ACOUSTIC REPORT

Noise and Vibration Impact Assessment

Upgrades to Kingswood Public School
Department of Education (DoE)

NDY
A TETRA TECH COMPANY

CONFIDENTIAL

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VERIFICATION

REVISION	DATE ISSUED	PREPARED BY	VERIFIED BY	AUTHORISED BY	COMMENT
1.0	15/11/2024	Jim Wu	Thomas Warren	Jarrad Underwood	Draft Planning Report
2.0	13/12/2024	Jim Wu	Thomas Warren	Jarrad Underwood	Planning Report
2.1	12/02/2025	Jim Wu	Thomas Warren	Jarrad Underwood	Planning Report
3.0	24/04/2025	Victoria Rastelli	Thomas Warren	Jarrad Underwood	Planning Report

STAKEHOLDERS

ROLE	TEAM MEMBER	ORGANISATION
Client Representative	Michael Dunn	SI
Architect	Niloofar Khodabandehloo	Fulton Trotter
Structural Engineer	John Bea	Meinhardt Group
Electrical Services Engineer	Shrinivas Sapre	NDY
Mechanical Services Engineer	Chia Halim	NDY
Fire Services Engineer	Louis Zhu	ACOR

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1 INTRODUCTION

This Noise and Vibration Impact Assessment has been prepared to accompany a Review of Environmental Factors (REF) for the Department of Education (DoE) for upgrades to Kingswood Public School (the activity) under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and *State Environmental Planning Policy (Transport and Infrastructure) 2021* (SEPP TI).

This document has been prepared in accordance with the *Guidelines for Division 5.1 assessments* (the Guidelines) by the Department of Planning, Housing and Infrastructure.

This report examines and takes into account the relevant environmental factors in the Guidelines and *Environmental Planning and Assessment Regulations 2021* under Section 170, Section 171 and Section 171A of the EP&A Regulation.

The school is located on 46-54 Second Ave, Kingswood, NSW 2747.

This report shall not be relied upon as providing any warranty or guarantee of the building, its services or equipment.

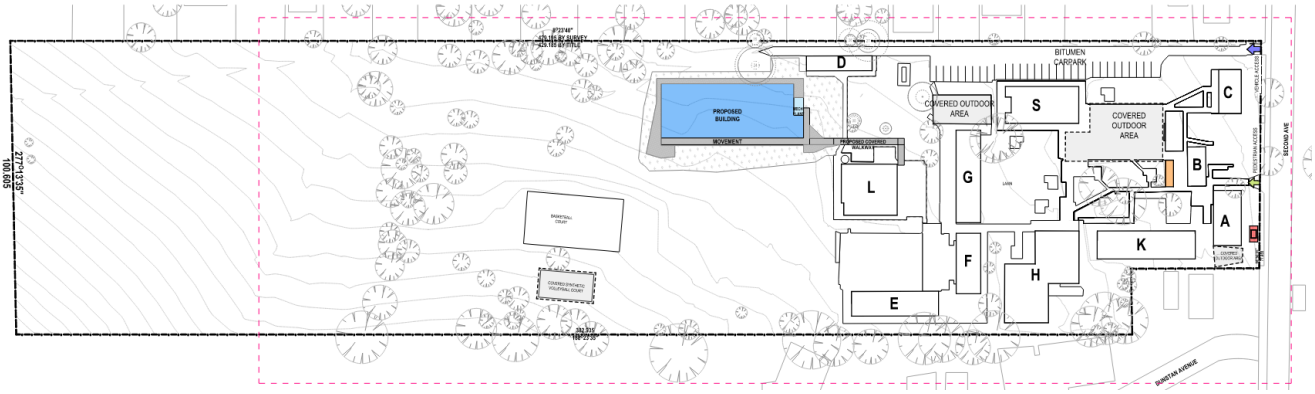

FIGURE 1: SITE LOCATION, WITH PROPOSED BUILDING SHOWN IN BLUE

1.1 AUTHORS

This report was prepared by Jim Wu, Member of the Australian Acoustical Society (M.A.A.S) and the Acoustic Society of New Zealand (M.A.S.N.Z). Quality assurance was carried out by Thomas Warren, Member of the Acoustic Society of New Zealand (M.A.S.N.Z). NDY is a Member of the Australasian Association of Acoustical Consultants (AAAC).

1.2 PURPOSE

The purpose of this report is to provide acoustic design input into the following areas:

- Baseline noise survey of the area
- Statement of environmental effect such as noise emissions to the boundary from onsite plant equipment
- Construction Noise and vibration assessment to the boundary

1.3 AUTHORITY

Authority to undertake this report was provided by Lynne Donohoe of RP Infrastructure.

1.4 INFORMATION SOURCES

The report is written with reference to the following information. Where a standard or guideline is listed, this does not necessarily mean that the standard has been adopted in its entirety, as it may not all apply to this site.

- NSW Noise Policy for Industry (NPfI) 2017
- NSW Interim Construction Noise Guideline (ICNG) 2009

- NSW Road Noise Policy (RNP) 2011
- NSW Government Department of Planning Development Near Rail Corridors and Busy Roads – Interim Guidelines (2008)
- NSW EPA Assessing Vibration: A Technical Guideline 2006
- State Environmental Planning Policy (Transport and Infrastructure) 2021
- AS / NZS 2107:2016 Acoustics, Recommended design sound levels and reverberation times for building interiors
- NSW Department of Environment & Climate Change (DECC), Interim Construction Noise Guideline, 2009
- DEFRA 2005 Data base, including the existing construction noise database on BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration control on construction and open sites Part 1 Noise and Part 2 Vibration
- NSW Interim Construction Noise Guideline 2009
- German DIN 4150: Part 3 – 1999 "Effect of Vibration on Structure" (DIN 1999)
- Australian Standard AS 2670.2 1990 – Evaluation of Human Exposure to Whole Body Vibration – Part 2: Continuous and Shock Induced Vibration in Building (1 Hz to 80 Hz)
- British Standard BS 6472 – 2008 – Evaluation of Human Exposure Vibration in Buildings (1 Hz to 80 Hz)
- NSW EFSG Design Guidelines 2020 (Applies to Education)
- Penrith Council LEP and DCP
- Architectural drawings for 80% Concept Design, issued by Fulton Trotter Rev P2, dated 18/10/24.
- NDY Electrical drawing set, concept design, Rev 2, 01/11/2024
- NDY Mechanical drawing set, concept design, Rev 2, 04/11/24

2 PROJECT INFORMATION

The proposed activity for upgrades to Kingswood Public School includes:

- One (1) new single storey classroom building comprising eight (8) general learning spaces (GLS), two (2) learning commons areas, two (2) multi-purpose spaces and a verandah along the eastern side of the building;
- The construction of a covered walkway that will provide a connection between the proposed classroom building and an existing covered outdoor learning area (COLA) to the north east of the proposed building; and
- Removal of existing portable classroom buildings containing ten (10) classrooms.

The project will be design in accordance with the current DoE standards.

2.1 SITE LOCATION AND DESCRIPTION

The project site is located at 46-54 Second Avenue, Kingswood and is legally described as Lot 172 in Deposited Plan (DP) 839785. Kingswood Public School is located on the southern side of Second Avenue.

Figure 2 provides an aerial photograph of the site.

FIGURE 2: AERIAL PHOTOGRAPH

The site is surrounded by a R3 – Medium Density Residential Zone and a SP2 – Educational Establishment Zone. A map showing the zoning of the site and nearby receivers is shown in Figure 3.

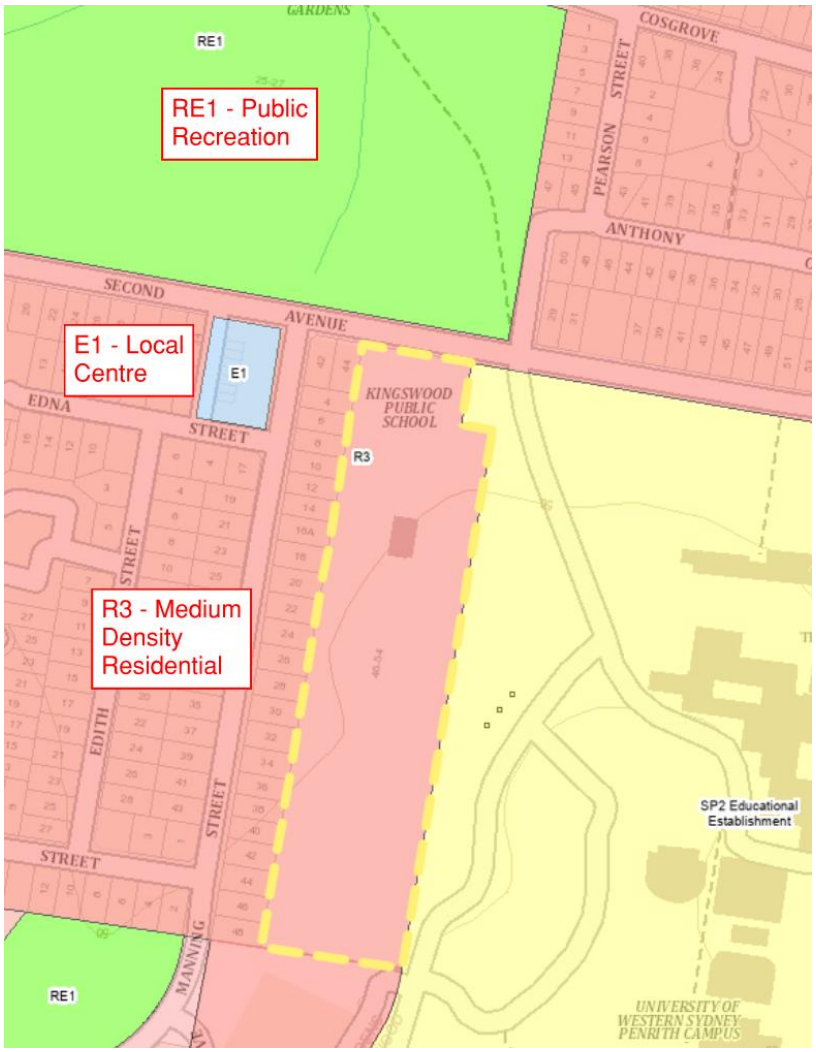

FIGURE 3 - SITE LOCATION, WITH THE BOUNDARIES OF THE SCHOOL SHOWN IN YELLOW

We understand inside the school, the closest buildings to the new block are going to be the below:

- Building D: toilet block that is inside the construction zone and not accessible for school use through the construction period.
- Building L: Hall (not a classroom Block).

2.2 SCHOOL OPERATION HOURS

We understand that the school operating hours will be as per below:

- School operating hours (school staff on site): 0700 – 1700 hours
- Limited operations for morning and evening periods and no night time operations

2.1 SENSITIVE RECEIVERS

The most sensitive receivers for this project are located as per table below:

TABLE 1: SENSITIVE RECEIVERS

RECEIVER	DISTANCE (APPROXIMATE)	TYPE OF RECEIVER / ZONE
16-22 Manning Street[1]	14.5m	Residential Property

FIGURE 4: SENSITIVE RECEIVERS LOCATIONS. NOTE RECEIVERS SHOWN SHADED IN RED, SCHOOL BOUNDARY SHOWN IN YELLOW, AND EXTENSION APPROXIMATE LOCATION SHOWN IN BLUE

[1] For brevity, these properties will be referred to as "20 Manning Street" within this report.

3 METHODOLOGY

This report was prepared using the below methodology:

- Review of the NSW standards, NPfI regulations and Penrith Council requirements for noise and vibration (Penrith LEP and DCP).
- Review of the site location, zoning and most affected receivers for all stages.
- Review of possible busy roads near the site and location of rail corridors.
- Selection of logger location was based on:
  - Critical receivers
  - Location of the receivers
  - Coordination with the planners discussing the proposed location.
- Assessment of operating noise and vibration sources, by coordinating with mechanical, electrical, and fire protection designers to establish noise sources and operating times. Other consultants involved were included such as traffic and garbage collection.
- To assess the construction noise and vibration sources, coordination was done with the client, project manager to understand the approximate construction programme and phases.
  - Note that for construction noise assessment, a preliminary estimation has been conducted using existing information. A detailed construction noise and vibration management plan is required if the predicted noise levels exceed 75 dBA.

4 ACOUSTIC ASSESSMENT OF THE EXISTING ENVIRONMENT

4.1 METEOROLOGICAL DATA

To verify that the noise data was obtained during suitable meteorological conditions, weather data such as rain and wind speed were obtained from the Weather Underground service (Station ID ISYDNE3787) as a representative site located 1000m away from the site.

Noise data is excluded (as per the NSW NPfI methodology) from the results in case of:

- Rain observed during any 15-minute noise measurement period and/or;
- Wind speeds exceeded 5 m/s during any 15-minute noise measuring period.

4.2 INSTRUMENTATION

Noise levels were measured using a Svantek SV 977C sound level meter. The details of this SLM and the calibration details are listed in Table 2.

TABLE 2: NOISE LOGGER AND SOUND LEVEL METER INFORMATION

NOISE LOGGER/SOUND LEVEL METER	TYPE	SERIAL NUMBER	DATE OF LAST CALIBRATION
Svan 977C	Class 1	98851	13/05/2024

The equipment calibration was checked prior to, and after the noise survey using a 94 dB external calibration tone at 1 kHz.

The noise loggers were configured to record all relevant noise parameters including background noise (L_{A90}) and equivalent continuous noise levels L_{Aeq}. Samples were recorded at 15-minute A-weighted continuous intervals. The noise monitor responses were set to fast response. The analysers are Class 1 compliant with AS IEC 61672.2-2004.

4.3 NOISE LOGGER LOCATION

The noise logger was deployed at the boundary of the school grounds, approximately next to 20 Manning St. This location was selected as it is the closest location from the proposed building to a sensitive receiver. This was agreed to with the project team and project planner. Logger was deployed between 24/10/24 to 06/11/24 and 20/11/2024 to 27/11/2024.

The location of this logger is shown in Figure 5.

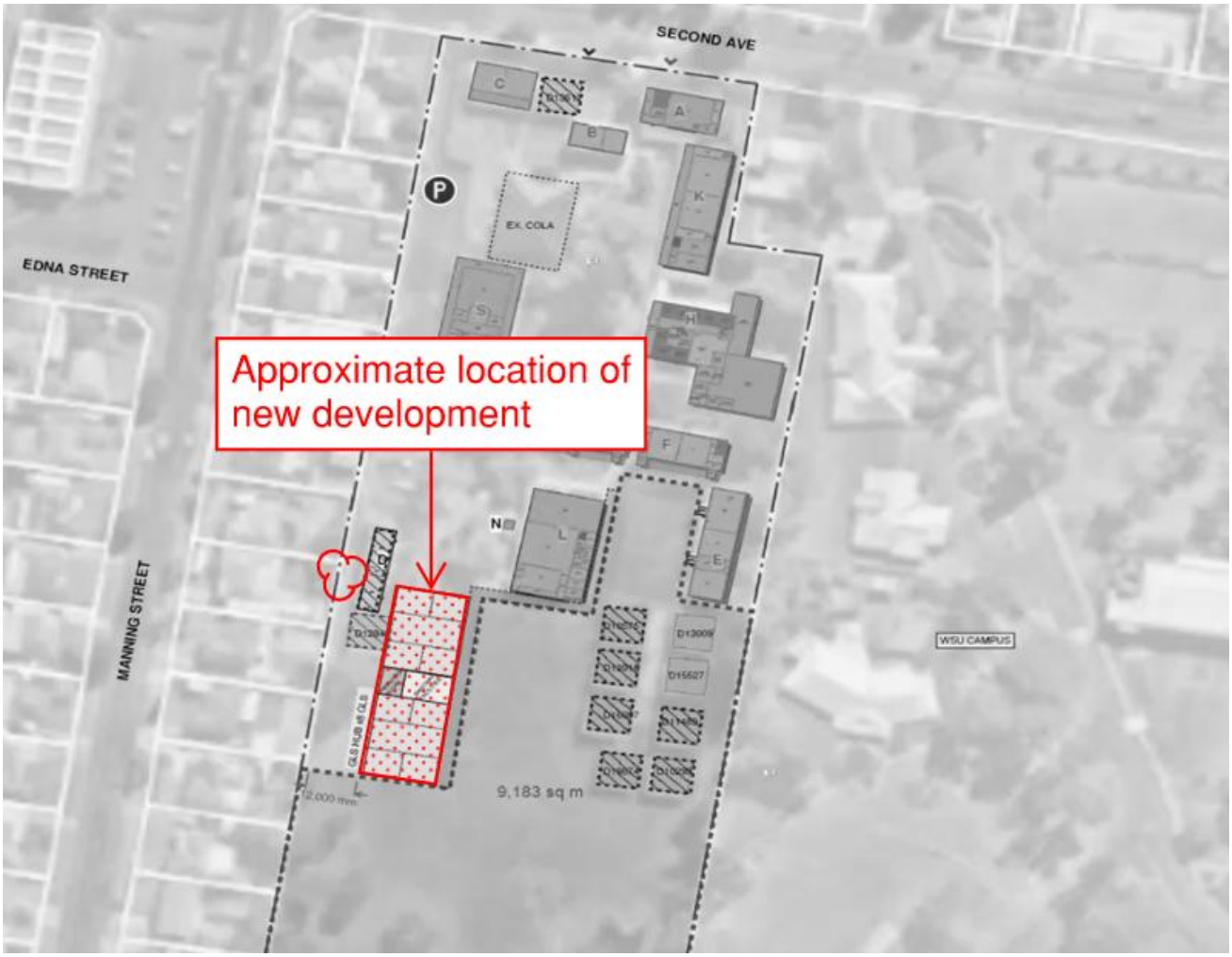

FIGURE 5: LOGGER DEPLOYMENT AREA SHOWN CLOUDED

5 NOISE AND VIBRATION CRITERIA

5.1 LOCAL CITY COUNCIL RULES

Kingswood Public School is located within the jurisdiction of the Penrith Council. The Penrith LEP 2010 states the following aims:

1.2 Aims of Plan

(1) This Plan aims to make local environmental planning provisions for land in Penrith in accordance with the relevant standard environmental planning instrument under section 3.20 of the Act.

(2) The particular aims of this Plan are as follows—

- *a. (aa) to protect and promote the use and development of land for arts and cultural activity, including music and other performance arts,*
- *a. to provide the mechanism and planning framework for the management, orderly and economic development, and conservation of land in Penrith,*
- *b. to promote development that is consistent with the Council's vision for Penrith, namely, one of a sustainable and prosperous region with harmony of urban and rural qualities and with a strong commitment to healthy and safe communities and environmental protection and enhancement,*
- *c. to accommodate and support Penrith's future population growth by providing a diversity of housing types, in areas well located with regard to services, facilities and transport, that meet the current and emerging needs of Penrith's communities and safeguard residential amenity,*
- *d. to foster viable employment, transport, education, agricultural production and future investment opportunities and recreational activities that are suitable for the needs and skills of residents, the workforce and visitors, allowing Penrith to fulfil its role as a regional city in the Sydney Metropolitan Region,*
- *e. to reinforce Penrith's urban growth limits by allowing rural living opportunities where they will promote the intrinsic rural values and functions of Penrith's rural lands and the social well-being of its rural communities,*
- *f. to protect and enhance the environmental values and heritage of Penrith, including places of historical, aesthetic, architectural, natural, cultural, visual and Aboriginal significance,*
- *g. to minimise the risk to the community in areas subject to environmental hazards, particularly flooding and bushfire, by managing development in sensitive areas,*
- *h. to ensure that development incorporates the principles of sustainable development through the delivery of balanced social, economic and environmental outcomes, and that development is designed in a way that assists in reducing and adapting to the likely impacts of climate change.*

The Penrith DCP 2023 outlines acoustic noise and privacy criteria for new developments within the Penrith Council area. Section 4.16 outlines the requirements for a Noise Impact Statement:

4.16. Noise Impact Statement

Where a Noise Impact Statement, prepared by a suitably qualified acoustic consultant, is required, it should include:

1) A description of the proposed development including plans and elevations. For rural development, this includes plans and elevations of any enclosures/external structures and descriptions of building construction and means of ventilation;

2) Details of local topography, existing and proposed buildings and exposed or shielded situations which may affect the results and any allowances made in this regard;

3) *Relevant legislation, standards, guidelines and policies that have been applied;*
4) *Background noise measurements. For rural development, this includes details of existing daytime and night-time background levels and the means by which these levels were obtained;*
5) *Details of instruments and methodology used for noise measurements;*
6) *Noises level data for all major sources, in octave band levels where appropriate;*
7) *A site map showing noise sources, measurements, locations and noise receivers;*
8) *Noise criteria applied to the proposal;*
9) *Noise predictions for the proposed activity;*
10) *Consideration of any other significant or relevant acoustic information concerning the project;*
11) *A comparison of noise predictions against noise criteria. Where appropriate, this should include a comparison of the predicted noise levels with the relevant design criteria at each potentially sensitive receiver location considered;*
12) *A description of proposed mitigation measures, the resultant noise reduction likely, and an assessment of the feasibility and reasonableness of these measures;*
13) *A statement of opinion confirming how compliance with acoustic criteria requirements can be practically achieved; and*
14) *In situations where vibration is considered to be an issue, a suitable assessment of any vibration impacts.*

5.2 NSW DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS

These guidelines support specific rail and road provisions of the State Environmental Planning Policy (Transport and Infrastructure) 2021 Clauses 2.100 and 2.120 for rail and busy roads.

The SEPP regulations apply where rail lines are close to the development, or if residential accommodations or similar spaces are a part of the development. The road noise or vibration clause applies for roads with an annual average daily traffic volume of more than 20,000 vehicles.

As there are no rail lines close to the school, clause 2.100 does not apply. There are also no residential accommodation or similar spaces within the development. Second Ave is the most major road around the school, but as this is a local largely residential road, traffic numbers here are not expected to exceed 20,000 vehicles annual. As such, we expect that traffic here will not exceed 20,000 vehicles. As a result, the SEPP criteria do not apply to this project.

5.3 NSW NOISE POLICY FOR INDUSTRY (NPFI) 2017

For the purpose of the assessment, the measured noise data was processed into the following time periods:

- Daytime: 0700 to 1800 hrs.
- Evening: 1800 to 2200 hrs.
- Night-time: 2200 to 0700 hrs.

The measured background (L_{A90}) and equivalent continuous (L_{Aeq}) noise levels during these defined time periods. The L_{A90} noise levels presented are *Rating Background Levels* (RBLs), being the median of the background L_{A90} (i.e. of the lowest 10th percentile of samples) in each daytime, evening and night-time measurement period, for each 24-hour period during the noise survey.

The L_{Aeq} noise levels presented are the logarithmic average of all the L_{Aeq} samples taken in each of the daytime, evening and night-time periods.

TABLE 3: MEASURED NOISE LEVELS FOR NOISE LOGGERS, DBA

LOCATION	NOISE INDEX	NOISE LEVEL, DB RE 20 µPA		
		Daytime 0700 to 1800	Evening 1800 to 2200	Night - time 2200 to 0700
20 Manning Street	L_{A90} (RBL)	38	39	33
	$L_{Aeq,period}$	54	51	45

5.4 AMENITY AND INTRUSIVENESS CRITERIA

The NSW NPfI provides assessment methodologies, criteria and detailed information on the assessment of environmental noise emissions in NSW. The NSW NPfI criteria for noise sources consider two (2) components:

- Controlling intrusive noise impacts for residential receivers. Assessing intrusiveness generally requires noise measurements to quantify background (LA90) noise levels at a location considered representative of the most potentially affected residential receiver(s). The intrusiveness criterion essentially means that the equivalent continuous noise level (LAeq) of the source(s) under consideration should be controlled to not exceed background noise levels by more than 5 dB(A).
- Maintaining noise amenity for various categories of land use (including residential receivers and other sensitive receivers). The amenity criterion is based on the sensitivity of a particular land use to industrial-type noise. The recommended amenity noise levels detailed in Table 2.2 of NSW NPfI represent the objective for total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location. This is to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area. The project amenity criteria for each new source of industrial noise is equalled to recommended amenity noise level minus 5dB(A).
- A +3dB(A) to be added to project amenity noise level for conversion from a period level to a 15-minutes level. Where the resultant project amenity noise level is 10dB or more below the existing industrial noise level, the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

TABLE 4: PROJECT SPECIFIC NSW NPFI AMENITY CRITERIA / TAKEN FROM TABLE 2.2 NPFI

TYPE OF RECEIVER	INDICATIVE NOISE AMENITY AREA	PERIOD OF TIME	L_{AEQ} DB(A)	AMENITY CRITERIA LAEQ DB(A) – 5 DB + 3 DB
Residence	Suburban	Day 7:00 to 18:00	55	53
		Evening 18:00 to 22:00	45	43
		Night 22:00 to 7:00	40	38

The NSW NPfI characterise the above areas as per the below description:

Receiver category	Typical planning zoning – standard instrument*	Typical existing background noise levels	Description
Rural residential	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime RBL <40 dB(A) Evening RBL <35 dB(A) Night RBL <30 dB(A)	**Rural** – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented in column 3 due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.
Suburban residential	RU5 – village RU6 – transition	Daytime RBL<45 dB(A) Evening RBL<40 dB(A)	**Suburban** – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.
	R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Night RBL <35dB(A)	
Urban residential	R1 – general residential R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime RBL> 45 dB(A) Evening RBL> 40 dB(A) Night RBL >35 dB(A)	**Urban** – an area with an acoustical environment that: • is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources • has through-traffic with characteristically heavy and continuous traffic flows during peak periods • is near commercial districts or industrial districts • has any combination of the above.

FIGURE 6: NPFI EXTRACT – TABLE 2.3 DETERMINING WHICH OF THE RESIDENTIAL RECEIVER CATEGORIES APPLIES

We believe the Suburban area description above is the one more suitable for our project location based on the measured ambient noise levels.

The NPfI recommends "Intrusive noise levels are only applied to residential receivers (residences)". For other receiver types identified in Table 2.2 (Table 4 of this report), only the amenity levels apply. The project amenity and intrusive noise levels are be listed below.

TABLE 5: PROJECT INTRUSIVENESS AND AMENITY NOISE CRITERIA

LOCATION	NOISE LEVEL, $L_{EQ,15MINS}$ [DBA]		
	Daytime 0700 to 1800	Evening 1800 to 2200	Night - time 2200 to 0700
20 Manning Street	**Project Amenity Assessment, $L_{Aeq,\ 15min}$**		

LOCATION	NOISE LEVEL, $L_{EQ,15MINS}$ [DBA]		
	Daytime 0700 to 1800	Evening 1800 to 2200	Night - time 2200 to 0700
	53	43	38
	Project Intrusiveness Assessment, $L_{Aeq, 15min}$		
	43	43	38

5.4.1 DETERMINATION OF PROJECT SPECIFIC NOISE TRIGGER LEVEL (PNTL)

The Project Noise Trigger Levels (PNTL) are the most stringent noise levels of the NSW NPfI project intrusiveness and project amenity noise levels for day, evening and night-time periods and are project specific, as shown below:

TABLE 6: EXTERNAL PROJECT NOISE TRIGGER LEVEL (PNTL) FOR OPERATION NOISE

LOCATION / AFFECTED	TIME	DESCRIPTOR	EXTERNAL PNTL [DBA]
Boundary with 20 Manning St	0700 to 1800	$L_{Aeq, Day}$	43
	1800 to 2200	$L_{Aeq, Evening}$	43
	2200 to 0700	$L_{Aeq, Night}$	38

5.5 SUMMARY OF OPERATIONAL NOISE CRITERIA

TABLE 7: SUMMARY OF NOISE CRITERIA

REGULATION	CRITERIA
Council LEP / DCP	• Minimise the projection of noise from the various activities anticipated to occur within the site.
PTNL (NPfI 2017)	• PTNL Day: 43 dBA / Evening: 43 dBA / Night: 38 dBA

5.6 CONSTRUCTION NOISE AND VIBRATION CRITERIA

5.6.1 INTERIM CONSTRUCTION NOISE GUIDELINE

The NSW Interim Construction Noise Guideline was developed by the NSW-Department of Environment & Climate Change DECC, NSW which incorporates the EPA. The Guideline contains detailed procedures for the assessment and management of construction noise impacts.

The guideline presents two ways of assessing construction noise impacts – the quantitative method, which is generally suited to longer term construction works and the qualitative method, which is generally suited to short term works (usually not more than 3 weeks) such as infrastructure maintenance.

It is expected that the length of the construction works associated with the activity would be more than 3 weeks and therefore a quantitative method has been used for this assessment.

Table 8 set out the management levels for noise at residence and sensitive land uses, respectively. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected management level' which is >75dBA.

Affected properties above 75 dBA might require community consultation and a Construction Noise & Vibration Management Plan (CNVMP). Based on the RBL of 38 – 39 dBA in the daytime, the recommended noise management level during all aspects of the construction program are summarised in Table 9 below.

TABLE 8: NOISE AT AFFECTED USING QUANTITATIVE ASSESSMENT

RECOMMENDED HOURS	EXTERNAL NOISE MANAGEMENT LEVEL (NML) $L_{EQ,15MIN}$ [dBA]	HOW TO APPLY
Recommended standard hours **Monday – Friday 7am to 6pm** **Saturday 8am to 1pm** **No work on Sundays or Public Holidays**	Noise Affected 48 dB(A) (38 + 10)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ minutes)}$ noise level is greater than the 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 period by restricting 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.
Outside Recommended standard hours	38 dBA (33 + 5)	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 7.22

*Section 6, 'work practices' of the *Interim Construction Noise Guideline*, states: "*there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise*".

Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

The Interim Construction Noise Guideline recommends the following noise levels for land uses other than residential, as shown in Table 9 below. The external noise levels should be assessed at the most affected occupied point on the premises. A conservative estimate of 10 dB is generally applied as the difference between the external and internal level for noise sensitive uses that require internal noise measurement.

5.6.2 NOISE MANAGEMENT LEVELS

Noise Management Levels (NML) associated with the construction works on the project site are presented in Table 9.

TABLE 9: CONSTRUCTION NOISE MANAGEMENT LEVELS, $L_{EQ\ 15MIN}$

RECEIVERS	RECOMMENDED HOURS	PERIOD	RBL $L_{A90,15MINS}$ [dBA]	EXTERNAL NOISE MANAGEMENT LEVEL [dBA]
Residential	Day time (standard construction hours)	When in use	45	(38 + 10) = 48 dB(A) (Noise affected) 75 dB(A) (highly noise affected)

For other sensitive land users different from residential, (classrooms and other educational institutions) the below table applies:

Table 3: Noise at sensitive land uses (other than residences) using quantitative assessment

Land use	Management level, $L_{Aeq\ (15\ min)}$ (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benfefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.

FIGURE 7: EPA CONSTRUCTION NOISE AND VIBRATION GUIDELINE, 2016 / EXTRACT NOISE AT SENSITIVE USERS

5.6.3 CONSTRUCTION VIBRATION CRITERIA

The effects of construction vibration upon buildings can be separated into three main categories:

Perceptibility of the occupants to the vibration and the possibility of them being disturbed or annoyed.
Vulnerability of the building structures to vibration induced damaged.
Vulnerability of the contents of the building that includes types of equipment, activities and processes.

5.6.3.1 Human Response to Vibration

Humans are very sensitive to vibration, and they can be disturbed, annoyed and have their work activities interfered with if the levels are too high. The Interim Construction Noise Guideline references "*Assessing Vibration: a technical guideline*" (Vibration Guideline) issued by the Department of Environment and Conservation NSW for measurement and assessment of vibration. The Vibration Guideline provides vibration criteria for continuous, impulsive and intermittent vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria.

The criteria are discussed in more detail in the following sections.

5.6.3.2 Continuous and impulsive vibration (1-80 Hz)

According to the Vibration Guideline for continuous and impulsive vibration, assessment of impact should be considered on the basis of weighted root-mean-square acceleration values and results are to be compared against the following preferred and maximum values given for each orthogonal axis. The frequency weightings as per BS6841:1987 (reproduced in Appendix B3 of the guideline) are to be applied to the RMS measurement values (1-80Hz).

The criteria in the Vibration Guideline are derived from the limiting values of the assessment curves and multiplying factors from BS 6472:1992 (the curves are no longer referenced in the superseded version of the standard BS 6472:2008).

Table 2.2 Preferred and maximum weighted rms values for continuous and impulsive vibration acceleration (m/s²) 1–80 Hz

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration					
Critical areas[2]	Day- or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
Impulsive vibration					
Critical areas[2]	Day- or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92

1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am

2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of this policy, and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472–1992

The Vibration Guideline notes "*Activities should be designed to meet the preferred values where an area is not already exposed to vibration. Where all feasible and reasonable measures have been applied, values up to the maximum value may be used if they can be justified. For values beyond the maximum value, the operator should negotiate directly with the affected community. Situations exist where vibration above the preferred values can be acceptable, particularly for temporary disturbances and infrequent events of short-term duration. An example is a construction or excavation project.*"

5.6.3.3 Intermittent vibration (1-80 Hz)

According to the Vibration Guideline for intermittent vibration, assessment of impact should be considered on the basis of vibration dose values (VDV). Acceptable values of vibration dose are given as follows.

Table 2.4 Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas.
Source: BS 6472–1992

5.6.3.4 Vibration Criteria – Building Contents and Structure

The vibration effects on the building itself are assessed international standards as follows:

- For transient vibration: British Standard BS 7385: Part 2 – 1993 "Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration" (BSI 1993); and
- For continuous or repetitive vibration: German DIN 4150: Part 3 – 1999 "Effects of Vibration on Structure" (DIN 1999).

5.6.3.5 Standard BS 7385 Part 2 – 1993

For transient vibration, as discussed in standard BS 7385 Part 2- 1993, the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building. These are summarised in Table 10 and illustrated in Figure 8.

TABLE 10: TRANSIENT VIBRATION CRITERIA AS PER STANDARD BS 7385 PART 2 – 1993

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

Standard BS 7385 Part 2 – 1993 states that the value in **Table 10** relate to transient vibration which does not cause resonant response in buildings. Where the dynamic loading caused by continuous vibration events is such that it results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in **Table 10** may need to be reduced by up to 50% (refer to Line 3 in Figure 8).

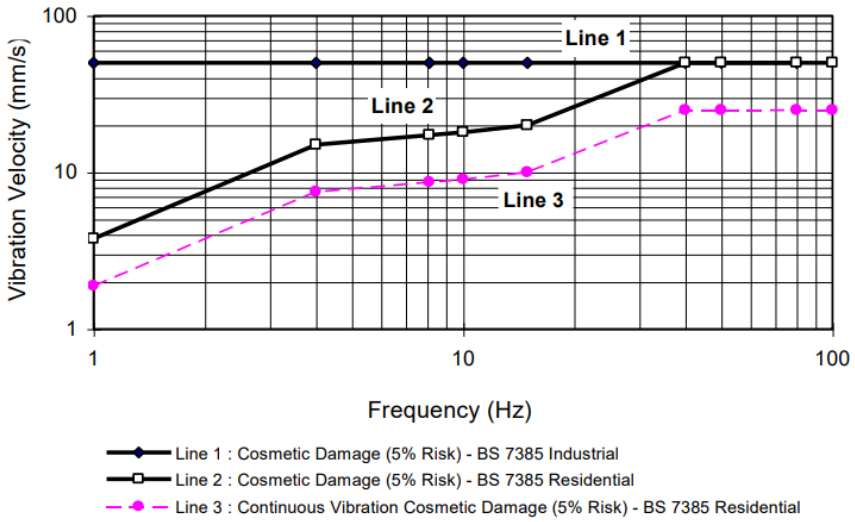

FIGURE 8 – BS 7385 PART 2 – 1993, GRAPH OF TRANSIENT VIBRATION VALUES FOR COSMETIC DAMAGES

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

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in **Table 10**, and major damage to a building structure may occur at values greater than four times the tabulate values.

Fatigue considerations are also addressed in the standard and it is concluded that unless the calculation indicated that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in **Table 10** should not be reduced for fatigue considerations.

5.6.3.6 Structural Response to Vibration - German Standard DIN 4150-3:1999

The German Standard DIN 4150-3 Structural Vibration Part 3: Effects on building and structures is commonly used in Australia to evaluate the effects of vibration on structures primarily used for static loading.

The response of a building to vibration is affected by several factors that include its type of foundation, the underlying ground conditions, its construction and the state of the building. Please note the construction vibration limits are designed to ensure the structural integrity of nearby buildings and are not for human comfort. the limits are well above perceptibility.

According to DIN 4150 short term vibration refers to vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance in the structure being evaluated. Long-term vibration refers to all types of vibration not covered by the definition of 'short-term vibration'. The criteria for short-term and long-term vibration are listed in the following.

5.6.3.7 Guideline Values for evaluation of short-term vibration - DIN 4150-3:1999

The vibration limits of table 1 in DIN 4150-3:1999 (replicated in **Table 11** below) refer to the evaluation of the effects of short-term vibration on structures.

It should however be noted that compliance with the vibration limits to avoid structural damage of buildings, cannot provide certainty. If damage occurs despite compliance with the standard, it is to be assumed that other causes are responsible, however, further investigations are necessary. And on the other hand, exceeding the limits does not necessarily lead to damage.

TABLE 11: DIN 4150-3 CONSTRUCTION VIBRATION LIMITS – SHORT TERM

TYPE OF STRUCTURES	GUIDELINE VALUES FOR VIBRATION VELOCITY (MM/S)			
	Vibration at the foundation at a frequency of			Vibration at horizontal plane of highest floor at all frequencies
	1Hz to 10Hz	10 to 50 Hz	50 to 100Hz (and above)	
Buildings for commercial purposes, Industrial building and building of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
Structures that because of their particular sensitivity to vibration, cannot be classified as above and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10	8

5.6.3.8 Guideline Values for evaluation of long-term vibration - DIN 4150-3:1999

The vibration limits of Table 3 in DIN 4150-3:1999 refer to the evaluation of the effects of long-term vibration on structures.

The criteria are the peak particle velocities measured on the uppermost full storey of any building not related to the site and are listed in **Table 12**.

According to the standard, *exceeding the values listed below does not necessarily lead to damage*.

If a building is subject to harmonic vibration, then maximum values can occur in floors other than the top floor, or in the foundation. The values given also apply in these cases.

TABLE 12: DIN 4150-3 CONSTRUCTION VIBRATION LIMITS – LONG TERM

TYPE OF STRUCTURES	GUIDELINE VALUES FOR VELOCITY, VI, IN MM/S OF VIBRATION IN HORIZONTAL PLANE OF HIGHEST FLOOR, AT ALL FREQUENCIES
Buildings for commercial purposes, Industrial building and building of similar design	10
Dwellings and buildings of similar design and/or occupancy	5
Structures that because of their particular sensitivity to vibration, cannot be classified as above and are of great intrinsic value (e.g. listed buildings under preservation order)	2.5

5.6.4 SUMMARY OF CONSTRUCTION NOISE AND VIBRATION CRITERIA

Construction noise criteria for the areas surrounding the project are NML levels (between RBL + 10 dBA and max. 75 dBA) for standard construction hours. As per below:

- Logger receivers:
  - Recommended standard hours: Noise affected – 48 dBA / Highly noise affected – 75 dBA
- School building receivers:

- Closest classroom blocks E and F 45 dBA (internal) / 55 dBA (external)
- For Building L: the same criteria as per classrooms would apply, this is 45 dBA (internal) / 55 dBA (external),as this is an educational building, if any activities are held during construction (such as assemblies, parents meetings, teachers meetings, etc).

Note: building D is a toilet block and building L is a Hall.

We consider that for this project the vibration criteria will be as per DIN 4150 – 3:1999 construction vibration limits – long term. Residential receivers in the area will have a peak particle velocity criterion of 5 mm/s and commercial buildings of 10 mm/s peak particle velocity criteria.

The construction noise assessment utilises the information provided by the team at this stage and conducts a preliminary construction noise and vibration assessment. If predicted construction noise and vibration levels are not exceeding the limits, there is no need for a future Construction noise and vibration management plan.

6 OPERATIONAL NOISE & VIBRATION IMPACT ASSESSMENT

The following sections present our assessment of noise emission impacts from operational noise sources from the project. Predicted noise levels and associated mitigation measures are also provided according to the noise assessment and criteria.

6.1 NOISE EMISSION FROM PA SYSTEMS AND SCHOOL BELLS

The school PA or bells are a part of the existing noise emissions from the school. It is understood that any PA or bell systems will be extended to the existing in order to cover the new building as required. These may be located on the new building and should be oriented to direct sound away from the neighbours where possible.

6.2 NOISE EMISSIONS FROM SERVICES

6.2.1 MECHANICAL SERVICES

According to the NDY mechanical services concept, the new building will require additional outdoor HVAC condenser units. These are expected to be located to the south of the building. It is understood that 4 outdoor units are expected to be located in this area and that they will operate during the school operating hours (i.e. only during daytime hours).

The location of the units is shown in Figure 9.

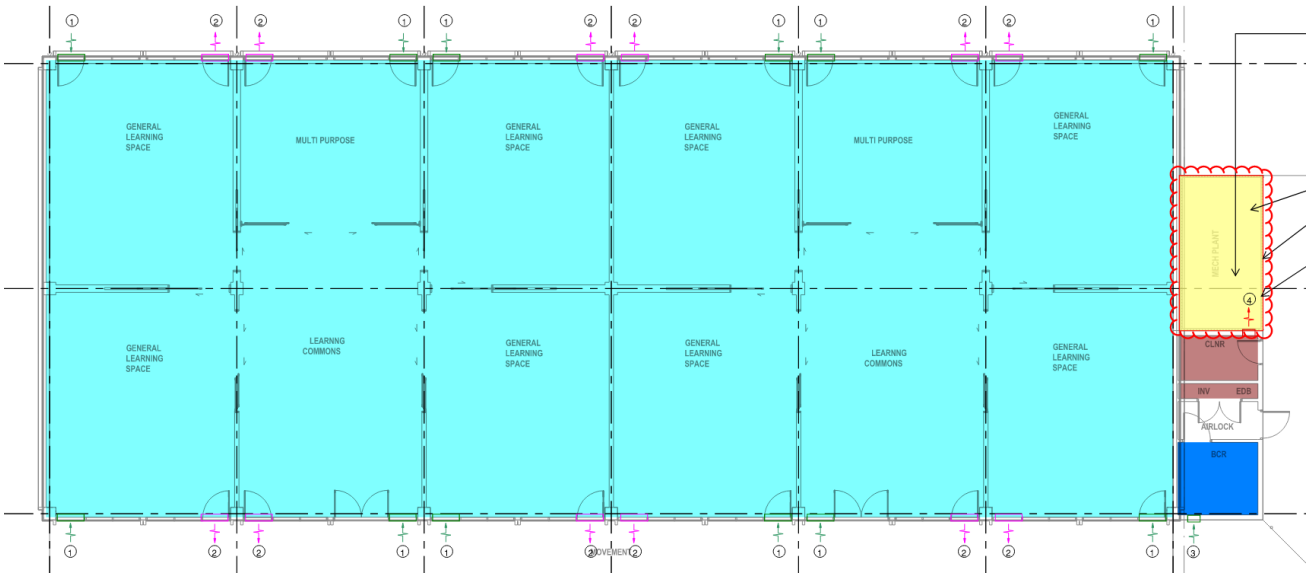

FIGURE 9: LOCATION OF NEW PLANT, SHOWN HERE CLOUDED. NOTE NEW PROPOSED BUILDING SHOWN IN TEAL.

In addition to this, there are several extract fans expected which will be detailed at a later stage. Locations of these are generally at the highest occupied level.

We understand that final equipment selections are not available at this stage, however a preliminary mechanical equipment assessment was conducted with equipment noise data used for similar projects. Along with the sensitive residential receivers, the NPfI categorises classrooms as sensitive spaces and requires a maximum internal noise limit of 45dBA to be met by the project. In order to ensure that the mechanical plant does not impact the existing classrooms and comply with the NPfI limit of internal noise 45dBA, the assessment was also done for noise propagated from the plant to the closest existing Block F which is estimated to be approximately 18m away from the mechanical plant (based on current layout of new building location).

Mechanical noise sources propagated to critical receivers is shown in table below:

TABLE 13 - MAXIMUM I SOUND POWER LEVELS FOR MECHANICAL EQUIPMENT

EQUIPMENT	SWL SOUND POWER LEVEL (dB) PER FREQUENCY BAND (HZ)								DBA
	63	125	250	500	1000	2000	4000	8000	
Daikin REYQ20BYM	80	81	77	70	66	60	55	47	**65**
Total ODU noise (6x units)	86	87	83	76	72	66	61	53	**79**
Extract fan 1	85	88	87	87	86	87	85	80	**93**
Extract Fan 2	80	84	84	81	79	77	74	65	**84**
Total fan noise (2x units)	86	89	89	88	87	87	85	80	**93**
Total noise for 6x ODUs and 2x fans (SPL at 1m)	82	84	82	80	79	79	77	72	**86**

It is assumed that a total of 6x ODUs and 2x extract fans are located at 14.5m to the residential sensitive receiver at 20 Manning St. For Block D, this is assumed to be a total of 6x ODUs located 9m away and 2x extract fans located 20m away. This is expected to be very conservative as the fan locations are expected to vary and not be concentrated at the closest location to both receivers. Based on these the following noise levels are predicted:

TABLE 14: MECHANICAL SERVICES NOISE PROPAGATED INTO CRITICAL RECEIVERS

RECEIVER	NOISE LIMIT	ESTIMATED NOISE LEVEL (OUTSIDE) / (SPL)	ESTIMATED NOISE LEVEL (OUTSIDE) / (SPL) AFTER ACOUSTIC TREATMENT
20 Manning Street	43 dB(A) (PTNL for Day)	50 dB(A)	43 dB(A)
Existing Block D (6m)	45 dB(A) Internally 55 dB(A) Externally[2]	60 dB(A)	55 dB(A)

Daytime PNTLs are the noise limits selected here as the new building is only expected to be running during daytime hours.

The total noise levels also take into account the following:

- Noise barrier between the new building and 20 Manning St and other adjacent residential properties (note it is understood that there is an existing fence, however this is low in height. If this fence cannot block line of sight from the HVAC grilles or plant, a new barrier to do so will be required.
- Minimum 20m standoff distance between inlet/outlets of fans and any nearby school buildings such as Block D
- Attenuators on fans
- Quieter fans may also be selected, the above only represent assumed fans for this stage of design. If quieter fans are used, the mitigation requirements may be reduced.

The attenuators used are presented below:

[2] A nominal 10 dB reduction has been applied for the façade of the building, so the external target is 55 dB(A)

TABLE 15: ASSESSED NOISE TRANSMISSION LOSSES FROM ACOUSTIC ATTENUATORS

ATTENUATOR PROPOSED	MIN. ATTENUATOR IL PER OCTAVE BAND FREQUENCY BAND (HZ)							
	63	125	250	500	1000	2000	4000	8000
Fantech Circular Attenuator C1, Standard Dia: 0.3 m, Length: 0.3 m	1	3	5	9	13	10	8	7

The above levels are propagated outside to the closest receiver's façade. With the recommended acoustic treatment measures utilizing fan attenuators, the noise from the HVAC plant will meet the relevant targets in the NPfI.

During mechanical equipment selection, it is recommended to use the utilize the assumed equipment sound data as a guideline and to ensure that the combined sound pressure levels at 1m for the plant do not exceed 88 dBA. If they exceed, further acoustic treatment will be required to ensure noise limits as per the NPfI are met. This could mean reselecting attenuators or fans.

6.2.2 OTHER SERVICES

No other major services are expected to be required due to the small scale of the proposed activity.

6.3 OPERATIONAL VIBRATION

For controlling vibration emissions on mechanical plant (VRF, condensers and similar), it would be recommended that all condensers are installed on Embelton or Mason Industries pads or equal. This would ensure compliance with the NSW EPA document Assessing Vibration: A technical guideline. However, as ODU units are small and far away from any nearby sensitive receivers, we do not consider this will be a noticeable impact on school grounds or residential areas.

7 CONSTRUCTION NOISE & VIBRATION IMPACT ASSESSMENT

The construction methodology details are not fully confirmed, however the following are understood:

- Construction will involve earthworks, concrete pad footing works, and construction and fitout works.
- The structural team has indicated that piling works are not expected to be required, but this may change pending a geotechnical report. Piling works have been considered as a part of this assessment to cover this possibility, but it is not expected to be required.

Construction hours are not confirmed, however it is recommended that the following hours are adopted to avoid times where construction noise criteria are more stringent:

- Weekdays 0700 to 1800
- Saturdays 0800 to 1300
- Sundays and public holidays: no work

7.1 CONSTRUCTION PLANT NOISE LEVELS

Minimum construction equipment for the estimated construction phases is described below:

TABLE 16 TYPICAL EXTERNAL NOISE LEVELS OF DEMOLITION AND CONSTRUCTION MACHINERY/ACTIVITY

ITEM #	ACTIVITY/MACHINERY	SOURCE AND REFERENCE NUMBER (BS 5228 – 1:2009)	L_{eq} SOUND PRESSURE LEVEL AT 10m (dBA)
Excavation and Demolition			
1	Tracked excavator 14t / 66kW	Table C2 Ref 25	69
2	Vibratory Roller passby, 3t / 20kW	Table C5 / Ref 27	73
3	Dumper truck 9T / 75 kW	Table C4 / Ref 4	76
Construction & Fitout Works			
4	Handheld circular saw 3 Kw	Table C4 / Ref 72	79
5	Handheld cordless nail gun	Table C4 / Ref 95	73
6	Diesel generator	Table C4 / Ref 76	61
Structural Works [3]			
7	Tracked excavator 14t / 66kW	Table C2 Ref 25	69
8	Dumper truck 9T / 75 kW	Table C4 / Ref 4	76
9	Mini piling rig (rock bolt) 250mm auger	Table C3 / Ref 18	74
10	Concrete pump + cement mixer truck (discharging) 8T / 350 bar	Table C4 / Ref 24	68

Notes:

- The above equipment shows every equipment noise level as per BS 5228 – 1:2009, the equipment inclusion in each phase is the general equipment that is used in this type of construction. A more detailed assessment will only be done if the preliminary assessment exceeds 75 dBA, if not, the above assessment is adequate for this type of report.

[3] Currently the structural works methodology have not been confirmed, however we understand that either piling or pad footings will be used. For this prediction, piling has been assumed as the worst-case scenario.

- NSW DECC 2009 Construction noise Guideline quotes on Appendix B Equipment Noise levels, the DEFRA 2005 database, which includes the above referenced BS 5228 – 1:2009 noise levels.

7.2 PREDICTED CONSTRUCTION NOISE

7.2.1 RESIDENTIAL RECEIVERS

Based upon the above plant sound power levels, predicted construction noise levels for the various works phases are presented below:

TABLE 17 PREDICTED CONSTRUCTION NOISE $L_{EQ,15MIN}$ TO THE RESIDENTIAL RECEIVERS

RECEIVERS	RECOMMENDED HOURS	PERIOD	PREDICTED CONSTRUCTION NOISE LEVEL	EXTERNAL NOISE MANAGEMENT LEVEL
Excavation and Demolition Phase				
20 Manning St	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	62 dB(A)	55dB(A)(noise affected) 75dB(A) (highly noise affected)
Construction & Fitout Works Phase				
20 Manning St	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	63 dB(A)	55dB(A)(noise affected) 75dB(A) (highly noise affected)
Structural Works Phase				
20 Manning St	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	62 dB(A)	55 dB(A)(noise affected) 75dB(A) (highly noise affected)
NB: 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.				

These noise levels are based on the following mitigation measures and conditions:

- All equipment during the excavation and demolition phase are assumed to have a 50% on-time, except the dumper truck which is assumed to have a 25% on-time.
- All equipment during the construction and fitout works phase are assumed to have a 50% on-time, except any circular saws which are assumed to have a 25% on-time.
- All equipment during the structural works phase are assumed to have a 50% on-time, except the dumper truck which is assumed to have a 25% on-time
- A 2m noise barrier around the construction site has been assumed for the predictions above. A construction barrier should be installed at this location for the duration of the construction works.

- Construction hours will only be during day-time.
- Construction site is large and not all machinery is expected to be located at the same distance when assessing on a particular boundary.
- Not all machinery are to be working simultaneously.
- The above estimations are the critical scenario for construction noise and assume a worst-case scenario where the equipment is generally located at the closest location to the receivers.

As shown construction noise levels during all stages phases were predicted below 75 dB(A). Under the ICNG, there is no requirements for construction noise to be managed as part of a construction noise and vibration management plan.

7.2.2 SCHOOL RECEIVERS

The construction is expected to affect receivers on school grounds located close to the site of construction.

We understand that block D is a toilet block, part of the construction zone and not accessible during construction. Block L is the hall, however this building could have some uses during the constriction and as an educational building, the same construction limits as per classrooms will apply (when in use).

Based on the below, the closest school receivers will be Block L (when in use, located at 15.2 m approximately) and block E, located further away from the construction (53 m approximately).

Based upon the above plant sound power levels, predicted construction noise levels for the various works phases are presented below:

TABLE 18: PREDICTED CONSTRUCTION NOISE $L_{EQ,15MIN}$ TO BLOCK L (WHEN IN USE)

EQUIPMENT	DISTANCE [M]	ON-TIME	PREDICTED CONSTRUCTION NOISE LEVEL	EXTERNAL NOISE MANAGEMENT LEVEL (EXTERNAL)[5]	MITIGATION MEASURES
Excavation and Demolition Phase					
Tracked Excavator	20	25%	49 dB(A)	45 dBA (internal) / 55 dBA (external)	2m Noise barrier between plant and Block L
Vibratory Roller	20	25%	51 dB(A)		2m Noise barrier between plant and Block L
Dump Truck	40	25%	51 dB(A)		2m Noise barrier between plant and Block L
Total			55 dB(A)	45 dBA (internal) / 55 dBA (external)	
Construction & Fitout Works Phase					
Circular Saw	30	25%	50 dB(A)	45 dBA (internal) / 55 dBA (external)	All works to occur internally
Nail Gun	20	50%	49 dB(A)		All works to occur internally
Diesel Generator	20	50%	49 dB(A)		2m Noise barrier between plant and Block L
Total			54 dB(A)	45 dBA (internal) / 55 dBA (external)	

[5] The EPA Construction Noise and Vibration Guidelines set internal noise limits within classrooms to be 45 dBA internally. A 10 dB reduction has been assumed for the façade, giving an external noise limit of 55 dBA.

EQUIPMENT	DISTANCE [M]	ON-TIME	PREDICTED CONSTRUCTION NOISE LEVEL	EXTERNAL NOISE MANAGEMENT LEVEL (EXTERNAL)[5]	MITIGATION MEASURES
Structural Works Phase					
Tracked Excavator	20	50%	51 dB(A)	45 dBA (internal) / 55 dBA (external)	2m Noise barrier between plant and Block L
Dump truck	40	25%	53 dB(A)		2m Noise barrier between plant and Block L
Mini piling rig	20	25%	53 dB(A)		2m Noise barrier between plant and Block L
Concrete Pump	20	50%	50 dB(A)		2m Noise barrier between plant and Block L
Total			58 dB(A)	45 dBA (internal) / 55 dBA (external)	

Due to the closeness of nearby school buildings to the construction site, mitigation is difficult. As these receivers are under the control of Kingswood Public School, some specific mitigation measures can be adopted to ensure that impacts to the users are minimised. The following mitigation measures are proposed to ensure that noise levels can be maintained to under 45 dBA internally when in use:

- Combined construction noise levels are predicted to exceed 55 dBA externally with several activities even with mitigation measures taken, however the individual noise levels for each activity do meet the criteria. Scheduling of loud works should be done so that they do not occur at the same time when the classrooms are in use should be done where possible.
- Scheduling activities in Block L, to be vacant while particularly loud works occur.
- Use of 2m high noise barriers to the buildings and exposed areas:
  - Noise barriers can also be installed at the buildings as well as around the construction site. Currently only noise barriers around the site have been accounted for so this would give additional reductions.
  - The noise barrier is to be constructed of 15 kg/m2 solid material and be sealed at the bottom and sides to be fully enclosed.
- Closing classroom windows on building E and F while loud works occur. This is expected to happen regardless due to dust and debris which may occur during the course of construction.

It should be noted that piling works are assessed but are not expected to be required for the construction. As piling is one of the noisiest works, this is expected to reduce the noise levels emitted during the structural phase.

In addition to the above, it should be noted that the 10 dB reduction through the façade assumed for the 55 dBA external criteria is relatively conservative for a structure with closed windows. Realistically, this reduction is likely to be closer to 20 dB depending on the structure (which will be confirmed once a final version of this report is issued), considering this the works are generally expected to be compliant with the 45 dBA internal level.

7.3 PREDICTED CONSTRUCTION VIBRATION

It is important to note that construction vibration levels depend on several factors, such as: activity, type of machine, geology of the ground and the distance between the affected buildings and the source. Surface works are expected to have a lower vibration impact than ground compacting/breaking works.

For the activity, earthworks are the only activity likely to cause some vibration, particularly earth compaction works which may require a vibratory roller compactor.

Compliance with vibration limits for building damage is expected based on ensuring ground compacting equipment is selected to adherer to minimum safe working distances. While these magnitudes do not predict cosmetic/structural damage, it is anticipated that human response/comfort would be impacted at these distances.

The current RMS Construction Noise and Vibration Guideline sets safe working distances for vibrating plant and equipment. These are summarised below in Table 19. For this size of works, the use of large hydraulic hammers would not be recommended for these works. Hence it is recommended that the use of smaller rock breakers and handheld jackhammers are used for activity close to the nearest affected residential receivers.

TABLE 19 RMS PLANT VIBRATION SAFE OPERATING DISTANCES - *Construction Noise and Vibration Guideline 2016*

PLANT ITEM	RATING/DESCRIPTION	MINIMUM WORKING DISTANCE	
		Cosmetic Damage (BS 7385)	Human Response (OH&E Vibration Guideline)
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Jackhammer	Handheld	1 m (nominal)	2 m

Vibration predictions on Piling and reinstatement works are included below, using Table E.1 Empirical Predictors for groundborne vibration arising from mechanized construction works of the BS 5228 – 2.2009 part II Vibration.

TABLE 20 EARTHWORKS ESTIMATED VIBRATION LEVELS AS PER TABLE E.1 OF THE BS 5228-2.2009

EQUIPMENT	VIBRATION LEVEL PPV (mm/s)	SOURCE
Steady state for vibratory compaction, 3m setback distance	4.5 mm/s	Table E1. BS 5228-2:2009

Notes: These levels were calculated (based on the below:

- Critical amplitude of vibration, scaling factor Ks of 143, 33% probability of predicted value being exceeded and 1 m drums width). BS 5228:2009 recommends that for vibrations over 1.0mm/s affected residents should be given prior warning and explanation as to the cause of the vibration.

The above levels meet the construction vibration criteria (residential structures, 5 mm/s) as per DIN 4150 – 3. These values are not likely going to produce complains on the neighbours and are below all the maximum recommended vibration values as depicted in the criteria section.

7.4 GENERAL RECOMMENDATIONS ON CONSTRUCTION NOISE AND VIBRATION MANAGEMENT

Predicted construction noise levels were determined not to exceed the 'Highly Noise Affected' noise levels, which have been specified in the Interim Guide for Construction Noise (ICNG). However, the Interim Guide for Construction Noise (IGCN) list a number of typical best practice measures which can be used to reduce construction related impacts. In addition, Australian Standards 2436-2010 provides best practice measures to mitigate construction noise and vibration.

The following recommendations should be also considered in the preparation of a construction noise and vibration management plan for the site, when details of the contractor works methodology become finalised.

7.4.1 GENERAL/SITE MANAGEMENT ISSUES

- All employees, contractors and subcontractors are to receive an environmental induction and should instruct all persons at the site with regard to all relevant project specific and standard noise mitigation measures, including but not limited to permissible hours or work, limitation of high noise generating activities, location of nearest affected noise receivers, construction employee parking areas, designated loading/unloading areas and procedures, site opening/closing times (including deliveries) and environmental incident procedures.
- A dedicated person will form a point of contact for dissemination of general information regarding site operations. Contact persons will also be defined to receive comment or complaints from the community.

7.4.2 CONSTRUCTION ACTIVITIES AND NOISE MITIGATION

The following general construction noise source control measures may be required:

- Extended construction hours are not recommended, for evening hours, less intrusive works will be scheduled to be carried out and/or works will be carried out away from sensitive receivers;
- Activities that approach the highly noise affected criteria for the residential receivers to be carried out during times where receivers are less sensitive to noise;
- Avoid unnecessary revving of engines and turn off plant that is not being used/required;
- Where possible organise the site so that delivery trucks and haulage trucks only drive forward to avoid the use of reversing alarms;
- Where possible, avoid using tonal reverse alarm outside standard construction hours;
- Organise and schedule the equipment operations to limit the noisiest machines operating simultaneously;
- Site set up/ movement of plant / delivery of material/ waste removal to site should generally be restricted to day period;
- Truck drivers are to be informed of site access routes, acceptable delivery hours and must minimise extended periods of engine idling;
- Ensure there is no unnecessary shouting or loud stereo/radios on site. There must be no dropping of metal from heights, throwing of metal items or slamming of doors;
- Use less noise intensive equipment where reasonable and feasible;
- Where practical fixed plant should be positioned as far as possible from the sensitive receivers;
- Use temporary site buildings and material stockpile as noise barrier;
- Employ the use of solid barrier plywood hoardings if required;

8 SUMMARY OF NOISE AND VIBRATION MITIGATION STRATEGIES

8.1 NOISE MITIGATION STRATEGIES

This section compiles the proposed recommended treatments and strategies mentioned throughout the report to mitigate noise from the activity.

8.1.1 MECHANICAL

- Based on the current mechanical design, external plant are limited to 4x HVAC outdoor units located on the western side of the building and HVAC fans.
- During mechanical equipment selection, the combined sound pressure levels at 1m for the mechanical plant is not to exceed 86 dBA. If it does, additional mitigations must be assessed and implemented.
- The outlet ducts of HVAC fans are to be treated with circular attenuators from NAP, Fantech or approved alternative that can provide required insertion losses for the final selected equipment.

8.1.2 CONSTRUCTION NOISE

Construction is not expected to exceed 75 dBA to the external residential receivers and 45 dBA internally to the nearby school buildings with the appropriate mitigation measures. These include the use of a solid perimeter barrier which should be installed to protect the existing buildings that will have classes during the excavation and structural phases of construction.

Appropriate site management should be applied as described earlier in this report.

TABLE 21: MITIGATION MEASURES

Mitigation Number/ Name	When is Mitigation Measure to be complied with	Mitigation Measure	Reason for Mitigation Measure
Construction Noise Barriers	During the course of the construction period	Installation of a solid noise barrier to the nearby sensitive receivers as outlined in Section 7.2	To ensure construction noise levels can meet the noise limit criteria
Construction Noise Equipment On-Time Control	During the course of the construction period	The on-time allowances as outlined in Section 7.2 are to be followed	To ensure construction noise levels can meet the noise limit criteria

9 CONCLUSIONS

This acoustic planning report considers that the proposed activity at Kingswood Public School is acceptable from a noise / vibration perspective according to the state and local regulations. The following summarises the findings of our assessment:

- Operational noise and vibration meet the relevant Penrith LEP/DCP and NPfI criteria with some mitigation in the form of attenuators on the HVAC fans.
- Construction noise will meet the criteria and are all predicted to be less than the highly noise affected criteria of 75 dBA to the nearby residents and 45 dBA internally at the nearby school buildings with the mitigation measures listed. This includes time management of works and noise barriers.

Construction vibration will meet the DIN4150-3 criteria.

CONTACT US

AUSTRALIA

ADELAIDE

T: +61 8 8290 6800
E: adelaide@ndy.com

BRISBANE

T: +61 7 3120 6800
E: brisbane@ndy.com

CANBERRA

T: +61 2 6295 1788
E: canberra@ndy.com

GOLD COAST

T: +61 7 5512 1235
E: goldcoast@ndy.com

MELBOURNE

T: +61 3 9862 6800
E: melbourne@ndy.com

PERTH

T: +61 8 9281 6800
E: perth@ndy.com

SYDNEY

T: +61 2 9928 6800
E: sydney@ndy.com

CANADA

VANCOUVER

T: +1 604 734 9338
E: vancouver@ndy.com

NEW ZEALAND

AUCKLAND

T: +64 9 307 6596
E: auckland@ndy.com

WELLINGTON

T: +64 4 471 0151
E: wellingtonadmin@ndy.com

UNITED KINGDOM

LONDON

T: +44 20 7553 9494
E: london@ndy.com

IRELAND

DUBLIN

T: +353 1 264 6995
E: dublin@ndy.com

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