1-13 Coleridge Street, Riverwood – DA Acoustic Assessment

WMK Architecture Pty Ltd
Level 2, 364 Kent Street,
Sydney NSW 2000,

Report number: 230318 – 1-13 Coleridge Street, Riverwood – DA Acoustic Assessment – R3
Date: 1 November 2024
Version: R3
Project Number: 230318

PULSE WHITE NOISE ACOUSTICS Suite 601, L6, 32 Walker St, North Sydney NSW 2060
P 1800 4 PULSE (1800 478 573) **E** info@pwna.com.au **pwna.com.au** ABN 95 642 886 306

DOCUMENT CONTROL

Project Name	1-13 Coleridge Street, Riverwood
Project Number	230318
Report Reference	230318 – 1-13 Coleridge Street, Riverwood – DA Acoustic Assessment – R3
Client:	WMK Architecture Pty Ltd

Revision	Description	Reference	Date	Prepared	Checked	Authorised
R0	For information	230318 – 1-13 Coleridge Street, Riverwood – DA Acoustic Assessment – R0	1 August 2023	Jack Liang	Matthew Furlong	Matthew Furlong
R1	For information	230318 – 1-13 Coleridge Street, Riverwood – DA Acoustic Assessment – R1	9 September 2024	Jack Liang	Matthew Furlong	Matthew Furlong
R2	For information	230318 – 1-13 Coleridge Street, Riverwood – DA Acoustic Assessment – R2	23rd October 2024	Jack Liang	Matthew Furlong	Matthew Furlong
R3	For Issue	230318 – 1-13 Coleridge Street, Riverwood – DA Acoustic Assessment – R3	1st November 2024	Matthew Furlong	Matthew Furlong	Matthew Furlong

PREPARED BY:

Pulse White Noise Acoustics Pty Ltd
ABN 95 642 886 306
Suite 601, Level 6, 32 Walker Street, North Sydney, 2060
1800 4 PULSE

TABLE OF CONTENTS

TABLES

FIGURES

1 INTRODUCTION

Pulse White Noise Acoustics Consultancy Pty Ltd (PWNA) has been engaged by WMK Architecture to undertake an acoustic assessment for the proposed residential development to be constructed at 1-13 Coleridge Street, Riverwood NSW 2210.

The proposed project includes the following:

- A four-storey development including residential dwellings.
- A basement carpark area.

This assessment includes the acoustic investigation into the following potential for noise and vibration sources:

- Noise emissions from the use of the site once works are completed, building services and basement noise.
- Environmental noise intrusion through the building envelope, in particular noise from the surrounding road network and adjacent rail corridor.
- Train vibration impacts from the adjacent rail corridor into the future building.

A glossary of acoustic terminology used in the acoustic assessment, is included in Appendix A.

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 Georges River Council LEP and DCP, State Environment Planning Policy (Transport and Infrastructure) 2021, Department of Planning's document *Development Near Rail Corridors and Busy Roads: Interim Guideline, 2008* as well as Australian New Zealand Standard AS/NZS 2107:2016 *'Acoustics–Recommended design sound levels and reverberation times for building interiors'* has been adopted.

Noise emission from the use of the development will be controlled by the requirements of the Georges River Council LEP and DCP, NSW EPA document *Noise Policy for Industry (NPI) 2017*, and the NSW EPA document *Road Noise Policy (RNP) 2011.*

Vibration intrusion into the development will be assessed for compliance in accordance with requirements of the Department of Planning's document *Development Near Rail Corridors and Busy Roads: Interim Guideline, 2008 and* NSW EPA document *"Assessing Vibration – A Technical Guideline".*

1.2 Surrounding Receivers

The site is bounded by Coleridge Street along the northern boundary with existing residential developments located further opposite. Located along the south-eastern boundary is the T8 Airport and South Rail Corridor which its nearest track will be approximately 12-15m from the corner of the future building. Along the southern boundary of the site is Phillip Street Reserve with the Rail Corridor further extending south-east beyond the park. Adjacent to the western boundary is existing residential buildings.

The project site is within an areas which is defined as a High Density Residential (R4) area as mapped under the NSW Planning Portal as can be identified in Figure 4 below.

The nearest sensitive residential receivers surrounding the site have been identified below.

Receiver 1: Two-story residential apartment block located western side of the project site at 15 Coleridge Street, Riverwood.

Receiver 2: Three-story residential apartment block located western side of the project site at 8 Phillip St, Riverwood NSW 2210.

Receiver 3: Three-story residential apartment block located western side of the project site at 17 Coleridge Street, Riverwood.

Receiver 4: Single-story residential dwelling located north side of the project site at 28 Coleridge Street, Riverwood.

Receiver 5: Two-story residential dwelling located north side of the project site at 26 Coleridge Street, Riverwood.

Receiver 6: Single-story residential dwelling located north side of the project site at 24 Coleridge Street, Riverwood.

Receiver 7: Single-story residential dwelling located north side of the project site at 22 Coleridge Street, Riverwood.

Receiver 8: Single-story residential dwelling located north side of the project site at 20 Coleridge Street, Riverwood.

Receiver 9: Three-story residential apartment block located north side of the project site at 14-18 Coleridge Street, Riverwood.

Receiver 10: Three-story residential apartment block located north side of the project site at 8-12 Coleridge Street, Riverwood.

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

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

Legend:

- **Project site**
- **Residential Receiver**
- **Attended Noise Measurement**
- **Attended Vibration Measurement**
- **Unattended Noise Logging Location**

2 NOISE DESCRIPTORS AND TERMINOLOGY

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

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

The most relevant environmental noise descriptors are the LAeq, LA1, LA10 and LA90 noise levels. The LAeq noise level represents the "equivalent energy average noise level". This parameter is derived by integrating the noise level measured over the measurement period and is equivalent to a level that would have been experienced had the fluctuating noise level remained constant during the measured time period.

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

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

3 EXISTING NOISE ENVIRONMENT

This section of the report details the acoustic survey which has been undertaken at the site for the purpose of obtaining existing background noise levels, as well as noise levels incident on the future building façades.

3.1 Unattended Noise Monitoring

As part of this assessment an acoustic survey of the existing acoustic environment at the site and surrounding receivers was undertaken. The survey included long-term unattended noise logging between Thursday 29th June 2023 and Wednesday 12th July 2023. 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 Bankstown Airport AWS (ID 066137).

Noise logging was undertaken on the site using a 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.

The unattended noise monitor was located along the southern boundary of the project site at Coleridge Street as can be identified in Figure 1. The purpose of noise monitoring at this location was to characterise the existing background noise level at the proposed development. This monitor was also used to establish criteria for noise emissions (i.e., to determine the noise level representative of the nearest noise sensitive receiver locations to the proposed development).

Charts presenting summaries of the measured daily noise data are attached to this report 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.

A review of the measured unattended noise monitor results shows a significant dip between 1:00am and 4:00am/4:30am period. This is due to the activity on the adjacent rail corridor ceasing. Typically, passenger trains don't operate during the 1:00am and 4:00am/4:30am period.

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

In order to assess the potential noise impacts of the development on nearby sensitive receivers the measured background noise data was processed in accordance with the Environmental Protection Authority (EPA) *Noise Policy for Industry* (NPI).

The Rating Background Noise Level (RBL) is the background noise level used for assessment purposes at the nearest potentially affected receiver. It is the 90th percentile of the daily background noise levels during each assessment period, being day, evening and night. RBL levels $L_{A90\ (15minute)}$ 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 Bankstown Airport weather station (ID 066137).

Table 1 Measured Ambient Noise Levels corresponding to the NPI's Assessment Time Periods

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)
1-13 Coleridge Street, Riverwood	44	61	45	60	37	55

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.

3.1.2 Results in accordance with NSW *EPA Road Noise Policy (RNP) 2011*

The measured ambient noise level in accordance with the NSW EPA Road Noise Policy (RNP) 2011 are provided in Table 2.

Table 2 Measured Ambient Noise Levels corresponding to the EPA Road Noise Policy (RNP) 2011 Time Periods

Measurement Location	Daytime[1] 7:00 am to 10:00 pm	Night-time[1] 10:00 pm to 7:00 am
	L_{Aeq}[1] (dBA)	L_{Aeq}[1] (dBA)
1-13 Coleridge Street, Riverwood	60	55

Note 1: Daytime 7:00 am – 10:00 pm and Night-time 10:00 pm – 7:00 am as defined by the NSW EPA Road Noise Policy (RNP) 2011.

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 Attended Noise Measurements

The survey included attended noise level measurements which were undertaken on Thursday 29th June 2023. Testing was conducted during a period when there was no inclement weather. This allowed the existing noise levels at the site to be quantified.

The attended noise measurements were conducted using a Bruel & Kjaer type 2270 sound level meter (serial number 2679267). 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.

The results of the attended acoustic survey are detailed in Table 3.

Table 3 Results of the Attended Noise Survey at the Site

Measurement Location	Time of Measurement [1]	Measured $L_{Aeq, 15min}$ dB(A) [2]	Comments
Southeastern boundary of project site (refer to Figure 1)	16:30 pm – 16:45 pm	60	Noise levels at the project site is dominated by rail traffic on T8 Rail corridor that consists primarily passenger trains. Occasional road traffic noise from Coleridge Street is audible at the measurement location.
Coleridge Street - north-west corner (refer to Figure 1)	16:50 pm – 17:05 pm	58	Noise levels at the project site is dominated by rail traffic on T8 Rail corridor that consists primarily passenger trains. Occasional road traffic noise from Coleridge Street is audible at the measurement location.

Note 1: Daytime 7:00 am – 10:00 pm and Night-time 10:00 pm – 7:00 am as defined by the NSW EPA Road Noise Policy (RNP) 2011.

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.

4 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.

4.1 Noise Intrusion Criteria

4.1.1 Georges River Council Local Environmental Plan 2021 (LEP) and Development Control Plan 2021 (DCP)

A review of the current Georges River Council Local Environmental Plan 2021 (LEPs), the document does not contain any applicable numerical building envelope acoustic criteria for residential developments. As such in the absence of any applicable requirements, objectives listed below will be adopted.

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

Section 2.100 Impact of rail noise or vibration on non-rail development states the following:

2.100 Impact of rail noise or vibration on non-rail development

1. *This section applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration —*

    a) *Residential Accommodation*

    b) *A place of public worship*

    c) *A hospital*

    d) *An educational establishment or centre based childcare facility*

2. *Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Secretary for the purposes of this clause and published in the Gazette.*

3. *If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded*

    a) *In any bedroom in the residential accommodation—35 dB(A) at any time between 10.00 pm and 7.00 am,*

    b) *Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.*

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

NSW Department of Planning's document DNRCBR adopts the same internal noise criteria outlined in the SEPP infrastructure (previous 2008, now updated 2021) see below. However, table 3.1 from the policy states:

Figure 2 Extract - DRCBR - Table 3.1

Table 3.1: Noise criteria

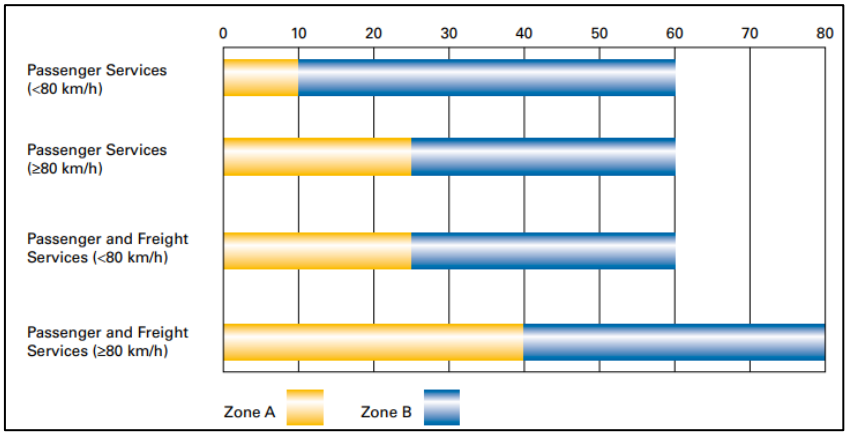
Residential Buildings		
Type of occupancy	Noise Level dBA	Applicable time period
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40	At any time
Non–Residential Buildings		
Type of occupancy		Recommended Max Level dBA
Educational Institutions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

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

As the proposed development is in proximity to the railway line north of the site, the *Development Near Rail Corridors and Busy Roads – Interim Guideline* was adopted to determine if an acoustic assessment of rail induced noise and vibration is required.

Section 3.5.1 of the *Development Near Rail Corridors and Busy Roads – Interim Guideline* includes a guidance for the requirement of an acoustic assessment for noise based on the distance of the site from the railway line as shown in Figure 3.

Figure 3 Noise Assessment Zones based on Distance (m) of Noise – Sensitive Development from Operational Track (Not Corridor)



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

In relation to design internal noise levels, standard AS/NZS 2107:2016 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.

The levels for areas relevant to this development are given in Table 4 below. In this report we will confine our recommendations to dBA levels, however, where the background noise appears to be unbalanced, standard 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.

Section 6.18 of standard 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 Table 4 should be referenced (see also Appendix D of AS/NZ 2107:2016 for additional guidance).

Table 4 Recommended design sound levels as per standard AS/NZS 2107:2016

Type of Occupancy/Activity	Design sound level range ($L_{Aeq,t}$)
Residential Buildings	
Apartment common areas (e.g., foyer, lift lobby)	45 to 50
Living areas	35 to 45
Sleeping areas (nighttime)	35 to 40
Work areas	35 to 45
Toilets	45 to 55

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

4.1.5 Summary of Project Requirements

Based on the acoustic criteria listed above, a summary of the most stringent requirement in each space is provided below. Compliance with the levels for each nominated spaces below will ensure compliance with all other requirements listed above.

Table 5 Project Internal Noise Level Requirements

Room Type	Required Internal Noise Level dBA $L_{Aeq\ (period)}$
Residential - Living areas (inclusive of living, working areas)	40 dBA $L_{Aeq\ (24\text{-}hour)}$
Residential - Sleeping areas	35 dBA $L_{Aeq\ (10:00pm\text{-}7:00am)}$
Toilets	55 dBA $L_{Aeq\ (when\ in\ use)}$ [1]
Apartment Common Areas	50 dBA $L_{Aeq\ (when\ in\ use)}$ [1]
Note 1: Time periods are not defined well in AS/NZS 2107:2016 – as such PWNA recommendation.	

4.2 Ground-Borne Noise and Vibration Criteria (Rail)

4.2.1 Ground-Borne Noise

The department of Planning's Development near Rail Corridors & Busy Roads – Interim Guideline" 2008 provides recommended criteria for ground-borne or regenerated rail noise.

Ground-borne noise is noise generated by vibration transmitted through the ground into a structure. The following ground-borne limits for residences are only applicable when ground-borne noise levels are higher than airborne noise levels. The ground-borne noise levels are for evening and night-time periods only, as the objectives are to protect the amenity and sleep of people when they are at home. Table 6 summaries the noise limits for sleeping and living spaces.

Table 6 Recommended internal Noise Criteria for Regenerated Rail Noise

Type of Occupancy/Activity	Design sound level range ($L_{AMax\ (Slow,\ 95\%)}$)	Time Period
Residential Buildings		
Sleeping areas (nighttime)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40	At any time
Note 1: Groundborne noise is calculated as Lmax (slow) for 95% of rail passby events		

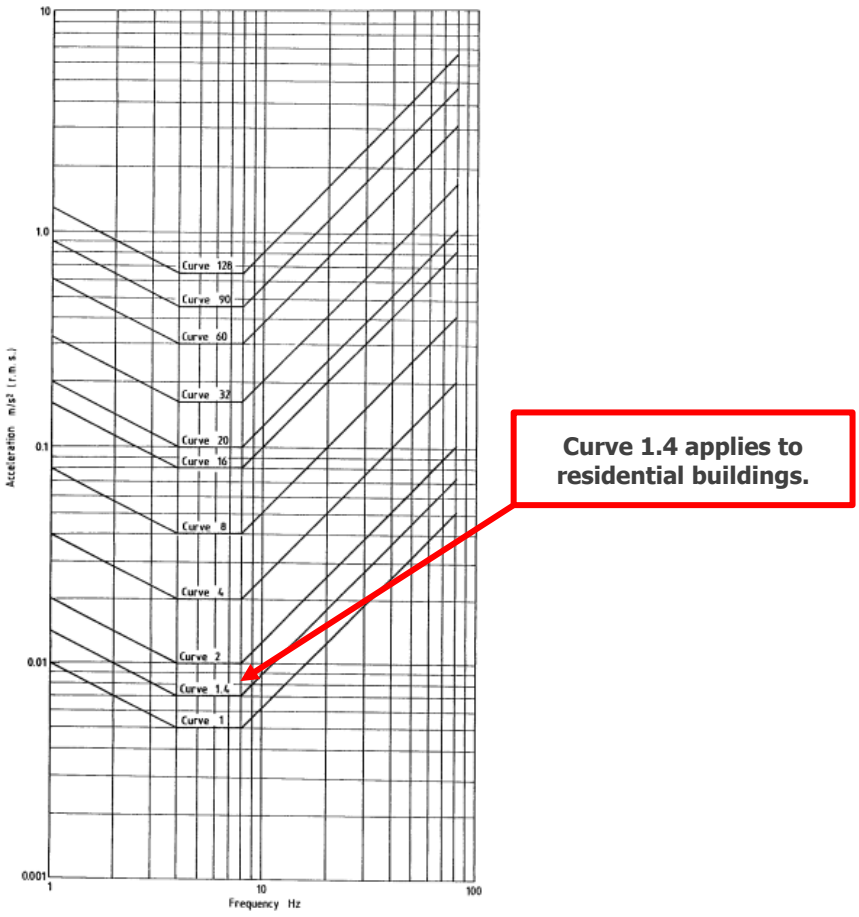
4.2.2 Rail Tactile Vibration

Section 3.6.3 of the Department of Planning Guideline provides recommended vibration criteria in accordance with the German Standard DIN4150 Part 3 1999 and British Standards BS 7385 Part 2 1993. Human comfort is normally assessed with reference to the above British Standard or Australian Standard AS 2670.2 1990.

After reviewing the aforementioned documents, the standards for evaluating the impact of train passby, tactile vibration on the proposed development have been determined and measured according to the *Assessing Vibration: A technical guideline (Department of Environment and Conservation, 2006) and British Standard BS6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*

Table 7 displays the standards outlined in the *British Standard BS6472:1992* for consistent vibration in residential areas, office spaces, and commercial workshops.

Table 7 Building vibration z-axis curves from acceleration (R.M.S)



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

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

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

Table 8 Intermittent vibration impacts criteria (m/s1.75) 1 Hz-80 Hz, Vibration Dose Values (VDV)

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

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

4.3 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 those from mechanical services.

4.3.1 Georges River Council Local Environmental Plan 2021 (LEP) and Development Control Plan 2021 (DCP)

Following a review of the current Georges River Local Environmental Plan (LEP) and Development Control Plan (DCP) 2021, we note that the document does not contain any applicable numerical acoustic criteria for the assessment of noise emissions. As such, in the absence of any applicable requirements, objectives listed in the NSW EPA Noise Policy for Industry (NPfI) 2017 below will be adopted.

4.3.2 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 *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.
- Maintaining noise level amenity of particular land uses for residents and sensitive receivers in other land uses.

4.3.2.1 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.

4.3.2.2 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).

Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level, the project amenity noise levels can be set at 10 dB below existing industrial noise levels.

4.3.2.3 Area Classification

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

> *An acoustical environment that:*
>
> - *is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources*
> - *has through-traffic with characteristically heavy and continuous traffic flows during peak Periods*
> - *is near commercial districts or industrial districts*
> - *has any combination of the above.*

Figure 4 is obtained from the NSW Planning ePlanning Spatial Viewer Zoning Maps and shows the land zoning map of the proposed development and the nearest sensitive receivers.

Figure 4 NSW Planning ePlanning Spatial Viewer Zoning Maps

As shown above, the site and its nearest surrounding receivers are located in an area defined as R4 (High Density Residential). The most appropriate zoning for the site and its surrounding receivers is *Urban Residential*.

For residential and non-residential receivers in an Urban residential area, the recommended amenity criteria are shown in Table 9 below.

When the existing noise level from industrial noise sources is close to the recommended "Amenity Noise Level" (ANL) given above, noise from the new source must be controlled to preserve the amenity of the area in line with the requirements of the NSW NPI.

Table 9 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	Urban	Day	60
		Evening	50
		Night	45

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.

4.3.2.4 Project Specific NPI Noise Emission Criteria

The intrusive and amenity criteria for industrial noise emissions, derived from the measured data at the logger location toward the northern boundary of the site, are presented in Table 10. 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 10.

Table 10 External noise level criteria in accordance with the NSW NPI (dBA)

Location	Time of Day [1]	Project Amenity Noise Level, $L_{Aeq, period}$ [2]	Measured $L_{A90, 15\ min}$ (RBL) [3]	Measured $L_{Aeq, period}$ [2] Noise Level	Intrusive $L_{Aeq, 15\ min}$ [2] Criterion for New Sources	Amenity $L_{Aeq, 15\ min}$ [2] Criterion for New Sources
Residential Receivers	Day	55	44	61	**49**	58
	Evening	45	45	60	~~50~~ [5] 49 [5]	**48**
	Night	40	37	55	**42**	43

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

Note 5: Based on the Section 2.3 of the NSW EPA NPfI Intrusive noise level target during the day and evening should not be higher than the day period. As such the evening Intrusiveness noise level has been amended to match daytime noise level.

4.3.2.5 Max Noise Level Event (Sleeping Disturbance)

Section 2.5 of the NPfI 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:*
>
> - *40 dB $L_{Aeq, 15\ minutes}$ or the prevailing RBL plus 5 dB, whichever is the greater; and / or*
> - *52 dB L_{AFmax} or the prevailing RBL plus 15 dB, whichever is the greater*

As outlined in section 3.1 above, the measured rating background noise level during the night hours (10:00pm to 7:00am) is 37 dBA L_{A90}. Therefore, the resulting RBL + 15dBA is 52dBA L_{AFMax} and RBL + 5dBA is 43dBA $L_{Aeq\ (10:00pm-7:00am)}$.

4.3.3 NSW DECCW – NSW Road Noise Policy (RNP) 2011

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW Road Noise Policy 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.

5 ACOUSTIC ASSESSMENT

In addressing all the criteria shown above, assessment of each relevant section is presented below.

5.1 Building Envelope Assessment

5.1.1 Glazing Recommendations

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

Table 11 In-principle Glazing Recommendations

Location	Spaces	Minimum Glazing System Rating Requirements (Rw)	Indicative Construction
Southern Façade (Facing Southern Façade)	Bedrooms and Living Areas	Rw (C;Ctr): 33 (0;-3)	10mm Float
All Other Façades	Bedrooms, Living Room and Common Rooms	Rw (C;Ctr): 31 (0;-3)	6.38mm Laminated Glazing
All Facades	Toilets	Rw (C;Ctr): 27 (0;-3)	4mm Float

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).**

A detailed review of the glazing assessment should be conducted during the design phase of the project.

5.1.2 External Wall Construction

If external wall constructions are to be constructed from a masonry construction, compliance with the internal noise criteria will be achieved. 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 45.

A detailed review of the façade should be assessed during the design phase of the project.

5.1.3 External Roof Construction

External roofing system will be a concrete construction. As such, no further acoustic treatments are 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.

A detailed review of the roof should be assessed during the design phase of the project.

5.1.4 Alterative Ventilation

The internal design sound levels detailed above are achieved with the external building openings closed to the façade, including noise from train passbys noise.

In addition to the windows closed requirement from the NSW Department of Planning document *Development Near Rail Corridor and Busy Roads – Interim Guideline* is a window open requirement. See below.

Figure 5 Extract - Development Near Rail Corridor and Busy Roads – Interim Guideline

3.6 WHAT NOISE AND VIBRATION CRITERIA SHOULD BE APPLIED

3.6.1 Airborne Noise

The noise criteria for residential buildings in **Table 3.1** for both road and rail are specified in the Infrastructure SEPP. Other values in **Table 3.1** are based on the Environmental Criteria for Road Traffic Noise (EPA 1999).

These criteria apply to all forms of residential buildings as well as aged care and nursing home facilities. For some residential buildings, the applicants may wish to apply more stringent design goals in response to market demand for a higher quality living environment.

The night-time 'sleeping areas' criterion is 5dBA more stringent than the 'living areas' criteria to promote passive acoustic design principles. For example, designing the building such that sleeping areas are less exposed to road or rail noise than living areas may result in less onerous requirements for glazing, wall construction and acoustic seals. If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia.

In accordance with the above requirement, PWNA have undertaken a detailed review of all operable window/doors and can confirm full compliance can be achieved in all areas, with exception of the areas identified below in **red**. Areas which are identified as **red** below will require an alternate source of ventilation in accordance with the Building Code of Australia and AS1668 (as deemed by a qualified Mechanical Engineer).

Figure 6 Ground Level – Window/Door Open Exceedance Markup

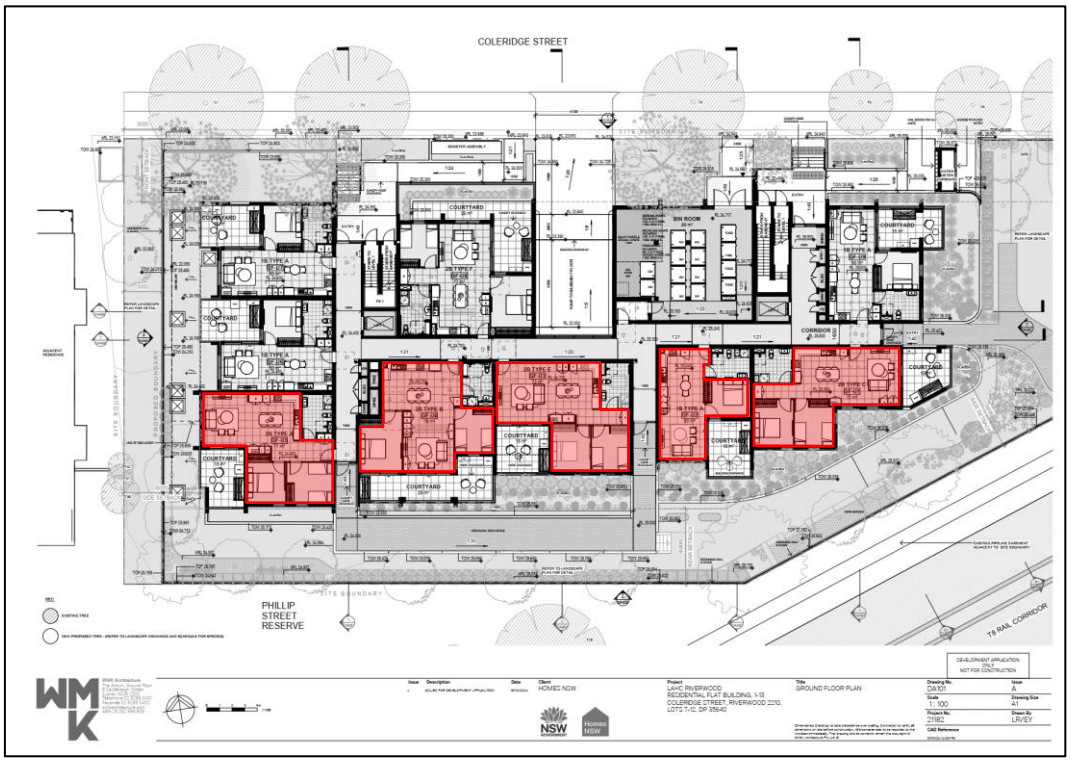


Figure 7 Level 01 – Window/Door Open Exceedance Markup

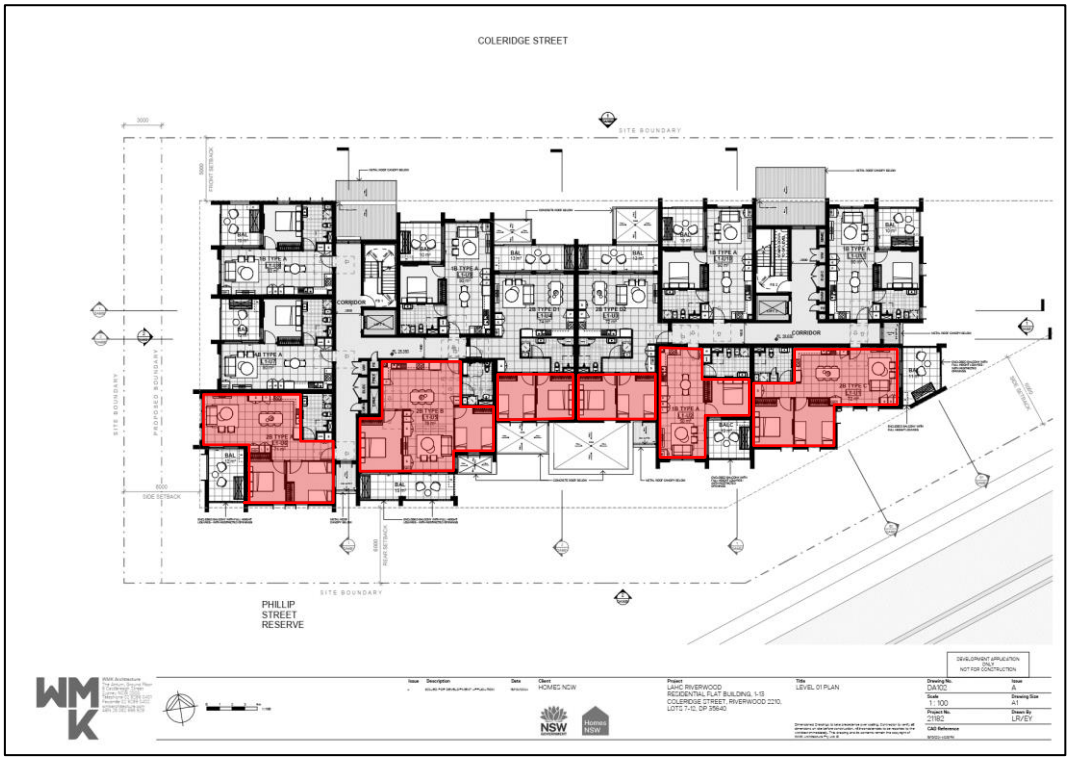


Figure 8 Level 02 – Window/Door Open Exceedance Markup

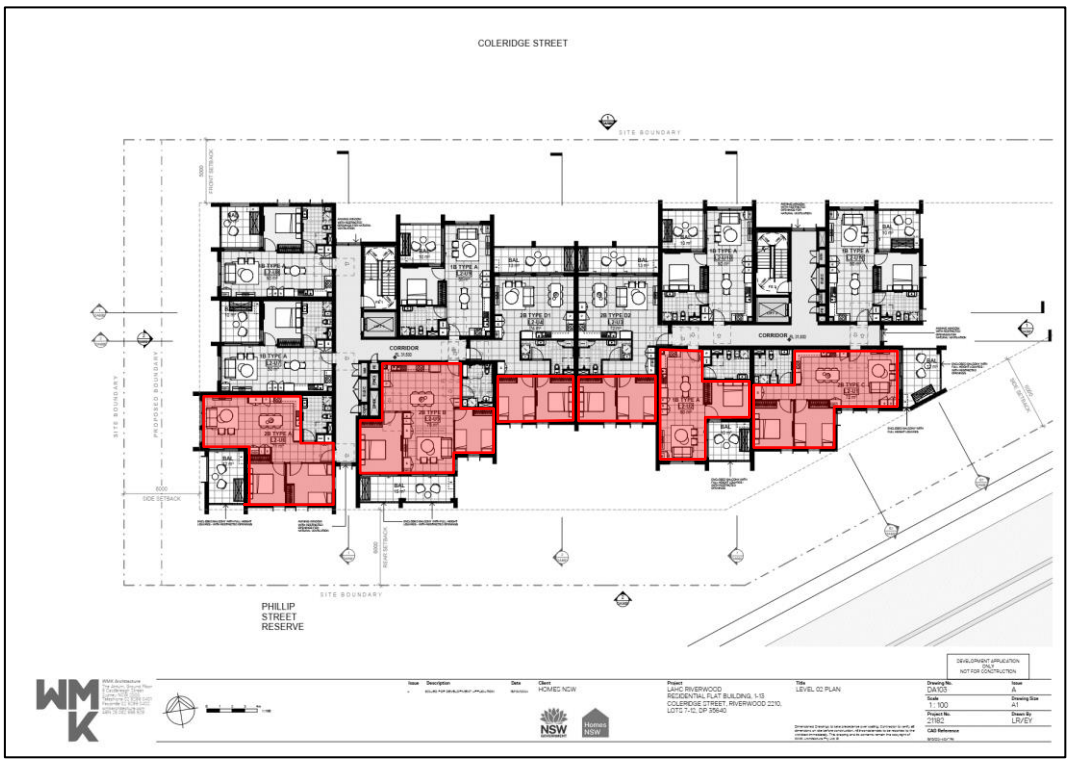
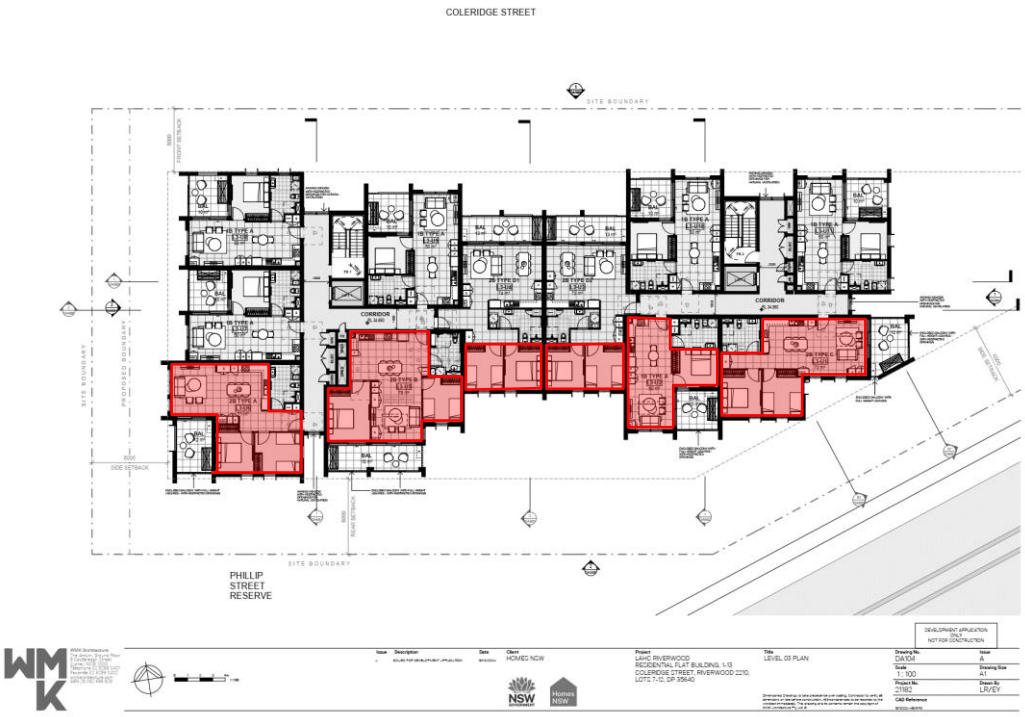


Figure 9 Level 03 – Window/Door Open Exceedance Markup



As part of the proposed development the provision for an alternative outside air source to all residential dwellings is required. The options for the proposed alternative source of ventilation are discussed below:

1. The acoustic design of the building includes performance of glass and solid façade elements which will ensure internal noise levels with operable windows closed will achieve internal noise level requirements and ensure a suitable acoustic amenity for future residence.

    a. The use of the operable windows and doors could be used to provide ventilation/cross ventilation to the units. This can be undertaken by opening the operable elements of the façade at the discretion of the future occupants.

2. In the event occupants choose to keep the windows closed, an alternative source of outside air will be provided to the residential dwellings. The method of providing an alternative outside air will include a design which is in accordance with AS1668 and does not reduce the acoustic performance of the building's external façade. Possible methods of providing an alternative outside air source include one of the following:

    a. The use of a mechanical system to provide outside air such as a dedicated fan or the use of the fan within a units FCU including an outside air source (which would not be required to condition air to provide outside air to the unit).

    b. Provision of an outside air source to the intake air side of the Fan Coil Units (FCU) located in the ceiling space of each apartment. The outside air is mixed with the return air in the return air plenum and provided to the dwelling using the fan of the FCU which can operate with or without air conditioning being functional.

    c. Provision of outside air via a dedicated supply air fan which can be operated at the discretion of future occupants.

    d. Other methods of outside air supply which are compliant with the requirements of the Australian Standard AS1668.2.

5.2 Noise from Engineering Services

At this stage of the project, the exact locations of key plant items, and the selection of items to be installed, have not been selected. As such, a detailed assessment of noise associated with engineering services cannot be undertaken.

All future plant and equipment are to be acoustically treated to ensure the noise levels at all surrounding receivers and internal receivers comply with noise emission and intrusion criteria detailed within this report. Experience with similar projects indicates 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 likely be either located on the roof or residential balconies. Providing condenser equipment is selected using suitable noise level data, then acoustic treatments can be implemented such as screening and treatment to exhaust to ensure that the relevant noise emission criteria will be achieved.

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

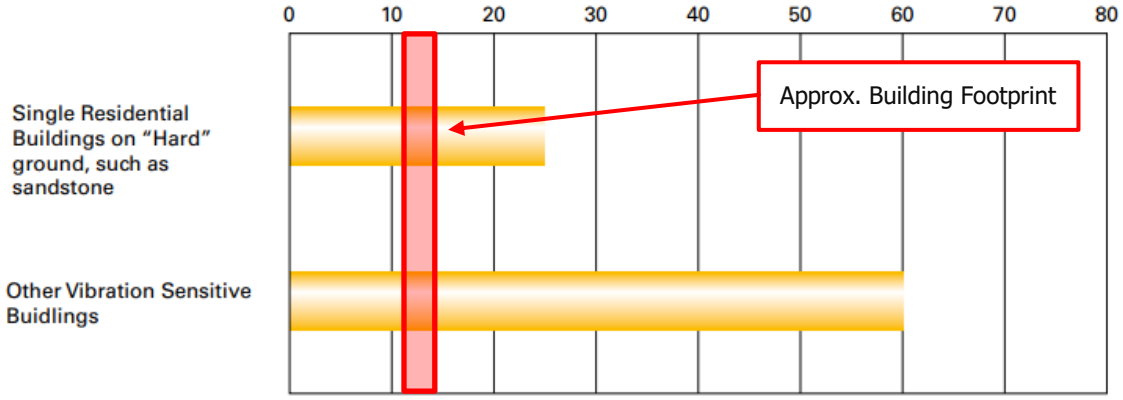
Experience with similar projects indicates that the acoustic treatment of whatever mechanical equipment is to be installed on the project is both possible and practical, in order to meet the relevant criteria at surrounding receivers, as well as the relevant noise intrusion criteria for internal receivers within the development.

5.3 Train Vibration Assessment

This section of the report presents the assessment of vibration intrusion from the adjacent rail corridor along the south-eastern boundary of the site.

As mentioned above, the distance between the nearest rail track and the future building is 12-15m. As per section 3.5.1 of the *Development Near Rail Corridors and Busy Roads – Interim Guideline* a vibration assessment is required, see below.

Figure 10 Vibration Assessment Zones based on Distance (m) of Sensitive Development from Operational Track (Not Corridor)



5.3.1 Vibration Measurement Equipment

The assessment included attended vibration measurements conducted on Thursday 29th June 2023. Vibration levels were measured using Apollo acoustic analyzer with data acquisition system. The vibration measurement was conducted at two locations adjacent to the railway lines shown in Figure 1. The senser used during the vibration measurement were accelerometers from Dytran Instruments, model number 3192A.

5.3.2 Measured/Predicted Structure Borne Noise Levels

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

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

> *Generally, ground borne noise is associated more closely with rail operations than roads. Where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present without the normal masking effect of airborne noise.*
>
> *In such cases, residential buildings should be designed so that the 95th percentile of train passbys complies with a ground-borne LAmax noise limit of 40dBA (daytime) or 35dBA (night-time) measured using the "slow" response time setting on a sound level meter.*

Attended vibration measurement were conducted at an approximated location of the future building foundation. The measurement location is approximately 12-15 m to the nearest rail track. The attended vibration measurement location is illustrated in Figure 1 above.

With onsite vibration levels at the location of the proposed future foundation, computational modelling was conducted to determine the resulting ground borne noise level within the future building. Predicted ground borne noise levels on for the ground level apartments directly adjacent to the corridor are presented below.

Table 12 Predicted Internal Ground Borne Noise Level – Ground Level Apartments

Assessment Location	Space	Predicted Ground Borne Noise Level dBA $L_{AMax, Slow (95\%)}$	Predicted Ground Borne Noise Level dBA $L_{AMax, Slow (95\%)}$	Compliance
Apartment 003 (South-east Corner)	Sleeping Spaces	32	35	**Yes**
	Living Spaces	32	40	**Yes**

As this corridor is above ground, the impact of airborne noise on the future residents within the proposed project site will be greater than the potential for structure borne noise levels. Provided that suitable treatments for airborne noise impacts are included in the design of the project are provided (as per the façade constructions recommended in Section 5.1) ground borne noise levels will comply with the relevant criteria.

5.3.3 Measured VDV Levels

In addition to the measurements/predictions presented above, analysis of the resulting vibration dosage over a typical day have been assessed.

Utilsing the obtained vibration levels and determining the number of train passby which occur daily resulting vibration exposure for the daytime and night-time periods Vibration Dose Values (VDV) were calculated.

The results of the vibration level measurements including the calculations for VDV are detailed in Table 13 below.

Table 13 Calculated VDVs

Location	Period	Criteria VDV $m/s^{1.75}$	Calculated VDV $m/s^{1.75}$
Apartment 003 (South-east Corner)	Daytime	0.20	0.08
	Night-Time	0.13	0.05

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

6 CONCLUSION

Pulse White Noise Acoustic Pty Ltd (PWNA) has been engaged by WMK Architecture to undertake an acoustic assessment of the proposed residential development at 1-13 Coleridge Street, Riverwood. The conclusions of this assessment are outlined in the following sections.

Minimum acoustic performances and associated indicative constructions for the building envelope have been provided in section 5.1 of this report. The recommended treatments have been provided to ensure compliance with the objectives presented in 4.1.

To control noise impacts at external and internal receivers, recommended indicative treatments for major engineering services have been provided in Section 6.2. 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. Experience with similar projects indicates that the acoustic treatment of the likely mechanical equipment to be installed on the project is both possible and practical, in order to meet the relevant criteria at surrounding receivers, as well as the relevant noise intrusion criteria for internal receivers within the development.

- 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 this report.

An assessment of the impacts associated with the number of vehicles on surrounding public roads around the site predicted the impact to be less than 2dBA and therefore is compliant with the NSW EPA RNP.

An assessment of the potential noise and vibration impacts from the Railway line to the south-east of the project site has been undertaken. From our study, an assessment for the potential for structure-borne noise was undertaken to predict the ground-born noise level at the future proposed residential development. The prediction shows that all residential space was under 35 dB(A). In addition, the railway is above-ground and adjacent to the site, thus the impact of airborne noise is expected to mask the effects of any potential structure-borne noise for both the proposed development. Additionally, human comfort has been assessed based on the impacts of tactile vibration measured by a vibration dosage value (VDV) and is expected to be compliant with the relevant criteria established in Section 4.

Regards,

Matthew Furlong
Principal Acoustic Engineer
PULSE WHITE NOISE ACOUSTICS PTY LTD
AAS Member and AAAC Member Firm

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
LMax	The maximum sound pressure level measured over a given period.
LMin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	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).
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
dB (A)	'A' Weighted overall sound pressure level
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.

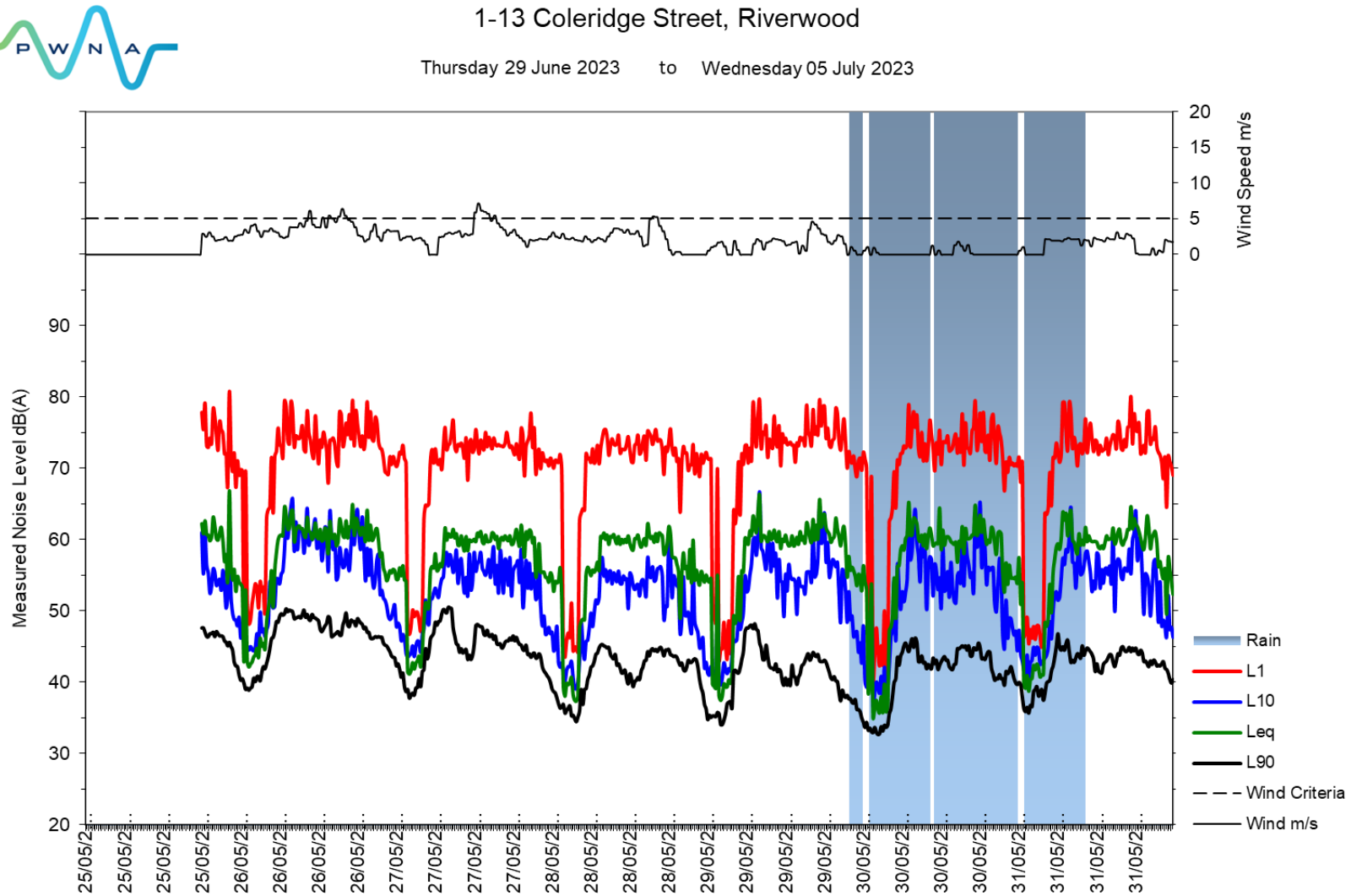
Sound Power Level, Lw dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with 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

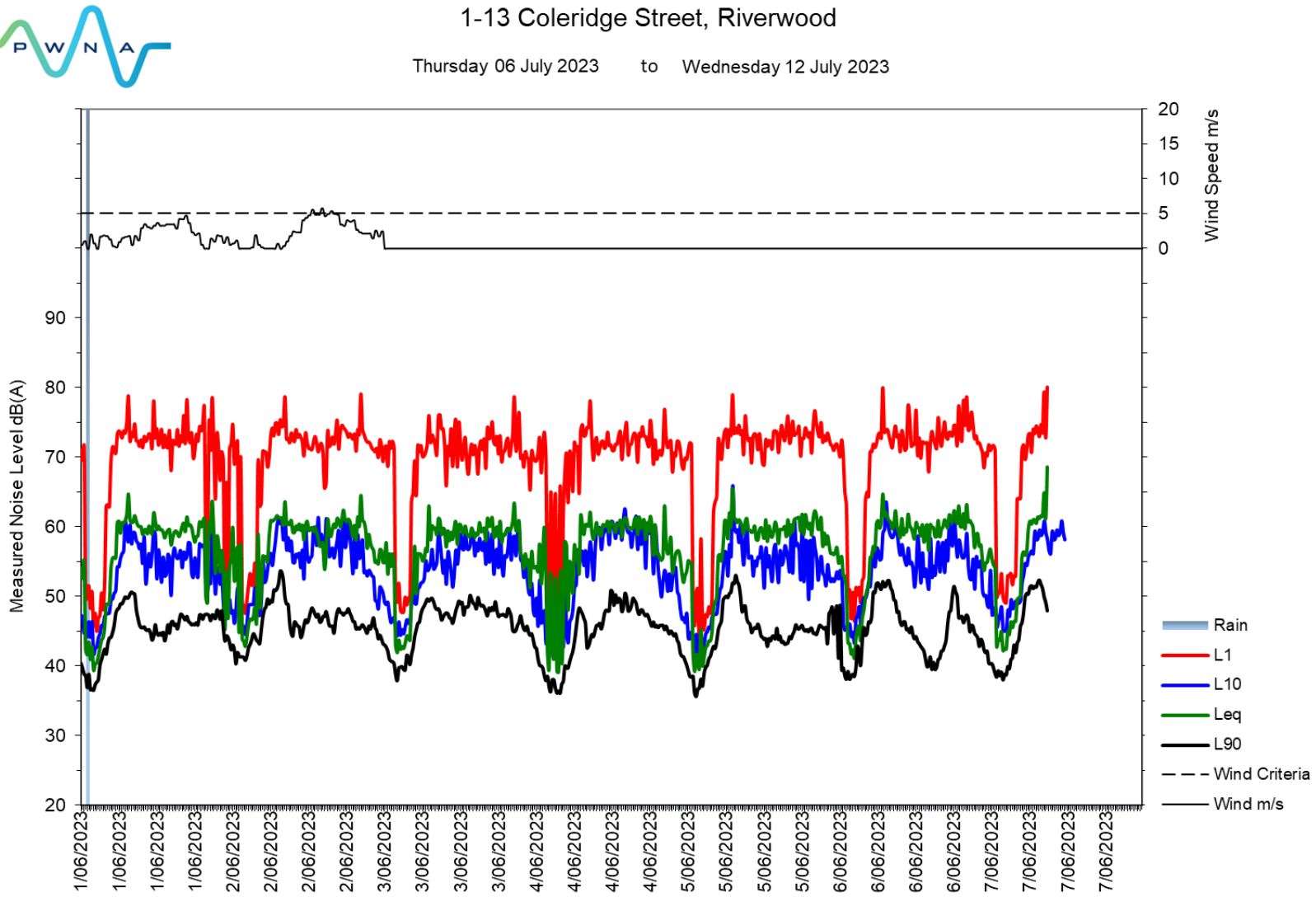
APPENDIX B: UNATTENDED NOISE MONITORING RESULTS

Weather Station: Bankstown Airport AWS

Weather Station ID: 066137

Coordinates: 33.9176°S 150.9837°E 8m AMS


1-13 Coleridge Street, Riverwood
Thursday 29 June 2023 to Wednesday 05 July 2023
Measured Noise Level dB(A)
Wind Speed m/s
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


1-13 Coleridge Street, Riverwood
Thursday 06 July 2023 to Wednesday 12 July 2023
Measured Noise Level dB(A)
Wind Speed m/s
20
15
10
5
0
90
80
70
60
50
40
30
20
1/06/2023
2/06/2023
3/06/2023
4/06/2023
5/06/2023
6/06/2023
7/06/2023
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s