REPORT

Noise and Vibration Impact Assessment – Planning Submission

Ulladulla Public School Upgrade
NSW Department of Education

NDY
A TETRA TECH COMPANY

CONFIDENTIAL

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VERIFICATION

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STAKEHOLDERS

ROLE	TEAM MEMBER	ORGANISATION
Client Representative	Jodi Gleeson	SI
Project Manager	Alex Jellie	RPInfrastructure
Architect	Jimmy He	Fulton Trotter
Planner	Rosie Sutcliffe	Urbis
Hydraulic and fire Engineering	Rhys Edwards	ACOR Consultants
Services Engineer – Mechanical	Chia Halim	NDY
Services Engineer – Electrical	Shrinivas Sapre	NDY

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1 INTRODUCTION

This Noise and Vibration Impact Assessment (NVIA) has been prepared to support a Review of Environmental Factors (REF) for the NSW Department of Education (DoE) for the Ulladulla Public School upgrade (the activity).

The purpose of the REF is to assess the potential environmental impacts of the activity prescribed by State Environmental Planning Policy (Transport and Infrastructure) 2021 (T&I SEPP) as "development permitted without consent" on land carried out by or on behalf of a public authority under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Section 3.37 of the T&I SEPP.

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 (DPHI) as well as the Addendum Division 5.1 guidelines for schools. The purpose of this report is to assess Noise and Vibration impacts from construction and operation of the project against the local and state regulations and provide mitigation options, if required

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

1.1 SITE DESCRIPTION

Ulladulla Public School is located at 241 Green Street, Ulladulla NSW 2539. The site is located within the Shoalhaven Local Government Area (LGA) and has an approximate area of 3.5 hectares. An aerial photograph of the site is provided at **Figure 1.** The site is comprised of three lots, legally referred to as follows:

- Lot 1 in Deposited Plan 122514
- Lot 1 in Deposited Plan 529425
- Lot 1 in Section 16 in Deposited Plan 759018

The site is zoned SP2 Educational Establishment and existing development comprises various buildings, a car park, landscaping, a sports field and sports courts associated with Ulladulla Public School. Ulladulla Public School currently comprises 22 Permanent Teaching Spaces (PTS) and 11 Demountable Teaching Spaces (DTS). The western portion of the site contains playing fields, sports courts and parking. Vegetation is interspersed throughout the site.

The site is irregularly shaped with a long frontage to Green Street to the south. Land to the north of the site is zoned RE1 which consists of natural bushland. Low density residential dwellings adjoin the site along the western boundary.

FIGURE 1: AERIAL PHOTOGRAPH OF THE SITE. SOURCE URBIS, JANUARY 2024.

1.2 PROPOSED ACTIVITY DESCRIPTION

The proposed activity relates to upgrades to Ulladulla Public School. Specifically, the proposed activity comprises the following:

- Construction of a new two-storey home base building over existing car park.
- Alterations to existing car park under new building.
- Construction of new stairs and covered walkways.
- Installation of new fencing.
- External landscape works.
- Installation of solar panels.
- Installation of new pedestrian gate and fire brigade booster.
- Tree removal.

Any works relating to the existing demountables or works associated with substations will be undertaken via a separate planning pathway. **Figure 2** provides an extract of the proposed site plan.

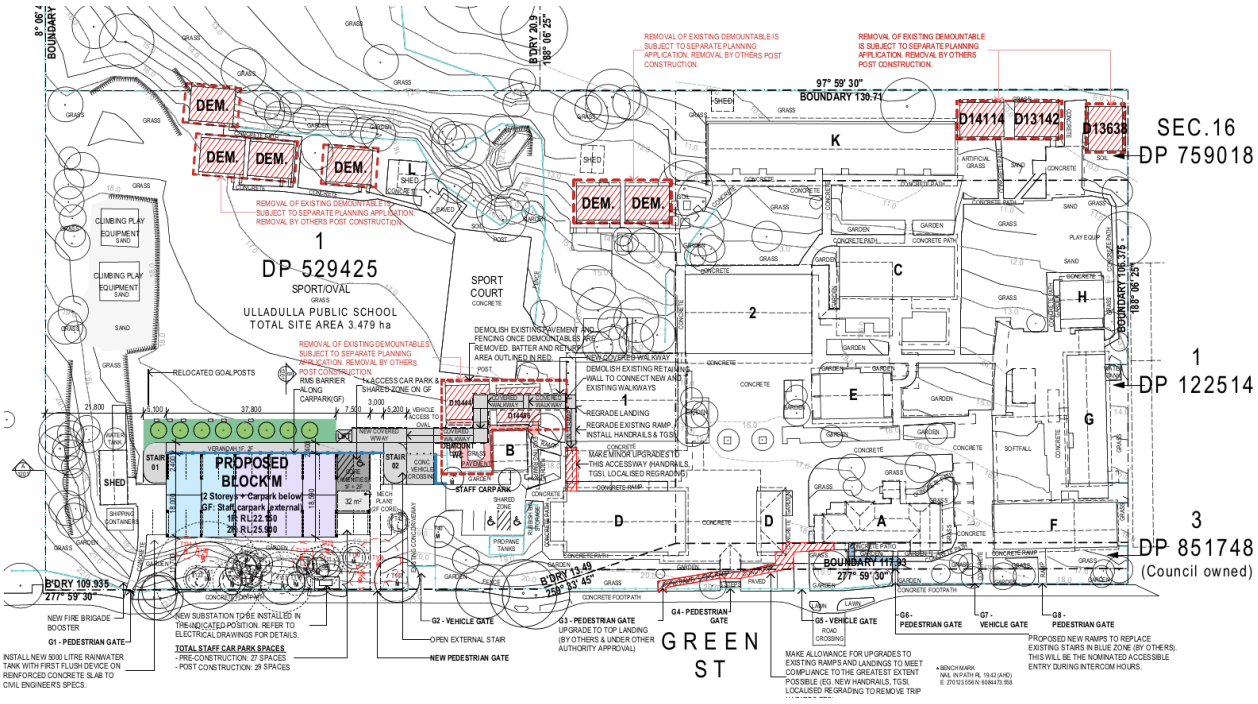

FIGURE 2: SITE PLAN. SOURCE FULTON TROTTER, 2025.

1.3 AUTHORS

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

1.4 PURPOSE

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

- Review of the zoning, type of area, LEP, DCP plans and desktop assessment to obtain amenity noise levels
- Statement of environmental effect such as noise emissions to the boundary from onsite plant equipment
- Construction Noise and vibration assessment to the boundary

1.5 AUTHORITY

Authority to undertake this report was provided by Jodi Gleeson of NSW Department of Education.

1.6 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)
- Shoalhaven Development Control Plan 2014
- Shoalhaven Local Environmental Control 2014
- Draft Due Diligence Report - Ulladulla Public School
- NBRS UPS - Master Plan Report-Rev 04, dated 19.09.23
- Urbis Town Planning due diligence report, Ulladulla Public School Upgrade, V2, May 2024
- Draft Ulladulla HS Geotechnical Investigations '36216BTrpt1 Draft' dated 19.10.2023
- Ulladulla Public School Rapid Transport Assessment-Version 2, issued by SCT Consulting on 24.09.23
- Ulladulla Masterplan Validation Report Final Draft Issue by Fulton Trotter Architects dated 25.09.2024
- Fulton Trotter Architects 100% schematic design issued, rev 07, dated 10.01.2025.
- VHS NDY Electrical Services Schematic Design, Rev 6, dated 17.01.2025.
- VHS NDY Mechanical Services Schematic Design, rev. 4, dated 17.01.2025.
- Urbis standard text dated 28.11.2024.
- FTA Concept Design Architecture drawings package, dated 27.09.2024.
- FTA Concept Proposed Site Plan, Drawing UPS-SD-103, dated 25.09.2024.

2 PROJECT INFORMATION

2.1 SITE LOCATION AND DESCRIPTION

The site is zoned SP2 Educational Establishment. The objectives of the SP2 zone as per *Shoalhaven Local Environmental Plan 2014* (the **SLEP2014**) are:

- To provide for infrastructure and related uses.
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.

Directly north of the site is land zoned RE1 which is heavily vegetated. Directly east of the site is land zoned SP2 Place of Public Worship and contains the Holy Family Catholic Church, carpark and retail stores. To the west of the site are low density residential dwellings. Ulladulla High School is located directly south of the primary school campus on the other side of Green Street.

FIGURE 3: SITE ZONING. SOURCE: NSW PLANNING PORTAL SPATIAL VIEWER

2.2 SCHOOL OPERATION HOURS

We understand the bell times for the school are 8:45 am to 2:50 pm. Based on the NSW NPfI times for the day, this means that the school facilities will operate during daytime (7:00 am – 6:00 pm) with limited/no activities during evening time (6:00 pm to 10:00 pm) and no activities during the nighttime (after 10:00 pm).

2.3 SENSITIVE RECEIVERS

The most sensitive receivers for this project have been identified, depicted in and listed in TABLE 1 below:

TABLE 1: SENSITIVE RECEIVERS

RECEIVER	RECEIVER ADDRESS	RECEIVER (APPROXIMATE) M	TYPE OF RECEIVER
R1	228 Green St, Ulladulla NSW 2539	30	Residential

RECEIVER	RECEIVER ADDRESS	RECEIVER (APPROXIMATE) M	TYPE OF RECEIVER
R2	28 Croft Ave, Ulladulla NSW 2539	30	
R3	65 St Vincent St, Ulladulla NSW 2539	200	Place of Worship

FIGURE 4: SENSITIVE RECEIVERS LOCATIONS

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.
- 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 and project manager to understand the approximate construction programme and phases.
- For construction noise assessment, if the REF assessment predicts any exceedance of the criteria, then it will be necessary to produce a detailed construction noise and vibration management plan.

4 ACOUSTIC ASSESSMENT OF THE EXISTING ENVIRONMENT

As the project is located in a quiet area with low background noise levels in a low-density residential receiver zone, the selected approach for the estimations of the project noise trigger (PNTL) levels was considering the allowed amenity noise levels for a suburban residential area.

4.1 SHORT TERM NOISE MEASUREMENTS

To confirm the above approach, during a site visit on 25.07.24, our team conducted a short-term noise measurement at 13:30 to capture peak hour background noise. The measurement was conducted at a representative location of the site location's background noise level, which was at the corner of Green and Croft St. The results are depicted in Table 2 and Table 3 below:

TABLE 2 – SHORT TERM NOISE MEASUREMENTS IN OCTAVE BANDS

LOCATION	SOUND PRESSURE LEVEL (DB) PER FREQUENCY BAND (HZ)								
	63	125	250	500	1000	2000	4000	8000	dBA
Cnr. Green and Croft St.	63	58	55	54	56	52	45	36	**59**

TABLE 3: EXISTING NOISE LEVELS (ATTENDED), DBA

SHORT TERM MONITORING LOCATION	DATE AND TIME	SHORT TERM ATTENDED MEASUREMENT	
		LAEQ	L90
Cnr. Green and Croft St.	25.07.24 / Daytime (13:30)	59	53

Note: the time of the measurement main noise source was traffic from the surroundings roads during peak hour.

FIGURE 5: SHORT TERM NOISE MEASUREMENT ON SITE 25.07.24

5 NOISE AND VIBRATION CRITERIA

5.1 LOCAL CITY COUNCIL RULES

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

5.2 NSW DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS

The project falls under the category of a sensitive development under the NPfI as it is an educational facility. However, upon review of planning maps and Google Maps, the roads in the vicinity such as Croft Avenue, St Vincent St, Green St and Princes Hwy 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

The NSW Noise Policy for Industry (NPFI) 2017 provides a methodology to determine the Project specific noise limits. The noise limits determined are categorised into the following time periods:

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

The noise indexes used for this methodology are the measured background (L_{A90}) and equivalent continuous (L_{Aeq}) noise levels. The L_{A90} noise levels represents the *Rating Background Levels* (RBLs), which is the median of the background L_{A90} (i.e. of the lowest 10^{th} percentile of samples) in each daytime, evening and night-time measurement period, for a 24-hour period.

The L_{Aeq} noise levels represents the logarithmic average of all the L_{Aeq} levels during the different time periods (daytime, evening and night-time periods). Using these noise levels, the policy provides a methodology to determine the Intrusiveness Noise Levels and Amenity Noise levels as discussed in below section.

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) is 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.

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 the activity location based on the review of land use zoning around the activity. The majority of the neighbourhood is categorised under (R2) low density and (R3) medium density residential zones. Based on this observation and information from Figure 6, this project location can be categorised as 'Suburban Residential'. In addition, handheld measurements obtained from the locality as depicted in Table 3 during peak times when the area background noise is assumed to be highest, was recorded to be a RBL of 53 dBA. The general background levels during the day will be much lower than this recorded value and hence we believe suburban area is ideal for the project.

The area of assessment is located in a quiet environment, we were not engaged to conduct a background noise assessment using loggers as we believe the existing LA90 levels of the area are low, and in fact would drag the PNTL results to artificially low levels. The proposed methodology in this case was to use the Amenity noise levels for day / evening and night, according to the type of area where the project and its critical receivers are located. We believe this criterion is conservative and adequate for the type of area in which the activity is located.

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

TYPE OF RECEIVER	INDICATIVE NOISE AMENITY AREA	PERIOD OF TIME	LAEQ 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

TYPE OF RECEIVER	INDICATIVE NOISE AMENITY AREA	PERIOD OF TIME	LAEQ dB(A)	AMENITY CRITERIA LAEQ dB(A) – 5 dB + 3 dB
		Night 22:00 to 7:00	40	38

5.3.2 DETERMINATION OF PROJECT SPECIFIC NOISE TRIGGER LEVEL (PNTL)

The project Noise trigger noise 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 5: EXTERNAL PROJECT NOISE TRIGGER LEVEL (PNTL) FOR OPERATION NOISE

LOCATION/ AFFECTED RECEIVER	TIME	DESCRIPTOR	EXTERNAL PNTL
Receiver 1 228 Green St, Ulladulla NSW 2539	0700 to 1800	$L_{Aeq, Day}$	53 dBA (Day) 43 dBA (Evening) 38 dBA (night)
	1800 to 2200	$L_{Aeq, Evening}$	
	2200 to 0700	$L_{Aeq, Night}$	
Receiver 2 28 Croft Ave, Ulladulla NSW 2539	0700 to 1800	$L_{Aeq, Day}$	
	1800 to 2200	$L_{Aeq, Evening}$	
	2200 to 0700	$L_{Aeq, Night}$	
Receiver 3 65 St Vincent St, Ulladulla NSW 2539	0700 to 1800	$L_{Aeq, Day}$	
	1800 to 2200	$L_{Aeq, Evening}$	
	2200 to 0700	$L_{Aeq, Night}$	

Notes:

- Other school buildings could be affected by these works. Other school buildings affected by noise from the activity should meet 45 dBA at façade.

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 project would be more than 3 weeks and therefore a quantitative method has been used for this assessment.

Table 6 sets 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 45 dBA in the daytime (suburban residential), the recommended noise management level during all aspects of the construction program is summarised in Table 6.

TABLE 6: NOISE AT AFFECTED USING QUANTITATIVE ASSESSMENT

RECOMMENDED HOURS	EXTERNAL NOISE MANAGEMENT LEVEL (NML) LAEQ,15MIN [dBA]	HOW TO APPLY
	Noise Affected 45 + 10=55 dB(A)	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
Recommended standard hours **Monday – Friday 7am to 6pm** **Saturday 8am to 1pm** **No work on Sundays or Public Holidays**	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.
Outside Recommended standard hours	40 dBA (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 7 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.

5.4.2 NOISE MANAGEMENT LEVELS

Noise Management Levels (NML) associated with the construction works on the project site are presented in Table 7.

TABLE 7: CONSTRUCTION NOISE MANAGEMENT LEVELS, $L_{EQ\ 15MIN}$

RECEIVERS	RECOMMENDED HOURS	PERIOD	RBL $LA90_{,15mins}$ [dBA]	EXTERNAL NOISE MANAGEMENT LEVEL [dBA]
All Sensitive Receivers (R1, R2, R3)	Day time (standard construction hours)	When in use	45 dBA	(45 + 10) = 55 dB(A) (Noise affected) 75 dB(A) (highly noise affected)

For other school building users, the below NML levels apply:

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)

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

5.4.3 CONSTRUCTION VIBRATION CRITERIA

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

1. Perceptibility of the occupants to the vibration and the possibility of them being disturbed or annoyed.
2. Vulnerability of the building structures to vibration induced damaged.
3. 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/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.*"

5.4.3.3 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 8 and illustrated in Figure 9.

TABLE 8: 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 8 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 8 may need to be reduced by up to 50% (refer to Line 3 in Figure 8).

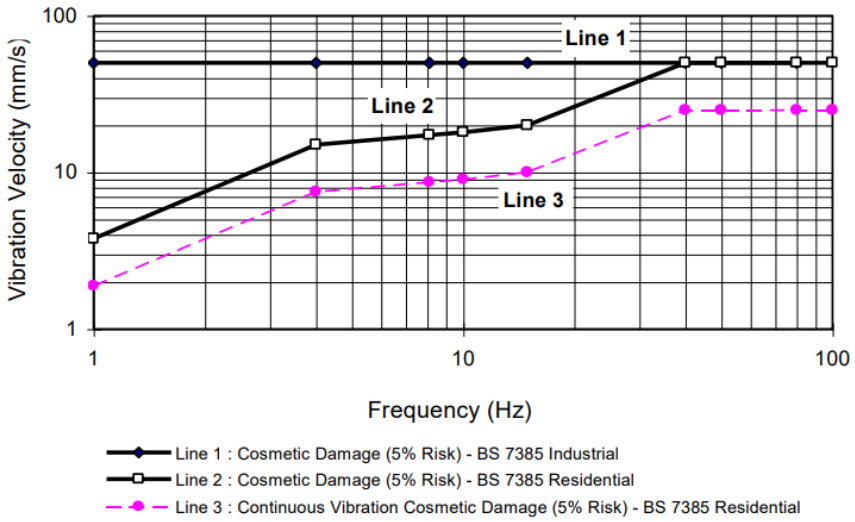

FIGURE 9 – BS 7385 PART 2 – 1993, GRAPH OF TRANSIENT VIBRATION VALUES FOR COSMETIC DAMAGES

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 8, 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 8 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 9 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 10: 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 listed in Table 11, are the criterion for the peak particle velocities measured on the uppermost full storey of any building not related to the site.

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 11: 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 project are NML levels (between 55 dBA and max. 75 dBA) for standard construction hours for the below sensitive receivers:

- Receiver 1: 228 Green St, Ulladulla NSW 2539
- Receiver 2: 28 Croft Ave, Ulladulla NSW 2539
- Receiver 3: 65 St Vincent St, Ulladulla NSW 2539

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.

Based on the NSW DECC Interim Construction Noise Guideline, this REF report will determine if a Construction noise and Vibration Management plan (CNVMP) is required, predicted construction noise and vibration levels are exceeding the above criteria in Section 7.

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 EMISSIONS FROM CARPARK

The project scope allows for expanding the capacity from 27 to 30 car spaces. This addition is negligible and is not expected to affect the current existing carpark noise impact.

6.2 NOISE EMISSIONS FROM SERVICES

6.2.1 MECHANICAL SERVICES

Upon interdisciplinary coordination, we understand that mechanical plant will be located on level one, between grids (F/G, 1/3). Plant will comprise outdoor condensers and fans (outside air, extraction air and toilet extraction air). Our updated calculations were based on the below:

- The plantroom is located approximately 30 m of residential receivers(Table 1).
- The plant would be expected to operate during daytime hours (7:00 am – 6:00 pm) with limited to no activities during evening time (6:00 pm to 10:00pm) and no activities during the nighttime. This will have to be confirmed by the project team.
- this updated assessment will consider the configuration as included in the NDY Mechanical set.

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

TABLE 12: SOUND LEVELS FOR MECHANICAL UNITS

EQUIPMENT	SOUND LEVELS SWL / SPL (dB) PER FREQUENCY BAND (HZ)								
	63	125	250	500	1000	2000	4000	8000	dBA
Total noise for VRF Outdoor Units (SPL at source)	89	86	85	82	75	73	71	67	83
Total noise from fans plant (SWL)	80	80	81	78	77	76	72	65	82

FIGURE 10: LOCATION FOR MECHANICAL PLANT IN NEW BUILDING

Based on the plant configuration above, the noise mitigation measures needed to meet the project PNTL and the required noise levels at the critical existing school buildings are listed below:

- ODU unit plant room surrounded by acoustic Louver type IAC SL100 or equivalent / as tall as the units.
- Fans GEF 001 / OAF 001 will have acoustic internal lining (50 mm thick) for both ends, min. 1m long.
- Fans GEF 002 / TEF 001 will have acoustic internal lining (50 mm thick) for both ends, min. 1.5 m long. TEF fan with acoustical flexible duct min. 0.5 m long.
- Any further changes to mechanical plant will require an updated acoustic assessment.

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 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 Building B which is estimated to be approximately 23m away from the mechanical plant.

TABLE 13: PLANTROOM ACOUSTIC LOUVERS FOR MECHANICAL PLANT

EQUIPMENT	MIN. INSERTION LOSSES (dB) PER FREQUENCY BAND (HZ)							
	63	125	250	500	1000	2000	4000	8000
Min. Insertion Loss from Acoustic Louvre (SL100 or equivalent)	5	4	5	6	9	13	14	13

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 lined ductwork, we predict that externally all PNTL levels will be met and internally the recommended internal noise levels as per AS / NZS 2107 can be achieved.

6.2.2 ELECTRICAL SERVICES

As per NDY electrical design, it Is proposed to introduce a 500kVA substation as shown in Figure 11. The closest sensitive receiver identified was 105 Camden St located around 35m from the proposed location.

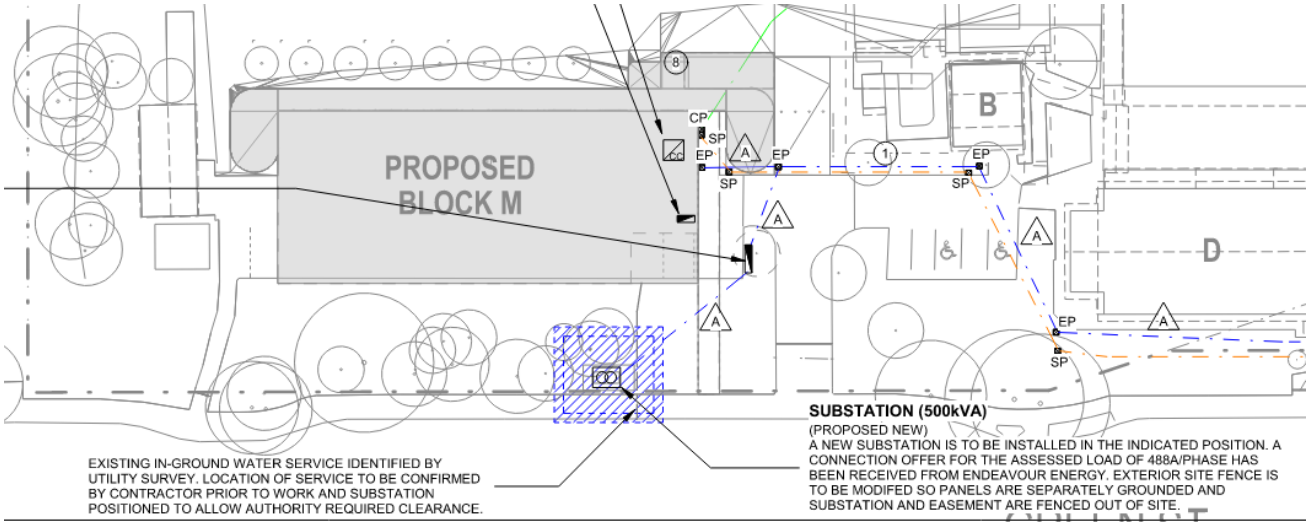

FIGURE 11: PROPOSED LOCATION FOR SUBSTATION

Sound data was not available for the substation at the time of this report; however, we have utilized sound data for a 750kVA substation used in a previous project of similar nature which had a noise level of 58 dBA (SWL). For a conservative approach we have assessed using a higher sound power level of 60 dBA which when propagated into the closest receiver meets all the project PNTL levels.

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 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 project 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 for the project 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 / fitout 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
- Note: any after hours construction will have to put in place a Construction Noise and Vibration Management Plan.

7.1 CONSTRUCTION PLANT NOISE LEVELS

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

TABLE 14 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 & Fitout 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 15 PREDICTED CONSTRUCTION NOISE $L_{EQ,15MIN}$

RECEIVERS	RECOMMENDED HOURS	PERIOD	PREDICTED CONSTRUCTION NOISE LEVEL	EXTERNAL NOISE MANAGEMENT LEVEL
Excavation and Demolition Phase				
Receiver 1	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	70 dB(A)	55 dB(A) (noise affected) 75dB(A) (highly noise affected)
Receiver 2			70 dB(A)	
Receiver 3			53 dB(A)	
Structural Phase				
Receiver 1	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			72 dB(A)	
Receiver 3			55 dB(A)	
Construction & Fitout Works Phase				
Receiver 1	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	73 dB(A)	55 dB(A) (noise affected) 75dB(A) (highly noise affected)
Receiver 2			73 dB(A)	
Receiver 3			57 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.				

Notes:

- Construction site is large and not all machinery is expected to be located at the same distance when assessing to a particular boundary.
- 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.

7.2.1 PREDICTED CONSTRUCTION NOISE INSIDE THE SCHOOL

For excavation and piling phases, it will be required a construction perimeter hoarding to protect buildings 1, D, B, D10444 and D14486. The perimeter hoarding needs to ensure the noise levels at the existing school building's façade do not exceed the criteria depicted in this report (55 dBA at the existing school building's facade).

The indicative extent of this perimeter barrier is shown in picture below:

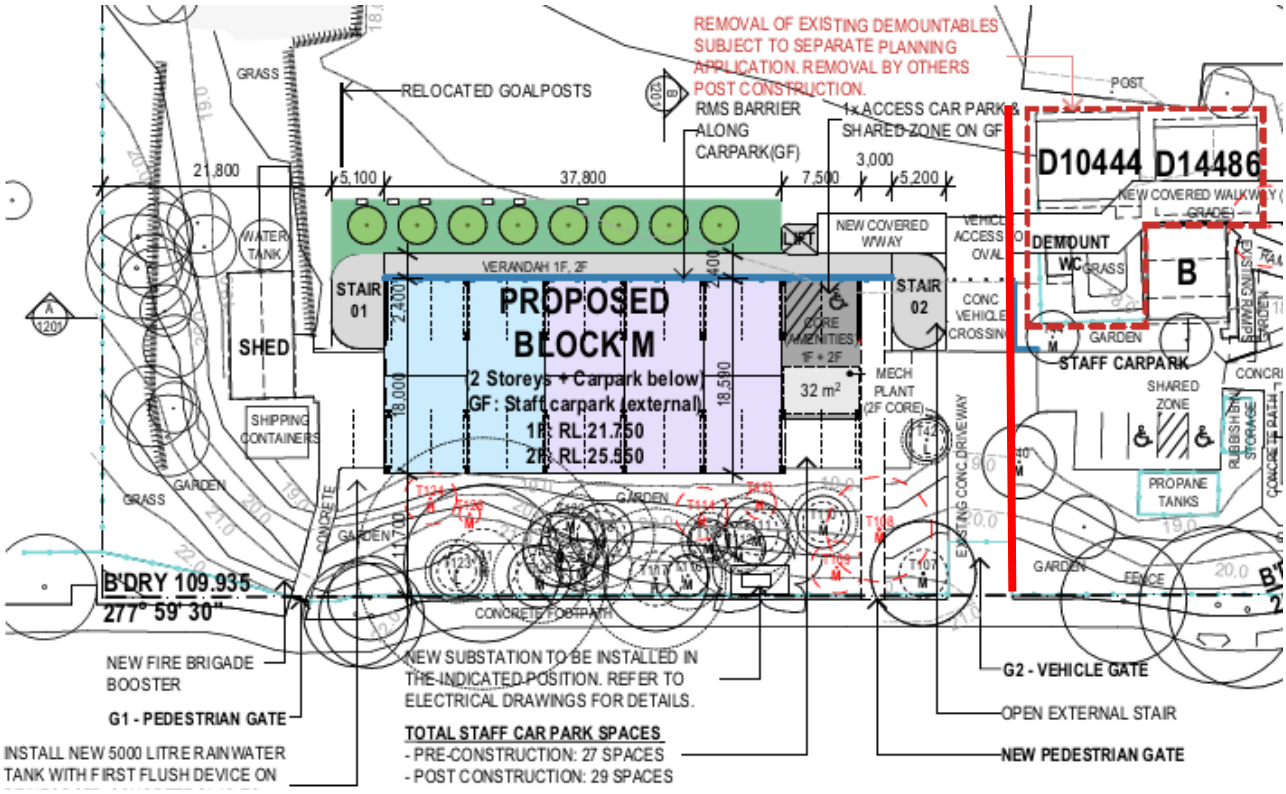

FIGURE 12: PROPOSED INDICATIVE LOCATION FOR PERIMETER HOARDING

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 project, 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 JK Geotechnics in their report '36216BTrpt1 Draft', the residual soils predominantly comprised of silty clay based on which 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 16. 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 16 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 ground borne vibration arising from mechanized construction works of the BS 5228 – 2.2009-part II Vibration.

TABLE 17 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 R1 and 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 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 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:

- For any extended construction hours, a CNVMP will be required.
- 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
- Build the perimeter hoarding so it ensures that the noise at the façade of existing school building meet the criteria.

8 CONCLUSIONS

The current noise and vibration assessment considers that the proposed project located on 241 Green Street, Ulladulla NSW 2539, is acceptable from a noise / vibration perspective according to the state and local regulations. The following summarises the findings of our assessment:

TABLE 18 MITIGATION MEASURES

PROJECT STAGE*	MITIGATION MEASURES	REASON FOR MITIGATION MEASURE	SECTION OF REPORT
D	Acoustic louvers installed surrounding mechanical plant and fans to have internally lined ducts with acoustic insulation.	To avoid impacts resulting from the plant room operation.	Section 6.3.1
O	Mechanical plant room to have limited operation during evening periods and no operation during night time periods (after 10 pm).	To meet the PNTL levels at night time.	Section 6.3.1
C	Construction noise for excavation and piling will require a perimeter hoarding as indicated to meet recommended noise levels inside nearest school building. Any out of hours construction activities will need a CNVMP.	To protect existing school buildings from construction noise.	Section 7.2

*Note: Project stages include: (D) Design, (C) Construction, (O) Operation

9 EVALUATION OF ENVIRONMENTAL IMPACTS

- The extent and nature of potential impacts are low and will not have significant impact on the locality, community and/or the environment.
- Potential impacts can be appropriately mitigated or managed to ensure that there is minimal impact on the locality, community and/or the environment.

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

To find out more about NDY go to **ndy.com** or follow us on LinkedIn