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Proposed Temporary Intersection – Out of Hours Construction
Mamre Road
Kemps Creek

CONSTRUCTION NOISE AND VIBRATION IMPACT ASSESSMENT




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Western Earthmoving

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1. Introduction

This report is in response to a request by Western Earthmoving (WEM) for a construction noise and vibration impact assessment 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.

This revised report includes further detail regarding the Responsible person and clarifies what works would require specific noise mitigation in accordance with the information request provided by the Department of Planning, Industry & Environment. Refer to Section 9.1 for details.

2. Site Description

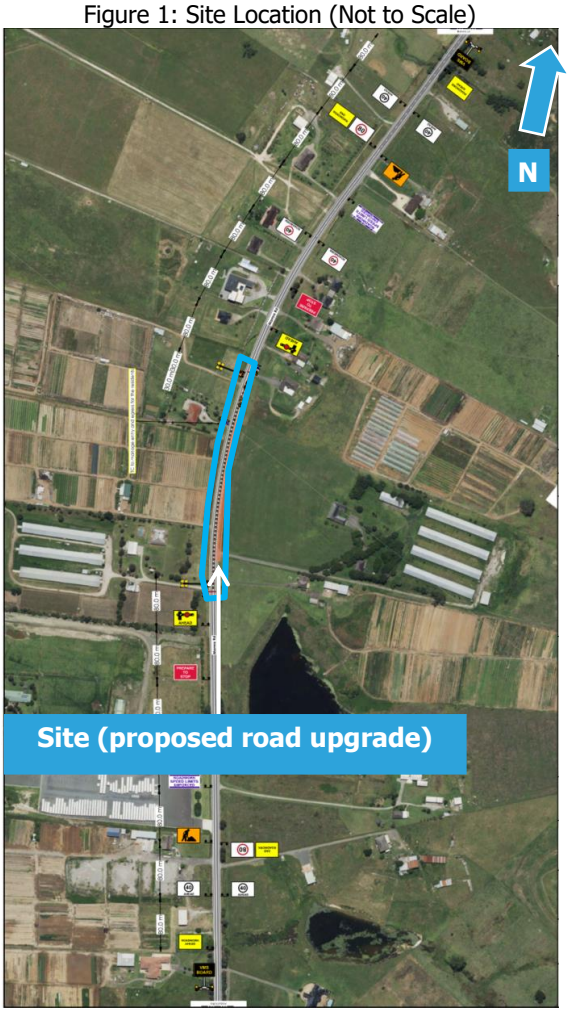
2.1 Roadworks Location

The site is described by the following:

Mamre Road, Kemps Creek

Refer to Figure 1 for site location.

Figure 1: Site Location (Not to Scale)



A site survey was conducted on the 7th December 2022 which identified the following in relation to the road and intersection upgrades:

- Residential dwellings are located on the eastern and western side of Mamre Road.
- Vacant land with approved industrial land use is located on the western side of Mamre Road adjacent to the proposed road upgrade.

2.2 Proposal

The proposal seeks to construct a temporary intersection on Mamre Road for the proposed Aspect Industrial Estate consisting of the following:

- Road works for up to six nights (weather dependent);
- Proposed construction hours of 8pm to 5am.
- Erection of signage;

The road works are expected to consist of the following machinery;

- Excavators (14T)
- Motor Graders
- Petrol generators
- Hiab
- Tip trucks
- Daymakers
- Power tools
- Roller (non-vibratory)

2.3 Acoustic Environment

The acoustic environment of the surrounding area is primarily affected by road traffic from Mamre Road and potentially construction works.

3. Conditions of Approval

The Department of Planning and Environment (DPE) has requested the following information in relation to the out of hours road construction works:

- Confirmation/clarification that the proposed duration is for 9-hour intervals of night works to be completed within 5 nights over a 2– to 4–week period.
- Clarification that the memo Out of Hours Work Assessment – Temporary Intersection (Element, 21/11/2022) is submitted as a construction noise impact statement (CNIS) as required in Section 6.2 of the Aspect Industrial Estate Construction Noise and Vibration Management Plan (SLR, 14 July 2022) approved under SSD-10448 PA-31. If so, please update the memo to be a CNIS and include references to the approved Construction Environmental Management Plan as approved under SSD-10448 PA-31, including relevant sub-plans such as the CNVMP, Construction Traffic Management Plan (CTMP) etc.
- Details of mitigation measures for specific receivers eligible for noise mitigation as identified in Figure 7 in Appendix 4 of the development consent and in Section 7 of the CVNMP (SLR, July 2022) such as temporary relocation measures for high-noise works during out of hours periods included in Section 7.2 Table 18 of the CNVMP (SLR, July 2022).

4. Noise Standards and Codes

We provide the following summary of noise 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 2017
- NSW Noise Policy for Industry 2017
- 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*.

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

Table 1: Application of codes and regulations

Code/standard title (abbreviated)	Applicable to construction noise?	Sets specific 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 2017	Not mentioned	No	Construction noise and vibration not specifically referenced but may be implied
NSW Noise Policy for Industry 2017	No	No	Construction noise is not dealt with by the INP as described in Section 1.3 of the policy
NSW Interim Construction Noise Guideline 2009	Yes	Yes	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	Yes	No	Applicable to noise associated with construction

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

4.1 NSW Interim Construction Noise Guideline 2009

4.1.1 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.

4.1.1.1 Residential uses

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

Table 2: Noise criteria for quantitative assessment - Residential

Time of day	Criterion LAeq(15min) *	How to apply
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.

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.

4.1.2 Ground-borne noise

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

Table 3: Ground-borne noise criteria

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.

4.2 Australian Standard AS2107

Australian Standard 2107-2016 *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.

4.3 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.

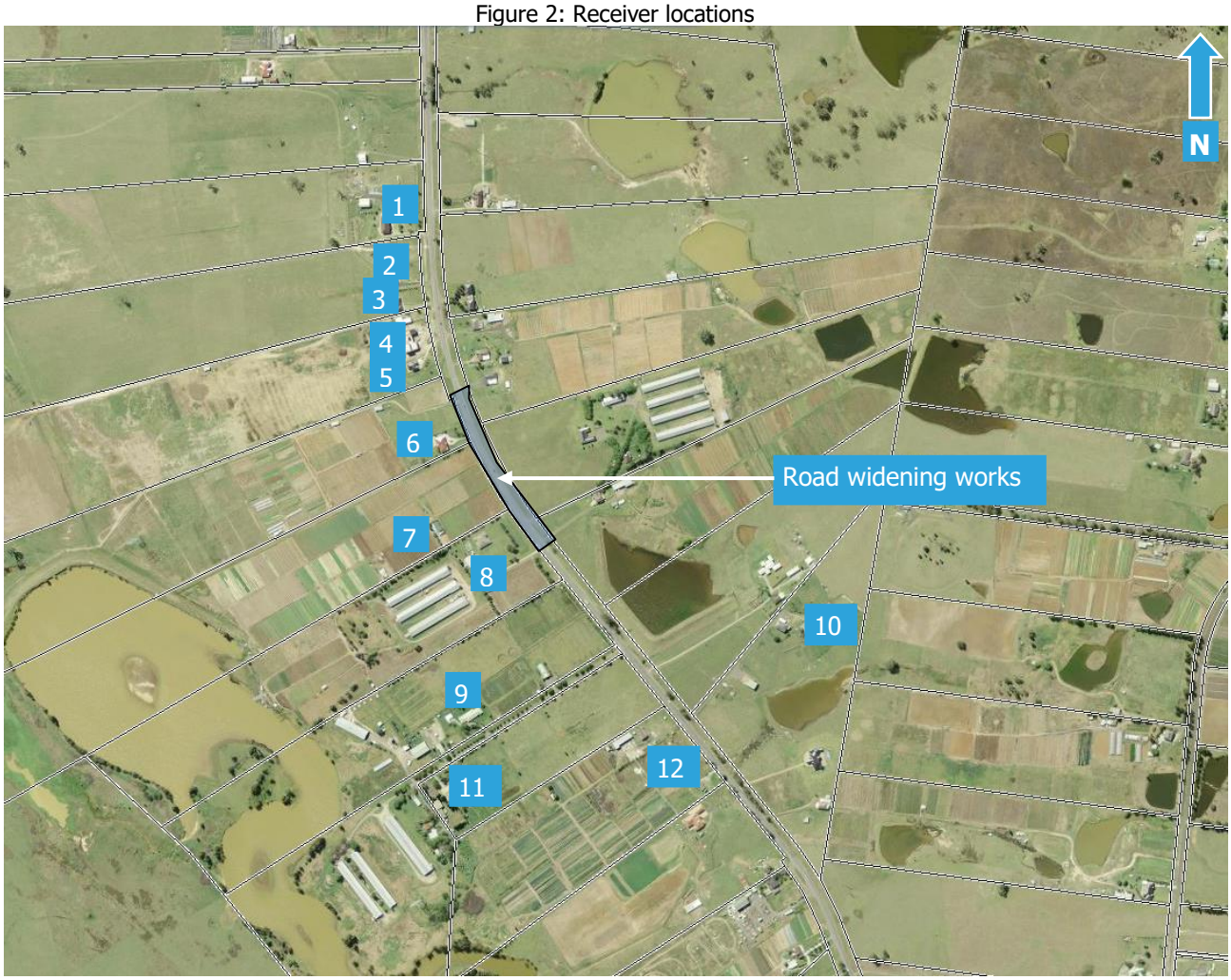
5. Receivers Locations

5.1 Receiver Locations

The nearest receiver locations (Figure 2) were identified as follows;

1. Residential dwelling located on the western side of Mamre Road at 819-831 Mamre Road.
2. Residential dwelling located on the western side of Mamre Road at 833A Mamre Road.
3. Residential dwelling located on the western side of Mamre Road at 833B Mamre Road.
4. Residential dwelling located on the western side of Mamre Road at 845 Mamre Road.
5. Residential dwelling located on the western side of Mamre Road at 845A Mamre Road.
6. Residential dwelling located on the western side of Mamre Road at 859-869 Mamre Road.
7. Residential dwelling located on the western side of Mamre Road at 871-883 Mamre Road.
8. Residential dwelling located on the western side of Mamre Road at 885-899 Mamre Road.
9. Residential dwelling located on the western side of Mamre Road at 901 Mamre Road.
10. Residential dwelling located on the eastern side of Mamre Road at 930-966 Mamre Road.
11. Residential dwelling located on the western side of Mamre Road at 919 Mamre Road.
12. Residential dwelling located on the western side of Mamre Road at 931Mamre Road.

Figure 2: Receiver locations



6. Existing Noise Levels

Ambient background noise levels nominated in the Construction Noise and Vibration Management Plan (CNVMP) prepared for the Aspect Industrial Estate (reference: SLR 610.19127-CNVMP-R05-v1.3-20220714.docx, dated July 2022) were utilised for the purpose of this assessment.

6.1 Background noise levels

The receivers nominated in Section 5.1 would fall under Noise Catchment Area 4 (NCA04), as defined in the SLR CNVMP prepared for the Aspect Industrial Estate. The measured background noise levels at the logger location for NCA 4 are as follows;

Table 4: Measured LA90 noise levels receiver

RBL		
Day	Evening	Night
39	39	32

7. Project specific noise criteria

7.1 Construction noise criteria

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

Table 5: Applicable noise limits for construction work

Receiver	Time	Criterion LAeq(15min)			Assessment location
		Day	Evening	Night	
Residential	Outside standard construction hours	*N/A	44	37	External

*Note the proposed out of hours works is for the evening and night periods only.

8. Predicted Noise Levels

Predicted noise associated with the proposed road widening 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.

Noise impacts were assessed using 3D SoundPLAN modelling generated in accordance with ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*. The model presents the predicted worst-case 15 minute noise impacts associated with and is broken down into 3 scenarios based on the machinery predicted to be operating at any given time.

Meteorological conditions, barrier screening, topographical screening, air and ground absorption were calculated in accordance with ISO 9613-2and Fact Sheet D of the Noise Policy for Industry. The itemised noise source list is presented in Table 6.

A list of noise sources and scenarios are presented in Table 6 below. Any correction for tonality or impulsiveness was included in the overall sound power level.

Table 6: Itemised Noise Sources

Scenario	Source	Source type	Sound Power Level L_w dBA
1	Tip truck	Line	97
	Roller (non-vibratory)	Line	107
	Voice conversation	Point	78
	Petrol generator	Point	96
	Daymaker	Point	98
	Reverse alarms	Line	103
	Power tools	Line	93
	Excavator (14t)	Line	100
2	Tip truck	Line	97
	Grader	Line	110
	Voice conversation	Point	78
	Petrol generator	Point	96
	Daymaker	Point	98
	Reverse alarms	Line	103
	Power tools	Line	93
	Excavator (14t)	Line	100
3	Hiab	Line	105
	Voice conversation	Point	78

8.1 Scenario 1 Cumulative Noise Impacts

The noise source levels at the receiver locations are shown in Table 7. LAeq results are not shown where the calculated total is less than 0dBA. Levels have been rounded to the nearest whole number.

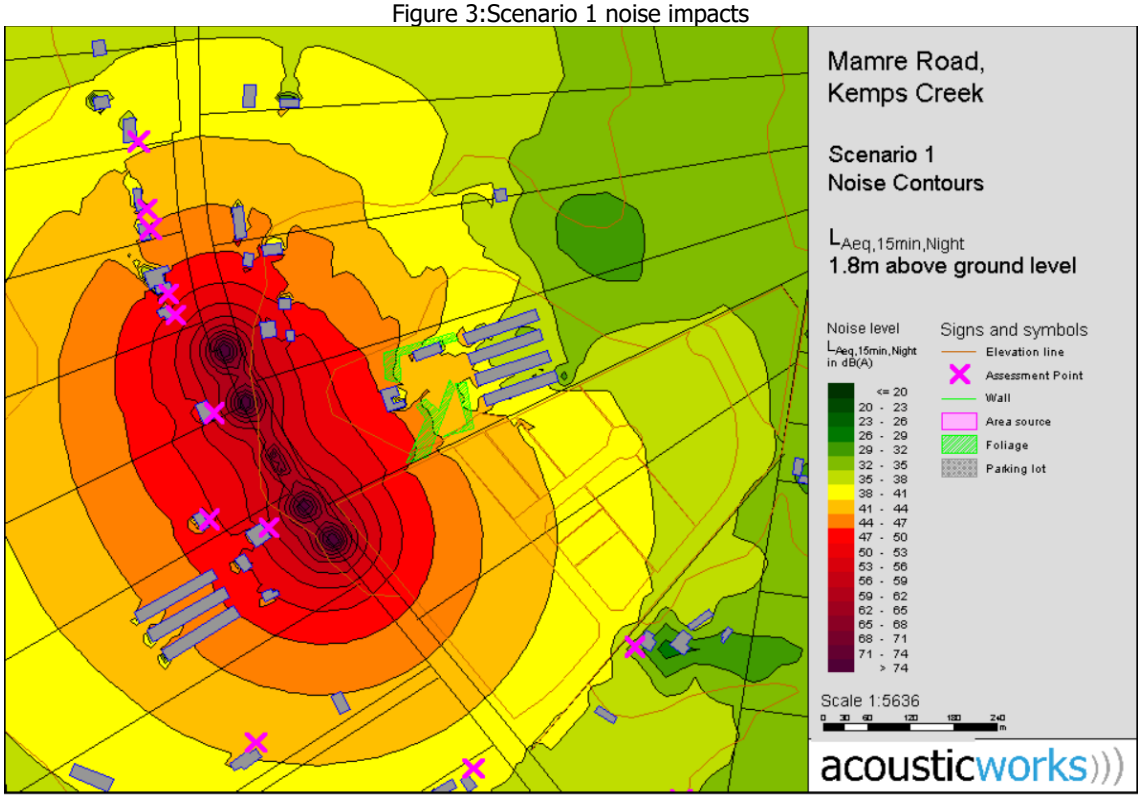
Table 7: Project specific noise levels – Scenario 1

Receiver	Project Specific Criteria $L_{eq,15min}$ dBA			Predicted Noise Impacts $L_{eq,15min}$ dBA			Complies (Yes/No)		
	Day	Eve	Night	Day	Eve	Night	Day	Evening	Night
1	N/A	44	37	N/A	41	41	N/A	Yes	No
2	N/A	44	37	N/A	43	43	N/A	Yes	No
3	N/A	44	37	N/A	44	44	N/A	Yes	No
4	N/A	44	37	N/A	49	49	N/A	No	No
5	N/A	44	37	N/A	51	51	N/A	No	No
6	N/A	44	37	N/A	59	59	N/A	No	No
7	N/A	44	37	N/A	50	50	N/A	No	No
8	N/A	44	37	N/A	55	55	N/A	No	No
9	N/A	44	37	N/A	42	42	N/A	Yes	No
10	N/A	44	37	N/A	38	38	N/A	Yes	No
11	N/A	44	37	N/A	38	38	N/A	Yes	No
12	N/A	44	37	N/A	39	39	N/A	Yes	No

Construction noise levels are predicted to be above the noise affected limit. Refer to Section 9 for details.

Figure 3 presents a graphical representation of the predicted noise levels.

Figure 3:Scenario 1 noise impacts



8.2 Scenario 2 Cumulative Noise Impacts

The noise source levels at the receiver locations are shown in Table 8. LAeq results are not shown where the calculated total is less than 0dBA. Levels have been rounded to the nearest whole number.

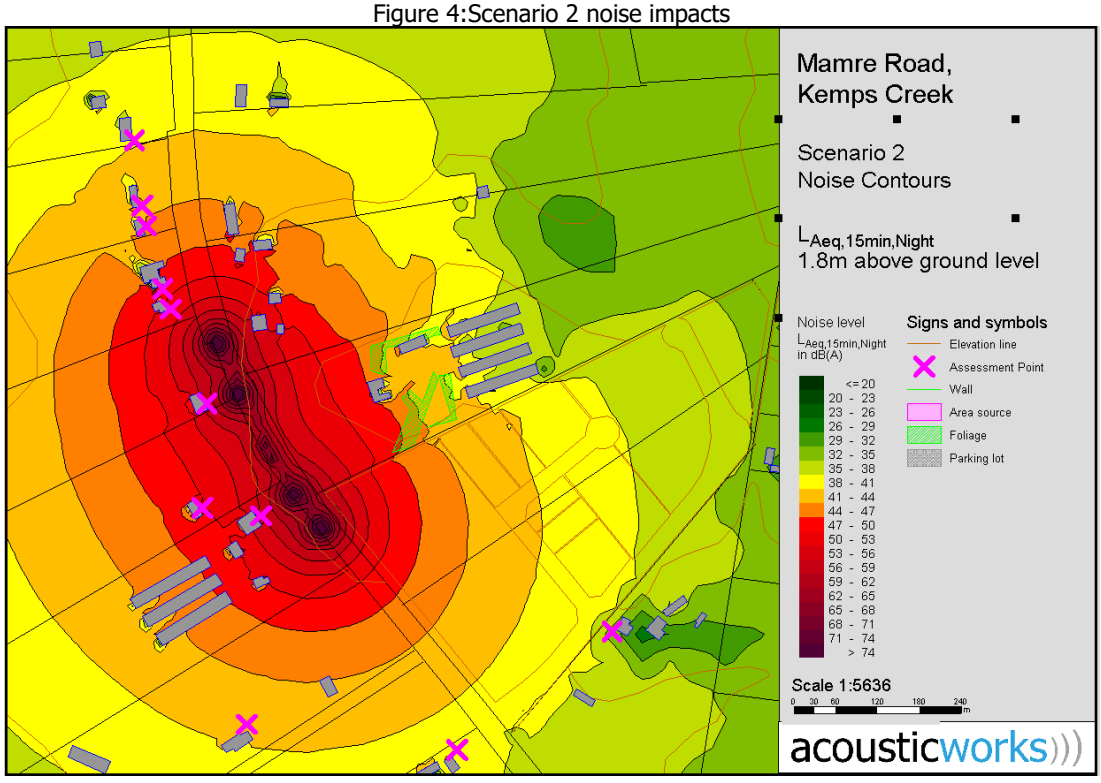
Table 8: Project specific noise levels – Scenario 2

Receiver	Project Specific Criteria $L_{eq,15min}$ dBA			Predicted Noise Impacts $L_{eq,15min}$ dBA			Complies (Yes/No)		
	Day	Eve	Night	Day	Eve	Night	Day	Evening	Night
1	N/A	44	37	N/A	41	41	N/A	Yes	No
2	N/A	44	37	N/A	43	43	N/A	Yes	No
3	N/A	44	37	N/A	44	44	N/A	Yes	No
4	N/A	44	37	N/A	49	49	N/A	No	No
5	N/A	44	37	N/A	51	51	N/A	No	No
6	N/A	44	37	N/A	59	59	N/A	No	No
7	N/A	44	37	N/A	50	50	N/A	No	No
8	N/A	44	37	N/A	56	56	N/A	No	No
9	N/A	44	37	N/A	42	42	N/A	Yes	No
10	N/A	44	37	N/A	38	38	N/A	Yes	No
11	N/A	44	37	N/A	39	39	N/A	Yes	No
12	N/A	44	37	N/A	39	39	N/A	Yes	No

Construction noise levels are predicted to be above the noise affected limit. Refer to Section 9 for details.

Figure 4 presents a graphical representation of the predicted noise levels.

Figure 4:Scenario 2 noise impacts



8.1 Scenario 3 Cumulative Noise Impacts

The noise source levels at the receiver locations are shown in Table 9. LAeq results are not shown where the calculated total is less than 0dBA. Levels have been rounded to the nearest whole number.

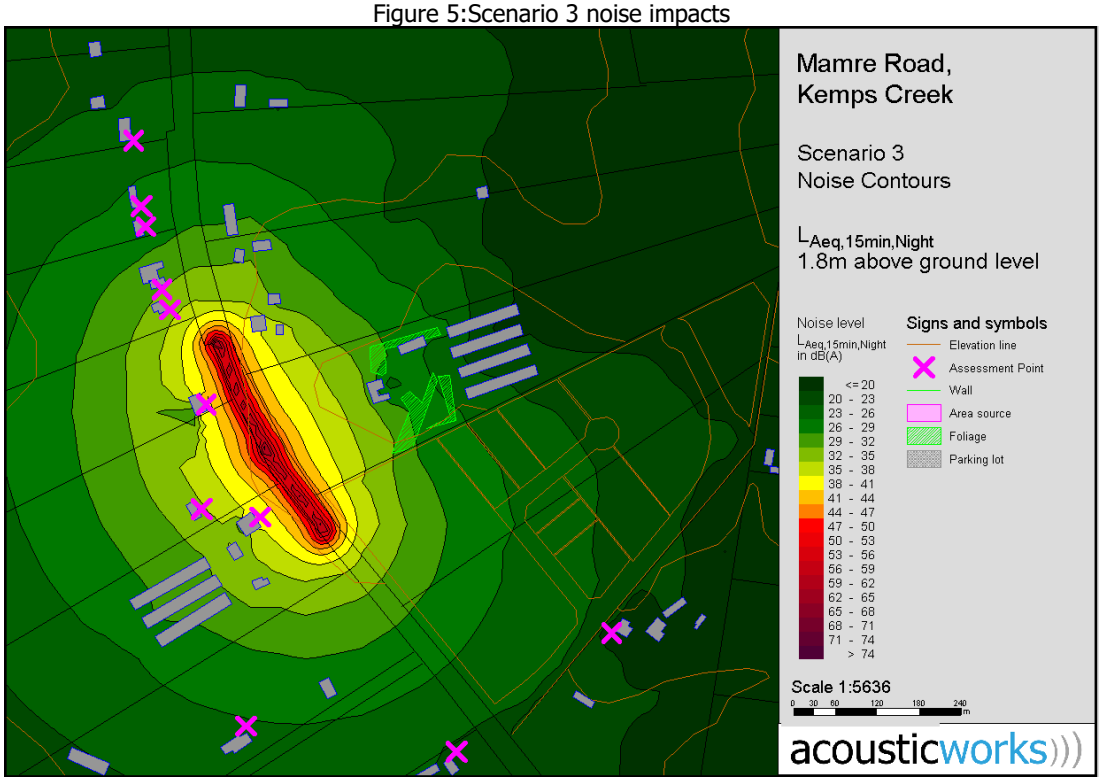
Table 9: Project specific noise levels – Scenario 3

Receiver	Project Specific Criteria $L_{eq,15min}$ dBA			Predicted Noise Impacts $L_{eq,15min}$ dBA			Complies (Yes/No)		
	Day	Eve	Night	Day	Eve	Night	Day	Evening	Night
1	N/A	44	37	N/A	25	25	N/A	Yes	Yes
2	N/A	44	37	N/A	27	27	N/A	Yes	Yes
3	N/A	44	37	N/A	28	28	N/A	Yes	Yes
4	N/A	44	37	N/A	32	32	N/A	Yes	Yes
5	N/A	44	37	N/A	34	34	N/A	Yes	Yes
6	N/A	44	37	N/A	42	42	N/A	Yes	No
7	N/A	44	37	N/A	36	36	N/A	Yes	Yes
8	N/A	44	37	N/A	39	39	N/A	Yes	No
9	N/A	44	37	N/A	26	26	N/A	Yes	Yes
10	N/A	44	37	N/A	22	22	N/A	Yes	Yes
11	N/A	44	37	N/A	23	23	N/A	Yes	Yes
12	N/A	44	37	N/A	22	22	N/A	Yes	Yes

Construction noise levels are predicted to be above the noise affected limit at Receivers 6 and 8. Refer to Section 9 for details.

Figure 5 presents a graphical representation of the predicted noise levels.

Figure 5:Scenario 3 noise impacts



9. Recommendations - Noise

9.1 General

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

1. Further noise mitigation is recommended, temporary acoustic barriers along the site works on Mamre Road should be installed during night road works (8pm to 5am). The height of acoustic barriers shall be a minimum of 2.4m high. If further noise reductions are required, install additional screening around noise sensitive areas or implement the options detailed in points 7 and 14.
2. Trucks shall not congregate directly in front of residential receivers unless actively involved in site works. This is an important factor in managing noise from the site.
3. Tip trucks shall not idle for prolonged periods (more than 10 minutes) when not actively involved site works.
4. Workers (including all drivers) shall not play amplified music throughout site works.
5. Vehicles that require reverse alarms should be fitted with broadband reverse alarms where feasible.
6. All workers shall be reminded during induction to keep noise to a minimum to consider neighbouring residences.
7. Temporary accommodation should be offered to noise affected receivers for the duration of night works (8pm to 5am).
8. 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.
9. 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.
10. 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.
11. Any moveable plant (e.g. compressors, generators, etc.) should be located as far as practical from the residential premises.
12. 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.

13. 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.
14. To help manage complaints, the Responsible Person shall offer the following to noise affected complainants:
    - Reoffer temporary accommodation for the duration of night works.
    - Offer to help relocate the tenants to any sleeping rooms at the rear of their property (if applicable).
    - Provide additional temporary acoustic screening around noise affected rooms.

9.2 Additional recommendations

In the event where noise affected residences refuse offers for temporary accommodation, the following additional recommendations are provided:

1. Notify residences to keep windows closed during site works and turn on air-conditioning (if available).
2. Offer partial reimbursement for the air-conditioning electricity bill.
3. Inform residences that sleeping in rooms towards the back of their property (not fronting Mamre Road) is advised, as the front of the house will provide additional screening.

The noise management plan is described in more detail in Section 9.3 with recommendations for noise monitoring provided in Section 9.4.

9.3 Construction 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;

9.3.1 All activities

Element	Operation of site works
Aim	To limit the times of potentially noisy onsite activities
Action	Workers shall be inducted and reminded to keep noise to a minimum where possible. Trucks not to congregate directly outside of residences unless actively involved in site works.

9.3.2 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 will be required to receive, document and respond in an appropriate manner to complaints made against the centre with regards to noise. 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.

9.3.3 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.

9.3.4 Deliveries

Element	Deliveries
Aim	Minimise noise impacts from vehicle activities delivering to the site.
Action	Trucks not to congregate directly outside of residences unless actively involved in site works.

9.3.5 Complaints

Element	Response to complaints
Aim	Provide a friendly and immediate response to complaints.
Action	Occupants of surrounding commercial premises should be provided with a telephone number for the "Responsible Person" in the event of a noise complaint. 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. The "Responsible Person" maintains a record of complaints, which records the following details (refer to the example noise complaint record sheet): -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); 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. In cases where a compliant 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.

9.3.6 Review

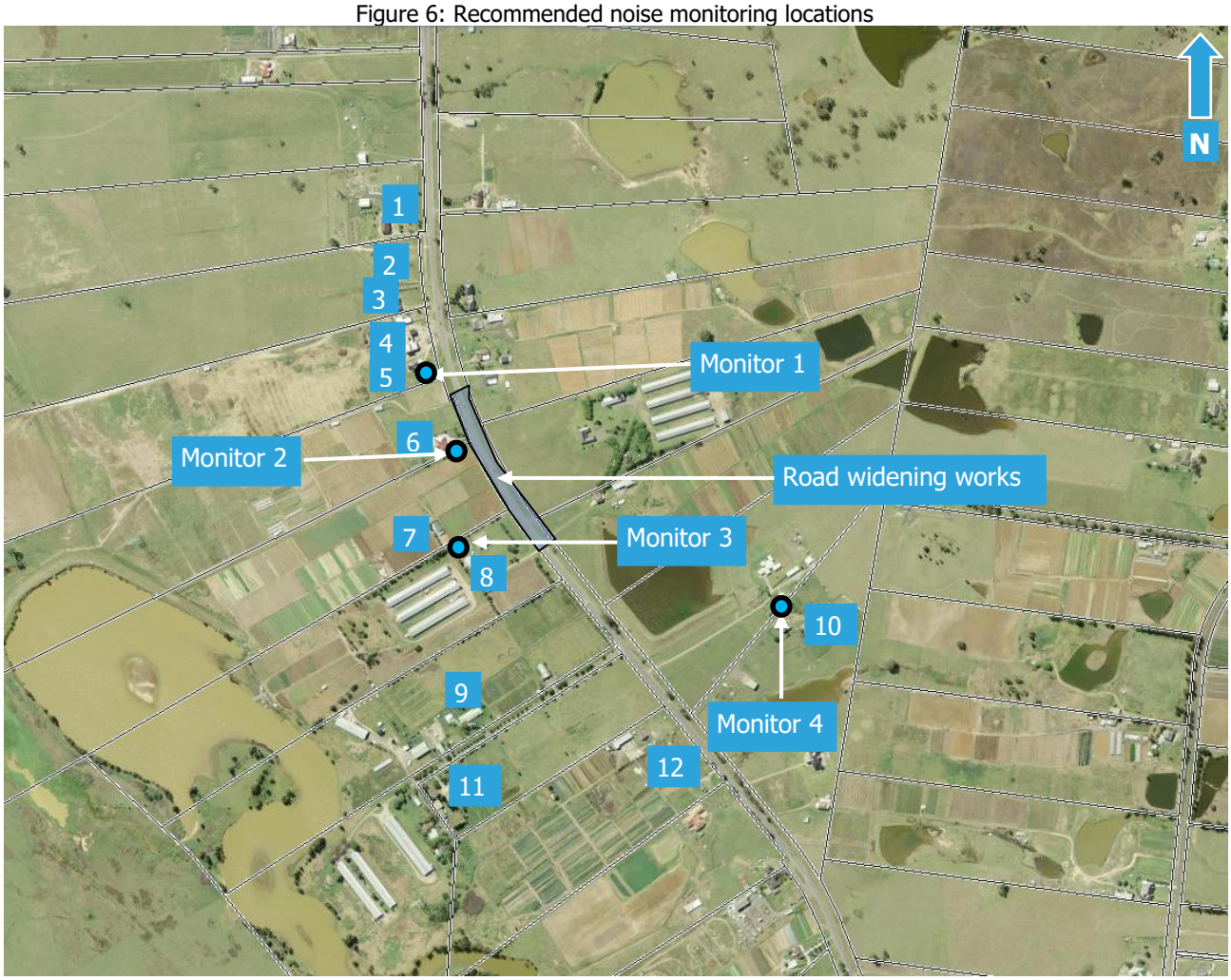
Element	Schedule for the Review Process
Aim	To review the incidents/ complaints register and to ensure the Noise Management Plan remains relevant to the operations/activities of the site.

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.

9.4 Construction noise monitoring

Continued unattended noise monitoring is recommended for the duration of the works at the locations shown in Figure 6.The results of the unattended noise monitoring would be suitable for investigating 'spot-checks' of noise complaints in most situations.

Figure 6: Recommended noise monitoring locations



9.4.1 Equipment

The environmental 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 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.

9.4.2 Parameters

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

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

9.4.3 Procedure for measuring noise

9.4.3.1 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. Typically this would be an outdoor location in the most exposed position in a receivers' yard.

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.

9.4.3.2 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.
- Equipment used for measurements.
- Location of measurements.
- Measured values.
- Corrected values (where applicable).
- Detail of instrumentation and calibration.
- Meteorological conditions.

10. Vibration Standards and Codes

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

- Assessing Vibration: A Technical Guideline 2006
- 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 10: Application of codes and regulations

Code/standard title (abbreviated)	Applicable to construction vibration?	Sets specific goals?	Comments
Assessing Vibration: A Technical Guideline 2006	Yes	Yes	Continuous, impulsive and intermittent vibration. Based on BS6472-1992
Australian Standard AS2670.2	Yes	Specific vibration goals	Used for vibration only
Australian Standard AS2187-1993	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.

10.1 Assessing Vibration: A Technical Guideline 2006

10.1.1 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.

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

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

Table 11: 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

10.1.3 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 12: 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

10.2 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 13: 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

10.3 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 14: 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.

11. Project Specific Vibration Criteria

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

Table 15: 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	5mm/s	-	5mm/s	-

12. Predicted Vibration Levels

Potential vibration impacts were assessed to determine typical levels within a set distance of the activity to the receiver with a predicted maximum combined Peak Particle Velocity level of less than 1 mm/s predicted depending on the equipment in operation and its proximity to the receiver. 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 that a strict management plan is implemented to allow for a proactive approach to addressing complaints including vibration monitoring of activities if complaints are received.

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

- The residential dwellings located adjacent the site works on the western side of Mamre Road - given the proximity of the roadworks to the buildings, it is recommended that continued vibration noise monitoring is conducted to ensure no adverse impacts are experienced by the tenants. Note adverse impacts may be caused by direct connection of the dwelling to the road by stormwater/hydraulic pipes. In addition to the noise monitoring, it is recommended that dilapidation assessment is undertaken prior to works being conducted.

12.1 Construction Vibration monitoring

It is recommended that continued vibration monitoring is conducted at receivers 6 and 8 (Figure 2) to ensure no adverse impacts are experienced by the tenants located adjacent the site on the western side of Mamre Road until the works have been completed.

13. Recommendations – Vibration

13.1 Location of Dilapidation Assessments – Vibration

Based on our review, it is recommended the following numbered locations in Figure 7 have a dilapidation assessment before works proceed.

Figure 7: Dilapidation Assessment Locations

13.2 Vibration Control

Due to the proximity of the roadworks in relation to nearby buildings (in particular to the west receivers adjacent the site works on Mamre Road), it is recommended that vibration monitoring is undertaken at this location for the duration of the night works. 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, Graders and Rollers – if vibration levels are triggered by the movement of excavators, graders or rollers, we recommend they reduce their movement speed onsite.
- 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.

13.1 Vibration Management

1. 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.
2. 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.
3. 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 near 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.
4. Any moveable vibrating plant (e.g. compressors) should be located as far as practical from the adjacent residential premises.
5. 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.

6. 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.
7. If complaints continue regarding excessive vibration and this is confirmed that vibration levels exceed the criteria continually, then respite periods can be adopted in consultation with council officers and the acoustic consultant to reduce non-compliant impacts to sensitive receivers.

A sample complaint form is provided in the appendices.

13.2 Maximum Vibration Levels

Based on inspection of the surrounding buildings, the maximum allowable levels would be a peak particle velocity of 5mm/s. All monitors installed onsite shall be set to a maximum limit of 3mm/s to provide adequate warning and to avoid exceedances of the maximum noise limits.

13.3 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 8pm to 5am every day with the geophone fixed to the building structure.
- 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 a trigger value 2/3 of the criterion limit. Therefore, in this case the vibration impact warning level trigger is to be set at 3mm/s. This will allow staff to be notified of vibration levels and take a proactive approach before the 5mm/s criteria is exceeded. The Acoustic consultant will also have a minimum of 2 staff nominated on the warning system.
- 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 the DPE.

13.3.1 Procedure for measuring Vibration

13.3.1.1 Where to measure vibration

Vibration is required to be measured at the receivers adjacent the site works on the western side of Mamre Road at receivers 6 and 8. The geophone must be fixed directly to building elements.

13.3.1.2 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 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. Based on the review of construction works, we recommend vibration monitoring is undertaken for the duration of the site works.

13.3.1.3 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

14. Conclusion

A construction noise and vibration impact assessment has been conducted for the proposed road widening works at Mamre Road, Kemps Creek. 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 methods to be used during construction may exceed the relevant vibration limits at the nearest receivers. Management should monitor complaints from these residents and if complaints regarding vibration are received, a detailed investigation may be required. Vibration monitoring is recommended for the duration of the works at receivers located adjacent to the site works on Mamre Road to the west at receivers 6 and 8.

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

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acousticworks)))

15. Appendices

15.1 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?)	