REVERB ACOUSTICS
Noise and Vibration Consultants

Construction Noise & Vibration Management Plan
Horizon Lee 5
Mixed-Use Development
45 Honeysuckle Drive
Newcastle NSW

June 2021

Prepared for BLOC Pty Ltd
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Building Acoustics-Council/EPA Submissions-Modelling-Compliance-Certification

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EXECUTIVE SUMMARY

Reverb Acoustics has been commissioned to prepare a noise and vibration management plan for the proposed Horizon Lee 5 mixed-use development at 45 Honeysuckle Drive, Newcastle. The proposed work will include earthworks, boring of piles, pouring of concrete and erection of structures.

The purpose of this assessment is to determine the noise impact construction activities will have upon nearby neighbours and to recommend practical and cost effective noise control options, where required.

Construction noise and vibration impacts are predicted in **Section 7** where suggested noise reduction measures are recommended for work close to neighbouring buildings in **Section 8**. The majority of potential noise impacts can be overcome by managing and co-ordinating noisy activities during less sensitive time periods and by providing an easily accessible complaints hotline to all concerned parties.

Simultaneous ground vibration monitoring is required when any vibration producing activity is conducted within the safe working distance noted in Table 7. It is also recommended that noise and vibration monitoring should be conducted for any activity identified by the construction/environmental manager that is not specifically mentioned within this report.

Noise control strategies are offered for consideration during the construction project. Suggested strategies include substituting noisy activities with quieter alternatives, requisite time periods for noisy activities, sensible equipment selection, etc.

Subject to noise control recommendations discussed in this report, this assessment has shown that construction of the development should result in only short-term periods of high noise for nearby neighbours, and we therefore recommend that works should proceed.

1 INTRODUCTION

Reverb Acoustics has been commissioned to prepare a Construction Noise and Vibration Management Plan for the Horizon Lee 5 mixed-use development at 45 Honeysuckle Drive, Newcastle. Construction activities include some bulk earthworks, followed by boring of piles, pouring of concrete and erection of the structure. No pile driving, ripping, etc, will occur on the site. Early earthworks are expected for a week or two, with a total project duration of more than 26 weeks

The Assessment was requested by BLOC Pty Ltd to satisfy Condition C9 of Development Consent, which requires preparation of a Construction Noise and Vibration Management Plan and to form part of the Construction Environmental Management Plan for construction activities.

2 TECHNICAL REFERENCE / DOCUMENTS

Beranek, L.L and Istvan, L.V. (1992). *Noise and Vibration Control Engineering.* John Wiley and Sons, Inc.

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Peterson, A.P.G. (1980). *Handbook of Noise Measurement*. Massachusetts, Genrad Inc.

Sharland, I. (1998). *Woods Practical Guide to Noise Control.* England, Woods Acoustics

NSW Environment Protection Authority (2009). *Interim Construction Noise Guideline.*

Department of Environment, Climate Change and Water's (2006). *Assessing Vibration: A Technical Guideline*

Department for Environment Food and Rural Affairs (DEFRA). (2005). *Update of Noise database for Prediction of Noise on Construction and Open Sites.*

Reverb Acoustics Pty Ltd (April 2019). *Noise Impact Assessment. Mixed-Use Development 45 Honeysuckle Drive Newcastle, NSW.*

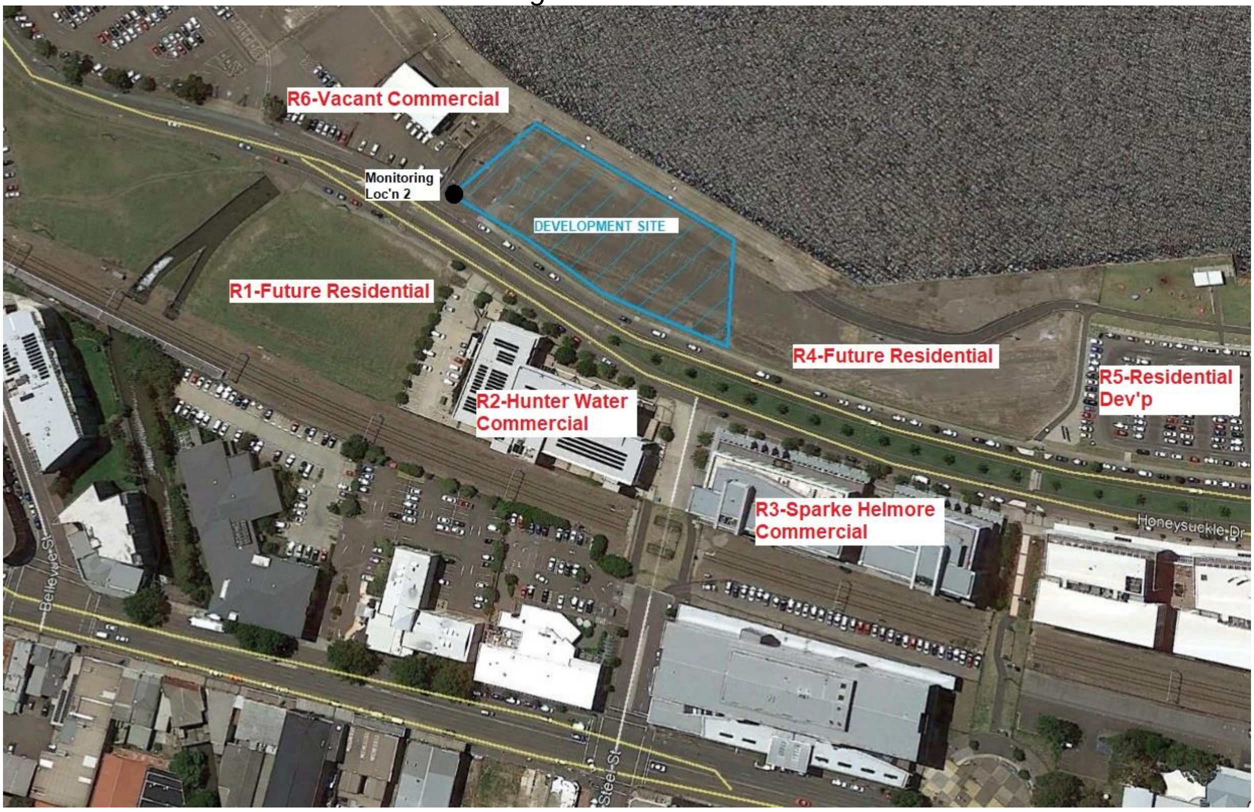
A Glossary of commonly used acoustical terms is presented in Appendix A to aid the reader in understanding the Report.

3 DESCRIPTION OF PROPOSAL

Anticipated works include bulk earthworks, followed by pouring of concrete and erection of structures.

Initial bulk earthworks are expected to employ an excavator and up to 1-2 trucks. Machines will generally be confined to a small work area as work progresses through each stage of the project. Excavated and filled areas will be balanced, ensuring little or no material will need to be transported from the site. Any material that must be ferried from the site will occur in registered single steer trucks. Anticipated construction hours are 7am to 6pm Monday to Friday and 8am to 1pm on Saturday, with no construction permitted on Sundays or public holidays. Nearest receivers are labelled on Figure 1 below:

Figure 1: Site Plan



4 EXISTING ACOUSTIC ENVIRONMENT

Background noise levels were established in the immediate receiver areas as part of the Noise Impact Assessment completed by Reverb Acoustics for the Development Application for the site. The following background noise levels were determined as part of the assessment:

Day	52dB(A),L90	7am-6pm
Evening	52dB(A),L90	6pm-10pm
Night	46dB(A),L90	10pm-7am

5 ASSESSMENT CRITERIA

5.1 Construction Noise – Residential Receivers

Various authorities have set maximum limits on allowable levels of construction noise in different situations. Arguably the most universally acceptable criteria, and those which will be used in this Report, are taken from the NSW Environment Protection Authority's (EPA's) Interim NSW Construction Noise Guideline (ICNG). Since the project involves a significant period of construction activity, a "quantitative assessment" is required, i.e. comparison of predicted construction noise levels with relevant criteria. For assessment of noise impacts at residential receivers Table 3 of the ICNG is reproduced below in Table 1:

Table 1: - Table 3 of ICNG Showing Relevant Criteria at Residences

Time of Day	Management Level Leq (15min)	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public holidays	Noise affected RBL +10dB(A) i.e**. 62dB(A) day**	- The noise affected level represents the point above which there may be some community reaction to noise. - Where the predicted or measured LAEQ (15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. - 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 75dB(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 proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. - If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining duration and noise level of the works, and by describing any respite periods that will be provided.
Outside recommended Standard hours	Noise affected RBL +5dB(A)	- A strong justification would typically be required for works outside the recommended standard hours. - 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 5dB(A) above the noise affected level, the proponent should negotiate with the community. - For guidance on negotiating agreements see Section 7.2.2

Section 4.2 of the ICNG also specifies the following external noise level limits for commercial and industrial premises.

Industrial premises	**75dB(A),Leq (15 min)**
Offices, retail outlets	**70dB(A),Leq (15 min)**

Construction will only occur during standard construction hours, i.e. 7am to 6pm Monday to Friday and 8am to 1pm on Saturday, with no construction permitted on Sundays or public holidays. Table 2 relevant for potentially affected existing receivers (also see Figure 1).

Table 2: Criteria Summary

Assessment Location	Standard Construction Hours		Outside Standard Hours
	Noise Affected	Highly Noise Affected	
R5 – Residential Dev'p	62	75	57/51 #
R2,R3 – Commercial Dev'p	70	75	70

#Evening and night periods.

5.2 Construction Vibration

Personal Comfort

The majority of maximum limits on allowable ground and building vibration in different circumstances and situations are directed at personal comfort rather than building damage. This usually leads, in virtually every situation, to people who interpret the effects of a vibration to ultimately determine its acceptability. The ICNG recommends that the EPA guideline, *Assessing Vibration: A Technical Guideline (2006),* should be used for assessing construction vibration. Limits set out in the Guideline are for vibration in buildings, and are directed at personal comfort for continuous, impulsive and intermittent vibrations. Table 3 shows the Vibration Dose Values for intermittent vibration activities such as pile driving and use of vibrating rollers etc, taken from Table 2.4 of the Guideline, above which various degrees of adverse comment may be expected.

Table 3: Acceptable Vibration Dose Values ($m/s^{1.75}$)
Above which Degrees of Adverse Comment are Possible

Location	Day (7am-10pm)		Night (10pm-7am)	
	Preferred	Maximum	Preferred	Maximum
Critical areas #	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Hospital operating theatres, precision laboratories, etc.

Building Safety:

Other criteria specifically dealing with Building Safety Criteria include Australian Standard AS2187.2-1993, dealing specifically with blasting vibration, specifies a maximum peak particle velocity of 10mm/sec for houses and a preferred limit of 5mm/sec where site specific studies have not been undertaken.

German Standard DIN 4150 - 1986, Part 3 Page 2, specifies a maximum vibration velocity of 5 to 15 mm/sec in the foundations for dwellings and 3 to 8 mm/sec for historical and sensitive buildings, for the range 10 to 50Hz. British Standard BS 7385 Part 2, specifies a maximum vibration velocity of 15mm/sec at 4Hz increasing to 20mm/sec at 15Hz increasing to 50mm/sec at 40Hz and above, measured at the base of the building.

Additionally, The Australian and New Zealand Environment Conservation Council (ANZECC) guideline *"Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration"* limit peak particle velocities from blasting to below 5mm/sec at residential receivers, with a long term regulatory goal of 2mm/sec.

The above listed criteria vary from 3mm/sec up to 15mm/sec, therefore, the more conservative limit of **3mm/sec** will be adopted for the purposes of Building Safety Criteria. It should be acknowledged, however, that intermittent ground vibration velocities at 5mm/sec are generally considered the threshold at which architectural (cosmetic) damage to normal dwellings may occur and velocities at 10mm/sec should not cause any significant structural damage, with the exception of the most fragile and brittle of buildings.

6 METHODOLOGY

Future noise and vibration sources on the site cannot be measured at this time, consequently noise and vibration levels produced by plant and machinery to be used on the site have been sourced from manufacturers' data, DEFRA database, and/or our library of technical data, which has been accumulated from measurements taken in many similar situations on other sites for others.

All noise level measurements were taken with a Svan 912A Sound & Vibration Analyser. This instrument has the capability to measure steady, fluctuating, intermittent and/or impulsive sound, and to compute and display percentile noise levels for the measuring period. A calibration signal was used to align the instrument train prior to measuring and checked at the conclusion. Difference in the two measurements was less than 0.5dB. Each measurement was taken over a representative time period to include all aspects of machine/process operation, including additional start-up noise where applicable. Sound measurements were generally made around all sides of each machine, to enable the acoustic sound power (dB re 1pW) to be calculated. The sound power level is then theoretically propagated to the receiver, with allowances made for spherical spreading.

Atmospheric absorption, directivity and ground absorption have been ignored in the calculations. As a result, predicted received noise levels are expected to slightly overstate actual received levels, thus providing a measure of conservatism. Addition of the received Sound Pressure Level (SPL) for each of the individual operating sources gives the total SPL at each receiver, which is then compared to the criteria. Where noise impacts above the criterion are identified, suitable noise control measures are implemented and reassessed to demonstrate satisfactory received noise levels.

Typical vibration levels for construction activities were measured at other sites for various ground types and situations primarily using a Vibroch V801 Seismograph coupled to a triaxial geophone. A sandbag was placed over the geophone or it was glued to the surface location during each measurement to ensure elevated readings were not recorded due to bouncing and movement, which may occur at higher vibration amplitudes. The unit is capable of measuring and storing peak Z-axis vibration velocities, as well as vibration in three directions simultaneously and gives peak velocity and acceleration on the x, y and z axes.

This theoretical assessment is based on a worst-case scenario, where all plant items are operating simultaneously in locations most exposed to the receiver. In reality, most plant will be located in shielded areas, so actual received noise is expected to be less than the predictions shown in this report, or at worst equal to the predicted noise levels for only part of the time.

7 ANALYSIS AND DISCUSSION

7.1 Predicted Noise levels - Construction Plant and Equipment

Received noise produced by anticipated construction activities is shown in Table 4 below, for a variety of distances to a typical receiver, with no noise barriers or acoustic shielding in place and with each item of plant operating at full power.

Table 4: Predicted Plant Item Noise Levels, dB(A)Leq

		Distance to Residence			
Plant/Activity	**(Lw)**	**40m**	**80m**	**100m**	**200m**
Tower crane	(104)	64	58	56	50
Hammering	(98)	58	52	50	44
Angle grinder	(106)	66	60	58	52
Air wrench (silenced)	(98)	58	52	50	44
Compactor	(111)	71	65	63	57
Road truck	(104)	64	58	56	50
Grader	(102)	62	56	54	48
Air compressor	(98)	58	52	50	44
Concrete Agitator	(112)	72	66	64	58
Concrete Pump	(110)	70	64	62	56
Pile boring machine	(112)	72	66	64	58
Sheet piling	(118)	78	72	70	64
Excavator	(104)	64	58	56	50
Positrack	(104)	64	58	56	50
Dewatering pump	(88)	48	42	40	34

7.2 Predicted Noise Impacts

Residential apartments are approximately 150 metres from the site implying compliance with the day criterion of 62dB(A),Leq for construction activities. Commercial receivers however, are within 40-50 metres of the site and some construction activities are expected to exceed the criteria, particularly mobile plant. Noise levels above 70dB(A) are possible at closest locations, and Adverse comment is possible. The ICNG recommends that as a first course of action, consideration should be given as to whether any alternate feasible or reasonable method of construction is possible. Consultation with the construction contractor confirms that due to the nature of ground conditions there are no quieter alternates available. The ICNG further recommends that when alternate feasible and reasonable options have been considered the proponent then should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and any respite periods that will be provided. These strategies will be discussed in more detail in Section 8.

When pile boring occurs noise levels in the order of 69-72dB(A) are possible at nearest locations. To reduce noise levels any appreciable amount a physical barrier would be required to intercept the line of site between the source and receivers. We suggest that temporary acoustic barriers between the source and receiver. Placing shipping containers or similar moveable barriers adjacent to a rig is another practical method of noise control. Note that barriers will not be required in situations where intervening structures provide acoustic barriers between the source and receiver. The above strategies may reduce noise levels at residential locations by up to 10dB(A),

It should be noted that calculations are based on plant items operating in exposed locations and at full power, with no allowances made for intervening topography or shielding provided by intervening structures. Cumulative impacts, from several machines operating simultaneously, may be reduced when machines are operating in shielded areas not wholly visible to receivers. In saying this, if two or more machines were to operate simultaneously on the site, received noise levels would be raised and higher exceedances may occur.

Initial earthworks are expected to employ an excavator, and 1-2 dump trucks. The combined acoustic power level of these machines, assuming normal contractor's machines up to 10 years old in reasonably good condition, is expected to be in the range 100 to 104B(A),Leq. However, the machines will typically be spread over the site, and noise at any receiver is typically dominated by the few closest machines, such as an excavator loading a truck, while a second truck reverses into position to be loaded by an excavator. With a combined acoustic power level of 102 dB(A) for 3 typical machines operating at full power, above 60dB(A) is expected at the closest receivers during peak activity, while noise levels as high as 72dB(A) may occur during compaction or major concrete pours.

Dewatering pumps may operate over a 24 hour period at the site, implying a night criterion of 51dB(A).Leq at nearest residential receivers. Predicted noise levels are in the order of 40-45dB(A) at nearest residential receivers, assuming 2-3 pumps operating in exposed locations. Noise levels are expected to be lower however, as pumps will be at or below ground level in shielded or partially shielded locations. Also see further suggestions below.

Constructing temporary barriers of plywood at least 2m high, at the perimeter of the construction site (or at least adjacent to noisy plant items) may be considered for mitigating some of the construction noise at nearest receivers. These barriers will offer the additional benefit of securing the site from unwanted visitors. With barriers in place, worst case construction will reduce by up to 10dB(A), although, as previously stated, these noise levels are expected to occur for a relatively short time and reduce as work progresses to a new area.

It should be acknowledged that construction activities that produce higher noise for a shorter period are often more desirable than alternate construction techniques that produce lower noise for a much longer period. This combined with noise control strategies discussed in Section 8 will ensure that minimum disruption occurs.

7.3 Predicted Vibration Impacts

Occupants of nearby buildings may also have concerns about ground vibration levels from vibrating machinery (excavators, compactors, etc). Ground vibration measurements carried out previously, on other sites, can be used to indicate the likely range of vibration levels produced by construction activities. Previous results do not necessarily apply to this site without considering influencing factors such as ground resonant frequency, energy produced, etc. Table 5 lists the results of previous vibration measurements, with each measurement corrected to a standard distance of 20m to represent nearest residential receivers.

Table 5: Average Maximum Ground Vibration Measurement Results, mm/s Peak.

Ground Type	Measured Distance to Vibration mm/sec	Minimum 40m to Receiver mm/sec
Excavator on clay soil	80m, 0.012	0.14
Excavator on dry alluvial soil	15m, 0.23	0.16
Excavator on wet alluvial soil	10m, 0.52	0.28
Road truck on potholes	10m, 0.15-2.7	0.1-1.2
Compactor on clay	40m, 0.20	0.20

Measured at construction sites in Newcastle CBD.

Table 5 shows a variety of vibration levels mainly due to differences in ground conditions from one site to the next. The Table shows a marked difference between clay and dry ground, with low resulting vibration, and water saturated ground with vibration levels an order of magnitude higher. Results from measurements on wet alluvial or clay soil are likely to apply to the site.

Since vibration varies over time for each process the EPA Guideline recommends that the following formula be used to estimate the vibration dose at the receiver location:

Equation 1: $eVDV = 1.4 \times a \times t^{0.25}$

where: k is nominally 1.4 for crest factors below 6 a_{rms} = weighted rms accel (m/s²)
t = total cumulative time (seconds) of the vibration event(s)

The following estimated vibration doses are expected at nearest receivers:

	eVDV
Excavator	0.28
Compactor	0.45

Based on the above results, adverse comment is possible, particularly when compaction takes place. We therefore recommend that these activities are not carried out unless simultaneous attended vibration monitoring is conducted when within safe working distances noted in Table 7. As previously stated, in many cases higher levels of vibration (and noise) are preferable that occur for only a short period of time than processes producing lower amplitudes for a much longer time period.

The effect of vibration in a building is observed in two ways, namely, it is felt by the occupant, or it causes physical damage to the structure. Subjective detection can be one of direct perception from rattling of windows and ornaments, or dislodgement of hanging pictures and other loose objects. The second is structural damage which may be either architectural (or cosmetic) such as plaster cracking, movement or dislodgement of wall tiles, cracked glass etc, or major such as cracking walls, complete falls of ceilings, etc, which is generally considered to impair the function or use of the dwelling. Vibration can be felt at levels well below those considered to cause structural damage. Complaints from occupiers are usually due to the belief that if vibration can be felt then it is likely to cause damage. Slamming of doors or footfall within a building can produce vibration levels above those produced by construction activities.

Any future structural damage, whether cosmetic or major, which may occur to any building will only be a result of natural causes such as differential settlement of foundations (particularly if on poorly compacted fill), expansion and contraction cycles due to changes in temperature, shrinkage due to drying out of timber framing and pre-stressed areas of the building. Obvious structural damage from any of these sources can usually be identified with the particular cause. Generally, one particular source is not the cause of damage to a structure, but rather a combination of two or more.

Vibration levels are unlikely to cause direct failure, and it is considered the main action is triggering cracks in materials already subjected to stress or natural forces, however, as previously mentioned, this may also arise from internal forces such as slamming of doors. In our experience, vibration will only begin to trigger "natural cracking" at levels above 1mm/sec. Findings by the Road Research Laboratory, reproduced in Table 6, gives an indication of the effects from varying magnitudes of vibration.

Table 6: Reaction of People and Damage to Buildings

Peak Vel (mm/s)	Human Reaction	Effect on Buildings
0 to 0.15	Imperceptible by people – no intrusion	Highly unlikely to cause damage
0.15 to 0.3	Threshold of perception – possibility of intrusion	Highly unlikely to cause damage
2.0	Vibrations perceptible	Recommended upper level of vibration for historical buildings
2.5	Level at which vibration becomes annoying	Very little risk of damage
5	Annoying to occupants	Threshold at which the risk of damage to houses is possible
10 to 15	Vibrations considered unpleasant and unacceptable	Will cause cosmetic damage and possibly structural damage

Construction noise and vibration strategies are discussed in detail in Section 8.

8 CONSTRUCTION NOISE & VIBRATION CONTROL STRATEGIES

8.1 Noise & Vibration Monitoring Program

We recommend that attended noise and vibration should be carried out at commencement of each process/activity that has the potential to produce excessive noise and/or vibration. Attended monitoring offers the advantage of immediate identification of noise or vibration exceedances at the receiver and ameliorative action required to minimise the duration of exposure. Unattended long-term monitoring only identifies a problem at a later date and is not recommended. Table 7 should be used as a guide for the construction team to consider and follow. When the nominated activity occurs within the safe working distance, attended vibration monitoring should be conducted at the relevant receiver type. It is usual practice to conduct attended noise monitoring in conjunction with vibration monitoring, as activities that produce high vibration amplitudes also regularly produce high levels of noise.

Table 7: Vibration Monitoring Program - Minimum Distance when Monitoring is Required

Activity/Process	Receiver Type	Distance to Receiver (m)
Tracked machine	Heritage structure	50
	Residential building	30
	Commercial	15
Pile boring	Heritage structure	40
	Residential building	20
	Commercial	10
Crane	Heritage structure	20
	Residential building	10
	Commercial	5
Concrete pours	Heritage structure	20
	Residential building	10
	Commercial	5
Truck movements	Heritage structure	20
	Residential building	10
	Commercial	5

Note: Attended vibration monitoring should also be conducted for other activities identified by the contractor that have the potential to create vibration, not noted in the above Table.

8.2 Equipment Selection

All combustion engine plant, such as generators, compressors and welders, should be carefully checked to ensure they produce minimal noise, with particular attention to residential grade exhaust silencers and shielding around motors.

Trucks and other machines should not be left idling unnecessarily, particularly when close to receivers. Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made. Framing guns and impact wrenches should be used sparingly, particularly in elevated locations, with assembly of modules on the ground preferred.

Table 8 shows some common construction equipment, together with noise control options and possible alternatives.

Table 8 - Noise Control, Common Noise Sources

Equipment / Process	Noise Source	Noise Control	Possible Alternatives
Compressor Generator	Engine	Fit residential muffler. Acoustic enclosure.	Electric in preference to petrol/diesel. Plant to be Located outside building Centralised system.
	Casing	Shielding around motor.	
Concrete breaking Drilling Core Holing	Hand piece	Fit silencer, reduces noise but not efficiency Enclosure / Screening	Use rotary drill or thermic lance (used to burn holes in and cut concrete) Laser cutting technology
	Bit	Dampened bit to eliminate ringing. Once surface broken, noise reduces. Enclosure / Screening.	
	Air line	Seal air leaks, lag joints	
	Motor	Fit residential mufflers.	
Drop/Circular saw Brick saw	Vibration of blade/product.	Use sharp saws. Dampen blade. Clamp product.	Use handsaws where possible. Retro-fitting.
Hammering	Impact on nail		Screws
Brick bolster	Impact on brick	Rubber matting under brick	Shielded area.
Rotary drills Boring	Drive motor and bit.	Acoustic screens and enclosures	Thermic lance Laser cutting technology.
Explosive tools (i.e. ramset gun)	Cartridge explosion	Use silenced gun	Drill fixing.
Material handling	Material impact	Cushioning by placing mattresses, foam, waffle matting on floor. Acoustic screening.	
Waste disposal	Dropping material in bin, trolley wheels.	Internally line bins/chutes with insertion rubber, conveyor belting, or similar.	
Dozer, Excavator, Truck, Grader, Crane	Engine, track noise	Residential mufflers, shielding around engine, rubber tyred machinery.	
Pile driving/boring	Hammer impact engine	Shipping containers between pile & receiver	Manual boring techniques

Note: Generally, noise reductions of 7-10dB will be achieved with the use of barriers, 15-30dB by enclosures, 5-10dB from silencers and up to 20-25dB by substitution with an alternate process.

8.3 Vibration Management Strategies

In addition to vibration monitoring, the following management strategies should also be considered:

Dilapidation Survey: We understand that this has been done as part of the management process.

Monitoring Changes in Building: Use of callipers, tell tales, etc, prior to commencement of major vibration generating works.

8.4 Acoustic Barriers/Screening

To minimise noise impacts during construction, early work should concentrate on grading and levelling the areas closest to buildings. In the event of complaints arising from occupants of nearby buildings, we offer the following additional strategies for consideration:

- Place acoustic enclosures or screens directly adjacent to stationary noise sources such as compressors, generators, drill rigs, etc.
- Temporary barriers of plywood at least 2m high, at the perimeter of the construction site

8.5 Consultation/Complaints Handling Procedure

The construction contractor should analyse proposed noise control strategies in consultation with the Acoustic Consultant as part of project pre-planning. This will identify potential noise problems and eliminate them in the planning phase prior to site works commencing.

Occupants of nearby buildings should be notified of the intended construction timetable and kept up to date as work progresses, particularly as work changes from one set of machines and processes to another. In particular, occupants should understand how long they will be exposed to each source of noise and be given the opportunity to inspect plans of the completed development. Encouraging resident understanding and "participation" gives the local community a sense of ownership in the development and promotes a good working relationship with construction staff. Programming noisy activities (such as sheet piling) outside critical times for court buildings should be arranged.

We recommend that construction noise management strategies should be implemented to ensure disruption to the occupants of nearby buildings is kept to a minimum. Noise control strategies include co-ordination between the construction team and building occupants to ensure the timetable for noisy activities does not coincide with sensitive activities.

The site manager/environmental officer and construction contractor should take responsibility and be available to consult with community representatives, perhaps only during working hours. Response to complaints or comments should be made in a timely manner and action reported to the concerned party.

All staff and employees directly involved with the construction project should receive informal training with regard to noise control procedures. Additional ongoing on the job environmental training should be incorporated with the introduction of any new process or procedure. This training should flow down contractually to all sub contractors.

8.6 Risk Assessment

A risk assessment should be undertaken for all noisy activities and at the change of each process. This will help identify the degree of noise and/or vibration impact at nearby receivers and ameliorative action necessary. A sample Risk Assessment Check Sheet is included in Appendix B as a guide.

9 CONCLUSION

During construction the total impact at each receiver is related to the received noise level and the duration of excessive noise. Generally, construction noise will comply with the criteria, however, during major construction activities some exceedances are expected to occur. However, nearby neighbours should accept some periods of high noise, considering the relatively short-term nature of louder construction activities.

To reduce the impact in the area during construction, we recommend that louder construction activities, should be completed with the minimum of undue delay. In any case, all reasonable attempts should be made to complete significant noisy activities within as short a time as possible.

As previously stated, construction activities that produce higher noise for a shorter period are often more desirable than alternate construction techniques that produce lower noise for a much longer period

Construction activities should generally be restricted to the nominated hours. If construction does occur outside the standard hours, it is vital that the local community be informed of the construction timetable with letter drops, meetings, etc.

Significant variation in measured vibration levels may occur due to site specific conditions such as the ground resonant frequency, driving frequency of equipment and energy of the associated process. Therefore, a regular noise and vibration monitoring program should be implemented, as described in Table 7. This program will verify our predictions and in the event that complaints may arise, enable strategies to be implemented, where required.

To minimise the chances of disruption to neighbours from excessive vibration (i.e. during site preparation, pile boring, etc), activities should not occur within the distances nominated in Table 7, unless simultaneous vibration and noise monitoring is carried out. Similarly, two compactors should not be operated in tandem over any part of the site, unless simultaneous attended vibration monitoring is conducted at the nearest receiver(s). Where practicable, required compaction should be achieved by heavy non-vibrating equipment.

We conclude, with a high degree of confidence, that vibration levels at the predicted magnitudes will not cause direct structural damage to any building. We suspect any damage that may occur to nearby buildings during construction activities would be the result of natural forces, as discussed in the previous section. It should be noted, however, that vibration may be noticed at times while a person is standing or seated quietly. Other noticeable indicators are rattling of window frames and ornaments, and visible movement of hanging pictures, etc.

Subject to recommendations discussed within this report, this assessment has shown construction activities will result in only short periods of excessive noise in the surrounding area. Therefore, with the proposed noise control and management measures incorporated into construction of the site, we see no acoustic reason why the proposal should not proceed.

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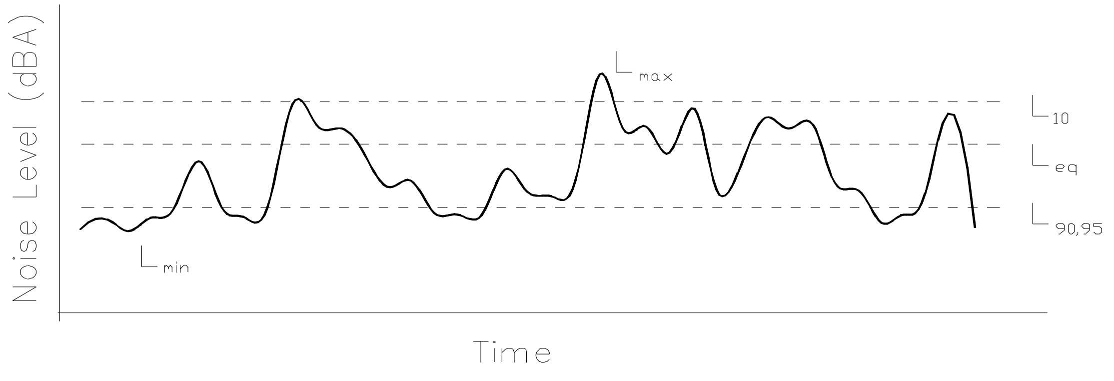
Principal Consultant

APPENDIX A
Definition of Acoustic Terms

Definition of Acoustic Terms

Term	Definition
dB(A)	A unit of measurement in decibels (A), of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.
ABL	*Assessment Background Level* – A single figure representing each individual assessment period (day, evening, night). Determined as the L90 of the L90's for each separate period.
RBL	*Rating Background Level* – The overall single figure background level for each assessment period (day, evening, night) over the entire monitoring period.
Leq	Equivalent Continuous Noise Level - which, lasting for as long as a given noise event has the same amount of acoustic energy as the given event.
L90	The noise level which is equalled or exceeded for 90% of the measurement period. An indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise (usually in dBA).
L10	The noise level which is equalled or exceeded for 10% of the measurement period. L_{10} is an indicator of the mean maximum noise level, and is generally used in Australia as the descriptor for intrusive noise (usually in dBA).



APPENDIX B
Risk Assessment Checklist

Risk Assessment Checklist

Item/Date	Risk Identified (Yes/No)	Risk Level (H/M/L)	Noise Control Required (Yes/No)	Noise Control Strategy