7. Existing background noise levels

The following tables present the measured existing ambient noise levels from the unattended noise survey. Any periods of inclement weather or extraneous noise are omitted from the measured data prior to determining the overall results.

7.1 Meteorological conditions

A brief summary of meteorological observations during the unattended noise monitoring survey were obtained from the Bureau of Meteorology website (http://www.bom.gov.au/climate/data), shown in Table 14 below. Reference for the unattended noise survey was conducted in accordance with the full daily data obtained from the Bureau of Meteorology for all time periods to ensure the recorded levels are valid in accordance with the Noise Policy for Industry.

Table 14: Meteorological conditions – Horsley Park

Day	Date	Rainfall (mm)	Wind			
			9am		3pm	
			Speed (km/h)	Direction	Speed (km/h)	Direction
Wednesday	06/10/21	0	9	W	2	S
Thursday	07/10/21	0	6	NNW	20	WNW
Friday	08/10/21	0	6	NE	17	E
Saturday	09/10/21	0	2	WNW	4	N
Sunday	10/10/21	0	4	N	15	SE
Monday	11/10/21	11.8	13	SSW	6	SSE
Tuesday	12/10/21	2.4	13	S	2	SE

7.2 Ambient background noise levels

7.2.1 Noise Monitor A (Receivers 2 to 4)

The measured rating background noise levels (RBL) were determined in accordance with the NSW Noise Policy for Industry, with levels for the monitoring location presented in Table 15.

Table 15: Measured RBL noise levels – Noise Monitor A

Day	Date	RBL dB(A) (Receivers 2 to 4)		
		Day	Evening	Night
Tuesday	05/10/21	x	40	39
Wednesday	06/10/21	47	44	40
Thursday	07/10/21	47	*46	38
Friday	08/10/21	49	43	37
Saturday	09/10/21	42	40	36
Sunday	10/10/21	42	43	40*
Monday	11/10/21	50	44	41
Tuesday	12/10/21	50	44	39
RBL		47	44	39

*Note high wind speeds and extraneous noise recorded on the 7th of October and rainfall recorded during the night time period on Sunday 10th October were found to affect the measurements during the evening period. Therefore, the data was omitted for the affected time periods.

8. Project specific criteria

8.1 Construction noise criteria

Based on the relevant codes and standards and the measured background noise levels, the applicable construction/earthworks noise limits would be as follows;

Table 16: Applicable noise limits for construction work

Time	Criterion LAeq(15min)	Assessment location
During standard construction hours	52dBA noise affected	External
	75dBA highly noise affected	External
Outside standard construction hours (daytime only)	52dBA	External
School Classrooms / Places of Worship / Hospitals	45dBA	Internal

8.2 Construction vibration criteria

Based on the relevant codes and standards, the applicable vibration limits would be as follows;

Table 17: Applicable vibration limits

Type	Measure	Location	Assessment period	Preferred values		Maximum values	
				z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous	RMS acceleration	Residences	Day time	0.01 m/s^2	0.0071 m/s^2	0.02 m/s^2	0.014 m/s^2
Impulsive	RMS acceleration	Residences	Day time	0.3 m/s^2	0.21 m/s^2	0.6 m/s^2	0.42 m/s^2
Intermittent	Vibration dose value	Residences	Day time	0.20 $m/s^{1.75}$	0.20 $m/s^{1.75}$	0.40 $m/s^{1.75}$	0.40 $m/s^{1.75}$
All	Peak particle velocity	Residences	Day time	10 mm/s	-	10 mm/s	-
Continuous	RMS acceleration	Schools	Day time	0.02 m/s^2	0.014 m/s^2	0.04 m/s^2	0.028 m/s^2
Impulsive	RMS acceleration	Schools	Day time	0.64 m/s^2	0.46 m/s^2	1.28 m/s^2	0.92 m/s^2
Intermittent	Vibration dose value	Schools	Day time	0.40 $m/s^{1.75}$	0.80 $m/s^{1.75}$	0.40 $m/s^{1.75}$	0.80 $m/s^{1.75}$
All	Peak particle velocity	Schools	Day time	10 mm/s	-	10 mm/s	-
All	Peak particle velocity	Warragamba Pipeline	Day time	3 mm/s	-	5 mm/s	-

9. Predicted Noise Levels

Predicted noise associated with the demolition and construction of the proposed development has been assessed based on the source noise levels and procedures contained in AS2436-2010, as well as the results of previous noise measurements and assessments conducted by Acoustic Works. Calculations are done, based on the earthworks and construction activities being at the closest relevant distance to each existing receiver.

It is noted that the calculations assume that all noise sources are operating simultaneously, at the closest point to the receiver in each case. In practice, this will generally not occur as process will be either spread over the site or occur on different days. The predicted noise levels represent the expected worst-case noise emissions due to site works.

9.1 Demolition

The predicted noise impacts of demolition are summarised as follows;

Table 18: Predicted demolition noise impacts (Receivers 1 to 3)

Receivers 1. North west residential 2. West resdiential 3. South west residential A. Crawford Public School (NE) B. Doonside Public School (E) C. Rooty Hill High School (SW) D. Rooy Hill Public School (SW) E. Melva McDonald Lodge (S) F. St Aidan's Primary School (W) G. Doonside Christadelphian Church (E)						LAeq 15 min Compliance	
Receiver	Description	Source Lw dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T ext. dB(A) Noise Affected	LAeq adj,T ext. dB(A) Highly Noise Affected	Noise affected	Highly noise affected
	Criteria						52	75
	Excavator large	107		107	41	41	Yes	Yes
1	Backhoe	104		104	41	41	Yes	Yes
	Bulldozer	108		108	39	39	Yes	Yes
	Jack hammers	121	5	126	57	57	No	Yes
	Loader (wheeled)	105		105	36	36	Yes	Yes
	Compressor large (silenced)	93	2	95	35	35	Yes	Yes
	Truck passby	90		90	20	20	Yes	Yes
	Truck reverse alarm	100	5	105	35	35	Yes	Yes
	Total				58	58	**No**	**Yes**
	Criteria						52	75
	Excavator large	107		107	42	42	Yes	Yes
2	Backhoe	104		104	42	42	Yes	Yes
	Bulldozer	108		108	40	40	Yes	Yes
	Jack hammers	121	5	126	58	58	No	Yes
	Loader (wheeled)	105		105	37	37	Yes	Yes
	Compressor large (silenced)	93	2	95	36	36	Yes	Yes
	Truck passby	90		90	21	21	Yes	Yes
	Truck reverse alarm	100	5	105	36	36	Yes	Yes
	Total				59	59	**No**	**Yes**
	Criteria						52	75
	Excavator large	107		107	41	41	Yes	Yes
3	Backhoe	104		104	41	41	Yes	Yes
	Bulldozer	108		108	39	39	Yes	Yes
	Jack hammers	121	5	126	57	57	No	Yes
	Loader (wheeled)	105		105	36	36	Yes	Yes
	Compressor large (silenced)	93	2	95	35	35	Yes	Yes
	Truck passby	90		90	20	20	Yes	Yes
	Truck reverse alarm	100	5	105	35	35	Yes	Yes
	Total				58	58	**No**	**Yes**

Table 19: Predicted demolition noise impacts (Receivers A to D)

Receiver	Description	Source Lw dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T int. dB(A) Mgmt Level	LAeq 15 min Compliance Management Level (Internal)
	Receivers 1. North west residential 2. West resdiential 3. South west residential A. Crawford Public School (NE) B. Doonside Public School (E) C. Rooty Hill High School (SW) D. Rooy Hill Public School (SW) E. Melva McDonald Lodge (S) F. St Aidan's Primary School (W) G. Doonside Christadelphian Church (E)					
	Criteria					45
	Excavator large	107		107	8	Yes
A	Backhoe	104		104	8	Yes
	Bulldozer	108		108	6	Yes
	Jack hammers	121	5	126	24	Yes
	Loader (wheeled)	105		105	3	Yes
	Compressor large (silenced)	93	2	95	2	Yes
	Truck passby	90		90		Yes
	Truck reverse alarm	100	5	105	2	Yes
	Total				25	**Yes**
	Criteria					45
	Excavator large	107		107	17	Yes
B	Backhoe	104		104	17	Yes
	Bulldozer	108		108	15	Yes
	Jack hammers	121	5	126	33	Yes
	Loader (wheeled)	105		105	12	Yes
	Compressor large (silenced)	93	2	95	11	Yes
	Truck passby	90		90		Yes
	Truck reverse alarm	100	5	105	11	Yes
	Total				34	**Yes**
	Criteria					45
	Excavator large	107		107	22	Yes
C	Backhoe	104		104	22	Yes
	Bulldozer	108		108	20	Yes
	Jack hammers	121	5	126	38	Yes
	Loader (wheeled)	105		105	17	Yes
	Compressor large (silenced)	93	2	95	16	Yes
	Truck passby	90		90	1	Yes
	Truck reverse alarm	100	5	105	16	Yes
	Total				39	**Yes**
	Criteria					45
	Excavator large	107		107	20	Yes
D	Backhoe	104		104	20	Yes
	Bulldozer	108		108	18	Yes
	Jack hammers	121	5	126	36	Yes
	Loader (wheeled)	105		105	15	Yes
	Compressor large (silenced)	93	2	95	14	Yes
	Truck passby	90		90		Yes
	Truck reverse alarm	100	5	105	14	Yes
	Total				37	**Yes**

Table 20: Predicted demolition noise impacts (Receivers E to G)

Receiver	Description	Source Leq@1m dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T int. dB(A) Mgmt Level	LAeq 15 min Compliance Management Level (Internal)
	Receivers 1. North west residential 2. West resdiential 3. South west residential A. Crawford Public School (NE) B. Doonside Public School (E) C. Rooty Hill High School (SW) D. Rooy Hill Public School (SW) E. Melva McDonald Lodge (S) F. St Aidan's Primary School (W) G. Doonside Christadelphian Church (E)					
	Criteria					45
	Excavator large	99		99	21	Yes
E	Backhoe	96		96	21	Yes
	Bulldozer	100		100	19	Yes
	Jack hammers	113	5	118	37	Yes
	Loader (wheeled)	97		97	16	Yes
	Compressor large (silenced)	85	2	87	15	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	10	Yes
	Total				38	**Yes**
	Criteria					45
	Excavator large	99		99	22	Yes
F	Backhoe	96		96	22	Yes
	Bulldozer	100		100	21	Yes
	Jack hammers	113	5	118	39	Yes
	Loader (wheeled)	97		97	18	Yes
	Compressor large (silenced)	85	2	87	16	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	12	Yes
	Total				39	**Yes**
	Criteria					45
	Excavator large	99		99	19	Yes
G	Backhoe	96		96	20	Yes
	Bulldozer	100		100	18	Yes
	Jack hammers	113	5	118	36	Yes
	Loader (wheeled)	97		97	15	Yes
	Compressor large (silenced)	85	2	87	14	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	9	Yes
	Total				37	**Yes**

Demolition noise levels are predicted to potentially be above the noise affected level of 48dBA at the nearest residential receivers but are predicted to comply with the highly affected noise limit of 75dBA LAeq 15min at each of the receiver locations, and the internal noise management levels at distant non-residential receivers. Refer to Section 12.2 for mitigation measures.

9.2 Construction

The predicted noise impacts of construction works are summarised as follows;

Table 21: Predicted construction noise impacts (Receivers 1 to 3)

Receivers
1. North west residential
2. West resdiential
3. South west residential
A. Crawford Public School (NE)
B. Doonside Public School (E)
C. Rooty Hill High School (SW)
D. Rooy Hill Public School (SW)
E. Melva McDonald Lodge (S)
F. St Aidan's Primary School (W)
G. Doonside Christadelphian Church (E)

Receiver	Description	Source Lw dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T ext. dB(A) Noise Affected	LAeq adj,T ext. dB(A) Highly Noise Affected	LAeq 15 min Compliance: Noise affected	LAeq 15 min Compliance: Highly noise affected
	Criteria						52	75
1	Concrete truck	103		103	43	43	Yes	Yes
	Concrete pump	102	2	104	44	44	Yes	Yes
	Power tools (electric)	91	2	93	33	33	Yes	Yes
	Compressor large (silenced)	93	2	95	35	35	Yes	Yes
	Truck passby	90		90	15	15	Yes	Yes
	Truck reverse alarm	100	5	105	30	30	Yes	Yes
	Forklift unloading	90	2	92	26	26	Yes	Yes
	Concrete pencil vibrator	103		103	43	43	Yes	Yes
	Saw (cutoff)	100		100	26	26	Yes	Yes
	Total				49	49	**Yes**	**Yes**
	Criteria						52	75
2	Concrete truck	103		103	44	44	Yes	Yes
	Concrete pump	102	2	104	45	45	Yes	Yes
	Power tools (electric)	91	2	93	34	34	Yes	Yes
	Compressor large (silenced)	93	2	95	36	36	Yes	Yes
	Truck passby	90		90	16	16	Yes	Yes
	Truck reverse alarm	100	5	105	31	31	Yes	Yes
	Forklift unloading	90	2	92	27	27	Yes	Yes
	Concrete pencil vibrator	103		103	44	44	Yes	Yes
	Saw (cutoff)	100		100	27	27	Yes	Yes
	Total				50	50	**Yes**	**Yes**
	Criteria						52	75
3	Concrete truck	103		103	43	43	Yes	Yes
	Concrete pump	102	2	104	44	44	Yes	Yes
	Power tools (electric)	91	2	93	33	33	Yes	Yes
	Compressor large (silenced)	93	2	95	35	35	Yes	Yes
	Truck passby	90		90	15	15	Yes	Yes
	Truck reverse alarm	100	5	105	30	30	Yes	Yes
	Forklift unloading	90	2	92	26	26	Yes	Yes
	Concrete pencil vibrator	103		103	43	43	Yes	Yes
	Saw (cutoff)	100		100	26	26	Yes	Yes
	Total				49	49	**Yes**	**Yes**

Table 22: Predicted construction noise impacts (Receivers A to D)

Receivers
1. North west residential
2. West resdiential
3. South west residential
A. Crawford Public School (NE)
B. Doonside Public School (E)
C. Rooty Hill High School (SW)
D. Rooy Hill Public School (SW)
E. Melva McDonald Lodge (S)
F. St Aidan's Primary School (W)
G. Doonside Christadelphian Church (E)

Receiver	Description	Source Leq@1m dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T int. dB(A) Mgmt Level	LAeq 15 min Compliance Management Level (Internal)
A	Criteria					45
	Concrete truck	95		95	20	Yes
	Concrete pump	94	2	96	21	Yes
	Power tools (electric)	83	2	85	10	Yes
	Compressor large (silenced)	85	2	87	12	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	7	Yes
	Forklift unloading	82	2	84	3	Yes
	Concrete pencil vibrator	95		95	20	Yes
	Saw (cutoff)	92		92	3	Yes
	Total				26	**Yes**
B	Criteria					45
	Concrete truck	95		95	19	Yes
	Concrete pump	94	2	96	21	Yes
	Power tools (electric)	83	2	85	10	Yes
	Compressor large (silenced)	85	2	87	12	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	7	Yes
	Forklift unloading	82	2	84	3	Yes
	Concrete pencil vibrator	95		95	20	Yes
	Saw (cutoff)	92		92	3	Yes
	Total				25	**Yes**
C	Criteria					45
	Concrete truck	95		95	24	Yes
	Concrete pump	94	2	96	25	Yes
	Power tools (electric)	83	2	85	14	Yes
	Compressor large (silenced)	85	2	87	16	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	12	Yes
	Forklift unloading	82	2	84	8	Yes
	Concrete pencil vibrator	95		95	24	Yes
	Saw (cutoff)	92		92	8	Yes
	Total				30	**Yes**
D	Criteria					45
	Concrete truck	95		95	22	Yes
	Concrete pump	94	2	96	23	Yes
	Power tools (electric)	83	2	85	12	Yes
	Compressor large (silenced)	85	2	87	14	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	9	Yes
	Forklift unloading	82	2	84	5	Yes
	Concrete pencil vibrator	95		95	22	Yes
	Saw (cutoff)	92		92	6	Yes
	Total				28	**Yes**

Table 23: Predicted construction noise impacts (Receivers E to G)

Receivers

1. North west residential
2. West resdiential
3. South west residential
A. Crawford Public School (NE)
B. Doonside Public School (E)
C. Rooty Hill High School (SW)
D. Rooy Hill Public School (SW)
E. Melva McDonald Lodge (S)
F. St Aidan's Primary School (W)
G. Doonside Christadelphian Church (E)

Receiver	Description	Source Leq@1m dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T int. dB(A) Mgmt Level	LAeq 15 min Compliance Management Level (Internal)
E	Criteria					45
	Concrete truck	95		95	23	Yes
	Concrete pump	94	2	96	24	Yes
	Power tools (electric)	83	2	85	13	Yes
	Compressor large (silenced)	85	2	87	15	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	10	Yes
	Forklift unloading	82	2	84	6	Yes
	Concrete pencil vibrator	95		95	23	Yes
	Saw (cutoff)	92		92	6	Yes
	Total				29	**Yes**
F	Criteria					45
	Concrete truck	95		95	24	Yes
	Concrete pump	94	2	96	25	Yes
	Power tools (electric)	83	2	85	14	Yes
	Compressor large (silenced)	85	2	87	16	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	12	Yes
	Forklift unloading	82	2	84	8	Yes
	Concrete pencil vibrator	95		95	24	Yes
	Saw (cutoff)	92		92	8	Yes
	Total				30	**Yes**
G	Criteria					45
	Concrete truck	95		95	21	Yes
	Concrete pump	94	2	96	23	Yes
	Power tools (electric)	83	2	85	12	Yes
	Compressor large (silenced)	85	2	87	14	Yes
	Truck passby	82		82		Yes
	Truck reverse alarm	92	5	97	9	Yes
	Forklift unloading	82	2	84	5	Yes
	Concrete pencil vibrator	95		95	22	Yes
	Saw (cutoff)	92		92	5	Yes
	Total				27	**Yes**

Construction noise levels are predicted to comply with the noise affected and highly noise affected limits of 52 dBA and 75dBA LAeq 15min at each of the receiver locations. Refer to Section 12.2 for mitigation measures.

10. Vibration Predictions

Potential vibration impacts were assessed to determine typical levels within a set distance of the activity to the receiver with a maximum combined Peak Particle Velocity of level of less than 2-3mm/s predicted depending on the equipment in operation. The level of impact may change depending on the ground composition, example stone/rock or concrete will allow higher levels of ground vibration than soft soil. It is recommended a strict management plan is implemented to allow a proactive approach to addressing complaints including vibration monitoring of activities if complaints are received and when earthworks and construction works are underway.

After review of the proposal in relation to vibration impacts, we provide the following recommendations:

- The surrounding residential receivers located in proximity to the site are separated from the roads and site by soil and the M7 motorway, with reasonable separation distances from onsite activities and local roads. The human exposures and Peak Particle levels are predicted to be below the criteria nominated in section 7.6 with no further treatments required.
- The surrounding industrial lots are predicted to comply with the criteria based on the proposed activities, with nearby industrial sites predicted to generate more vibration than the proposal.
- If complaints are received for onsite activities from any of the sensitive receivers we recommend that compliance monitoring is undertaken as detailed in Section 12.3.

10.1 Earthworks

Based on the separation distance to the nearest receiver locations and ground composition to the nearest residential receivers, the maximum vibration level due to demolition activities is expected to be less than 2-3mm/s, which is predicted to comply with the criteria.

Therefore, vibration monitoring is only required at the nearest residential receivers in the event complaints are received.

10.2 Building construction

If complaints are received regarding vibration, we recommend that activities are minimised in proximity to the complainant, a vibration monitor should be installed to monitor the levels and to ensure no adverse impacts. The monitor should be located at the complainants until the works have been completed or for a period to show that the cause of the complaint was a one of occurrence.

11. Recommendations – Vibration

11.1 Location of Dilapidation Assessments – Vibration

Based on our review, it is recommended the following numbered locations in Figure 4 have a dilapidation assessment before works proceed.

Figure 4: Location of Dilapidation Assessments

11.2 Vibration Control

Due to the proximity of the proposed construction works in relation to nearby buildings (in particular the industrial buildings surrounding the site), it is recommended within the Construction Noise and Vibration Management Plan that vibration monitoring is only undertaken at these locations if complaints are received. To minimise exceedances, monitoring equipment shall include SMS alert to the site manager and project staff including the acoustic consultant. Where an alert indicates exceedance of the criteria, use of the onsite plant responsible for the vibration shall cease until the cause is identified and mitigated. Alternative construction methods may be required if problems are identified onsite as follows:

- Excavators – if vibration levels are triggered by the movement of excavators onsite, we recommend they reduce their movement speed onsite and maintain a minimum separation distance of 50 metres from the nearest sensitive receivers for vehicle movement.
- Dump trucks – during the earthworks for the development, we recommend the trucks maintain a minimum 50 metre separation distance to the building's sensitive receivers when not located on the main road.
- If equipment causes vibration levels to be triggered multiple times at the monitoring location that exceed the maximum allowable criteria, the works/equipment responsible will cease with an investigation to determine management controls to prevent exceedances in the future. These may include but not limited to minimum separation distances being set from the receiver, construction of a ditch along the boundary to reduce the vibration path and possibly reducing the speed of equipment movement onsite.
- During all works onsite, the nominated person will keep a log regarding any SMS events from the vibration monitors including exceedances of the criteria and the equipment causing the issue. Immediate action will be taken to minimise the potential for the exceedance occurring again.

11.3 Vibration Management

1. Allowable construction hours as follows:

   Monday to Friday 7 am to 6 pm

   Saturday 8 am to 1 pm

   No work on Sundays or public holidays
2. Assign the task of managing vibration complaints or recorded exceedance of the criteria to a person (the 'responsible person') that is likely to be present on-site most of the time that activity is occurring (usually the Site Manager). This person would be responsible for handling vibration complaints and ensuring that work does not commence before the specified allowable times. The name and contact details of the 'responsible person' should be displayed outside the principal construction office.
3. If complaints arise regarding vibration, the complaint will be directed to the 'responsible person', who will determine the source of the vibration or engage the acoustic consultant to investigate immediately. This may involve moving the vibration source further away from affected premises, replacing the equipment, operating at a reduced speed, or excavating a ditch 0.5 metre wide and 1 metre deep between the receiver and the site.
4. The Responsible Person should notify the adjacent residential premises of the intention to commence work that may cause adverse impacts on surrounding residents. If plant is to be operated in close proximity to residential premises, the Responsible Person should advise the occupants of the premises the length of time that the plant will be in operation proximate to the property boundary.

5. Any moveable vibrating plant (e.g. compressors) should be located as far as practical from the adjacent residential premises.
6. The Responsible Person maintain a record of complaints, which records the following details (refer to the example complaint record sheet in the appendix to this plan):
   - The time and date of lodgement of the complaint;
   - The name and telephone number of the complainant;
   - The nature of the complaint, including a description of the vibration (e.g. likely vibration source, duration of the event - is the vibration continuous, or of a short duration);
   - The outcome of the investigation.
7. If a complaint is raised regarding a particular piece of plant, the plant shall be inspected for working condition, with particular attention given to the condition of equipment operating components. If machinery is in good condition, attended vibration measurements shall be undertaken to determine the cause with recommendations provided by a qualified acoustic consultant to rectify the situation.

A sample complaint form is provided in the appendices.

11.4 Maximum Vibration Levels

Based on inspection of the surrounding buildings, the maximum allowable levels would be a peak particle velocity of 10mm/s. If monitors are installed onsite they shall be set to a maximum limit of 6mm/s to provide adequate warning and to avoid exceedances of the maximum noise limits.

11.5 Vibration Monitoring Procedure

To ensure the vibration monitoring is effective, we recommend the following:

- All vibration monitors will be set to a maximum measurement interval of 5 minutes and record over the construction period commencing at 6am to 7pm every day.
- The client shall provide a list of relevant construction staff (including mobile phone numbers) working on the project to be notified of exceedance of the nominated vibration levels.
- All vibration monitors will be fitted with an internal SMS warning system (allow the unit to send SMS notification of vibration levels when the nominated level is exceeded). The SMS warning from the vibration monitors will go out to all staff who have provided their mobile numbers for use for notifications from the vibration monitor.
- The vibration monitor will be set to provide vibration impact warnings at 2/3 of the criteria (10mm/s), this will allow staff to be notified of vibration levels and take a proactive approach before the criteria is exceeded. The Acoustic consultant will also have a minimum of 2 staff nominated on the warning system.
- The vibration monitors will be installed with additional battery packs to extend the operation of the monitor to a minimum of 6 weeks with recharge.
- Regardless of warning or notification, the vibration monitor will be downloaded on a monthly basis with a monthly report provided to the client, the report will be suitable for submission to council.

11.5.1 Procedure for measuring Vibration

11.5.1.1 Where to measure vibration

Vibration is required to be measured at any complainant's property with the geophone located at the nearest point of the dwelling to the site. The geophone can be fixed to the ground using mounting spikes in line with the nearest point of the development or fixed directly to dwelling, note that relocation of the geophone may be required to be representative of the nearest location of works being conducted onsite. Note multiple vibration monitors (two) are recommended to avoid the need for relocating the geophone multiple times.

11.5.1.2 When to measure vibration from construction

Measurements of construction vibration should be undertaken at the time(s) when the site is operating during the approved construction hours. If attended vibration measurements are required, they should be representative of the current maximum level of activity from the site, or at times when complaint has been received.

11.5.1.3 Information to be reported

Any reporting should be concise. The minimum requirements to be included in a report are;

- Date and duration of measurements.
- Time of measurements or measurement period.
- Person(s) performing measurements or placing equipment used for long term monitoring.
- Equipment used for measurements.
- Location of measurements including photos.
- Measured values including graphed PPV for the period of monitoring.
- Corrected values (where applicable).
- Notes regarding vibrating sources.
- Notes regarding any extraneous sources that may have influenced measurements.
- Detail of instrumentation and calibration.
- Meteorological conditions.
- Explanation of any high levels below the criteria including exceedances

Action taken for any exceedance including changes to site operations

12. Recommended Acoustic Treatments & Management Principles

12.1 General comments

For the majority of the works it is expected that noise will generally comply with the highly noise affected limit of 75dB(A) LAeq 15min for residential receivers. There is the potential for the works to exceed the noise affected limit of 52dBA LAeq 15min during the demolition phase. In particular, noise from jackhammers is calculated to have the highest potential impact to receiver locations. Therefore close liaising with nearby residences would be recommended, with unattended noise monitoring to be conducted at receivers 1, 2 & 3 for a period of two weeks if complaints are received. Other receivers located further away from the site are predicted to comply.

Due to proximity of the surrounding industrial buildings, in the event of a complaint for vibration, unattended monitoring during construction works should be undertaken for a two week period to ensure vibration levels are compliant with the criteria nominated in Section 5.6.

12.2 Noise control

The following general acoustic treatments and management principles are recommended for the project:

1. The conditioned construction hours would be as follows:

   Monday to Friday 7 am to 6 pm
   Saturday 8 am to 1 pm
   No work on Sundays or public holidays
2. If further noise mitigation is required, acoustic barriers around the perimeter of the site can be installed during the works. If further noise reductions are required, install additional screening around noise sensitive areas.
3. Workers or delivery trucks do not congregate at or outside the site before 7am. This is an important factor in managing noise from the site.
4. Assign the task of managing noise emissions to a person (the 'responsible person') that is likely to be present on-site most of the time that activity is occurring (usually the Site Manager). This person would be responsible for handling noise complaints, and ensuring that work does not commence before the specified allowable times. The name and contact details of the 'responsible person' should be displayed outside the principal construction office.
5. If complaints arise regarding noise, the complaint will be directed to the 'responsible person', who will determine the source of the noise, and take immediate steps to investigate further or mitigate the noise as required. This may involve moving the noise source further away from affected premises, replacing the equipment, installing high performance silencers, or in some cases, engaging a qualified acoustic consultant to provide specialist control advice.
6. The Responsible Person should notify the adjacent residential premises of the intention to commence work that may cause adverse impacts on surrounding residents. If plant is to be operated in close proximity to residential premises, the Responsible Person should advise the occupants of the premises the length of time that the plant will be in operation proximate to the property boundary.
7. Any moveable plant (e.g. compressors) should be located as far as practical from the residential premises.

8. The Responsible Person maintain a record of complaints, which records the following details (refer to the example complaint record sheet in the appendix to this plan):
   - The time and date of lodgement of the complaint;
   - The name and telephone number of the complainant;
   - The nature of the complaint, including a description of the noise (e.g. likely noise source, duration of the noise event - is the noise continuous, or of a short duration);
   - The outcome of the investigation.
9. If a complaint is raised regarding a particular piece of plant, the plant shall be inspected for working condition, with particular attention given to the condition of engine covers or enclosures, and exhaust system. If machinery is in good condition, a high performance silencer should be installed.

The noise management plan is described in more detail in the Appendices.

12.2.1 Construction noise monitoring

If required, short-term operator-attended noise measurements will be suitable for investigating 'spot-checks' of noise complaints in most situations. The methodology must establish the difference between the ambient noise level and the noise source being investigated and check for compliance. For ongoing noise complaints, we recommend long tern noise monitoring at the nearest receiver locations with fortnightly reporting.

12.2.2 Equipment

Spot Checks - Sound level meters must have accuracy at least equivalent to a Type 1 meter, as described in Australian Standard AS1259. The sound level meter must be fitted with a windshield and must have a current laboratory calibration certificate or label in accordance with calibration requirements outlined in AS1259 and AS2659. Equipment should also be calibrated in the field in accordance with these standards.

Long term noise monitoring – Environment nosie logger must have accuracy at least equivalent to a Type 1 meter. The noise monitor must be fitted with a windshield and must have a current laboratory calibration certificate or label in accordance with calibration requirements outlined in AS1259 and AS2659. Equipment should also be calibrated in the field in accordance with these standards.

The sound level meter or noise monitor must be capable of L_{eq} measurement and statistical L_n measurement (e.g. L_{10}, L_{90} etc), using the broadband 'A' scale frequency weighting.

12.2.3 Parameters

For measurement of ambient noise (without site noise), the sound level meter must be set to the following parameters;

- 15 minute measurement duration.
- 'Fast' time response.
- 'A' frequency weighting.
- Broadband spectrum (when available on a sound meter).

The measured descriptors of ambient noise are background noise $L_{A90,15min}$ and $L_{Aeq,15min}$.

For measurement of noise from construction activities at the site, the sound level meter must be set to the following parameters;

- 'Fast' time response.
- 'A' frequency weighting.
- Broadband spectrum (when available on a sound meter).

The measured descriptors of site noise should include (when available on a sound meter); L_{A90}, L_{Aeq}, L_{A10}, L_{A1}, L_{pA}.

Measurement duration may change depending on the duration of each relevant source.

12.3 Procedure for measuring noise

12.3.1 Where to measure noise

Noise should be measured at the affected receiver locations. Typically this would be an outdoor location in the most exposed position in a receivers' yard. The address of locations for assessment should be those locations where complaints have been received.

The sound level meter should be held at arm's length or set up on a tripod so the microphone is 1.2 to 1.5 metres above the ground. Where possible the measurement position should be 3 to 5 metres from walls, buildings and other reflecting surfaces which is also required for unattended noise monitoring.

12.3.4 What to avoid

The following conditions shall be avoided during the noise assessment;

- Average wind speed (at the microphone height) greater than 5m/s (approximately 20km/h). Typically at a wind speed of 5 m/s, leaves and branches would be in constant motion and the wind would extend a small flag.
- Rain periods (if intermittent, any affected data can be excluded).
- Other extraneous noise, such as noisy vehicle passby etc.
- Noise such as talking or physically bumping the sound level meter in a manner that will affect the readings.

12.3.5 Steps for measurement

The steps for performing a noise measurement are as follows;

10. Calibrate the sound level meter before commencing noise measurements. The sound pressure level shown on the meter should match the stated sound pressure level for the calibrator being used. The equipment should not vary by more than 1 dB. If it has then the measurements may be invalid.
11. Ensure the meter is set to 'Fast' time weighting and 'A' frequency weighting. Descriptors include L_{A90}, L_{Aeq}, L_{A10}, L_{A1}, LpA.
12. Measure the ambient noise level continuously for 15 minutes (where possible), excluding all distinct extraneous noises. If extraneous noise is present, pause the meter when this occurs or choose another measuring time or restart the measurement at another location. If more than one valid noise measurement of the ambient noise for a location is obtained, use the lowest level as the ambient noise level. Note the $L_{A90,15min}$ value and other relevant values as described above. Where it is not possible to continuously measure over a 15-minute period, then note the duration of the measurement.
13. Measure the noise emanating from the site, excluding all distinct extraneous noises. Note the duration of the measurement. Note the relevant measured values and description of the types of noise that were audible/measurable from the site.
14. Note whether the measured noise appears to contain tonal or impulsive characteristics and apply correction factors where appropriate.
15. Check the field calibration at the end of the monitoring period in accordance with Australian Standard IEC 61672.1-2004 and Australian Standard 2659. Re-monitoring may be required where there is a calibration drift greater than that allowed by the standards.

12.3.6 Information to be reported

Any reporting should be concise. The minimum requirements to be included in a report are;

- Date of measurements.
- Time of measurements.
- Person(s) performing measurements.
- Equipment used for measurements.
- Location of measurements.
- Measured values.

- Corrected values (where applicable).
- Notes regarding audibility of noise sources.
- Notes regarding any extraneous sources that may have influenced measurements.
- Detail of instrumentation and calibration.
- Meteorological conditions.

12.3.7 Vibration Control

As previously discussed, the neighbouring receivers to the south and north are predicted to comply with the vibration criteria.

If complaints are received from neighbouring residents regarding vibration during earthworks and basic infrastructure works, we recommend continued vibration monitoring at the receiver location with SMS warning system issued to the responsible persons onsite. The Responsible Person shall cease works that may be causing the vibration intrusion and engage a qualified person to determine suitable management and physical controls to reduce excessive vibration to compliant levels from demolition works. If excessive vibration is determined, works generating the vibration cannot resume until satisfactory mitigation treatment is implemented.

12.3.8 Contingency Management Plan

If monitoring, inspections and/or auditing indicate that mitigation measures are not effective, additional mitigation measures shall be implemented, with further unattended noise monitoring conducted at nearby receivers to confirm the effectiveness of the new mitigation measures.

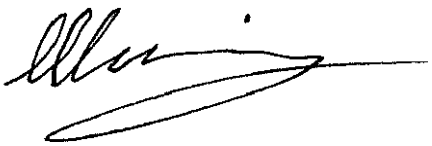
13. Conclusion

A noise assessment has been conducted for the proposed industrial/warehouse development at 600 Woodstock Avenue, Glendenning. Specific criteria have been referenced for construction noise and vibration as required by the development approval. A management strategy has been recommended that ensures attention to noise complaints and includes a system for achieving reasonable outcomes.

With respect to vibration, the processes to be used during works may impact the nearby residential receivers and should be continually monitored throughout the works as noted in section 10.3. The essence of the construction noise and vibration management plan is to ensure good communication between the site manager and the nearby residents, and to limit the operational hours of machinery activities in accordance with regulatory requirements.

If you should have any queries please do not hesitate to contact us.

Report Compiled by:



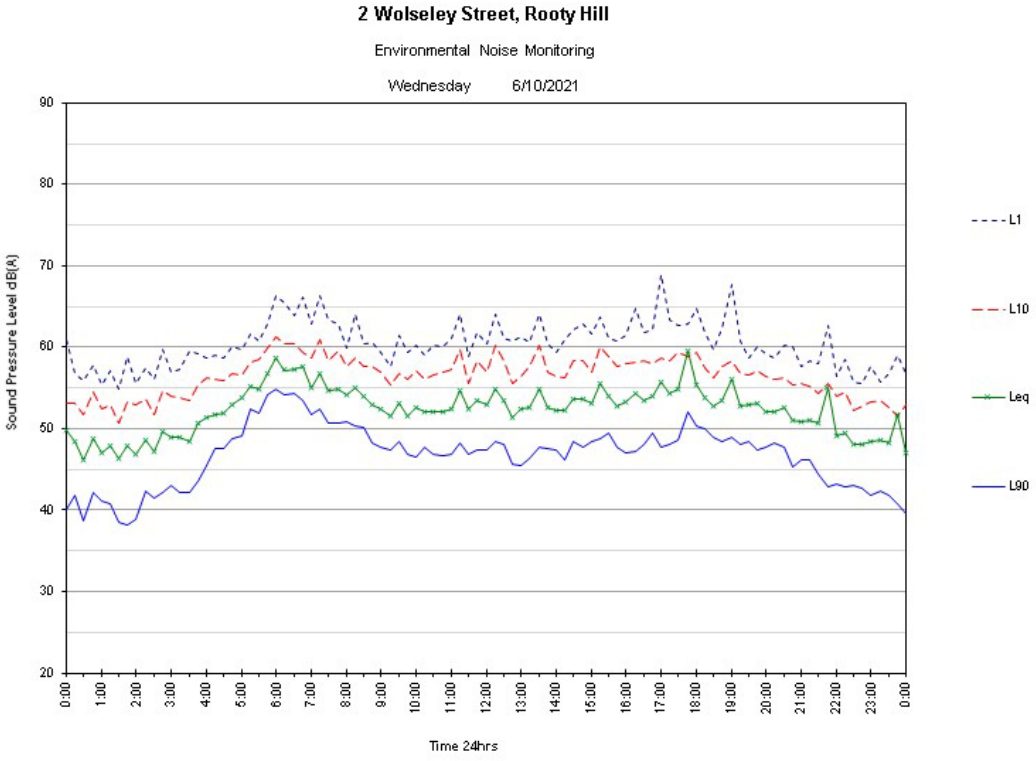
Michael Gunning M.ArchSci
Acoustic Consultant
acousticworks)))

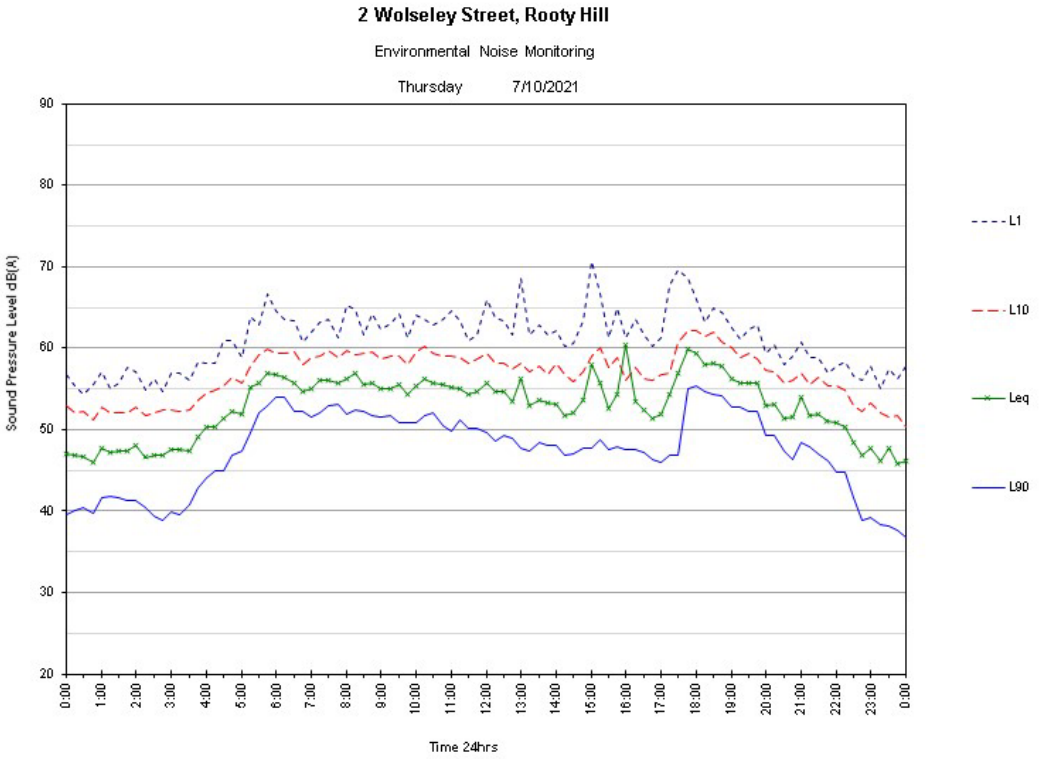
Report Reviewed by:

Greg Pearce B.Eng (Mech)
Director
acousticworks)))

14. Appendices

14.1 Noise Monitoring Charts

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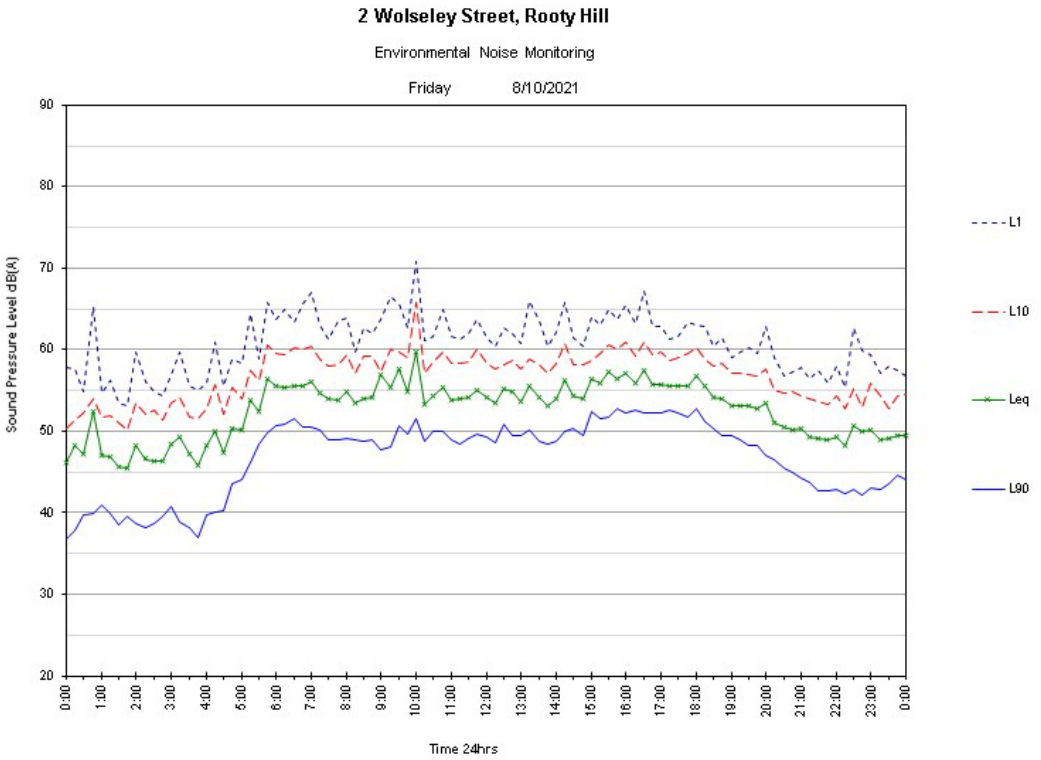
Environmental Noise Monitoring
Thursday 7/10/2021
Sound Pressure Level dB(A)
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time 24hrs
L1
L10
Leq
L90


2 Wolseley Street, Rooty Hill
Environmental Noise Monitoring
Friday 8/10/2021
Sound Pressure Level dB(A)
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
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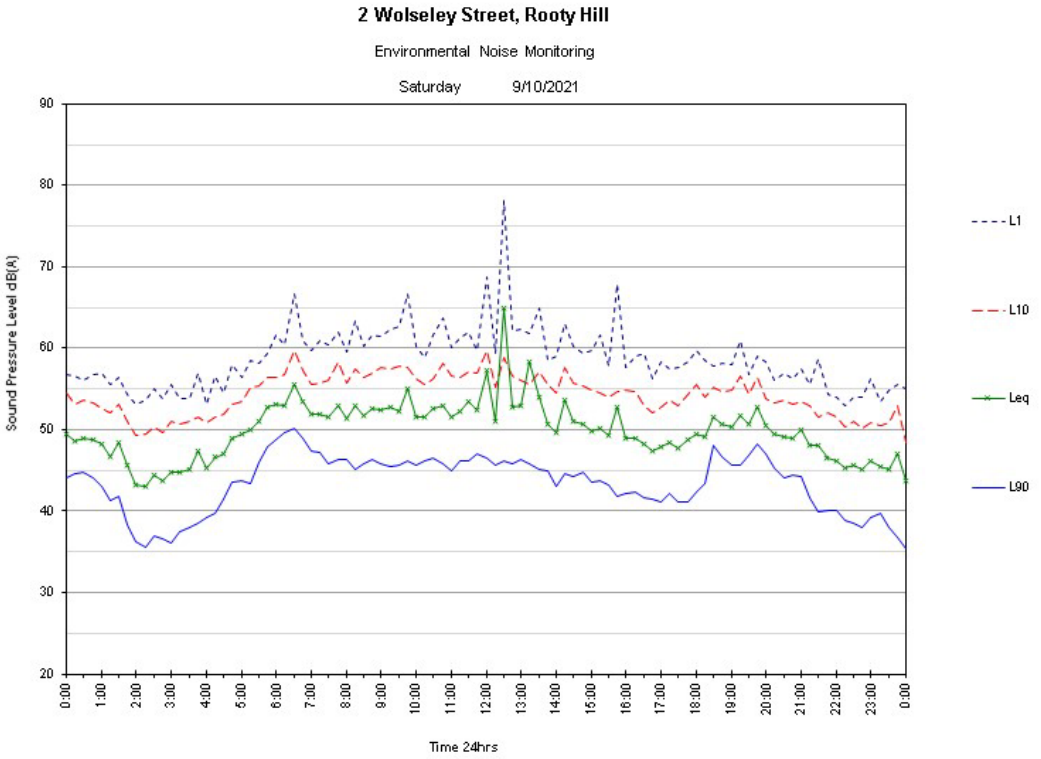
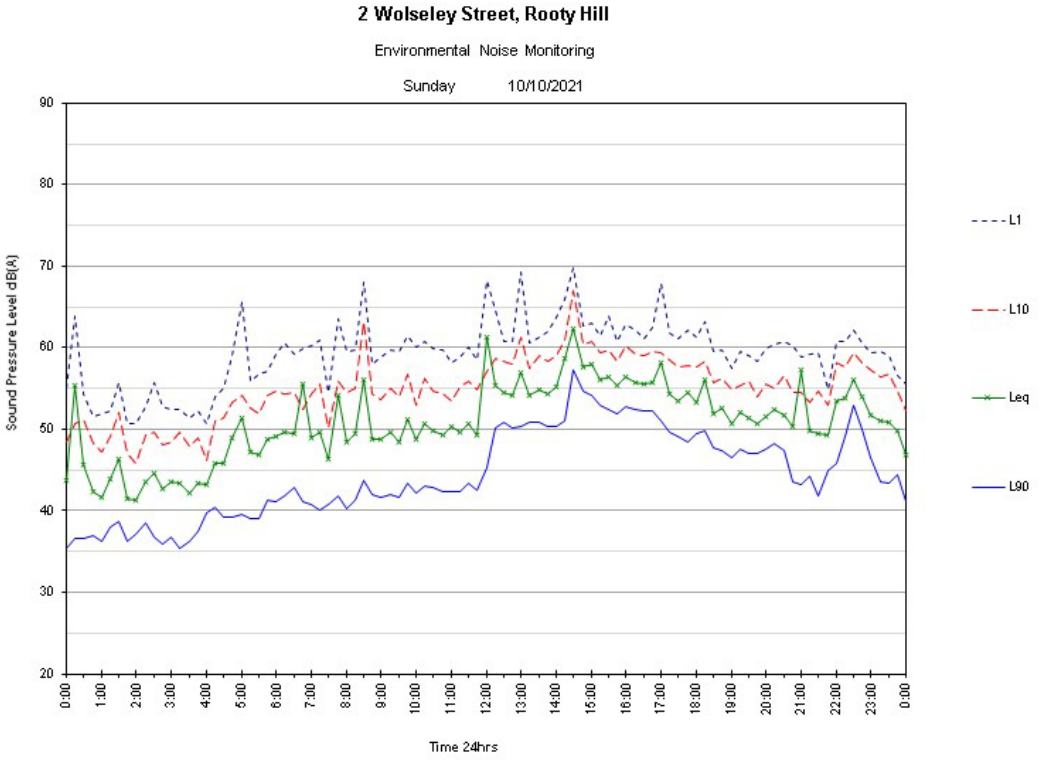
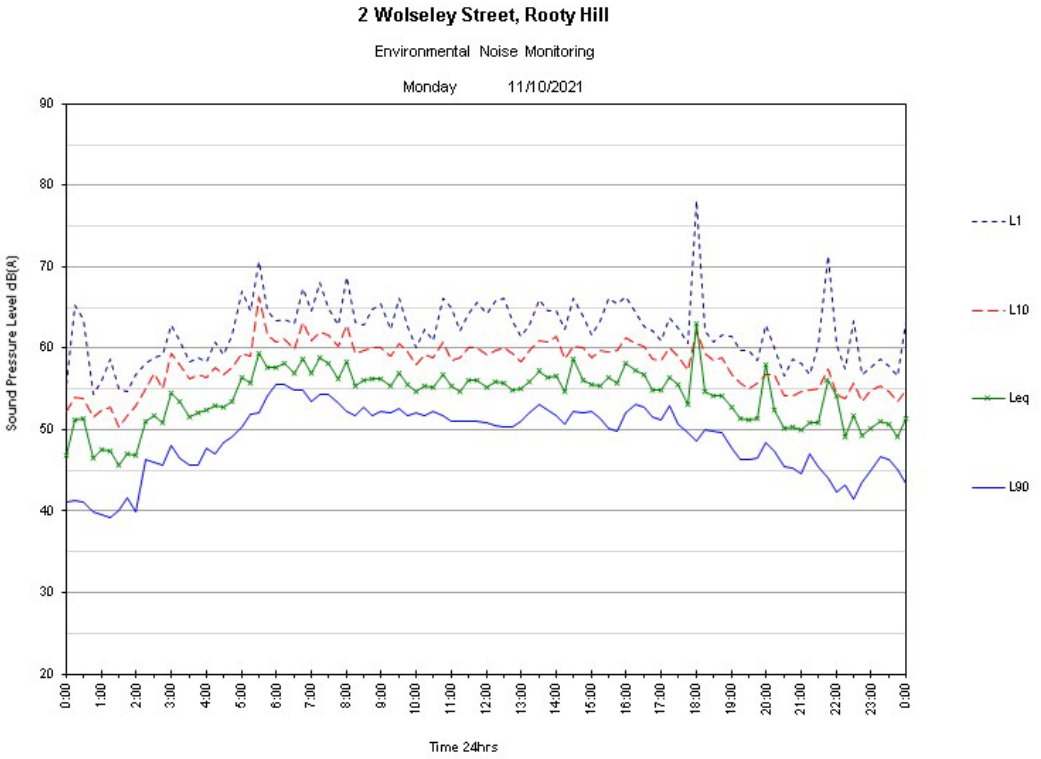
21:00
22:00
23:00
0:00
Time 24hrs
L1
L10
Leq
L90


2 Wolseley Street, Rooty Hill
Environmental Noise Monitoring
Saturday 9/10/2021
Sound Pressure Level dB(A)
Time 24hrs
L1
L10
Leq
L90


2 Wolseley Street, Rooty Hill
Environmental Noise Monitoring
Sunday 10/10/2021
Sound Pressure Level dB(A)
Time 24hrs
L1
L10
Leq
L90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Environmental Noise Monitoring
Monday 11/10/2021
Sound Pressure Level dB(A)
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
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13:00
14:00
15:00
16:00
17:00
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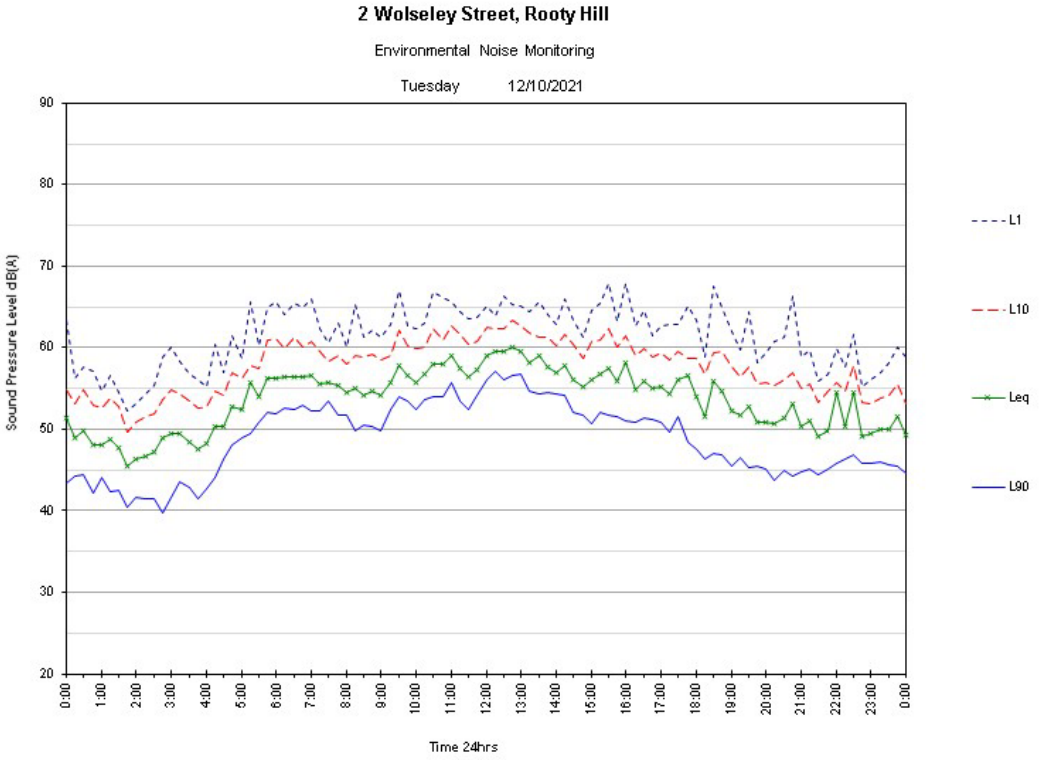
20:00
21:00
22:00
23:00
0:00
Time 24hrs
L1
L10
Leq
L90


2 Wolseley Street, Rooty Hill
Environmental Noise Monitoring
Tuesday 12/10/2021
Sound Pressure Level dB(A)
90
80
70
60
50
40
30
20
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1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time 24hrs
L1
L10
Leq
L90


2 Wolseley Street, Rooty Hill
Environmental Noise Monitoring
Wednesday 13/10/2021
Sound Pressure Level dB(A)
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time 24hrs
L1
L10
Leq
L90

14.2 Noise Management Plan

The overall aim of the noise management plan is to provide a program of actions and practices to minimise potential noise annoyance associated with onsite activities impacting adjacent properties.

Unattended noise monitoring is recommended at receivers 1, 2, 3 & 5 for a period of 2 weeks during construction to determine the effectiveness of the implemented mitigation measures. If noise levels are below the "Noise Affected" criteria and no complaints are received, no further monitoring is required. If noise levels are above the criteria, additional mitigation measures shall be implemented, with their effectiveness to be confirmed by further unattended noise monitoring at the receivers where exceedances were measured.

Site management are to elect a "Responsible Person" who is responsible for implementation of the Noise Management Plan to ensure the aims and objectives are achieved. The "Responsible Person" should ensure actions are being carried out by management, staff and subcontractors and that it is reviewed at appropriate times.

Where possible, performance indicators should be used to ensure noise annoyance from onsite activities is minimised. The most apparent performance indicator is the number of complaints made with regards to noise annoyance. Complaints shall be handled in accordance with the Community Consultation Strategy (CCS) and Construction Environmental Management Plan (CEMP).

The effectiveness and time taken to act and remediate noise issues, if complaints are made, is also considered a performance indicator for the site.

The various elements, aims and actions of the noise management plan are as follows;

14.2.1 All activities

Element	Operation of site works
Aim	To limit the times of potentially noisy onsite activities
Action	Allowed hours as follows: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays Workers or delivery trucks do not congregate outside the site before 6.45am.

14.2.2 Implementation of Management Plan

Element	Responsible Person
Aim	Provide a personnel contact for the Noise Management Plan
Action	The head contractor is to elect a "Responsible Person" who is onsite during construction hours and who has sufficient time and authority to implement the management plan. The Responsible Person is to keep record of performance indicators and feedback from management, staff, subcontractors and adjacent noise receivers as appropriate. The person would also be responsible for documenting changes/modifications to the Noise Management Plan.

14.2.3 Active Involvement

Element	Responsible Person
Aim	All management, staff and sub-contractors actively support and implement the noise management plan.
Action	The management, staff and Responsible Person should show active support and implementation for the management plan so that all are aware of the importance of the plan. Notify staff and subcontractors of the importance of the management plan. Actions and practices of the management plan, where relevant, should also be placed in appropriate locations. Responsible Person to implement notification new staff or subcontractors with respect to the Noise Management Plan.

14.2.4 Deliveries

Element	Deliveries
Aim	Minimise noise impacts from vehicle activities delivering to the site.
Action	Deliveries only between; Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No deliveries on Sundays or public holidays Delivery trucks do not congregate outside the site before 6.45am.

14.2.5 Onsite Mechanical Plant

Element	New equipment
Aim	Ensure new onsite equipment does not cause annoyance to noise sensitive receivers.
Action	All fixed onsite mechanical plant (e.g. air conditioning for site sheds) must be designed and installed to satisfy noise requirements.

14.2.6 Complaints

Element	Response to complaints
Aim	Provide a friendly and immediate response to complaints.
Action	Refer to the Community Consultation Strategy for complaint handling.

14.2.7 Review

Element	Schedule for the Review Process
Aim	To review the incidents/ complaints register and to ensure the Noise Management Plan remains relevant to the operations/activities of the site.
Action	Management is to review the incident/complaints register on a regular basis (at least fortnightly) to determine any common or recurring issues to be addressed. The plan should be reviewed if processes or activities onsite are change/modified or new activities are introduced. The plan should also be reviewed if noise complaints are being made with regards to a single activity or type of noisy activity occurring onsite. Document all changes/modifications to the Noise Management Plan.

14.3 Noise monitoring

Initial unattended noise monitoring shall be conducted over a period of two weeks at receivers 1, 2, 3 & 5 to determine the effectiveness of mitigation measures. If levels are found to be below the "Noise Affected" level and no complaints are received, no further monitoring is required. If levels are found to be above the "Noise Affected" level, additional mitigation measures shall be implemented, with their effectiveness to be confirmed by further unattended noise monitoring at the receivers where exceedances were measured.

14.3.1 Equipment

Sound level meters must have an accuracy at least equivalent to a Type 1 meter as described in Australian Standard AS1259. The sound level meter must be fitted with a windshield and must have a current laboratory calibration certificate or label in accordance with calibration requirements outlined in AS1259 and AS2659. Equipment should also be calibrated in the field in accordance with these standards.

The sound level meter must be capable of L_{eq} measurement and statistical L_n measurement (e.g. L_{10}, L_{90} etc), using the broadband 'A' scale frequency weighting.

14.3.2 Parameters

For measurement of ambient noise (without site noise), the sound level meter must be set to the following parameters;

- 15 minute measurement duration.
- Broadband
- 'Fast' time response.
- 'A' frequency weighting.

The measured descriptors of ambient noise are background noise $L_{A90,15min}$ and $L_{Aeq,15min}$.

For measurement of noise from construction activities at the site, the sound level meter must be set to the following parameters;

- 15 minute measurement duration.
- 'Z' (Linear) frequency weighting for 1/3 octave frequency spectrum.
- 'A' frequency weighting for overall broadband result.
- 'Fast' time response.

The measured descriptors of site noise should include (when available on a sound meter); L_{eq}, Lp, and 1/3 octave spectrum (to establish any tonal characteristics).

Measurement duration may change depending on the duration of each relevant source.

14.3.3 Procedure for measuring noise

14.3.3.1 Where to measure noise

In accordance with the code, noise levels should be measured at the property boundary that is most exposed to construction noise, at a height of 1.5 m 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. Typically this would be an outdoor location in the most exposed position in a receivers' yard. The address of locations for assessment should be those locations where complaints have been received.

The sound level meter should be held at arm's length or set up on a tripod so the microphone is 1.5 metres above the ground. Where possible the measurement position should be 3 to 5 metres from walls, buildings and other reflecting surfaces.

The location of vegetation also needs to be considered, because noise levels can be increased locally by even a light breeze rustling leaves. Noise due to wind in vegetation can make accurate measurement difficult. Where possible, move away from nearby plants if rustling noise is present.

14.3.3.2 When to measure ambient noise

Ambient noise should be measured when it is representative of minimum levels that would occur during the time the activity would typically be conducted. Suitable times may include;

- Prior to commencement of daily activities.
- During smoko or lunchbreak (if site activities are ceased).
- On RDO's (rostered days off).
- After completion of daily activities.

Ideally, a number of ambient noise measurements should be taken at various times of day. Ambient noise measurement should only be done at times or locations unaffected by noise from the site.

14.3.3.3 When to measure noise from construction

Measurements of construction noise should be taken at the time(s) when the noise is representative of the current maximum level of noise emanating from the site, or at times when a complaint has been received.

14.3.3.4 What to avoid

The following conditions shall be avoided during the noise assessment;

- Average wind speed (at the microphone height) greater than 5m/s (approximately 20km/h). Typically at a wind speed of 5 m/s, leaves and branches would be in constant motion and the wind would extend a small flag.
- Rain periods (if intermittent, any affected data can be excluded).
- Other extraneous noise, such as train passby etc.
- Noise such as talking or physically bumping the sound level meter in a manner that will affect the readings.

14.3.3.5 Steps for measurement

The steps for performing a noise measurement are as follows;

1. Calibrate the sound level meter before commencing noise measurements. The sound pressure level shown on the meter should match the stated sound pressure level for the calibrator being used. The equipment should not vary by more than 1 dB. If it has then the measurements may be invalid.
2. Ensure the meter is set to 'Fast' time weighting, 'A' frequency weighting for broadband measurement, 'Z' weighting for 1/3 octave measurement. Descriptors include L_{90}, L_{eq}, and LpA.
3. Measure the ambient noise level continuously for 15 minutes (where possible), excluding all distinct extraneous noises. If extraneous noise is present, pause the meter when this occurs or choose another measuring time or restart the measurement at another location. If more than one valid noise measurement of the ambient noise for a location is obtained, use the lowest level as the ambient noise level. Note the $L_{A90,15min}$ value and other relevant values as described above. Where it is not possible to continuously measure over a 15-minute period, then note the duration of the measurement.
4. Measure the noise emanating from the site, excluding all distinct extraneous noises. Note the duration of the measurement. Note the relevant measured values and description of the types of noise that were audible/measurable from the site.
5. Note whether the measured noise appears to contain tonal or impulsive characteristics and apply correction factors where appropriate.
6. Check the field calibration at the end of the monitoring period in accordance with Australian Standard IEC 61672.1-2004 and Australian Standard 2659. Re-monitoring may be required where there is a calibration drift greater than that allowed by the standards.

14.3.3.6 Information to be reported

Any reporting should be concise. The minimum requirements to be included in a report are;

- Date of measurements.
- Time of measurements.
- Person(s) performing measurements.
- Equipment used for measurements.
- Location of measurements.
- Measured values.
- Corrected values (where applicable).
- Notes regarding audibility of noise sources.
- Notes regarding any extraneous sources that may have influenced measurements.
- Detail of instrumentation and calibration.
- Meteorological conditions.

14.4 Construction vibration monitoring

The preferred measurement technique is one which records unfiltered data from which any desired values can later be determined, including frequency-weighted RMS and peak values.

Vibration monitoring equipment should be calibrated in accordance with relevant Australian or standards.

Vibration should be measured on a structural surface designed to support a person, with the floor or ground as the preferred reference surface. The z-axis (vertical) shall be measured. Ideally more than two points in a receiver location should be measured at one time to obtain space average vibration levels. If the above is not practicable, one position of the receiver location is chosen where, in the opinion of an authorised officer, the vibration level is the greatest. The locations should be either clearly marked or clearly defined on a diagram for later identification. The transducer should not be attached to a flexible floor covering which may damp the vibration. The transducer shall be firmly fixed in the position, and the method of fixing shall be reported.

Items to be reported include;

- Date and time of measurement.
- Location of measurements (including diagram of measurement positions).
- Equipment used for measurements (including calibration details).
- Method of fixing of transducer.
- Description of the type of equipment or source of vibration (where possible).
- One-third octave band frequency analysis (1Hz to 80Hz) reported as z-axis r.m.s acceleration in units of ms^{-2}. For each measurement this should include starting and ending time and brief description of events occurring within the measurement time frame.
- Overall broadband peak particle velocity (ppv) reported as z-axis velocity in units of ms^{-1}. For each measurement this should include starting and ending time and brief description of events occurring within the measurement time frame.
- The results of the one-third octave band analysis and peak particle velocity analysis should be compared with the vibration limits.
- Statement of whether the vibration complies with the recommended limits.