William Carey Christian College

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Acoustics Report

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1. Introduction

Northrop Consulting Engineers Pty Ltd (Northrop) Acoustics have been engaged by Marathon Modular to provide an acoustic report to support the development application for a new school building within William Carey Christian College at 38-44 Bumbera Street, Prestons NSW 2170.

A noise survey was conducted to measure the ambient noise at the most affected noise receivers in the vicinity of the Project. Based on the ambient noise measurements and requirements of the EPA NSW Noise Policy for Industry, the noise criteria were established.

Noise emission levels to the surrounding sensitive receivers from the operations of the development were assessed against the project criteria, including receivers from future developments. The noise and vibration from the construction of the development were also assessed. Where exceedances occurred, recommendations were provided for compliance.

Provided our recommendations are implemented, noise emissions from the subject development will comply with the acoustic requirements of Liverpool Council, NSW EPA Noise Policy for Industry and relevant Australian standards and guidelines.

1.1 Referenced Documents

This assessment has been prepared considering the following documentation:

1.1.1 Project Documents:

- Architectural drawings issued by Marathon Modular on 26/08/2024 – see Appendix A
- Mechanical Engineering Drawings issued by WalkerBai Consulting on 17/09/2024 – see Appendix A
- Site plan drawings for development application (ref: DA-347/2020) issued by Cardno on 01/04/2020

1.1.2 Consent Authority, Design Guidelines and Standards:

- Liverpool Council Development Control Plan (DCP), 2008 (28/02/2024 edition)
- NSW Noise Policy for Industry (NPfI), 2017, issued by NSW Environmental Protection Authority
- NSW Interim Construction Noise Guideline (ICNG), 2009, issued by NSW Department of Environment, Climate Change and Water
- AS 2436:2010: Guide to Noise and vibration control on construction demolition sites, 2010, issued by Standards Australia
- AS 2670:2001: Vibration and shock – Guide to the evaluation of human exposure to whole body vibration, 2001, issued by Standards Australia
- Update of Noise Data Base for the Prediction of Noise on Construction Sites, 2005, issued by UK Department for Environment Food and Rural Affairs
- DIN 4150: Part 3, Structural Vibration: Effects of Vibration on Structures – issued by Standards Australia

2. Project and Site Description

2.1 Project Understanding

Marathon Modular have proposed to build a two-storey classroom building. The proposed new building will comprise:

- Ground Floor:
  - 2 Science lab rooms
  - Storage rooms
  - Electrical distribution (EDB) room
  - Communications room
  - Toilets
- Level 1:
  - 4 General learning areas (GLA)

2.2 Site Description

The Project is located at 38-44 Bumbera Street, Prestons NSW 2170 and is situated within the existing school grounds. The school grounds are bounded by residential receivers in all directions.

The west boundary of the Project is proposed to be a residential complex. Drawings from the approved development application (ref: DA-347/2020) for this future residential complex have been referenced for this report.

2.3 Sensitive Receivers

The following neighbouring buildings are identified as sensitive receivers which have potential for noise impact.

Table 1: Identified Nearest Affected Receivers

Receiver ID	Address	Land Use	Location
R01	26 Tate Crescent, Horningsea Park	Residential	West of Project
R02	1 Drinkwater Lane, Edmondson Park	Residential	South of Project
R03	28B Mullenderree Street, Prestons	Residential	East of Project
R04	34 Mullenderree Street, Prestons	Residential	East of Project
R05	53 Bumbera Street, Prestons	Residential	North of Project
R06	1895 Camden Valley Way, Horningsea Park[1]	Residential (Future)	West of Project

1. Receiver location is representative of the worst affected lot as per the site plan drawings

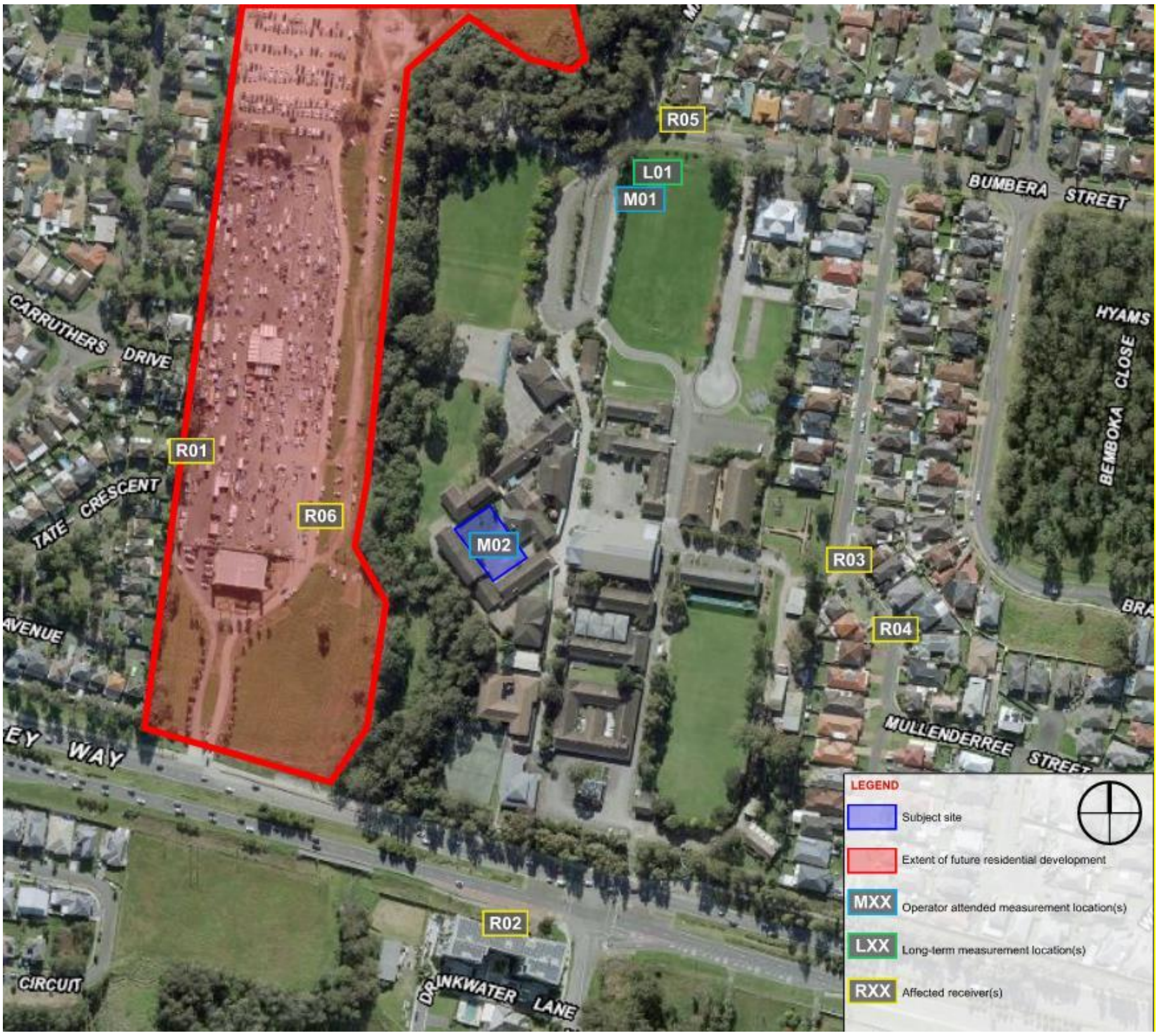


Figure 1: Aerial view of Project with nearest affected receivers

3. Existing Environment

A site survey was undertaken as part of the noise assessment, where the existing noise levels were determined. The survey included long term unattended noise monitoring and operator attended noise measurements.

The results of the survey are summarised in the following sections.

3.1 Long Term Noise Logging

Automatic logging noise measurements were performed at the Project to document the existing acoustic environment.

Long-term noise monitoring was conducted between 27/08/2024 and 04/09/2024 at Logger location shown in Figure 1 above. Detailed results of the logger measurements are shown in Appendix C.

Details of the noise monitoring locations are summarised in Table 2.

Table 2: Noise monitoring locations

Logger ID	Address	Equipment used	Description
L01	38-44 Bumbera Street, Prestons	Rion NL-52 (serial number: 00386740)	Noise monitor installed within an open field north of the Project. The microphone was installed at a height of 1.5m above ground level.

The equipment used are detailed in Table 2 and are all Type 1 noise monitors and carry traceable calibration certificates. Field calibration was undertaken before and after the noise monitoring period. No significant drift in calibration was recorded.

The noise logger was set to continuously record noise levels over fifteen-minute periods, capturing noise parameters including L_{eq}, L_{max}, L_{min}, L_{90}, and L_{10}.

Meteorological data was retrieved from a Bureau of Meteorology station located within 30km of the Project.

The results of the automatic logging measurements are shown in Table 3 below.

Table 3: Long-term noise monitoring results

Period	Equivalent Continuous Noise Level $L_{Aeq,15min}$ – dB(A)	Rating Background Noise Level RBL $L_{A90,15min}$ – dB(A)
Day	60	46
Evening	51	43
Night	50	37

The L_{A90} rating background noise levels were determined using the methodology as described in the Noise Policy for Industry.

3.2 Operator Attended Measurements

Fifteen minute attended measurements were conducted to verify unattended background noise levels, to establish the octave band noise levels and to characterise the acoustic environment around the

Project. Operator attended noise measurement survey was conducted with an integrating Type 1 NTi XL2 sound level meter (serial number: A2A-15765-E0) and windshield. Measurements were taken continuously, and the microphone was set to receive direct frontal sound and facing the direction of sound emission. Field calibrations were undertaken before and after each measurement. No significant drift in calibration was recorded.

The operator attended noise measurements were performed on 27/08/2024 and 04/09/2024 at locations *M1 and M2,* marked in blue in Figure 1. Results are presented in Table 4 below.

Table 4: Operator attended measurements

Location	Measurement date and time	$L_{Aeq, 15 minute}$ – dB(A)	$L_{A10, 15 minute}$ – dB(A)	$L_{A90, 15 minute}$ – dB(A)
M1	27/08/2024 9:23am – 9:38am	67	71	56
M2	27/08/2024 9:51am – 10:06am	56	59	48
M1	04/09/2024 12:17am – 12:32am	55	58	47

4. Noise Emission Assessment

This section assesses noise emissions from the development impacting the surrounding noise receivers.

4.1 Criteria

4.1.1 Liverpool City Council Development Control Plan (DCP) 2008

Liverpool City Council DCP does not provide quantitative criteria for noise emissions, thus guidance has been taken from the Noise Policy for Industry (NPfI).

4.1.2 NSW EPA Noise Policy for Industry (2017)

The NPfI sets out noise criteria to control the noise emission from industrial noise sources. Operational noise from the development will be assessed in accordance with the NPfI.

The NPfI assessment procedure has two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

The project noise trigger level is the lower (that is, the more stringent) value of the project intrusiveness noise level and project amenity noise level determined in Section 4.1.2.1 and Section 4.1.2.2. The project noise trigger level provides a benchmark for assessing the noise emissions from a development.

4.1.2.1 Project Intrusiveness Noise Level

The intrusiveness noise level aims to limit the change in the existing environment due to the introduction of a new noise source. The intrusiveness noise level is defined as:

$$L_{Aeq,15min} = RBL + 5\ dB$$

Where the RBL is determined through the background noise monitoring undertaken in Section 3.1.

The project intrusiveness noise levels are presented in Table 5 below.

Table 5: Project intrusiveness noise level (residential receivers only)

Receiver	Time period[1]	Measured RBL – $L_{90,15min}$ dBA	Project intrusiveness noise level – $L_{eq,15min}$ dBA
Residential (R01 – R06)	Day	46	51
	Evening	43	48
	Night	37	42

1. Time periods defined as: Day 7am to 6pm Monday to Saturday and 8am to 6pm Sunday; Evening 6pm to 10pm Monday to Sunday; Night 10pm to 7am Monday to Saturday and 10pm to 8am Sunday

4.1.2.2 Project Amenity Noise Level

For the purpose of limiting continual increase in noise levels, recommended noise levels are defined to maintain acoustic amenity for different types of land uses. The recommended amenity noise levels are described in Table 2.2 of the NPfI.

Based on the RBLs presented in and Table 2.3 of the NPfI, the residential receivers can be considered as "suburban". This includes the future residential receivers as it is expected that the noise amenity would not be highly affected by the future residential complex development.

Table 6: Amenity noise levels

Receiver	Noise amenity area	Time period[1]	Recommended amenity noise level – $L_{eq, period}$ dBA	Project amenity noise level – $L_{eq, period}$ dBA[2]	Project amenity noise level – $L_{eq,15min}$ dBA[3]
Residential	Suburban	Day	55	50	53
		Evening	45	40	43
		Night	40	35	38

1. Time periods defined as: Day 7am to 6pm Monday to Saturday and 8am to 6pm Sunday; Evening 6pm to 10pm Monday to Sunday; Night 10pm to 7am Monday to Saturday and 10pm to 8am Sunday
2. Recommended amenity noise level minus 5 dB
3. In accordance with the NPfI, a 3dBA correction has been applied to convert from a period level to a 15 minute level

4.1.2.3 Project Trigger Levels

The project noise trigger level is the more stringent of the project intrusiveness noise level and project amenity noise level. The site specific project trigger levels have been determined for the nearby sensitive receivers and have been detailed in Table 7.

Table 7: Project noise trigger levels

Receiver ID	Land use	Time period[1]	Project intrusiveness noise level – $L_{eq,15min}$ dBA	Project amenity noise level – $L_{eq,15min}$ dBA	Project trigger levels – $L_{eq,15min}$ dBA
R01 – R06	Residential (Suburban)	Day	51	53	51
		Evening	48	43	43
		Night	42	38	38

1. Time periods defined as: Day 7am to 6pm Monday to Saturday and 8am to 6pm Sunday; Evening 6pm to 10pm Monday to Sunday; Night 10pm to 7am Monday to Saturday and 10pm to 8am Sunday

4.2 Noise Emission Assessment

4.2.1 Noise Sources

4.2.1.1 External Mechanical Plant

It is expected that the main noise emission source from the development would be the external mechanical plant servicing the development.

Based on the latest mechanical drawings as outlined in Appendix A, the external mechanical plant is proposed to be comprised of the following:

- 14 cooling units (CU)
- 5 fan units

Table 8 below outlines the noise levels of each fan unit and Table 9 outlines the noise levels of each condenser unit used for the purposes of the assessment.

Table 8: Noise source data of proposed fans

Fan Designation	Manufacturer	Product Number	Sound power levels $L_{eq,15min}$, dBA	Number of Units
EF-1	PIFAN	PIFAN SERIES II	85	1
EF-2	FANTECH	JETLINE-200ECO	67	1
EF-3	FANTECH	JETLINE-100ECO	56	1
EF-4	FANTECH	JETLINE-200ECO	63	1
SF-1	FANTECH	PCD356DD	64	1

Table 9: Noise source data of proposed CUs

CU Designation	Manufacturer	Product Number	Sound power levels $L_{eq,15min}$, dBA	Number of Units
CU-G-1A	Mitsubishi	MSZ-AP71VGD2-A1	69	1
CU-G-1B				1
CU-G-1C				1
CU-G-2A				1
CU-G-2B				1
CU-G-2C				1
CU-1-2A				1
CU-1-2B				1
CU-1-3A				1
CU-1-3B				1
CU-1-4A				1
CU-1-4B				1
CU-1-5A				1
CU-1-5B				1

4.2.2 Noise Emission Model

This section has assessed the noise generated from the proposed development. The noise emissions were modelled using a 3D noise modelling program (Cadna-A version 2023).

4.2.2.1 Methodology

The noise model takes the following into account:

- Noise attenuation from the buildings and barriers
- Ground type between the source and the receiver

Table 10 details the modelling inputs.

Table 10: Noise modelling inputs

Modelling In puts	Description
Calculation method	ISO 9613
Source height	CU: 1.6m above ground level EF-1: 1m above finished roof level EF-2, EF-3, EF-4 intake: 3m above ground level
Receiver height	R01, R03, R04, R05, R06 – 1.5m above ground level R02 – 13.5m above ground level
Receiver location	As shown in Figure 1
Ground contours	1m ground contours obtained from ELVIS
Ground absorption	0.5 – Global

4.2.2.2 Predicted Noise Levels

Noise emissions were predicted at the nearest affected receivers shown in Table 11 below.

Table 11: Predicted noise emissions levels at each identified affected receivers

Receiver ID	Land use	Criteria[1]			Predicted noise level $L_{eq,15\ min}$ dBA
		Day	Evening	Night	
R01	Residential	51	43	38	28
R02	Residential	51	43	38	25
R03	Residential	51	43	38	25
R04	Residential	51	43	38	27
R05	Residential	51	43	38	23
R06	Residential	51	43	38	30

1. Time periods defined as: Day 7am to 6pm Monday to Saturday and 8am to 6pm Sunday; Evening 6pm to 10pm Monday to Sunday; Night 10pm to 7am Monday to Saturday and 10pm to 8am Sunday

Based on the results shown in Table 11, the noise levels are predicted comply with the criteria set in Table 7, hence no mitigation measures are required for the external mechanical plant equipment.

5. Construction Noise and Vibration

5.1 Construction Proposal

The construction works are proposed to occur anywhere within the site boundary shown in Figure 1.

The works are expected to be undertaken in stages. For modelling purposes, three separate construction scenarios were assessed and are detailed in Table 12.

Table 12: Construction Modelling Scenarios

Scenario ID	Construction activity
SC01	Foundations
SC02	Building module install
SC03	Commissioning works

5.1.1 Construction Hours

As of writing, the proposed hours of construction have not been specified. Thus, standard construction hours were assumed as specified below.

- Monday to Friday 7 am to 6pm
- Saturday 8 am to 1 pm
- No work on Sundays or public holidays

5.2 Construction Noise Objectives

Construction noise can adversely affect, sleep, concentration and learning performance and mental and physical health. Therefore, it is critical to feasible and reasonably minimise construction noise impacts.

The NSW ICNG is specifically focuses on applying a range of work practices most suited to minimise construction noise impacts. The ICNG provides Noise Management Levels (NMLs) as a benchmark for assessing construction noise emissions. The NMLs for residential receivers are presented in Table 13.

Table 13: ICNG Noise Management Level (residential receivers)

Time of day	Noise Management Level (NML) – $L_{eq,15min}$ dBA	How to apply
Recommended Hours: 7 am – 6 pm, Mondays to Fridays inclusive; and 8 am – 1 pm, Saturdays. No work may be carried out 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 LAeq (15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining, regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) If the community is prepared to accept longer period of construction in exchange for restrictions on construction times.
Outside recommended hours	Noise affected RBL + 5 dB	A strong justification would typically be required for work outside the recommended hours The proponent should apply all feasible and reasonable work practices to meet the noise affected level Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community For guidance on negotiating agreements see Section 7.2.2 (NSW Interim Construction Noise Guideline)

Table 14 presents the site specific NMLs for the nearby residential receivers.

Table 14: Construction Noise Management Levels at residential receivers

Receiver	Measured day time RBL,	Day NML, $L_{eq,15min}$ dBA
Residential (R01 – R06)	46	56

5.3 Construction Vibration Objectives

The following criteria are considered applicable when assessing vibration emission levels from the construction works.

The effects of ground vibration on buildings near construction sites may be broadly defined by the following two categories:

- Effects on building structures - Vibration that can result into cosmetic building damage
- Disturbance to building occupants - Vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.

Vibration criteria is provided for both scenarios in Section 5.3.1 and 5.3.2.

5.3.1 Cosmetic Building Damage and Structural Integrity

The vibration criteria for cosmetic damage have been taken from the German Standard DIN4150 2016 '*Structural vibration: Effects of vibration on structures*'. DIN4150 provides recommended limits to ensure minimal risk of damage. Furthermore, it presents different sets of criteria for different types of structures. The DIN4150 vibration limits used for this Project are provided in Table 15.

Table 15: DIN4150-3:2016 Cosmetic Damage Criteria, Peak Particle Velocity – PPV

Group	Type of structure	Vibration velocity, mm/s				
		At foundation in all directions at frequency of			Plane of floor uppermost storey in horizontal direction	Floor slabs, vertical direction
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	All frequencies	All frequencies
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20

5.3.2 Human Comfort

For disturbance to human occupants of buildings, guidance has been taken from the AVaTG. This document provides criteria which are based on the British Standard BS 6472-1992, 'Evaluation of human exposure to vibration in buildings (1-80Hz)'.

Vibration sources are defined as Continuous, Impulsive or Intermittent. Section 2 of the AVaTG guideline defines each type of vibration as follows:

'Continuous vibration continues uninterrupted for a defined period (usually throughout the day-time and/or night-time).

Impulsive vibration is a rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.

Intermittent vibration can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude'.

The criteria are to be applied to a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

'Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472).'

Preferred and maximum values for continuous and impulsive vibration are defined in Table 16.

Table 16: Preferred and maximum weighted RMS values for continuous and impulsive vibration acceleration (m/s^2) 180Hz

Location	Assessment period	Preferred values		Maximum values	
		z axis	x & y axis	z axis	x & y axis
Continuous vibration					
Residences	Daytime (7am-10pm)	0.010	0.0071	0.020	0.014
Impulsive vibration					
Residences	Daytime (7am-10pm)	0.30	0.21	0.60	0.42

Intermittent vibration is to be assessed using VDV. The VDV method is a fourth power approach which is more sensitive to peaks in the acceleration waveform and makes corrections to the criteria based on the duration of the source's operation.

The VDV can be calculated using the overall weighted rms acceleration of the vibrating source in each orthogonal axis and the total period during which the vibration may occur. Weighting curves are provided in each orthogonal axis.

Preferred and maximum VDV values are defined in Table 17 below extracted from Table 2.4 of the AVaTG.

Table 17: Preferred and Maximum VDV Values, $m/s^{1.75}$

Location	Day time (7am-10pm)		Night time (10pm-7am)	
	Preferred values	Maximum values	Preferred values	Maximum values
Residences	0.20	0.40	0.13	0.26

5.4 Construction Noise Assessment

5.4.1 Noise Source Levels

The proposed plant and equipment are summarised in Table 18. The sound power levels have been sourced from TfNSW Construction Noise and Vibration Strategy and the Department for Environment Food and Rural Affairs (United Kingdom), Update of noise database for prediction of noise on construction and open sites – Phase 3: Noise measurement data for construction plant used on quarries.

Table 18: Proposed Construction Plant and Equipment

Equipment	Sound Power Level dBA	No. of equipment per scenario		
		SC01	SC02	SC03
Truck (medium rigid)	103			
Excavator (35 tonne)	110	1		
Front end loader (23 tonne)	112			
Truck and dog	108	1	1	
Concrete saws[1]	119	1		
Concrete truck	109			
Concrete pump	102			
Franna crane	98		1	
Grinder[1]	109	1		
Hand tools	104	1	1	1
Forklifts	106			
Scissor Lifts	98		1	1
Compressor	109			
Generator	103			
Jack hammer[1]	113			
Vibrating roller	114			
Water truck	107			
Grader	113			

1. Includes a 5dB penalty to account for annoying characteristics

5.4.2 Noise Modelling Methodology

Noise emissions were predicted by using Cadna-A (version 2023) noise modelling program. The predicted noise levels are presented as a range, which represents the calculated noise levels based on the noise sources being located at the closest distance to the receiver and when the noise source is located at the furthest distance to the receiver.

Equipment with special audible characteristics is not expected to operate for the majority of the construction works. Therefore, the predicted noise levels have been presented as a worst case scenario (includes noise generated by equipment with special audible characteristics) and a typical scenario (does not include noise generated by equipment with special audible characteristics).

For a conservative assessment, it is assumed that all the plant and equipment are operating concurrently. However, in reality not all plant and equipment will be operating concurrently and therefore the actual construction noise levels will be lower than the predicted noise levels presented below.

The noise model takes the following into account:

- Distance from source to receiver
- Ground type between the source and the receiver

- Shielding from surrounding buildings and barriers

The noise modelling inputs are summarised in Table 19.

Table 19: Construction noise modelling Inputs

Modelling inputs	Description
Calculation method	ISO 9613
Source height	Construction plant and equipment: 2m above ground level Truck: 2m
Receiver height	R01, R03, R04, R05, R06 – 1.5m above ground level R02 – 13.5m above ground level
Receiver location	As shown in Figure 1
Ground contours	1m ground contours obtained from ELVIS
Ground absorption	0.5

5.4.3 Predicted Noise Levels

The noise emissions from construction noise were predicted at the nearest affected receivers and presented in Table 20.

Table 20: Predicted construction noise levels

Receiver ID	Receiver Type	Daytime NML	HNA	Predicted Noise Levels			
				SC01		SC02	SC03
				Typical	Worst Case	Typical	Typical
R01	Residential	56	75	52	62	50	47
R02	Residential	56	75	48	58	44	43
R03	Residential	56	75	48	57	44	42
R04	Residential	56	75	42	52	39	37
R05	Residential	56	75	49	52	49	37
R06	Residential	56	75	53	62	51	47

1. **Bold** font indicates an exceedance of the HNA

Based on Table 20, in some construction scenarios, the construction noise levels are predicted to exceed the day time NMLs at the nearest affected receivers, therefore mitigation measures such as implementation of feasible and reasonable measures should be considered (see Section 5.4.4).

5.4.4 Construction Noise Mitigation Measures

Prior to construction, it is recommended that a CNVMP is to be prepared to assess the specific construction works associated with the Project.

Feasible and reasonable work practices should be implemented to reduce the noise impact to the nearest affected receivers. The following is recommended to reduce the noise impacts:

- Community engagement / liaison: Notify the community of planned noisy activities. The community should be notified at least two weeks prior to works beginning and should include the duration and reason for the activity. There should be a communication system such as letter dropping, availability of a site contact and a complaint handling system in place
- Locating plant and equipment as far away from sensitive receivers.
- Where feasible, find “less noisy” alternative construction process
- Select quieter equipment or fit equipment with silencers, where feasible
- Regularly inspecting and maintaining equipment
- Schedule noisy activities during less sensitive times of the day. The time of day will depend on the specific receiver and should be determined through community consultation.
- Organising the site layout to promote one-way traffic to reduce vehicle reversing movements
- No idling of delivery trucks
- Switch off any equipment not in use for extended periods of time
- Educating staff and contractors about noise and quiet work practices. This could include signage and site inductions

Table 21 provides the typical noise reductions for standard engineering mitigation measures.

Table 21: AS 2436:2010 – Possible construction noise mitigation measures

Noise mitigation measure	Typical noise reduction
Distance attenuation	6 dB per doubling of distance
Screening and barriers	Typically, 5 to 10 dBA maximum 15 dBA
Enclosure	Typically, 15 to 25 dBA maximum 50 dBA
Silencing	Typically, 5 to 10 dBA maximum 20 dBA

5.5 Construction Vibration Assessment

The management objective for the Project is to limit vibration from construction activities so as to avoid building damage and human discomfort associated with the construction works. It is noted that buildings in the vicinity of development are residential and commercial. Vibration impacts on the buildings and their occupants should be considered for the assessment of cosmetic damage and human annoyance.

Typical construction plant equipment most likely to cause significant vibration are summarised below.

- Vibratory roller

- Jackhammer

Vibration management strategies shall be implemented on site for the vibration intensive equipment.

5.5.1 Indicative minimum working distances for vibration intensive equipment

To minimise the risk of cosmetic damage, minimum working distances for vibration intensive activities have been provided. The minimum working distances are based on the TfNSW document *Construction Noise and Vibration Strategy (2019)* and are presented in Table 22.

Table 22: Recommended minimum buffer distances for construction plant (cosmetic damage)

Plant item	Recommended minimum buffer distance
Jack hammers	1 m (nominal)
Vibratory rollers > 18 tonne	25 m

The relationship between vibration and the probability of causing human annoyance or damage to structures is complex. This complexity is mostly due to the magnitude of the vibration source, the particular ground conditions between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of design (i.e. dimensions, materials, type and quality of construction and footing conditions). Therefore, site specific minimum buffer distances should be determined through attended vibration monitoring.

The vibration intensive works must comply with the minimum working distances, where feasible. When works need to occur within these recommended minimum buffer distances, vibration monitoring is proposed.

6. Conclusion

This noise and vibration assessment forms part of the development application submission for the proposed development of William Carey Christian College at 38-44 Bumbera Street, Prestons NSW 2170.

A noise survey was conducted to measure the ambient noise at the most affected noise receivers in the vicinity of the Project. Based on the ambient noise measurements and requirements of the EPA NSW Noise Policy for Industry, the noise criteria were established.

Noise emission levels from the operations of the development attributed mainly to the external mech plant were assessed to the identified receivers.

Additionally, a construction noise and vibration assessment undertaken to assess impact on the identified potentially affected receivers.

Where exceedances occurred, recommendations were provided for compliance.

Provided our recommendations are implemented, noise emissions from the developments operations as well as construction noise and vibration emissions are expected to comply with the acoustic requirements of Liverpool City Council, NSW EPA Noise Policy for Industry and relevant Australian standards and guidelines.

Appendix A: Drawings

The following drawings were used in the preparation of this report.

Architectural Drawings

Architectural drawings issued by Marathon Modular

Drawing No.	Revision	Title	Date Issued
SK1C.01	A	TRUE NORTH	22/08/2024
SK1C.02	B	SITE PLAN	26/08/2024
SK1C.03	B	GROUND FLOOR PLAN	26/08/2024
SK1C.04	B	FIRST FLOOR PLAAN	26/08/2024
SK1C.05	B	ROOF PLAN	26/08/2024
SK1C.06	B	ELEVATION 1	26/08/2024
SK1C.07	B	ELEVATION 2	26/08/2024

Mechanical Drawings

Mechanical drawings issued by WalkerBai Consulting

Drawing No.	Revision	Title	Date Issued
M001	A	MECHANICAL SERVICES LEGEND, NOTES & SPECIFICATION	17/09/2024
M002	A	MECHANICAL SERVICES EQUIPMENT SCHEDULE	17/09/2024
M210	A	MECHANICAL SERVICES MECHANICAL LAYOUT – GROUND	17/09/2024
M211	A	MECHANICAL SERVICES MECHANICAL LAYOUT – FIRST	17/09/2024
M212	A	MECHANICAL SERVICES MECHANICAL LAYOUT – ROOF	17/09/2024
M500	A	MECHANICAL SERVICES EQUIPMENT DETAILS	17/09/2024

Appendix B: Glossary of Acoustic Terminology

Decibel – dB – relative unit of measurement for acoustic power, pressure and intensity defined by the ratio of square of the sound pressure, power or intensity to a reference sound pressure, power or intensity value (usually the threshold of human hearing at 1 kHz). Any value expressed as “level” will use decibels as units. Humans have a large sound-sensitivity range so values are expressed in decibels for a more practical range. Values expressed in decibels such as sound pressure level and sound power level cannot be added arithmetically, as their pressure or power values are expressed as a logarithmic ratio. Two equal sound levels combined will result in sound pressure level of 3dB higher than the sound level of one source (e.g. 60 dB + 60 dB = 63 dB). Levels with 10 or more dB difference will not add (e.g. 50 dB + 60 dB = 60 dB). All values in this report expressed in decibels assume reference pressure of 20 µPa.

A-weighted decibel – dB(A), dBA – frequency weighted sound levels in decibels correlated with perceived human hearing at low and medium levels. dB(A) and dBA are used to express the units; A used as a subscript e.g. L_{Aeq} or L_{A90} denotes an A-weighting applied to that value.

C-weighted decibel – dB(C), dBC – frequency weighted sound levels in decibels correlated with perceived human hearing at high and peak levels. dB(C) and dBC are used to express the units; C used as a subscript e.g. L_{Ceq} or L_{C90} denotes that a C-weighting applied to that value.

Linear or z-weighted decibels – dB, dBz – no frequency weighting applied. dBz is often denoted to remove ambiguity that a frequency weighting has not been applied to a given set of data.

Sound Pressure Level – SPL, L – sound pressure measured in decibels. Logarithmic values relative to a reference value are used to convert the large range of sound pressure (in Pascals) audible to humans to a more practical range. Sound pressure level is a measured value and is dependent on distance from the sound source(s) and acoustic environment.

Sound Power Level – SWL – sound power in decibels. Logarithmic values relative to a reference value are used to convert the large range of sound power (in Watts) audible to humans to a more practical range. Sound power level is a calculated value that is inherent to a sound source and is independent of distance and acoustic environment.

Background noise – The background noise at a given location is the noise measured in absence of any intermittent or extraneous noise sources. The measured L_{90} value is statistically considered the background noise level at the measurement location.

Ambient noise – The ambient noise at a given location is the noise comprising all noise sources occurring during the measurement period. The measured L_{eq} value is statistically considered the ambient noise level at the measurement location.

Octave band (and centre frequency) – octave bands divide the spectrum of audible sound into equal parts. An octave band is denoted by its “centre frequency”, in Hertz, Hz. Each octave or octave band includes a range of frequencies whose upper frequency limit is twice that of its lower frequency limit. For example, the 1000 Hz octave band contains sound energy at all frequencies from 707 Hz to 1414 Hz, rounded to 710 Hz and 1410 Hz for practical reasons. One-third octave bands span one-third of an octave and are often used for more precise applications.

L_{max} or $L_{max,T}$ – The Maximum Noise Level over a sample period (often specified in the subscript) is the maximum level, measured on fast response, during the sample period.

L_{Amax} or $L_{Amax,T}$ – A-weighted L_{max} measured in dB(A).

L_{10} or $L_{10,T}$ – The noise level which is exceeded for 10% of the sample period (often specified in the subscript). During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{10} is a common noise descriptor for environmental noise and road traffic noise.

L_{A10} or $L_{A10,T}$ – A-weighted L_{max} measured in dB(A).

L_{eq} or $L_{eq,T}$ – The equivalent continuous sound level is the energy average of the varying noise over the sample period (often specified in the subscript) and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise. L_{eq} is measured in dB.

L_{Aeq} or $L_{Aeq,T}$ – A-weighted L_{eq} measured in dB(A).

L_{90} or $L_{90,T}$ – The noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{90} level for 10% of the time. This measure is commonly referred to as the background noise level or RBL. L_{90} is measured in dB.

L_{A90} or $L_{A90,T}$ – A-weighted L_{90} measured in dB(A).

L_{min} or $L_{min,T}$ – The Minimum Noise Level over a sample period (often specified in the subscript) is the minimum level, measured on fast response, during the sample period.

L_{Amin} or $L_{Amin,T}$ – A-weighted L_{min} measured in dB(A).

SEL, L_E – Sound Exposure Level – the constant sound level containing equal energy in one second to the original event. A-weighted Sound Exposure Level is denoted by L_{AE}.

NRC – a single number index from 0 to 1 representing the proportion of sound energy reflected by a surface where 1 equals total absorption and 0 equals zero absorption (total reflection), given by the average value of the absorption coefficients in the 250 Hz, 500 Hz, 1 kHz and 2 kHz octave bands. NRC is used to compare sound absorption performance in the midrange of frequencies for building materials.

Acoustic insulation – a general term to describe the ability or effectiveness of a building element such as a wall, window, door or floor to reduce sound transmission depending on its composition and construction. Insulation materials such as fiberglass and polyester – often referred to as "insulation" – can be used in walls, floors, ceilings etc. to reduce interstitial reflections in the cavity which may increase the acoustic insulation performance.

Transmission loss – the reduction in sound pressure level between two designated locations in a sound transmission system.

Sound insulation transmission loss – the difference in decibels between the average sound pressure levels across a partition separating source and receiver rooms.

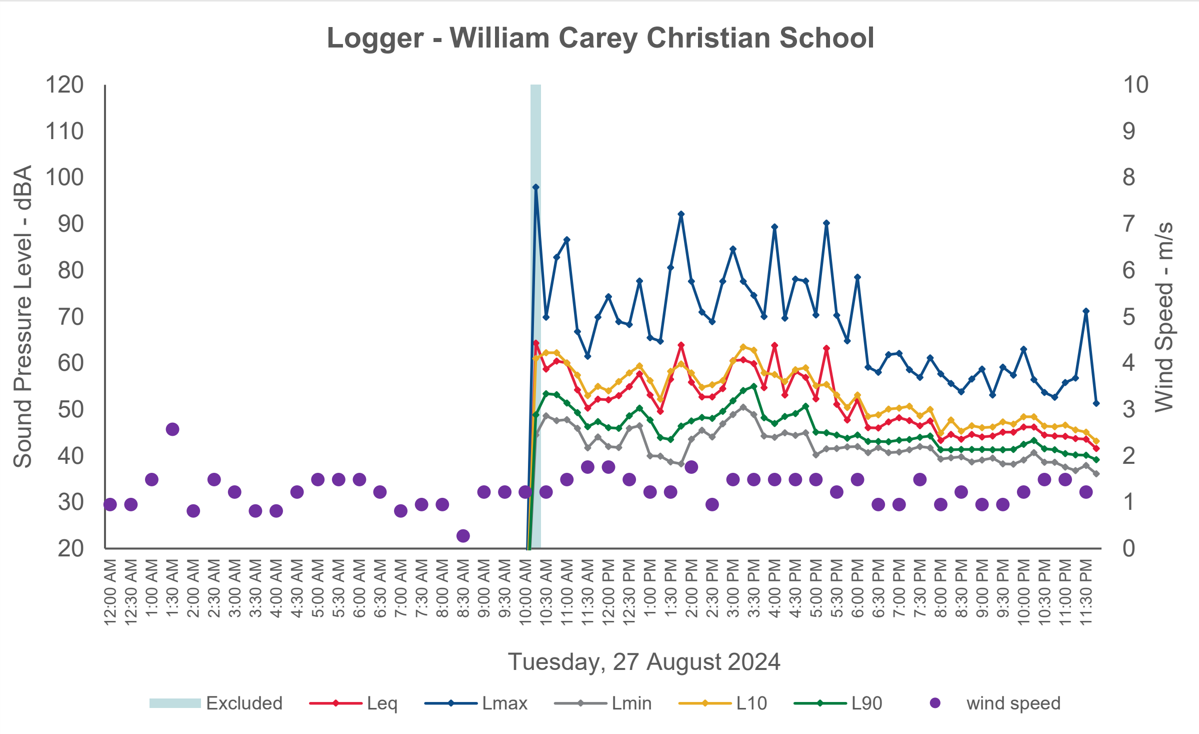
R_w – Weighted Sound Reduction Index – the design value representing the effective sound reduction of a building element. Each increasing increment in R_w is equivalent to 1 dB of noise reduction. R_w is based on laboratory measurement, where negligible flanking is present. Spectrum adaptation terms C and C_{tr} are often added to the measured R_w result to account for low frequency noise. R_w is measured in (linear) dB.

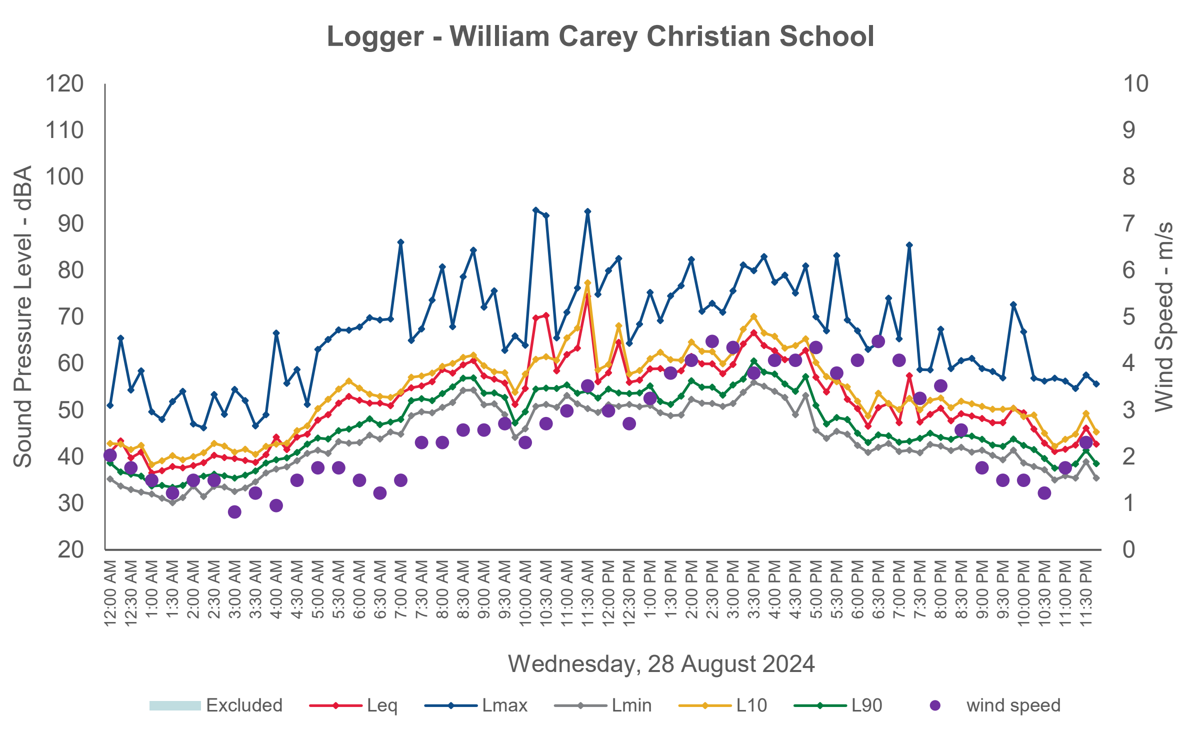
Appendix C: Long Term Noise Monitoring Results

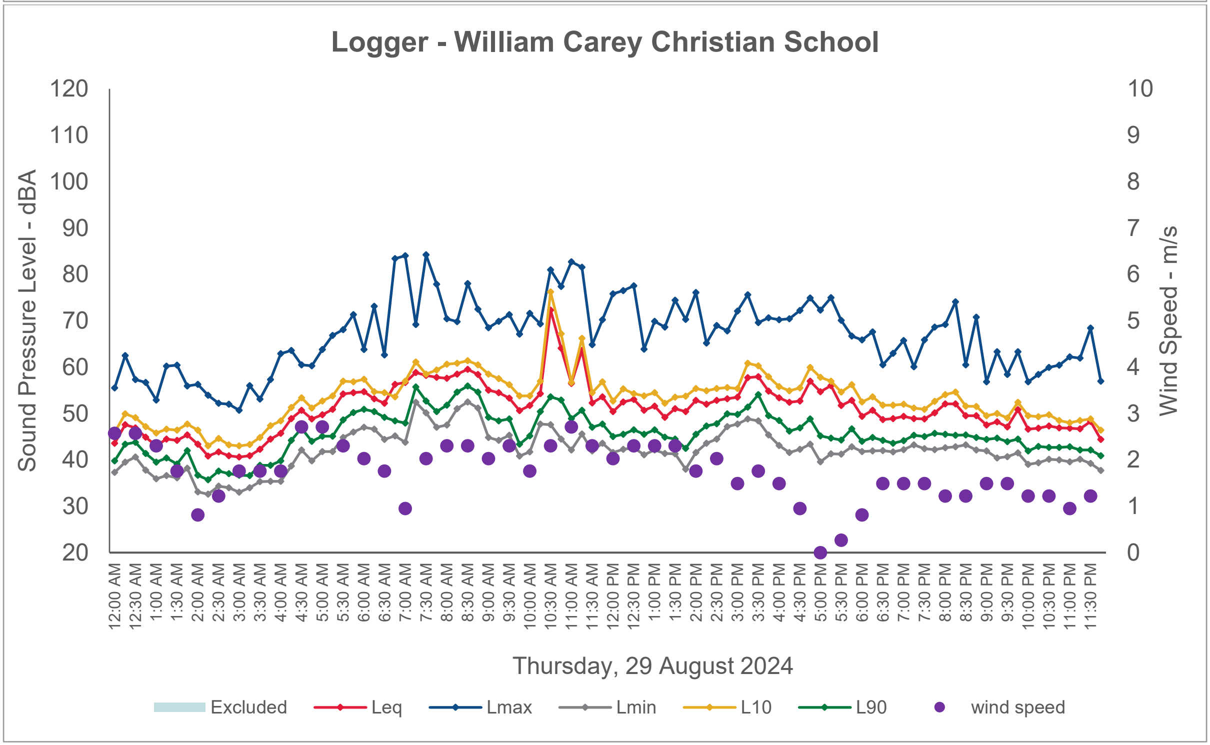
The details are of the noise logging measurements are shown below. The measurements are in accordance with the NSW EPA Noise Policy for Industry (2017).

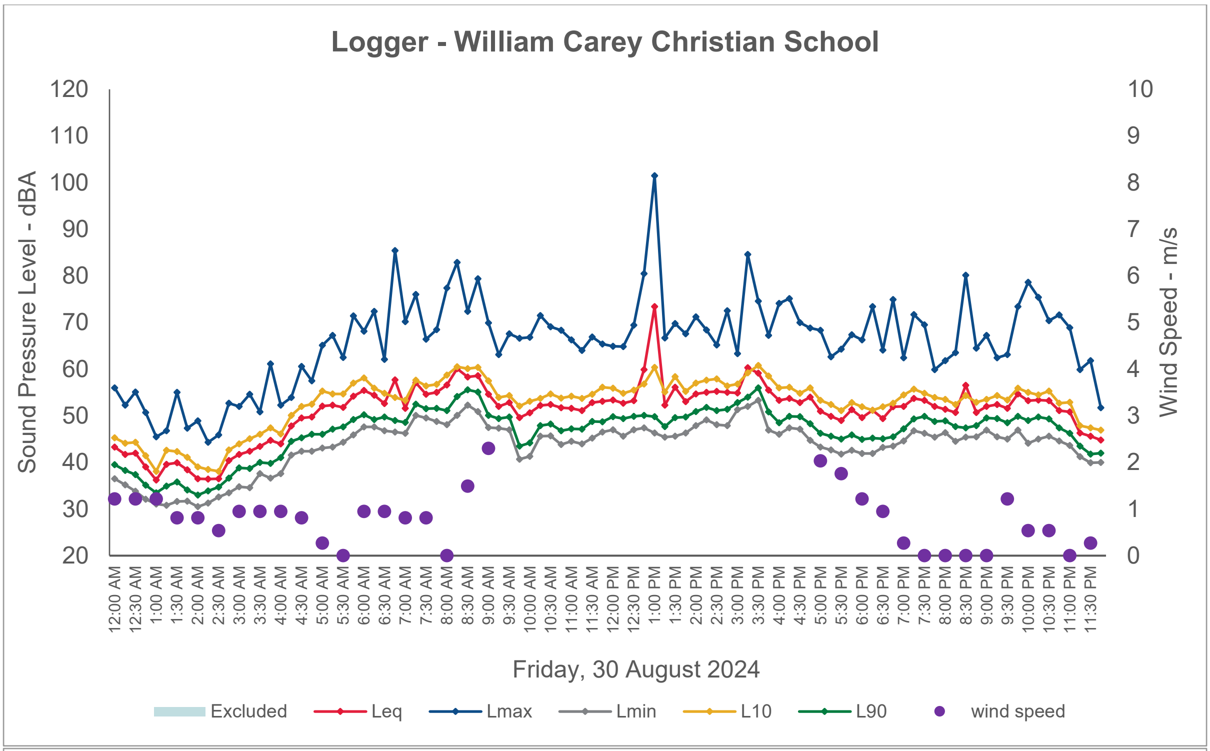
To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are plotted in the graphs below, are here defined.

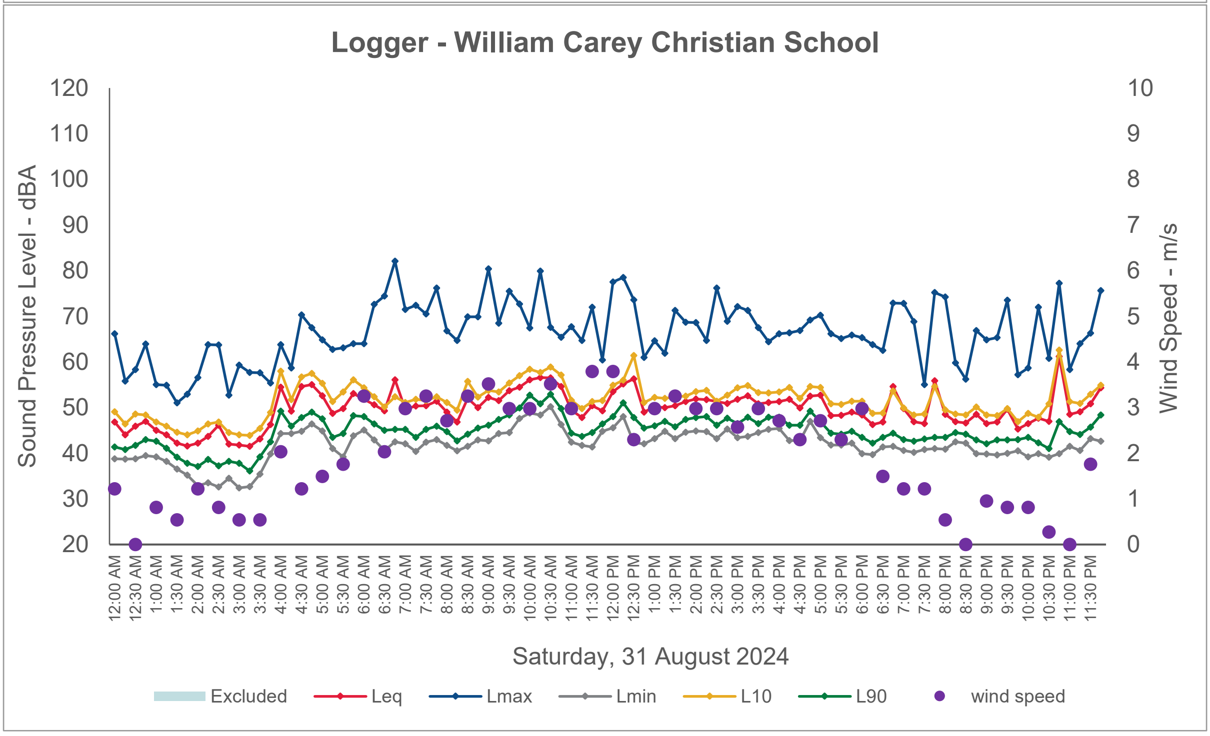
The sections marked in blue have been omitted due to rain that may have affected the measurements.

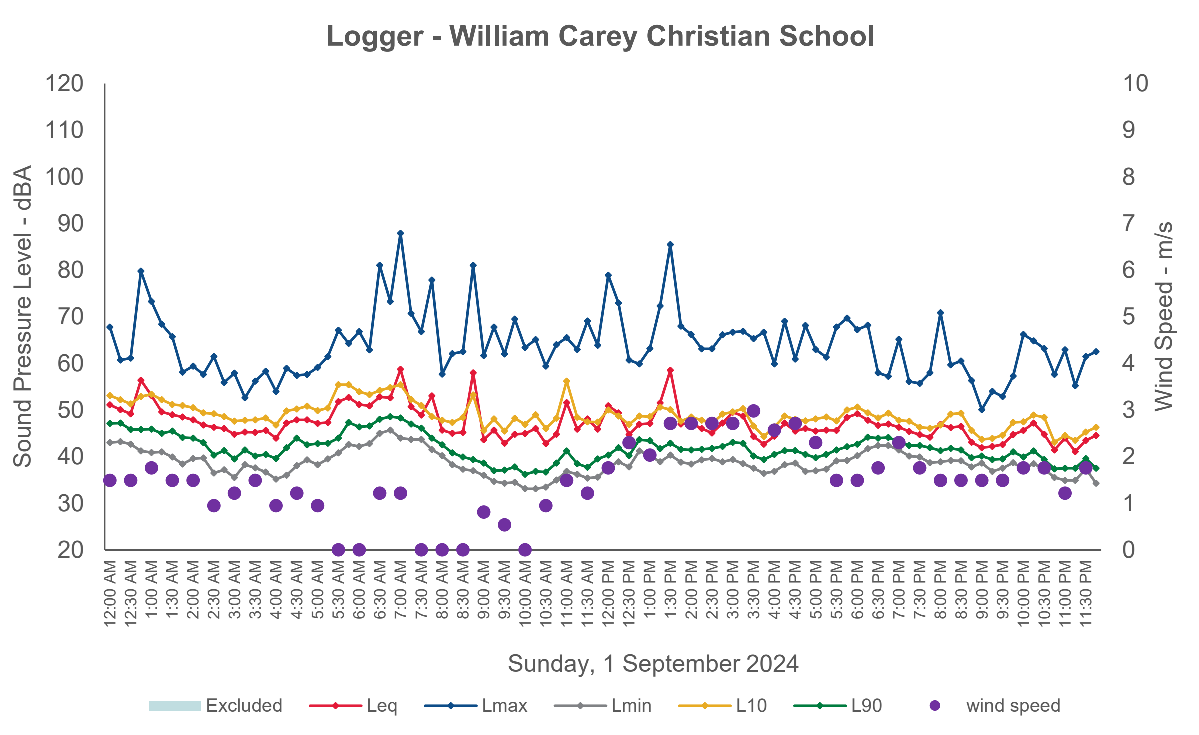


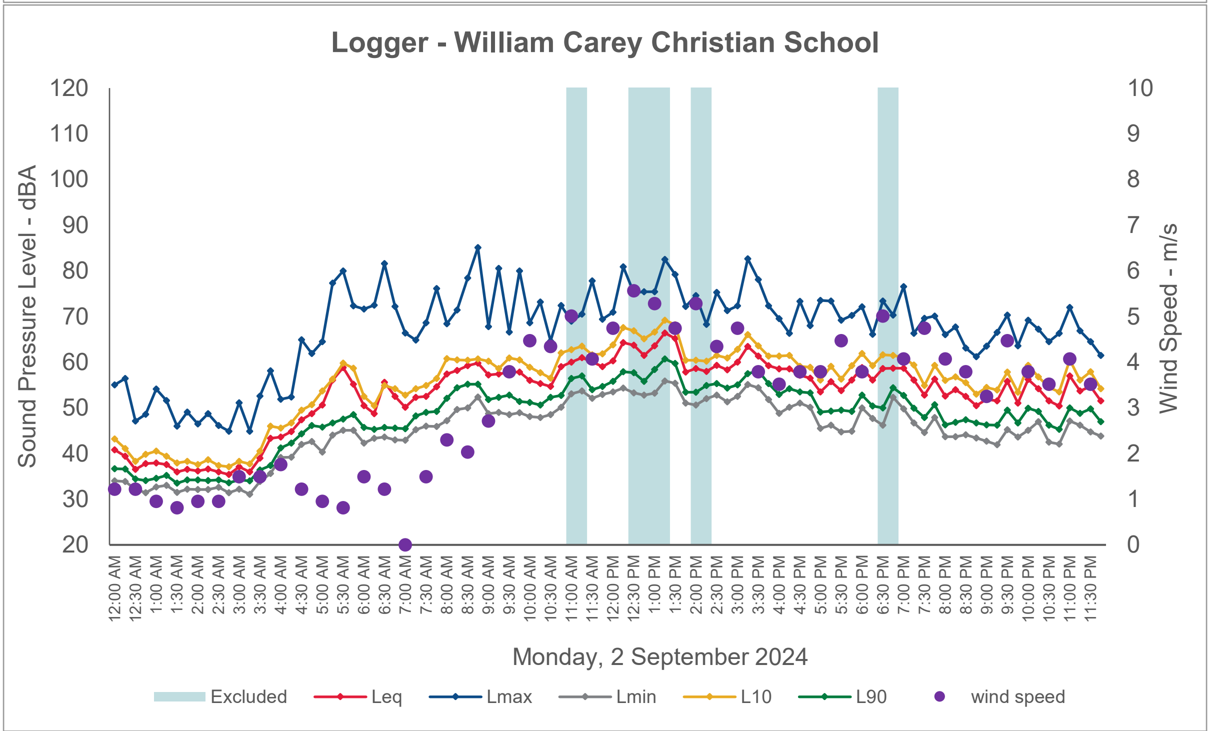

Logger - William Carey Christian School
Sound Pressure Level - dBA
Wind Speed - m/s
Wednesday, 28 August 2024
Excluded
Leq
Lmax
Lmin
L10
L90
wind speed

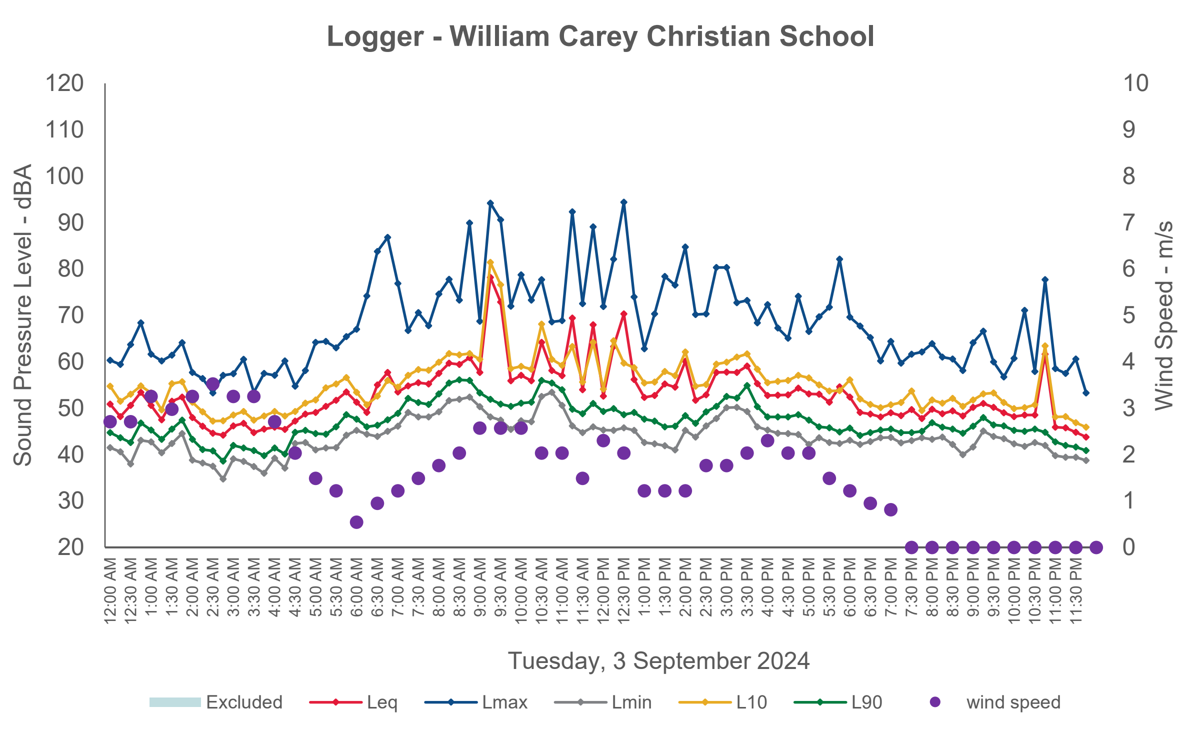

Logger - William Carey Christian School
Sound Pressure Level - dBA
Wind Speed - m/s
Thursday, 29 August 2024
Excluded
Leq
Lmax
Lmin
L10
L90
wind speed

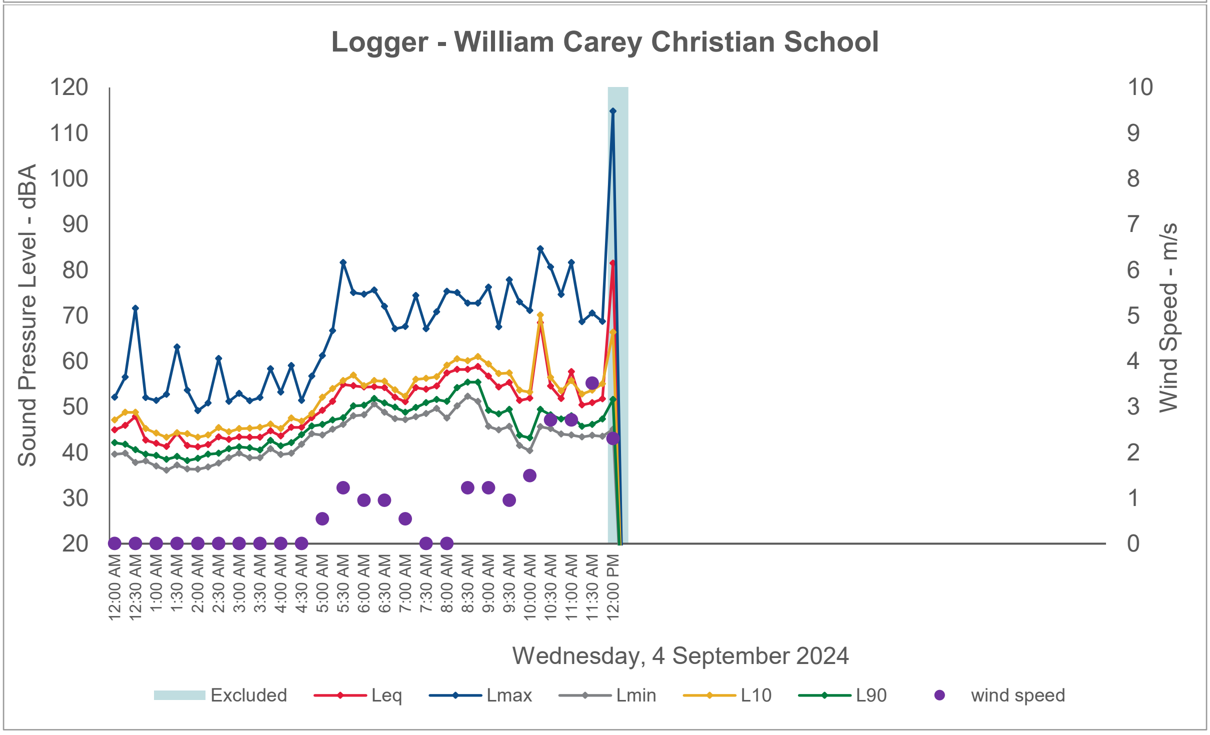

Logger - William Carey Christian School
Sound Pressure Level - dBA
Wind Speed - m/s
Friday, 30 August 2024
Excluded
Leq
Lmax
Lmin
L10
L90
wind speed


Logger - William Carey Christian School
Sound Pressure Level - dBA
Wind Speed - m/s
Saturday, 31 August 2024
Excluded
Leq
Lmax
Lmin
L10
L90
wind speed


Logger - William Carey Christian School
Sound Pressure Level - dBA
Wind Speed - m/s
Sunday, 1 September 2024
Excluded
Leq
Lmax
Lmin
L10
L90
wind speed


Logger - William Carey Christian School
Sound Pressure Level - dBA
Wind Speed - m/s
Monday, 2 September 2024
Excluded
Leq
Lmax
Lmin
L10
L90
wind speed


Logger - William Carey Christian School
Sound Pressure Level - dBA
Wind Speed - m/s
Tuesday, 3 September 2024
Excluded
Leq
Lmax
Lmin
L10
L90
wind speed


Logger - William Carey Christian School
Sound Pressure Level - dBA
Wind Speed - m/s
Wednesday, 4 September 2024
Excluded
Leq
Lmax
Lmin
L10
L90
wind speed

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