RODNEY STEVENS ACOUSTICS
Acoustic Consultants

REPORT R190405R4

Revision 1

Construction Noise & Vibration Management Plan

Proposed Development

28 - 32 Evan Street, Penrith

PREPARED FOR:
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1 October 2019

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Proposed Development

28 - 32 Evan Street, Penrith

PREPARED BY:

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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
R190405R3	Revision 0	1 October 2019	James Wilkinson	Rodney Stevens	Rodney Stevens
R190405R4	Revision 1	5 December 2019	James Wilkinson	Rodney Stevens	Rodney Stevens

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1 INTRODUCTION

Rodney Stevens Acoustics Pty Ltd (RSA) has been engaged by Morson Group to prepare a Construction Noise & Vibration Management Plan (CNVMP) for the proposed addition at 28 - 32 Evan Street, Penrith.

The CNVMP has been prepared in accordance with NSW Environment Protection Authority's (EPA) *Interim Construction Noise Guideline* (ICNG, 2009). prior to issue of the Construction Certificate.

Specific acoustic terminology is used in this report. An explanation of common acoustic terms is provided in Appendix A.

2 OBJECTIVES

Develop a Construction Noise & Vibration Management Plan for the subject works addressing the following aspects:

- Identification of the specific activities that will be carried out and associated plant and equipment.
- Identification of all potentially affected sensitive receivers.
- Procedure for the determination of the construction noise objectives, in accordance with the NSW Environment Protection Authority's (EPA) *Interim Construction Noise Guideline* (ICNG, 2009).
- Determination of appropriate construction vibration criteria.
- Determination of appropriate noise and vibration objectives for each identified sensitive receiver.
- Noise and vibration monitoring, reporting and response procedures.
- Description of specific mitigation treatments, management methods and procedures that can be implemented to control noise (and vibration) during construction.
- Procedures for notifying residents of construction activities that are likely to affect their amenity through noise and vibration.
- Contingency plans to be implemented in the event of non-compliances and/or noise complaints.

3 PROJECT DESCRIPTION

3.1 Site Location

The proposed works will take place at 28 - 32 Evan Street, Penrith. The site is bounded by residential dwellings to the north, south and west and a cemetery to the east. The site and its surroundings are shown in Figure 3-1.

Figure 3-1 Site Location

Aerial image courtesy of Near Map © 2019

3.2 Proposed Development

The proposal is to demolish the existing residential dwellings and construct a 5-storey residential development with two levels of basement. The floor plans of the proposed residential development are presented in Appendix E.

4 BASELINE NOISE SURVEY

4.1 Unattended Noise Monitoring

In order to characterise the existing acoustical environment of the area, unattended noise monitoring was conducted between Wednesday 21st August and Wednesday 28th August 2019 at the logging location shown in Figure 3-1. 2 noise loggers were set up on site. The first logger was located in the front yard of the site overlooking Evan Road, this location is representative of the traffic noise levels that the site will be exposed to.

The second logger was located on the rear yard of the site, noise monitoring at this location is representative of the typical acoustic environment of the site.

Logger locations were selected with consideration to other noise sources which may influence readings, security issues for noise monitoring equipment and gaining permission for access from residents and landowners.

Instrumentation for the survey comprised of 2 RION NL-42 environmental noise loggers (serial numbers 133010 and 572559) fitted with microphone windshields. Calibration of the logger was checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dB(A). All equipment carried appropriate and current NATA (or manufacturer) calibration certificates. Measured data has been filtered to remove data measured during adverse weather conditions upon consultation with historical weather reports provided by the Bureau of Meteorology (BOM).

The logger determines LA1, LA10, LA90 and LAeq levels of the ambient noise. LA1, LA10, LA90 are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary for definitions in Appendix A). Detailed results at the monitoring location are presented in graphical format in Appendix B. The graphs show measured values of LA1, LA10, LA90 and LAeq for each 15-minute monitoring period.

4.2 Data Processing

In order to assess noise emission from the proposed development, the data obtained from the noise logger has been processed in accordance with the procedures contained in the NSW Environmental Protection Authority's (EPA) *Noise Policy for Industry* (NPfI, 2017) to establish representative noise levels that can be expected in the residential vicinity of the site. The monitored baseline noise levels are detailed in Table 4-1.

Table 4-1 Measured Baseline Noise Levels Corresponding to Defined NPfI Periods

Location	Measurement Descriptor	Measured Noise Level – dB(A) re 20 µPa		
		Daytime 7 am - 6 pm	Evening 6 pm – 10 pm	Night-time 10 pm – 7 am
Logger on eastern boundary (Rear of site)	L_{Aeq}	49	46	42
	RBL (Background)	39	36	32

Notes: All values expressed as dB(A) and rounded to nearest 1 dB(A);

L_{Aeq} Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.

L_{A90} Noise level present for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).

5 NOISE GUIDELINES AND CRITERIA

In the absence of specific criteria for construction noise, the EPA *Interim Construction Noise Guideline* (ICNG, 2009) will be used.

5.1 Construction Noise Management Levels

Construction noise is managed in accordance with the EPA *Interim Construction Noise Guideline* (ICNG, 2009) which provides management objectives for construction noise at residential and other sensitive land uses.

The ICNG airborne noise goals are to be applied to assess noise impacts and determine requirement for the reasonable and feasible management of construction noise to minimise potential for disturbance.

5.1.1 Residential Receivers

Table 5-1 details the ICNG guidelines for determining construction noise management levels at residential receivers.

Table 5-1 Construction airborne noise management levels for residences (ICNG)

Time of Day	Noise Management Level. L_{Aeq} dB(A)	How to Apply
Recommended standard hours (SH): Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected Rating Background Level (RBL) + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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 if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours (OOH) - All other times including Public Holidays	Noise affected Rating Background Level (RBL) + 5 dB(A)	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 of the ICNG.

Site specific L_{Aeq} construction noise management levels in Table 5.2 have been established adopting measured existing baseline L_{A90} noise levels (Rating Background Level, RBL) and the ICNG corrections for the time of construction work.

Table 5-2 Adopted Construction Noise Management Levels for Residential Receivers

Residential Receivers	Construction Noise Management Level $L_{Aeq,(15min)}$ - dB(A)			
	Standard Hours (SH)	Out-of-Hours (OOH)		
	Daytime Mon-Fri 7.00am – 6.00 pm	Daytime Saturday 8.00am – 1.00 pm	Evening 6.00pm – 10.00pm	Night 10.00pm – 7.00am
Surrounding Residential Receivers	49	49	46	42

5.2 Sleep Disturbance

The NSW EPA Noise Policy for Industry (NPfI) provides a guidance for sleep disturbance or sleep arousal assessment. The NPfI states the following:

> *The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.*
> *Where the subject development/premises night-time noise levels at a residential location exceed:*
> *• LAeq,15min 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
>
> *• LAFmax 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*
>
> *a detailed maximum noise level event assessment should be undertaken. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy*
>
> *Other factors that may be important in assessing the extent of impacts on sleep include:*
>
> *• how often high noise events will occur*
>
> *• the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development*
>
> *• whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods)*
>
> *• current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.*
>
> *Maximum noise level event assessments should be based on the LAFmax descriptor on an event basis under 'fast' time response.*

The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels

5.3 Vibration Damage Criteria - Surface Structures

Most commonly specified "*safe*" structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have potential to cause damage to the main structure.

5.3.1 British Standard 7385: Part 2 - 1993

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187: Part 2-2006 "*Explosives - Storage and Use - Part 2: Use of Explosives*" recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 "*Evaluation and measurement for vibration in buildings Part 2*" as they "are applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 5-3 and graphically in Figure 5-1.

Table 5-3 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

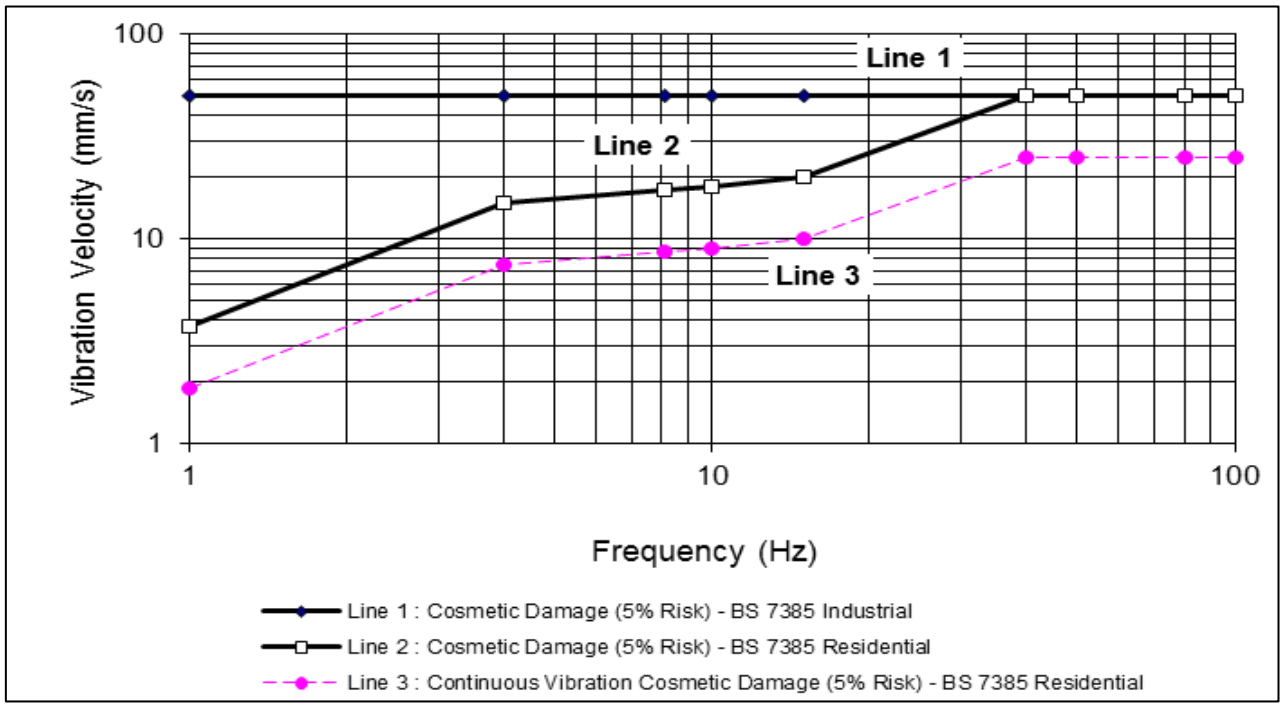
Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial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

The standard states that the guide values in Table 5-3 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 5-3 may need to be reduced by up to 50%.

Note: rockbreaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures (e.g. residences) and it may therefore be appropriate to reduce the transient values by 50%.

Figure 5-1 Graph of Transient Vibration Guide Values for Cosmetic Damage



In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard goes on to state that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 5-3 and major damage to a building structure may occur at values greater than four (4) times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 5-3 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS 2187 specifies that vibration measured should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 5-3**.**

It is noteworthy that extra to the guide values nominated in Table 5-3, the standard states that:

“Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.”

Also that:

“A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.”

5.4 Human Comfort Vibration Criteria

5.4.1 General

Humans are far more sensitive to vibration than is commonly realised. They can detect vibration levels which are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not, in itself, be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 5-4.

Table 5-4 Peak Vibration Levels and Human Perception of Motion

Approximate Vibration Level	Degree of Perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hz to 80 Hz.

Table 5-4 suggests that people will just be able to feel floor vibration at levels of about 0.15 mm/s and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

5.4.2 Human Comfort Criteria for Construction Vibration

British Standard 6472-2008 "*Guide to evaluation of human exposure to vibration in building*" nominates criteria for various categories of disturbance, the most stringent of which are the levels of building vibration associated with a "low probability of adverse comment" from occupants. The "low probability of adverse comment" level for residential buildings is:

0.4 to 0.8 $m/s^{1.75}$ (16 hour daytime Vibration Dose Value)

0.2 to 0.4 $m/s^{1.75}$ (8 hour night-time Vibration Dose Value)

BS 6472-2008 provides criteria for continuous, transient and intermittent (in the case of road traffic) events that are based on a Vibration Dose Value (VDV), rather than a continuous vibration level. The vibration dose value is dependent upon the level and duration of the short-term vibration event, as well as the number of events occurring during the daytime or night-time period.

The criteria presented in BS 6472 supersede the EPA's *"Assessing Vibration: A Technical Guideline"*.

5.4.3 Vibration Dose Limits

The permissible rms particle velocity levels corresponding to the vibration dose value vary according to the duration of exposure. Table 5-5 shows the range of satisfactory vibration dose values for which various degrees of adverse comment may be expected in the buildings surrounding the project.

Table 5-5 Vibration Dose Values ($m/s^{1.75}$) above which Various Degrees of Adverse Comment May Be Expected in Residential Buildings, Offices and Workshops

Location	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential buildings 16 hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Offices 16 hour day	0.4 to 0.8	0.8 to 1.6	1.6 to 3.2
Workshops 16 hour day	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

Situations exist where motion magnitudes above the dose levels given in BS 6472 can be acceptable, particularly for temporary disturbances and infrequent events of short-term duration. An example is a construction project.

When short-term works such as piling, demolition or compaction give rise to impulsive vibrations, it should be considered that undue restriction on vibration levels can significantly prolong these operations and result in greater annoyance.

In certain circumstances, the use of higher magnitudes of acceptability may be considered, e.g. for projects having social worth or broader community benefits or in view of the economic or practical feasibility of reducing vibration to the recommended levels. In such cases, best management practices should be employed to reduce levels as far as practical.

6 CONSTRUCTION NOISE ASSESSMENT

The most sensitive receivers are the residential dwellings to the north, south and west. Figure 6-1 below shows the site location in reference to the surrounding receivers

Figure 6-1 Site Layout and Nearest Receivers

6.1 Sleep Disturbance

The proposed construction activities will only occur during the daytime hours (7:00 to 18:00 Monday to Friday and 8:00 to 13:00 on Saturday) and no works will be carried out during the Sunday and/or public holidays, therefore a sleep disturbance assessment is not required.

6.1.1 Typical Equipment Noise Levels

A detailed construction equipment schedule has not been provided at this stage. We have used equipment noise levels for demolition and excavation activities in accordance to Australian Standard AS2436-2010. The following table presents the sound power levels (SWL) from the related equipment.

Table 6-1 Typical Sound Levels of Construction Equipment

Plant Description	A-weighted Sound power Levels L_{WA} dB ref: 10^{-12}W		A-weighted Sound Pressure Levels L_{PA} (mid point) dB at 10m
	Typical Range	Typical (mid point)	
Excavator	97-117	107	79
Hand Tools (electric)	95-110	102	74
Hand Tools (pneumatic)	114-117	116	88
Bulldozer	102-114	108	80
Compactor	110-115	113	85

6.1.2 Construction Stages

The proposed construction works will comprise of site establishment, excavation, demolition and construction of new structures.

Calculations using the date from the table above have been carried out in order to assess the impacts of the proposed activities, we have assumed the worst case scenarios were all machinery will be operating at once.

6.1.3 Project Construction Hours

The hours of operation will be in accordance with the NSW Environment Protection Authority's (EPA) *Interim Construction Noise Guideline* (ICNG, 2009) and are as follows:

Standard hours (SH)

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm
- No work on Sundays or public holidays

We note that no out of hours construction has been proposed at this stage.

6.1.4 Modelling Results

Calculations of the expected noise levels at the nearest sensitive receivers are presented in the tables below. We note that all noise levels are external $L_{AEQ(15min)}$

Table 6-2 Calculated Noise Level Results

Receiver	Calculated Noise Level $L_{AEQ(15min)}$	Criteria		Complies
		Standard Hours RBL + 10 dB	Highly Noise Affected	
R1	49	49	75	Yes
R2	49	49	75	Yes
R3	47	49	75	Yes

We note that no out of hours works have been proposed at this stage. If out of hours works are required in the future, a new noise assessment must be carried out by a suitable consultant.

The results presented in the tables above are based on noise levels for construction equipment derived from Australian Standard AS2436-2010. These noise levels are likely to change if different construction equipment is used.

7 MONITORING OF CONSTRUCTION NOISE & VIBRATION

7.1 Noise Monitoring

Noise monitoring will be performed in the event of a complaint received by the construction contractor, by an Acoustical Consultant engaged directly by the client.

Noise monitoring would be undertaken using statistical noise loggers supplemented by attended monitoring (where necessary) in order to differentiate between construction noise sources and other sources (such as road traffic and aircraft noise) and also in order to observe and identify any abnormally noisy construction equipment or operations.

During attended monitoring, typical maximum noise levels associated with particular operations and/or plant items will be noted. Where possible, extraneous noise events such as road and air traffic noise will be excluded from the results or highlighted in accompanying notes.

Noise monitoring will, if required, be undertaken by the Acoustical Consultant and reported weekly. Equipment and methods will comply with AS 1055.1-1989. The statistical parameters to be measured will be the L_{Amin}, L_{A90}, L_{A10}, L_{A1}, L_{Amax} and L_{Aeq} evaluated over consecutive 15 minute periods.

7.2 Vibration Monitoring

Vibration monitoring, will be performed in the event of a complaint received by the construction contractor, by an Acoustical Consultant engaged directly by the client. Vibration monitoring would be carried out continuously on the closest, potentially most affected structures during any works considered to potentially generate significant levels of vibration.

A single geophone mounting plate would be installed on the adjacent buildings/structures. The monitoring locations would be on a stiff part of the structures (at the foundations) on the side of the structures adjacent to the subject excavation works, in accordance with BS 7385:1993 Part 2.

The vibration monitoring system will be configured to record the peak vibration levels and to trigger an audible/visual alarm when predetermined vibration thresholds are exceeded. The thresholds correspond to an "Operator Warning Level" and an "Operator Halt Level", where the Warning Level is 75% of the Halt Level

The vibration threshold will be set to an "Operator Warning Level" of 6 mm/s (ppv) and an "Operator Halt Level" of 8 mm/s (ppv), the exceedance of which will be indicated by the audible/visual alarm in the construction site.

Based on the foregoing information, the nominated site control vibration criteria are presented in Table 7-1 and correspond to the minimal risk of cosmetic damage criterion from BS 7385.

Table 7-1 Nominated Site Control Vibration Criteria (ie Operator Warning and Halt Levels)

Structure	Site Control Criteria	
	Operator Warning Level	Operator Halt Level
Nearest Potentially Affected	6 mm/s	8 mm/s

Exceedance of the "Operator Warning Level" does not require excavation activity to cease but rather alerts the construction contractor to proceed with caution at reduced force or load. An exceedance of the "Operator Halt Level" requires the construction contractor to implement an alternative excavation technique. The vibration monitoring equipment would be downloaded on a weekly basis by the Acoustical Consultant.

Weekly reports of the measured vibration levels and their likely impacts would be prepared by the Acoustical Consultant and distributed by the Project Manager.

Attended vibration monitoring will, if considered necessary, be conducted by the Acoustical Consultant. Attended vibration monitoring (structural damage and/or human comfort) will also be carried out in response to complaints or to structural damage criterion exceedances. This monitoring will provide direct feedback to the operators in order to allow appropriate modification of excavation techniques.

8 NOISE MITIGATION MEASURES

The following noise mitigation measures will be implemented by the construction contractor.

The construction contractor will, where reasonable and feasible, apply best practice noise mitigation measures including:

- Maximising the offset distance between noisy plant items and nearby noise sensitive receivers.
- Avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers.
- Minimising consecutive works in the same locality.
- Orienting equipment away from noise sensitive areas.
- Carrying out loading and unloading away from noise sensitive areas.

Further, in order to minimise noise impacts during the works, the construction contractor will take all reasonable and feasible measures to mitigate noise effects.

The contractor will also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers. Silenced air compressors fitted with noise labels indicating a maximum (L_{Amax}) sound pressure level of not more than 75 dB(A) at 7 m will be used on site. The sound pressure level of noise emitted from a compressor used will comply with noise label requirements.

9 VIBRATION MITIGATION MEASURES

The following vibration mitigation measures will be implemented by the construction contractor:

- Relocate any vibration generating plant and equipment to areas within the site in order to lower the vibration impacts.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of excavation plant and equipment e.g. smaller capacity rockbreaker hammers.
- Minimise consecutive works in the same locality (if applicable).
- Schedule a minimum respite period of at least 0.5 hour before activities commence which are to be undertaken for a continuous 4 hour period.
- Use only dampened rockbreakers and/or “city” rockbreakers to minimise the impacts associated with rockbreaking works.

10 SUMMARY OF MITIGATION MEASURES

The noise and vibration mitigation measures to be implemented by the construction contractor are summarised in Table 10-1.

Table 10-1 Noise and Vibration Mitigation Measures

Item	Description
Construction Hours	Works will be carried out within the approved construction hours.
Deliveries	Deliveries will be carried out within the approved construction hours.
Site Layout	Where possible, plant and equipment will be located and orientated to direct noise away from sensitive receivers.
Quietest Suitable Equipment	Plant and equipment will be selected to minimise noise emission, where possible, whilst maintaining efficiency of function. Residential grade silencers will be fitted and all noise control equipment will be maintained in good order.
Reversing Alarms	Mobile plant and trucks operating on site for a significant portion of the project will have reversing alarm noise emissions minimised, where possible, recognising the need to maintain occupational safety standards.
PA System	No public address system will be used at this site.
Vibration Monitoring	Vibration monitoring will be carried out where any vibration intensive activities are required to be carried out where there is considered to be a risk that vibration levels may exceed the relevant structural damage criteria.
Truck Noise (off site)	All trucks regularly used for the project are to have mufflers and all noise control equipment will be maintained in good working order. Trucking routes will use main roads, where feasible.
Community Liaison	A programme of community liaison and complaint response will be implemented.
Training	Site induction training will include a noise awareness component.

11 IDENTIFYING AND MANAGING FUTURE NOISE AND VIBRATION ISSUES

If additional activities or plant are found to be necessary that will emit noise and/or vibration emissions significantly exceeding those assumed for this assessment, these will be assessed by the Acoustical Consultant on a case-by-case basis and appropriate mitigation measures will be implemented.

Progressive impact assessments will be conducted as the works proceed in the event that works significantly deviate from those originally planned.

12 NON COMPLIANCE AND CORRECTIVE ACTION

Where the noise and/or vibration monitoring identifies non-compliance with the relevant criteria, the construction contractor will plan and carry out corrective action. The corrective action may involve supplementary monitoring in order to identify the source of the non-conformance and/or may involve modification of the construction techniques or programme to avoid any recurrence or minimise its adverse effects.

13 COMPLAINT HANDLING

The construction contractor will adopt the following protocol for handling complaints. This protocol is intended to ensure that the issues are addressed and that appropriate corrective action is identified and implemented as necessary:

- The construction contractor will record all verbal and telephone complaints in writing and will forward all complaints to the Project Manager together with details of the circumstance leading to the complaint and all subsequent actions.
- Complaints received by the Project Manager will, as an initial step, be referred to the construction contractor. The construction contractor will respond as described above.
- The Project Manager will investigate the complaint in order to determine whether a criterion exceedance has occurred or whether noise and/or vibration have occurred unnecessary.
- If excessive or unnecessary noise and/or vibration have been caused, corrective action will be planned and implemented by the construction contractor.
- Complainants will be informed by the Project Manager that their complaints are being addressed, and (if appropriate) that corrective action is being taken.
- Follow up monitoring or other investigations will be carried out by the Project Manager and the construction contractor to confirm the effectiveness of the corrective action.
- Complainants will be informed of the implementation of the corrective action that has been taken to mitigate the adverse effects.

14 COMMUNITY CONSULTATION AND LIAISON

Community consultation will be undertaken via the construction contractor and will include:

- Advising the community of work to be undertaken.
- Recording and managing any complaints.

These and other elements of the community consultation will be addressed under the relevant procedures for the subject works.

15 CONCLUSION

RSA has conducted a construction noise impact assessment of the proposed remedial works at 28 - 32 Evan Street, Penrith. The assessment has comprised the establishment of noise criteria and assesses noise impacts with regard to relevant statutory requirements.

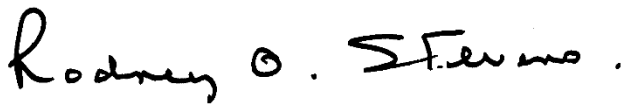
This assessment has addressed the potential direct and cumulative construction noise impacts of the project, and found that noise impacts have been predicted to exceed the 'noise affected' management level at the majority of considered receiver locations. Consequently, feasible and reasonable work practices and best practice methods utilised on construction and demolition sites have been recommended to avoid, mitigate and manage any adverse noise throughout the work activities for the proposed site.

It is advised that site management review the work processes of the major noise source contributors and investigate the implementation of the most practical feasible and reasonable work practices detailed in this report.

Noise emissions criteria for mechanical plant has been stablished in this report, a future noise survey may be required once the mechanical plan schedules are available.

It is understood that complaints received surrounding construction noise will be managed and therefore, it is anticipated that a satisfactory noise complaint handling strategy is currently in place, however an indicative noise complaint handling strategy has been provided within Appendix D.

Approved:-



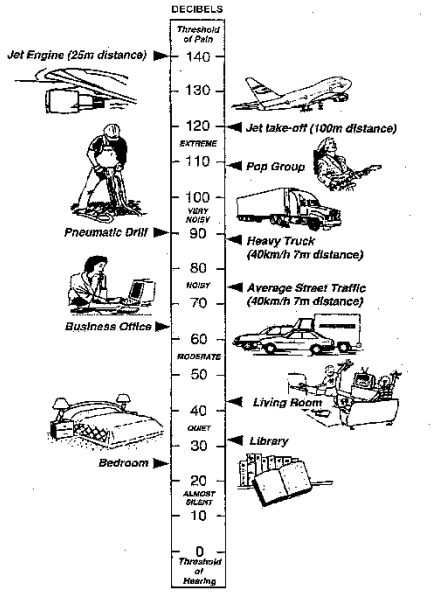
Rodney Stevens

Manager/Principal

Appendix A – Acoustic Terminology

A-weighted sound pressure	The human ear is not equally sensitive to sound at different frequencies. People are more sensitive to sound in the range of 1 to 4 kHz (1000 – 4000 vibrations per second) and less sensitive to lower and higher frequency sound. During noise measurement an electronic '*A-weighting*' frequency filter is applied to the measured sound level *dB(A)* to account for these sensitivities. Other frequency weightings (B, C and D) are less commonly used. Sound measured without a filter is denoted as linear weighted dB(linear).
Ambient noise	The total noise in a given situation, inclusive of all noise source contributions in the near and far field.
Community annoyance	Includes noise annoyance due to: character of the noise (e.g. sound pressure level, tonality, impulsiveness, low-frequency content) character of the environment (e.g. very quiet suburban, suburban, urban, near industry) miscellaneous circumstances (e.g. noise avoidance possibilities, cognitive noise, unpleasant associations) human activity being interrupted (e.g. sleep, communicating, reading, working, listening to radio/TV, recreation).
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Cumulative noise level	The total level of noise from all sources.
Extraneous noise	Noise resulting from activities that are not typical to the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Feasible and reasonable measures	Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors: Noise mitigation benefits (amount of noise reduction provided, number of people protected). Cost of mitigation (cost of mitigation versus benefit provided). Community views (aesthetic impacts and community wishes). Noise levels for affected land uses (existing and future levels, and changes in noise levels).

Impulsiveness	Impulsive noise is noise with a high peak of short duration or a sequence of these peaks. Impulsive noise is also considered annoying.
Low frequency	Noise containing major components in the low-frequency range (20 to 250 Hz) of the frequency spectrum.
Noise criteria	The general set of non-mandatory noise levels for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (e.g. noise levels for various land use).
Noise level (goal)	A noise level that should be adopted for planning purposes as the highest acceptable noise level for the specific area, land use and time of day.
Noise limits	Enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.
Performance-based goals	Goals specified in terms of the outcomes/performance to be achieved, but not in terms of the means of achieving them.
Rating Background Level (RBL)	The rating background level is the overall single figure background level representing each day, evening and night time period. The rating background level is the 10th percentile min L_{A90} noise level measured over all day, evening and night time monitoring periods.
Receptor	The noise-sensitive land use at which noise from a development can be heard.
Sleep disturbance	Awakenings and disturbance of sleep stages.
Sound and decibels (dB)	Sound (or noise) is caused by minute changes in atmospheric pressure that are detected by the human ear. The ratio between the quietest noise audible and that which should cause permanent hearing damage is a million times the change in sound pressure. To simplify this range the sound pressures are logarithmically converted to decibels from a reference level of 2 x 10-5 Pa. The picture below indicates typical noise levels from common noise sources.



dB is the abbreviation for decibel – a unit of sound measurement. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

Sound power Level (SWL)

The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in *dB(A)*.

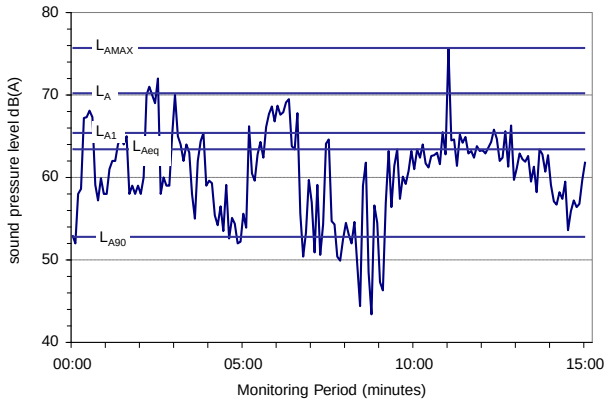
Sound Pressure Level (SPL)

The level of noise, usually expressed as SPL in *dB(A)*, as measured by a standard sound level meter with a pressure microphone. The sound pressure level in *dB(A)* gives a close indication of the subjective loudness of the noise.

Statistic noise levels

Noise levels varying over time (e.g. community noise, traffic noise, construction noise) are described in terms of the statistical exceedance level.

A hypothetical example of A weighted noise levels over a 15 minute measurement period is indicated in the following figure:



Key descriptors:

L_{Amax} Maximum recorded noise level.

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} Noise level present for 10% of the 15 minute interval. Commonly referred to the average maximum noise level.

L_{Aeq} Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.

L_{A90} Noise level exceeded for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).

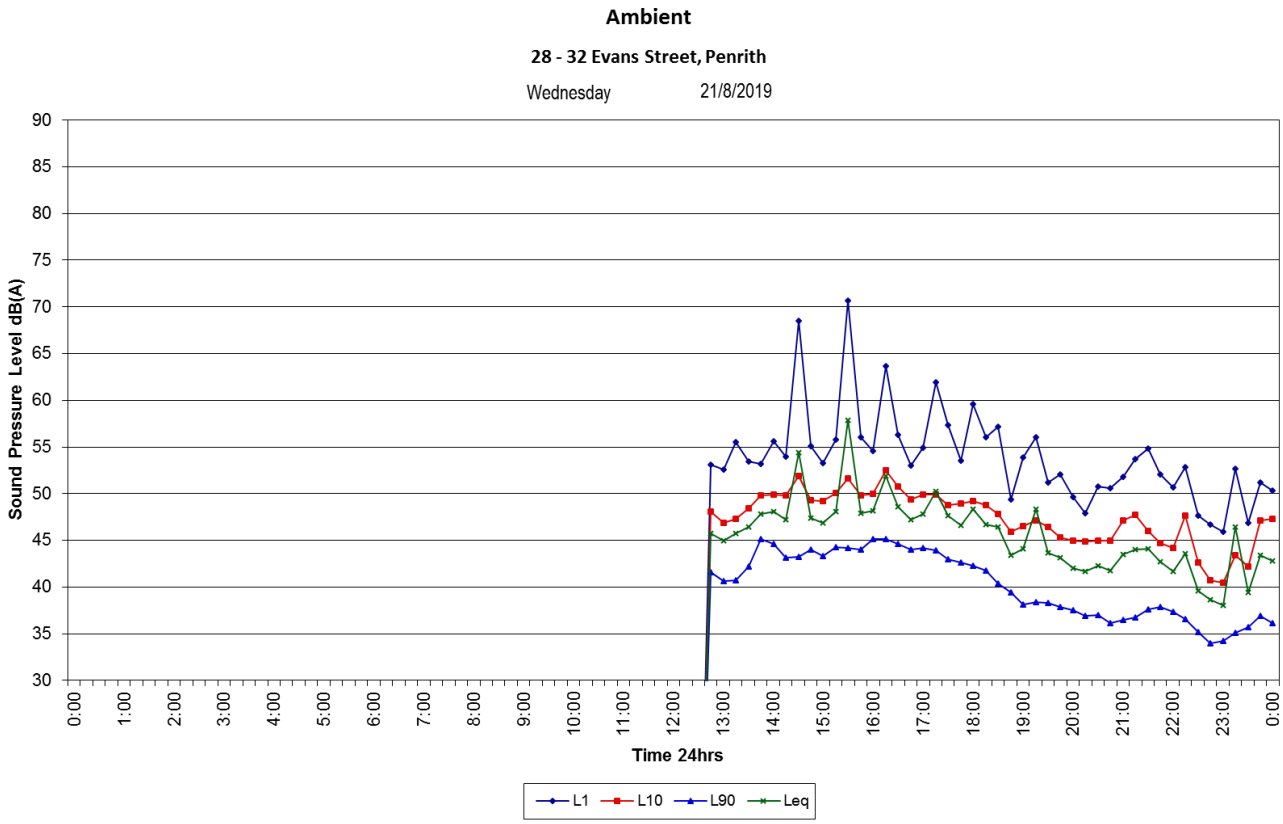
Threshold

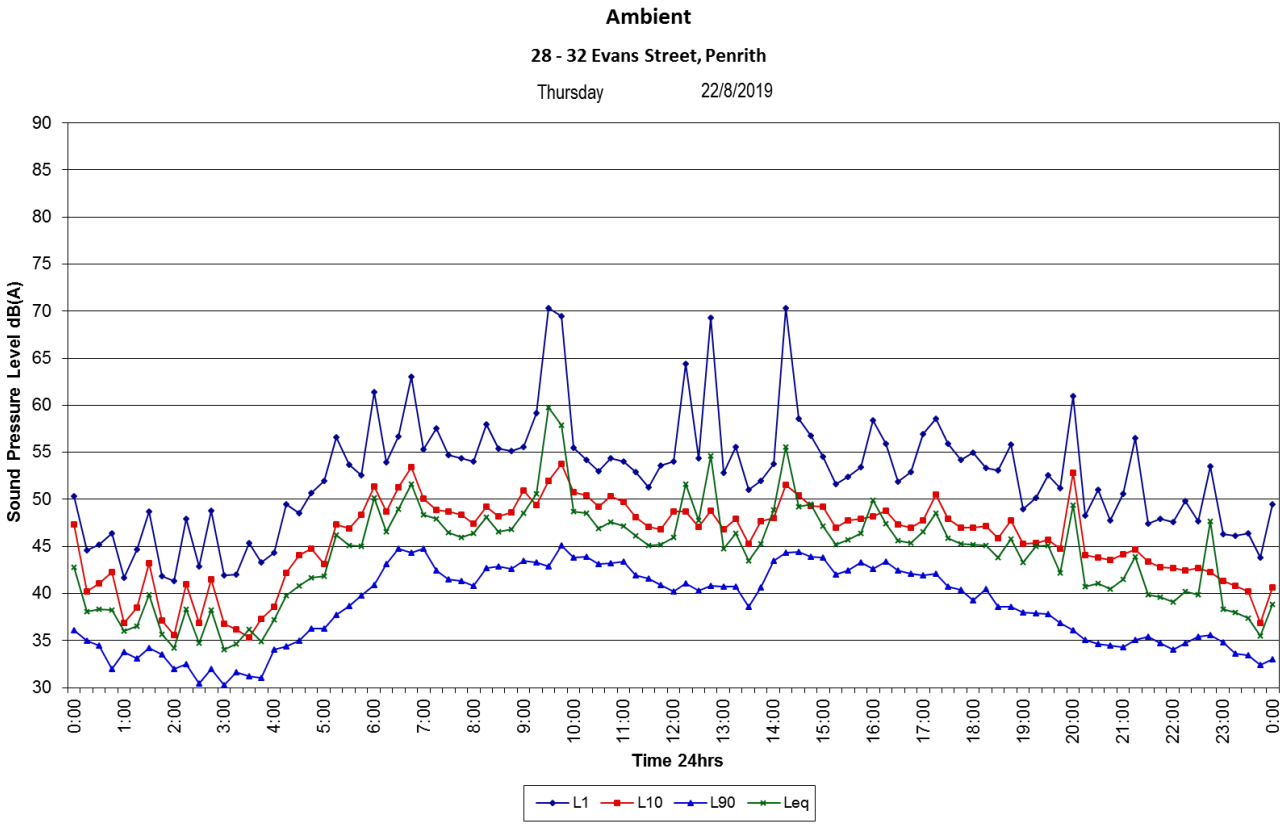
The lowest sound pressure level that produces a detectable response (in an instrument/person).

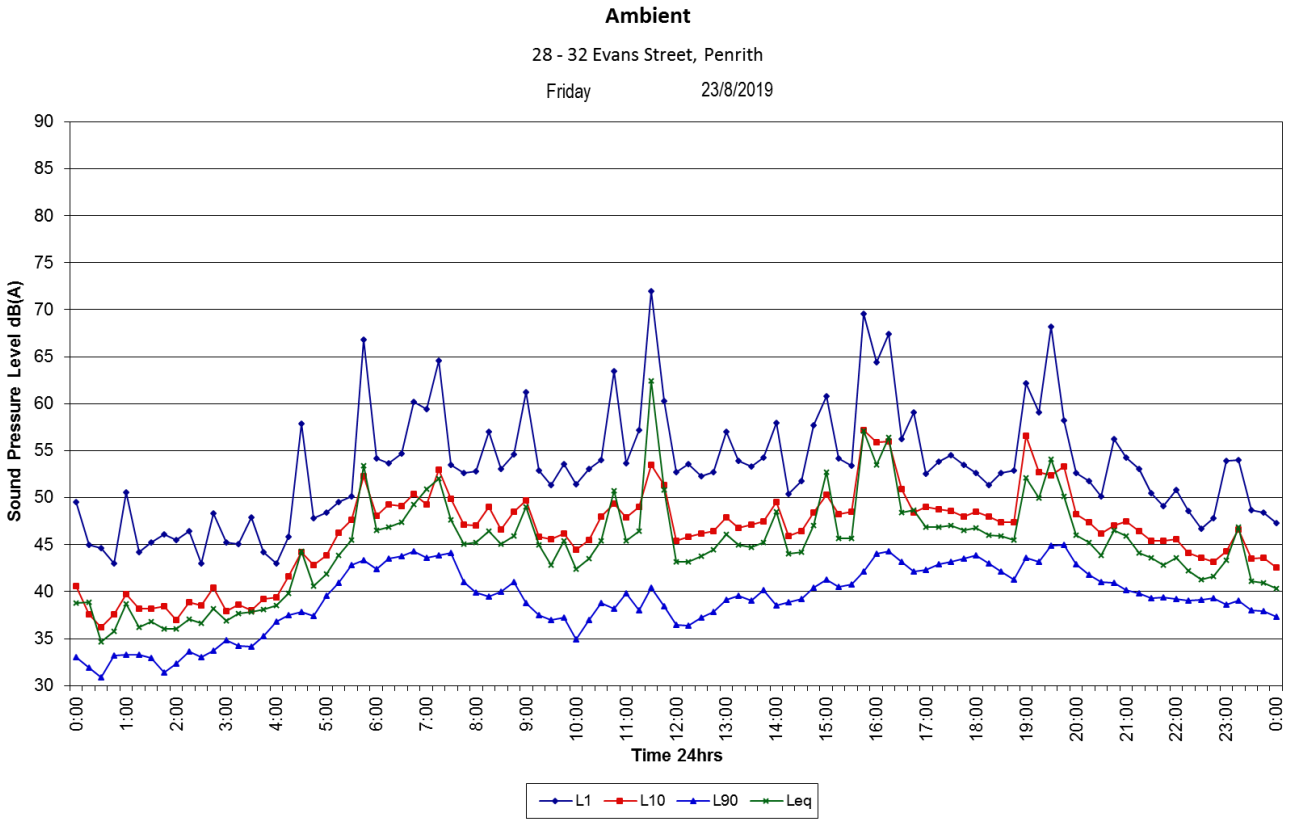
Tonality

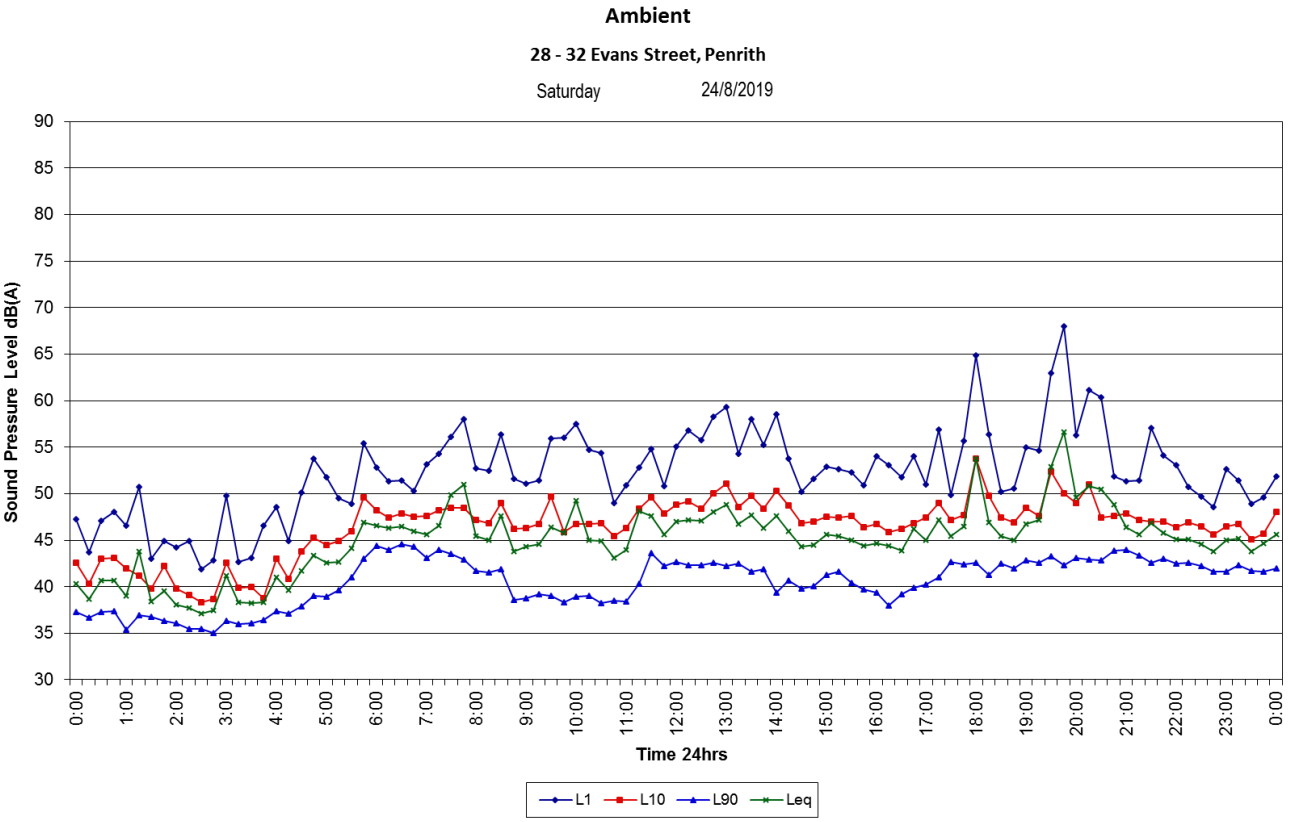
Tonal noise contains one or more prominent tones (and characterised by a distinct frequency components) and is considered more annoying. A 2 to 5 dB(A) penalty is typically applied to noise sources with tonal characteristics

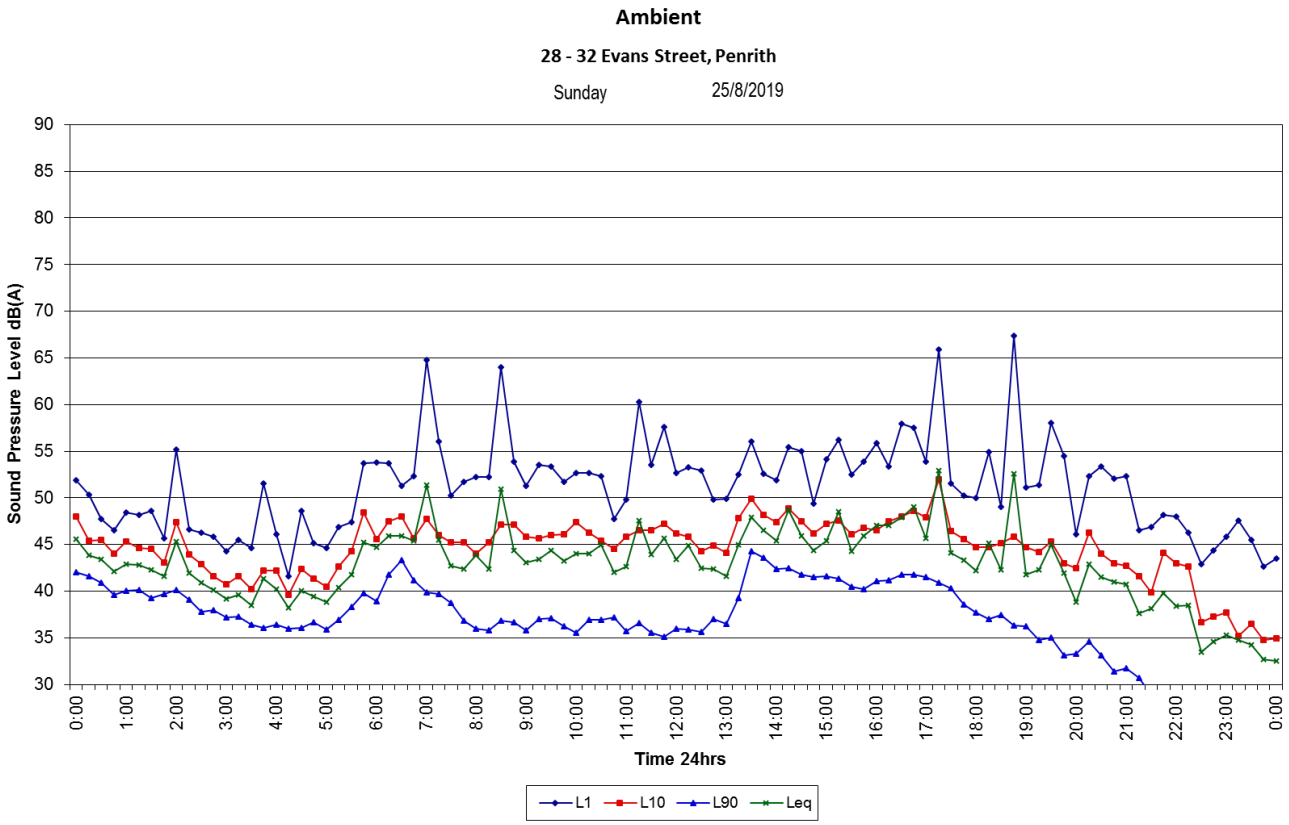
Appendix B – Baseline Noise Survey Graphs

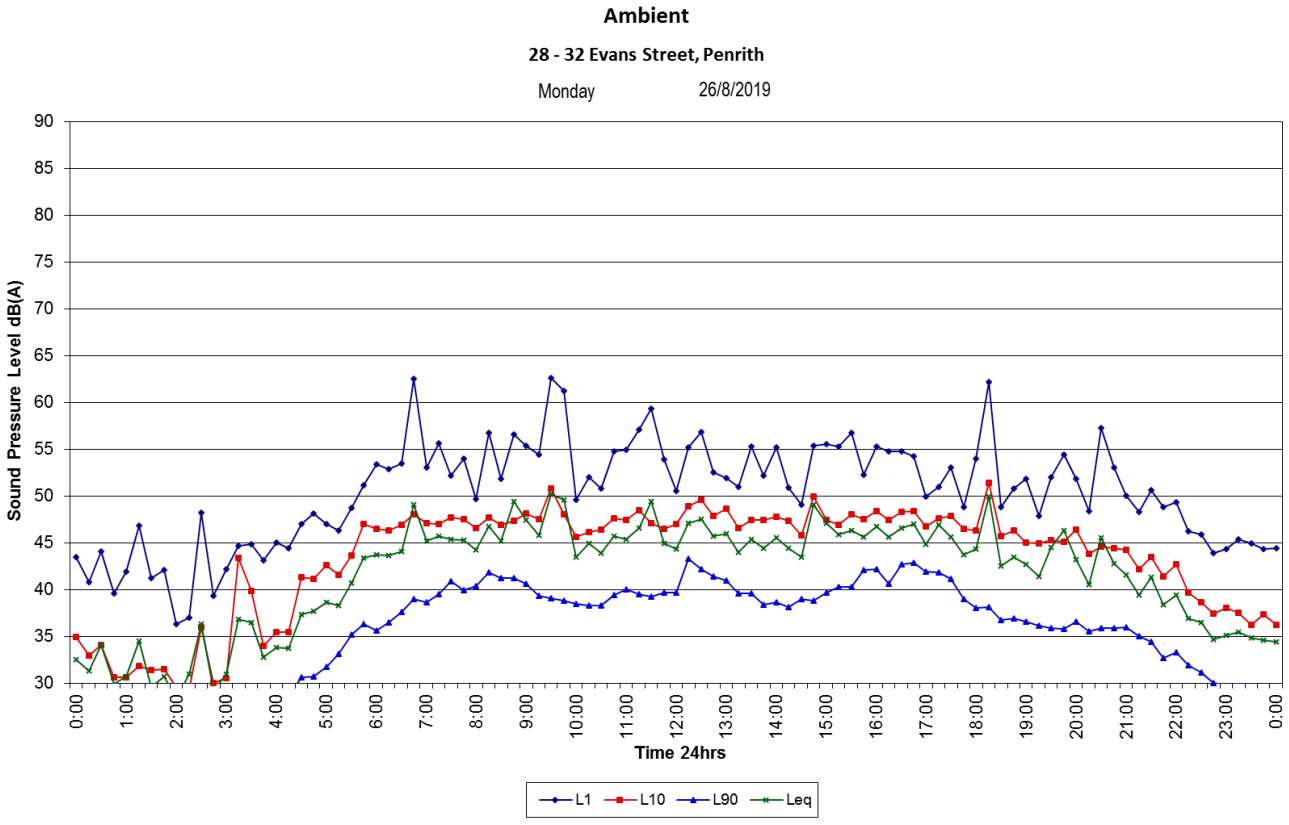


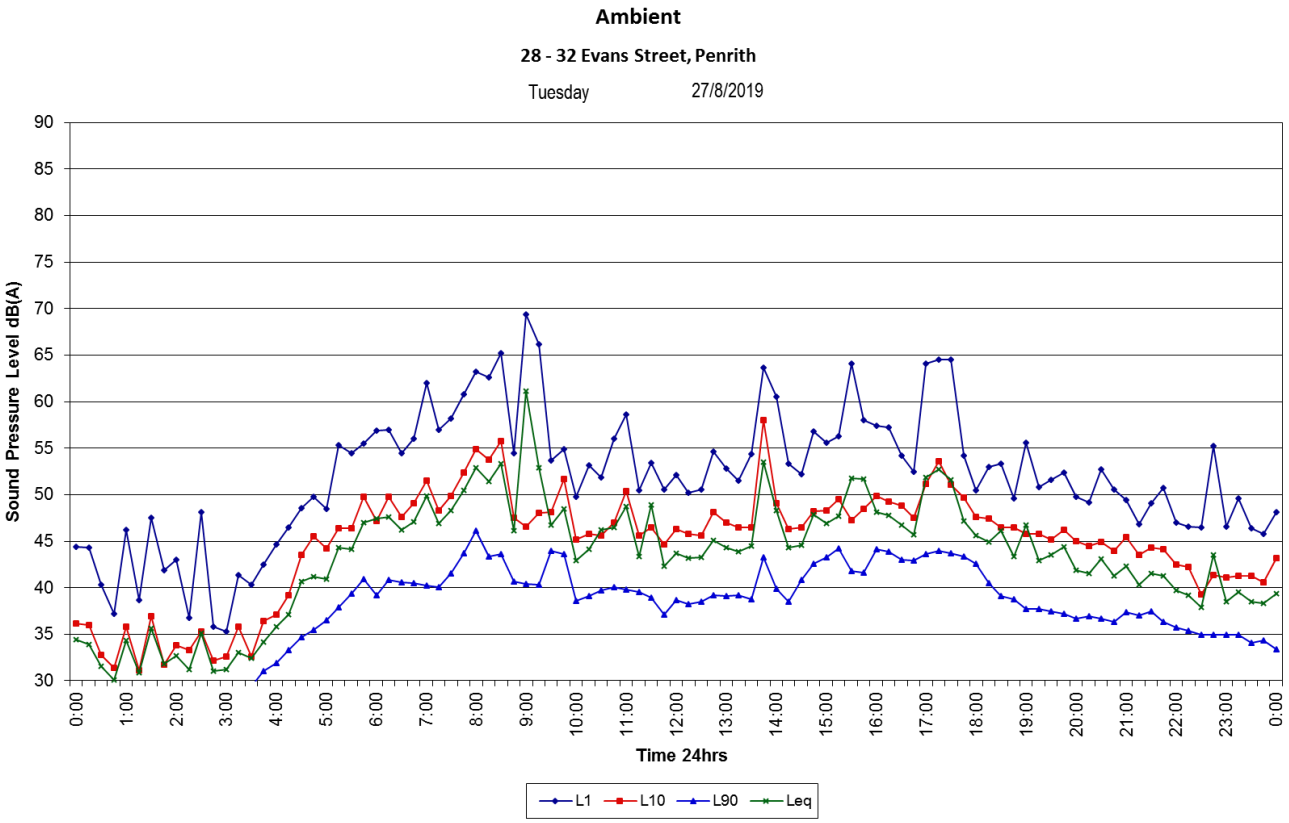


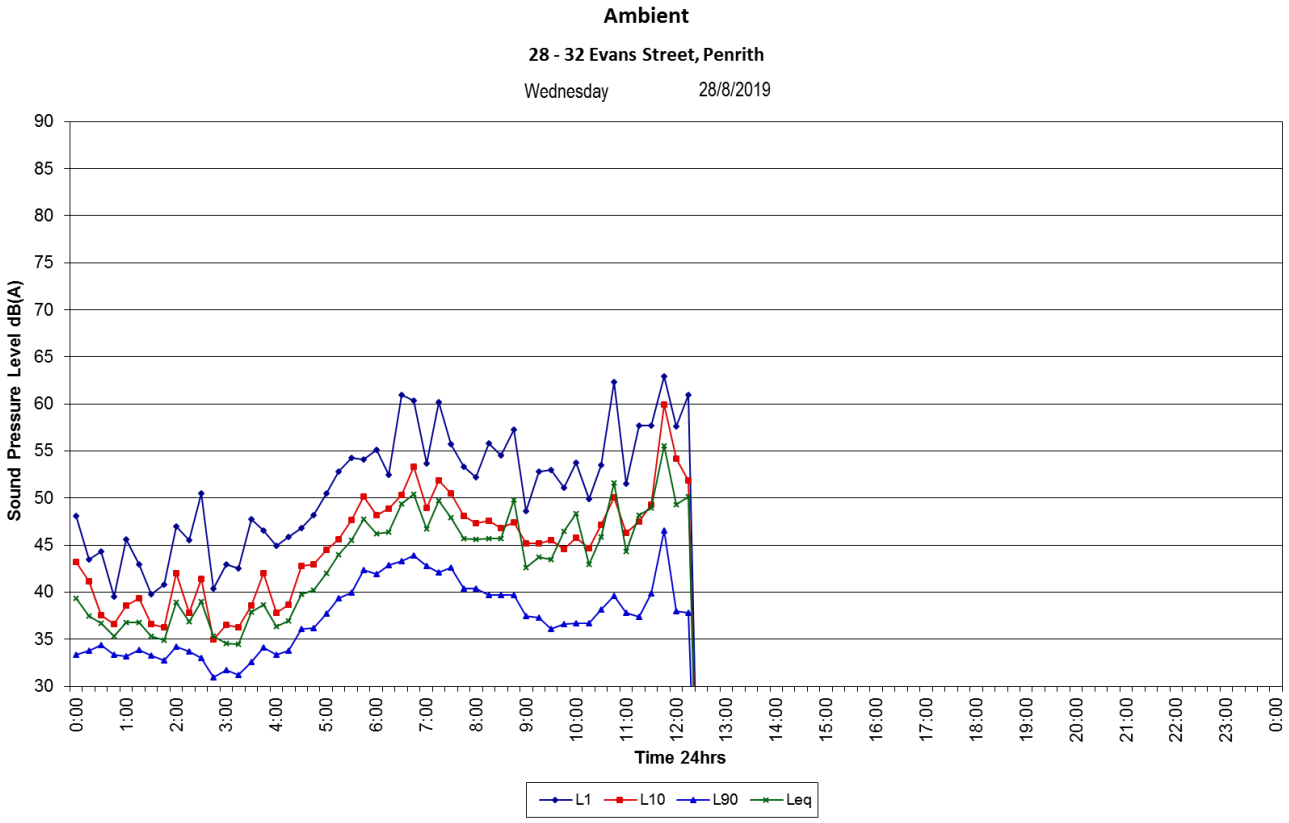












Appendix C – Instrument Calibration Certificate

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Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C19414

Client Details	Rodney Stevens Acoustics Pty Ltd 1 Majura Close St Ives Chase NSW 2075
Equipment Tested/ Model Number :	Rion NL-42EX
Instrument Serial Number :	00572559
Microphone Serial Number :	170395
Pre-amplifier Serial Number :	72897

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	24°C	**Ambient Temperature :**	24.2°C
Relative Humidity :	42.9%	**Relative Humidity :**	42.1%
Barometric Pressure :	99.94kPa	**Barometric Pressure :**	99.9kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 11 Jul 2019
Secondary Check: Eloise Burrows
Report Issue Date : 15 Jul 2019
Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 2 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.21dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Appendix D - Noise Complaint Handling Strategy

In the absence of a pre-existing noise complaint handling strategy the following strategy may be adopted for all noise enquiries / complaints. The strategy provides guidance on actions to be undertaken by site management or nominated personnel to actively address complaints received from the surrounding community.

[1]. On receipt of a noise enquiry/complaint, site management or nominated personnel will complete a Record of Construction Noise Complaint, including specific details as follows:

- full name and contact details of the complainant;
- time and date of the incident;
- details of the complainant's location;
- description of construction noise;
- any other details the complainant may wish to provide; and
- whether the complainant requests further action.

[2]. The noise enquiry is then referred to site management for investigation. Upon completion of the investigation, the complainant will be contacted by site management or nominated personnel to discuss the event that caused the noise enquiry. Contact with the complainant should take place as soon as practicable, but no later than 1 day from when the complaint was recorded.

[3]. If the complaint requires further action, or site management believes the matter warrants further investigation, an independent acoustic consultant should be engaged to undertake attended noise measurements at the location of the complainant during works identified as giving rise to the complaint.

[4]. In the event that attended noise measurements reveal that construction noise levels comply with the applicable noise criteria for the location, no further action is required however it is advised to provide the complainant with relevant information about the construction works.

[5]. Should the attended noise measurements reveal that construction noise levels exceed the applicable noise criteria for the location, all feasible, reasonable and practical work practices must be investigated and implemented in order to reduce the current level of construction noise. Noise levels should then be re-measured in order to evaluate the level of reduction achieved.

[6]. If the construction noise levels have been satisfactorily reduced to comply with the applicable noise criteria no further action is required. If the construction noise levels continue to exceed the applicable noise criteria for the location number 5 should be repeated in order to further reduce construction noise levels.

Appendix E – Architectural Plans

PROPOSED RESIDENTIAL FLAT BUILDING
LEVEL 5
DA10
A

PROPOSED RESIDENTIAL FLAT BUILDING
WEST ELEVATION
DA20
A