Project No: 161221

Noise Impact Assessment
Commercial Development
Cnr Stewart Avenue and Hunter Street, Newcastle, NSW

Prepared for:

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INTRODUCTION

This report provides the results, findings and recommendations arising from an acoustical assessment of the proposed use of a commercial development at the corner of Hunter Street and Stewart Avenue, Newcastle (Lot 101 DP1191992).

Site details have been obtained from inspections and also with reference to plans obtained from the proponent (plans by CKDS Architects, dated 19/6/15).

The assessment was requested to support a D.A. to Newcastle City Council (NCC). Specifically NCC has requested an "*acoustic report to address construction, car park and plant noise impacts generated by the proposed development as they impact on the adjacent serviced apartments and other surrounding land uses*."

Table 1 contains a glossary of commonly used acoustic terms and is presented as an aid in understanding this report.

TABLE 1
GLOSSARY OF ACOUSTICAL TERMS

Term	Definition
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level – The summation of noise events integrated over a selected period of time. This noise descriptor is commonly used to correlate noise exposure and human annoyance.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period
L10	Average Maximum Noise Level - the level exceeded for 10% of the monitoring period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level.

BACKGROUND TO THE PROPOSAL

The development is to consist of a ground floor commercial/retail tenancy with four floors of office space above and an associated seven storey car park as shown in **Figure 1**.

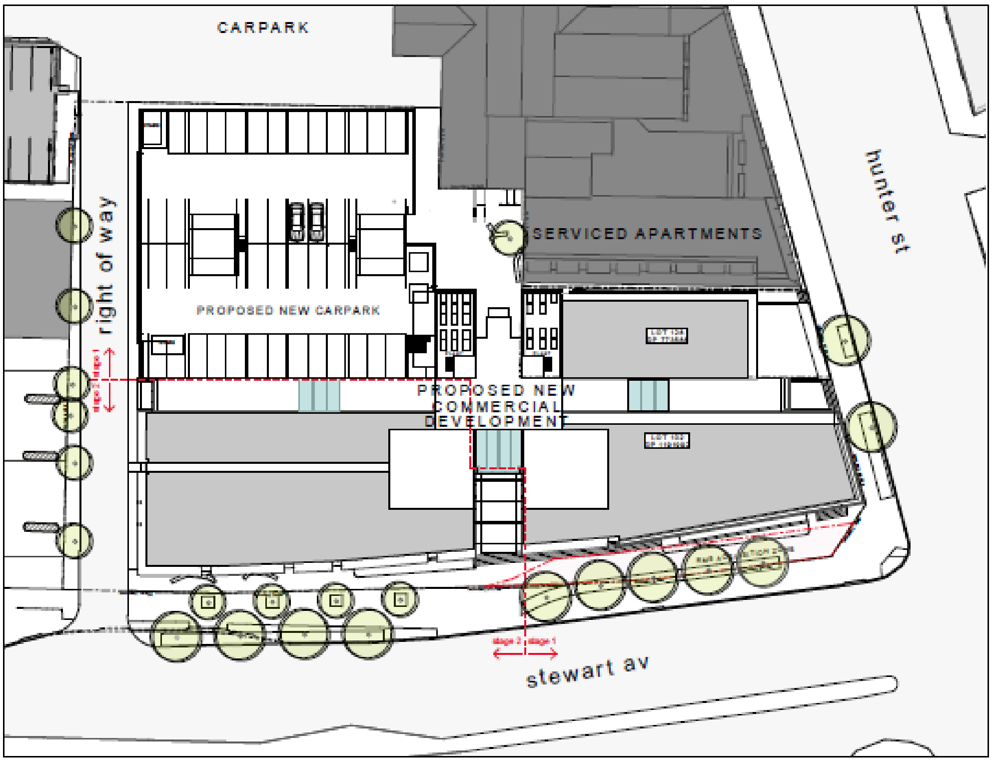


Figure 1 – Site Plan

EXISTING ACOUSTIC ENVIRONMENT

A Rion NL-42 sound level meter, set up as an environmental noise logger, was installed on the site to measure the existing acoustic environment.

At the time of the logging the site was completely cleared and the logger was located on a small elevated concrete slab at the rear of the site as shown in **Appendix I**. The logger was in place from Friday, 15th April until Friday 22nd April 2014.

The instrument was programmed to accumulate environmental noise data continuously over sampling periods of fifteen (15) minutes duration for the entire monitoring period. Internal software calculates and stores the Ln Percentile Noise Levels for the chosen sampling period, which are then retrieved for detailed analysis.

Table 2 shows a summary of the relevant measured data from the logger which is also shown graphically in Appendix I.

The acoustic environment of the area is dominated by traffic noise with minor commercial and domestic noise. Analysis of the logger data showed that the background noise level (L90) rose significantly for a brief period in the early evenings. This is possibly due to a spurious short term noise source not evident at the time of deploying or retrieving the logger. This data was removed from the set prior to further analysis and is not included in the results shown in Table 2.

TABLE 2
MEASURED AMBIENT NOISE LEVELS
STEWART AVENUE - 15/4/16 to 22/4/16

	Noise Levels dB(A)		
Percentile	Day	Evening	Night
L_{90}	54	50	40
L_{eq}	63	60	56

NOISE ASSESSMENT CRITERIA

The assessment of noise from commercial or industrial developments in NSW is usually undertaken in line with procedures detailed in the *NSW Industrial Noise Policy* (INP).

The INP sets out two separate noise criteria designed to ensure developments meet environmental noise objectives. The first criteria account for intrusive noise and the others apply to the protection of amenity of particular land uses. Depending on the existing acoustic environment, a new development is usually assessed by applying both criteria to the situation and adopting the more stringent of the two.

The amenity criterion is designed to protect areas from increasing industrial noise. As such, the acceptable noise levels for various receiver types listed in the INP refer only to noise from industrial sources.

The site of the proposed development is relatively remote from major industrial noise sources. The logger location was dominated by noise from traffic passing the site. There are commercial premises near the site but noise from activity at those premises would not have significantly affected the measured results.

In this instance then the Intrusiveness criteria (background + 5dB(A)) are the ones applicable to the assessment. The Project Specific Noise Goals (PSNG) for residential receivers for the assessment are thus shown in **Table 3**.

TABLE 3 PROJECT SPECIFIC NOISE GOALS	
Period	Intrusiveness Criterion* L_{eq} (15 min) dB(A)
Day (7am to 6pm 6 days, 8am to 6pm Sunday)	**59**
Evening (6pm to 10pm)	**55**
Night (all other times)	**45**

* - Rating Background Level (RBL) + 5 dB. RBL is the median value of each ABL (Assessment Background Level) over the entire monitoring period. The ABL is a single figure representing the "L90 of the L90's" for each separate day of the monitoring period.

NOISE ASSESSMENT

Mechanical Plant

Mechanical plant for the building will be located in two roof top plant podiums as shown in **Figure 2**. As requested by NCC the noise from this plant is to be assessed to determine any potential impacts at the serviced apartments in Hunter Street (also shown on Figure 2).

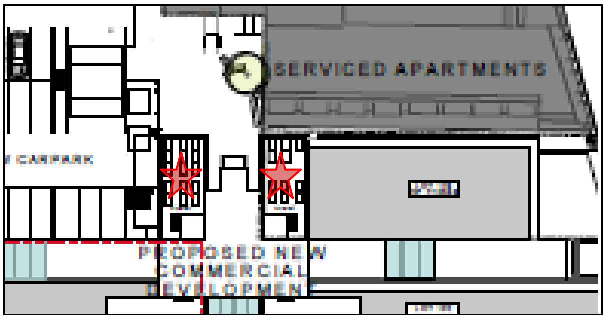


Figure 2 - Roof Top A/C Condenser Locations

The exact plant to be used in the building is yet to be finalised. Based on Spectrum Acoustics technical database of measurements of plant and equipment for buildings of similar size to the current proposal, it is typical for the air conditioning condensers to have an unshielded sound power level range of between 72 and 78 dB(A).

Assuming there are up to ten such condensers on both podiums and each with worst case sound power level of 78 dB(A) and all plant working continuously, the combined Lw of the podiums will be 88 dB(A) Leq (15 min).

The plant podiums will be located on the roof level (above the fourth floor) of the proposed building, at approximately R.L. 26m. The nearby serviced apartments are a two storey construction with windows and small balconies, facing towards the proposed building, on the second storey with floor levels at approximately R.L. 12m.

The structure of the proposed building and the angle of incidence of the noise propagation path will, therefore, form a significant acoustic barrier in relation to the transmission of the plant noise in the direction of the receivers in the serviced apartments.

Table 4 shows a calculation of noise impacts from the roof top plant podiums. The calculation assumes that the tops of the condensers are 1.2m above roof level and they are located a minimum of 2m from the building edge (which is effectively an acoustic barrier). For the calculations Podium 1 is closest to the apartments (see Figure 2). The distance loss includes the horizontal and vertical components of the propagation path.

The building will house offices and a ground floor commercial tenancy. It is considered that, for the most part, the offices will be occupied during the day and, possibly, early evening time periods and, therefore, the plant will likely only operate at those times. The received noise level has been compared to the criteria for both of these time periods.

TABLE 4
CALCULATED SPL AT NEAREST RESIDENTIAL RECEIVER
A/C CONDENSER UNITS – as dB(A) Leq (15 min)

	Octave Band Centre Frequency, Hz								
Item	dB(A)	63	125	250	500	1k	2k	4k	8k
Podium 1	88	57	60	72	76	82	83	80	78
Distance loss to receiver (18m)		32	32	32	32	32	32	32	32
Barrier loss (building)		8	10	12	15	18	21	24	24
SPL @ receiver Leq (15 min)	36	17	18	28	29	32	30	24	22
Podium 2	88	57	60	72	76	82	83	80	78
Barrier loss (building)		6	7	9	11	14	17	20	23
SPL @ receiver Leq (15 min)	39	17	19	30	31	34	33	27	22
Combined Noise	**41**								
Criterion Leq (day/evening)	59/55								
Impact	**0**								

The results in Table 4 show that there will be no adverse impacts due to the assessed noise emissions from the mechanical plant.

Car Park Noise

There will be a multi storey car park at the rear of the site, with a total of 263 parking spaces. It is intended that the car park be for the use of people working in the various offices and commercial space as well as providing some overflow parking for nearby offices. The car park will not be open to the general public. The majority of use of the car park will, therefore, be limited to the day and evening periods at the beginning and end of normal office hours.

Noise in car parks typically comes from vehicles moving in and out of parking spaces at low speeds as well as from people walking to and from cars, doors opening and closing etc. Each noise event is characterised by a brief peak which when averaged out over a 15 minute period has a relatively low Leq. The impact of each noise event on any single receiver is also variable depending upon the location of individual cars within a car park and as they move in and out. In addition to this, people arriving or departing their work site would normally be expected to do so in a relatively quiet and orderly fashion.

The peak usage of the car parks for an office would, generally, occur over a brief period during the morning and afternoon/evening. A traffic study for the project has determined that the worst case traffic generation for the site will be 163 vehicle movements per hour in the morning peak. The afternoon peak will be slightly lower than this.

Noise levels from car parks have been sourced from the Spectrum Acoustics technical database. This contains noise measurements from a series of vehicles arriving and departing a car park with people moving to and from vehicles. The measurements were made over a representative period to ascertain a typical noise level from these activities. The measurements were made at varying distances from each car to approximate the situation in relation to an adjacent residence over a 15 minute interval. That is, at any time throughout each 15 minute interval various car parks, at different distances from the nearest residences, will be in use.

The measurements in the database show a noise level of 53 dB(A) Leq measured over a 5 minute period where up to 6 vehicles moved in and out of a car park. The measurements were made at an average distance of 7m.

Assuming the noise from the 6 vehicles is consistent for a full 15 minutes at a distance of 7m this equates to a sound power level of 73 dB(A) Leq (15 min) for car park noise. The traffic study has determined a maximum of 160 vehicle movements in an hour. To consider a worst case this acoustic assessment assumes 80 car parks are utilised in a single 15 minute period. This value has been used to determine impacts over a 15 minute assessment period during the morning.

The car park will be a multi storey design. Noise from the upper levels of the car park will be shielded from receivers at the serviced apartments by the structure of the car park building. That is, the “barrier” effect of the floors and the directivity of the openings in the façade relative to the apartments, which are at a lower height.

The car park will have 13 separate tiers, as shown in **Figure 3**, with the top two tiers being on the roof top.

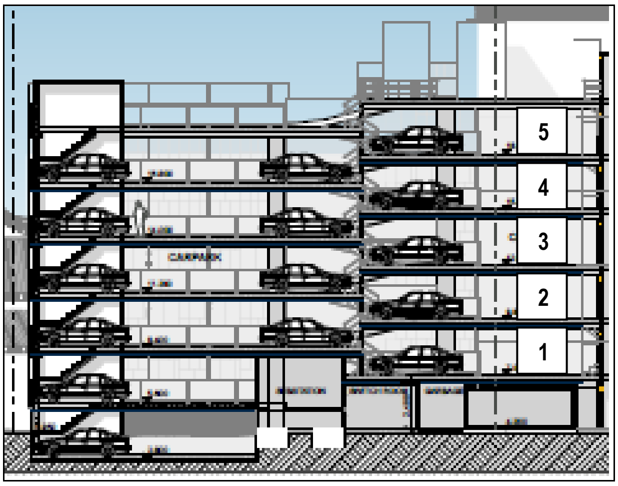


Figure 3 – Car Park Section

It is assumed that the 80 car parks in use will be distributed over the lower 11 tiers of the car park (that is, it is considered that the roof top parks will only be used when the lower levels are full). This equates to approximately seven car parks in use per tier.

Due to the layout of the car park, individual parking spaces will be at various distances and orientations from receivers in the serviced apartments. Many will be shielded from the outdoor areas of the apartments by other buildings and the structure of the car park itself as shown on **Figure 4**. For example vehicles, on each tier, in the section show as "A" on Figure 4 will have limited line of sight to the receivers.

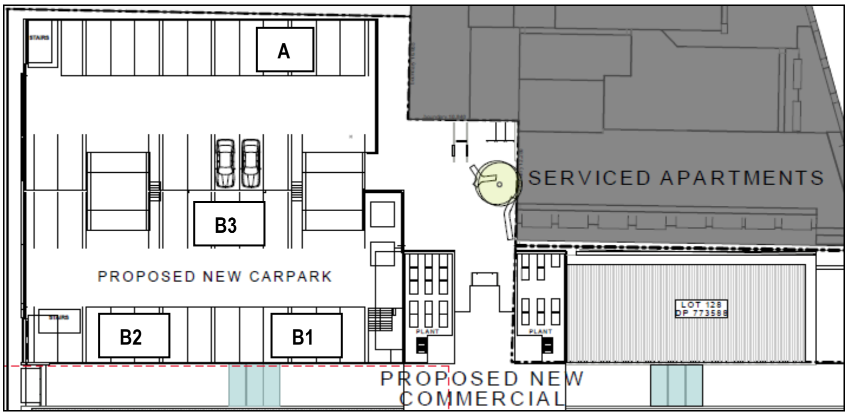


Figure 4 – Car Park Layout

To consider a worst case a scenario was assessed where there were 17 cars on each of levels 1, 2, 3 and 4 (from Figure 3) parked in sections B1, B2 and B3 on each level. Note that level 5 is significantly higher than the receiver and noise from this is shielded as per the previous discussion.

Table 5 shows a sample calculation of the noise from the three banks of car parks (B1, B2 and B3 on Figure 4) on level 3 (Figure 3) impacting on the external areas of the serviced apartments.

TABLE 5 RECEIVED NOISE (Leq (15 min)) – CAR PARK LEVEL 3			
Item	dB(A)		
	3 - B1	3 - B2	3 - B3
Sound Power Level (Leq)	73	73	73
Distance Loss to Receiver	38 (30m)	40 (40m)	38 (30m)
Received Noise	35	33	35
Total	**39**		
Criterion (day)	59		

The results in Table 5 show that the assessed received noise from level 3 will be significantly lower than the day time noise criterion. Level 3 is at approximately the same level as the receivers in the serviced apartments.

Similar calculations were undertaken for the noise from levels 1, 2 and 4 as impacting on the receiver. Levels 1 and 2 are lower than the receiver and the floors above will provide a degree of acoustic shielding for the noise from these car parks relative to the receiver. For simplicity a nominal 5dB(A) insertion loss was included in the results for noise emissions from these levels. The results are shown in **Figure 6**.

TABLE 6 RECEIVED NOISE (Leq (15 min)) – CAR PARK	
Car Park Level	Receiver 1
1	39
2	39
3	34
4	34
Total	**43**
Criterion (day)	59

The results in Table 6 show there will be no exceedance of the day time noise criterion as a result of the assessed car park noise.

Construction Noise

The assessment of construction/demolition noise impacts in NSW is undertaken in accordance with the *Interim Construction Noise Guideline* (ICNG). The ICNG is a non-mandatory guideline that is usually referred to by local councils and the NSW Department of Planning and Infrastructure when construction/demolition works require development approval.

Section 1.5 of the ICNG outlines the steps for management of construction noise impacts as follows:

1. **identify sensitive land uses** that may be affected.
2. **identify hours** for the proposed construction works.
3. **identify impacts** at sensitive land uses.
4. **select and apply the best work practices** to minimise noise impacts.

Each of the above four points is assessed in detail in the following sections.

Surrounding Land Uses

The building is in an inner city urban area in the vicinity of three busy roads and near commercial premises.

The only "residential receivers" in the near vicinity are in the serviced apartments on Hunter Street.

The closest parts of the construction works will be approximately 100m from the studios of ABC Radio and 150m from the TAFE buildings on Hunter Street.

There are no other sensitive land users in the near vicinity of the site.

Operating Hours

The recommended standard hours for construction works are shown in Table 1, section 2.2 of the ICNG as reproduced below. Note that no blasting is proposed for the current project.

Table 1: Recommended standard hours for construction work

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

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

Construction works outside the hours in Table 1 is normally only permissible for delivery of oversized structures, emergency works, public infrastructure works that are supported by the affected community or where the proponent demonstrates and justifies a need to work outside the recommended standard hours (ICNG, p9).

The construction will be typical of commercial or multi storey developments and will be undertaken during the "recommended standard hours" detailed above.

Impacts at Sensitive Land Uses

The ICNG provides two assessment methodologies for construction noise impacts: a 'qualitative' assessment where works occur for less than three weeks and a 'quantitative' assessment for works of longer duration. As the construction works will take longer than three weeks, the quantitative methodology is applicable.

Table 2 of the ICNG sets out noise management levels for construction works as reproduced below.

Table 2: Noise at residences using quantitative assessment

Time of day	Management level $L_{Aeq\ (15\ min)}$ *	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	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: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Based on the measured background noise levels (from the unattended noise logger) the daytime construction noise management level is, therefore, **64 dB(A),Leq (15 min)** in accordance with Table 2 from the ICNG.

For offices and retail outlets the construction noise management level is 70 dB(A) external and for classrooms at schools or other educational institutions (such as the TAFE) the applicable noise criterion is 45 dB(A) inside the room.

Work Practises and Noise Sources

The site is clear and level. The first phase of construction will involve excavation of footings etc. and the piling of foundations.

It is proposed that an excavator will be used to extract any material from the site which will be removed by truck and dog. It is also proposed that pile boring methodology will be used.

Plant such as rollers, truck and dogs, wheel loaders excavators will be involved in various aspects of the ground preparation and construction throughout the site. This will involve preparation and construction of slabs and driveways as well as construction of any retaining walls.

The structure of the buildings will be of in situ concrete construction.

The initial phases of the construction will involve use of concrete agitator trucks, concrete pump and vibrator during concrete pours to form slabs, bases and walls. Cranes would be used to lift materials into place.

The Spectrum Acoustics technical database has been referenced to determine the Lw most applicable to the actual equipment proposed to be used on the site. These levels are shown in **Table 7**.

By definition mobile plant such as many of those detailed in Table 7 will move about and will be, be at various operating levels (and thus producing various levels of noise) throughout any 15 minute period.

The levels shown in Table 7 are based on measurements of worst case 15 minute Leq noise levels for the machinery under typical operating conditions on construction sites similar to the current project.

TABLE 7 TYPICAL CONSTRUCTION EQUIPMENT SOUND POWER LEVELS	
Equipment	Lw as dB(A) Leq (15 min)
30t Excavator	105
Truck & Dog	107
Roller	106
Wheel Loader	104
Concrete Agitator	110
Concrete Pump	107
Vibrator	105
Mobile Crane	108
Piling Rig (boring)	108
Piling Rig (piling)	116*

*dependant on the duration of piling

Noise emissions from the construction works will vary throughout individual days and also throughout the length of the overall project. The noise level at individual receivers will also be dependent upon the location of the various works, relative to those receivers, at different times.

To gauge some potential impacts a construction operational scenario for the excavation phase of the works has been considered where an excavator, 2 x truck and dogs and wheel loader were all considered to be working in close proximity at existing ground level. As the excavation works will be undertaken at various distances from any individual receivers (residential and commercial), **Table 8** shows the results of a sample calculation of potential noise impacts at several representative distances, as a result of the noise emissions from the described excavation works taking place.

TABLE 8 EXCAVATING NOISE as dB(A) Leq (15 min)				
	@ 30 m	@ 40 m	@ 100 m	@ 200m
Excavating Noise	112	112	112	112
Distance Loss to Receiver	38	40	48	54
Received Noise	74	72	64	58
Criterion	64/70	64/70	64/70	64/70
Impact	10/4	8/2	0	0

The results in Table 8 show that, during the excavation phase of works some residential receivers in the serviced apartments may be in the ”noise affected” category as defined in the ICNG. This phase may take up to a several weeks to complete.

Noise from pile boring (piling) will be higher than that shown in Table 8. As indicated though the noise from the pile boring will be of limited duration. This will be dependent on the drilling process and the actual duration of pile driving required. The noise level shown for this in Table 7 is considered as a worst case Leq (15 min) level.

The site preparation and road works phases of the construction will have similar sound power levels as an Leq (15 min) to that of the excavation works. This indicates that the noise emissions from these phases of the works will be at similar levels and with similar impacts at the distances shown.

The calculated results in Table 8 assume a direct line of sight from the noise source (construction works) to the individual receiver. In reality, acoustic shielding from intervening structures such as other buildings and the barrier effects of cuttings etc. could result in received noise levels lower than those shown in the tables.

Similarly, receivers further removed from the site will be, at least partially, acoustically shielded from the noise by barrier effects of structures closer to the noise source.

The scenarios considered in Table 8 represent a worst case for construction noise emissions from the site. The typical operating noise levels detailed in Table 7 show that the noise from other plant and machinery to be used on the site will be at lower levels than those calculated in Table 8 or will likely be on site for significantly shorter duration. Under these circumstances, resultant received noise and/or potential impacts at the various residences around the site will, therefore, also be at lower levels than those shown in the table.

The results show that, under the assessed conditions, at distances of less than about 30m from the excavation works receivers may be in the "highly affected" zone as defined in the ICNG.

Vibration

Human Comfort

Various authorities have set maximum limits on allowable ground and building vibration in different situations. In this report, vibration criteria were obtained from *"Assessing Vibration: A Technical Guideline"* (AVTG, 2006).

The AVTG indicates that the assessment of intermittent vibration should be done using a vibration dose value (VDV), which is defined as the fourth root integral with respect to time of the acceleration after it has been weighted. The VDV is fully described in British Standard

BS 6472: 1992 "*Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*".

The guideline indicates that the vibration criteria are based on the effects of vibration on people. That is, it is stated that individuals can detect building vibration values that are well below those that can cause any risk of damage to the building or its contents. The level of vibration that affects amenity is, therefore, lower than that associated with building damage.

Vibration associated with machinery carrying out construction works would be considered to be intermittent in nature. **Table 9** shows the acceptable VDV's for intermittent vibration taken from Table 2.4 of the AVTG.

TABLE 9
ACCEPTABLE VDV's FOR INTERMITTENT VIBRATION ($m/s^{1.75}$)

Area, Time	Preferred Value	Maximum Value
Residential – Day	0.20	0.40
Offices, educational institutions	0.40	0.80

Day time is between 7am and 10pm

Based on the data presented in Table 9 and procedures set out in Appendix B of the AVTG, for residential receivers, a maximum allowable peak particle velocity for day time of 8.4 mm/s applies to intermittent ground vibration, such as that from excavators or pile boring (drilling), which is typically at frequencies greater than 10Hz.

Building Damage

There are a number of Standards designed for the assessment of damage to building structures, one frequently referred to is German Standard DIN 4150: Part 3-1986 *Structural Vibration in Buildings – Effects on Structures*. DIN 4150 presents a series of "safe limit" values below which no damage due to vibration has been observed (as shown in **Table 10**).

Damage is specifically defined as including minor superficial cracking, the enlargement of existing cracks in cement render and the separation of partitions from load bearing walls.

TABLE 10 STRUCTURAL DAMAGE SAFETY LIMITS FOR BUILDING VIBRATION					
Gp	Type of Source	Vibration Velocity in mm/s			
		At Foundations		Plane of Floor of Uppermost Story	
		<10 Hz	10 - 50 Hz	50-100 Hz	All Freqs
1	Buildings used for commercial purposes, industrial buildings and similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design or use.	5	5 - 15	15 - 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in 1, or 2 and have intrinsic value (e.g. buildings under a preservation order).	3	3 to 8	8 to 10	8

A more recent standard than DIN 4150 for assessing building damage is British Standard BS 7385: Part 2 – 1993 *Evaluation and Measurement of Vibration in Building part 2*. This standard was developed following a full review of available data, including other international standards, publications, and a review of UK data. The standard concludes by providing guidance for threshold values corresponding to the minimum risk of cosmetic damage from vibration. Details are shown in **Table 11**.

TABLE 11 TRANSIENT VIBRATION LEVELS FOR COSMETIC DAMAGE			
Line	Type of Building	Peak Particle Velocity	
		4 Hz to 15 Hz	> 15 Hz
1	Reinforced or framed structures - Industrial or heavy commercial buildings	50 mm/s	50 mm/s
2	Un-reinforced or light framed 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

BS 7385 specifically notes:

- Historic buildings should not to be assumed to be more sensitive to vibration (unless structurally unsound); and

- Structures below ground are known to sustain higher levels of vibration and are very resistant to damage, unless in poor condition.

Using the most stringent of the damage criteria for residential buildings, an allowable peak particle velocity of 5 mm/s (from Table 10) has been adopted as the criterion for this assessment.

The potential for vibration impacts will come from the use of the excavator and, to a lesser extent, the movement of dump trucks around the site. Vibration from pile boring is not dissimilar to that foe heavy machinery moving about a site or drilling.

Typical vibration levels associated with these activities are shown below in **Table 12** (Sources: RMS Environmental Noise Management Manual and Spectrum Acoustics technical database).

TABLE 12
TYPICAL VIBRATION LEVELS – CONSTRUCTION PLANT @ 10m

Plant Item	Peak Particle Velocity mm/s
Pile Boring	
Loaded Truck	1 - 2
Excavator	< 2
Dozer	1.5 - 4
7 tonne compactor	4 - 7
Roller	4 - 6
Jackhammer	0.5

The typical vibration levels shown in Table 12 indicate that received vibration levels will be less than a peak particle velocity of 2 mm/s at distances of approximately 10 m from an excavator or pile boring.

The attenuation of vibration through the ground is highly dependent upon ground type. For hard soils and densely compacted sands the attenuation is approximately inversely proportional to distance. That is, at double the distance from the source the vibration level will be halved. The attenuation through hard rock is lower than this and through soft soil higher.

A detailed analysis of the ground types on the site has not been undertaken for this assessment and a hard packed soil has been assumed.

There will be no significant excavation works undertaken within 10m of any receivers. For the current site this indicates that received vibration levels would be below the adopted human comfort and building damage criteria at all receivers.

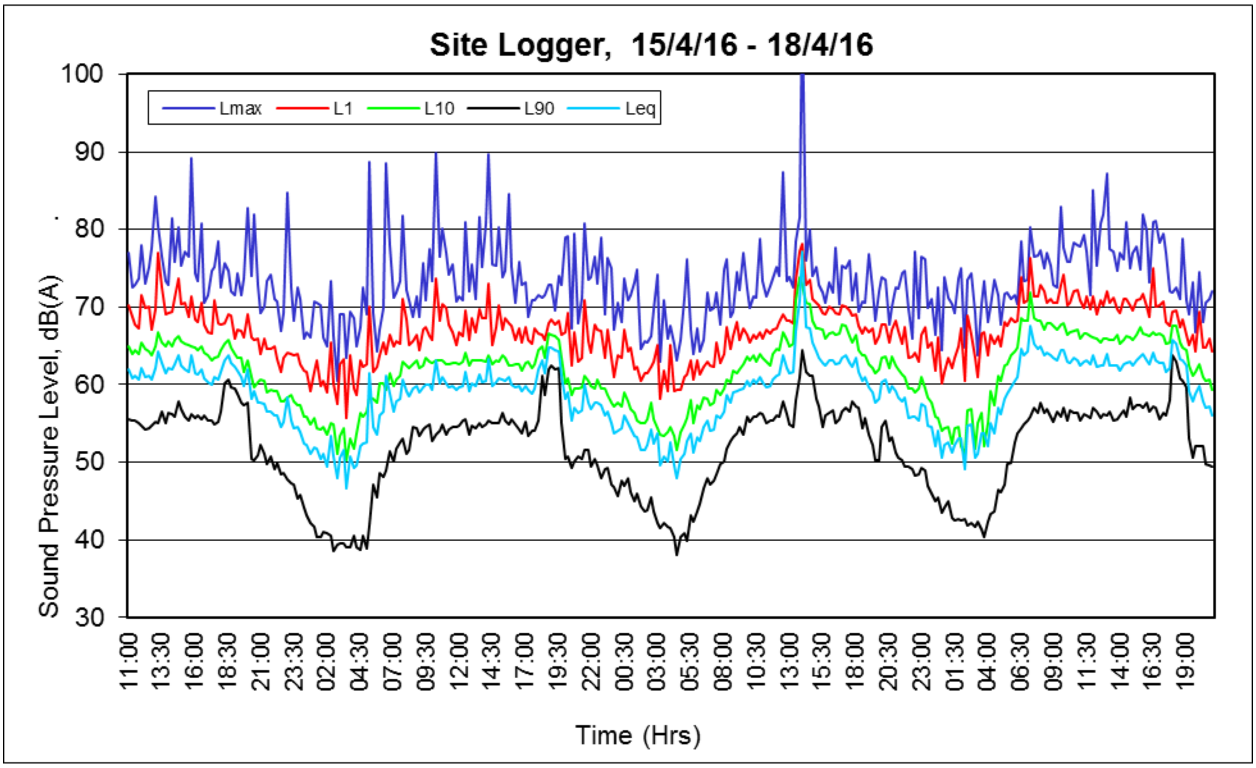
CONCLUSION

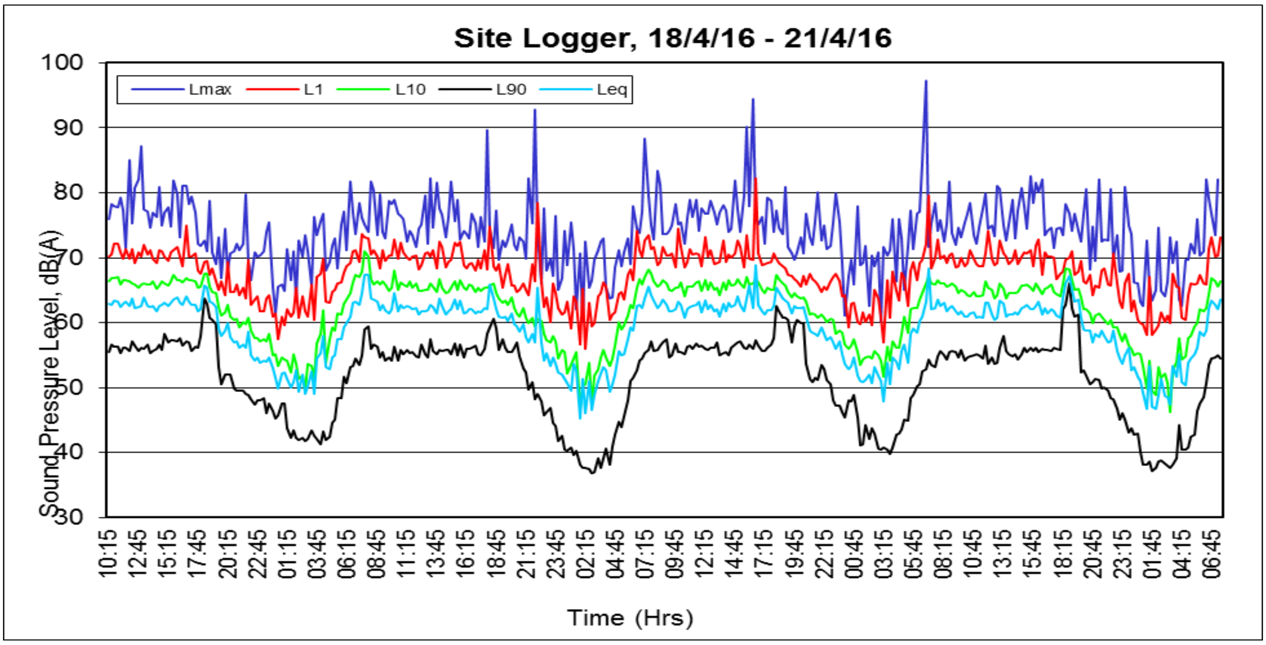
A noise assessment has been carried out in regard to the proposed use of a commercial development at the corner of Hunter Street and Stewart Avenue, Newcastle (Lot 101 DP1191992).

The assessment has shown that there will be no adverse noise or vibration impacts as a result of the construction or operation of the building and car park.

Appendix I

Noise Logger Charts


Site Logger, 15/4/16 - 18/4/16
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)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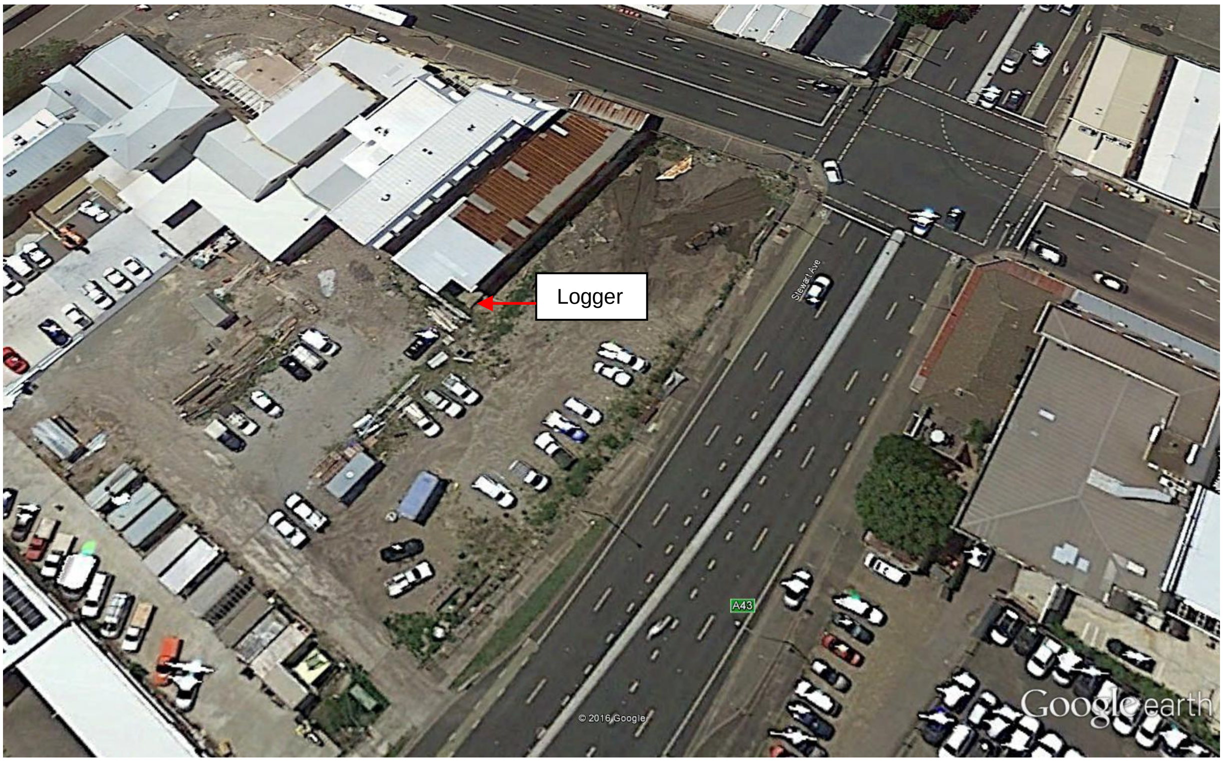
Logger
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