



Construction Noise and Vibration Management Plan
884-928 Mamre Road
Kemps Creek

NOISE MANAGEMENT PLAN



Client:

Altis Property Partners
Attn: Anthony Murr

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1. Introduction

This report is in response to a request by Altis Property Partners for a construction noise and vibration management plan for the proposed infrastructure works located at 884-928 Mamre Road, Kemps Creek. This report provides a noise management plan and recommendations for noise control during earthworks and construction of the proposed development as required by the NSW Department of Planning, Industry & Environment.

The construction noise and vibration management plan was prepared 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-17647189*) which requires the following matters to be addressed:

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 including:

§ the identification of impacts associated with construction works, operational emission, and traffic generation at noise affected sensitive receivers, including the provision of operation noise contours and a detailed sleep disturbance assessment;

§ details of noise monitoring surveys, 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 nearby existing and future developments;

§ details and analysis of the effectiveness of the 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.

Table 1 provides a summary of the SEARs requirements and the locations within this report that they are addressed:

Table 1: SSD-17647189 SEARS requirements

Condition	Section References
§ the identification of impacts associated with construction works, operational emission, and traffic generation at noise affected sensitive receivers, including the provision of operation noise contours and a detailed sleep disturbance assessment;	Construction noise assessed in Sections 7-8. Operational noise assessed in a separate report (ref: <i>1020168 R01M 884-928 Mamre Road Kemps Creek ENV.docx</i>)
§ details of noise monitoring surveys, background noise levels, noise source inventory and worst-case noise emission scenarios;	Provided in Sections 4-5
§ consideration of annoying characteristics of noise and prevailing meteorological conditions in the study area;	Sections 5,7 & 8
§ a cumulative impact assessment inclusive of impacts from other nearby existing and future developments;	Assessed in a separate report (ref: <i>1020168 R01M 884-928 Mamre Road Kemps Creek ENV.docx</i>)
§ details and analysis of the effectiveness of the 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.	Construction noise assessed in Sections 7-8. Operational noise assessed in a separate report (ref: <i>1020168 R01M 884-928 Mamre Road Kemps Creek ENV.docx</i>)

The assessment considers noise and vibration impacts for all construction stages of the proposed development.

2. Site Description

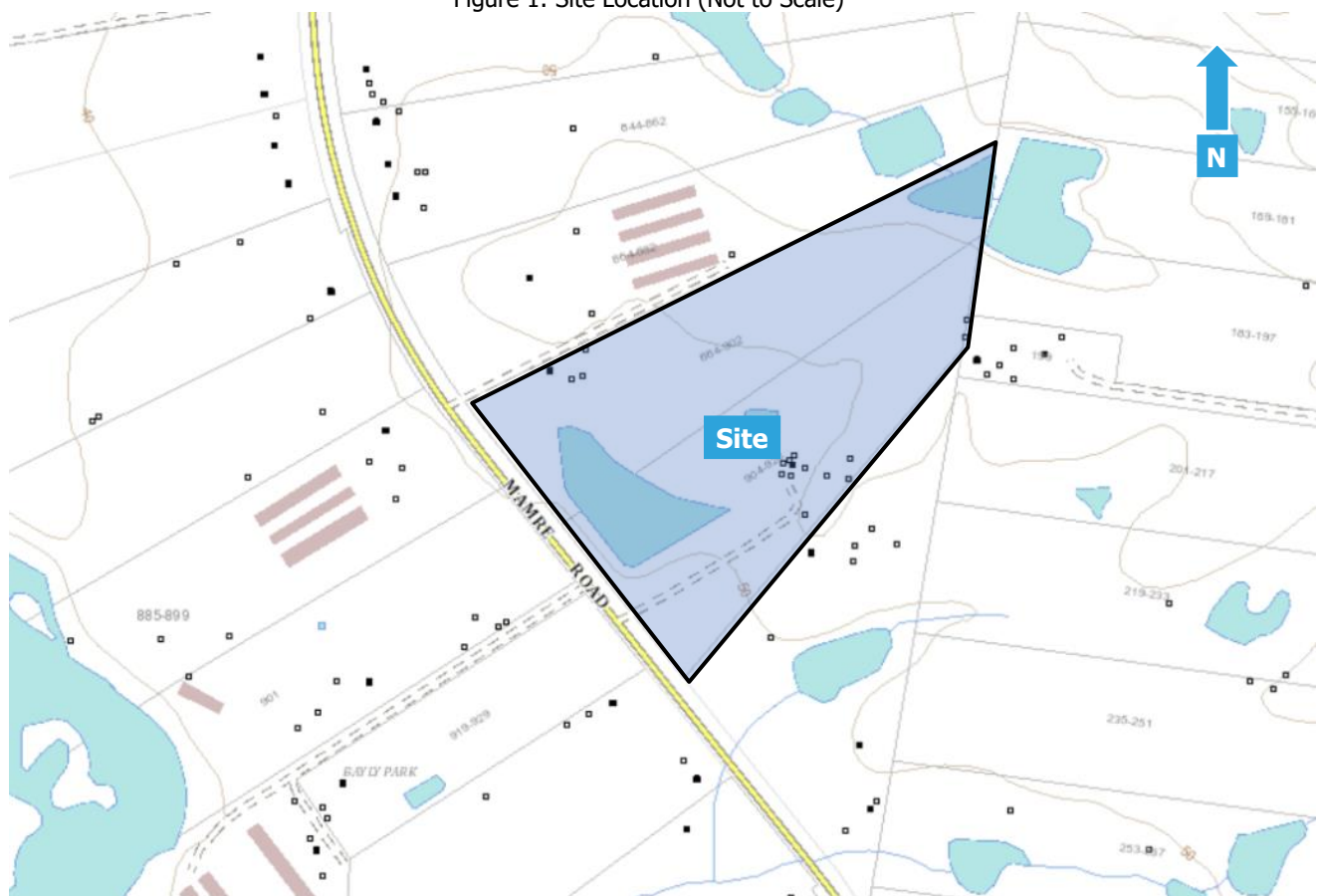
2.1 Site Location

The site is described by the following:

884-928 Mamre Road, Kemps Creek
Lots 52 & 53 on DP259135

Refer to Figure 1 for site location.

Figure 1: Site Location (Not to Scale)



A comprehensive site survey was conducted on the 30th September 2020 which identified the following:

- The site is currently located in IN1 – General Industrial as defined in the State Environmental Planning policy (Western Sydney Employment Area) 2009.
- Residential dwellings currently occupy the site and will be demolished to make way for the development.
- Mamre Road separates the site from residential dwellings and home industries.
- Residential dwellings are located north, east and south of the site.

2.2 Proposal

The proposal is the construction of an industrial warehousing estate with associated infrastructure. The earthworks are expected to consist of the following machinery;

- Excavators
- Backhoe Loaders
- Bulldozers
- Skid Steer Loaders
- Motor Graders
- Waste removal trucks

The construction works are expected to consist of the following;

- Concrete trucks
- Compressor
- Forklifts
- Waste removal
- Power tools

The expected hours of the works are 7am to 6pm Mondays to Fridays and 8am to 1pm Saturdays with no work on Sundays or public holidays.

2.3 Acoustic Environment

The surrounding area is primarily affected by road traffic from Mamre Road.

3. 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 2: 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.

3.1 Assessing Vibration: A Technical Guideline 2006

3.1.1 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.

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

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

Table 3: 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

3.1.3 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 4: 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

3.1.4 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.

3.2 NSW Interim Construction Noise Guideline 2009

3.2.1 Hours for construction work

The recommended standard hours for construction work are shown below in Table 5, 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 5: 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.

3.2.2 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.

3.2.2.1 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 6: Noise criteria for quantitative assessment - Residential

Time of day	Criterion LAeq(15min) *	How to apply
Recommended standard hours	Noise affected RBL + 10dB	<p>The noise affected level represents the point above which there may be some community reaction to noise.</p> <p>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.</p> <p>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.</p>
	Highly noise affected 75dBA	<p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <p>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:</p> <ol style="list-style-type: none"> 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	<p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>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.</p> <p>For guidance on negotiating agreements see section 7.2.2.</p>

* 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.

3.2.2.2 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 7: 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

3.2.2.3 Commercial and industrial properties

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

Table 8: 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.

3.2.3 Ground-borne noise

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

Table 9: 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.

3.3 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.

3.4 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.

3.5 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 10: 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

3.6 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 11: 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.

3.7 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 12 – 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

4. Noise Monitoring and Receivers

4.1 Receiver Locations

4.1.1 Receiver Locations

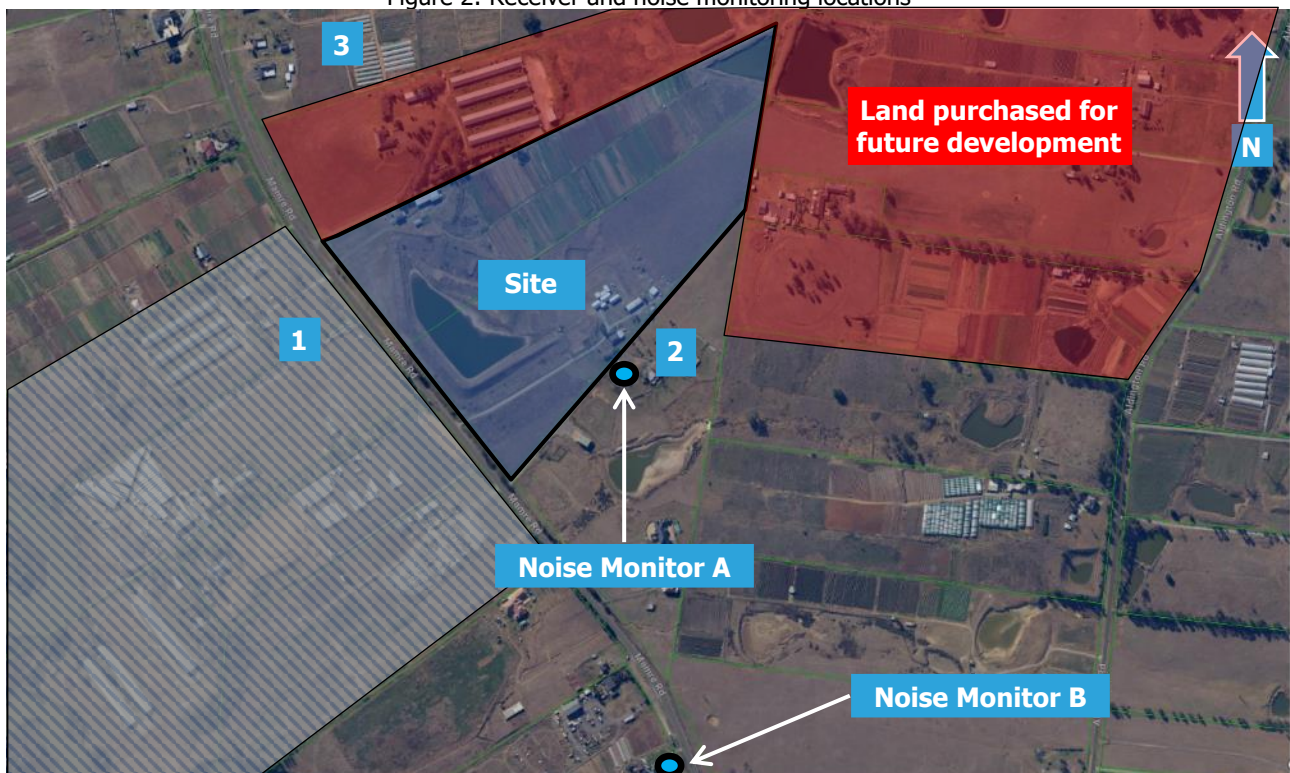
The nearest sensitive receiver locations were identified as follows;

1. Mamre Road separates the site from residential dwellings at 885-899, 901, 917, 919-929 and 931 Mamre Road.
2. A two storey residential dwelling is located adjacent the southern site boundary at 930-966 Mamre Road.
3. A single storey residential dwelling is located to the north of the site at 844-862 Mamre Road.

Land highlighted in red has been purchased for future industrial development with residences on these lots unoccupied, therefore these residences have not been assessed.

These locations were chosen as being representative of the nearest sensitive receivers to the proposed development. Refer to Figure 2 for these locations.

Figure 2: Receiver and noise monitoring locations



4.2 Equipment

The following equipment was used to record noise levels:

- Rion Environmental Noise Monitors (SN# 00175548 and 00171587)
- 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.

4.3 Unattended Noise Monitoring

Rion NL42 and Rion NL52 environmental noise monitors were placed at 930-966 Mamre Road (location A) and 1003 Mamre Road (location B) as shown in Figure 2 to measure existing ambient noise levels. These locations were selected as they were representative of the nearest sensitive residential receivers. The noise monitors were set to record noise levels between 20th to 28th of May 2019 (location A) and 20th to 27th of March 2020 (location B).

The noise monitors were set to "A" weighting, Fast response and 15 minute statistical intervals. The microphones were approximately 1.4 metres above ground level. Ambient noise monitoring was conducted generally in accordance with Australian Standard AS1055 '*Acoustics – Description & Measurement of Environmental Noise*'.

Weather conditions were fine for the majority of the monitoring period, with some periods of intermittent wind and rain.

5. Existing 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.

5.1 Meteorological conditions

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 13 below.

Table 13: Meteorological conditions – Badgerys Creek

Day	Date	Rainfall (mm)	Wind			
			9am		3pm	
			Speed (km/h)	Direction	Speed (km/h)	Direction
Monday	20/05/2019	0	4	ENE	11	N
Tuesday	21/05/2019	0.2	Calm	-	11	NNE
Wednesday	22/05/2019	0	4	NNE	17	E
Thursday	23/05/2019	0	4	SE	9	N
Friday	24/05/2019	0	4	E	9	NNE
Saturday	25/05/2019	0	4	N	7	NNE
Sunday	26/05/2019	0	9	NNW	15	WSW
Monday	27/05/2019	0	17	NNW	33	W
Tuesday	28/05/2019	0	11	W	13	WSW
Friday	20/03/2020	0	-	Calm	-	NW
Saturday	21/03/2020	0	6	S	22	ESE
Sunday	22/03/2020	0	-	Calm	17	BE
Monday	23/03/2020	0	11	SW	2	ESE
Tuesday	24/03/2020	0	6	SSE	11	ENE
Wednesday	25/03/2020	0	4	ENE	17	ESE
Thursday	26/03/2020	27.2	11	WSW	15	SE

5.2 Ambient background noise level

5.2.1 Receivers 2 & 3

The measured rating background noise levels (RBL) were determined in accordance with the NSW Noise Policy for Industry, with levels for the different monitoring locations presented in Table 2.

Table 14: Measured L90 noise levels (Monitor A)

Day	Date	Receivers 2 to 4 (Monitor A)		
		Background L90 dBA		
		Day	Evening	Night
Monday	20/05/2019	x	44.8	38.6
Tuesday	21/05/2019	40.3	44.4	40.4
Wednesday	22/05/2019	42.2	45.4	35.3
Thursday	23/05/2019	40.6	46.1	41.0
Friday	24/05/2019	40.8	46.5	39.9
Saturday	25/05/2019	39.6	42.3	32.8
Sunday	26/05/2019	41.7	40.6	36.8
Monday	27/05/2019	50.4	42.3	34.7
RBL		41	45	39

High wind speeds recorded on Monday 27th May 2019 were found to have affected the measured noise levels during the day time period, therefore the data was omitted from the results.

5.2.2 Receiver 1

The measured rating background noise levels (RBL) were determined in accordance with the NSW Noise Policy for Industry, with levels for the different monitoring locations presented in Table 2.

Table 15: Measured L90 noise levels (Monitor B)

Day	Date	Receiver 1 (Monitor B)		
		Background L90 dBA		
		Day	Evening	Night
Friday	20/03/2020	x	47.2	41.7
Saturday	21/03/2020	45.4	41.5	41.3
Sunday	22/03/2020	43.0	42.4	40.4
Monday	23/03/2020	48.3	46.2	39.8
Tuesday	24/03/2020	46.4	41.7	40.6
Wednesday	25/03/2020	48.3	49.8	43.2
Thursday	26/03/2020	49.8	49.6	39.8
RBL		48	48	40

Heavy rainfall recorded on Thursday 26th March 2020 was found to have affected the measured noise levels during the day time period, therefore the data was omitted from the results.

6. Project specific criteria

6.1 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
	Receiver 1	Receivers 2 to 3	
During standard construction hours	58dBA noise affected	51dBA noise affected	External
	75dBA highly noise affected	75dBA highly noise affected	External
Outside standard construction hours (daytime only)	53dBA	46dBA	External

6.2 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	-

7. Predicted Noise Levels

Predicted noise associated with the earthworks and construction of the proposed works 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.

The predicted noise impacts of earthworks are summarised as follows;

Table 18: Predicted earthworks noise impacts

Receiver	Receivers	Source Leq@1m 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	
	Description						Noise affected	Highly noise affected
1	1. 885-899, 901, 917, 919-929 & 931 Mamre Rd (W) 2. 930-966 Mamre Rd (S) 3. 844-862 Mamre Rd (N)							
	Criteria						58	75
	Excavator large	99		99	51	51	Yes	Yes
	Backhoe	96		96	48	48	Yes	Yes
	Bulldozer	100		100	55	55	Yes	Yes
	Grader	102		102	57	57	Yes	Yes
	Loader (wheeled)	97		97	46	46	Yes	Yes
	Compressor large (silenced)	85	2	87	42	42	Yes	Yes
	Truck passby	82		82	27	27	Yes	Yes
	Truck reverse alarm	92	5	97	42	42	Yes	Yes
	Total				60	60	No	Yes
	Criteria						51	75
	Excavator large	99		99	56	56	No	Yes
2	Backhoe	96		96	53	53	No	Yes
	Bulldozer	100		100	60	60	No	Yes
	Grader	102		102	62	62	No	Yes
	Loader (wheeled)	97		97	50	50	Yes	Yes
	Compressor large (silenced)	85	2	87	46	46	Yes	Yes
	Truck passby	82		82	33	33	Yes	Yes
	Truck reverse alarm	92	5	97	48	48	Yes	Yes
	Total				66	66	No	Yes
	Criteria						51	75
	Excavator large	99		99	46	46	Yes	Yes
	Backhoe	96		96	44	44	Yes	Yes
	Bulldozer	100		100	51	51	Yes	Yes
	Grader	102		102	52	52	No	Yes
3	Loader (wheeled)	97		97	41	41	Yes	Yes
	Compressor large (silenced)	85	2	87	37	37	Yes	Yes
	Truck passby	82		82	22	22	Yes	Yes
	Truck reverse alarm	92	5	97	37	37	Yes	Yes
	Total				56	56	No	Yes
	Criteria						51	75
	Excavator large	99		99	46	46	Yes	Yes
	Backhoe	96		96	44	44	Yes	Yes
	Bulldozer	100		100	51	51	Yes	Yes
	Grader	102		102	52	52	No	Yes
	Loader (wheeled)	97		97	41	41	Yes	Yes
	Compressor large (silenced)	85	2	87	37	37	Yes	Yes
	Truck passby	82		82	22	22	Yes	Yes
	Truck reverse alarm	92	5	97	37	37	Yes	Yes
	Total				56	56	No	Yes

Earthworks noise levels are predicted be above the noise affected level of 51dBA and 58dBA but are predicted to comply with the highly affected noise limit of 75dBA LAeq 15min at each of the receiver locations.

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

Table 19: Predicted construction noise impacts

Receiver	Description	Receivers					L _{Aeq} 15 min Compliance	
		Source Leq@1m dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	L _{Aeq} adj, T ext. dB(A) Noise affected	L _{Aeq} adj, T ext. dB(A) Highly noise affected	Noise affected	Highly noise affected
1	Criteria						58	75
	Concrete truck	95		95	50	50	Yes	Yes
	Concrete pump	94	2	96	51	51	Yes	Yes
	Power tools (electric)	83	2	85	40	40	Yes	Yes
	Compressor large (silenced)	85	2	87	42	42	Yes	Yes
	Truck passby	82		82	22	22	Yes	Yes
	Truck reverse alarm	92	5	97	37	37	Yes	Yes
	Forklift unloading	82	2	84	33	33	Yes	Yes
	Concrete pencil vibrator	95		95	50	50	Yes	Yes
	Saw (cutoff)	92		92	33	33	Yes	Yes
	Total				56	56	Yes	Yes
2	Criteria						51	75
	Concrete truck	95		95	57	57	No	Yes
	Concrete pump	94	2	96	58	58	No	Yes
	Power tools (electric)	83	2	85	47	47	Yes	Yes
	Compressor large (silenced)	85	2	87	49	49	Yes	Yes
	Truck passby	82		82	29	29	Yes	Yes
	Truck reverse alarm	92	5	97	44	44	Yes	Yes
	Forklift unloading	82	2	84	40	40	Yes	Yes
	Concrete pencil vibrator	95		95	57	57	No	Yes
	Saw (cutoff)	92		92	41	41	Yes	Yes
	Total				63	63	No	Yes
3	Criteria						51	75
	Concrete truck	95		95	44	44	Yes	Yes
	Concrete pump	94	2	96	46	46	Yes	Yes
	Power tools (electric)	83	2	85	35	35	Yes	Yes
	Compressor large (silenced)	85	2	87	37	37	Yes	Yes
	Truck passby	82		82	17	17	Yes	Yes
	Truck reverse alarm	92	5	97	32	32	Yes	Yes
	Forklift unloading	82	2	84	28	28	Yes	Yes
	Concrete pencil vibrator	95		95	45	45	Yes	Yes
	Saw (cutoff)	92		92	28	28	Yes	Yes
	Total				50	50	Yes	Yes

Construction noise levels are predicted be above the noise affected level of 51dBA but are predicted to comply with the highly affected noise limit of 75dBA L_{Aeq} 15min at each of the receiver locations.

8. Predicted Vibration Levels

The nearest existing residential buildings in the area are located adjacent the southern site boundary. This location contains a residential dwelling giving a recommended vibration limit of 10 mm/s.

The predicted earthworks impacts to the nearest residential receivers is predicted to be between 1 to 2 mm/s due to earthworks activities.

Due to proximity of neighbouring buildings, vibration levels in some cases may need to be monitored during earthworks depending on the ground substrate.

9. Recommended Acoustic Treatments & Management Principles

9.1 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 58dBA and 51dBA LAeq 15min. In particular, noise from graders, bulldozers, concrete trucks and pumps are calculated to have the highest potential impact to receiver locations. Therefore close liaising with nearby residences would be recommended, with additional attenuation and/or alternative methods if needed.

Due to proximity of neighbouring buildings, vibration levels may need to be continually monitored during earthworks to ensure vibration levels remain generally compliant with the criteria nominated 7.2.

9.2 Noise control

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

1. Recommended 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.

9.3 Vibration Control

As previously discussed, due to the proximity of the neighbouring receivers, vibration is predicted to be an issue if not managed.

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.

9.4 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.

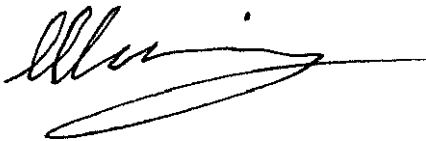
10. Conclusion

A noise assessment has been conducted for the proposed infrastructure works at 884-928 Mamre Road, Kemps Creek. Specific criteria have been referenced for construction noise and vibration as required by statutory requirements. 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 earthworks may impact nearby residents and may need to be continually monitored throughout the demolition period and basic construction works as noted in section 9.3. The essence of the construction noise 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

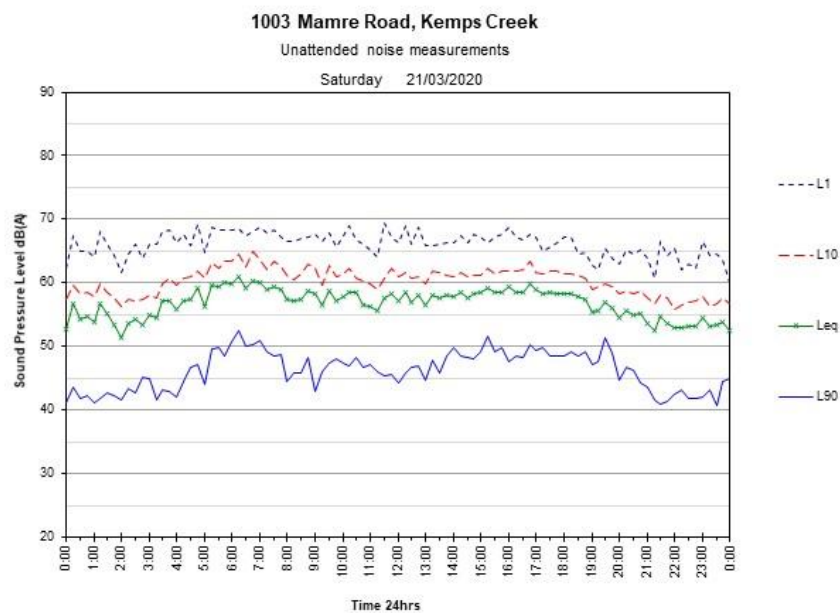
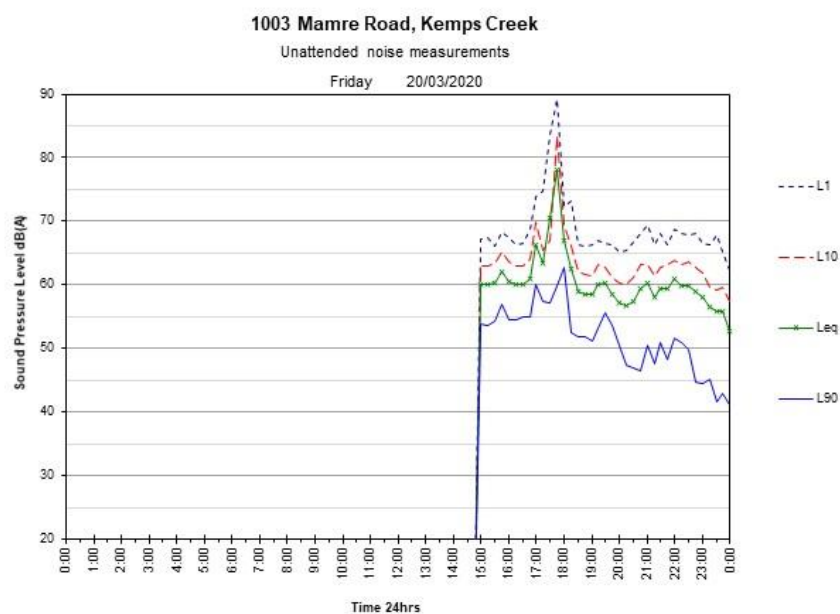
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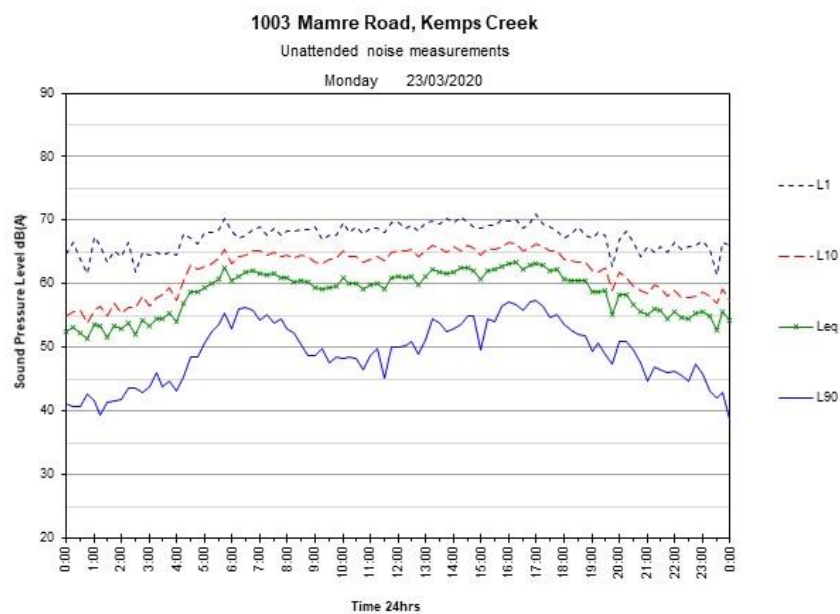
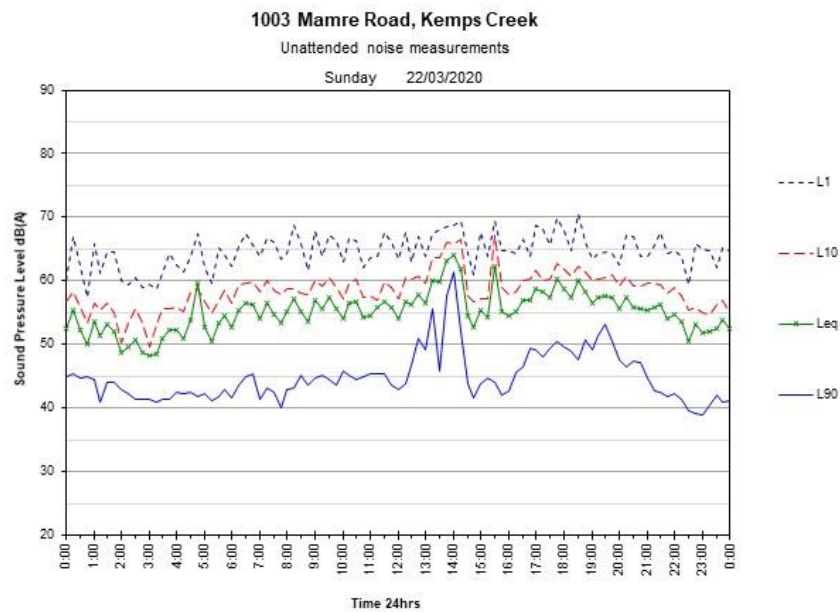
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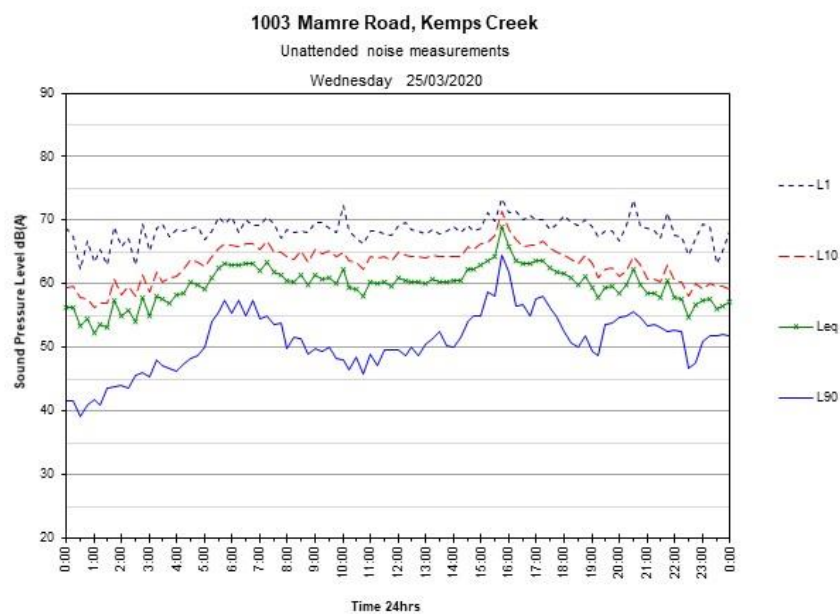
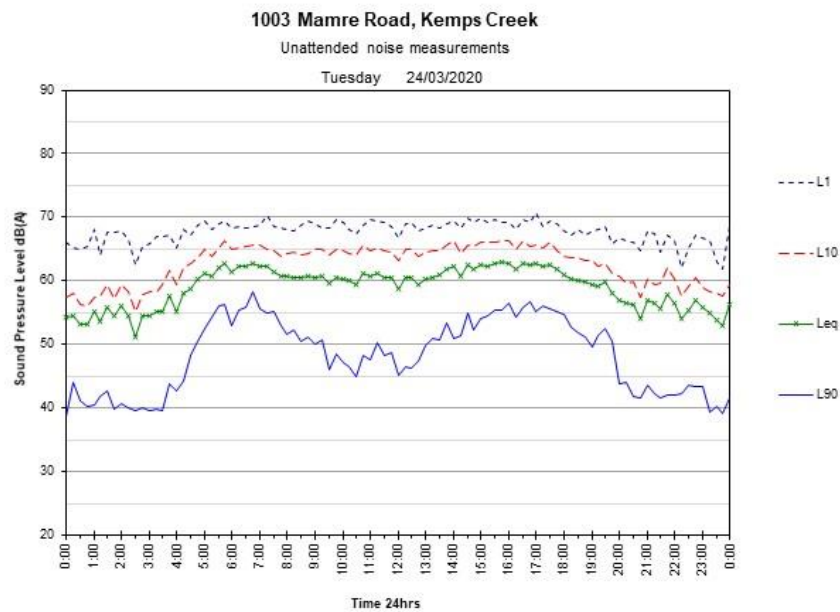
11. Appendices

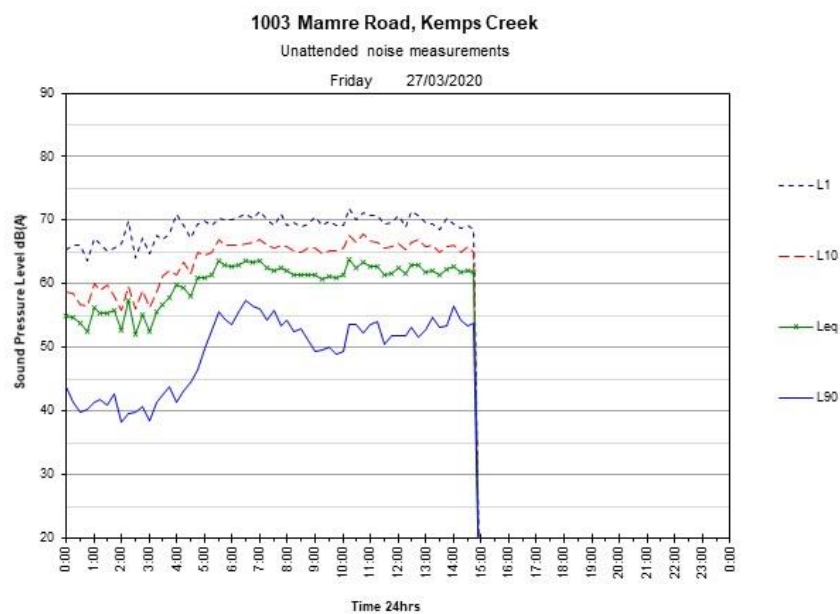
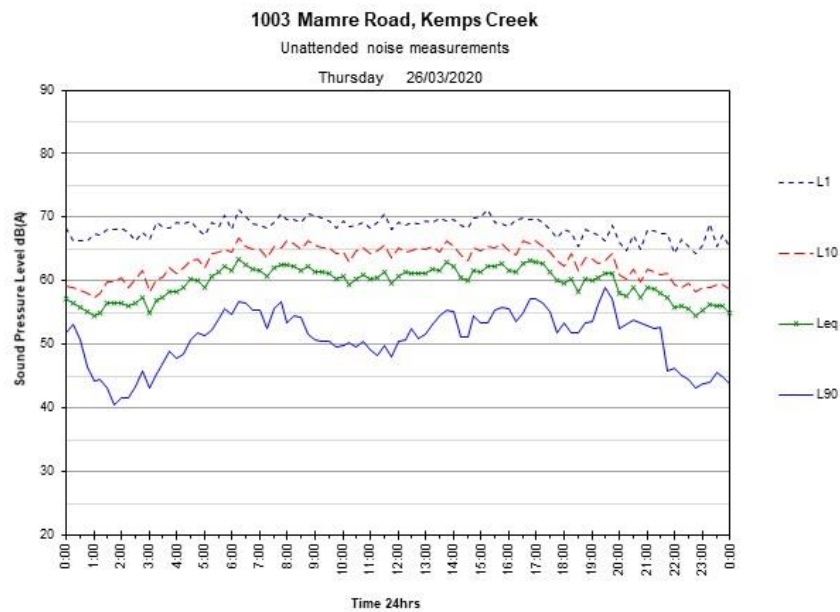
11.1 Noise monitoring charts

11.1.1 1003 Mamre Rd (Receiver 1)

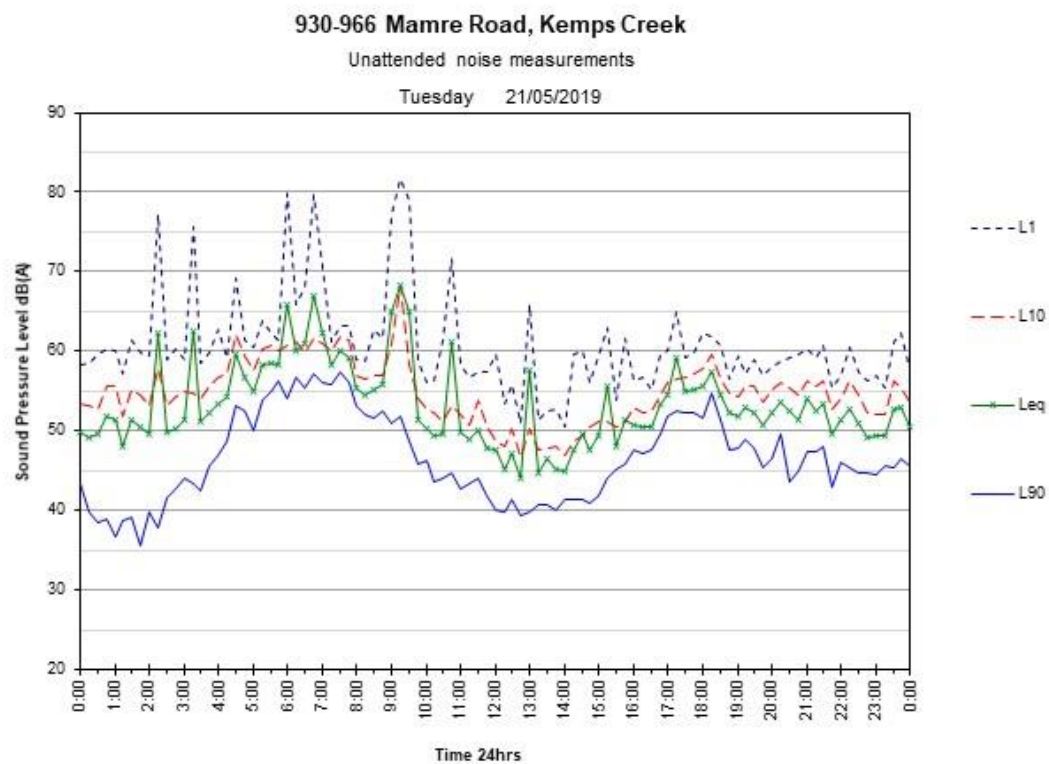
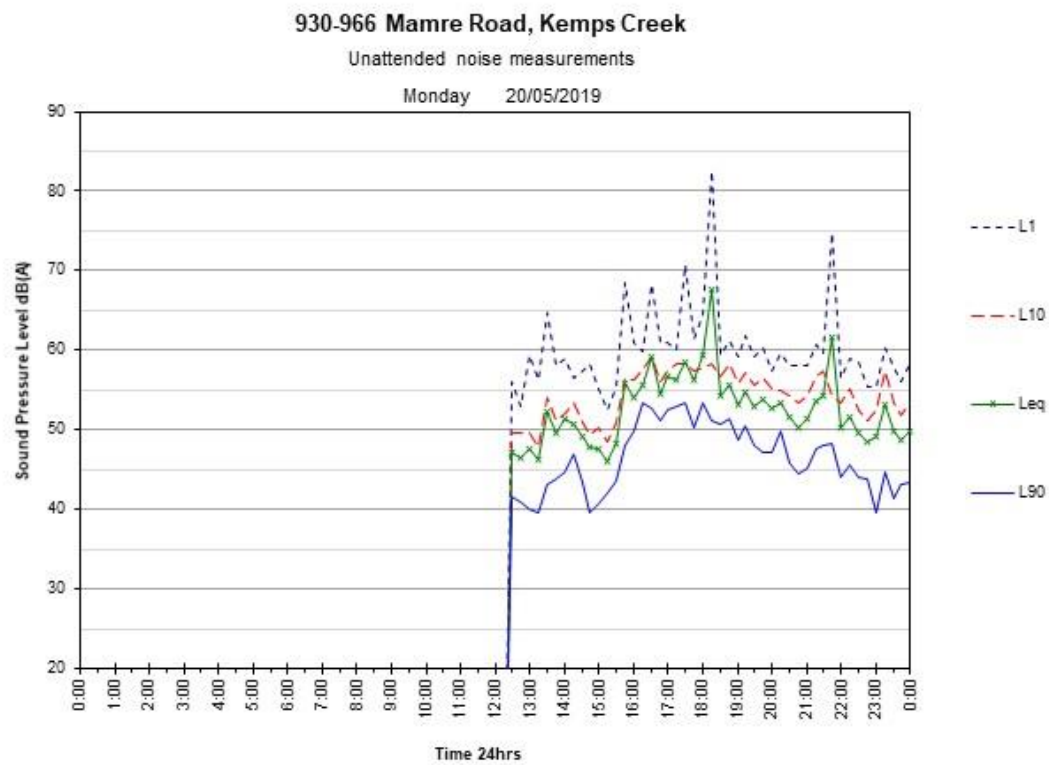


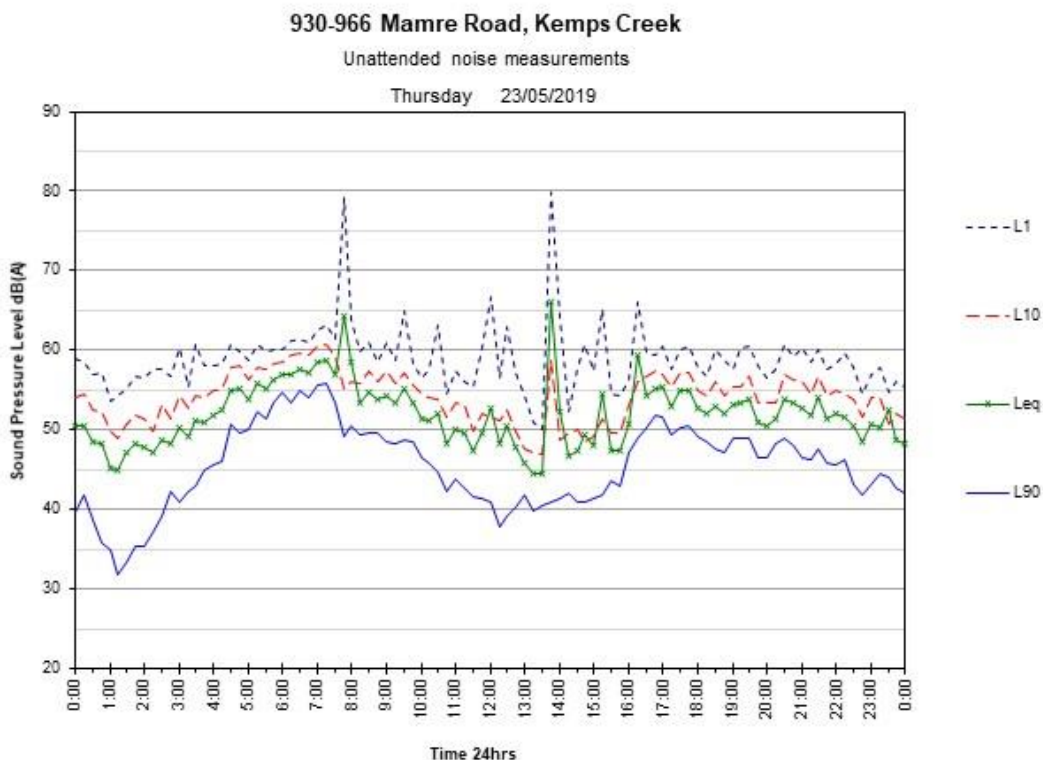
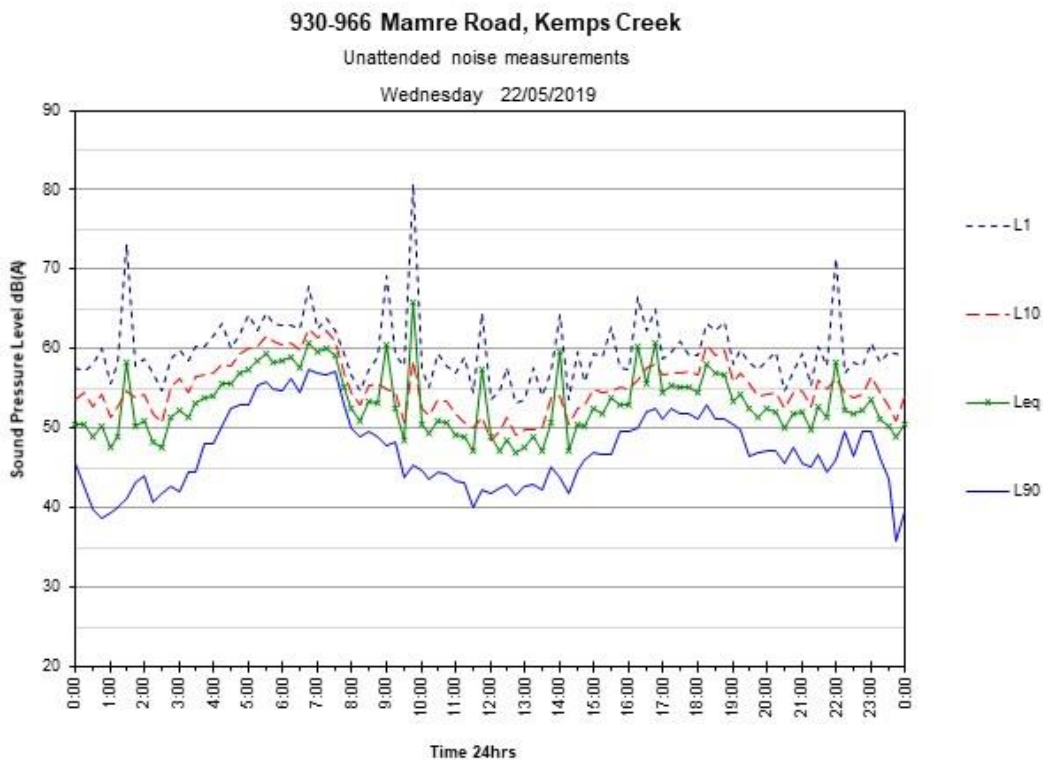


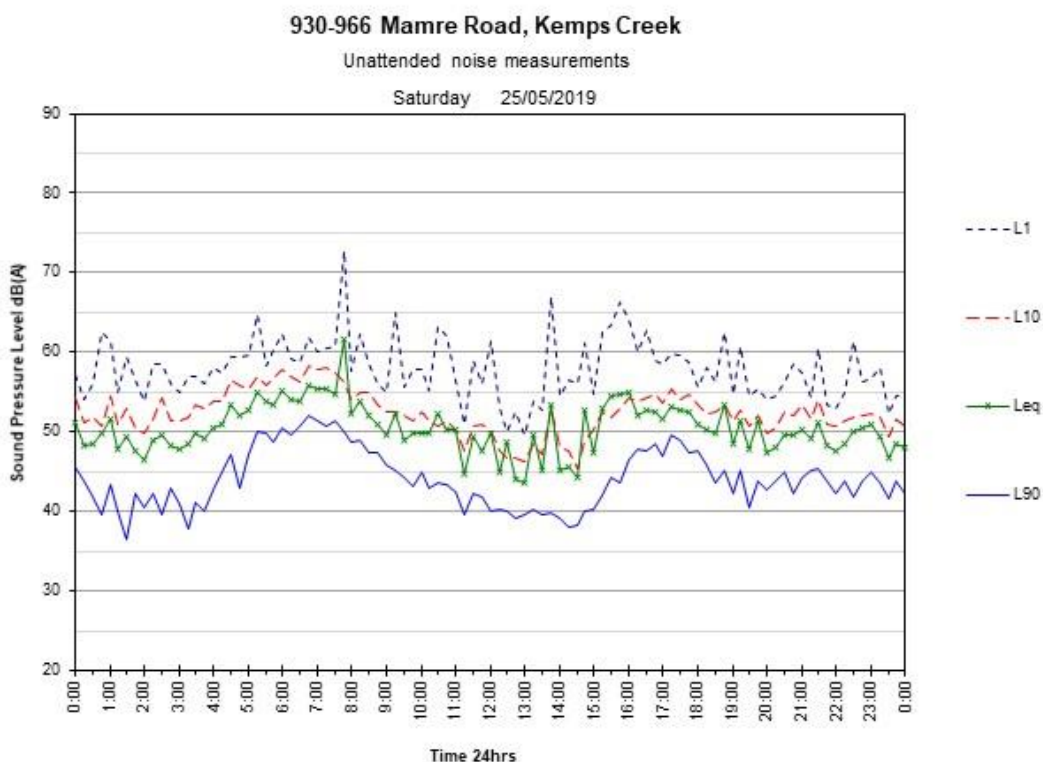
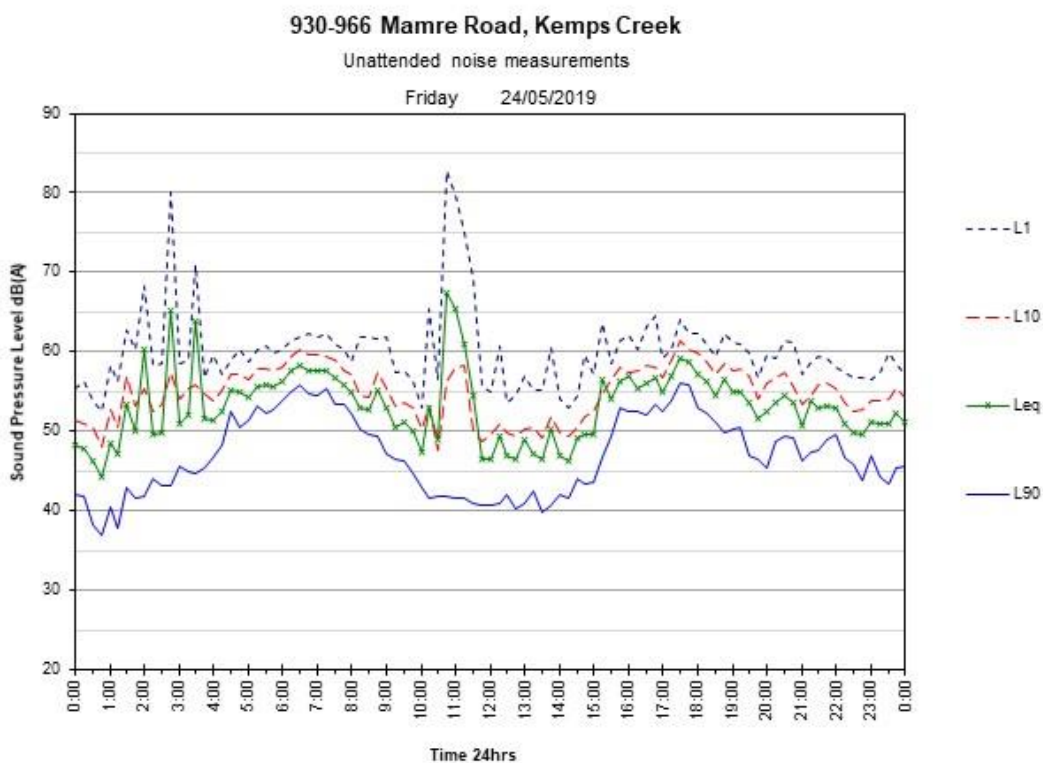


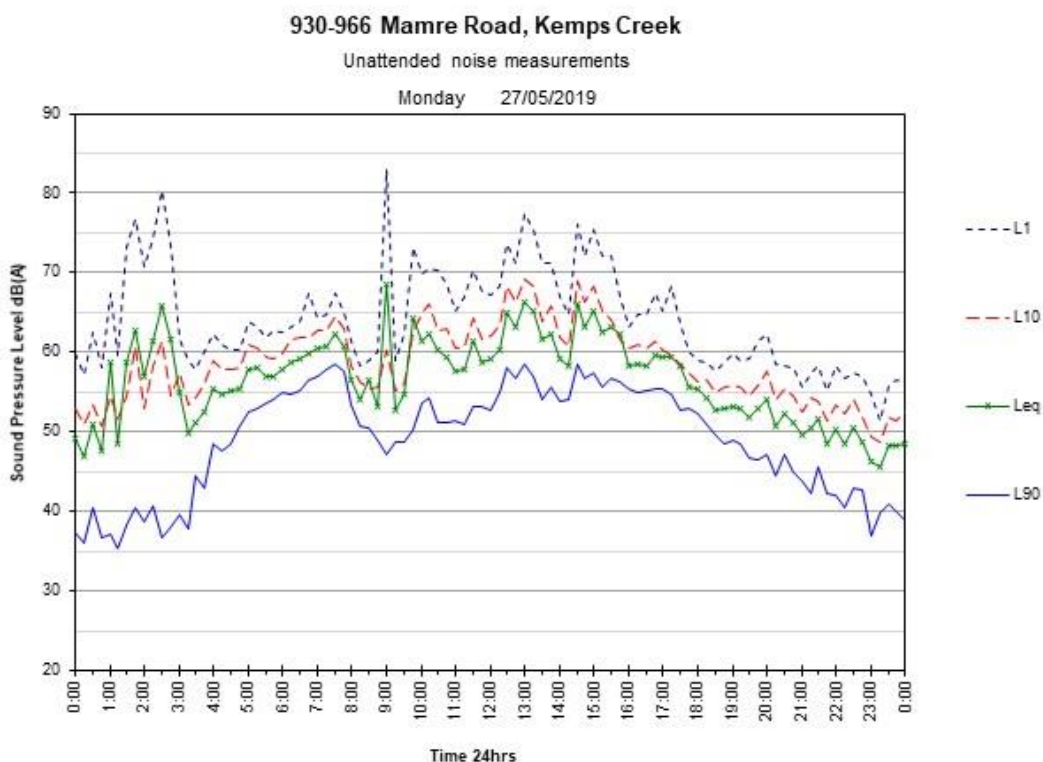
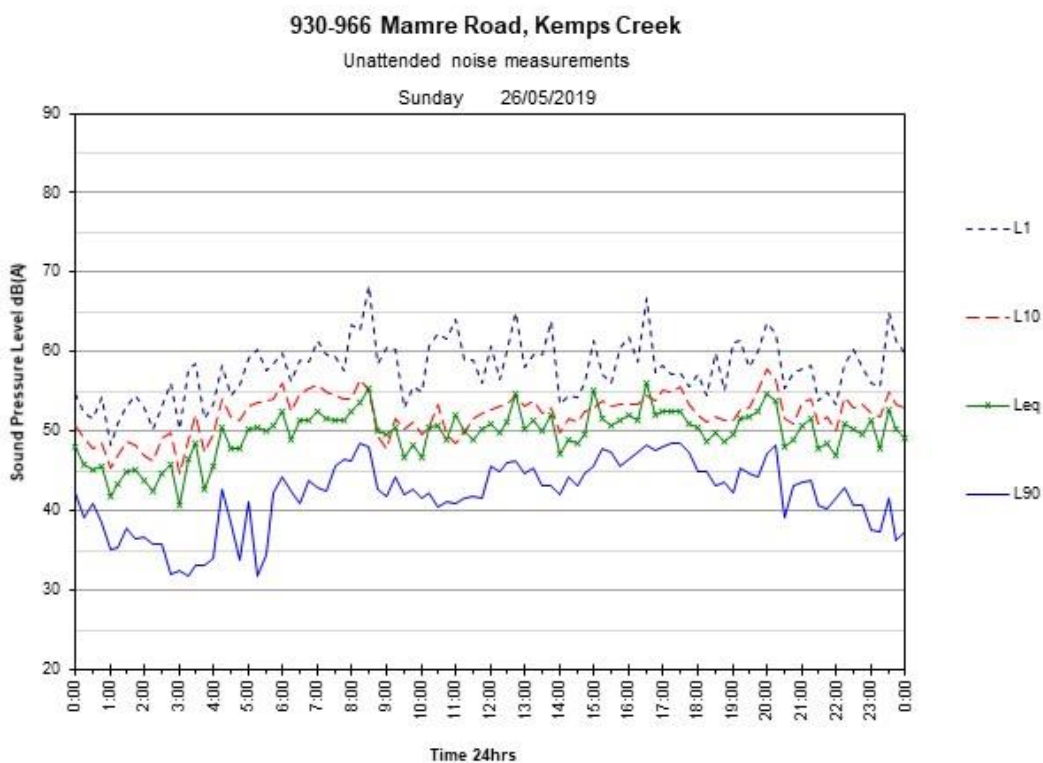


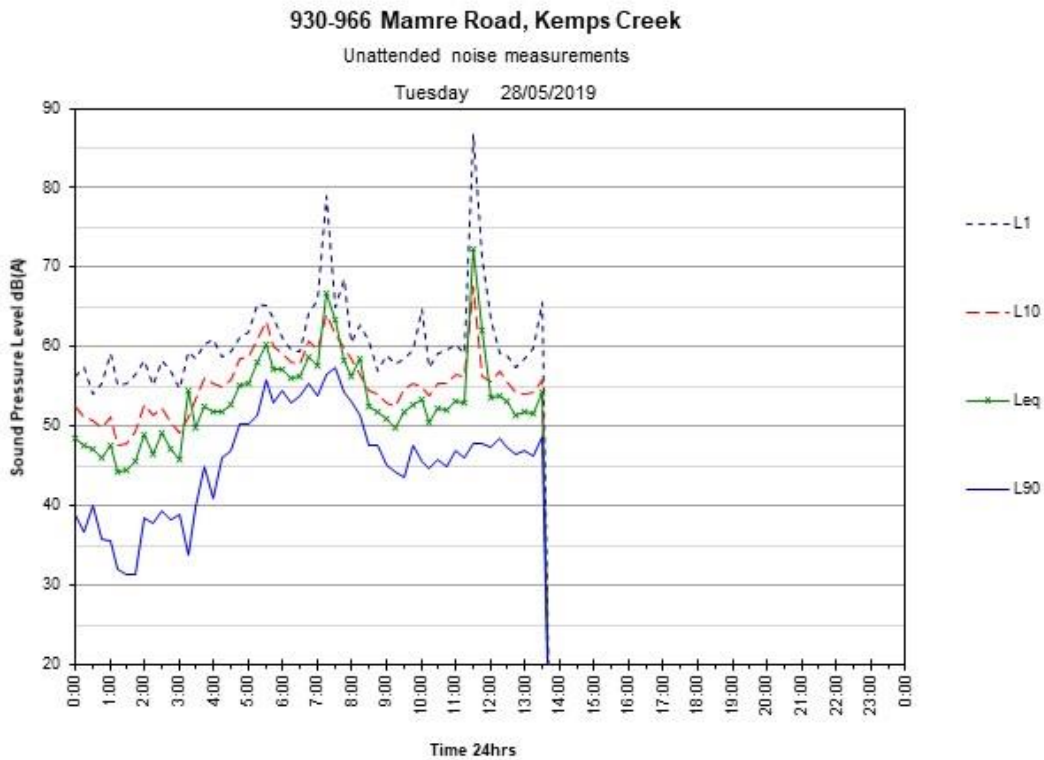
11.1.2 930-966 Mamre Road (Receivers 2 to 4)











11.2 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.

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.

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

The "Responsible Person" should also document comments by others on the performance of the Noise Management Plan and provide his/her own performance overview during reviews of the plan.

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

11.2.1 All activities

Element	Operation of site works
Aim	To limit the times of potentially noisy onsite activities
Action	<p>Recommended 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</p> <p>Workers or delivery trucks do not congregate outside the site before 6.45am.</p>

11.2.2 Implementation of Management Plan

Element	Responsible Person
Aim	Provide a personnel contact for the Noise Management Plan
Action	<p>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.</p> <p>The Responsible Person will be required to receive, document and respond in an appropriate manner to complaints made against the centre with regards to noise.</p> <p>The Responsible Person is to keep record of performance indicators and feedback from management, staff, subcontractors and adjacent noise receivers as appropriate.</p> <p>The person would also be responsible for documenting changes/modifications to the Noise Management Plan.</p>

11.2.3 Active Involvement

Element	Responsible Person
Aim	All management, staff and sub-contractors actively support and implement the noise management plan.
Action	<p>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.</p> <p>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.</p> <p>Responsible Person to implement notification new staff or subcontractors with respect to the Noise Management Plan.</p>

11.2.4 Deliveries

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

11.2.5 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.

11.2.6 Complaints

Element	Response to complaints
Aim	Provide a friendly and immediate response to complaints.
Action	<p>Occupants of surrounding commercial premises should be provided with a telephone number for the "Responsible Person" in the event of a noise complaint.</p> <p>If a complaint is made, the "Responsible Person" responds to it in an appropriate and friendly manner and investigates the source of the complaint, and takes action to immediately reduce the noise level, if it is reasonable complaint.</p> <p>The "Responsible Person" maintains a record of complaints, which records the following details (refer to the example noise complaint record sheet):</p> <ul style="list-style-type: none"> -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); <p>If the complaint is on-going, an investigation by a qualified acoustical consultant may be necessary to determine if the complaint is bona-fide (i.e. noise is occurring beyond the limits set out in the approved acoustic assessment), and if so, recommend noise controls to achieve the approved noise limits.</p> <p>In cases where a complaint has been determined to be bona-fide, the "Responsible Person" should contact the complainant (if the complainant wishes) to advise on noise control measures, if any, adopted to reduce the noise impact. The noise control measures may include behavioural or physical, or a combination of the two.</p>

11.2.7 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	<p>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.</p> <p>The plan should be reviewed if processes or activities onsite are change/modified or new activities are introduced.</p> <p>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.</p> <p>Document all changes/modifications to the Noise Management Plan.</p>

11.3 Example noise complaint record sheet

COMPLAINT LODGEMENT INFORMATION	
Date of complaint	
Time of complaint	
Name of complainant (if given)	
Contact telephone number of complainant	
Description of noise (e.g. mechanical plant, vehicle noise)	
Duration of noise event (e.g. did it last a short time, or is it continuous)	

ACTION TAKEN	
Identification of noise source by Responsible Person	
Immediate action taken	
Previous similar complaints	
Contact with complainant after noise control implemented (e.g. is noise still an issue?)	
Is further action required (e.g. is an Acoustical Consultant required?)	

11.4 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 level of noise from the noise source being investigated and check for compliance.

11.4.1 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.

11.4.2 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} , L_p , and 1/3 octave spectrum (to establish any tonal characteristics).

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

11.4.3 Procedure for measuring noise

11.4.3.1 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.

11.4.3.2 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.

11.4.3.3 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.

11.4.3.4 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.

11.4.3.5 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 L_pA .
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.

11.4.3.6 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.

11.5 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.