ACOUSTIC REPORT

Noise and Vibration Impact Assessment

Dalmeny Public School Upgrade
NSW Department of Education

NDY
A TETRA TECH COMPANY

CONFIDENTIAL

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VERIFICATION

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STAKEHOLDERS

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Table of contents

1 INTRODUCTION

This Noise and Vibration Impact Assessment (NVIA) report has been prepared to accompany a Review of Environmental Factors (REF) prepared for the Department of Education (DoE) relating to the Dalmeny Public School Upgrade (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 – Consideration of environmental health facilities and schools, Addendum October 2024 (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 as outlined in Table 1.

TABLE 1: SUMMARY OF RELEVANT SECTION OF THE PART 5 GUIDELINES AND EP&A REGULATION

REGULATION / GUIDELINE SECTION	REQUIREMENT	RESPONSE	REPORT SECTION
Noise policy for Industry NPFI	Meet PNTL levels for day, evening and night time for operational noise sources at receivers	Operational noise and vibration impact assessment for PA and school bells, carpark Services	Section 6
Interim construction noise guideline	Meet the NML and maximum noise level 75 dBA at affected properties during construction	Construction noise and vibration impact assessment	Section 7
Guidelines for Division 5.1 assessments Considerations of environmental factors for health services facilities and Schools / Addendum October 2024	a) Environmental impact of the community	(a1) assessing impact during construction (a2) impact post construction	Section 7 (a1) Section 6 (a2)
	d) reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality	(d1) impacts onto adjoining properties and spaces such as acoustic, noise and vibration	Section 6 and 7 (d1)
	l) pollution of the environment	l1) Any pollution during construction and post construction including noise and vibration	Section 6 and 7 (l1)
	r) other relevant factors	r3) noise / air pollution, vibration and safety impacts from roads, rail, drop off and pickup areas, parking	Sections 5.2, 6.2 (r3)

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

1.1 AUTHORS

This report was prepared by Rohith Vincent and Kanvin Chen. Quality assurance was carried out by Thomas Warren. NDY holds a Sydney membership of the Australasian Association of Acoustical Consultants, and Kanvin Chen and Thomas Warren are Members of the Acoustical Society of Australia / New Zealand.

1.2 PURPOSE

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

- Baseline noise survey of the area
- Review of the zoning, type of area, LEP, DCP plans and assessment to obtain Project trigger noise levels
- Statement of operational and construction noise environmental effects such as noise emissions to the boundary from onsite plant equipment and from construction.

1.3 AUTHORITY

Authority to undertake this report was provided by Paul Nickson of NSW Department of Education.

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)
- 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)
- Liverpool Local Environmental Plan LEP 2008
- Liverpool Development Control Plans DCP 2008
- Dalmeny PS Planning Approval Pathway Strategy Version 3, Approved 21.08.2023
- SINSW Dalmeny PS Detailed Due Diligence checklist dated 12.05.2023
- Dalmeny Public School Upgrade Draft Rapid Transport Assessment V2 dated 19.10.2024
- Dalmeny Public School Schematic Design Design Architectural Package, by Fulton Trotter dated 10.02.2025
- Dalmeny Public School Final Schematic Design Mechanical Drawing Set DAPS-NDY-XX-XX-DR-M-000011 dated 12.02.2025
- Dalmeny Public School Upgrade Electrical Drawing Set Concept Design DAPS-NDY-XX-XX-DR-M-000011 Rev P1 dated 11.10.2024
- Election Commitment Feasibility Study dated 14.08.2023
- Dalmeny Public School Election Commitment Feasibility Study dated 14.08.2023
- Geotechnical Report - Targeted Detailed Site Investigation 'PS206292-CLM-REP-Dalmeny Final Rev B' by WSP dated 01.11.2023

2 ACTIVITY INFORMATION

2.1 PROPOSED ACTIVITY DESCRIPTION

The proposed activity for the Dalmeny Public School Upgrade includes the construction and occupation of a two-storey classroom building and associated covered walkways and landscaping.

Demolition

- Demolish part of existing fence on Dalmeny Drive;
- Remove two (2) trees; and
- Earthworks;

Construction and occupation

- Two-storey classroom building (Block H);
- Covered walkways (excluding between Block G and H),
- Footpath between block G and block H
- Landscaping (surrounding Block H),
- Fence and gate south of Block H;
- OSD tank;
- New Main Switch Board;
- Substation; and
- Fire Hydrant.

The classroom building will consist of the following floor layout:

- **Ground Floor Level**: Comprises eight (8) general learning spaces (GLS) and two (2) learning commons spaces (LCS). Also located on the ground floor level are amenities, services, storage spaces and a lift and two staircases to provide access to the first-floor level; and
- **First Floor Level**: The first-floor level will also comprise eight (8) GLS and two (2) LCS. Also located on the first-floor level are amenities, a mechanical plant room and other rooms for services.

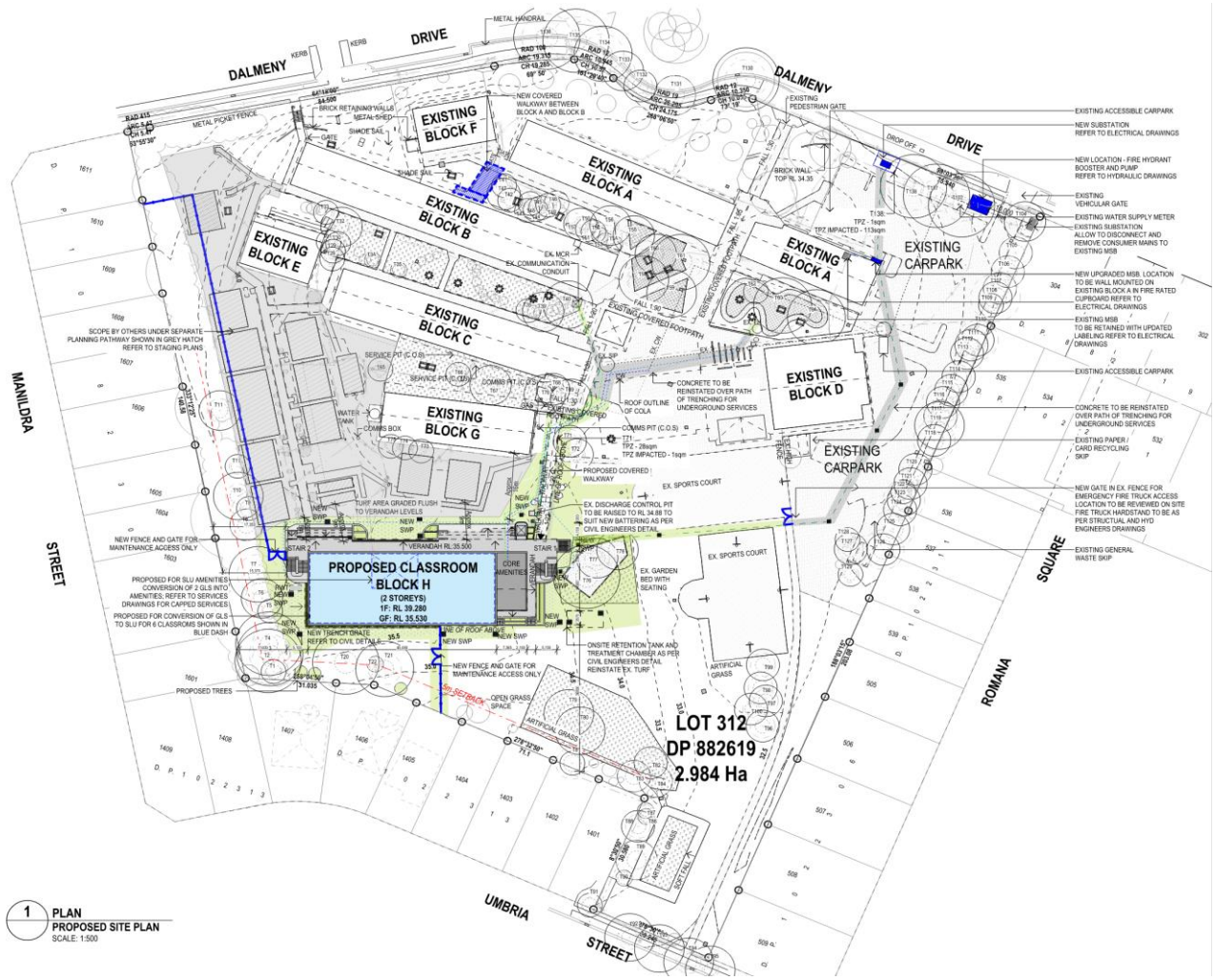

FIGURE 1: PROPOSED SITE PLAN

Works to be undertaken under separate Planning Pathway (not part of this REF)

Works to be undertaken under a separate planning pathway cannot be undertaken until the Activity is completed and operational.

- Decommission and remove existing single storey portable classrooms;
- Decommission and remove existing portable amenities;
- Associated covered walkways to be demolished;
- Associated site infrastructure works;
- Shade structure over pathway between block G and H;
- Remainder of landscaping
- Fencing and gate north-west of Block H.

2.2 ACTIVITY SITE

The site is located at 129 Dalmeny Drive, Prestons and is legally described as Lot 312 DP 882619.

Dalmeny Public School is located on the southern side of Dalmeny Drive and on the northern side of Umbria Street. The surrounding context of the site is predominantly low density residential. Figure 2 depicts an aerial photograph of site.

FIGURE 2: AERIAL PHOTOGRAPH OF SITE

2.3 SITE ZONING

The site is zoned R2 Low Density Residential on Liverpool City Council's LEP. As observed in Figure 3 the site is surrounded by residential areas, and there is an RE1 Public Recreation corridor running from southeast to northwest to the west of the school. In addition, the Detailed Due Diligence reports states that the built form in the area is mostly single dwelling houses.

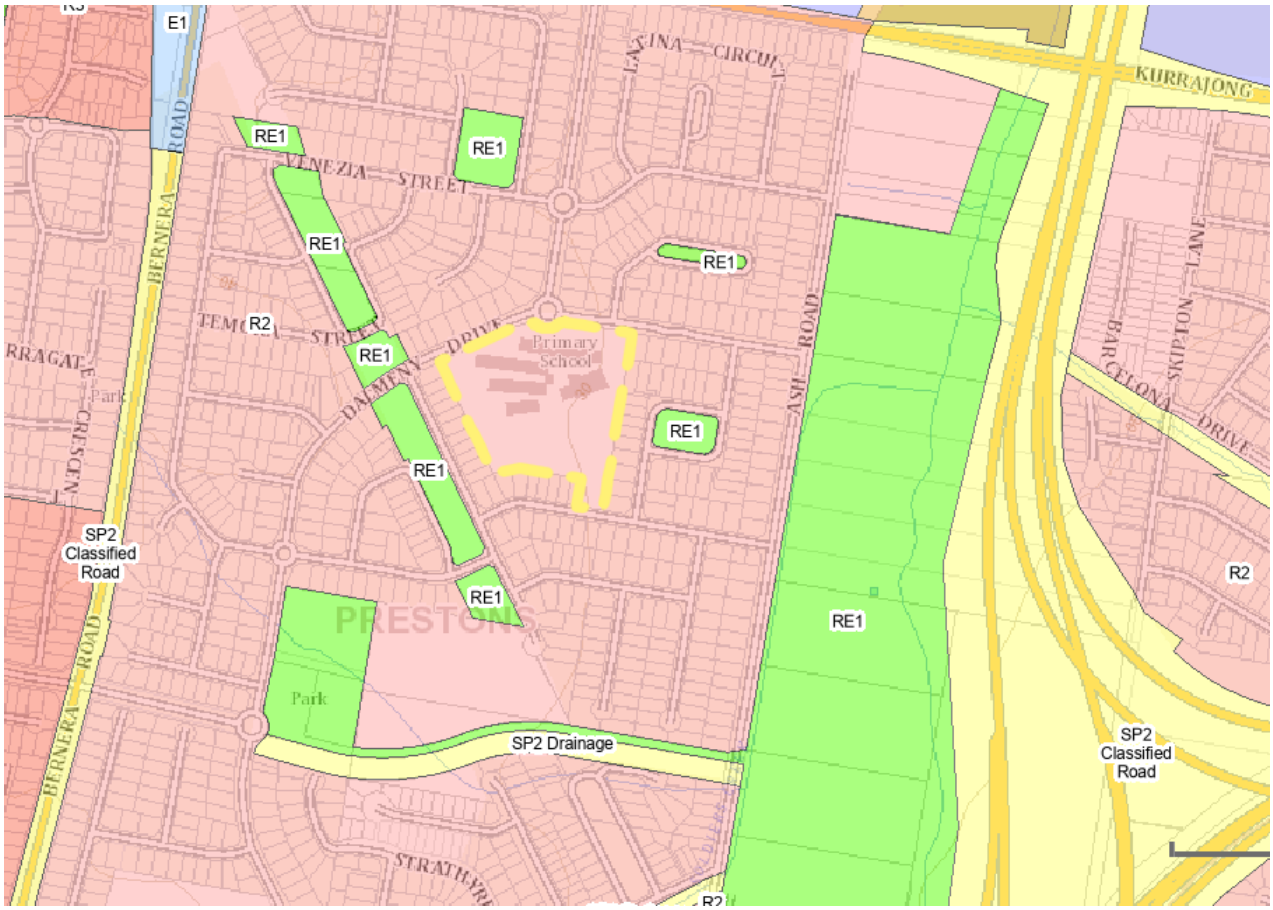

FIGURE 3: SITE LOCATION OBTAINED FROM NSW PLANNING PORTAL SPATIAL VIEWER

2.4 SCHOOL OPERATION HOURS

The school facilities will operate during daytime (7:00 am – 6:00pm) with limited/no activities during evening time (6:00 pm to 10:00pm) and no activities during the nighttime (after 10 pm).

2.5 SENSITIVE RECEIVERS

The most sensitive receivers for this activity have been identified, depicted in Figure 4 and listed in Table 2 below:

TABLE 2: SENSITIVE RECEIVERS

RECEIVER	RECEIVER ADDRESS	(APPROXIMATE) RECEIVER DISTANCE	TYPE OF RECEIVER
R1	18 Manildra St, Prestons, NSW 2170	18 m	Residential
R2	19 Umbria St, Prestons, NSW 2170	25 m	
School building G		35 m	Existing school building

FIGURE 4: LOCATION OF SENSITIVE RECEIVERS

3 METHODOLOGY

This report was prepared using the below methodology:

- Review of the NSW standards, NPfI regulations and local requirements for noise and vibration (local council DCP / LEP).
- 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's location was based on:
  - Critical receivers
  - Location of the receivers
  - A prelim. meeting with 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.

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 station 'Edmondson Park' (Latitude / Longitude: 33.965° S, 150.851° E)**,** Station ID **ISYDNE3595** as a representative site located approximately 4km 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 noise loggers. Table 3 provides information relating to each noise loggers/sound level meter.

TABLE 3: NOISE LOGGER AND SOUND LEVEL METER INFORMATION

NOISE LOGGER/SOUND LEVEL METER	TYPE	SERIAL NUMBER
SVAN 977A	Class 1	SN 46003
SVAN 977A	Class 1	SN 99735

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 and Class 2 compliant with AS IEC 61672.2-2004.

4.3 NOISE LOGGERS' LOCATIONS

The noise logger locations that were agreed with the project team are as follows, which were selected to represent the most affected sensitive receivers:

- **Logger 1**: SN 46003 at west side school boundary behind sensitive receivers in Manildra St
- **Logger 2**: SN 99735 at south side school boundary next to sensitive receivers in Umbria St

Below figures depicts the noise loggers installed at site and their measurement locations, which based on our assessment is appropriate in representing noise levels of sensitive receivers surrounding the site.

FIGURE 5: LOGGERS DEPLOYMENT LOCATIONS

5 NOISE AND VIBRATION CRITERIA

5.1 LOCAL CITY COUNCIL RULES

The Liverpool Local Environmental Plan 2014 (LEP 2008) and Liverpool Development Control Plan (DCP 2008) have been reviewed and have no particular requirements for noise.

5.2 NSW DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS

The activity falls under the category of a sensitive activity under the NPfI as it is an educational facility. However, upon review of planning maps and Google Maps, the roads in the vicinity such Dalmeny Dr, Manildra St, Umbria St, Romana Square and Ash Rd are not busy with light and fast-moving traffic. In addition, the location is not located close to rail lines. Therefore, no rail or road noise or vibration assessment is required for this report.

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 noise indexes are the 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 4: 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
Logger 1	L_{A90} (RBL)	37*	41	35
	$L_{Aeq,period}$	57	49	48
Logger 2	L_{A90} (RBL)	37*	41	36
	$L_{Aeq,period}$	61	51	49

* RBL obtained from noise logging was very low (37dBA) this is 20 dB lower in comparison with the existing noise levels of the area (L_{Aeq} 57 – 61) and 8 dB lower than the usual background daytime noise of a suburban area (RBL 45) as per Table 2.2 of the NPfI. Considering this, the RBL for Day time was adjusted to what table 2.3 of the NPfI recommends for a suburban area (RBL 45) so the calculation of the project PNTL levels are in line with the representative noise of this area.

5.3.1 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.

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
	R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Night RBL <35dB(A)	following characteristic: evening ambient noise levels defined by the natural environment and human activity.
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

As most of the neighbourhood comprises of low-density R2 residential zoning, we believe the suburban area description above is the one more suitable for our project. As reflected in table above, this area should have a Daytime RBL of 45 dBA, evening RBL of 40 dBA and night RBL of 35 dBA.

TABLE 5: 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 Area	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 NPfI recommends "Intrusive noise levels are only applied to residential receivers (residences)". For other receiver types identified in Table 2.2, only the amenity levels apply. The project amenity and intrusive noise levels are be listed below.

TABLE 6: PROJECT INTRUSIVENESS AND AMENITY NOISE CRITERIA

LOGGER	NOISE LEVEL, $L_{EQ,15MINS}$ [DBA]		
	Daytime 0700 to 1800	Evening 1800 to 2200	Night - time 2200 to 0700
Receiver R1	**Project Amenity Assessment, $L_{Aeq, 15min}$**		
	53	43	38
	Project Intrusiveness Assessment, $L_{Aeq, 15min}$		
	50	46	40
Receiver R2	**Project Amenity Assessment, $L_{Aeq, 15min}$**		
	53	43	39
	Project Intrusiveness Assessment, $L_{Aeq, 15min}$		
	50	46	41

5.3.2 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 7: EXTERNAL PROJECT NOISE TRIGGER LEVEL (PNTL) FOR OPERATION NOISE

LOCATION/AFFECTED	TIME	DESCRIPTOR	EXTERNAL PNTL [DBA]
Receiver 1 18 Manildra St	0700 to 1800	$L_{Aeq, Day}$	50
	1800 to 2200	$L_{Aeq, Evening}$	43
	2200 to 0700	$L_{Aeq, Night}$	38
Receiver 2 19 Umbria St	0700 to 1800	$L_{Aeq, Day}$	50
	1800 to 2200	$L_{Aeq, Evening}$	43
	2200 to 0700	$L_{Aeq, Night}$	39

5.4 CONSTRUCTION NOISE AND VIBRATION CRITERIA

5.4.1 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.

As outlined by this regulation, if affected properties receive construction noise below 75 dBA, this would Not require a Construction Noise & Vibration Management Plan (CNVMP). Based on the **RBL of 38 – 39 dBA** in the daytime, the recommended noise management levels during all aspects of the construction program are summarised in table below.

Table 8: NOISE AT AFFECTED USING QUANTITATIVE ASSESSMENT

RECOMMENDED HOURS	EXTERNAL NOISE MANAGEMENT LEVEL (NML) LAEQ,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 **55 dB(A)** (45 + 10)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (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: – Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences). – If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

RECOMMENDED HOURS	EXTERNAL NOISE MANAGEMENT LEVEL (NML) LAEQ,15MIN [DBA]	HOW TO APPLY
Outside Recommended standard hours	**40 dB(A)** (35 + 5) RBL from nighttime	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.

For other sensitive land users different from residential, 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 benefits 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

5.4.2 NOISE MANAGEMENT LEVELS

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

TABLE 9: CONSTRUCTION NOISE MANAGEMENT LEVELS, LEQ 15MIN

RECEIVERS	RECOMMENDED HOURS	PERIOD	RBL $LA90_{,15mins}$ [dBA]	EXTERNAL NOISE MANAGEMENT LEVEL [dBA]
All Sensitive Receivers (R1, R2)	Day time (standard construction hours)	When in use	45 dBA	(45 + 10) = **55 dB(A)** (Noise affected) **75 dB(A)** (highly noise affected)
School Buildings			-	**45 dBA** (internal) / **~55 dBA*** at façade, externally
School Playgrounds				**65 dB(A)**

* The 55 dB(A) external noise level criteria for school buildings can be considered conservative, as some building facades may achieve greater performance.

5.4.3 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.

5.4.3.1 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.

5.4.3.2 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/s^2) 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.*"

5.4.3.3 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

5.4.3.4 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).

5.4.3.5 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).

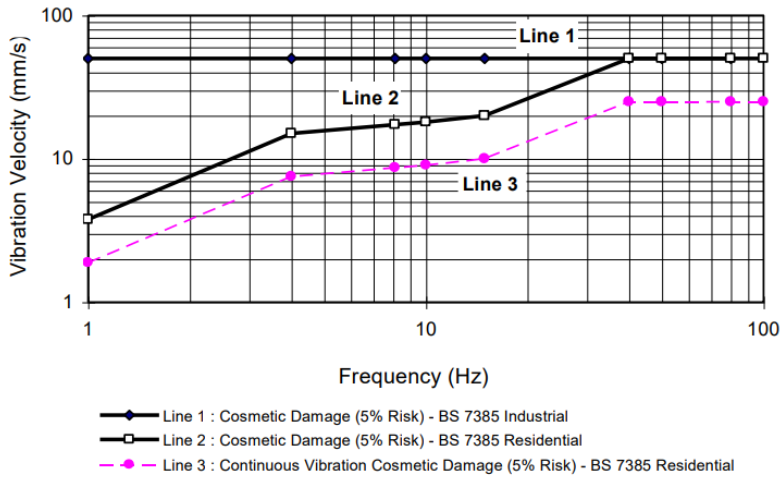

FIGURE 8 – BS 7385 PART 2 – 1993, GRAPH OF TRANSIENT VIBRATION VALUES FOR COSMETIC DAMAGES

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.

5.4.3.6 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.

5.4.3.7 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

TYPES 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

5.4.3.8 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

TYPES OF STRUCTURES	GUIDELINE VALUES FOR VIBRATION VELOCITY (MM/S) OF VIBRATION IN HORIZONTAL PLANE OF FIRST 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

5.4.4 SUMMARY OF CONSTRUCTION NOISE AND VIBRATION CRITERIA

Construction noise criteria for the areas surrounding the activity are NML levels (between 55 dBA and max. 75 dBA) for standard construction hours for the below sensitive receivers:

- **Receiver 1**: 18 Manildra St, Prestons, NSW 2170
- **Receiver 2**: 19 Umbria St, Prestons, NSW 2170

We consider that for this activity 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.

REF construction noise assessment will utilise the information provided by the team at this stage and conduct a preliminary construction noise and vibration assessment to assess if construction can meet NML levels.

6 OPERATIONAL NOISE & VIBRATION IMPACT ASSESSMENT

The following sections present our assessment of noise emission impacts from operational noise sources from the activity. 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

As the activity is only replacing the existing temporary teaching spaces with permanent buildings, the current school population is assumed to remain the same. Hence, there is no increase in the current existing impact (see Fact A NPfI) as this would have been assessed in the initial/original school DA report.

We are not aware that any of the demountable modules, that are to be relocated, will use more PA Systems or school bells other than the existing ones.

6.2 NOISE EMISSIONS FROM CARPARK

As the activity is only replacing the existing temporary teaching spaces with permanent buildings, the current number of staff and students is assumed to remain the same. In addition, the proposed works do not refer to provision of new additional carparks based on which we assume no new carparks are being introduced in the activity that will impact/increase the existing noise emissions.

6.3 NOISE EMISSIONS FROM SERVICES

6.3.1 MECHANICAL SERVICES

As per NDY mechanical schematic design sketches and mechanical spatial designs, the location of the mechanical plant room for the new proposed building as per below:

- Proposed new building roof: 32 sqm for ODU units to be located on rooftop. The plant would be on the east side of the proposed building facing away from Manildra St.

The current locations for the mechanical plant can be seen in Figure 9. The plant is assumed to be operational during the assumed school operation hours which is during daytime (7:00 am – 6:00pm) with limited to no activities during evening time (6:00 pm to 10:00pm) and no activities during the nighttime.

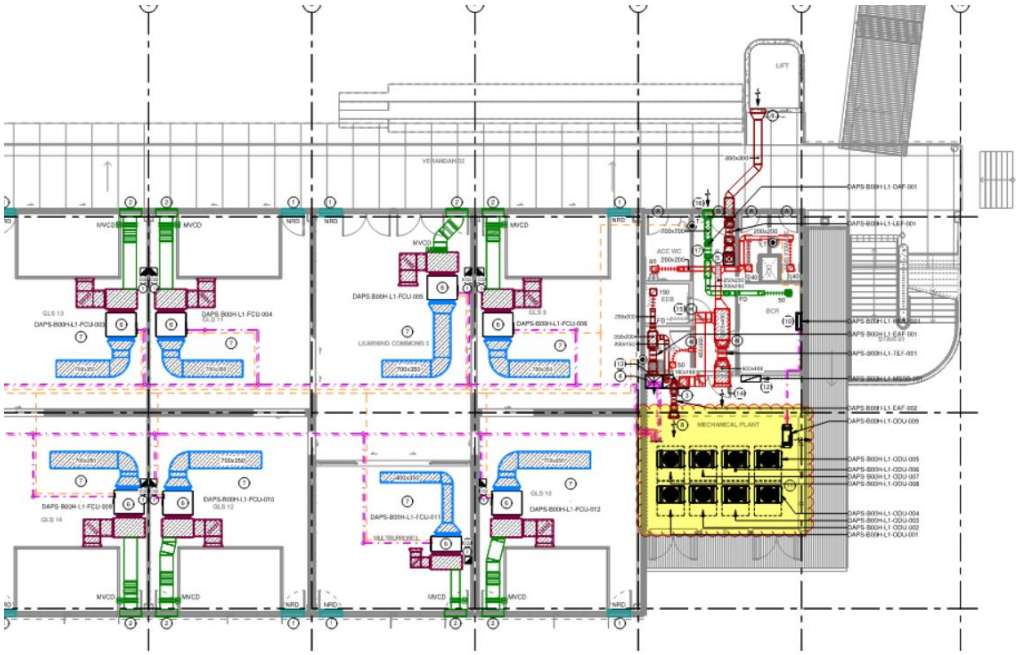

FIGURE 9: PROPOSED LOCATION FOR MECHANICAL PLANT IN NEW BUILDING

We understand that final equipment selections are not available at this stage, however a preliminary mechanical equipment assessment was conducted with equipment noise data determined from the mechanical services team. For the assessment, we have allowed for the following:

- Max. 9 Outdoor units (ODU) and max. 2 rooftop fans and the sound data for each equipment is listed in Table 13.

TABLE 13: SOUND PRESSURE LEVELS AT 1M FOR ASSUMED MECHANICAL UNITS

EQUIPMENT	SPL SOUND PRESSURE LEVEL (dB) PER FREQUENCY BAND (HZ) AT 1M DISTANCE								
	63	125	250	500	1000	2000	4000	8000	dBA
Medium-Large Sized Outdoor Unit (per ODU)	68	66	66	64	58	55	52	44	**65**
Rooftop Fan 1	73	71	65	66	65	67	63	58	**72**
Rooftop Fan 2	47	47	50	51	47	46	45	36	**53**
Cumulative noise of plant for 9 ODUs and 2 different fans (equivalent SPL at 1m)	78	76	76	74	68	65	62	54	**75**

The noise impact assessment was conducted for to sensitive receivers. The closest possible receivers were identified and their approximate distances to the proposed plant room were determined. The PTNLs for evening period have been used as the noise limits (as the school will not be operational during nighttime). The closest possible sensitive receivers identified are:

- **Receiver R1**: 18 Manildra St at approximately 65m from mechanical plant
- **Receiver R2**: 19 Umbria St at approximately 32m from mechanical plant
- **Existing - School Building G:** approximately 35m from mechanical plant

In addition to noise assessments to residential sensitive receivers, the NPfI categorises classrooms as sensitive spaces and requires a maximum internal noise limit of 45dBA to be met by the activity. 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 Building G, which is estimated to be approximately 35m away from the mechanical plant (based on current layout of new building location).

The estimated noise impacts of the mechanical plant from the noise assessment are summarised in below Table 14. As seen in the results, exceedances were observed in the assessment. Required acoustic treatment to reduce the sound propagation are the use of acoustic louvres / solid noise barriers to reduce noise from the ODUs and allowance for attenuators and acoustically lined ductwork for fans.

For this preliminary assessment, we have allowed for the following treatment:

- The acoustic louvres / noise barriers are to be installed on all sides of the plant room to treat noise propagation in all directions.
- The acoustic louvres are to be minimum 300mm deep that can provide the below sound transmission loss in Table 15.
- The outlet ducts of rooftop fans have been assessed with an indicative attenuator selection with insertion losses in Table 16. (Internally lined ductwork is also suitable).
- An acoustically lined bend before the termination of fan ductwork

For both louvres and attenuators, the final mechanical design must be assessed to select appropriate louvres and attenuators/lined ductwork to meet the noise limits. Depending on final selections, the required performance may be higher or lower than stated here.

The Table 14 also provides results to the assessment of noise propagated from the mechanical plant to the critical receivers when such treatment is utilized.

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
Receiver R1	50 dB(A) (PTNL for day)	53 dB(A)	~44 dB(A)
Receiver R2		58 dB(A)	~49 dB(A)
Existing Building 'G'	45 dB(A) (internal) ~55 dB(A) on external facade	57 dB(A)	~45 dB(A) external

TABLE 15: ASSESSED NOISE TRANSMISSION LOSSES FROM ACOUSTIC LOUVRES

LOUVER PROPOSED	MIN. LOUVER TL PER OCTAVE BAND FREQUENCY BAND (HZ)							
	63	125	250	500	1000	2000	4000	8000
300mm Acoustic Louvre	6	7	10	12	18	18	14	13

TABLE 16: ASSESSED NOISE TRANSMISSION LOSSES FROM ACOUSTIC ATTENUATORS

ATTENUATOR PROPOSED	MIN. ATTENUATOR INSERTION LOSSES PER OCTAVE BAND FREQUENCY BAND (HZ)							
	63	125	250	500	1000	2000	4000	8000
Circular Attenuator	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 acoustic louvres / noise barriers on all plant walls as well as fan attenuators and lined ductwork, we predict that the recommended internal noise levels as per AS / NZS 2107 can be achieved.

During detailed design 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 75 dBA. If they exceed, further acoustic treatment will be required to ensure noise limits as per AS / NZS 2107 are met.

6.3.2 ELECTRICAL SERVICES

As per NDY electrical concept sketches and designs, it is proposed to introduce a pad mount substation behind Block A, facing Dalmeny Dr as shown in Figure 10. The closest sensitive receiver identified was at 2 Montella Place, located around 25m from the proposed location.

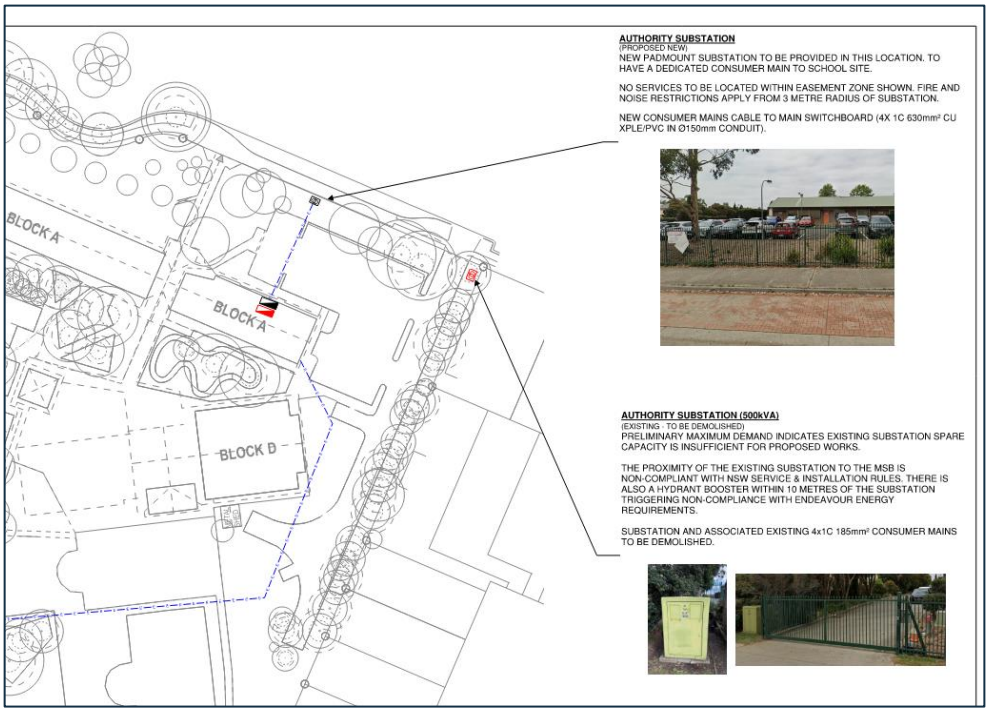

FIGURE 10: PROPOSED LOCATION FOR SUBSTATION

Selections were not available for the substation at the time of this report; however, as a conservative approach we have utilized sound data for a high rated substation, a 750kVA substation used in a previous project of similar nature which had a noise level of 58 dBA (SWL). When propagated to the identified closest receiver, it was observed that the sound levels met all the PNTL levels.

6.4 OPERATIONAL VIBRATION

For controlling vibration emissions on mechanical plant (VRF, condensers and similar), it would be recommended that all condensers are installed on isolation pads by Mason Industries, Embelton, or equal to ensure compliance with the NSW EPA document Assessing Vibration: A technical guideline. However, as the current assumed plant equipment units are small, we do not consider this will be a noticeable impact on school grounds or residential areas.

Note that acoustic and vibration impact to internal areas is not considered in REF scope.

7 CONSTRUCTION NOISE & VIBRATION IMPACT ASSESSMENT

We understand the critical construction activities proposed in the activity involves the removal and relocation of demountable classrooms, the construction of a new two storey building and refurbishment works to upgrade the existing buildings. The proposed construction plan and equipment selection is still subject to further development. For preliminary assessment purposes and based on previous experience on similar projects, we have assumed that the following plant and equipment will be used in the following phases:

- Excavation Demolition (only for new building)
- Structural Phase (only for new building)
- Construction / internal works for both new and existing buildings

We assume the hours of construction will be standard as per below:

- 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 17 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	Dumper truck 9T / 75 kW	Table C4 / Ref 4	76
Structural Phase			
3	Tracked excavator 14t / 66kW	Table C2 Ref 25	69
4	Dumper truck 9T / 75 kW	Table C4 / Ref 4	76
5	Mini piling rig (rock bolt) 250mm auger	Table C3 / Ref 18	74
6	Concrete pump + cement mixer truck (discharging) 8 T / 350 bar	Table C4/ Ref24	68
Construction & internal works			
7	Handheld circular saw 3 Kw	Table C4 / Ref 72	79
8	Handheld cordless nail gun	Table C4 / Ref 95	73
9	Diesel generator	Table C4 / Ref 76	61

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.
- 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

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 $L_{EQ,15MIN}$

RECEIVERS	RECOMMENDED HOURS	PERIOD	PREDICTED CONSTRUCTION NOISE LEVEL	EXTERNAL NOISE MANAGEMENT LEVEL
Excavation and Demolition Phase				
Receiver 1- 18 Manildra St	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	71 dB(A)	55 dB(A) (noise affected) 75dB(A) (highly noise affected)
Receiver 2- 19 Umbria St			70 dB(A)	
Structural Phase				
Receiver 1- 18 Manildra St	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	72 dB(A)	55 dB(A) (noise affected) 75dB(A) (highly noise affected)
Receiver 2- 19 Umbria St			72 dB(A)	
Construction & internal Works Phase				
Receiver 1- 18 Manildra St	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	72 dB(A)	55 dB(A) (noise affected) 75dB(A) (highly noise affected)
Receiver 2- 19 Umbria St			72 dB(A)	
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.				

Expected construction noise levels are meeting the NML levels with the below mitigation measures.

7.2.1 CONSTRUCTION MITIGATION MEASURES

To meet the NML levels, construction should follow the below:

- Construction hours will only be during day-time (from 7 am – 6 pm).
- Equipment time management per phase is as per below table:

TABLE 19 CONSTRUCTION EQUIPMENT TIME MANAGEMENT PER CONSTRUCTION PHASE

CONSTRUCTION PHASE	REQUIREMENTS FOR TIME MANAGED MACHINERY
Excavation and demolition	– 80% of the construction time for the Tracked excavator 14t / 66kW – 50% of the construction time for the Dumper truck 9T / 75 kW
Structural phase	– 80% of the construction time for the Tracked excavator 14t / 66kW – 30% of the construction time for the Dumper truck 9T / 75 kW – 40% of the construction time for the Mini piling rig (rock bolt) 250mm auger – 70% of the construction time for the Concrete pump + cement mixer truck (discharging) 8 T / 350 bar
Construction and internal works phase	– 30% of the construction time for the handheld circular saw 3 Kw – 60% of the construction time for the handheld cordless nail gun

Notes:

- Not all machinery is to be working simultaneously.
- The above estimations are the critical scenario for construction noise.
- Fitout works are expected to be substantially less than shown in the table, assuming noise sources (builders, handheld tools, etc) will be kept inside the new building and shielded from other receivers.

To meet NML at all receivers, including the exiting school blocks, a construction perimeter hoarding will need to be built (min height 2 m, min construction 12-15 kg/m2 dense) during excavation and piling as per below sketch:

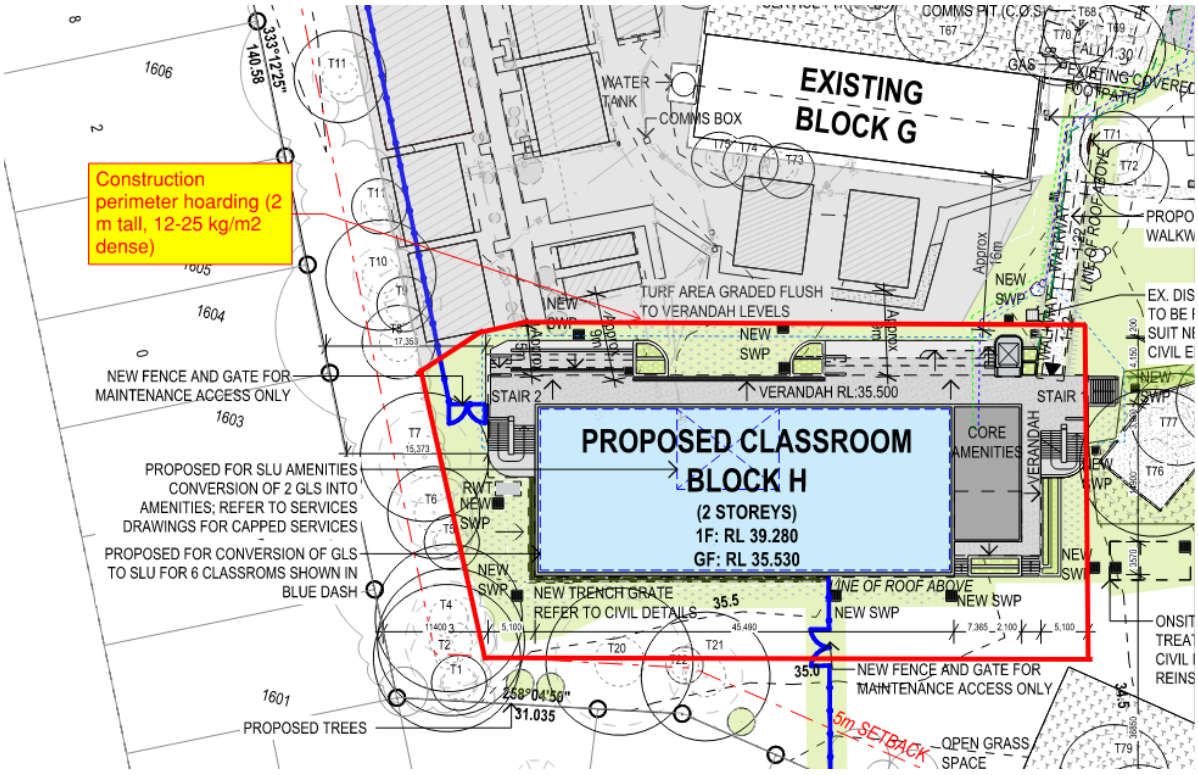

FIGURE 11: PROPOSED LOCATION FOR CONSTRUCTION PERIMETER HOARDING

As shown construction noise levels during all stages phases are predicted to be below 75 dB(A) at external receivers, hence a CNVMP is not required as per the Interim Construction Guideline. However, due to the sensitive nature of all receivers (residential and school buildings) a Construction Noise and Vibration

Management plan is required once construction methodologies and programme are finalized prior to construction certificate.

7.2.2 PREDICTED CONSTRUCTION NOISE INSIDE THE SCHOOL

The proposed perimeter hoarding around construction works is required to shield the existing closest school buildings that will hold classes during noisy works.

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 proposed activity, construction activities likely to cause some vibrations are piling, earthworks, reinstatement works for roads pavement construction and earth compaction, etc.

As per the findings of Geotechnical Investigations by WSP in their report, the subsurface conditions encountered beneath the site mostly comprised of silty or gravelly sandy clay. Based on these findings, we have assumed the soil type to be cohesive for our assessments.

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 20. 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 20 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 for 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 21 PILING AND REINSTATEMENT WORKS ESTIMATED VIBRATION LEVELS AS PER TABLE E.1 OF THE BS 5228-2.2009

EQUIPMENT	VIBRATION LEVEL PPV (mm/s)	SOURCE
Percussive piling, piles at 10 m depth with cohesive soils. distance to receiver R2 = 30m	0.06 mm/s	Table E1. BS 5228-2:2009

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

- Piling at 10 m depth with a W factor of 85Kj for percussive piling
- No vibratory piling.

- As per the FTA masterplan, geotechnical section, the soil is mainly consisting of fills, hence it would be a soft soil. This means that the above vibration is a conservative value, calculated for cohesive soils.

The above levels meet the construction vibration criteria (sensitive structures to vibration, 2.5 mm/s) as per DIN 4150 – 3. These values are not likely going to produce complains from the neighbours and are below all the maximum recommended vibration values as depicted in the criteria section.

7.4 BEST PRACTICES ON CONSTRUCTION NOISE AND VIBRATION MANAGEMENT

Predicted construction noise levels were determined not to exceed the 'Highly Noise Affected' noise levels at external receivers, which have been specified in the Interim Guide for Construction Noise (ICNG). However, the Interim Guide for Construction Noise (IGCN) list several 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 development of a construction noise and vibration management plan for the site, when details of the contractor work 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:

- No extended construction hours
- 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
- organise the site so that delivery trucks and haulage trucks only drive forward to avoid the use of reversing alarms
- 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

8 NOISE MITIGATION MEASURES

TABLE 22: NOISE MITIGATION MEASURES

PROJECT STAGE	MITIGATION MEASURES	REASON FOR MITIGATION MEASURE	SECTION OF REPORT
D	• Combined sound pressure levels for the mechanical plant is not to exceed max value as per Table 13 of the NVIA prepared by NDY, dated 06.03.25.	To minimise mechanical plant noise emissions to the nearest sensitive receivers and meet PNTL levels.	6.3.1
D	• If mechanical plant sections exceed values at table 13, acoustic louvres (as per Table 15) / solid noise barriers are required and noise attenuators (as per table 16) of the NVIA prepared by NDY, dated 06.03.25 and acoustically lined ductwork for fans.	To minimise mechanical plant noise emissions to the nearest sensitive receivers and meet PNTL levels.	6.3.1
O	• Mechanical plant operational only during daytime (7:00 am – 6:00pm).	To minimise mechanical plant noise emissions to the nearest sensitive receivers and meet PNTL levels.	6.3.1
D	• Electrical substation should generate a max. noise of 58 dBA (SWL). If noise levels are higher, acoustic louvers will be needed around substation.	To minimise electrical plant noise emissions to the nearest sensitive receivers and meet PNTL levels.	6.3.2
C	• Construction hours will only be during day-time (from 7 am – 6 pm). • Equipment time management per construction phase need to be as per Table 19 of the NVIA prepared by NDY, dated 06.03.25. • A construction perimeter hoarding will need to be built (min height 2 m, min construction 12-15 kg/m2 dense). As per Figure 11 of the NVIA prepared by NDY, dated 06.03.25. • No vibratory piling. • Best practices on construction noise and vibration management are as per section 7.4 of the NVIA prepared by NDY, dated 06.03.25.	To minimise Construction noise emissions and vibration to the nearest sensitive receivers and meet NML levels.	7.2, 7.3 & 7.4
D & C	• Due to the sensitive nature of all receivers (residential and school buildings) a Construction Noise and Vibration Management plan is required once construction methodologies and programme are finalized prior to construction certificate. The CNVMP need to include an updated construction equipment list as per	To minimise Construction noise emissions and vibration to the nearest sensitive receivers and meet NML levels.	7.1 7.2, 7.3 & 7.4

PROJECT STAGE	MITIGATION MEASURES	REASON FOR MITIGATION MEASURE	SECTION OF REPORT
	section 7.1 and an updated assessment as per sections 7.2, 7.3 and 7.4 of the NVIA prepared by NDY, dated 06.03.25.		

Notes:

- D design
- O operation
- C Construction

9 EVALUATION OF ENVIRONMENTAL IMPACTS

This Noise and Vibration impact assessment for the activity, prepared by NDY confirms that this activity will not have "a significant affect on the environment" (refer to Section 5.7 of the EP&A Act), the noise and vibration impacts from the activity can be adequately mitigated through the required mitigation measures included in this report.

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