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Acoustical Assessment
Brisbane Water Legacy Village Redevelopment Project

At: -

51 to 57 Masons Parade,

Point Frederick, NSW 2250

Prepared for: -

Gridley Construction Pty Ltd
55 Grandview Street
Pymble NSW 2073

Reference: 2006010E-R

Prepared by: -

Matthew Harwood MAAS
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Grindley Construction Pty Ltd commissioned Harwood Acoustics to carry out a Noise Impact and Noise Intrusion Assessment for the redevelopment of Brisbane Legacy Club Village at 51 to 57 Masons Parade, Frederick Point, NSW.

The redevelopment will include the construction of a seven (7) storey building with a combination of 1, 2 and 3 bedroom self contained units over six floors with a communal room, administration room and amenities on the ground floor and on site car parking.

This acoustical assessment considers noise intrusion into the proposed development from passing road traffic, noise impact on surrounding neighbours from the operation of the development and preliminary advice relating to compliance with the acoustical provisions of Part F5 of the Building Code of Australia.

Accordingly, Harwood Acoustics 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 and may not be suitable for use beyond that scope.

Harwood Acoustics undertakes no duty nor accepts any responsibility to any third party who may rely upon this report.

Advice and recommendations provided in this report are in relation to acoustical issues only. No claims of expertise are made, and no liability is accepted, in relation to issues falling outside the field of acoustical consulting. These may include, but are not limited to, structural and waterproofing considerations, fire rating or thermal rating. Relevant authorities and / or experts should be consulted regarding areas other than acoustics.

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1. INTRODUCTION AND SUMMARY

Grindley Constructions is currently in the process of preparing development application documentation to Central Coast Council on behalf of Brisbane Water (NSW) Legacy for the redevelopment of Legacy Village located at 51 to 57 Masons Parade, Point Frederick, NSW (the Site).

The Site is located on the eastern side of Masons Parade opposite the Broadwater and Brisbane Water estuary. The Site is bound to the north, east and south by multi storey residential apartment buildings. There is also a small café to the north with a new development beyond that which is currently under construction. Opposite Masons Parade to the west is the Gosford Olympic Swimming Pool, large food premises and public car park with the Broadwater and Brisbane Water estuary beyond.

A location plan is shown in Figure 1.

The Site will be subdivided into two separate lots and the northern of the two lots is the subject of this assessment. The existing facility on the newly created northern lot will be demolished and a new residential development will be constructed. The development will comprise a seven-storey building containing 54 one, two and three bedroom residential apartments, communal internal and external spaces as well as on site car parking. A Site plan is shown in Figure 2 and an example residential floor plan is shown in Figure 3. Full details can be seen in Integrated Design Group's architectural drawings for project number GRI20033, Issue T, dated 10/09/2021.

It is a requirement of Central Coast Council that an acoustical assessment be prepared and submitted along with the Development Application. The assessment is to address the following acoustical matters:-

- Traffic noise intrusion into the development from Masons Parade, carried out in accordance with Clause 102 of the *State Environment Planning Policy* (Infrastructure) 2007 (ISEPP) for apartments and Australian Standard AS2107:2016 '*Acoustics – Recommended design sound levels and reverberation times for building interiors*' (AS2107) for communal rooms,
- Noise emission arising from mechanical plant to potentially impact on existing residential neighbours, carried out in accordance with Council's DCP and the NSW EPA's relevant noise guidelines, and
- Advice relating to the acoustical provisions of Part F5 of the Building Code of Australia (BCA) for the construction of internal walls, floors and services for building elements with the Class 2 building classification in this development.

At this stage, the details of mechanical plant are preliminary and yet to be finalised and so this assessment provides initial design advice for Grindley Constructions and the mechanical contractor and this may be updated and revised as necessary prior to the issue of a Construction Certificate. Similarly, the proposed construction of internal partitions is yet to be finalised and again advice relating to compliance with the acoustical provisions of the BCA may be finalised prior to the issue of a Construction Certificate.

Existing background and traffic noise levels have been measured at the Site to determine the extent to which traffic noise affects the Site and to establish noise design goals for operational noise in accordance with the NSW EPA's *Noise Guide for Local Government* 2013.

External traffic noise levels at the closest proposed façade of the development are 61 dBA ($L_{eq, 15\ hour}$) during the day time period (7 am to 10 pm) and 58 dBA ($L_{eq, 9\ hour}$) during the night time period (10 pm to 7 am).

An assessment of the potential noise intrusion into the various apartments has been undertaken based on Integrated Design Group's architectural drawings for project number GRI20033 dated September 2021.

Recommendations are made in Section 5 of this Report to ensure the internal noise limits set by Clause 102 of ISEPP 2007 will be met in all residential apartments. Recommendations include an upgrade to thicker than standard glazing in most rooms and advice on the construction of external walls.

Noise design goals for any mechanical plant servicing the building have been derived from the NSW Environment Protection Authority's (EPA) *Noise Guide for Local Government* 2013 based on background noise levels measured in the vicinity of the neighbouring receptors.

These range from 53 dBA to 58 dBA ($L_{eq, 15\ minute}$) during the day time; 53 dBA to 55 dBA ($L_{eq, 15\ minute}$) during the evening time and 40 dBA to 43 dBA ($L_{eq, 15\ minute}$) during the night depending on the distance of each receptor to Mason Parade.

Consideration is also given to Clause 52 of the *Protection of Environment Operations (Noise Control Regulation)* 2017 for the air conditioning units.

Recommendations are made in Section 6 of this Report to ensure the level of noise emission from mechanical plant is within the noise design goals at all receptors. A final assessment will be required prior to the issue of a Construction Certificate once all selections of mechanical plant are finalised.

Recommendations are made in Section 7 of this report to address the BCA *Deemed-to-Satisfy Provisions* and / or *Performance Requirements* of Part F5 for the construction of internal building elements.

2. SITE AND DEVELOPMENT DESCRIPTION

2.1 Site Description

The Site is located on the eastern side of Masons Parade opposite the Broadwater and Brisbane Water estuary. The Site is bound to the north, east and south by multi storey residential apartment buildings, with a new development to the north currently under construction. There is also a café to the north and a fish and chip to the south. Opposite Masons Parade to the west is the Gosford Olympic Swimming Pool, large food premises and public car park with the Broadwater and Brisbane Water estuary beyond.

Once the subject Site is subdivided the southern portion of the land is likely to be sold and owned by a separate party. It is assumed that residential development will constructed on the Site in the future, else, at least, the residential building on the southern portion of the Site will be retained. In any case the adjoining southern lot post subdivision is considered as a residential receptor in this assessment.

The nearest receptors to the Site are shown in Figure 1 below and are as follows:-

R1 – 51 to 57 Masons Parade (south) (adjoining south)

R2 – 3 to 5 Shortland St (adjoining North)

R3 – 162 Albany Street (adjoining east)

Figure 1. Location Plan – 51 to 57 Masons Parade, Point Frederick, NSW

(source: NSW Government Spatial Information Exchange ©)

2.2 Development Description

The Site will be subdivided into two separate lots and the northern of the two lots is the subject of this assessment. The existing facility on the newly created northern lot will be demolished and a new residential development will be constructed. The development will comprise a seven-storey building containing 54 one, two and three bedroom residential apartments, communal internal and external spaces as well as on site car parking.

A Site plan is shown in Figure 2 and an example residential floor plan is shown in Figure 3. Full details can be seen in Integrated Design Group's architectural drawings for project number GRI20033 dated September 2021.

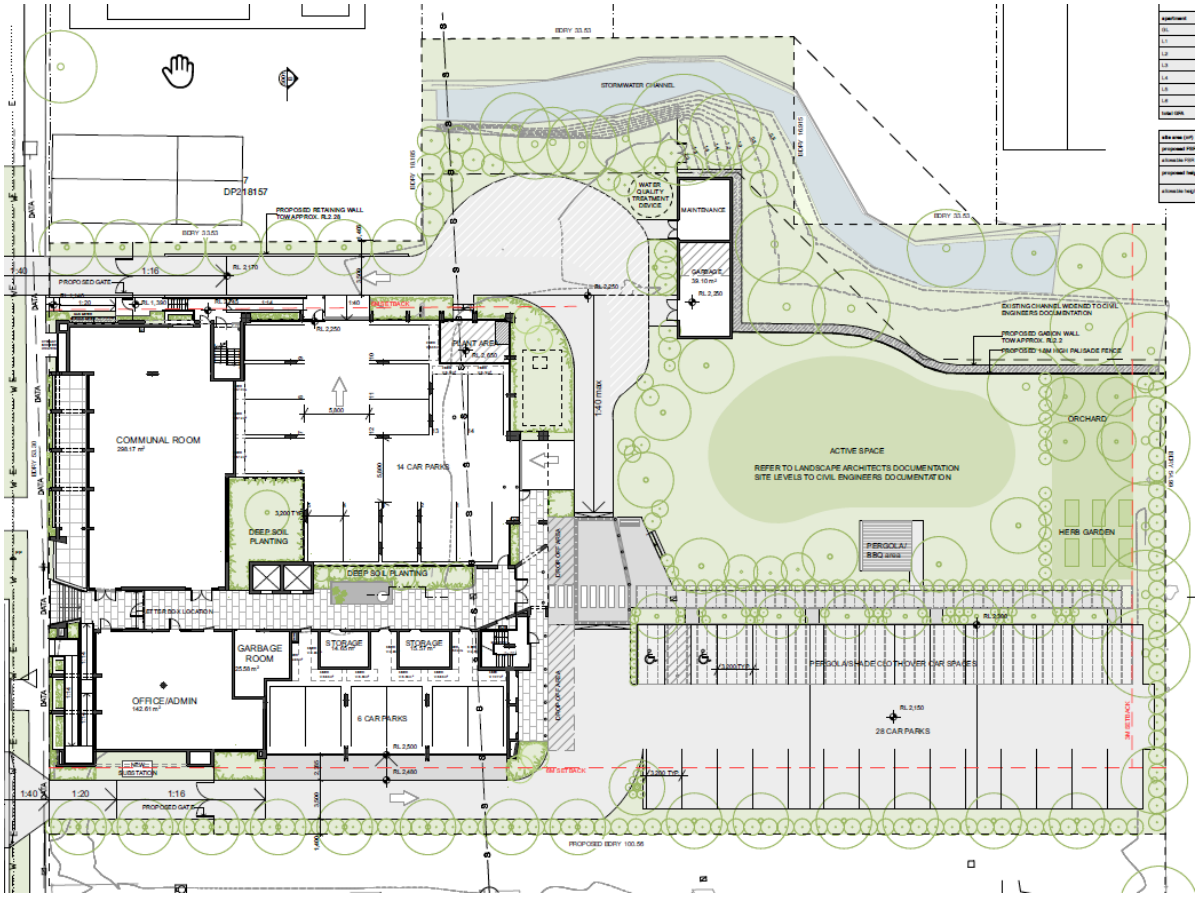


Figure 2. Site Plan

(source: Integrated Design Group's architectural drawing DA-0100 for project number GRI20033 dated 10/09/2021)

Figure 3. First Floor Plan

(source: Integrated Design Group's architectural drawing DA-1101 for project number GRI20033 dated 10/09/2021)

3. ACOUSTICAL CRITERIA AND NOISE DESIGN GOALS

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

3.1 Clause 102 - State Environment Planning Policy (Infrastructure) 2007

Clause 102 of the State Environment Planning Policy (Infrastructure) (ISEPP) states:-

"102 Impact of road noise or vibration on non-road development

(1) This clause 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 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:

(a) a building for residential use,

(b) a place of public worship,

(c) a hospital,

(d) an educational establishment or child care centre.

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

(3) If the development is for the purposes of a building for residential use, 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."

3.2 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 Clauses 87 and 102 and in addition, state:-

"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".

3.3 Central Coast Council's Gosford Development Control Plan (DCP) 2013

Central Coast Council in its Gosford Development Control Plan (DCP) 2013 Section 3.3.3.5.3 *Site Planning* states:-

"d(iii) Demonstrate that habitable rooms located within 60m of the railway or facing a classified major road would satisfy the acoustic criteria published by Standards Australia and State Government authorities".

Compliance with the noise limits set by Clause 102 of the ISEEP as detailed in Section 3.1 of this Report addresses the intent of Section 3.3.3.5.3. of the DCP.

3.4 NSW EPA's Noise Guide for Local Government

The Environment Protection Authority (EPA) published the *Noise Guide for Local Government* in June 2013. The policy is specifically aimed at assessing noise from light industry, shops, entertainment, public buildings, air conditioners, pool pumps and other noise sources in residential areas.

The EPA in Section 2.2.1 of the Noise Guide for Local Government states that a noise source is generally considered to be intrusive if the noise from the source, when measured over a 15-minute period ($L_{eq,\ 15\ minute}$), exceeds the background noise ($L_{90,\ 15\ minute}$) by more than 5 dB.

This criterion is in keeping with the EPA's *Noise Policy for Industry* (2017) Intrusiveness Criteria and Council's standard noise conditions.

The noise from the source is measured or assessed at the most affected point within the residential property boundary, or of that is more than 30 metres from the residence, at the most affected point within 30 metres of the residence. For upper floors the noise is assessed outside the nearest upstairs window.

3.5 Protection of the Environment Operations (Noise Control) Regulation 2017

"45. Use of Air Conditioners on Residential Premises

(1) A person is guilty of an offence if

(a) the person cause or permits an air conditioner to be used on residential premises in such a manner that it emits noise that can be heard within any room in any other residential premises (that is not a garage, storage area, bathroom, laundry, toilet or pantry) whether or not any door or window to that room is open:

(i) before 8 am or after 10 pm on any Saturday, Sunday or public holiday, or

(ii) before 7 am or after 10 pm on any other day."

52. Use of Pumps on Residential Premises

(1) A person is guilty of an offence if

(a) the person cause or permits a pump to be used on residential premises in such a manner that it emits noise that can be heard within any room in any other residential premises (that is not a garage, storage area, bathroom, laundry, toilet or pantry) whether or not any door or window to that room is open:

(i) before 8 am or after 8 pm on any Saturday, Sunday or public holiday, or

(ii) before 7 am or after 8 pm on any other day."

(2) In this clause-

Pump includes any of the following (but does not include a heat pump water heater, within the meaning of clause 53)-

(a) A swimming pool pump

(b) A spa pump"

3.6 Existing Background Noise Levels

In order to establish the Intrusiveness Criteria, 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 (RBL) 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.

When measuring background noise levels, it is important to undertake sufficient monitoring of background noise to allow intrusive noise to be assessed adequately.

In this instance noise loggers were placed at two separate locations on the Site, as shown in Figure 1. Noise measurements were taken at Location 1 between Saturday 1 and Wednesday 5 August 2020 and at Location 2 between Sunday 9 and Saturday 15 August 2020.

The Rating Background Noise Levels in proximity to the nearest residential receptors to the Site, are shown in Table 1 below.

Table 1 Rating Background Noise Levels

Time of Day	Minimum Assumed Rating Background Level dBA	Minimum Project Intrusive Noise Level ($L_{eq,\ 15\ minute}$, dBA)
Location 1 (south eastern corner of the Site)		
Day (7 am to 6 pm)	**53**	**61**
Evening (6 pm to 10 pm)	**50**	**60**
Night (10 pm to 7 am)	**38**	**58**
Location 2 (western (rear) side of the Site)		
Day (7 am to 6 pm)	**48**	**59**
Evening (6 pm to 10 pm)	**48**	**57**
Night (10 pm to 7 am)	**35**	**49**

Background noise levels are established in this assessment in order to derive appropriate noise goals for the assessment of mechanical plant noise emission.

3.7 Project Specific Noise Goals

When all the above factors are considered, project specific noise goals are as follows: -

Traffic Noise Intrusion – Clause 102 of the ISEPP

- **35 dBA** $L_{eq,\ 1\ hour}$ inside bedrooms between 10 pm and 7 am, and
- **40 dBA** $L_{eq,\ 1\ hour}$ inside common living areas at any time.

Noise Design Goals for the operation of mechanical plant

Receptor R1

- (53 + 5 =) **58 dBA** $L_{eq,\ 15\ minute}$ during the day time period,
- (50 + 5 =) **55 dBA** $L_{eq,\ 15\ minute}$ evening time period, and
- (38 + 5 =) **43 dBA** $L_{eq,\ 15\ minute}$ during the night time period.

Receptors R2 and R3

- (48 + 5 =) **53 dBA** $L_{eq,\ 15\ minute}$ during the day time period and evening period,
- (35 + 5 =) **40 dBA** $L_{eq,\ 15\ minute}$ evening time period.

4. MEASURED EXTERNAL TRAFFIC NOISE LEVELS

Traffic noise measurements have been taken at two locations on the Site, as shown in Figure 1, and these measured noise levels have been used to establish traffic noise levels at the future façade of each of the proposed apartments.

The octave band and overall 'A' frequency weighted sound pressure levels, in decibels re: 1 pW, of traffic noise at various facades of the development, are shown in Table 2 below.

Table 2 L_{eq} Traffic Noise Levels – Closest future dwelling façade

Traffic Noise Levels		Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)							
	dBA	63	125	250	500	1k	2k	4k	8k
Nearest future apartments									
Daytime $L_{eq, 15\ hr}$	**61**	72	70	63	56	56	52	46	38
Night-time $L_{eq, 9\ hr}$	**58**	69	67	60	53	53	49	43	35
Centre future dwellings									
Daytime $L_{eq, 15\ hr}$	**59**	70	68	61	54	54	50	44	36
Night-time $L_{eq, 9\ hr}$	**56**	67	65	58	51	51	47	41	33
Furthest future apartments									
Daytime $L_{eq, 15\ hr}$	**58**	69	67	60	53	53	49	43	35
Night-time $L_{eq, 9\ hr}$	**55**	66	64	57	50	50	46	40	32

Spectra are based on measured traffic noise levels at the Site and include heavy vehicles.

The required traffic noise reduction is as follows:

Nearest future apartments to the Central Coast Highway

- (61 – 40 =) 21 dB for all Living areas, and
- (58 – 35 =) 23 dB for all sleeping areas

Centre future apartments to Central Coast Highway

- (59 – 40 =) 19 dB for all Living areas, and
- (56 – 35 =) 21 dB for all sleeping areas

Furthest future apartment

- (58 – 40 =) 18 dB for all Living areas, and
- (55 – 35 =) 20 dB for all sleeping areas.

5. EXTERNAL NOISE INTRUSION CONSTRUCTION RECOMMENDATIONS

5.1 Noise Modelling Methodology

We have modelled the proposed apartments using Integrated Design Group's architectural drawings for project number GRI20033, Issue T, dated 10/09/2021.

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

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

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 Clause 102 of the SEPP (Infrastructure) 2007 can be met using the following construction methods and materials.

5.2.1 Walls

- External walls of masonry construction will be acceptable acoustically,
- Non-masonry external wall elements, should be constructed as follows: -
    - Cement composite cladding with a minimum mass of 17 kg/m^2 (for example CSR *Cemintel, Hardies Stria or Linea)* on the outside of 90 mm (minimum) steel studs,
    - Internal wall linings should consist of standard 10 mm (minimum) thick standard plasterboard for masonry walls and 13 mm (minimum) thick standard plasterboard for non-masonry walls, and
    - 50 mm (minimum) glasswool or polyester insulation in the wall cavity (with a minimum density of 11 kg/m^3).

<u>Important notes</u>

- Any external cladding on non-masonry walls is to be installed in accordance with the manufacturer's installation instructions so as to achieve the specified acoustical ratings.

5.2.2 Ceiling and Roof System

- If the roof is of <u>concrete slab construction</u>, this will be acoustically acceptable and ceilings may of standard construction as specified by the architect if masonry roof construction,
- If the roofs are to be of <u>concrete tile of sheet steel construction</u>, the following will be required:-
    - Heavy duty vapour barrier laid below the roof,

- Ceilings under the roof should comprise one layer of 13 mm (minimum) thick standard plasterboard or 10 mm thick sound rated plasterboard in all apartments with the exception of the following:-
  - Sixth Floor (2 x two bed apartments and 1 x three bed apartment) – ceilings should comprise one layer of 13 mm (minimum) thick standard plasterboard or 10 mm thick sound rated plasterboard

- 50 mm (minimum) glasswool or polyester insulation in the ceiling cavity (with a minimum density of 10 kg/m^3).

5.2.3 Windows and Glazed Doors

Glazing

- Windows and glazed doors may be fixed, sliding, awning or double hung style in aluminium or timber frames,
- Table 3 below specifies minimum sound reduction index (R_w) ratings required for various windows and glazed doors. Glazing other than those specified in Table 3 may be of standard thickness with a minimum **R_w 25**,
- An example glazing specification is given in Table 3, however an alternative construction may be used providing the minimum R_w rating is achieved.

Table 2 Recommended Window Schedule

Unit / Room / Glazing	Min R_w	Example Glazing Specification
First, Second, Third and Fourth Floors		
2 Bedroom Apartments		
All west facing glazing all rooms	**34**	10.38 mm laminated glass
All north facing glazing all rooms	**32**	6.38 mm laminated glass
All east facing glazing all rooms	**29**	5 mm float glass
3 Bedroom Apartment		
All west facing glazing all rooms	**34**	10.38 mm laminated glass
All south facing glazing all rooms	**32**	6.38 mm laminated glass
All east facing glazing all rooms	**29**	5 mm float glass
1 Bedroom Apartments – West Facing (floors 1 and 2 only)		
All west facing glazing all rooms	**34**	10.38 mm laminated glass
All east facing glazing all rooms	**29**	5 mm float glass
1 Bedroom Apartments – Central West		
All living rooms all glazing	**29**	5 mm float glass
All bedrooms	**32**	6.38 mm laminated glass
1 Bedroom Apartments – Central East		
All windows all rooms	**29**	5 mm float glass

Table 2 Recommended Window Schedule *Cont…*

Unit / Room / Glazing	Min R_w	Example Glazing Specification
First, Second, Third and Fourth Floors		
1 Bedroom Apartments – South East		
All windows all rooms	**29**	5 mm float glass
Fifth and Sixth Floors		
2 Bedroom Apartments		
All west facing glazing all rooms	**34**	10.38 mm laminated glass
All north facing glazing all rooms	**32**	6.38 mm laminated glass
All east facing glazing all rooms	**29**	5 mm float glass
3 Bedroom Apartment		
All west facing glazing all rooms	**34**	10.38 mm laminated glass
All south facing glazing all rooms	**32**	6.38 mm laminated glass
All east facing glazing all rooms	**29**	5 mm float glass
1 Bedroom Apartments – Central and South East		
All windows all rooms	**29**	5 mm float glass

Marked up floor plans are provided in Appendix B.

All glazed doors in Table 2 should be fitted with acoustic seals comprising foam weather seals (e.g. Q-Lon from Schlegel or similar).

6. MECHANICAL PLANT NOISE

It is not known at the time of writing this report what make or model of mechanical plant will be installed at the Site. Mechanical plant is likely to include individual air conditioning units associated with each apartment.

Noise emission from mechanical plant combined is required to meet the noise goals outlined in Section 3.7 of this Report, and reiterated below:-

Receptor R1

- (53 + 5 =) **58 dBA** $L_{eq,\ 15\ minute}$ during the day time period,
- (50 + 5 =) **55 dBA** $L_{eq,\ 15\ minute}$ evening time period, and
- (38 + 5 =) **43 dBA** $L_{eq,\ 15\ minute}$ during the night time period.

Receptors R2 and R3

- (48 + 5 =) **53 dBA** $L_{eq,\ 15\ minute}$ during the day time period and evening period,
- (35 + 5 =) **40 dBA** $L_{eq,\ 15\ minute}$ evening time period.

All mechanical plant should be located as far from neighbouring receptors as practicable.

To achieve the noise design goals, as an example, individual air conditioning condenser units should not exceed a sound power level (L_w) of **76 dBA** if located no closer than 10 metres from the closest residential boundary (without screening or shielding).

This assumes that there are three condenser units affecting the one receptor simultaneously and that the evening noise goal of 53 dBA $L_{eq,\ 15\ minute}$ is the noise goal.

This level is readily achievable for an individual domestic condenser unit.

If the condenser units are likely to be audible within any of the neighbouring residential dwellings, with their windows open after 10 pm, the units should not be operated outside of the hours outlined in Section 3.5 of this Report in accordance with Clause 45 of the *Protection of the Environment Operations (Noise Control) Regulation* 2017.

A final assessment of all mechanical plant noise will be undertaken prior to the issue of a Construction Certificate once all details of mechanical plant selections have been finalised.

Any noise controls, if required, will not be onerous and the acceptable noise limits can easily be achieved.

7. BCA ACOUSTICAL ASSESSMENT

The following sections outline the relevant acoustical requirements of the BCA. A glossary of Sound Insulation Descriptors is provided in Appendix A.

7.1 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) 2016, *Part F5 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.*

A description of the sound insulation descriptors discussed in the following sections is provided in the attached Appendix C.

Floors

F5.4 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 $L_{n,w} + C_I$ (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

F5.5 Sound insulation rating of walls

A wall in a Class 2 building must -

(i) have an $R_w + C_{tr}$ (airborne) not less than 50, if it separates *sole-occupancy units*; and

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

(iii) 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*.

Discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

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

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

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.

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

(i) the underside of the floor above; or

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

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

(i) the underside of the roof above; or

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

Services

F5.6 Sound insulation rating of services

(a) 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-

(i) 40 if the adjacent room is a *habitable room* (other than a kitchen); or

(ii) 25 if the adjacent room is a kitchen or non-*habitable room*.

(b) If a storm water pipe passes through a *sole-occupancy unit* it must be separated in accordance with (a)(i) and (ii).

Pumps

F5.7 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.

7.2 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 provides a rating for airborne sound insulation for walls, impact isolation of floors and internal building services.

Table 1 Summary of AAAC Ratings for Apartment Sound Insulation

Intertenancy Activities	2 Star	3 Star	4 Star	5 Star	6 Star
Airborne Sound Insulation for Walls Between Separate Tenancies $D_{nT,w} + C_{tr} \geq$	35	40	45	50	55
Impact Isolation of Floors Between Separate Tenancies $L_{n,w} \leq$	65	55	50	45	40

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 builder wishes to provide a higher level of acoustic isolation.

7.3 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.

7.3.1 Floors

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

The following options for various floor coverings are recommended to meet the *deemed-to-satisfy* provisions of the BCA

Carpet

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

Tile or Timber Floors

Option 1

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

- Example underlay as follows:-
  - Regupol 5512 (5 mm thick) supplied by Regupol Australia https://www.regupol.com.au/products/noise-and-vibration/impact-sound-insulation-floors/5512-5mm/; or
  - Impactamat 5 mm supplied by Embelton http://vibration-isolation.embelton.com/architectural-isolation/impactamat-acoustic-underlay/; or
  - 5 mm AcoustaMat supplied by A1 rubber http://a1rubber.com/products-info/acoustic/; or
  - RF 700 5 mm supplied by Uniroll Australia http://www.uniroll.com.au/acoustic-underlay-products/
- Alternative products may be acceptable and should be checked prior to installation.

- 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 G).

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 $L_{n,w} + C_I$ (impact) of not more than 62 to meet the requirement of the BCA *Deemed-to-Satisfy Provisions* in Section F5.4 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 there are adjacent 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).

7.3.2 Walls

Walls Separating Units

A variety of construction options are available for walls separating sole occupancy units, some examples of which are provided below.

Option 1

- 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,
- 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/m^3) in the cavity between the studs.

Option 2

- Two rows of minimum 64 mm steel studs at 600 mm centres and a minimum 50 mm air gap between the rows of studs,
- Minimum 50 mm thick glaswool or 60 mm thick polyester insulation (min density 11 kg/m^3) in the cavity between one row of the studs,
- Two layers of 13 mm thick fire rated plasterboard (or one layer of 6 mm thick fibre cement sheet and one layer of 13 mm thick fire rated plasterboard) fixed to both sides of the studs.

Option 3

- One leaf of AFS Logicwall 162 system,
- One layer of 10 mm thick plasterboard fixed to a 64 mm steel stud wall spaced 20 mm from the AFS wall,
- and standard plasterboard lining on 35 mm furring channel and thermal insulation in the cavity

Option 4

- Insitu 150 mm concrete, with
    - One row of minimum 64 mm steel studs spaced a minimum 20 mm from the concrete panel on both sides,
    - One layer of 13 mm plasterboard or moisture board equivalent (e.g. 6 mm villaboard with tiles) fixed to the outside of each stud,
    - Minimum 50 mm thick glasswool or polyester insulation (min density 10 kg/m^3), or approved equivalent, 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 F5.5 of the BCA and are therefore acceptable.

Walls Separating Units from Corridors

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

Walls Separating Occupancy Units from a Lift Shaft

There are no walls separating apartments from a lift shaft in this development.

7.3.2 Services

Construction Separating Services from Habitable Rooms

In order to achieve the required acoustic rating of $R_w + C_{tr}$ 40, we recommend either of the following options.

See Appendix D

- 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.

These constructions will meet the *Deemed-to-Satisfy Provisions* in section F5.6 of the BCA to achieve an acoustic rating of $R_w + C_{tr}$ 40.

To achieve a **$R_w + C_{tr}$ 40** rating between the services located in the ceiling space of a Bathroom / Ensuite and the adjacent Bedroom in the same apartment, we recommend the construction shown in the attached Appendix D.

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 (see Appendix E)

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 (see Appendix F)

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 F5.6 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*.

We recommend that a **$R_w + C_{tr}$ 40** rating construction be used to separate the services located in kitchen ceiling space or bulkhead from the adjoining Living and Dining Room.

NB

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.

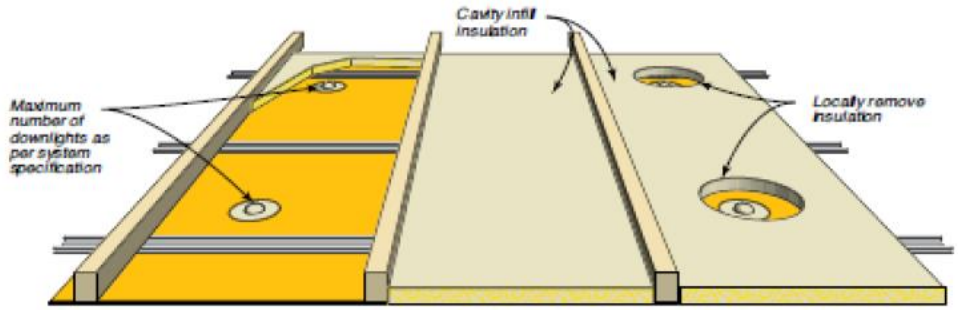
For example, services systems such as ceilings or bulkheads may often incorporate downlights.

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.

NB 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 can also undermine the acoustical integrity of a service system. In this instance, all services will be acoustically lagged and this will be acceptable for bathroom ceilings requiring an acoustic rating of $R_w + C_{tr}$ 25.

If there are any services that serve one sole occupancy unit and pass through the ceiling bulkhead in a separate sole occupancy unit and there is an exhaust or supply grille that serves a habitable room located in that ceiling bulkhead, the following will be required:-

- the services should be acoustically lagged,
- insulation installed in the ceiling space / bulkhead beneath the services, **and**
- a metal plenum box installed over the air grilles, internally lined with 50 mm thick glasswool insulation (density 32 kg/m^3), 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 this situation occurs additional details may be provided on request.

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/m^2.

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 detailed in Section 4.2 above 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 detailed in Section 4.2 above 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 walls and floors detailed in Sections 4.1 to 4.2 above

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.

8. CONCLUSION

An acoustical assessment for the redevelopment of Brisbane Legacy Club Village at 51 to 57 Masons Parade, Frederick Point, NSW.

Consideration has been given to noise intrusion into the development from road traffic on the Central Coast Highway as well as noise emission arising from the operation of the mechanical plant servicing the apartments and the acoustical provisions of Part F5 of the BCA.

The internal noise limits set by Clause 102 of the *State Environment Planning Policy (Infrastructure)* 2007 can be met providing recommendations made in Section 5 of this Report are implemented.

A further assessment of mechanical plant noise emission will be undertaken prior to the issue of a Construction Certificate are outlined in Section 6 of this Report.

Recommendations are made in Section 7 of this report to address the BCA *Deemed-to-Satisfy Provisions* and / or *Performance Requirements* of Part F5 for the construction of internal building elements.

Matthew Harwood, MAAS

Principal Acoustical Consultant

Attachments:-

- Important Note
- Appendix A – Noise Survey Instrumentation
- Appendix B – Recommended Glazing Upgrade Floor Plan Mark Up
- Appendix C – Sound Insulation Descriptors
- Appendices D to G – Acoustical Details for Services (these are not intended as construction drawings and are shown to provide to the architect and builder)
- Appendix H – Acoustic Underlay Installation Guide
- Appendices I – Background and Traffic Noise Survey Results

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 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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Opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal opinions.

Noise Survey Instrumentation	Appendix A

The instrumentation used during the noise surveys consisted of the following:-

Description	Model No.	Serial No.
SVANTEK Sound Level Meter	957	15395
SVANTEK Sound Level Meter	971	74362
Svantek Acoustical Calibrator	SV 34A	58762
Infobyte Noise Logger (Type 2)	iM4	104
Condenser Microphone 0.5” diameter	MK 250	104

The sound level meters conform to Australian Standard AS IEC 61672.1-2004: ‘Electroacoustics - Sound level meters – Specifications’ as Class 1 precision sound level meters.

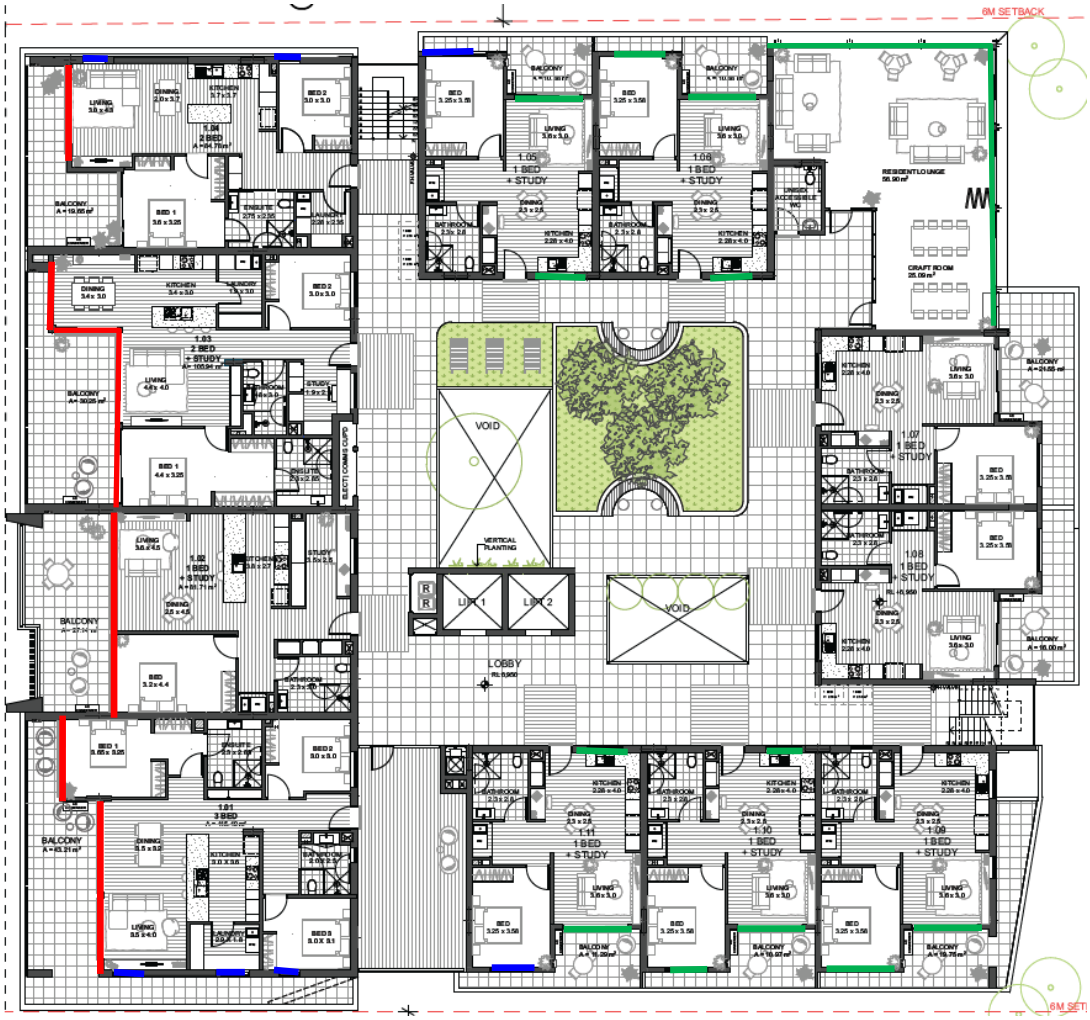
The Infobyte model iM4 noise logger conforms to Australian Standard AS 1259 as a Type 2 sound level meter.

The calibration of the meters was checked before and after the measurement periods. No significant system drift occurred over the measurement periods.

The sound level meters and calibrator have been checked, adjusted and aligned to conform to the factory specifications and issued with conformance certificates as required by the regulations.

Glazing Requirements – Floor Plan Mark Ups	Appendix B

First, Second, Third and Fourth Floor example



- R_w 34 – e.g. 10.38 mm laminated glass
- R_w 32 – e.g. 6.38 mm laminated glass
- R_w 29 – e.g. 5 mm float glass

Sound Insulation Descriptors	Appendix C

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.

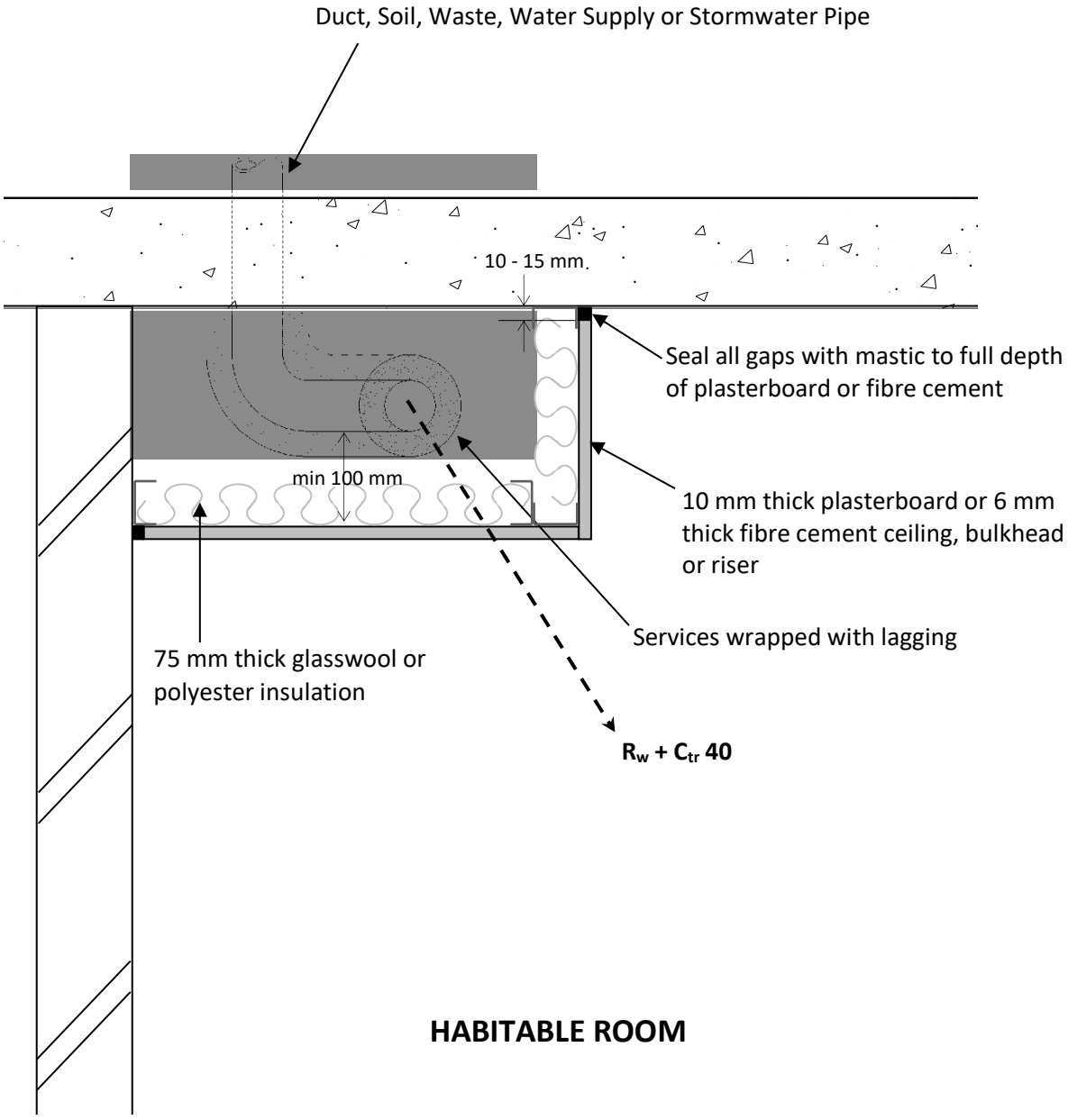
C_{tr} is a correction factor to adjust for the lower frequency content of the sound source. The C_{tr} factor is a negative value that is added to the R_w rating to get an overall $R_w + C_{tr}$ airborne rating. For masonry walls, the C_{tr} factor is typically between –5 and –3, while for plasterboard 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.

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

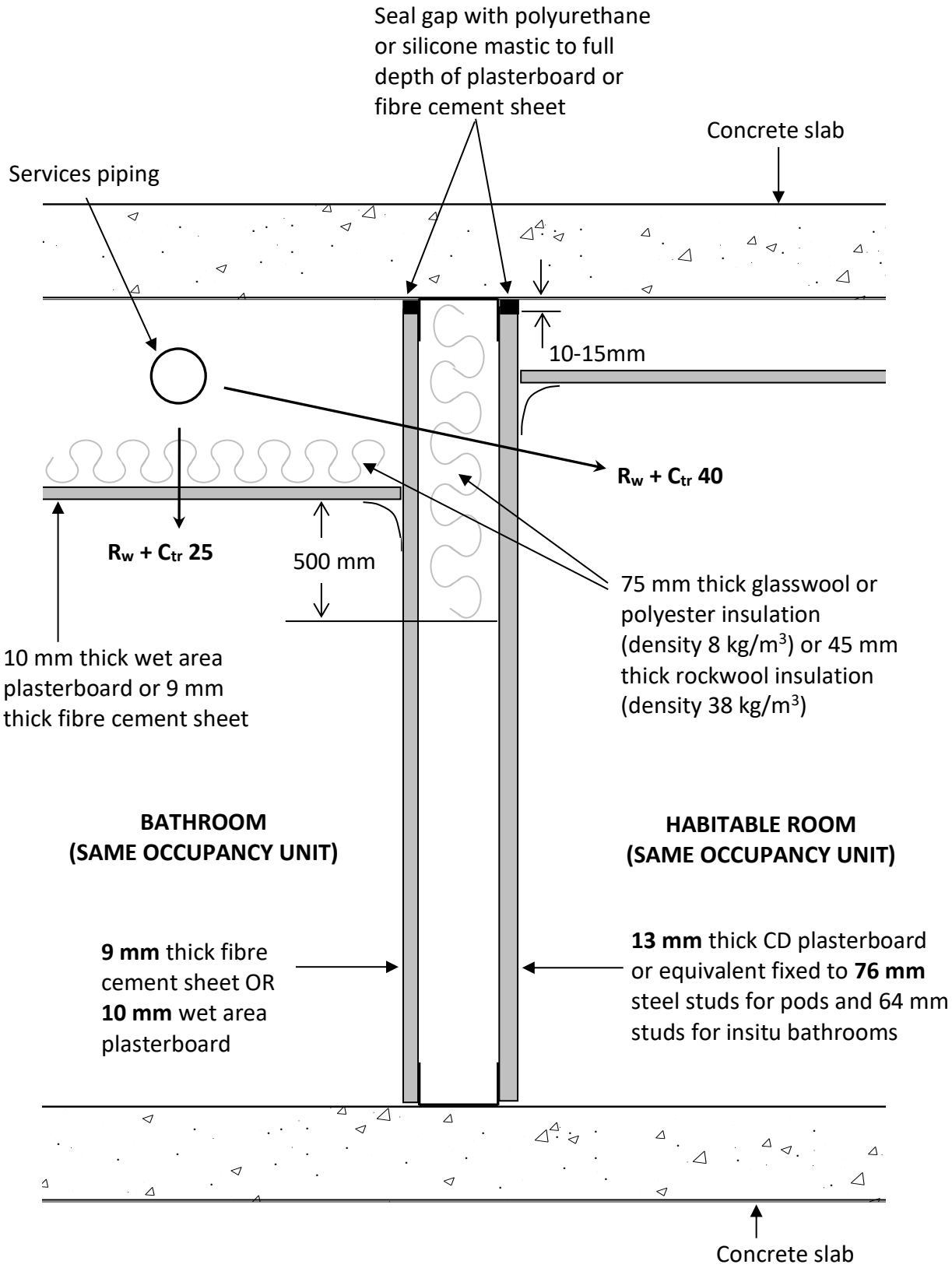
$R_w + C_{tr}$ 40 Construction Separating Services from Habitable Rooms	Appendix D

$R_w + C_{tr}$ 40 – (section 7.3)



Not to scale

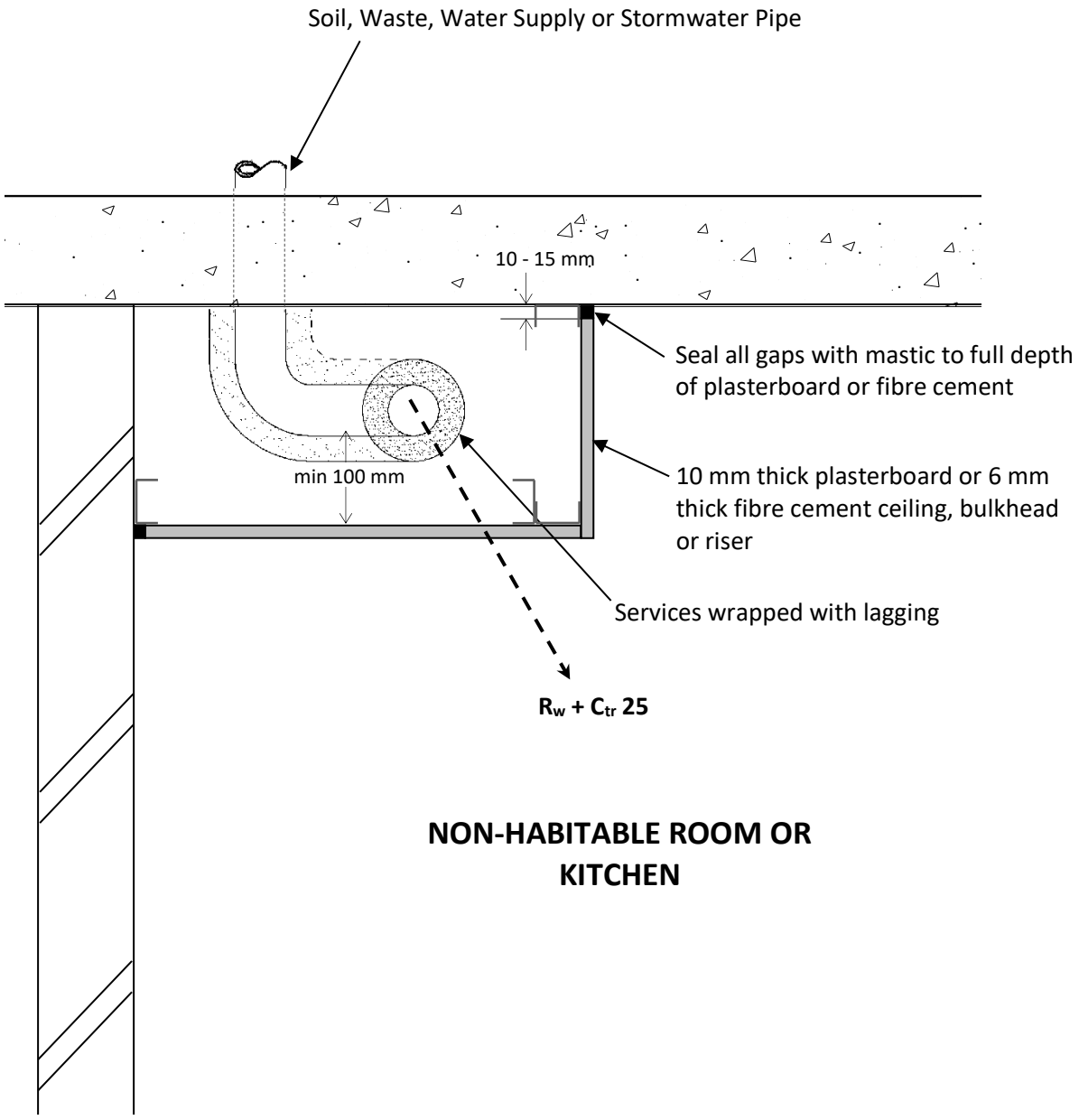
$R_w + C_{tr}$ 40 Construction Section View of Wall Between Wet Area and Habitable Room	Appendix E



As an alternative to the insulation in the wall and ceiling cavity, the pipe may be lagged with Soundlag 4525c or equivalent.

$R_w + C_{tr}$ 25 Construction Separating Services from Non - Habitable Rooms	Appendix F

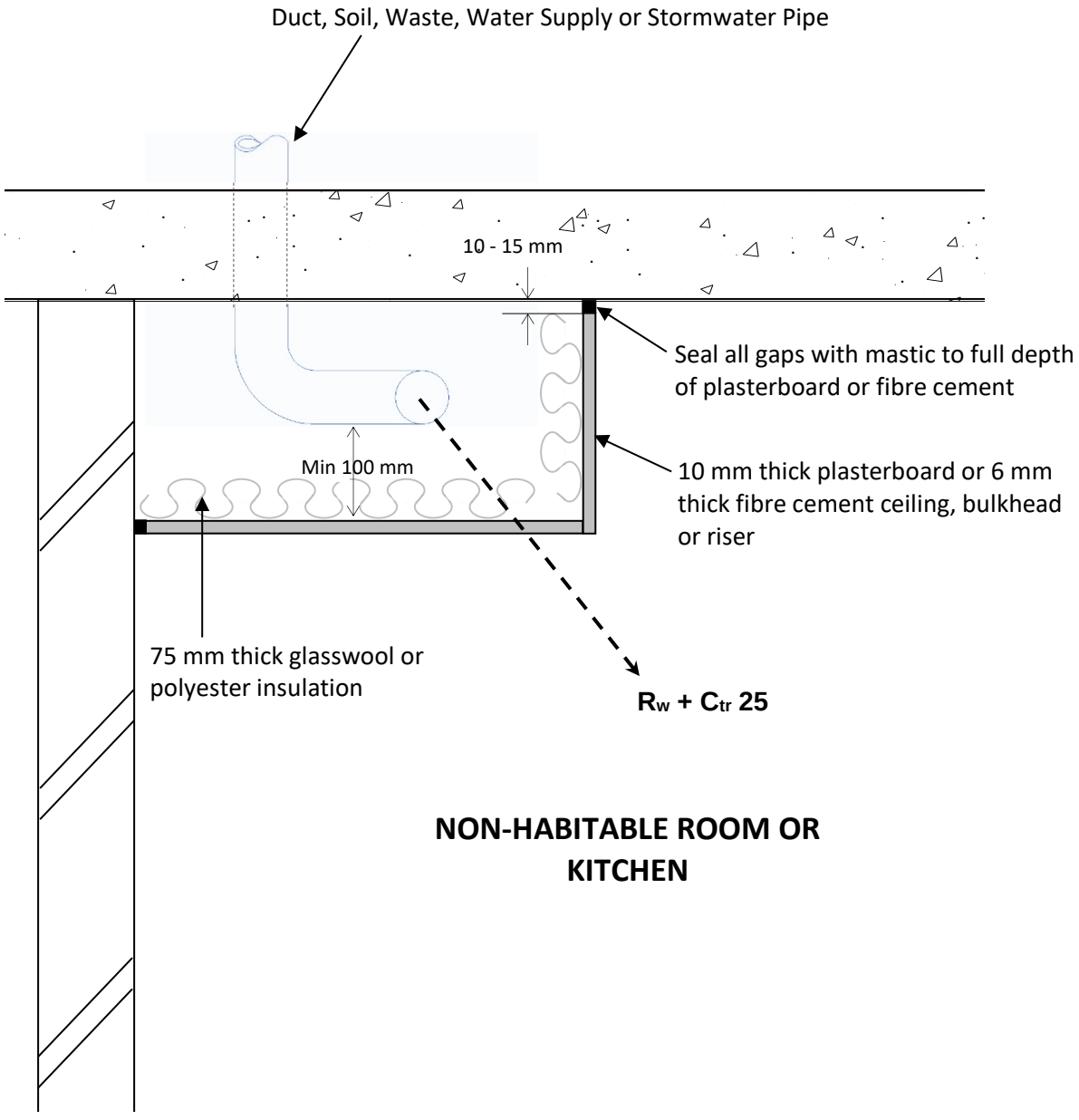
$R_w + C_{tr}$ 25 – Option 1 (section 7.3)



Not to scale

$R_w + C_{tr}$ 25 Construction Separating Services from Non - Habitable Rooms	Appendix G

$R_w + C_{tr}$ 25 – Option 2 (section 7.3)



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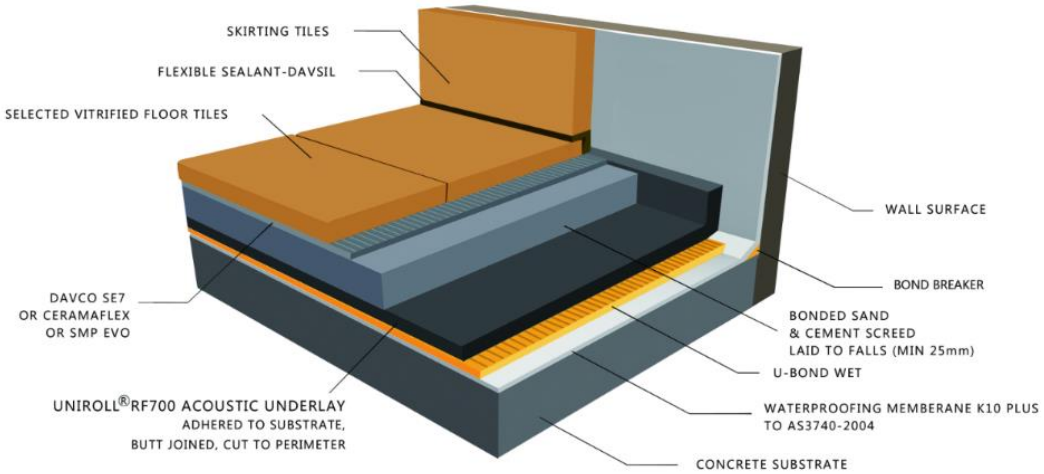
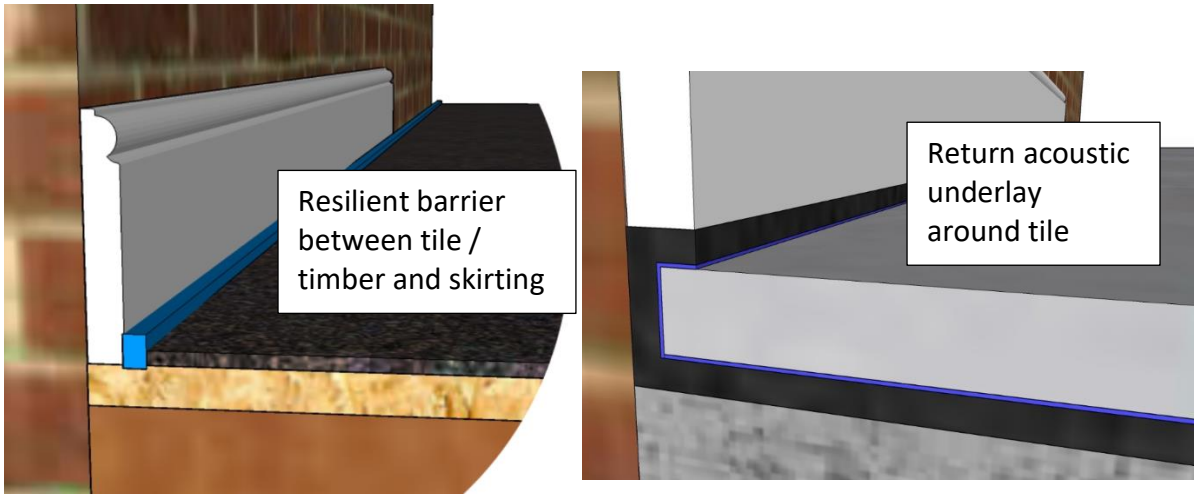
Acoustic Underlay / Flexible Sealant	Appendix H



UNDER SCREED SYSTEM

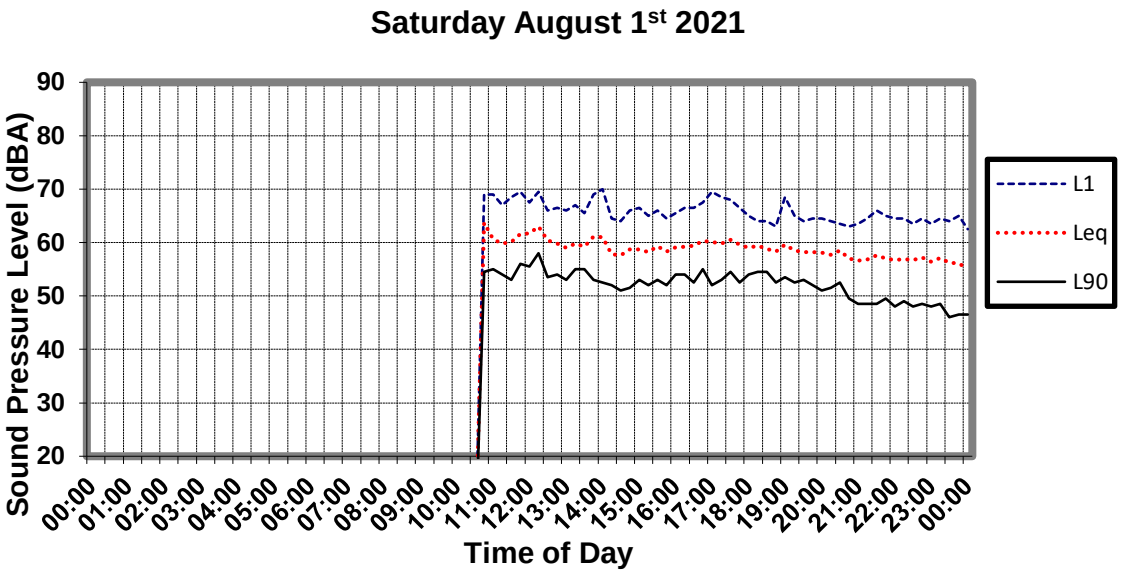
Source (www.uniroll.com.au)

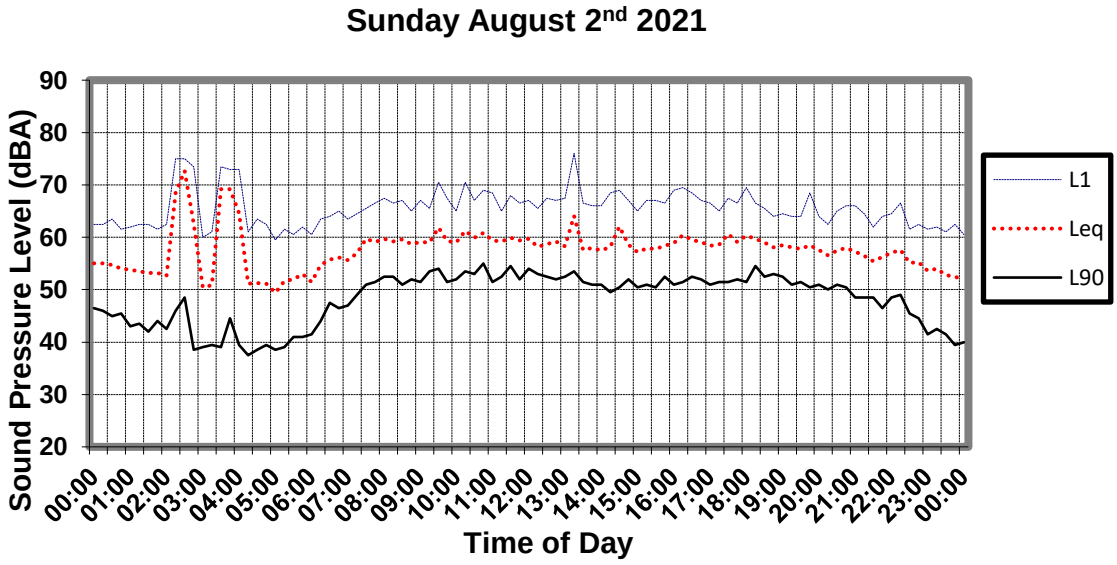


Source (www. https://www.soundproofingstore.co.uk)

Background Noise and Traffic Noise Survey Results	Appendix I

Traffic Noise Survey





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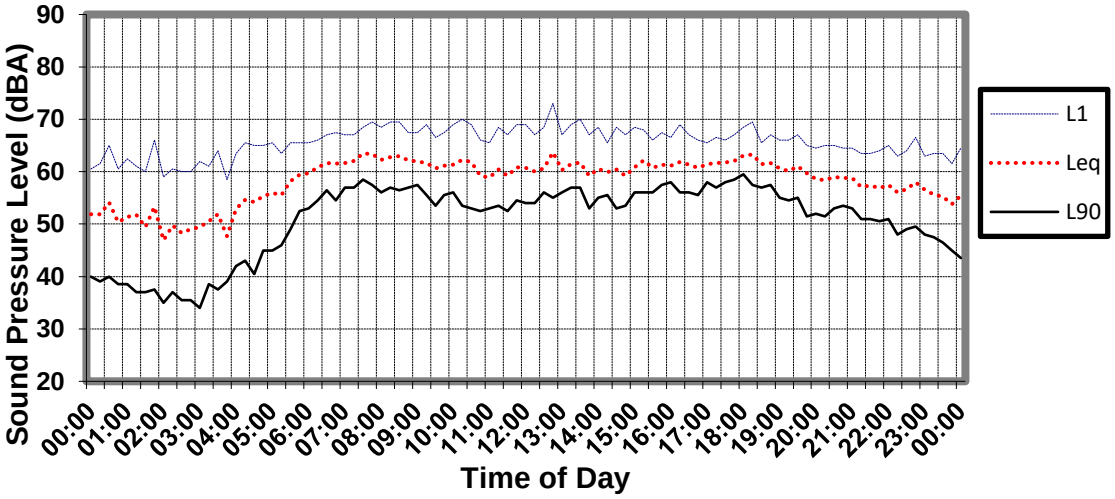

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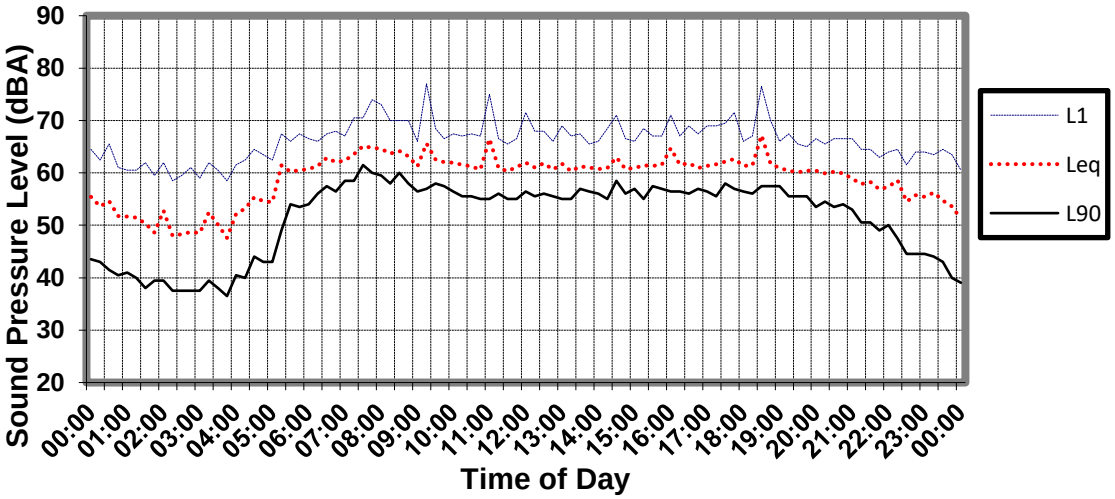
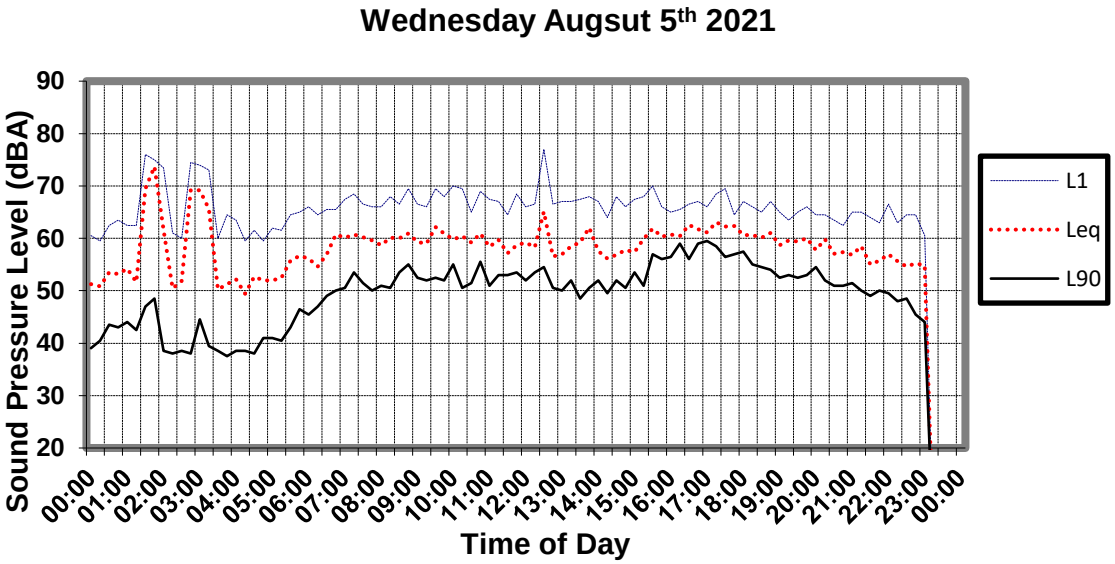
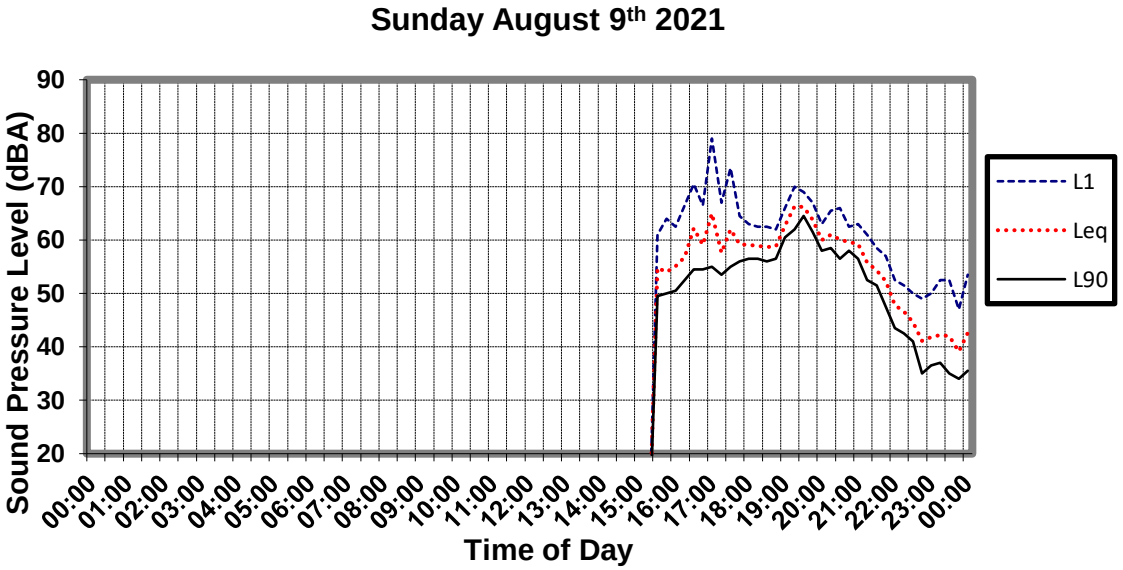




Background Noise Survey



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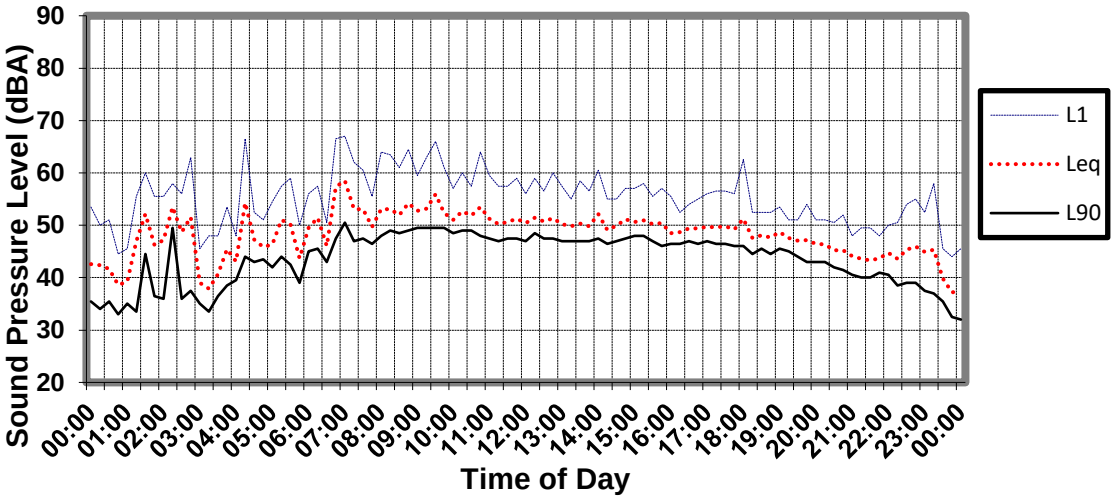

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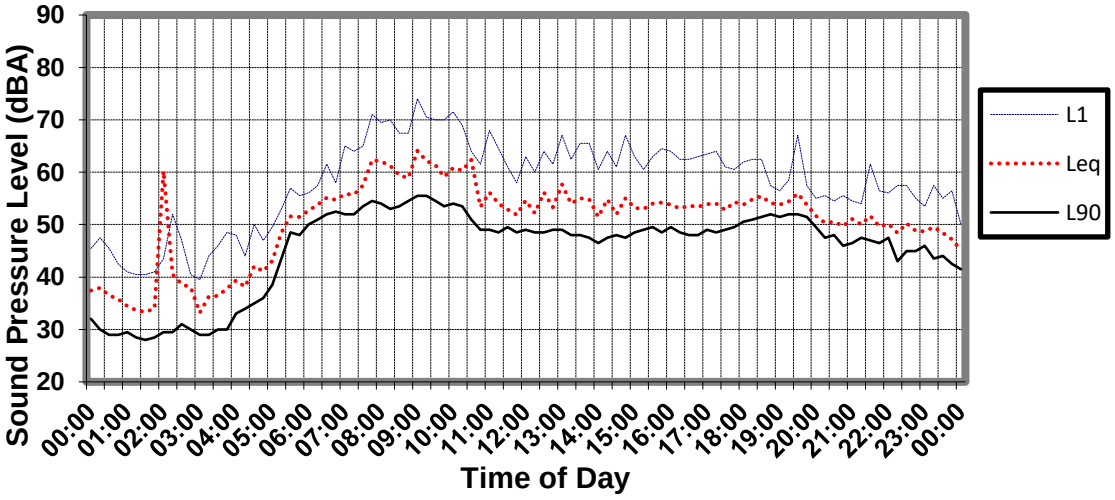

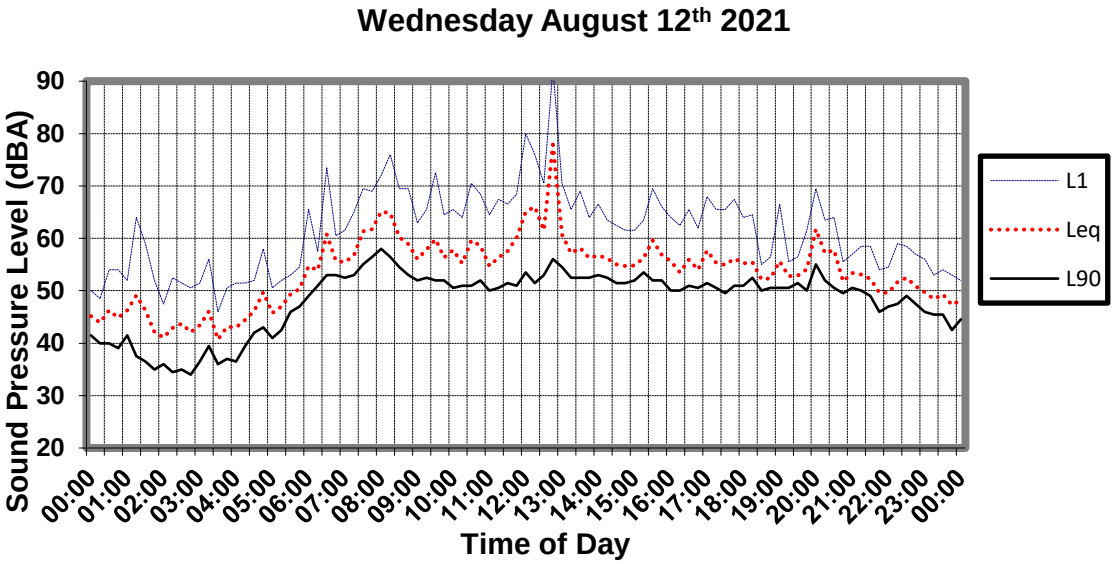
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80
70
60
50
40
30
20
00:00
01:00
02:00
03:00
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05:00
06:00
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23:00
00:00
Time of Day
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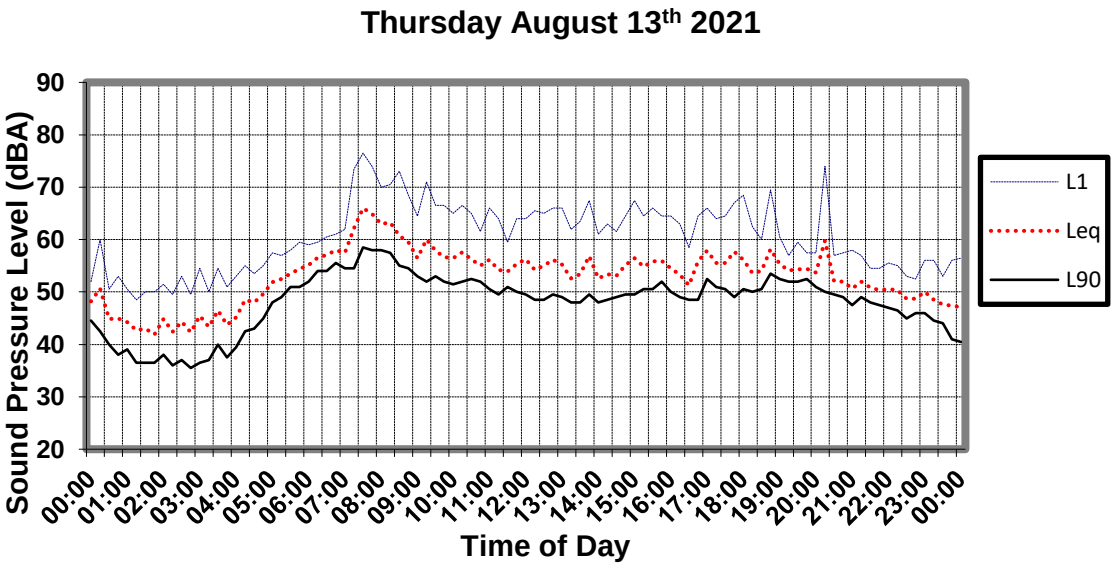
Leq
L90


Thursday August 13th 2021
Sound Pressure Level (dBA)
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80
70
60
50
40
30
20
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02:00
03:00
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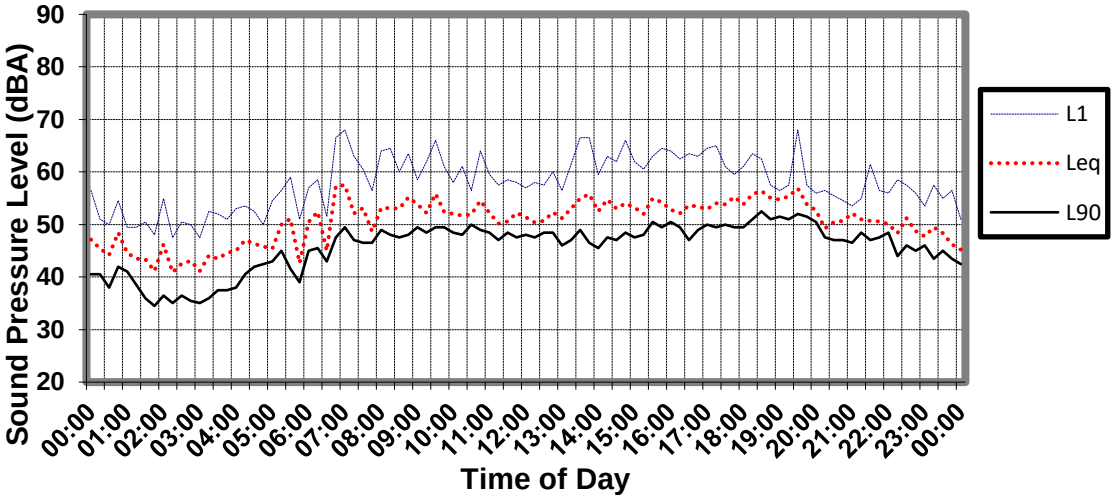
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Time of Day
L1
Leq
L90

Friday August 14th 2021



Satuday August 15th 2021