ADP
Consulting : Engineering

81-95 Burnley Street & 26-34 Doonside Street, Richmond

Acoustic Town Planning Report

Prepared for: Burnley Street Developments by Gurner

Project No: MEL2264
Date: 20 June 2023
Revision: 04

Creating great environments with great people

Project:	81-95 Burnley Street & 26-34 Doonside Street, Richmond
Location:	81 Burnley Street Richmond, VIC 3121
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Project Team	
Client / Principal	Burnley Street Developments by Gurner
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1. Introduction

1.1 Document purpose

ADP Consulting Pty Ltd has been engaged by Burnley Street Developments by Gurner to undertake acoustic engineering services for the proposed mixed-use development at 81-95 Burnley Street, Richmond.

This document is to be used as a briefing document, and to provide information to the client and the design team prior to the detailed design. It may also be issued to the Yarra City Council as part of the Town Planning Application.

This report addresses design criteria and provides preliminary advice for the following:

- the impact of operations on nearby sensitive receivers (including noise emission from emergency plant and equipment)
- internal noise levels and reverberation times
- sound insulation between noisy areas and sensitive spaces
- vibration requirements

The design criteria and acoustic treatment concepts in this report demonstrate the pathways by which these will be addressed by ADP Consulting and the project team through further analysis, recommendations, and coordination as the design progresses.

Acoustic terminology is included in Appendix A.

1.2 Reference design documentation, codes and standards

The following guidelines, standards, regulatory requirements, drawings, conditions and other project-specific information have been referenced in preparing this report:

- Fender Katsalidis, Doonside Yards Architectural Drawings, dated 04 November 2021 (Architectural Drawings)
- Gurner, 81-95 Burnley Street & 26-34 Doonside Street Development Plan, dated December 2022 (Development Plan)
- Schedule 15 to clause 43.04 Development Plan Overlay in City of Yarra Planning Scheme
- VIC EPA, Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues, Publication 1826.4, dated 1 July 2021 (EPA Noise Protocol)
- VIC EPA, Summary of noise framework, Publication 1757.2, dated May 2021 (EPA Summary of Noise Framework)
- VIC EPA, Guide to the Environment Protection Regulations, Publication 1753.2, dated May 2021 (EPA Guide to the EP Regulations)
- National Construction Code 2019 – Volume One, Building Code of Australia, Class 2 to 9 Buildings (NCC)
- Apartment Design Guidelines for Victoria, Victoria State Government Environment, Land, Water and Planning, dated December 2022 (ADG)

- AS/NZS 2107:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors (AS/NZS 2107)
- AS 1055.2:1997 Acoustics – Description and Measurement of Environmental Noise Part 2: Application to Specific Situations (AS 1055.2)
- AS 2670.2:1990 Evaluation of Human Exposure to Whole-Body Vibration Part 2: Continuous and Shock-Induced Vibration in Buildings (1 to 80 Hz) (AS 2670.2)
- AS/NZS 1668.1:2015 The Use of Ventilation and Air Conditioning in Buildings Part 1: Fire and Smoke Control in Buildings (AS/NZS 1668.1)
- Assessing Vibration: A Technical Guideline – NSW Department of Environment and Conservation, dated February 2006 (AVTG)
- BS 6472–1992 – Evaluation of Human Exposure to Whole-Body Vibration in Buildings (1 to 80 Hz) (BS 6472)
- Schedule 15 to Clause 43.04 Development Overlay (DP015) 81-95 Burnley Street and Doonside Street, Richmond.

1.3 Site description

The site is located within a Mixed-Use Zone (MUZ), with nearby land zones including general residential (GRZ2, GRZ3 an GRZ4), comprehensive development (CDZ1), health and community (PUZ3) industrial (INI1Z) neighbourhood residential (NRZ1), and road zones (RDZ1).

Specifically, the site is bounded by the following:

- Doonside Street to the north (MUZ and CDZ1)
- Appleton Street to the south (GRZ4 and NRZ1)
- Embassy Richmond (multi-level residential building on 39 Appleton Street to the east (MUZ)
- Burnley Street to the west (RDZ1 and GRZ4)

Other significant features surrounding the site include:

- Trinity Catholic School to the south-east (GRZ4)
- Victoria Gardens Shopping Centre to the north (CDZ1)
- Yarra River and Annettes Place to the east (PPRZ and PUZ1)

The nearest noise sensitive receivers are as follows:

- 2 – 38 Appleton Street 15 meters to the south,
- Embassy Residences (39 Appleton Street) on the eastern border of the site.
- 86 - 88 Burnley St 20 metres to the west
- Trinity Catholic School 50 metres to south-west

Figure 1 provides a site map of the proposed development and its surrounds.

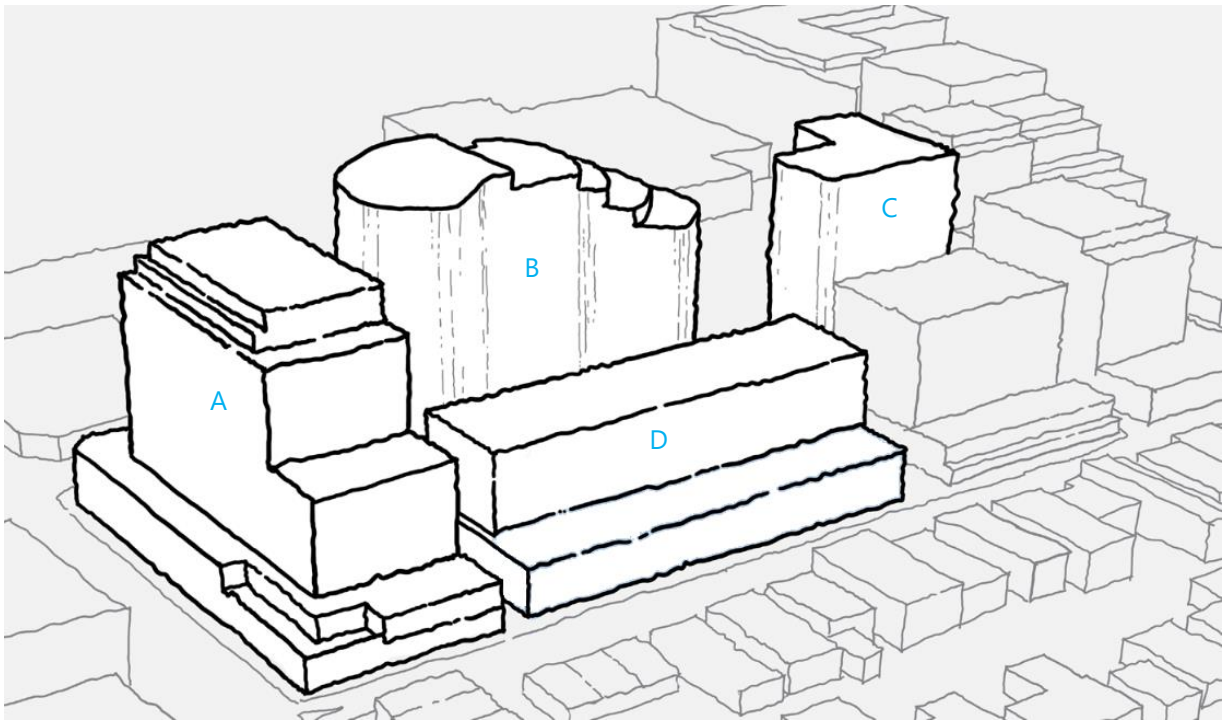
Figure 1 Site and surrounds of 81-95 Burnley Street

1.4 Project summary

The project proposes the following land uses:

- Approximately15 storey mixed-use building (Building A), to include:
  - Residential Apartments
  - a multi-level Commercial Tenancy (Ground Floor, Showroom Level 1)
  - a Bar and Alfresco tenancy (Ground Floor)
- Approximately 17 storey mixed-use building including (Building B), to include:
  - Residential Apartments
  - Retail Tenancies (Ground Floor)
- Approximately 12 storey residential building (Building C), to include:
  - Residential Apartments
  - Retail Tenancies (Ground Floor)
  - Recreational Area (Ground Floor)
  - Commercial Tenancies (Level 1)
- Approximately 7 storey residential building (Building D), to include:
  - Residential Apartments
  - Retail Tenancies (Ground Floor)
- Basement area

Figure 2 Tower layout of 81-95 Burnley Street (from Architectural Drawings)



2. Noise Measurements

2.1 Noise measurement equipment

The following instrumentation was used for noise measurements and analysis:

- Noise Sentry NSRT Mk3 Class 1 sound level meter data logger (S/N: AnNerf2Y0%2doBlCz0pRtD), utilised as an unattended noise logger (Location L1 – see Figure 1)
- Noise Sentry NSRT Mk3 Class 1 sound level meter data logger (S/N: AtHcpPWQ2%+3KBlCZwrxFD), utilised as an unattended noise logger (Location L2 – see Figure 1)
- Bruel and Kjaer 2250 Integrating Sound Level Meter (S/N: 3030531), with Bruel and Kjaer Type 1 microphone comprising of:
  - ZC 0032 preamplifier (S/N: 31407)
  - 4189 capsule (S/N: 3318503)
- Svan Type SV36 acoustic calibrator (S/N:106880)

All instrument systems has been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 0.2dB during attended measurements. No adjustments for instrument drift during the measurement period were warranted.

2.2 Unattended noise measurements

Unattended noise measurements were conducted for a period of 7 days between Friday 21 April 2023 and Friday 28 April 2023 at Location L1 and L2 (see Figure 1).

At this location, the long-term monitoring devices were both located in free field conditions, with the microphone:

- L1 – top of carpark entry fence 3m above ground level
- L2 – level 1 of the existing development 5m above ground level

Located at the north and west boundary of the subject site, and chosen to collect background noise levels in the area to set noise emission criteria for the proposed development.

It was observed that the background noise levels of the site and surrounds were predominantly influenced by noise contributions from road traffic and vehicle traffic / pedestrian activity on Burnley Street and Doonside Street.

Background noise levels at Location L1 and L2 are summarised in Table 1.

Table 1 Unattended background noise measurements, dB(A)

Location	**Daytime** (07:00-18:00)	**Evening** (18:00-22:00)	**Night-time** (22:00-07:00)	**$L_{Aeq,16h}$ 06:00-22:00**	**$L_{Aeq,8h}$ 22:00-06:00**
Location L1	50 dBL_{A90}	46 dBL_{A90}	47 dBL_{A90}	59	57

Location	Daytime (07:00-18:00)	Evening (18:00-22:00)	Night-time (22:00-07:00)	$L_{Aeq,16h}$ **06:00-22:00**	$L_{Aeq,8h}$ **22:00-06:00**
Location L2	59 dBL_{A90}	53 dBL_{A90}	42 dBL_{A90}	69	62

2.3 Attended noise measurements

ADP Consulting conducted attended noise measurements on Friday 21 April 2023 and Friday 28 April 2023 at Locations A1 to A3 (Figure 1).

These noise measurements were taken during key time periods to qualify and quantify the typical noise levels for the area, to inform acoustic requirements of the proposed development façades.

The ambient/traffic noise levels measured at Locations A1 to A3 are summarised in Table 2.

Table 2 Attended noise measurements, dB(A)

Date and time	Location and comments	Noise level, dB(A)		
		L_{eq}	L_{10}	L_{90}
Friday 21 April 2023, 4.23pm to 4.33pm	**Location A1** – Measuring local traffic and ambient noise levels along Doonside Street at the carpark entry of Harry the Hirer carpark, in proximity to the carpark entry driveway.	59	58	46
Friday 21 April 2023, 4.35pm to 4.45pm	**Location A2** – Measuring busy traffic and ambient noise levels along Burnley Street at the western façade of Harry the hirer, opposite carpark entry of 85-88 Burnley Street.	69	73	58
Friday 21 April 2023, 4.45pm to 4.55pm	**Location A3** – Measuring local traffic and ambient noise levels along Appleton Street, traffic noise audible from Burnley street.	51	54	41
Friday 28 April 2023, 10.29am to 10.39am	**Location A1** – Measuring local traffic and ambient noise levels along Doonside Street at the carpark entry of Harry the Hirer carpark, in proximity to the carpark entry driveway.	52	53	47
Friday 28 April 2023, 10.41am to 10.51am	**Location A2** – Measuring busy traffic and ambient noise levels along Burnley Street at the western façade of Harry the hirer, opposite carpark entry of 85-88 Burnley Street.	69	73	55
Friday 28 April 2023, 10.52am to 11.02am	**Location A3** – Measuring local traffic and ambient noise levels along Appleton Street, traffic noise audible from Burnley street.	53	57	41

Date and time	Location and comments	Noise level, dB(A)		
		L_{eq}	L_{10}	L_{90}
Tuesday 20 June 2023, 3.46am to 3.56am	**Location A1** – Measuring ambient noise levels along Doonside Street at the carpark entry of Harry the Hirer carpark, in proximity to the carpark entry driveway.	46	45	43
Tuesday 20 June 2023, 3.58am to 4.08am	**Location A4** – Measuring ambient noise levels in front of Embassy Richmond.	43	43	41
Tuesday 20 June 2023, 4.11.am to 4.21am	**Location A3** – Measuring ambient noise levels along Appleton Street, light traffic noise audible from Burnley street.	42	42	38
Tuesday 20 June 2023, 4.22.am to 4.32am	**Location A2** – Measuring traffic and ambient noise levels along Burnley Street at the western façade of Harry the hirer, opposite carpark entry of 85-88 Burnley Street. 6 Large trucks pass-by during the measurement.	66	62	43
Tuesday 20 June 2023, 5.22.am to 5.32am	**Location A1** – Measuring ambient noise levels along Doonside Street at the carpark entry of Harry the Hirer carpark, in proximity to the carpark entry driveway. Commercial truck loading activity, truck idle and pickup during the measurement.	57	57	45
Tuesday 20 June 2023, 5.33.am to 5.43am	**Location A4** – Measuring ambient noise levels in front of Embassy Richmond. Loading activity not audible from Doonside Street.	48	49	45
Tuesday 20 June 2023, 5.45.am to 5.55am	**Location A3** – Measuring ambient noise levels along Appleton Street, traffic noise audible from Burnley street.	47	46	42
Tuesday 20 June 2023, 5.56.am to 6.06am	**Location A2** – Measuring traffic and ambient noise levels along Burnley Street at the western façade of Harry the hirer, opposite carpark entry of 85-88 Burnley Street. Multiple truck pass-by and two cars exiting apartment carpark.	69	74	50
Tuesday 20 June 2023, 6.08.am to 6.19am	**Location A1** – Measuring ambient noise levels along Doonside Street at the carpark entry of Harry the Hirer carpark, in proximity to the carpark entry driveway. Light traffic and 2 cars entry into Harry the Hirer.	57	57	47

3. Acoustic design criteria

3.1 Noise emissions

New Environment Protection Regulations (EP Regulations) in Victoria started to take effect on 1 July 2021. The EP Regulations include the EPA Noise Protocol as the new reference document which sets the required approach to determine noise limits and assess noise emissions. The EPA Noise Protocol has replaced the following:

- State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade), SEPP N-1.
- State Environment Protection Policy (Control of Music Noise from Public Premises), SEPP N-2.

3.1.1 Commercial, industrial and trade premises noise – EPA Noise Protocol Part I

Noise emission restrictions apply to base building and commercial tenant activity and systems (e.g. plant/equipment). These must be planned, designed and installed to include suitable sound attenuation, vibration isolation, and other necessary acoustic treatments. This report provides an approach that need to be incorporated in the proposed development to meet the noise emission requirements of the EPA Noise Protocol Part 1.

The requirements include determination of noise limits at the nearest external residential receivers, as well as within the proposed development, based on background noise levels and a zoning level set based on upon surrounding land use. For emergency equipment such as standby generators, standby boilers and fire pumps increased noise limits apply.

Two zoning noise limit calculation points have been selected to represent the different noise sensitive receivers as follows:

- Embassy Richmond (39 Appleton Street, Richmond), on the eastern boundary of the project site
- 85-88 Burnley Street, Richmond, west of the project site

Table 3 presents the noise limit criteria applicable,

Table 3 Noise emission criteria – noise sensitive area

	Measured Background noise levels, dBL_{A90}	EPA Noise Protocol Part I noise limits, $dBL_{Aeq,30min}$	
Time of operation		**Operational**	**Emergency**
Receivers: 2-38 Appleton Street, and Embassy Residences at 39 Appleton Street			
Day (7am to 6pm)	50[1]	56	66
Evening (6pm to 10pm)	46[1]	49	54
Night (10pm to 7am)	43[2]	46	55
Receivers: 85-88 Burnley Street			

Time of operation	Measured Background noise levels, dBL_{A90}	EPA Noise Protocol Part I noise limits, $dBL_{Aeq,30min}$	
		Operational	Emergency
Day (7am to 6pm)	59[3]	65	75
Evening (6pm to 10pm)	53[3]	56	61
Night (10pm to 7am)	42[3]	45	50

Note:
1. L_{A90} averaged from logger L1
2. Supplementary night period attended measurement at A4 was used as the night time logging data was deemed compromised by nearby commercial loading activity (Slide Productions, Victoria Gardens).
3. L_{A90} averaged from logger L2

The cumulative noise emissions from operations at the proposed development are to meet the specific noise criteria defined in Table 3.

At time of writing, the retail/commercial tenancies are yet to be identified / selected, therefore, each tenancy may be required to demonstrate compliance with the EPA Noise Protocol Part I and a separate submission to Council may be required.

3.1.2 Entertainment venues and events – EPA Noise Protocol Part II

Noise emission restrictions also apply to potential commercial music and entertainment noise. A methodology to determine noise limits as well as to assess music noise is included in the EPA Noise Protocol Part II

Any tenants that are expected to create commercial music and entertainment noise are to advise on their operational conditions (e.g., patron numbers and music noise and a separate assessment and submission to the Yarra City Council may be necessary to demonstrate that the requirements of the EPA Noise Protocol Part II are complied with.

Preliminary assessment criteria have been derived based on the measured background noise levels in Section 3.1.1. The criteria are presented in Table 4 and Table 5, and are applicable at noise sensitive receivers.

The assumed operating hours of the licensed premises are for the day, evening and night-time period.

Table 4 Day/evening period music noise limits (subject to change) – Indoor venue

Descriptor	dB(A)
Receivers: 2-38 Appleton Street, and Embassy Residences at 39 Appleton Street	
Base noise limit, L_{eq}	32
Minimum measured period $L_{90,15min}$ falling within licensed operating hours of venue[1]	*46*

Descriptor	dB(A)
Receivers: 2-38 Appleton Street, and Embassy Residences at 39 Appleton Street	
Calculated noise limit – any number of events, L_{eq}[3]	*51*
Receivers: 85-88 Burnley Street	
Base noise limit, L_{eq}	32
Minimum measured period $L_{90,15min}$ falling within licensed operating hours of venue[2]	*47*
Calculated noise limit – any number of events, L_{eq}[3]	*52*

Note:

1. $L_{90,15min}$ from logger data at L1.
2. $L_{90,15min}$ from logger data at L2.
3. The L_{Aeq} noise limits for indoor venues for the day/evening period are the background L_{A90}+5 dB, except where these fall below the base noise limit.

Table 5 Night period music noise limits (subject to change) – Indoor venue

Receivers: 2-38 Appleton Street, and Embassy Residences at 39 Appleton Street

Descriptor	Frequency (Hz)							
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**dB(A)**
Base noise limit, L_{10} (dB)	40	30	20	20	15	10	10	-
Minimum measured period $L_{90,15min}$ falling within licensed operating hours of venue (dB)[1]	*51*	*49*	44	*41*	*40*	*32*	*22*	43
Calculated noise limit, L_{10} (dB)[3]	*59*	*57*	*52*	*49*	*48*	*40*	*30*	-

Receivers: 85-88 Burnley Street

Descriptor	Frequency (Hz)							
	63	125	250	500	1000	2000	4000	dB(A)
Base noise limit, L_{10} (dB)	40	30	20	20	15	10	10	-
Minimum measured period $L_{90,15min}$ falling within licensed operating hours of venue (dB)[2]	52	47	43	42	37	28	20	43
Calculated noise limit, L_{10} (dB)[3]	*60*	*55*	*51*	*50*	*45*	*36*	*28*	-

Receivers: 2-38 Appleton Street, and Embassy Residences at 39 Appleton Street								
Descriptor	**Frequency (Hz)**							
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**dB(A)**
Note:	1. The spectrum data from attended measurements at location A1. 2. The spectrum data from attended measurements at location A2. 3. The L_{OCT10} noise limits for indoor venues for the night period are the background L_{OCT90} + 8 dB, except where this fall below the base noise limit.							

3.2 Internal acoustic environment

3.2.1 Noise levels and reverberation times

Indoor background design noise levels, which are deemed acceptable to the majority of reasonable occupants are published in AS/NZS 2107. These apply to continuous/steady sources of noise (e.g. traffic, noise from plant equipment, etc.), and noise from fully fitted out and completed buildings, excluding occupant noise. The acoustic design will have to make appropriate allowances for the individual contributions from these different noise sources.

Furthermore, AS/NZS 2107:2016 refers to ideal reverberation times for various spaces. Low reverberation times are critical for speech intelligibility and perception of a space as having high acoustic quality.

The recommended design sound levels and reverberation times are presented in Table 6.

Table 6 AS/NZS 2107 recommended design sound levels and reverberation times

Type of occupancy	**Design sound level, $dBL_{Aeq,T}$,**	**Design reverberation time (T), range, s**
Apartment sleeping areas– in inner city areas	35 to 40	-
Apartment living areas – in inner city areas	35 to 45	-
Residential common areas (e.g. foyer, lift lobby, corridors)	45 to 50	-
Private dining area	45 to 50	-
Office corridors and lobbies	45 to 50	< 1.0
General office areas	40 to 45	0.4 to 0.6
Fitness room	< 50	< 1.0
Small retail stores (general)	<50	Minimised
Coffee shops	40 to 50	Minimised
Restaurants	40 to 50	Minimised
Games room	45 to 50	< 1.0
Washrooms and toilets	45 to 55	-

Type of occupancy	Design sound level, $dBL_{Aeq,T}$,	Design reverberation time (T), range, s
Kitchen and storage areas (including typical BOH areas)	< 55	-
Enclosed carparks	< 65	-

3.2.2 Fire mode noise conditions

Building systems which only operate in fire mode, and during periodic testing, do not add to background noise under typical conditions. In accordance with AS/NZS 1668.1:2015, these systems are subject to noise limits, relating not to occupant comfort but rather to occupant distress and the intelligibility of emergency commands.

The fire mode noise limits are presented in Table 7.

Table 7 Fire mode maximum sound pressure levels

Area type	Maximum SPL, L_{Aeq}, dB(A)
Occupied Area	65
Fire-isolated exit (e.g. fire stair)	80

3.2.3 Communal terraces

To minimise noise levels caused by the usage of outdoor amenity areas and terraces, noise limits for adjacent occupied areas within this development are proposed in Table 8 below.

Table 8: Maximum internal airborne and structure-borne noise levels from communal amenity areas and gym

		Internal noise criterion, dBL_{Amax}	
Activity/operation	Adjacent space	Day/ Evening (7am to 10pm)	Night (10pm to 7am)
• Communal amenity areas	Residences	40	35
•	Office areas	45	

3.2.4 Noise intrusion

In cases where noise intrusion is not expected to be driven by commercial noise, the noise limit is based on the Australian Standards internal noise level provided in Section 3.2.1.

A summary of the noise intrusion criteria for the proposed development is provided in Table 9 below.

Table 9: Noise Intrusion Limits

Source	Noise limits,		Comment
	External	Internal	
Road traffic noise	NA	Bedrooms: 35dBL$_{Aeq,8h}$ Living Rooms 40dBL$_{Aeq,16h}$	Based on City of Yarra Guidelines and Standard D16 and primarily applicable to Burnley Street.
Commercial noise	45 dBL$_{Aeq,30min}$	25 dBL$_{Aeq,30min}$	The reverse amenity EPA noise limit based on measured night-time background noise levels and zoning information away from Burnley Street (20dB reduction for outside to inside with closed windows)

3.2.5 Acoustic separation

Acoustic separation is important where there is a need to protect personal and sensitive conversations and/or to control noise disturbance.

The amount of noise transferred between the source and receiving space depends on:

- The level of sounds created in the source room.
- The sound insulation provided by walls, doors, roof, floor, ductwork and other elements separating the source and receiving spaces.
- Sound flanking paths that allow sound to go around the intervening partition/floor.

Internal sound insulation of the residential component of the development needs to comply with the NCC requirements as a minimum.

As design progresses further specific internal sound insulation targets for other uses within the project will be determined on a case-by-case basis and with reference to sustainability targets and/or other design standards as required.

3.2.5.1 NCC requirements for residential buildings

For apartments of multi-residential buildings, the NCC specifies minimum sound insulation ratings between various occupancies. This is defined in terms of a weighted standardised level difference $D_{nT,w}$ and a weighted standardised level difference with adapted spectrum $D_{nT,w}+C_{tr}$. These ratings are determined by field testing conducted in accordance to AS/NZS 1276.1 or ISO 717.1.

The NCC also offers deemed-to-satisfy provisions based on wall sound insulation ratings determined by laboratory testing in accordance to AS/NZS 1276.1 or ISO 717.1 standards.

Table 10 schedules NCC field-tested sound insulation ratings needed to achieve compliance, along with corresponding NCC deemed-to-satisfy provisions.

Table 10: Building construction requirements

Element	Description	NCC performance	
		Deemed to Satisfy	Field testing rating
Walls	Airborne Sound		
	Separating any two sole occupancy units	$R_w + C_{tr} \geq 50$	$D_{nT,w} + C_{tr} \geq 45$
	Separating a habitable room in one dwelling and a laundry, kitchen, bathroom or toilet in another dwelling	$R_w + C_{tr} \geq 50$ + impact	$D_{nT,w} + C_{tr} \geq 45$ + impact
	Separating a sole occupancy unit and a stairway, public corridor, public lobby or the like, or parts of a different classification	$R_w \geq 50$	$D_{nT,w} \geq 45$
	Separating a sole occupancy unit and a plant room or lift shaft	$R_w \geq 50$ + impact	$D_{nT,w} \geq 45$ + impact
Doors	Door that separates a sole occupancy unit from a stairway, public corridor, public lobby or the like	$R_w \geq 30$	$D_{nT,w} \geq 25$
Floors	Airborne Sound		
	Separating any two sole occupancy units, or separating a sole occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification	$R_w+C_{tr} \geq 50$	$D_{nT,w}+C_{tr} \geq 45$
	Impact Sound		
	Separating any two sole occupancy units, or separating a sole occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification	$L_{n,w} \leq 62$	$L_{nT,w} \leq 62$
Services	If the adjacent room is a habitable room	$R_w+C_{tr} \geq 40$	N/A
	If the adjacent room is a non-habitable (wet) room	$R_w+C_{tr} \geq 25$	N/A
	Access panel in acoustical walls and acoustical barrier ceilings	$R_w+C_{tr} \geq 25$ equivalent	N/A
	If a storm water pipe passes through a sole-occupancy unit, it must be separated as stated above		

Note: Open kitchens are considered non-habitable (wet) source rooms but also habitable receiver rooms. For instance, where services are adjacent to a kitchen which is open to a living room, the kitchen would then be a habitable room and an NCC performance requirement of $R_w + C_{tr} \geq 40$ would apply to the services.

Where there is an identified risk of structure-borne sound transmission, the NCC requires a discontinuous construction, as scheduled in Table 11.

Table 11: NCC specified constructions for wall impact sound insulation

Wall or door type	Discontinuous construction
Wall separating a non-habitable (wet) area in one unit from a habitable room in adjacent unit; OR Wall separating a unit from a plant room or a lift shaft	Discontinuous construction means a wall having a minimum 20mm cavity between 2 separate leaves and: For masonry walls where ties are required between leaves, they are to be of the resilient type, and For walls other than masonry, no mechanical linkage between the leaves, except at the perimeter.

In addition to codified ratings, specific higher-performing constructions may be required in some areas (e.g. plant rooms, etc.) to reduce noise to the adjacent sensitive spaces. Similarly, specific detailed constructions and treatments may be needed to maintain the specified sound insulation rating even across wall elements beyond typical wall types, such as at the junction of internal walls and the façade.

Notwithstanding deemed-to-satisfy provisions based on lab tests, field performance is critically dependent on good workmanship and installation quality, which is also a requirement of the acoustic design.

3.2.6 Internal vibration levels

Limits for vibration of the building structure potentially affecting human comfort have been derived from AS 2670.2 and BS 6472, both of which are referenced and discussed practically in the AVTG. These standards propose maximum vibration levels in terms of baseline curves and multiplication factors.

In addition, the AAAC Gym Guideline provides the same maximum vibration level criteria recommendations as those contained within the standards and AVTG.

For the purpose of minimising the disturbing perceptibility of vibration within the occupied areas of this development; Table 12 and Table 13 specify recommended appropriate limits for continuous and impulsive floor vibration respectively in a simplified form.

With regard to the proposed Gym tenancy on Level 1 of the Mixed Use Building, it shall be noted that the AAAC Gym Guideline states:

- *Perceived vibration resulting from the use and operation of gymnasiums and exercise facilities is generally not a significant issue at receiver locations. If structure-borne (regenerated) noise can be reduced to acceptable levels when designing mitigation, it is often the case that levels of vibration within receiver properties will be imperceptible.*
- *Tables from the (AVTG) are provided below for reference, however the AAAC notes that the vibration resulting from the operation of gymnasiums and exercise facilities is likely to be neither continuous, nor impulsive, as per the (AVTG) definitions. As such, a typical objective for vibration emission from a gymnasium or exercise facility, is likely to fall within the ranges given by the (AVTG) for impulsive and continuous vibration.*
- *For the provision of guidance, the AAAC considers that the "Continuous" levels may be used for guidance when assessing vibration from cardio areas, and repetitious or cyclical activities, given vibration resulting from such activities is typically continuous in nature, when in use.*
- *The vibration events resulting from the dropping of weights may be classified as "occasional", typically with several occurrences per day, or per assessment period. Where the number of such events is only occasional the Preferred "Impulsive" levels may be used for guidance when assessing vibration from the weights areas.*

Where many weight dropping events are expected to occur during each period values below the "Impulsive" levels may be more appropriate.

> *The vibration generated from the dropping of weights onto the gym floor typically induces maximum acceleration in the vertical axis. Accordingly, the "Preferred Value, z-axis" criteria in (the below tables) should be applied to the analysis and assessment.*

Table 12 Internal vibration limits – Continuous vibration

Adjacent space	Time	Weighted r.m.s. acceleration (mm/s^2) (1-80Hz)		Velocity (mm/s)	
		Preferred to Maximum values		Preferred to Maximum values	
		z axis	x/y axes	RMS velocity	Peak velocity
Residences, Sleeping areas	Day	10 to 20	7.1 to 14	0.20 to 0.40	0.28 to 0.56
	Night	7 to 14	5 to 10	0.14 to 0.28	0.20 to 0.40
Offices, Retail, Circulation / Other occupied spaces	Day or Night	20 to 40	14 to 28	0.40 to 0.80	0.56 to 1.10

Table 13 Internal vibration limits – Impulsive vibration

Adjacent space	Time	Weighted r.m.s. acceleration (mm/s^2) (1-80Hz)		Velocity (mm/s)	
		Preferred to Maximum values		Preferred to Maximum values	
		z axis	x/y axes	RMS velocity	Peak velocity
Residences	Day	300 to 600	210 to 420	6.0 to 12.0	8.6 to 17.0
	Night	100 to 200	71 to 140	2.0 to 4.0	2.8 to 5.6
Offices, Retail, Circulation / Other occupied spaces	Day or Night	640 to 1280	460 to 920	13.0 to 26.0	18.0 to 36.0

Radiated structure-borne noise caused by vibration from building services and plant shall be limited to ensure the internal noise limits are not exceeded.

3.2.7 Internal noise levels from gym tenancy impacts

Further to the vibration limits, airborne and structure-borne sound in sensitive areas adjacent to the gym tenancy and associated with impacts are recommended to comply with the limits scheduled in Table 14 which have been derived from the AAAC Gym Guideline.

Table 14 Maximum internal airborne and structure-borne sound pressure levels

Adjacent space	Internal noise criterion, L_{AFmax} (dB(A)) (31.5-250Hz)

	Day (7am to 6pm)	Evening (6pm to 10pm)	Night* (10pm to 7am)
Residences	35	30	25
Offices, Retail, Circulation / Other occupied spaces	40	40	40

Note: *. In accordance with the AAAC Gym Guideline, the Night period shall be considered as 10pm to 8am on Sundays and public holidays.

4. Recommendations

4.1 Mechanical plant and equipment

Commercial noise emissions, including plant noise emissions, from any base-building systems and commercial tenancies within the subject development are required to comply with the EPA Noise Protocol Part I noise limits.

At time of writing, plant and equipment selection is yet to be finalised. It is anticipated that provision has been included in the current scheme to incorporate standard acoustic treatment, such as silencers, barriers, acoustically lined ductwork, acoustic louvres, etc. to meet the noise emission requirements the EPA Noise Protocol Part I.

As the design progresses through the detailed design phase, acoustic measures will be incorporated in the design so that the noise emission criteria presented in Section 3.1.1 will be complied with.

Generally, the following allowances should be made for in the design:

- Selection of low noise fans, allowance for smooth and low velocity airflow conditions in ductwork, use of attenuators and lined duct work while minimising regenerated noise at bends, take-offs and transitions.
- Support points for major plant items should be structurally rigid. Mid span areas of floor slab should be avoided where practical. Ideally columns, thick structural slabs or very strong beams (local stiffening) should be provided in such cases.
- For major plant items such as chillers, cooling towers and diesel generators, plant and associated motor and drive assemblies should be mounted on rigid integral steel chassis or concrete inertia bases (in accordance with ASHRAE).
- Vibration isolation for rotating plant should have an isolation efficiency greater than 90%.
- All penetrations to plant rooms should be properly dimensioned, packed and sealed. Main services ducts and pipes to have their own individual penetrations, with suitable spacing to allow good sealing.
- Speed controllers, if used, should be of good quality and compatible with the motor model. Poor quality controllers can result in significant increase in motor noise, as much as 10dB(A), with an offensive.

4.2 Façade treatment

The road traffic noise intrusion criteria provided in Section 3.2.4 of 35dB$L_{Aeq,8h}$ and 40dB$L_{Aeq,16h}$ for sleeping areas is predicted to be met on the following basis:

- The worst-case measured road traffic noise level of 69 dB$L_{Aeq,16h}$ and 62 dB$L_{Aeq,8h}$ measured 3m from Burnley Road during peak hour based on noise logging data.
- An 8 m setback to the façade of the proposed development.
- A standard 6/12/6 DGU that meets R_w35 (windows closed).
- Any solid façade construction will have the same or higher acoustic performance as the DGU.

The commercial noise intrusion criteria provided in Section 3.2.4 of 25 dB(A) for any habitable space is predicted to be marginally exceeded on the following basis:

- The worst-case night-time commercial operational noise level of 57 dBL_{Aeq} measured opposite the Doonside Street parking and Victoria Gardens (location A1).
- An 8 m setback to the façade of the proposed development.
- A standard 6/12/6 DGU that meets R_w35 (windows closed).
- Any solid façade construction will have the same or higher acoustic performance as the DGU.

A standard 6/12/6 DGU façade is calculated to marginally exceed the indoor EPA commercial noise limit by in the order of 2 dB. This exceedance is considered acceptable, reasonable amenity achieved and risk of noise nuisance and complaint addressed because:

- A change of noise level in the order of 2dB is not typically considered noticeable.
- The predicted noise level of 27 dB is very low and may be masked by typical apartment noise such as electronics or mechanical services; it is below other standards and guidelines for commercial noise.
- The worst-case night-time noise scenario occurs during a 'shoulder period' in the early morning.
- Some noise sources are not technically commercial noise and should be minimised through management of existing commercial operations (ie idling trucks on public roads).
- Future development in this area; including the commercial operation opposite the Doonside Street parking and Victoria Gardens is expected to be developed with mixed use residential and lighter commercial uses.

A standard 6/12/6 DGU façade is recommended to address road traffic noise and commercial noise ingress.

It is not practical to meet the most onerous external reverse amenity commercial noise criteria on the Doonside Street façade and so internal noise amenity is provided to reduce the risk of noise nuisance and complaint.

Windows are required to be closed to achieve the R_w35 rating and so there is a requirement for alternative ventilation pathways that do not compromise the acoustic performance of the façade, such as mechanical ventilation or acoustically attenuated natural ventilation.

The final façade acoustic performance and construction should be refined during design development.

4.3 Music and patron noise

The development may include tenants that create commercial music and patron noise. These tenants are required to achieve compliance with the criteria presented in Section 3.1 and may require noise mitigation measures.

Tenants should provide specific details and operational conditions of this area (e.g. hours of operation, number of patrons, etc.) and assessed further during detailed design.

The tennants may consider best practice measures to limit venue noise emissions. Reference may be made to Victorian Planning Practice Note 81, dated May 2016, for measures to attenuate music venues. As stated in the Victorian Practice Note, these may include:

- Orienting and positioning the stage or loudspeakers of external entertainment spaces to direct noise away from any noise sensitive residential uses.
- Installing a sound limiter to cap the volume of any amplified sound to an appropriate level.
- Implementing a venue management plan focussed on minimising noise.

A separate application to council may be required prior to the operation of this facility.

4.4 Retail gym

Any noise and vibration transmitted by gyms within the proposed development is required to comply with the noise and vibration limits scheduled in Section 3.2.3 and Section 1 respectively. Specific gym designs to achieve these limits shall be the responsibility of the relevant contractor.

Noise mitigation/management measures may include:

- 200mm concrete slabs.
- Gym floors to incorporate resilient floor finishes where possible.
- Walls and ceilings to incorporate sound absorptive finishes for reverberance and noise control.
- Gym equipment to feature acoustic isolation treatments.
- The development of an effective management strategy for body corporate and gym users.
- Restriction on the times of operation to only the day and evening periods (7am to 10pm).

It is recommended that a any retail gym inclusion in the development is considered as part of the base build structural design to allow for any slab set down or stiffening or located at grade.

4.5 Lifts

The contractor is to ensure the following items are complied with:

- The noise generated by the lift operation is to be 5dB(A) below the noise satisfactory levels presented in Section 3.2.1
- Lift passby noise is to be inaudible inside habitable spaces inside hotel rooms.
- Noise levels inside the lift care are not to exceed 55dB(A) under the following circumstances:
  - Door opening and closing
  - Accelerating and decelerating
- Noise levels inside the lift care are not to exceed 50dB(A) when running at constant speed.
- The lift chime is not to exceed 25dB(A) inside the apartment with the apartment door closed.
- Lift guide alignment should be accurate enough such as to not give rise to increased levels of noise during operation.
- Noise from lift shaft riser is to be inaudible in habitable spaces of apartments.
- Lift shafts are to be constructed with a minimum R_w of 50.

4.6 Outdoor terraces

Impact noise will need to be addressed in the outdoor terraces/amenity to protect adjacent residences. The following treatment should be considered:

- 200mm concrete slab.
- Floor build-up to include an acoustic underlay for impact noise control
- Apartment ceilings below to include resilient mounts and acoustic insulation in the cavity.

5. Conclusion

A site investigation of the existing surrounds at 81-95 Burnley Street, Richmond has been completed to determine existing noise levels for the environment and surrounds for a proposed mixed-use redevelopment of the site.

Current standards associated with the development have been reviewed and assessed in accordance with existing site constraints. Preliminary construction standards have been provided to ensure that relevant guidelines are satisfied.

ADP Consulting believe there are no site conditions, statutory or other requirements that would preclude this development from complying with the criteria defined in this report.

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Appendix A
Glossary of Acoustic Terminology

Air-borne sound

The sound emitted directly from a source into the surrounding air, such as speech, television or music.

Ambient sound

Of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources, near and far. This is normally taken to be the L_{Aeq} value.

Background noise level

The average of the lowest levels of the noise levels measured in an affected area in the absence of noise from occupants and from unwanted external ambient noise sources. Usually, the L_{A90} value represents the background noise level.

dB(A)

Unit of acoustic measurement weighted to approximate the sensitivity of human hearing to sound frequency.

Decibel scale

The decibel scale is logarithmic, to better represent the response of the human ear. For example, a 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. It is generally accepted that a 10 dB increase in the sound pressure level corresponds to a perceived doubling in loudness.

Examples of decibel levels of common sounds are as follows:

- 0 dB(A) Threshold of human hearing
- 30 dB(A) A quiet country park
- 40 dB(A) Whisper in a library
- 50 dB(A) Open office space
- 70 dB(A) Inside a car on a freeway
- 80 dB(A) Outboard motor
- 90 dB(A) Heavy truck pass-by
- 100 dB(A) Jackhammer / Subway train
- 110 dB(A) Rock Concert
- 115 dB(A) Limit of sound permitted in industry
- 120 dB(A) 747 take off at 250 metres

Frequency

The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high-pitched sound and a low frequency to a low-pitched sound.

L_{90}, L_{10}, etc

A statistical measurement giving the sound pressure level which is exceeded for the given percentile of a measurement period (i.e., L_{90} is the level which is exceeded for 90 percent of a measurement period). L_{90} is commonly referred to as a basis for measuring the background sound level.

$L_{Aeq,T}$

The equivalent continuous A-weighted sound pressure level. The value of the A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval T, has the same A-weighted sound energy as the actual time-varying sound.

L_{Amax}

The maximum sound pressure level measured over the measurement period.

L_{Amin}

The minimum sound pressure level measured over the measurement period.

Day

Referred to as the period between 7 am and 6 pm for Monday to Saturday and 8 am to 6 pm for Sundays and Public Holidays.

Evening

Referred to as the period between 6 pm and 10 pm for Monday to Sunday and Public Holidays.

Night

Referred to as the period between 10 pm and 7 am for Monday to Saturday and 10 pm to 8 am for Sundays and Public Holidays.

Assessment background level (ABL)

The overall background noise level on each day, evening, and night periods for each day of the noise monitoring.

Rating background level (RBL)

The overall background level on each day, evening, and night periods for the entire length of noise monitoring.

Reverberation

The persistence, after emission by the source has stopped, of a sound field in an enclosure.

Sound isolation

A reference to the degree of acoustical separation between two spaces. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term 'sound isolation' does not specify any grade or performance quality and requires the units to be specified for any contractual condition.

Sound pressure level, L_p, dB of a sound

A measurement obtained directly obtained using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the R.M.S. sound pressure to the reference sound pressure of 20 micro-Pascals.

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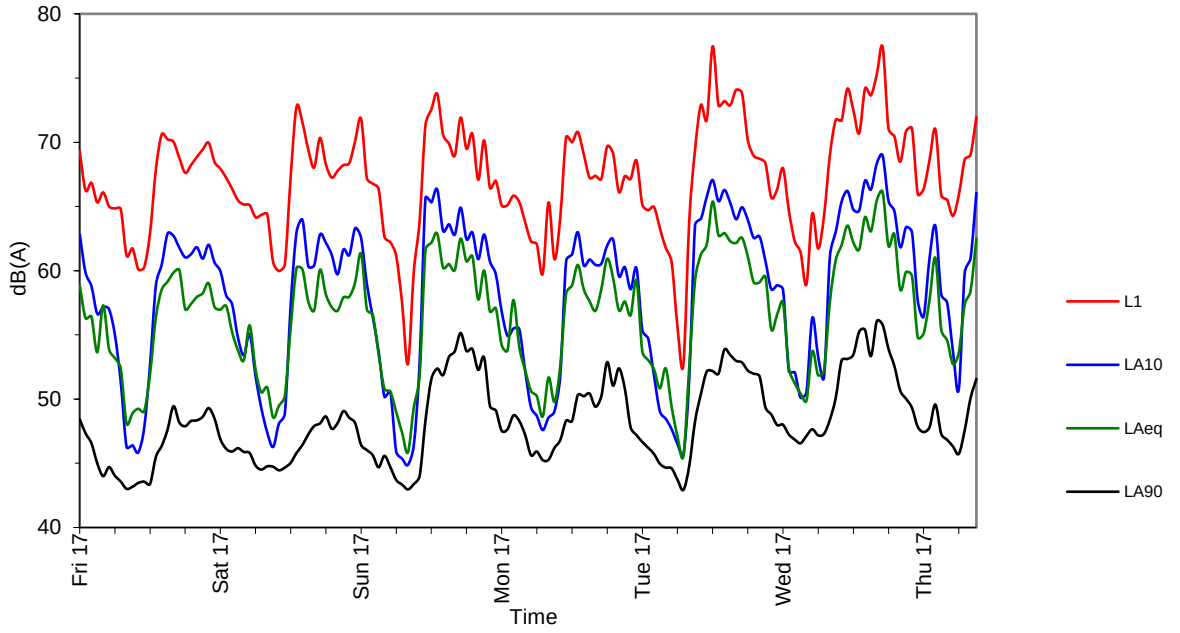
Appendix B
Unattended Measurement Data

Doonside Street

L1 Unattended Measurement

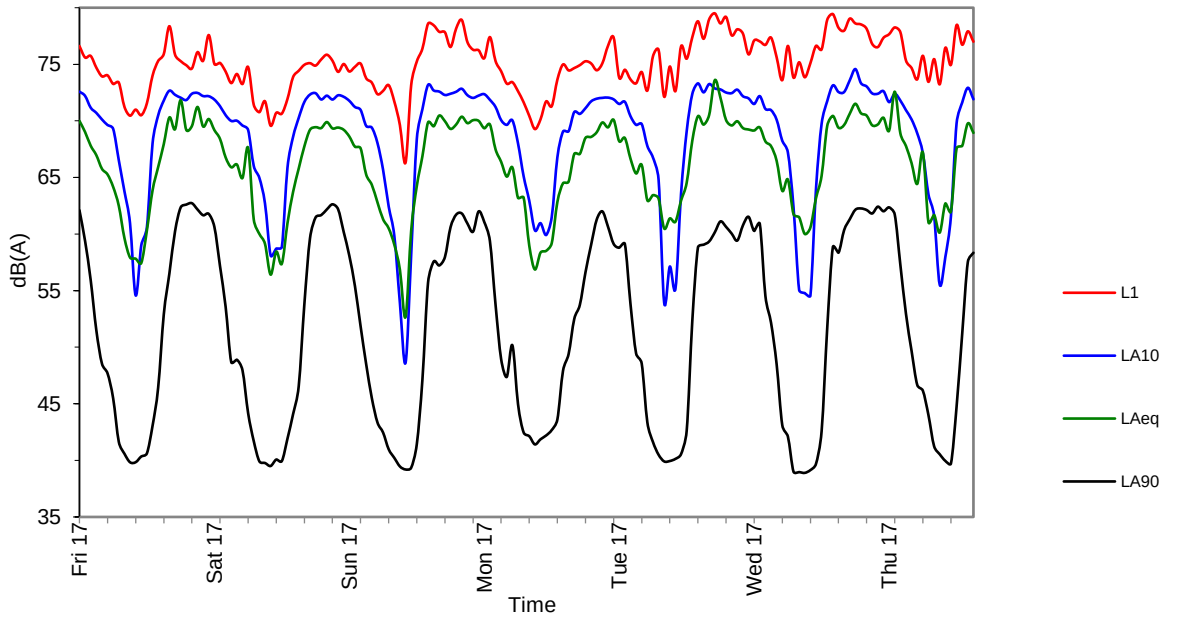
Friday 21 April 2023
to
Thursday 27 April 2023



Burnley Street

L2 Unattended Measurement

Friday 21 April 2023
to
Thursday 27 April 2023



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