Rail Noise Intrusion Assessment

Proposed Alterations & Additions to Existing Dwelling

8 Hampden Street, Hurlstone Park, NSW

Client:

Mr Sida Chen

C/o- Mason Projects Pty Ltd

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Sydney Head Office
Suite 2
174 Willoughby Rd
St Leonards NSW 2065
T: 02 9908 1270

Melbourne Office
Suite 11
70 Racecourse Rd
Nth Melbourne VIC 3051
T: 03 7015 5112

ABN: 36 105 797 715
PO Box 270
Neutral Bay NSW 2089
E: info@acousticdynamics.com.au
W: www.acousticdynamics.com.au

Client	Mr Sida Chen
C/o-	Mason Projects Pty Ltd
Contact	Mr Ethan Sant
Address	26 Surf Lane, Cronulla, NSW 2230
Mobile	0413 007 040
Email	ethan@masonprojects.com.au

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GLOSSARY

NOISE

Noise is produced through rapid variations in air pressure at audible frequencies (20 Hz – 20 kHz). Most noise sources vary with time. The measurement of a variable noise source requires the ability to describe the sound over a particular duration of time. A series of industry standard statistical descriptors have been developed to describe variable noise, as outlined in **Section 2** below.

NOISE DESCRIPTORS

L_{eq} – The sound pressure level averaged over the measurement period. It can be considered as the equivalent continuous steady-state sound pressure level, which would have the same total acoustic energy as the real fluctuating noise over the same time period.

$L_{Aeq(15min)}$ – The A-weighted average equivalent sound level over a 15 minute period.

L_{A10} – The A-weighted noise level that has been exceeded for 10% of the measurement duration.

L_{A90} – The A-weighted noise level that has been exceeded for 90% of the measurement duration. This descriptor is used to describe the background noise level.

RBL – Rating Background Level. The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24hr period used for assessment background level) This is the level used for assessment purposes.

dB – Decibels. The fundamental unit of sound, a Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell. Probably the most common usage of the Decibel in reference to sound loudness is dB sound pressure level (SPL), referenced to the nominal threshold of human hearing. For sound in air and other gases, dB(SPL) is relative to 20 micropascals (μPa) = 2×10^{-5} Pa, the quietest sound a human can hear.

R_w – Weighted Sound Reduction Index. A measure of sound insulation performance of a building element. The higher the number, the better the insulation performance.

A-WEIGHTING

"A-weighting" refers to a prescribed amplitude versus frequency curve used to "weight" noise measurements in order to represent the frequency response of the human ear. Simply, the human ear is less sensitive to noise at some frequencies and more sensitive to noise at other frequencies. The A-weighting is a method to present a measurement or calculation result with a number representing how humans subjectively hear different frequencies at different levels.

NOISE CHARACTER, NOISE LEVEL AND ANNOYANCE

The perception of a given sound to be deemed annoying or acceptable is greatly influenced by the character of the sound and how it contrasts with the character of the background noise. A noise source may be measured to have only a marginal difference to the background noise level, but may be perceived as annoying due to the character of the noise. Acoustic Dynamics' analysis of noise considers both the noise level and sound character in the assessment of annoyance and impact on amenity.

1 INTRODUCTION

1.1 EXECUTIVE SUMMARY

Acoustic Dynamics is engaged by **Mason Projects** on behalf of Mr Sida Chen to prepare an assessment of external rail noise intrusion and vibration emission for the proposed residential development located at 8 Hampden Street, Hurlstone Park, NSW.

This document provides an assessment of rail noise intrusion into the various areas of the subject building and is prepared in accordance with the relevant acoustic assessment requirements of:

(a) Canterbury-Bankstown Council;
(b) NSW Policies and Legislation
(c) NSW Department of Planning and Infrastructure; and
(d) Australian Standards.

1.2 PROJECT DESCRIPTION

The development proposal is for renovations and new construction at 8 Hampden Street, Hurlstone Park, NSW as shown in the floor plans within **Appendix A**.

At this location, the property is subject to noise intrusion from rail noise associated with the upcoming use of the Bankstown Southwest Rail line. The project site and surrounding area is shown in the Location Map and Aerial Image presented within **Appendix A**.

1.3 SCOPE OF WORKS

Acoustic Dynamics is engaged to provide an external noise intrusion assessment confirming the proposed Change of Use will satisfy the design goals and comply with the various relevant internal acoustic criteria.

The scope of the assessment is to include the following:

- Review of legislation, Council criteria, NSW Guidelines and Australian Standards relevant to assessment of rail traffic noise intrusion at the development;
- Assessment of noise measurements and establishment of maximum rail noise levels at the development site;
- Examine architectural drawings, review proposed construction elements and calculate the sound transmission reduction required to meet the criteria; and
- Provide recommendations for design measures, materials and construction techniques to be incorporated to achieve the required noise attenuation.

2 ASSESSMENT CRITERIA AND STANDARDS

Acoustic Dynamics has conducted a review of the local council, state government and federal legislation that is applicable to noise assessment for the proposed change of use. The relevant sections of the legislation are presented below.

2.1 COUNCIL CRITERIA

2.1.1 COUNCIL PLANNING & DEVELOPMENT CONTROL INSTRUMENTS

Acoustic Dynamics has conducted a review of the relevant Inner West Council's planning and development control instruments including the following documents:

- *Canterbury-Bankstown Council Local Environmental Plan 2023 (LEP); and*
- *Canterbury-Bankstown Council Development Control Plan 2016* (DCP).

Acoustic Dynamics' review of the Canterbury-Bankstown Council LEP did not yield specific acoustic criteria or information relevant to this assessment.

Acoustic Dynamics' review of the Canterbury-Bankstown Council DCP did not yield specific acoustic criteria or information relevant to this assessment.

2.2 STATE GOVERNMENT POLICIES AND LEGISLATION

2.2.1 STATE ENVIRONMENTAL PLANNING POLICY (INFRASTRUCTURE) 2007

Acoustic Dynamics has conducted a review of the relevant state environmental planning policies, legislative acts and statutory instruments, including the *State Environmental Planning Policy (Transport and Infrastructure) 2021.*

The TI SEPP provides information and criteria for the assessment of infrastructure development within NSW and identifies matters to be considered for development adjacent to various infrastructure projects. The following issues must be considered when assessing the impact of rail noise and vibration on residential developments:

*"**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 child care facility.

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

(3) If the development is for the 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."

2.3 NSW DEPARTMENT OF PLANNING AND ENVIRONMENT

Acoustic Dynamics has reviewed various planning and assessment guidelines published by the NSW Department of Planning and Environment (DPIE), including the *Development Near Rail Corridors and Busy Roads – Interim Guideline 2008* (DNRCBR).

The DNRCBR document provides information and criteria for the assessment of developments within proximity to rail corridors and busy roads, including guidance on building design, internal layout, and architectural principles to achieve an acceptable internal acoustic environment.

The following guidelines to assess and control the impacts of rail and noise intrusion into a residential development are included:

"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."

Table 2.1 Noise Criteria for Residential Buildings (Extract from Interim Guidelines Table 3.1)

Residential Buildings		
Type of Occupancy	***Noise Levels dB(A)***	***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*

"3.6.3 Vibration criteria

Vibration levels such as the intermittent vibration emitted by trains should comply with the criteria in Assessing Vibration: a technical guideline (DECC 2006). The standards used for assessing the risk of vibration damage to structures are German Standard DIN 4150 Part 3 1999 and British Standard BS 7385 Part 2 1993. Human comfort is normally assessed with reference to the above British Standard or Australian Standard AS 2670.2 1990."

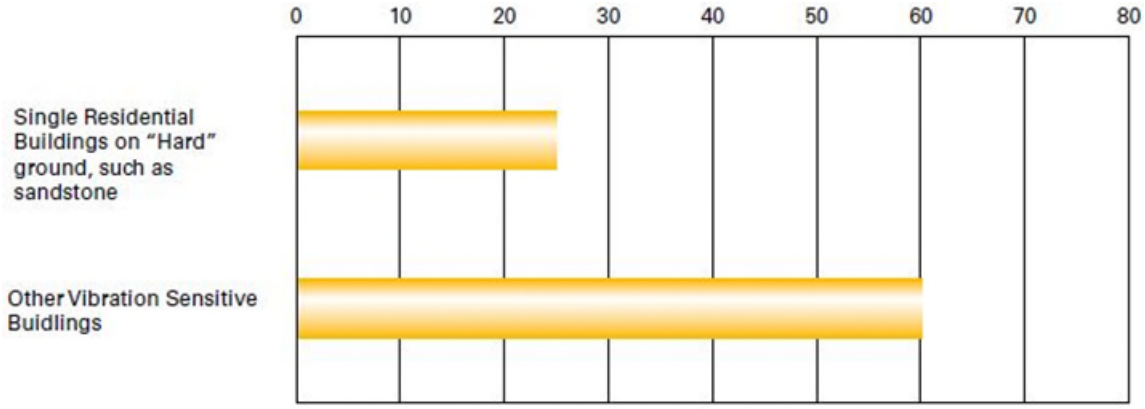
In addition to the above information, developments that are located within close proximity to a rail corridor may require an assessment of vibration impacts. The NSW DP&I provides the following guidance for the assessment of vibration impacts:

"Rail Vibration

The vibration assessment zone for typical development sites adjacent to rail corridors or above rail tunnels is shown in Figure 3.2. The assessment zone may need to be increased for specific areas where vibration issues are known to already exist. Refer to section 3.6.3 vibration criteria for additional information.

Developments within this zone will need a vibration assessment.

Figure 3.2: *Distance from the nearest operational track (m)*



Acoustic Dynamics advises that the development site falls within the vibration assessment zone (approximately 25m away from the nearest track corridor) and a vibration assessment will be required.

2.4 EPA'S TECHNICAL GUIDELINE FOR ASSESSING VIBRATION

The NSW EPA document *"Assessing Vibration: A Technical Guideline"* presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations of the measurement and evaluation techniques.

The criteria presented are non-mandatory goals that should be sought to be achieved through the application of all feasible and reasonable mitigation measures. Sources of vibration, covered in this guideline include construction and excavation equipment, rail and road traffic, and industrial machinery.

When assessing intermittent vibration, the vibration dose value (VDV) is used. The VDV accumulates the vibration energy received over the daytime and night-time periods. The vibration dose is fully described within British Standard BS 6472-1992.

The VDV is given by the fourth root of the integral of the fourth power of the acceleration after it has been frequency-weighted:

$$VDV = \left(\int_0^T a^4(t)\, dt \right)^{0.25}$$

where VDV is the vibration dose value (in $m/s^{-1.75}$), a(*t*) is the frequency-weighted acceleration (ms^{-2}) and T is the total period of the day (in seconds) during which vibration may occur.

Where there are repeated vibration events of differing magnitude, the total vibration dose for the day or night period is obtained using the following formula:

$$VDV = \left(\sum_{i=1-N} VDV_i^4 \right)^{0.25}$$

where VDV_i is the individual dose value.

Acceptable VDVs for intermittent vibration are set out in the guideline and reproduced within **Table 2.2** below.

Table 2.2 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

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

Workshops	*0.80*	*1.60*	*0.80*	*1.60*

Note: 1) Daytime is 7.00am to 10.00pm and night-time is 10.00pm to 7:00am.
2) Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulse of criteria critical areas.

There is low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. Activities should be designed to meet the preferred values where an area is not already exposed vibration.

2.5 AUSTRALIAN STANDARDS

Acoustic Dynamics has conducted a review of relevant Australian Standards in relation to the subject development. The following details this review.

2.5.1 AS 2107:2016 "ACOUSTICS–RECOMMENDED DESIGN SOUND LEVELS"

Australian Standard 2107:2016 "Acoustics–Recommended design sound levels and reverberation times for building interiors" recommends satisfactory and maximum design sound levels for various types of occupancy within buildings. AS 2107 recommends the following satisfactory and maximum design sound levels for the various types of occupancies and areas within the proposed development.

Table 2.3 Recommended Design Sound Levels for Different Areas (Extract from AS 2107 Table 1)

Type of occupancy / activity	***Design sound level, ($L_{Aeq,t}$) range [dB (A)]***
7 RESIDENTIAL BUILDINGS	
Houses and apartments in suburban areas or near minor roads-	
Living areas	*35 to 45*
Sleeping Areas (night time)	*35 to 40*
Work Areas	*35 to 45*

Acoustic Dynamics advises that any levels of airborne noise transmitted into the development should not exceed the relevant design sound levels presented above.

By ensuring the internal noise levels do not exceed the recommended internal design levels, it is likely to ensure occupants of the development are not adversely affected by rail noise intrusion.

2.6 SLEEP DISTURBANCE DUE TO RAIL PASS-BY EVENTS

In addition to the short-term $L_{Aeq(1hour)}$ noise levels, Acoustic Dynamics has considered the (sleep disturbance) noise impacts associated with rail pass-by events during the most sensitive time period (being the night time).

A review of the Carramar Station timetable indicates passenger rail pass-bys may occur up to 3 times per hour during the night time period. Freight rail pass-bys also occur during the night time period along the same rail line, with noise associated with the pass-by event lasting for approximately 10-15 seconds. Due to the relatively short duration of the train pass-by events, the 16 hour, 8 hour and even 1 hour L_{Aeq} sample periods may not adequately describe the intrusiveness of the associated noise nor do they convey the potential for sleep disturbance.

The World Health Organisation guidelines (WHO 1999) recommend that for noises with continuous character, the noise descriptor L_{Aeq} is acceptably correlated with sleep disturbance. However, for noises with an intermittent or impulsive character, a different descriptor that takes into account the emergence of the noise, described by measures such as (L_{AFmax}-L_{Aeq}) or (L_{AFmax}-L_{AF90}), the highest level of noise and the number of events, may be needed to obtain a better correlation with sleep disturbance.

The NSW EPA has previously published the following additional information relating to findings of significant research carried out for sleep disturbance:

> *"Maximum internal noise levels below 50-55 dBA are unlikely to cause awakening reactions… One or more noise events per night, with maximum internal noise levels of 65-70 dBA, are not likely to affect health and wellbeing significantly."*

To ensure the acoustic amenity of residents is protected during a rail pass-by event Acoustic Dynamics advises the construction of bedrooms within the development should be designed to ensure the internal noise levels comply with an internal maximum noise objective (**$L_{AMax} \leq 55$**).

3 NOISE MEASUREMENT EQUIPMENT & STANDARDS

All measurements were conducted in general accordance with Australian Standard 1055.1-1997, *"Acoustics - Description and Measurement of Environmental Noise Part 1: General Procedures"*. Acoustic Dynamics' sound measurements were carried out using precision sound level meters conforming to the requirements of IEC 61672-2002 *"Electroacoustics: Sound Level Meters – Part 1: Specifications"*. The survey instrumentation used during the survey is set out in **Table 3.1**.

Table 3.1 Noise Survey Instrumentation

Type	Serial Number	Instrument Description
2250	2679541	Brüel & Kjaer Modular Precision Sound Level Meter
4189	2670479	Brüel & Kjaer 12.5 mm Prepolarised Condenser Microphone
4230	1234136	Brüel & Kjaer Acoustic Calibrator

Type	Serial Number	Instrument Description
NTi-XL2	A2A-04313-D1	NTI Audio XL2 Noise Logger
716A0403	BE10428	Instantel 4 Channel Minimate Plus
714A9701	BG9660	Instantel Tri-axial Geophone

The reference sound pressure level was checked prior to and after the measurements using the acoustic calibrator and remained within acceptable limits.

4 EXTERNAL NOISE INTRUSION ASSESSMENT

The following subsections provide an assessment of rail traffic noise intrusion into the proposed development against the various noise criteria and objectives outlined in **Section 2** above.

4.1 SITE SURVEY & NOISE MONITORING

A site survey was undertaken and operator-attended measurements were performed between 7:30am and 8:30am on Monday 9 March 2026 to determine the maximum rail noise intrusion levels at the subject site.

In the absence of rail operations on the existing trainline at the rear of the subject site, and understanding that the existing trainline will be used by the Metro rail services in the near future, Acoustic Dynamics advises that the rail noise survey of Metro rail pass-bys at Chatswood Station. The noise measurement was conducted at a location with direct line of sight to the railway, approximately 25 metres away from the nearest metro railway line.

The prevailing weather conditions during the operator-attended noise measurements were generally calm and did not influence the noise measurements taken. The measurement location is shown in **Appendix A.**

The measurement results obtained during the attended noise survey included the noise levels of 22 passenger Metro train pass-bys.

The results of the operator-attended rail pass-by measurements are presented in **Table 4.1.**

Table 4.1 Operator Attended Noise Measurement Results of Metro Rail Pass-bys

Measurement Description	Track	Measured L_{AFmax} of Train Pass-by [dB][1]	Measured L_{Aeq} of Train Pass-by [dB][1]
Passenger	Northbound	74	70
Passenger	Southbound	73	67
Passenger	Southbound	73	68
Passenger	Northbound	75	68
Passenger	Southbound	75	67
Passenger	Northbound	73	66

Measurement Description	Track	Measured L_{AFmax} of Train Pass-by [dB][1]	Measured L_{Aeq} of Train Pass-by [dB][1]
Passenger	Southbound	74	67
Passenger	Northbound	75	69
Passenger	Northbound	74	66
Passenger	Northbound	75	66
Passenger	Northbound	73	68
Passenger	Southbound	74	69
Passenger	Northbound	74	67
Passenger	Northbound	72	66
Passenger	Southbound	74	68
Passenger	Northbound	71	65
Passenger	Southbound	74	66
Passenger	Northbound	71	65
Passenger	Southbound	73	67
Passenger	Northbound	72	69
Passenger	Southbound	73	68
Passenger	Northbound	73	66
Average L_{AFMax} Noise Level		**73**	**-**
Average L_{Aeq} Noise Level		**-**	**67**

Note: 1) Acoustic Dynamics advises that these passenger trains were typically travelling at a speed of approximately 50 km/hr, departing and arriving at Chatswood Station.

In addition to the short-term $L_{Aeq(1\ hr)}$ and L_{AMax} noise levels, Acoustic Dynamics has considered the (sleep disturbance) noise impacts associated with passenger and freight train pass-by events during the most sensitive time period (being the night time). Unattended noise monitoring was completed between 9 June 2026 and 12 June 2026 at the subject site, to determine the maximum noise intrusion levels associated with freight train pass-bys. The noise logger had direct line of sight to the railway, approximately 25m away from the nearest freight railway line.

A small sample of freight train pass-bys within the entire monitoring period was analysed, with the results of these measurements presented in **Table 4.2**

Table 4.2 Unattended Noise Measurement Results of Freight Rail Pass-bys

Date & Time	Freight Pass-by Duration [HH:MM:SS]	Measured L_{AFmax} of Train Pass-by [dB][1]	Measured L_{Aeq} of Train Pass-by [dB][1]
Day-time & Evening Freight Rail Pass-bys			
9/06/2026 15:43	0:00:52	71.7	64.9
9/06/2026 16:06	0:01:08	71.9	65.7
9/06/2026 18:53	0:01:50	72.9	64.6
9/06/2026 19:27	0:02:28	75.2	65.7
10/06/2026 13:33	0:01:25	75.7	67.3
10/06/2026 17:30	0:00:57	77.2	68.5
10/06/2026 18:19	0:01:18	71.4	67.8
10/06/2026 21:47	0:00:49	73.5	66.2
11/06/2026 9:44	0:01:02	77.5	66.8
11/06/2026 19:46	0:01:18	72.2	66.3
11/06/2026 21:31	0:01:55	81.1	68.6
12/06/2026 12:39	0:01:45	75.2	65.7
Avg L_{AFMax} Noise Level		**76**	**-**
Avg L_{Aeq} Noise Level		**-**	**67**
Night-time Freight Rail Pass-bys			
9/06/2026 23:46	0:03:55	72.0	61.9
10/06/2026 1:30	0:02:10	78.3	67.5
10/06/2026 4:33	0:01:25	70.9	66.0
10/06/2026 23:03	0:02:10	71.3	66.8
10/06/2026 23:07	0:01:35	78.0	65.2
11/06/2026 2:14	0:02:10	75.1	65.3
11/06/2026 6:05	0:02:27	69.6	62.4
11/06/2026 6:13	0:01:52	70.9	62.4
11/06/2026 22:34	0:02:39	83.7	65.2
12/06/2026 3:32	0:02:05	77.0	64.2
12/06/2026 6:08	0:01:45	82.4	68.3
Avg L_{AFMax} Noise Level		**78**	**-**
Avg L_{Aeq} Noise Level		**-**	**65**

A review of the current Metro North West & Bankstown Line timetable indicates metro pass-bys occur up to 30 times per hour during the day-time and evening time periods, and up to 12 times per hour during the night time period.

Based on the unattended noise monitoring, Acoustic Dynamics notes that the frequency of freight rail pass-bys within one hour period varies between 2 - 4 freight train pass-bys. Additionally, the duration of the freight train pass-by varies, with noise events as short as one minute and as long as three minutes. Acoustic Dynamics has conservatively calculated the noise levels received from freight train pass-bys on a maximum of 4 trains per hour during any time period, with an average duration of approximately two minutes.

Due to the relatively short duration of the train pass-by events, the $L_{Aeq(16\ hr)}$, $L_{Aeq(8\ hr)}$ and $L_{Aeq(1\ hr)}$ sample periods may not adequately describe the intrusiveness of the associated noise nor do they convey the potential for sleep disturbance.

To ensure the acoustic amenity of residents is protected during a pass-by event, Acoustic Dynamics advises the construction of bedrooms should be designed to ensure the internal noise levels comply with an internal maximum noise objective of $\mathbf{L_{AMax} \leq 55}$, in accordance with the NSW EPA's guidelines on managing sleep disturbance. Acoustic Dynamics has assessed to the lower extent of the NSW EPA's sleep disturbance guidelines (i.e. $\mathbf{L_{AMax} \leq 50}$) to achieve a higher level of acoustic amenity.

Based on the results of the operator-attended measurements, Acoustic Dynamics advises the following maximum $L_{Aeq(1\ hr)}$ and L_{AMax} noise levels have been determined for the most exposed facades of the proposed development and include attenuation due to distance loss, topography and shielding from the noise barrier along the railway line.

Note that facades located further away or not directly exposed to the railway line will experience lower noise levels than at the facades direct to the railway line.

Table 4.3 Determined Maximum Noise Levels at Development Facade

Location	Time Period	Determined $L_{Aeq(1\ hr)}$ Noise Level [dB]		Determined L_{AFMax} Noise Level [dB]	
		Passenger	Freight	Passenger	Freight[1]
8 Hampden St Hurlstone Park	Day	60	58	73	78
	Night	56	57		

Note: 1) Value determined from the measured L_{AFMax} given in **Table 4.2,** with the higher value adopted.

4.2 INTERNAL DESIGN SOUND LEVELS

The internal design sound level for a particular area of the subject development is the maximum permissible $L_{Aeq(1hr)}$ noise level within that area, with external windows and doors closed.

The internal design sound levels applicable to the critical areas of the proposed development have been determined in accordance with the criteria and guidelines of NSW Guidelines and Australian Standards, and are presented in **Table 4.3** below.

Table 4.4 Internal Design Sound Levels

Room type	Maximum Internal Noise Level $L_{Aeq,1hr}$ [dB]	Time Period
Sleeping areas	35	Between 10:00pm and 7:00am
Living areas	40	At any time

Further, **maximum** internal noise levels to the bedrooms of the proposed development have been determined in accordance with the sleep disturbance guidelines provided by the NSW EPA, and presented in **Table 4.5** below.

Table 4.5 Maximum Internal Design Sound Levels (Sleep Disturbance)

Room type	Maximum Internal Noise Level L_{Amax} [dB]	Time Period
Sleeping areas	50 to 55	Between 10:00pm and 7:00am

A summary of the internal design noise level objectives and the required Rail Traffic Noise Reduction (TNR) is provided in **Table 4.6**.

Table 4.6 Summary of Required TNR's

Room type	Time Period	Max Internal Noise Level Objective [dB]		Determined Noise Level [dB][1]	Required TNR [dB]
Sleeping areas	Between 10:00pm and 7:00am	$L_{Aeq,1hr}$	35	57	22
		L_{Amax}	50	78	28
Living areas	At any time	$L_{Aeq,1hr}$	40	60	20

Note: 1) Value taken as the higher value between metro or freight train pass-by, based on **Table 4.3**.

Note is made that sleeping areas have been assessed in accordance with the lower extent of the L_{Amax} internal noise levels outlined by the NSW EPA with regards to sleep disturbance, for an improved level of acoustic amenity.

4.3 TRAFFIC NOISE REDUCTION (TNR)

Based on the measured noise levels at the subject site presented above, Acoustic Dynamics has calculated the maximum external noise level generated by rail traffic, at the most exposed facades of the proposed development.

The Rail Traffic Noise Reduction is the level (measured in decibels) of rail traffic noise attenuation required to satisfy the relevant criterion. It is used to evaluate the suitability of building components to achieve the required noise reduction.

The TNR is determined by subtracting the **internal design sound level** for the internal spaces from the **maximum external rail traffic noise level** at the facade of each area.

The TNRs required for habitable and non-habitable areas have been determined for the proposed development. The weighted sound reduction indexes (R_w's) for building components to be used in each area, have been calculated based on the information provided in the proposed architectural drawings and are presented in **Table 4.7**.

Table 4.7 Noise Attenuation & R_w Requirements for Building Components

Area	Indoor Design Sound Level [dB(A)][1]	Calculated Max External Noise Level [dB(A)][1,2]	Req'd TNR [dB(A)]	Required Component Noise Attenuation[2]					
				Walls		Windows / Doors		Roof	
				TNA_c	R_w	TNA_c	R_w	TNA_c	R_w
Kitchen, Living & Dining Area	40	60	20	22	28	**D02** 6 **W03** 11 **D01** 20	12 17 26	18	24
Kitchen, Living & Dining Area	40	60	20	22	28	**W04** 15 **W01** 9 **W02** 8 **W07** 20	21 15 14 26	18	24
Master Bedroom & Sunroom	50	78	28	28	34	**Glass Bricks** 20 **W05** 31 **W06** 22	26 37 28	34	40

Note: 1) Maximum indoor design sound level based on AS 2107 maximum recommended design sound level for apartments near major roads. These values are also consistent with the SEPP criteria. See **Table 2.1**.

2) The Calculated Maximum External (Rail) Traffic Noise Levels for the living room are $L_{Aeq(1\ hr)}$ noise levels, based on the measured noise levels, and include adjustments to take account of distance losses and shielding.

Further, Australian Standard 3671 provides the following note:

> *"Either STC or R_W may be used as a guide to the selection of components able to provide a desired TNA_c value, provided that approximate allowance is made for the spectral composition of the noise as follows-*
>
> $$TNA_c \approx R_w - 6 \text{ or } R'_w - 6"$$

During peak periods of high traffic noise levels, the calculated noise levels within some of the rooms for any potential development may exceed the relevant internal noise level criteria by more than 10 dB, with the windows and/or glass doors open.
Acoustic Dynamics recommends that consideration be given to installing air-conditioning systems to service the dwelling. This will provide the option for mechanical ventilation of the dwelling, and provide building occupants with the option to leave external doors and windows closed, during peak periods of high traffic noise levels.

Construction systems and materials should be selected to provide the required design noise reduction shown in **Table 4.3** for the respective areas within the development.

4.4 VIBRATION EMISSION LEVELS

The results for the vibration levels measured within the premises above are presented within **Table 5.3**. The measured Vibration Dose Values (VDVs) of each freight rail pass-by are presented, along with the vibration emission objectives for intermittent vibration, in accordance with the NSW EPA criteria.

Unattended vibration monitoring was completed at the rear yard of the subject site between 9 June 2026 and 12 June 2026. A peak vibration level of 0.20 mm/s was set for the vibration monitor. If a freight pass-by causes an excitation that generates a peak vibration response larger than 0.20 mm/s, a waveform event is captured.

The vibration data within the frequency range of 1-80 Hz has been processed and assessed to the EPA's preferred and maximum VDVs.

Table 4.8 Calculated Vibration Dose Values (VDVs) (1-80Hz) & Objectives (Freight Rail Pass-bys)

Date	Time	Freight Event	Calc'd VDV (1-80 Hz) [mm/s$^{1.75}$]	Calc'd Total VDV (1-80 Hz) [m/s$^{1.75}$][1]	NSW EPA Criteria[2]		Complies?
					Preferred [m/s$^{1.75}$]	Max [m/s$^{1.75}$]	
9/06/2026	16:07:01	1	8.452	0.02	0.13	0.26	**Yes**
9/06/2026	16:57:31	2	11.393				
9/06/2026	18:53:18	3	12.010				
10/06/2026	0:17:24	4[3]	8.700				

Date	Time	Freight Event	Calc'd VDV (1-80 Hz) [mm/s$^{1.75}$]	Calc'd Total VDV (1-80 Hz) [m/s$^{1.75}$][1]	NSW EPA Criteria[2]		Complies?
					Preferred [m/s$^{1.75}$]	Max [m/s$^{1.75}$]	
10/06/2026	0:17:46	4[3]	7.047				
10/06/2026	0:18:01	5	7.430				
10/06/2026	1:58:54	6	7.996				
11/06/2026	0:06:36	7[3]	11.090				
11/06/2026	0:06:40	7[3]	8.637	0.02	0.13	0.26	**Yes**
11/06/2026	0:06:46	7[3]	10.716				
11/06/2026	6:05:19	8[3]	11.419				
11/06/2026	6:05:22	8[3]	11.156				
12/06/2026	0:37:24	9[3]	9.264				
12/06/2026	0:37:32	9[3]	7.970				
12/06/2026	9:54:50	10[3]	7.072				
12/06/2026	9:54:53	10[3]	6.422				
12/06/2026	9:55:09	10[3]	7.247				
12/06/2026	9:55:18	10[3]	6.223				

Note: 1) Calculated as the total sum of all individual calculated VDV's within the dataset.

2) Night-time criteria for intermittent vibration have been applied. Achieving compliance with the night-time ensures compliance is achieved for the less stringent day-time period.

3) Acoustic Dynamics notes that these captured vibration waveforms are within the same freight pass-by event.

5 RECOMMENDATIONS & DESIGN ADVICE

Acoustic Dynamics' analysis and prediction calculations indicate the following recommendations should be incorporated into the proposed development, as a minimum, to ensure that the internal design sound levels are achieved.

5.1 EXTERNAL WALL SYSTEMS

Acoustic Dynamics understands that the wall construction of the proposed development is to be of lightweight steel sheet cladding and must achieve a minimum sound transmission performance of $\mathbf{R_w + C_{tr} \geq 28}$ in the living room and $\mathbf{R_w + C_{tr} \geq 34}$ in the bedroom.

The following tables detail the minimum external wall construction recommended to ensure the internal design sound levels at the proposed development are achieved.

Table 5.1 Recommended External Steel Sheet Cladding Wall System (R_w + C_{tr} 31)[1] (Living Room)

External Facade
1. Corrugated Steel sheet cladding minimum 0.42mm BMT; to 2. One (1) layer of Bradford Enviroseal™ Wall Wrap (or equivalent); to 3. One (1) layer of 13mm Gyprock Fyrchek MR™ Plasterboard; to
Framing & Insulation
4. Minimum 90mm timber studs at 600mm maximum centres; with 5. Minimum 90mm Bradford Gold Batts™ R2.0 Insulation (or equivalent); to
Internal Lining
6. One (1) layer of 10mm Gyprock Plus™ Plasterboard (living areas); or One (1) layer of 10mm Gyprock Aquachek™ Plasterboard (wet areas).

Note: 1) External wall system adapted from system number CSR 5605(b) in *CSR Redbook (2026)*. Refer to CSR Redbook for more information.

2) Wall system ratings have also been predicted using *Insul Sound Transmission Prediction Software (2017) Version 9.0.23*. Acoustic Dynamics notes a margin of error is generally within R_w ± 3 dB.

Table 5.2 Recommended External Steel Sheet Cladding Wall System (R_w + C_{tr} 35)[1] (Bedroom)

External Facade
1. Corrugated Steel sheet cladding minimum 0.42mm BMT; to 2. One (1) layer of Bradford Enviroseal™ Wall Wrap (or equivalent); to 3. One (1) layer of 13mm Gyprock Fyrchek MR™ Plasterboard; to
Framing & Insulation
4. Minimum 90mm timber studs at 600mm maximum centres; with 5. Minimum 90mm Bradford Gold Batts™ R2.0 Insulation (or equivalent); to
Internal Lining
6. One (1) layer of 16mm Gyprock Fyrchek™ Plasterboard (living areas);

Note: 1) External wall system adapted from system number CSR 5608(c) in *CSR Redbook (2026)*. Refer to CSR Redbook for more information.

2) Wall system ratings have also been predicted using *Insul Sound Transmission Prediction Software (2017) Version 9.0.23*. Acoustic Dynamics notes a margin of error is generally within R_w ± 3 dB.

Acoustic Dynamics understands that the existing wall construction in both the living room and bedroom consists of a lightweight timber structure with fibre cement sheet cladding. Acoustic Dynamics recommends that an inspection of the existing walls be undertaken, to confirm that the quality of the construction is of a high standard.

Further to the minimum specifications above, Acoustic Dynamics advises the external facades must be installed in consideration of the following:

1. The acoustic performance of external wall systems can be reduced by penetrations for various components such as plumbing and electrical switches;

2. Any sound flanking paths or airgaps around structural, plumbing, and electrical components must be sealed airtight with a fire rated mastic sealant such as Gyprock Fire Mastic™ or CSR FireSeal™ to provide adequate acoustic insulation; and

3. Acoustic Dynamics recommends that consideration be given to installing air-conditioning systems to service the dwelling. This will provide the option for mechanical ventilation and provide building occupants with the option to leave external doors and windows closed during peak periods of high external noise levels.

Acoustic Dynamics advises that the acoustic integrity of an external wall system is dependent on **high quality installation**. If well-constructed, the external wall systems detailed above are expected to achieve an acceptable design sound transmission performance for the various areas of the development.

5.2 ROOF SYSTEMS

Acoustic Dynamics understands that the roof construction of the proposed development is to be of low-pitched steel sheeting and must achieve a minimum sound transmission performance of $\mathbf{R_w + C_{tr} \geq 24}$ in the living room and $\mathbf{R_w + C_{tr} \geq 40}$ in the bedroom.
The following tables detail the minimum roof construction recommended to ensure the internal design sound levels at the proposed development are achieved.

Table 5.3 Recommended Low-Pitched Steel Roof System ($R_w + C_{tr}$ 36)[1] (Living Room)

Roofing
1. Steel sheet roof minimum 0.42mm BMT; over 2. 60mm Bradford Anticon™ R1.3 roof blanket (or equivalent); over 3. 40mm timber battens; over
Framing & Insulation
4. Ceiling joists or trusses at 600mm maximum centres; with 5. Minimum 140mm Bradford Gold Batts™ R2.5 Insulation (or equivalent); to
Internal Lining
6. One (1) layer of 10mm Gyprock HD™ Plasterboard (over living areas); or One (1) layer of 10mm Gyprock Aquachek™ Plasterboard (over wet areas).

Note: 1) Roof system adapted from system number CSR 10194(a) in *CSR Redbook (2026)*. Refer to CSR Redbook for more information.

Table 5.4 Recommended Low-Pitched Steel Roof System ($R_w + C_{tr}$ 42)[1] (Bedroom)

Roofing
1. Steel sheet roof minimum 0.42mm BMT; over 2. 60mm Bradford Anticon™ R1.3 roof blanket (or equivalent); over 3. 40mm timber battens; over
Framing & Insulation
4. Ceiling joists or trusses at 600mm maximum centres; with 5. Minimum 215mm Bradford Gold Batts™ R4.1 Insulation (or equivalent); to
Internal Lining
6. One (1) layer of 13mm Gyprock Fyrchek™ Plasterboard; to 7. One (1) layer of 16mm Gyprock Fyrcheck™ Plasterboard (any order) (over living areas); or One (1) layer of 13mm Gyprock Aquachek™ Plasterboard (over wet areas).

Note: 1) Roof system adapted from system number CSR 6644(c) in *CSR Redbook (2026)*. Refer to CSR Redbook for more information.

Further to the minimum specifications above, Acoustic Dynamics advises the roof systems must be installed in consideration of the following:

1. The acoustic performance of roof and ceiling systems can be reduced by penetrations for various components such as downlights;

2. Any sound flanking paths or airgaps around structural, plumbing, and electrical components must be sealed airtight with a fire rated mastic sealant such as Gyprock Fire Mastic™ or CSR FireSeal™ to provide adequate acoustic insulation;

3. Except for penetrations for down lights, for which Acoustic Dynamics recommends the inclusion of acoustic cones within the ceiling space, Acoustic Dynamics recommends that specific advice be sought for any such penetrations;

4. Fireproof downlight cones can also be used however care should be taken when using these as manufacturers advise that downlights and their transformers need space for heat to escape and should not be covered; and

5. It is recommended that LED downlights be used where possible.

Acoustic Dynamics advises that the acoustic integrity of a roof and ceiling system is dependent on **high quality installation**. If well-constructed, the roof systems detailed above are expected to achieve an acceptable design sound transmission performance for the various areas of the development.

5.3 WINDOWS AND GLASS DOORS

The following table sets out the minimum required glazing for the various glazed components associated with the proposed alterations within the development and have been recommended based on the architectural drawings and specifications provided.

Table 5.5 Development Glazing Schedule Requirements

Window/ Door	Min. Required $R_W + C_{tr}$ of Glazing	Minimum Recommended Glazing	
		Single Glazed Option	Double Glazed Option
D01	≤ 29	6.38mm Laminated	10mm Annealed / 12mm Gap / 4mm Annealed
D02	≤ 29	6.38mm Laminated	10mm Annealed / 12mm Gap / 4mm Annealed
W01	≤ 29	6.38mm Laminated	10mm Annealed / 12mm Gap / 4mm Annealed
W02	≤ 29	6.38mm Laminated	10mm Annealed / 12mm Gap / 4mm Annealed
W03	≤ 29	6.38mm Laminated	10mm Annealed / 12mm Gap / 4mm Annealed
W04	≤ 29	6.38mm Laminated	10mm Annealed / 12mm Gap / 4mm Annealed
W05	37	12.5mm Vlam Hush™	10mm VFloat™ / 16mm Gap / 10.5mm Vlam Hush™
W06	≤ 29	6.38mm Laminated	10mm Annealed / 12mm Gap / 4mm Annealed
W07	≤ 29	6.38mm Laminated	10mm Annealed / 12mm Gap / 4mm Annealed
Glass Bricks	≤ 29	6.38mm Laminated	10mm Annealed / 12mm Gap / 4mm Annealed

Note: 1) Minimum glazing has been specified to meet acoustic requirements. Acoustic Dynamics advises that some windows may also need to meet applicable safety standards. Additional advice should be sought to verify such requirements.

Further to the above minimum glazing requirements, Acoustic Dynamics advises the glazed systems must be installed in consideration of the following:

1. Any sound flanking paths (airgaps) around the windows, doors, framing components and wall structure must be sealed **airtight** to provide adequate acoustic insulation. All airgaps are to be sealed with a flexible mastic sealant;

2. Sliding doors should have a high performing wipe and sweep seal installed to form an **airtight seal** between the sliding door and the adjacent panel and stile. Appropriate sliding door wipe/gasket/sweep seals are:

    - Raven RP17B™ Sweep Seal with RP13™ Threshold Plate; or
    - Raven RP89™ Sweep Seal with RP116™ Threshold Plate;

NB: The use of brush seals or mohair seals **will not** provide acoustic benefit;

3. Operable windows should be fitted with a compressible perimeter seal to form an **airtight seal** when the window is closed. Appropriate compressible seals are:

    - Raven RP120™ Perimeter Seal;
    - Raven RP150™ Perimeter Seal; or
    - Raven RP500™ Series Window Strips;

4. It is advised that the acoustic performance of the selected glazing frames be confirmed with the suppliers, to ensure that the glazing and frame systems will achieve the minimum acoustic performance levels recommended above.

Acoustic Dynamics notes that louvred windows (W01) are proposed to be installed along the western facade in the living room. Generally, Acoustic Dynamics recommends installation of awning or casement windows as opposed to a sashless or louvred window, as awning and casement windows typically form an airtight seal when closed.

If there is a preference for louvred windows to be installed, Acoustic Dynamics recommends liaising with the glazing supplier to confirm that the acoustic performance of the louvred windows are capable of achieving the sound reduction requirements presented in **Table 5.5.** Acoustic Dynamics advises that Breezeway™ manufacture louvred windows that might achieve the performance requirement provided in **Table 5.5**. We recommend consulting with Breezeway to confirm whether their louvred product is suitable for this application, if this is desired.

Acoustic Dynamics advises that the acoustic integrity of glazed windows and door systems is dependent on **high quality installation**. If well-constructed, the glazed systems detailed above are expected to achieve an acceptable design sound transmission performance for the various areas of the development.

5.4 RESIDENTIAL ENTRY DOORS

To provide an adequate sound transmission performance, Acoustic Dynamics recommends that all entry door systems be constructed to achieve a minimum acoustic rating of **R_w 30**.

To achieve the required sound transmission performance, Acoustic Dynamics recommends the entry door system be installed in consideration of the following:

1. All residential entry doors must be **solid-core doors** and be a minimum thickness of **40mm**;

2. Compression type, silicon rubber **perimeter seals** are required to be installed around the head and jambs of the door frame. Appropriate perimeter seals include:

    - Raven RP10Si™; or
    - Raven RP78Si™;

3. Automatic, mechanically spring-loaded **door bottom seals** are required to seal the gap between the bottom of the door and the floor underneath. Appropriate door bottom seals include:

    - Raven RP8Si™; or
    - Raven RP35Si™;

4. Door frames must form an **airtight seal** with the adjacent wall to maintain the acoustic rating of the system. Sealants must be flexible, durable and have capacity to retain acoustic properties for the life of the design. Appropriate sealants are polyurethane or silicone based.

Acoustic Dynamics advises that the acoustic integrity of entry doors is dependent on **high quality installation**. If well-constructed, the entry door system detailed above is expected to achieve an acceptable design sound transmission performance.

5.5 VIBRATION CONSTRUCTION ADVICE

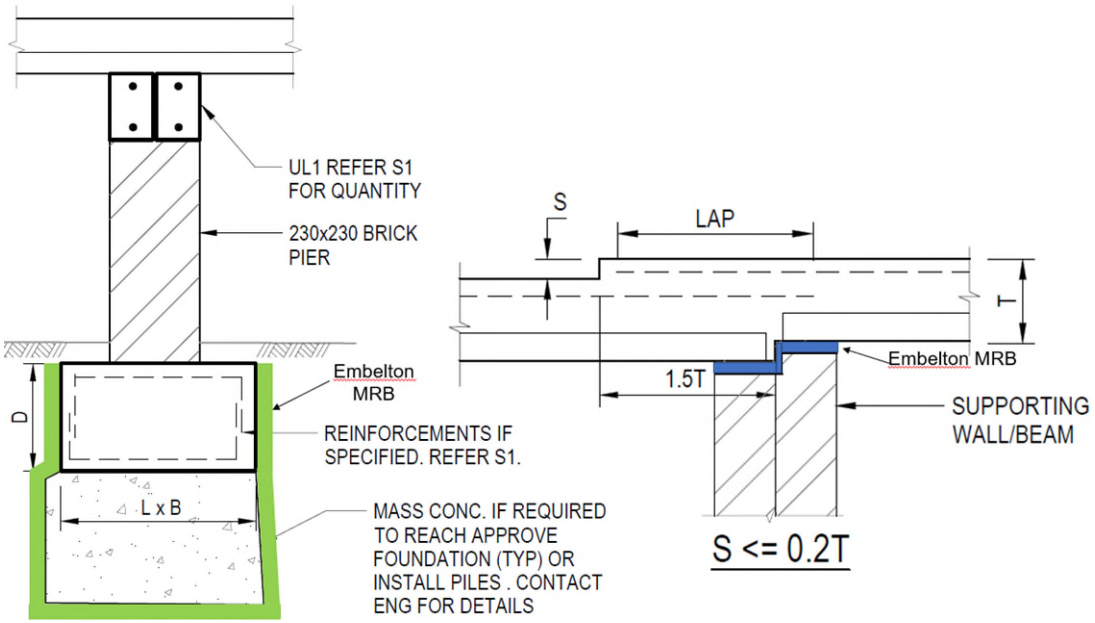
Based on the measured vibration emission levels in **Section 4.4**, Acoustic Dynamics advises that the calculated Vibration Dose Values (VDV's) are below the NSW EPA's vibration emission criteria for intermittent vibration, and unlikely to cause significant disturbance to building occupants. Given the results of the vibration measurements and understanding that there are no significant changes to the building structure, Acoustic Dynamics advises that additional measures to mitigate the level of ground-borne vibration would not result in significant improvements.

Should there be works seeking to mitigate ground-borne vibration further, Acoustic Dynamics recommends the installation of building isolation products, to absorb any structure-borne vibration generated by train pass-bys.

Embelton Multi-Plate Rubber Bearings are recommended to be installed beneath the footings of the concrete columns. Where the beams rest on the footings and existing structure, similar vibration isolation products should be installed to decouple the beams from the existing building structure. An example may be two to three layers of Embelton Acoustic Shearflex pads or Multi-Plate Rubber Bearings between the beam and the surrounding structure.

Acoustic Dynamics recommends a suitably qualified structural engineer liaise with Embelton to assist with product selection, based on the load requirements for the subject deck. **Figure 5.1** provides an example of how building isolation products are installed for a slab construction.

Figure 5.1 – Example of Installed Building Isolation Products in a Slab Construction



5.6 BUILDING MATERIAL CERTIFICATION

Acoustic Dynamics advises that all building materials specified must be tested and certified by a locally recognised and accepted testing agency in respect of their intended use. Where appropriate, materials and noise mitigation measures specified by Acoustic Dynamics must be certified by a locally recognised (qualified) and accepted professional for suitability (structural, wind loading, or other) for the intended use.

6 CONCLUSION

Acoustic Dynamics has conducted an assessment of external noise intrusion and vibration emission into the proposed residential development at 8 Hampden Street, Hurlstone Park, NSW. A review of applicable noise standards and local authority noise criteria has been conducted.

Noise levels were assessed in accordance with the requirements of:

(a) Canterbury-Bankstown Council;
(b) NSW Policies and Legislation;
(c) NSW Department of Planning & Infrastructure; and
(d) Australian Standards.

The performance of the building components proposed for use in the development have been assessed to determine their suitability for achieving compliance with the noise criteria.

The assessment examined all facades exposed to noise intrusion. The minimum construction requirements have been determined for each area, allowing the selection of components to be optimised for the respective areas within the development.

Recommendations and design advice have been provided in **Section 5** for construction systems and materials to be incorporated into the building design. Should alternative construction systems and materials be selected, the selected construction systems should meet the required design noise reduction values shown in **Table 4.7** for the respective areas within the development.

Acoustic Dynamics advises that the incorporation of these report recommendations into the construction of the proposal will achieve compliance with the relevant acoustic design requirements of Canterbury-Bankstown Council, NSW Guidelines and relevant Australian Standards.

Acoustic Opinion

Further to our review of the architectural drawings, proposed construction materials, our review of the relevant acoustic criteria and requirements, our analysis and calculations, Acoustic Dynamics advises that the proposed development has been designed and constructed to comply with the relevant acoustic criteria of Canterbury-Bankstown Council, State Environmental Planning Policies and Australian Standards.

We trust that the above information meets with your present requirements and expectations. Please do not hesitate to contact us on 02 9908 1270 should you require more information.

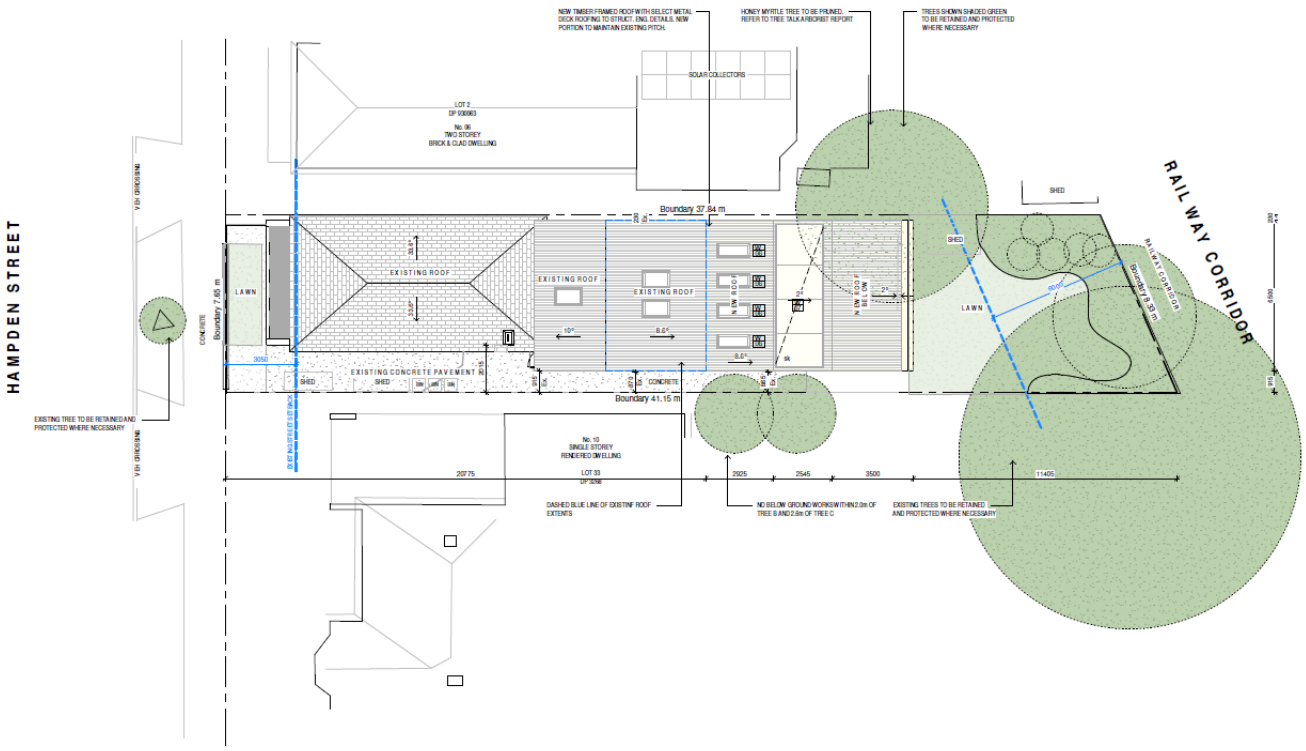
APPENDIX A — LOCATION MAP, AERIAL IMAGE AND DRAWINGS

A.1 LOCATION MAP (COURTESY OF SIX MAPS)

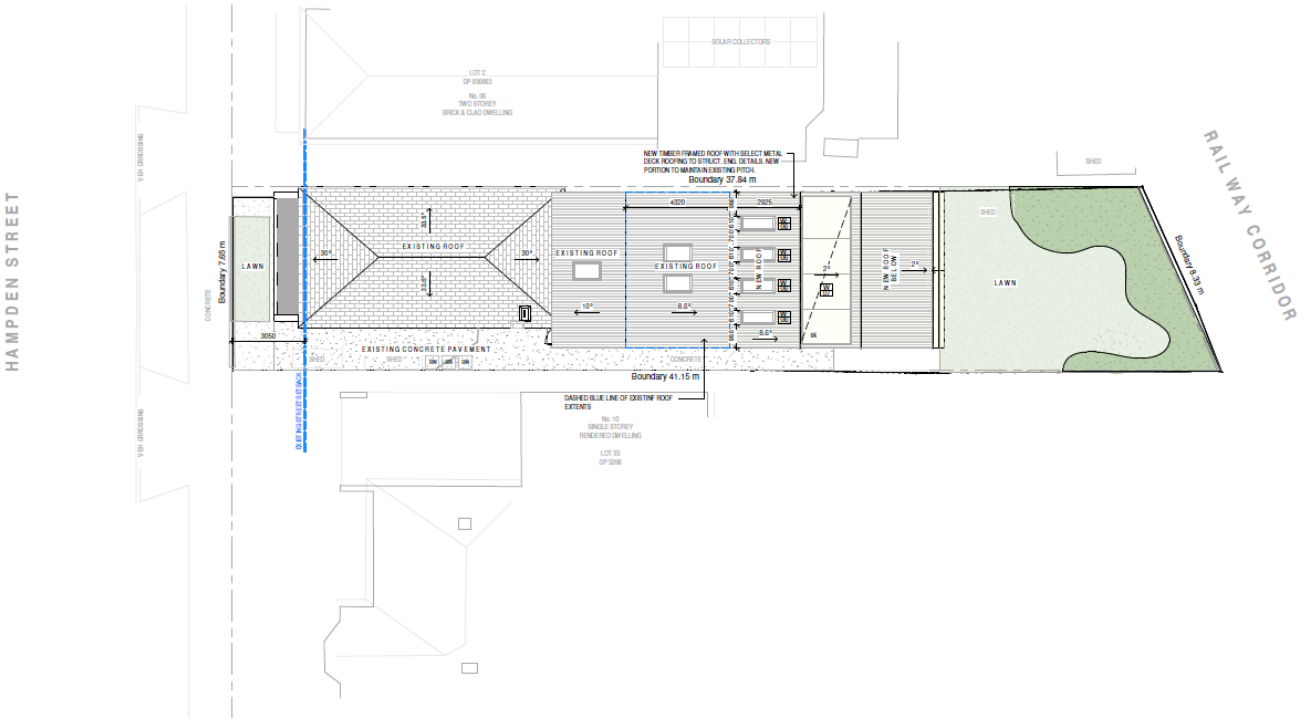
A.2 AERIAL IMAGE (COURTESY OF SIX MAPS)

A.3 ARCHITECTURAL PLANS (COURTESY OF MASON PROJECTS)

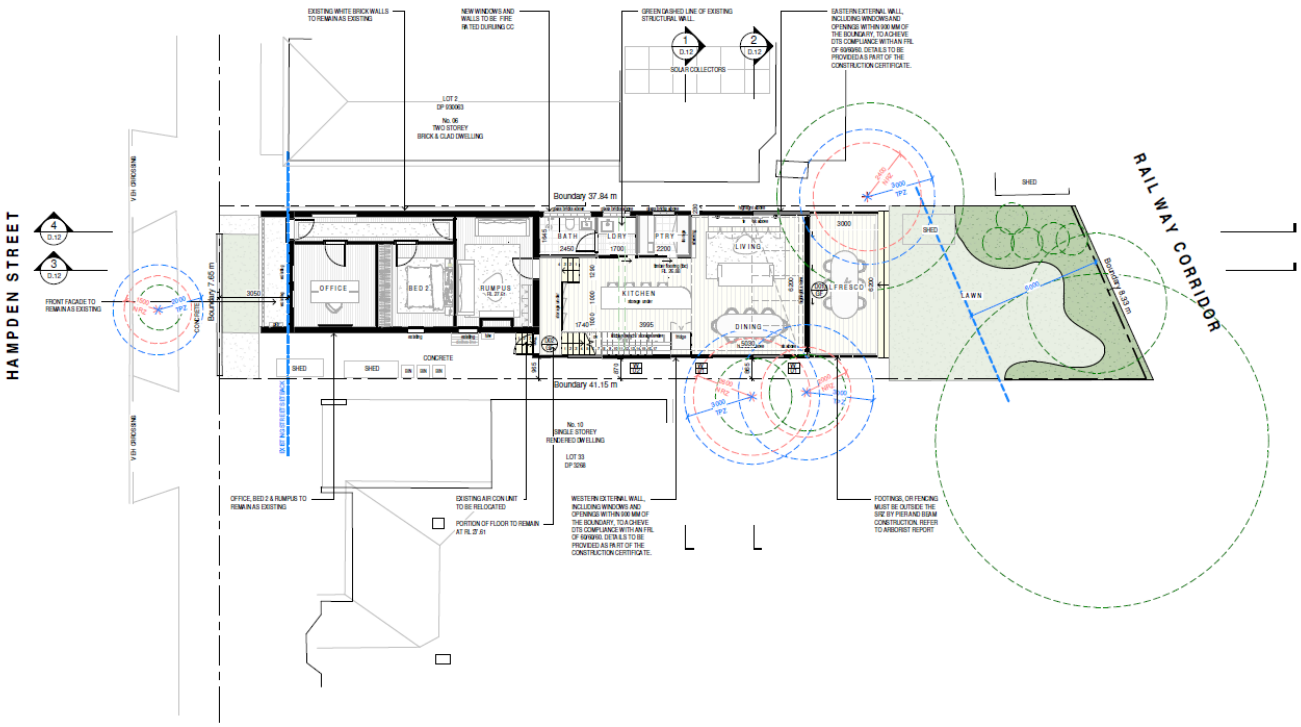
A.3.1 SITE PLAN



A.3.2 ROOF PLAN



A.3.3 GROUND FLOOR PLAN



A.3.4 FIRST FLOOR PLAN