Rutledge Street Apartments, Lot 2 DP117998, Lot 31 DP771673, Queanbeyan – DA Acoustic Assessment

The Village Building Co
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1 INTRODUCTION

Pulse White Noise Acoustics Pty Ltd (PWNA) has been engaged by The Village Building Co to undertake an acoustic assessment for the proposed shop top housing development to be constructed at Lot 2 DP117998, Lot 31 DP771673, Queanbeyan, known as Rutledge Street Apartments.

This assessment will address the following:

- Potential surrounding environmental noise intrusion impacts on the development (i.e. road traffic, mechanical and other external noise sources).
- Noise emissions on nearby receivers from mechanical plant and other base building services, vehicle movements as well as noise associated with the pool, gym and multi-purpose space; and
- Acoustic separation requirements.

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. Australian and International Standards will be adopted where local and state legislation are not applicable.

Noise intrusion into the development will be controlled by the requirements of Queanbeyan-Palerang Regional Council (QPRC) *Queanbeyan Development Control Plan (DCP) 2012*. The objectives of Australian / New Zealand Standard AS/NZS 2107:2016 Acoustics–Recommended design sound levels and reverberation times for building interiors has been adopted.

Internal construction requirements are governed by the requirements of Section F5 of the Building Code of Australia (BCA) component of the National Construction Code (NCC).

Furthermore, the noise emission impacts from the proposed development on the adjacent receivers are regulated by Queanbeyan-Palerang Regional Council (QPRC) *Queanbeyan Development Control Plan (DCP) 2012*, NSW EPA Noise Policy for Industry (NPI) 2017 and the NSW EPA Road Noise Policy (RNP) 2011.

1.2 Proposed Development

The proposed main acoustic related modifications are:

- Two (2) levels of basement parking (818 spaces), building services areas and storage areas.
- Two nine (9) storey buildings with the following:
    - Ground level with commercial spaces, waste, foyers and vehicle ramps.
    - Levels one (1) through seven (7) are residential apartments.
    - Level eight (8) will accommodate a combination of residential apartments and communal spaces along Rutledge Street.
    - Level nine (9) are residential apartments.

Figure 1 Architectural Plan –Perspective

Figure 2 Architectural Plan – Perspective

Architectural drawings for the proposed development, which have been used in our assessment, were prepared by Kasparek Architects Pty Ltd.

1.3 Site Description

The project site is located at Lot 2 DP117998, Lot 31 DP771673, along Rutledge Street, Queanbeyan NSW which is defined as a B3 zoning based on NSW ePlanning. As outlined below the site is currently surrounded by existing and under construction multi-storey developments, single storey residential dwellings and community facilities.

Located along the north-western boundary of the site is the future Queanbeyan Civic and Cultural Precinct currently under construction due for completion in 2023.

Situated along the north-eastern boundary is Crawford Street which carries a low to moderate volume of traffic. Further beyond Crawford Street is existing commercial/place of worship type receivers.

Along the south-eastern boundary of the site is Rutledge Street which also carries a low to moderate volume of traffic. Rutledge Street will provide the main vehicle access to the development and pedestrian connection to the Queanbeyan Civic and Cultural Precinct. Located opposite is a combination of residential dwelling and place of worship receiver.

Along the south-western boundary of the site is existing single storey commercial receivers with a multi-storey residential apartment building (three stories) further beyond. Located on the western side of the apartments building is Lowe Street which carries a moderate volume of traffic.

The nearest receivers to the site have been identified below.

Receiver 1: Three storey residential building located along the south-western of the site on the corner of Rutledge Street and Lowe Street.

Receiver 2: Single storey residential dwellings located opposite across Rutledge Street.

Receiver 3: Residential accommodation to the northeast of the site across the intersection of Crawford Street and Rutledge Street

Receiver 4: Queanbeyan Uniting Church located opposite across Rutledge Street.

Receiver 5: Macedonian Orthodox Church of the Prophet Elijah.

Receiver 6: Queanbeyan Civic and Cultural Precinct along the north-western boundary of the site.

A map showing the site location and all measurement locations as well as nearest receivers is provided in Figure 3 below.

Figure 3 Site Map, Measurement Locations and Surrounding Receivers – Sourced from Architectural Drawings

2 ACOUSTIC NOISE AND VIBRATION SURVEY

Measured noise levels from both the unattended and attended noise surveys are outlined below.

2.1 Unattended Noise Monitoring

Two (2) unattended noise surveys were conducted between Monday 23rd May 2022 until Thursday 2nd June 2022 at the two locations as shown in Figure 3 above (Rutledge Street Frontage and Rear of Site).

Instrumentation for the acoustic surveys comprised of two (2) Rion NL-42 noise monitors (serial numbers 00396931 and 01000231). Calibration of the loggers was checked prior to and following the measurements. Drift in calibration did not exceed ±0.5 dB. 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 and C. The charts present each 24-hour period and show the L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15-minute periods. This data has been filtered to remove periods affected by adverse weather conditions based on weather information.

Based on the unattended noise measurements outlined above, the results of each survey are presented below.

2.1.1 Results in accordance with the NSW *EPA Noise Policy for Industry (NPI) 2017* (RBL's)

In order to assess the acoustical implications of the development at nearby noise sensitive receivers, the measured background noise data of the logger was processed in accordance with the NSW EPA's *Noise Policy for Industry* (NPI, 2017).

The Rating Background Noise Level (RBL) is the background noise level used for assessment purposes at the nearest potentially affected receiver. It is the 90th percentile of the daily background noise levels during each assessment period, being day, evening and night. RBL $L_{A90\ (15minute)}$ and L_{Aeq} noise levels are presented in Table 1.

Data affected by adverse meteorological conditions and by spurious and uncharacteristic events has been excluded from the results, and also excluded from the data used to determine the noise emission criteria. Meteorological information has been obtained from the Canberra Airport weather station (ID 70351).

Measured noise levels are detailed below.

Table 1 Measured Ambient Noise Levels (Rating Background Noise Levels – RBL's)

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	
	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)
Location 1 – Rutledge Street Frontage (See Figure 3)	48 (Sunday only: 45)	60 (Sunday only: 58)	43	56	42	51
Location 2 – Rear of Site (See Figure 3)	46 (Sunday only: 39)	57 (Sunday only: 51)	35	48	30	45

Note 1: Typically, 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

Note 2: The L_{A90} noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

Note 3: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

Note: During the period of monitoring, daytime measured noise levels have been affected by construction activities associated with the Queanbeyan Civic and Cultural Precinct. To determine accurate façade noise levels and rating background levels, measured data from Sunday will only be adopted as they are not constructed noise affected. This is only relevant during approved construction hours which is 7:00am to 6:00pm).

2.1.2 Results in accordance with the NSW EPA "Road Noise Policy (RNP)" defined time periods

In determining the required façade construction for the proposed building in accordance with the internal noise level requirements as outlined in section 3.1 below, measured noise levels from the unattended noise monitoring has been processed for the time periods correlated to the NSW EPA Road Noise Policy (RNP) as a industry practice.

Data affected by adverse meteorological conditions and by spurious and uncharacteristic events have been excluded from the results, and also excluded from the data used to determine the noise emission criteria.

Table 2 Measured Ambient Noise Levels (Facade Determination)

Measurement Location	Daytime [1] 7:00 am to 10:00 pm	Night-time [1] 10:00 pm to 7:00 am
	L_{Aeq} (whole period) [2] (dBA)	L_{Aeq} (whole period) [2] (dBA)
Location 1 – Rutledge Street Frontage (See Figure 3)	59	51
Location 2 – Rear of Site (See Figure 3)	56	45

Note 1: For Monday to Sunday, Daytime 7:00 am – 10:00 pm; Night-time 10:00 pm – 7:00 am.

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.

2.1.3 Attended Noise Measurements

In addition to the unattended noise survey, an attended noise survey was carried out to establish levels at key locations surrounding the site. These are summarised below.

The attended noise measurements were conducted using a Brüel & Kjær Type 2250 sound level meter (serial number 2709757). Calibration of the sound level meter was checked prior to and following the measurements using a Brüel & Kjær Type 4231 sound calibrator (serial number 3009148). The calibrator emitted a calibration tone of 94 dB at 1 kHz. The drift in calibration did not exceed ±0.5 dB. All equipment carries appropriate and current NATA (or manufacturer) calibration certificates.

Attended noise measurements were undertaken on Monday 23rd May 2022 between 4:30pm and 5:00pm. Results of the attended noise measurements are outlined in Table 3 below.

Table 3 Measured Results of the Attended Noise Survey

Measurement Location	Date and Time	Measured Noise Level (dBA)		Comments
		$L_{A90\ (15\text{-}min)}$[1]	$L_{Aeq\ (15\text{-}min)}$[2]	
Location 1: Crawford Avenue (See Figure 3)	Monday 23rd May 2022	49	61	Local traffic.
Location 2: Rutledge Street (See Figure 3)		50	62	Local traffic.

Note 1: The L_{A90} noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

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.

3 ACOUSTIC CRITERIA

The acoustic criteria which have been adopted for this assessment are outlined below. All criteria have been separated into the relevant assessment type. These are: *Noise Intrusion Criteria* (Assessment of building envelope), *Noise Emission Criteria* (Assessment of noise to surrounding receivers), and *Acoustic Separation Criteria* (Assessment of acoustic privacy within the building).

3.1 Noise Intrusion Criteria

External noise intrusion into the building will generally be via the building envelope (External wall, glazing or external roof). The design of the building envelope should be such that the requirements listed below are achieved.

3.1.1 Queanbeyan-Palerang Regional Council (QPRC) Queanbeyan Development Control Plan (DCP) 2012

Review of Queanbeyan-Palerang Regional Council (QPRC) Queanbeyan Development Control Plan (DCP) 2012, any site-specific noise intrusion requirements do not exist. In the absence of any applicable acoustic requirements, the recommended internal noise levels as outlined in Australian/New Zealand AS/NZS 2107:2016 as shown below will be adopted.

3.1.2 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 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 Recommended Design Sound Levels

Type of Occupancy/Activity	Design sound level range dBA ($L_{Aeq,t}$)	Project Design Noise Level [1] dBA ($L_{Aeq,t}$)
Residential Buildings—		
Houses and apartments in suburban areas or near minor roads -		
Apartment common areas (eg. Foyer, lift lobby)	45 to 50	**50**
Living areas	30 to 40	**40**
Sleeping areas (nighttime)	30 to 35	**35**
Work areas	35 to 40	**40**
Office Buildings—		
General office areas	40 to 45	**45**
Shop Buildings—		
Small retail stores (generally)	<50	<50

Note 1: Overall recommended level for mechanical services noise and intrusive noise, combined.

Note 2: 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.

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 is to be avoided.

3.2 Noise Emission Criteria (Operational Criteria)

Noise emissions from the operation of the site impacting on the adjacent land users are outlined below. Noise emissions expected from the use of the site include vehicle movements in the basement carpark and associated driveways, additional traffic on public roads, mechanical services, multi-purpose spaces and residents amenities (pools and gym).

3.2.1 Queanbeyan-Palerang Regional Council (QPRC) Queanbeyan Development Control Plan (DCP) 2012

Review of Queanbeyan-Palerang Regional Council (QPRC) Queanbeyan Development Control Plan (DCP) 2012, any site-specific noise emission requirements do not exist. In the absence of any applicable acoustic requirements, the requirements of the NSW EPA Noise Policy for Industry (NPI) 2017 and Road Noise Policy (RNP) 2011 as shown below will be adopted.

3.2.2 NSW EPA Noise Policy for Industry (NPI) 2017

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

The NSW EPA has released a document titled *Noise Policy for Industry* (NSW NPI) which provides a framework and process for determining external noise criteria for the assessment of noise emission from industrial developments. The NSW NPI criteria for industrial noise sources have two components:

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

3.2.2.1 Intrusive Noise Impacts (Residential Receivers)

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

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

3.2.2.2 Protecting Noise Amenity (All Receivers)

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

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

Project amenity noise level for industrial developments is specified as the recommended amenity noise level (Table 2.2 of the NPI) minus 5 dBA. To standardise the time periods for the intrusiveness and amenity noise levels, this policy assumes that the $L_{Aeq,15min}$ will be taken to be equal to the $L_{Aeq,period}$ + 3 decibels (dB).

Where the resultant project amenity noise level is 10 dB or more lower than the existing traffic noise level, the project amenity noise levels can be set at 15 dB below existing traffic noise levels (i.e. *$L_{Aeq,period(traffic)}$ minus 15 dBA*).

3.2.2.3 Area Classification

The NSW NPI characterises the "Urban Residential" noise environment as an area that has the following characteristics:

- An acoustical environment that:

  Suburban residential–

  - *"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"*

- The policy also suggests that typically existing background noise levels are:
    - Daytime (7:00am to 6:00pm): <45dBA
    - Evening (6:00pm to 10:00pm): <40dBA
    - Night (10:00pm): < 35dBA

Figure 4 is obtained from the NSW Planning *ePlanning Spatial Viewer* website; it shows the land zoning map of the proposed development and the nearest sensitive receivers.

Figure 4 NSW Planning *ePlanning Spatial Viewer*

As shown above, the site and its surrounding receivers are within are a mix of B3 and R2 zoning. Based on the acoustical characteristics measured and observed onsite, as well as the description above, the surrounding residences are deemed Suburban Residential.

Table 5 NSW NPI – Recommended L_{Aeq} Noise Levels from Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level ($L_{Aeq, period}$)[2] (dBA)
Surrounding Residences	Urban Residential	Day	60
		Evening	50
		Night	45
Places of Worship	N/A	When in use	40 (Internal)
Commercial (including Civic and Cultural)	N/A	When in use	65

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

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.

3.2.2.4 Maximum Noise Level Event (Sleeping Disturbance) – Residences

Section 2.5 of the NPI states the following:

> *The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.*
>
> *Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - *$L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
> - *L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*
>
> *a detailed maximum noise level event assessment should be undertaken.*

As outlined in section 2 above, the measured rating background noise level during the proposed night operating hours (10:00pm to 7:00am) is 30dBAL_{A90}. Therefore, the resultant sleeping disturbance L_{AFmax} noise criteria is 52dBA L_{AFmax}.

3.2.2.5 Project Trigger Noise Levels

The intrusive and amenity criteria for industrial noise emissions, derived from the measured data, are presented in Table 6. These criteria are nominated for the purpose of determining the operational noise limits for mechanical plant associated with the development which can potentially affect noise-sensitive receivers.

For each assessment period, the lower (i.e. the more stringent) of the amenity or intrusive criteria are adopted, which are shown in bold text in Table 6.

Table 6 External noise level criteria in accordance with the NSW NPI

Location	Time of Day [1]	Project Amenity Noise Level, $L_{Aeq, period}$ [2] (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [3] (dBA)	Measured $L_{Aeq, period}$ Noise Level [4] (dBA)	Intrusive $L_{Aeq, 15\ min}$ Criterion [4] for New Sources (dBA)	Amenity $L_{Aeq, 15\ min}$ Criterion [4] for New Sources (dBA)
Surrounding Residential Receivers	Day	50	39	51	**44**	53
	Evening	40	35	48	**40**	43
	Night	35	30	45	**35**	38
Place of Worship	When in use	-	-	-	-	**38** (Internal)
Commercial	When in use					**63**

Note 1: For Monday to Saturday, Daytime 7:00 am – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 10:00 pm; Night-time 10:00 pm – 8:00 am.

Note 2: Project Amenity Noise Levels corresponding to the discussion in Section 3.2.1 (i.e. existing L_{Aeq} noise level -15dBA).

Note 3: The L_{A90} noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

Note 4: 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.

Note 5: In accordance with section 2.3 of the NPI policy, the project intrusiveness noise level during the evening period should be set at the same level or lower than the daytime period. As such this has been amended.

Note 6: Project Trigger Noise Levels (PTNL) are outlined in bold.

3.2.3 NSW EPA Road Noise Policy (RNP) 2011

In order to determine the noise impact on local roads, the future traffic generated by the proposed site is compared with the existing traffic. The noise impact on residences from local road traffic is considered significant if the vehicle number on surrounding roads increases by around 60% of the existing traffic volumes (this would result in an increase in traffic noise by 2 dB).

3.3 Acoustic Separation Criteria

Acoustic separation between apartments/dwellings within the development must comply with the requirements listed below.

3.3.1 National Construction Code (NCC) & Building Code of Australia (BCA) 2019

The Building Code of Australia (BCA) is a uniform set of technical provisions for the design and construction of buildings and other structures throughout Australia. The BCA is produced and maintained by the Australian Building Codes Board (ABCB) and given legal effect through the Building Act 1975. The National Construction Code (NCC) comprises the Building Code of Australia and the Plumbing Code of Australia (the Plumbing Code of Australia is given legal effect through the Plumbing and Drainage Act 2002 (Qld)) and is published in three volumes. Volumes one and two relate to the BCA.

Part F5 of Volume One of the BCA / NCC provides the Sound Transmission and Insulation requirements for Class 2 or 3 buildings. These requirements are identified below:

3.3.1.1 Inter-Tenancy Walls (Apartment to Apartment)

Section FP5.2 of the BCA requires:

Walls separating sole-occupancy units or a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby, or the like, or parts of a different classification, must provide insulation against the transmission of -

a) airborne sound; and

b) impact generated sound, if the wall is separating a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit,

Sufficient to prevent illness or loss of amenity to the occupants.

F5.5 of the BCA provides the sound insulation performance rating of walls as follows:

a) A wall in a Class 2 or 3 building must –

i. have an Rw + Ctr (airborne) not less than 50, if it separates sole-occupancy units; and

ii. have an Rw (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and

iii. comply with F5.3(b) if it separates—

a) a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or

b) a sole-occupancy unit from a plant room or lift shaft.

b) A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, provided the door assembly has an Rw not less than 30.

c) A wall in a Class 9c building must have an Rw not less than 45 if it separates—

i. sole-occupancy units; or

ii. a sole-occupancy unit from a kitchen, bathroom, sanitary compartment (not being an associated ensuite), laundry, plant room or utilities room.

d) In addition to (c), a wall separating a sole-occupancy unit in a Class 9c building from a kitchen or laundry must comply with F5.3 (b).

e) Where a wall required to have sound insulation has a floor above, the wall must continue to -

i. the underside of the floor above; or

ii. a ceiling that provides the sound insulation required for the wall.

f) Where a wall required to have sound insulation has a roof above, the wall must continue to-

i. the underside of the roof above; or

ii. a ceiling that provides the sound insulation required for the wall.

FV5.2 states that compliance with FP5.2(a) to avoid the transmission of airborne sound through walls is verified when it is measured in-situ that –

a) a wall separating sole-occupancy units has a weighted standardised level difference with spectrum adaptation term (DnT,w + Ctr) not less than 45 when determined under AS/NZS 1276.1 or ISO 717.1; or

b) a wall separating a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby, or the like, or parts of a different classification, has a weighted standardised level difference (DnT,w) not less than 45 when determined under AS/NZS 1276.1 or ISO 717.1; or

c) any door assembly located in a wall that separates a sole-occupancy unit from a stairway, public corridor, public lobby, or the like, has a weighted standardised level difference (DnT,w) not less than 25 when determined under AS/NZS 1276.1 or ISO 717.1.

F5.3 (b) states the following:

a) A floor in a building required to have an impact sound insulation rating must -

i. have the required value for weighted normalised impact sound pressure level (Ln,w) determined in accordance with AS ISO 717.2 using results from laboratory measurements; or

ii. comply with Specification F5.2.

b) A wall in a building required to have an impact sound insulation rating must -

i. for a Class 2 or 3 building be of discontinuous construction; and

ii. for a Class 9c building, must—

a) for other than masonry, be two or more separate leaves without rigid mechanical connection except at the periphery; or

b) be identical with a prototype that is no less resistant to the transmission of impact sound when tested in accordance with Specification F5.5 than a wall listed in Table 2 of Specification F5.2.

c) For the purposes of this Part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

i. for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and

ii. for other than masonry, there is no mechanical linkage between leaves except at the periphery.

3.3.1.2 Inter-Tenancy Floors (Apartment to Apartment)

Section FP5.1 of the BCA states that for Class 2 or 3 buildings:

Floors separating -

a) sole-occupancy units; or

b) sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby, or the like, or a part of a different classification,

must provide insulation against the transmission of airborne and impact generated sound sufficient to prevent illness or loss of amenity to the occupants.

F5.4 provides the sound insulation performance rating of floors as follows:

a) *A floor in a Class 2 or 3 building must have an Rw+Ctr (airborne) not less than 50 and an Ln,w (impact) not more than 62 if it separates—*

   (i) sole-occupancy units; or

   (ii) a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.

b) *A floor in a Class 9c building separating sole-occupancy units must have an Rw not less than 45.*

FV5.1 states that compliance with FP5.1 is verified when it is measured in-situ that the separating floor has -

a) *airborne: a weighted standardised level difference with spectrum adaptation term (DnT,w + Ctr) not less than 45 when determined under AS/NZS 1276.1 or ISO 717.1; and*

b) *impact: a weighted standardised impact sound pressure level with (LnT,w) not more than 62 when determined under AS ISO 717.2.*

3.3.1.3 Summary of BCA Acoustic Requirements

A summary of the acoustic requirements of the NCC 2019 for Class 2 or 3 buildings is given in Table 7 below.

Table 7 NCC 2019 Sound Insulation Requirements

Construction	2019 NCC	
	Laboratory performance requirements	**Verification method**
Walls between sole occupancy units	$R_w + C_{tr}$ not < 50	$D_{nT,w} + C_{tr}$ not < 45
Walls between a bathroom, sanitary compartment, laundry or kitchen in one sole occupancy unit and a habitable room (other than a kitchen) in an adjoining unit	$R_w + C_{tr}$ not < 50 and Must have a minimum 20 mm cavity between two separate leaves	$D_{nT,w} + C_{tr}$ not < 45 "Expert Judgment" Comparison to the "Deemed to satisfy" Provisions
Walls between sole occupancy units and a plant room or lift shaft	R_w not < 50 and Must have a minimum 20 mm cavity between two separate leaves[1]	$D_{nT,w}$ not < 45
Walls between sole occupancy units and a stairway, public corridor, public lobby or the like, or parts of a different classification	R_w not < 50	$D_{nT,w}$ not < 45
Door assemblies located in a wall between a sole-occupancy unit and a stairway, public corridor, public lobby or the like	R_w not < 30 [2]	$D_{nT,w}$ not < 25
Floors between sole-occupancy units or between a sole-occupancy unit and a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification	$R_w + C_{tr}$ not < 50 $L_{n,w}$ not > 62	$D_{nT,w} + C_{tr}$ not < 45 $L'_{nT,w}$ not > 62
Soil, waste, water supply and stormwater pipes and ductwork to habitable rooms	$R_w + C_{tr}$ not < 40	n/a
Soil, waste, water supply and stormwater pipes and ductwork to kitchens and other rooms	$R_w + C_{tr}$ not < 25	n/a
Intra-tenancy Walls	There is no statutory requirement for airborne isolation via intra-tenancy walls.	

Note 1: A wall must be of "discontinuous construction" if it separates a sole occupancy unit from a plant room or lift shaft. Clause F5.3(c) defines "discontinuous construction" as a wall having a minimum 20mm cavity between two separate leaves with no mechanical linkage except at the periphery.

Note 2: Clause FP5.3(b) in the 2016 BCA states that the required insulation of a floor or wall must not be compromised by a door assembly.

Note 3: Masonry walls must be laid with all joints filled solid, including those between the masonry and any adjoining construction.

3.4 Construction Noise and Vibration Objectives

3.4.1 Construction Noise Criteria

3.4.1.1 NSW EPA Interim Construction Noise Guideline (ICNG) – DECC 2009

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 residential receivers have been reproduced from the guideline and are listed in the table below.

Table 8 NMLs for quantitative assessment at residences

Time of Day	Noise Management Level $L_{Aeq(15minute)}$[1,2]	How to Apply
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 Level"*** 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.

Time of Day	Noise Management Level $L_{Aeq(15minute)}$[1,2]	How to Apply
(See above)	***"Highly Noise Affected Level"*** 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1 *Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

Note 2 *The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Noise Policy for Industry (EPA 2017).*

Note 3 *Requirements listed in the table above are in accordance with the Construction Hours listed in Condition C4 and C5.*

Construction noise levels at other noise receivers are outlined below:

- Construction noise levels at offices, retail outlets is not to exceed 70dB LAeq,15minute, when measured externally.

3.4.1.2 Construction Traffic Noise Criteria

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

3.4.2 Vibration Criteria

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

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.

- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects.

- Effects on building structures – where vibration can compromise the integrity of the building or structure itself.

3.4.2.1 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).

3.4.2.1.1 British 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 9 and illustrated in Figure 5.

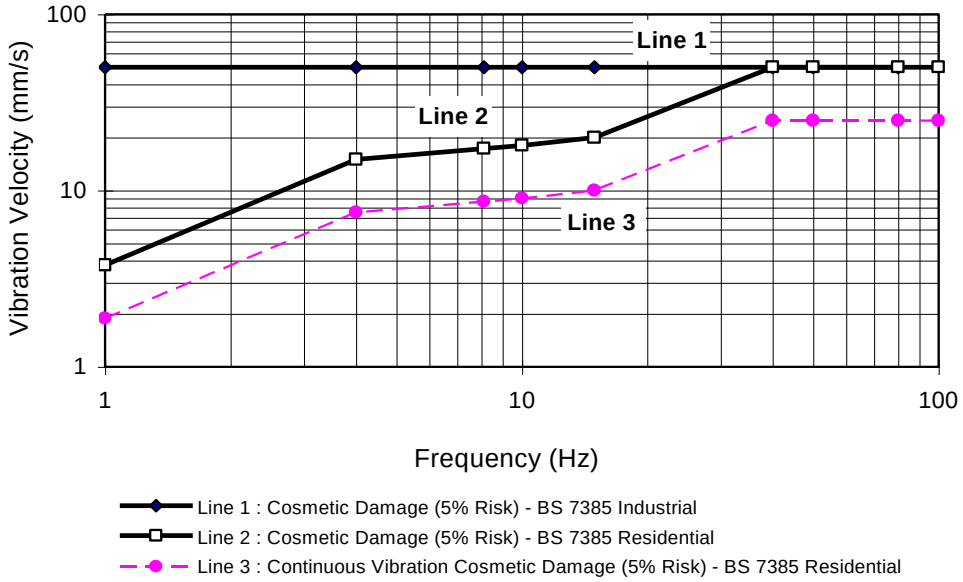
Table 9 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure 5	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 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 may need to be reduced by up to 50% (refer to Line 3 in Figure 5).

Figure 5 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 9, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 9 should not be reduced for fatigue considerations.

3.4.2.1.2 German 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. The criteria are frequency dependent and specific to particular categories of structures.

Table 10 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15

Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

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

3.5 Ground-Borne Noise Criteria

According to the NSW EPA *Interim Construction Noise Guideline (*ICNG) 2009, the criteria for ground-borne noise at residences is defined as follows:

- Maximum internal noise levels of 40 dB LAeq(15mins) between 6:00pm and 10:00pm.

It is noted that the ground borne criteria will apply for construction works undertaken outside of standard hours. That is, work conducted during the evening period Monday to Friday between 6:00pm and 7:00pm only.

4 ACOUSTIC ASSESSMENT

In addressing all the criteria shown above, each component of the development is assessed and discussed below.

4.1 Noise Intrusion – Building Envelope

4.1.1 Glazing Recommendations

The recommended sound transmission loss requirement required to satisfy the specified internal noise level criteria outlined above are summarised below.

Table 11 In-principle Glazing Recommendations.

Facade	Occupancy Area [1]	Minimum Glazing System Rating Requirements [1]	Indicative Construction [1]
North-East Façade	Sleeping Spaces	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm Laminate.
	Living Spaces	Rw (C;Ctr): 29 (-1;-3)	Windows with min. 6mm Float.
	Commercial	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm Laminate.
South- East Façade (Rutledge Street)	Sleeping Spaces	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm Laminate.
	Living Spaces	Rw (C;Ctr): 29 (-1;-3)	Windows with min. 6mm Float.
	Commercial	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm Laminate.
North-West Facade	Sleeping Spaces	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm Laminate.
	Living Spaces	Rw (C;Ctr): 29 (-1;-3)	Windows with min. 6mm Float.
	Commercial	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm Laminate.
South- West Facade	Sleeping Spaces	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm Laminate.
	Living Spaces	Rw (C;Ctr): 29 (-1;-3)	Windows with min. 6mm Float.
	Commercial	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm Laminate.

Note 1: These are preliminary selections will be confirmed in the detailed design stage once the layouts and façade orientations are finalised.

Note 2: Glazing recommendations have been formulated in conjunction with noise emission control mitigation measures.

Please note that, for windows, this performance is not only subject to the glazing selection but also to the construction of the window frame and the frame seal selection. Therefore, it is recommended that the window manufacturer should confirm that the required sound insulation can be achieved. It is anticipated that the window system should comprise Q-Lon (or equivalent) or fin seals with deep C channels as part of the window track **(i.e. Performance levels outlined above need to be achieved with glazed panels + frame + seals).**

4.1.2 External Wall Construction

External wall constructions will be constructed either from a solid dense construction (i.e., like a concrete or masonry system) or light weight cladding systems. In the event the external wall is constructed from a solid dense construction as summarised above, no further acoustic upgrading is required.

However, in the event the external walls are constructed from a lightweight cladding system, the following construction is recommended.

Table 12 Recommended Light Weight External Wall Construction

Location	Occupancy Area [1]	External Lining	Studwork System	Internal Lining
All Facades	All Spaces	1 x External Cladding as specified	Minimum 90mm Studwork + 75mm thick 14kg/m^3 glasswool insulation	1 x 13mm Standard Plasterboard **OR** 1 x 6mm Fibre Cement Sheeting

Note 1: Recommended constructions are identical for each level.
Note 2: These are preliminary selections will be confirmed in the detailed design stage once the layouts and façade orientations are approved.

If penetrations through any external skin are required, all gaps remaining in the penetration are to be filled with an acoustic grade sealant which provides an equal or better performance to the system being penetrated.

4.1.3 External Roof Construction

External roof constructions will be constructed from a solid dense construction (i.e. concrete), no further acoustic upgrading is required. If penetrations through any external skin are required, all gaps remaining in the penetration are to be filled with an acoustic grade sealant which provides an equal or better performance to the system being penetrated.

4.1.4 Open Windows Assessment

Utilising the measured onsite noise levels windows open along all facades will be compliant with the recommended windows open criteria as outlined in the NSW Government *"Development Near Rail Corridors and Busy Roads – Interim Guideline" (DNRC & BR – IG*). No further assessment or acoustic treatment is required.

4.2 Noise from Engineering Services

At this stage of the project, the location of major plant items has been selected, however the exact selection of plant items is not known. As such, a detailed assessment of noise associated from engineering services cannot be undertaken.

However, to ensure the site can be demonstrated to comply with the requirements of the NSW EPA NPI2017, a preliminary review of typical plant areas/items has been undertaken. The assessment which is detailed below is based on advice from the project team as well as our experiencer with similar type of developments and the type of plant systems installed.

The preliminary assessment below above has showed the site is capable of compliance with the requirements of the NSW EPA NPI 2017. However, to ensure all engineering services comply with the acoustic requirements as outlined above, a detailed assessment of all plant items is recommended prior to the issue of the Construction Certificate (CC) and submitted to the certifier. All acoustic requirements outlined in this report must be complied with.

Carpark ventilation systems

It is anticipated that basement ventilation fans will intake/discharge on a ground level utilising an inline fan. It is recommended that internally lined ductwork or inline attenuators are used on both the intake and discharge side of the fan. On this assumption, compliance would be achieved.

Air Conditioning or PAC Systems

Air conditioning condensers are recommended to have the following acoustic treatments installed.

- Condenser plant are to be isolated from the base building structure with a rubber pad.
- Night operation mode must be in operation between 9:00pm and 7:00am and provided a minimum of 4-5dBA.
- In some cases may require acoustic enclosures and or internally lined ductwork.

Loading Dock Ventilation Systems

It is anticipated that loading ventilation fans will discharge on ground level utilising an inline fan. It is recommended that internally lined ductwork or inline attenuators are used on both the intake and discharge side of the fan. On this assumption, compliance would be achieved.

Lobby Ventilation Systems

It is anticipated that lobby ventilation fans will discharge on a low-level roof utilising an inline fan. It is recommended that internally lined ductwork or inline attenuators are used on both the intake and discharge side of the fan. On this assumption, compliance would be achieved.

Kitchen Exhaust Systems (Apartments)

Kitchen exhaust fans for the units will individually discharge along the façade utilising a façade louvre above the glazed elements. It is recommended that 2m with of flexible ducting is used on the intake and discharge side of the fan, on this assumption compliance would be achieved.

Toilet Exhaust Systems (Apartments)

Toilet exhaust fans for the units will individually discharge along the façade utilising a façade louvre above the glazed elements. It is recommended that 1m with acoustic flexible ducting is used on the intake and discharge side of the fan, on this assumption compliance would be achieved.

4.3 Waste Dock Noise

The buildings waste dock is located on ground and is situated in the southwest accessway of the development. Access to the loading dock is via a shared accessway. To ensure the operation of the loading dock does not exceed acoustic criteria outlined above, an assessment has been undertaken. Refer to below.

For the purpose of this assessment, we have assumed the following noise level:

- Noise level of a Medium Rigid Vehicle (driving/reversing into the loading dock – 95dBA Sound Power Level (Lw).

Predicted noise levels associated with the loading dock is addressed in the table below. The predictions below have been determined based on the following assumptions:

- A maximum of one (1) single truck delivery within anyone (1) 15-miniute interval.
- Use of the waste dock is limited to 7:00am to 6:00pm.
- Once a truck is stationary in the waste dock, truck engines are switched off.

Table 13 Predicted Noise Level – Waste Dock

Receiver Location	Predicted Noise Level dB(A)$L_{Aeq(15\text{-}minute)}$ [1]	Acoustic Criteria dB(A)$L_{Aeq(15\text{-}minute)}$ [1]	Compliance
Receiver 1 (See Figure 3)	42dBA	Daytime: **44dBA**	**Yes.** Refer to recommendations below
Receiver 2 (See Figure 3)			

Note 1: 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.

Based on the compliance above, the loading dock should be limited to:

- A maximum of one (1) single truck delivery within anyone (1) 15-miniute interval.
- Use of the waste dock is limited to 7:00am to 6:00pm.
- Once a truck is stationary in the waste dock, truck engines are switched off.

4.4 Noise from the Basement

A review of the noise associated with the basement areas of the development has been undertaken. From our review noise which occurs within the basement will be compliant with the requirements of the NSW EPA NPI 2017 as the spaces are generally located below ground level are contained non-naturally ventilation spaces. This means the basement is not open for noise to breakout. As such the basement and associated vehicle driveways are acoustically acceptable.

4.5 Noise from Additional Vehicles on Local Roads

Noise impacts from the increase in vehicle movements along Rutledge Street are to be assessed in accordance with the NSW EPA Road Noise Policy (RNP) 2011.

XXX has been engaged by the proponent to undertake a XXX for the proposed development. Outlined in the projected traffic volumes section of the report, the following statement is provided.

Insert Traffic Statement

Based on the information above the projected noise impacts associated with the proposal is below the approved master plan and therefore is considered acoustically acceptable.

4.6 Acoustic Separation

As this project is still within the development approval phase, information regarding the proposed constructions that will be separating areas within the development is not known at this stage. As such, a detailed review of the constructions for compliance with the airborne and impact ratings from the National Construction Code cannot be undertaken. It is usual for such work to be conducted at the Construction Certificate (CC) stage of the development. The required airborne and impact ratings have been presented in Section 3.3 of this report.

4.7 Construction Noise and Vibration Impacts

As the project is still in a planning phase, a detailed construction noise and vibration cannot be undertaken at this stage as there several unknown variables.

As such it is recommended that a DA Condition be implemented requiring that a detailed Construction Noise Vibration Management Plan (CNVMP) be prepared prior to the issue of a Construction Certificate. The plan should be undertaken based on the noise and vibration objectives outlined in section 3.4 above

5 CONCLUSION

Pulse White Noise Acoustics Pty Ltd (PWNA) has been engaged by The Village Building Co to undertake an acoustic assessment for the proposed shop top housing development to be constructed at Lot 2 DP117998, Lot 31 DP771673, Queanbeyan, known as Rutledge Street Apartments.

As part of this assessment, we have undertaken a review of the building envelope, assessed noise emissions from the use of the site, as well as established the applicable acoustic separation requirements. From this assessment we note the following:

- Minimum acoustic performances and associated indicative constructions for the building envelope have been provided in section 4.1 of this report. The recommended treatments have been provided to ensure compliance with the objectives presented in 3.1.
- To control noise impacts at external receivers, recommended indicative treatments for major engineering services have been provided in section 4.2. From our review we have formulated the following opinion:
    - At this stage of the project the exact selections/locations of plant items are not known. A preliminary assessment, however, has been carried out using our experience with similar types of developments and the typical plant items installed in each type of plant room.
    - From this review we recommend the selection of high-performance acoustic treatment to ensure that the operation of the plant items comply with the project criteria. Therefore, it is recommended that prior to the issue of a Construction Certificate (CC) a detailed acoustic assessment is undertaken to ensure all cumulative noise from engineering services (including the roof plant room) comply with the requirements as listed in section 3.2.
    - A review of noise from vehicles associated with driveway and loading dock activities has been conducted. From this review we can confirm the use of the driveway and loading dock comply with the requirements listed in this report.
    - A review of noise from vehicles associated with the proposed development on public roads has been conducted. From this review noise impacts associated with the proposal is below the approved master plan approval and therefore is considered acceptable.
- Establishment of the acoustic requirements for the separation between units within the development has been formulated in accordance with the National Construction Code (NCC). Details of the constructions are not known at this stage of the project. It is recommended that a detailed review is undertaken at the Construction Certificate (CC) stage to ensure all requirements are achieved.
- Prior to the issue of the Construction Certificate, it is recommended that a *Construction Noise and Vibration Management Plan (CNVMP)* be undertaken to formulate relevant compliance with the objectives detailed above.

For any additional information please do not hesitate to contact the person below.

Regards,

Matthew Furlong
Principal Acoustic Engineer
PULSE WHITE NOISE ACOUSTICS PTY LTD

APPENDIX A – ACOUSTIC GLOSSARY

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

Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; 0dB the faintest sound we can hear 30dB a quiet library or in a quiet location in the country 45dB typical office space. Ambience in the city at night 60dB Martin Place at lunch time 70dB the sound of a car passing on the street 80dB loud music played at home 90dB the sound of a truck passing on the street 100dB the sound of a rock band 115dB limit of sound permitted in industry 120dB deafening
dB(A)	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Background	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources.

Sound Low	Usually taken to mean the L_{A90} value
Ctr	A frequency adaptation term applied in accordance with the procedures described in ISO 717.
dB (A)	'A' Weighted overall sound pressure level
Noise Reduction	The difference in sound pressure level between any two areas. The term "noise reduction" does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply
NR Noise Rating	Single number evaluation of the background noise level. The NR level is normally around 5 to 6 dB below the "A" weighted noise level. The NR curve describes a spectrum of noise levels and is categorised by the level at 1000 Hz ie the NR 50 curve has a value of 50 dB at 1000 Hz. The NR rating is a tangential system where a noise spectrum is classified by the NR curve that just encompasses the entire noise spectrum consideration.
R_W	Weighted Sound Reduction Index - Laboratory test measurement procedure that provides a single number indication of the acoustic performance of a partition or single element. Calculation procedures for Rw are defined in ISO 140-2:1991 "Measurement of Sound Insulation in Buildings and of Building Elements Part 2: Determination, verification and application of precision data".
R'_W	Field obtained Weighted Sound Reduction Index - this figure is generally up to 3-5 lower than the laboratory test determined level data due to flanked sound transmission and imperfect site construction.
Sound Isolation	A reference to the degree of acoustical separation between any two areas. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term "sound isolation" does not specify any grade or performance quality and requires the units to be specified for any contractual condition
Sound Pressure Level, L_P dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, L_W dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt
Speech Privacy	A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
Transmission Loss	Equivalent to Sound Transmission Loss and to Sound Reduction Index in terminology used in countries other than Australia. A formal test rating of sound transmission properties of any construction, by usually a wall, floor, roof etc. The transmission loss of all materials varies with frequency and may be determined by either laboratory or field tests. Australian Standards apply to test methods for both situations.

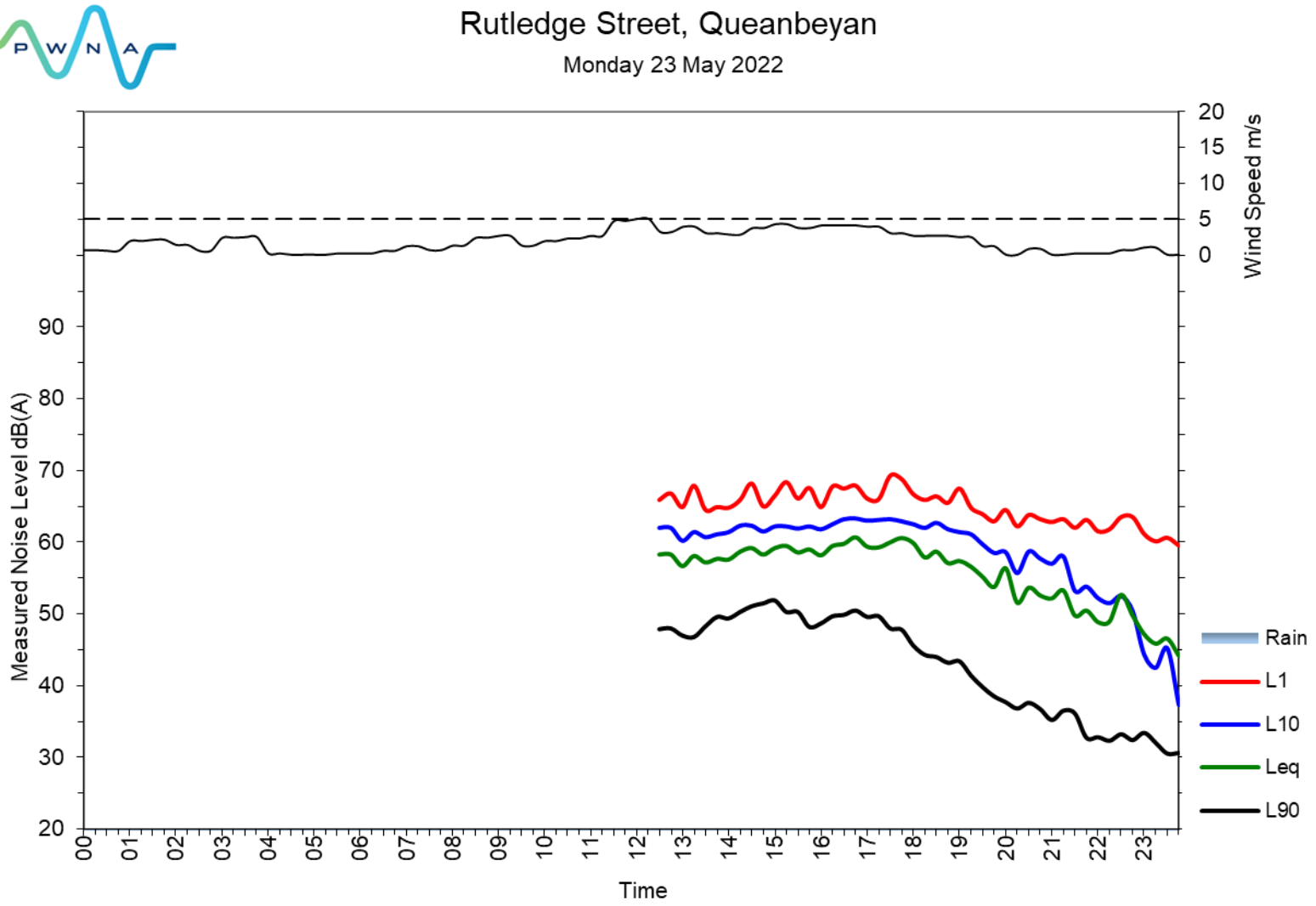
APPENDIX B: UNATTENDED NOISE MONITORING RESULTS – LOCATION 1 (RUTLEDGE STREET)

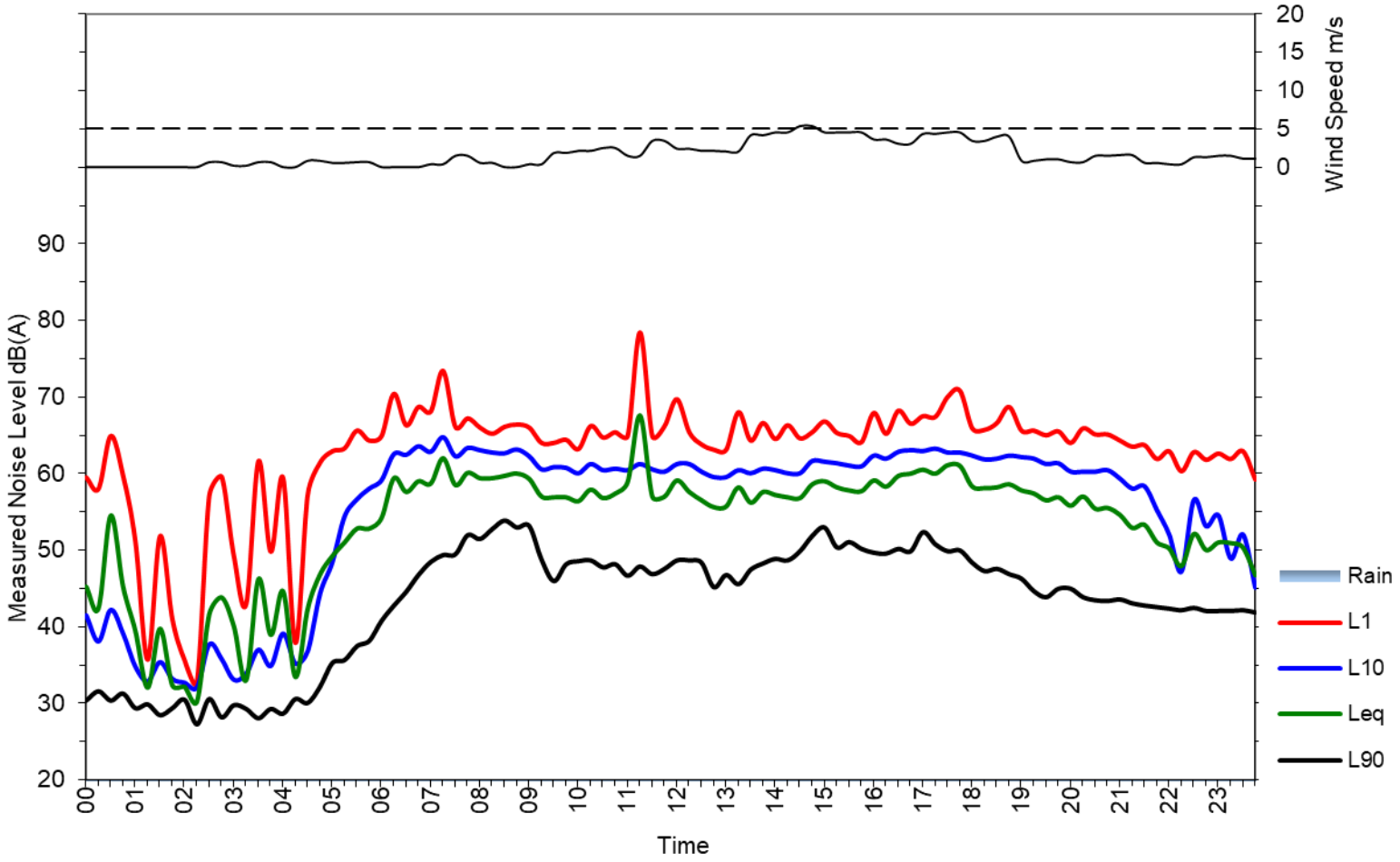
Weather Station: Canberra Airport

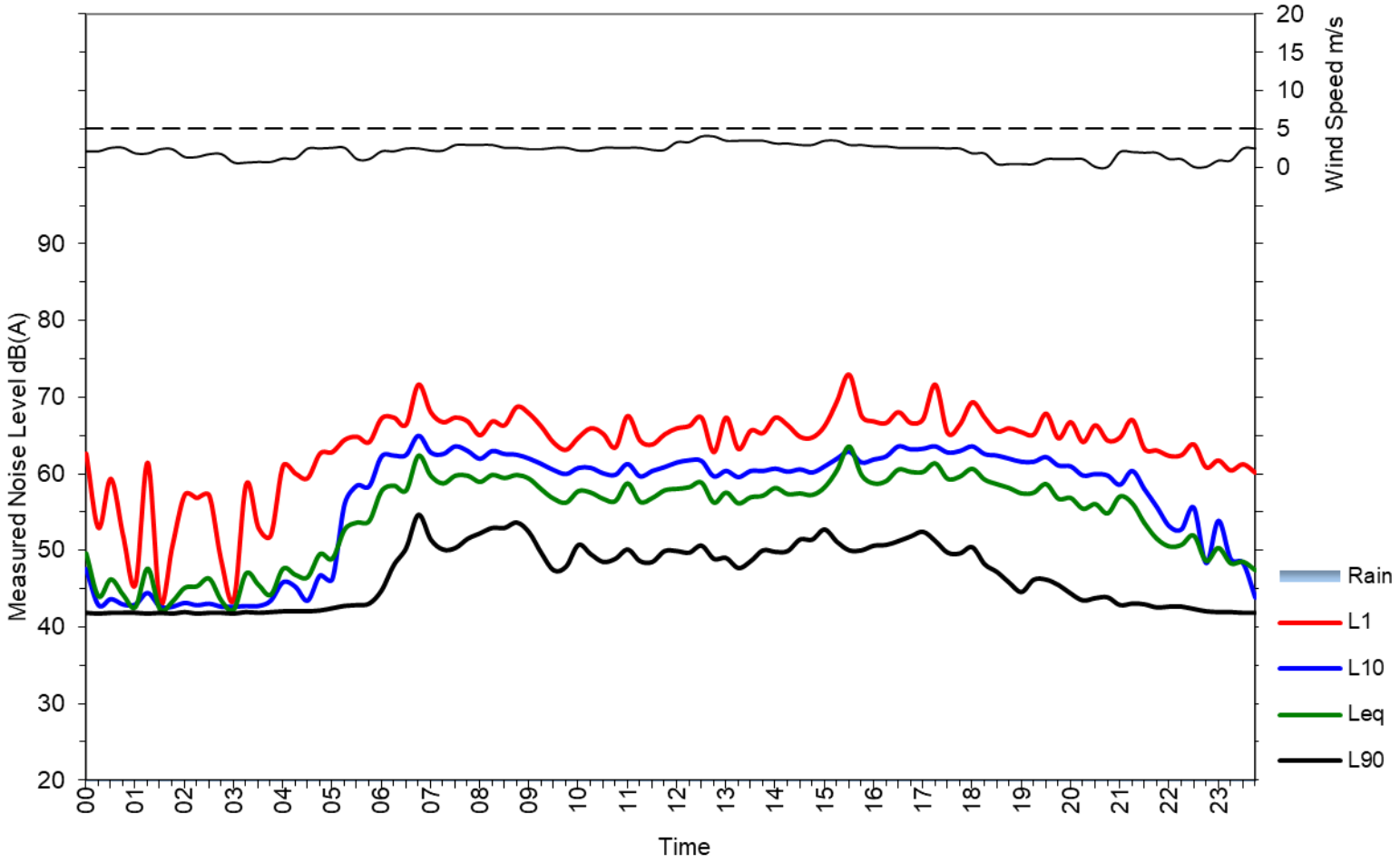
Weather Station ID: 70351

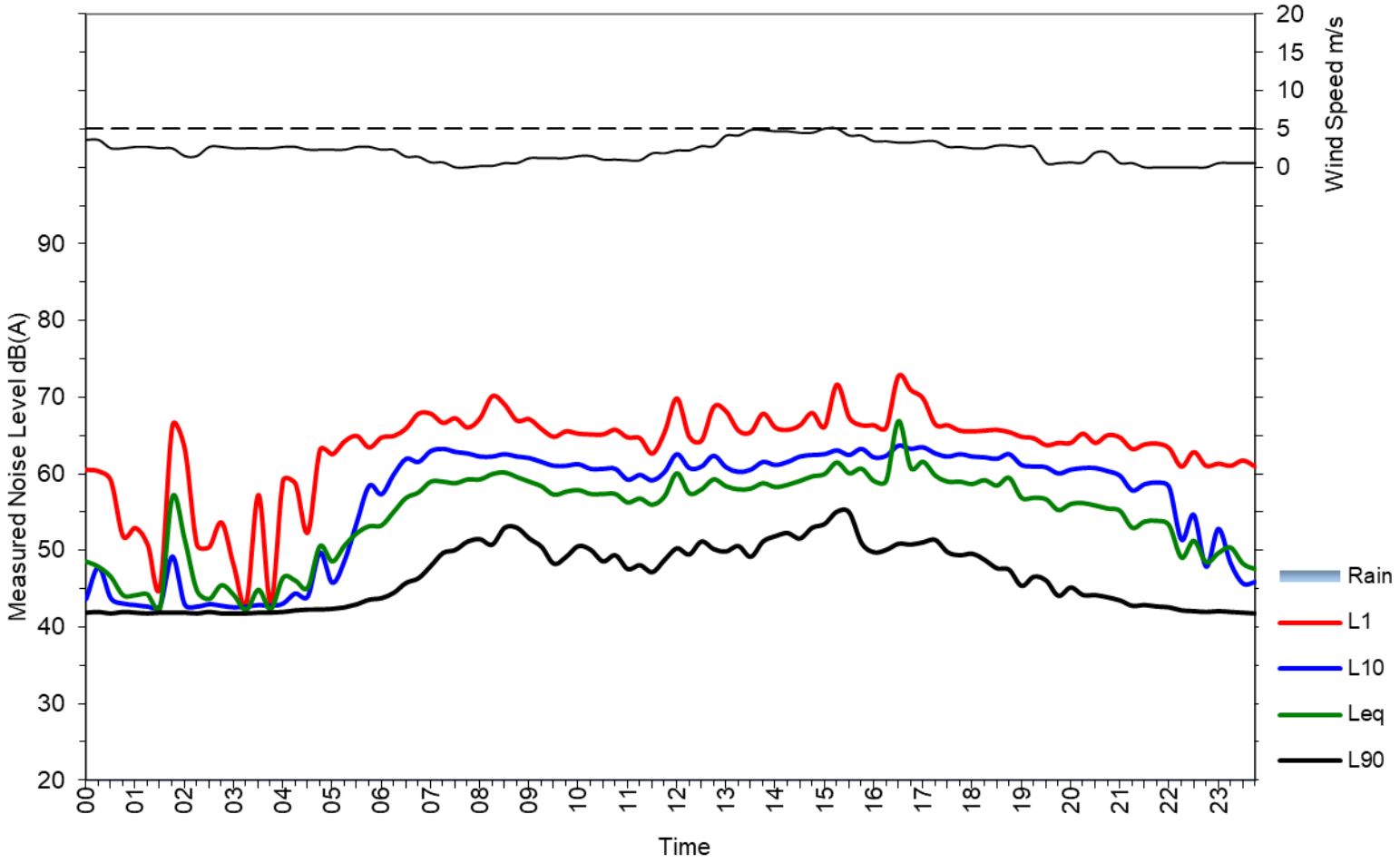
Co-ordinates: Lat: -35.3088°S, Lon: 149.2004°E, Height: 578.0 m (AMSL)

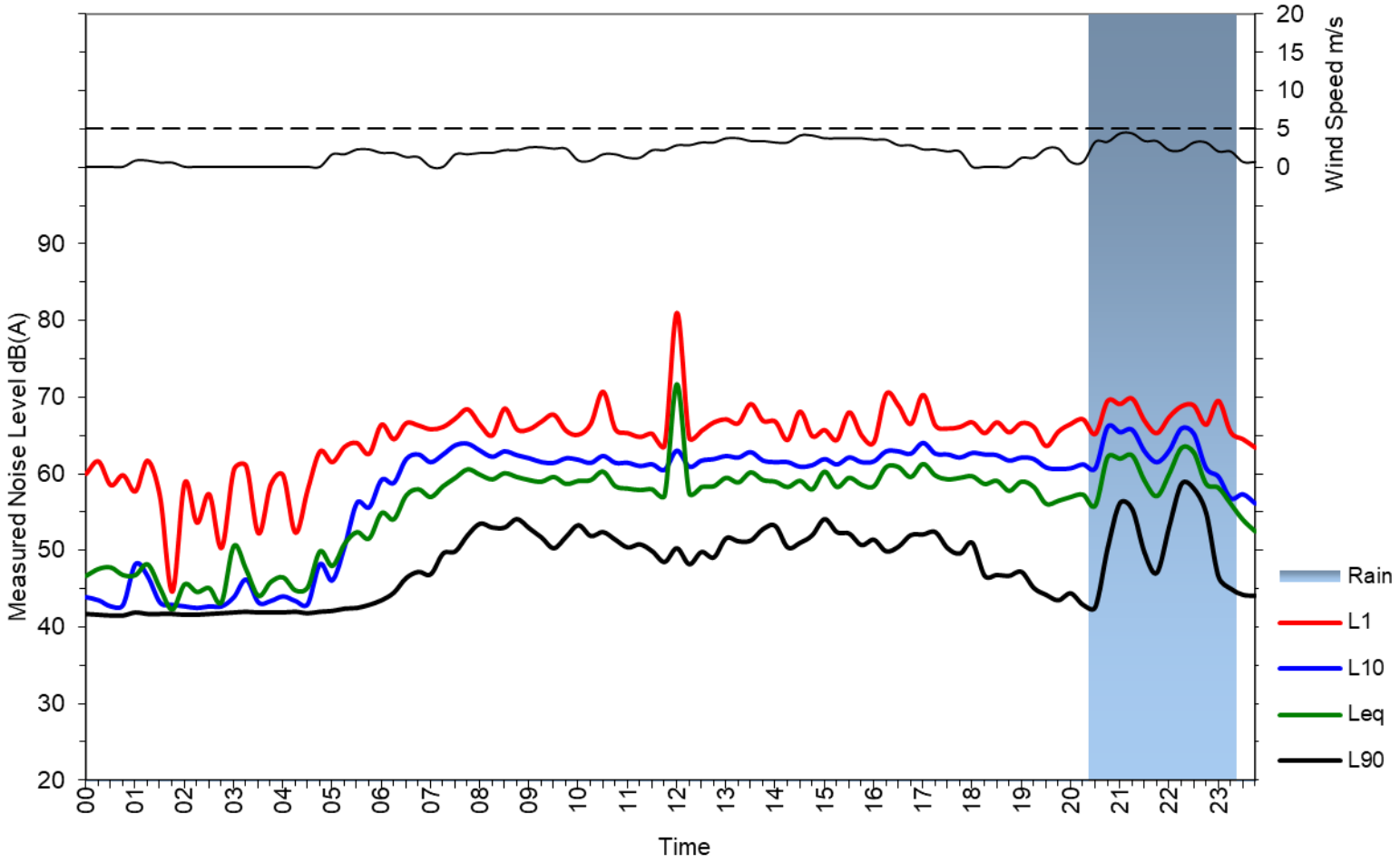
Figure 6 Noise Monitor Install Photo – Rutledge Street

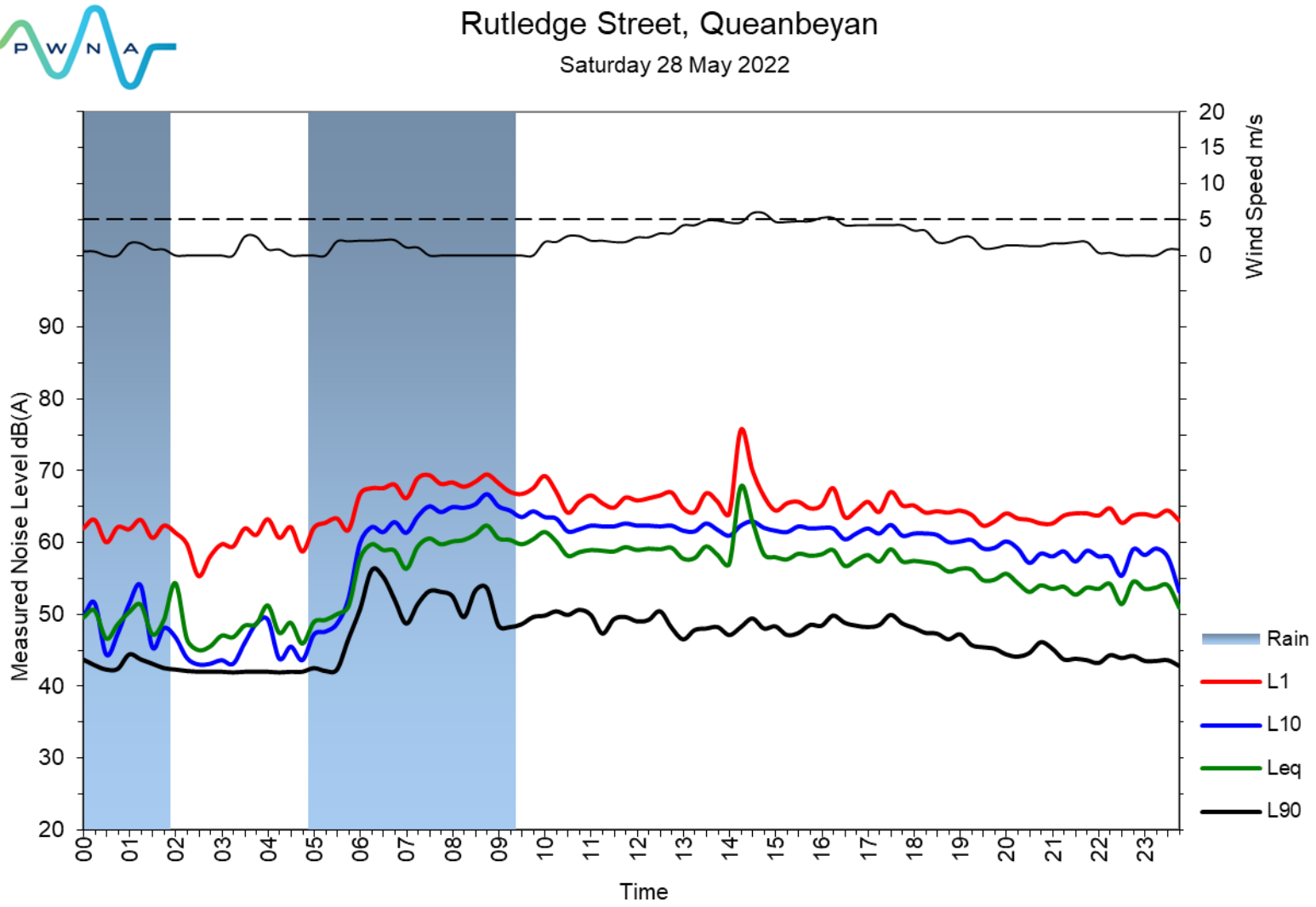

Rutledge Street, Queanbeyan
Monday 23 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

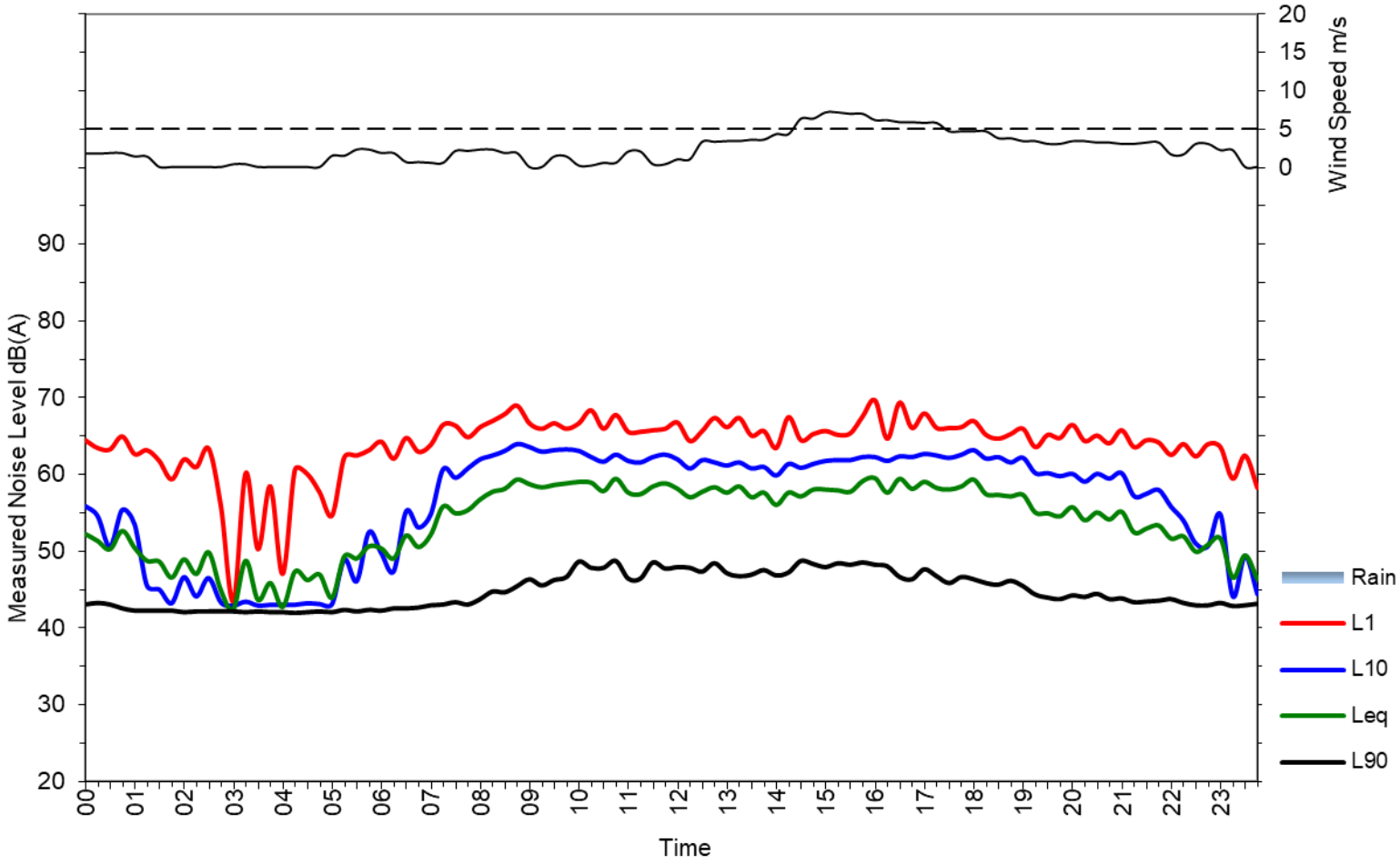

Rutledge Street, Queanbeyan
Tuesday 24 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

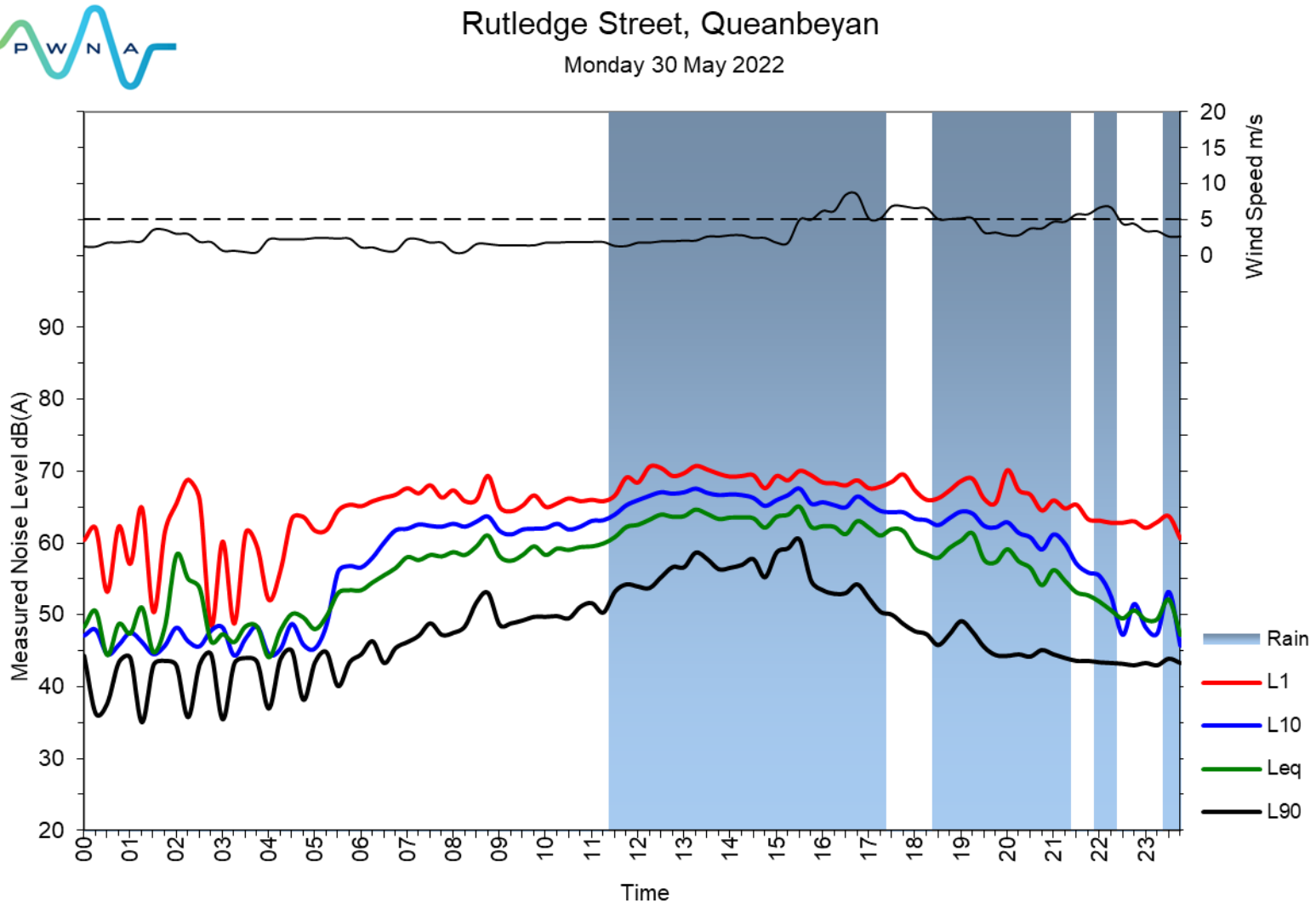

Rutledge Street, Queanbeyan
Wednesday 25 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

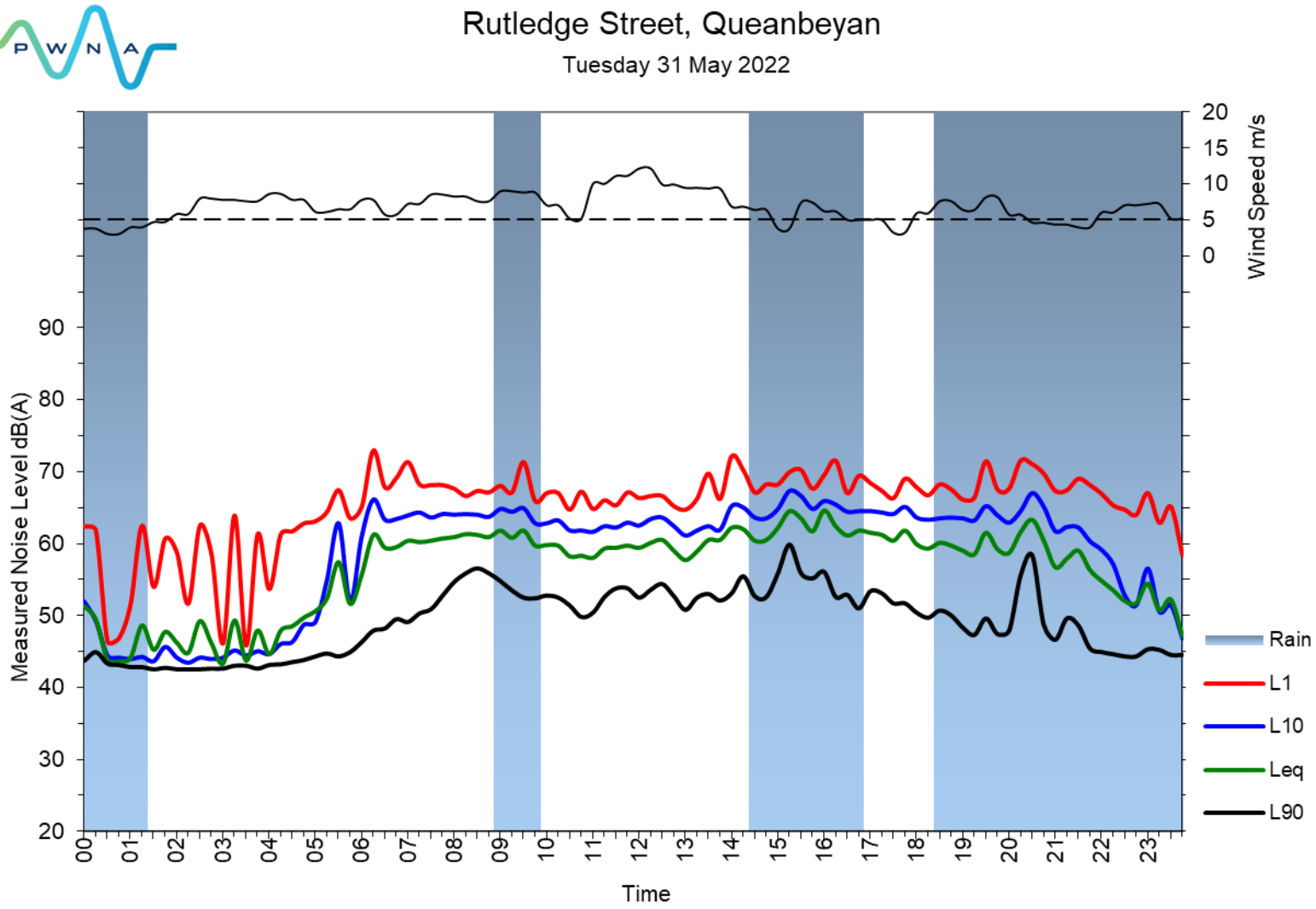

Rutledge Street, Queanbeyan
Thursday 26 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

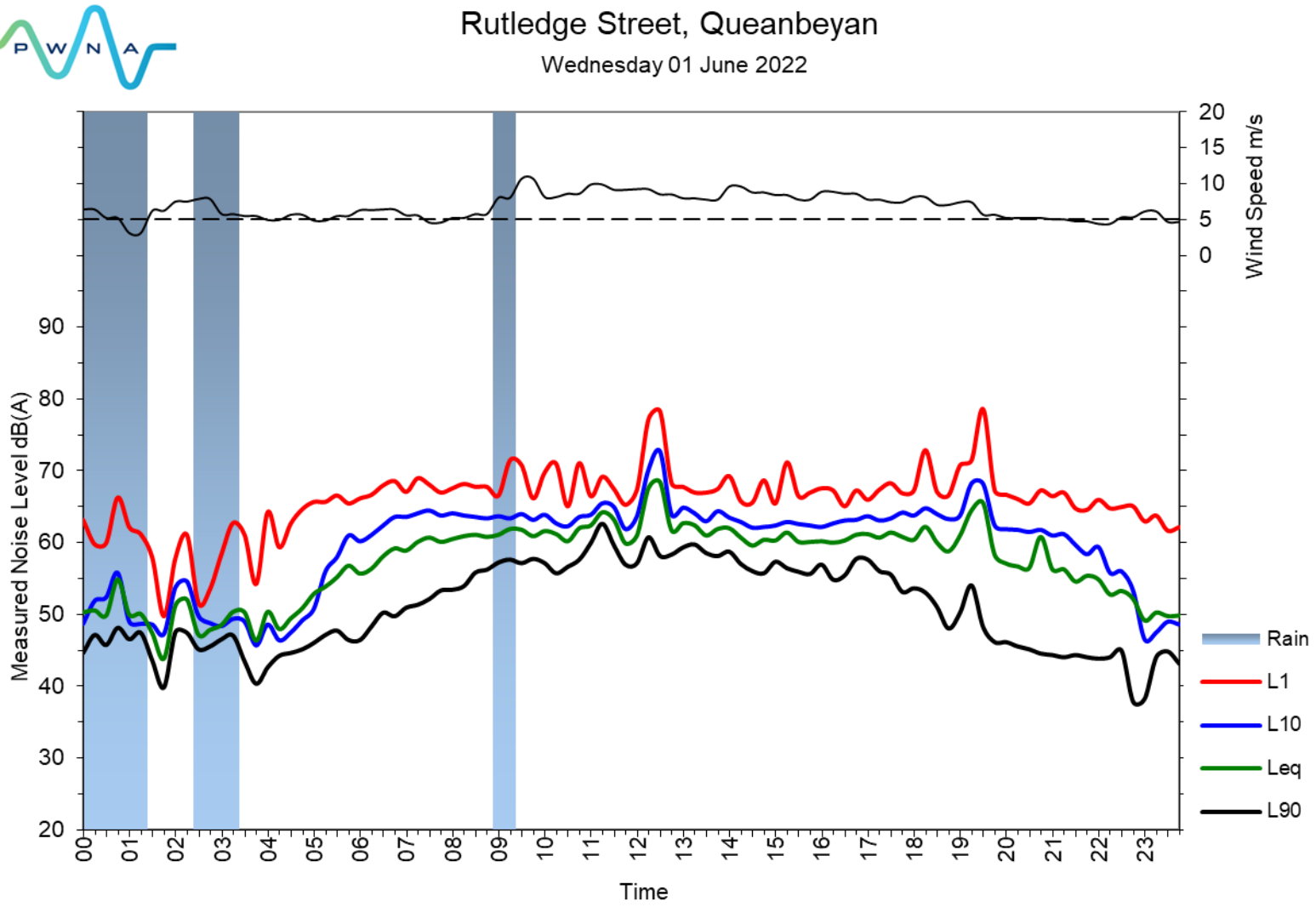

Rutledge Street, Queanbeyan
Friday 27 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

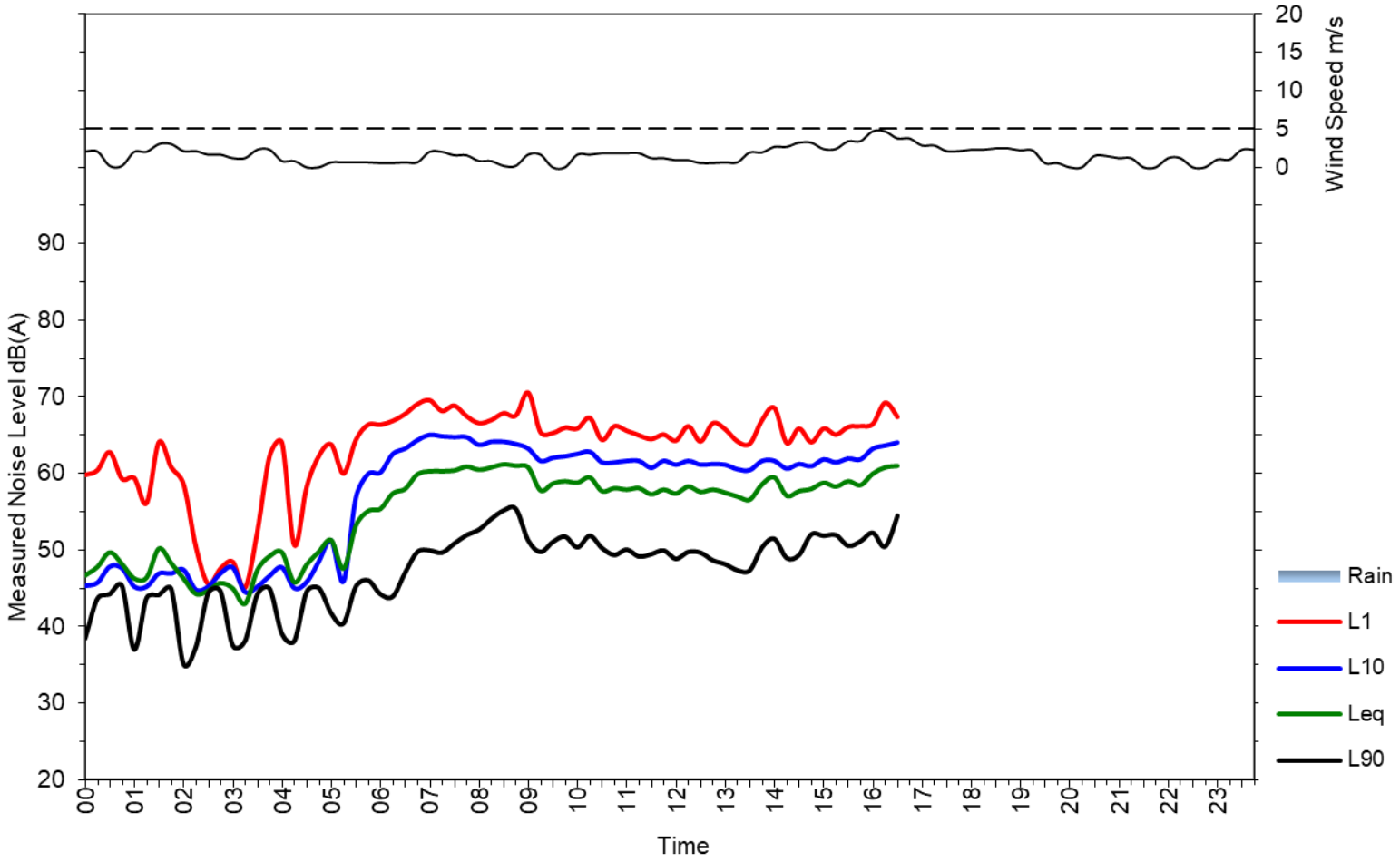

Rutledge Street, Queanbeyan
Saturday 28 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Sunday 29 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Monday 30 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Tuesday 31 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Wednesday 01 June 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Thursday 02 June 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

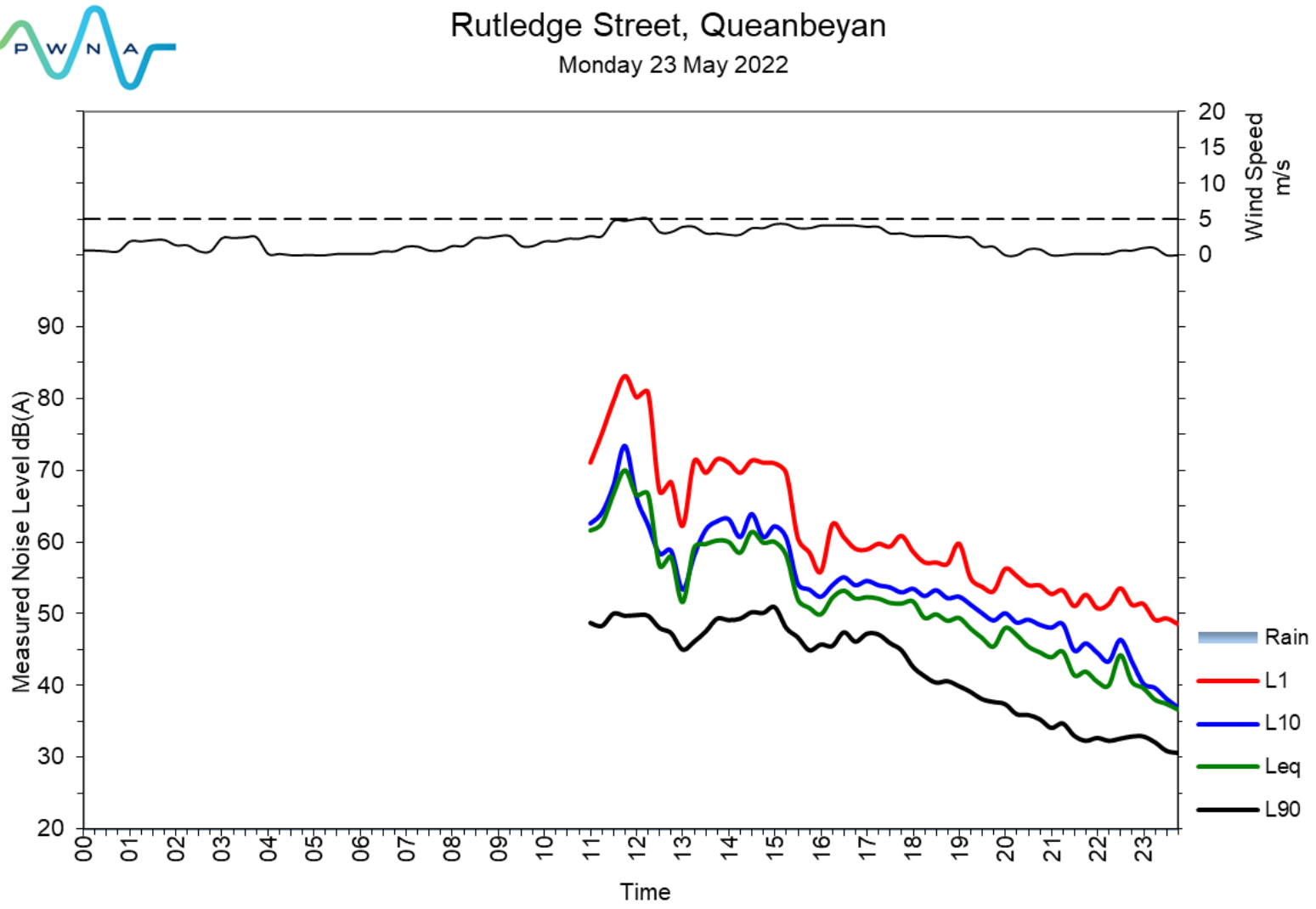
APPENDIX C: UNATTENDED NOISE MONITORING RESULTS – LOCATION 2 (REAR OF SITE)

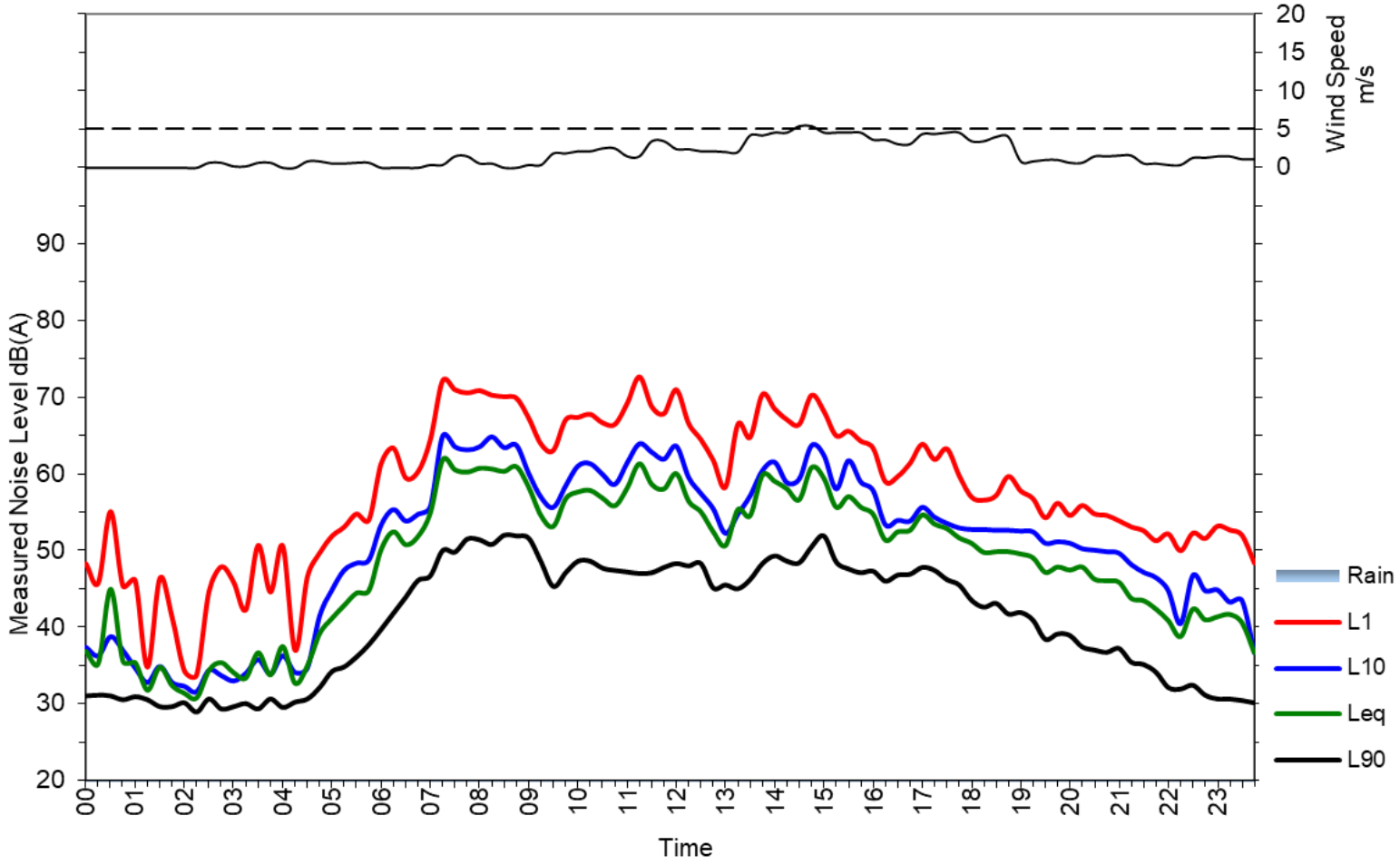
Weather Station: Canberra Airport

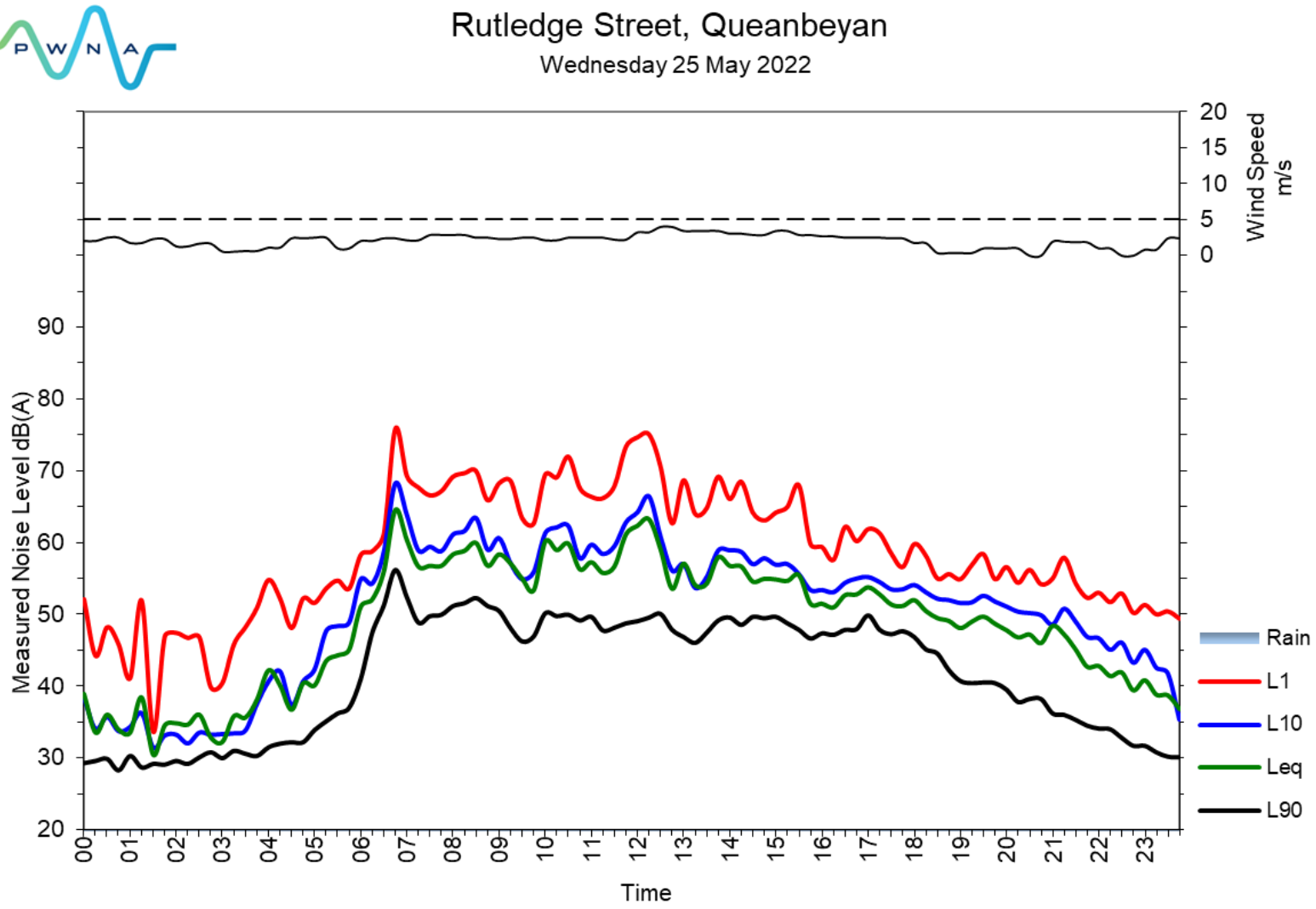
Weather Station ID: 70351

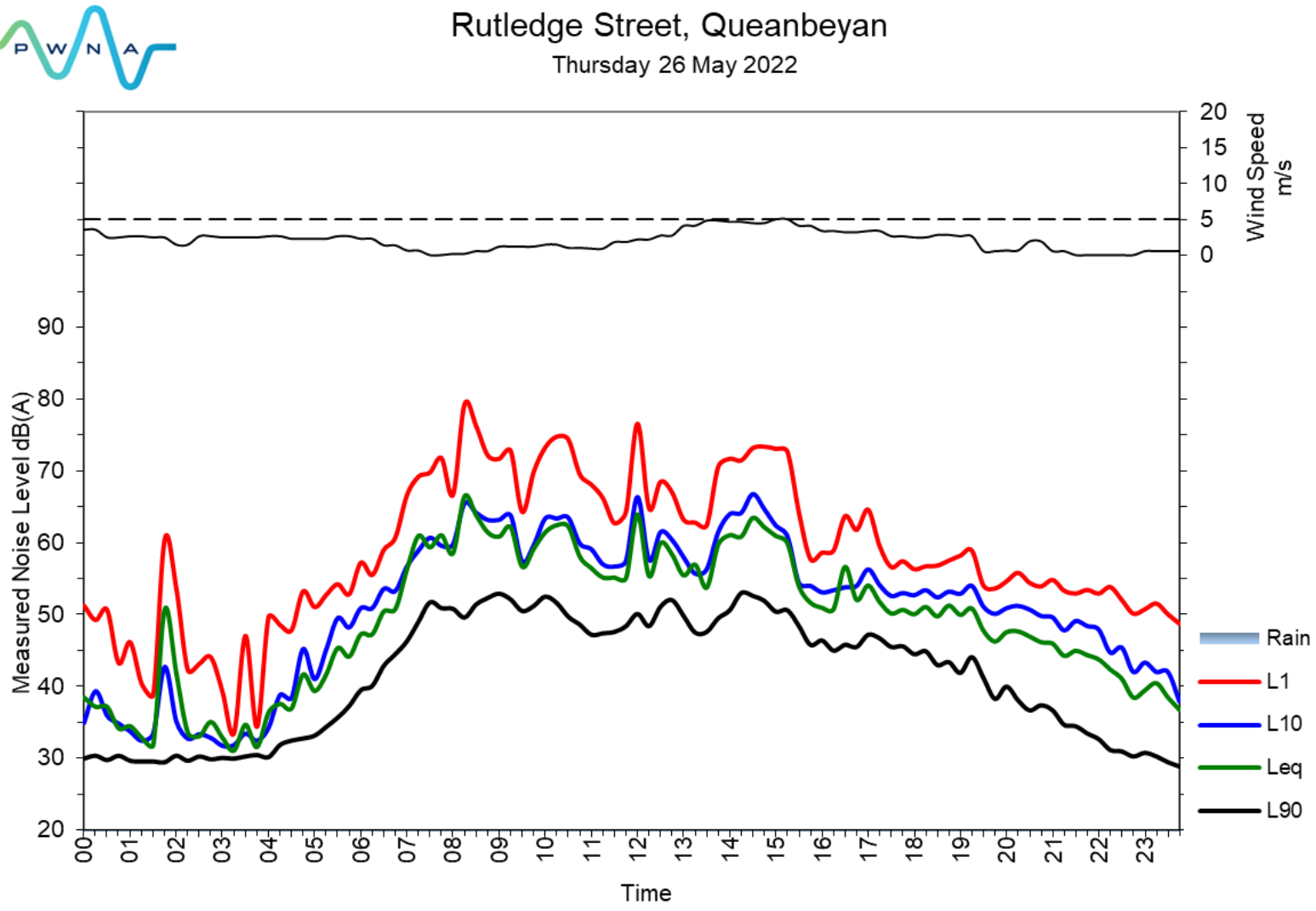
Co-ordinates: Lat: -35.3088°S, Lon: 149.2004°E, Height: 578.0 m (AMSL)

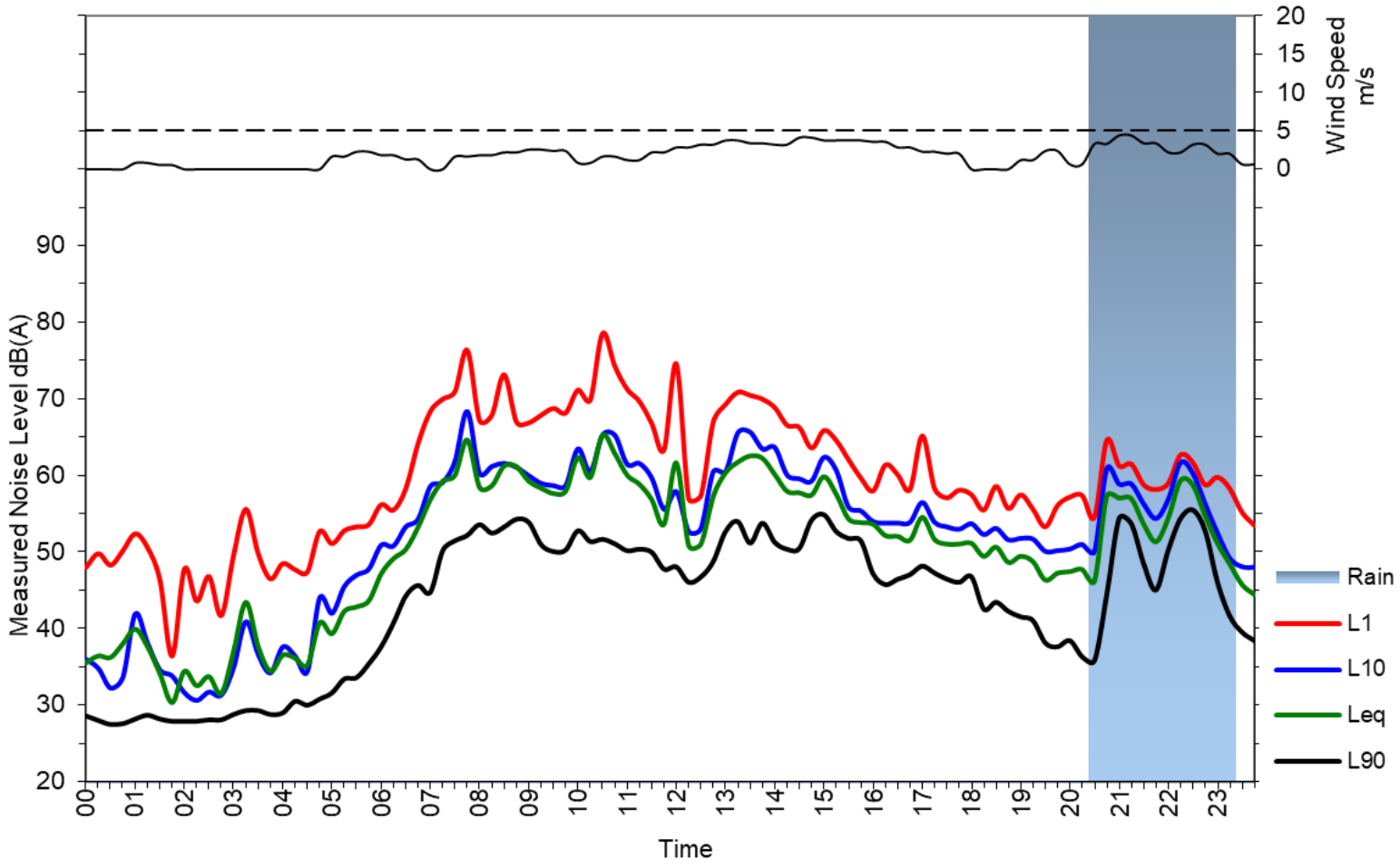
Figure 7 Noise Monitor Install Photo – Rear of Site

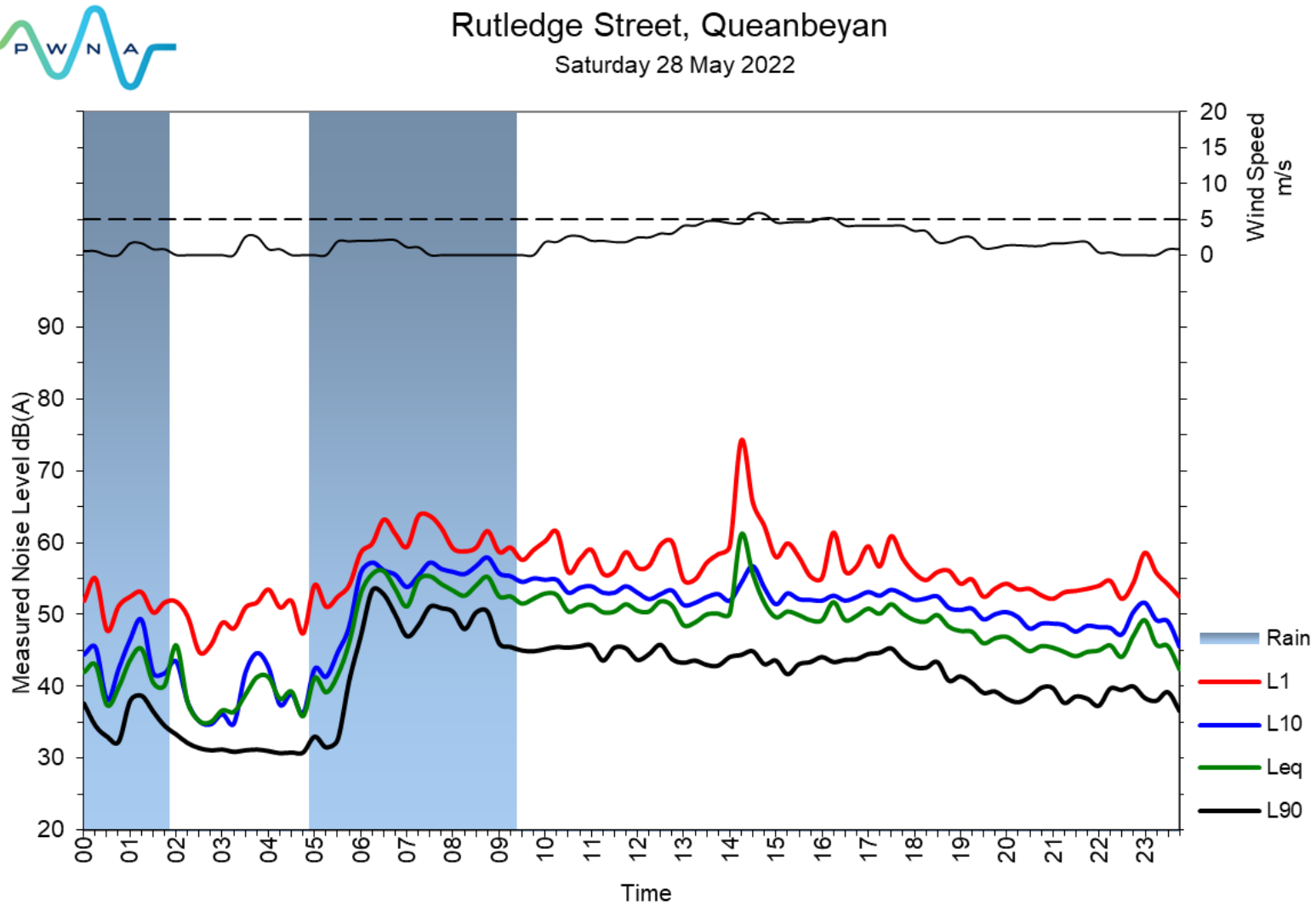

Rutledge Street, Queanbeyan
Monday 23 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

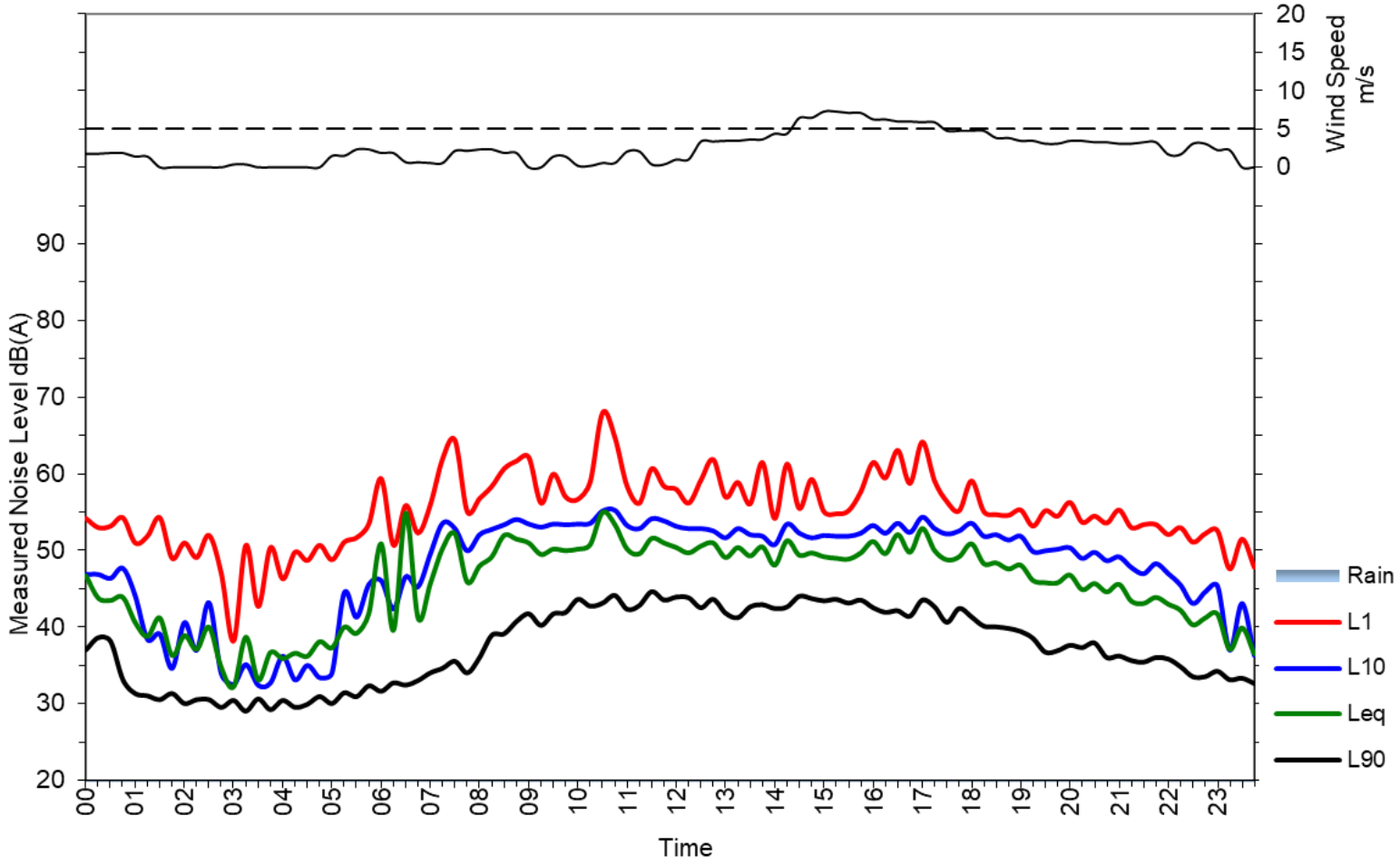

Rutledge Street, Queanbeyan
Tuesday 24 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

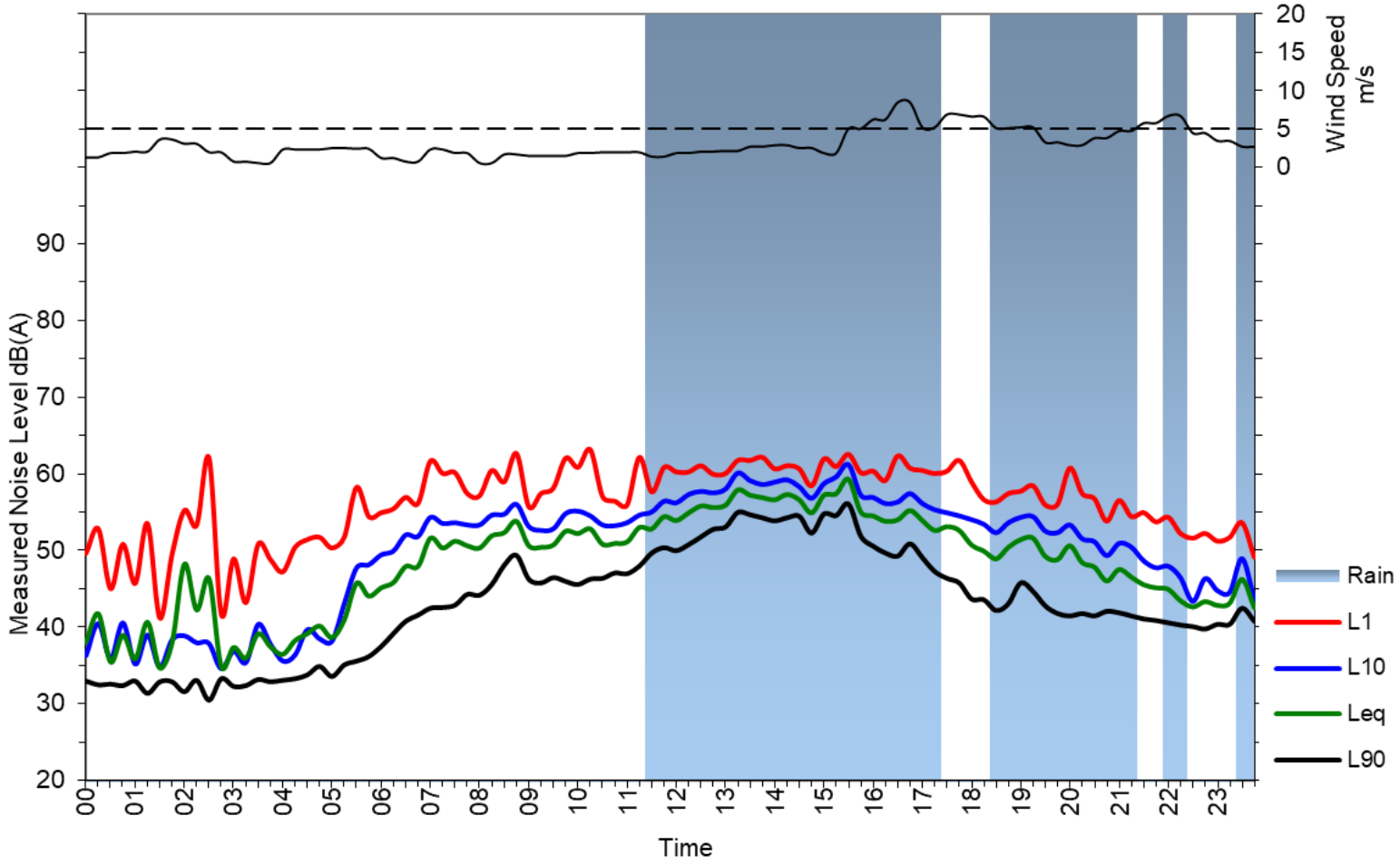

Rutledge Street, Queanbeyan
Wednesday 25 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

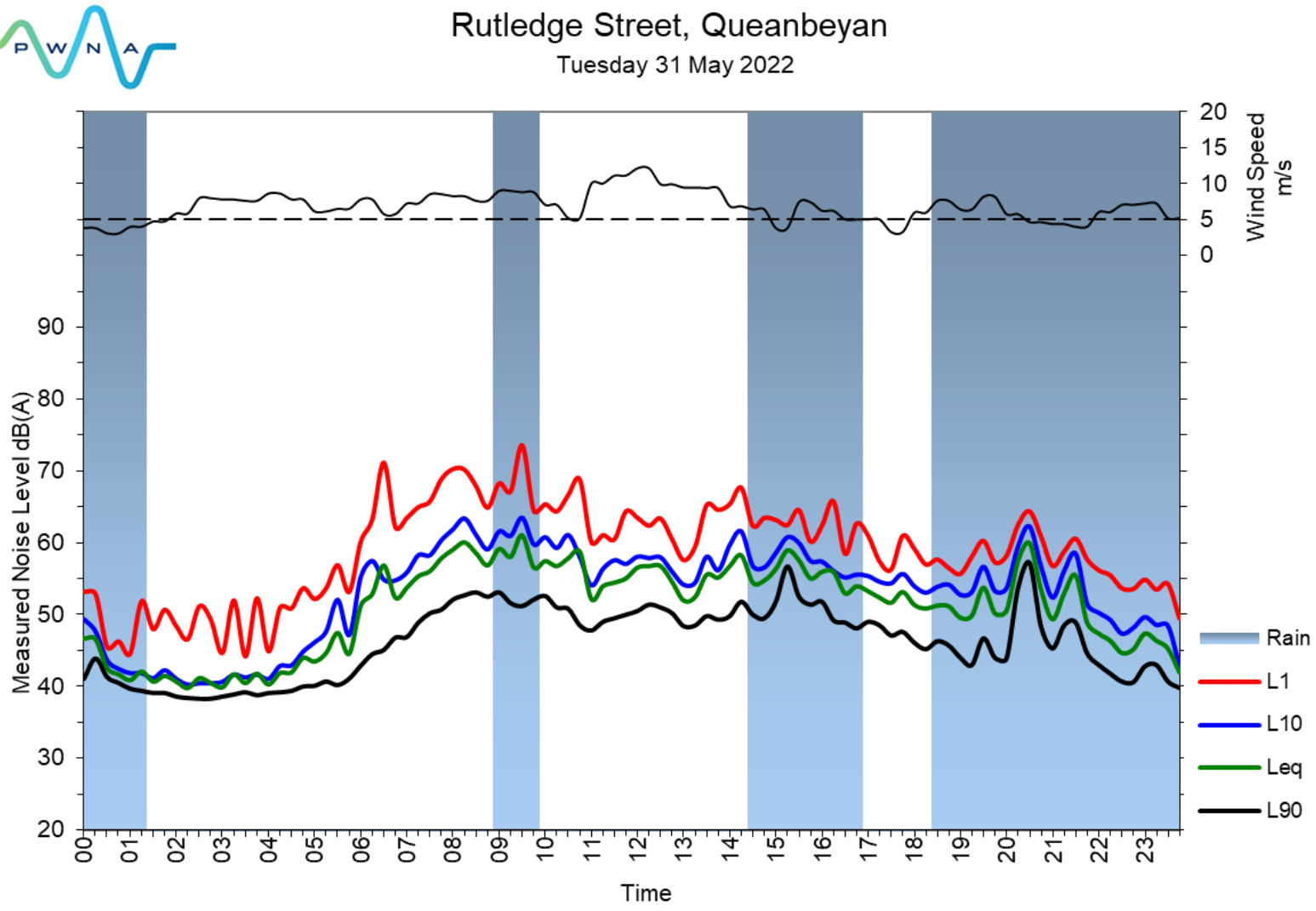

Rutledge Street, Queanbeyan
Thursday 26 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

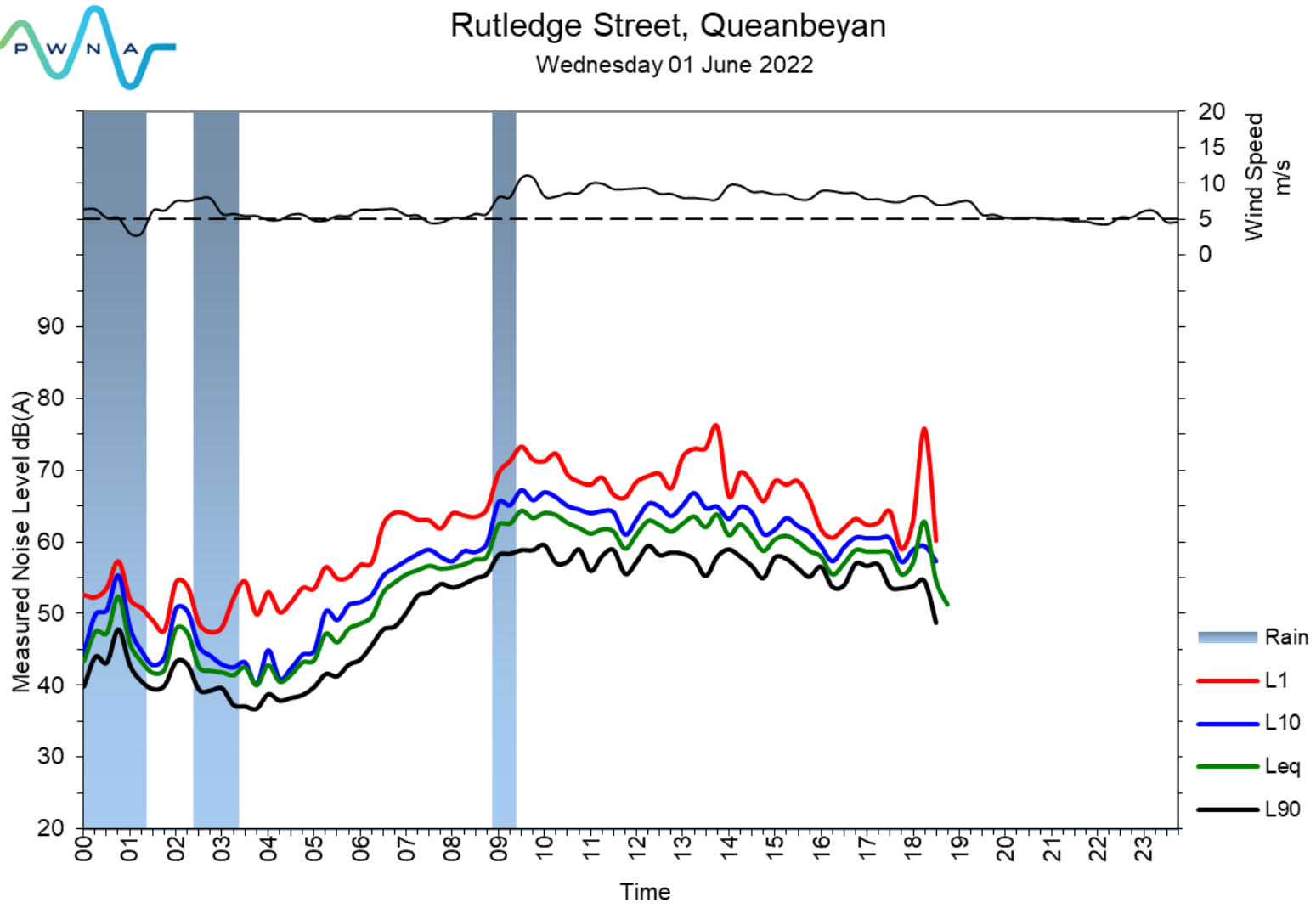

Rutledge Street, Queanbeyan
Friday 27 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Saturday 28 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Sunday 29 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Monday 30 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Tuesday 31 May 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Rutledge Street, Queanbeyan
Wednesday 01 June 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90