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Acoustical Assessment Alterations and Additions to Approved Mixed Use Development

At: -

1A Hill Street (Cnr 105 Forest Road),
Hurstville, NSW 2220

Prepared for: -

TQM Design and Construct
C/- Design Workshop Australia Pty.
91a Princes Highway
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Reference: 2506005E-R

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Environmental
Acoustics

Occupational
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Design Workshop Australia Pty Ltd on behalf of TQM Design and Construct Pty. Ltd. commissioned Harwood Acoustics Pty. Ltd. to carry out an Acoustical Assessment for alterations and additions to an approved mixed-use development to be constructed at 1A Hill Street, cnr Forest Road, Hurstville, NSW.

The development will comprise twenty (20) levels of residential apartments above ground floor commercial premises and basement car parking.

This acoustical assessment considers noise intrusion into the proposed development from passing road and rail traffic and provides advice relating to compliance with the acoustical provisions of Part F7 of the Building Code of Australia 2022.

Accordingly, Harwood Acoustics Pty Ltd has prepared this report for the exclusive use of the Client identified on the title page. The report is prepared in accordance with the brief and scope of works agreed between the Client and Harwood Acoustics Pty Ltd and may not be suitable for use beyond that scope.

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TABLE OF CONTENTS

1.	INTRODUCTION AND SUMMARY	4
2.	SITE AND DEVELOPMENT DESCRIPTION	5
2.1	Site Description	5
2.2	Development Description	6
3.	acoustical criteria AND NoiSE DESIGN GOALS	9
3.1	Georges River Council	9
3.2	NSW EPA’s Noise Guide for Local Government	9
3.3	NSW EPA’s Noise Policy for Industry 2017 Amenity Noise Levels	9
3.4	Measured Background Noise Levels	10
3.5	Clause 2.100 - State Environmental Planning Policy (Transport & Infrastructure) 2021	11
3.6	Clause 2.120 - State Environment Planning Policy (Transport & Infrastructure) 2021	11
3.7	Train Vibration Criteria	12
3.8	NSW Department of Planning, Industry and Environment	12
3.9	Project Specific Noise Goals	12
4.	EXTERNAL ROAD AND RAIL NOISE LEVELS	13
5.	EXTERNAL NOISE INTRUSION	14
5.1	Noise Modelling Methodology	14
5.2	Building Construction Recommendations	15
5.2.1	Walls	15
5.2.2	Ceiling and Roof System	15
5.2.3	Windows and Glazed Doors	15
5.3	Mechanical Ventilation Requirements	15
6.	BCA Acoustical ASSESSMENT	17
6.1	Building Code of Australia (BCA)	17
6.2	AAAC Apartment and Townhouse Acoustic Rating Guide (2017)	18
6.3	Initial Construction Recommendations	19
6.3.1	Floors	19
6.3.2	Walls	21
6.3.3	Services	22
7.	MECHANICAL PLANT NOISE	26
8.	CONCLUSION	26

1. INTRODUCTION AND SUMMARY

Design Workshop Australia Pty Ltd on behalf of TQM Design and Construct Pty. Ltd. commissioned Harwood Acoustics Pty. Ltd. to carry out an Acoustical Assessment for alterations and additions to an approved mixed-use development to be constructed at 1A Hill Street, cnr Forest Road, Hurstville, NSW.

A development application for a previous development on the Site was approved by Hurstville City Council (via the Joint Regional Planning Panel) in November 2012, reference 12/DA-132 for a 7 – 13 storey mixed use development with basement car parking (the Approval). A Section 96 application was subsequently approved by Georges River Council in August 2017, reference MOD2017/0033 for alterations and additions to the 2012 approved development and an S4.55(1) modification application was subsequently approved in October 2021 reference Mod 2021/0067.

It is now proposed to seek approval for alterations and additions to the previously approved design via a new development application to the NSW housing Delivery Authority (HDA).

To date the following acoustical assessments were prepared for the Site:-

- Acoustic Assessment for Section 96 submission prepared by Koikas Acoustics Pty. Ltd. reference 2033R20170222mfc1AHillStHurstvillev4, dated February 2017 (the Koikas Report),
- Noise Intrusion Assessment prepared by Harwood Acoustics Pty. Ltd., reference 2209001T-R dated September 2022 (the 2022 NIA), and
- Acoustical Assessment prepared by Harwood Acoustics Pty. Ltd., reference 2209001T-R2 dated April 2024 (the 2024 NIA).

It is now proposed to seek approval for alterations and additions to the approved design which will include twenty (20) levels of residential apartments and roof top terrace above ground floor commercial premises and basement level car parking.

The Site is located on the southern side of Forest Road and the northern side of the South Coast Rail Line as shown in Figure 1. Given the proximity of the Site to the transport corridors it is a requirement of Georges River Council that a road and rail noise intrusion assessment be carried out.

The assessment is required to demonstrate compliance with the requirements of Clauses 2.100 (rail) and 2.120 (road) of the *State Environmental Planning Policy (Transport and Infrastructure) 2021* (the SEPP). The clauses set internal noise level criteria from road and rail noise emission. These are 35 dBA (L_{eq}) inside bedrooms between 10 pm and 7 am and 40 dBA (L_{eq}) inside all habitable spaces at any time.

The 2017 Koikas Report provides a comprehensive acoustical assessment addressing the potential for road and rail traffic noise intrusion, mechanical plant noise and acoustic privacy between units (under the then BCA 2016) for the proposal at the time. The Koikas Report is referenced in the current Development Consent for Development Application MOD2021/0067. It is a requirement of the consent, that prior to the issue of a construction certificate, certification is to be provided that the recommendations of the Koikas Report are satisfactorily incorporated into the design documentation.

However, the new design and layout and building materials proposed by the architect in the current application may differ slightly to those associated with the design at the time of approval.

As such this Report provides an updated acoustical assessment of the current proposal and includes advice in relation to compliance with the acoustical provisions of the current BCA 2022.

The external road and rail noise levels established in the Koikas Report are used in this assessment to address the potential for noise intrusion into the proposed apartments.

Recommendations are made in Section 5 of this Report to ensure the internal noise limits set by Council's Development Consent condition will be met in all residential apartments. Recommendations include an upgrade to thicker than standard glazing in some windows.

Recommendations are made in Section 6 of this report to address the BCA *Deemed-to-Satisfy Provisions* and / or *Performance Requirements* of Part F7 of the BCA 2022 for the construction of internal building elements.

2. SITE AND DEVELOPMENT DESCRIPTION

2.1 Site Description

The Site is located on the southern side of Forrest Road and the eastern side of Hill Street and Treacy Street. To the south of the Site is a railway corridor that accommodates the Illawarra and T4 Eastern Suburbs Rail lines.

The Site is bound to the east and southeast by multi-storey mixed-use buildings comprising residential apartments. To the west and southwest, across Hill Street, are additional multi-storey mixed-use residential buildings. To the north, across Forrest Road, are commercial premises. The nearest sensitive receivers are identified in Figure 1 below, with their corresponding addresses listed as follows:-

- 103 Forest Road
- 1 to 5 Treacy Street
- 144 Forest Road
- 97 Jack Brabam Drive
- 107 Forest Road
- 132 to 138 Forest Road

Receptors

- R1 represents the multi storey residential receptors bounding the Site to the Site to the east and those beyond,
- R2 represents the multi storey residential receptors bounding the Site to the south east,
- R3 represents the multi storey residential receptors across Hill Street to the west and those beyond,
- R4 represents the multi storey residential receptors across Hill Street to the north west and those beyond,
- R5 represents the St Georges Hurstville Anglican Church, and
- R6 represents the closest commercial premises across Forest Road

Compliance with the noise goals at the nominated receptors will ensure compliance at all receptors in the vicinity of the Site.

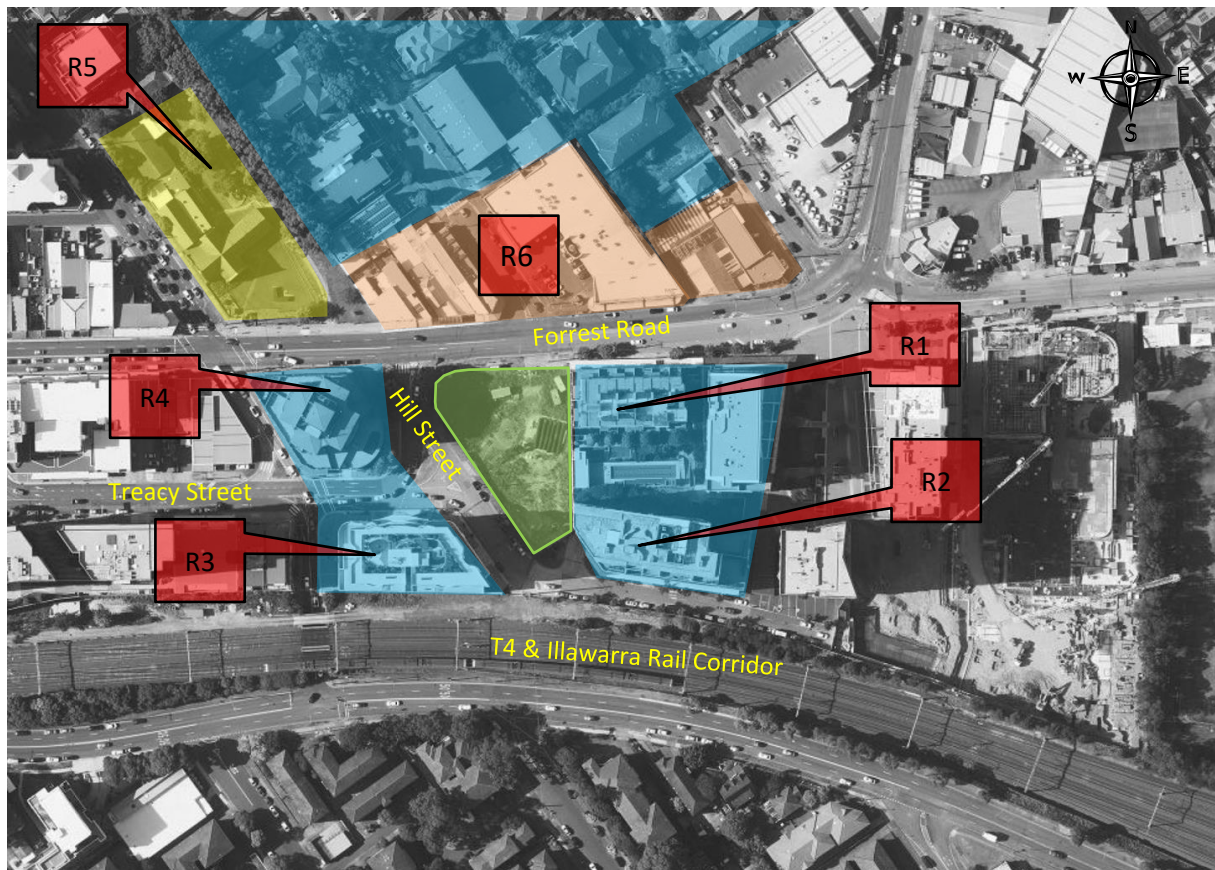


Figure 1. Location Plan – 1A Hill Street, Hurstville, NSW

(source: metromap.com.au ©)

	Development Site		Commercial Premises
	Residential Premises		Place of Public Worship

2.2 Development Description

The development will comprise twenty (20) levels of residential apartments with a roof top terrace above ground floor commercial tenancies and basement level car parking. A site plan and example floor plans are shown in Figures 2, 3 and 4 and full details can be seen in Design Workshop Australia Pty. Ltd.’s architectural drawings for project number 2867 dated July 2025.

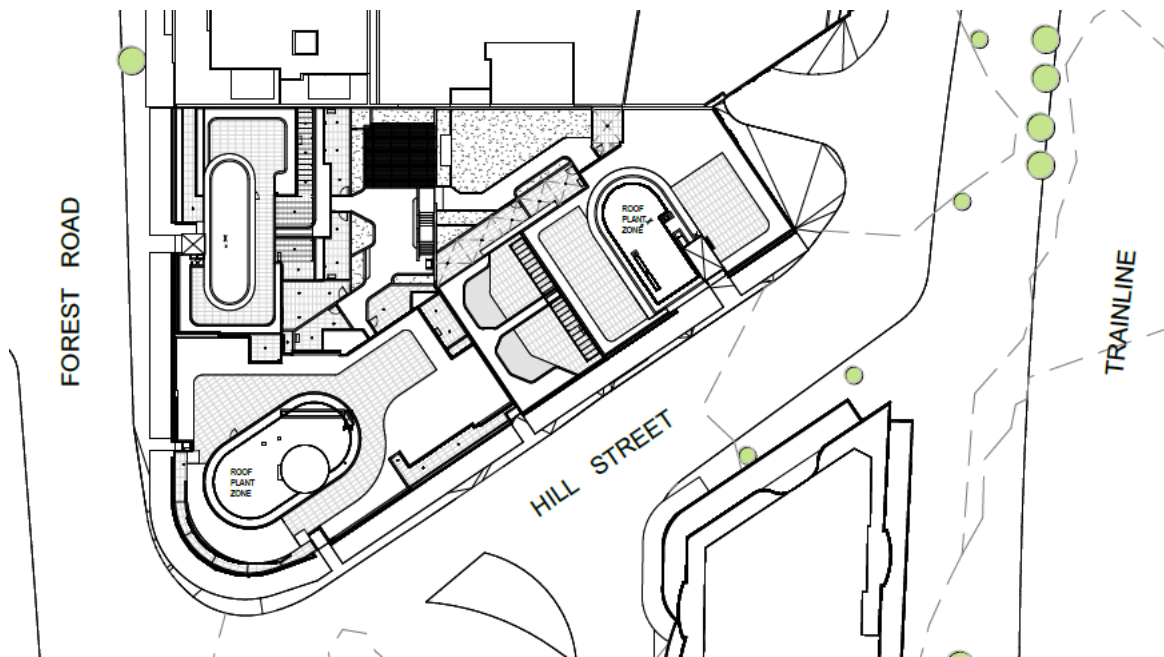


Figure 2. Site Plan

(source: Design Workshop Australia's Architectural Drawing 0.90 for Project Number 2867 dated July 2025)

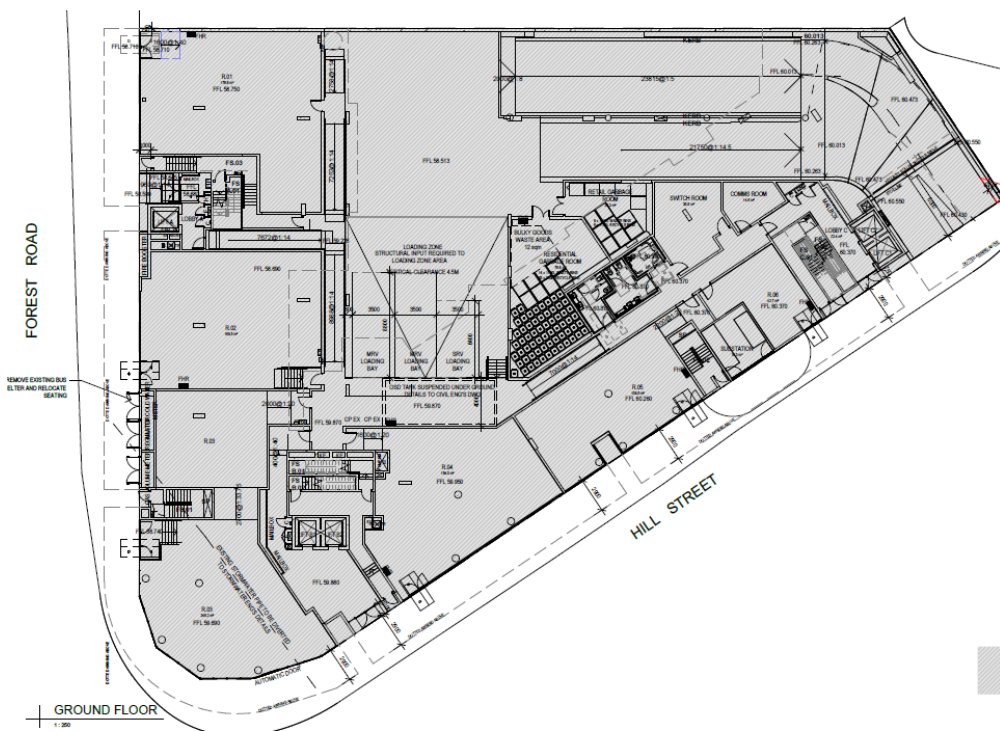


Figure 3. Ground Floor Plan

(source: Design Workshop Australia's Architectural Drawing 1.05 for Project Number 2867 dated July 2025)

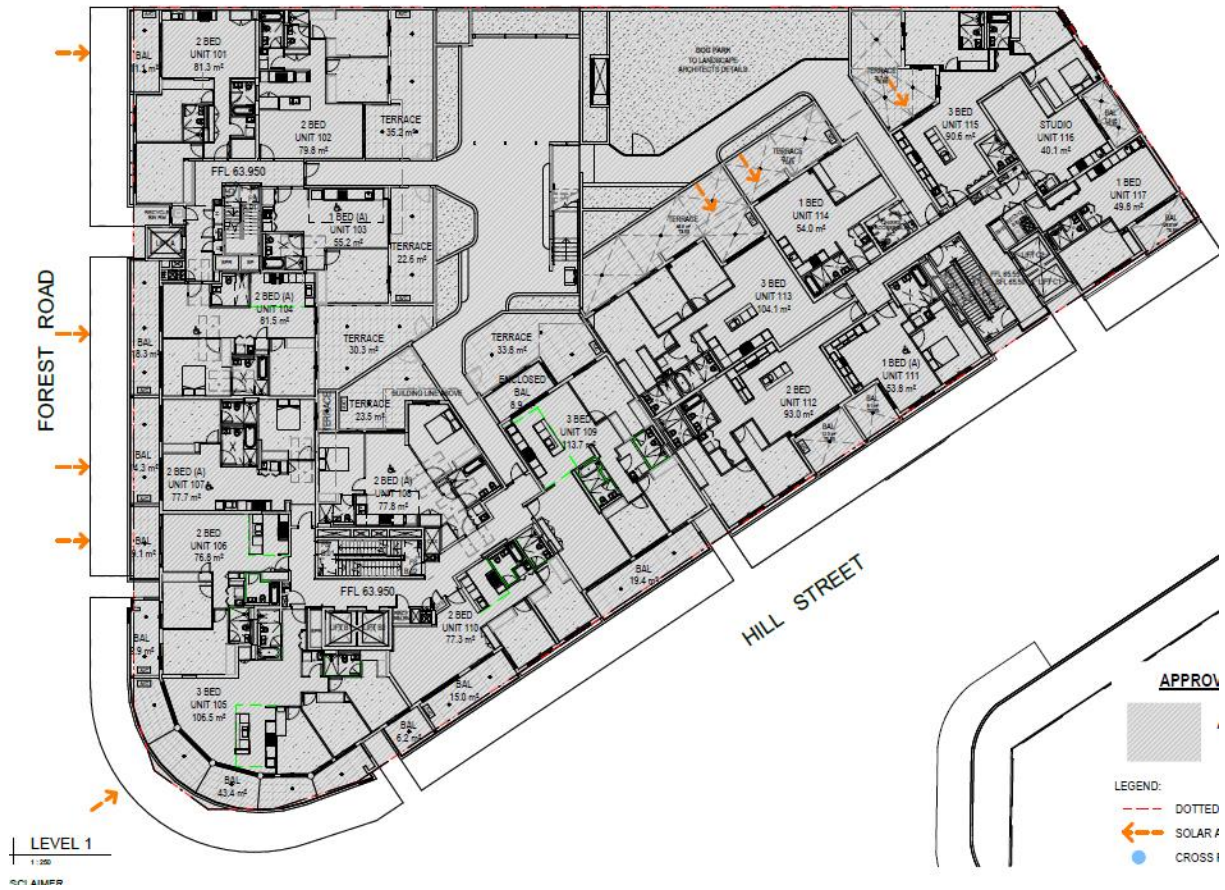


Figure 3. Level 1 Floor Plan

(source: Design Workshop Australia’s Architectural Drawing 1.06 for Project Number 2867 dated July 2025)

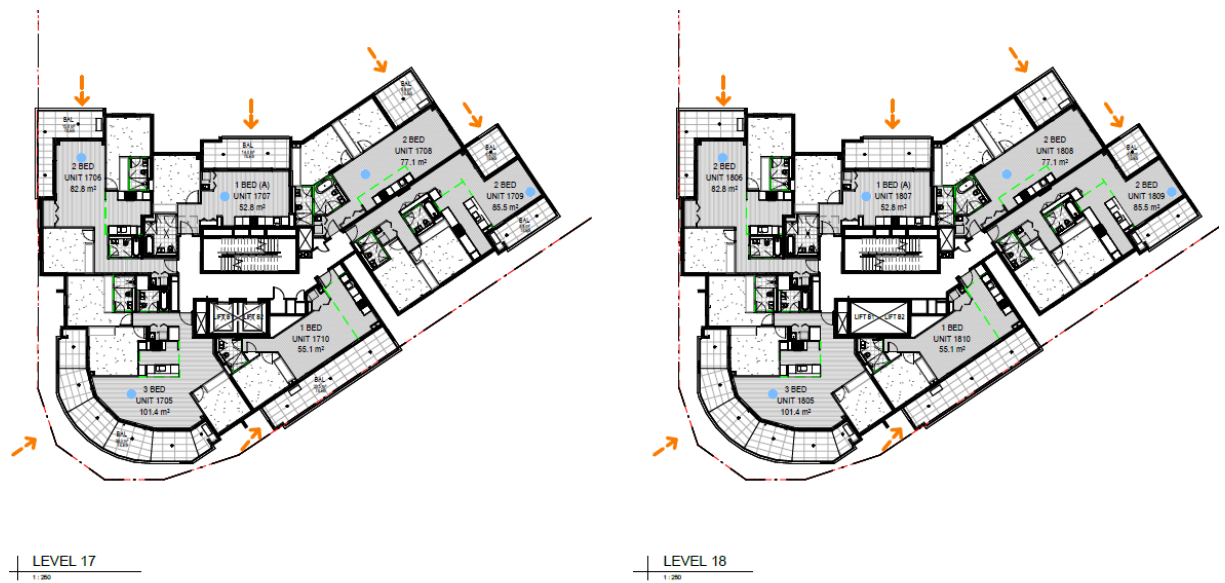


Figure 4. Levels 17 & 18

(source: Design Workshop Australia’s Architectural Drawing 1.19 for Project Number 2867 dated July 2025)

3. ACOUSTICAL CRITERIA AND NOISE DESIGN GOALS

This section outlines Development Consent conditions relating specifically to acoustical issues.

3.1 Georges River Council

It is a requirement of Georges River Council that consideration is given to the following acoustical matters:-

- noise emission arising from the operation of any mechanical plant servicing the building to impact existing receptors,
- consideration of noise intrusion into the future apartments from road and rail traffic in accordance with Clauses 2.100 (rail) and 2.120 (road) of the *Environmental Planning Policy (Transport and Infrastructure) 2021*.

3.2 NSW EPA's Noise Guide for Local Government

The Environment Protection Authority (EPA) published the *Noise Guide for Local Government* in June 2023 (the Guide). The Guide replaced the former 2013 version in January 2023 and provides practical guidance to council officers on day-to-day management of common neighbourhood noise problems. The Guide focuses on the regulation, assessment and management of neighbourhood noise issues, which generally are managed by councils. The Guide is not a statutory document but may help councils determine how to respond to noise issues in their area.

Part 2 of the Guide provides an overview of the legal framework for noise control in NSW and includes advice in relation to the assessment and management of a variety of specific noise sources and noise related issues that Council may encounter. These include, for example, agricultural noise, music venues, outdoor entertainment activities, air conditioners, heat pump hot water heaters and pool / spa pumps, shooting ranges, etc.

It is generally accepted that a noise source is generally considered to be intrusive if the noise from the source when measured over a 15-minute period ($L_{eq, 15 \text{ minute}}$), exceeds the background noise ($L_{90, 15 \text{ minute}}$) by more than 5 dB.

This criterion is derived from and are in keeping with the EPA's *Noise Policy for Industry 2017* and the policy is also used to establish noise goals for commercial receptors in vicinity of the Site as well as the preschool as detailed in Section 3.3.

3.3 NSW EPA's Noise Policy for Industry 2017 Amenity Noise Levels

The NSW Environment Protection Authority (EPA) published the *NSW Noise Policy for Industry* in October 2017 (NPfI).

The NPfI provides amenity noise levels which are useful to establish noise goals at non residential receptors, such as commercial premises, schools, child care centres, etc.

Relevant parts of EPA Table 2.2 of the NPfI are replicated in Table 1 below.

Table 1 Amenity Noise Levels (EPA Table 2.2)

Receiver	Noise Amenity Area	Time of Day	L _{Aeq} , dBA
(see Table 2.3 to determine which residential receiver category applies)			Recommended amenity noise level
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Place of worship – internal	All	When in use	40
Commercial premises	All	When in use	65

Relevant Notes:

Time of day is defined as follows:

- day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays
- evening – the period from 6 pm to 10 pm
- night – the remaining periods.
- Amenity noise levels are assessed over the entire period (i.e. day, evening or night) and to convert from a period level to a 15 minute noise level, the Policy recommends an addition of 3 dB.

3.4 Measured Background Noise Levels

In order to establish the noise goals, it is necessary to determine the background noise levels in the vicinity of all potentially affected residential Receptors.

The background noise level is defined by the EPA as ‘the underlying level of noise present in ambient noise when all unusual extraneous noise is removed’ and is considered to be represented by the L_{A90, 15 minute} descriptor. This is a statistical measure of the sound pressure level that is exceeded for 90 % of the time.

The Rating Background Level is the single-figure background noise level derived from monitoring L_{A90, 15 minutes} over a representative period of time. The Rating Background Level is established for the day, evening and night time periods and is used for assessment purposes.

It has not been practicable to undertake long term background noise measurements at the Site recently given the level of construction activity and resulting extraneous noise. However, as mentioned in the introduction, the Koikas Report referenced in the current development consent provides background noise levels for the establishment of noise goals for the operation of mechanical plant.

These are shown in Table 2 below.

Table 2 Rating Background Noise Levels – Hill Street, Hurstville

Period / Time of Day	Rating Background Level dBA (L _{90, 15 minute})	Existing Ambient Noise Levels dBA (L _{eq, 15 minute})
Day Time Period (7 am to 6 pm)	51	65
Evening Time Period (6 pm to 10 pm)	50	65
Night Time Period (10 pm to 7 am)	40	60

3.5 Clause 2.100 - State Environmental Planning Policy (Transport & Infrastructure) 2021

Clause 2.100 of Subdivision 2 under Division 15 states:-

“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 that is 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 centre.*

(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 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 L_{Aeq} levels are not exceeded:

- (a) in any bedroom in the building-35 dB(A) at any time between 10.00 pm and 7.00 am,*
- (b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)-40 dB(A) at any time.”*

3.6 Clause 2.120 - State Environment Planning Policy (Transport & Infrastructure) 2021

Clause 2.120 of Subdivision 2 under Division 17 states:-

“2.120 Impact of road noise or vibration on non-road development

(1) This section applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with annual average daily traffic volume of more than 20,000 vehicles (based on the traffic volume data published on the website of TfNSW) and that the consent authority considers is likely to be adversely affected by road noise or vibration:

- (a) residential accommodation,*
- (b) a place of public worship,*
- (c) a hospital,*
- (d) an educational establishment or centre-based child care centre.*

(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 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 L_{Aeq} levels are not exceeded:

- (a) in any bedroom in the building-35 dB(A) at any time between 10.00 pm and 7.00 am,
- (b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)-40 dB(A) at any time.”

(4) In this section, freeway, tollway or transitway have the same meaning as they have in Road ACT 1993.

3.7 Train Vibration Criteria

The Guidelines require that vibration levels emitted by passing trains comply with the criteria in the NSW EPA’s *Assessing Vibration: a technical guideline*.

The EPA published the *Assessing Vibration: a technical guideline* in February 2006. This guideline is based on the British Standard BS 6472:1992 *Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)*.

Compliance with this guideline will also ensure compliance with the Australian Standard AS 2670 *Evaluation of human exposure to whole-body vibration*.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques.

Table 2.4 of the guideline sets limits for ‘vibration dose values’ to assess vibration from intermittent sources, such as passing trains, and these are replicated in Table 3 below.

Table 3 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
Residences	0.20	0.40	0.13	0.26

¹ Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.

3.8 NSW Department of Planning, Industry and Environment

The NSW Department of Planning, Industry and Environment published the *Development Near Rail Corridors and Busy Roads – Interim Guidelines* in 2008 (the Guidelines). The Guidelines refer to the internal noise limits set by Clause 87 and in addition, states:-

“If internal noise levels with windows or doors open exceed the criteria by more than 10 dB, 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”.

3.9 Project Specific Noise Goals

When all the above factors are considered, the most relevant noise design goals are as shown in Table 4 below.

Table 4 Noise Design Goals for All Receptors

Noise Source / Receptor / Description	Assessment Criteria dBA		
	L _{eq} , 15 minute		
	Day Time (7 am to 6 pm)	Evening Time (6.30 to 7 am)	Night Time (6.30 to 7 am)
<i>Mechanical Plant Noise</i>			
All residential receptors	56 ¹	48 ²	43 ³
Non residential receptors	When in Use		
Anglican Church	50 ⁴		
Commercial Premises	63 ⁵		
<i>Noise Intrusion Into Future Apartments</i> ⁷	Day Time (7 am to 10 pm)	Night Time (7 am to 10 pm)	
Bedrooms	40	35	
All other habitable rooms	40	40	

Notes to Table 4:-

1. From measured day time Rating Background Level of 51 dBA + 5 dB,
2. From the Urban ,
3. From the recommended evening time noise amenity level for Urban amenity noise areas minus 5 dB to accommodate future noise sources, plus 3 dB for conversion to a 15 minute energy average sound pressure level (i.e. 50 - 5 + 3 = 48),
4. From the recommended night time noise amenity level for Urban amenity noise areas minus 5 dB to accommodate future noise sources, plus 3 dB for conversion to a 15 minute energy average sound pressure level (i.e. 45 - 5 + 3 = 43),
5. From the recommended internal noise level of 40 dBA + 10 dB to estimate an appropriate external noise level,
6. From the amenity noise level for commercial receptors of 65 dBA minus 5 dB to accommodate cumulative future noise sources plus 3 dB for conversion to a 15 minute energy average sound pressure level (i.e. 65 – 5 + 3 = 63),
7. From Clauses 2.100 & 2.120 of the *State Environmental Planning Policy (Transport & Infrastructure) 2021*.

4. EXTERNAL ROAD AND RAIL NOISE LEVELS

External road and rail noise levels established in the Koikas Report, referenced in the previous development consent are used in this assessment to address the potential for noise intrusion into the new apartments.

These are shown in Tables 5 and 6 below for the facades of the building closes to Forest Road and the rail corridor respectively.

Table 5 **L_{eq} Traffic Noise Levels – Closest façade to Forest Road**

Traffic Noise Levels	dBA	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
Daytime L _{eq, 15 hr}	69	51	53	58	65	67	52	59	54
Night-time L _{eq, 9 hr}	64	46	48	53	60	62	47	54	49

Table 6 **L_{eq} Rail Noise Levels – Closest façade to T4 & Illawarra Rail Corridor**

Traffic Noise Levels	dBA	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
Daytime L _{eq, 15 hr}	65	69	66	65	60	59	59	53	47
Night-time L _{eq, 9 hr}	60	64	61	60	55	54	54	48	42

The required traffic noise reduction is as follows:

Nearest future apartments to Forest Road

- (69 – 40 =) 29 dB for all Living areas, and
- (64 – 35 =) 29 dB for all sleeping areas

Nearest future apartments to Illawarra Rail Corridor

- (65 – 40 =) 25 dB for all Living areas, and
- (60 – 35 =) 25 dB for all sleeping areas

It is worth noting that a number of multi storey buildings have been constructed in close proximity to the Site since the preparation of the Koikas Report which will shield some of the proposed apartments from traffic noise on Forest Road depending on the orientation of windows.

However, the majority of proposed new apartments will still have line of sight to the rail corridor and, in part, Forest Road and so no adjustment has been made to the noise levels to account for building attenuation as a worst-case scenario.

5. EXTERNAL NOISE INTRUSION

5.1 Noise Modelling Methodology

We have modelled the proposed apartments using Design Workshop Australia's Architectural Drawings for Project Number 2867 dated July 2025.

The internal noise level can be calculated using the formula: -

$$L_{p2} = L_{p1} - R_w + 10 \log_{10} (S/A) - K + 6 \text{ dB}$$

Where:

- L_{p1} is the external noise level,
- R_w is the weighted sound reduction index of the partition,
- S is the area of the partition (e.g. wall, roof, window or glazed door),
- A is the acoustic absorption of the room,
- K is an angle of view correction.

5.2 Building Construction Recommendations

The levels of traffic noise intrusion have been calculated based on reductions achieved after transmission through the roof, floor, walls, glazed doors and windows.

The required internal noise levels set by George River Council can be met using the following construction methods and materials.

5.2.1 Walls

- External walls of masonry construction will be acceptable acoustically
 - It is propose to construct the walls using 150 mm (minimum) tilt up concrete panel which will be acoustically acceptable,
- Internal wall linings may consist of standard 10 mm (minimum) thick standard plasterboard,
- 50 mm (minimum) glasswool or polyester insulation in the wall cavity (with a minimum density of 10 kg/m³).

5.2.2 Ceiling and Roof System

- The roof is to be of concrete slab construction, this will be acoustically acceptable, and ceilings may of standard construction as specified by the architect if masonry roof construction.

5.2.3 Windows and Glazed Doors

Glazing

- Windows and glazed doors may be fixed, sliding, awning or double hung style in aluminium frames,
- Floor plan mark ups are provided in Appendix C specifying the minimum weighted sound reduction index (R_w) ratings required for various windows and glazed doors.
- An example glazing specification is given in Appendix C, however an alternative construction may be used providing the minimum R_w rating is achieved.

All glazed doors and windows should be fitted with acoustic seals comprising foam weather seals (e.g. Q-Lon from Schlegel or similar).

NB - a number of factors affect the glazing requirements that are outside acoustical issues. Confirmation should be sought from the glazing manufacturer or supplier that whichever glazing is selected achieves the minimum acoustical rating shown in Appendix C.

Consideration will also need to be given to other requirements including, for example, but not necessarily limited to, safety, thermal and energy efficiency.

5.3 Mechanical Ventilation Requirements

The NSW Department of Planning, Industry and Environment's document Development near Rail Corridors and Busy Roads – Interim Guideline 2008 states:

“If internal noise levels with windows or doors open exceed the criteria by more than 10dB, 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.”

The intent of this requirement is to enable the occupants to close the windows in these rooms and still have access to a fresh air supply.

Based on the external noise levels at the Site and the predicted internal noise levels, rooms in the majority of units are required to be ventilated in accordance with the BCA with a fresh air supply

Examples of achieving this, are provided below.

On example of achieving this, are provided below.

Option 1 – Mechanical Ventilation (Air conditioning system)

Install any mechanical ventilation system (air conditioning) with a fresh air supply option. For example <https://www.rapidcold.com.au/daikin-split-system-us7-air-conditioner/>

Option 2 - Passive Fresh Air Ventilation

Consideration may be given to installing a wall mounted proprietary silent air vent into the external wall of the lounge. Such as, for example, silencer air acoustic ventilators (www.silenceair.com).

Alternative products, such as AeroPac acoustic air ventilators may also be acceptable.

<https://www.acoustica.com.au/product/aeropac/>

Alternatively, an air conditioning system with a fresh air supply may be installed.

Option 3 - Ducted Fresh Air Supply

Install a small in line air supply fan unit with a minimum length of 3 metres of acoustically lined ductwork in the ceiling space of each of the relevant rooms, as shown in Figure 4 below.

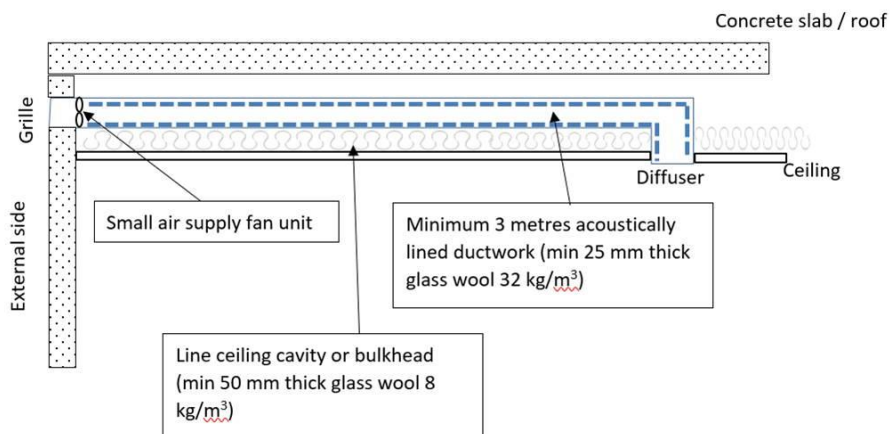


Figure 5. Example Fresh Air Supply Ventilation System

Apartments or rooms NOT requiring assisted ventilation in accordance with the BCA are also shown in Appendix C.

6. BCA ACOUSTICAL ASSESSMENT

This section outlines the relevant acoustical requirements of the BCA. A glossary of Sound Insulation Descriptors is provided in Appendix A.

6.1 Building Code of Australia (BCA)

The information in this section is extracted from the Building Code of Australia (BCA), which is now part of the National Construction Code (NCC), *Part F7 Sound Transmission and Insulation*. The acoustical requirements and the building solutions in this report are based on the Deemed-to-Satisfy Provisions of the BCA.

The residential units in the proposed development are classified as a Class 2 building.

The *Objective* of this Part is to safeguard occupants from illness or loss of amenity as a result of undue sound being transmitted:-

- (a) between adjoining *sole-occupancy units*; and
- (b) from common spaces to *sole-occupancy units*; and
- (c) from parts of different classifications to *sole-occupancy units*.

The Objective only applies to a Class 2 or 3 building or a Class 9c *aged care building*.

Floors

F7D5 BCA Sound insulation rating of floors

A floor in a Class 2 building must have an $R_w + C_{tr}$ (airborne) not less than 50 and an $L_{n,w}$ (impact) not more than 62 if it separates-

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

BCA Walls

F7D6 Sound insulation rating of walls

1. A wall in a Class 2 building must -
 - a) have an $R_w + C_{tr}$ (airborne) not less than 50, if it separates *sole-occupancy units*; and
 - b) have an R_w (airborne) not less than 50, if it separates a *sole-occupancy unit* from a plant room, lift *shaft*, stairway, *public corridor*, public lobby or the like, or parts of a different classification; and
 - c) be of discontinuous construction if it separates:
 - (A) a bathroom, *sanitary* compartment, laundry or kitchen in one *sole-occupancy unit* from a *habitable room* (other than a kitchen) in an adjoining unit; or
 - (B) a *sole-occupancy unit* from a plant room or lift *shaft*.
2. A door may be incorporated in a wall in a Class 2 building that separates a *sole-occupancy unit* from a stairway, *public corridor*, public lobby or the like, provided the door assembly has an R_w not less than 30.
5. Where a wall *required* to have sound insulation has a floor above, the wall must continue to -
 - a) the underside of the floor above; or

- b) a ceiling that provides the sound insulation *required* for the wall.
6. Where a wall required to have sound insulation has a roof above, the wall must continue to -
- a) the underside of the roof above; or
 - b) a ceiling that provides the sound insulation required for the wall.

Services

F7D7 Sound insulation rating of services

1. If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one *sole-occupancy unit*, the duct or pipe must be separated from the rooms of any *sole-occupancy unit* by construction with an $R_w + C_{tr}$ (airborne) not less than-
 - a) 40 if the adjacent room is a habitable room (other than a kitchen); or
 - b) 25 if the adjacent room is a kitchen or non-habitable room.
2. If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (1)(a) and (b).

Pumps

F7D8 Sound isolation of pumps

A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating or other pump.

6.2 AAAC Apartment and Townhouse Acoustic Rating Guide (2017)

The Building Code of Australia (BCA) regulates minimum acceptable construction standards for buildings and sets minimum standards for privacy. Many in the housing industry have interpreted these as absolute requirements, applicable to all types of dwellings.

The result has been that owners of luxury apartments built to BCA standards have sometimes become dissatisfied with the acoustic performances, which in their view are not commensurate with the price they have paid.

To fulfil a need identified by the community and the housing industry, member firms of the AAAC have prepared a 'star' rating system to rank the acoustical quality of apartments.

The following Table 7 provides a rating for airborne sound insulation for walls, impact isolation of floors and internal building services.

Table 7 Summary of AAAC Ratings for Apartment Sound Insulation

Intertenancy Activities	2 Star	3 Star	4 Star	5 Star	6 Star
Airborne Sound Insulation of Walls and Floors					
Between Separate Tenancies $D_{nT,w} + C_{tr} \geq$	35	40	45	50	55
Between a Lobby / Corridor and Bedroom $D_{nT,w} + C_{tr} \geq$	30	40	40	45	50
Between a Lobby / Corridor and Living Area $D_{nT,w} + C_{tr} \geq$	25	40	40	40	45
Corridor, Foyer to Living Space Via Door(s) $D_{nT,w}$	20	25	30	35	40
Impact Isolation of Floors					
Between Tenancies $L_{n,w} \leq$	65	55	50	45	40
Between All Other Spaces and Tenancies $L_{n,w} \leq$	65	55	50	45	40
Impact Isolation of Walls					
Between Tenancies	No	Yes	Yes	Yes	Yes
Between Common Areas and Tenancies	No	No	No	Yes	Yes

The performance requirements of the BCA are in line with the 4 star rating for airborne sound transmission through walls and floors, however they are more in line with the 2 star rating for impact isolation of floors. That is because the BCA rating for impact isolation is set to a particularly low level.

This report provides recommendations in the following sections to satisfy the requirements of the BCA. Additional advice may be given to achieve the various Star ratings of the AAAC guideline if the architect or the builder wishes to provide a higher level of acoustical isolation.

6.3 Initial Construction Recommendations

The proposed construction methods and materials are not finalised for this proposal at this stage. The following recommendations are provided for consideration by the architect and a final design review will be undertaken prior to the issue of a Construction Certificate. Any advice provided in this Section is for the architect's consideration and should not be used for construction details by the builder.

6.3.1 Floors

The floors separating the occupancy will be of a minimum 200 mm thick concrete slab construction with standard plaster board ceilings below.

Carpet

- Carpet installed on top of slab as per manufacturer's instructions,
- Ceilings below these floors to architect's specifications.

Tiled Floors (Wet Areas)

Option 1

An acoustic underlay should be installed below timber, vinyl or tile flooring in all rooms*

- Example underlay as follows:-
 - Regupol Sonus Core 5 (5 mm thick) supplied by Regupol Australia
<https://acoustics.regupol.com.au/products/range/regupol-sonus-core/regupol-sonus-core-5/>, or
 - 5 mm AcoustaMat supplied by A1 rubber
<https://a1rubber.com/our-products/acoustic-flooring/acoustamat/>, or
 - RF 700 5 mm supplied by Uniroll Australia
[Contact Uniroll direct on 02 9759 7066](#)
- Alternative products may be acceptable and should be checked prior to installation.
- Suspended plasterboard ceilings below these floors to architect's specifications.
- Acoustic underlay should be installed to manufacturer's specifications, care should be taken to ensure that the underlay returns up the wall (or flexible sealant is used) to ensure that there is no mechanical connection between the tile or timber and the wall or skirting (see Appendix C).

Option 2

- Tile or timber flooring installed on slab to builder's or manufacturer's specifications,
- Ceilings below these floors to comprise minimum one layer of minimum 13 mm thick standard plasterboard fixed to furring channel or hanging rods with isolation mounts,
 - Example Rondo STWC clip
<https://www.rondo.com.au/products/acoustic-assemblies>

These floor/ceiling constructions are designed to achieve an acoustic rating of $R_w + C_{tr}$ 50 (airborne) and $L_{n,w}$ (impact) of not more than 62 to meet the requirement of the BCA *Deemed-to-Satisfy Provisions* in Section F7D5 and are therefore acceptable.

Recommendations

Once the propriety product for floor impact isolation is selected, confirmation that the design will meet the required goal should be obtained in writing from the supplier. An on-site progress test is strongly recommended as flanking paths can limit the performance of the floor-ceiling system. The impact sound propagates vertically, horizontally and diagonally – hence, whilst not strictly required, consideration should be given to the impact treatment for terraces, balconies, corridors with hard surfaces where they are above habitable spaces.

Access panels required to be installed in the ceiling should be acoustically rated to achieve $R_w + C_{tr}$ 25 (see Section on access panels below).

Important Notes

- * The impact isolation rating of floor applies to all floors in the apartments including tiles in bathrooms, ensuites, toilets and laundries, and not just living rooms or kitchens. Therefore either option 1 (acoustic underlay) or option 2 (resiliently mounted ceilings) applies to all floors, including tiled wet areas, and including the Level 1 apartments that are located above retail premises on the ground floor.

6.3.2 Walls

Walls Separating Units

Internal party walls separating sole-occupancy units may be constructed as follows (the following are examples only and alternative construction methods may be acceptable):-

Option 1 - Hebel Wall System

- Minimum 75 mm thick autoclaved aerated concrete (Hebel Power panel) with one layer of 13 mm thick fire rated or sound rated plasterboard or 10 mm thick moisture resistant board directly fixed to outside face of the power panel,
- One row of minimum 64 mm steel studs spaced a minimum 20 mm from the power panel,
- One layer of 13 mm thick fire rated or sound rated plasterboard or 10 mm thick moisture resistant board fixed to the outside of the stud,
- Minimum 75 mm thick glasswool insulation (min density 11 kg/m³) in the cavity between the studs.

Option 2 – Hebel Wall System with Furring Channel

- Minimum 75 mm thick autoclaved aerated concrete (Hebel Power panel) with one layer of 13 mm thick fire rated or sound rated plasterboard or 10 mm thick moisture resistant board fixed to one side of the panel using 28 mm furring channel,
- 50 mm thick polyester insulation (min density 9 kg/m³) fixed between the furring channel and the plasterboard wall lining,
- One row of minimum 64 mm steel studs spaced a minimum 35 mm from the power panel,
- One layer of 13 mm thick fire rated or sound rated plasterboard or 10 mm thick moisture resistant board fixed to the outside of the stud,
- Minimum 105 mm thick glasswool insulation (min density 7 kg/m³) in the cavity between the studs.

Option 3 - Shaft liner construction (e.g. CSR System 1535)

- 13 mm thick sound rated plasterboard fixed to a minimum 64 mm steel stud,
- Minimum 20 mm air gap,
- One layer of 25 mm thick CSR shaft liner panel in *H Studs*
- Minimum 20 mm air gap,
- 13 mm thick sound rated plasterboard fixed to a minimum 64 mm steel stud,
- Minimum 75 mm thick glasswool insulation (min density 14 kg/m³) sound batts in both cavities in both cavities.

These wall systems are designed to achieve R_w 50 with **discontinuous construction**, where required, to meet the *Deemed-to-Satisfy Provisions* of section F7D6 of the BCA and are therefore acceptable.

Walls Separating Units from Corridors

Either of the wall options listed above will be suitable for the construction of walls separating sole occupancy units from corridors.

This wall system is designed to achieve R_w 50 and meets the *Deemed-to-Satisfy* provisions in Part F7D6 of the BCA and is therefore acceptable.

Walls Separating Occupancy Units from a Lift Shaft

The walls separating the *sole-occupancy units* from the lift shafts may be constructed using the following wall type:-

- **Minimum 200 mm thick in-situ concrete**, with:
 - One row of minimum 64 mm steel studs spaced a minimum 20 mm from the concrete panel,
 - One layer of 13 mm thick plasterboard fixed to the studs,
 - Minimum 75 mm thick glasswool insulation (min density 11 kg/m³) in the cavity.

This wall system is of discontinuous construction and is designed to achieve R_w 50 and meets the *Deemed-to-Satisfy* provisions in Part F7D6 of the BCA and is therefore acceptable.

6.3.3 Services

Construction Separating Services from Habitable Rooms

In order to achieve the required acoustic rating of $R_w + C_{tr}$ 40, we recommend the following construction:-

- All services serving one sole occupancy unit passing through habitable rooms in another sole occupancy unit must be acoustically lagged,
 - E.g. Nuwrap 5 or Soundlagg 4525C or Acoustiflex PL4.5/15 pipe lagging
- All risers or bulkheads or ceiling cavities containing services should be constructed from one layer of minimum 10 mm thick plasterboard (or 6 mm thick fibre cement sheet).
- Bulkhead or ceiling cavity must also be lined internally with 75 mm thick glasswool or polyester insulation.

This construction will meet the *Deemed-to-Satisfy Provisions* in section F7D7 of the BCA to achieve an acoustic rating of $R_w + C_{tr}$ 40.

This recommendation should also be constructed to achieve an **$R_w + C_{tr}$ 40** rating between the services located in the ceiling space of a Bathroom / Ensuite and the adjacent Bedroom in the same apartment.

This construction method is detailed in ADM Architects Pty. Ltd.'s architectural detail 10 in drawing A-406 for Project No. 2019-05 dated 28/02/2023.

Construction Separating Services from Bathrooms and Non-Habitable Rooms

In order to achieve the required acoustic rating of $R_w + C_{tr}$ 25, we recommend either of the following options.

Option 1

All services serving one sole occupancy unit passing through habitable rooms in another sole occupancy unit must be acoustically lagged;

- E.g. Nuwrap 5 or Soundlagg 4525C or Acoustiflex PL4.5/15 pipe lagging

- All risers or bulkheads or ceiling cavities containing services should be constructed from one layer of minimum 10 mm thick plasterboard (or 6 mm thick fibre cement sheet).

Option 2

As an alternative to acoustically lagging services:

- All risers, bulkheads or ceilings containing services may be constructed using one layer of 10 mm plasterboard (or 6 mm fibre cement sheet) lined internally with 75 mm thick glasswool or polyester insulation. (i.e. insulation in the cavity in lieu of pipe lagging).

These constructions will meet the *Deemed-to-Satisfy Provisions* in section F7D7 to achieve an acoustic rating of $R_w + C_{tr}$ 25.

Services Separation from Open Plan Kitchens

$R_w + C_{tr}$ 25 construction is required to separate the following services from a Kitchen and $R_w + C_{tr}$ 40 construction is required to separate the services from the adjoining Living and Dining Room:

1. duct, soil, waste or water supply pipe, that is located in a wall or floor cavity and that serves or passes through more than one *sole-occupancy unit*.
2. storm water pipe that passes through a *sole-occupancy unit*.

However, we recommend that an $R_w + C_{tr}$ 40 rating construction be used to separate the services located in kitchen ceiling space or bulkhead if it adjoins a Living or Dining room in open plan apartments.

All acoustical lagging must provide complete coverage for the full extent of the pipe or duct.

Penetrations and Downlights in Services Systems

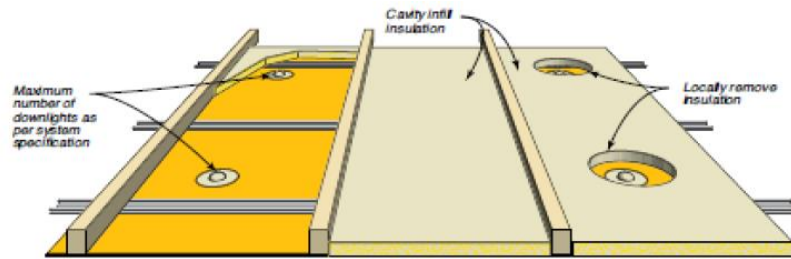
Penetrations in any services systems that are required to be acoustically rated may undermine the acoustical performance of the system.

For example, services systems such as ceilings or bulkheads may often incorporate downlights. The distribution of downlights in a services system (bulkhead or bathroom ceiling for example) should be kept to a minimum and be evenly distributed, no closer than 900 mm apart where practicable.

The recommended distribution of downlights in a services system will vary depending on the construction of the system (e.g. thickness of plasterboard lining), whether the services are lagged, whether there is insulation in the ceiling or bulk head and the required acoustical rating of the system.

Advice should be sought prior to construction in relation to downlights and penetrations in ceilings and bulkheads where services are located.

Example installation guide (source CSR Redbook)



Example acoustically rated downlight (source CSR Redbook)



Exhaust Air Grilles

Exhaust air grilles in the bathroom ceiling, where pipes or other services from another apartment pass through the ceiling space, will require either of the following acoustical treatment options:

- Services in the ceiling space lagged using Nuwrap 5 or Soundlagg 4525C or Acoustiflex PL4.5/15 pipe lagging; OR
- Metal plenum box installed over the air grilles, internally lined with 50 mm thick glasswool insulation (density 32 kg/m³), faced with a minimum of 20% open area perforated steel or foil. The box should be roughly cubic in shape with each side having a clear inside dimension approximately twice that of the neck diameter of the diffuser or the major dimension of a rectangular air grille.

If any services serve one sole occupancy unit and pass through the ceiling bulkhead in a living room or bedroom of a separate sole occupancy unit where an exhaust or supply grille serves a habitable room (living room or bedroom) in that ceiling bulkhead, the services would be required to be acoustically lagged, insulation installed in the ceiling space beneath the services **and** a plenum box installed as described above. It is unlikely that this situation would occur in this development, but this advice is provided in case it does. The requirement does not relate to duct work passing through ceiling bulkheads that serves the same unit (e.g. a kitchen, laundry or toilet exhaust duct).

Duct, Soil and Waste Pipe Wall Penetrations

Ducts, soil and waste pipes required to penetrate the walls should be vibration isolated to ensure that the pipes do not directly contact any walls.

For non fire-rated walls, this may be achieved by providing a clearance of 10 – 15 mm between the full perimeter of the duct / pipe and the wall. The gap should then be sealed with a polyurethane or silicone mastic.

For fire rated masonry walls where the pipes are fitted with a fire collar, care should be taken to ensure that mortar does not bridge the pipe and the wall.

Access Doors or Panel

A door or panel, providing access to a duct, pipe or other service that passes through more than one sole occupancy unit, must not open into any *habitable room* (other than a kitchen).

The access door or panel in any other part must be firmly fixed so as to overlap the frame or rebate of the frame by not less than 10 mm, be fitted with a sealing gasket along all edges and constructed of -

- (i) wood, particleboard or blockboard not less than 33 mm thick; or
- (ii) compressed fibre reinforced cement sheeting not less than 9 mm thick; or
- (iii) other suitable material with a mass per unit area not less than 24.4 kg/m².

Alternatively, the access panels can be propriety R_w 30 or R_w + C_{tr} 25 access panels (available from manufacturers and suppliers such as Panther Panels from Rondo www.rondo.com.au/products/access-panels/panther-access-panels/, or Trafalgar Access Panels www.taccess.com.au).

Water Supply Pipes

A water supply pipe that is required to pass through an acoustically rated wall must-

- only be installed in the cavity of discontinuous construction; and
- in the case of a pipe that serves only one *sole-occupancy unit*, not be fixed to wall leaf on the side adjoining any other *sole-occupancy unit* and have a clearance not less than 10 mm to the other wall leaf.

Electrical Outlets

Electrical outlets required to be installed in an acoustically rated wall must be offset from each other-

- in masonry or concrete block walling, not less than 100 mm; and
- in timber, steel frames or Hebel walling, not less than 300 mm.

Chasing of Services in Walls

The BCA *Deemed-to-Satisfy* construction requires that services are not chased into concrete or masonry elements so that the acoustic performance of walls and floors is maintained. In our opinion, chasing of electrical cables in walls will not reduce the acoustical performance of the walls and will be acoustically acceptable providing that the chasing is not deeper than approximately 20 mm and the chased area is backfilled with mortar.

Ducts, soil, waste or water pipes should not penetrate through masonry sections of an acoustically rated wall.

Ducts, soil, waste or water pipes should not be chased in the acoustically rated walls or floors.

Pumps

A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating or other pump.

7. MECHANICAL PLANT NOISE

The selection of mechanical plant has not been finalised at this stage, however it is likely to include car park and building ventilation fans as well as air conditioning units for each apartment.

A final assessment of mechanical plant noise emission will be undertaken at the Construction Certificate stage of the proposal, once the selection of all plant and equipment to service the building has been finalised.

Any noise controls, if required, will not be onerous and may include, as an example, acoustical lining of duct work or installation of silencers for the car park ventilation fans and the selection of low noise condensers for air conditioning units. The noise goals established in Section 3.4 of this Report will be able to be met for this proposal.

8. CONCLUSION

An acoustical assessment for alterations and additions to an approved mixed use development to be constructed at 1A Hill Street, Hurstville, NSW was undertaken.

Consideration was given to noise intrusion into the development from road traffic on Forest Road and rail traffic on the T4 and Illawarra Line as well as the acoustical provisions of Part F7 of the BCA 2022.

Road and rail noise levels were established in the vicinity of the development Site during the preparation of the original assessment. These noise levels were used to calculate internal noise levels within each of the apartments.

The internal noise level requirements set by Clauses 2.100 (rail) and 2.120 (road) of the *State Environmental Planning Policy (Transport and Infrastructure) 2021* will be met for this development based on recommendations made in Section 5 of this Report.

Recommendations are made in Section 6 of this report to address the BCA *Deemed-to-Satisfy Provisions* and / or *Performance Requirements* of Part F7 for the construction of internal building elements.

A further assessment of mechanical plant noise emission will be undertaken prior to the issue of a Construction Certificate as detailed in Section 7 of this Report.



Matthew Harwood, MAAS

Director & Principal Consultant

Harwood Acoustics Pty. Ltd.

Attachments:-

- Important Note
- Appendix A – Sound Insulation Descriptors
- Appendix B – Acoustic Underlay Installation Guide
- Appendix C – Glazing requirements

Important Note

Advice in this Report is intended as for the architect for input in preparing final construction drawings and is not intended as use as construction details for the builder.

*All products and materials suggested by Harwood Acoustics Pty Ltd are selected for their acoustical properties only. Recommendations made in this report are intended to resolve acoustical problems only, therefore all other properties such as aesthetics, air flows, chemical, corrosion, combustion, construction details, decomposition, expansion, fire rating, fumes, grout or tile cracking, loading, shrinkage, smoke, ventilation etc. are outside Harwood Acoustic's field of expertise and **must** be checked with the supplier or suitably qualified specialist before purchase.*

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Sound Insulation Descriptors	Appendix A
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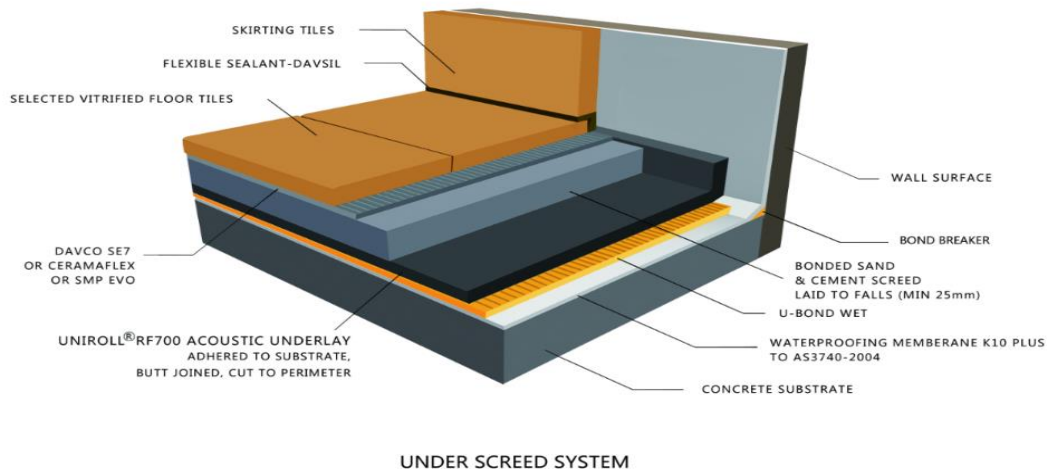
R_w (weighted sound reduction index) provides an acoustical rating of the sound insulation of walls and partitions due to airborne sound. Sound insulation varies with frequency and is dependent on the type of wall construction, however, the R_w provides a convenient method of rating sound insulation using a single number. The higher the R_w rating the better the sound insulation provided by the partition.

C_{tr} is a correction factor to adjust for the lower frequency content of the sound source. The C_{tr} factor is a negative value that is added to the R_w rating to get an overall R_w + C_{tr} airborne rating. For masonry walls, the C_{tr} factor is typically between –5 and –3, while for plasterboard walls the factor may often be as low as –12, depending on the construction type.

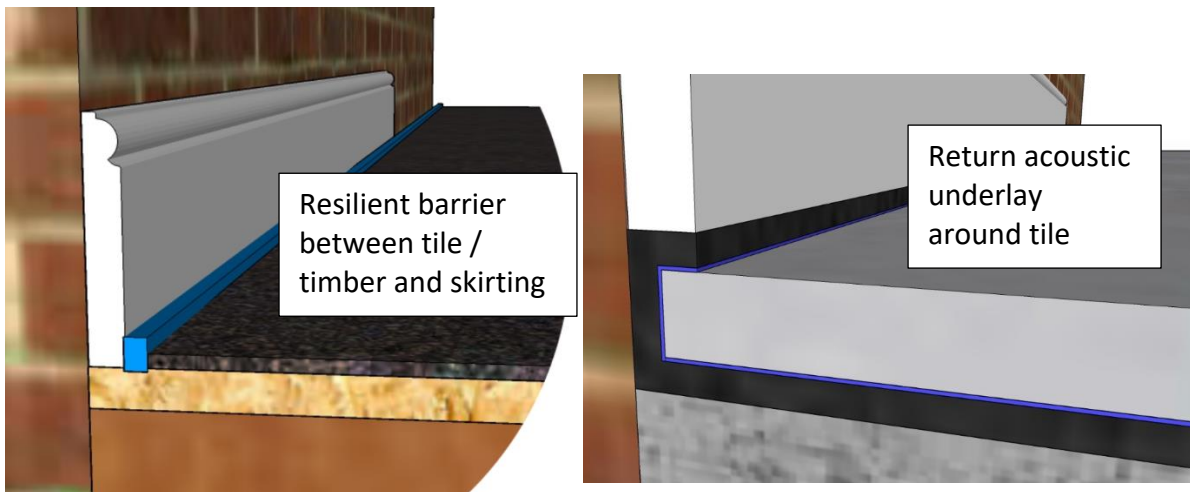
D_{nT,w} is a weighted standardised level difference. This is found by comparing the standardised level difference (D_{nT}) in each of the 1/3 octave bands between 100 Hz and 3.15 kHz to a standard curve and adjusting the 1/3 octave bands until the difference between the two is as close as possible to 32 without exceeding 32. The value at 500 Hz is then taken as the single value.

L_{n,w} (weighted normalised impact sound pressure level) is used to describe the impact sound insulation of a floor. In contrast to the R_w rating, the lower the L_{n,w} of the floor, the better the performance of the floor in terms of impact sound insulation.

Acoustic Underlay / Flexible Sealant	Appendix B
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Source (www.uniroll.com.au)



Source ([www. https://www.soundproofingstore.co.uk](https://www.soundproofingstore.co.uk))



Source (www.soundblock.com.au/sound-proofing-products/floors)

Recommended Minimum Acoustical Glazing Requirements	Appendix C
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A number of factors affect the glazing requirements that are outside acoustical issues.








For this reason, it is not practicable to provide a specific glazing thickness or glazing construction type as these may not be suitable for a number of other reasons, for example, safety, thermal or energy ratings.

It is incumbent on the builder or developer to ensure that all requirements are satisfied in the final selection of windows and glazed doors.

The following marked up floor plans provide the minimum weighted sound reduction index (R_w) ratings required for windows and glazed doors throughout the development.





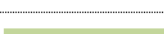


An example of typical window and glazed door constructions to achieve these acoustical ratings is provided in Table C1 below. Again, certification should be sought, prior to construction, that the final window and glazed door selections satisfy all necessary requirements.

Table C1 Minimum Required (R_w) Rating & Example Window Construction

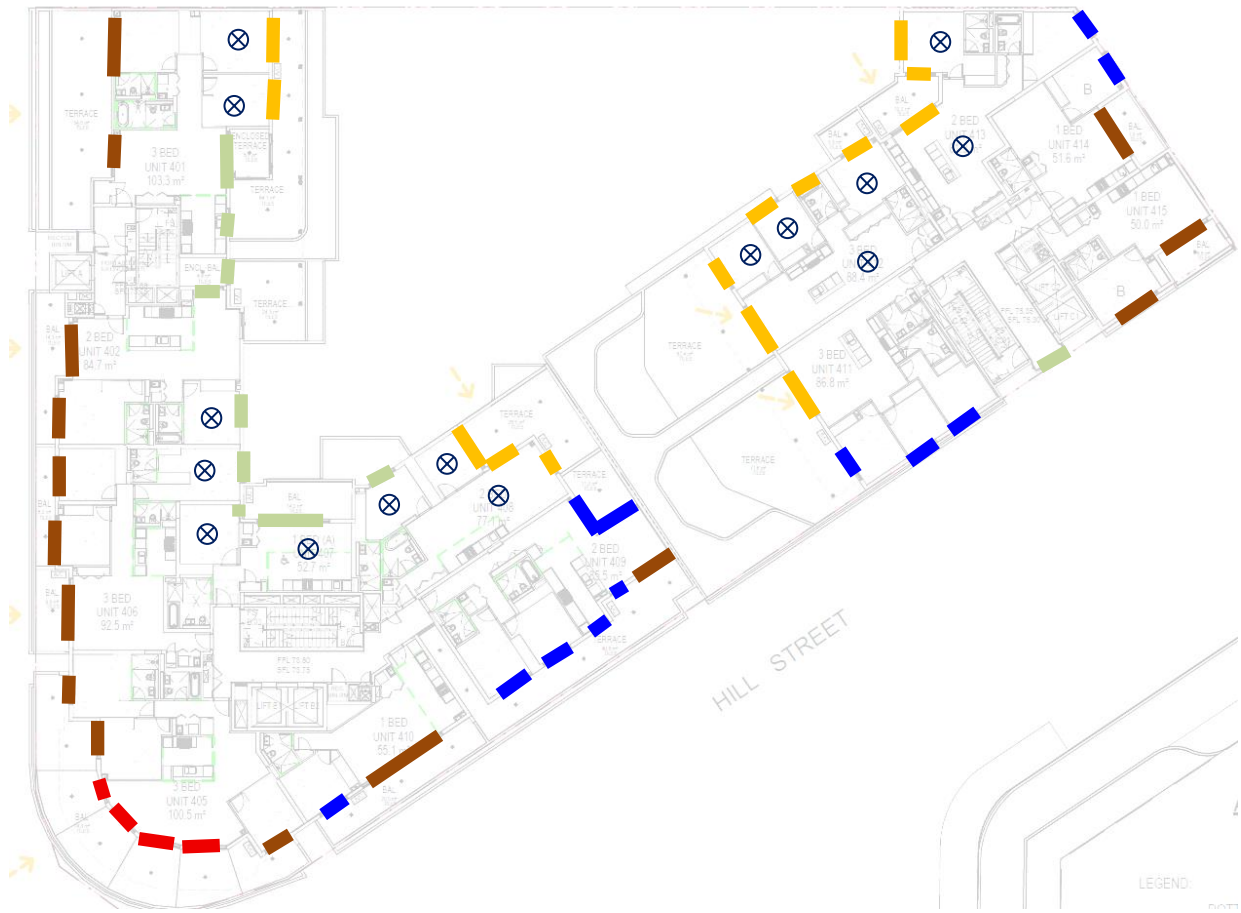
Reference in Mark Ups	Min R_w	Example Glazing Specification
	41	8.76 mm / 25 mm air gap / 6.38 mm
	38	12.38 mm laminated glass
	35	10.5 mm V Lam Hush (or 10.38 mm)
	32	6.38 mm laminated glass
	29	5 or 6 mm float glass
	25	5 mm float glass
	-	Assisted ventilation NOT required

Levels 1 to 3



Reference in Mark Ups	Min R_w	Example Glazing Specification
	41	8.76 mm / 25 mm air gap / 6.38 mm
	38	12.38 mm laminated glass
	35	10.5 mm V Lam Hush (or 10.38 mm)
	32	6.38 mm laminated glass
	29	5 or 6 mm float glass
	25	5 mm float glass
	-	Assisted ventilation NOT required








Level 4



Reference in Mark Ups	Min R _w	Example Glazing Specification
	41	8.76 mm / 25 mm air gap / 6.38 mm
	38	12.38 mm laminated glass
	35	10.5 mm V Lam Hush (or 10.38 mm)
	32	6.38 mm laminated glass
	29	5 or 6 mm float glass
	25	5 mm float glass
	-	Assisted ventilation NOT required








Levels 5 & 6



Reference in Mark Ups	Min R _w	Example Glazing Specification
	41	8.76 mm / 25 mm air gap / 6.38 mm
	38	12.38 mm laminated glass
	35	10.5 mm V Lam Hush (or 10.38 mm)
	32	6.38 mm laminated glass
	29	5 or 6 mm float glass
	25	5 mm float glass
	-	Assisted ventilation NOT required

Levels 7 & 8



Reference in Mark Ups	Min R_w	Example Glazing Specification
	41	8.76 mm / 25 mm air gap / 6.38 mm
	38	12.38 mm laminated glass
	35	10.5 mm V Lam Hush (or 10.38 mm)
	32	6.38 mm laminated glass
	29	5 or 6 mm float glass
	25	5 mm float glass
	-	Assisted ventilation NOT required








Level 9



Reference in Mark Ups	Min R _w	Example Glazing Specification
	41	8.76 mm / 25 mm air gap / 6.38 mm
	38	12.38 mm laminated glass
	35	10.5 mm V Lam Hush (or 10.38 mm)
	32	6.38 mm laminated glass
	29	5 or 6 mm float glass
	25	5 mm float glass
	-	Assisted ventilation NOT required








Level 10



Reference in Mark Ups	Min R_w	Example Glazing Specification
	41	8.76 mm / 25 mm air gap / 6.38 mm
	38	12.38 mm laminated glass
	35	10.5 mm V Lam Hush (or 10.38 mm)
	32	6.38 mm laminated glass
	29	5 or 6 mm float glass
	25	5 mm float glass
	-	Assisted ventilation NOT required

Levels 11 to 15



Reference in Mark Ups	Min R_w	Example Glazing Specification
	41	8.76 mm / 25 mm air gap / 6.38 mm
	38	12.38 mm laminated glass
	35	10.5 mm V Lam Hush (or 10.38 mm)
	32	6.38 mm laminated glass
	29	5 or 6 mm float glass
	25	5 mm float glass
	-	Assisted ventilation NOT required

Levels 18 to 20



Reference in Mark Ups	Min R_w	Example Glazing Specification
	41	8.76 mm / 25 mm air gap / 6.38 mm
	38	12.38 mm laminated glass
	35	10.5 mm V Lam Hush (or 10.38 mm)
	32	6.38 mm laminated glass
	29	5 or 6 mm float glass
	25	5 mm float glass
	-	Assisted ventilation NOT required