REPORT

NOISE AND VIBRATION IMPACT ASSESSMENT

Parramatta East Public School (PEPS) Upgrade
NSW Department of Education

NDY
A TETRA TECH COMPANY

CONFIDENTIAL

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STAKEHOLDERS

ROLE	TEAM MEMBER	ORGANISATION
Client Representative	Michael Ing	SiNSW
Project Director	Daniel Smith	John Staff
Project Manager	Luke Jacobs	John Staff
Architect	Jason Tan	JDH Architects
Services Engineer	Richard Hopkins	Steensen Varming (Mechanical)
Services Engineer	Michael Slatter	Erbas

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1 INTRODUCTION AND DECLARATION

1.1 INTRODUCTION

This Noise and Vibration Impact Assessment has been prepared by NDY on behalf of the NSW Department of Education to assess the potential environmental impacts that could arise from the Parramatta East Public School (PEPS) upgrade (the **proposal**) at Brabyn Street, North Parramatta (The **site**). The works are proposed by the NSW Department of Education to meet the growth in educational demand in Collet Park precinct, and the broader North Parramatta area.

This report has been prepared to assess the potential noise and vibration environmental impacts that could arise from construction and operation of the above activity.

1.1.1 SUMMARY OF THE ACTIVITY

The activity comprises upgrades to PEPS to provide replacement teaching facilities in place of the existing temporary and permanent facilities that are no longer fit for purpose, involving the following works:

- Site preparation and required earthworks;
- Demolition of existing Buildings C, D, E and F, and associated structures including adjacent ramps and walkways;
- Construction of the following:
  - A new 3-storey school building (referred to as Block R) including teaching spaces, library/administration, and staff/student amenities;
  - Upgrade of soft and hard landscape and playground areas;
  - A new at-grade parking area;
  - Formalised waste area, with access being retained from Gaggin Street;
  - Public Domain Works with upgrades to the pedestrian access south of the school, and new kiss and ride zone on Albert Street East;
  - Entrance and School logo signage along the Northern Albert Street East frontage of Block R;
- Refurbishment works to existing buildings;
- Removal of trees as required and retention where possible; and
- Installation and augmentation of services and infrastructure as required.

Refer to the Review of Environmental Factors prepared by Ethos Urban for a full description of works.

1.1.2 SITE DESCRIPTION

The site is located at Brabyn Street within the City of Parramatta Local Government Area. Parramatta East Public School is located in the suburb of North Parramatta, within the City of Parramatta Local Government Area (LGA). The site is approximately 1.5km northeast of the Parramatta CBD, and 24km west of the Sydney CBD.

The site currently comprises a single lot to make up Parramatta East Public School; referred to as **Lot 100, DP1312418,** and the land is owned by the Minister for Education and Early Learning.

The site has an area of approximately 1.782Ha, is of an irregular shape, and is bounded by Brabyn Street to the West, Albert Street East to the North, and Gaggin Street/Webb Street to the East. The project area is contained within the site and represents where the proposed worls will be undertaken, with an area of approximately 1.492Ha.

An aerial image of the site is shown at Figure 1 below.

FIGURE 1: SITE AERIAL. SOURCE NEARMAPS, ETHOS URBAN.

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

1.1.3 SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

Based on the identification of potential issues, and an assessment of the nature and extent of the impacts of the proposed activity, it is determined that:

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

1.2 AUTHORS

This report was prepared by Victoria Rastelli, Member of the Acoustical Society of New Zealand and the Association of Australasian Acoustical Consultants. Quality assurance was carried out by Thomas Warren.

1.1 PURPOSE

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

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

1.2 AUTHORITY

Authority to undertake this report was provided by Michael Ing of DoE on 15.05.2024.

1.3 INFORMATION SOURCES

The report is based upon the following information:

- NSW Noise Policy for Industry (NPfI) 2017.
- NSW Interim Construction Noise Guideline (ICNG) 2009.
- NSW Road Noise Policy (RNP) 2011.
- NSW Government Department of Planning Development Near Rail Corridors and Busy Roads – Interim Guidelines (2008).
- NSW EPA Assessing Vibration: A Technical Guideline 2006.
- State Environmental Planning Policy (Transport and Infrastructure) 2021.
- AS / NZS 2107:2016 Acoustics, Recommended design sound levels and reverberation times for building interiors.
- NSW Department of Environment & Climate Change (DECC), Interim Construction Noise Guideline, 2009
- DEFRA 2005 Data base, including the existing construction noise database on BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration control on construction and open sites Part 1 Noise and Part 2 Vibration.
- NSW Interim Construction Noise Guideline 2009.
- German DIN 4150: Part 3 – 1999 "Effect of Vibration on Structure" (DIN 1999)
- Australian Standard AS 2670.2 1990 – Evaluation of Human Exposure to Whole Body Vibration – Part 2: Continuous and Shock Induced Vibration in Building (1 Hz to 80 Hz).
- British Standard BS 6472 – 2008 – Evaluation of Human Exposure Vibration in Buildings (1 Hz to 80 Hz)
- Parramatta DCP 2023 / LEP 2023.
- GDH Architecture set Rev A, TD 100% Issued for Tender, dated 28.11.24.
- Steensen Varming Mechanical services HVAC Project, 100% SD, Issue A, dated 16.09.24.
- Steensen Varming Electrical services package, revision C, 100% SD, dated 16.09.24.
- Erbas Fire protection set, P3 dated 16.09.24 100% SD issue.
- Erbas Hydraulic Services, P3 dated 16.09.24 100% SD issue.
- Elephants foot Operational waste management plan, Revision D, dated 01.10.24.
- TTW Parramatta East public School Rapid Transport Assessment, dated 11.11.2022.
- TTW Transport and accessibility impact assessment updated, dated 18.10.24.
- TTW Prelim Construction traffic management plan upgrade, dated 01.11.24
- Ethos Urban Parramatta East Public School upgrade – REF instructions, 30.01.2025.
- JK Geotechnics, dated 22.09.2022

2 PROJECT INFORMATION – CONSULTANT INTRODUCTION

We understand that the school refurbishment works will produce noise / vibration impacts to the surrounding areas with the kiss and drop and carpark areas, increase of student number, demolition and construction of buildings, mechanical and electrical services, fire protection services and garbage collection services.

- We understand that staff number will increase from approximately 32 to 41 and student number will increase from approximately 500 – 667.
- The mechanical services strategy consists of a main rooftop plant area for ODU / condensers in building R with some (extract / supply) fans also on this rooftop. This plant area will be partially shielded with a solid screen around the perimeter. There will be a group of standalone ODU / condensers units between building R and Brabyn St.
- The existing kiosk substation will be replaced with a new kiosk substation (nominal 1,000kVA) in front of building B (Albert St side).
- There will be a new hydrant diesel pump, close to the garbage and emergency vehicle entry in Gagging Street, near
- Proposed carpark will have 21 staff spaces and will be located in Brabyn St. near receiver 5.
- We understand that the current waste management strategy will not be changed.

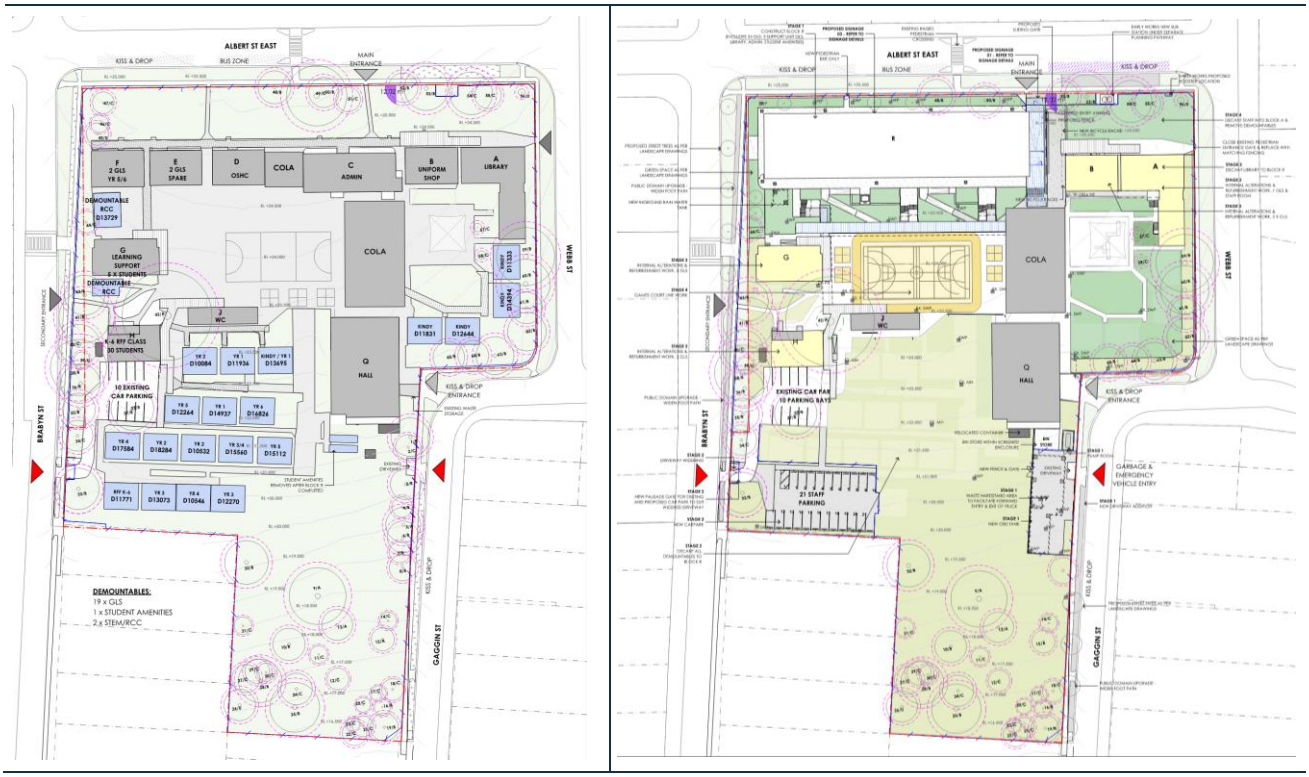


FIGURE 2: SITE PLAN, EXISTING (LEFT) / PROPOSED (RIGHT)

2.1 SITE LOCATION AND DESCRIPTION

The proposed activity is located at 30-32 Brabyn Street, North Parramatta within an R3 Medium Residential Zone at all boundaries and it is surrounded by minor traffic streets as Albert Street East in the North Boundary, Webb Street in the East boundary and Brabyn Street in the West boundary. This proposed activity is not affected by rail or busy road noise / vibration.

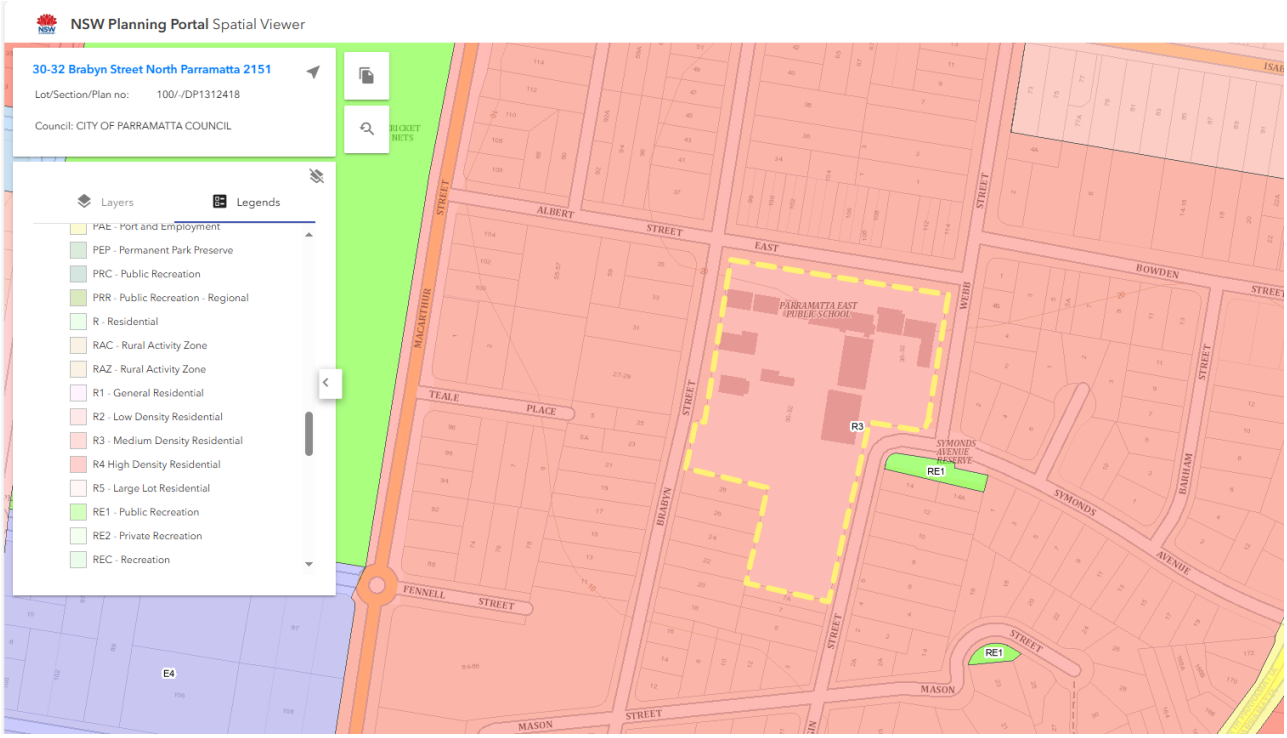


FIGURE 3: SITE LOCATION (NSW PLANNING PORTAL SPATIAL VIEWER)

2.2 SCHOOL OPERATION HOURS

School operating hours will be as per below:

- Operating hours: daytime from 7:00 am – 6:00 pm, limited activities for evening time, between 6:00 pm – 10:00pm and no activities for night time after 10:00pm.

Noise and vibration impacts are calculated based on the above operating times.

2.3 SENSITIVE RECEIVERS

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

TABLE 1: SENSITIVE RECEIVERS

STAGE	RECEIVER	DISTANCE (APPROXIMATE)	TYPE OF RECEIVER / ZONE
Receiver 1 (**inside school**)	Existing building B	8.8 m	Other school buildings
	Existing building G	15.5 m	
Receiver 2 outside school	31 Brabyn Street	16.5 m	Residential R3
Receiver 3 outside school	104 Albert St. East or	19 m	
Receiver 4 outside school	2 Symonds Avenue	19 m	
Receiver 5 outside school	28 Brabyn Street	8.8 m	
Receiver 6 outside school	14 Gagging Street	36.5 m	

FIGURE 4: SENSITIVE RECEIVER LOCATIONS (RECEIVERS OUTSIDE THE SCHOOL)

3 METHODOLOGY

This report was prepared using the below methodology:

- Kick-off meeting conducted in mid. May 2024.
- Regular design meetings.
- Review of the NSW standards, NPfI regulations and local requirements for noise and vibration (local council DCP / LEP).
- Review of the site location, zoning and most affected receivers for all stages.
- Review of possible busy roads near the site and location of rail corridors.
- Selection of logger location was based on:
  - Critical receivers
  - Location of the receivers
  - A preliminary meeting with team
- Acoustic loggers were left on site (inside the school for security reasons but next to Brabyn and Webb streets) from 30.05 to 12.06.24, closest weather station was Sydney Olympic Park.
- To assess the operative noise and vibration sources, a comprehensive coordination was made with the mechanical, electrical and fire protection teams to understand their noise source locations and operating times. Other consultants involved were included such as traffic and garbage collection.
- To assess the construction noise and vibration sources, coordination was done with the client, project manager to understand the approximate construction programme and phases.

4 ACOUSTIC ASSESSMENT OF THE EXISTING ENVIRONMENT

4.1 METEOROLOGICAL DATA

To verify that the noise data was obtained during suitable meteorological conditions, weather data such as rain and wind speed were obtained from the Bureau of Meteorology Sydney Olympic Park Station, ID: IDN60901 as a representative site located at approx. 5.5 km away from the site.

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

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

4.2 INSTRUMENTATION

Noise levels were measured using noise loggers. Table 2 provides information relating to each noise loggers/sound level meter.

TABLE 2: NOISE LOGGER AND SOUND LEVEL METER INFORMATION

NOISE LOGGER/SOUND LEVEL METER	TYPE	SERIAL NUMBER	DATE OF LAST CALIBRATION
ARL NL – 42 EX	Class 2	00184111	22/11/2023
ARL NL – 42 EX	Class 2	00184110	13/14/2023

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

The noise loggers were configured to record all relevant noise parameters including background noise (L_{A90}) and equivalent continuous noise levels L_{Aeq}. Samples were recorded at 15-minute A-weighted continuous intervals. The noise monitor responses were set to fast response. The analysers are Class 1 and Class 2 compliant with AS IEC 61672.2-2004.

4.3 NOISE LOGGER LOCATIONS

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

- Logger 1: 00184110, Webb St. side.
- Logger 2: 00184111, Brabyn St. side.

Below is a layout of the noise logger and measurement location, which based on our assessment is appropriate in representing noise levels of sensitive receivers surrounding the site.

FIGURE 5: LOGGERS DEPLOYMENT AREAS

FIGURE 6: LOGGERS DEPLOYMENT

5 NOISE AND VIBRATION CRITERIA

5.1 LOCAL CITY COUNCIL RULES

Part 4 - for non-residential developments of Parramatta Development Control Plan 2023 include the below controls:

Section 4.1.2 Noise amenity:

- C01 Non residential development is not to adversely affect the amenity of adjacent residential development as a result of noise.
- C02 Accompany all Development Applications for potential noise generating industries adjacent to residential zoned land with documentation from a qualified Acoustic engineer specifying noise standards.

Section 4.5 Educational establishments / acoustic privacy

- C04 the design of the proposed educational establishment should minimize the projection of noise from the various activities anticipated to occur within the site. Adjoining residents should not be exposed to unreasonable levels of noise arising from the proposed use.
- C05 A noise impact assessment statement, prepared by a suitable qualified acoustic engineer, is to be submitted with all applications for development withing residential zones. This should describe hours pf operation and predicted noise levels from regular lunch and tea breaks and for special events.

Open space areas
- Control C06 for open space areas considers only new educational establishments, we understand that the new development is not proposing a new open space for this school.

Traffic, parking and access
- O.10 Minimise the impact of parking on the local streets

Note: Parramatta LEP 2023 has no particular requirements for noise.

5.2 NSW NOISE POLICY FOR INDUSTRY (NPFI) 2017

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

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

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

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

TABLE 3: AMENITY NOISE LEVELS FOR NOISE LOGGERS, DBA

LOCATION	NOISE INDEX	NOISE LEVEL, DB RE 20 µPA		
		Daytime 0700 to 1800	**Evening 1800 to 2200**	**Night - time 2200 to 0700**
Logger 1 / 00184110	L_{A90} (RBL)	42	39	36
	$L_{Aeq,period}$	54	51	48
Logger 2 / 00184111	L_{A90} (RBL)	41	44	39
	$L_{Aeq,period}$	54	51	49

5.2.1 AMENITY AND INTRUSIVENESS CRITERIA

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

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

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

TYPE OF RECEIVER	INDICATIVE NOISE AMENITY AREA	PERIOD OF TIME	L_{AEQ} DB(A)	AMENITY CRITERIA LAEQ DB(A) – 5 DB + 3 DB
Residence	Suburban Area	Day 7:00 to 18:00	55	53
		Evening 18:00 to 22:00	45	43
		Night 22:00 to 7:00	40	38
School classroom – internal		all	35	N/A

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

Receiver category	Typical planning zoning – standard instrument*	Typical existing background noise levels	Description
Suburban residential	RU5 – village RU6 – transition	Daytime RBL<45 dB(A) Evening RBL<40 dB(A)	**Suburban** – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the
	R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Night RBL <35dB(A)	following characteristic: evening ambient noise levels defined by the natural environment and human activity.

FIGURE 7: NPFI EXTRACT – TABLE 2.3 DETERMINING WHICH OF THE RESIDENTIAL RECEIVER CATEGORIES APPLIES

Suburban area description above is the one more suitable for our proposed activity location.

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

TABLE 5: PROJECT INTRUSIVENESS AND AMENITY NOISE CRITERIA

LOGGER	NOISE LEVEL, $L_{EQ,15MINS}$ [DBA]		
	Daytime 0700 to 1800	**Evening 1800 to 2200**	**Night - time 2200 to 0700**
Logger 1 / 00184110	**Project Amenity Assessment, $L_{Aeq, 15min}$**		
	53	43	38
	Project Intrusiveness Assessment, $L_{Aeq, 15min}$		
	47	44	41
Logger 2 / 00184111	**Project Amenity Assessment, $L_{Aeq, 15min}$**		
	46	43	39
	Project Intrusiveness Assessment, $L_{Aeq, 15min}$		
	46	49	44

5.2.2 DETERMINATION OF PROJECT SPECIFIC NOISE TRIGGER LEVEL (PNTL)

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

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

LOCATION / AFFECTED	TIME	DESCRIPTOR	EXTERNAL PNTL [DBA]
Logger 1 / 00184110	0700 to 1800	$L_{Aeq, Day}$	47
	1800 to 2200	$L_{Aeq, Evening}$	43
	2200 to 0700	$L_{Aeq, Night}$	38
Logger 2 / 00184111	0700 to 1800	$L_{Aeq, Day}$	46
	1800 to 2200	$L_{Aeq, Evening}$	43
	2200 to 0700	$L_{Aeq, Night}$	39

5.2.3 MODIFYING FACTOR' ADJUSTMENTS

Penalties may be applied if the noise from the project "... contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level."

To take into account the potential annoying character of the noise an adjustment of +2dB(A) or +5 dB(A) for each annoying character aspect and cumulative of up to a total of 10 dB(A), may be added to the measured value to penalise the noise for its potential greater annoyance aspect.

Table C1 of the NSW NPfI provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

5.2.4 FACT SHEET C NPFL CORRECTIONS FOR ANNOYING NOISE CHARACTERISTICS

When a single event noise is continuous for a period less than two hours in any assessment period (24 hours), the allowable exceedance of the $L_{Aeq(15\ min)}$ equivalent noise criterion is relaxed as per below table.

TABLE 7: TABLE C3, FACT SHEET C (NPFI) ALLOWABLE EXCEEDANCE OF $L_{Aeq(15min)}$

Allowable duration of noise (one event in any 24-hour period)	**Allowable exceedance of $L_{Aeq,15min}$ equivalent project noise trigger level at receptor for the period of the noise event, dB(A)**	
	Daytime and evening (7 am–10 pm)	**Night-time (10 pm–7 am)**
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

This applies to the new carpark noise, garbage collection, diesel hydrant pump and kiss and drop zone.

5.2.5 FACT SHEET A NPFL DETERMINING EXISTING NOISE LEVELS

For the assessment of modifications to existing premises, where the premises has been operating for a significant period of time and it is considered a normal part of the acoustic environment, it may be included in the background noise assessment.

Some existing impacts that were confirmed to remain unchanged will fall under this category, such as garbage collection and school bells.

As this school will increase slightly the personnel from 32 to 41 and students from 500 to 667 (167 new students), some noise impacts such as carpark noise and sports courts noise will consider only the increase of the existing population and not the total student / staff numbers.

5.3 EPA NSW ROAD NOISE POLICY (RNP) 2011

Noise from the vehicles associated with the proposed activity will be assessed using NSW Road Noise Policy. Figure 8 presents the noise assessment criteria for the land use with potential to create additional traffic on existing local roads.

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from **new** freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15\ hour)}$ 55 (external)	$L_{Aeq, (9\ hour)}$ 50 (external)
	2. Existing residences affected by noise from **redevelopment** of existing freeway/arterial/sub-arterial roads 3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq, (15\ hour)}$ 60 (external)	$L_{Aeq, (9\ hour)}$ 55 (external)
Local roads	4. Existing residences affected by noise from **new** local road corridors 5. Existing residences affected by noise from **redevelopment** of existing local roads 6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (external)

FIGURE 8: RNP TABLE 4 EXTRACT – NOISE ASSESSMENT CRITERIA FOR RESIDENTIAL LAND USES AFFECTED BY PROPOSED ROAD PROJECTS AND TRAFFIC GENERATING DEVELOPMENTS

As per section 9 of the Transport and Accessibility impact assessment, the existing school consist of two kiss and ride zones (one in Gaggin Street for 8 vehicles and another on Albert Street East with a capacity of three vehicles).

We understand that a new kiss and ride zone will be designated in Albert Street East (35 m long, with a capacity of 6 cars) to handle the student increase.

5.4 SUMMARY OF OPERATIONAL NOISE CRITERIA

TABLE 8: SUMMARY OF NOISE CRITERIA

REGULATION	CRITERIA
EPA NSW Road Noise Policy (RNP) 2011	• $L_{Aeq(1\ hour)}$ 55 (external) during the day
PTNL and fact sheets A / C (NPfI 2017)	• PTNL Day (Webb St): 47 dBA / Evening: 43 dBA / Night: 38 dBA • PTNL Day (Brabyn St): 46 dBA / Evening: 43 dBA / Night: 39 dBA • Fact sheets A and C of NPfI apply to some impacts
Sleep disturbance criteria (NPfI 2017)	• No activities after 10:00 pm

Note, as defined in the NSW NPfI, the day is divided as below:

- Day time from 7:00 am – 6:00 pm
- Evening time from 6:00 pm – 10:00 pm
- Night time after 10:00 pm and before 7:00 am

5.5 CONSTRUCTION NOISE AND VIBRATION CRITERIA

5.5.1 Interim Construction Noise Guideline

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

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

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

Table 9 set out the management levels for noise at residence and sensitive land uses, respectively. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected management level' which is >75dBA.

This regulation stipulates that if affected properties receive an estimated construction noise below 75 dBA, there will not be a requirement for a Noise & Vibration Management Plan (CNVMP). Based on the RBL of 38 – 39 dBA in the daytime, the recommended noise management level during all aspects of the construction program are summarised in Table 10 below.

TABLE 9: NOISE AT AFFECTED USING QUANTITATIVE ASSESSMENT

RECOMMENDED HOURS	EXTERNAL NOISE MANAGEMENT LEVEL (NML) $L_{EQ,15MIN}$ [dBA]	HOW TO APPLY
Recommended standard hours **Monday – Friday 7am to 6pm** **Saturday 8am to 1pm** **No work on Sundays or Public Holidays**	Noise Affected 42 + 10	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ minutes)}$ noise level is greater than the affected level, the proponent need to apply all feasible and reasonable* work practices to meet the noise affected level. The proponent needs also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) requires respite period by restricting hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended standard hours	43 dBA (42 + 5) RBL from night time	A strong justification would typically be required for works outside the recommended standard hours. The proponent to 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 to negotiate with the community. For guidance on negotiating agreements see section 7.22

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

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

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

5.5.2 NOISE MANAGEMENT LEVELS

Noise Management Levels (NML) associated with the construction works on the site are presented in Table 10.

TABLE 10: CONSTRUCTION NOISE MANAGEMENT LEVELS, $L_{EQ\ 15MIN}$

RECEIVERS	RECOMMENDED HOURS	PERIOD	RBL $L_{A90,15MINS}$ [dBA]	EXTERNAL NOISE MANAGEMENT LEVEL [dBA]
Receivers' logger 1	Day time (standard construction hours)	When in use	41	(41 + 10) = 51 dB(A) (Noise affected) 75 dB(A) (highly noise affected)
Receivers' logger 2			42	(42 + 10) = 52 dB(A) (Noise affected) 75 dB(A) (highly noise affected)
School buildings			NA	Internal noise level 45 dBA / external noise level at façade 55 dBA

5.5.3 CONSTRUCTION VIBRATION CRITERIA

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

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

5.5.3.1 Human Response to Vibration

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

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

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

5.5.3.2 Continuous and impulsive vibration (1-80 Hz)

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

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

Table 2.2 Preferred and maximum weighted rms values for continuous and impulsive vibration acceleration (m/s^2) 1–80 Hz

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

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

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

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

5.5.3.3 Intermittent vibration (1-80 Hz)

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

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

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

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

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

5.5.3.4 Vibration Criteria – Building Contents and 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).

5.5.3.5 Standard BS 7385 Part 2 – 1993

For transient vibration, as discussed in standard BS 7385 Part 2- 1993, the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building. These are summarised in Table 11 and illustrated in Figure 9.

TABLE 11: TRANSIENT VIBRATION CRITERIA AS PER STANDARD BS 7385 PART 2 – 1993

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

Standard BS 7385 Part 2 – 1993 states that the value in **Table 11** relate to transient vibration which does not cause resonant response in buildings. Where the dynamic loading caused by continuous vibration events is such that it results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in **Table 11** may need to be reduced by up to 50% (refer to Line 3 in Figure 9).

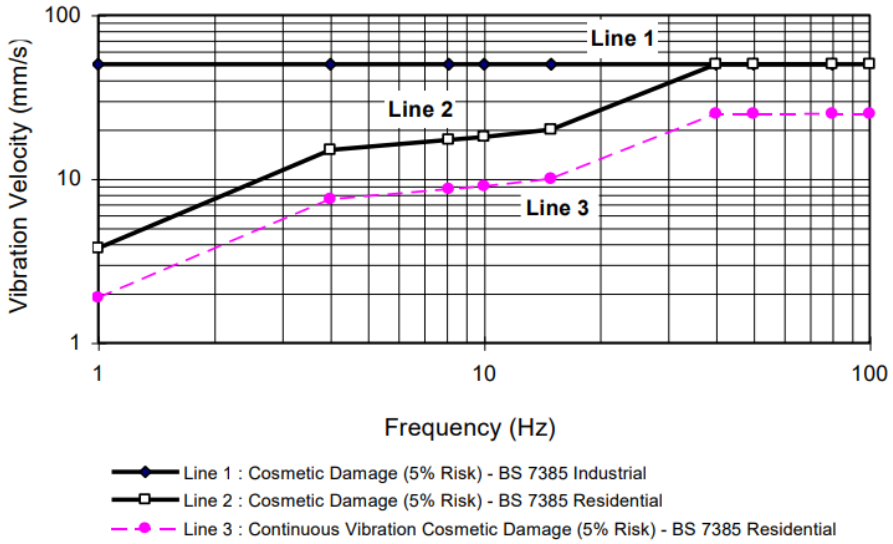


FIGURE 9 – BS 7385 PART 2 – 1993, GRAPH OF TRANSIENT VIBRATION VALUES FOR COSMETIC DAMAGES

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz, where a high

displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in **Table 11**, 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 the calculation indicated that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in **Table 11** should not be reduced for fatigue considerations.

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

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

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

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

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

The vibration limits of table 1 in DIN 4150-3:1999 (replicated in **Table 12** below) refer to the evaluation of the effects of short-term vibration on structures.

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

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

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

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

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

The criteria are the peak particle velocities measured on the uppermost full storey of any building not related to the site and are listed in **Table 13**.

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

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

TABLE 13: DIN 4150-3 CONSTRUCTION VIBRATION LIMITS – LONG TERM

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

5.5.4 SUMMARY OF CONSTRUCTION NOISE AND VIBRATION CRITERIA

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

- Logger 1 receivers: 51 dBA – 75 dBA.
- Logger 2 receivers: 52 dBA – 75 dBA.
- School receivers: max. noise at the facade of school buildings during school hours to be 55 dBA / internal noise to be max. 45 dBA.

For this proposed activity, the vibration criteria will be as per DIN 4150 – 3:1999 construction vibration limits – long term. Residential receivers and existing school building receivers in the area will have a maximum vibration velocity criterion of 5 mm/s^2.

NVIA construction noise assessment will utilize the information provided by the team at this stage and conduct a preliminary construction noise and vibration assessment, if predicted construction noise and vibration levels are not exceeding the limits, there is no need for a future Construction noise and vibration management plan. This is addressed in section 7 of this report.

6 OPERATIONAL NOISE & VIBRATION IMPACT ASSESSMENT

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

6.1 WASTE COLLECTION

It was confirmed by the team that the current works to the school would not change the current garbage collection frequency. The existing garbage collection is currently in a similar location in Gaggin St. The new facilities will share waste and recycling areas, bins and collection services within the existing site. The garbage collection strategy will remain general waste 3x weekly and recycling 3x weekly during daytime hours.

According to the waste collection plan, the day of service the garbage collection will enter the site from Gaggin Street and park in the loading bay, adjacent to the bin storage area as per below:

FIGURE 10 – WASTE COLLECTION POINT

The approximate distance from the bin store to main residential receivers on Gaggin St. is 36 m.

The noise impact was calculated using a time averaged L_{Aeq} for an assumed 15 mins of the garbage truck arriving, emptying the bin and leaving the site, propagated into the four critical properties (15 Gaggin St.), also assuming a 15 km/hr velocity for the truck. For the calculation, typical sound power levels data for garbage truck is given below:

TABLE 14: TYPICAL SOUND POWER LEVELS DATA FOR WASTE TRUCKS

ACTIVITY	ESTIMATED SOUND POWER LEVEL SWL DBA
Waste Collection Truck	101
Waste truck emptying bin	97

The time average noise level of the garbage truck coming, emptying the bin and leaving, propagated into the critical receiver is estimated to be 42 dBA. This meets the project trigger level PNTL for day time. Waste collection will only happen during day time.

6.2 NOISE EMISSION FROM PA SYSTEMS AND SCHOOL BELLS

PA and school bells will maintain the current frequency of the existing buildings, any new PA systems are to be oriented away from residential receivers. We do not expect this will negatively impact the existing environment.

6.3 NOISE EMISSION FROM OUTDOOR AREAS

The proposed activity does not involve the creation of a new outdoor area, but the use of the existing one, located between buildings COLA, R, G and H. The changes between the existing open play space and the proposed one is almost the same, the new play area is bigger than the existing one, but this means that the student density is lower.

The increase of students expected for this proposed activity is 167 students. Current sport courts are an 8 m x 12.5 m baseball hoops and a 30 m x 14 m multipurpose court. These courts are shielded from residential neighbours 2, 3 and 4, affecting residential neighbour 5 with an approximate distance of 77 – 81 m.

Noise from the sport courts due to the increase of students, propagated into the critical receiver will not be noticeably different from the current sport courts noise, particularly given the team sizes for a given game will not change.

6.4 NOISE EMISSION FROM OPERATIONAL TRAFFIC

Kiss and drop is included in the REF scope. Rapid transport assessment determined that there will be two peak times for this kiss and drop zones to work in full capacity:

- Morning between 8:30 – 9:30 am / this is day time according to the NSW NPfI
- Afternoon between 2:30 – 4:00 pm / this is also day time according to the NSW NPfI

The noise impact was calculated using a time averaged L_{Aeq} for an assumed 30 mins of the peak time, propagated into the four critical properties (108, 110, 112 and 114 Albert St East), also assuming a 15 km/hr velocity for the cars. For the calculation, typical sound pressure levels data for cars main noise sources (pass by, ignition and door slamming) is as shown below:

TABLE 15: TYPICAL SOUND PRESSURE LEVELS DATA FOR CARS MAIN NOISE SOURCES

ACTIVITY	HEIGHT OF SOURCE	SINGLE EVENT NOISE LEVEL LAEQ DB AT 10 M
Car pass by	0.5	67
Car ignition and pull out	0.5	72
Door slamming	0.5	64

FIGURE 11 KISS AND DROP AREA

The noise of the full capacity kiss and drop area propagated into the critical receiver is estimated to approx. 48 dBA, which meets the EPA NSW Road Noise Policy (RNP) 2011 max. value at the façade of residences near local roads (55 dBA for day time).

An existing kiss and ride area is located it along Gaggin St, affecting mainly properties from 06 Gaggin St to 16 Gaggin St. Calculations estimate the same levels as per above, meeting the EPA NSW Road Noise Policy (RNP) 2011 values.

6.5 NOISE EMISSIONS FROM CARPARK

The proposed new carpark will have a maximum capacity of 31 carpark spaces. Currently existing 10 spaces carpark and new 21 space carpark, including 1 accessible carpark. This new carpark is located on the Brabyn St side, we expect that this carpark will be used mainly during the day time (7:00 am – 6:00 pm) and occasionally during evening time (not in full capacity from 6:00 pm – 10:00 pm) and no uses during night time (after 10:00 pm and before 7:00 am).

The closest receivers outside the school would be 21, 23 and 25 Brabyn St. located at approx. 25 m from the carpark entrance.

FIGURE 12 PROPOSED NEW CARPARK

The noise impact was calculated using a time averaged L_{Aeq} for an assumed 60 mins of the peak time, propagated into the four critical properties (21, 23 and 25 Brabyn St.), also assuming a 15 km/hr velocity for the cars. For the calculation, typical sound pressure levels data for cars main noise sources (pass by, ignition and door slamming) is the same as per Table 15.

The noise of the full capacity carpark propagated into the critical receiver is estimated to be 45 dBA, which meets the PNTL levels for day time and the EPA NSW Road Noise Policy (RNP) 2011 max. value at the façade of residences near local roads (55 dBA for day time).

If the carpark is intended to be used in full capacity during the evening, in order to meet the evening PNTL level (43 dBA), the peak events for the carpark to be full / empty need to last max. 2.5 hours, which is very feasible. This means that this impact can be managed to fully meet the project PNTL levels.

Required additional noise control measures are visual signage for users not to raise their voices, avoid the use of loud music, limit the use of the honk and similar.

6.6 NOISE EMISSIONS FROM SERVICES

6.6.1 MECHANICAL SERVICES

Mechanical plant will consist of:

- Internal FCU units, extraction and supply fans and rooftop plant room at building R.
- Buildings A, B, G and H with no new air conditioning works required.
- Mechanical design intends for 12 ODU units' type ARUM240LTE5 (Max. SPL at 1 m 67 dBA) located at the rooftop plant room (level 2 between grids 5 – 4 / Albert St East side). The ODU and their ducted outlets will not be higher than the roof ridge level.

- Also, in this roof we expect two fans, however the fans are not inside the plant room and located on the roof level.
- In the ground floor level, there are expected a max. 3 ODU units located between building R and Brabyn St.
- In terms of operating time, as per Section 2.2, no night time operation is expected, only day and evening time.
- The mechanical equipment assessment was conducted with equipment noise data confirmed by the team mechanical consultant.

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

TABLE 16 - MAXIMUM IN-DUCT SOUND POWER LEVELS FOR MECHANICAL EQUIPMENT

EQUIPMENT	SPL SOUND POWER LEVEL (dB) PER FREQUENCY BAND (HZ) AT 1 M								SPL
	63	125	250	500	1000	2000	4000	8000	dBA
Rooftop ODU units (12 units)	84	80	79	75	73	69	67	63	78
Rooftop fan 1	72	76	76	73	71	69	66	57	76
Rooftop fan 2	77	80	79	79	78	79	77	72	85
Total rooftop noise	85	84	83	81	80	80	78	73	86
Total 3 x ODU units on the GF noise	78	74	73	69	67	63	61	57	72

With the max. above configuration, the rooftop plant room exceeds the project PNTL levels 4 dB for day time and 8 dBs for evening PNTL levels, (no night activities, this is after 10:00 pm and before 7:00 am) without any acoustic mitigation measures.

The fans noise is the main cause for the exceedance (not the ODU plant). For the plant room to achieve the project PNTL levels the below acoustic mitigation measures are required:

- Setting a maximum SWL levels for each fan not to exceed 65 dBA each one.
- If fans are to exceed the max. SWL as above, they will need to be ducted and have fitting attenuators with the below minimum acoustic performance:

TABLE 17 – MINIMUM ACOUSTIC PERFORMANCE FOR FANS ATTENUATORS (DUCTED FANS)

EQUIPMENT	IL INSERTION LEVELS OF ATTENUATOR (dB) PER FREQUENCY BAND (HZ)							
	63	125	250	500	1000	2000	4000	8000
Min. perf of acoustic attenuators for roof fans	6	9	17	31	32	21	18	14

Internal coverage is required inside the plant room with outdoor absorptive materials (such as Reapor NRC 1 or performance equivalent), covering 15% of the plant room walls, to reduce the reverberation inside this space, this will help the maintenance tasks. Required fitting visual signage for hearing protection for maintenance personnel to access this plant room.

For the four ODU units on the ground floor to achieve the project PNTL levels (day and evening), acoustic louvers need to be installed around them, covering all the unit's perimeter and as tall as the units + 100 mm. minimum louver acoustic performance as per table below:

TABLE 18 – MINIMUM ACOUSTIC PERFORMANCE FOR LOUVERS (ODU GF UNITS)

EQUIPMENT	MIN, TL TRANSMISSION LOSSES OF LOUVERS (dB) PER FREQUENCY BAND (HZ)							
	63	125	250	500	1000	2000	4000	8000
Min. perf of acoustic louver	5	4	5	6	9	13	14	13

If additional or louder mechanical units are updated for the project, the acoustic mitigation measures will need to be reviewed. The assessment at this stage shows that compliance will be readily achievable.

6.6.2 ELECTRICAL SERVICES

We understand there will be a decommission of the existing 315kVA substation to be replaced by a new 1,000 kVA substation at the same location (Albert St East side). We understand that this replacement will not impact on a noise basis, as the noise level was confirmed to be 58 dBA (SWL), which propagated into the closest receiver meets all the project PNTL levels.

In case the selected substation exceeds the expected 58 dBA (SWL), this unit will need to be assessed and surrounded by acoustic louvers.

6.6.3 FIRE PROTECTION AND HYDRAULIC SERVICES

It is confirmed by the team that this project will not have a fire sprinkler pump. From the hydraulic concept, there will be a fire hydrant pump inside a dedicated room (size 5600 x 3000 x 2100), model is to be confirmed. This pump will be located on the Gaggin St side, next to the garbage bins. For this noise source the most affected receiver would be 15 Gaggin St, located at approx. 20 m away.

Final selection is to be confirmed; however the expected pump is to be similar to an Aline Single diesel engine pump as per below:

- type SD 380 100X65-200
- 21kW engine
- 3,000 rpm
- Naturally aspirated
- Air consumption 2.03 m^3/min
- Provided noise level (just for the engine) 100 dBA / does not indicate if SWL level or SPL level
- Proposed pump room dimensions: 5600 W x 3000 L x 2100 H

Based on the above technical information, we estimated that the noise produced by this type of pump would be as per below:

TABLE 19 – NOISE LEVELS OF THE FIRE PUMP (ESTIMATED BASED ON RECEIVED INFORMATION)

EQUIPMENT	SPL SOUND POWER LEVEL (dB) PER FREQUENCY BAND (HZ)								
	63	125	250	500	1000	2000	4000	8000	dBA
Inlet + casing	94	99	99	99	101	100	95	87	105
Exhaust	**120**	**126**	**122**	**114**	**110**	**104**	**94**	**86**	**118**

Diesel pumps are particularly noisy, and they need to be located in an acoustically designed enclosure with the below items:

- Acoustic walls and ceilings: min. 190 mm blockwork construction for walls and ceiling.
- Exhaust muffler type super critical with 40-50 dB attenuation.
- Acoustic access door with acoustic seals, min. Rw 36.
- Internal absorption to mitigate reverberation (min 20 sqm with min. NRC 0.65, on walls / ceilings, where available).
- Pump must be tested only during day time (from 7:00 am to 6:00 pm).
- Acoustic louver for ventilation max 4 sqm and Min acoustic rating Rw as per below:

TABLE 20 – MIN REQUIRED PERFORMANCE FOR ACOUSTIC LOUVER

EQUIPMENT	MIN ACOUSTIC PERFORMANCE, TL OF LOUVER/ PER FREQUENCY BAND (HZ)								
	63	125	250	500	1000	2000	4000	8000	dBA
IAC slimshield or similar	6	7	10	12	18	18	14	13	105

As soon as the design progresses, this treatment needs to be updated by the engaged acoustic consultant for design and construction.

6.7 OPERATIONAL VIBRATION

For controlling vibration emissions on mechanical plant (VRF, condensers and similar), all condensers are installed on Embelton Supershearflex pads or equal. Ensuring compliance with the NSW EPA document Assessing Vibration: A technical guideline. However, the internal acoustic assessment of this school is not part of the REF scope.

7 CONSTRUCTION NOISE & VIBRATION IMPACT ASSESSMENT

We understand construction will be split into 2 primary components, the new building (block R) and the refurbishment (blocks A, B, G & H). Block R is estimated to take 13 months, while the refurb will take 9 months. We understand the confirmed hours of construction will be standard as per below:

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

7.1 CONSTRUCTION PLANT NOISE LEVELS

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

TABLE 21 TYPICAL EXTERNAL NOISE LEVELS OF DEMOLITION AND CONSTRUCTION MACHINERY/ACTIVITY

ITEM #	ACTIVITY/MACHINERY	SOURCE AND REFERENCE NUMBER (BS 5228 – 1:2009)	L_{eq} SOUND PRESSURE LEVEL AT 10m (dBA)
Excavation and Demolition			
1	Tracked excavator 14t / 66kW	Table C2 Ref 25	69
2	Dumper truck 9T / 75 kW	Table C4 / Ref 4	76
Structural Phase			
3	Tracked excavator 14t / 66kW	Table C2 Ref 25	69
4	Dumper truck 9T / 75 kW	Table C4 / Ref 4	76
5	Mini piling rig (rock bolt) 250mm auger	Table C3 / Ref 18	74
6	Concrete pump + cement mixer truck (discharging) 8 T / 350 bar	Table C4/ Ref24	68
Construction & internal works			
7	Handheld circular saw 3 Kw	Table C4 / Ref 72	79
8	Handheld cordless nail gun	Table C4 / Ref 95	73
9	Diesel generator	Table C4 / Ref 76	61
Carpark Construction			
10	Compactor 60kg / 3kW	Table C5 / Ref 29	83
11	Vibratory Roller passby, 3t / 20kW	Table C5 / Ref 27	73
12	Asphalt paver and tipper lorry 112kW / 12t hopper	Table C5 / Ref 30	76

Notes:

- The above equipment shows every equipment noise level as per BS 5228 – 1:2009, the equipment inclusion in each phase is the general equipment that is used in this type of construction. A more detailed assessment will only be done if the preliminary assessment exceeds 75 dBA, if not, the above assessment is adequate for this type of report.
- NSW DECC 2009 Construction noise Guideline quotes on Appendix B Equipment Noise levels, the DEFRA 2005 database, which includes the above referenced BS 5228 – 1:2009 noise levels.

7.2 PREDICTED CONSTRUCTION NOISE

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

TABLE 22 CONSTRUCTION NOISE MAIN RECEIVERS

RECEIVER	ADDRESS	DISTANCE (APPROXIMATE)	TYPE OF RECEIVER / ZONE
Receiver 1 (inside school)	**School building B / COLA**	8.8 m	Other school buildings
	School building G	15.5 m	
Receiver 2 outside school	31 Brabyn Street	16.5 m	Residential R3
Receiver 3 outside school	104 Albert St. East or	19 m	
Receiver 4 outside school	2 Symonds Avenue	19 m	
Receiver 5 outside school	28 Brabyn Street	8.8 m	

Table below shows predicted construction noise on critical receivers per phase (receivers with same or higher distances will be affected by less noise intensity levels).

TABLE 23 PREDICTED CONSTRUCTION NOISE $L_{EQ,15MIN}$

RECEIVERS	RECOMMENDED HOURS	PERIOD	PREDICTED CONSTRUCTION NOISE LEVEL	EXTERNAL NOISE MANAGEMENT LEVEL
Excavation and Demolition Phase				
Receiver 1(**School buildings**)	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	55 dB(A)*	Internal noise 45 dBA / external façade noise 55 dBA
Receiver 3 + Receiver 4			74 dB(A)	51-52 dB(A)(noise affected) 75dB(A) (highly noise affected)
Receiver 2			74 dB(A)	
Structural Phase				
Receiver 1(**School buildings**)	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	55 dB(A)*	Internal noise 45 dBA / external façade noise 55 dBA
Receiver 3 + Receiver 4			74 dB(A)	51-52 dB(A)(noise affected) 75dB(A) (highly noise affected)
Receiver 2			74 dB(A)	
Construction & internal Works Phase				
Receiver 1(**School buildings**)	Monday Friday 7am to 6pm	Day	55 dB(A)*	Internal noise 45 dBA / external façade noise 55 dBA

RECEIVERS	RECOMMENDED HOURS	PERIOD	PREDICTED CONSTRUCTION NOISE LEVEL	EXTERNAL NOISE MANAGEMENT LEVEL
Receiver 3 + Receiver 4	Saturday 8am to 1pm No work on Sundays or Public Holidays		66 dB(A)	51-52 dB(A)(noise affected) 75dB(A) (highly noise affected)
Receiver 2			66 dB(A)	
Carpark Construction Phase / Just including critical receivers, other buildings are further away (including school buildings)				
28 Brabyn Street (8.8 m) critical receiver 5	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	73 dB(A)	51-52 dB(A)(noise affected) 75dB(A) (highly noise affected)
Receiver 2			73 dB(A)	
NB: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.				

7.2.1 CONSTRUCTION MITIGATION MEASURES

To minimize NML construction needs to comply with:

- Construction hours will only be during day-time (7 am to 6 pm).
- Receiver 5: 28 Brabyn Street is only affected by the carpark construction and use. This is why this receiver is not considered for other construction stages.
- Equipment time management per phase is as per table below:

TABLE 24 TIME MANAGEMENT DURING CONSTRUCTION

CONSTRUCTION PHASE	REQUIREMENTS FOR TIME MANAGED MACHINERY
Excavation and demolition	• excavator 75% of the construction time per day and dump trucks 65% of the construction time per day. • excavation and demolition near buildings G, COLA and B equipment will need to work 55% of the construction time per day and not simultaneously. • Perimeter hoarding as per figure 13.
Structural phase	• All equipment need to be time managed to 60% of the construction time. • near buildings G, COLA and B, equipment will have to work on 50% of the construction time, locating the truck and concrete pump as far as practicable from the school buildings and additionally avoiding all equipment working simultaneously to meet the criteria during school hours. • Users of building B notified previously when piling is to be conducted at their side of building R.
Construction and internal works	• any external use of a saw or similar needs to be time managed to 50% of the time. • During all external works, perimeter hoarding is required as per figure 14.

CONSTRUCTION PHASE	REQUIREMENTS FOR TIME MANAGED MACHINERY
	• After all external works finalize, the majority of the works will happen internally, inside the new building. The hoarding as per figure 14 can be removed.
Carpark construction	• all machinery needs to be time managed at 30% and 45% of the construction journey and an acoustic barrier 2 m tall (Density to be finalized when the Construction Noise and Vibration Management Plan is prepared) needs to be installed between the carpark and the southern affected (receiver 5, 28 Brabyn St) as per figure 15.

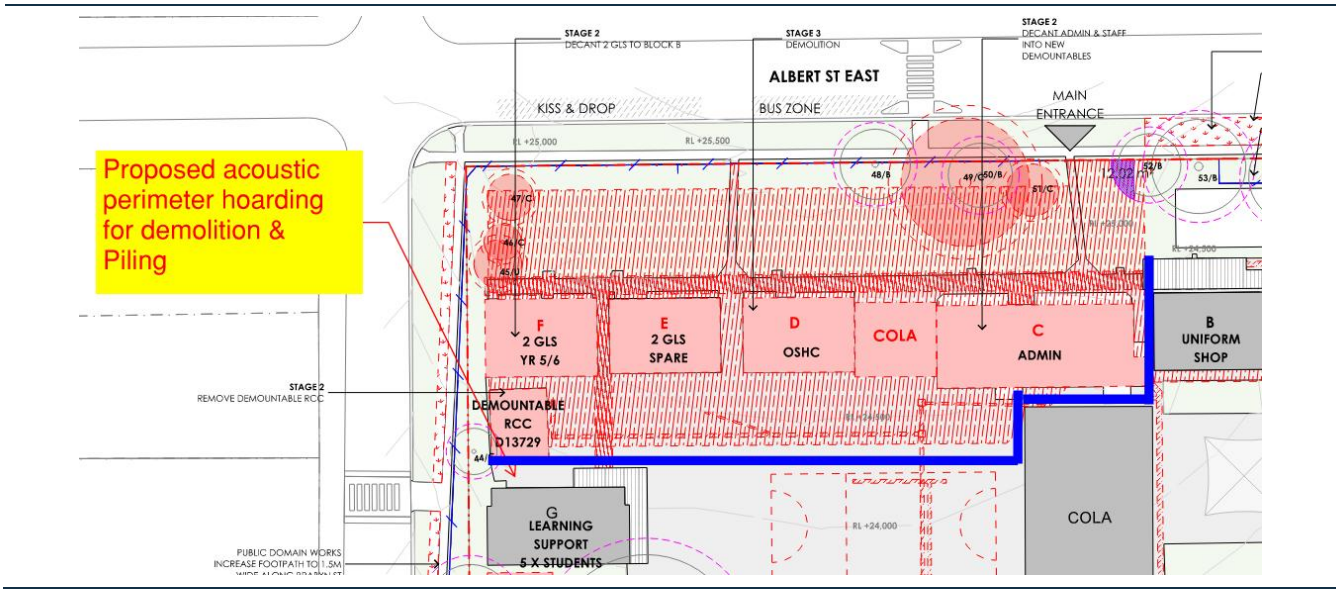


FIGURE 13 PROPOSED PERIMETER HOARDING FOR EXCAVATION & DEMOLITION PHASE AND PILING PHASE

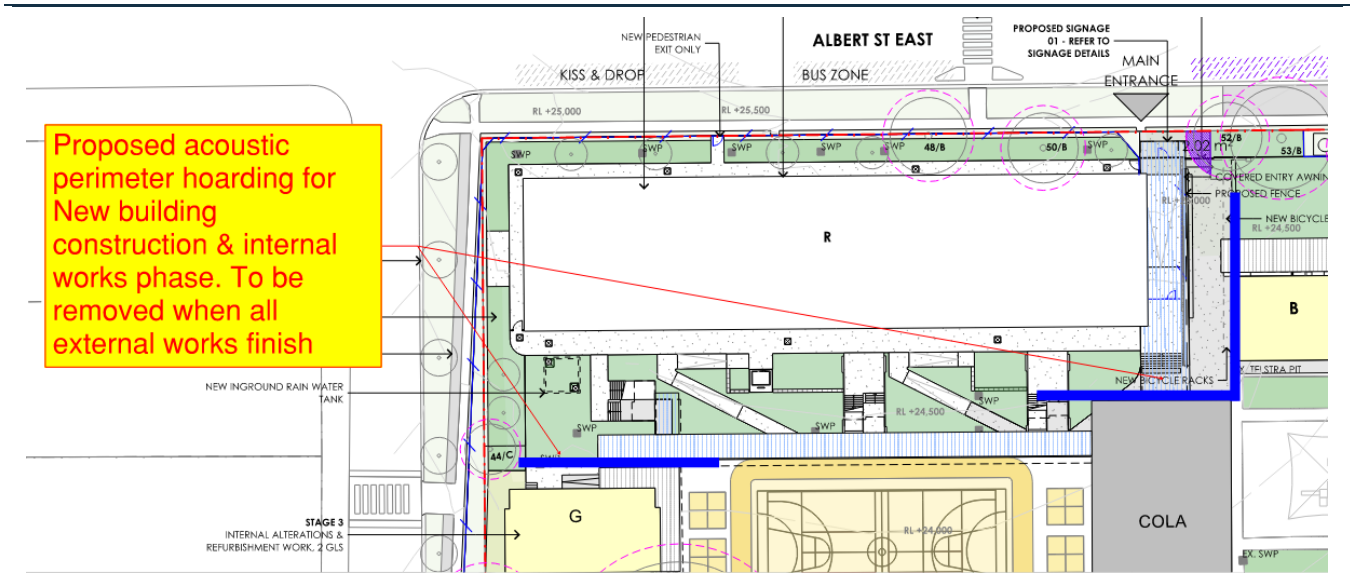


FIGURE 14 PROPOSED ACOUSTIC SCREENS FOR CONSTRUCTION AND INTERNAL WORKS PHASE

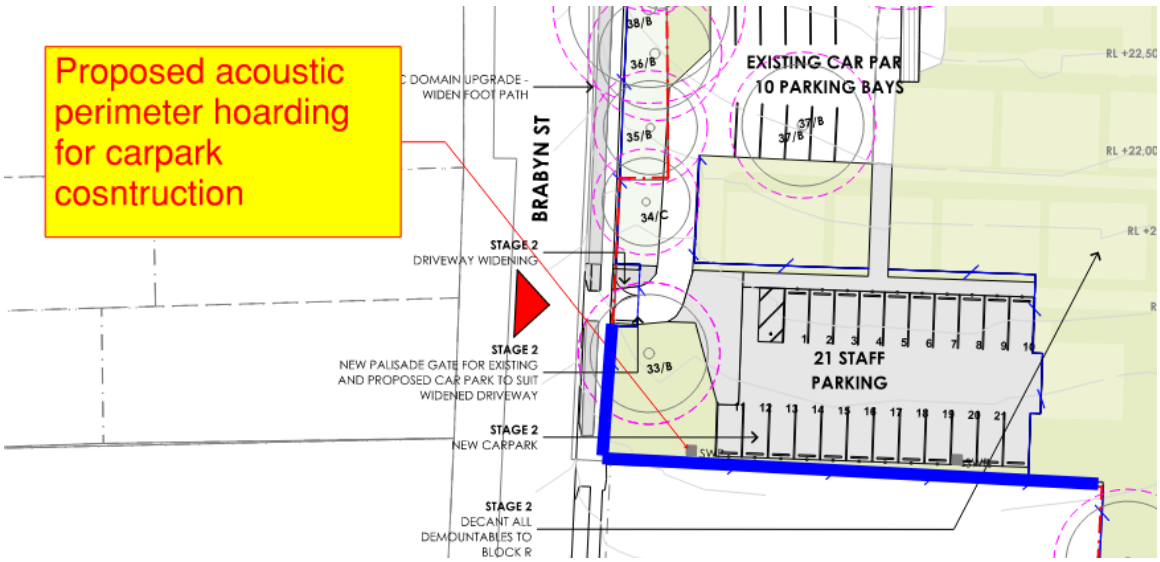


FIGURE 15 PROPOSED ACOUSTIC SCREENS FOR CARPARK CONSTRUCTION PHASE

As shown construction noise levels during all stages phases were predicted below 75 dB(A). Under the ICNG, there is no requirements for construction noise to be managed as part of a construction noise and vibration management plan. Despite this, limits are too close to exceedance for existing school buildings and residential receivers, hence a Construction Noise and Vibration Management Plan (CNVMP) is required.

The final minimum density of the construction hoarding will be finalized at the moment of the Construction Noise and Vibration Management Plan (CNVMP), once the construction methodologies and programme are defined. Grade A hoardings that can meet the above height, extent specified can be suitable.

7.3 PREDICTED CONSTRUCTION VIBRATION

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

Construction activities likely to cause some vibration are: piling, earthworks and reinstatement works (carpark or roads pavement construction and earth compaction).

According to the Geotechnical report, boreholes present a soil with mainly sandstone, silty clay, fill, siltstone, laminate sandstone, which is indicative of a soft to very soft soil. This is the most favourable condition to prevent vibration transmission into the closest receivers.

Compliance with vibration limits for building damage is expected based on ensuring ground compacting equipment is selected to adherer to minimum safe working distances. No vibratory piling in this site.

7.4 GENERAL MITIGATION MEASURES ON CONSTRUCTION NOISE AND VIBRATION MANAGEMENT

The following needs to be considered in the future preparation of a construction noise and vibration management plan for the site when details of the contractor works methodology become finalised.

7.4.1 GENERAL/SITE MANAGEMENT ISSUES

- All employees, contractors and subcontractors are to receive an environmental induction andinstruct all persons at the site with regard to all relevant project specific and standard noise mitigation measures, including but not limited to permissible hours or work, limitation of high noise generating activities, location of nearest affected noise receivers, construction employee parking areas, designated loading/unloading

areas and procedures, site opening/closing times (including deliveries) and environmental incident procedures.
- A dedicated person will form a point of contact for dissemination of general information regarding site operations. Contact persons will also be defined to receive comment or complaints from the community.

7.4.2 CONSTRUCTION ACTIVITIES AND NOISE MITIGATION

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

8 MITIGATION MEASURES

TABLE 25 MITIGATION MEASURES

PROJECT STAGE DESIGN (D) CONSTRUCTION (C) OPERATION (O)	MITIGATION MEASURE	REASON FOR MITIGATION MEASURE	RELEVANT SECTION OF REPORT
D	• PA and school bells will maintain the current frequency of the existing buildings, any new PA systems are to be oriented away from residential receivers.	To avoid impacts resulting from the PA and school bells operation and meet PNTL levels.	Section 6.2
O	• Carpark not to operate after 10:00 pm and before 7:00 am. • Visual signage for users not to raise their voices, avoid the use of loud music, limit the use of the honk and similar.	To avoid impacts resulting from the carpark operation and meet PNTL levels.	Section 6.5
D	• If Rooftop fans exceed maximum SWL level of 76 dBA, will require acoustic attenuators as per section 6.6.1, table 17. • Internal coverage is required inside the plant room with outdoor absorptive materials (such as Reapor NRC 1 or performance equivalent), covering 15% of the plant room walls. • ODU on the ground floor require acoustic louvers all around as per section 6.6.1 table 18. • Any changes to the plant, will need an updated acoustic assessment. • Required fitting visual signage for hearing protection for maintenance personnel to access this plant room.	To avoid impacts resulting from the mechanical services operation and meet PNTL levels.	Section 6.6.1
D	• If selected electrical substation technical sheet documents more noise than 58 dBA (SWL), acoustic louvers will be needed.	To avoid impacts resulting from the electrical services operation and meet PNTL levels.	Section 6.6.2
D	• Diesel hydrant pump will need to comply with max. noise levels in table 19 and have an acoustic enclosure: • Acoustic walls and ceilings: min. 190 mm blockwork construction for walls and ceiling. • Exhaust muffler type super critical with 40-50 dB attenuation. • Acoustic access door with acoustic seals, min. Rw 36. • Internal absorption to mitigate reverberation (min 20 sqm with min. NRC 0.65, on walls / ceilings, where available). • Pump must be tested only during day time (from 7:00 am – 6:00 pm).	To avoid impacts resulting from the fire protection and hydraulic services operation and meet PNTL levels.	Section 6.6.3

PROJECT STAGE DESIGN (D) CONSTRUCTION (C) OPERATION (O)	MITIGATION MEASURE	REASON FOR MITIGATION MEASURE	RELEVANT SECTION OF REPORT
	• Acoustic louver for ventilation max 4 sqm and Min acoustic rating Rw as per table 20.		
C	• Construction hours will only be during day-time (7 am to 6 pm). • Equipment time management per phase as per table 24. • It is required a perimeter hoarding of 2m height (min. weight to be determined at the moment of the Construction noise and Vibration Management Plan (CNVMP) is prepared) as per section 7.2 during excavation and piling phase as per figure 13. • It is required a perimeter hoarding of 2m height (min. weight to be determined at the moment of the Construction noise and Vibration Management Plan (CNVMP) is prepared) as per section 7.2 during external works of construction phase as per figure 14. • It is required a perimeter hoarding of 2m height and min. weight TBC in the CNVMP as per section 7.2 during carpark construction phase as per figure 15. • No vibratory piling in this site.	To avoid impacts resulting from the construction and meet NML levels.	Section 7.2
C	• All employees, contractors and subcontractors are to receive an environmental induction and instruct all persons at the site with regard to all relevant project specific and standard noise mitigation measures, including but not limited to permissible hours or work, limitation of high noise generating activities, location of nearest affected noise receivers, construction employee parking areas, designated loading/unloading areas and procedures, site opening/closing times (including deliveries) and environmental incident procedures. • A dedicated person will form a point of contact for dissemination of general information regarding site operations. Contact persons will also be defined to receive comment or complaints from the community. • Activities that approach the highly noise affected criteria for the residential receivers to be carried out during times where receivers are less sensitive to noise; • Avoid unnecessary revving of engines and turn off plant that is not being used/required; • Organise the site so that delivery trucks and haulage trucks only drive forward to avoid the use of reversing alarms; • avoid using tonal reverse alarm outside standard construction hours;	To avoid impacts resulting from the construction and meet NML levels.	Section 7.4

PROJECT STAGE DESIGN (D) CONSTRUCTION (C) OPERATION (O)	MITIGATION MEASURE	REASON FOR MITIGATION MEASURE	RELEVANT SECTION OF REPORT
	• Organise and schedule the equipment operations to limit the noisiest machines operating simultaneously; • Site set up/ movement of plant / delivery of material/ waste removal to site to be restricted to day period; • Truck drivers are to be informed of site access routes, acceptable delivery hours and must minimise extended periods of engine idling; • Ensure no shouting or loud stereo/radios on site. There must be no dropping of metal from heights, throwing of metal items or slamming of doors; • Use less noise intensive equipment where reasonable and feasible; • fixed plant positioned as far as possible from the sensitive receivers; • Use temporary site buildings and material stockpile as noise barrier;		
C	• Contractor needs to meet 55dBA at the façade of existing school buildings and less than 75 dBA at the residential façade. For this construction needs to prepare their own management and monitoring plans. • A construction noise and vibration management plan must be prepared prior to commencement of construction and include the measures included this noise report, including those outlined in Section 7.2, 7.3 and 7.4.	To avoid impacts resulting from the construction and meet NML levels.	Section 7.2 & 7.4

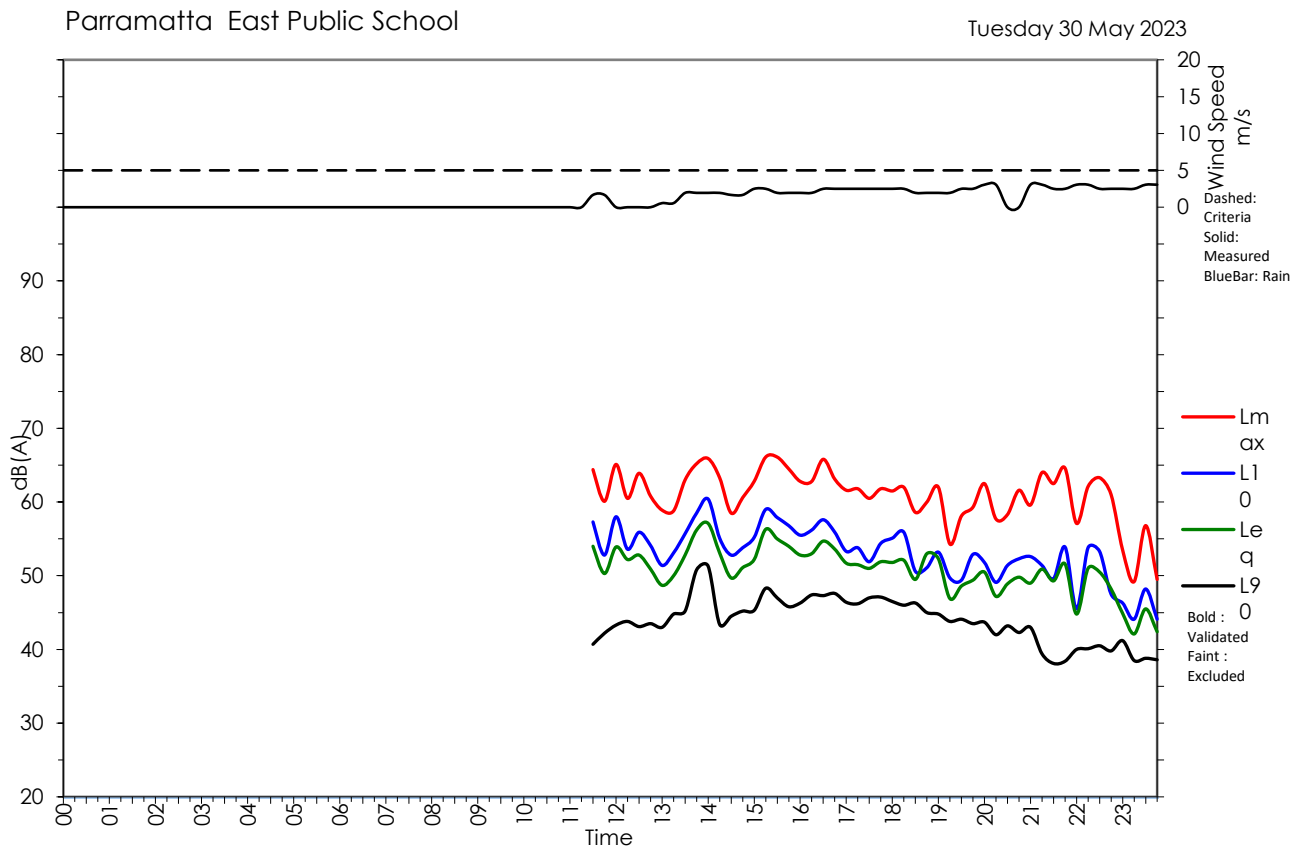
Notes:

- D design
- O Operation
- C Construction

8.1 CONCLUSIONS

This Noise and Vibration Impact Assessment concludes that the activity is expected to meet local regulations provided that the above mitigation measures are incorporated.

8.2 LOGGER 1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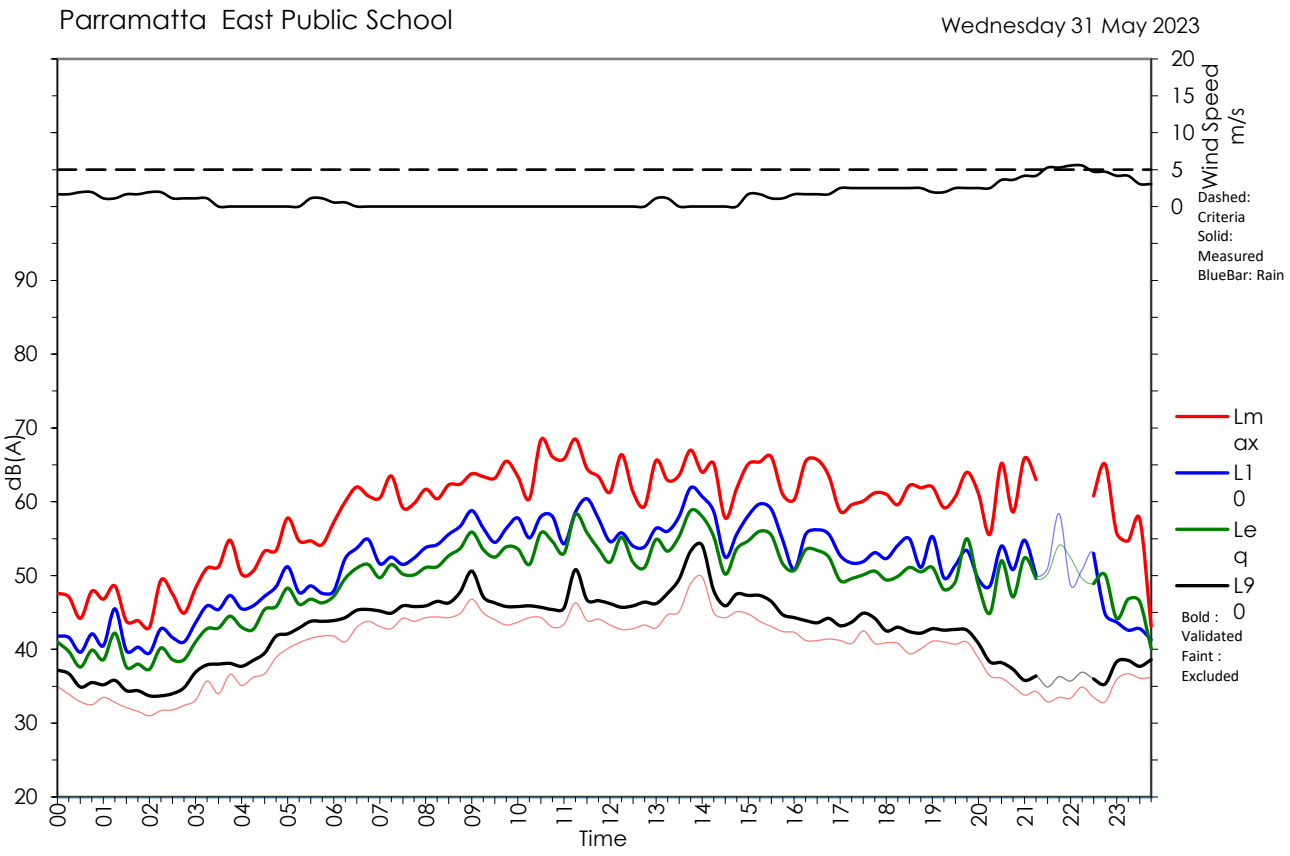
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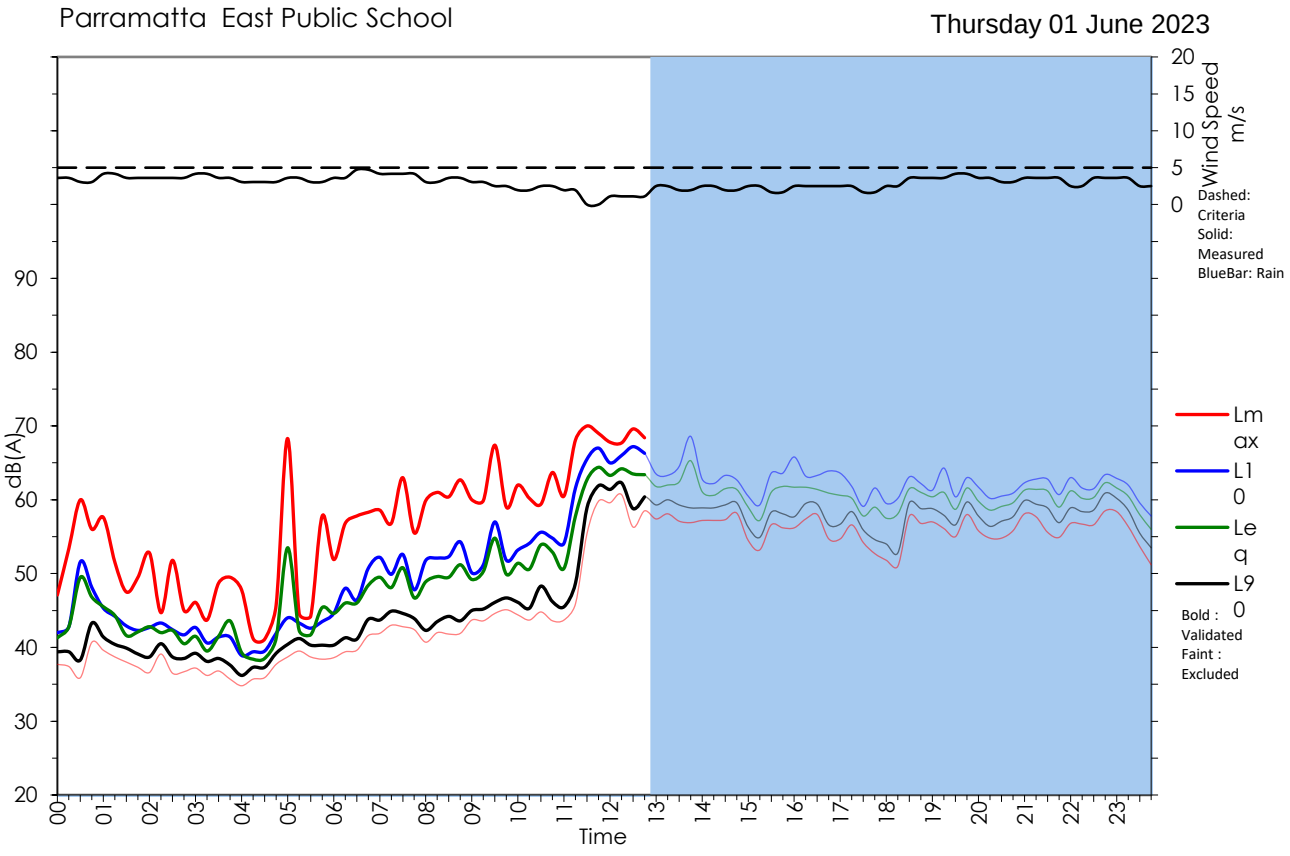
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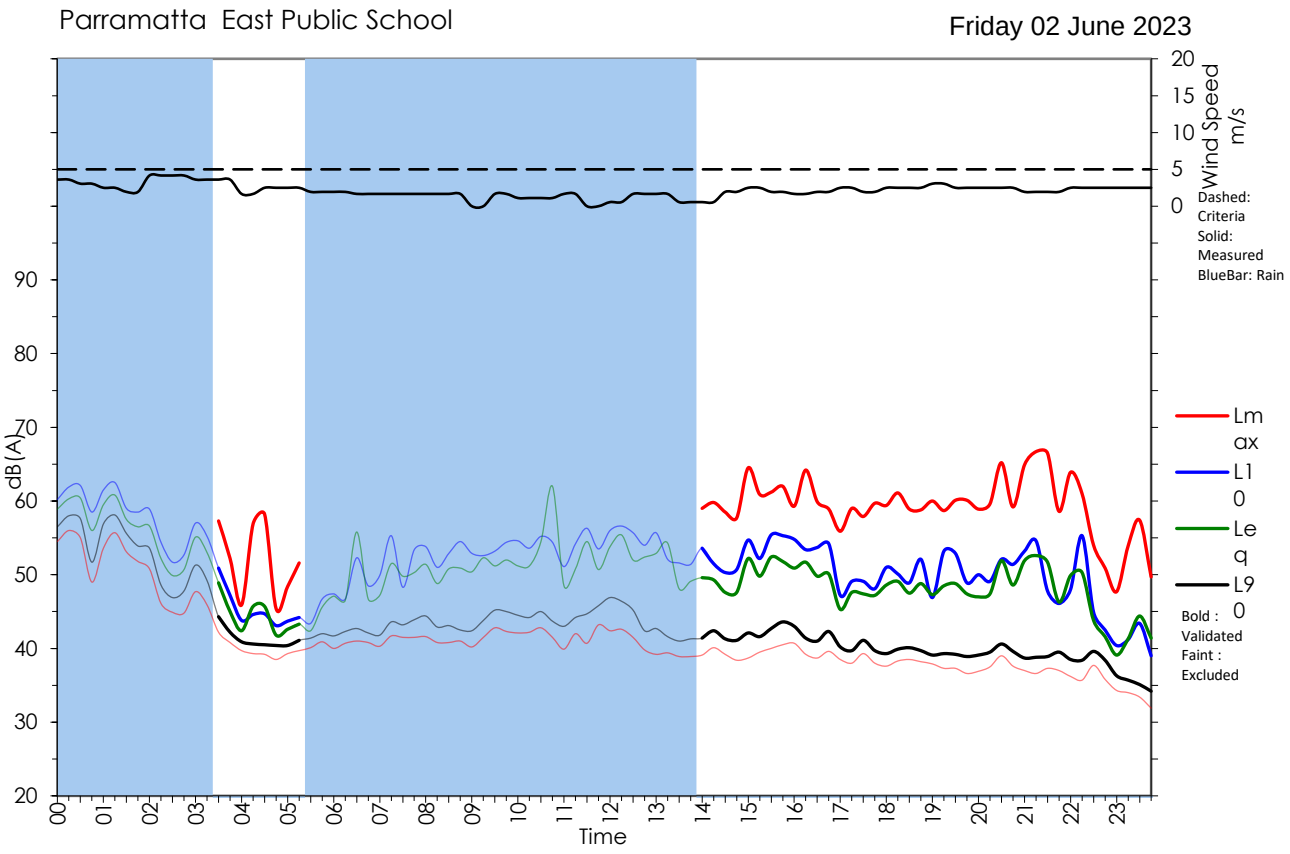
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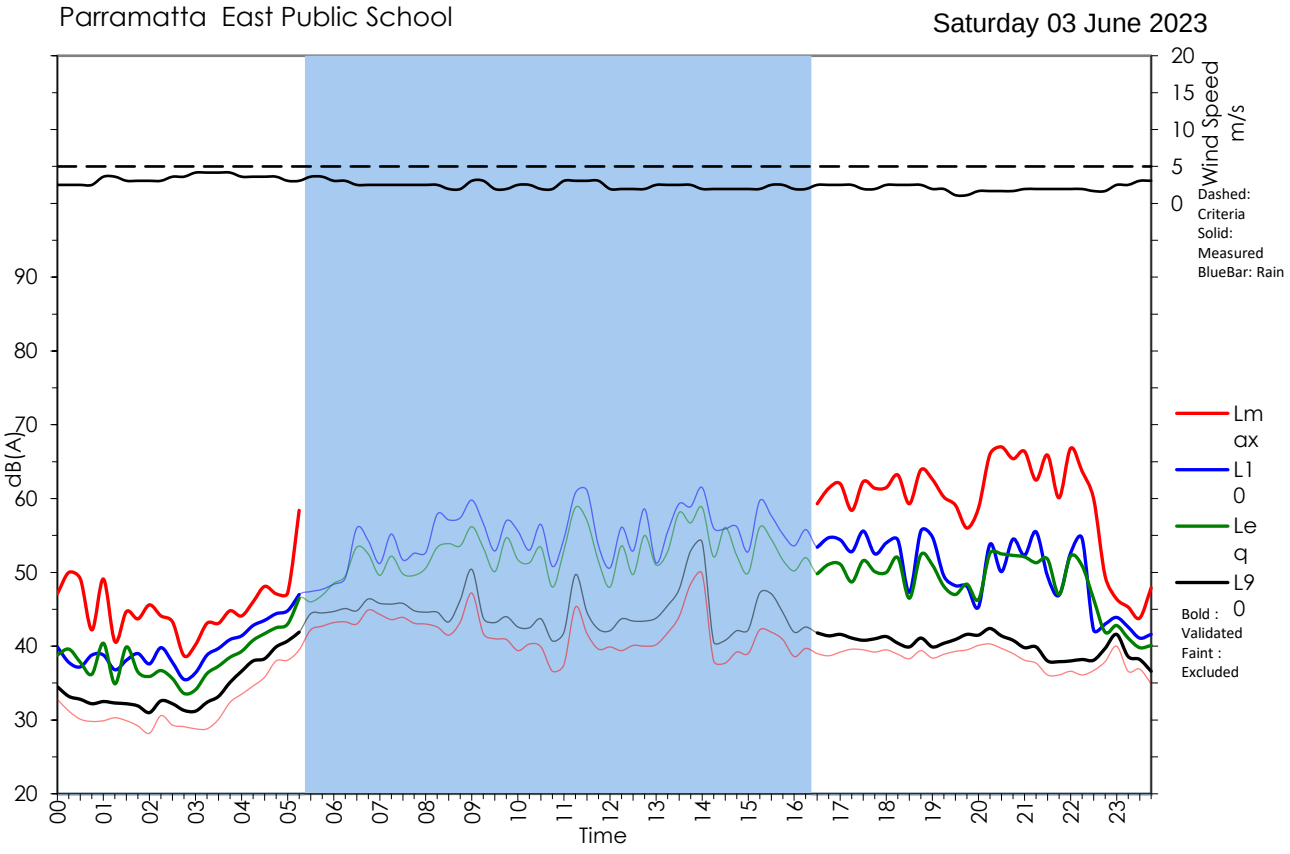
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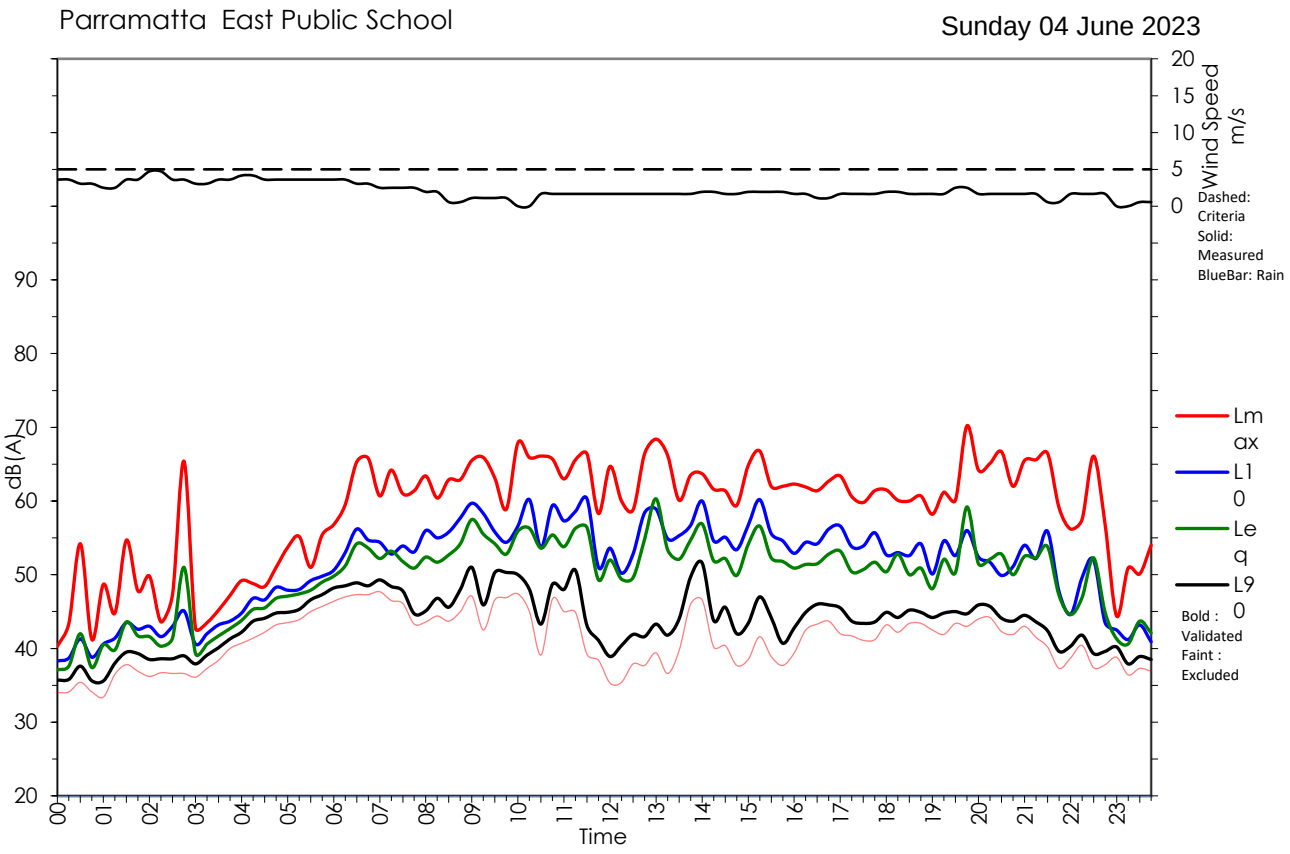
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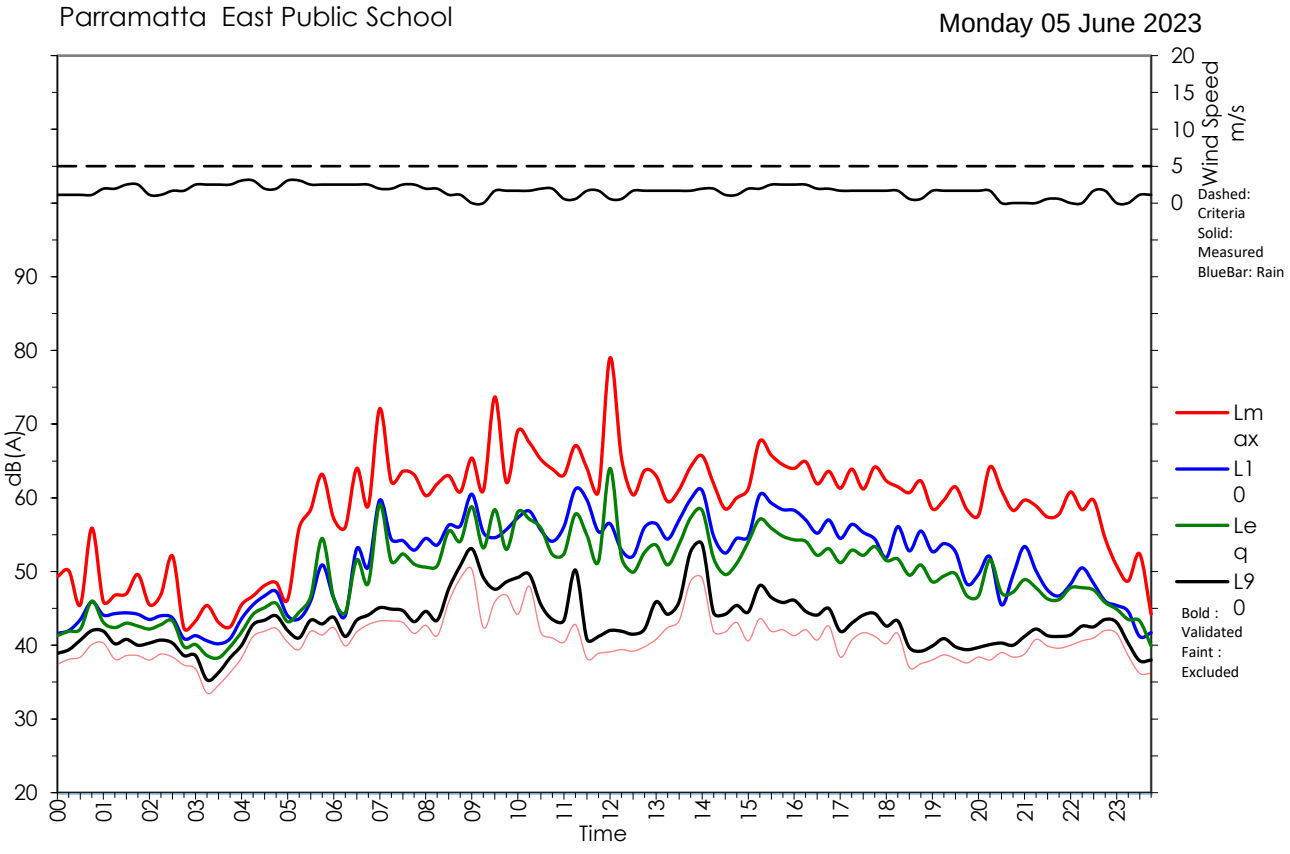
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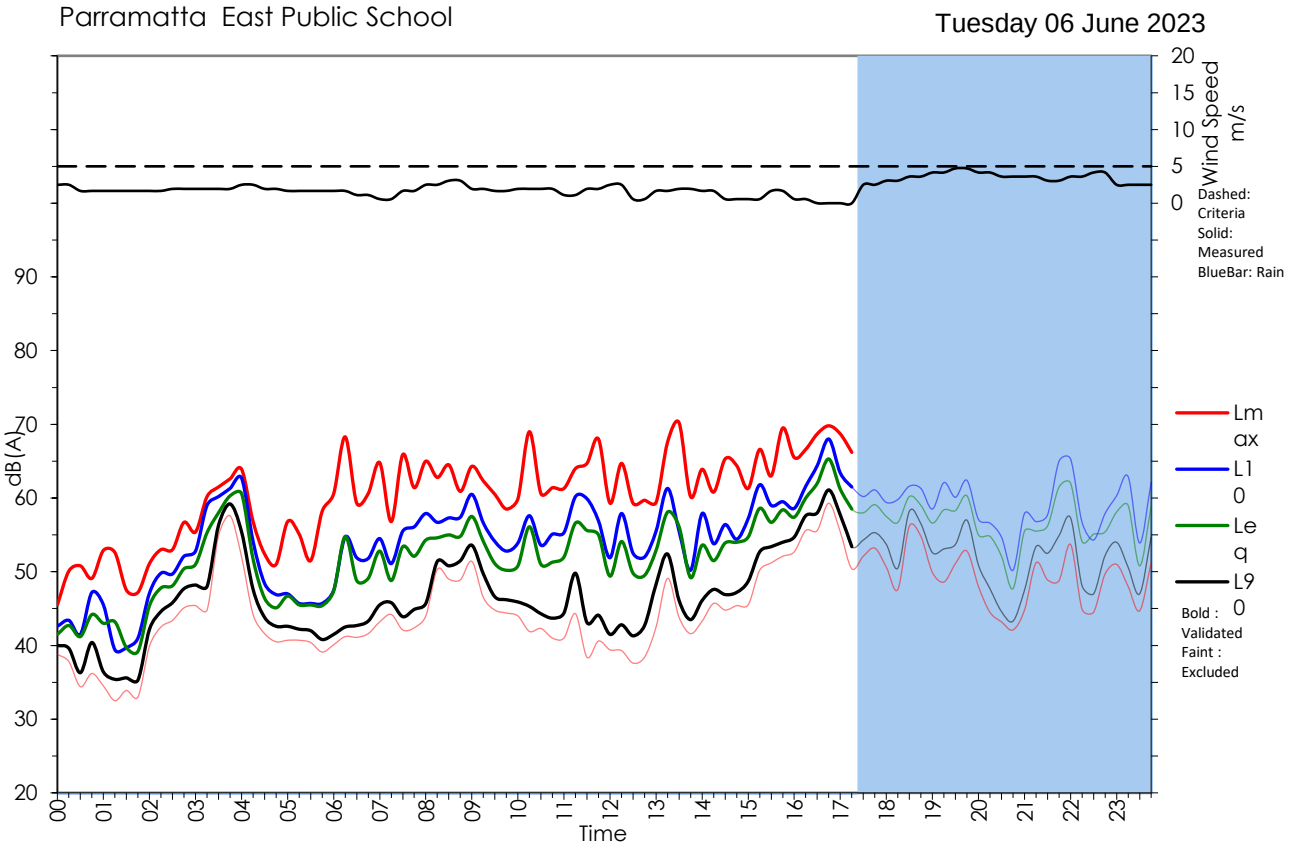
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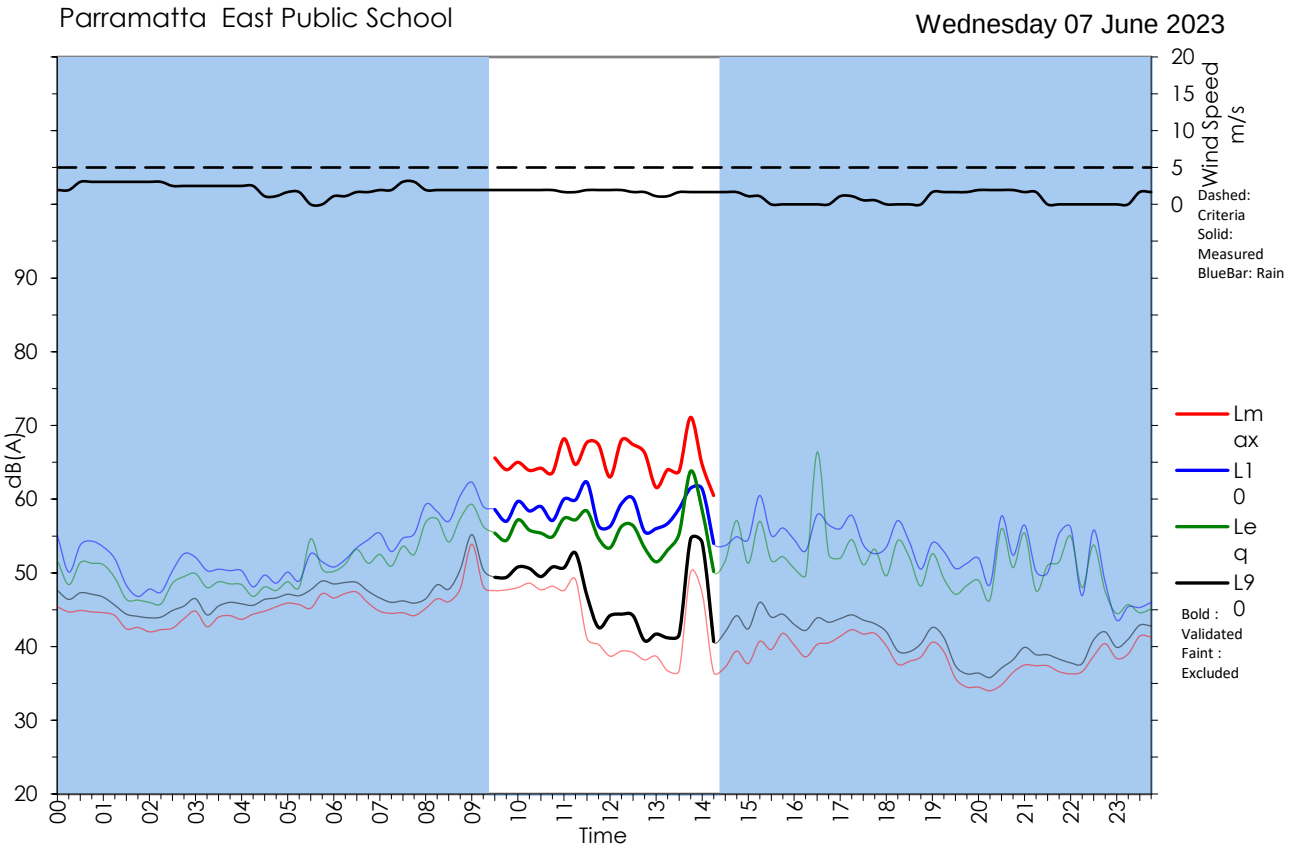
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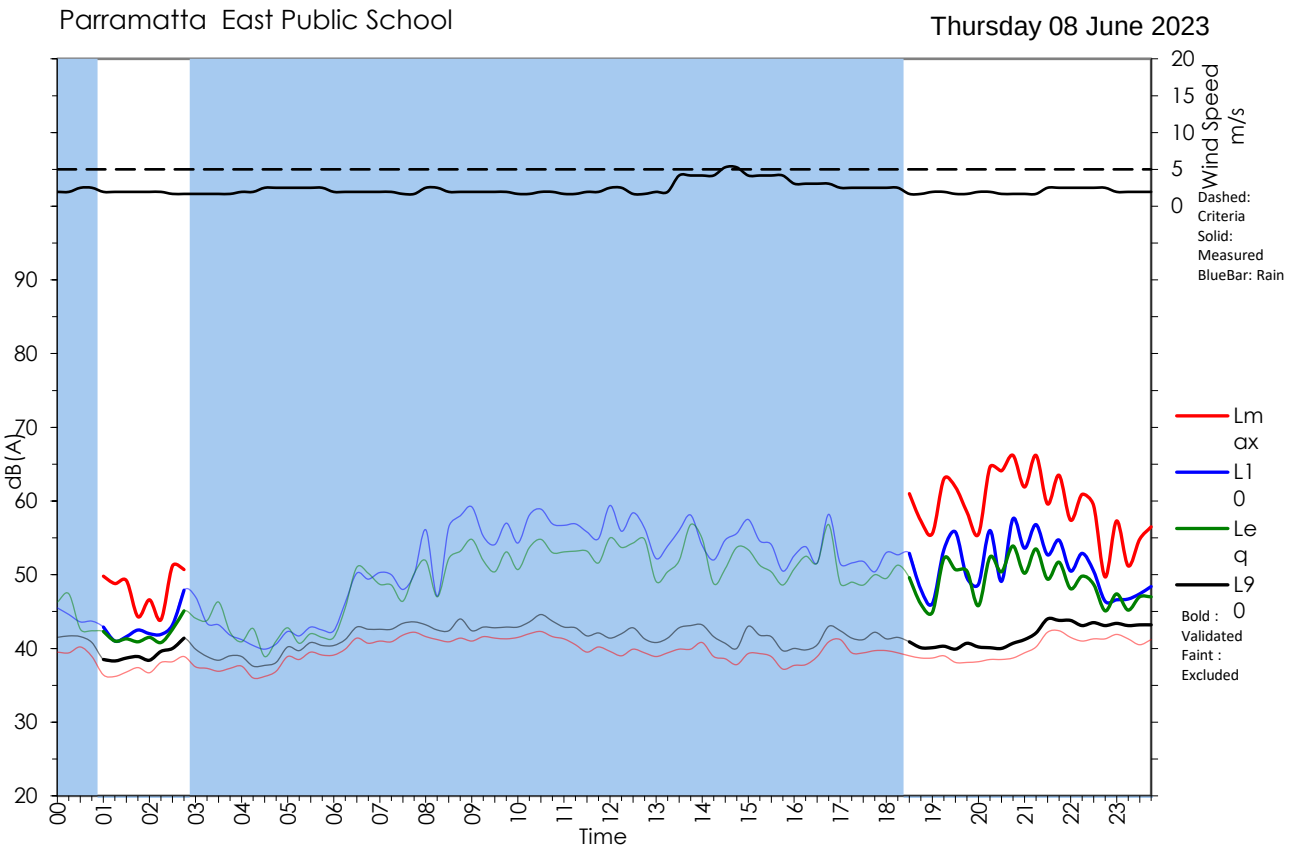
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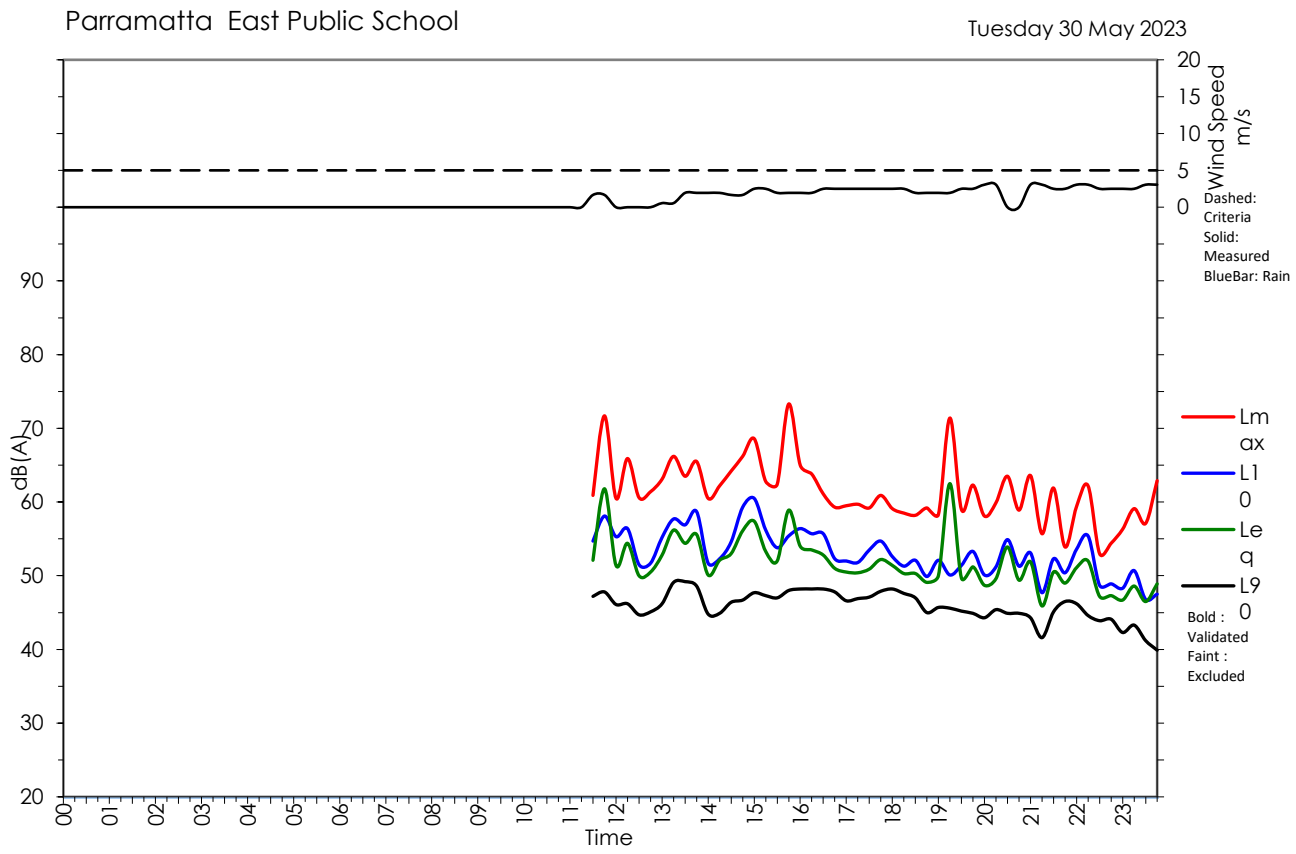
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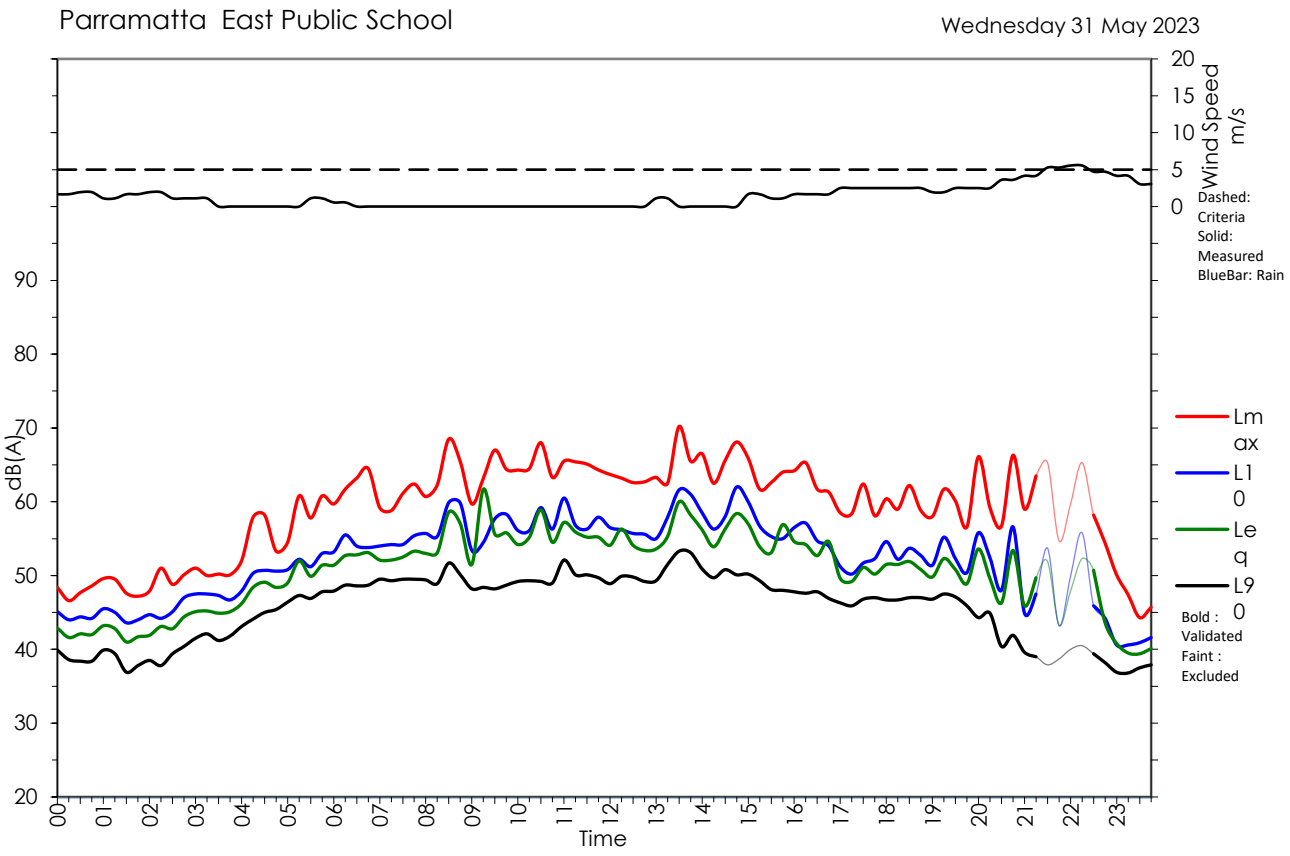
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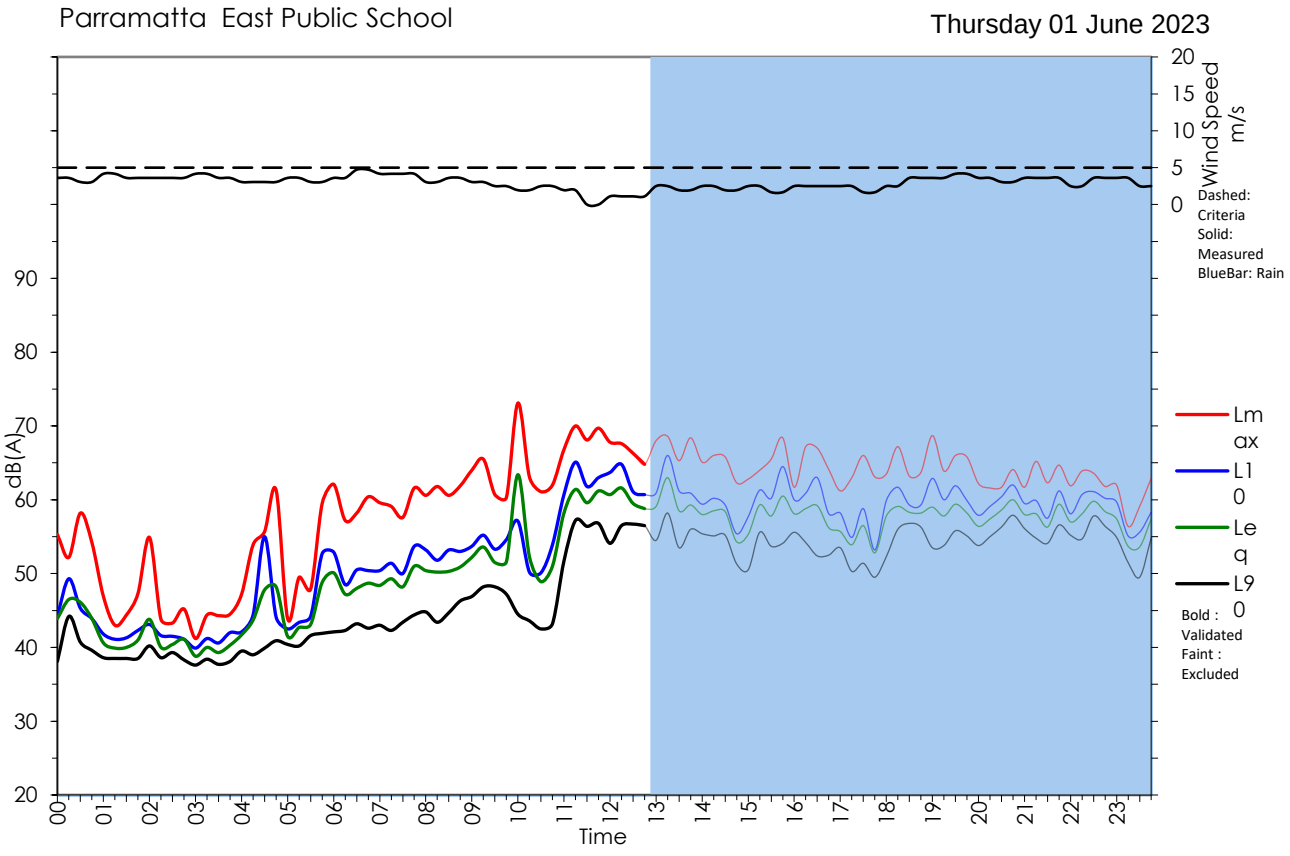
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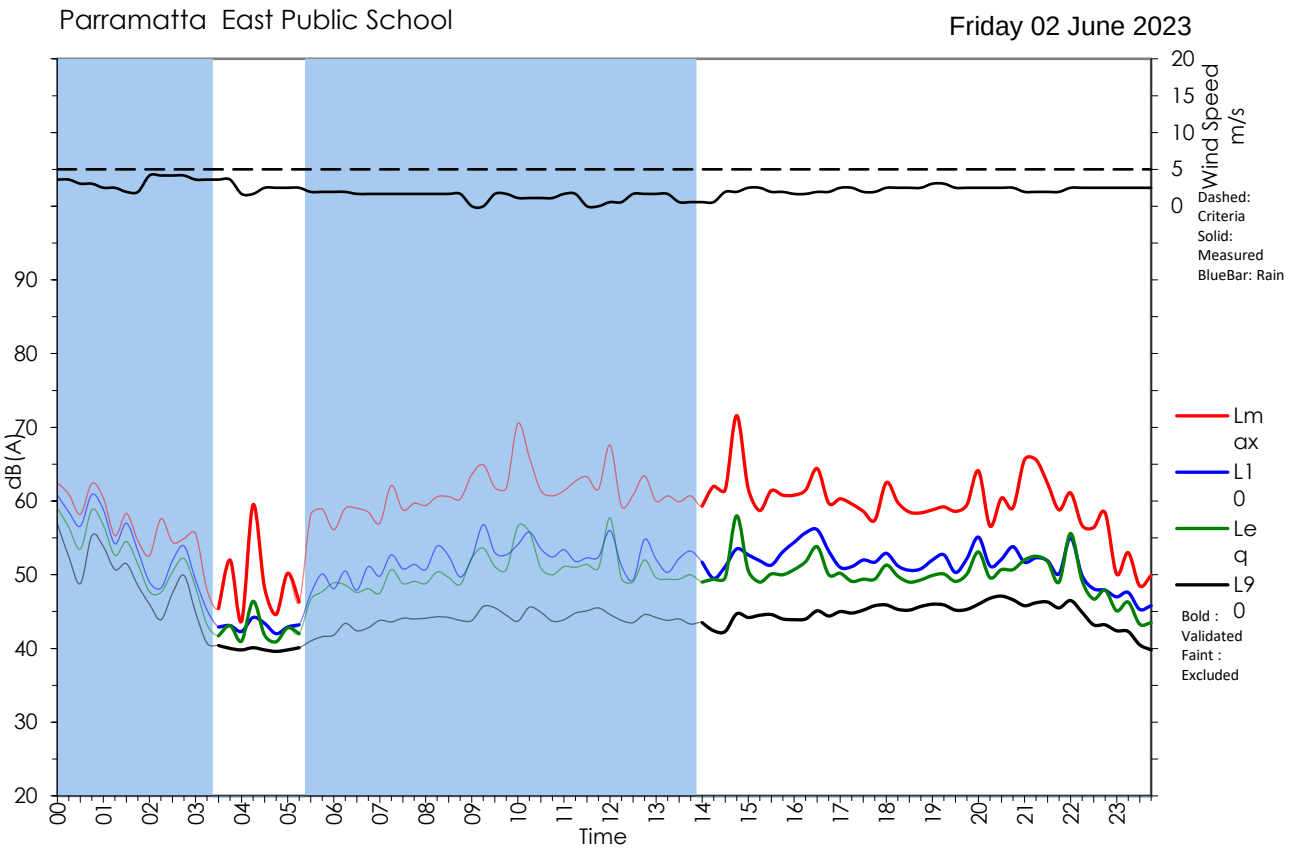
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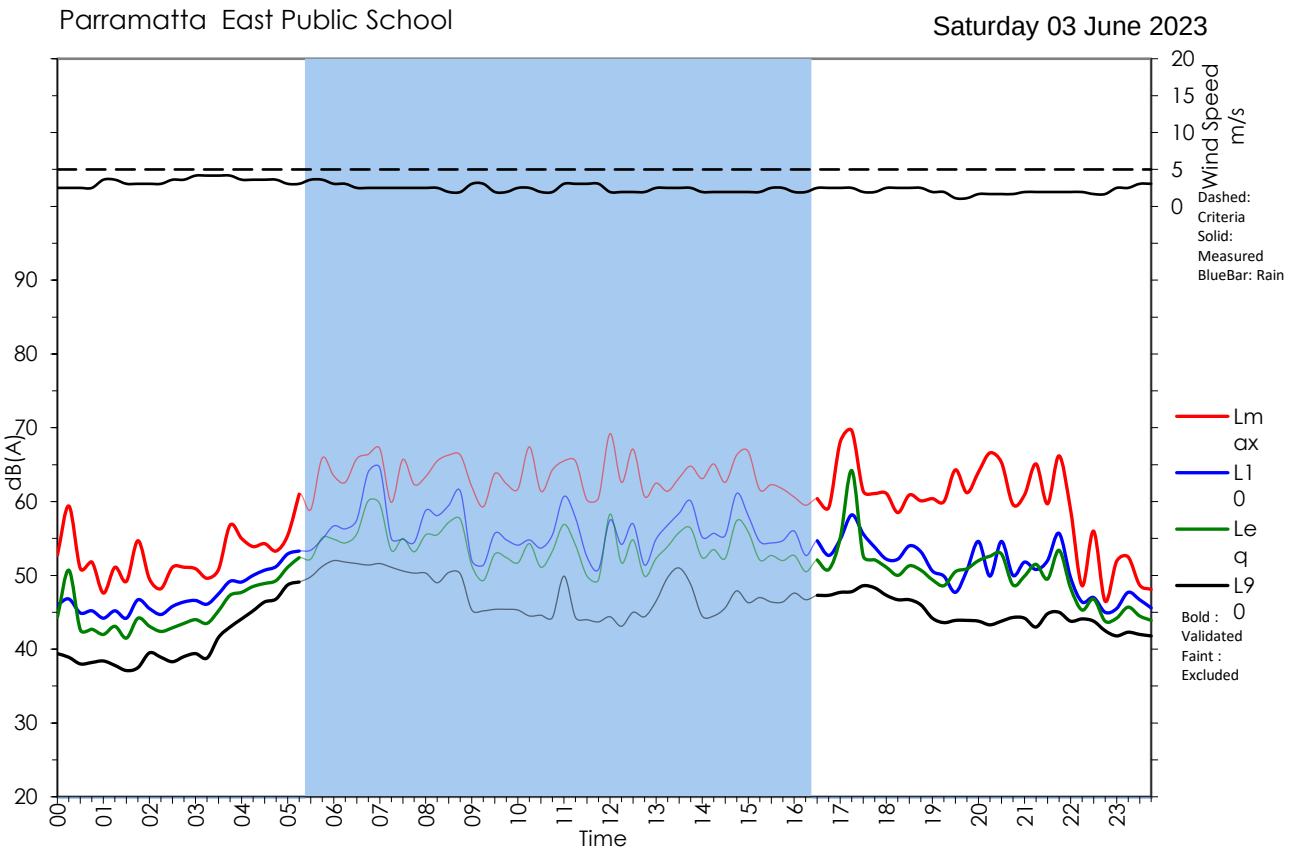
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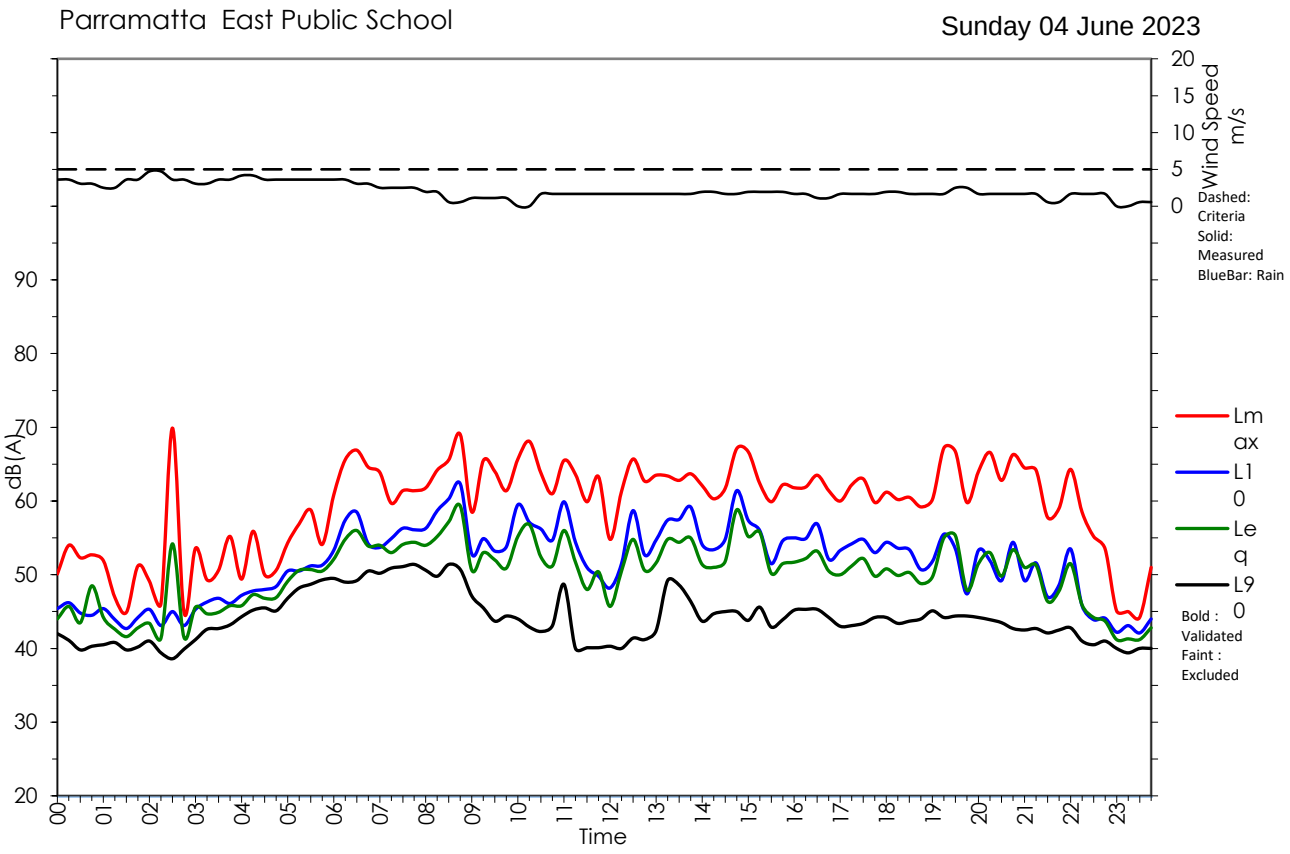
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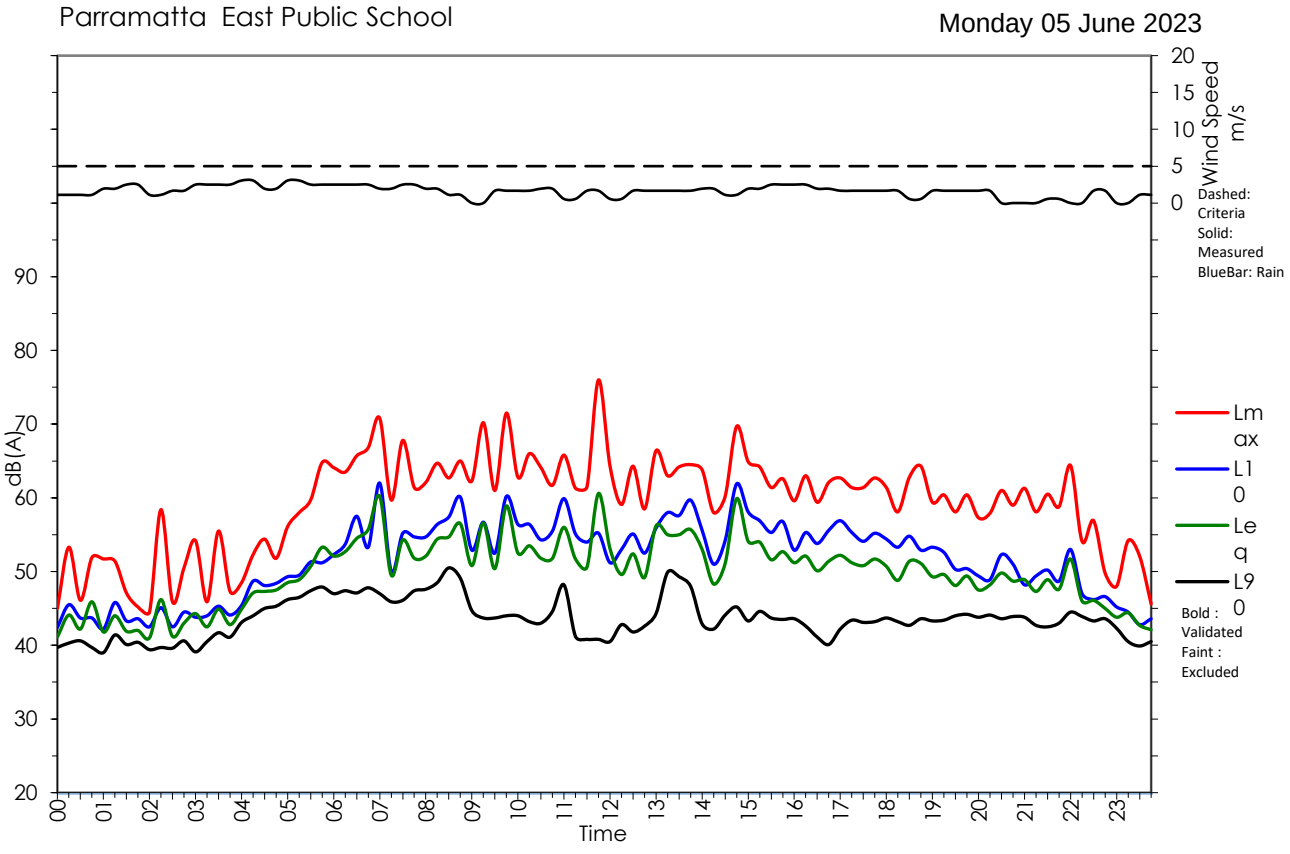
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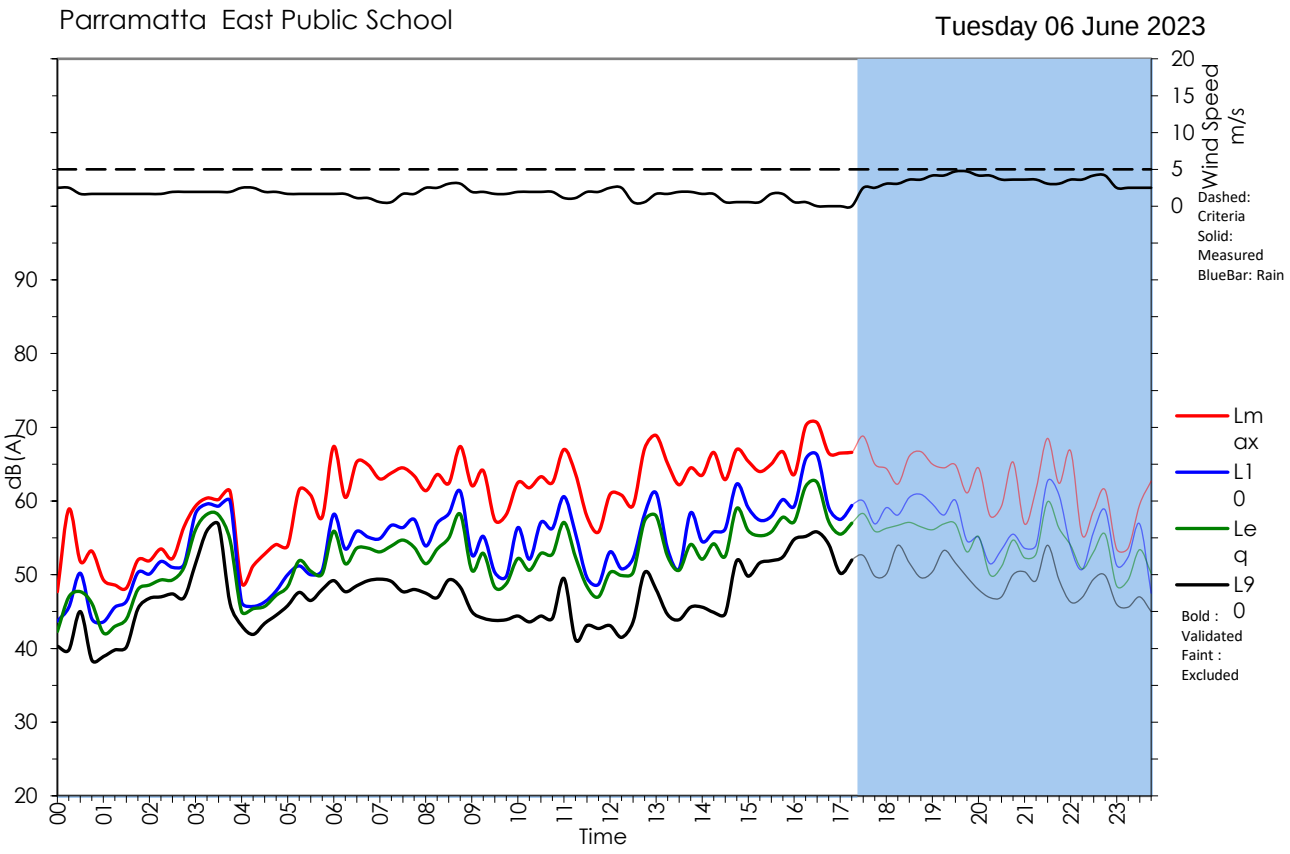
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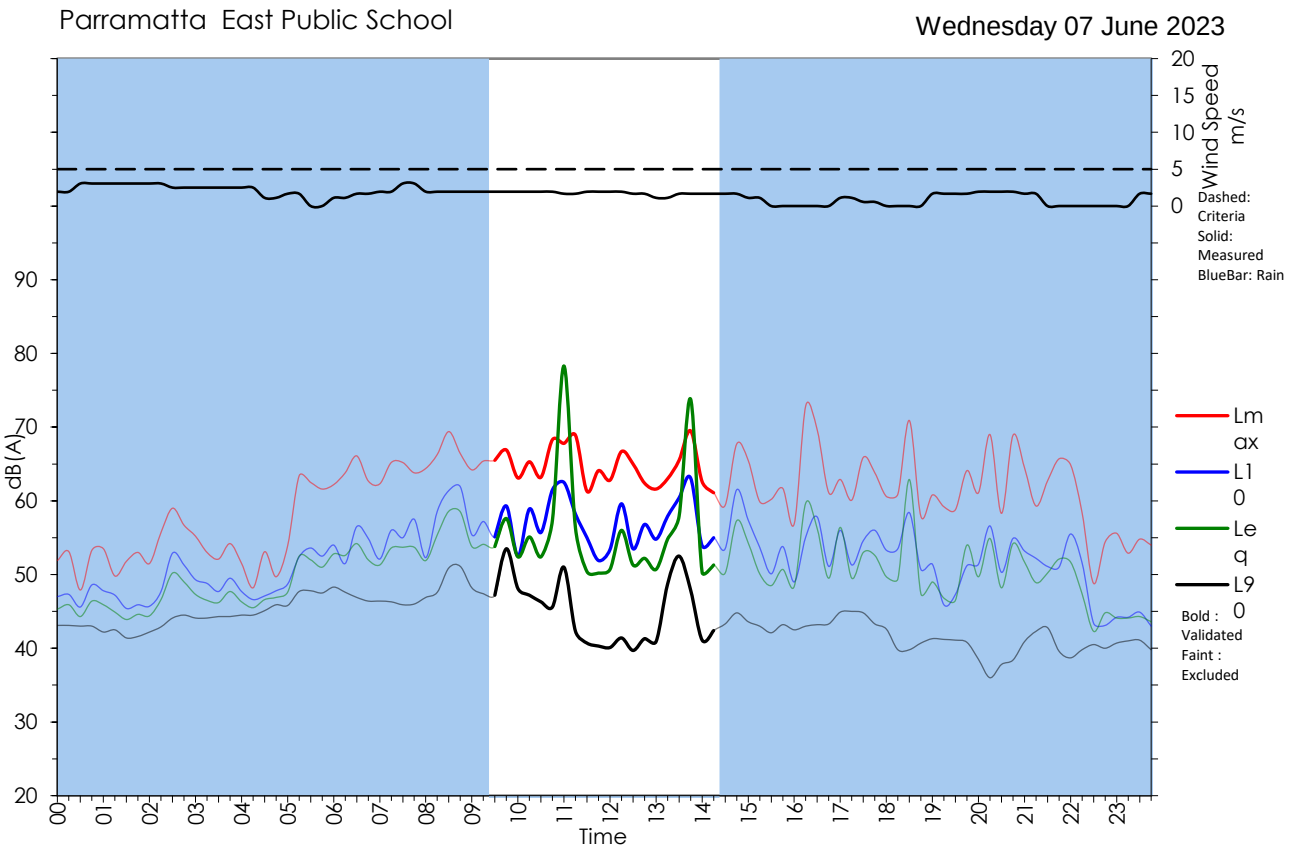
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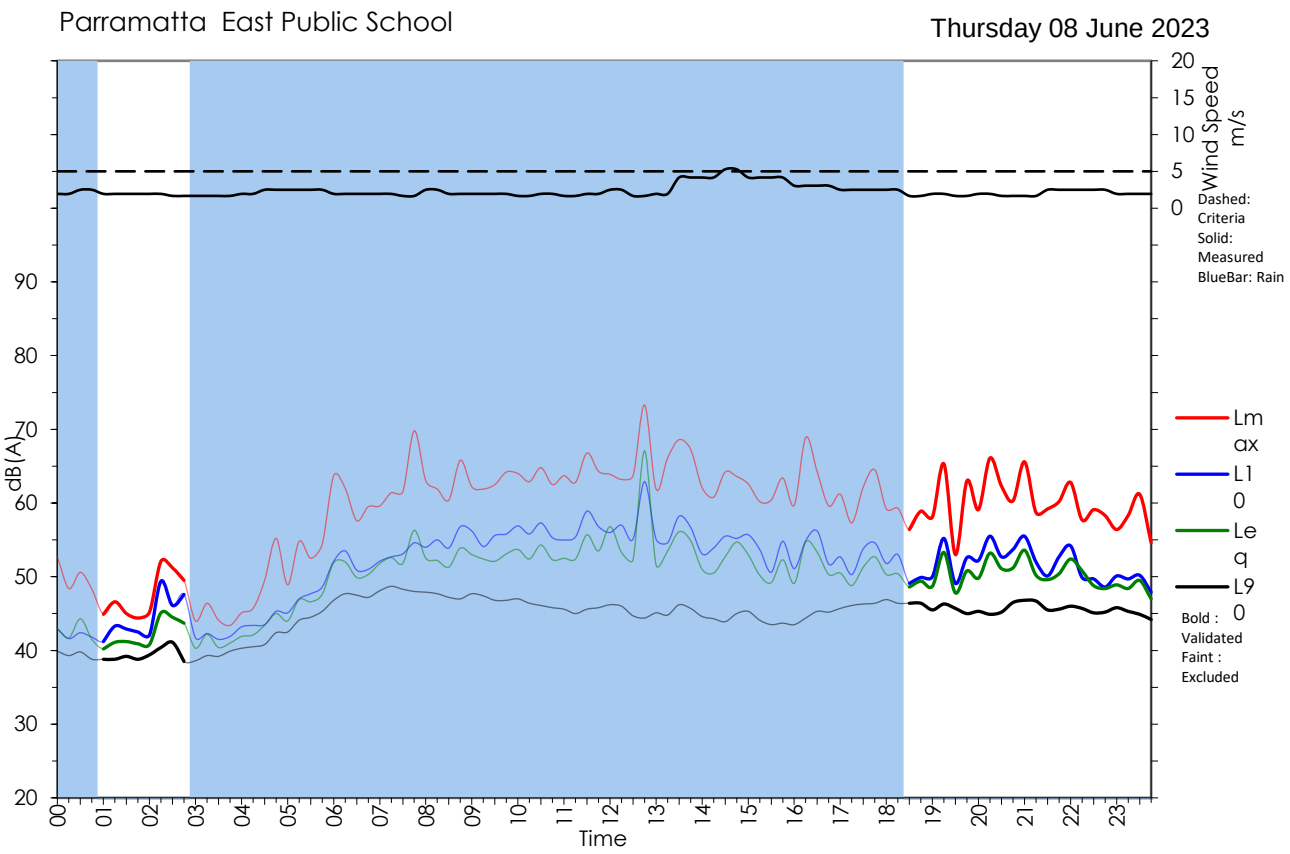
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