Acoustic Consulting

New Public School

Smalls Road, Ryde

Secretary's Environmental Assessment Requirements - Noise Impact Report

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Revision Record

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Executive Summary

TTM has undertaken a noise impact assessment for the proposed new school at Smalls Road, Ryde, NSW 2112. This assessment was undertaken under the Secretary's Environmental Assessment Requirements (SEARS), Section 78A(8A) of the Environmental Planning and Assessment Act, and Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

Operational and construction noise impacts on the community were assessed.

The operational noise criteria derived in accordance with the NSW Industrial Noise Policy were applied to the Public Address system, school bell/period alarm, use of school hall for concerts and community uses, and mechanical plant. All criteria were met at all times of the day. Practical advice has been provided where relevant to minimise any adverse impact to the community. However, any noise impact is expected to be negligible to none.

Assessment of construction noise showed, as expected, that the Interim Construction Noise Guideline 'Management Levels' would be exceeded at all Noise Sensitive Receivers (NSR) assessed. However, the 'Highly Noise Affected' level of 75 dB(A) was not exceeded at any NSR. Practical advice for the minimisation and management of construction noise and vibration has been provided. In addition to this advice it is recommended that a Construction Noise and Vibration Management Plan is produced by the contractor before they commence work on site. Nevertheless, it is expected that construction noise can be managed to minimise any adverse impact and build a collaborative rapport with the community.

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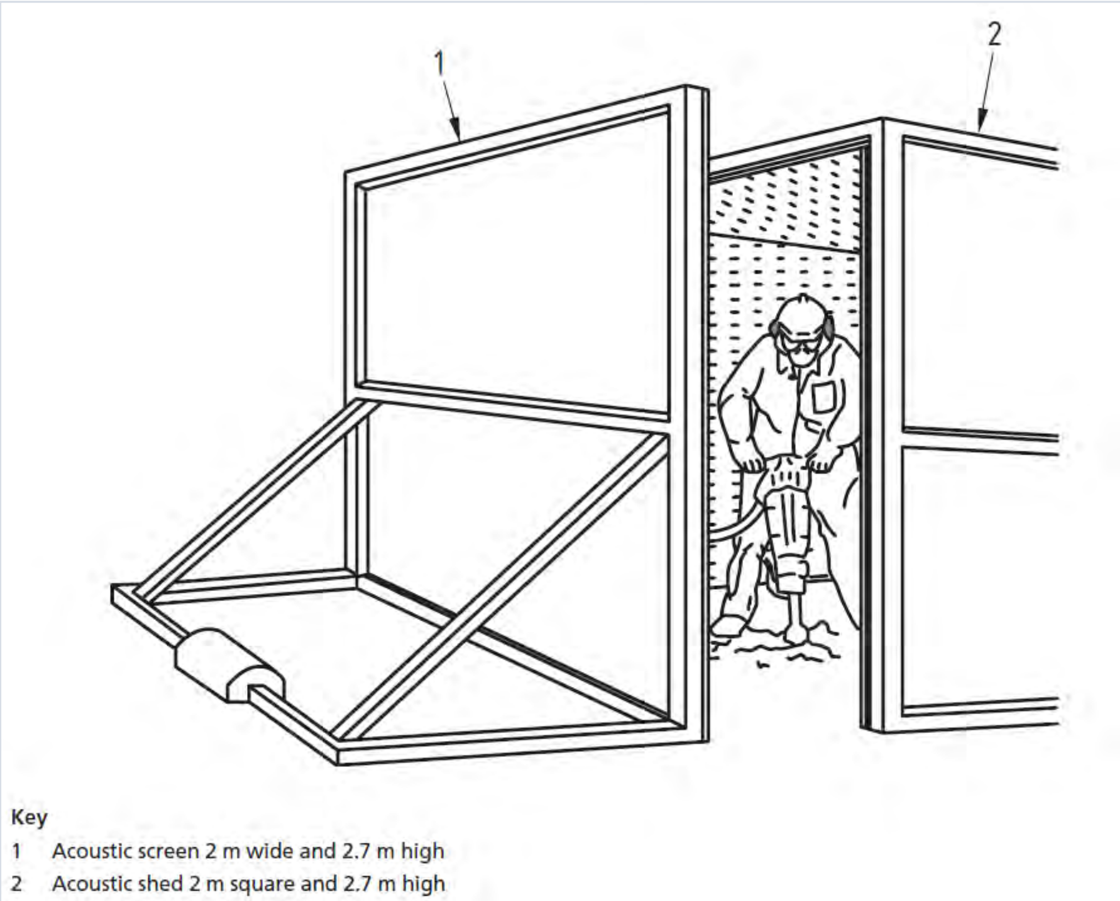


1 Introduction

1.1 Background

TTM was engaged by Conrad Gargett Ancher Mortlock Woolley to undertake a noise impact assessment of the new Smalls Road Public School located at 3B Smalls Road, Ryde. This report will address the Secretary's Environmental Assessment Requirements (SEARs) for noise and vibration and be submitted to the NSW Department of Education.

The assessment is based on the following:

- NSW Industrial Noise Policy[1]
- Interim Construction Noise Guideline[2]
- Assessing Vibration: A Technical Guideline 2006[3]
- Architectural plans by Conrad Gargett Ancher Mortlock Woolley, as presented in Appendix A
- Noise measurements, analysis and calculations conducted by TTM.

1.2 Scope

The assessment includes the following:

- Description of the development site and proposal.
- Measurement of existing ambient noise levels.
- Statement of assessment criteria relating to environmental and construction noise emissions, and vibration.
- Assess potential noise impact of the development on the local community.
- Assess noise and vibration impact during construction of the development.
- Details of noise control recommendations to be incorporated to achieve predicted compliance.

[1] NSW Environment Protection Authority (2000), NSW Industrial Noise Policy

[2] NSW Department of Environment and Climate Change (DECC) (2009), Interim Construction Noise Guideline

[3] NSW Department of Environment and Climate Change (DECC) (2006), Assessing Vibration: a technical guideline

2 Site Description

The site is located at 3B Smalls Road, Ryde. The existing school will be demolished to make way for the new Smalls Road Public School.

The site fronts Smalls Road to the north-west. The site is bounded by residential properties to the south, south-east and west. To the south-west of the site is the Cerebral Palsy Alliance Site. To the east of the site is a fenced parkland.

An aerial image of the site locality is shown in Figure 1.

Figure 1: Site Locality

The current acoustic environment of the site is typical of a quiet suburban area with intermittent local road traffic.

3 Proposed Development

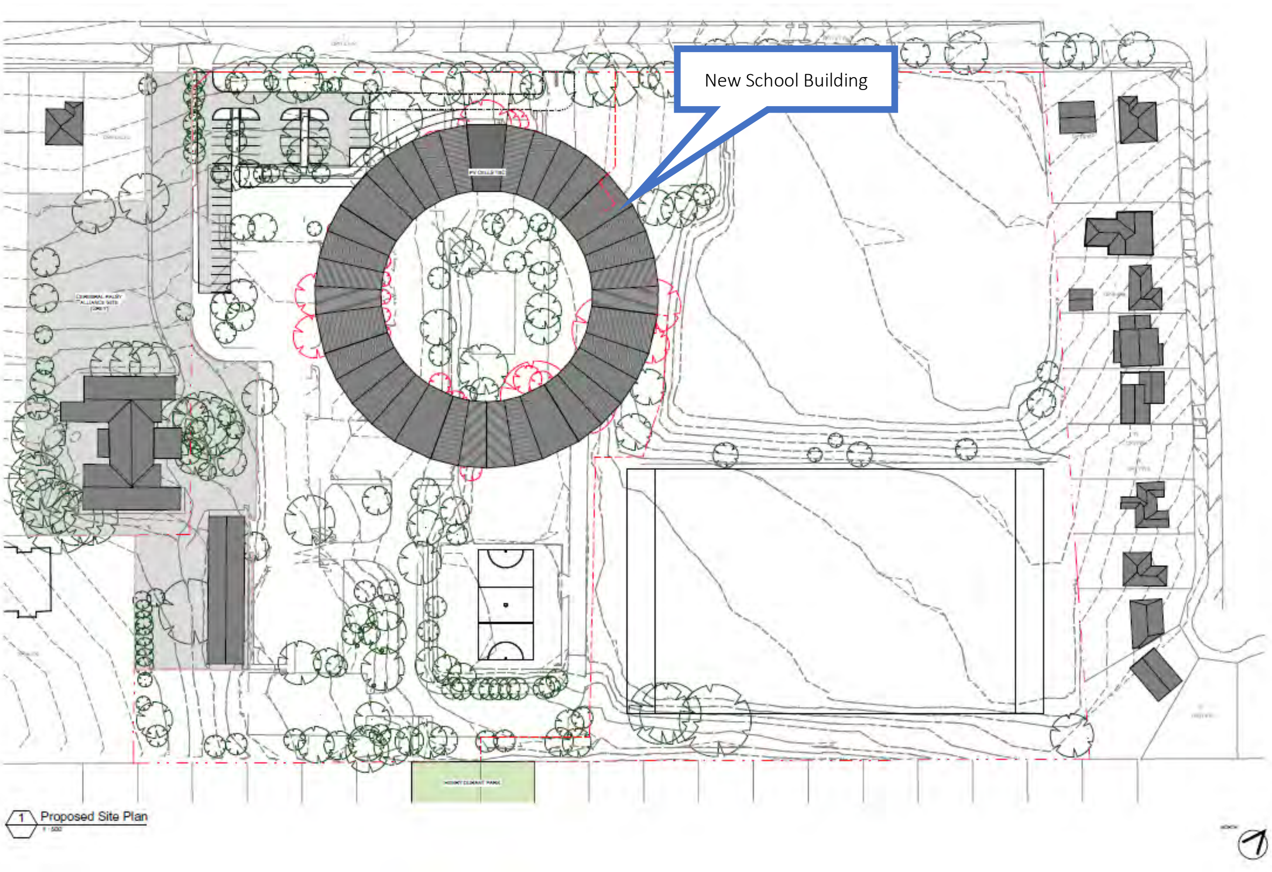
3.1 Development Description

The proposed development involves the demolition of the existing school building and the construction of a new public school for 1000 students. The development needs to consider following potential noise and vibration impacts:

- Noise and vibration impact during demolition and construction
- Operational noise impact such as, the public address system, school bells/period alarms, mechanical plant.
- Noise impact of the use of the school hall during and outside school hours for activities such as, concerts or community group activities.

A site plan of the proposed development is shown in Figure 2.

Figure 2: Development Plan



3.2 Noise Sensitive Receivers (NSRs)

There are many NSR's around the site. The NSRs identified below have been selected based on their proximity to the site, and general topography of the site. As such, compliance with the derived noise criteria at the above NSRs means that compliance is also expected to be met at properties located further away. This is due to additional distance attenuation and the shielding from noise by surrounding structures/houses.

Properties which may be adversely impacted by noise and vibration generated from the proposed development, are as follows:

1. R1 – Lowset and highset residential, south-east of site – 2-18 Lavarack Street, Ryde
2. R2 – Highset residential – 185-187 Quarry Road, Ryde
3. R3 – Cerebral Palsy Alliance Buildings (Educational) – 3A Smalls Road, Ryde
4. R4 – Lowset residential, west of site – 3 Smalls Road
5. R5 – Lowset and highset residential, north of site – 4-10 Smalls Road, Ryde
6. R6 – Active recreating area, east of site – 3B Smalls Road, Ryde

The location of the NSRs have been marked on Figure 3.

Figure 3: Noise Sensitive Receivers (NSRs)

4 Noise Measurements

4.1 Equipment

The following equipment was used to measure existing ambient noise levels at the site:

- Unattended ambient noise:
  - Brüel & Kjær Type 2250 Light, Noise Logger (S/N 3006261)
  - ARL Environmental Noise Logger (S/N 16-707-045)
- Attended ambient noise:
  - Brüel & Kjær Type 2250, Type 1 Sound Level Meter (S/N 3004473)
- Calibrator:
  - Brüel & Kjær Type 4231, Sound Calibrator (S/N 3009809)

All equipment was calibrated by a National Association of Testing Authorities (NATA) accredited laboratory. The equipment was calibrated before and after the measurement session. No significant drift from the reference signal was recorded.

4.2 Ambient Noise Monitoring

4.2.1 Unattended

Unattended noise monitoring was undertaken to measure existing ambient noise levels from the 17th to 24th July 2017. Two noise monitors were installed on site: One at the back of the site away from Smalls Road and the other at the front of the site facing Smalls Road. The microphone was positioned at approximately 1.5 metres above ground level.

Average, maximum and statistical noise parameters were recorded at 15-minute intervals. The weather throughout the monitoring period can be described as fine with light wind breeze and no rain, and suitable for noise monitoring.

The noise monitoring locations are shown in Figure 4.

Figure 4: Ambient Noise Monitoring Location

4.2.2 Attended

Attended noise measurements were also undertaken next to the noise logger to verify and supplement the unattended noise logger data. The sound level meter was checked for calibration before and after the measurement and no significant drift was observed.

4.3 Results of Noise Monitoring

Table 1 presents the measured ambient noise levels at both locations and are based on the unattended noise monitoring data that is graphically shown in Appendix B and Appendix C. The measurement results were used to determine the assessment criteria for the development.

Table 1: Measured unattended noise levels

Period*	Rating Background Noise Levels, RBL (L_{90}) in dB(A)	Existing Noise Levels in dB(A)		
		L_{eq}	L_{10}	L_1
Front of site – Noise Logger 1				
Day	45	61	66	72
Evening	42	57	63	69
Night	36	55	64	70
Back of site – Noise Logger 2				
Day	38	50	53	66
Evening	37	45	48	60
Night	29	42	47	59

Note: *
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800 (Sundays and Public Holidays)

5 Noise Criteria

The main guidelines, standards and other policy documents relevant to the assessment contained in this acoustic report include:

- NSW Industrial Noise Policy, 2000
- Interim Construction Noise Guideline, 2009
- Assessing Vibration: A Technical Guideline, 2006

5.1 NSW Industrial Noise Policy

For noise emissions generated on the site (school grounds) resulting from the activities associated with the school, such as, school bells, concerts in the hall, the relevant noise criteria are defined in the NSW Industrial Noise Policy (INP).

The policy offers guidelines to minimise noise impact to Noise Sensitive Receivers (NSRs) not associated with the development. Project-specific noise levels (PSNLs) are determined and set at the boundary of relevant NSRs which are not to be exceeded.

The policy states that the most stringent of the intrusive and amenity criteria, described below, sets the PSNL.

5.1.1 Intrusiveness criterion

The INP states:

> *The intrusiveness of an industrial noise may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period does not exceed the background noise level measured in absence of the source by more than 5dB.*

The INP recommends methods for determining the background noise level. At the planning and approval stage, the long-term method is used which is designed to ensure that the criterion for intrusive noise will be achieved for at least 90% of the time periods (day/evening/night), known as the Rating Background Level (RBL).

The intrusiveness criterion can thus be summarised by:

$$L_{Aeq,\ 15\ minute} \leq \text{Rating Background Level plus 5dB}$$

5.1.2 Amenity criterion

The INP sets Acceptable Noise Levels (ANLs) for areas impacted by industrial noise that should ideally not be exceeded to protect against impacts such as speech interference and community annoyance. Any new industrial noise sources should not increase the overall industrial noise in an area and cause 'background creep', where background noise levels rise overtime as each new noise source is introduced. Where all practical and reasonable noise mitigation has been applied and still the ANL cannot be achieved, the INP suggests a Recommended Maximum noise level which is 5 dB above the ANL.

Where there is an existing level of industrial noise affecting the NSRs, modifications to the ANL are required as defined in Section 2.2 of the INP.

5.1.3 Project-specific noise levels

The Project-specific noise level (PSNL) is the target noise emission level from the new noise source as a result of the new development, at the boundaries of the identified NSRs. The PSNL is taken to be the lowest and most stringent of the intrusiveness and amenity noise criteria.

5.1.4 Evaluated INP Criteria

Based on the measured unattended noise levels onsite given in Table 1, the applicable criteria have been evaluated and are summarised in Table 2.

Table 2: NSW INP Evaluated criteria

Type of receiver	Assessment period	Intrusiveness Criterion, $L_{eq,15min}$ dB(A)	Amenity Criterion L_{eq} dB(A)*	Project-Specific Noise Levels (PSNLs) $L_{eq,15min}$ dB(A)
Front of site – Smalls Road				
Residential	Day	50	55	**50**
	Evening	47	45	**45**
	Night	41	40	**40**
School classroom – Internal (Cerebral Palsy site)	Noisiest 1-hour period when in use	-	35	**35**
Active recreation area	When in use	-	50	**50**
Commercial premises (Cerebral Palsy site – Offices)	When in use	-	65	**65**
Back of site – Lavarack Street				
Residential	Day	43	55	**43**
	Evening	42	45	**42**
	Night	34	40	**34**
School classroom – Internal (Cerebral Palsy site)	Noisiest 1-hour period when in use	-	35	**35**
Active recreation area	When in use	-	50	**50**
Commercial premises (Cerebral Palsy site – Offices)	When in use	-	65	**65**

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)

* The amenity criterion has been based on the recommended acceptable noise levels for Suburban Noise Amenity Area as given in Table 2.1 of the INP. No modifications are applicable in this situation.

Table 2 shows that at the front of the site (Smalls Road), the intrusiveness criterion is more stringent for the day-time period while the amenity criterion is more stringent for the evening and night-time periods, and therefore, these are the PSNLs for residential properties.

At the back of the site (Lavarack Street), the intrusiveness criterion is more stringent for all time periods, and are therefore this is the PSNLs for residential properties.

For the other types of receiver, such as the Cerebral Palsy site and the active recreation area, the PSNLs are set by the amenity criteria.

By meeting the PSNLs at the identified NSRs, all other properties located further away from the development site are expected to comply with INP noise requirements.

5.2 Interim Construction Noise Guideline

The DECC Interim Construction Noise Guideline[4] (ICNG) provides guidelines for the assessment and management of noise from construction works. Construction activities proposed for this development mean it is considered a major construction project, therefore the quantitative approach has been adopted for the construction noise impact assessment.

5.2.1 ICNG noise management levels

The ICNG suggests the following standard hours for construction activities where noise is audible at sensitive land uses:

- Monday to Friday, 7am to 6pm
- Saturday, 8am to 1pm, and
- No construction work is to take place on Sundays or public holidays.

Time restrictions on construction works are the primary management tool of the ICNG.

The guideline also provides noise management levels for sensitive land uses for both the recommended, and outside standard hours of construction. The noise management levels recommended for residential and non-residential premises have been extracted from the ICNG and are shown in Table 3.

[4] Department of Environment and Climate Change (DECC). NSW Government (2009). Interim Construction Noise Guideline.

Table 3: Residential and commercial – ICNG noise management levels

Time of day	Management level, $L_{Aeq\ (15\ min)}$ *	How to apply
Residential		
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm 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: a. 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 b. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• 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.
Classrooms at schools and other educational institutions		
When in use	Internal noise level 45 dB(A)	Internal noise levels are to be assessed at the centre of the occupied room.
Active recreation area		
When in use	External noise level 65 dB(A)	External noise levels are to be assessed at the most affected point within 50 m of the area boundary.
Commercial and industrial premises - Offices		
When in use	External noise level 70 dB(A) $L_{eq,15min}$	External noise levels should be assessed at the most-affected occupied point of the premises.
Note: * Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.		

5.2.2 Evaluation of Construction Noise Criteria

Construction noise criteria have been derived relative to the measured L_{A90} background noise levels on site. The criteria are summarised in Table 4.

Table 4: Evaluated construction noise criteria

Measurement location	RBL, dB(A)	Management levels, dB(A)	'Highly Noise Affected' Maximum levels, dB(A)
Residential – Front of the site (Smalls Road)	45	55	75
Residential – Back of the site (Lavarack Street)	38	48	75
Cerebral Palsy site – Classrooms	-	45 Internal	-
Cerebral Palsy site – Offices	-	70	-
Active recreation areas	-	65	-

5.3 Vibration Criteria

5.3.1 Assessing Vibration: A Technical Guideline[5]

The guidelines are based on British Standard BS 6472-1992 *Evaluation of human exposure to vibration in building* (1-80 Hz). The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurements and evaluation techniques.

The guidelines do not address occupational vibration or vibration-induced damage to buildings or structures.

5.3.1.1 Acceptable values for continuous vibration (1-80 Hz)

The nature of the construction activities for the development is considered as continuous vibrations. The acceptable values of human exposure to continuous vibration are given in Table 2.2 of the Guideline and is reproduced in Table 5.

Table 5: Preferred and maximum weighted rms value for continuous vibration acceleration (m/s^2) 1-80 Hz

Location	Assessment period*	Preferred values		Maximum values	
		z-axis	x and y-axes	z-axis	x and y-axes
Residences	Day-time	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools	Day or night-time	0.020	0.014	0.040	0.028
Note: * Day-time is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am					

5.3.2 Australian Standard AS 2670

The *Assessing Vibration: A Technical Guideline* is generally based on British Standard *BS6472*. *BS6472* and its Australian equivalent, Australian Standard *AS2670.2*[6] give a series of rating curves to assess human exposure to vibration and provide further guidance on acceptable vibration levels.

[5] NSW Department of Environment and Climate Change (DECC) (2006), Assessing Vibration: a technical guideline

[6] Australian Standard AS2670.2 (1990) – Evaluation of human exposure to whole-body vibration. Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)

Table 2 of *AS2670.2* recommends multiplication factors of the base curve day-time continuous or intermittent human comfort vibration limits for vibration sensitive receivers that should not be exceeded. The multiplication factors have been used to derive the human comfort vibration limits for the day-time period and are summarised in Table 6.

Table 6: Human comfort vibration levels (Velocity) equivalent to Curve 4b given in *AS2670.2*

Criteria (Day-time period)	Vibration Limit, rms in mm/s (Velocity)		Comments
	Continuous or intermittent	Transient vibration with several occurrences per day	
Human comfort in residences	0.2 – 0.4	3 – 9*	To be monitored and reported should a complaint be received.
Office	0.4	6 – 12.8	
Note: *AS2670 suggests that for transient vibration people may not elicit an adverse reaction to vibration levels 30 to 90 times to the threshold of perception (0.1 mm/s).			

5.3.3 Vibration-induced damage to buildings and structures

The likelihood of structural or even cosmetic damage to buildings located around the site is considered highly unlikely given the machinery and equipment proposed to be used in the construction activities. However, for the sake of completeness a building damage vibration criterion has been provided below.

There is little reliable data on the threshold of vibration-induced damage in buildings. Although vibration induced in buildings by ground-borne excitation are often noticeable, there is little evidence that cosmetic damage[7] are actually produced. The lack of data is one of the reasons that there is variation between International Standards.

Vibration will be felt by the occupants of a building at levels far lower than those at which damage is likely to occur. Therefore, for the purposes of the project, it is recommended to set a building damage vibration criterion that is conservative. In doing so, in the unlikely event that the criterion is exceeded, the works can be stopped and any vibration damage can be established. If no damage is observed and the occupants' fears have been allayed, the construction works can resume.

Construction vibration levels are to be measured on or close to the foundations of the closest building to where the vibration generating work is taking place. A recommended conservative vibration criterion for building damage is provided in Table 7.

Table 7: Recommended conservation vibration criterion – Building damage

Criteria	Vibration Limit Peak Particle Velocity (PPV)	Comments
Structural/Cosmetic Damage	5 mm/s	Set as an initial limit, to be monitored during construction for excavation, use of hydraulic hammers and compaction plant.

[7] Building Research Establishment (1995), 'Damage to Structures from Ground-borne Vibration', BRE Digest

5.3.4 Vibration Sensitive Areas

An adverse vibration impact is not a high risk for the construction of the development in terms of damage to buildings or human comfort for the majority of construction activities and machinery/equipment likely to be used. However, there may be some activities, such as the use of hydraulic hammers and vibratory/foot rollers during any excavation, earthworks or landscape and restoration stages at the completion of the project, that may exceed the human comfort criteria at properties located at up to 40 metres from the construction site.

Therefore, vibration sensitive areas are defined as any residential/commercial/educational property within 40 metres of the construction site where hydraulic hammers and compactors/vibratory/foot rollers/large tracked excavators are being used.

6 Noise Impact Assessment

This section of the report assesses the following:

- Operational noise emissions from the development:
  - Public address system
  - School bells/ Period alarms
  - Mechanical plant
  - Use of school hall both during and outside school hours
- Construction noise and vibration

6.1 Operational Noise Assessment

6.1.1 Public Address System

A public address (PA) system has been assumed to be a distributed system split into zones to control coverage and commissioning control of sound levels to each zone around the major internal school areas as appropriate. All PA loudspeakers are assumed to be located inside the school buildings and not in any outside area. The main zone for the PA system is expected to be in the Assembly Area on the ground floor area as shown in Figure 5.

As recommended in the EFSG[8], the Assembly Area must be a gathering space able to accommodate the whole school, a forum for public addresses and performances, space for informal games, seating and shade. The PA system will typically be used for making public commentaries and announcements. Loudspeakers are also expected to be installed inside the buildings in the GLAs, home bases, other teaching spaces, offices, library and hall, which will make up the PA zones.

It is not clear whether the PA will double as a voice alarm system.

6.1.1.1 Assessment Methodology and Results

To achieve the high speech intelligibility needed for effectively communication, speech sound levels must exceed background sound levels by at least 15 dB (15 dB Signal to Noise Ratio [SNR]) across all zones, in particular, the Assembly Area.

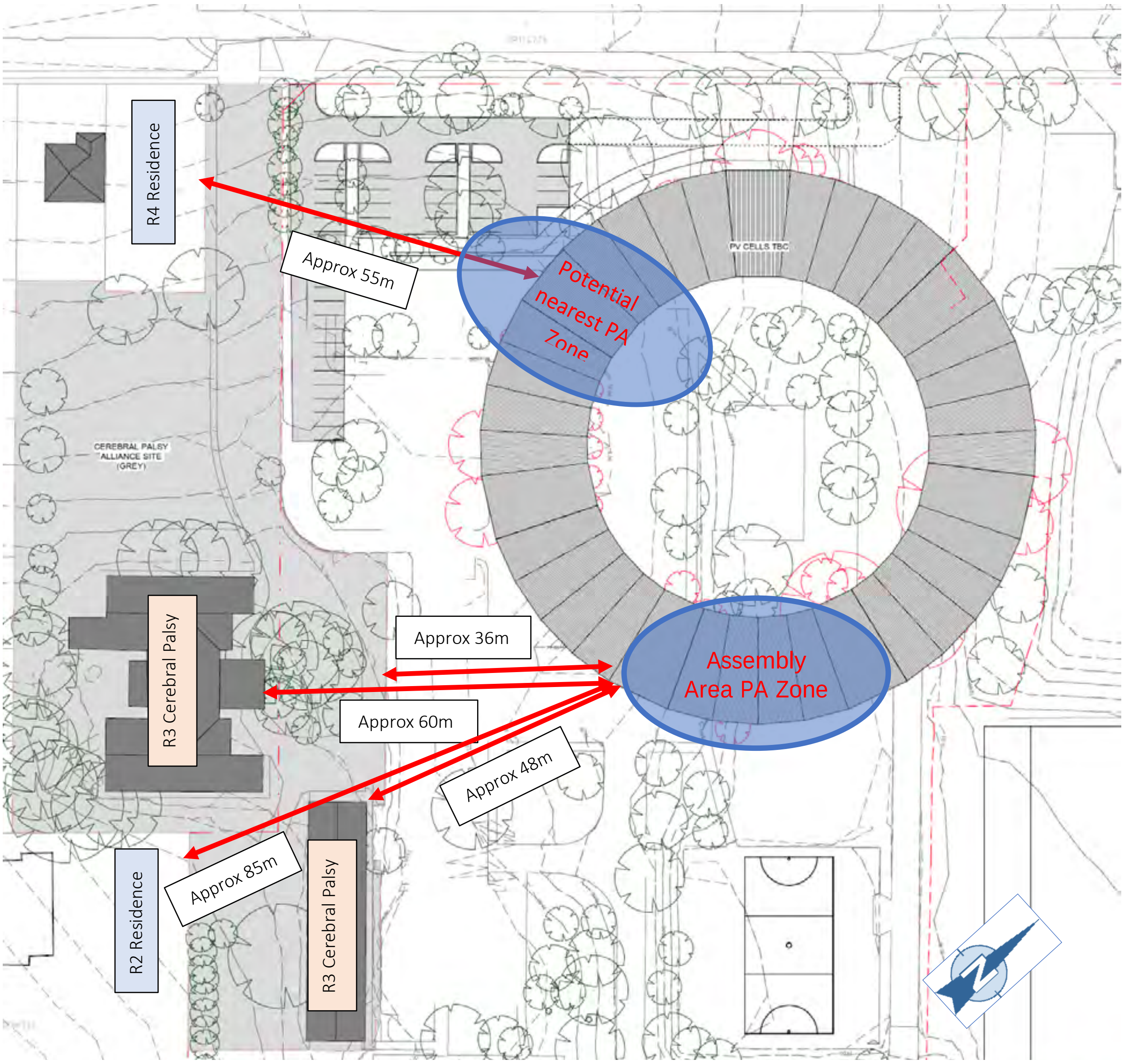
As the PA loudspeakers will be located inside the school building the impact to noise sensitive receivers outside of the school will be minimised by the sound insulation provided by the building envelope.

[8] NSW Department of Education - Educational Facilities Standards & Guidelines

Occupational noise levels in the assembly area and other occupied zones where the PA is installed are not expected to be greater than 60 dB(A) during normal school activities. Therefore, to achieve a signal to noise ration of 15dB at the perimeter of each zone will not exceed 75dB(A).

Figure 5 shows the nearest NSR's to the likely nearest PA zones in the school. There will be other PA zones but the zones shown are the nearest to the NSR's. Noise predictions at the relevant measurement locations at the NSR's have been made according to the approximate distances shown and an assumed conservative 10dB noise reduction through an open window.

Figure 5: Nearest potential PA Zones to nearest noise sensitive receivers



The predicted noise levels versus the relevant criteria at the nearest and most affected noise sensitive receivers are provided in Table 8.

Table 8: Predicted PA noise levels versus criteria at most affected NSR's

NSR	Description	INP Criterion dB(A)	Predicted Noise Level dB(A)	Meets Criterion?
R2	Residential external	Day 43dB $L_{Aeq,15min}$	31	✓
		Evening 42dB $L_{Aeq,15min}$	31	✓
		Night 34dB $L_{Aeq,15min}$	31	✓
R3	Cerebral Palsy Classrooms - Internal	35dB $L_{Aeq,1hour}$	22	✓
R4	Residential external	Day 50dB $L_{Aeq,15min}$	27	✓
		Evening 45dB $L_{Aeq,15min}$	27	✓
		Night 40dB $L_{Aeq,15min}$	27	✓

The results of the PA noise predictions based on an occupational noise level of 60dB(A) plus 15dB signal to noise ratio for the PA across each zone show that the relevant noise criteria are comfortably met at all NSR's at all times. However, it is unlikely that the PA will be used during the evening and night times.

6.1.2 School Bells/ Period Alarms

The period alarms are intended for the indication of events throughout the school from a central control point, usually the Clerical Office. The signal type and frequency of the period alarm will vary from site to site depending on the schools start and finish time, daily period program, assemblies, sports programs, the weather, evacuations and other unforeseen emergencies.

The period alarm system for Smalls Road has not yet been designed, but based on the recommendations of the EFSG, bells/alarms are to be installed as follows:

- Internally – one bell per building per floor, located in corridors, spaced to best utilise the effective range of the bell, typically no more than 15 metres from the end of a corridor and spaced at a maximum of 60 metres apart – in noisy locations one bell every 30 metres.
- Externally – one bell outside the multi-purpose hall adjacent to the Canteen, one bell within each separate courtyard and one directed towards each major playing area.

The final locations of the bells/alarms have yet to be confirmed but will generally be in accordance with the recommendations of the EFSG.

School bells/alarms located inside the building are unlikely to cause an adverse impact to NSR's having a signal to noise ratio as for the PA system. However, depending on the type of bell/alarm signal a penalty correction of 5dB may be added to account for the tonal or impulsive characteristics of the bell/alarm. For this reason, the bell/alarm signal should be selected not to contain these characteristics.

It is also recommended that an electronic sounder is selected in preference to a bell because electronic sounders are directional, whereas a bell radiates equally in all directions, meaning that for a given sound pressure level at a given distance the bell will have more sound energy, which is unnecessary for the school's purposes and can add to unwanted noise spill to other areas.

The EFSG guidelines recommend that school bells/period alarms are also located in specific external locations. This means the risk of an adverse noise impact to NSR's is greater because the bell does not benefit from the 10dB attenuation through an open window compared with bells located inside the building. However, the main outdoor play area is in the centre of the school building, which means that the school building acts as a barrier to attenuate sound between the alarm sounder and the NSR's. This will provide 10-15dB(A) of attenuation to off-set that provided by the open window for alarm sounders inside the building.

The only outside school area that requires a period alarm is the netball/multi-purpose court to the rear of the building facing Henry Durrant Park. To avoid the period alarm having to project sound 25m from the nearest part of the school building, it would be beneficial to locate a directional electronic sounder on a pole close to the court and directed back towards the school building and away from any NSR's. This would mean that lower sound levels would be required to provide the period alarm alert to the users of the court.

If the electronic sounder was located to the side but level with the centre circle of the court and pointing back towards the school it would be approximately 40m from the nearest boundary of NSR 1 and approximately 40m from the school building. Given the daytime criterion is **43dBL_{Aeq}**, accounting for distance loss (32dB) and directionality downpoints (6-12dB) of using a medium throw horn loudspeaker (typical horizontal 60^0 / vertical 40^0 coverage) the predicted maximum allowable level at 1m from the horn loudspeaker would be **81-86 dBA**. This is expected to be sufficient to carry out the purpose of the period alarm for the court.

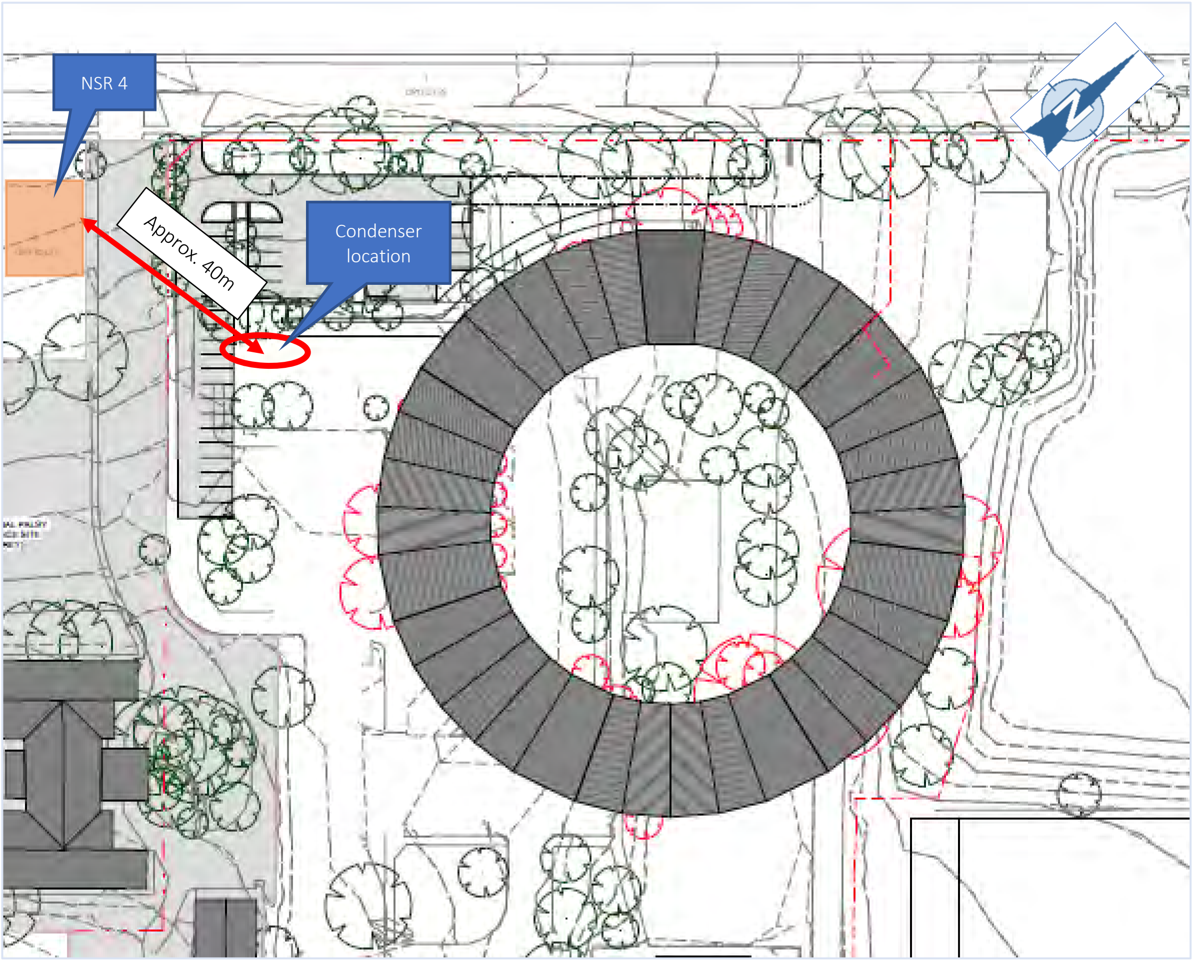
Based on this assessment it is unlikely that noise from the period alarms will cause an adverse noise impact to the NSR's, providing care is taken with the design of the period alarm system.

Recommendations to minimise noise intrusion from the school bells/alarms to NSRs are provided in Section 7.2.

6.1.3 Mechanical Plant

Although natural ventilation is proposed for the office, teaching and learning areas of the new school building, a small number of split system condensers are required. Theses condenser units are proposed to be located next to the car parking area, adjacent to the school building as shown in Figure 6.

Figure 6: Proposed location of mechanical plant



The proposed mechanical plant noise is required to meet the PSNL derived from the NSW INP at the most affected and closest NSR's.

The closest NSR is R4, a lowset residential property, located at approximately 40 metres from the proposed mechanical plant location. The most stringent PSNL at R4 during the night-time period is 40 dB(A) L_{eq}.

TTM has assumed source noise levels of the split system condensers as follows:

Table 9: 8kW split system AC unit measured at 1 metre.

Overall Sound Level (Single Unit) dB		Octave Band Centre Frequency Sound level (dB), Frequency (Hz)							
dB(A)	dB(Linear)	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
59	68	66	58	54	57	56	50	42	32

Based on the sound levels provided in Table 8 the predicted noise levels at NSR 4 versus the PSNL are given in Table 10.

Table 10: Mechanical noise predictions at NSR4 versus PSNL

NSR	Description	Assumed number of units	Shielding from barrier?	Character correction?	INP Criterion dB(A)	Predicted Noise Level dB(A)	Meets Criterion?
R4	Residential external	6	Assumed no barrier	+5dB	Day 50dB $L_{Aeq,15min}$	40	✓
					Evening 45dB $L_{Aeq,15min}$	40	✓
					Night 40dB $L_{Aeq,15min}$	40	✓
R4	Residential external	6	Barrier if required	+5dB	Day 50dB $L_{Aeq,15min}$	30	✓
					Evening 45dB $L_{Aeq,15min}$	30	✓
					Night 40dB $L_{Aeq,15min}$	30	✓

Table 10 shows that the PSNL is met at all times, based on our understanding of the mechanical plant proposed. A noise barrier is an option to reduce noise levels further if the selected plant exceeds our assumptions at this stage. The character correction is conservative and may not need to be applied.

Based on the most stringent nigh-time PSNL the combined noise emission must not exceed 72 dB(A) L_{eq} measured at one metre from the source to achieve compliance. As the assessment above shows, this is likely to be achievable for a small number of condenser units. However, if larger items of plant such as, chillers or pumps are likely, then further assessment and noise control may be required.

In any case, it is good practice to locate mechanical plant as far away from the residential receivers as possible, and particularly away from windows.

It is recommended that care is taken with respect to the noise level when selecting plant.

6.1.4 School/Community Hall

The Communal Hall is a flexible facility catering for a range of multimodal activities for groups of students, teachers, parents and the general community. This hall also provides a space to cater for large group school/community events, presentations and ceremonies. There is potential for community access out of school hours. Communal halls are typically used after hours for church meetings, dance/Zumba classes, karate classes, school fetes and fairs, and small local theatrical groups.

The stage in the communal hall is for school presentations and student concerts generally that occur during school hours.

6.1.4.1 Assessment Methodology and Results

To assess the potential noise impact of the activities of the school/community hall on the local community a worst-case sound generating scenario of a school concert or school formal/disco has been assumed with an internal reverberant sound pressure level shown in Table 11. The sound spectrum represents a typical rock music spectrum that has a significant low frequency component.

Table 11: Assumed worst-case music reverberant sound level in the hall

Overall Sound Level (Single Unit) dB		Octave Band Centre Frequency Sound level (dB), Frequency (Hz)							
dB(A)	dB(Linear)	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
90	99	97	92	89	85	85	83	80	71

Using the above sound spectrum as an expected worst-case reverberant source music level, predictions have been made assuming that the doors/operable wall at the rear of the hall opening out into the mini amphitheatre are open at all times. However, in practice it is unlikely that the doors will be open at night time.

The predictions have considered the following:

- Doors/operable wall at the rear are all open.
- Distance loss.
- A conservative barrier effect, where the school building blocks line-of-sight to the NSR's.
- A 10dB loss through an open window/door.

Table 12 shows the results of the predictions at the NSR's.

Table 12: Noise breakout predictions at NSR's versus PSNL

NSR	Description	Approximate distance (m)	Line of sight to between NSR and hall correction?	Low Frequency Correction?	INP Criterion dB(A)	Predicted Noise Level dB(A)	Meets Criterion?
R1	Residential external	135m	-10dB	No	Day 43dB $L_{Aeq,15min}$	31	✓
					Evening 42dB $L_{Aeq,15min}$	31	✓
					Night 34dB $L_{Aeq,15min}$	31	✓
R2	Residential external	145m	-10dB	No	Day 43dB $L_{Aeq,15min}$	30	✓
					Evening 42dB $L_{Aeq,15min}$	30	✓
					Night 34dB $L_{Aeq,15min}$	30	✓
R3	Cerebral Palsy (Internal classroom)	115m	0dB	No	35 dB $L_{Aeq,1hour}$	32	✓
R4	Residential external	130m	-10dB	No	Day 50dB $L_{Aeq,15min}$	31	✓
					Evening 45dB $L_{Aeq,15min}$	31	✓
					Night 40dB $L_{Aeq,15min}$	31	✓
R5	Residential external	80m	-10dB	No	Day 50dB $L_{Aeq,15min}$	36	✓
					Evening 45dB $L_{Aeq,15min}$	36	✓
					Night 40dB $L_{Aeq,15min}$	36	✓

As shown in Table 12 the relevant PSNL's for each NSR are met at all times when the doors are open. In the unlikely scenario that higher reverberant sound levels than those assumed as a worst-case are experienced, the doors/operable wall can be closed to provide a minimum additional 20dB attenuation.

This conservative assessment has shown that noise impact to the community from the use of the school hall for school and, evening and weekend community activities is expected to be negligible to none.

6.2 Construction Noise Assessment

6.2.1 General construction schedule

The construction schedule below outlines the expected stages involved in the construction program of the Smalls Road School:

- Demolition & Preparation works
- Construction – Structure
- Construction – Finishes
- Testing, Commissioning & Handover.

6.2.2 Plant and equipment noise source levels

The typical plant and machinery source noise levels expected for each step of the construction program are summarised in Table 13. This information has been used to predict construction noise levels at the noise sensitive areas close to the school.

The plant selected and percentage on-times during the working day have been estimated based on previous experience. The approximate percentage on-times are deemed appropriate due to the transient and changing nature of the construction noise activities, which are dependent upon site-conditions, timelines, delays and other unexpected occurrences.

Table 13: Plant and equipment used and % use per day for each step of the construction schedule

Construction schedule	Noise impact	Equipment	% use per day
Demolition & Preparation works	To be investigated	1 x Chainsaw 1x Dozer 1 x 30T excavator 1 x rockbreaker 2 x D6 Loader 1 x 10T Truck 1 x Water truck 1 x Diesel generator	20 50 80 50 70 50 50 100
Construction – Structure	To be investigated	1 x crane 1 x Concrete pump truck 1 x Material delivery truck 1 x Concrete boom pump 2 x concrete pokers Hand tools (pneumatic) 1 x Diesel generator 1 x Brick saw 1 x Air compressor	70 30 70 30 30 60 100 40 60
Construction – Finishes	To be investigated	1 x Concrete/ring saw 1 x Scissor lift 2 x Material delivery trucks 1 x Diesel generator 3 x Hand tools (electric)	40 70 40 100 70
Testing, Commissioning & Handover	Not expected	-	-

The source sound levels for each of the items of plant and equipment are provided in Table 14.

Table 14: Sound power levels, Lw, of construction plant and equipment

Construction phase	Plant and equipment	Lw, dB(A)	Reference
Demolition & Preparation works	Chainsaw	107	https://webgate.ec.europa.eu/growth-portal/noise/reports/EN/EN_EQUIPMENT28.PDF
	Dozer	108	AS2436
	30T Excavator	107	AS2436
	Rockbreaker	118	AS2436
	D6 Loader	113	AS2436
	10T Truck	107	AS2436
	Water truck	107	AS2436
	Diesel generator	99	AS2436
	TOTAL Lw including % on-times	**118**	-

Construction phase	Plant and equipment	Lw, dB(A)	Reference
Construction – Structure	Crane	105	AS2436
	Concrete pump truck	108	AS2436
	Material delivery truck	106	AS2436
	Concrete boom pump	108	AS2436
	2x concrete Pokers	101	AS2436
	Hand tools (pneumatic)	116	AS2436
	Diesel generator	99	AS2436
	Brick saw	117	AS2436
	Air compressor (Silenced)	101	AS2436
	TOTAL Lw including % on-times	**118**	-
	Concrete/ring saw	117	AS2436
	Scissor lift	105	AS2436
	Material delivery truck	106	AS2436
	Diesel generator	99	AS2436
	Hand tools (electric)	102	AS2436
	TOTAL Lw including % on-times	**115**	-

6.2.3 Assessment methodology

The construction noise level for each applicable construction phase has been predicted to the surrounding noise sensitive areas based on the following:

- Expected construction schedule and % use per day given in Table 13
- Plant and equipment source sound level information given in Table 14
- Average position of plant and equipment is in the middle of the site
- Distance loss, and
- Air absorption.

6.2.4 Prediction results

Construction noise has been predicted to the identified closest noise sensitive receivers (NSRs) and the results are presented in Table 15. All predicted noise levels are external except for NDR R3, which is an internal Management Level (ML).

Table 15: Predicted construction noise levels

Construction phase	External predicted construction noise levels at NSRs, in dB(A)					
	R1 – Residential ML 48 dB(A)	R2 – Residential ML 48 dB(A)	R3 – Classrooms/Offices ML 45 dB(A) internal	R4 – Residential ML 55dB(A)	R5 – Residential ML 55 dB(A)	R6 – Active recreation areas ML 65 dB(A)
Demolition & Preparation works	65	70	73	71	70	65
Construction – Structure	62	67	70	70	69	64
Construction – Finishes	60	65	68	66	65	60

As is frequently the case with construction noise occurring close to sensitive land uses, the predicted construction noise level results show that the noise management levels (ML) will be exceeded at all the NSRs. However, the NSRs will not be 'highly noise affected' (greater than 75 dB(A) - Residential) by the construction activities.

6.2.5 Discussion

The prediction results of the construction noise assessment in Table 15 show that all the NSRs will exceed the ICNG noise management levels. The residential noise sensitive areas will however not be 'highly noise affected' by the construction works.

During construction activities, plant and equipment are used for different periods of time across the entire site. Plant and equipment are expected to operate at one location for a short period and move on the next location. Consequently, when works are conducted on the eastern boundary of the site, noise sensitive areas located on the western boundary side will be less impacted.

Furthermore, plant and equipment are usually spread out across the site conducting specific tasks and not all operating at the same time. The impact of one item of plant or equipment will be considerably less than the cumulative impact of all plant and equipment.

Although construction noise is expected to be audible and there is likely to be some degree of adverse impact, as is typical with construction projects near people, by incorporating noise control measures, the noise impact to residents and other noise sensitive receivers surrounding the site can be significantly reduced with practical and feasible management advice. Construction noise can be managed and minimised through a Construction Noise and Vibration Management Plan (CNVMP) to minimise the adverse impact and build goodwill with the community.

6.3 Construction Vibration Assessment

The risk of vibration caused by the construction works onto nearby buildings is considered highly unlikely due to the type of activities taking place, the large distances involved and the high levels of vibration required to cause damage.

It is recommended to set a conservative building damage vibration criterion so that in the unlikely event that the criterion is exceeded, the construction works can be stopped and the vibration damage established. If no damage is observed and after the occupants' fears have been allayed, the works can resume. The recommended vibration criterion for building damage is set at **5 mm/s PPV.**

The greatest risk of vibration causing an adverse impact to the residents is by causing discomfort or fear of damage to their premises.

For reference, the safe working distances for vibration causing plant which may be used during the construction activities have been taken from the *Transport Infrastructure Development Corporation Construction Noise Strategy (Rail Projects) 2007* and are summarised in Table 16.

Table 16: Recommended safe working distances for hydraulic hammer rock breaking attachments

Plant Item	Rating/Description	Safe Working Distance, in metres	
		Cosmetic Damage (BS7385[9])	Human Response (AS2670)
Small Hydraulic Hammer	300kg – 5 to 12t excavator	2	7
Medium Hydraulic Hammer	900kg – 12 to 18t excavator	7	23

6.3.1 Potential exceedance?

Exceedances of the building damage criterion from plant and activities associated with the demolition and construction of Smalls Road School are considered highly unlikely. The biggest risk of an exceedance is from the rockbreaker. However, as Table 16 shows the cosmetic damage criterion only predicts an exceedance at up to 7m for an 18t excavator with a medium hydraulic hammer attachment. Tracked excavators can also cause vibration, but significant levels are not expected above the distances in Table 16 .

The safe working distances given in Table 16 should be adhered to, but by selecting smaller plant when conducting construction work very close to occupied structures, the risk of cosmetic building damage or human comfort vibration impact, and complaints of vibration from the residents are expected to be low.

[9] BS 7385 -2: 1993 Guide to damage levels from ground borne vibration

7 TTM Recommendations

Based on the noise impact assessment, recommendations have been made to ensure compliance with the relevant noise criteria is achieved.

7.1 Public Address System (PA)

The following recommendations are made:

- The PA system must only be used to communicate to students, or playing low background music, and not for giving commentaries, or advertising.
- Loudspeakers should be small, low-power units located in areas close to the listener position. It is recommended to have a higher number of smaller loudspeakers distributed to be close to the listeners rather than fewer more powerful loudspeakers that are required to project the sound large distances to reach the listeners.
- Loudspeakers must point in the appropriate direction towards the listeners, such as ceiling or wall mounted loudspeakers.
- It is not recommended to have loudspeakers located at the front of the assembly area projecting sound all the way to the back. This results in unnecessarily high sound levels near the front and is likely to result in noise spill through the building envelope.
- No PA loudspeakers should be located outside.
- A sound level limiting circuit is an option to be incorporated in the amplifier to control the signal amplitude to a fixed level, regardless of the loudness of the operator's voice.
- High-power systems are not required for communicating to the students in the Assembly Area and should not be used.

7.2 School Bells/ Period Alarms

The following recommendations are made:

- Install bells/alarms in the middle of the corridor of the building, away from external doors.
- Only install bells/alarms where the corridor is enclosed.
- An electronic sounder should be selected in preference to a bell because electronic sounders are directional, whereas a bell radiates equally in all directions, causing unnecessary noise spill.
- The external bell/alarm should be installed on the side of the building facing the middle landscape area.

- To alert users of the netball/multi-purpose court it is recommended to install a horn loudspeaker midway along the side of the court facing back towards school building to minimise noise spill to the NSR's
- Do not install a period bell/alarm in the administration, Canteen or library buildings. Bells located externally on the pupil side of the administration area, or in adjacent corridors near libraries can achieve the desired result.
- Where buildings are without corridors or corridors are adjacent to external walls, internal bells will not be required as recommended in the EFSG.

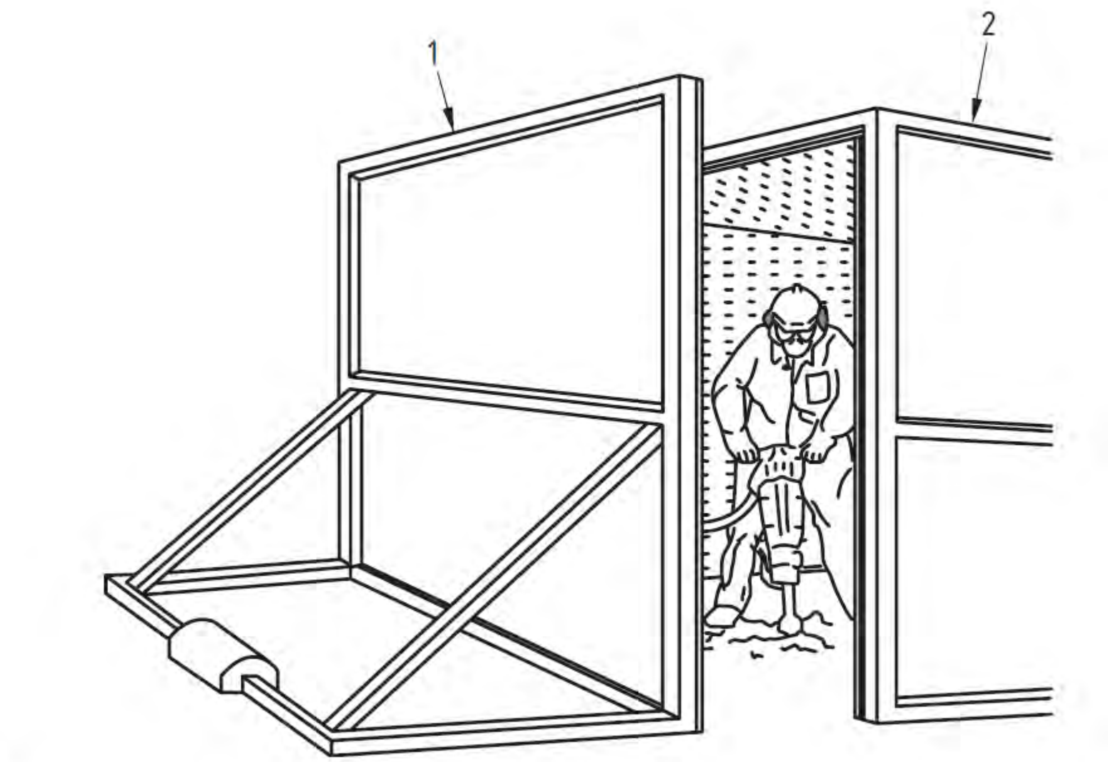
7.3 Mechanical noise

- The noise assessment based on our understanding of the mechanical plant proposed has shown that all criteria will be met at all times and no further noise control is necessary.
- A noise barrier is an option to reduce noise levels further if the selected plant exceeds our assumptions.
- Based on the most stringent nigh-time PSNL the combined noise emission must not exceed **72 dB(A) L_{eq}** measured at one metre from the source to achieve compliance. As the assessment above shows, this is likely to be achievable for a small number of condenser units. However, if larger items of plant such as, chillers or pumps are likely, then further assessment and noise control may be required.
- It is good practice to locate mechanical plant as far away from the residential receivers as possible, and particularly away from windows.
- It is recommended that care is taken with respect to the noise level when selecting plant.

7.4 Construction noise

The opportunities for practical physical noise control are few given the transient and constantly moving nature of the construction work. However, it is recommended to use mobile noise barriers/enclosures during certain construction work, such as around stationary work activities and plant. Examples of a mobile enclosure and demountable noise barriers are shown in Figure 7 and Figure 8 respectively.

Figure 7: Illustration of a mobile enclosure and barrier



Key

1 Acoustic screen 2 m wide and 2.7 m high

2 Acoustic shed 2 m square and 2.7 m high

Figure 8: Photos demountable noise barriers

In addition to physical noise control or in situations where this is not practical, management measures should be employed to minimise the construction noise impact onto neighbouring buildings. These should include all feasible and reasonable measures employed by the builder such as:

- Informing and consulting residents and interested parties, as far as practicable, regarding impending or current events that may cause high levels of noise and how long they are expected to take. This may take the form of letter drops, or community notices.
- Provide a complaints telephone number prominently displayed where the works are taking place and on any letter drops or community notices.
- Respite hours agreed with residents when noisy works will not take place if necessary.
- Investigate complaints when received to establish the cause, and where possible implement a corrective action such as, provide a respite period or other practical measure.
- Minimising the operating noise of machinery brought on to the site.
- Where appropriate, obtaining acoustic test certificates for machinery brought on to the site.
- Undertake noise monitoring at the start of a new noisy activity so noise levels can be investigated should a complaint be received.
- If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours.
- Where it is not practical to sufficiently mitigate the noise impact of a particular activity, substitute methods of construction should be considered for example, using a rock saw or stitch drilling to excavate rock instead of a rock breaker, which uses impact as its operating energy.
- Ensuring that plant is not left idling when not in use.
- Ensuring that plant is well maintained and in good working order and not causing unnecessary noise, such as damaged mufflers on plant.
- All access hatches for plant to be kept closed.
- Provision of a toolbox talk to personnel on-site so that everyone understands the importance of controlling noise and vibration.
- To provide a framework for construction noise management on-site it is recommended that a Construction Noise and Vibration Management Plan (CNVMP) is produced by the contractor. This should include all pertinent information regarding the control and management of noise and vibration, and would be used as a working document on-site by contractors and sub-contractors so that everyone is aware of their responsibilities.

7.5 Vibration monitoring - Construction

It is recommended to conduct vibration monitoring when construction work is being undertaken inside or close to the safe working distances, in order to provide measurement records to interested parties should a complaint be received.

8 Conclusion

A noise impact assessment has been undertaken by TTM for the construction of the proposed new school at Smalls Road, Ryde.

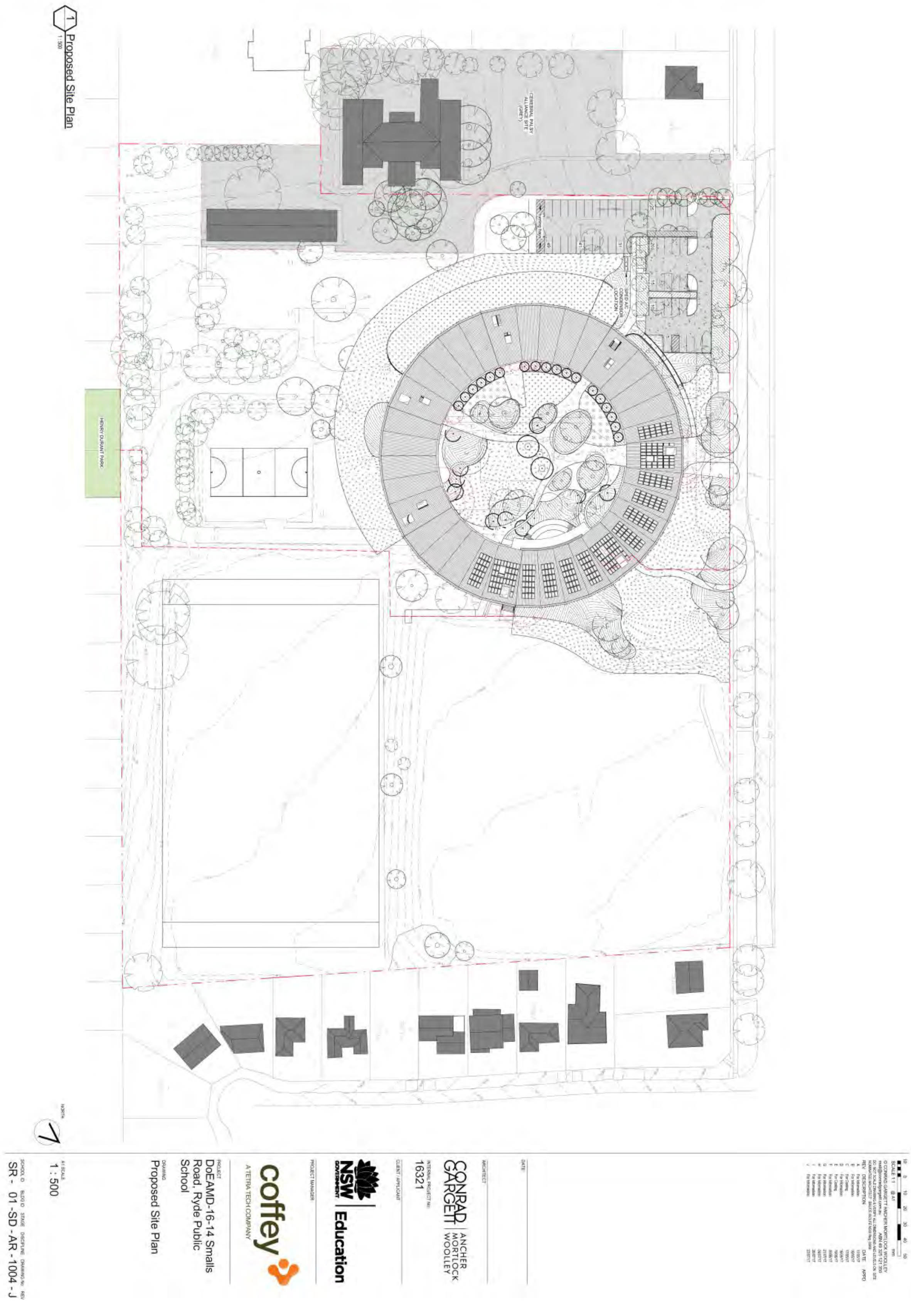
The assessment has considered the potential noise impact to the community from the following noise sources and activities; Public Address system, School bell/period alarm, Mechanical Plant, school and community events and activities in the school hall, and construction noise and vibration for the demolition and construction stages of the project.

The relevant noise criteria have been derived and applied to the assessment. The assessment found that all operational noise criteria are predicted to be met at all times. The construction noise assessment found, as is frequently the case, that the Management Levels are exceeded at all noise sensitive receivers (NSR's), but that the 'Highly Noise Affected', level of 75 dB(A) was not exceeded at any NSR.

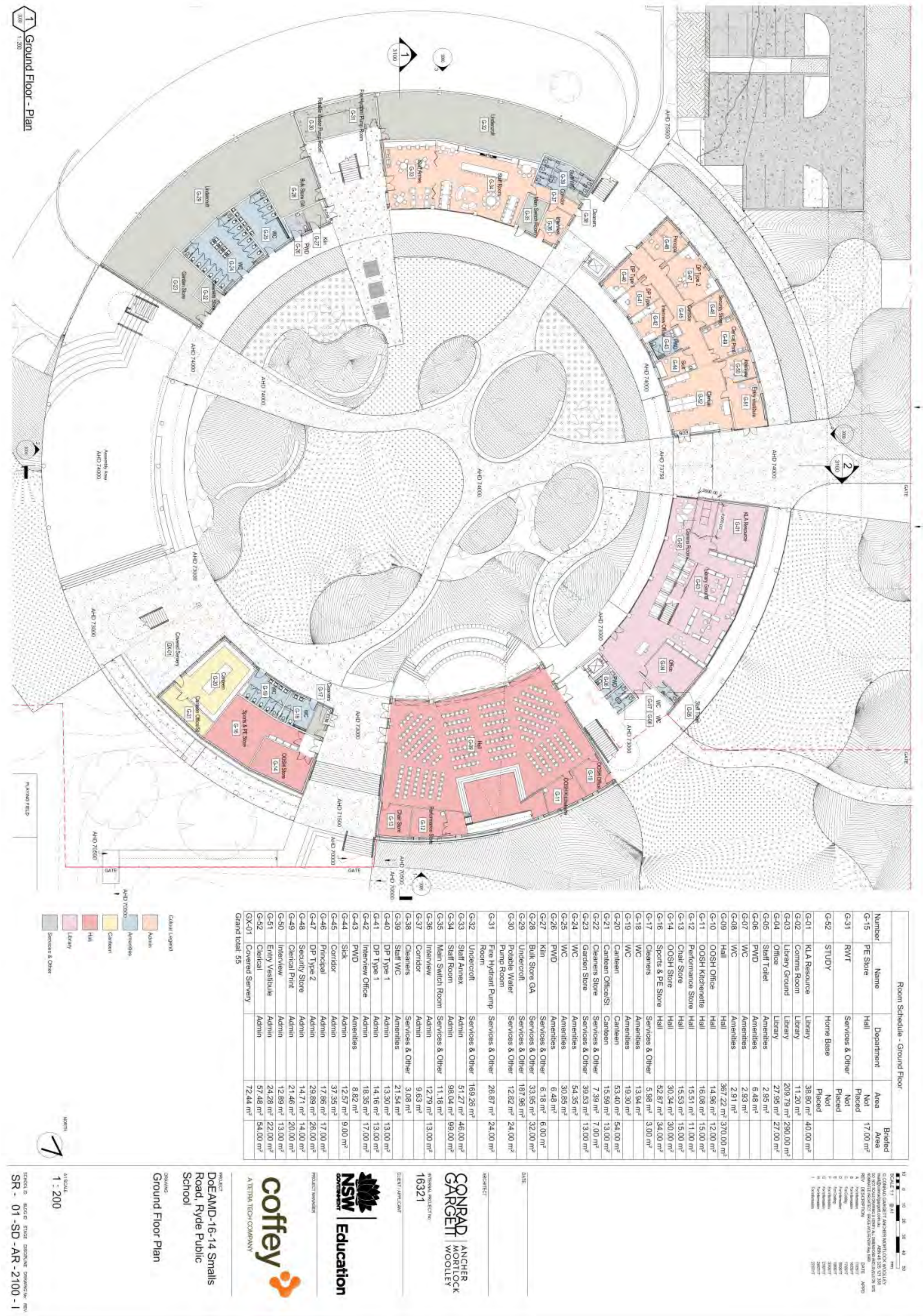
Practical advice has been provided to minimise any adverse noise impact for both operational and construction noise. However, based on the information available this noise impact assessment report has shown that the operational criteria are expected to be met and the noise impact on the community is expected to be negligible.

The construction noise impact is expected to be higher, but with good practical management, can be minimised to acceptable levels.

Appendix A Relevant Development Plans



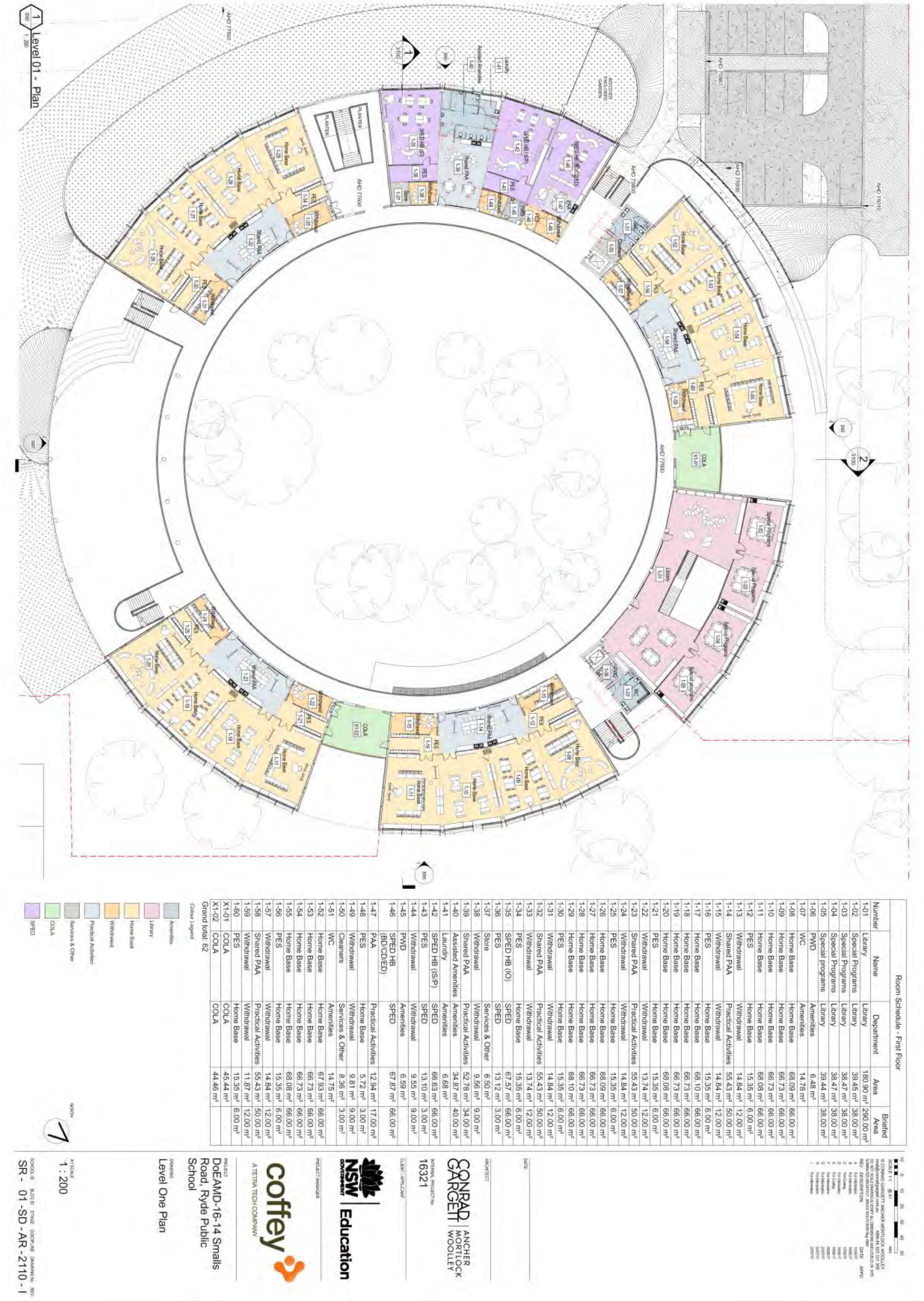
Proposed Site Plan
1 : 500
SR - 01 -SD -AR -1004 -J
Proposed Site Plan
DoEAMD-16-14 Smalls Road, Ryde Public School
coffey
A TETRA TECH COMPANY
NSW GOVERNMENT
Education
16321
CONRAD GARGETT
ANCHER MORTLOCK WOOLLEY



Room Schedule - Ground Floor

Number	Name	Department	Area	Briefed Area
G-15	PE Store	Hall	Not Placed	17.00 m²
G-31	RWT	Services & Other	Not Placed	
G-52	STUDY	Home Base	Not Placed	
G-01	KLA Resource	Library	38.80 m²	40.00 m²
G-02	Comms Room	Library	11.20 m²	
G-03	Library Ground	Library	209.79 m²	290.00 m²
G-04	Office	Library	27.95 m²	27.00 m²
G-05	Staff Toilet	Amenities	2.95 m²	
G-06	PWD	Amenities	6.48 m²	
G-07	WC	Amenities	2.93 m²	
G-08	WC	Amenities	2.91 m²	
G-09	Hall	Hall	367.22 m²	370.00 m²
G-10	OOSH Office	Hall	14.96 m²	12.00 m²
G-11	OOSH Kitchenette	Hall	16.08 m²	15.00 m²
G-12	Performance Store	Hall	15.51 m²	11.00 m²
G-13	Chair Store	Hall	15.53 m²	15.00 m²
G-14	OOSH Store	Hall	30.34 m²	30.00 m²
G-16	Sports & PE Store	Hall	52.87 m²	34.00 m²
G-17	Cleaners	Services & Other	5.98 m²	3.00 m²
G-18	WC	Amenities	13.94 m²	
G-19	WC	Amenities	19.30 m²	
G-20	Canteen	Canteen	53.40 m²	54.00 m²
G-21	Canteen Office/St	Canteen	15.59 m²	13.00 m²
G-22	Cleaners Store	Services & Other	7.39 m²	7.00 m²
G-23	Garden Store	Services & Other	39.53 m²	13.00 m²
G-24	WC	Amenities	54.35 m²	
G-25	WC	Amenities	30.85 m²	
G-26	PWD	Amenities	6.48 m²	
G-27	Kiln	Services & Other	6.18 m²	6.00 m²
G-28	Bulk Store GA	Services & Other	33.95 m²	32.00 m²
G-29	Undercroft	Services & Other	187.96 m²	
G-30	Potable Water Pump Room	Services & Other	12.82 m²	24.00 m²
G-31	Fire Hydrant Pump Room	Services & Other	26.87 m²	24.00 m²
G-32	Undercroft	Services & Other	169.26 m²	
G-33	Staff Annex	Admin	51.27 m²	46.00 m²
G-34	Staff Room	Admin	98.04 m²	99.00 m²
G-35	Main Switch Room	Services & Other	11.18 m²	
G-36	Interview	Admin	12.79 m²	13.00 m²
G-37	Corridor	Admin	9.63 m²	
G-38	Cleaners	Services & Other	3.08 m²	
G-39	Staff WC	Amenities	21.54 m²	
G-40	DP Type 1	Admin	13.30 m²	13.00 m²
G-41	DP Type 1	Admin	14.16 m²	13.00 m²
G-42	Interview Office	Admin	18.35 m²	17.00 m²
G-43	PWD	Amenities	8.82 m²	
G-44	Sick	Admin	12.57 m²	9.00 m²
G-45	Corridor	Admin	37.35 m²	
G-46	Principal	Admin	17.86 m²	17.00 m²
G-47	DP Type 2	Admin	29.89 m²	26.00 m²
G-48	Security Store	Admin	14.71 m²	14.00 m²
G-49	Clerical Print	Admin	21.46 m²	20.00 m²
G-50	Interview	Admin	12.89 m²	13.00 m²
G-51	Entry Vestibule	Admin	24.28 m²	22.00 m²
G-52	Clerical	Admin	57.48 m²	54.00 m²
GX-01	Covered Servery		72.44 m²	

Grand total: 55


Level 01 - Plan
Room Schedule - First Floor
CONRAD GARGETT ANCHER MORTLOCK WOOLLEY
16321
NSW Education
coffey
A TETRA TECH COMPANY
DoEAMD-16-14 Smalls Road, Ryde Public School
Level One Plan
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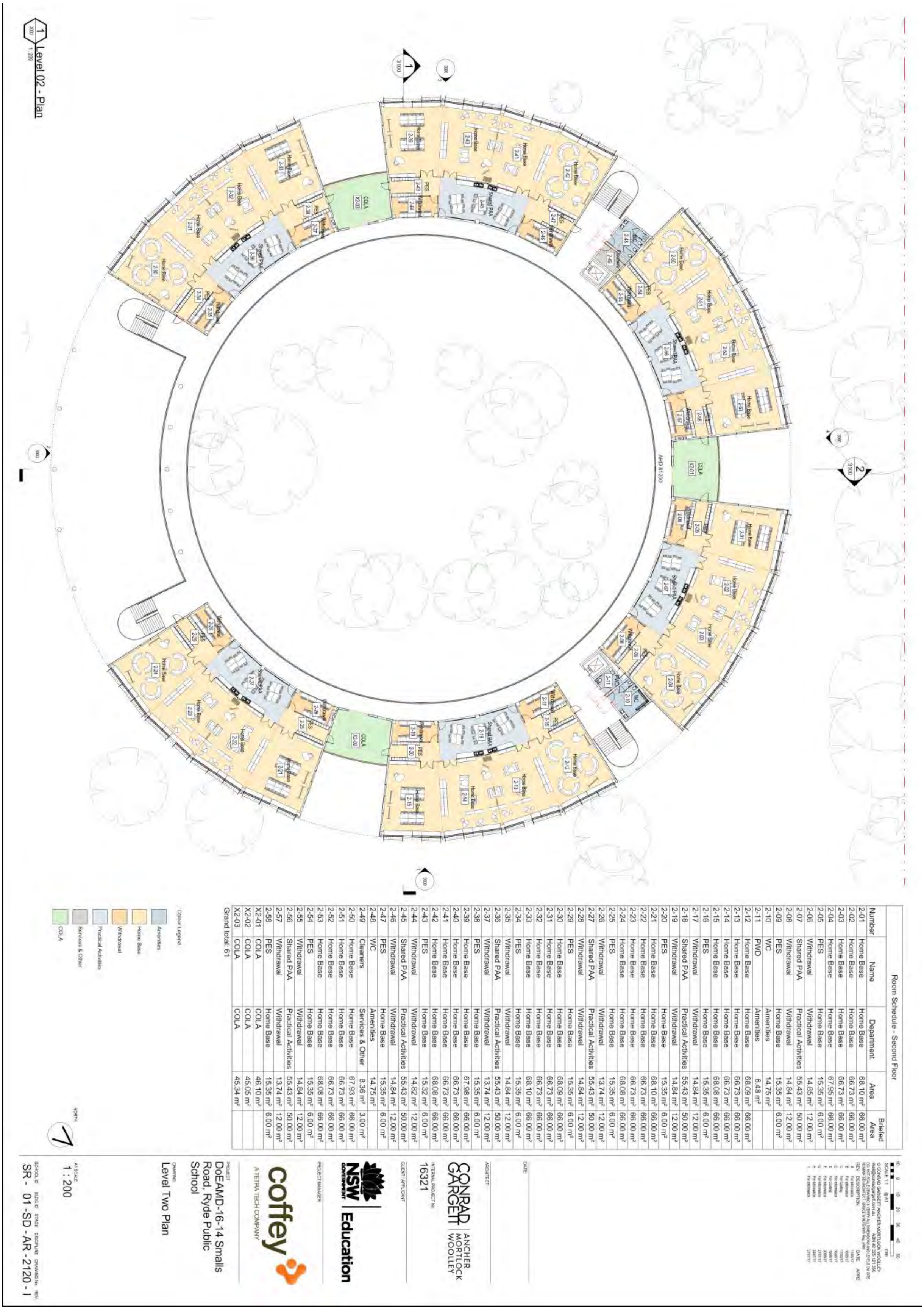
Level 02 - Plan
1 : 200
Room Schedule - Second Floor
Colour Legend
Amenities
Home Base
Withdrawal
Practical Activities
Services & Other
COLA
Grand total: 61
CONRAD GARGETT | ANCHER MORTLOCK WOOLLEY
16321
NSW GOVERNMENT | Education
coffey
A TETRA TECH COMPANY
DoEAMD-16-14 Smalls Road, Ryde Public School
Level Two Plan
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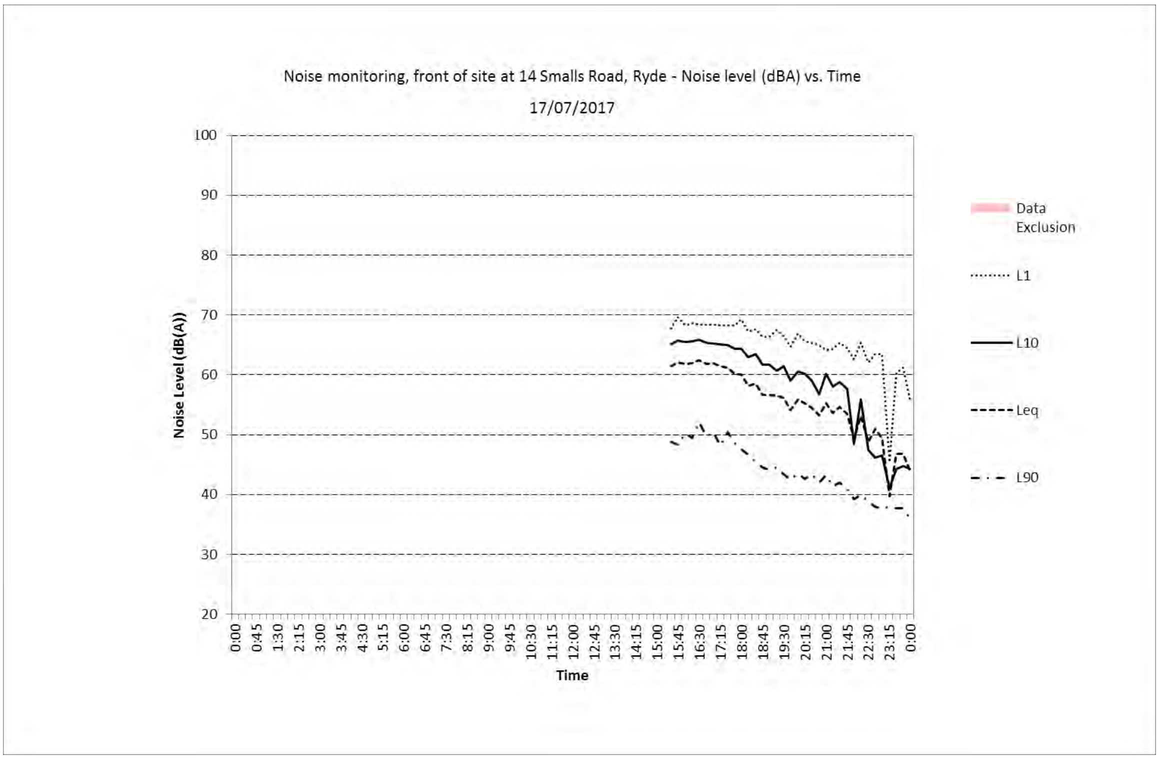
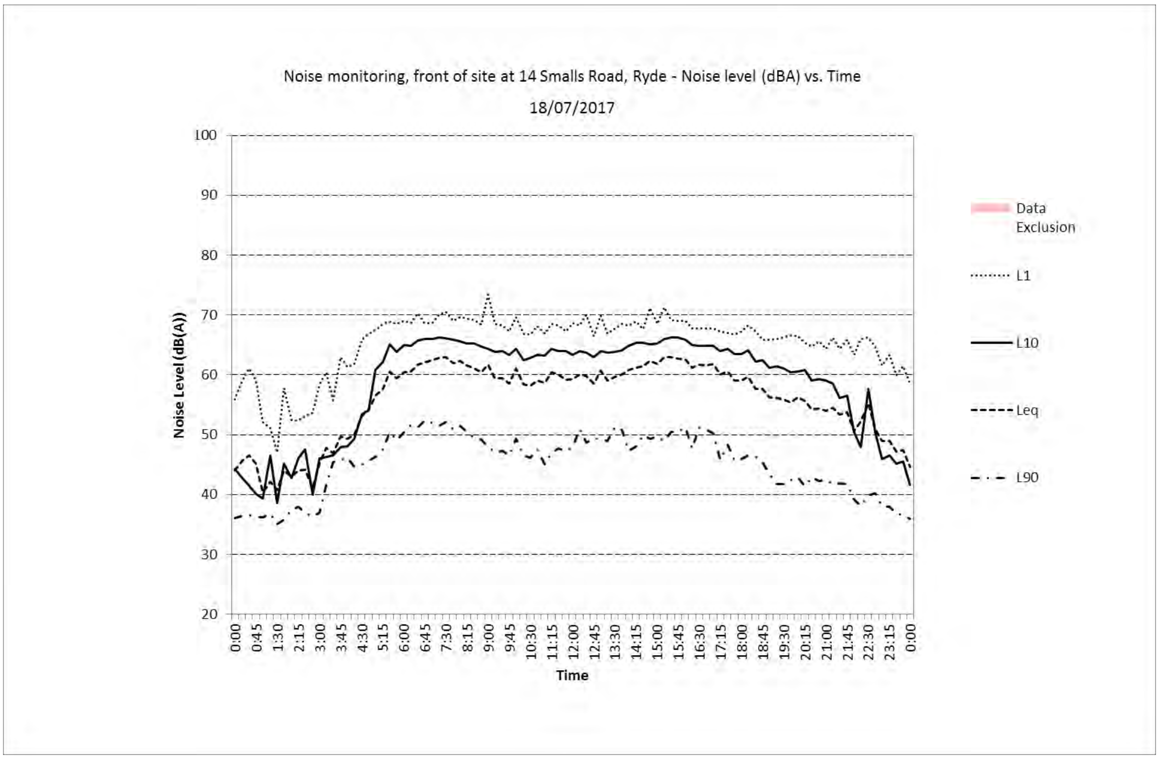
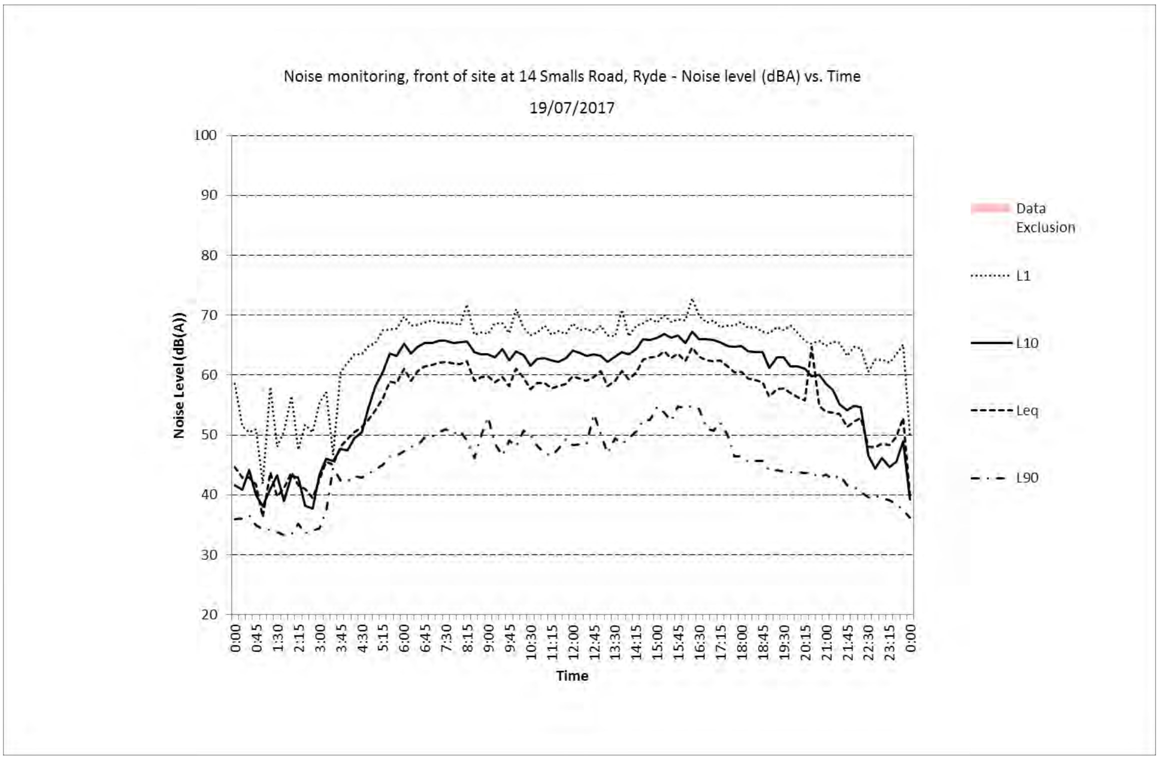
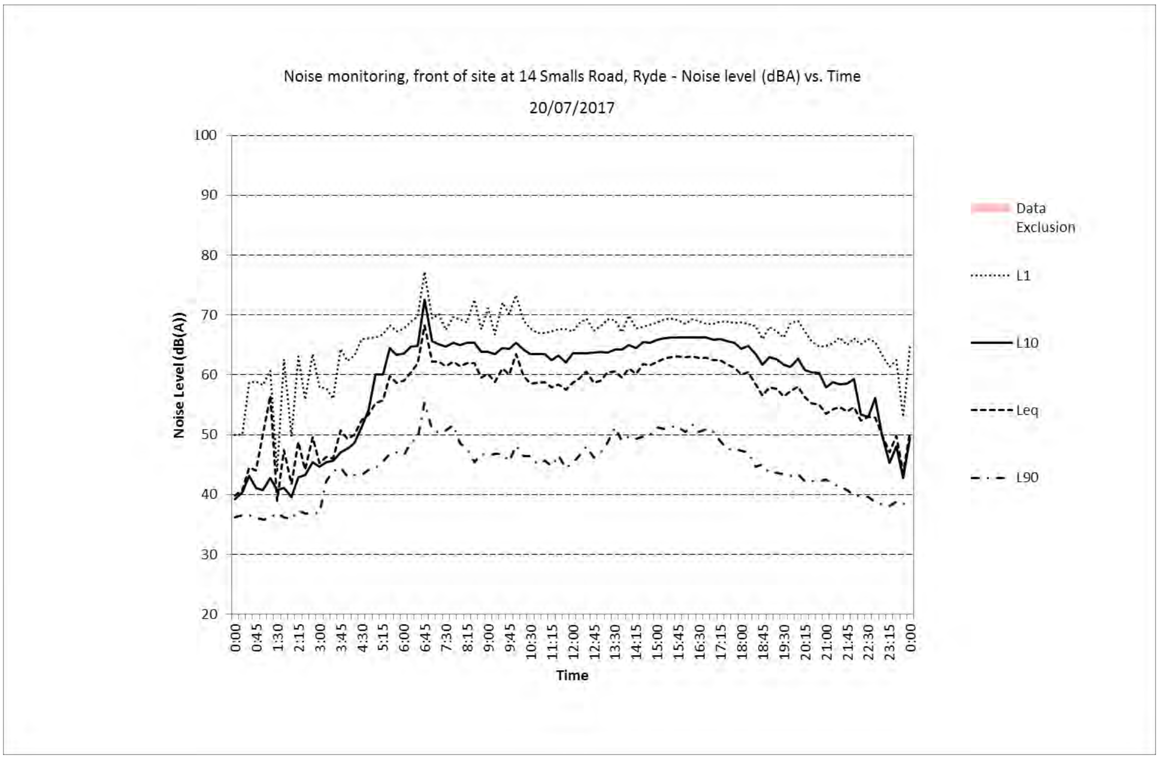
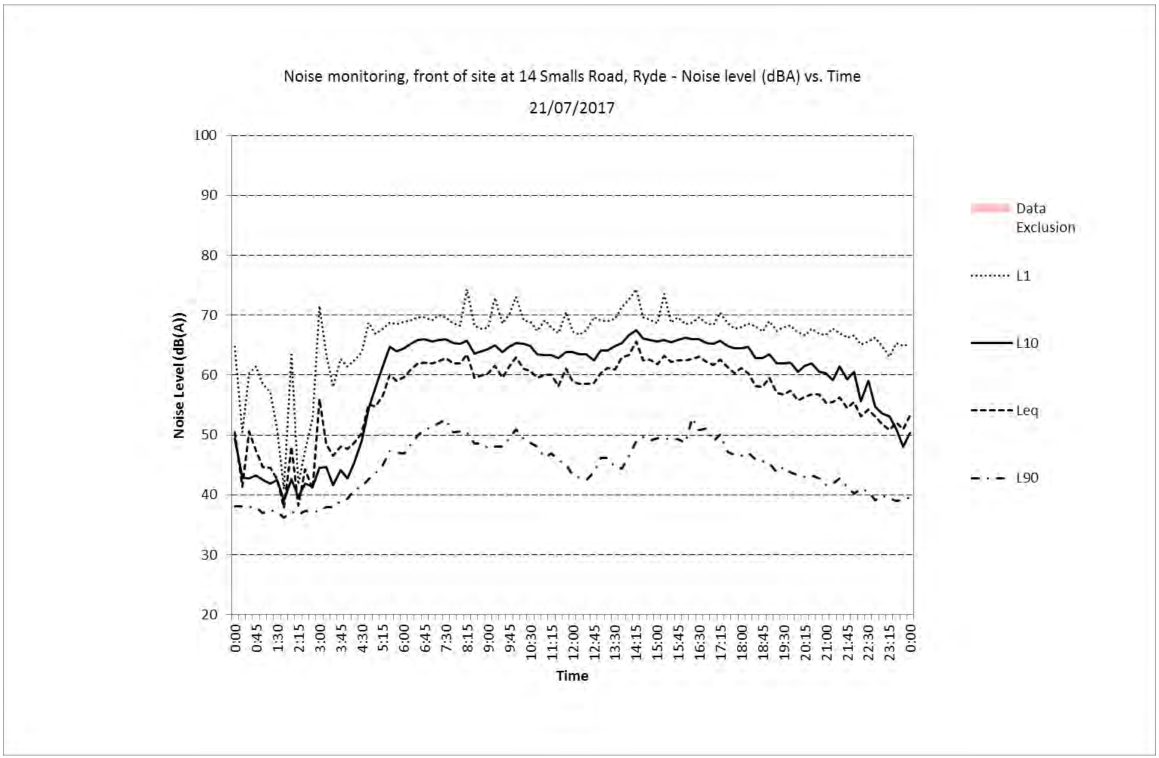
Appendix B Unattended Noise Monitoring Graphs – Front of site (Smalls Road)

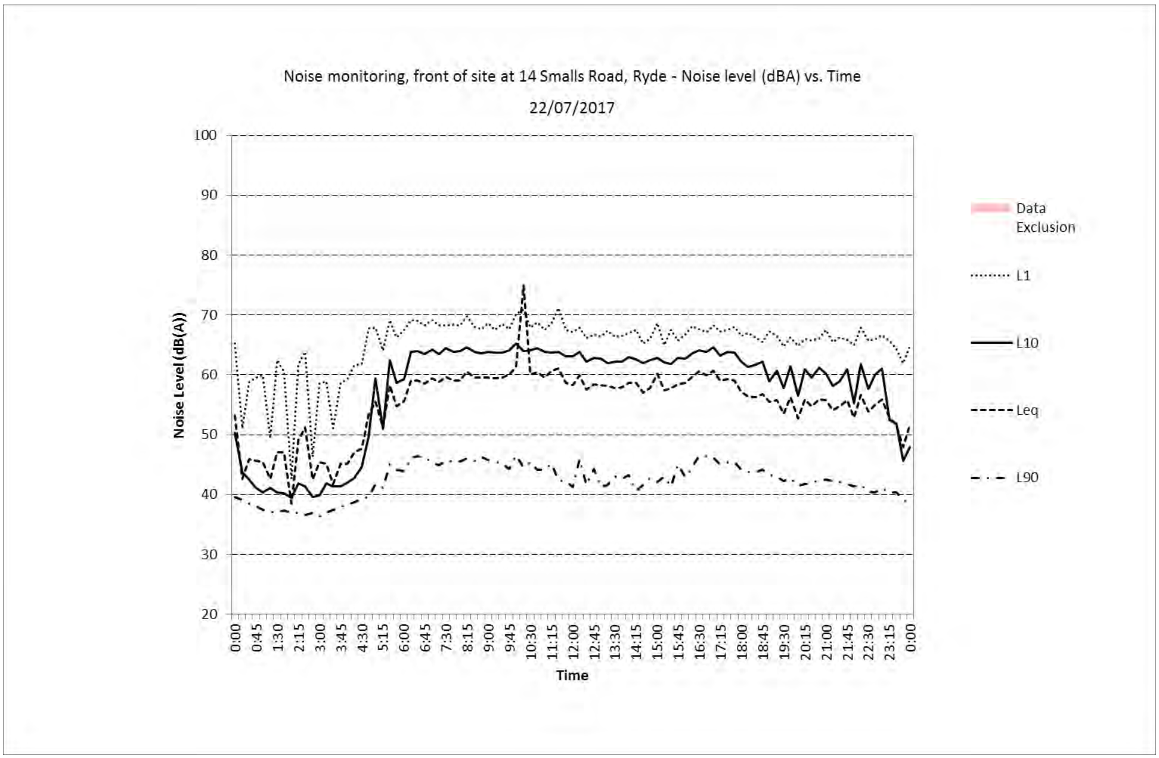



Noise monitoring, front of site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
18/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

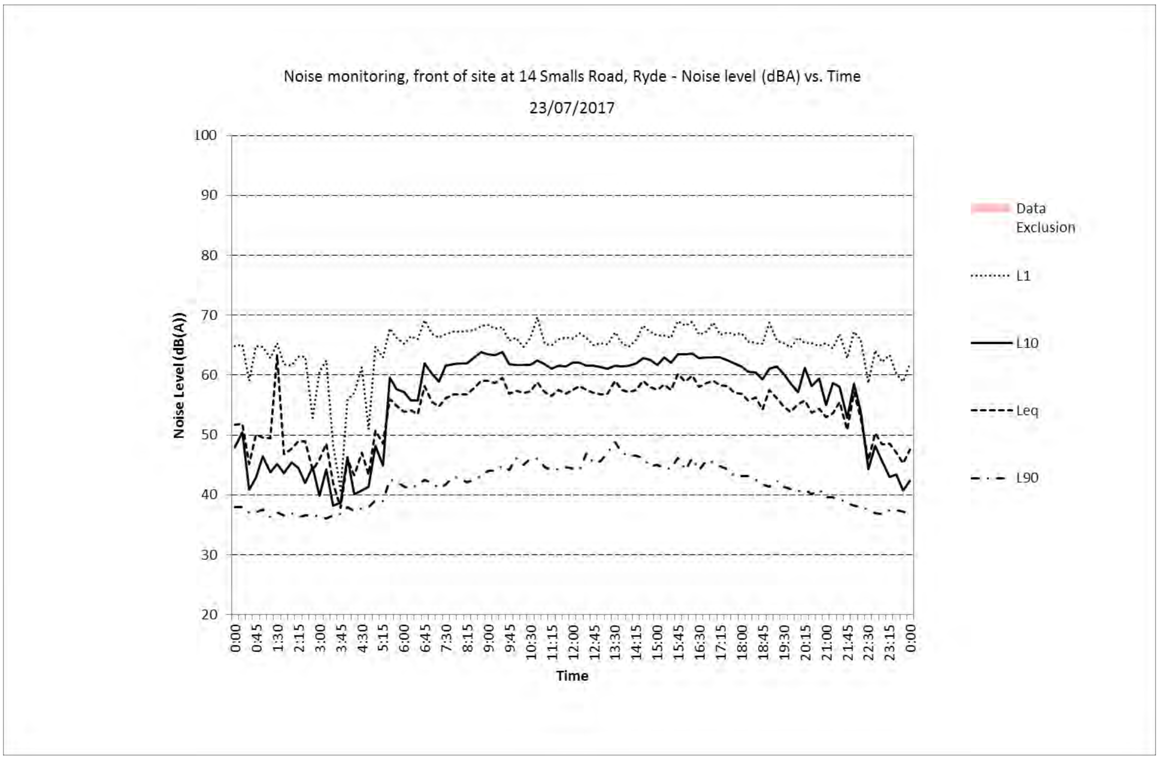

Noise monitoring, front of site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
19/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring, front of site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
20/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

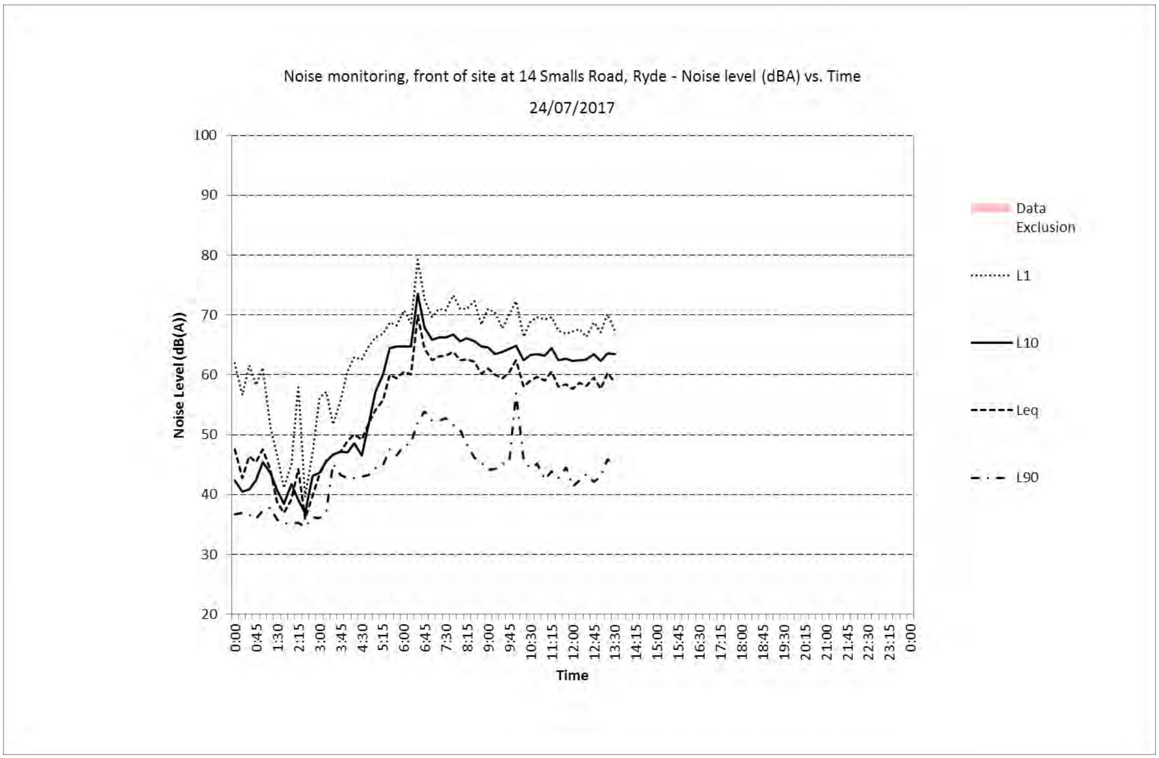

Noise monitoring, front of site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
21/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90



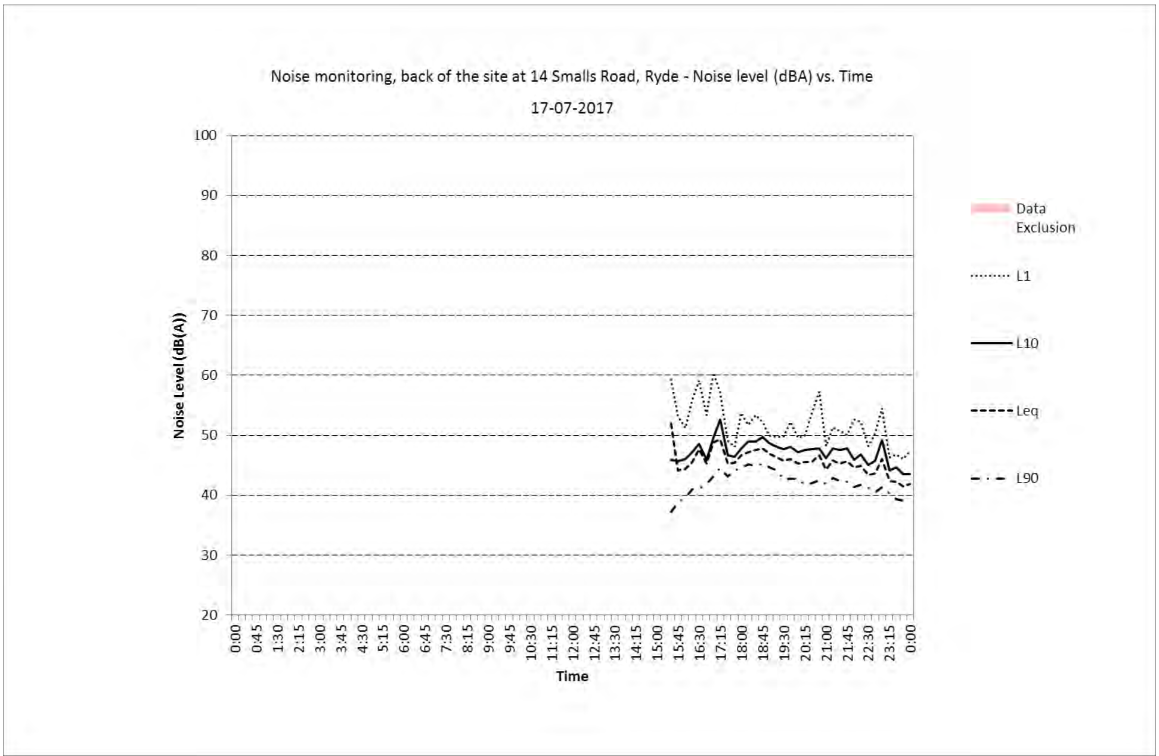
Noise monitoring, front of site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
22/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

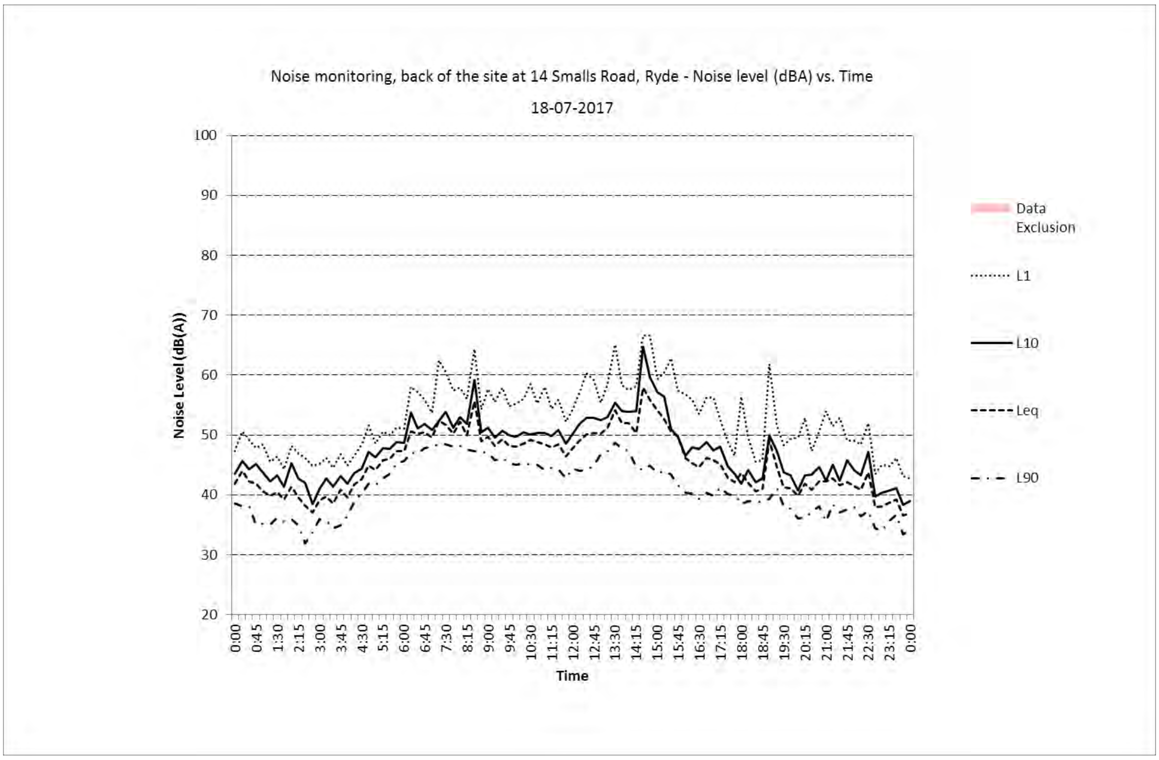


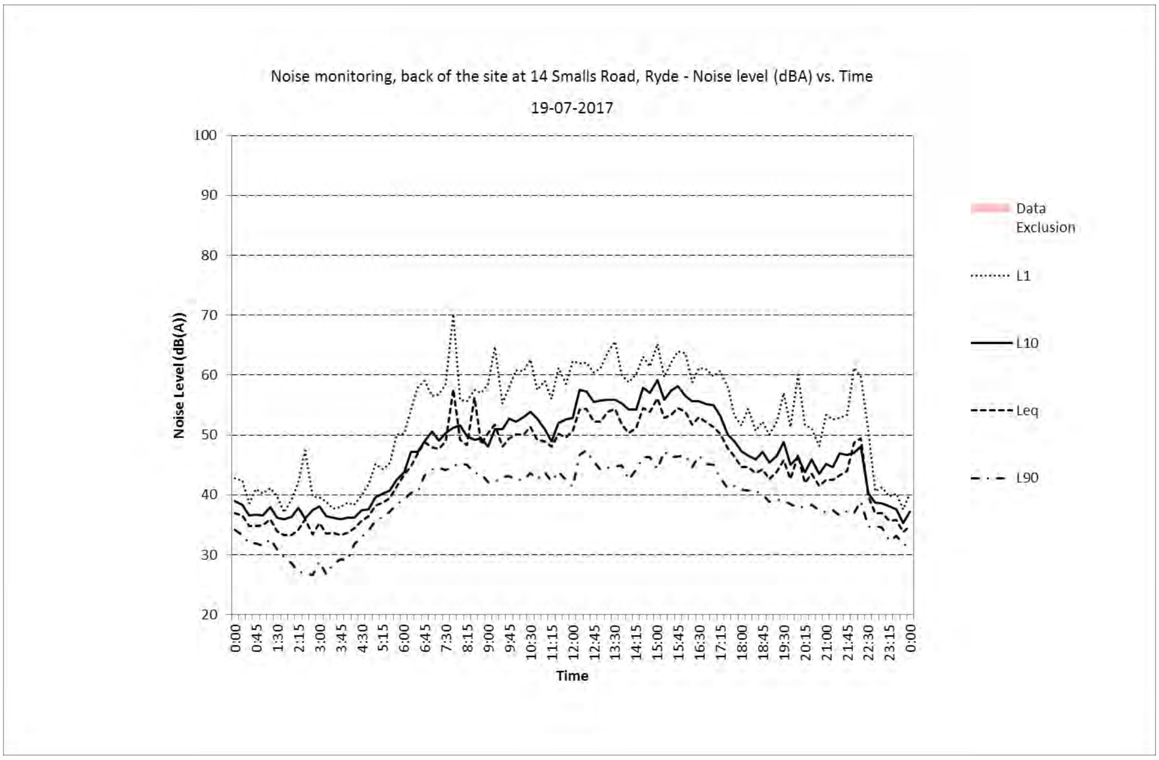
Noise monitoring, front of site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
23/07/2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

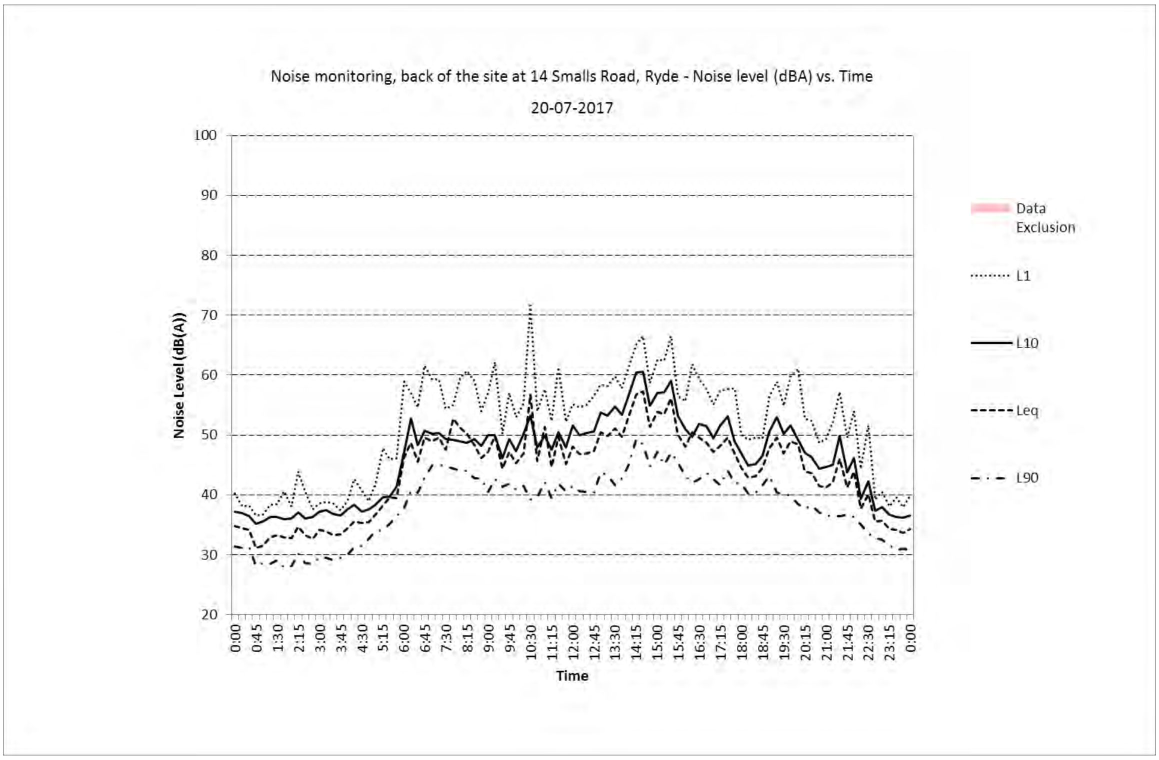

Noise monitoring, front of site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
24/07/2017
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90

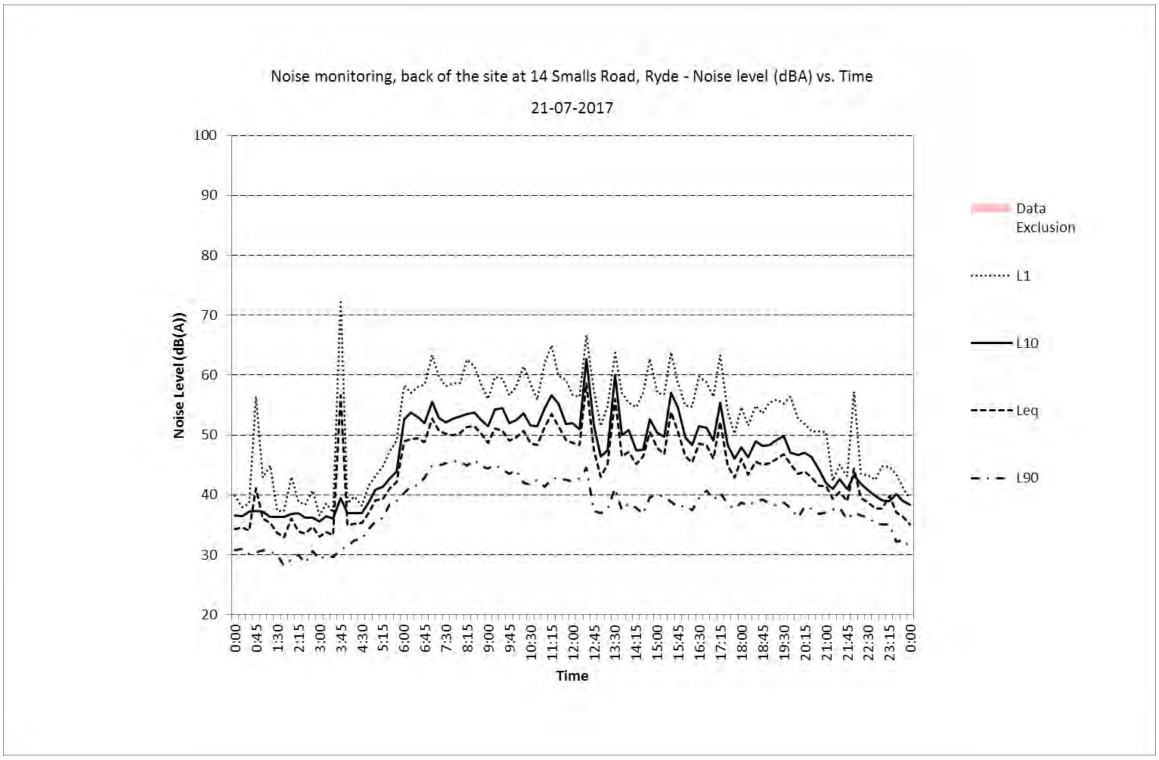
Appendix C Unattended Noise Monitoring Graphs – Back of site (Lavarack Street)

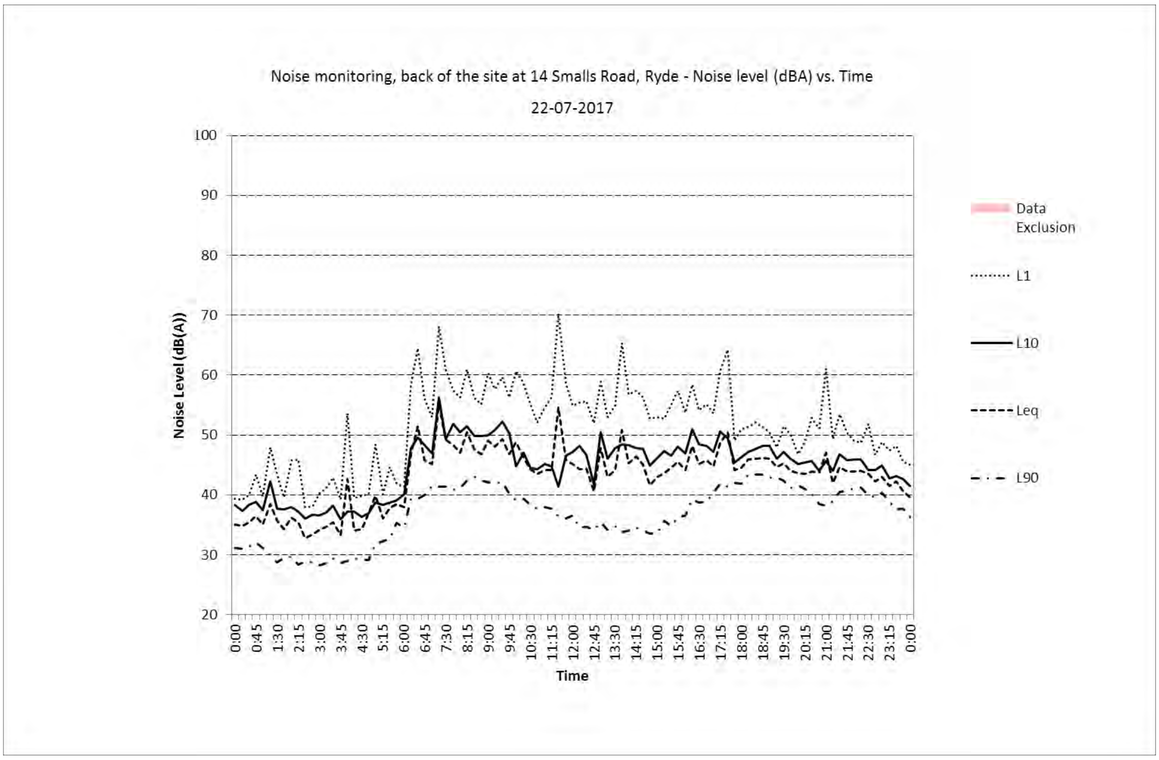


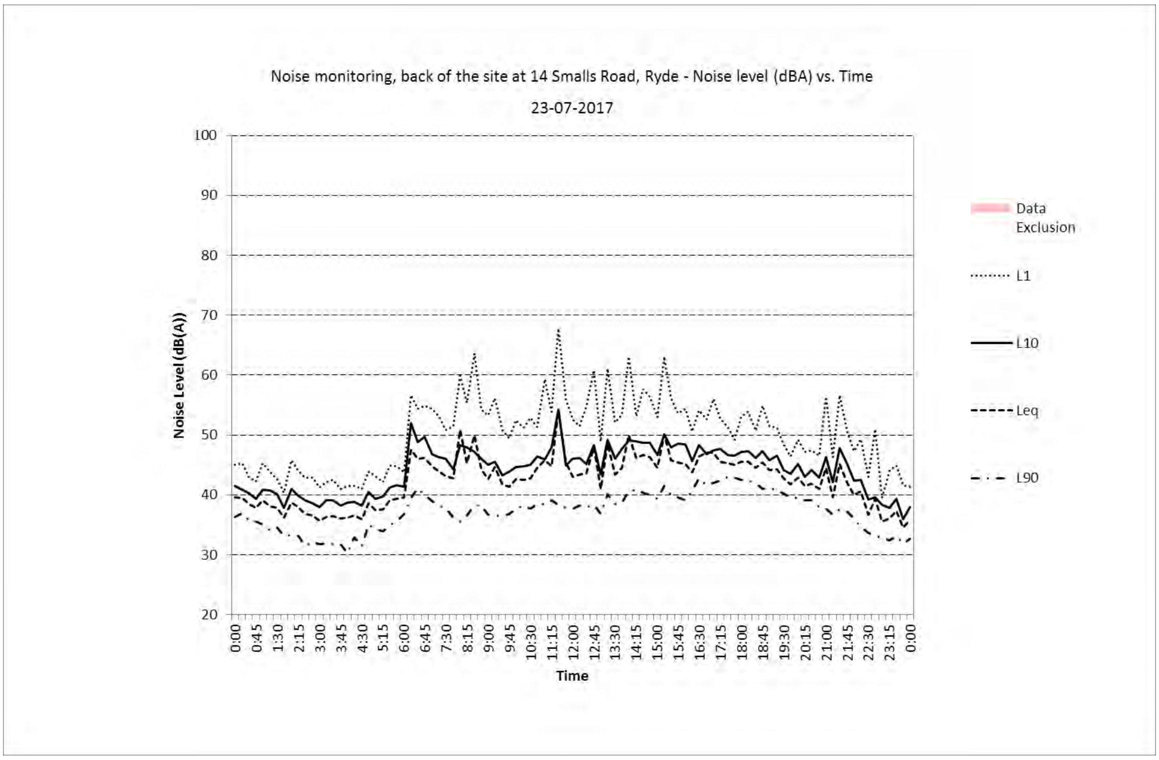

Noise monitoring, back of the site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
18-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90

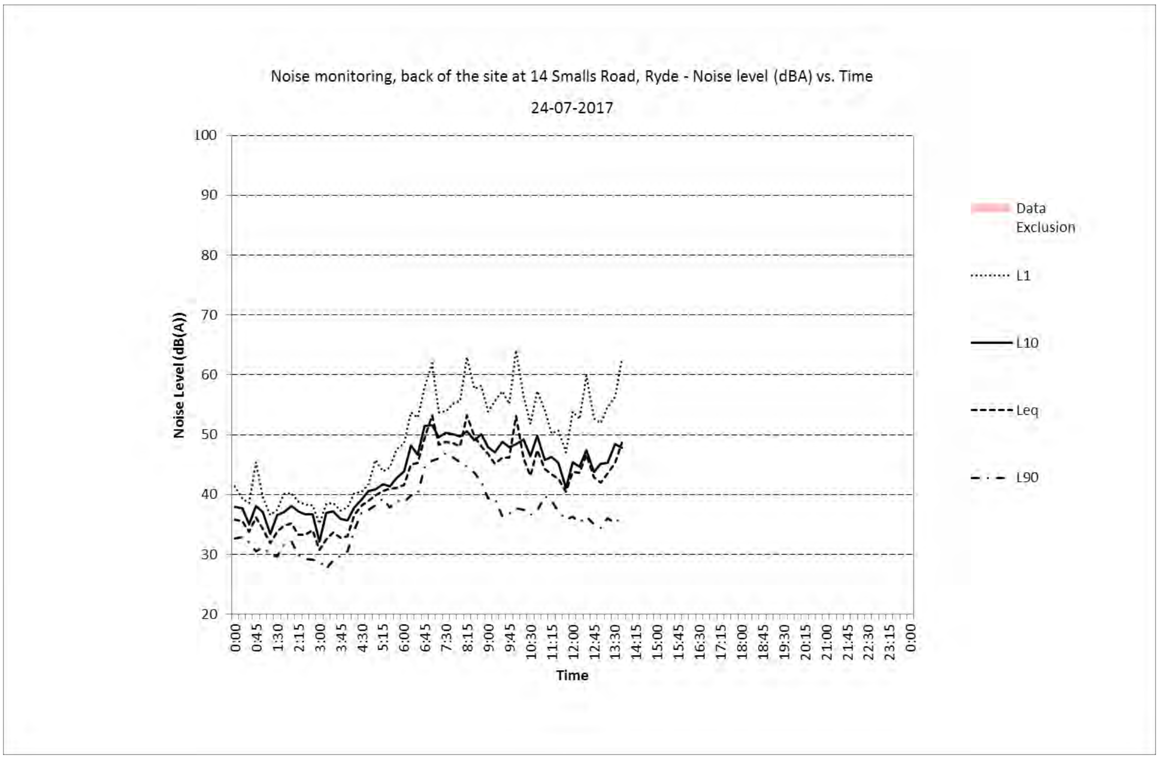

Noise monitoring, back of the site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
19-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring, back of the site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
20-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring, back of the site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
21-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring, back of the site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
22-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90


Noise monitoring, back of the site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
23-07-2017
Noise Level (dB(A))
Time
Data Exclusion
L1
L10
Leq
L90



Noise monitoring, back of the site at 14 Smalls Road, Ryde - Noise level (dBA) vs. Time
24-07-2017
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90

Appendix D Glossary

GLOSSARY

In this acoustic report unless the context of the subject matter otherwise indicates or requires, a term has the following meaning:

TERM	DEFINITION
ABL	The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night-time (for each day). It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.
Adverse Weather	Weather effects that increases noise (i.e. wind and temperature inversion) that occurs at a site for a significant period of time (i.e. wind occurring more than 30% of the time in any assessment period in any season and / or temperature inversion occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources both near and far.
Assessment Period	The period in a day over which assessments are made: day (0700 to 1800h), evening (1800 to 2200h) or night (2200 to 0700h) or actual operating period if only a part of a period(s).
A – Weighting Filter	A-weighting is the most commonly used of a family of curves defined in the International standard IEC 61672:2003 and various national standards relating to the measurement of sound

	pressure level. A-weighting is applied to instrument-measured sound levels in effort to account for the relative loudness perceived by the human ear, as the ear is less sensitive to low audio frequencies.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is excluded. Usually described using the L90 measurement parameter.
C – Weighting Filter	The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dB(A)). The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments and entertainment noise.
Decibel	The ratio of sound pressures which we can hear is a ratio of 106 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (Lp) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.
dB(A)	The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a sound level meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.
Equivalent Continuous Sound Level (L_{eq})	Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period, similar to the average. Hence fluctuating levels can be described in terms of a single figure level.
Extraneous Noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated during holiday periods and during special events such as concert or sporting events.
Fast Time Weighting	125 ms integration time while the signal level is increasing and decreasing.
Frequency	The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, e.g. 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
Impulse Time Weighting	35 ms integration time while the signal level is increasing and 1.5s integration time while the signal level is decreasing.
L_{Aeq}	See equivalent continuous sound level definition above. This is the A-weighted energy average of the varying noise over the sample period and is equivalent to the level of a constant noise

	which contains the same energy as the varying noise environmental. This measure is also a common measure of environmental noise and road traffic noise.
$L_{Aieq,T}$	Equivalent continuous A-weighted sound pressure level over the measurement period T with impulse time weighting.
$L_{Ceq,T}$	The equivalent continuous C-weighted sound pressure level (integrated level) that, over the measurement period T, has the same mean square sound pressure (referenced to 20 µPa) as the fluctuating sound(s) under consideration.
$L_{C, Peak}$	The C-weighted Peak sound pressure level during a designated time interval or a noise event.
Low Frequency	Noise containing major components in the low-frequency range (20Hz to 250Hz) of the frequency spectrum.
Maximum Noise Levels L_{max}	The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
Minimum Noise Levels L_{min}	The minimum noise level over a sample period is the minimum level, measured on fast response, during the sample period.
Noise Sensitive Receiver (NSR)	A noise sensitive receiver is any person or building or outside space in which they reside or occupy that has the potential to be adversely impacted by noise from an outside source, or noise not generated by the noise sensitive receiver.
Octave Bands	Octave bands are frequency ranges in which the upper limit of each band is twice the lower limit. Octave bands are identified by their geometric mean frequency, or centre frequency.
Project-Specific Noise Levels	They are target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive or amenity criteria derived from the NSW Industrial Noise Policy.
RBL	The Rating Background Level for each period is the median value of the ABL values for the period over all the days measured. There is a therefore an RBL value for each period – daytime, evening and night-time.
Shoulder Periods	Where early morning (5 am to 7 am) operations are proposed, it may be unduly stringent to expect such operations to be assessed against the night-time criteria (especially if existing background noise levels are steadily rising in these early morning hours). In these situations, appropriate noise level targets may be negotiated with the regulatory/consent authority on a case-by-case basis.
Slow Time Weighting	1 second integration time while the signal level is increasing and decreasing.
Sound Level Difference (D)	The sound insulation required between two spaces may be determined by the sound level difference needed between them. A single figure descriptor, the weighted sound level difference, D_w, is sometimes used (see BS EN ISO 717-1).
Sound Power	The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level varies as a function of distance from a source. However, the

	sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.
Sound Reduction Index (R)	The sound reduction index (or transmission loss) of a building element is a measure of the loss of sound through the material, i.e. its attenuation properties. It is a property of the component, unlike the sound level difference which is affected by the common area between the rooms and the acoustic of the receiving room. The weighted sound reduction index, R_w, is a single figure description of sound reduction index which is defined in BS EN ISO 717-1: 1997. The R_w is calculated from measurements in an acoustic laboratory. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the R'_w ratings.
Statistical Noise Levels	For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten per cent of the period under consideration, has been adopted in this country for the assessment of road traffic noise. The L_{90}, the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one per cent of the time, is representative of the maximum levels recorded during the sample period. A-weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference period (T) is normally included, e.g. $dBL_{A10, 5min}$ or $dBL_{A90, 8hr}$.
L_{A1}	The L_{A1} level is the A-weighted noise level which is exceeded for 15 of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.
L_{A10}	The L_{A10} level is the A-weighted noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.
L_{A50}	The L_{A50} level is the A-weighted noise level which is exceeded for 50% of the sample period.
L_{A90}	The LA90 level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the LA90 level for 10% of the time. This measure is a commonly referred to as the background noise level.
Structureborne Noise	The L_{A90} level is the A-weighted noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is a commonly referred to as the background noise level.
Temperature Inversion	An atmospheric condition in which temperature increases with height above the ground.
Tonality	Noise containing a prominent frequency and characterised by a definite pitch.