Northern Rivers Flood Recovery - Richmond River High Campus Redevelopment

Noise & Vibration Assessment Report

NSW Department of Education
105 Phillip Street
Parramatta NSW 2150

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1 INTRODUCTION

1.1 Proponent

The Department of Education (DoE) is the proponent and determining authority pursuant to Section 5.1 of the Environmental Planning and Assessment Act 1979 (the Act). The activity will be determined by the Reconstruction Authority (RA) under the Ministerial powers in Section 68 of the NSW Reconstruction Authority Act 2022 (RA Act).

1.2 Introduction

This Noise & Vibration Assessment Report has been prepared to support a Review of Environmental Factors (REF) for the rebuild of Richmond River High Campus (the activity) (RRHC). The REF has been prepared to support an approval for the RRHC development under Section 68 of the NSW Reconstruction Authority Act 2022 (RA Act).

The purpose of this report is to discuss the findings obtained from the acoustic assessment. This assessment addresses the impacts from typical operational activities. The report also discusses preliminary measures aimed at minimising any possible acoustic impact from construction activities.

A list of acoustic terminology used in this report is included in Appendix A of this report.

1.3 Site Description

The site is located at Dunoon Road, North Lismore, also known as 163 and 170 Alexandra Parade, North Lismore. The site comprises of three separate lots, located to the north of Alexandra Parade, with Dunoon Road running parallel to the eastern boundary of the site.

The site is legally described as:

- Lot 1 DP 539012
- Lot 2 DP 539012
- Lot 1 DP 376007

The site area is approximately 33.53 hectares. The proposed activity will be undertaken mainly within the southeastern portion of the site. The site is outlined in Figure 1.

Figure 1 Aerial image of site (source: Nearmap)

1.4 Proposed Activity Description

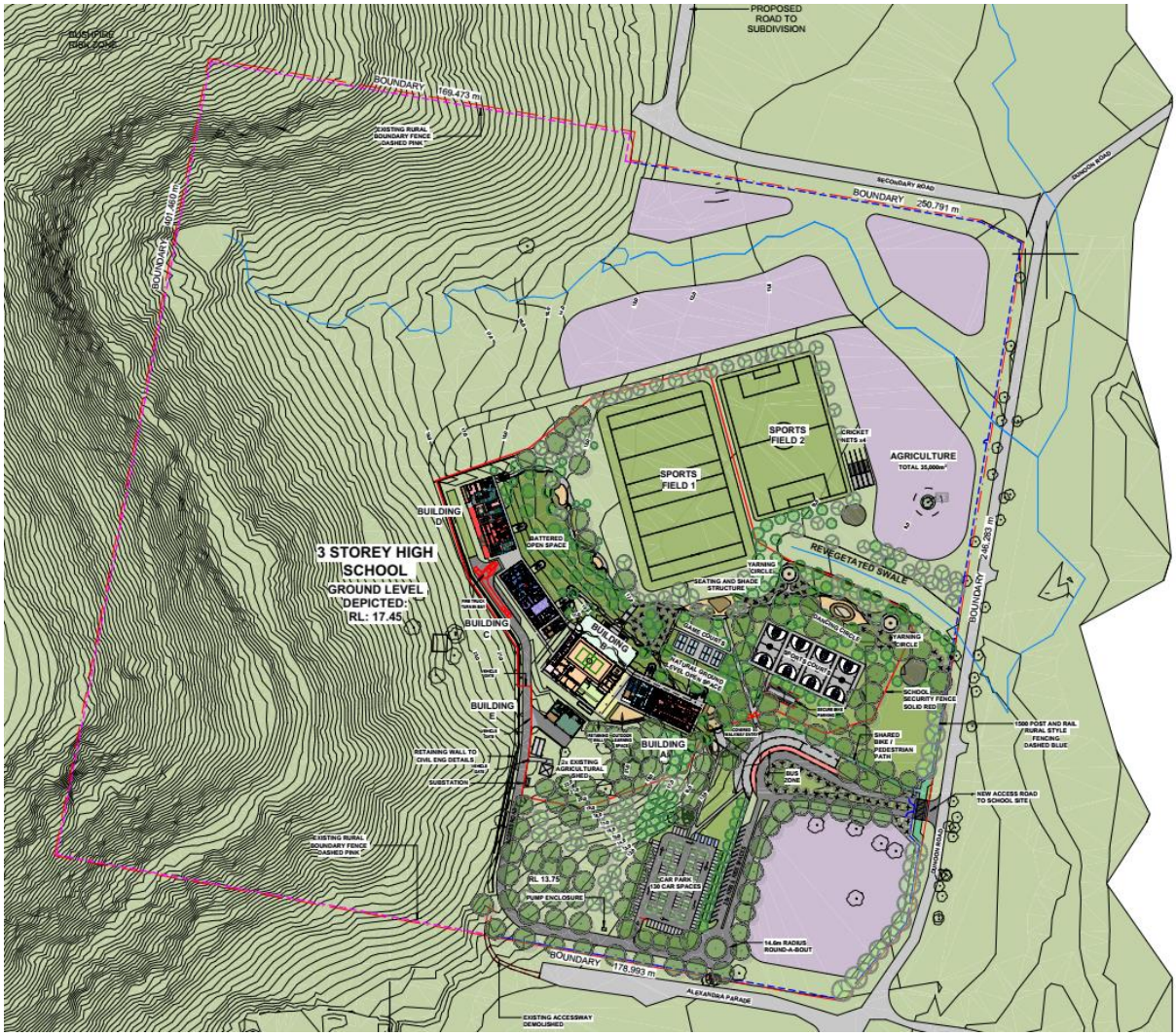
The proposed activity comprises the relocation and rebuild of the Richmond River High Campus from its existing temporary location alongside The Rivers Secondary College Lismore High Campus at East Lismore to the site at 163 and 170 Alexandra Parade, North Lismore.

The school proposal will be delivered in one stage. A detailed description of the proposal is as follows:

- Demolition of existing features including existing buildings, cattle drinking well, cattle sheds, and wire fencing, and removal of trees to accommodate school development.
- Construction of a new 3 storey building on the southeastern portion of the site for the proposed public secondary school including:
    - General and Specialist Learning Spaces and Workshops
    - Administration and Staff facilities,
    - Library, Hall and Movement Studio
    - Construction, Hospitality and Agricultural Learning Facilities
    - Amenity, Plant, Circulation and Storage areas
    - Outdoor Learning Spaces and play spaces
- Landscaping including tree planting.
- Public domain works comprising:
    - Access road off Dunoon Road, comprising a separate shared bicycle/pedestrian pathway, and internal access roundabout.
    - Kiss and ride drop-off and pick up zones.
    - Bus transport arrangements with a separate bus zone.
- Outdoor spaces including assembly zones, agricultural spaces, sports fields, games courts, dancing circles, yarning and dancing circles, seating and shade structures.
- On-site carparking, including accessible spaces and provision for EV charging spaces.

Figure 2 below show the scope of works.

Figure 2 Overall site context plan (source: EJE Architecture)



1.5 Operational Conditions

The school timetable proposed for the new RRHC is shown in Figure 3. This timetable summarises the typical operational hours for the school. Areas which are likely to be used outside of school hours are the library, theatre and school hall.

The proposed maximum student capacity of the new RRHC is 660 students, with 66 staff. These figures are obtained from report titled *"Northern Rivers Flood Recovery - Richmond River High Campus, Transport and Accessibility Impact Assessment"* (dated 19 June 2025, issued by Crossley Transport Planning).

Figure 3 Proposed school timetable

Monday		Tuesday		Wednesday		Thursday		Friday	
1	8:30	1	8:30	1	8:30	1	8:30	1	8:30
warning bell	9:07	warning bell	9:07	warning bell	9:07	warning bell	9:07	warning bell	9:07
Year Meetings 9:10-9:20		Year Meetings 9:10-9:20		Year Meetings 9:10-9:20		Year Meetings 9:10-9:20		Year Meetings 9:10-9:20	
2	9:20	2	9:20	2 SPORT	9:20	2	9:20	2	9:20
3	10.10	3	10.10	3 SPORT	10.10	3	10.10	3	10.10
RECESS	11:00	RECESS	11:00	RECESS	11:00	RECESS	11:00	RECESS	11:00
warning bell	11:17	warning bell	11:17	warning bell	11:17	warning bell	11:17	warning bell	11:17
4	11:20	4	11:20	4	11:20	4	11:20	4	11:20
5	12:10	5	12:10	5	12:10	5	12:10	5	12:10
LUNCH 1	1:00	LUNCH 1	1.00	LUNCH 1	1.00	LUNCH 1	1.00	LUNCH 1	1.00
LUNCH 2	1:20	LUNCH 2	1:20	LUNCH 2	1:20	LUNCH 2	1:20	LUNCH 2	1:20
warning bell	1:37	warning bell	1:37	warning bell	1:37	warning bell	1:37	warning bell	1:37
6	1:40	6	1:40	6	1:40	6	1:40	6	1:40
7	2:30	7	2:30	7	2:30	7	2:30	7	2:30
HOME	3:15	HOME	3:15	HOME	3:15	HOME	3:15	HOME	3:15

1.6 Site Layout

The site layout and land zoning around the RRHC site are defined in Figure 4. From this information, we note the project site is currently surrounded by nearest impacted receivers:

- Rural residential properties located at approximately 36m north-east from the project site, along Dunoon Road.
- Rural residential properties located at approximately 35m south-east from the project site. These properties are situated in the intersection of Alexandra Parade, Dunoon Road and Tweed Street.
- Active recreation areas (mostly comprising the Lismore Speedway and Lismore Kart Racing Club), located at approximately 38m east of the site boundary, along Dunoon Road.
- Commercial property (i.e. Lismore Saleyards) located across Alexandra Parade, approximately 30m south from site boundary.
- Industrial property located at approximately 66m from southern site boundary.
- Land allocated for environmental conservation. This is categorised as passive recreation areas. This is located along the western and north-western site boundaries.

Some rural properties are allocated as part of the urban release for the North Lismore Plateau. This land is located along the northern site boundary at its closest approach to the RRHC; and extends towards the west. We note this land will include residential zones and passive recreation areas.

This land includes the following residential developments:

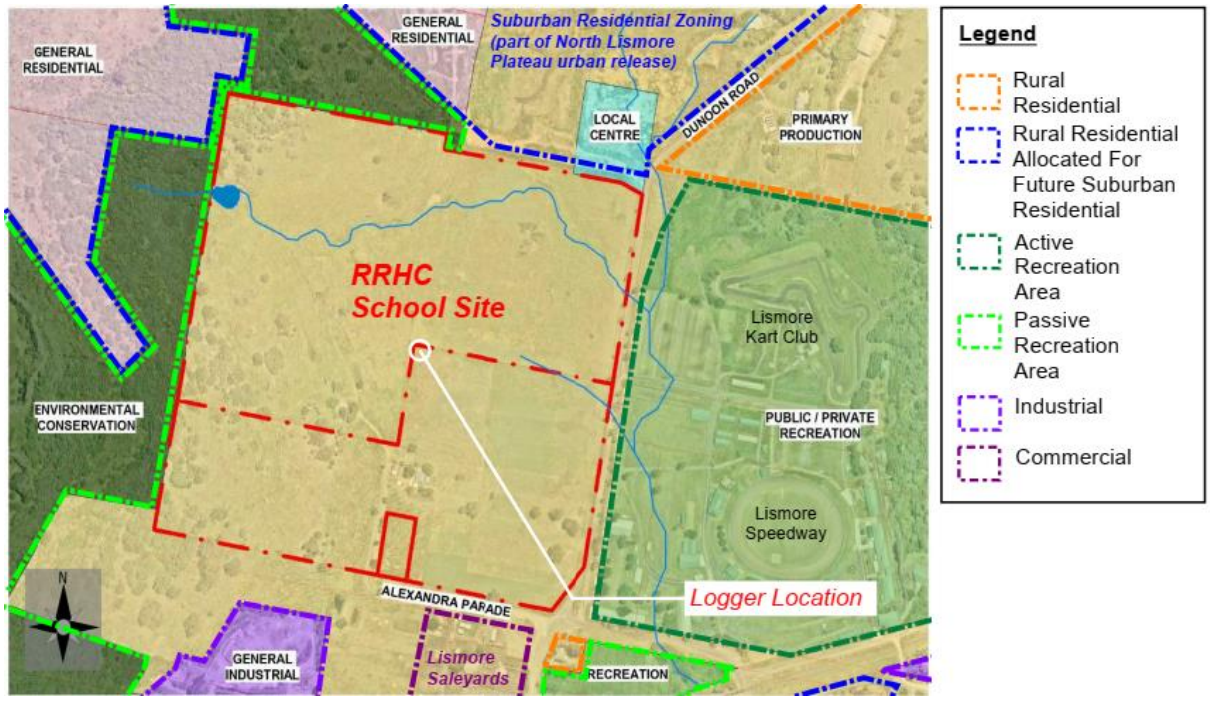
- Lot 3 DP 808657, 55 Dunoon Road, North Lismore; and Lot 2 DP 1214953, 8 Sexton Road. North Lismore. Consent conditions for this development are provided in development application number 5.2020.462.1, issued by Lismore City Council.

- Allura Parkland Estate, Dunoon Road, North Lismore. The environmental management plan for this development is discussed in report titled *"North Lismore Plateau, Environmental Management Plan"* (dated April 2024, prepared by Australian Wetlands Consulting Pty Ltd). A separate noise impact assessment report is also issued for the development, this is titled *"Allura Parklands Estate, Noise Impact Assessment, Dunoon Road, North Lismore NSW 2480"* (dated 22 May 2024, authored by ENV Services).

We expect the existing ambient noise levels will increase once these developments are completed. Hence, for the purpose of our cumulative noise assessment, this land is classified as suburban residential.

Finally, we note existing residential buildings located within the project site, will be acquired as part of the RRHC site. It is expected that these residences will be vacant during construction stage.

Figure 4 Site layout



1.7 Events at Lismore Kart Club & Lismore Speedway

As discussed in Section 1.6, the Lismore Kart Club and Lismore Speedway are located east from the project site, along Dunoon Road.

Table 1 summarises typical events that are conducted at the Lismore Kart Club and Lismore Speedway. These events are listed for years 2024 and 2025. As noted from Table 1, we find the following:

- In relation to Lismore Kart Club, all events are conducted during weekends. That is, these events are held outside RRHC's operational hours.

- Regarding Lismore Speedway, most events are conducted during weekends or school holiday periods. Only one event is held during weekdays: practice runs (i.e. Friday 1 November 2024). However, these are undertaken between 6:00pm and 10:00pm. Therefore, we find all events are held outside RRHC's operational hours.

Table 1 Typical events at Lismore Kart Club and Lismore Speedway

Calendar	2024 - 2025 Dates & Events
Lismore Kart Club - calendar	Saturday 17 - Sunday 18 February 2024: Club meeting, 4SS city/country series round 1 Sunday 24 March 2024: Club meeting Sunday 28 April 2024: Club meeting Saturday 22 – Sunday 23 June 2024: Lismore young guns Sunday 25 August 2024: Club meeting Sunday 22 September 2024: Club meeting Sunday 3 November 2024: Club meeting Saturday 30 November 2024: Club meeting
Lismore Speedway - calendar	Friday 1 November 2024: Practice runs. These are conducted between 6:00pm and 10:00pm Saturday 2 November 2024: Fan appreciation day, V8 dirt modifieds, wingless sprints, RSA sedans, AMCA Nationals, junior sedans Saturday 16 November 2024: 410 sprintcars, 360 LS sprintcars, wingless sprints, production sedans, compact speedcars Thursday 26 December 2024: V8 dirt modifieds, wingless sprints, RSA sedans, AMCA Nationals, junior sedans Wednesday 8 January 2025: 410 sprintcars, 360 LS sprintcars, wingless sprints, production sedans, compact speedcars Saturday 11 January 2025: Modified sedans, modlites, AMCA Nationals, Monster trucks Saturday 15 February 2025: Speedcars, wingless sprints, RSA sedans, AMCA Nationals, junior sedans Saturday 1 March 2025: 410 sprintcars, 360 LS sprintcars, production sedans, junior sedans Saturday 15 March 2025: Modified sedans, V8 dirt modifieds, RSA sedans, junior sedans Saturday 5 April 2025: Super sedans, late models, production sedans, modlites, junior sedans Saturday 19 – Sunday 20 April 2025: V8 dirt modifieds, wingless sprints, AMCA Nationals, production sedans, RSA sedans Saturday 3 May 2025: Speedcars, AMCA Nationals, V8 dirt modifieds, junior sedans Saturday 7 – Sunday 8 June 2025: Wingless sprints, AMCA Nationals, RSA street stockers, production sedans, legend cars, junior sedans Saturday 21 June 2025: Speedway awards night

Notes

1. Dates indicated with light blue font, are found within school holiday periods

2 EXISTING ACOUSTIC ENVIRONMENT

2.1 Unattended Noise Monitoring

To determine the existing ambient noise levels on site, unattended noise measurements were conducted between Saturday 24 August and Thursday 29 August 2024. The measurements were undertaken at the logger location shown in Figure 4. Measurements at this location are representative of existing ambient noise levels and façade incident noise levels impacting the future RRHC school buildings. The instrumentation used for the survey was a Ngara noise logger (serial number 87826E)

Calibration of all noise loggers was checked prior to and following measurements using a Bruel & Kjaer Type 4230 sound calibrator (serial number 1275644). The calibrator emitted a calibration tone of 94 dB at 1 KHz. The drift in calibration did not exceed ±0.5 dB. All equipment carries appropriate and current NATA (or manufacturer) calibration certificates.

Charts presenting summaries of the measured daily noise data are attached in Appendix B. The charts present each 24 hour period and show the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15 minute periods. This data has been filtered to remove periods affected by adverse weather conditions, based on weather information obtained from Lismore Airport AWS weather station (ID 058214).

2.2 Noise Descriptors & Terminology

Environmental noise constantly varies in level with time. Therefore, it is necessary to measure environmental noise in terms of quantifiable time periods and statistical descriptors. Typically, environmental noise is measured over 15 minute periods and relevant statistical descriptors of the fluctuating noise are determined to quantify the measured level.

Noise (or sound) consists of minute fluctuations in atmospheric pressure capable of detection by human hearing. Noise levels are expressed in terms of decibels, abbreviated as dB or dBA, the "A" indicating that the noise levels have been frequency weighted to approximate the characteristics of normal human hearing. Because noise is measured using a logarithmic scale, 'normal' arithmetic does not apply, e.g. adding two sound sources of equal values result in an increase of 3dB (i.e. 60 dBA plus 60 dBA results in 63 dBA). A change of 1 dB or 2 dB in the sound level is difficult for most people to detect, whilst a 3 dB – 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change roughly corresponds to a doubling or halving in loudness.

The most relevant environmental noise descriptors are the L_{Aeq}, L_{A1}, L_{A10} and L_{A90} noise levels. The L_{Aeq} noise level represents the "equivalent energy average noise level". This parameter is derived by integrating the noise level measured over the measurement period. It represents the level that the fluctuating noise with the same acoustic energy would be if it were constant over the measured time period.

The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample period. These levels can be considered as the maximum noise level, the average repeatable maximum and average repeatable minimum noise levels, respectively.

Specific acoustic terminology is used in this assessment report. An explanation of common acoustic terms is included as Appendix A.

2.3 Noise Monitoring Results

The noise levels measured at the logger location have been used to assess the noise impact of the development to the nearest noise affected receivers identified in Section 1.6. The time periods used are in accordance with those recommended in the NSW Noise Policy for Industry (NSW NPI). The measurement results are presented in Table 2 below.

Table 2 Measured ambient noise levels in accordance with the NSW NPI

Measurement Location	Daytime 7:00 am to 6:00 pm		Evening 6:00 pm to 10:00 pm		Night Time 10:00 pm to 7:00 am	
	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}
Logger Location	33 dBA	47 dBA	33 dBA	48 dBA	23 dBA	39 dBA

Notes:

1. *For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am*
2. *The L_{A90} noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level*
3. *The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.*

3 OPERATIONAL ACOUSTIC CRITERIA

3.1 NSW Noise Policy for Industry

In NSW, the control of noise emissions is the responsibility of Local Governments and the NSW Environment Protection Authority (NSW EPA).

Consequently, the NSW EPA has prepared a document titled Noise Policy for Industry (NSW NPI) which provides a framework and process for determining external noise criteria and subsequent assessments. The NSW NPI criteria for industrial noise sources have two components:

- Controlling the intrusive noise impacts for residents and other noise sensitive receivers in the short term; and
- Maintaining noise level amenity of particular land uses for residents and sensitive receivers in other land uses.

3.1.1 Intrusive Noise Impacts (Residential Receivers)

The NSW NPI states that the noise from any single source should not intrude greatly above the prevailing background noise level. Industrial noises are generally considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (L_{Aeq}), measured over a 15 minutes period, does not exceed the background noise level measured in the absence of the source by more than 5 dBA. This is often termed the Intrusiveness Criterion.

The 'Rating Background Level' (RBL) is the background noise level to be used for assessment purposes and is determined by the methods given in the NSW NPI. Using the rating background noise level approach results in the intrusiveness criterion being met for 90% of the time. Adjustments are to be applied to the level of noise produced by the source that is received at the assessment point where the noise source contains annoying characteristics such as tonality or impulsiveness.

3.1.2 Protecting Noise Amenity (All Receivers)

To limit continuing increase in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW NPI. That is, the ambient L_{Aeq} noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the 'Background Creep' or Amenity Criterion.

The amenity assessment is based on noise criteria specified for a particular land use and corresponding sensitivity to noise. The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. These criteria relate only to other continuous industrial-type noise and do not include road, rail or community noise. If the existing (measured) industrial-type noise level approaches the criterion value, then the NSW NPI sets maximum noise emission levels from new sources with the objective of ensuring that the cumulative levels do not significantly exceed the criterion.

3.1.3 Area Classification

We note the L_{A90} noise levels measured on site (refer to Table 2), concur with the RBL values listed in Table 3 for rural residential properties. These RBL values and corresponding receiver definitions in Table 3, are obtained from Table 2.3 of the NSW NPI.

Therefore, for our acoustic assessment, the residential properties around the project site are classified as rural residential.

Finally, based on the information discussed above, the recommended amenity criteria for residential and non-residential receivers, are shown in Table 3 below.

Table 3 Definition for residential receiver categories

Receiver Category	Typical Planning Zoning – Standard Instrument	Typical Existing Background Noise Levels	Description
Rural	RU1 – primary production RU2 – rural landscape RU4 – primary production, small lots R5 – large lot residential E4 – environmental living	Daytime RBL< 40 dBA Evening RBL < 35 dBA Night RBL < 30 dBA	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.

Table 4 NSW NPI – Recommended L_{Aeq} noise levels from industrial noise sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level ($L_{Aeq, period}$)[2]
Residences Along Dunoon Road Intersection of Alexandra Parade, Dunoon Road and Tweed Street	Rural	Day	50
		Evening	45
		Night	40
Active recreation areas Lismore Speedway Lismore Kart Racing Club	All	When in use	55
Passive recreation areas Environmental conservation zones	All	When in use	50
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70

Notes

1. *For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am*
2. *The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.*

3.1.4 Project Trigger Noise Levels

The intrusive and amenity criteria for industrial noise emissions derived from the measured data are presented in Table 5. These criteria are nominated for the purpose of determining the operational noise limits for mechanical plant associated with the school development, to potentially affected noise sensitive receivers.

For each assessment period, the lower (i.e. the more stringent) of the amenity or intrusive criteria are adopted. These are shown in bold text in Table 5.

Table 5 External noise level criteria in accordance with the NSW NPI

Location	Time of Day	Project Amenity Noise Level, $L_{Aeq, period}$ [1] (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [2] (dBA)	Measured $L_{Aeq, period}$ Noise Level (dBA)	Intrusive $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)	Amenity $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA) [4]
Rural residences Along Dunoon Road Intersection of Alexandra Parade, Dunoon Road and Tweed Street	Day	45	35 [5]	47	**40** [5]	48
	Evening	40	33	48	**38**	43
	Night	35	30 [5]	39	**35** [5]	38
Active recreation areas Lismore Speedway Lismore Kart Racing Club	When in use	50	-	47	-	**53**
Passive recreation areas Environmental conservation zones	When in use	45	-	47	-	**48**
Commercial premises	When in use	60	-	47	-	**63**
Industrial premises	When in use	65	-	47	-	**68**

Note 1: Project Amenity Noise Levels corresponding to "rural" areas, equivalent to the Recommended Amenity Noise Levels (Table 4) minus 5 dBA
Note 2: L_{A90} Background Noise or Rating Background Level
Note 3: Project Noise Trigger Levels are shown in bold
Note 4: This is based on the assumption that the existing noise levels are unlikely to decrease in the future
Note 5: Minimum project intrusiveness noise level as per Table 2.1 of the NSW NPI

3.1.5 Sleep Disturbance

In accordance with the NSW NPI, sleep disturbance is to be assessed in two stages addressing the likelihood of sleep disturbance and sleep awakening.

For the criterion addressing the likelihood of sleep disturbance, the NSW NPI recommends that the maximum noise level event should not exceed the following:

- 40 dB $L_{Aeq, 15\ minutes}$ or the prevailing RBL plus 5 dB, whichever is the greater; and / or
- 52 dB L_{AFmax} or the prevailing RBL plus 15 dB, whichever is the greater

As a result, the criteria for the likelihood of sleep disturbance at all residences, are summarised in Table 6.

Table 6 Criteria for the likelihood of sleep disturbance

Residential Receiver	Criteria for the Likelihood of Sleep Disturbance
Rural residences: Along Dunoon Road Intersection of Alexandra Parade, Dunoon Road and Tweed Street	40 dB $L_{Aeq, 15\ minutes}$ 52 dB L_{AFmax}

Regarding sleep awakening, ongoing research is still being undertaken to quantify an appropriate criterion. The NSW Road Noise Policy (NSW RNP) provides guidelines and a summary of current research being undertaken on this topic. According to the NSW RNP, an accurate representation of sleep disturbance impacts on a community from a noise source is particularly difficult to quantify mainly due to differing responses of individuals to sleep disturbance – this is found even within a single subject monitored at different stages of a single night's sleep or during different periods of sleep.

In addition, the differing grades of sleep state make a definitive definition difficult, and even where sleep disturbance is not noted by the subject, factors such as heart rate, mood and performance can still be negatively affected.

An assessment of sleep disturbance should consider the maximum noise level or $L_{A1(1\ minute)}$, and the extent to which the maximum noise level exceeds the background level and the number of times this may happen during the night-time period. Factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur;
- Time of day (normally between 10.00pm and 7.00am); and
- Whether there are times of day when there is a clear change in the existing noise environment (such as during early morning shoulder periods).

Currently the information relating to sleep disturbance impacts indicates that:

- Maximum internal noise levels below 50–55 dBA are unlikely to cause an awakening from a sleep state.
- One or two noise events per night with maximum internal noise levels of 65–70 dBA are not likely to affect health and wellbeing significantly.

As a result, the adopted sleep awakening criterion for the project is an internal noise level of 50 - 55 dB L_{AFmax}. This criterion is applicable for noise emissions generated by short term events occurring during the night time period. Therefore, allowing for a 10 dB noise reduction for open windows, it is proposed that the noise screening criterion for sleep awakening should be 60 - 65 dB L_{AFmax} external noise level at residential properties.

3.1.6 Emergency Plant / Infrequent Operational Activities

For emergency plant (such as stand-by generators) or activities which are conducted infrequently, such as waste collection; the NSW NPI allows for modifying factors that can be subtracted from the predicted noise levels. These modifying factors should be applied prior to assessing against the external noise level criteria. These duration modifying factors are summarised in Table 7 below.

Under the assumption that each waste collection event has a duration of between 15 minutes to 1 hour, and there is only one such event in a 24 hour period, then a modifying factor of 5 dB can be applied to the predicted noise levels. Alternatively, the modifying factor can be added to the relevant criterion (as a leniency factor) prior to the assessment.

Table 7 Modifying factors for duration

Allowable Duration of Noise (one event in any 24 hour period)	Allowable Exceedance at Receiver for the Period of Noise Event	
	Daytime and Evening (7am – 10pm)	Night time (10pm – 7am)
1 to 2.5 hours	2	Nil
15 minutes to 1 hour	5	Nil
6 minutes to 15 minutes	7	2
1.5 minutes to 6 minutes	15	5
Less than 1.5 minutes	20	10

Note: Where the duration of the noise event is smaller than the duration of the project trigger noise level (PNTL), that is, less than 15 minutes, the allowable adjusted project noise trigger level (APNTL) is derived as follows:

$$APNTL = 10\log((10^{\frac{PNTL}{10}}\ x\ (\frac{900 - duration}{900})) + (10^{\frac{PNTL+allowable\ exceedance\ in\ table\ above}{10}}\ x\ duration))$$

3.2 Outdoor Noise Emissions (Play Areas & Multi-Purpose Hall)

No mandatory legislation is available which addresses external noise emission from communal halls, or outdoor gatherings (generally caused by student activities such as talking, playing, etc). However, the *"Guideline for Child Care Centre Acoustic Assessment"* (version 3.0, dated September 2020), issued by the Association of Australasian Acoustical Consultants (AAAC) provides guidance on how to assess similar activities to a primary school.

For outdoor play areas that have the potential to impact on residential receivers the guideline states:

> *The noise impact from children at play in a childcare centre differs from the domestic situation in that it is a business carried out for commercial gain, the number of children can be far greater than in a domestic situation and the age range of the children at the centre does not significantly vary over time as it would in a domestic situation. However, the noise from children is vastly different, in both character and duration, from industrial, commercial or even domestic machine noise. The sound from children at play, in some circumstances, can be pleasant, with noise emission generally only audible during the times the children play outside. Night-time, weekend or public holiday activity is not typical and childcare centres have considerable social and community benefit.*
>
> ***Base Criteria*** *– With the development of childcare centres in residential areas, the background noise level within these areas can at certain times, be low. Thus, a base criterion of a contributed $L_{eq,15min}$ 45 dB(A) for the assessment of outdoor play is recommended in locations where the background noise level is less than 40 dB(A).*
>
> ***Background Greater Than 40 dB(A)*** *– The contributed $L_{eq,15min}$ noise level emitted from an outdoor play and internal activity areas shall not exceed the background noise level by more than 5 or 10 dB at the assessment location, depending on the usage of the outdoor play area. AAAC members regard that a total time limit of approximately 2 hours outdoor play per morning and afternoon period should allow an emergence above the background of 10 dB (i.e. background +10 dB if outdoor play is limited to 2 hours in the morning and 2 hours in the afternoon).*
>
> ***Up to 4 hours (total) per day*** *– If outdoor play is limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed $L_{eq,15\ minute}$ noise level emitted from the outdoor play shall not exceed the background noise level by more than 10 dB at the assessment location.*

More than 4 hours (total) per day *– If outdoor play is not limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed $L_{eq,15\ minute}$ noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5 dB at the assessment location.*

- *The assessment location is defined as the most affected point on or within any residential receiver property boundary. Examples of this location may be: 1.5 m above ground level;*
- *On a balcony at 1.5 m above floor level;*
- *Outside a window on the ground or higher floors*

Although the guideline is intended for childcare centres, we are of the opinion that assessing noise from children at play based on the NSW NPI criteria is overly restrictive. This type of noise emissions is different in both character and duration to that of industrial, commercial or even machine noise emissions. For example, noise generated by students playing is intermittent in character, as noise from mechanical services is typically constant.

Based on noise measurement results discussed in Section 2; the noise targets summarised in Table 8 are adopted for the assessment of noise emissions by children at play in outdoor areas and inside the multi-purpose hall.

Table 8 Noise targets for assessment of noise emissions by children at play

Type of Receiver	Daytime Period 7:00 am – 6:00 pm (dB $L_{Aeq,\ 15\ minutes}$)	Evening Period 6:00 pm – 10:00 pm (dB $L_{Aeq,\ 15\ minutes}$)	Night time Period 10:00 pm – 12:00 am (dB $L_{Aeq,\ 15\ minutes}$)
Rural residences Along Dunoon Road Intersection of Alexandra Parade, Dunoon Road and Tweed Street	45	45	45
Suburban residences North Lismore Plateau urban release	47	45	45

It is noted that a noise target of 45 dB $L_{Aeq,\ 15\ minutes}$ is also adopted for the night-time period. This is consistent with the typically recommended external noise level of 45 dB L_{Aeq} outside a bedroom window. This is obtained by allowing a noise reduction of 10 dB for slightly open windows and a design noise level of 35 dB L_{Aeq} inside the bedroom (as per Table 1 of standard AS/NZS 2107:2016).

3.3 Noise Emissions from Carpark & Access Road

It is likely that all traffic activity related to the school development (i.e. transportation for students and parking within the school premises) will be produced by light vehicles. Additionally, buses will also be used for school transportation, with waste collection and services vehicles using the same access road.

Therefore, it is considered feasible to assess noise emissions from carpark and access road with reference to the NSW NPI. It is also expected that traffic movements are most likely to occur during distinct time periods, i.e. in the morning before school commences and again in the afternoon following the end of school hours. The NSW NPI criterion which is relevant for this assessment, is the daytime project specific noise level of 40 dB $L_{Aeq,\ 15\ minutes}$.

However, same residential receivers are also subject to a more lenient criterion discussed in Section 3.6 (i.e. 55 dB $L_{Aeq,\ 1\ hour}$). Therefore, the NSW NPI criterion can be exceeded provided noise emissions from the school development do not increase the overall external noise level from road traffic to levels higher than 55 dB $L_{Aeq,\ 1\ hour}$.

Therefore, noise emissions from carpark and access road, should not exceed **45 dB $L_{Aeq,\ 15\ minutes}$**.

3.4 Internal Noise Level Criteria

3.4.1 The State Environmental Planning Policy (Transport & Infrastructure) 2021

The State Environmental Planning Policy (Transport & Infrastructure) 2021 (referred in this report as the *T&I SEPP*) provides conditions for noise intrusion generated by road and rail traffic noise. The guidelines for the assessment of noise intrusion are discussed in the document prepared by the Department of Planning of the NSW Government and which is titled *"Developments Near Rail Corridors and Busy Roads – Interim Guideline"* (DNRC & BR-IG).

The DNRC & BR-IG applies to development adjacent to rail corridors and busy roads. It can also provide a useful guide for all development that may be impacted by, or may impact on, rail corridors or busy roads.

Chapter 2, Part 2.3, Sections 2.119 and 2.120 of the T&I SEPP, state the following regarding traffic noise or vehicle noise emissions:

2.119 Development with frontage to classified road

(2) The consent authority must not grant consent to development on land that has a frontage to a classified road unless it is satisfied that -

(c) The development is of a type that is not sensitive to traffic noise or vehicle emissions, or is appropriately located and designed, or includes measures, to ameliorate potential traffic noise or vehicle emissions within the site of the development arising from the adjacent classified road.

2.120 Impact of road noise or vibration on non-road development

(1) This section applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 20,000 vehicles (based on the traffic volume data published on the website of TfNSW) and that the consent authority considers is likely to be adversely affected by road noise or vibration:

(a) residential accommodation,

(b) a place of public worship,

(c) a hospital,

(d) an educational establishment or centre-based child care facility

(2) Before determining a development application for development to which this section applies, the consent authority must take into consideration any guidelines that are issued by the Planning Secretary for the purposes of this section and published in the Gazette.

(3) If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:

(a) In any bedroom in the residential accommodation—35 dBA at any time between 10 pm and 7 am,

(b) Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dBA at any time.

To address the requirements in clause (2) of condition 2.120, the following additional information is discussed:

- The DNRC & BR-IG (dated December 2008). This is further discussed in Section 3.4.2.

In accordance with clause (3) of condition 2.120, for the purpose of residential accommodation, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded (with windows and doors closed):

- In any bedroom in the building – 35 dB $L_{Aeq\ (9hour)}$ between 10:00 pm and 7:00 am
- Anywhere else in the building (other than a garage, kitchen, bathroom or hallway) – 40 dB L_{Aeq} at any time (i.e. $L_{Aeq\ (15hour)}$ and $L_{Aeq\ (9hour)}$).

However, we understand that the new RRHC is not to be used as residential accommodation. Therefore, these requirements do not apply. However, the internal noise level criteria are still required to be in accordance with the requirements discussed in Section 3.4.2 and 3.4.3.

3.4.2 Developments Near Rail Corridors and Busy Roads – Interim Guideline

As previously discussed, the DNRC & BR-IG has been developed to support specific rail and road acoustic provisions discussed in the T&I SEPP (i.e. condition 2.119 and 2.120).

Section 3.6.1 of the DNRC & BR-IG states that for educational institutions, including childcare centres, the road traffic noise assessment criterion is **40 dB $L_{Aeq\ (1\ hr)}$ for internal spaces when in use**. That criterion is interpreted as follows for the following for external areas immediately outside internal sensitive spaces:

- 50 dB $L_{Aeq\ (1\ hr)}$ based on a slightly open window or door
- 65 dB $L_{Aeq\ (1\ hr)}$ based on a non-openable window or door (assuming a noise reduction of 25 dB for such non-openable window or door).

3.4.3 Project Specific Requirements

Noise from air-conditioning plant and traffic noise intrusion are generally the principal contributors to the overall internal noise levels. It is important that an appropriate ambient noise level is established in an educational development.

A reduced level of ambient noise is required in certain spaces to achieve good communication throughout the space. A higher level of ambient noise is generally preferable in open plan spaces to ensure a moderate level of acoustic privacy between workstations. Too loud a background noise level may, however, lead to communication difficulties and fatigue.

The new school development is subject to the internal noise level requirements discussed in the Engineering Facilities Standards & Guidelines 2.0 (EFSG 2.0), issued by School Infrastructure NSW (SI NSW). However, certain departures from the EFSG 2.0 criteria have been submitted to SI NSW for approval.

In the interim we recommend that mechanical services should be designed to achieve overall compliance with the approved EFSG 2.0 criteria. This overall compliance should account for the intrusion of external noise sources such as local road traffic.

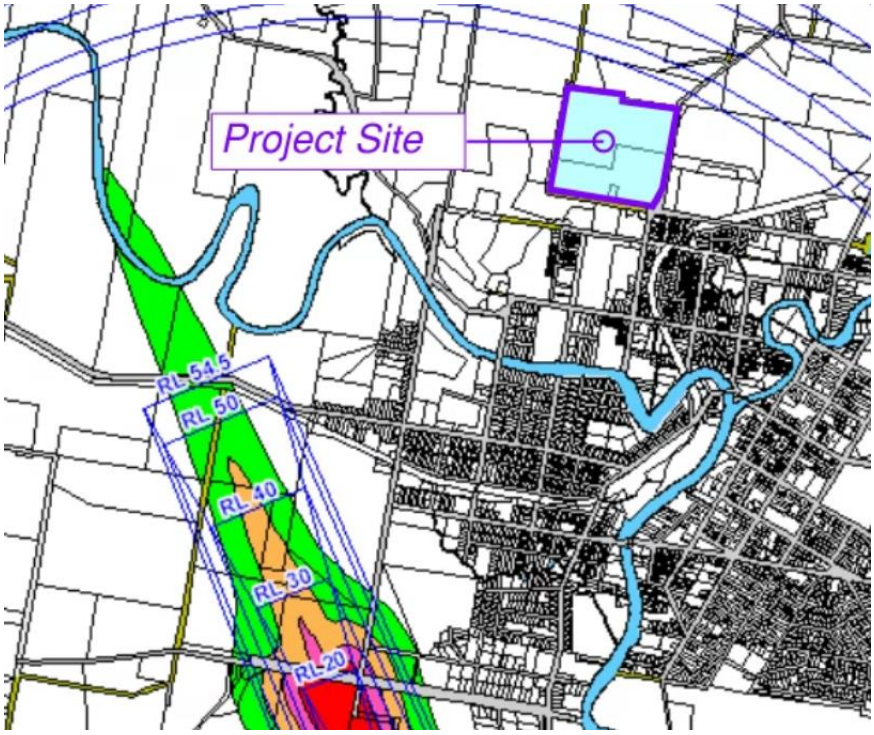
3.5 Aircraft Noise Intrusion

ANEF contours for Lismore Regional Airport are provided in document titled *"Lismore City Council – Lismore Development Control Plan"* (applying to land addressed in the Lismore Local Environmental Plan 2012, referred herein as the *Lismore DCP*). An extract of the ANEF contours is shown in Figure 5, with the project site indicated in this figure.

From Figure 5, we note that the project site will be exposed to less than an ANEF 20 noise contour. According to standard AS 2021:2015 *"Acoustics - Aircraft noise intrusion - Building siting and construction"*, the location of a school site is acceptable if it is in an area exposed to less than ANEF 20, and conditionally acceptable if it is within ANEF 20 and 25.

Therefore, we find the project site is within an acceptable zone for aircraft noise intrusion. As a result, the site does not require an aircraft noise intrusion assessment.

Figure 5 ANEF contour map for Lismore Regional Airport



3.6 Noise Impact On Local Roads

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW Road Noise Policy (NSW RNP) states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night-time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

Also, the NSW RNP recommends the criteria summarised in Table 9 which is applicable to residential land uses.

Table 9 Road traffic noise assessment criteria for residential land uses according to the NSW RNP

Road Category	Type of project/land use	Assessment Criteria	
		Day (7:00 am – 10:00 pm)	**Night (10:00 pm – 7:00 am)**
Local roads	Existing residences affected by noise from new local road corridors Existing residences affected by noise from redevelopment of existing local roads Existing residences affected by additional traffic on existing local roads generated by land use developments	55 dB $L_{Aeq, 1\ hour}$ (external)	50 dB $L_{Aeq, 1\ hour}$ (external)

3.7 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled *"Assessing Vibration – A Technical Guideline"*. (AVTG) This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration - from uninterrupted sources (refer to Table 10).
- Impulsive vibration - up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 11).
- Intermittent vibration - such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 12).

Table 10 Continuous vibration acceleration criteria (m/s^2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
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
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 11 Impulsive vibration acceleration criteria (m/s^2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
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

Table 12 Intermittent vibration impacts criteria (m/s$^{1.75}$) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
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

3.8 Cumulative Noise Impact Criteria

As previously discussed in Section 1.6, rural residential properties located along the northern project site boundary, are planned to be developed into residential zones and passive recreation areas. As a result, we expect the existing ambient noise levels will increase once these developments are completed. Therefore, these future residential zones are classified as suburban residences.

Table 13 Cumulative noise impact criteria for future residential zones

Location	Time of Day	Project Amenity Noise Level, $L_{Aeq, period}$ [1] (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [2] (dBA)	Measured $L_{Aeq, period}$ Noise Level (dBA)	Intrusive $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)	Amenity $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA) [4]
Suburban residences North Lismore Plateau urban release	Day	50	-	-	-	**53**
	Evening	40	-	-	-	**43**
	Night	35	-	-	-	**38**

Note 1: Project Amenity Noise Levels corresponding to "suburban" areas, equivalent to the Recommended Amenity Noise Levels minus 5 dBA

Note 2: L_{A90} Background Noise or Rating Background Level

Note 3: Project Noise Trigger Levels are shown in bold

Note 4: This is based on the assumption that the existing noise levels are unlikely to decrease in the future

Note 5: Minimum project intrusiveness noise level as per Table 2.1 of the NSW NPI

The criteria should be assessed by accounting the noise contributions from other surrounding developments such as the North Lismore Plateau urban release, and redevelopment works at the Lismore Kart Club.

As summarised in Section 1.7, we find that events held at Lismore Kart Club and Lismore Speedway are conducted outside school operational hours. Therefore, the noise intrusion impact from these events are not considered as part of our acoustic assessment.

4 CONSTRUCTION ACOUSTIC CRITERIA

4.1 Construction Noise Criteria

4.1.1 Interim Construction Noise Guideline

Noise criteria for construction and demolition activities are discussed in the *Interim Construction Noise Guideline* (ICNG). The ICNG also recommends procedures to address potential impacts of construction noise on residences and other sensitive land uses. The main objectives of the ICNG are summarised as follows:

- Promote a clear understanding of ways to identify and minimise noise from construction works
- Focus on applying all "feasible" and "reasonable" work practices to minimise construction noise impacts
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The NML affectation categories for residential receivers have been reproduced from the guideline and are listed in Table 14 below.

Specific non-residential receivers in the vicinity of the proposed construction site, and their recommended 'management levels', are presented in Table 15.

Based on the measured background noise levels summarised in Section 2, the NMLs to be used in this assessment are listed in Table 16.

We recommend that construction works should be conducted under typical standard construction hours. It is assumed that rural residential properties will still be present around the project site during construction works (i.e. prior to these being developed into suburban residential properties).

Table 14 NMLs for quantitative assessment at residences (from ICNG)

Time of Day	Noise Management Level $L_{Aeq(15minute)}$[1,2]	How to Apply
Recommended standard hours: Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1 *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.*

Note 2 *The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA 2000).*

Table 15 NMLs for quantitative assessment at non-residential receivers

Land Use	$L_{Aeq(15minute)}$ Construction NML
Active recreation areas Lismore Speedway Lismore Kart Racing Club	65 (external)
Passive recreation areas Environmental conservation zones	60 (external)
Commercial premises	70 (external)
Industrial premises	75 (external)

Note 1: External noise level criterion estimated from internal noise level criterion assuming a 25 dB noise level difference for non-openable facade windows

Note 2: External noise level criterion estimated from internal noise management level of 45 dB $L_{Aeq,\ 15\ minutes}$ for construction activities within private enclosed offices

Table 16 NMLs as basis for the acoustic assessment

Receiver Types	NML, dB $L_{Aeq(15minute)}$	
	Standard Hours **Monday to Friday: 7 am to 6 pm** **Saturday: 8 am to 1 pm**	**Outside Standard Hours**
Residences: Along Dunoon Road Intersection of Alexandra Parade, Dunoon Road and Tweed Street	45 (external)	N/A
Active recreation areas Lismore Speedway Lismore Kart Racing Club	65 (external)	N/A
Passive recreation areas Environmental conservation zones	60 (external)	N/A
Commercial premises	70 (external)	N/A
Industrial premises	75 (external)	N/A

Note 1: External noise level criterion estimated from internal noise level criterion assuming a 25 dB noise level difference for non-openable facade windows

Note 2: External noise level criterion estimated from internal noise management level of 45 dB $L_{Aeq,\ 15\ minutes}$ for construction activities within private enclosed offices

4.1.2 Sleep Disturbance

At this stage it is noted that construction works will be undertaken during standard construction hours. These standard hours are only part of the daytime period. Therefore, a sleep disturbance assessment is not required.

4.2 Construction Traffic Noise Criteria

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW Road Noise Policy (NSW RNP) states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night-time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

4.3 Vibration Criteria

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed. Refer to further discussion in Section 3.7.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects. Refer to further discussion in Section 4.3.1.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself. Refer to further discussion in Section 4.3.1.

4.3.1 Vibration Criteria – Building Contents & Structure

The vibration effects on the building itself are assessed against 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).

4.3.1.1 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 17 and illustrated in Figure 6.

Table 17 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure 6	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 values in Table 17 relate to transient vibration which does not cause resonant responses in buildings.

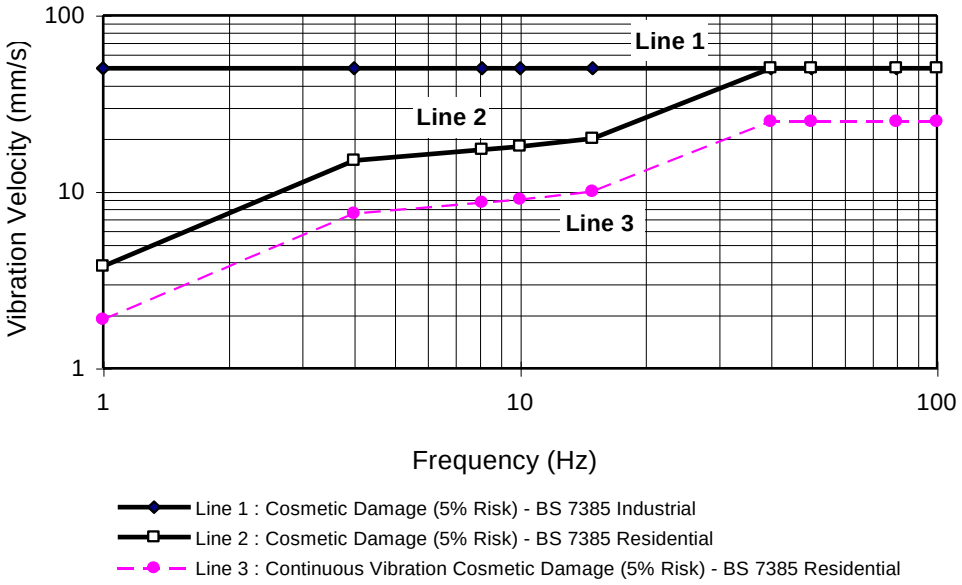
Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 17 may need to be reduced by up to 50% (refer to Line 3 in Figure 6).

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 17, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 17 should not be reduced for fatigue considerations.

Figure 6 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage



4.3.1.2 Standard DIN 4150 Part 3 – 1999

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 18. The criteria are frequency dependent and specific to particular categories of structures.

Table 18 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Note 1: For frequencies above 100Hz, at least the values specified in this column shall be applied.

5 OPERATIONAL ACOUSTIC ASSESSMENT

5.1 External Noise Emissions – Building Services

We recommend the mechanical plant design and equipment selection should be made so that the aggregate noise level from all external emissions, comply with the external noise level criteria as follows:

- Section 3.1 for existing scenario which includes rural residential properties.
- Section 3.8 for future scenario where suburban residences are developed as part of the North Lismore Plateau urban release.

This should be conducted as part of the detailed assessment of mechanical noise emissions. This detailed assessment is to be undertaken at later design stages.

From schematic design, we understand the following plant items will contribute to external noise emissions:

- Outdoor units
- Roof mounted fans and roof ventilators.
- Ducted inlets and outlets to fans, FCUs and ERVs.
- Exhaust air and make-up air systems.
- Dust extraction systems.

Therefore, the following design measures could be considered as part of the detailed design stage to achieve compliance:

- Mechanical plant installation locations and the positioning of external air duct paths (such as inlets and outlets) near the property boundary should be limited, as far as practicable.
- Plant room walls should achieve a minimum airborne sound insulation performance of Rw 45 -50. Whenever possible, the plant rooms should only be accessible from inside the building.
- If airflow paths are required to/from outside (such as outside air, exhaust air, relief air, etc) these paths should be fully ducted and include minimum 50 mm thick internal insulation; and / or include acoustic louvres. When the extent of ductwork is not sufficient for treatment, then rectangular silencers may be required (this especially applies to fans and AHUs).
- Ornamental louvres should generally only be considered if they are blanked off with FC sheeting or plant room external walls (subject to further Detailed Design acoustic assessment).
- All plant room walls and roof / ceiling to be internally lined with insulation, which in combination with insulation facing, should achieve a minimum noise reduction coefficient (NRC) rating of 0.8.
- AHUs and FCUs should include return air / outside air plenums which are in internally lined with minimum 50 mm thick insulation.
- For dust extraction systems, the following treatments should be considered:
    - Silencers to be installed on outlet side and inlet side of dust extraction fan.
    - Discharge to aim vertically upwards.
    - Dust extraction fan to be contained within acoustic enclosure.

  - Reticulation to comprise metal ductwork
  - Treatment for dirt separator / filter depends on dust extraction system to be implemented (i.e. compressed air pulse jet system, wet scrubbers, electrostatic precipitators, etc). Therefore, treatment to be determined upon confirmation of plant selection.
  - All plant items should be resiliently vibration mounted.

- Variable speed drives should be implemented whenever possible.
- Reduce the number of operational plant items between 6:00 pm and 7:00 am (and during the night-time period generally).
- Outdoor units and other plant items to be screened from direct line of sight to the affected residences (depending on their locations).

The above recommendations should be considered as in-principle, best practice acoustic treatment that will need to be confirmed during detailed design stages.

Finally, it is recommended that mechanical services should be designed to achieve compliance with external noise level criteria discussed in Section 3.1 for existing scenario, and Section 3.8 for future scenario.

5.2 Internal Noise Emissions – Building Services

As discussed in Section 5.1, the mechanical ventilation design is still ongoing at the time of issuing this report. Nevertheless, it is advised that this should be designed to achieve the internal noise level criteria discussed in Sections 3.4.2 and 3.4.3.

The assessment of internal noise levels should account for noise emission by building services, as well as noise intrusion from external noise sources such as local road traffic.

The following down-duct treatments are envisaged to mitigate internal noise emissions from ducted FCUs and ERVs:

- Supply air duct to comprise internally lined ductwork (with minimum 50mm insulation) and internally lined flexible ductwork.
- All supply, return and relief air registers to include internally lined plenums behind registers (with minimum 25-50mm insulation).
- Return air duct to comprise the following internally lined ductwork components (with minimum 50mm insulation):
  - Internally lined plenum
  - Minimum one internally lined bend
  - Internally lined straight ductwork
- Based on selected ceiling finishes and plant item location, ERVs and FCUs should be externally wrapped with loaded vinyl.
- All ductwork connected to or from ERVs (including those between ERVs and FCUs) should comprise internally lined ductwork (with minimum 50mm insulation). Extent of internally lined ductwork to be determined once plant selection is confirmed.
- Outside air ductwork between external air intake and cassette units should comprise internally lined ductwork (with minimum 50mm insulation).

Mechanical plant should be resiliently mounted. Vibration isolation mounts and supports should be designed to achieve compliance with vibration criteria discussed in Section 3.7.

5.3 Building Envelope Constructions

Building envelope constructions of school buildings should be treated so noise intrusion from external noise sources (such as local road traffic), do not increase the overall internal noise levels and compliance is achieved with the criteria discussed in Sections 3.4.2 and 3.4.3. Besides noise intrusion from external noise sources, the assessment of overall internal noise levels should account for noise emissions from building services.

Design of building envelope constructions is still ongoing. However, the following conceptual treatments are envisaged for Buildings A, C and D:

- All external windows and external doors should achieve a minimum sound reduction performance of Rw 35 (subject to detailed design assessment). Window performance is not only subject to the glazing selection but also to the construction of the window frame and the frame seal selection. Therefore, it is advised window manufacturer should confirm that the required sound insulation can be achieved. It is anticipated that the window system should comprise Q-Lon (or equivalent) or fin seals with deep C channels as part of the window track. Windows should also include laminated glass panels.

- As per the windows, the performance of sliding doors is not only subject to the glass selection, but also to the door frame construction and frame seals. Therefore, it is recommended that the door manufacturer confirms that the door system achieves the required performance. Typically, these doors should include fin rubber seals and Q-Lon seals, with deep C channels as part of the door track and laminated glass panels.

- External non-glazed walls should achieve a minimum sound insulation performance of Rw 45-50 (subject to detailed design assessment). Walls can comprise lightweight and masonry elements. Wall cavities should be filled with open porous insulation such as glasswool, rockwool or polyester.

- External roof construction should achieve a minimum sound insulation performance of Rw 45-50 (subject to detailed design assessment). Roof construction can comprise lightweight elements (such as metal deck roof) provided that ceiling cavity includes open porous insulation such as glasswool, rockwool or polyester.

Treatments for building envelope constructions in Buildings B (Multi-Purpose Hall & Movement Studio/Theatre), and E (Agricultural Shed) require further detailed assessment, based on the use and activities undertaken in these buildings. Conceptual treatments are provided for Building B in Section 5.5. Regarding Building E, the treatments will depend on the type of machinery to be used within the shed; or would the shed only be used for storage.

These conceptual treatments should be considered during detailed design stages. Consequently, these should be further developed by considering other operational procedures such as use or activity to be undertaken within the school building.

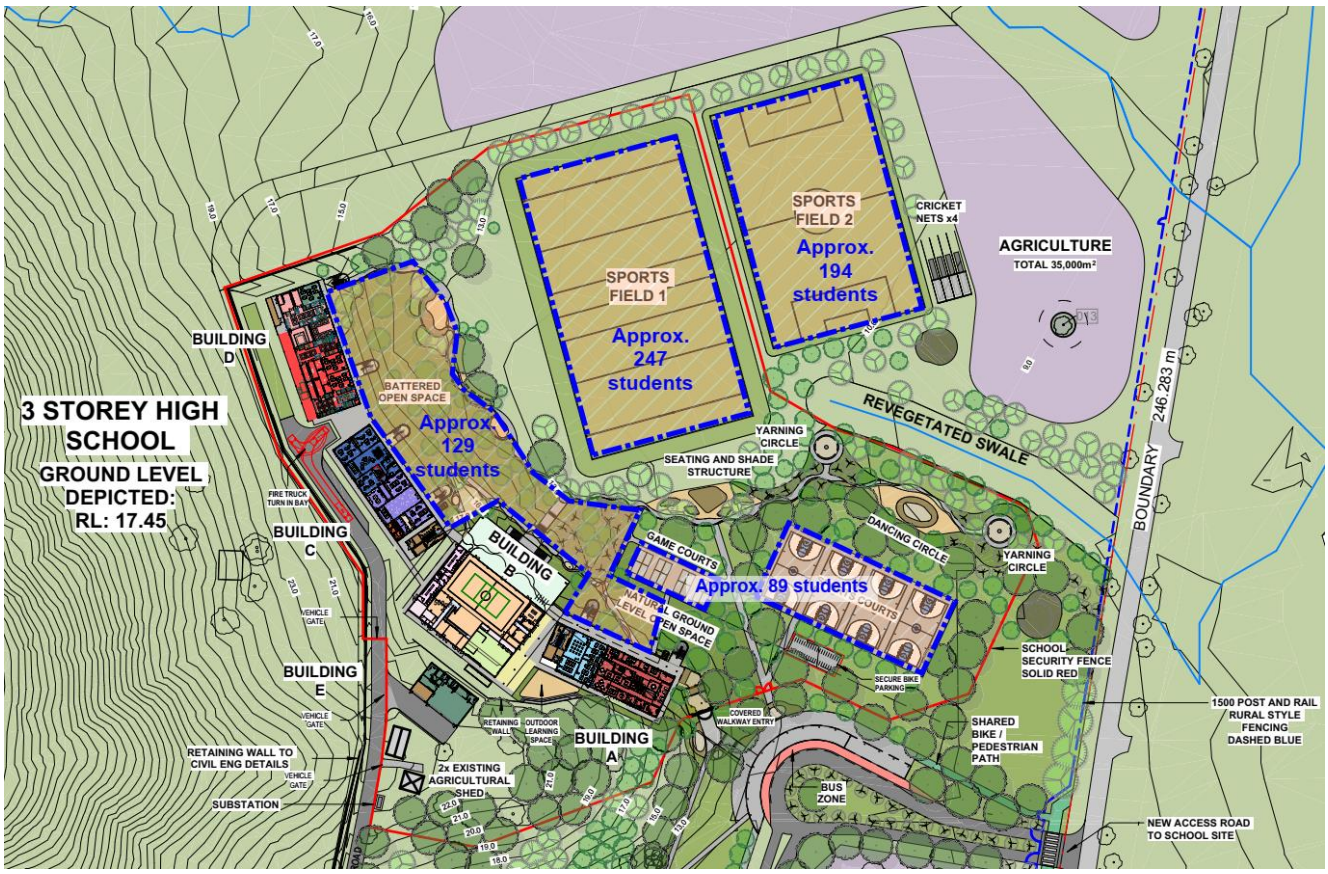
5.4 Outdoor Noise Emissions – Playgrounds & Sport Fields

For the prediction of outdoor noise emissions due to students playing in outdoor areas, a typical lunch / recess period has been considered. In this scenario, it is assumed all students are in the designated playground areas as summarised in Table 19 and Figure 7. This distribution of students is consistent with providing each student the required minimum area of 5-10 m^2. It is also assumed that all 660 students are in the outdoor play areas during recess periods.

Table 19 Summary of noise modelling assumptions

Outdoor Area	Approximate Number of Students	Sound Power Level dB $L_{Aeq,\ 15\ minutes}$ (plane source across area of play)
Open spaces (adjacent to school buildings)	129	99
Sports field 1	247	102
Sports field 2	194	100
Game and sports courts	89	97

Figure 7 Distribution of students during outdoor activities (for noise modelling purposes)



Based on the assumptions discussed above, predicted noise levels during outdoor play, are predicted at the nearest impacted receivers. These predicted noise levels are summarised in Table 20.

Table 20 Predicted noise emissions for a typical lunch / recess period

Residential Receiver	Predicted Noise Levels (dB $L_{Aeq, 15\ minutes}$)	Daytime Noise Emission Target (dB $L_{Aeq, 15\ minutes}$)	Assessment Outcomes
Residence along northern property boundary (part of North Lismore Plateau urban release)	50-53	45	Noise mitigation measures to be considered

In relation to Table 20, we note:

- Predicted noise levels during periods of the day when all students are utilising the outdoor play areas (i.e., recess and lunch), are likely to intermittently exceed the formulated noise target levels in a worst-case scenario assessment.
- However, in our experience, the noise levels emitted are equivalent to those found in a community's public park. Therefore, these levels could be considered typical of a large open space of this nature.
- As discussed in Section 3.2, in NSW there is no defined acoustic criteria for the operational use of school playgrounds (indoors or outdoors). As such, we developed target noise levels based on most relevant guidelines.
- Notwithstanding the discussion above, the following management mitigation measures should be implemented by the school to minimise impacts to surrounding residential receivers:
    - All use of the school playground is to be supervised by school staff to ensure no excessive yelling or screaming occurs.
    - Use of the school playground is limited to the school hours during the daytime period as proposed.
    - Use of the Public Address (PA) system is in accordance with Section 5.6.
    - Outdoor playgrounds should not be used before 7:00am.
    - All of the listed mitigation measures are to be reflected in the School's Operation Management Plan (OMP).

Therefore, in our professional opinion we believe the outdoor play area of the school is acoustically acceptable and justified.

5.5 Outdoor Noise Emissions – Building B (Multi-Purpose Hall & Movement Studio/Theatre)

As discussed in Section 1.5, Building B (Multi-Purpose Hall & Movement Studio/Theatre) is proposed to be used for regular school activities during typical school hours; as well as during OSHC (outside school hours care). As such an acoustic assessment is undertaken during the daytime and evening periods. This assessment assumes the following operational conditions:

- Movement Studio/Theatre: Maximum student capacity is 133. This is representative of 20% of the total maximum student capacity within this space, with installed PA system under operation. Additionally, overall sound pressure levels within the theatre do not exceed 85 dB $L_{Aeq\ (15\text{-}minute)}$.
- Multi-Purpose Hall: All students are within the hall and the PA system is in operation. This also assumes overall sound pressure levels within the hall do not exceed 85 dB $L_{Aeq\ (15\text{-}minute)}$.
- Both spaces are used simultaneously.

Table 21 Predicted noise levels from school activities in Building B

Residential Receiver	Predicted Noise Levels (dB $L_{Aeq,\ 15\ minutes}$)		Daytime & Evening Noise Emission Targets (dB $L_{Aeq,\ 15\ minutes}$)	Assessment Outcomes
	Hall Doors Open	Hall Doors Closed		
127 Tweed St (at junction between Tweed St, Alexandra Pde & Dunoon Rd)	45	< 30	45	Building B, doors open: Compliance is achieved provided overall internal noise level do not exceed 85 dB $L_{Aeq,\ 15\ min}$. Building B, doors closed: Compliance with noise target levels is achieved, subject to implementation of architectural and miscellaneous treatments
Along northern property boundary (part of North Lismore Plateau urban release)	40	< 30	45	Building B, doors open: Compliance is achieved provided overall internal noise level do not exceed 85 dB $L_{Aeq,\ 15\ min}$. Building B, doors closed: Compliance with noise target levels is achieved, subject to implementation of architectural and miscellaneous treatments.

From Table 21 we note that when doors in Building B are open, compliance is achieved with all noise target levels, provided the following architectural and miscellaneous treatments are implemented:

- Noise levels within the multi-purpose hall and movement studio/theatre should not exceed 85 dB $L_{Aeq\ (15\ minutes)}$. Therefore, PA system should be designed not to exceed this maximum allowable noise level. This is likely for PA system to include a noise limiter.
- Folding doors should achieve a minimum sound insulation performance of Rw 20. This implies that although these doors can be foldable, this should comprise non-perforated finishes.
- Hinged external doors should achieve a minimum sound insulation performance of Rw 30. These doors should include a solid core, with rubber acoustic seals installed along the door frame and bottom threshold.

- Building envelope should be designed as to not provide additional flanking paths for breakout noise emissions. Recommended sound insulation performance for non-glazed façade elements should be Rw 45-50. Glazed façade elements in Building B should achieve the minimum sound insulation performance listed in Table 22. Product example: 8.38mm laminated glass.

Table 22 Minimum sound insulation performance for glazed façade elements, Building B

Overall Sound Insulation Performance Rw (C; Ctr)	Min. Sound Insulation Performance in Octave Band Centre Frequencies							
	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz
Rw 35 (-1; -3)	21	23	27	32	35	36	44	44

5.6 Outdoor PA System

The location and design of the public address/bell system has not been undertaken at this stage. However, this will be required from an operation perspective. Therefore, we recommend that noise levels emitted by the outdoor PA system should not exceed the following:

- For existing scenario that includes rural residential properties: Intrusiveness criteria at nearest impacted residences (i.e. noise emissions should not exceed the RBL + 5 dB). The intrusiveness criteria are summarised in Table 5.

- For future scenario whereby suburban residences are developed as part of the North Lismore Plateau urban release: Refer to criteria discussed in Section 3.8 (i.e. Table 13).

A detailed review should be undertaken during the detailed design phase to ensure compliance with this criterion. The following it is advised that should be considered during this detailed design stage:

- Outdoor PA system should not operate outside school opening hours (i.e. between 3:00 pm and 6:30 am), and should not operate within the night time period (i.e. between 10:00 pm and 7:00 am).

- Low-powered horn-type speakers should be located and orientated to provide a good coverage of the school areas whilst being directly away from residences and sensitive receivers. System coverage shall be reviewed during the design phases.

- Speakers should be mounted with a downward angle and as close to the floor as possible. Speakers should be mounted below the height of school buildings and include directional speakers to mitigation noise spill to neighbouring receivers.

- Once appropriate noise levels from the speakers are obtained within school premises and at nearest affected receivers, the system gain should be limited so that staff cannot increase the noise levels.

- During compliance survey, noise levels measured from PA system should be obtained in the absence of noise reflections from walls or vertical structures.

5.7 Noise Emissions From Carpark & Drop-Off Areas

Figure 2 shows the location of the carpark, kiss & drop zones and bus stops within the RRHC campus. These are located in the south-eastern corner of the campus, with nearest impacted receivers located along Alexandra Parade, Dunoon Road and Tweed Street. These receivers include residential property situated at 127 Tweed Street (at junction between Tweed Street, Alexandra Parade and Dunoon Road).

Access to the carpark, kiss & drop zones and bus stops, is via Dunoon Road. The bus stops are located 40-45m east of Building A, with carpark and kiss & drop zones situated 70-75m south-east of same building.

The carpark is designed to accommodate 130 standard parking spaces. Therefore, we assume 130 vehicle movements in a 1.5 hour period (i.e. as part of the morning or afternoon peak hour traffic).

During the same morning or afternoon peak hour traffic, we based our predictions on the following traffic flow figures:

- Maximum of 12 school buses arriving or departing,
- Maximum of 455 vehicle movements for student drop-off or pick-up.

The figures above are obtained from report titled *"School Transport Plan, Northern Rivers Flood Recovery – Richmond River High Campus Redevelopment"* (revision 4, dated 25 June 2025, issued by Crossley Transport Planning).

For our noise predictions, the sound power levels summarised in Table 23 are considered for light vehicles and buses.

Table 23 Sound power levels for vehicle movements and activities

Vehicular Activity	Sound Power Level (dB re 1pW) [1]
Light vehicles	
Light vehicle pass-by	91 dB L_{Amax}, 52 dB $L_{Aeq,\ 15\ min}$
Car door closing	98 dB L_{Amax}, 59 dB $L_{Aeq,\ 15\ min}$
Engine start	93 dB L_{Amax}, 54 dB $L_{Aeq,\ 15\ min}$
Buses	
Bus departing	85 dB L_{Amax}, 46 dB $L_{Aeq,\ 15\ min}$
Bus idle	98 dB L_{Amax}, 60 dB $L_{Aeq,\ 15\ min}$
Note 1: Noise information used for the prediction of $L_{Aeq,15\ minutes}$ noise levels	

Based on the information discussed above, we predict a noise level of 45 dB $L_{Aeq,15min}$ is predicted at nearest impacted residence. Hence, we find this noise level compliant with the noise level criterion discussed in Section 3.3 (i.e. 45 dB $L_{Aeq,\ 15\ min}$). As a result, no further acoustic treatment is required.

5.8 Waste Collection

As an operational measure, we recommend commercial waste collection should only be conducted between 7:00 am and 10:00 pm. This is recommended to minimise noise impact to local residences.

5.9 Noise Impact On Local Roads

Based on the vehicle movements for the school carpark and drop-off areas, as discussed in Section 5.7 (for light vehicles and buses); as well as typical sound power levels listed in Table 23, we predict a noise level of 57 dB $L_{Aeq,\ 1\ hr}$ for nearest impacted residence at 127 Tweed Street.

We find this predicted noise level as marginally compliant with the noise assessment criteria discussed in Section 3.6. It is considered marginally compliant, since the 2 dB exceedance is found to be subjectively unnoticeable. Therefore, it is expected that impact from road traffic noise levels generated by the development; will be negligible.

6 CONSTRUCTION ACOUSTIC ASSESSMENT

6.1 Construction Noise & Vibration Management Plan

At the time of issuing this report, detailed information of the construction program is not available. Therefore, an impact assessment of construction noise and vibration has not been conducted.

Nevertheless, due to the size of the project and extent of works (as discussed in Section 1.4), it is envisaged that a construction noise and vibration management plan (CNVMP) will be required.

The following works should be provided as part of the required CNVMP:

- An on-site noise monitoring is recommended in order to confirm the existing ambient noise levels. This can influence how the NMLs are established, and as a result, the management procedures to undertake;
- A detailed construction program should be provided which should include the following:
    - Schedule of construction activities (classified into scenarios if applicable)
    - List of construction equipment per activity
    - Location of construction equipment
    - Duration of construction activities, as well as proposed construction hours
- Assess predict noise levels in accordance with the procedures discussed in Section 4.
- Based on the outcome of the assessment, establish management and operational procedures to address noise and vibration mitigation measures and complaints. Refer to Section 6.2 for typical noise mitigation measures to be considered.
- For vibration generating equipment, we recommend that safe working distances be determined to maintain compliance with the appropriate human comfort criteria (refer to Section 3.7) as well as to minimise impact on buildings (refer to Section 4.3). Indicative safe working distances are provided in Table 24. These indicative distances should be confirmed during detailed design stages of the project by undertaking vibration validation tests involving the actual equipment to be used. These validating tests should be performed at the commencement of works.

Table 24 Recommended indicative safe working distances for vibration intensive plant

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage (BS 7385: Part 2 DIN 4150: Part 3)	Human Comfort (AVTG)
Vibratory roller	< 50 kN (Typically 1 – 2 tonnes)	5	15 – 20
	< 100 kN (Typically 2 – 4 tonnes)	6	20
	< 200 kN (Typically 4 – 6 tonnes)	12	40
	< 300 kN (Typically 7 – 13 tonnes)	15	100
	> 300 kN (Typically more than 13 tonnes)	20	100
Small hydraulic hammer	300 kg, typically 5 – 12 tonnes excavator	2	7
Medium hydraulic hammer	900 kg, typically 12 – 18 tonnes excavator	7	23
Large hydraulic hammer	1600 kg, typically 18 – 34 tonnes excavator	22	73
Vibratory pile driver	Sheet piles	2 – 20	20

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage (BS 7385: Part 2 DIN 4150: Part 3)	Human Comfort (AVTG)
Jackhammer	Hand held	1	Avoid contact with structure and steel reinforcements

- Identify heritage structures as well as vibration sensitive premises (such as those containing scientific and surgery equipment). Safe working distances from vibration generating equipment should be established to achieve compliance with the criteria discussed in Section 4.3.
- Identify of other vibration sensitive structures such as tunnels, gas pipelines, fibre optic cables, Sydney Water retention basins. Specific vibration goals should be determined on a case-by-case basis by an acoustic consultant which is to be engaged by the construction contractor.
- Undertake an assessment of road traffic noise generated by light and heavy vehicle movements which are associated with the construction works for the development. A construction traffic study should be provided to determine the relevant traffic flows. These predicted noise levels of construction traffic will then be assessed in accordance with the criteria discussed in Section 4.2.
- Al construction works should be undertaken during recommended standard hours (as listed in Table 14).
- Local council and community should be notified prior to start of construction activities likely to have a high noise impact. Additionally, prior notification and strong justification should be provided for work which is to be undertaken outside standard construction hours.

6.2 Typical Noise & Vibration Mitigation Procedures

The following are typical mitigation measures which can be considered in the CNVMP, these are to be confirmed once detailed information of the construction program becomes available and further noise measurements have been conducted on site:

- Undertake all feasible and reasonable measures to minimise noise impacts and achieve compliance with the NMLs (refer to Section 4.1).
- Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and the contact details for the proposal. This can be conducted as part of a community consultation process.
- A potential approach would be to schedule a respite period of one hour for every three hours of continuous construction activity, or undertaking high noise generating works at less sensitive times such as 9:00 am to 12:00 pm and / or 2:00 pm to 5:00 pm
- Undertake following operational procedures:
    - Maximise the offset distance between plant items and nearby noise sensitive receivers.
    - Prevent noisy plant working simultaneously and adjacent to sensitive receivers.
    - Minimise consecutive works in the same site area.
    - Orientate equipment away from noise sensitive areas.
    - Carry out loading and unloading away from noise sensitive areas.

  - Minimise noise emissions from reversing alarms by the use of "forward only" traffic flows through the site, broadband alarms (rather than tonal alarms), maintaining occupational safety standards, etc.
  - No use of PA systems on site.
  - Site induction training to include noise awareness component
  - Site deliveries to be conducted during standard construction hours

- Conduct supplementary noise and structural damage and/or human comfort vibration monitoring to confirm compliance with the adopted construction noise and vibration criteria. These measurements can also be carried out in response to complaints, exceedances or for the purpose of refining construction techniques to minimise noise and vibration emissions.
- Establish a complaint handling procedure to address complaints, identify corrective action and implement if possible. The corrective action may involve supplementary monitoring to identify the source of the non-conformance and/or may involve modification of the construction techniques or programme to avoid any recurrence or minimise its adverse effects.
- Any vibration generating plant and equipment is to be located in areas within the site in order to lower the vibration impacts.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of construction plant and equipment, that is, smaller capacity plant.
- Minimise performing vibration generating works consecutively in the same area (if applicable).
- Schedule respite periods, these are to be determined based on the outcomes of detailed construction noise assessment and in coordination with the contractor.
- Maximise hammer penetration (and reduce blows) by using sharp hammer tips. Keep stocks of sharp profiles at site, and monitor the profiles in use.

7 CONCLUSIONS

Pulse White Noise Acoustics (PWNA) has been engaged to undertake a noise and vibration assessment for the rebuild of Richmond River High Campus (RRHC). This assessment is conducted to support a submission for Review of Environmental Factors (REF) in accordance with Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

From the operational noise and vibration assessment, the following findings and mitigation measures are summarised in Table 25.

Table 25 Summary of mitigation measures

Mitigation Name	Aspect	Mitigation Measure
Aircraft noise intrusion	Project site location	The project site is exposed to a less than 20 ANEF contour. Therefore, the site is no subject to the aircraft noise intrusion assessment.
External noise emissions from mechanical services	Mechanical services	Mechanical plant should be designed to achieve compliance with external noise level criteria discussed in Section 3.1. Conceptual recommendations are presented in Section 5.1 for consideration during detailed design stages.
Building envelope constructions	Architectural design	Treatments for building envelope constructions should be designed to mitigate noise intrusion from external noise sources (such as local road traffic). Conceptual treatments are discussed in Section 5.3. Treatments for building envelope constructions in Buildings B (Multi-Purpose Hall & Movement Theatre) and E (Agricultural Shed) should be provided to mitigate noise break-out noise emissions, based on the use and activities undertaken in these buildings. Conceptual treatments are provided for Building B in Section 5.5 Regarding Building E, the treatments will depend on the type of machinery to be used within the shed; or if the shed will only be used for storage. These conceptual treatments should be further developed by considering other operational procedures such as use or activity to be undertaken within these school buildings.
Internal noise emissions from mechanical services	Mechanical services	Mechanical plant should also be designed to achieve compliance with internal noise level criteria discussed in Section 3.4. The assessment of internal noise levels should account for noise emission by building services, as well as noise intrusion from external noise sources such as local road traffic. Additionally, all mechanical plant should be resiliently vibration mounted to achieve compliance with vibration criteria as per Section 3.7.
Noise emissions from outdoor playgrounds	Operational procedures	Management mitigation measures should be implemented to manage noise emissions from outdoor playgrounds. These measures should be included as part of the School's Operation Management Plan (OMP). These measures are discussed in Section 5.4. Outdoor playgrounds should not be used before 7:00am. This measure should also be included as part of the OMP.

Mitigation Name	Aspect	Mitigation Measure
External noise emissions from Buildings B (Multi-Purpose Hall & Movement Theatre)	PA system, architectural design	PA system should be designed so internal noise levels do not exceed 85 dB $L_{Aeq\ (15\ minutes)}$. Additionally, refer to Section 5.5 for preliminary architectural treatments for hall doors and building envelope treatments. Hall doors should be maintained closed for school events, especially if these events are conducted during the evening and night-time periods.
Noise emissions from outdoor PA system	PA system	Outdoor PA system should be designed so noise emissions do not exceed the intrusiveness criteria at nearest impacted residences. Also, refer to Section 5.6 for conceptual treatments to be considered during detailed design. Outdoor PA system should only operate between 9:00am and 3:00pm
Noise emissions from waste collection services	Waste collection, operational procedures	Waste collection should only be conducted between 7:00 am and 10:00 pm
Outside of school hours care	Operational procedures	Students and carers should be located indoors between 6:30 am and 7:00 am
Construction noise and vibration management plan (CNVMP)	Prior to start of construction works	A construction noise and vibration management plan (CNVMP) is advised due to the size of the project and extent of construction works. Conceptual mitigation measures are recommended in Section 6 to address the acoustic impact from such construction activities. These measures should be considered when developing the CNVMP.

Finally, it is our opinion that the proposed development can achieve the acoustic conditions as required as part of the REF submission and no significant environment impact will be produced, provided the conceptual recommendations discussed herein are implemented and further developed during detailed design stages.

APPENDIX A: ACOUSTIC TERMINOLOGY

The following is a brief description of the acoustic terminology used in this report.

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:
	0dB(A) Threshold of human hearing 30dB(A) A quiet country park 40dB(A) Whisper in a library 50dB(A) Open office space 70dB(A) Inside a car on a freeway 80dB(A) Outboard motor 90dB(A) Heavy truck pass-by 100dB(A) Jackhammer/Subway train 110 dB(A) Rock Concert 115dB(A) Limit of sound permitted in industry 120dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Ambient sound	The all-encompassing sound at a point composed of sound from all sources near and far.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
Reverberation	The persistence of sound in a space after the source of that sound has been stopped (the reverberation time is the time taken for a reverberant sound field to decrease by 60 dB)
Air-borne sound	The sound emitted directly from a source into the surrounding air, such as speech, television or music
Impact sound	The sound emitted from force of one object hitting another such as footfalls and slamming cupboards.
Air-borne sound isolation	The reduction of airborne sound between two rooms.
Sound Reduction Index [R] (Sound Transmission Loss)	The ratio the sound incident on a partition to the sound transmitted by the partition.
Weighted sound reduction index [R_w]	A single figure representation of the air-borne sound insulation of a partition based upon the R values for each frequency measured in a laboratory environment.
Level difference [D]	The difference in sound pressure level between two rooms.

Normalised level difference [D_n]	The difference in sound pressure level between two rooms normalised for the absorption area of the receiving room.
Standardised level difference [D_{nT}]	The difference in sound pressure level between two rooms normalised for the reverberation time of the receiving room.
Weighted standardised level difference [$D_{nT,w}$]	A single figure representation of the air-borne sound insulation of a partition based upon the level difference. Generally used to present the performance of a partition when measured in situ on site.
C_{tr}	A value added to an R_w or $D_{nT,w}$ value to account for variations in the spectrum.
Impact sound isolation	The resistance of a floor or wall to transmit impact sound.
Impact sound pressure level [L_i]	The sound pressure level in the receiving room produced by impacts subjected to the adjacent floor or wall by a tapping machine.
Normalised impact sound pressure level [L_n]	The impact sound pressure level normalised for the absorption area of the receiving room.
Weighted normalised impact sound pressure level [$L_{n,w}$]	A single figure representation of the impact sound insulation of a floor or wall based upon the impact sound pressure level measured in a laboratory.
Weighted standardised impact sound pressure level [$L'_{nT,w}$]	A single figure representation of the impact sound insulation of a floor or wall based upon the impact sound pressure level measured in situ on site.
C_I	A value added to an L_{nW} or $L'_{nT,w}$ value to account for variations in the spectrum.
Energy Equivalent Sound Pressure Level [$L_{A,eq,T}$]	'A' weighted, energy averaged sound pressure level over the measurement period T.
Percentile Sound Pressure Level [$L_{Ax,T}$]	'A' weighted, sound pressure that is exceeded for percentile x of the measurement period T.

*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 *"Acoustics – Glossary of terms and related symbols"*

APPENDIX B: UNATTENDED NOISE MEASUREMENTS

163 Alexandra Parade, North Lismore

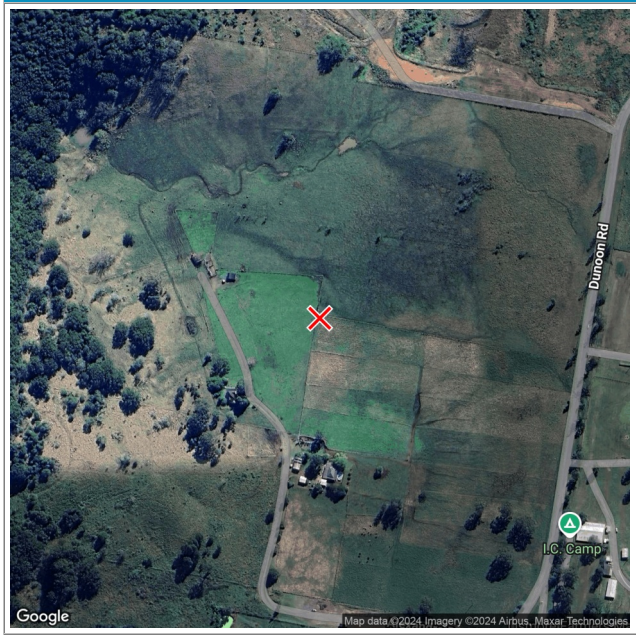
Ambient noise monitoring report

Item	Information
Logger Type	NGARA
Serial number	87826E
Address	163 Alexandra Parade, North Lismore
Location	163 Alexandra Parade, North Lismore
Facade / free field	Free field
Environment	

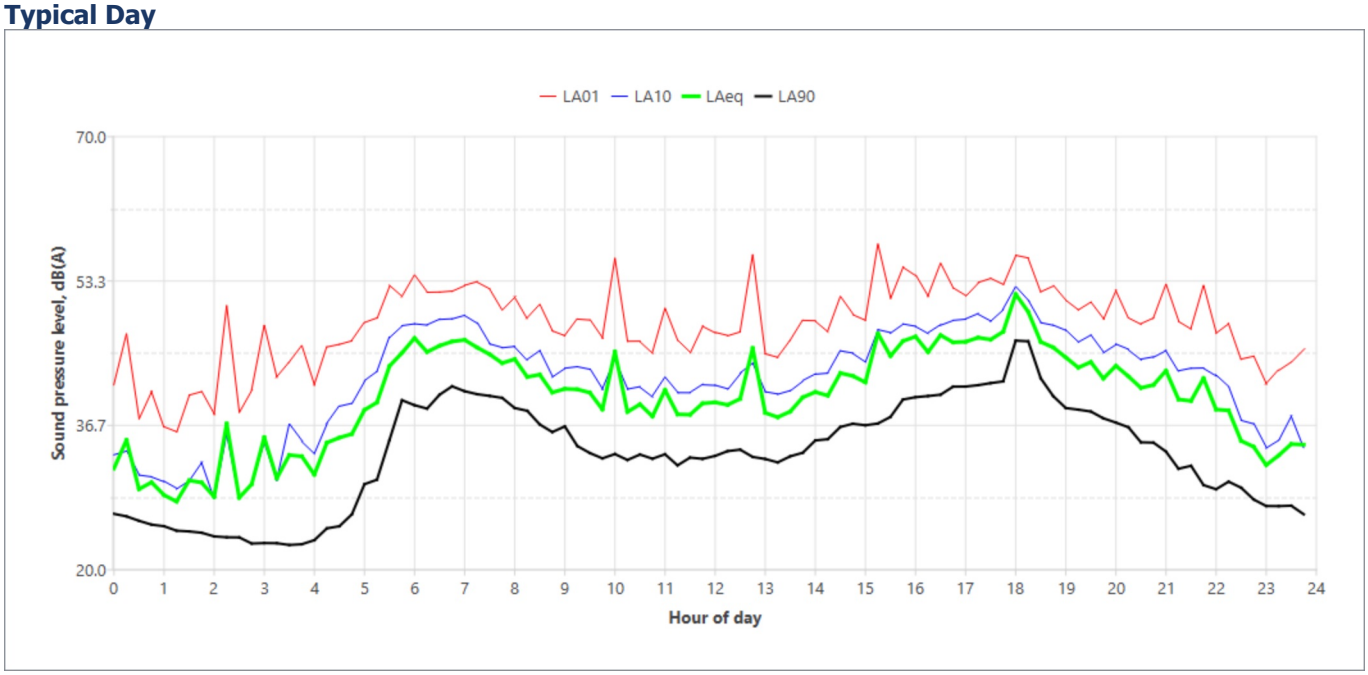
Measured noise levels

Logging date	Rating Background Level			$L_{Aeq,period}$		
	Daytime 7am-6pm	Evening 6pm-10pm	Night-time 10pm-7am	Daytime 7am-6pm	Evening 6pm-10pm	Night-time 10pm-7am
Sat 24 Aug 2024	36	32	23	50	47	38
Sun 25 Aug 2024	33	33	24	48	51	38
Mon 26 Aug 2024	34	34	23	44	45	39
Tue 27 Aug 2024	31	34	23	44	49	39
Wed 28 Aug 2024	35	32	25	45	46	40
Thu 29 Aug 2024	31	30	-	44	45	41
Summary	**33**	**33**	**23**	**47**	**48**	**39**

Note: Results with a '-' identify that there were not enough measurements available to correctly calculate the level, in accordance with the Noise Policy for Industry. The data has been excluded either from weather or manual exclusions. See the charts for more information

Logger location	Logger deployment photo
	

Typical Day



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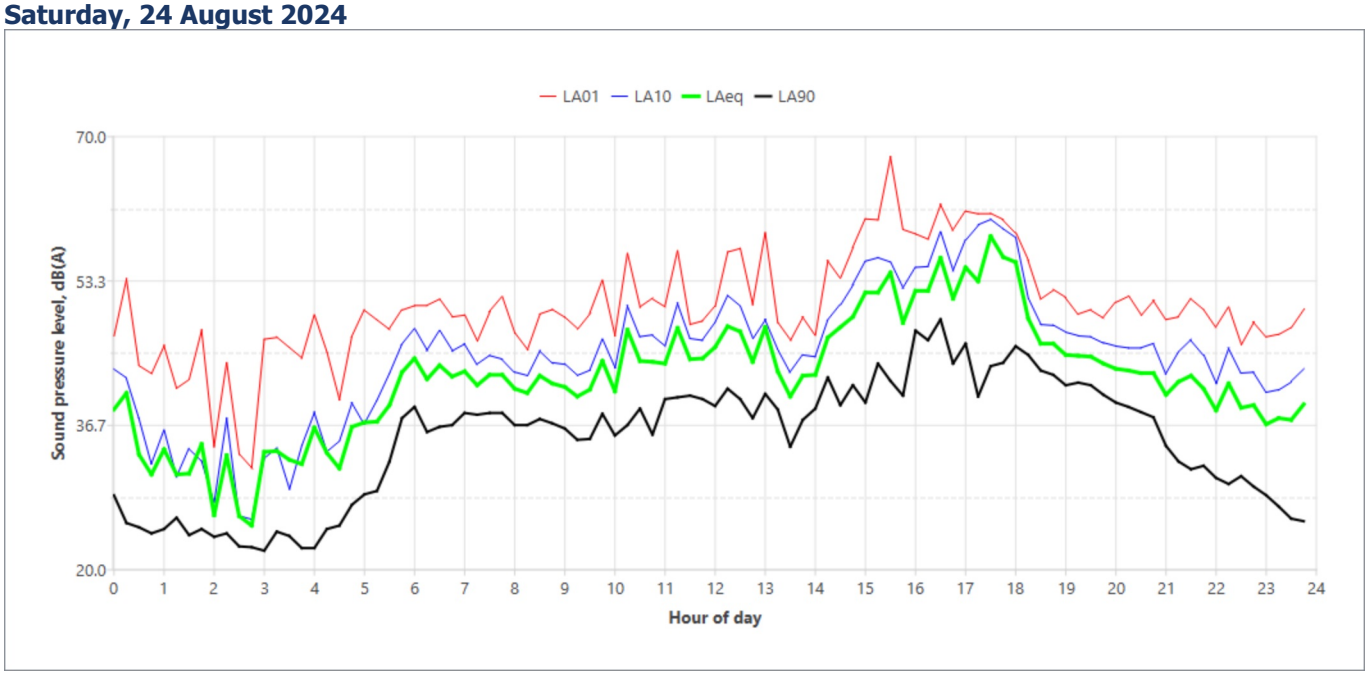
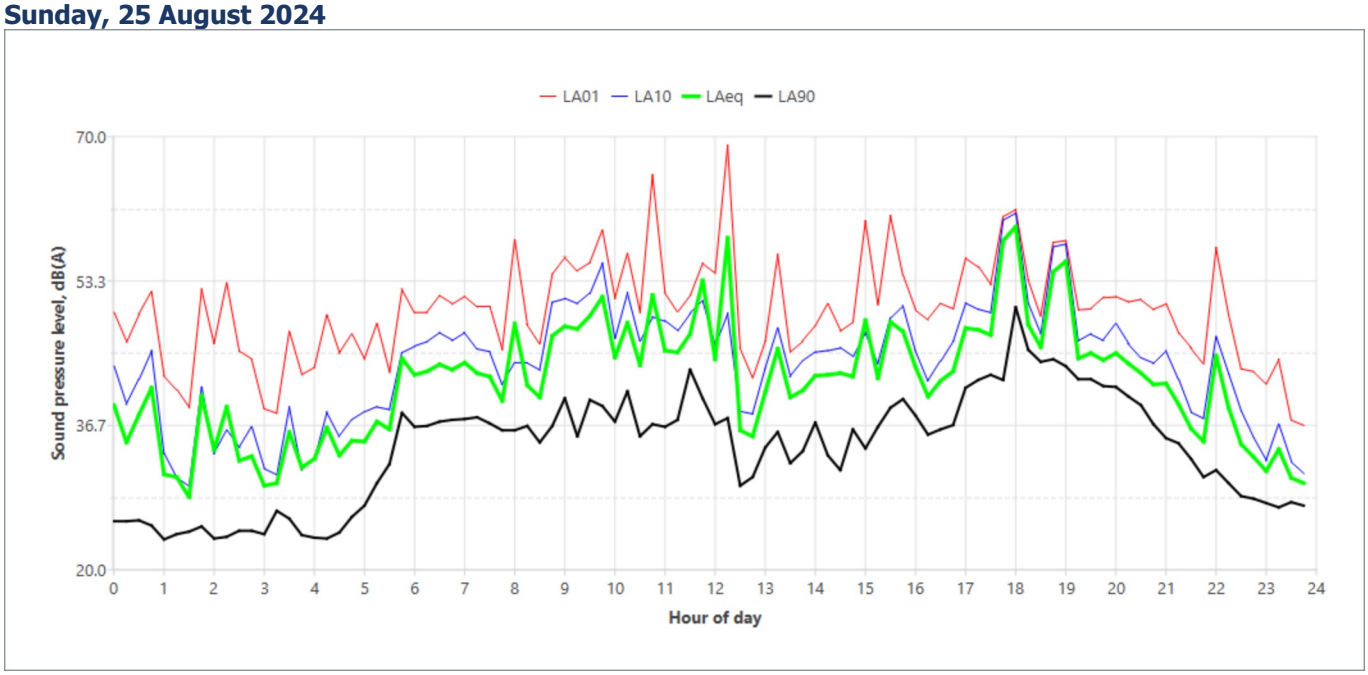
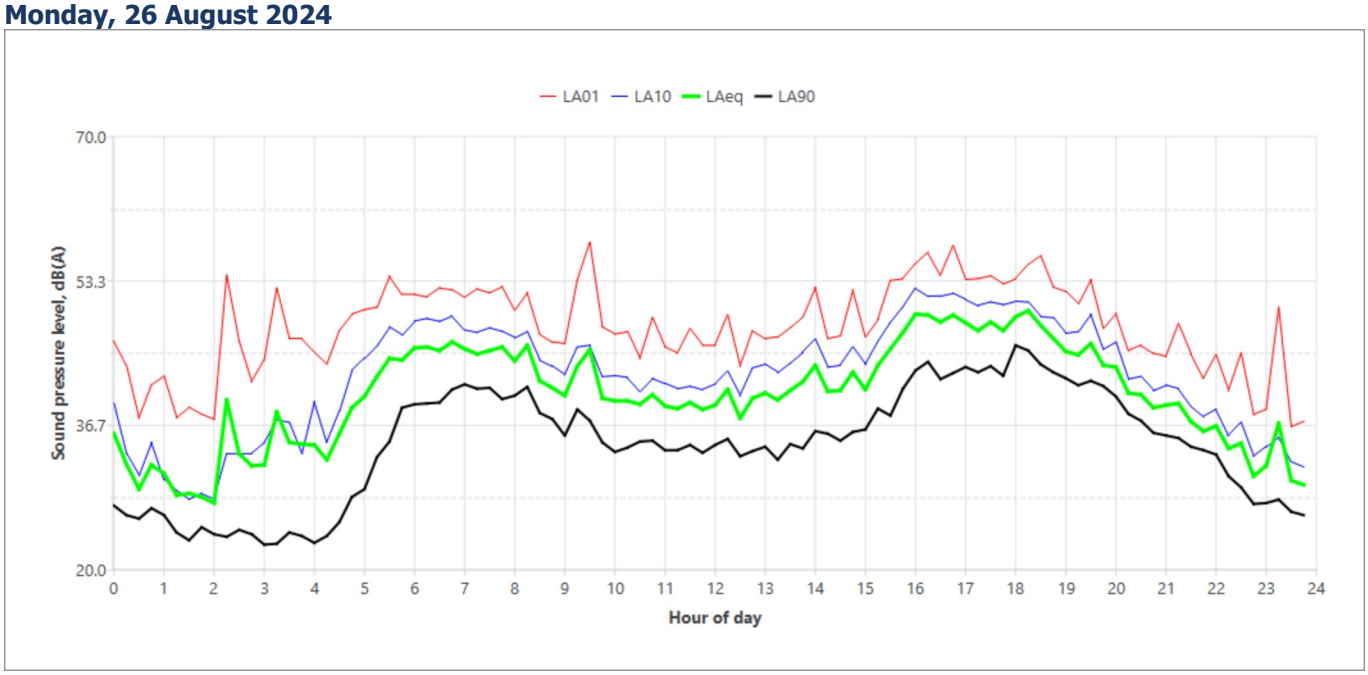


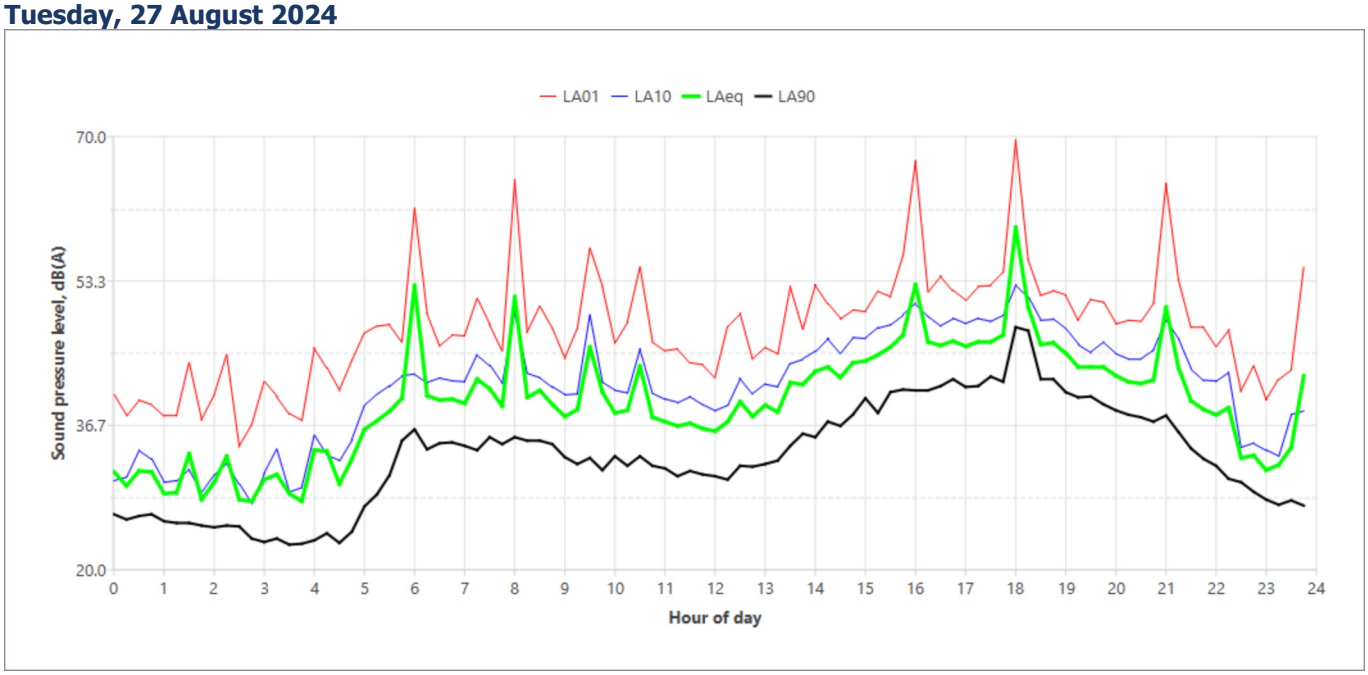
Sunday, 25 August 2024



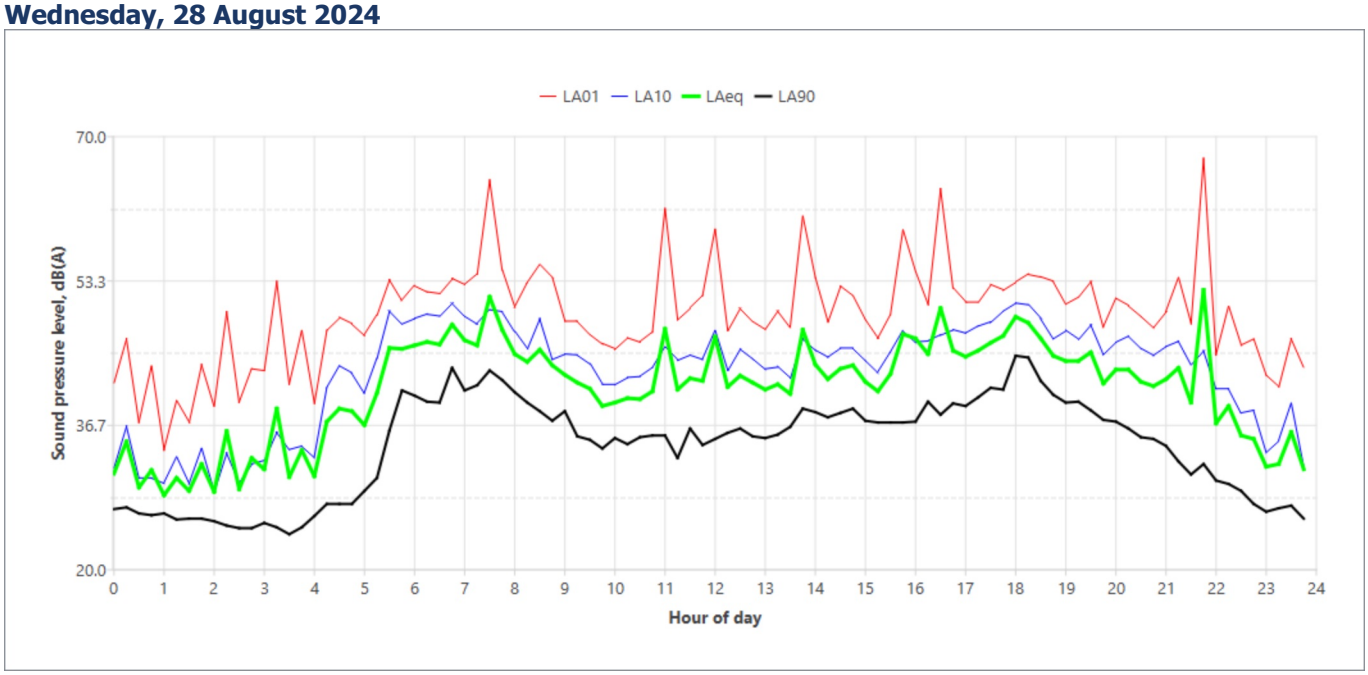
Monday, 26 August 2024



Tuesday, 27 August 2024



Wednesday, 28 August 2024



Thursday, 29 August 2024