



120-122 Smith Street, Wollongong Stage 2

SSD Noise and Vibration Impact Assessment

The Smith St Development Partnership

Report number: 220465-3 -Smith St, Stage 2, Wollongong-SSD Noise and Vib Impact Assessment-R4
Date: 18 May 2026
Version: For Submission

DOCUMENT CONTROL

Project Name	120-122 Smith Street, Wollongong Stage 2
Project Number	220465-3
Report Reference	220465-3 -Smith St, Stage 2, Wollongong-SSD Noise and Vib Impact Assessment-R3
Client:	The Smith St Development Partnership

Revision	Description	Reference	Date	Prepared	Checked	Authorised
0	For Information	220465-3 -Smith St, Stage 2, Wollongong-SSD Noise and Vib Impact Assessment-R0	25 August 2025	Ben White	Matt Furlong	Ben White
1	For Information	220465-3 -Smith St, Stage 2, Wollongong-SSD Noise and Vib Impact Assessment-R1	16 February 2026	Ben White	Matt Furlong	Ben White
2	For Submission	220465-3 -Smith St, Stage 2, Wollongong-SSD Noise and Vib Impact Assessment-R2	23 February 2026	Ben White	Matt Furlong	Ben White
3	For Submission	220465-3 -Smith St, Stage 2, Wollongong-SSD Noise and Vib Impact Assessment-R3	2 April 2026	Ben White	Matt Furlong	Ben White
4	For Submission	220465-3 -Smith St, Stage 2, Wollongong-SSD Noise and Vib Impact Assessment-R4	26 May 2026	Ben White	Matt Furlong	Ben White

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TABLE OF CONTENTS

1	INTRODUCTION	6
1.1	Relevant Guidelines	6
1.2	Proposed Development	7
2	PROJECT DETAILS.....	8
2.1	Site Location	8
3	EXISTING ACOUSTIC ENVIRONMENT	9
3.1	Noise Descriptors and Terminology	10
3.2	Noise Survey Results	10
3.2.1	Unattended Acoustic Monitoring.....	10
3.2.2	Attended Noise Measurements.....	11
4	INTERNAL NOISE LEVEL ASSESSMENT	12
4.1	NSW Government Legislation – State Environmental Planning Policy (Transport and Infrastructure) 2021	12
4.2	NSW Department of Planning and Environments Development Near Rail Corridors and Busy Roads – Interim Guideline 2008.....	13
4.2.1	Australian / New Zealand Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors - (AS/NZS 2107:2016)	13
4.3	Project Airborne Noise Requirements	14
5	ENVIRONMENTAL NOISE INTRUSION ASSESSMENT	15
5.1	External Glass Elements	15
5.2	External Building Elements	15
5.3	External Roof	16
5.4	External Opening and Penetrations	16
5.5	Alternative Ventilation Requirements	16
6	RAIL PASS-BY VIBRATION	17
6.1	Vibration Impact Criteria	17
6.1.1	Tactile Vibration Impacts.....	17
6.1.2	Structure Borne Noise	17
6.2	Rail Pass By Vibration Measurements.....	18
6.2.1	Vibration Measurements.....	18
7	EXTERNAL NOISE EMISSION ASSESSMENT.....	19
7.1	NSW Noise Policy for Industry	19
7.1.1	Intrusive Noise Impacts (Residential Receivers).....	19
7.1.2	Protecting Noise Amenity (All Receivers).....	19
7.1.3	Area Classification	20
7.1.4	Project Trigger Noise Levels	21
8	OPERATIONAL ACOUSTIC ASSESSMENT.....	22
8.1	Mechanical Services Equipment	22
8.2	Waste and Garbage Collections.....	22



9	CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN	23
9.1	Construction Noise	23
9.1.1	Proposed Appliances.....	24
9.1.2	Construction Noise Criteria	25
9.1.3	Construction Noise Management – Qualitative Assessment.....	28
9.1.4	Construction Noise Assessment – Quantitative Assessment	28
9.2	Construction Vibration Assessment.....	30
9.2.1	Vibration Criteria – Human Comfort.....	30
9.2.2	Vibration Criteria – Building Contents and Structure.....	31
9.2.3	Standard BS 7385 Part 2 - 1993.....	31
9.2.4	Standard DIN 4150 Part 3 - 1999.....	33
9.2.5	Project Vibration Criteria	33
9.3	Contingency Plans	33
9.4	General Mitigation Measures (Australia Standard 2436-2010)	34
9.4.1	Adoption of Universal Work Practices	34
9.4.2	Plant and Equipment.....	34
9.4.3	On Site Noise Mitigation	34
9.4.4	Work Scheduling	34
9.4.5	Source Noise Control Strategies	35
9.4.6	Construction Vibration Impacts	35
9.5	Noise and Vibration Measurements and Monitoring.....	35
9.6	Community Engagement.....	36
10	CONCLUSION	37
11	APPENDIX A: ACOUSTIC TERMINOLOGY	38
12	APPENDIX B: UNATTENDED NOISE LOGGING	40

TABLES

Table 3-1	Measured ambient noise levels in accordance with the NSW NPI	11
Table 3-2	Measured ambient noise levels in accordance with the NSW NPI	11
Table 4-1	Recommended Design Sound Levels.....	14
Table 4-2	Project Internal Environmental Noise Level Criteria	14
Table 5-1	External Glass Acoustic Requirements.....	15
Table 6-1	Intermittent vibration impacts criteria ($\text{m/s}^{1.75}$) 1 Hz-80 Hz, Vibration Dose Values (VDV).....	17
Table 6-2	Calculated VDV	18
Table 8-1	NSW NPI – Recommended LAeq Noise Levels from Industrial Noise Sources	20
Table 8-2	External noise level criteria in accordance with the NSW NPI	21
Table 10-1	Noise Level from Expected Demotion Appliances	24
Table 10-2	Noise Management Levels from Construction	26
Table 10-3	Site Construction Noise Management Levels	27
Table 10-4	Quantitative Assessment of Construction Noise to Neighboring Residence.....	29
Table 10-5	Continuous vibration acceleration criteria (m/s^2) 1 Hz-80 Hz.....	30
Table 10-6	Impulsive vibration acceleration criteria (m/s^2) 1 Hz-80 Hz	30
Table 10-7	Intermittent vibration impacts criteria ($\text{m/s}^{1.75}$) 1 Hz-80 Hz.....	31
Table 10-8	Transient vibration criteria as per standard BS 7385 Part 2 - 1993.....	31
Table 10-9	Structural damage criteria as per standard DIN 4150 Part 3 - 1999	33

FIGURES

Figure 2-1	Site location and Noise Measurement Locations	8
Figure 3-1	Site Location of Map 18C of the RTA's <i>Traffic Volume Maps for Noise Assessment for Buildings on Land Adjacent to Busy Roads</i>	9
Figure 4-1	Extract - DNRCBR - Table 3.1.	13
Figure 10-1	BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage	32



1 INTRODUCTION

This Noise and Vibration Impact Assessment is submitted to the Department of Planning, Housing and Infrastructure (the Department) on behalf of Urban Property Group (Urban) (the Applicant) in support of a State Significant Development Application (SSDA) (SSD- 122745741) for a mixed use development containing shoptop housing and co-living rooms at 120-122 Smith Street (the site).

Pulse White Noise Acoustics Consultancy Pty Ltd (Pulse White Noise Acoustics) has been engaged to undertake the noise and vibration impact assessment for the SSD submission of the mixed-use development to be located at 120-122 Smith Street (Stage 2), Wollongong project.

This assessment will address the following:

- Potential surrounding environmental noise intrusion impacts on the development (i.e., traffic, train noise and other noise external noise sources).
- Noise emissions on nearby receivers from operation of the base building services (i.e., electrical, hydraulic and mechanical plant).
- Potential for vibration impact on the site resulting from train pass buys on the railway line to the west of the site.
- Noise emission on nearby receivers from the movement of vehicles in and out of the site.
- Construction noise and vibration impact during the construction stage of the project.

This report will discuss the relevant acoustic criteria which have been adopted as well as the outcome of the assessment.

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

1.1 Relevant Guidelines

Acoustic criteria which have been adopted in this assessment include requirements from the local and state authorities and in the absence of any applicable criteria from these bodies, Australian and International Standards will be utilised, including those required to comply with the Industry SEARs.

This noise and vibration impact assessment addresses the following relevant Secretary’s Environmental Assessment Requirements (SEARs), which were issued on 15 May 2025 in relation to the project, as set out in the table below.

10. Noise and Vibration • Provide a noise and vibration impact assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	Noise and Vibration Impact Assessment
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1.2 Proposed Development

The overarching project site comprises a Stage 1 and Stage 2 component at 106 and 120-122 Smith Street and 3A Charlotte Street, Wollongong. Consent was granted on 4 April 2025 by the Department for the construction of a shoptop housing development on the Stage 1 Portion of the site. This development was subsequently modified three times and specifically comprises:

- Two x 8 to 10-storey residential buildings with ground level retail/commercial uses;
- 150 apartments (including 27 affordable housing apartments);
- communal open space at podium and roof top level;
- two levels of above ground car parking with 183 car spaces;
- vehicular access from Smith Street and Charlotte Street with associated road upgrade works; and
- publicly accessible through-site link and landscaping works.

The proposed development comprises a mixed-use development incorporating shop-top housing and co-living accommodation. The built form consists of a single, continuous four-storey podium with three residential towers above, providing residential accommodation in the form of apartments and co-living rooms. Specifically, the proposed development comprises:

- A single continuous 4-storey podium containing:
 - Resident and visitor car parking;
 - Bicycle parking;
 - A commercial tenancy and another non-residential tenancy to be addressed under a future DA;
 - Waste storage and collection areas, including loading areas;
 - Three separate lobbies;
 - Residential accommodation, including apartments (within Building A and B) and co-living rooms (within Building C); and
 - Communal open space on the podium rooftop, inclusive of an aboveground swimming pool and other amenities as well as landscaping;
- A 25-storey tower (Tower A) comprising residential apartments and associated amenities;
- A 30-storeys tower (Tower B) comprising residential apartments and associated amenities;
- A 12-storey building (Building C) comprising co-living rooms and associated amenities;
- A pedestrian bridge spanning from Throsby Drive to the proposed development; and
- Landscaping and public domain works.

To facilitate the proposed development, amendments to the Wollongong Local Environmental Plan 2009 are being sought via a concurrent Rezoning Proposal. The key amendments comprise an increase to the FSR and height controls on the site.

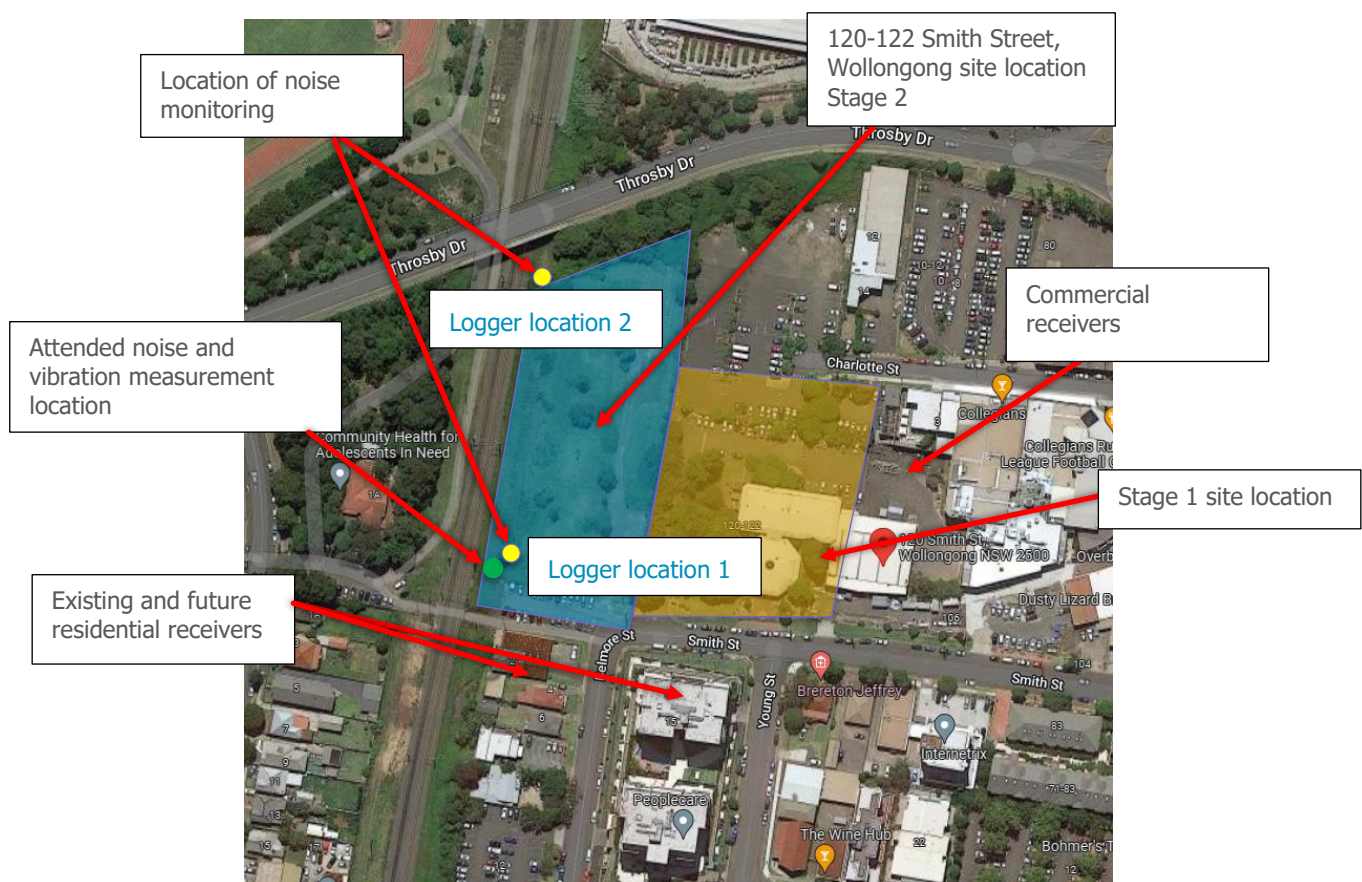
2 PROJECT DETAILS

2.1 Site Location

The subject site is a 11,003m² parcel of land located at 120 Smith St, Wollongong- Stage 2, NSW 2500. The site is the second stage of the Keira Place project. The site consists of a generally clear, flat area aside from the Northern portion, where there is an approximate 9m fall from Throsby Drive. The site is aex-Jemena gasworks site, and although remediated, is subject to an Interim-Term Environmental Management Plan. Additionally, there is an easement for drainage located along the Eastern boundary which separates Stage 1 from Stage 2. There is a further restriction on use of land in a small portion of the Northeast corner of the site.

The site location is detailed in Figure 2-1 below.

Figure 2-1 Site location and Noise Measurement Locations



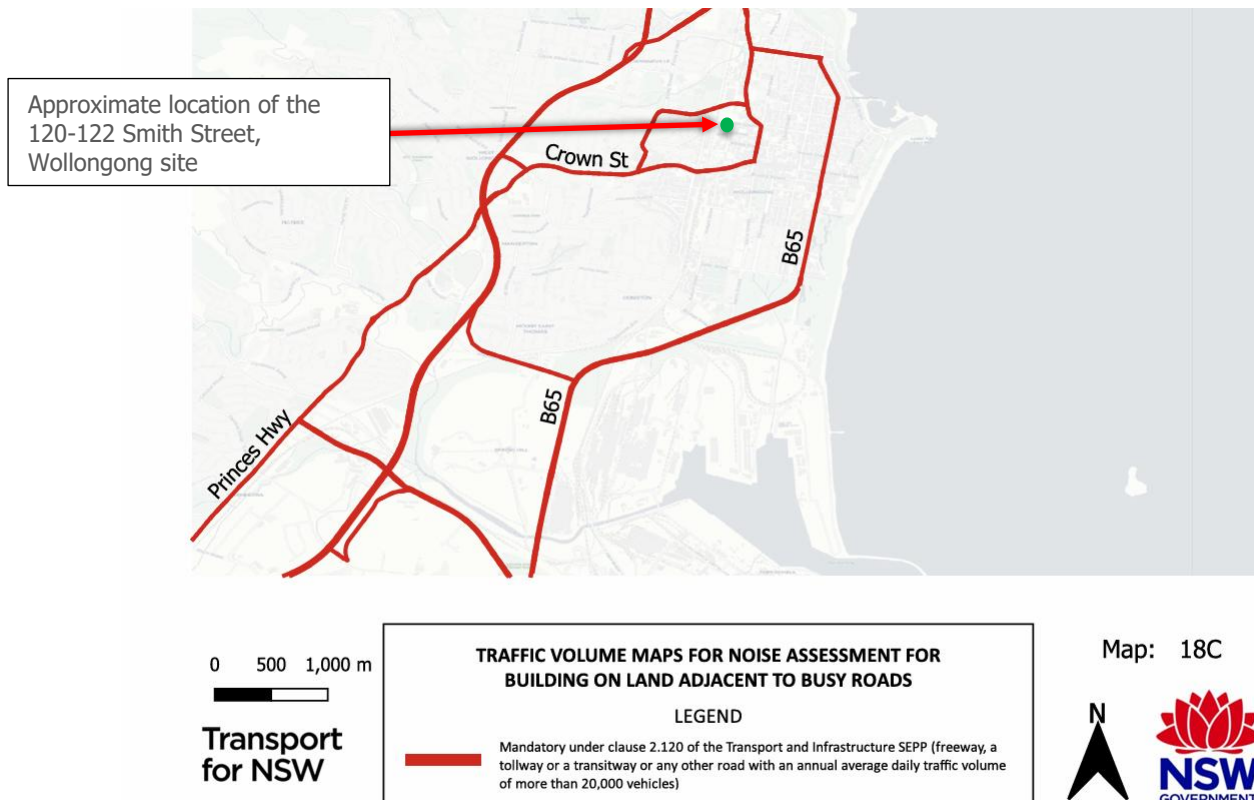
3 EXISTING ACOUSTIC ENVIRONMENT

The 120-122 Smith Street, Wollongong Stage 2 site is located with an area which is classified as Suburban residential area as defined by the NSW EPA *Noise Policy for Industry*. The exiting noise levels at the site are predominantly as a result from traffic noise within the vicinity of the site on surrounding roadways and the train line which is located to the west of the site.

The site is located on Smith Street and Throsby Drive which are not defined as a busy road carrying over 200,000 Annual Average Daily Traffic (AADT) number as defined in Map 18C of the RTA's *Traffic Volume Maps for Noise Assessment for Buildings on Land Adjacent to Busy Roads*.

See the Figure below which includes the site location included on Map 18C of the RTA.

Figure 3-1 Site Location of Map 18C of the RTA's *Traffic Volume Maps for Noise Assessment for Buildings on Land Adjacent to Busy Roads*



Note: The map traffic volume data is largely derived from third-party handset tracking data. Where required, any localised discontinuities or inconsistencies should be resolved by local traffic counts

3.1 Noise Descriptors and Terminology

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

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

The most relevant environmental noise descriptors are the LAeq, LA1, LA10 and LA90 noise levels. The LAeq noise level represents the "equivalent energy average noise level". This parameter is derived by integrating the noise level measured over the measurement period. It represents the level that the fluctuating noise with the same acoustic energy would be if it were constant over the measured time period.

The LA1, LA10 and LA90 levels are the levels exceeded for 1%, 10% and 90% of the sample period. These levels can be considered as the maximum noise level, the average repeatable maximum and average repeatable minimum noise levels, respectively.

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

3.2 Noise Survey Results

As part of this assessment an acoustic survey of the existing acoustic environment at the site was undertaken. The survey included attended noise level measurements at the site and undertaken as part of the previous project approvals, during various times of the day on the 7th September 2022 as well as long term unattended noise logging which was undertaken between the 7th and the 15th September, 2022. During the testing periods there was no inclement weather periods and supplemented with additional attended measurements as detailed in this section of the report.

3.2.1 Unattended Acoustic Monitoring

Noise logging was undertaken using Rion NL-42EX type noise monitors with serial numbers 00998079 and 00998081 with calibration certificate numbers C19678 and C19677. The noise logger was located on the project site as detailed in Figure 2-1 above to obtain representative background noise levels. The logger was positioned such that it included façade corrects which have been applied in this assessment.

3.2.1.1 Monitoring Instrumentation

Instrumentation used for the noise survey comprised sound level meter / analysers fitted with a microphone windshield. Calibration of the logger was checked prior to and following the measurements. Drift in calibration did not exceed ± 0.5 dBA. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Charts presenting summaries of the measured daily noise data are attached in Appendix B. These charts, representing each 24 hour period, show the LA10, LAeq and LA90 noise levels measured over 15 minute time periods.

Logging was conducted continuously between the 7th and the 15th September, 2022. The measurement results have been filtered to remove data affected by adverse weather conditions, such as excessively windy or rainy time periods, as recorded by the nearest Bureau of Meteorology weather station at Bellambi Point, Wollongong. Detailed noise logging results are shown in Appendix B.

The measured background noise data of the logger was processed in accordance with the recommendations contained in the NSW Environment Protection Authority's (EPA) *Noise Policy for Industry* (NPI).

The Rating Background Noise Level (RBL) is the background noise level used for assessment purposes at the nearest potentially affected receivers. It is the 90th percentile of the daily background noise levels during each assessment period, being day, evening and the night. The RBL LA90 (15minute) and LAeq noise levels are presented in Table 3-1 for the unattended logging. The measured noise levels are considered to be representative of the levels to be expected at the nearest and most affected residence to the proposed development.

Table 3-1 Measured ambient noise levels in accordance with the NSW NPI

Measurement Location	Daytime ¹ 7:00 am to 6:00 pm		Evening ¹ 6:00 pm to 10:00 pm		Night-time ¹ 10:00 pm to 7:00 am	
	LA90 ²	LAeq ³	LA90 ²	LAeq ³	LA90 ²	LAeq ³
Logger Location 1	53	62	48	62	42	60
Logger Location 2	43	70	41	65	37	63
<i>Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am</i> <i>Note 2: The LA90 noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.</i> <i>Note 3: The LAeq is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.</i>						

3.2.2 Attended Noise Measurements

Supplementary attended noise testing was conducted at the site to conform the previous noise logging completed and detailed in the sections above. Attended noise level testing was undertaken using a Bruel and Kjaer 2236C type meter. The meter was calibrated before and after testing and no significant drift was recorded.

The attended and unattended noise locations were selected to obtain suitable noise levels for the assessment of background noise levels ($L_{90(t)}$) as well as the impact from traffic movements ($Leq(t)$).

Attended noise level measurements were undertaken at the site on the 25th August 2025 during the morning period of 8.30pm to 10am. The results of the attended noise level measurements are detailed in the table below.

Table 3-2 Measured ambient noise levels in accordance with the NSW NPI

Measurement Location	Time of measurement	Measured LAeq, 15min dB(A)	Measured LA90, 15min dB(A)	Comments
Attended noise measurement location facing railway to the west	8.45am to 9.00am	63	45	Noise levels resulting from natural noise sources and traffic noise from roadways and the train line to the west of the site.
	9.05am to 9.20am	64	45	

4 INTERNAL NOISE LEVEL ASSESSMENT

Internal noise levels within the future residential occupancies have been based on the relevant noise levels as detailed within the Australian Standard AS2107:2016 *Acoustics - Recommended design sound levels and reverberation times for building interiors* and the Department of Planning *Development Near Rail Corridor and Busy Roads – Interim Guideline* (DNRCBR).

4.1 NSW Government Legislation – State Environmental Planning Policy (Transport and Infrastructure) 2021

Due to the proximity of the above ground railway corridor to the proposed development site, the Transport and Infrastructure SEPP has been considered.

Clause 2.100 outlines indoor noise level requirements for non-rail developments that are for residential use. Clause 2.100 states the following:

2.100 Impact of rail Noise or Vibration on non-rail development

1. *This section applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration—*
 - a) *residential accommodation,*
 - b) *a place of public worship,*
 - c) *a hospital,*
 - d) *an educational establishment or centre based childcare facility.*
2. *Before determining a development application for development to which this section applies, the consent authority must take into consideration any guidelines that are issued by the Planning Secretary for the purposes of this section and published in the Gazette.*
3. *If the development is for the purpose of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded—*
 - a) *In any bedroom in the residential accommodation – 35 dB(A) at any time between 10:00 pm and 7:00 am,*
 - b) *Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom, or hallway) – 40 dB(A) at any time.*

4.2 NSW Department of Planning and Environments Development Near Rail Corridors and Busy Roads – Interim Guideline 2008

NSW Department of Planning's document DNRCBR adopts the same internal noise criteria outlined in the SEPP infrastructure identified above. Table 3.1 from the DNRCBR requires the following airborne noise levels resulting from surrounding road network.

Figure 4-1 Extract - DNRCBR - Table 3.1.

Table 3.1: Noise criteria		
Residential Buildings		
Type of occupancy	Noise Level dBA	Applicable time period
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40	At any time
Non-Residential Buildings		
Type of occupancy	Recommended Max Level dBA	
Educational Institutions including child care centres	40	
Places of Worship	40	
Hospitals	- Wards	35
	- Other noise sensitive areas	45

Note: airborne noise is calculated as $L_{eq}(9h)$ (night) and $L_{eq}(15h)$ (day). Groundborne noise is calculated as L_{max} (slow) for 95% of rail pass-by events.

4.2.1 Australian / New Zealand Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors - (AS/NZS 2107:2016)

Recommended ambient noise levels and reverberation times for internal spaces are given in a number of publications including Table 1 of Australian / New Zealand Standard 2107:2016 "*Acoustics - Recommended design sound levels and reverberation times for building interiors*". Unlike the previous version of this Standard, this latest edition recommends a range with lower and upper levels (rather than "satisfactory" and "maximum" internal noise levels) for building interiors based on room designation and location of the development relative to external noise sources. This change has occurred due to the fact that sound levels below 'satisfactory' could be interpreted as desirable, but the opposite may in fact be the case. Levels below those which were listed as 'satisfactory' can lead to inadequate acoustic masking resulting in loss of acoustic isolation and speech privacy.

Internal noise levels due to the combined contributions of external noise intrusion and mechanical ventilation plant should not exceed the maximum levels recommended in this Standard. The levels for areas relevant to this development are given in Table 4-2 below. The mid to maximum points of the internal noise level ranges are generally adopted as the internal design noise criteria for the combined effect of mechanical services and external noise intrusion. In this report we will confine our recommendations to dBA levels, however, where the background noise appears to be unbalanced, AS/NZS 2107:2016 provides direction in terms of suitable diagnostic tools that can be used to assess the spectrum distribution of the background noise.

Table 4-1 Recommended Design Sound Levels

Type of Occupancy/Activity	Design sound level range dBA ($L_{Aeq,t}$)	Project Design Noise Level ¹
Residential Buildings		
Houses and apartments in inner city areas or entertainment districts or near major roads-		
Apartment common areas (e.g foyer, lift lobby)	45 to 50	50 dB(A) L_{eq} (15 hours)
Living areas	35 to 45	40 dB(A) L_{eq} (15 hours)
Sleeping areas (night time)	35 to 40	35 dB(A) L_{eq} (9 hours 10pm to 7am)
Work areas	35 to 40	40 dB(A) L_{eq} (15 hours)
Retail Areas	<50	50 dB(A) L_{eq} (15 hours)
Commercial Areas	40 to 45	45 dB(A) L_{eq} (15 hours)
<i>Note 1: Overall recommended level for mechanical services noise and intrusive noise, combined.</i>		

Section 6.18 of AS/NZ 2107:2016 notes that the presence of discrete frequencies or narrow band signals may cause the sound level to vary spatially within a particular area and be a source of distraction for occupants. Where this occurs, the sound level shall be determined as the highest level measured in the occupied location(s).

If tonal components are significant characteristics of the sound within a measurement time interval, an adjustment shall be applied for that time interval to the measured A-weighted sound pressure level to allow for the additional annoyance. If the background sounds include spectral imbalance, then the RC (Mark II) levels indicated in the Standard should be referenced (see also Appendix D of AS/NZ 2107:2016 for additional guidance).

Generally, where the final noise levels are within +/- 2 dB of the specified level given above, the design criteria will be considered met. Both the upper and lower limits will need to be satisfied especially where privacy is important or where noise intrusion to be avoided.

4.3 Project Airborne Noise Requirements

Based on the details included in the section above, the project internal noise levels requirements are summarised in the table below.

Table 4-2 Project Internal Environmental Noise Level Criteria

Type of Occupancy/Activity	Design sound level maximum ($L_{Aeq,t}$)
Common areas (e.g. foyer, lift lobby)	55 L_{Aeq} 24 min
Residential¹ - Living areas	40 L_{Aeq} 24 hour
Residential¹ - Sleeping areas (night time)	35 L_{Aeq} 9 hour ¹
Retail/Commercial Tenancies	45 L_{Aeq} 24 hour
Toilets	55 L_{Aeq} 24 min
<i>Note 1: The criteria for residential dwellings included within the Australian Standard have been used for the assessment of the proposed shop top development.</i>	

5 ENVIRONMENTAL NOISE INTRUSION ASSESSMENT

This section of the report details the assessment of environmental noise intrusion into the proposed development and the recommended acoustic treatments to ensure the recommended internal noise levels detailed in the Sections above (including environmental noise and train noise intrusion) are achieved. Internal noise levels within the future areas of the development will result from the noise intrusion into the building through the external façade including glass, masonry and other façade elements. Typically, the acoustic performance of building elements including the relatively light weight elements of the building façade, including glass and/or plasterboard constructions, will be the determining factors in the resulting internal noise levels.

Calculations of internal noise levels have been undertaken based on the measured traffic and calculated environmental noise levels at the site and the characteristics of the building, including window openings, buildings constructions and the like.

5.1 External Glass Elements

The recommended acoustic constructions to the buildings external façade glass elements are detailed in the table below to ensure the recommended internal noise levels detailed above are achieved, with the façade building openings closed.

Table 5-1 External Glass Acoustic Requirements

Building	Façade Orientation	Room Type	Recommended Glass Construction	Minimum Façade Acoustic Performance ¹
Stage 2	Facing west towards the railway line	Bedrooms	10.38mm Laminated	Rw 35
		Living Rooms	10.38mm Laminated	Rw 35
		Wet areas	6.38mm Laminated	Rw 30
		Commercial areas	6.38mm Laminated	Rw 30
	Facing north towards Throsby Drive	Bedrooms	10.38mm Laminated	Rw 35
		Living Rooms	10.38mm Laminated	Rw 35
		Wet areas	6.38mm Laminated	Rw 30
		Commercial areas	6.38mm Laminated	Rw 30
	All Other Façade orientation	Bedrooms	6.38mm Laminated	Rw 30
		Living Rooms	6.38mm Laminated	Rw 30
		Wet areas	6.38mm Laminated	Rw 30
		Commercial areas	6.38mm Laminated	Rw 30
Note 1: The acoustic performance of the external façade includes the installed glazing and frame including (but not limited to) the façade systems seals and frame. All external glazing systems are required to be installed using acoustic bulb seals.				

The recommended glass constructions detailed in the table above include those required to ensure the acoustic requirements of the project are achieved. Thicker glazing may be required to achieve other project requirements such as structural, thermal, safety or other requirements and is to be advised by others.

5.2 External Building Elements

The proposed external building elements including masonry or concrete external walls and roof are acoustically acceptable without additional acoustic treatment.

Any lightweight external plasterboard walls should be constructed from a construction with a minimum acoustic performance of R_w 50.

5.3 External Roof

The required external roof and ceiling constructions for the project are required to include the following:

- Concrete external roof construction – no additional acoustic treatments required.
- Metal Deck or tiled room construction –
 - Bedrooms – external roof, 1x 13mm plasterboard ceilings and insulation in the ceiling cavity.
 - Living Rooms – external roof, 1x 13mm plasterboard ceilings and insulation in the ceiling cavity.

5.4 External Opening and Penetrations

All openings and penetrations are required to be acoustically treated such that the performance of the building construction is not compromised. This may require lining of duct work behind mechanical service openings/grills, treatments to ventilation opening and the like.

5.5 Alternative Ventilation Requirements

Internal noise levels with the windows open should achieve the design internal level + 10 dB(A). In areas where this can not be achieved an alternative method of outside air ventilation is required to be provided in accordance with relevant regulations including the Building Code of Australia and AS1668.

Areas where an alternative source of outside air is required to be provided includes the following locations:

1. Façade of residential dwellings with a façade which faces to the west directly towards the railway line.

The installation of the ventilation should not compromise the acoustic performance of the external building shell and is required to comply with the noise emission criteria detailed in the following section.

6 RAIL PASS-BYS VIBRATION

This section of the report details the suitable vibration criteria for possible impacts from the railway line located to the west of the project at approximately 45 m from the site.

6.1 Vibration Impact Criteria

The potential for vibration impact from a rail pass-bys on the line to the west of the site has been assessed for both tactile vibration impact as well as ground borne vibration resulting in structure borne noise.

The suitable criteria for the assessment of tactile vibration and structure borne noise are detailed in the following sections.

6.1.1 Tactile Vibration Impacts

The Department of Planning *Development Near Rail Corridor and Busy Roads – Interim Guideline (DNRCBR)* references to "Assessing Vibration – A Technical Guideline".

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled "Assessing Vibration – A Technical Guideline". (AVTG). The AVTG recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)".

The British Standard details suitable criteria for the assessment of intermittent vibrations to prevent advise impacts on future residence.

Table 6-1 Intermittent vibration impacts criteria (m/s^{1.75}) 1 Hz-80 Hz, Vibration Dose Values (VDV)

Measurement Location	Daytime		Night-Time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26

For the purpose of this assessment the *Preferred Values* detailed in the standard have been used as the criteria used in this assessment.

6.1.2 Structure Borne Noise

The borne vibration is the potential for audible noise to be generated as the result of vibration transferred through the building structure and emanating from the building surfaces (such as walls, ceilings and the like) as audible noise within the future residential dwellings within the development.

Potential structure borne noise impacts as a result of the proposed light rail has been assessed in accordance with the criteria detailed within the DNRCBR which includes the following:

Generally, ground borne noise is associated more closely with rail operations than roads. Where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present without the normal masking effect of airborne noise.

In such cases, residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground-borne L_{Amax} noise limit of 40dBA (daytime) or 35dBA (night-time) measured using the "slow" response time setting on a sound level meter.



As the railway line located to the west of the site is an above ground line and not within a tunnel the requirements for ground borne vibration is not required to be assessed based on the DNRCBR as detailed above.

As existing rail is above ground the impact of airborne noise on the future residence will be greater than the potential for structure borne noise levels. Providing suitable treatments for airborne noise impacts are included in the design of the project and tactile vibration levels comply with the relevant criteria then all relevant acoustic requirements will be achieved.

6.2 Rail Pass Bye Vibration Measurements

As part of the assessment measurements of vibration impacts from a rail pass bye on the railway line to the west of the site has been conducted.

To assess potential noise and vibration impacts on the proposed development measurements of light rail pass byes (at a representative location of the future building façade) has been conducted in this assessment.

Vibration measurements have been undertaken at the location detailed in Figure 2-1 above.

6.2.1 Vibration Measurements

This section of the report details the measured vibration levels associated with rail pass byes at the location detailed in Figure 2-1 of this report.

The assessment included attended vibration measurements conducted on the 25th August, 2025 between 8.30am and 9.30am. Vibration levels were undertaken using a Svan 958 type vibration meter and analyzer fitted with a triaxial accelerometer and included a minimum of 8 rail pass byes.

Obtained vibration levels included a number of light rail pass beys which have been used to determine the period vibration exposure for the daytime and night-time periods Vibration Dose Values (VDV).

The results of the vibration level measurements including the calculations for VDV are detailed in the table below.

Table 6-2 Calculated VDV

Location	Period	Criteria VDV m/s ^{1.75}	Calculated VDV m/s ^{1.75}
Future Residential Dwellings	Daytime	0.20	<0.1
	Night-Time	0.13	<0.07

Based on the results of the assessment of tactile vibration no additional acoustic treatment (or building vibration isolation) is required to comply with the relevant standards and ensure a suitable acoustic amenity for future occupants of the development.

7 EXTERNAL NOISE EMISSION ASSESSMENT

This section of the report details the relevant noise level criteria for noise emissions generated on the site once completed.

The relevant authority which provides the required noise level criteria for noise levels generated on the site includes the NSW Environmental Protection Authority's (EPA) Noise Policy for Industry (NPI).

This section contains noise criteria on the operational criteria, construction criteria and vibration criteria.

The following criteria are relevant for the assessment of noise and vibration emissions from the proposed development:

- For the assessment of the predicted operational noise emissions by the training facility: The criteria have been derived in accordance with the *Noise Policy for Industry* (EPA, 2017), details are included in the following sections of this report.

7.1 NSW Noise Policy for Industry

In NSW, the control of noise emissions is the responsibility of Local Government and the NSW Environment Protection Authority (NSW EPA). In October 2017, the NSW EPA released the *Noise Policy for Industry* (NSW NPI). The purpose of the policy is to ensure that noise impacts associated with particular industrial developments are evaluated and managed in a consistent and transparent manner. The policy aims to ensure that noise is kept to acceptable levels in balance with the social and economic value of industry in NSW.

The NSW NPI criteria for industrial noise sources have two components:

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

The project noise trigger level is derived from the more stringent value out of the project intrusiveness noise level and the project amenity noise level.

7.1.1 Intrusive Noise Impacts (Residential Receivers)

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

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

7.1.2 Protecting Noise Amenity (All Receivers)

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

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

7.1.3 Area Classification

The NSW NPI characterises the “Suburban Residential” as an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.

For the considered receptors in the rural area, the recommended amenity noise level is shown in Table 7-1 below. When the existing noise level from industrial noise sources is close to the recommended “Amenity Noise Level” (ANL) given above, noise from the new source must be controlled to preserve the amenity of the area in line with the requirements of the NSW NPI.

Table 7-1 NSW NPI – Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day ¹	Recommended Amenity Noise Level ($L_{Aeq, period}$) ²
Residence	Suburban	Day	55
		Evening	45
		Night	40
Commercial Receiver	-	When in use	65
<i>Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am</i> <i>Note 2: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.</i>			

7.1.4 Project Trigger Noise Levels

The intrusive and amenity criteria for industrial noise emissions derived from the measured data are presented in Table 7-2. The amenity and intrusive criterion are nominated for the purpose of determining the operational noise limits for noise sources associated with the development which can potentially affect noise sensitive receivers.

For each assessment period, the project trigger noise levels are the lower (i.e. the more stringent) of the amenity or intrusive criteria. The project trigger noise levels are shown in bold text in Table 7-2.

Table 7-2 External noise level criteria in accordance with the NSW NPI

Location	Time of Day	Project Amenity Noise Level, LAeq, period ¹ (dBA)	Representative Background Noise level LA90, 15 min (RBL) ² (dBA)	Measured LAeq, period Noise Level (dBA)	Intrusive LAeq, 15 min Criterion for New Sources (dBA) ³	Amenity LAeq, 15 min Criterion for New Sources (dBA) ^{3, 4}
Residence (Suburban)	Day	50	43	62	48	53
	Evening	40	41	62	46	43
	Night	35	37	60	42	38
Commercial Receiver	When in Use	60	-	-	-	63
<i>Note 1: Project Amenity Noise Levels corresponding to "suburban" areas, equivalent to the Recommended Amenity Noise Levels minus 5 dBA</i> <i>Note 2: LA90 Background Noise or Rating Background Level, including LA90 Background Noise or Rating Background Level based on the assumed minimum rating of the EPA NPI.</i> <i>Note 3: Project Noise Trigger Levels are shown in bold</i> <i>Note 4: According to Section 2.2 of the NSW NPI, the LAeq, 15 minutes is equal to the LAeq, period + 3 dB</i>						

8 OPERATIONAL ACOUSTIC ASSESSMENT

This section of the report details the assessment of potential noise generated as a result of the operation of the proposed development.

The assessment of potential noise impacts from various sources of noise on the site are detailed in the following sections.

8.1 Mechanical Services Equipment

Detailed selections of the proposed mechanical plant and equipment to be used on the site are not available at this time. All future plant and equipment are to be acoustically treated to ensure the noise levels at all surrounding receivers comply with noise emission criteria detailed within this report. Experience with similar projects indicated that it is both possible and practical to treat all mechanical equipment such that the relevant noise levels are achieved. Examples of the possible acoustic treatments to mechanical equipment includes the following:

- Supply and Exhaust Fans – Equipment will include fans which are located within the project and will acoustic mitigations including internally lined ductwork or acoustic silencers as required to achieve project trigger noise levels as detailed in this report.
- General supply and exhaust fans – general exhaust and supply fans such as toilet, kitchen, lobby and other small mechanical fans can be acoustically treated using acoustic flex ducting or internally lined ducting.
- Residential Condensers – The project may include external residential condenser units which will likely be located on the roof-top or individually balconies. Providing condenser equipment is selected using suitable noise level data, then acoustic treatments can be implemented such as screening and treatment to exhaust to ensure that the relevant noise emission criteria will be achieved.

Details of the required mechanical services equipment and acoustic treatments to ensure the relevant noise level criteria is achieved will be provided as part of the CC submission of the project.

Experience with similar projects indicates that the acoustic treatment of the proposed mechanical equipment to be installed on the project is both possible and practical.

8.2 Waste and Garbage Collections

Noise resulting from the removal of waste and garbage from the site, including garbage trucks and the like will be undertaken in accordance with council's waste management requirements.

Noise resulting from the collection of waste from the site will include intermittent collection using approved waste collection vehicles. The resulting noise impact from the site will be similar to noise levels currently experienced by exiting receivers from exiting waste collection services, train noise and vehicle movements on surrounding roadways.

The recommended acoustic treatments to the building facade detailed in this report include those required to ensure internal noise levels within the future dwellings of the project from the collection of waste will be acoustically acceptable and compliant with the recommended internal noise levels.

9 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

This section of the report details the construction noise and vibration impacts and the required mitigations and management controls required to be implemented as part of the construction of the building. The assessment of construction noise and vibration has been undertaken in accordance with the EPA's *Interim Construction Noise Guideline*.

9.1 Construction Noise

This section of the report details the assessment of noise associated with the proposed construction activities associated with the development. The assessment has been undertaken to assess the potential noise impacts from construction and demolition on surrounding receivers to the site.

The proposed construction and demolition activities to be undertaken on the site with limited external demolition of structures on the site. The development will then be constructed using normal construction processes.

The assessment of construction noise impacts generated from the site has been undertaken in accordance with the requirements of the EPA Interim Construction Noise Guideline.

The EPA's Interim Construction Noise Guideline defines normal day time hours as the following:

2.2 Recommended standard hours

The recommended standard hours for construction work are shown in Table 1; however, they are not mandatory. There are some situations, as described below, where construction work may need to be undertaken outside of these hours. The likely noise impacts and the ability to undertake works during the recommended standard hours should be considered when scheduling work.

Table 1: Recommended standard hours for construction work

Work type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

* The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.

9.1.1 Proposed Appliances

The proposed construction appliances which will be used as part of the demolition and construction of the project are detailed in the table below.

Table 9-1 Noise Level from Expected Demotion Appliances

Tasks	Equipment	Sound Power Levels per task dB(A) L ₁₀	Aggregate Sound Power Level per Task dB(A) L ₁₀
Site Demolition works	Jack hammer mounted on excavator	118	122
	Excavators and bulldozers	115	
	Hand held jack hammer	111	
	Concrete saw	119	
	Skid steer	110	
	Power hand tools	109	
	Materials Movements	105	
Site Ground Works	Jack hammer mounted on excavator	118	122
	Saw cutting	119	
	Excavators and bulldozers	115	
	Materials Movements	105	
	Bulldozers	115	
	Trucks	109	
Construction Works	Piling	115	120
	Welder	101	
	Saw cutter	109	
	Dump truck	109	
	Concrete saw	119	
	Power hand tools	109	
	Cranes	110	
Note: Noise levels of proposed equipment to be used on the site based on the Australian Standard AS2436-2010 and noise level measurements previously undertaken of similar equipment on construction sites.			

9.1.2 Construction Noise Criteria

This section of the report details the relevant construction noise criteria which is applicable to the site including the EPA's *Interim Construction Noise Guideline* (ICNG).

9.1.2.1 Interim Construction Noise Guideline

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

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

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

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

Table 9-2 Noise Management Levels from Construction

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

Table 10-2 Continued

Receiver Type	Time of Day	Noise Management Level $L_{Aeq}(15\text{minute})^{1,2}$	How to Apply
offices, retail outlets: external	When in use	$L_{Aeq}(15\text{ min})$ 70 dB(A)	During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.
<i>Note 1</i> 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. <i>Note 2</i> The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA 2000).			

Based on the table above the suitable construction noise management levels for works undertaken on the site is detailed in Table 6 below.

Table 9-3 Site Construction Noise Management Levels

Noise Source	Time Period	Receiver Type	Construction Noise Management Level ¹	'High Noise Affected' Level ¹
Construction Noise	During period of approved hours of works	Residential Receivers	53 dB(A) L_{Aeq} (15min)	75 dB(A) L_{Aeq} (15min)
<i>Note 1: Construction noise management levels based on the Interim Construction Noise Guideline</i>				

9.1.3 Construction Noise Management – Qualitative Assessment

Based on the assessment conducted of the expected construction noise levels generated from the site, levels are generally expected to require the building contractor to engage in management of activities on the site and engagement with the local community.

Notwithstanding, the following management controls are recommended to mitigate construction noise levels on the site:

1. Construction to be undertaken within the approved hours detailed within the projects *Conditions of Consent*.
2. All plant and equipment are to be maintained such that they are in good working order.
3. A register of complaints is to be recorded in the event of complaints being received, including location, time of complaint, nature of the complaint and actions resulting from the complaint.
4. If required a noise level measurement of the offending plant item generating complaints is to be conducted and noise mitigations undertaken to reduce noise levels to within Noise Management levels in the event magnitude of noise levels is found to be above suitable levels.
5. The use of percussive and concrete sawing should be undertaken behind a closed façade when possible.
6. The use of percussive equipment including hydraulic hammering should be limited such that they are not undertaken prior to 7.30am on weekdays and prior to 8.30am on Saturdays.
7. Where possible any excavation to be undertaken on the site is to include ripping of material where possible.

In addition to the recommended mitigations above details of the proposed construction (including demolition) works to be conducted on the site, including type of activities to be conducted as well as the expected duration of activities should be provided to the neighbouring receivers.

In the event noise levels are found to require additional noise reduction then all possible and practical mitigations are required to be included in the construction of the project. Possible acoustic treatments and controls may include the following:

1. Use of alternative appliances to complete the required works which result in reduced noise impacts on surrounding neighbours.
2. Period when noisy appliances are undertaken, such as undertaking noisy works on locations with the greatest distance to residential receivers during morning periods if possible.
3. Construction of acoustic screening to permanently located high noise generating equipment such as pumps and generators.
4. Scheduling of high noise generating works outside of noise sensitive periods if possible.
5. Other site specific treatments and controls which may become possible once works commence.

9.1.4 Construction Noise Assessment – Quantitative Assessment

A quantitative assessment of the construction noise levels resulting from the proposed works to be undertaken as part of the project on surrounding receivers has been undertaken.

The assessment has been based on the expected noise levels to be generated on the site including those detailed in Section 9.1.1 above. Calculations of the resulting construction noise levels of the receivers within proximity to the site is detailed in the table below.

Table 9-4 Quantitative Assessment of Construction Noise to Neighboring Residence

Source Noise	Equipment	Sound Power Levels dB(A) L ₁₀	Site Cumulative Sound Power Level dB(A) L ₁₀	Calculated Construction Noise Level – Residential Receivers
Site Demolition works	Jack hammer mounted on excavator	118	122	Up to 75 dB(A) when items used externally
	Excavators and bulldozers	115		
	Hand held jack hammer	111		
	Concrete saw	119		
	Skid steer	110		
	Power hand tools	109		
	Materials Movements	105		
Site Excavations	Jack hammer mounted on excavator	118	122	Up to 75 dB(A) when items used externally
	Saw cutting	119		
	Excavators and bulldozers	115		
	Materials Movements	105		
	Bulldozers	115		
	Trucks	109		
Construction Works	Piling	115	120	Up to 75 dB(A) when items used externally
	Welder	101		
	Saw cutter	109		
	Dump truck	109		Up to 52 dB(A) once items used internally within the building structure
	Concrete saw	119		
	Power hand tools	109		
	Cranes	110		

Note 1: Calculated qualitative noise levels are based on the overall Aggregate Sound Power Level for the expected demolition and construction works to be undertaken in the site.

Based on the qualitative assessment of construction noise suitable management controls and community notifications are required to be conducted.

The required management of construction noise impacts are included in Section 9.1.3 above and the Community Consultation included in Section 9.6 of this report.

9.2 Construction Vibration Assessment

This section of the report details the assessment of construction vibration impacts on surrounding receivers.

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

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed. Refer to further discussion in Section 9.2.1.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects. Refer to further discussion in Section 9.2.2.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself. Refer to further discussion in Section 5.3.

9.2.1 Vibration Criteria – Human Comfort

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

- Continuous vibration – from uninterrupted sources (refer to Table 9-5).
- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 9-6).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 9-7).

Table 9-5 Continuous vibration acceleration criteria (m/s²) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 9-6 Impulsive vibration acceleration criteria (m/s²) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Table 9-7 Intermittent vibration impacts criteria (m/s^{1.75}) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

9.2.2 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).

9.2.3 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 and illustrated in the Figure below.

Table 9-8 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure 9-1	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Standard BS 7385 Part 2 – 1993 states that the values in Table 9-8 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 9-8 may need to be reduced by up to 50% (refer to Line 3 in the Figure below).

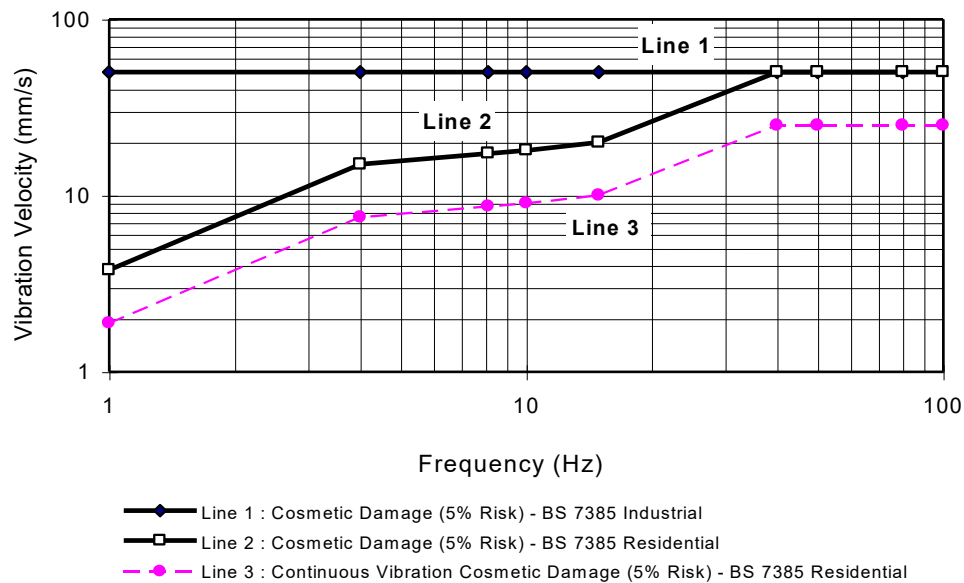


Figure 9-1 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 10-8, and major damage to a building structure may occur at values greater than four times the tabulated values.

9.2.4 Standard DIN 4150 Part 3 - 1999

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 10-9. The criteria are frequency dependent and specific to particular categories of structures.

Table 9-9 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

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

9.2.5 Project Vibration Criteria

Based on the details included in the sections above the project specific vibration criteria to protect the surrounding residential receivers from structural or architectural damage includes the following:

1. Project construction vibration criteria at all surrounding building structures – 7 mm/s

9.3 Contingency Plans

Contingency plans are required to address noise or vibration problems if excessive levels are measured at surrounding sensitive receivers and/or if justified complaints occur. Such plans could include:

- Stop the onsite works.
- Identify the source of the main equipment within specific areas of the site which is producing the most construction noise and vibration at the sensitive receivers; and
- Review the identified equipment and determine if an alternate piece of equipment can be used or the process can be altered.
- In the event an alternate piece of equipment or process can be used, works can re-commence.
- In the event an alternate piece of equipment or process cannot be determined implement a construction assessment to be performed by a suitably qualified acoustic consultant.

9.4 General Mitigation Measures (Australia Standard 2436-2010)

As well as the above project specific noise mitigation controls, AS 2436-2010 "*Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*" sets out numerous practical recommendations to assist in mitigating construction noise emissions. Examples of strategies that could be implemented on the subject project are listed below, including the typical noise reduction achieved, where applicable.

9.4.1 Adoption of Universal Work Practices

- Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration.
- Regular identification of noisy activities and adoption of improvement techniques.
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby sensitive receivers.
- Where possible, avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicle reversing for example (particularly at night), by arranging for one-way site traffic routes.
- Use of broadband audible alarms on vehicles and elevated work platforms used on site.
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact.
- Minimising truck movements.

9.4.2 Plant and Equipment

- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Selecting plant and equipment with low vibration generation characteristics.
- Operating plant and equipment in the quietest and most efficient manner.

9.4.3 On Site Noise Mitigation

- Maximising the distance between noise activities and noise sensitive land uses.
- Installing purpose-built noise barriers, acoustic sheds and enclosures.

9.4.4 Work Scheduling

- Providing respite periods which could include restricting very noisy activities to time periods that least affect the nearby noise sensitive locations, restricting the number of nights that after-hours work is conducted near residences or by determining any specific requirements.
- Scheduling work to coincide with non-sensitive periods.
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers.
- Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.

- Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

9.4.5 Source Noise Control Strategies

Some ways of controlling noise at the source are:

- Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives.
- Modify existing equipment: Engines and exhausts are typically the dominant noise sources on mobile plant such as cranes, graders, excavators, trucks, etc. In order to minimise noise emissions, residential grade mufflers should be fitted on all mobile plant utilised on site.
- Siting of equipment: locating noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
- Regular and effective maintenance.

9.4.6 Construction Vibration Impacts

An assessment of the potential for vibration generated as part of the required construction activities on the project (including excavation, demolition and construction) has been undertaken.

The proposed development does not require demolition as there are currently no structures on the site.

Based on the proximity of the surrounding receivers to the site ground works and construction activities on the site are expected to comply with all vibration criteria detailed in this report.

In the event excavation is required on the site including removal of stone, the following management technique should be included in the excavation methodology:

- A saw cut at the perimeter of any excavation within rock on the excavation boundary adjacent neighbouring residential properties are required to include a saw cut to the rock prior to use of any excavation or ripping.

9.5 Noise and Vibration Measurements and Monitoring

As part of the management of noise from the proposed demolition, excavation and construction activities to be undertaken on the site the following noise and vibration measurements are recommended to be undertaken:

1. Noise – Attended noise level measurements of typical demolition, excavation and construction activities should be undertaken at site.

Attended construction noise surveys of the site and surrounding impacts on neighbours should be undertaken during the following as a minimum:

- a. Commencement of any rock breaking or sawing on the site.
- b. In response to any ongoing complaints received from neighbours.

2. Vibration – Based on the proximity of the surrounding receivers to the works attended vibration measurements of typical demolition, excavation and construction activities should be undertaken at site.

Attended construction vibration measurements at representative locations to the neighbouring building structures should be undertaken at the following times as a minimum:

- a. Commencement of any hydraulic hammering required for demolition of construction on the site and required to be conducted within 30m of neighbouring buildings.

- b. Commencement of any rock breaking or sawing on the site required to be conducted within rock during the excavation stage of the project and required to be conducted within 30m of neighbouring buildings.
- c. In response to any ongoing complaints received from neighbours.

9.6 Community Engagement

During the proposed construction of the project (including excavation and construction) the building contractor is required to engage in community interaction. The community interaction and notification is required to include the following:

1. Notification of the proposed works to be undertaken on the site and the periods when works will be conducted, including information regarding the programme of works such as demolition and excavation. This should include the expected period when activities such as hydraulic hammering, rock breaking, concrete or rock sawing is required to be undertaken.
2. Details of the relevant site representative where complaints can be registered.
3. Details of the methodology to respond to complaints raised from the surrounding receivers.
4. A register of complaints, to be kept on site including record of time and nature of the complaint as well as the outcomes and comments regarding investigations resulting from the complaint.

10 CONCLUSION

Pulse White Noise Acoustics Consultancy Pty Ltd (Pulse White Noise Acoustics) has been engaged to undertake the Noise and Vibration Impact Assessment for the SSD submission of the proposed mixed use development including Stage 2 of the 120-122 Smith Street, Wollongong project.

This report details the required acoustic constructions of the building's façade, including external windows, to ensure that the future internal noise levels comply with the relevant noise levels of the Australian Standard AS2107:2016 for environmental noise. Providing the recommended constructions detailed in this report are included in the construction of the project the required internal noise levels will be achieved.

An assessment of the potential for noise and vibration impact from the operation of the railway line which is located to the west of the site has been undertaken and providing the recommendations in this report are included in the design and construction of the project compliance with the Department of Planning *Development Near Rail Corridors and Busy Roads – Interim Guideline* and the *Infrastructure SEPP* will be achieved.

External noise emissions from the site have been assessed and detailed in accordance with the NSW Environmental Protection Authorities *Noise Policy for Industry*. The future design and treatment of all building services associated with the project can be acoustically treated to ensure all noise emissions from the site comply with the EPA NPfI criteria including the following:

1. Operation of mechanical services on the site.

An assessment of construction noise and vibration has also been undertaken and the required noise and vibration management and controls as well as community consultation have been presented in this report. The details in this report include those required to ensure works are undertaken in accordance with the EPA's *Interim Construction Noise Guideline*.

Regards

A handwritten signature in blue ink that reads "Ben White".

Ben White
Director

Pulse White Noise Acoustics

11 APPENDIX A: ACOUSTIC TERMINOLOGY

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

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

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

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

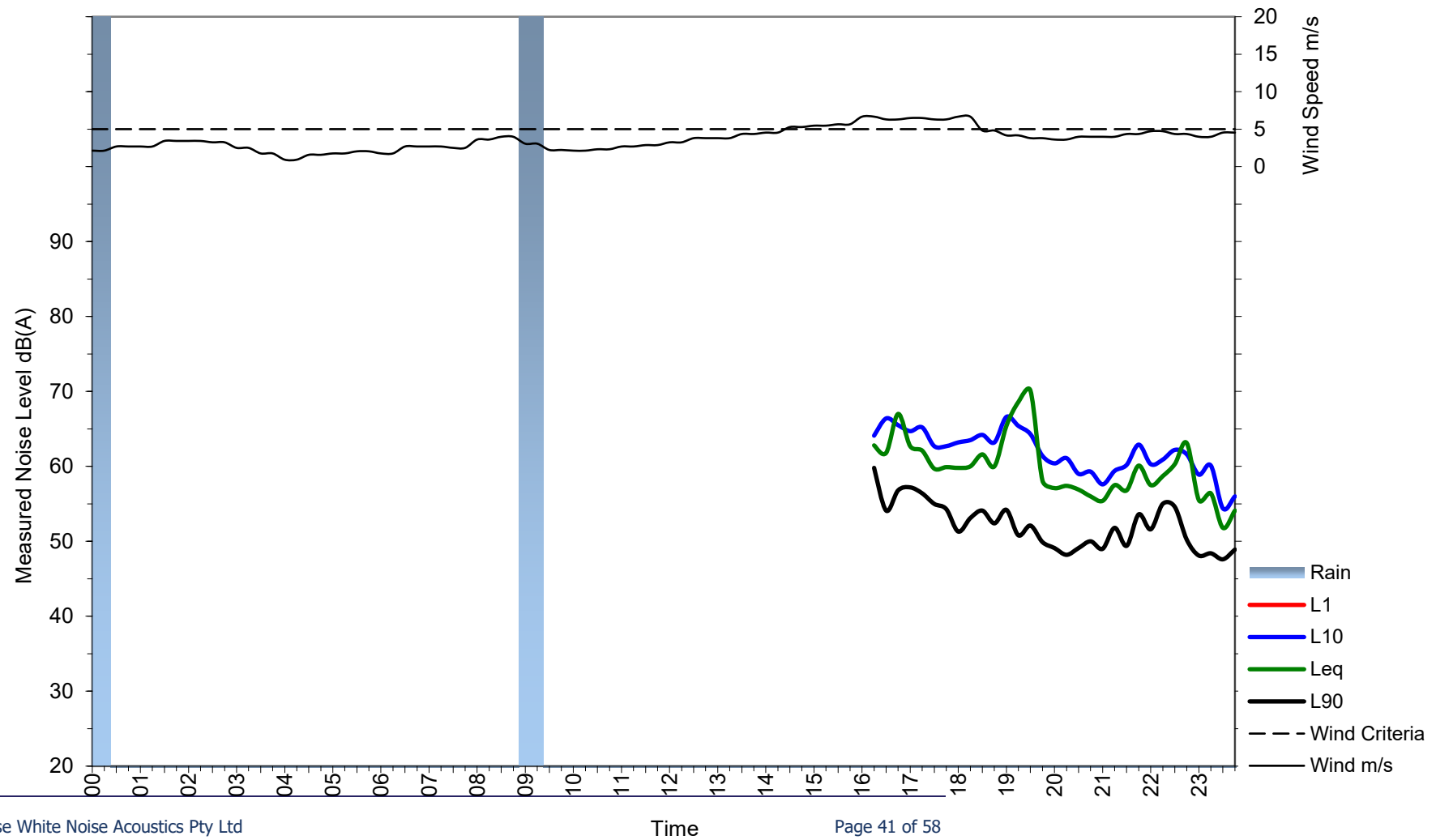


12 APPENDIX B: UNATTENDED NOISE LOGGING



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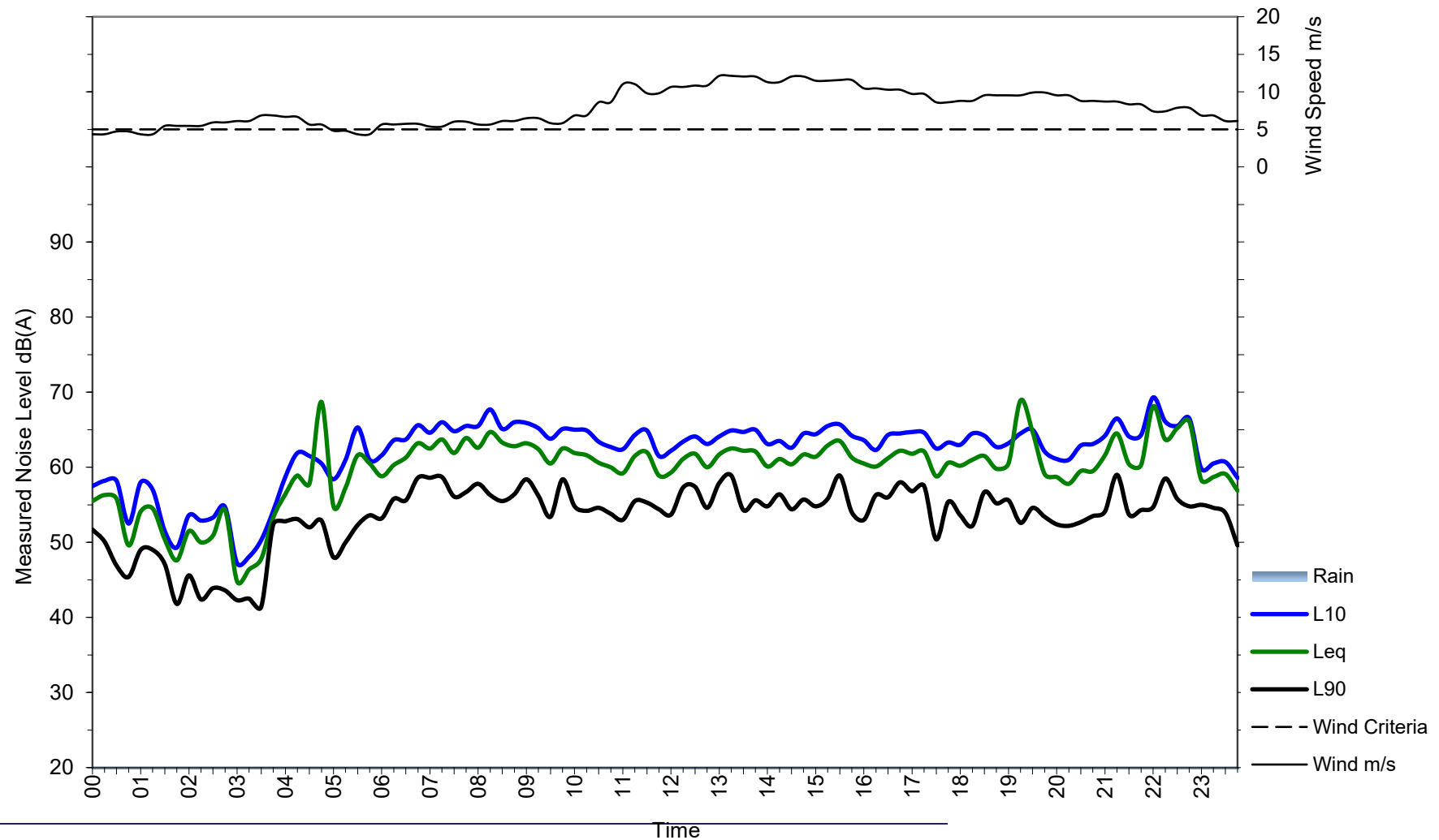
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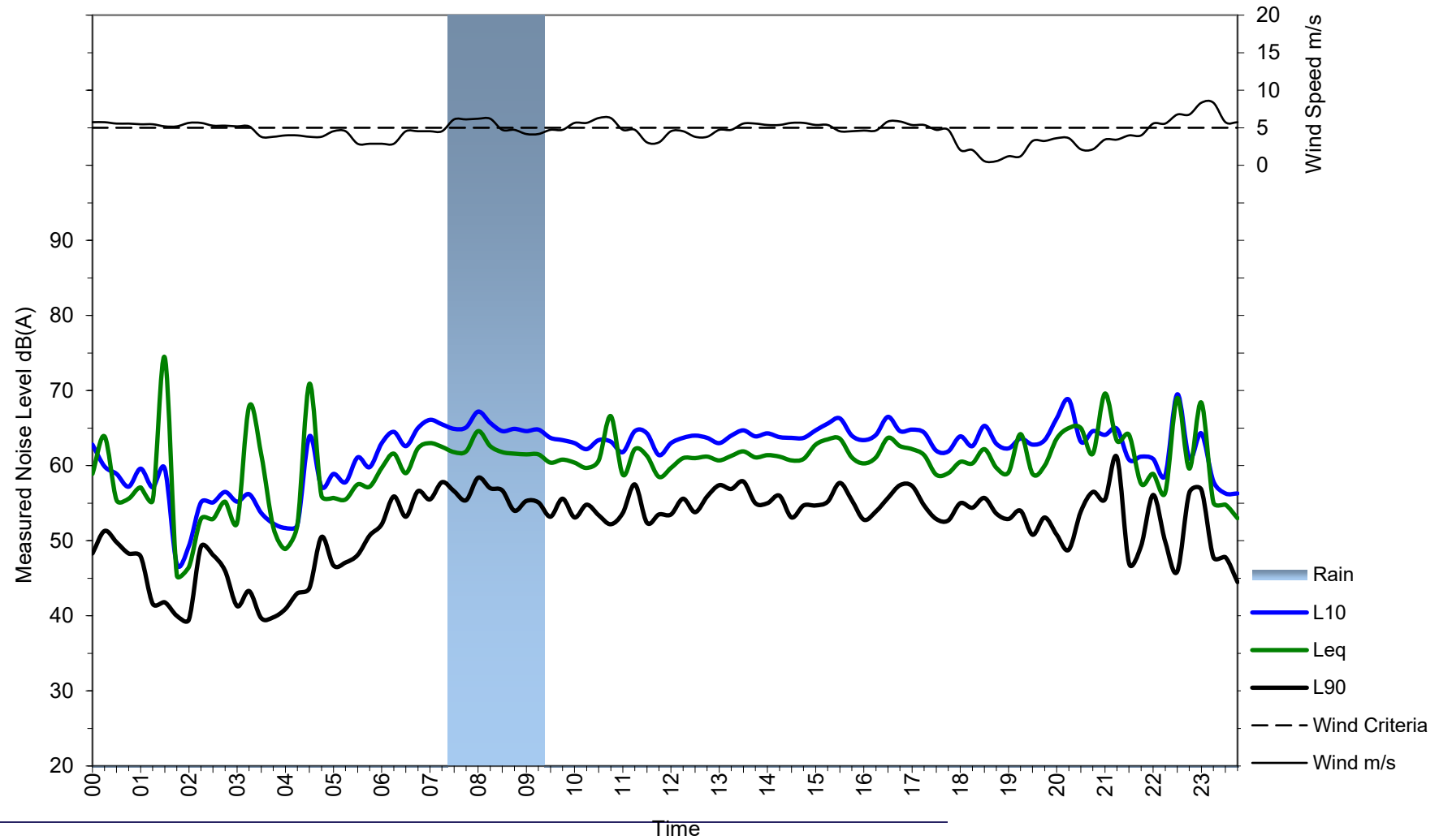
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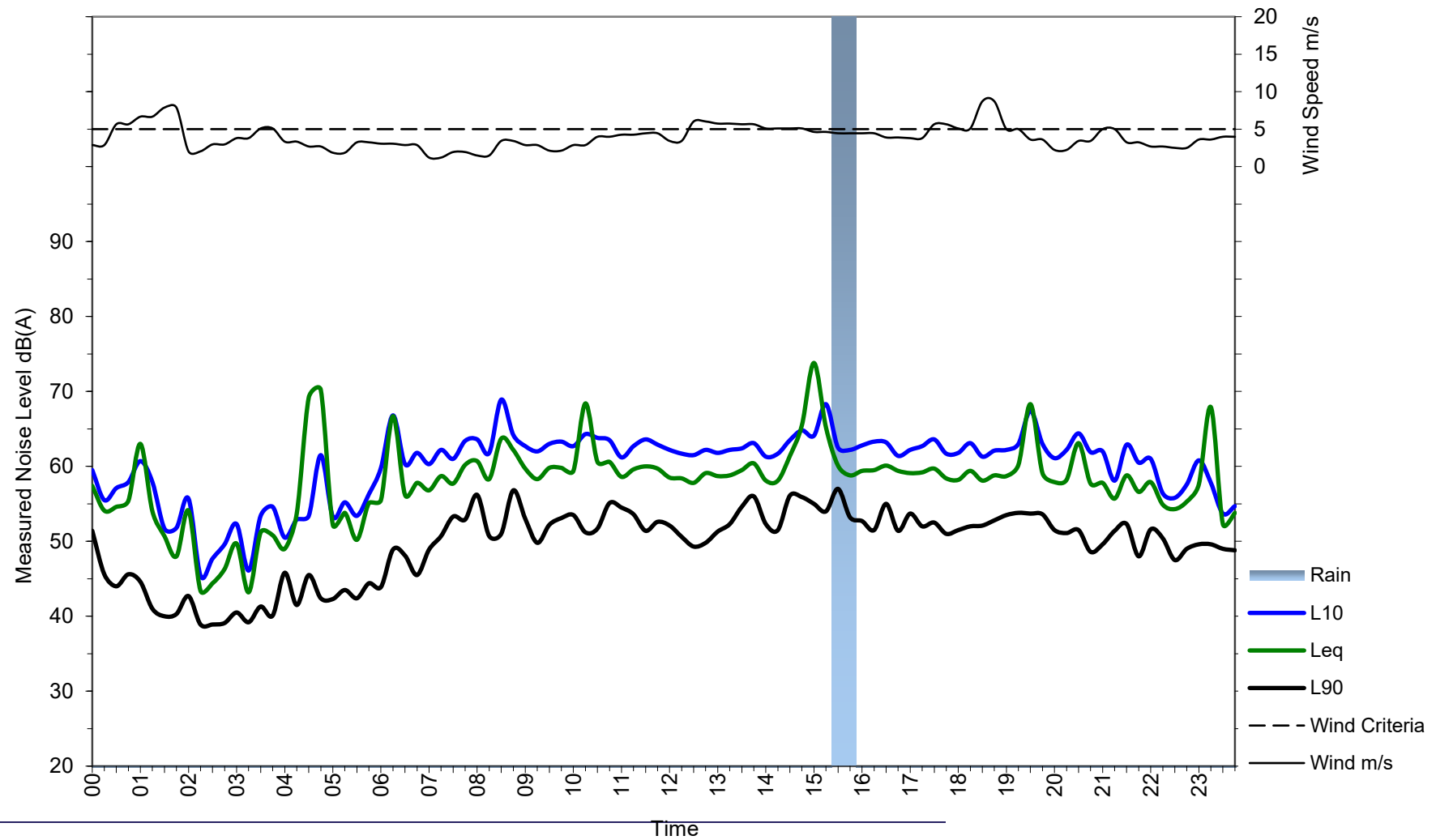
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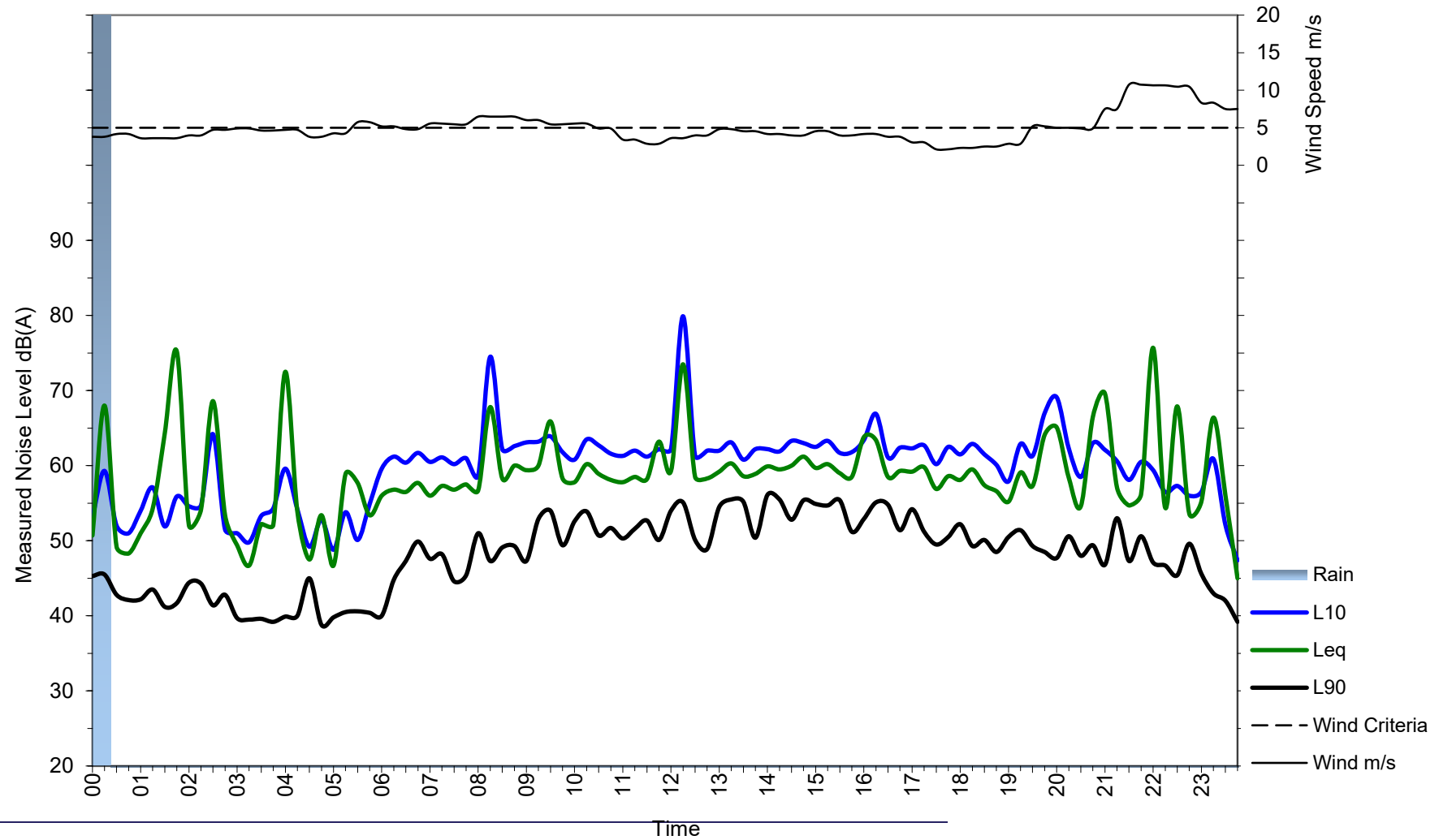
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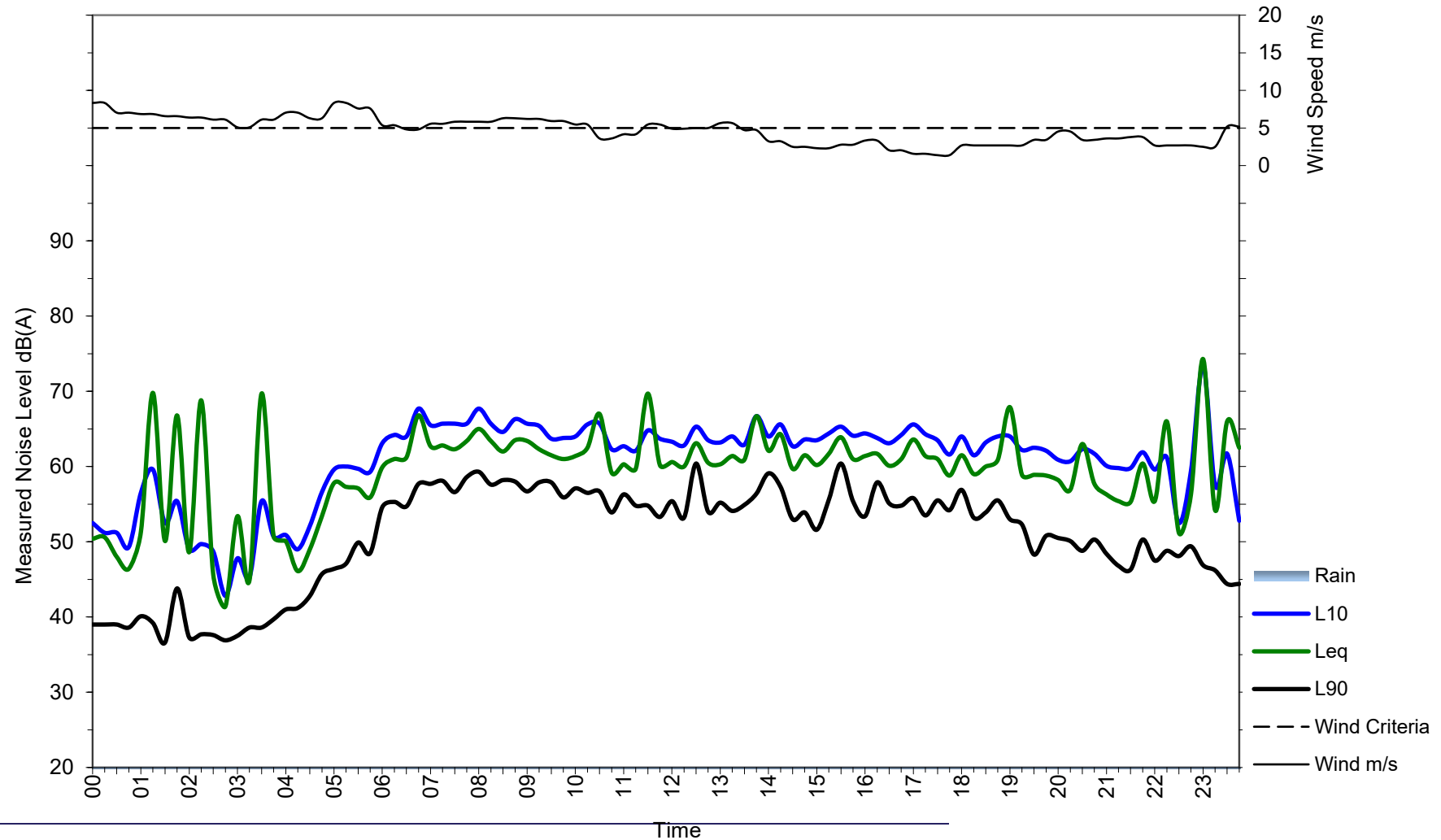
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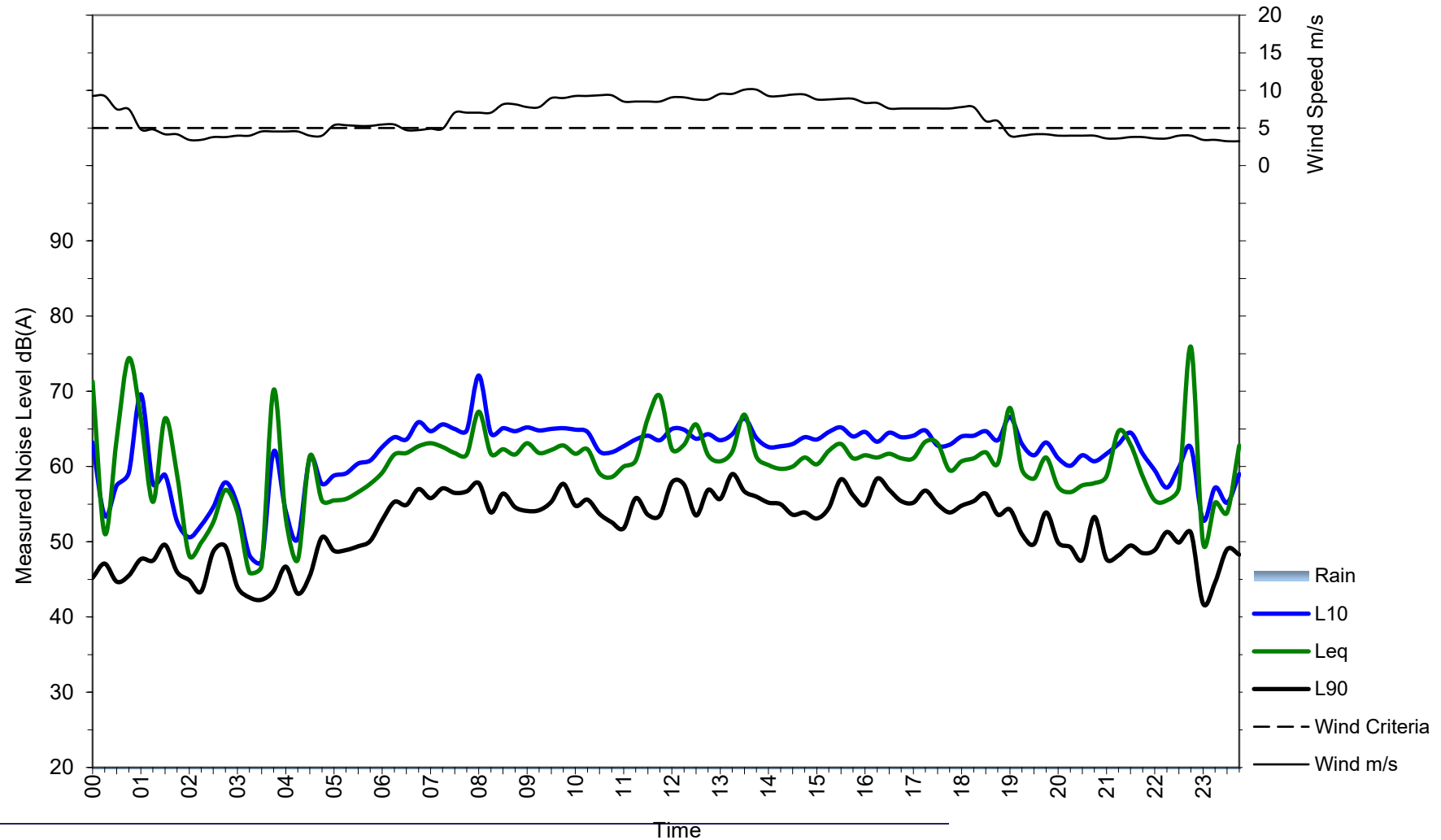
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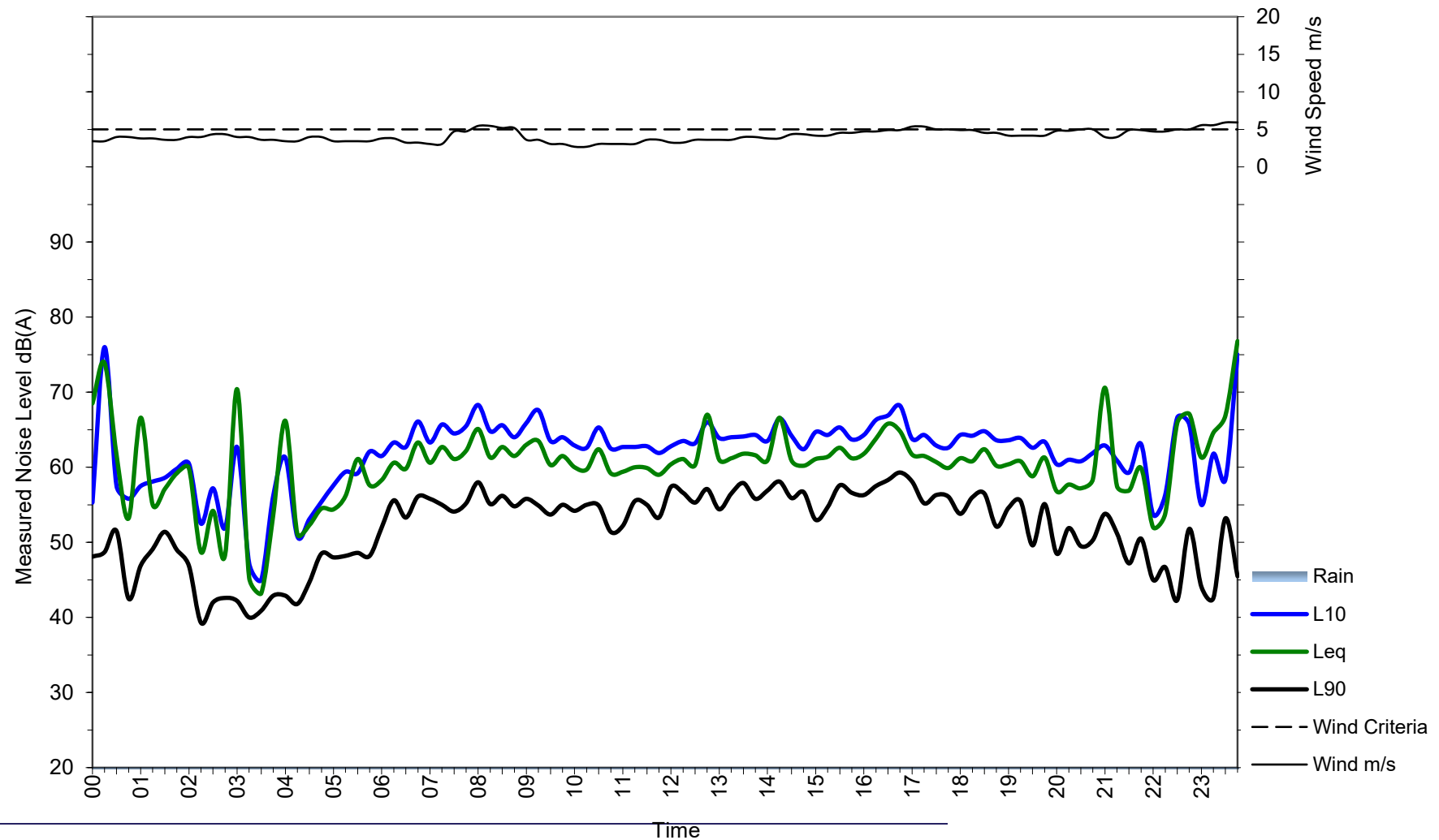
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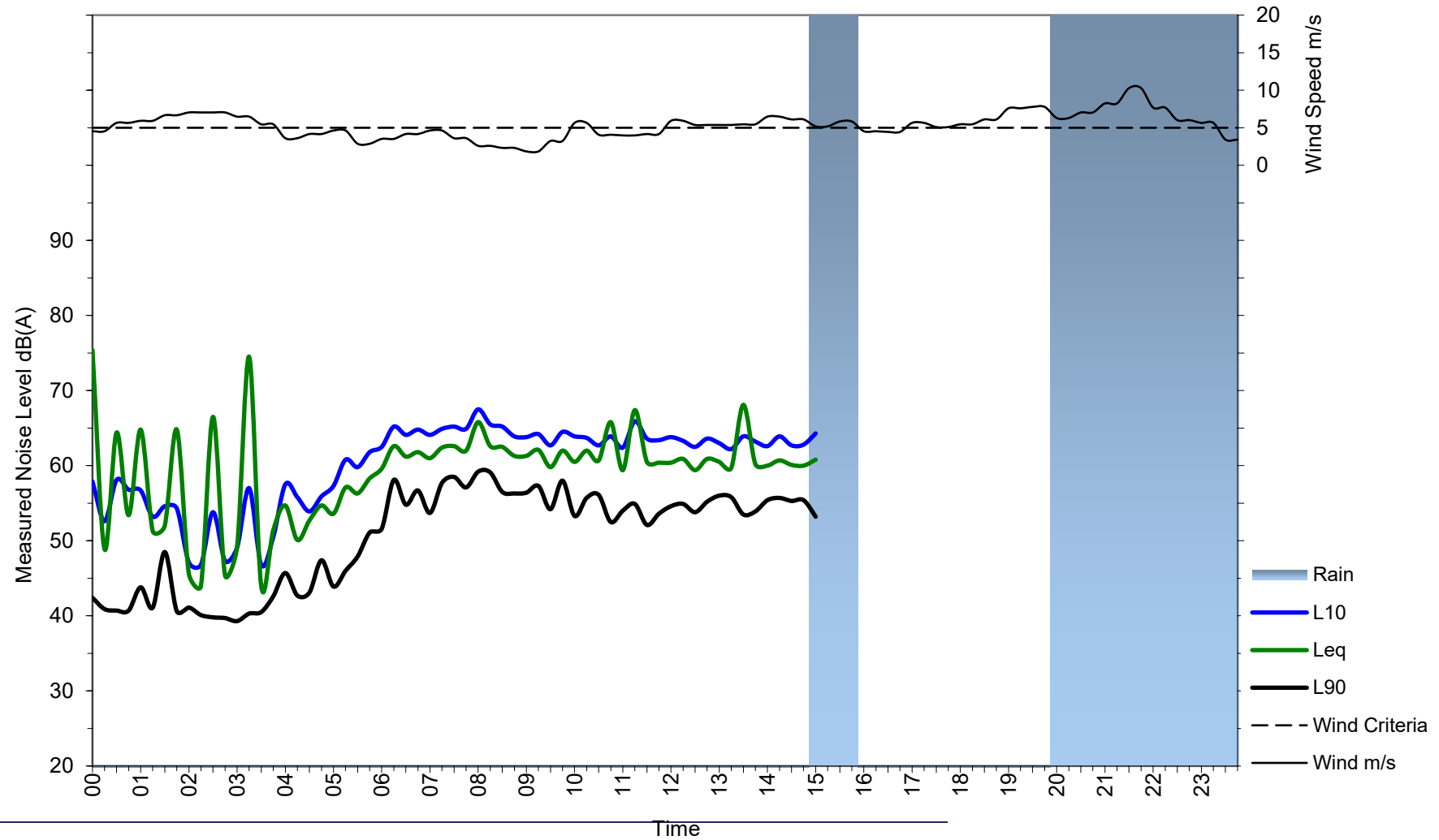
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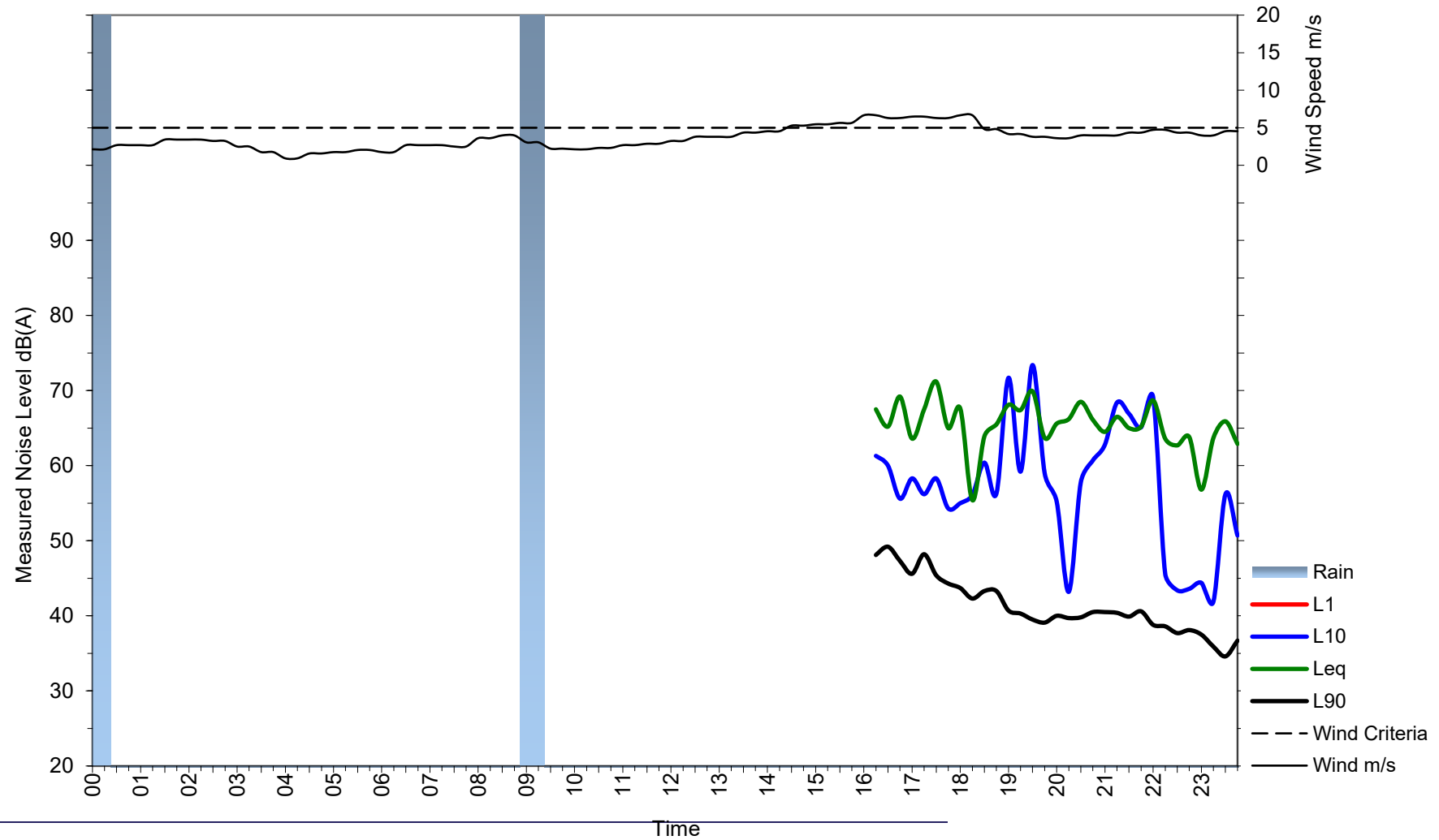
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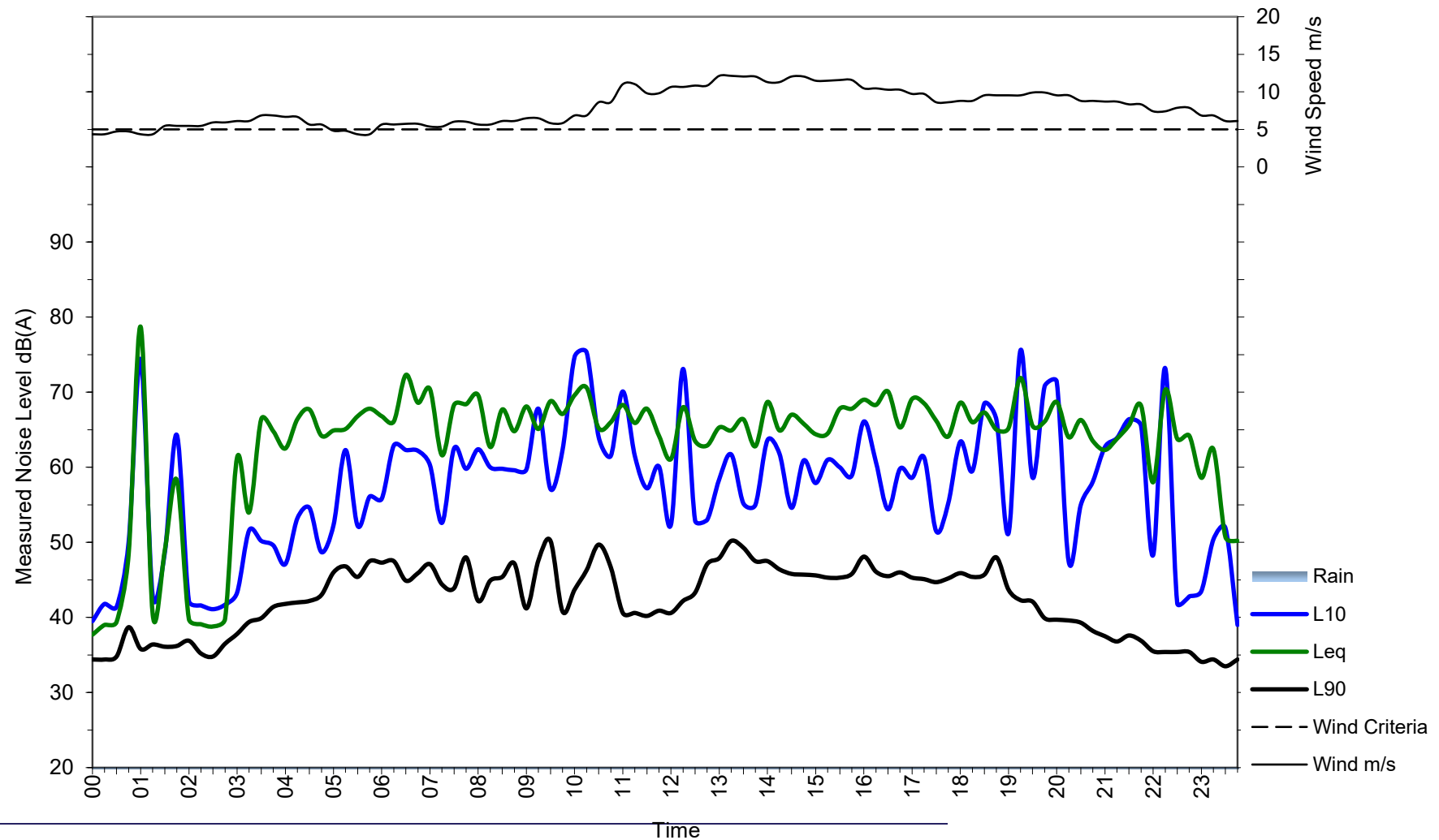
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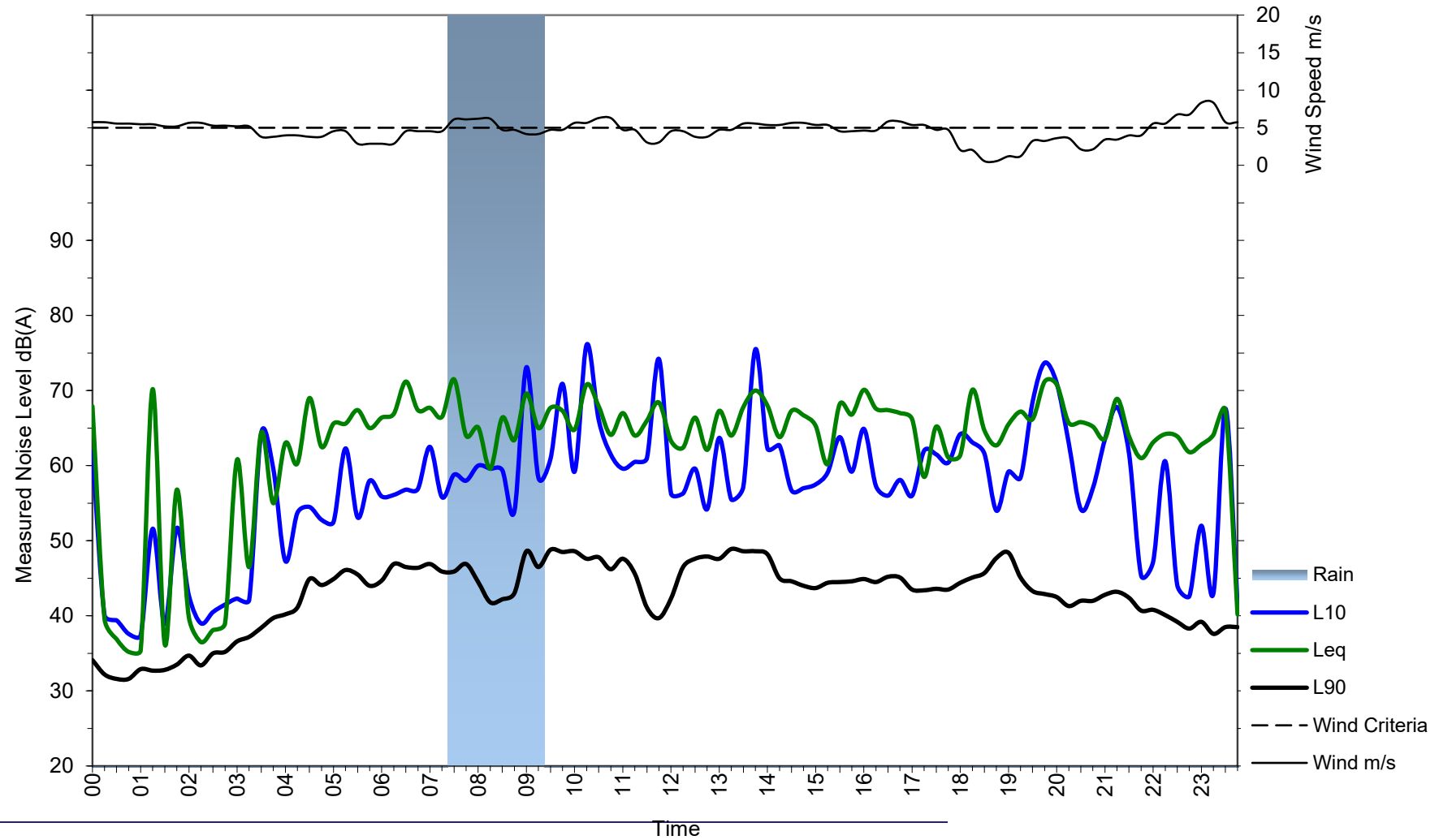
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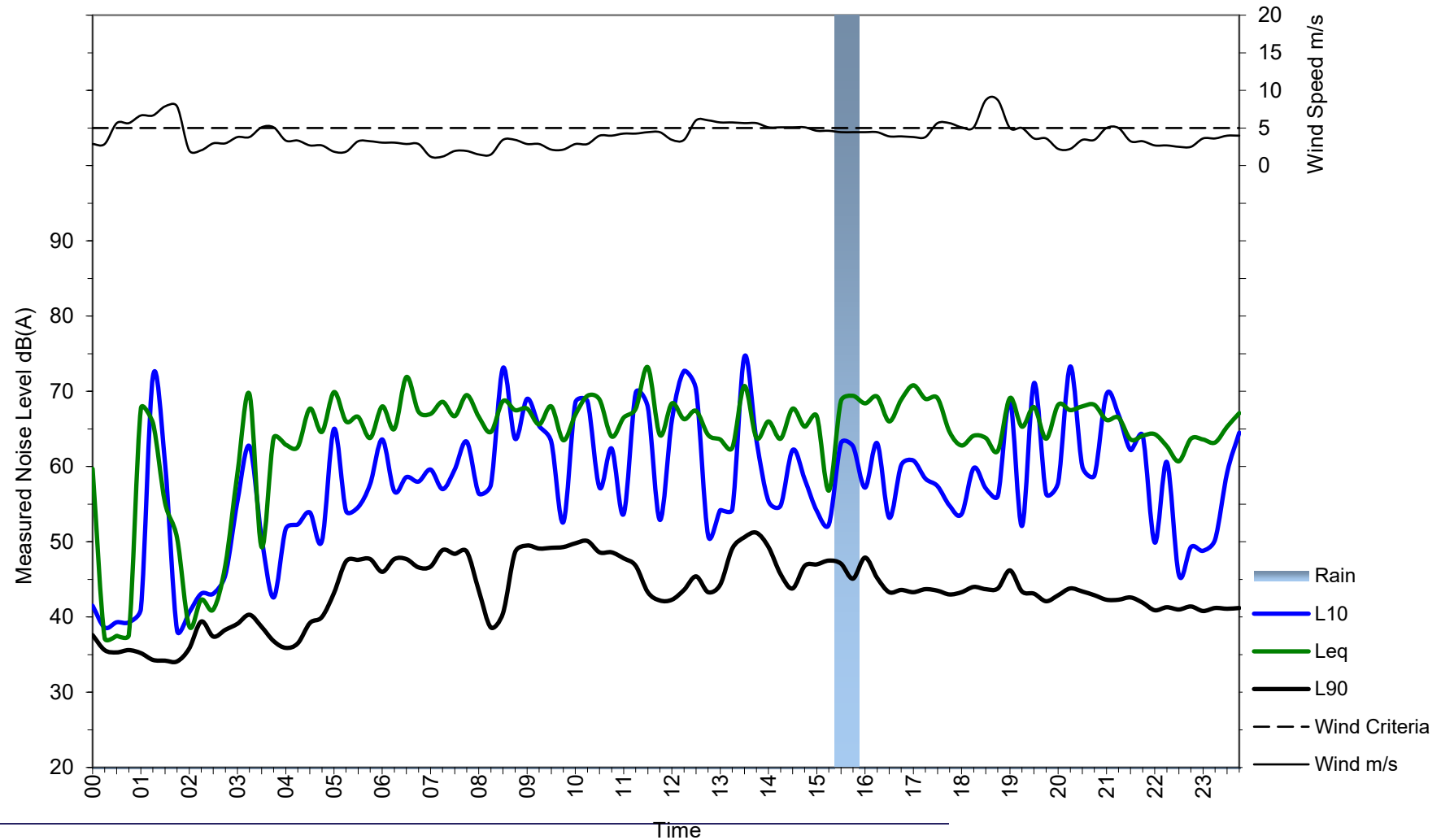
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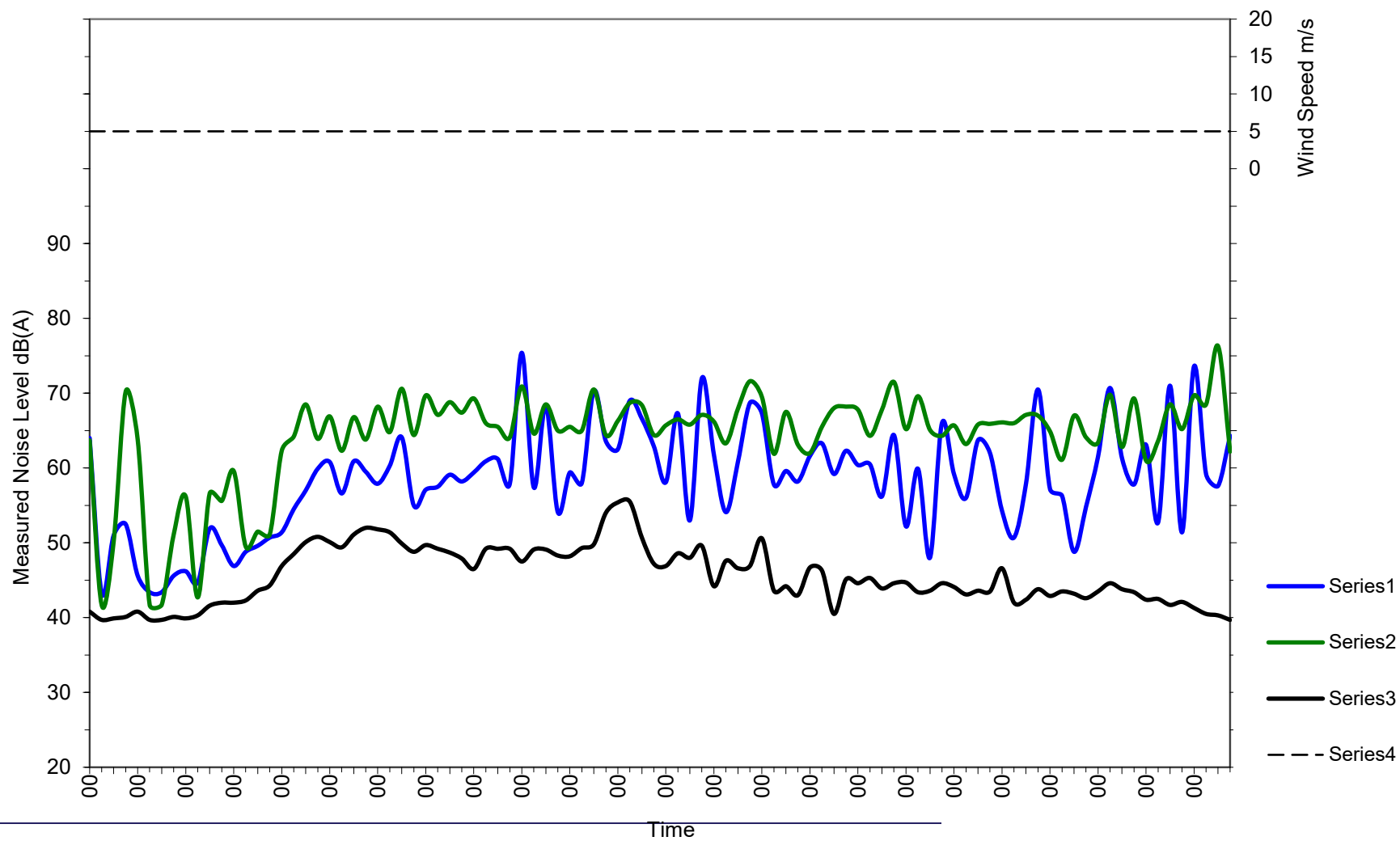


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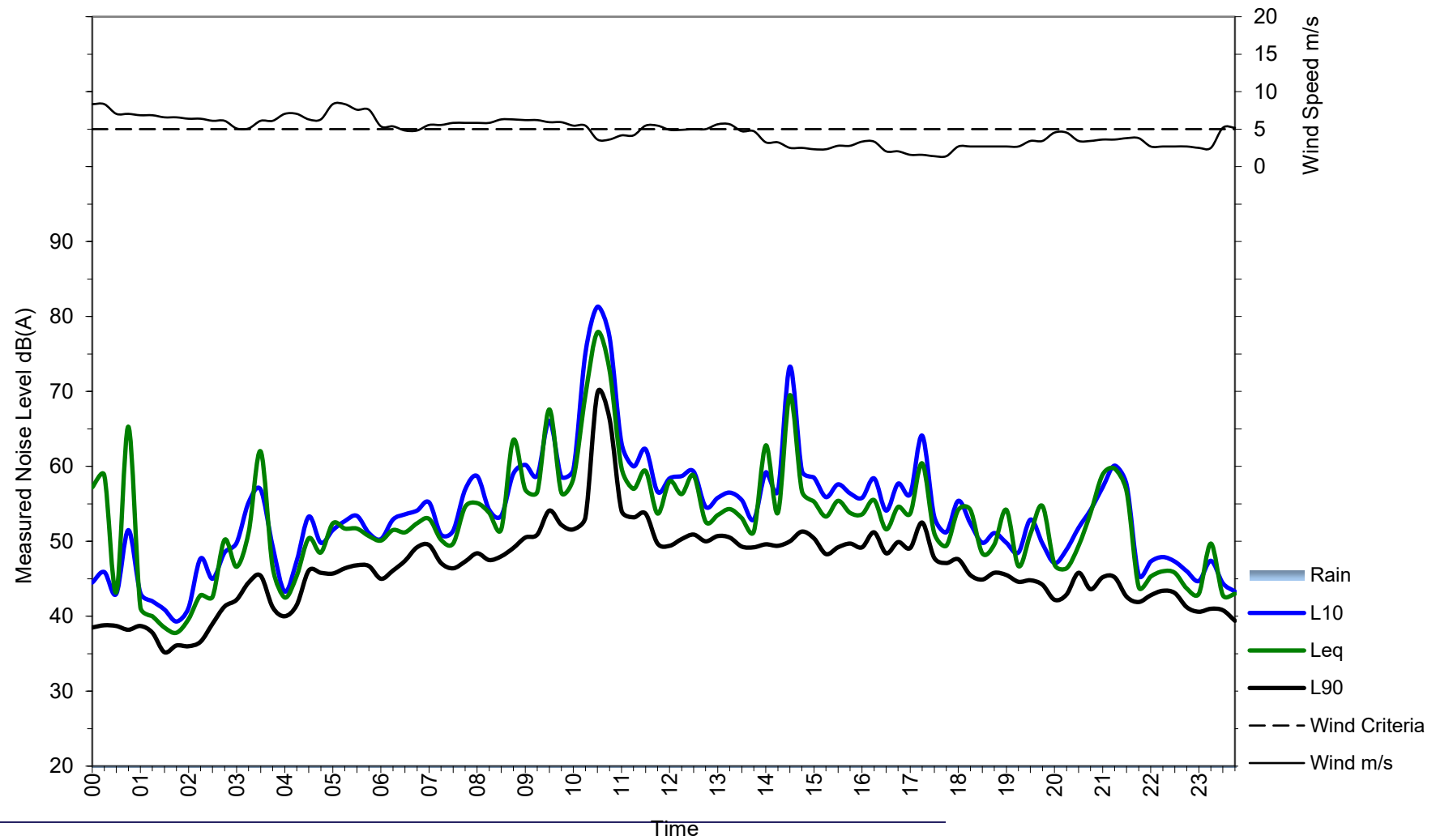
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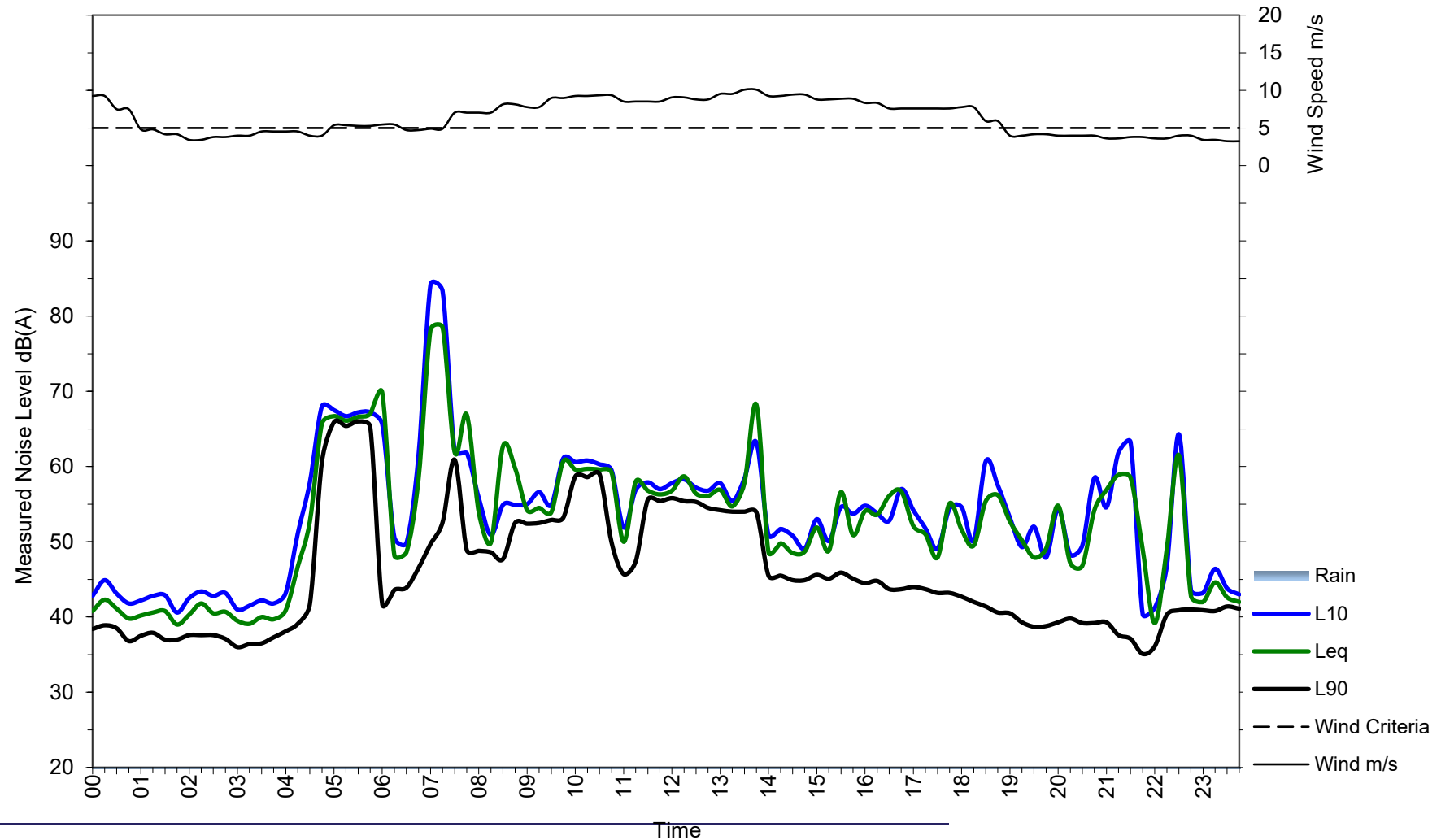
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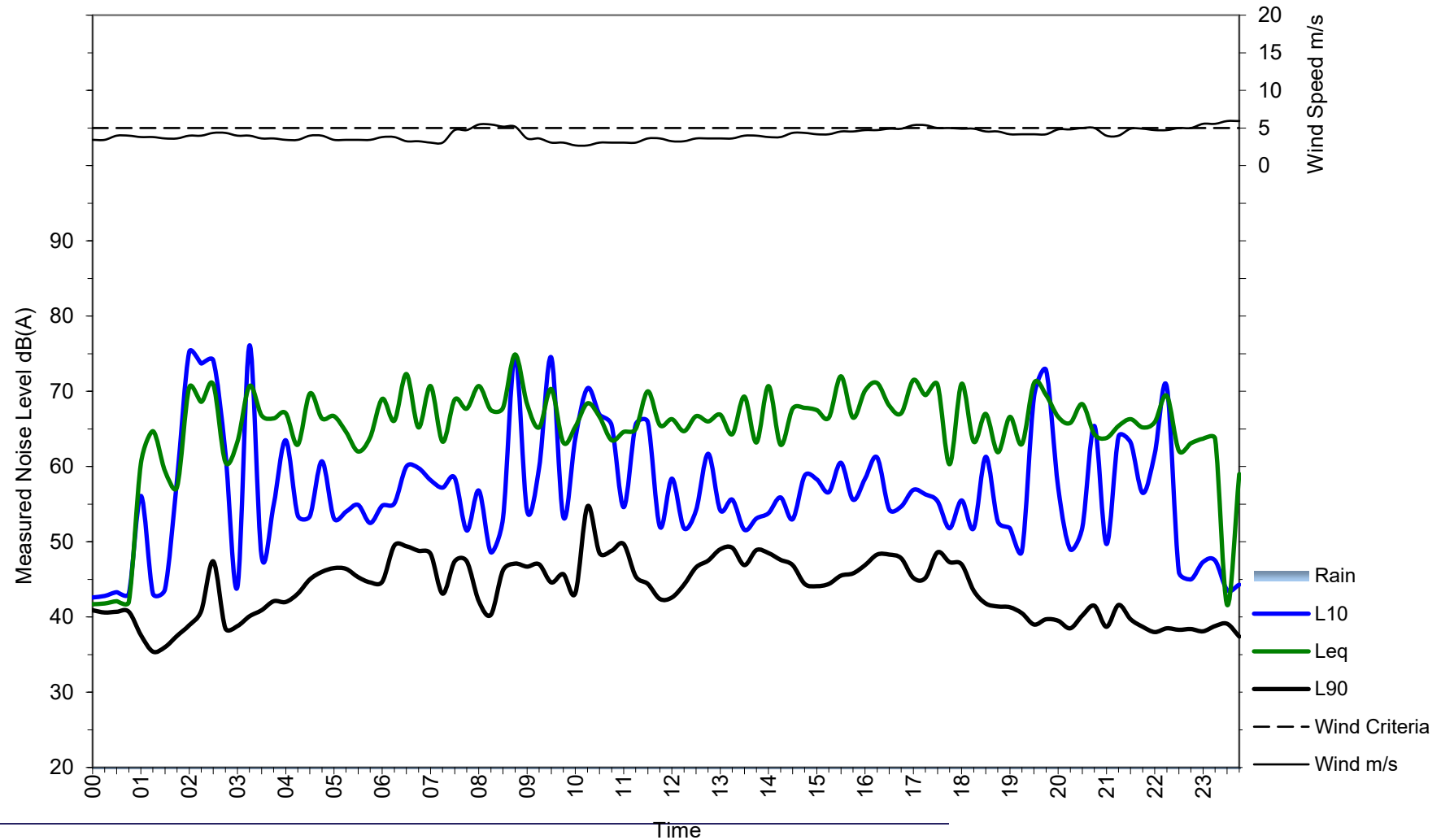
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Wednesday 14 September 2022





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Thursday 15 September 2022

