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16 Wyatt Avenue, Belrose – Boarding House Development

Noise Impact Assessment

Northern Beaches Essential Services Accommodation Pty Ltd

Report number: 210354 - 16 Wyatt Avenue, Belrose Boarding House Development - DA Acoustic Assessment - R5
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TABLE OF CONTENTS

TABLES

FIGURES

1 INTRODUCTION

Pulse White Noise Acoustics Pty Ltd (PWNA) has been engaged by Northern Beaches Essential Services Accommodation Pty Ltd to undertake an acoustic assessment of the proposed Boarding House development to be located at 16 Wyatt Avenue, Belrose NSW 2085.

The assessment looks at the potential noise intrusion impacts on the development and noise emissions on nearby receivers from mechanical plant and communal areas. This report will discuss the 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.

Noise intrusion into the development will be controlled by the requirements of the Australian / New Zealand Standard AS/NZS 2107:2016 *Acoustics–Recommended design sound levels and reverberation times for building interiors*.

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 the NSW EPA Noise Policy for Industry 2017.

1.2 Proposed Development

The Development Application (DA) proposes to construct a multi-level Boarding House development with the following areas contained within two separate buildings:

Lower Building (North)

- Two (2) storeys and basement car park.
- 32 boarding rooms (each room includes an ensuite)
- 20 car parking spaces, 2 External Visitor Spaces, 8 motor bike spaces, and 32 racks for bicycles
- Two internal common areas and two common outdoor terraces on Ground floor
- Two internal common areas and one common outdoor terrace on First floor

Upper Building (South):

- Three (3) storeys and basement car park.
- 22 boarding rooms (each room includes an ensuite)
- 1 manager's room (room includes ensuite)
- 11 car parking spaces, 5 motor bike spaces, and 23 racks for bicycles
- An internal communal room on Lower Ground floor
- An internal common area and common outdoor terrace on Ground floor

This report has been undertaken using the proposed architectural drawings from Platform Architects with job number WAB2 with revision DA04 and dated 8/12/21.

1.3 Site Description

The project site is located at 16 Wyatt Avenue, Belrose NSW 2085. The surrounding area is a combination of residential, rural, school and electricity substation.

Located along the eastern and western boundaries of the site are residential dwellings on large lots of land. Located across Wyatt Avenue to the south are a series of residential dwellings.

The nearest sensitive receivers to the site have been identified below.

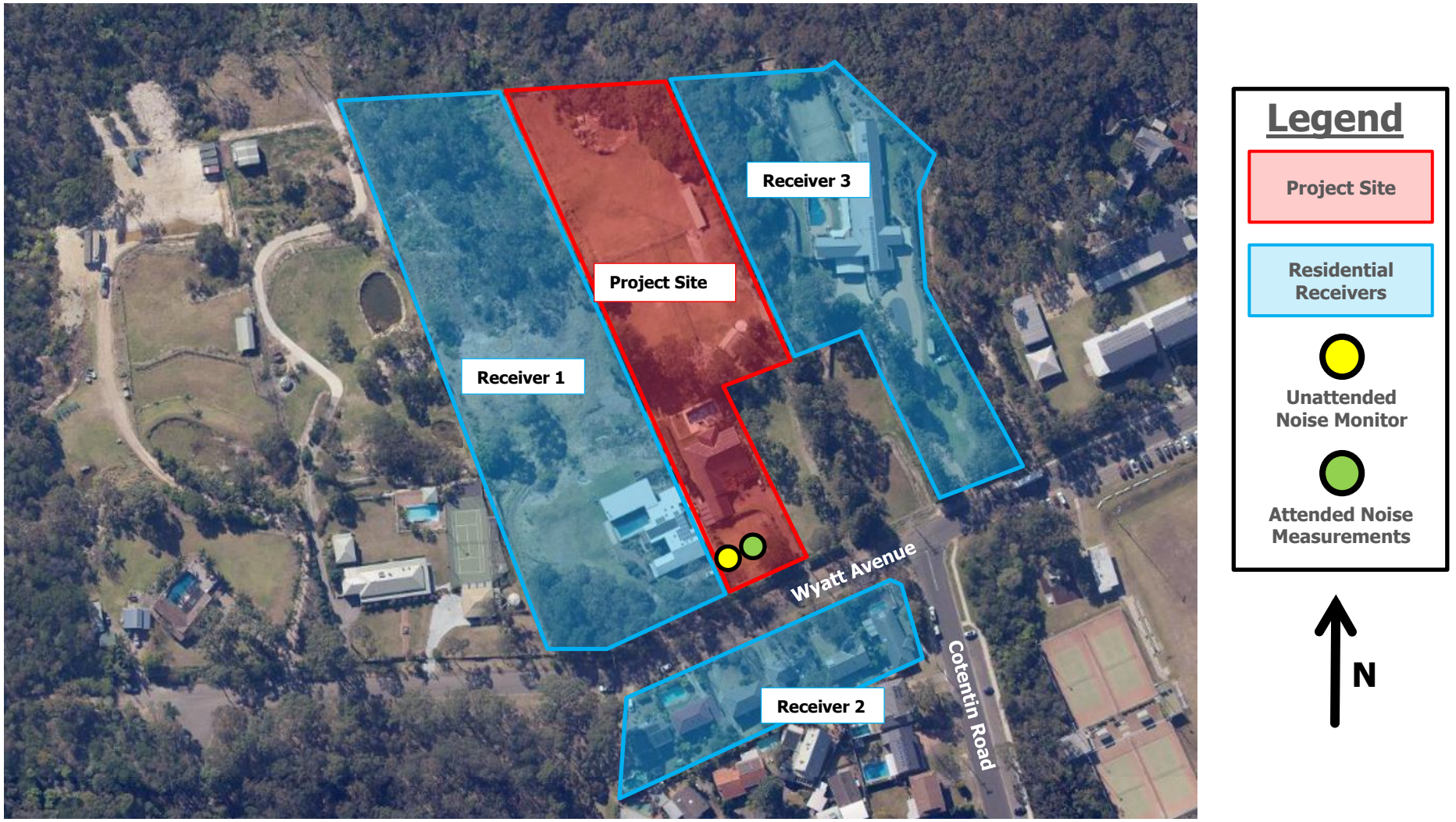
Receiver 1: Residential dwelling situated along the western boundary of the site, located at 18 Wyatt Avenue, Belrose NSW 2085.

Receiver 2: Residential dwellings situated across Wyatt Avenue to the south of the site located at 11-21 Wyatt Avenue, Belrose NSW 2085.

Receiver 3: Residential dwelling situated along the eastern boundary of the site, located at 10 Wyatt Avenue, Belrose NSW 2085.

A map showing the site location and all measurement locations, as well as nearest receivers, is provided in Figure 1 below.

Figure 1 Site Map, Measurement Locations and Surrounding Receivers – Sourced from SixMaps NSW



2 ACOUSTIC SURVEY

Measured noise levels from the unattended noise survey are outlined below.

2.1 Unattended Noise Monitoring

As part of this assessment an acoustic survey of the existing acoustic environment at the site and surrounding receivers was undertaken. An unattended noise survey was conducted between Monday 2nd August 2021 and Monday 9th August 2021 at the location shown in Figure 1 above. Namely, the unattended noise monitor was positioned near the southern boundary of the project site. This survey was conducted in order to measure the existing ambient noise level which is representative of the nearest noise affected receivers. 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. Meteorological information has been obtained from the Terrey Hills weather station (ID 066059).

Instrumentation for the survey comprised one RION NL-42 type noise monitor with serial number 00998079. Calibration of the logger 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. The charts present each 24-hour period and show the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15-minute periods. This data has been filtered to remove periods affected by adverse weather conditions based on weather information.

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 have 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 Observatory Hill weather station.

Table 1 Measured Ambient Noise Levels Corresponding to EPA Noise Policy for Industry Assessment Time Periods

Measurement Location	Daytime[1]		Evening[1]		Night-time[1]	
	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)
16 Wyatt Avenue, Belrose – Southern boundary, front lawn	36	53	30	44	30[4]	44

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_{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 4: L_{A90} noise level during the night-time period is equal to the recommended minimum noise level adopted by the NSW EPA NPI.

2.2 Calculated L_{Aeq} Noise Levels at Future Façades (Noise Intrusion)

In determining the required construction for the future building envelope, contributing L_{Aeq} noise levels from surrounding roads to each future façade need to be determined. Utilising the difference between the 15-minute interval and overall period results, the calculated noise levels at each façade are determined below. Where applicable, angle of view and distance corrections have also been applied.

Table 2 Predicted Noise Levels at Future Façades

Prediction Location	Predicted Façade Noise Level $L_{Aeq\ (Period)}$ [1] (dBA)			
	Daytime (7:00am-10:00pm)		Night-time (10:00pm-7:00am)	
	$L_{Aeq\ (Whole\ Period)}$	$L_{Aeq\ (1\ Hour)}$	$L_{Aeq\ (Whole\ Period)}$	$L_{Aeq\ (1\ Hour)}$
Future Southern Façade (Along Wyatt Avenue)	50	54	44	49
Future Eastern Façade	46	50	40	45
Future Western Façade	46	50	40	45

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.

3 ACOUSTIC CRITERIA

The acoustic criteria which have been adopted for this assessment are outlined below. All criteria have been separated into; *Noise Intrusion* (Assessment of building envelope), *Noise Emissions* (Assessment of noise to surrounding receivers) or *Acoustic Separation* (Assessment of noise 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 Warringah Development Control Plan (DCP) 2011

The subject site falls under Warringah DCP 2000. As Warringah DCP 2000 has no noise requirements, we have used Warringah DCP 2011 as a reference only. Following a review of the current Warringah Development Control Plan (DCP) 2011, we note that the document does not contain any applicable building envelope acoustic criteria for residential developments. As such, in the absence of any applicable requirements, objectives listed in AS/NZS standard below will be adopted.

3.1.2 Australian and New Zealand Standard AS/NZS 2107:2016 Acoustics– Recommended design sound levels and reverberation times for building interiors

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 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 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.

Table 3 AS2107 Design Sound Levels for Different Occupancies

Type of occupancy/activity	Design Sound Level Range $L_{Aeq\ (Period)}$ [1] (dBA)	Time Period
Apartment common areas (e.g., foyer, lift lobby)	45 to 50	Anytime
Residential - Living areas	30 to 40	Anytime
Residential - Sleeping areas (night-time)	30 to 35	Night-time
Toilets	45 to 55	Anytime

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.

3.2 Noise Emission 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 mechanical services and communal areas.

3.2.1 Warringah Development Control Plan (DCP) 2011

The subject site falls under Warringah DCP 2000. As Warringah DCP 2000 has no noise requirements, we have used Warringah DCP 2011 as a reference only. Section *D3 Noise* of the Warringah Development Control Plan (DCP) 2011 relates to noise emissions from the use of the site. This section of the DCP specifies the following:

D3 Noise

Objectives

- *To encourage innovative design solutions to improve the urban environment.*
- *To ensure that Noise emission does not unreasonably diminish the amenity of the area or result in Noise intrusion which would be unreasonable for occupants, users or visitors.*

Requirements

1. *Noise from combined operation of all mechanical plant and equipment must not generate Noise levels that exceed the ambient background Noise by more than 5dB(A) when measured in accordance with the NSW Industrial Noise Policy at the receiving boundary of residential and other Noise sensitive land uses.*

See also NSW Industrial Noise Policy Appendices

2. *Development near existing Noise generating activities, such as industry and roads, is to be designed to mitigate the effect of that Noise.*
3. *Waste collection and delivery vehicles are not to operate in the vicinity of residential uses between 10pm and 6am.*
4. *Where possible, locate Noise sensitive rooms such as bedrooms and private open space away from Noise sources. For example, locate kitchens or service areas closer to busy road frontages and bedrooms away from road frontages.*
5. *Where possible, locate noise sources away from the bedroom areas of adjoining dwellings/properties to minimise impact.*

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 recently 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 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.

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 dB(A). 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).

3.2.2.3 Area Classification

The NSW NPI characterises the "Suburban Residential" noise environment 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 characteristics:

- Evening ambient noise levels defined by the natural environment and activity.

For residential and non-residential receivers in a suburban residential area, the recommended amenity criteria are shown in Table 4 below.

When the existing noise level from industrial noise sources is close to the recommended "Amenity Noise Level" (ANL) given below, 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 4 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)
Residence	Suburban	Day	55
		Evening	45
		Night	40
Commercial		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 Project Trigger Noise Levels

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

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

Location	Time of Day [1]	Project Amenity Noise Level, $L_{Aeq, period}$ (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [2] (dBA)	Measured $L_{Aeq, period}$ Noise Level (dBA)	Intrusive $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)	Amenity $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)
Residential Receivers	Day	50	36	53	**41**	53
	Evening	40	30	44	**35**	43
	Night	35	30[4]	44	**35**	38
Commercial Receivers	When in use	60	N/A	N/A	N/A	**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: L_{A90} Background Noise or Rating Background Level.

Note 3: Project Noise Trigger Levels are shown in bold and underlined.

Note 4: L_{A90} noise level during the night-time period is equal to the recommended minimum noise level adopted by the NSW EPA NPI.

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 6 below.

Table 6 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

4 ACOUSTIC ASSESSMENT

4.1 Road Traffic Noise Intrusion

The results of the monitoring that provides the façade noise levels of the proposed building are presented in Table 2. The relevant noise intrusion criterion relating to AS 2107 are summarised in Table 7 below, together with the monitored external noise levels and the predicted noise levels on the eastern and western building facades.

Table 7 Summary of Façade Noise Levels and Relevant Assessment Criteria

Facade Location		Day Time [1, 2] (dBA)		Night Time [1, 2] (dBA)	
		$L_{Aeq\ (Whole\ Period)}$	$L_{Aeq\ (1\ Hour)}$	$L_{Aeq\ (Whole\ Period)}$	$L_{Aeq\ (1\ Hour)}$
Measured/Predicted Noise Levels					
Future Southern Façade (Along Wyatt Avenue)		50	54	44	49
Future Eastern Façade		46	50	40	45
Future Western Façade		46	50	40	45
Noise Criteria Applicable (All Facades)					
Apartment common areas	AS 2107 – Anytime	**45 to 50 (anytime)**			
Living areas	AS 2107 – Anytime	**40**		N/A	
Sleeping areas	AS 2107 – Night-time	N/A		**35**	
Commercial	AS 2107 - Anytime	**<50**		N/A	

Note 1: Daytime 7:00 am – 10:00 pm; Night-time 10:00 pm – 7:00 am.

Note 2: For internal noise level criteria which are presented as a range, compliance is determined based on the highest level in the range.

4.1.1 Glazing Recommendations

The recommended sound transmission loss requirements required to satisfy the specified internal noise level criteria outlined above are summarised in Table 8 below.

Please note these recommendations are also based on the floor details shown in the architectural drawings included in Appendix C.

Table 8 In-principle Glazing Recommendations

Location	Occupancy Area [1]	Minimum Glazing System Rating Requirements	Indicative Construction [2, 3]
Future Southern Façade (Along Wyatt Avenue)	Sleeping Areas	Rw (C;Ctr): 27 (0;-3)	Windows with min. 5mm float glass.
	Living Areas	Rw (C;Ctr): 27 (0;-3)	Windows with min. 5mm float glass.
Future Eastern Façade	Sleeping Areas	Rw (C;Ctr): 27 (0;-3)	Windows with min. 5mm float glass.
	Living Areas	Rw (C;Ctr): 27 (0;-3)	Windows with min. 5mm float glass.
Future Western Façade	Sleeping Areas	Rw (C;Ctr): 27 (0;-3)	Windows with min. 5mm float glass.
	Living Areas	Rw (C;Ctr): 27 (0;-3)	Windows with min. 5mm float glass.

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

Please note 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

If external wall constructions are constructed either from existing concrete or masonry construction 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.

Any light-weight external plasterboard walls should be constructed from a construction with a minimum acoustic performance of Rw 50.

4.1.3 External Roof Construction

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

1. Concrete external roof construction – no additional treatments required.

2. Light Weight Construction – Install an acoustic insulation within the external roof/ceiling cavity similar to a 75 mm thick 14 kg/m^3 insulation.

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 External Openings 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 ductwork behind mechanical service openings/grills, treatments to ventilation opening and the like.

4.2 Noise from Engineering Services

Detailed selections of the proposed mechanical plant and equipment to be used on the site, and the exact location of key plant items, 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 – location of fans within the building and treated using internally lined ductwork or acoustic silencers.
- 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 be located within the basement, on balconies, or on the roof-top. 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.

4.3 Noise from Communal Areas (Internal and External Spaces)

Noise associated with communal areas is not well addressed in NSW. Both the Warringah DCP and the NSW EPA *Noise Policy for Industry* do not address noise from communal areas. As such, to ensure the acoustic amenity is reasonably maintained for the existing surrounding developments, PWNA believe that an RBL + 5dBA as a L_{Aeq} approach is considered acceptable. Adoption of a background + 5 approach is similar to the criteria typically adopted in the assessments of external areas of a licensed venue during the daytime period (note: NSW Liquor and Gaming use a L_{10} rather a L_{Aeq}).

The proposed development has the following main communal areas spread across both the Upper and Lower buildings:

- Lower Building (North):
    - Two internal common areas and two common outdoor terraces on Ground floor
    - Two internal common areas and one common outdoor terrace on First floor
- Upper Building (South):
    - An internal communal room on Lower Ground floor
    - An internal common area and common outdoor terrace on Ground floor

4.3.1 Assessment of Communal Areas

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

- Single person talking – 69dBA L_{Aeq}.
- Background music (for internal areas only) – 65dBA L_{Aeq}.

Predicted noise levels associated with the communal areas are addressed in the table below. The predictions below have been determined based on the following assumptions:

- Permitted use of the external communal areas is to include the hours of 7:00am-12:00am Monday to Saturday and 8:00am-12:00am on Sundays and Public Holidays.
- The windows to the common area can be open during periods of normal use for general activities such as cooking and the like. In the event the space is to be used for high noise activities, such as the playing of amplified music or the like, the external windows and doors of the internal communal areas are recommended to be closed between 10:00pm-7:00am Monday to Saturday and 10:00pm-8:00am on Sundays and Public Holidays. This is similar to the use of typical residential areas such that noise from the use of a dwelling is mitigated as part of being part of a neighbourhood.
- The external communal area on ground level of the Lower Building will have no more than twenty (20) people utilising the space at any one time with an assumption that one in two are speaking in conversation. The external communal area on ground level of the Upper Building will have no more than ten (10) people utilising the space at any one time with an assumption that one in two are speaking in conversation.
- All internal communal areas are to have a glazing construction of 6.38mm Laminate with a Rw (C;Ctr): 30 (0;-3).
- Continuous glazed/solid acoustic screens must be installed to a height of 1,800mm above the finished floor level on any exposed side of an outdoor communal area that faces another building where the building is within 20m of the exposed side.

Predicted noise levels from the use of the internal communal areas all comply with the requirements listed above provided the façade construction installed provides an approximate 25 dB reduction (with a 6.38mm Laminate, for example).

Noise levels predicted from the use of the external communal areas are provided in the table below.

Table 9 Predicted Noise Levels from the use of External Communal Areas

Receiver [1]	External Communal Area / Assessment Point on Receiver Property	Predicted Noise Level $L_{Aeq(15\text{-}min)}$ (dBA)	Criteria [2] $L_{Aeq(15\text{-}min)}$ (dBA)	Compliance?
Receiver 1: 18 Wyatt Avenue, Belrose NSW 2085	**Upper Building** - Ground floor common outdoor terrace / Eastern Façade	34	41 (Daytime) 35 (Evening Time)	Yes. See recommendations below in Section 4.3.2.
Receiver 3: 10 Wyatt Avenue, Belrose NSW 2085	**Lower Building** - Ground floor common outdoor terrace / Western Façade	31	41 (Daytime) 35 (Evening Time)	Yes. See recommendations below in Section 4.3.2.

Note 1: Refer to Figure 1 for detailed receiver locations.
Note 2: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm.

4.3.2 Communal Area Acoustic Treatments

From our assessment shown above, operation of each of the internal and external communal spaces is determined based on a compliant level at the nearest receivers.

To ensure compliance, the following treatments are recommended:

- Permitted use of the external communal areas is to include the hours of 7:00am-12:00am Monday to Saturday and 8:00am-12:00am on Sundays and Public Holidays.
- The windows to the internal communal areas can be open during periods of normal use for general activities such as cooking and the like during all periods of the day, evening and night =. In the event the space is to be used for high noise activities, such as the playing of amplified music or the like, the external windows and doors of the internal communal areas are recommended to be closed between 10:00pm-7:00am Monday to Saturday and 10:00pm-8:00am on Sundays and Public Holidays. This is similar to the use of typical residential areas such that noise from the use of the internal communal areas is mitigated as part of being part of a neighbourhood.
- The external communal area on ground level of the Lower Building will have no more than twenty (20) people utilising the space at any one time with an assumption that one in two are speaking in conversation. The external communal area on ground level of the Upper Building will have no more than ten (10) people utilising the space at any one time with an assumption that one in two are speaking in conversation.
- All internal communal areas are to have a glazing construction of 6.38mm Laminate with a Rw (C;Ctr): 30 (0;-3).
- Continuous glazed/solid acoustic screens must be installed to a height of 1,800mm above the finished floor level on any exposed side of an outdoor communal area that faces another building where the building is within 20m of the exposed side.
- Continuous glazed/solid acoustic screens must be installed to a height of 1,800mm above the finished floor level on any exposed side of an outdoor communal area that faces another building where the building is within 20m of the exposed side.
- No playing of amplified music is to be undertaken on the external communal area. No external speakers should be included in the design and construction of the external areas.

- Use of the external ground of the project are to include the following:
    - No fixed speakers are to be included as part of the external grounds area.
    - Use of the external grounds is not to include the playing of amplified music for entertainment levels. That is music can be played for background levels only.
    - The use of the external grounds is to be used for normal residential activities including use by the dwellings of the building and their guests only. The use of the proposed external terraces would be required to be used by residential occupants exhibiting normal behaviour including a requirement to be "good neighbours" as applies within all residential areas. Details of these requirements are to be included in the relevant protocols and boarding house agreements.

4.4 Noise from Access Driveway

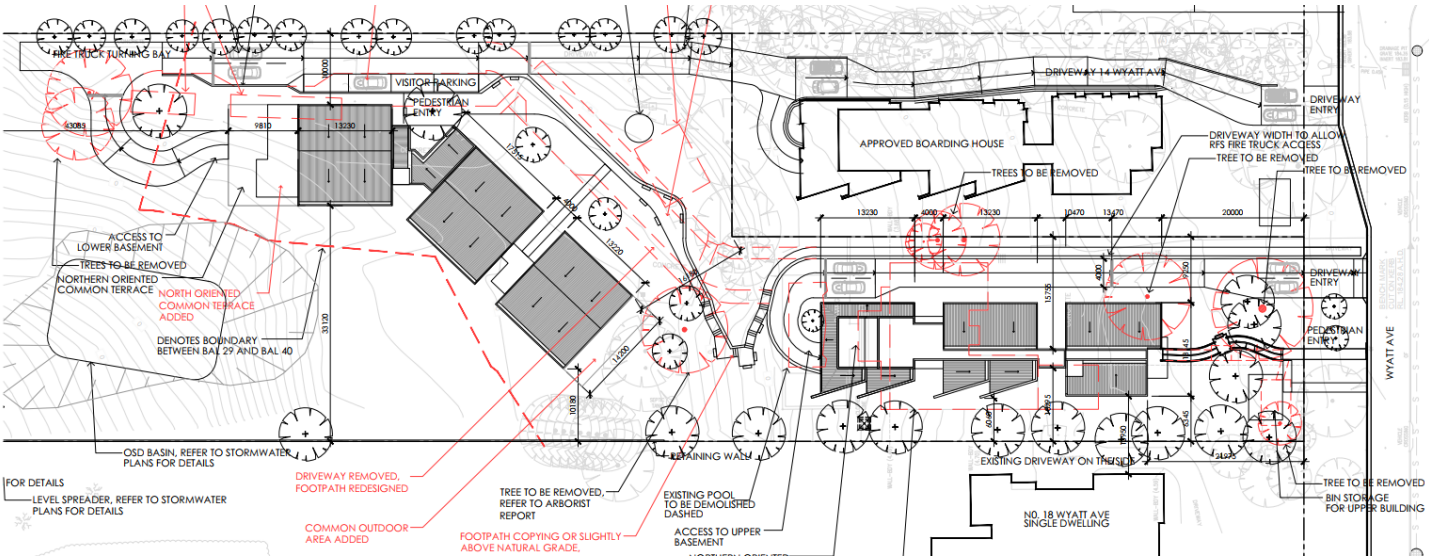
This section of the report details the assessment of potential noise impact resulting from the use of the access driveway from vehicles accessing the site. As part of the proposed development there is an accessway which allows for the movement of vehicles into the basement parking areas of the project. As part of the proposed development the following is proposed:

1. Upper Building – 11 car parking spaces.

2. Lower Building – 20 Car parking spaces.

The proposed site layout including the internal accessway is detailed in the figure below.

Figure 2 Details of the Proposed Access Way



Based on the proposed location of the access way the following characteristics are discussed:

1. The use of the access way by vehicles will include screening from the proposed upper building structure to the existing dwelling located to the south of the site at 18 Wyatt Avenue.

2. The exiting dwelling located at 10 Wyatt Avenue includes a significant distance separation based on the location of the building on site, including an approximate distance of 25m from the proposed boundary of the site.

A review of the NSW Legislation *Protection of the Environment Operations (Nosie Control) Regulation 2017* states the following:

> ***"Division 2 Motor vehicles that emit offensive or other noise***
> ***Use of motor vehicles on residential premises***
> *(1) A person is guilty of an offence if—*
> *(a) the person causes or permits a motor vehicle to be used on residential premises in such a manner that it emits noise that can be heard within any room in any other residential premises (that is not a garage, storage area, bathroom, laundry, toilet or pantry) whether or not any door or window to that room is open—*
> *(i) before 8 am or after 8 pm on any Saturday, Sunday or public holiday, or*
> *(ii) before 7 am or after 8 pm on any other day, and*
> *(b) within 7 days of doing so, the person is warned by an authorised officer or enforcement officer not to cause or permit a motor vehicle to be used on residential premises in that manner, and*
> *(c) the person again causes or permits a motor vehicle to be used on residential premises in that manner within 28 days after the warning has been given.*
> *Maximum penalty—100 penalty units in the case of a corporation or 50 penalty units in the case of an individual.*
> ***(2) A person is not guilty of an offence under this clause merely because noise is emitted from the motor vehicle while the motor vehicle is entering or leaving residential premises."***

Therefore, based on the current NSW Legislation, the noise associated with the entering or exiting of motor vehicles within the site is not deemed offensive and does not warrant any additional assessment.

In addition to the review of the policy above a number of acoustic mitigations are recommended to minimise the potential impacts of noise from the proposed vehicle movements on the site to surrounding receivers.

1. The *Plan of Management* for site includes the encouragement of lodgers to use public transport and bicycles such that motorised movements will be minimised.

2. There should not be any speed humps or uneven surfaces used for speed control.

3. Any required grates and drains should include fixings to prevent noise resulting from movement of surfaces.

Providing the proposed mitigations included above are included in the design and construction of the proposed development, the resulting noise emissions from the proposed development will be minimised and the resulting noise emissions will be acoustically acceptable.

4.4.1 Sleep Disturbance Assessment

In addition to the assessment detailed in the section above as assessment of potential sleep disturbance events from the use of the internal access way has been undertaken.

An accurate representation of sleep disturbance impacts on a community from a noise source is particularly difficult to quantify mainly due to differing responses of individuals to sleep disturbance – this is found even within a single subject monitored at different stages of a single night's sleep or during different periods of sleep.

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

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

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

The most recent NSW guidance in relation to sleep disturbance is contained in the NSW EPA's online *Application notes – NSW industrial noise policy*. For the purposes of this assessment a night-time sleep disturbance 'screening criterion' noise goal of RBL +15 dB(A) is applied.

The term 'screening criterion' indicates a noise level that is intended as a guide to identify the likelihood of sleep disturbance. While it is not a firm criterion to be met, where the criterion is met, sleep disturbance is not likely. When the screening criterion is not met, a more detailed analysis is required.

With regard to reaction to potential sleep awakening events, the RNP gives the following guidance:

> *'From the research on sleep disturbance to date it can be concluded that:*
> - *maximum internal noise levels below 50–55 dBA are unlikely to awaken people from sleep*
> - *one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly*

The EPA's *Industrial Noise Policy for Industry* (NPfI) and the *NSW Road Noise Policy (RNP)* includes suitable criteria for the assessment of potential sleep awakening events, which have been used as the basis of this report.

The NPfI includes the following commentary regarding possible sleep awakening events:

> ***2.5 Maximum noise level event assessment***
>
> *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:*
> - *LAeq,15min 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
> - *LAFmax 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*
>
> *A detailed maximum noise level event assessment should be undertaken.*
>
> *The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy.*

The RNP includes the following comments regarding sleep disturbance:

> *From the research on sleep disturbance to date it can be concluded that:*
> - *maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
> - *one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.*

Based on the NSW *Noise Policy for Industry* and the *Road Noise Policy* is a suitable assessment of intermittent noise impacts to protect the health and wellbeing of residential receivers from intermittent noise levels generated on the site.

Based on the relevant standards detailed above, a summary of the sleep disturbance noise level criteria is detailed in the following table.

Table 10 Sleep Disturbance Criteria

Type of Receiver	Location	Policy	Description	Background Noise level Night	Resulting Maximum Noise Level
Residential Receiver	External Noise levels	Noise Policy for Industry	The potential for sleep disturbance from maximum noise level events	30 dB(A) $L_{90,15min}$	$L_{Aeq,15min}$ 35 dB(A) Externally
					L_{AFmax} 45 dB(A) Externally
	Within the residential dwelling	Road Noise Policy	1 or 2 events unlikely to awaken people from sleep		65-70 dB(A) L_{max} Internally
			Maximum internal noise unlikely to awaken people from sleep		50-55 dB(A) L_{max} Internally

Based on the details included within the NPfI and the RNP, in the event a noise level of 45 dB(A) L_{max} or 35 $_{LAeq\ 15\ min}$ does not occur externally at the residential receiver as a result of the use of the operation of the property (internally within the residential receiver) then noise levels are *unlikely to awaken people from sleep,* and compliance with the requirements of the NPfI and the RNP regarding sleep disturbance would be achieved.

Based on the proposed use of the site, an assessment of potential for a sleep disturbance event has been undertaken for the use of the internal driveway area of the project. The assessment includes the potential for a maximum noise level from the proposed uses to the residential receivers within proximity to the site from a vehicle using the driveway. The sample calculation for potential maximum sleep disturbance noise levels are included below.

Table 11 Sleep Disturbance Noise Calculation to Residential Receiver – External Noise Levels

Descriptor	Noise Levels
Receiver Location	Residential Receivers
Maximum Noise Source	Car Pass By - 90 dB(A) L_{Amax}
Distance Correction	15m = -31 dB
Barrier Corrections for existing structures and buildings	-5 dB
Resulting external noise levels	54 dB(A) L_{max}
Maximum Noise Level Sleep Disturbance Level (external)	45 dB(A) L_{max}
Noise Level Compliance	**Stage 2 Assessment Required See Below**

Based on the predicted noise levels above, there are possible noise events which may exceed the maximum noise level '*screening test*' and, as a result, a future assessment of the possible *sleep awakenings* has been undertaken.

Table 12 Sleep Disturbance Noise Calculation to Residential Receiver – Internal Noise Levels

Descriptor	Noise Levels
Receiver Location	Residential Receivers
Maximum Noise Source	Car Pass By - 90 dB(A) L_{Amax}
Distance Correction	15m = -31 dB
Barrier Corrections for existing structures and buildings	-5 dB
Correctio for an Open Window	-4
Resulting external noise levels	50 dB(A) L_{max}
Maximum Noise Level Sleep Disturbance Level (external)	50-55 L_{max} – repetitive events 65-70 L_{max} – 1-2 events
Noise Level Compliance	**Stage 2 Assessment Required See Below**

Based on the results of the assessment detailed above, the resulting maximum noise level from the use of the internal driveway will comply with the relevant criteria for sleep disturbance based on the normal continuously occurring events on the site and will therefore be acoustically acceptable.

Based on the assessment of the noise from the proposed use of the driveway, traffic using the driveway from the Northern building to the road via the proposed boarding house at 14 Wyatt Ave will not have adverse effects on the amenity of the proposed boarding house dwellings within the building at 14 Wyatt Ave.

4.5 Additional Traffic Noise on Pubic Roadways

The site is located with access off Wyatt Avenue which carries existing traffic volumes including public buses and the like.

This section of the report details the assessment of future traffic noise on surrounding streets as a result of vehicles using the site.

The suitable noise criteria for the assessment of road traffic noise generated by vehicles using the site are set out in the NSW Government's NSW Road Noise Policy (RNP). Table 3 of the RNP standard details the assessment criteria to be applied at residences potentially impacted by additional traffic volumes based on the road category and land use. The relevant noise criteria is detailed in the table below.

Table 3 Road traffic noise assessment criteria for residential land uses

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

Note: Land use developers must meet internal noise goals in the Infrastructure SEPP (Department of Planning NSW 2007) for sensitive developments near busy roads (see **Appendix C10**).

In addition to the table above the RNP includes criteria for sites where existing noise levels exceed those levels detailed in the table above. Section 3.4.1 of the RNP *Process of applying the criteria* includes the following:

> *For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.*

In order to generate an increase of 2 dB on local road traffic noise, existing traffic volumes should increase by approximately 60%. Based on the location of the site, roads in close proximity to the site including Wyatt Avenue, the traffic volume generated by the development will be significantly less than 60% of the existing traffic flows on the exiting roadway.

Therefore, the expected increase on existing traffic noise levels from the site, due to the additional traffic generation, will be less than 2 dB on local roadways and will be 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 3.3.1 of this report.

5 CONCLUSION

Pulse White Noise Acoustics Pty Ltd (PWNA) has been engaged by Northern Beaches Essential Services Accommodation Pty Ltd to undertake an acoustic assessment of the proposed Boarding House development to be located at 16 Wyatt Avenue, Belrose NSW 2085. As part of this assessment, we have undertaken a review of the building envelope, noise emissions from the use of the site and 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 Section 3.1.

- To control noise impacts at external receivers, recommended indicative treatments for major engineering services have been provided in Section 4.1.3. From our review we have formulated the following opinion:

    - Details of the exact location and selection of all engineering services is not known at this stage of the project. A proof-of-concept assessment has been carried out based on our experience with similar types of developments and the typical plant items installed. 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. 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 comply with the requirements as listed in Section 3.2.

    - Noise impacts from the internal and external communal areas have been reviewed. On the proviso that the management and building controls outlined in Section 4.3 are installed or adhered to, noise levels from the use of the communal spaces will achieve the established target levels.

- 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.

As such, we believe that the proposal is acoustically acceptable and meets all the detailed acoustic criteria listed above.

Regards,

Alex Danon

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
dBA	*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 dBA. Practically all noise is measured using the A filter. The sound pressure level in dBA 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 dBA.
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Sound Pressure Level, LP 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, Lw 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.

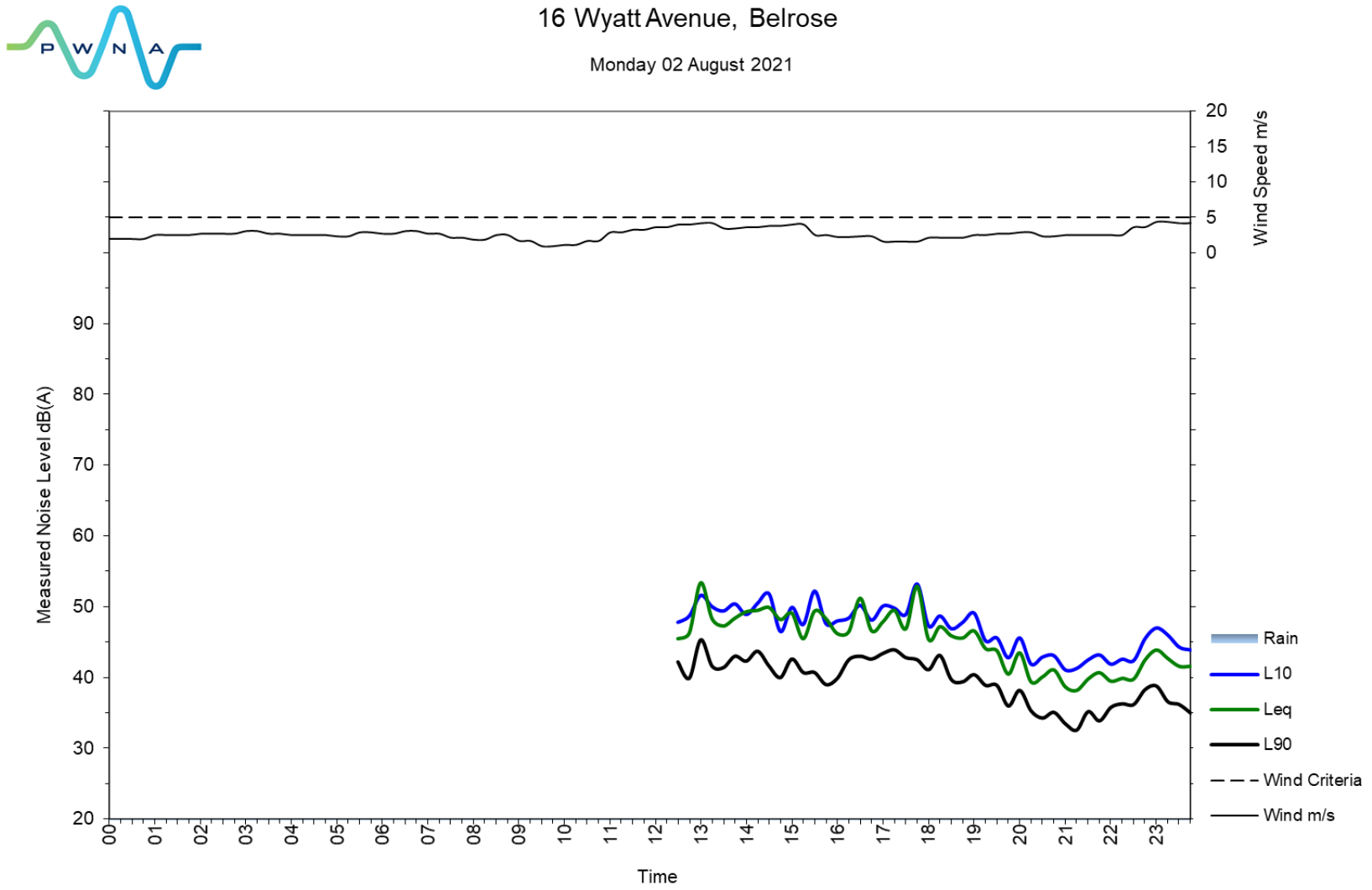
APPENDIX B: UNATTENDED NOISE MONITORING RESULTS – 16 WYATT AVENUE, BELROSE

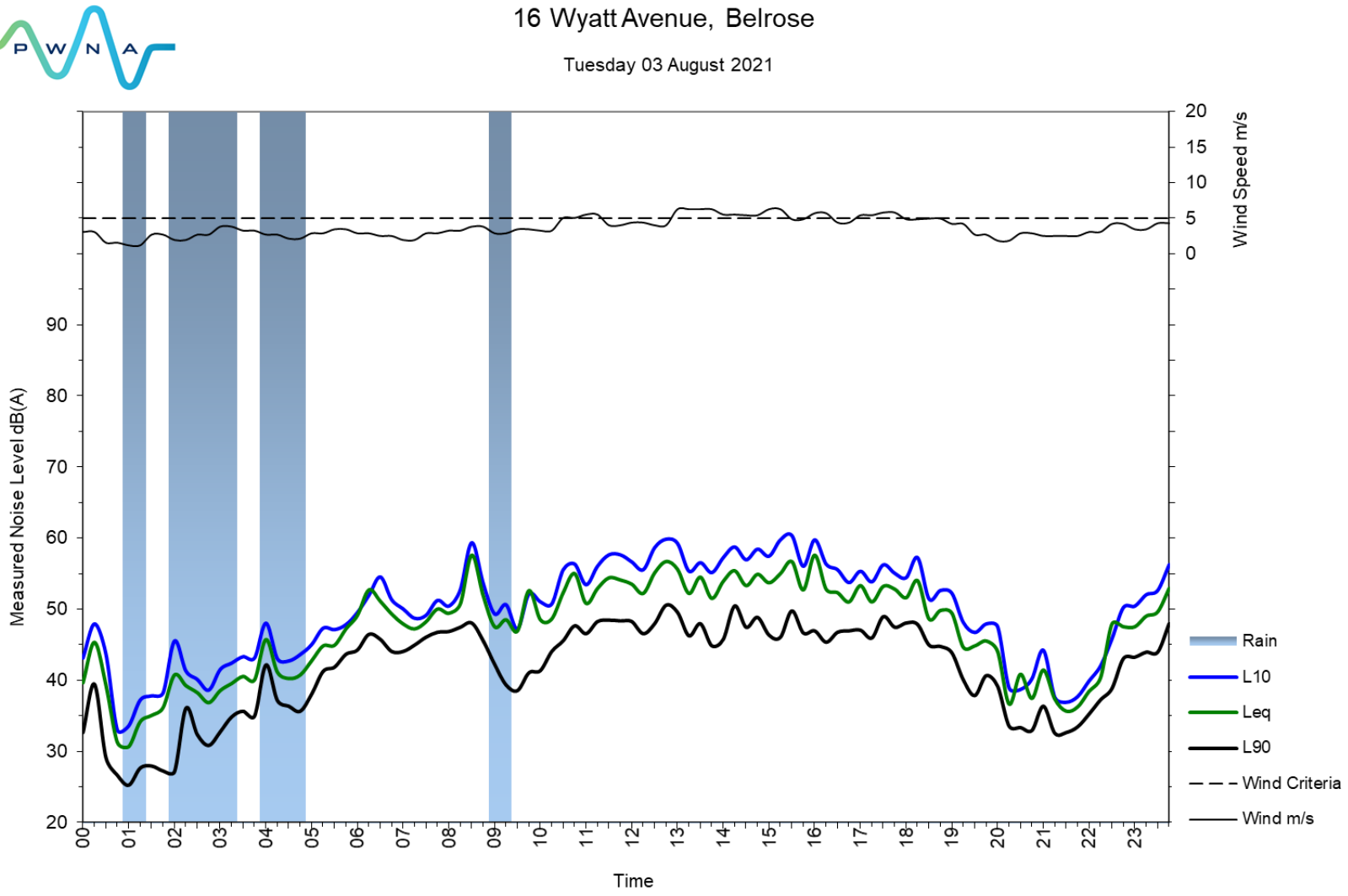
Weather Station: Terrey Hills

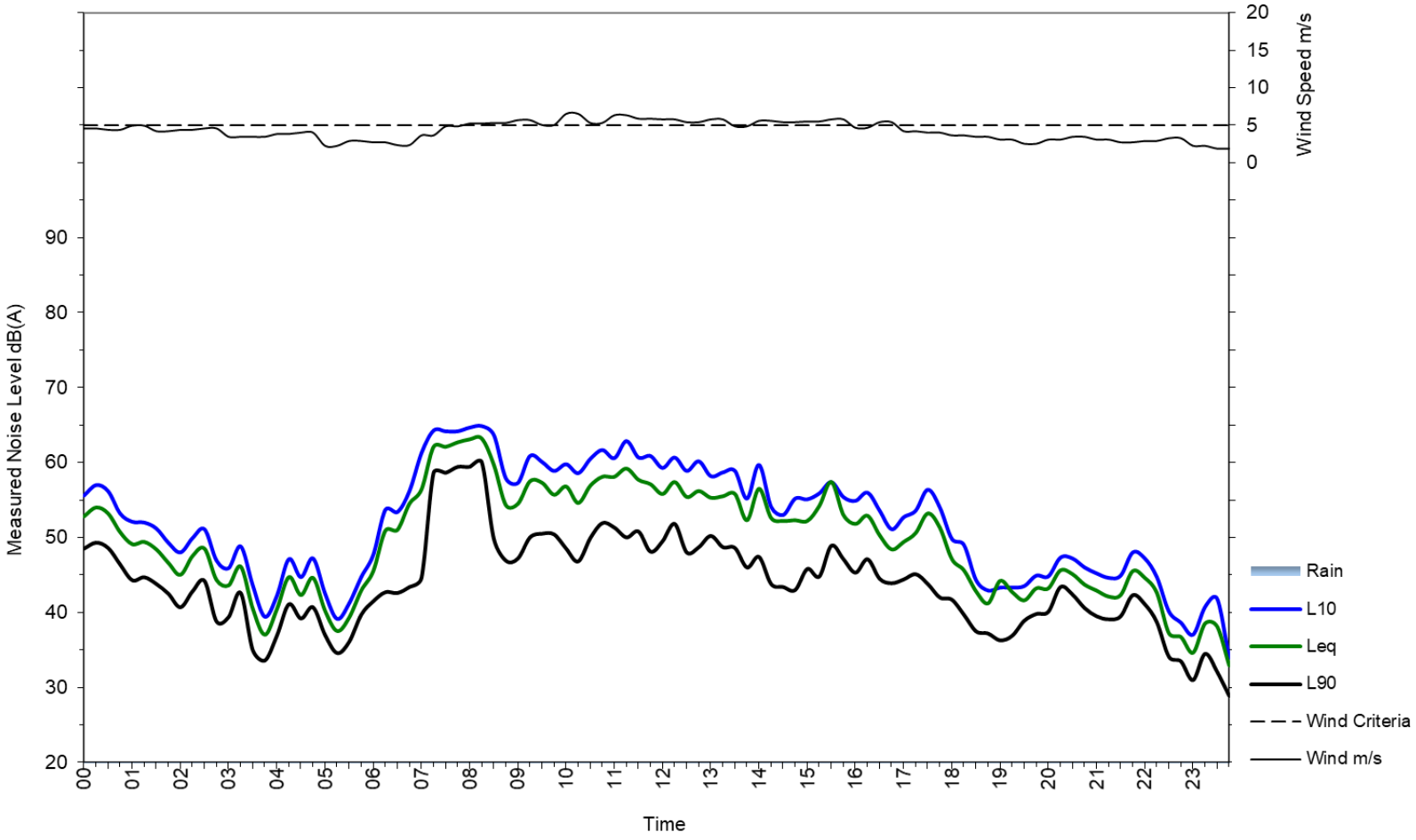
Weather Station ID: 066059

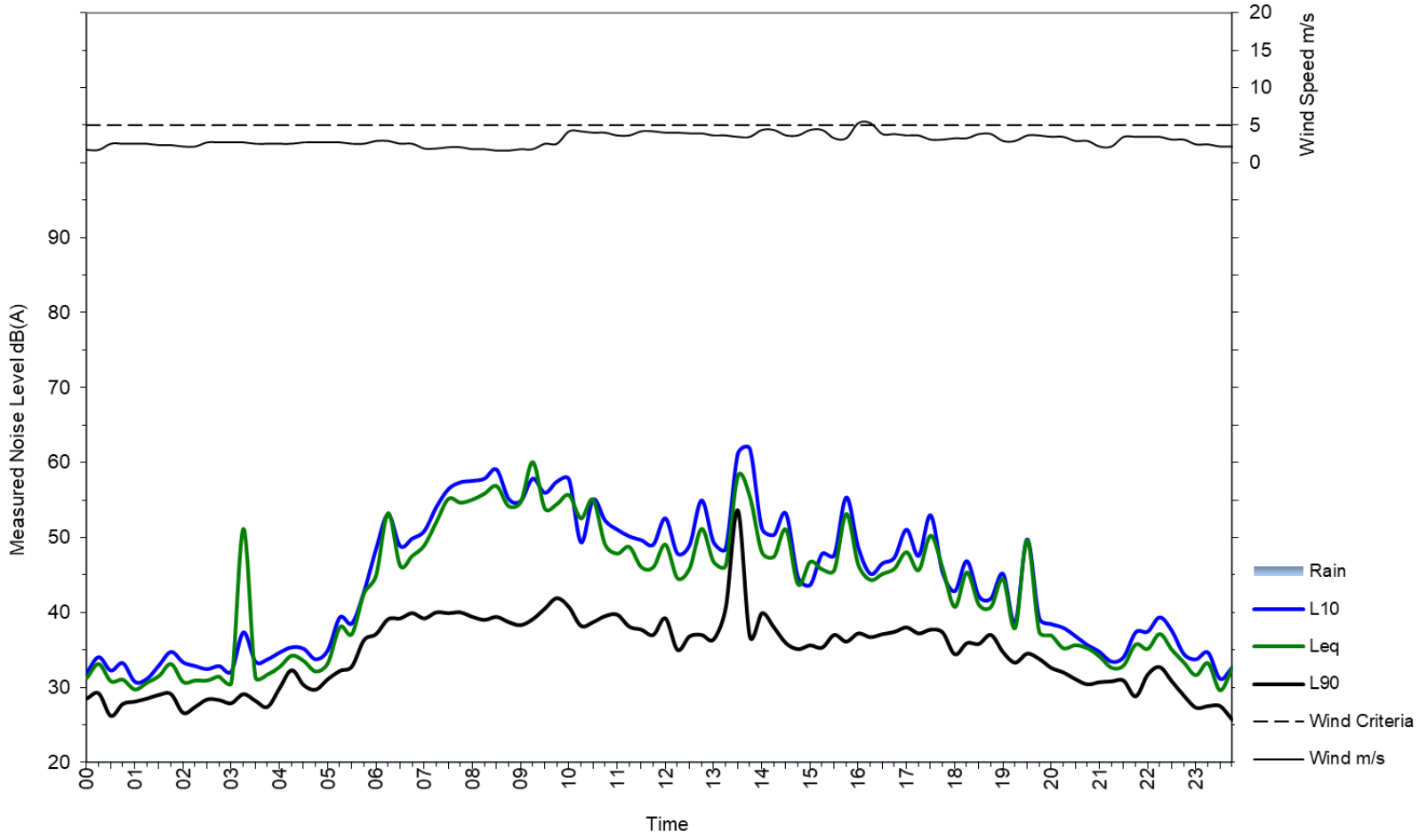
Coordinates: Lat: -33.69, Lon: 151.23, Height: 199.0 m

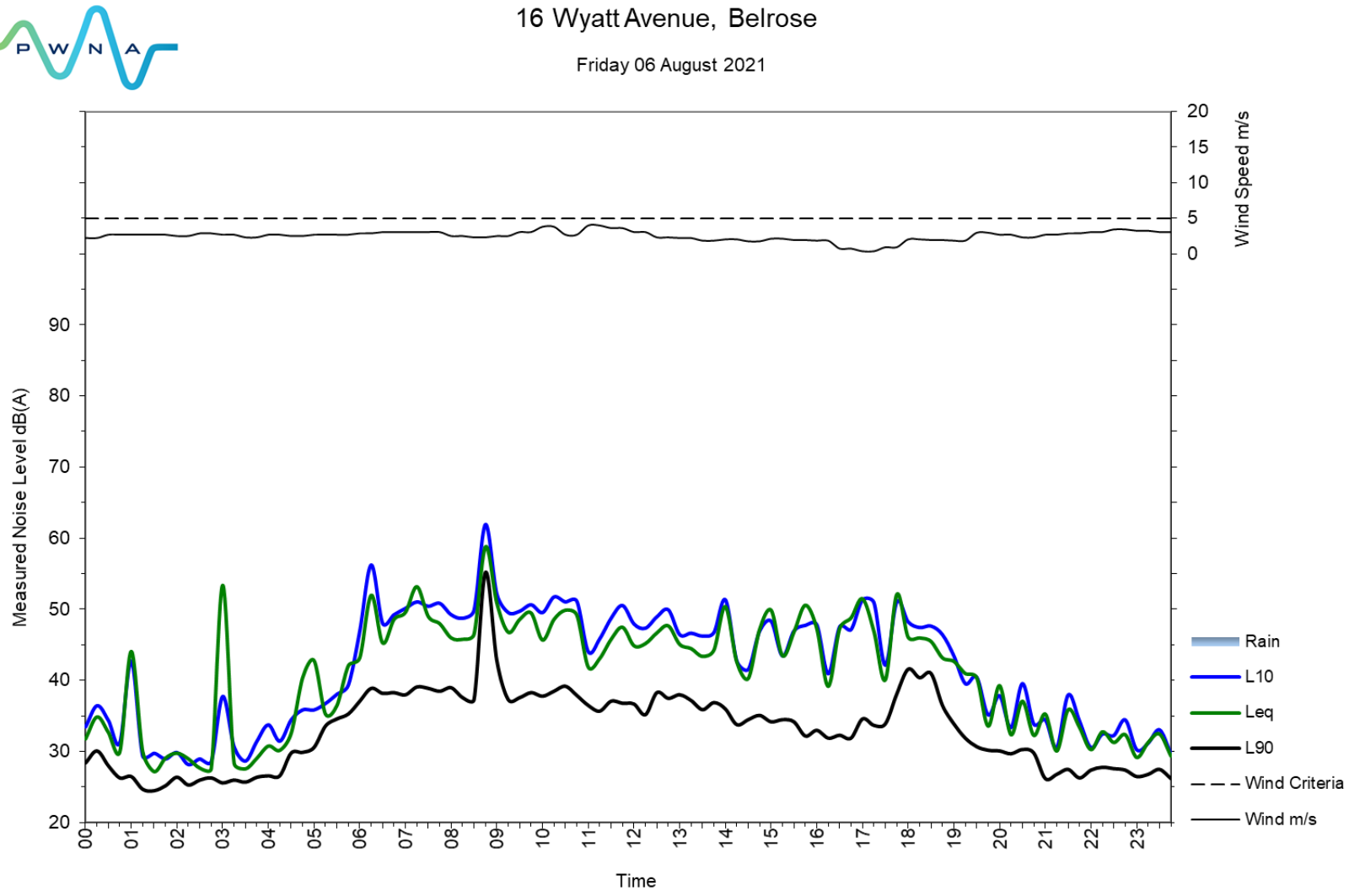
Figure 3 Photos of Unattended Noise Monitor Location – 16 Wyatt Avenue, Belrose

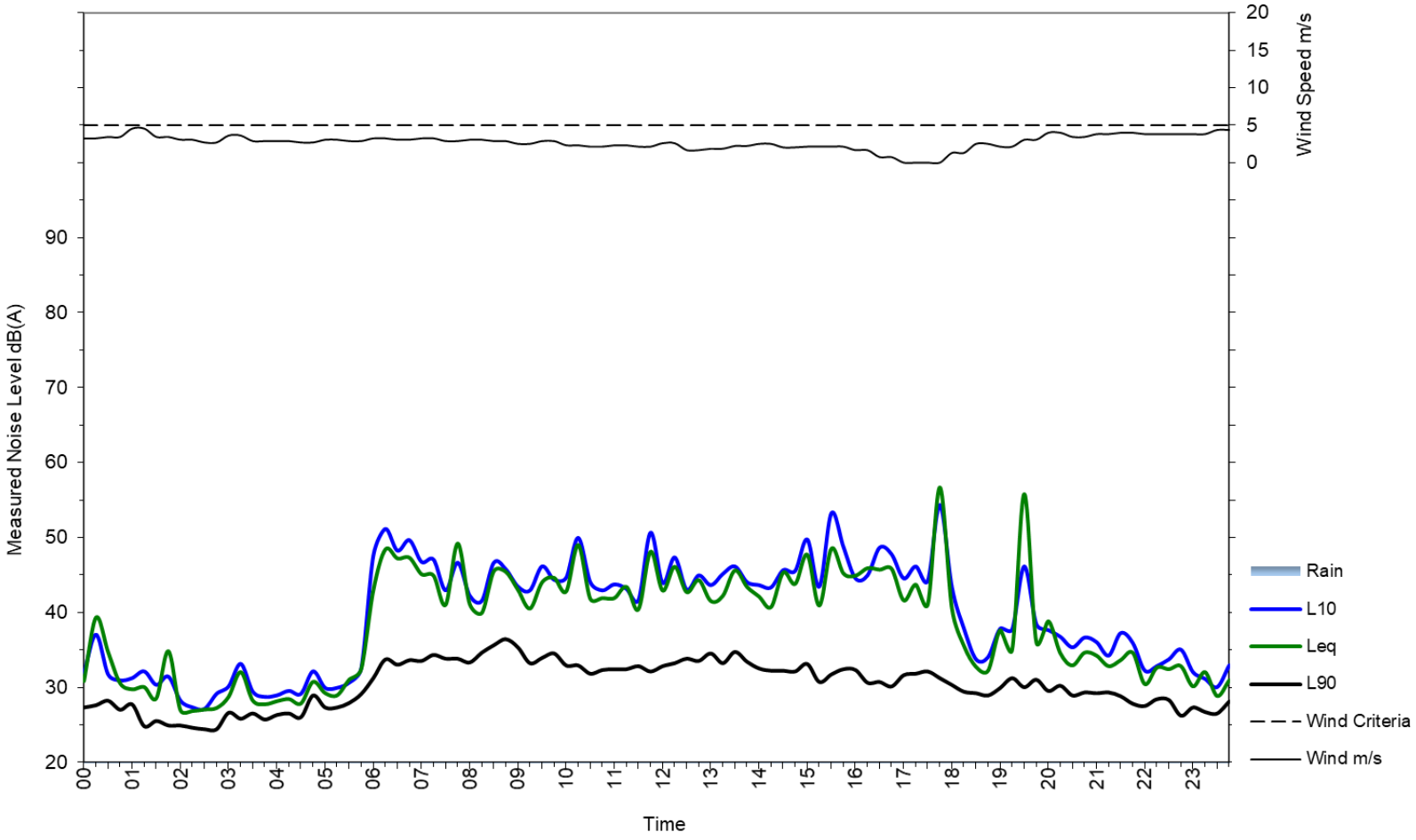

16 Wyatt Avenue, Belrose
Monday 02 August 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L10
Leq
L90
Wind Criteria
Wind m/s

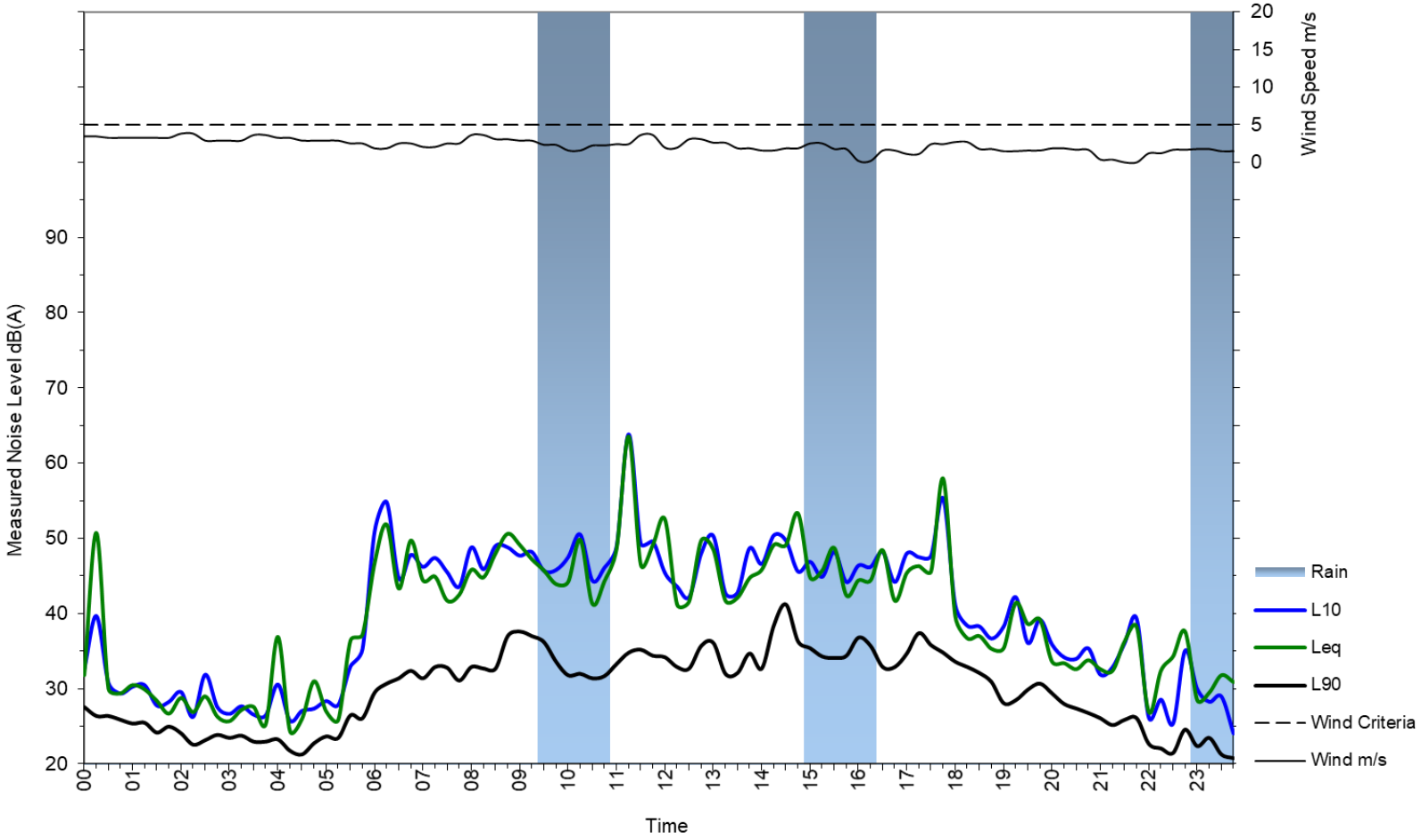

16 Wyatt Avenue, Belrose
Tuesday 03 August 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L10
Leq
L90
Wind Criteria
Wind m/s

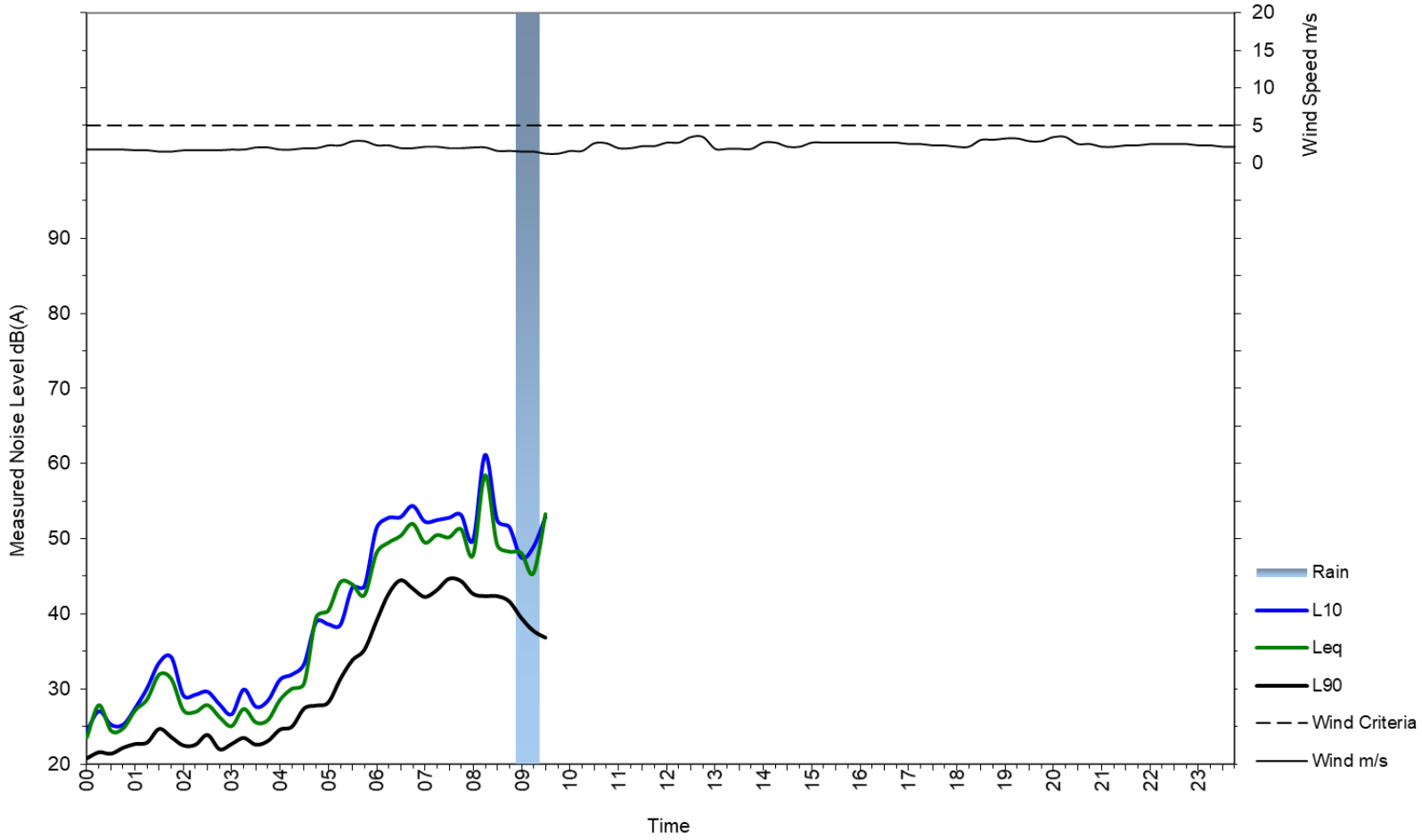

16 Wyatt Avenue, Belrose
Wednesday 04 August 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L10
Leq
L90
Wind Criteria
Wind m/s


16 Wyatt Avenue, Belrose
Thursday 05 August 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L10
Leq
L90
Wind Criteria
Wind m/s


16 Wyatt Avenue, Belrose
Friday 06 August 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L10
Leq
L90
Wind Criteria
Wind m/s


16 Wyatt Avenue, Belrose
Saturday 07 August 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L10
Leq
L90
Wind Criteria
Wind m/s


16 Wyatt Avenue, Belrose
Sunday 08 August 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L10
Leq
L90
Wind Criteria
Wind m/s


16 Wyatt Avenue, Belrose
Monday 09 August 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L10
Leq
L90
Wind Criteria
Wind m/s