



Acoustic Engineering

Town Planning Acoustic Report

6 Cross Street, Footscray, VIC

Project No: 207683-A
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Document Control

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Project No: 207683-A

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Revision History

Doc.	Rev.	Date	Purpose	Author	Reviewer
TPR	0	17/07/2024	Not for endorsement	A Horng	T Chong
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TPR	2	2/08/2024	For Endorsement	A Horng	T Chong

Executive Summary

DDEG has been appointed to provide acoustic engineering consulting services associated with the proposed mixed-use development at 6 Cross Street, Footscray, VIC.

Advice in relation to the following acoustic engineering elements has been requested, and is presented in this document:

Table 1 Acoustic Engineering Elements and Reference Criteria

Acoustic Engineering Element	Reference Criteria
External noise ingress via building facade and roof	<ul style="list-style-type: none"> ▪ AS/NZS 2107:2016 ▪ Victoria Planning Provisions Clause 58.04-3
Environmental noise emissions due to domestic air conditioning condenser units and other domestic plant serving individual dwellings.	<ul style="list-style-type: none"> ▪ Environment Protection Regulations 2021 ▪ EPA Publication 1973 – Noise Guideline
Environmental noise emissions due to mechanical plant serving common areas and commercial parts of the building.	<ul style="list-style-type: none"> ▪ Environment Protection Regulations 2021 ▪ Part I of EPA Publication 1826 – Noise Protocol
Music noise emissions	<ul style="list-style-type: none"> ▪ Environment Protection Regulations 2021 ▪ Part II of EPA Publication 1826 – Noise Protocol
Environmental noise emissions due to deliveries and private waste collections	<ul style="list-style-type: none"> ▪ EPA Publication 1254 – Noise Control Guidelines

A review of the above elements has been undertaken and it is considered that the proposed project will satisfy the reference criteria with inclusion of the following acoustic engineering measures:

Table 2 Recommended Acoustic Engineering Measures

System	Acoustic Engineering Measure
External Walls	<ul style="list-style-type: none"> ▪ External walls constructed of minimum 150 mm thick precast concrete or an alternative construction that achieves $R_w \geq 55$ are calculated to be acoustically sufficient to achieve the target internal noise levels..
Roof	<ul style="list-style-type: none"> ▪ Roof construction (including balconies above apartments) comprising minimum 200 mm thick concrete slabs are calculated to be acoustically sufficient to achieve the target internal noise levels.

System	Acoustic Engineering Measure
External Glazing	<ul style="list-style-type: none"> ▪ Required external glazing sound insulation ratings to satisfy the internal noise level criteria are presented in Section 6.4, along with indicative glazing configurations that would be expected to meet the acoustic performance requirements. ▪ Framing must be specified to match the required acoustic rating of the glazing. ▪ Openable windows and doors must include rubber or dense foam acoustic seals e.g. Schlegel Q-Lon or equivalent.
Domestic Air-Conditioning Units	<ul style="list-style-type: none"> ▪ Noise due to domestic air-conditioning units will need to comply with EPA Publication 1973. ▪ Indicative treatment measures are presented in Section 7.2. ▪ Acoustic review of the domestic air conditioning systems should be conducted to confirm the specified indicative noise control measures and any additional measures that may be required once building mechanical services layouts and equipment selections have been developed.
Domestic Exhaust and Ventilation	<ul style="list-style-type: none"> ▪ It is expected that dwelling kitchen and toilet exhaust fans will be domestic-type in-line fans located in the ceiling space within each dwelling and ducted to an external wall or roof. ▪ Noise emissions from these fans are not expected to require acoustic treatment to control noise impacts to nearby residential receptors.
Mechanical Plant Serving Common Parts of the Building	<ul style="list-style-type: none"> ▪ Noise due to common parts of the building will need to comply with EPA Noise Protocol Part I noise limits. ▪ Acoustic review of the common and commercial mechanical plant should be conducted once building mechanical services layouts and equipment selections have been developed. ▪ Further details are presented in Section 7.4.
Fire Pump Room	<ul style="list-style-type: none"> ▪ Specifications of the fire pump room equipment should be submitted for acoustic review once equipment selections have been finalised. ▪ Indicative treatment measures are presented in Section 7.5.
Substation	<ul style="list-style-type: none"> ▪ Specifications of the substation equipment should be submitted for acoustic review once equipment selections have been finalised. ▪ Indicative treatment measures are presented in Section 7.6.
Commercial / Retail Tenancy Mechanical Services Equipment	<ul style="list-style-type: none"> ▪ It will be the responsibility of the commercial tenants to ensure that the mechanical plant serving the commercial tenancies achieves compliance with the EPA Noise Protocol Part I noise limits. ▪ Refer to Section 7.7 for further details.

System	Acoustic Engineering Measure
Music Noise from Ground Floor Retail	<ul style="list-style-type: none"> ▪ It is considered that general background music (internal L_{Aeq} Sound Pressure Level of no more than 74 dB(A)) played within the commercial tenancies will not impact nearby Noise Sensitive Areas. ▪ It is recommended that a detailed acoustic assessment be undertaken in accordance with the EPA Noise Protocol if the commercial tenancies propose to: <ul style="list-style-type: none"> – Play music at higher levels than would be considered general background / ambience music; or – Host live music entertainment; or – Include outdoor / footpath dining; or – Broadcast music to outdoor areas. ▪ Refer to Section 8 for further details.
Acoustic Review of General Building Layout	<ul style="list-style-type: none"> ▪ Refer to Section 9 for indicative acoustic advice for the lifts, waste chutes, gymnasium, and communal spaces.
Deliveries and Private Waste Collection	<ul style="list-style-type: none"> ▪ Deliveries and private waste collections associated with the commercial spaces should be conducted between the hours presented in Table 20 in accordance with Section 6 and Section 9 of the EPA Noise Control Guidelines. ▪ Delivery vehicle engines, including ancillary motors for refrigeration equipment should be turned off whilst making the delivery.

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1 Introduction

1.1 Purpose

DDEG has been appointed to provide acoustic engineering consulting services associated with the proposed mixed-use development at 6 Cross Street, Footscray, VIC.

The scope of this document comprises:

- Review of existing environmental noise levels at the site and provision of advice on noise attenuation measures to protect future occupants from external noise.
- In principle advice in relation to control of environmental noise emissions from external mechanical plant.
- Review of the proposed design within respect to noise transmission within the development.

A glossary of the acoustic nomenclature used in this document is presented in Appendix A.

1.2 Reference Documentation

This document is based on information contained in the following documents and drawings:

Table 3 Reference Documentation

Document	Prepared by	Issue
Town Planning Architectural Drawings Project No. 10205; Drawing No. TP01 to TP11; Rev: G	Artisan Architects	Received 19/06/2024

1.3 Document Limitations

The following limitations are applicable with respect to the acoustic advice presented in this document:

- DDEG has prepared this document for the sole use of the relevant stakeholders and approval authorities and for the specific purpose expressly stated in the document. No other party should rely on this document without the prior written consent of DDEG. DDEG undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document.
- The information contained in this document provides advice in relation to acoustics and vibration only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics and vibration engineering including and not limited to structural integrity, fire rating, architectural buildability and fitness-for-purpose, waterproofing and the like. Supplementary professional advice should be sought in respect of these issues.

- Documents marked 'Not for Construction' or 'Draft' may be subject to change and are not released as final documents. DDEG accepts no liability pending release of the final version of the document.
- In preparing this document DDEG may have relied upon information provided by the Client and other third parties, some of which may not have been verified. DDEG accepts no responsibility or liability for any errors or omissions which may be incorporated into this document as a result.
- The recommendations, data and methodology presented in this document are based on the listed reference documentation. The recommendations apply specifically to the project under consideration and must not be utilised for any other purpose. Any modifications or changes to the project from that described in the listed reference documentation may invalidate the advice provided in this document, necessitating a revision.
- Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

2 Project Characteristics

2.1 Site Location

The project site is located at 6 Cross Street, Footscray, VIC, as shown in Figure 1. The topography in the area of the site is relatively flat.

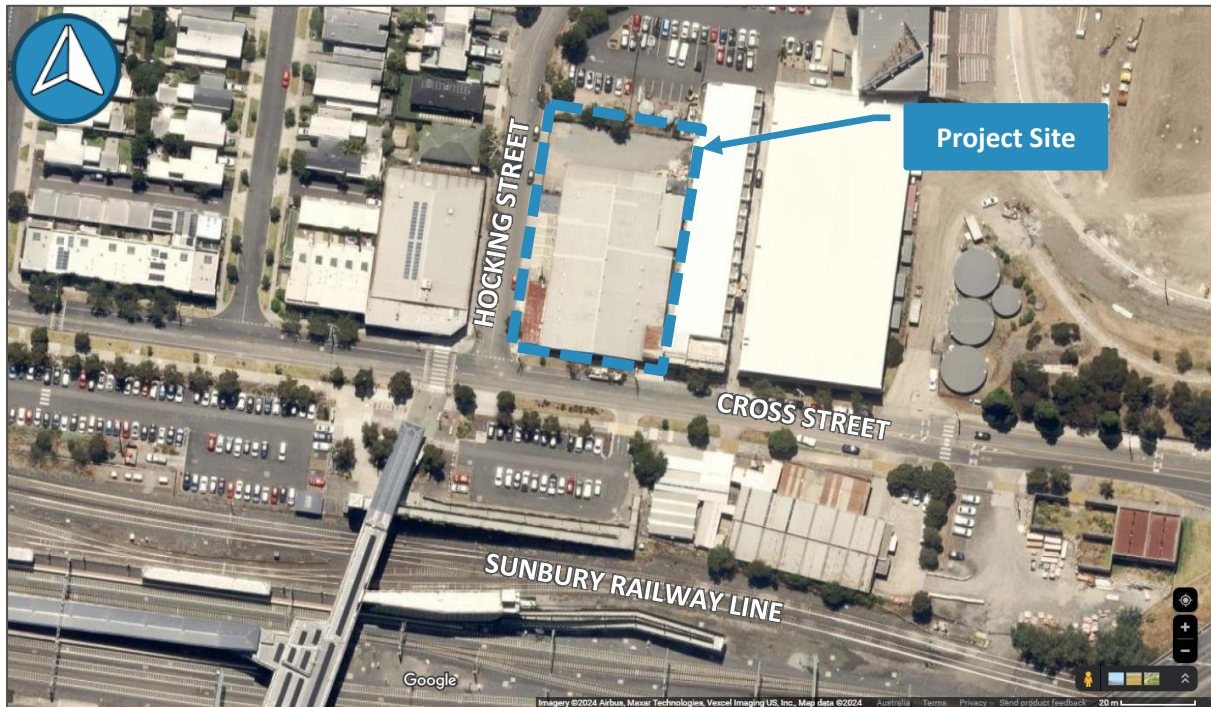


Figure 1 Aerial Image of Site (Aerial Photo Source: Google Maps)

2.2 Proposed Project

The project comprises a proposed 8-storey mixed-use building incorporating retail and office tenancies, apartments, and basement car parking.

Floor plans of the proposed development are presented in Appendix B.

3 Legislation and Guidelines

3.1 Summary of Relevant Documents

Table 4 presents a summary of the relevant legislation and guidelines applicable to the proposed project. The information contained in these documents forms the basis of the design criteria and advice presented in this document. Further details are presented in the subsequent subsections.

Table 4 Summary of Relevant Statutory Requirements and Guidelines

Document	Status	Relevance to this Project
Victoria Planning Provisions Clause 58.04-3 (Victoria Planning Provisions, 2021)	Legislation	Prescribes maximum interior noise levels for new apartments five or more storeys within prescribed distances of high traffic roads, railways and industrial areas.
Passenger Rail Infrastructure Noise Policy (State of Victoria, 2013)	Policy	Provides guidance to transport bodies and planning authorities of the impacts of rail noise from rail infrastructure developments or changes to land use near rail corridors.
AS/NZS 2107:2016 Acoustics – Design Sound Levels and Reverberation Times for Building Interiors (Standards Australia, 2016)	Guideline	Provides guidance on internal noise levels and reverberation times for different types of spaces. The guidance provided is relevant to the development in respect of noise intrusion from external sources.
Environment Protection Regulations 2021 (EPRs) (State of Victoria, 2021)	Legislation	Prescribes requirements in relation to noise emissions from prescribed items serving individual dwellings (includes heating equipment such as central heating, a hot water system, or air conditioner). Defines unreasonable or aggravated noise from commercial, industrial and trade premises, as well as from entertainment venues and outdoor entertainment events.
EPA Publication 1826 – Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues (EPA Noise Protocol) (EPA Victoria, 2021)	Legislation	Prescribes the methods for determining the statutory environmental noise limits that apply to noise emissions from industrial, commercial, and trade premises within Victoria, and the methods to be used for assessment. Mechanical plant noise emissions due to common and commercial parts of the development will be subject to the requirements of the EPA Noise Protocol.

Document	Status	Relevance to this Project
EPA Publication 1973 – Noise Guideline: Assessing Noise from Residential Equipment (EPA Victoria, 2021)	Guideline	Provides guidance in relation to assessing noise from fixed residential equipment including air conditioners for heating and cooling, heat pump hot water systems, swimming pool pumps, water pumps and ducted heating systems.
EPA Publication 1254 – Noise Control Guidelines (EPA Victoria, 2021)	Guideline	Provides guidance on interpretation and application of the Environment Protection Regulations. Provides guidance in relation to appropriate delivery and waste collection times to control noise impacts on adjacent residences.

3.2 Victoria Planning Provisions 58.04-3

Victoria Planning Provisions Clause 58.04-3 (State of Victoria, 2022) states that apartment buildings 5-storeys or more should be designed to protect residents from external and internal noise sources. Noise sources, such as mechanical plant should not be located near bedrooms of immediately adjacent existing dwellings.

Noise sensitive rooms (such as living areas and bedrooms) should be located to avoid noise impacts from mechanical plant, lifts, building services, non-residential uses, car parking, communal areas and other dwellings.

3.3 Environment Protection Regulations 2021

Noise emissions from residential premises, and from commercial, industrial and trade premises, and from entertainment venues, must comply with the *Environment Protection Regulations 2021* (EPRs) (State of Victoria, 2021).

The EPRs prescribe the times (termed “Prohibited Times”) during which certain types of noise emission from residential premises is deemed to be unreasonable noise for the purposes of Section 167(2) of the *Environment Protection Act 2017* (State of Victoria, 2021).

Guidance to assist with interpretation of the EPRs for noise from fixed domestic plant is provided in *EPA Publication 1973 – Noise Guideline: Assessing Noise from Residential Equipment* (EPA Victoria, 2021).

The EPRs prescribe the time periods, relevant noise sources, base noise limits, and specify the noise levels above which noise emitted is defined as ‘Aggravated Noise’.

For the purpose of assessing noise emissions in relation to the requirements of the EPRs, prediction, measurement, and assessment of noise from commercial, industrial and trade premises, and from entertainment venues, and from common parts of a residential or mixed-use development, must be conducted in accordance with *EPA Publication 1826 – Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues* (EPA Noise Protocol) (EPA Victoria, 2021).

3.4 EPA Publication 1826 – Noise Protocol

EPA Publication 1826 – Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues (EPA Noise Protocol) (EPA Victoria, 2021) prescribes the procedures used to determine limits for, and assess, environmental noise emissions from sources such as mechanical equipment and activities associated with commercial, industrial or trade operations, as well as music noise emissions from entertainment venues.

The limits prescribed by the EPA Noise Protocol apply at or within Noise Sensitive Areas, such as residential dwellings, as defined in Appendix A.

3.4.1 Part I – Commercial, Industrial and Trade Premises

Part I of the EPA Noise Protocol (EPA Victoria, 2021) prescribes the procedures used to determine limits for, and assess, environmental noise emissions from sources such as mechanical equipment and activities associated with commercial, industrial or trade operations, or equipment which serves common parts of a residential development.

The limits are dependent on a number of factors including:

- The time of day at which the noise emissions occur;
- The planning zone types in the area of the Noise Sensitive Area; and
- The background noise levels at the Noise Sensitive Area.

In accordance with the EPA Noise Protocol, noise emissions from the source under consideration are measured so as to obtain an L_{Aeq} Sound Pressure Level that is representative of the audible noise at the Noise Sensitive Area over a continuous 30-minute period. Adjustments to the measured level are applied where necessary to account for characteristics such as duration, intermittency, reflections, impulsiveness, tonality, and measurement location. The adjusted noise level is termed the Effective Noise Level, and it is the Effective Noise Level that is assessed in relation to the noise limits.

3.4.2 Part II – Entertainment Venues

Part II of the EPA Noise Protocol (EPA Victoria, 2021) prescribes the procedures used to determine limits for, and assess, music noise emissions from entertainment venues and events.

For indoor venues, the noise limits prescribed by the EPA Noise Protocol are dependent on the background noise levels at the Noise Sensitive Area, and on the time of day, as follows:

Table 5 Part II EPA Noise Protocol Noise Limit Calculation

Period	Applicable Times	Noise Limit, dB / dB(A)
Day / Evening	<ul style="list-style-type: none"> ▪ Monday to Saturday (other than a public holiday) from 7 am to 11 pm; ▪ Sunday or a public holiday (other than if either is preceding a public holiday) from 9 am to 10 pm; ▪ Sunday or a public holiday (if either is preceding a public holiday), from 9 am to 11 pm. 	$L_{Aeq} \leq L_{A90}$ Background Noise + 5 dB(A)
Night	<ul style="list-style-type: none"> ▪ Monday to Friday (other than a public holiday or a day preceding a public holiday), from 11 pm to 7 am the following day; ▪ Saturday or any day preceding a public holiday, from 11 pm to 9 am the following day; ▪ Sunday or a public holiday (if neither is preceding a public holiday), from 10 pm to 7 am the following day. 	$L_{OCT10} \leq L_{OCT90}$ Background Noise + 8 dB

The following base (minimum) noise limits apply in accordance with the Environment Protection Regulations 2021 where background noise levels are very low:

- **Day / Evening:** 32 dB(A) L_{Aeq}
- **Night:** L_{OCT10} base noise limits as per Table 6.

Table 6 Night Period Base Noise Limits for Music

Frequency (Hz)	63	125	250	500	1000	2000	4000
Base Noise Limit, dB L_{OCT10}	40	30	20	20	15	10	10

The noise levels are to be assessed over a 15-minute period, and, except where the conditions prescribed by Clause 106 of the EPA Noise Protocol apply, the noise limits apply outdoors within 'Noise Sensitive Areas' defined by the Environment Protection Regulations 2021.

Generally, a Noise Sensitive Area is the part of a property that is within 10 m of a residential dwelling or other type of building where people may sleep, or within 10 m of a school or childcare building during the operating hours of the school / childcare centre - see Appendix A for full definition.

3.5 EPA Publication 1973 – Noise Guideline: Assessing Noise from Residential Equipment

EPA Publication 1973 – Noise Guideline: Assessing Noise from Residential Equipment (EPA Victoria, 2021) sets out the methodology for assessing noise from fixed residential equipment including air conditioners for heating and cooling, heat pump hot water systems, swimming pool pumps, water pumps and ducted heating systems.

The guideline also prescribes when noise from fixed residential equipment is considered to be unreasonable.

3.6 EPA Publication 1254 – Noise Control Guidelines

EPA Publication 1254 – Noise Control Guidelines (EPA Victoria, 2021) provides guidance relating to assessment and management of noise from a range of specific sources. It addresses a number of sources that are not explicitly covered by other policies and guidelines, and provides complementary guidance for some types of noise that are also addressed by other noise legislation, policies and guidelines.

The guidelines are primarily intended to assist in the resolution of complaints or to avert a possible noise nuisance. Many of the guidelines do not require an actual measurement of the noise, but rather prescribe parameters (such as operating hours or minimum separation distances) outside of which an activity would be likely to be unreasonable noise.

4 Noise Sensitive Areas

Table 7 and Figure 2 identify the nearest and potentially most-affected Noise Sensitive Areas (NSAs) in the vicinity of the project site, as defined by the relevant environmental noise legislation.

Assessment of environmental noise emissions due to the project will be undertaken at these locations. It is expected that compliance with the environmental noise criteria at these locations will also result in compliance at all other nearby NSAs.

Table 7 Details of Potentially Most-Affected Noise Sensitive Areas (NSAs)

NSA Ref.	Address	No. Storeys	NSA Type	Notes
1	6 Cross Street, Footscray	7	Apartments	Project Site
2	50 Hocking Street, Footscray	1	Single Dwelling	North West of the Site
3	4 Cross Street, Footscray	4	Multi Dwelling Residential Building	East of the Site

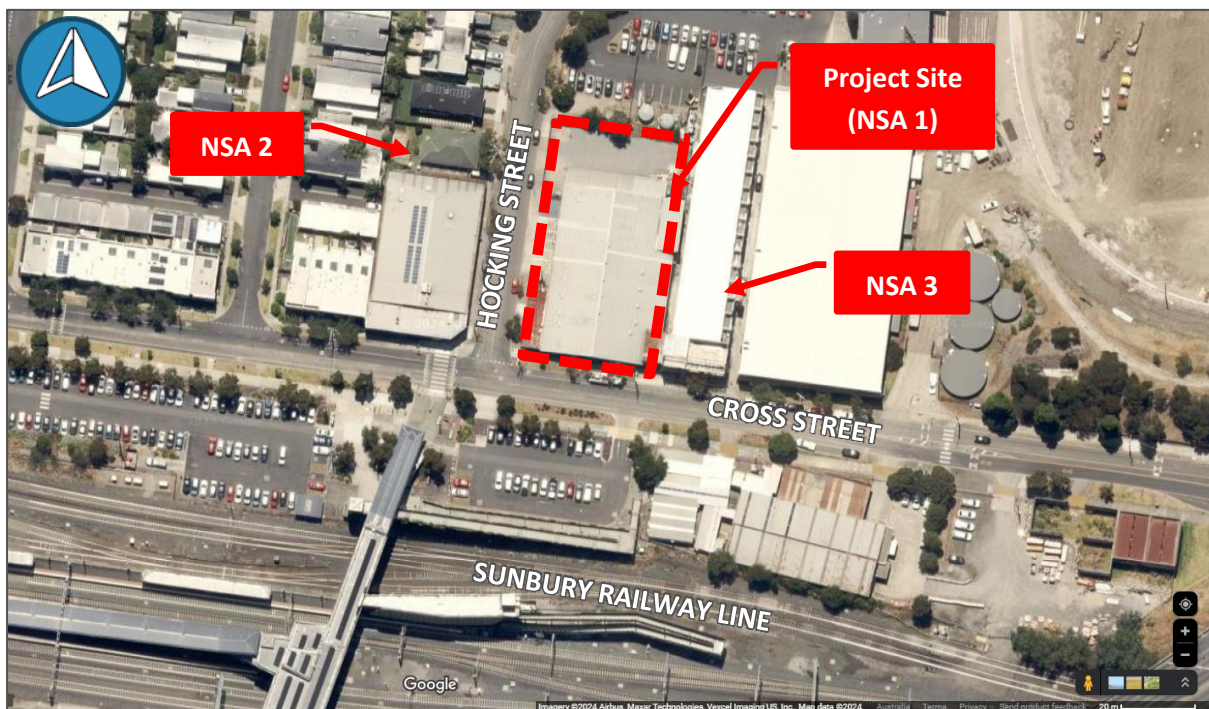


Figure 2 Locations of Potentially Most-Affected Noise Sensitive Areas (NSAs)
(Aerial Photo Source: Google Maps)

5 Existing Acoustic Conditions

5.1 Exterior Soundscape

During our site visits on 8 and 15 June 2022, the soundscape was dominated by road traffic noise from Cross Street and intermittent railway noise from West Footscray Railway Station.

5.2 Background Noise Levels

Attended and unattended noise measurements were performed between 8 and 15 June 2022. Details of the measurement location and measurement methodology are presented in Appendix B.

5.2.1 Attended Short Term Noise Measurements

Attended noise measurements were performed in the vicinity of the site on 8 June 2022 between 4:38 pm and 4:51 pm.

Table 8 presents a summary of the measured noise levels.

Table 8 Measured Attended Noise Levels

Location	L _{zeq,5min} Ambient Noise Level, dB							Overall L _{Aeq,5min} Noise Level, dB(A)	
	63	125	250	500	1k	2k	4k	Attended	Logger
Location 1 – Cross Street	61	56	52	50	51	46	35	65	65
Location 2 – Hocking Street	54	50	45	43	44	39	29	65	71

Comparison between the unattended noise logging data and the simultaneous noise data from the attended measurements indicates that:

- The free-field noise levels measured at 1.5 m above ground is the same as the noise levels measured at the noise logging location at 2.5 m above ground.
- The noise levels along Hocking Street, adjacent NSA 2 are nominally 6 dB lower than at the noise logging location.

5.2.2 Unattended Noise Logging

Environmental noise logging was performed at the southern boundary of the project site along Cross Street to establish the background noise levels. The background noise levels at the selected noise logging location are considered to be representative of the background noise levels at NSA 1. In accordance with the findings in the previous section, the background noise levels at NSA 2 are taken to be 6 dB lower than the background noise levels at NSA 1.

Table 9 and Table 10 present summaries of the measured background noise levels, as determined in accordance with the procedures given by the EPA Noise Protocol. Graphs showing the variation of background noise level over the full measurement period are presented in Appendix D.

Table 9 Background Noise Levels – EPA Noise Protocol Part I

Period	Applicable Times	L _{A90} Background Noise Level, dB(A)	
		NSA 1, 3	NSA 2
Day	<ul style="list-style-type: none"> 7 am to 6 pm Monday to Saturday 	52	46
Evening	<ul style="list-style-type: none"> 6 pm to 10 pm Monday to Saturday 7 am to 10 pm Sundays and Public Holidays 	50	44
Night	<ul style="list-style-type: none"> 10 pm to 7 am All Days 	42	36

Table 10 Background Noise Levels – EPA Noise Protocol Part II

Period	Applicable Times	Background Noise Level																											
		NSA 1, 3	NSA 2																										
Day / Evening	<ul style="list-style-type: none"> Monday to Saturday (other than a public holiday) from 7 am to 11 pm; Sunday or a public holiday (other than if either is preceding a public holiday) from 9 am to 10 pm; Sunday or a public holiday (if either is preceding a public holiday), from 9 am to 11 pm. 	46 dB(A) L _{A90}	40 dB(A) L _{A90}																										
*Night	<ul style="list-style-type: none"> Monday to Friday (other than a public holiday or a day preceding a public holiday), from 11 pm to 12 am the following day; Saturday or any day preceding a public holiday, from 11 pm to 12 am the following day; Sunday or a public holiday (if neither is preceding a public holiday), from 10 pm to 12 am the following day. 	<table border="1"> <thead> <tr> <th rowspan="2">Freq, Hz</th> <th colspan="2">L_{OCT90}, dB</th> </tr> <tr> <th>NSA 1, 3</th> <th>NSA 2</th> </tr> </thead> <tbody> <tr> <td>63</td> <td>57</td> <td>51</td> </tr> <tr> <td>125</td> <td>46</td> <td>40</td> </tr> <tr> <td>250</td> <td>45</td> <td>39</td> </tr> <tr> <td>500</td> <td>40</td> <td>34</td> </tr> <tr> <td>1k</td> <td>39</td> <td>33</td> </tr> <tr> <td>2k</td> <td>28</td> <td>22</td> </tr> <tr> <td>4k</td> <td>23</td> <td>17</td> </tr> </tbody> </table>		Freq, Hz	L _{OCT90} , dB		NSA 1, 3	NSA 2	63	57	51	125	46	40	250	45	39	500	40	34	1k	39	33	2k	28	22	4k	23	17
Freq, Hz	L _{OCT90} , dB																												
	NSA 1, 3	NSA 2																											
63	57	51																											
125	46	40																											
250	45	39																											
500	40	34																											
1k	39	33																											
2k	28	22																											
4k	23	17																											

* Night period background noise levels have been derived from the referenced acoustic engineering report prepared by Watson Moss Growcott.

5.3 Environmental Noise Levels

Data from the background noise logging described in Section 5.2 was also used to establish the traffic and railway noise levels at the site.

Table 11 presents a summary of the measured Sound Pressure Levels. Graphs showing the variation of the Sound Pressure Levels over the full measurement period are presented in Appendix D.

Table 11 Summary of Measured Environmental Noise Levels

Date	Measured Sound Pressure Level, dB(A)					
	Day Period (6 am to 10 pm)			Night Period (10 pm to 6 am)		
	Overall $L_{Aeq,16hr}$	Loudest $L_{Aeq,1hr}$	Maximum L_{AFmax}^1	Overall $L_{Aeq,8hr}$	Loudest $L_{Aeq,1hr}$	Maximum L_{AFmax}^1
Wednesday, 8 June 2022	64 ²	65	91 ²	56	60	82
Thursday, 9 June 2022	64	66	90	58	61	82
Friday, 10 June 2022	64	67	89	57	61	79
Saturday, 11 June 2022	64	69	85	55	59	80
Sunday, 12 June 2022	62	64	84	55	59	80
Monday, 13 June 2022	61	63	82	54	57	83
Tuesday, 14 June 2022	63	66	86	58	60	82
Wednesday, 15 June 2022	64 ³	66	88 ³	-	-	-
Adopted Design Sound Level	64	69	90	58	61	83

1 95th percentile L_{AFmax} .

2 Partial measurement period: 4:45 pm to 10 pm only.

3 Partial measurement period: 6 am to 5 pm only.

6 External Noise Intrusion

6.1 Acoustic Criteria

6.1.1 Victoria Planning Provisions 58.04-3

Victoria Planning Provision Clause 58.04-3 (Victoria Planning Provisions, 2021) states that buildings within a Noise Influence Area should be designed and constructed to achieve the indoor noise levels specified in Table 12. Due to the proximity of the site to the Sunbury railway line, the site is within a defined Noise Influence Area. The policy also states that noise levels should be assessed in unfurnished rooms with a finished floor and the windows closed.

In accordance with Clause 58.04-3, the following criteria will be adopted for the external noise intrusion to apartments within the building:

Table 12 Victoria Planning Provisions Prescribed Indoor Noise Levels

Type of Space	Design Internal Noise Level
Living Areas (6 am to 10 pm)	$L_{Aeq, 16hr} \leq 40$ dB(A)
Sleeping Areas (10 pm to 6 am)	$L_{Aeq, 8hr} \leq 35$ dB(A)

6.1.2 Sleep Disturbance

The following internal L_{AFmax} noise criteria are commonly adopted in Victoria for residences adjacent to railway lines to minimise sleep disturbance to an acceptable level:

- 55 dB(A) L_{AFmax} in bedroom areas
- 60 dB(A) L_{AFmax} in living room areas

These design noise levels have been determined to provide a reasonable balance between managing the risk of sleep disturbance and achieving acceptable building construction requirements from a practical and economic viewpoint.

The criteria have been developed based on a range of sleep disturbance research and have previously been accepted by the Victorian Civil and Administrative Tribunal (VCAT) as providing acceptable internal noise levels for residences adjacent to railway lines (VCAT Reference No. P2470/2003).

This assessment will therefore adopt the design L_{AFmax} internal noise level presented in Table 13.

Table 13 Adopted Design L_{AFmax} Internal Noise Levels

Environment	Time Period	Recommended Maximum Noise Level, L_{AFmax} , dB(A)
In bedrooms	Night (10 pm to 6 am)	≤ 55
In living areas	Day (6 am to 10 pm)	≤ 60

6.1.3 Commercial / Retail Tenancies

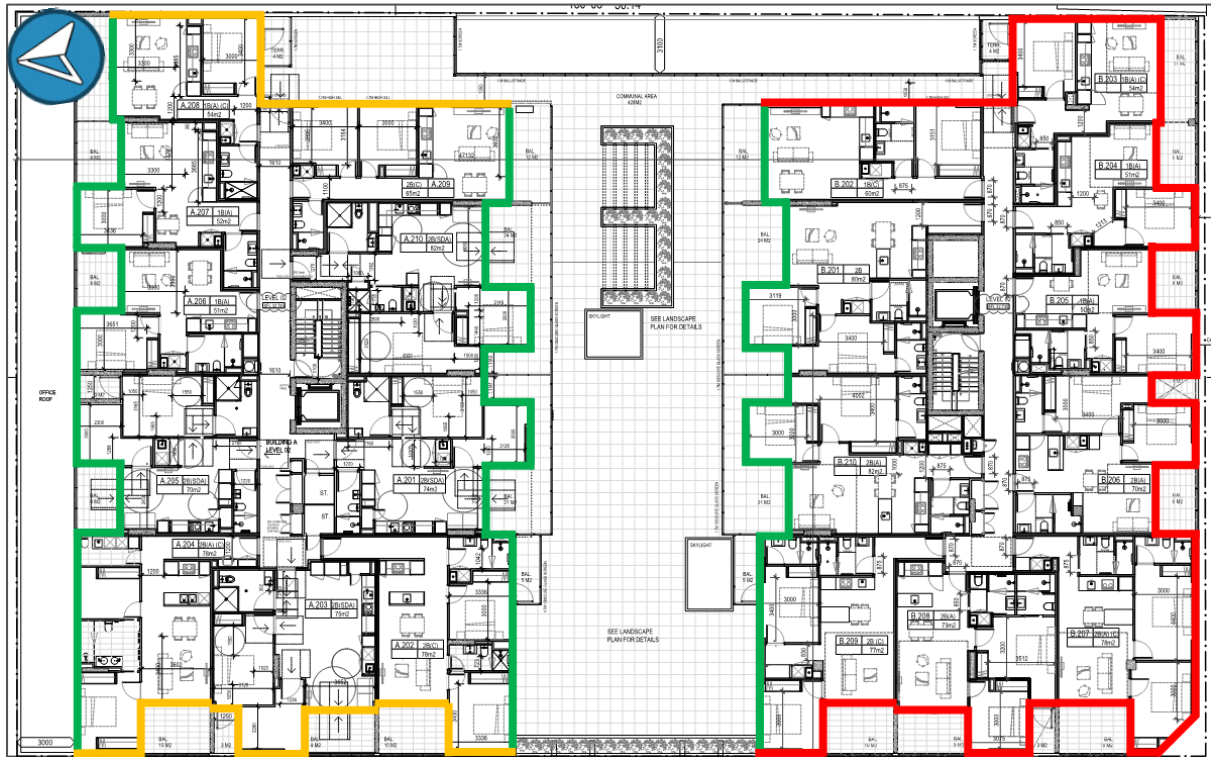
Table 14 presents the internal noise level criteria for the types of commercial / retail spaces that may be present in the completed building based on the recommendations of Australian Standard AS/NZS 2107:2016 *Acoustics – Design Sound Levels and Reverberation Times for Building Interiors* (Standards Australia, 2016). The AS/NZS 2107:2016 criteria apply to the combined internal noise levels due to building services and external noise sources such as traffic and mechanical plant.

Table 14 Internal Noise Level Criteria for Completed Commercial / Retail Tenancies

Type of Occupancy / Activity	Recommended Design Internal Noise Level $L_{Aeq,16hr}$, dB(A)
General Office Areas	40 to 45
Foyers and Lobbies	45 to 50
Small Retail Stores (General)	< 50
Gymnasiums	< 50

6.2 Adopted External Noise Levels

The external noise levels at the proposed building facades have been calculated based on the noise measurements conducted at the site. Figure 3 shows the external noise levels that will be adopted at the building facades for the purpose of the acoustic design. Figure 3 shows the level 2 plan, however, the same noise levels have been adopted at equivalent facade positions on all other floors.



Legend

Façade Zone	Day / Evening Period (6 am to 10 pm)		Night Period (10 pm to 6 am)	
	$L_{Aeq, 16hr}$, dB(A)	L_{AFmax}^* , dB(A)	$L_{Aeq, 8hr}$ dB(A)	L_{AFmax}^* , dB(A)
Red	64-61	90-87	58-55	83-80
Yellow	58-55	84-81	52-49	77-74
Green	54-53	80-78	48-46	73-71

* 95th percentile L_{AFmax} .

Figure 3 Adopted External Noise Levels – Level 2 Shown (Image Source: Artisan Architects)

6.3 Review of External Wall and Roof Design

Calculations of internal noise levels have been conducted based on the building being constructed as per the baseline construction detailed in Table 15. Room dimensions and areas of each facade material have been taken to be as per the reference architectural drawings.

Table 15 Baseline Building Facade Details

Facade Element	Adopted Baseline Construction Parameters
External Walls	<p>External walls are understood to be constructed of either:</p> <ul style="list-style-type: none"> ▪ Minimum 150 mm precast concrete panels. These panels alone will provide adequate sound insulation. Any insulation and internal linings will further improve the sound insulation performance. ▪ An alternative construction with a minimum sound insulation rating of R_w 55.
Ceiling / Roof	<ul style="list-style-type: none"> ▪ The roof construction (including balconies above apartments) is understood to be concrete slab construction, with minimum 200 mm thickness. ▪ This construction is calculated to achieve a sound insulation rating of R_w 57.

6.4 External Glazing

Based on the adopted external noise levels and the external wall and roof construction presented in Section 6.3, required sound insulation ratings for external glazing in order to satisfy the internal noise level criteria are presented in Figure 4 to Figure 11.

Indicative glazing configurations that would be expected to meet the acoustic performance requirements are presented in Table 16.

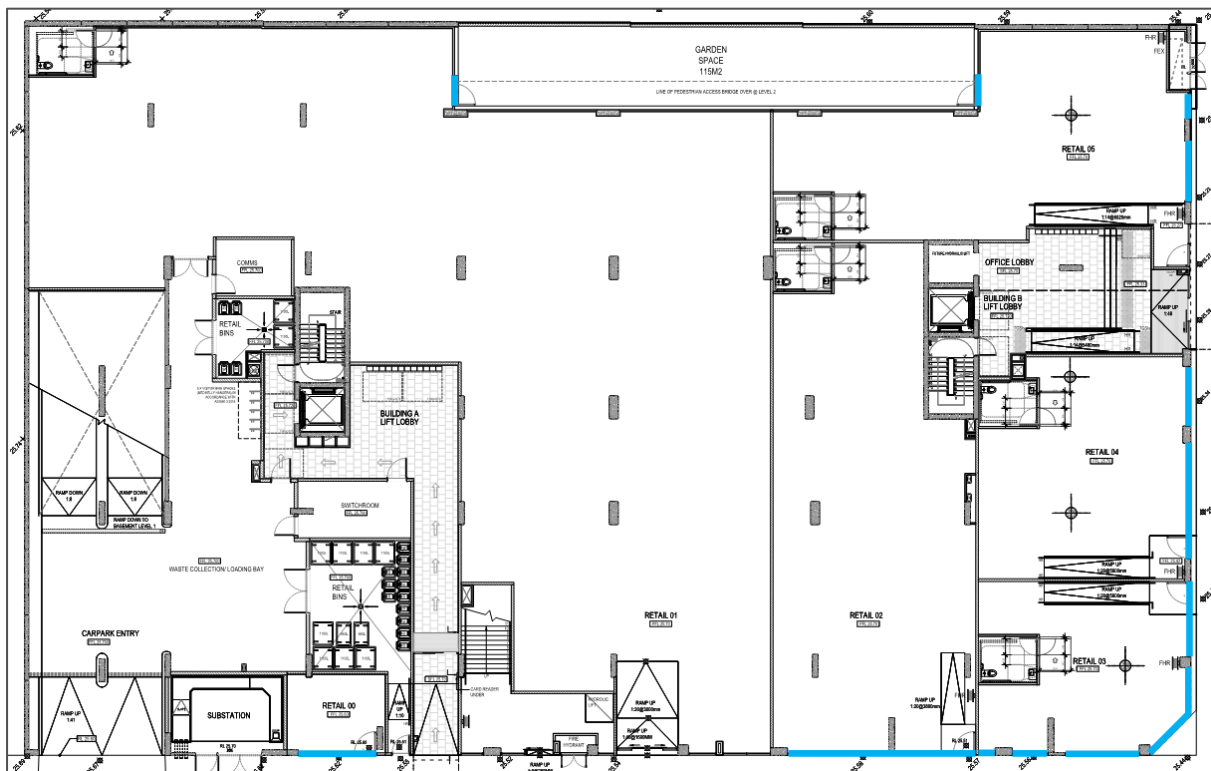


Figure 4 External Glazing Requirements – Ground Level (Image Source: Artisan Architects)

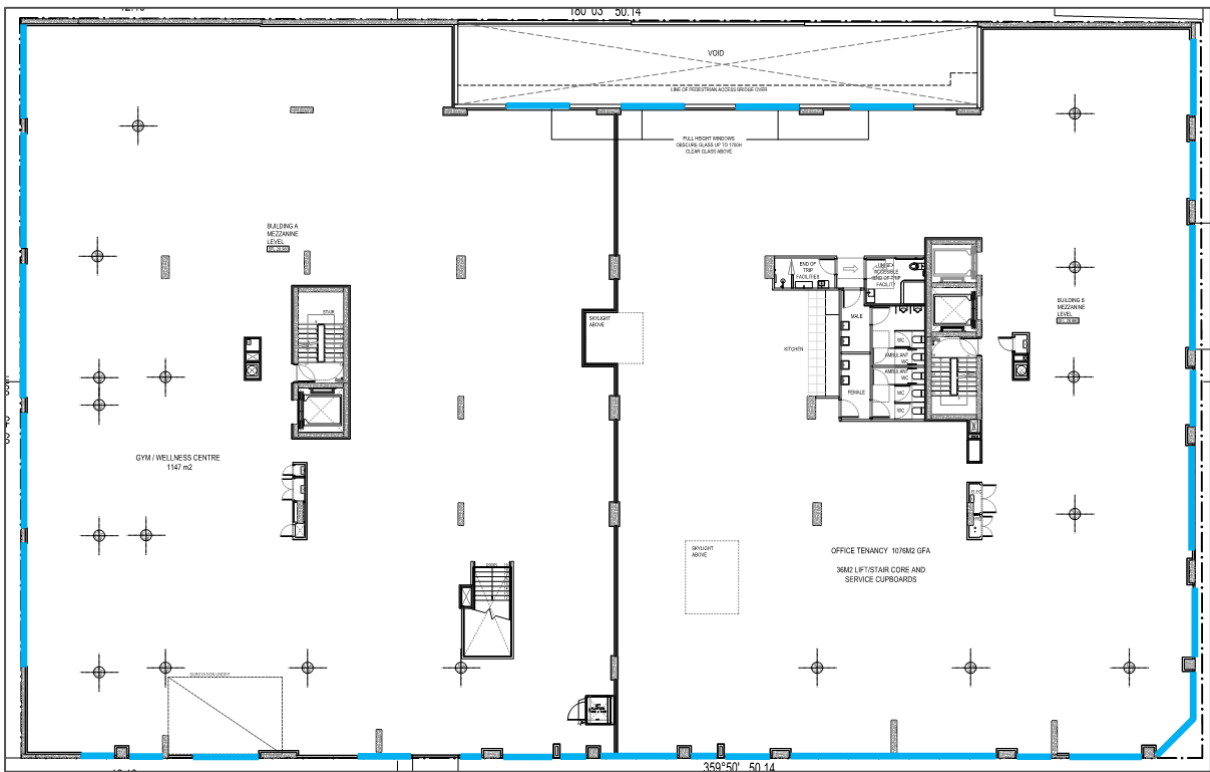


Figure 5 External Glazing Requirements – Mezzanine (Image Source: Artisan Architects)

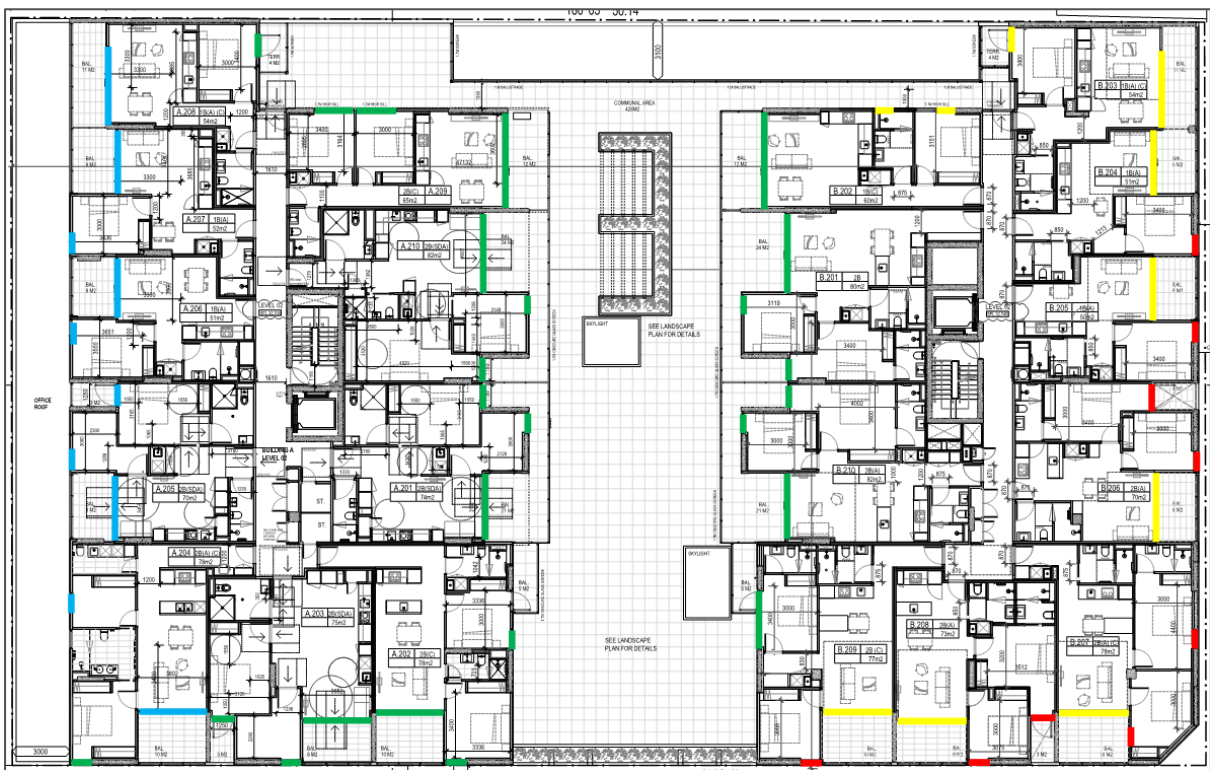


Figure 6 External Glazing Requirements – Level 2 (Image Source: Artisan Architects)



Figure 7 External Glazing Requirements – Level 3 (Image Source: Artisan Architects)



Figure 8 External Glazing Requirements – Level 4 (Image Source: Artisan Architects)



Figure 9 External Glazing Requirements – Level 5 (Image Source: Artisan Architects)



Figure 10 External Glazing Requirements – Level 6 (Image Source: Artisan Architects)



Figure 11 External Glazing Requirements – Level 7 (Image Source: Artisan Architects)

Table 16 Recommended External Glazing Specifications

External Glazing Type	Recommended External Glazing Specifications
Glazing Type 1	<ul style="list-style-type: none"> ▪ Single glazing unit consisting of 6 mm thick glass; or ▪ Double glazing unit consisting of 6 mm glass + 12 mm air gap + 6 mm glass; or ▪ Alternative equivalent glazing system rated to $R_w + C_{tr} \geq 29$. ▪ Framing must be specified to match the required acoustic rating of the glazing. ▪ Openable windows must include rubber or dense foam acoustic seals e.g. Schlegel Q-Lon or equivalent.
Glazing Type 2	<ul style="list-style-type: none"> ▪ Single glazing unit consisting of 6.38 mm thick laminated glass; or ▪ Double glazing unit consisting of 6 mm glass + 12 mm air gap + 6.38 mm laminated glass; or ▪ Alternative equivalent glazing system rated to $R_w + C_{tr} \geq 30$. ▪ Framing must be specified to match the required acoustic rating of the glazing. ▪ Openable windows must include rubber or dense foam acoustic seals e.g. Schlegel Q-Lon or equivalent.

External Glazing Type	Recommended External Glazing Specifications
Glazing Type 3	<ul style="list-style-type: none"> ▪ Single glazing unit consisting of 10 mm thick glass; or ▪ Double glazing unit consisting of 10 mm glass + 12 mm air gap + 4 mm glass; or ▪ Alternative equivalent glazing system rated to $R_w + C_{tr} \geq 31$. ▪ Framing must be specified to match the required acoustic rating of the glazing. ▪ Openable windows must include rubber or dense foam acoustic seals e.g. Schlegel Q-Lon or equivalent.
Glazing Type 4	<ul style="list-style-type: none"> ▪ Single glazing unit consisting of 10.38 mm thick laminated glass; or ▪ Double glazing unit consisting of 10 mm glass + 12 mm air gap + 6 mm glass; or ▪ Alternative equivalent glazing system rated to $R_w + C_{tr} \geq 34$. ▪ Framing must be specified to match the required acoustic rating of the glazing. ▪ Openable windows must include rubber or dense foam acoustic seals e.g. Schlegel Q-Lon or equivalent.

6.5 Heating / Cooling and Ventilation

The design internal noise levels will only be achieved when all external windows and doors are closed. It is recommended that the mechanical services design should consider whether a mechanical HVAC system is required to enable the building to be adequately heated, ventilated, and cooled if the occupant chooses not to open the windows and/or doors.

It is recommended that externally connected ventilation or ductwork paths serving bedrooms and living areas should be designed to achieve a minimum sound reduction of 31 dB(A) from outside to inside. Indicatively, this level of sound reduction may be achieved by:

- Installing acoustic-rated passive ventilation systems (such as those offered by Silence Air);
- Installing sufficient lengths of acoustically treated ductwork between internal and external openings;
- Flexible ductwork should be acoustic flexible duct;
- Sheetmetal ductwork should be internally lined with acoustic insulation;
- Fitting dampers and insulated plenums where ductwork exhausts or intakes air at the external wall or roof.

Inclusion of one or more of the above acoustic treatment measures should be determined as part of the mechanical services design for the development.

7 Mechanical Plant Noise Emissions

7.1 Design Criteria

7.1.1 Mechanical Plant Serving Residential Dwellings

Table 17 presents the guidance provided by *EPA Publication 1973 – Noise Guideline: Assessing Noise from Residential Equipment* (EPA Victoria, 2021), and the recommended design criteria for this project, based on the measured background noise levels.

Table 17 EPA Noise Guideline and Design Criteria for Fixed Domestic Plant

Period	Applicable Times	EPA Noise Guideline	Recommended Project Design Criterion (Outdoors), L_{Aeq} , dB(A)	
			NSA 1, 3	NSA 2
Day / Evening (Non-Prohibited Times)	7 am to 10* pm Monday to Friday. 9 am to 10* pm Weekends and Public Holidays.	Where noise from any fixed domestic plant is audible beyond the boundary of the residential premises on which the plant is situated, the intrusive noise shall not exceed the background noise level (L_{A90}) by more than 5 dB at the measurement position.	51	46
Night** (Prohibited Times)	10* pm to 7 am Monday to Friday. 10* pm to 9 am Weekends and Public Holidays.	Noise from any fixed domestic plant must not be audible within a habitable room of any other residence (regardless of whether any door or window giving access to the room is open).	40	35

*The non-prohibited times are extended to 11 pm for an air-conditioner which is used for cooling, although the non-prohibited times for the same air-conditioner being used for heating finish at 10 pm.

**Note: The level of sound that would be audible or inaudible is difficult to define precisely, as audibility depends on a number of factors including the level of the sound, its spectral characteristics, the characteristics of the background acoustic environment, the hearing abilities of the listener, and environmental influences such as screening due to fences and noise reductions from outside to inside the receiving building. For design purposes, the recommended 'Night' period noise limit has been set based on the lowest measured $L_{A90, 15 \text{ min}}$, and also on the Environment Protection Regulations 2021 'Night' period base noise limit of 35 dB(A).

7.1.2 Mechanical Plant Serving Common and Commercial Areas

The noise limits presented in Table 18 have been determined to apply at the potentially most affected Noise Sensitive Areas in accordance with *Part I of EPA Publication 1826 – Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues* (EPA Noise Protocol) (EPA Victoria, 2021).. Details of the Zoning Level and noise limit calculations are presented in Appendix E.

Table 18 EPA Noise Protocol Part I Noise Limits

Period	Applicable Times	Noise Limit, L_{eff} , dB(A)	
		NSA 1, 3	NSA 2
Day	<ul style="list-style-type: none"> 7 am to 6 pm Monday to Saturday 	58	53
Evening	<ul style="list-style-type: none"> 6 pm to 10 pm Monday to Saturday 	53	47
	<ul style="list-style-type: none"> 7 am to 10 pm Sundays and Public Holidays 		
Night	<ul style="list-style-type: none"> 10 pm to 7 am All Days 	45	42

7.1.3 Emergency Equipment

Mechanical equipment operated as a result of an emergency (e.g. a fire pump) is exempt from the noise limit requirements of the EPA Noise Protocol Part I, however limits do apply to the noise emitted during testing or maintenance, as presented in Table 19 below.

Table 19 EPA Noise Protocol Noise Limits – During Testing or Maintenance of Emergency Equipment

Period	Applicable Times	L_{eff} Noise Limits, dB(A)	
		NSA 1, 3	NSA 2
Day	<ul style="list-style-type: none"> 7 am to 6 pm Monday to Saturday 	68	63
Evening	<ul style="list-style-type: none"> 6 pm to 10 pm Monday to Saturday 	58	52
	<ul style="list-style-type: none"> 7 am to 10 pm Sundays and Public Holidays 		
Night	<ul style="list-style-type: none"> 10 pm to 7 am All Days 	50	47

7.2 Domestic Outdoor Air Conditioning Condenser Units

Based on the proposed floor plan layout, dwelling balconies / private open spaces feature separating screens between balconies / private open spaces. Where domestic outdoor air conditioning condenser units are installed, the following noise control measures are recommended:

- AC condenser units should have individual Sound Power Levels of no more than 62 dB(A); and
- AC condenser units should be installed at locations that do not have direct line of sight to windows of habitable spaces or private open spaces of neighbouring dwellings.
- Where this is not possible through positioning of the units, consideration should be given to installing acoustic screening between the units and the nearby potentially affected dwelling(s).

- Separating screens between adjoining balconies should be constructed to the full depth of the balconies / private open spaces.
- Separating screens should be solid and provide minimum R_w 30. Acceptable sheeting materials include 9 mm thick fibre cement sheet, 6 mm thick glass, or another suitable sheeting material of at least 15 kg/m² mass.
- Indicatively, the height of the screening should be no less than 500 mm taller than the AC condenser unit.

Acoustic review of the domestic air conditioning systems should be conducted to confirm the noise control measures above and any additional measures that may be required once building mechanical services layouts and equipment selections have been developed.

7.3 Domestic Exhaust and Ventilation

It is expected that dwelling kitchen and toilet exhaust fans will be domestic-type in-line fans located in the ceiling space within each dwelling and ducted to an external wall or roof. Noise emissions from these fans are not expected to require acoustic treatment to control noise impacts to nearby residential receptors.

7.4 Mechanical Plant Serving Common Parts of the Building

Any mechanical plant proposed to serve common parts of the building, such as the ground floor waste area, must be designed to comply with Part I of the EPA Noise Protocol.

Any mechanical plant equipment located within the basement, which is fully enclosed with masonry construction and separated from the nearest Noise Sensitive Areas by the ground floor and mezzanine commercial tenancies, will likely not require additional noise control measures.

However, any mechanical plant equipment located at or ducted to external areas such as the rooftops will likely require additional noise control measures.

Acoustic review of the common and commercial mechanical plant should be conducted once building mechanical services layouts and equipment selections have been developed.

7.5 Fire Pump Room

Specifications of the fire pump room equipment should be submitted for acoustic review once equipment selections have been finalised.

It is anticipated that the following acoustic treatment measures will need to be incorporated into the design to comply with Part I of the EPA Noise Protocol:

- Air intakes and ventilation / exhaust outlets should be located as far away from balconies and windows of nearby residences as possible.
- Air intakes and ventilation / exhaust air outlets are likely to require the fitment of attenuators or acoustic louvres in order to control noise emissions via those paths. Allowance should be made for attenuators of up to 1800 mm in length in preliminary spatial planning.
- A suitably specified exhaust silencer / muffler will need to be fitted to the diesel engine exhaust.
- Pump room walls should be constructed from concrete, masonry, or core-filled blockwork.

Specific details and acoustic specifications in relation to each of the above measures will need to be determined once the pump selection has been confirmed and further detail regarding the pump room layout has been developed.

7.6 Substation

Specifications of the substation equipment should be submitted for acoustic review once equipment selections have been finalised.

It is anticipated that the following acoustic treatment measures will need to be incorporated into the design of the substation to comply with Part I of the EPA Noise Protocol:

- Air intakes and ventilation / exhaust outlets should be located as far away from balconies and windows of nearby residences as possible.
- Air intakes and ventilation / exhaust air outlets are likely to require the fitment of attenuators or acoustic louvres in order to control noise emissions via those paths. Allowance should be made for attenuators / louvres of up to 900 mm in length in preliminary spatial planning.
- The floor / ceiling assembly separating the substation from any occupiable space above should be designed to achieve $R_w + C_{tr} \geq 50$ (airborne sound insulation). This will require a minimum 150 mm thick concrete slab.
- Substation walls should be constructed from concrete, masonry, or core-filled blockwork.

Specific details and acoustic specifications in relation to each of the above measures will need to be determined once the equipment selections have been confirmed and further detail regarding the substation room layout has been developed.

7.7 Commercial Tenancy Mechanical Services Equipment

It will be the responsibility of the commercial tenants to ensure that noise emissions from any mechanical plant installed as part of fit-out achieve compliance with the EPA Noise Protocol Part I noise limits. From preliminary review, there are no material matters that would prevent compliance with Part I of the EPA Noise Protocol being practicably achieved with appropriate plant selection and/or acoustic treatment. It is recommended that the requirement to provide any acoustic treatment necessary to comply with Part I of the EPA Noise Protocol be included in the tenancy contract for the commercial spaces.

8 Music Noise Emissions from Commercial Tenancies

Music associated with operation of any commercial tenancies will need to comply with the requirements of Part II of the EPA Noise Protocol (EPA Victoria, 2021).

Based on the background noise levels measured at the site, it is considered that general background music played within any of the commercial tenancies will not impact nearby Noise Sensitive Areas.

It is recommended that a detailed acoustic assessment should be undertaken in accordance with Part II of the EPA Noise Protocol if any of the commercial tenancies proposes to:

- Play music at levels louder than 74 dB(A). This level is be considered to be representative of a general background / ambience music for a restaurant / cafe; or
- Host live music entertainment; or
- Include outdoor / footpath dining areas; or
- Broadcast music to outdoor areas.

9 Noise Transmission Between Internal Spaces

9.1 Design Criteria

Noise transmission between dwellings and between dwellings and other types of spaces are to be addressed by complying with the applicable version of the Building Code of Australia (BCA) Deemed-To-Satisfy (DTS) Sound Insulation Performance Requirements.

9.2 Acoustic Review of General Building Layout

9.2.1 Lifts

The lifts in both towers share a wall with dwellings on all residential levels. The walls between the lift shafts and any part of a dwelling must be of discontinuous construction and rated at $R_w \geq 50$ in order to meet the BCA DTS Provisions.

The lifts are not located adjacent to bedrooms of any dwellings. This is an acoustically desirable configuration.

9.2.2 Apartment Entry Doors from Common Corridor

Apartment entry doors into common corridors are generally spaced well apart. Entries to apartments which have entry doors closer together incorporate dog-leg entry corridors to the apartment, which will reduce any noise impacts to habitable spaces due to noise received through the entry door. Overall, the layout of apartment entry doors is considered to be in an acoustically satisfactory configuration.

9.2.3 Office Tenancy

Based on typical office activities, it is not anticipated that noise from the office tenancy would be audible in adjacent spaces. Any airborne noise emissions from the office tenancy to dwellings within the subject building will be appropriately addressed by complying with the BCA DTS Provisions for sound insulation. In accordance with the relevant BCA DTS Provisions, the floor / ceiling assembly separating the office tenancy and the SOUs above must be designed and constructed to achieve an airborne sound insulation rating of no less than $R_w + C_{tr} 50$.

It is also recommended that the requirement to provide any acoustic treatment necessary to comply with Part I and Part II (if applicable) of the EPA Noise Protocol should be included in the office tenancy contract.

9.2.4 Gymnasium Noise

Gymnasiums are often a source of unsatisfactory structure-borne noise in buildings if not treated appropriately.

It is advised that as the design progresses, a review of the proposed types of gym equipment should be undertaken to determine the level of acoustic treatment required to control structure-borne noise. Pneumatic resistance equipment from manufacturers such as HUR or Keiser should be considered instead of typical cable-borne or weight resistance machines, where possible.

It is indicatively recommended that, at minimum, the flooring within the gym should include at least 40 mm thick low-density rubber or polyurethane foam underlay such as Regupol FX50 or 4080.

It is recommended that the ceiling / floor assembly which separates the gym from Sole-Occupancy Units above should achieve a minimum sound insulation rating of $R_w + C_{tr} \geq 60$. Furthermore, any music played within the gym will need to comply with EPA Noise Protocol Part II.

9.2.5 Waste Chute

Any wall assembly which separates a waste chute from a dwelling will need to achieve a minimum sound insulation rating of $R_w \geq 50$ in order to satisfy Building Code of Australia (BCA) sound insulation requirements.

To minimise the risk of vibration and structure-borne noise impacting apartments, it is recommended that waste chute systems be vibration isolated from the building structure. This should be achieved by using rubber isolation mounts or pads at the points where the chute mounts to the structure. In addition, waste chute doors should incorporate a rubber gasket or bump stops to minimise any impact noise associated with closure of the chute doors.

9.2.6 Mechanical Services Risers

Any wall assembly which separate mechanical services risers (e.g. kitchen exhaust from ground floor retail) from a dwelling will need to achieve a minimum sound insulation rating of $R_w \geq 50$ and $R_w + C_{tr} \geq 25$ (for wet areas) or $R_w + C_{tr} \geq 40$ (for habitable areas) in order to satisfy Building Code of Australia (BCA) sound insulation requirements. All equipment, ducts and pipes should be vibration isolated from the structure of the building.

10 Deliveries and Private Waste Collections Noise

Based on the reference documentation, existing levels of background noise, and environmental noise at the site, it is considered that the noise due to deliveries and private waste collections associated with the site will not adversely impact on the nearby residences provided that such deliveries and collections are conducted between the hours presented in the table below, in accordance with Section 6 and 9 of *EPA Publication 1254 – Noise Control Guidelines* (EPA Victoria, 2021).

Table 20 Deliveries and Private Waste Collections Schedules

Activity Type	Permitted Times
Deliveries	<ul style="list-style-type: none"> ▪ 7 am to 10 pm Monday to Saturday ▪ 9 am to 10 pm Sundays and Public Holidays
Private Waste Collections	<ul style="list-style-type: none"> ▪ 7 am to 8 pm Monday to Saturday ▪ 9 am to 8 pm Sundays and Public Holidays

Delivery vehicle engines, including ancillary motors for refrigeration equipment should be turned off whilst making the delivery.

If any tenant proposes to schedule deliveries or private waste collections outside of these permitted times, the proposed schedule should be submitted for acoustic review by a suitably qualified acoustic consultant to confirm that the resulting noise will not adversely affect the amenity of surrounding noise sensitive receivers.

11 Conclusion

This document has presented a town planning acoustic assessment for the proposed mixed-use development at 6 Cross Street, Footscray, VIC.

The assessment has been undertaken with regard to the acoustic requirements prescribed by *Victoria Planning Provisions Clause 58.04-3, Environment Protection Regulations 2021, EPA Publication 1826 – Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues* (EPA Noise Protocol), as well as the guidelines prescribed by *EPA Publication 1973 – Noise Guideline: Assessing Noise from Residential Equipment, EPA Publication 1254* and *AS/NZS 2107:2016 Acoustics – Design Sound Levels and Reverberation Times for Building Interiors*.

Subject to implementation of the advice presented in Sections 6 to 10 of this document, it is considered that compliance with the project acoustic criteria will be achieved.

12 References

EPA Victoria. (2021, May). EPA Publication 1254 - Noise Control Guidelines. Victoria.

EPA Victoria. (2021, May). EPA Publication 1826 – Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues. Victoria.

EPA Victoria. (2021, May). EPA Publication 1973 - Noise Guideline: Assessing Noise from Residential Equipment. Victoria.

Standards Australia. (2016, October). AS/NZS 2107:2016 Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors.

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State of Victoria. (2021, July 01). Environment Protection Act 2017.

State of Victoria. (2021). *Environment Protection Regulations 2021 - Statutory Rule Number 47/2021*.

State of Victoria. (2022). *Victoria Planning Provisions*. Victoria.

Victoria Planning Provisions. (2021, December 20). Amenity Impacts 58.04-3.

Appendix A Glossary of Acoustic Terms

dB / dB(A)	<p>Decibels or 'A'-weighted Decibels, the units of Sound Pressure Level and Sound Power Level. 'A'-weighting adjusts the levels of frequencies within the sound spectrum to better reflect the sensitivity of the human ear to different frequencies at Sound Pressure Levels typical of everyday sounds. [Unit: dB / dB(A)]</p> <p>The following are examples of the decibel readings of everyday sounds;</p> <ul style="list-style-type: none"> ▪ 0 dB The faintest sound we can hear ▪ 30 dB A quiet library or in a quiet location in the country ▪ 45 dB Typical office space. Ambience in the city at night ▪ 60 dB The sound of a vacuum cleaner in a typical lounge room ▪ 70 dB The sound of a car passing on the street ▪ 80 dB Loud music played at home ▪ 90 dB The sound of a truck passing on the street ▪ 100 dB The sound of a rock band ▪ 120 dB Deafening
C _{tr}	<p>A spectrum adaptation term, commonly used with R_w and D_{nT,w}. C_{tr} adjusts the sound insulation ratings to better describe the performance of the particular construction under consideration when subject to low frequency noise, such as noise from heavy vehicle traffic or subwoofers. [Unit: dB]</p>
Effective Noise Level	<p>"Effective noise level" means the level of noise emitted from the commercial, industrial or trade premises, or from plant serving common areas of residential premises and adjusted if appropriate for character and duration.</p>
Frequency	<p>The rate of repetition of a wave i.e. the number of cycles per second [Unit: Hz]</p>
L _{A90,T}	<p>The value of A-weighted Sound Pressure Level which is exceeded for 90 percent of the time during given measurement period T. This is commonly used to represent the background noise level. [Unit: dB / dB(A)]</p>
L _{Aeq,T}	<p>The Equivalent Continuous A-weighted Sound Pressure Level measured over the period T (also known as Time-Average Sound Pressure Level). The Equivalent Continuous A-weighted Sound Pressure Level is the constant value of A-weighted Sound Pressure Level for a given period that would be equivalent in sound energy to the time-varying A-Weighted Sound Pressure Level measured over the same period. In simple terms, this can be thought of as the average Sound Pressure Level. [Unit: dB / dB(A)]</p>

$L_{AFmax,T}$	The maximum value of A-weighted, F time-weighted Sound Pressure Level which occurs during a given measurement period T. [Unit: dB / dB(A)]
L_{eff}	See 'Effective Noise Level'.
L_{OCT10}	Means the C-weighted or Linear Sound Pressure Level for a specified octave band that is exceeded for 10 per cent of the time interval considered. [Unit: dB]
L_{OCT90}	Means the C-weighted or Linear Sound Pressure Level for a specified octave band that is exceeded for 90 per cent of the time interval considered. [Unit: dB]
Noise Sensitive Area	<p>For the purposes of assessment of noise levels in relation to <i>Environment Protection Regulations 2021</i>, a Noise Sensitive Area is defined as:</p> <p>a) That part of the land within the boundary of a parcel of land that is–</p> <ul style="list-style-type: none"> i. within 10 metres outside the external walls of any of the following buildings– <ul style="list-style-type: none"> A. a dwelling (including a residential care facility but not including a caretaker's house); B. a residential building; C. a noise sensitive residential use; or ii. within 10 metres of the outside of the external walls of any dormitory, ward, bedroom or living room of one or more of the following buildings– <ul style="list-style-type: none"> A. a caretaker's house; B. a hospital; C. a hotel; D. a residential hotel; E. a motel; F. a specialist disability accommodation; G. a corrective institution; H. a tourist establishment; I. a retirement village; J. a residential village; or iii. within 10 metres of the outside of the external walls of a classroom or any room in which learning occurs in the following buildings (during their operating hours)– <ul style="list-style-type: none"> A. a child care centre; B. a kindergarten; C. a primary school; D. a secondary school; or <p>b) subject to paragraph c), in the case of a rural area only, that part of the land within the boundary of–</p> <ul style="list-style-type: none"> i. a tourist establishment;

- ii. a campground;
- iii. a caravan park; or
- c) despite paragraph b), in the case of a rural area only, where an outdoor entertainment event or outdoor entertainment venue is being operated, that part of the land within the boundary of the following are not noise sensitive areas for the purposes of that event or venue–
 - i. a tourist establishment;
 - ii. a campground;
 - iii. a caravan park.

Reverberation Time	Reverberation Time is defined as the time (in seconds) that would be taken for the Sound Pressure Level in a space to decay by 60 decibels after the source of sound has stopped. Spaces with excessively long reverberation times may be characterised by echoes and poor speech intelligibility, while spaces with very short reverberation times may sound ‘dead’.
R _w	Weighted Sound Reduction Index. A single number rating of the airborne sound insulation performance of a specific building element in the absence of flanking transmission. R _w is a laboratory test rating for a single building element (e.g. a door, a window or a wall) determined under ideal conditions with minimal flanking transmission, and is largely independent of partition size and room effects. R _w ratings cannot be accurately tested outside of a controlled laboratory environment. A higher R _w value indicates better airborne sound insulation. [Unit: dB]
Sound Power Level	A measure of the total sound energy radiated by a source, per unit time. Mathematically, it is ten times the logarithm to the base ten of the ratio of the sound power (W) of the source to the reference sound power; where the reference sound power is 1x10 ⁻¹² W. [Unit: dB]
Sound Pressure Level	A measure of the magnitude of a sound wave. Mathematically, it is twenty times the logarithm to the base ten of the ratio of the root mean square sound pressure at a point in a sound field, to the reference sound pressure; where sound pressure is defined as the alternating component of the pressure (Pa) at the point, and the reference sound pressure is 2x10 ⁻⁵ Pa. [Unit: dB]

Appendix B Proposed Floor Plans

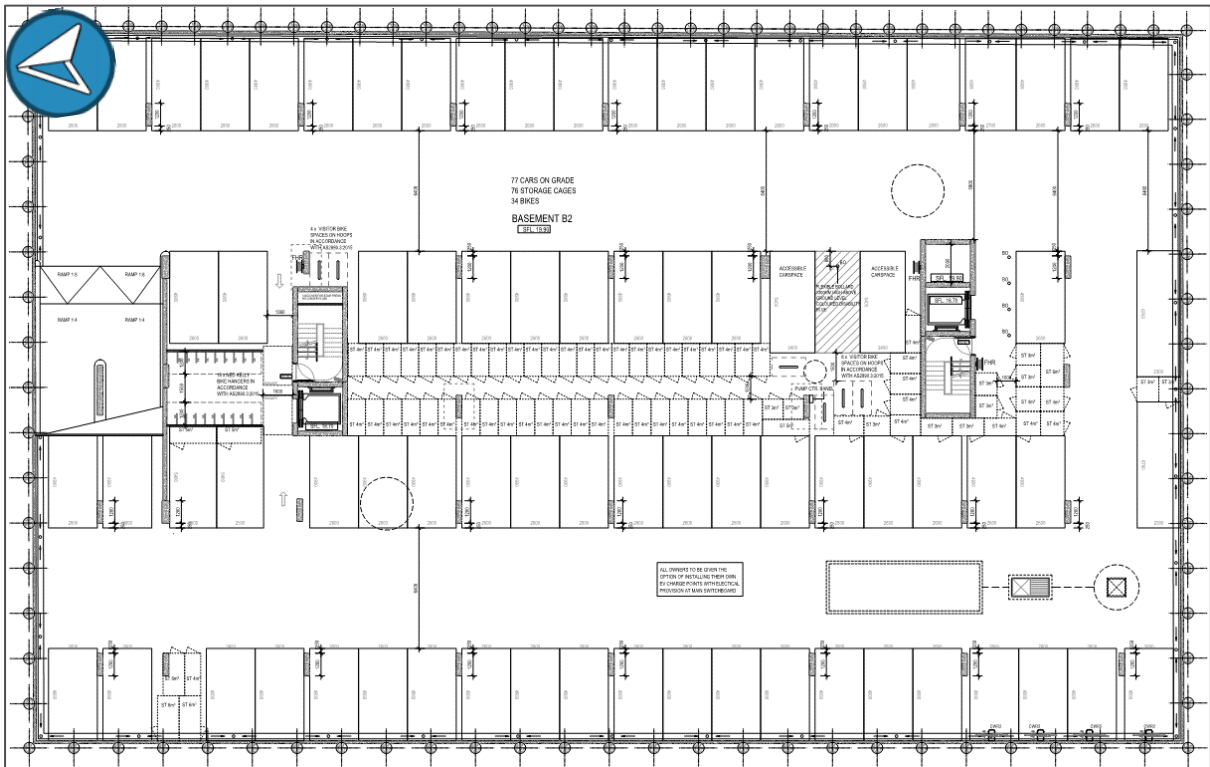


Figure 12 Proposed Floor Plans – Basement 2 (Image Source: Artisan Architects)

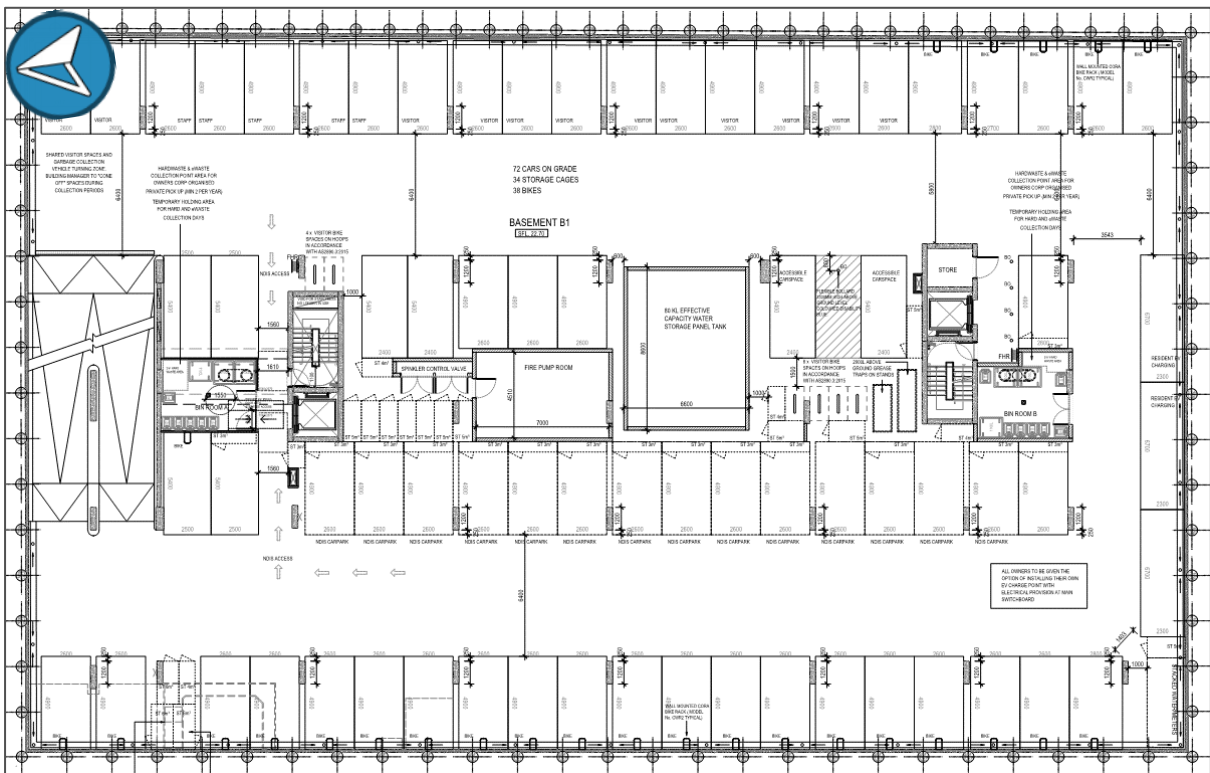


Figure 13 Proposed Floor Plans – Basement 1 (Image Source: Artisan Architects)

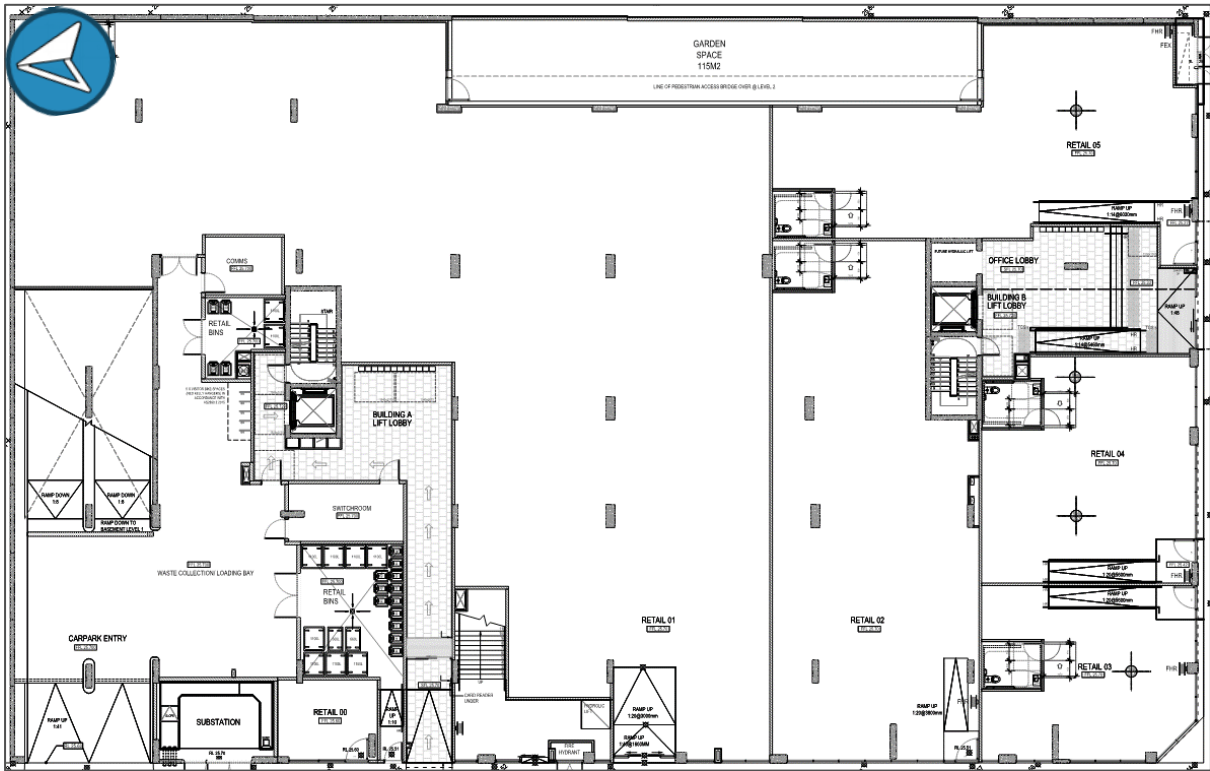


Figure 14 Proposed Floor Plans – Ground Level (Image Source: Artisan Architects)

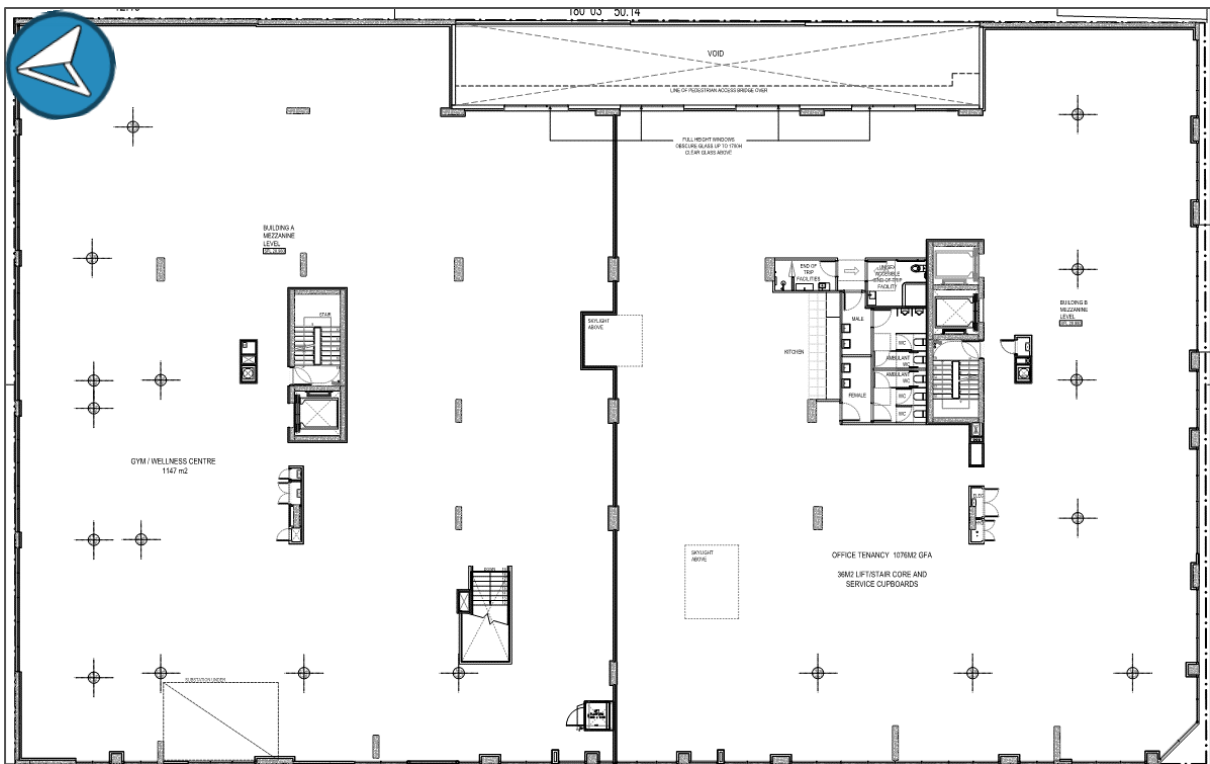


Figure 15 Proposed Floor Plans – Mezzanine Level (Image Source: Artisan Architects)

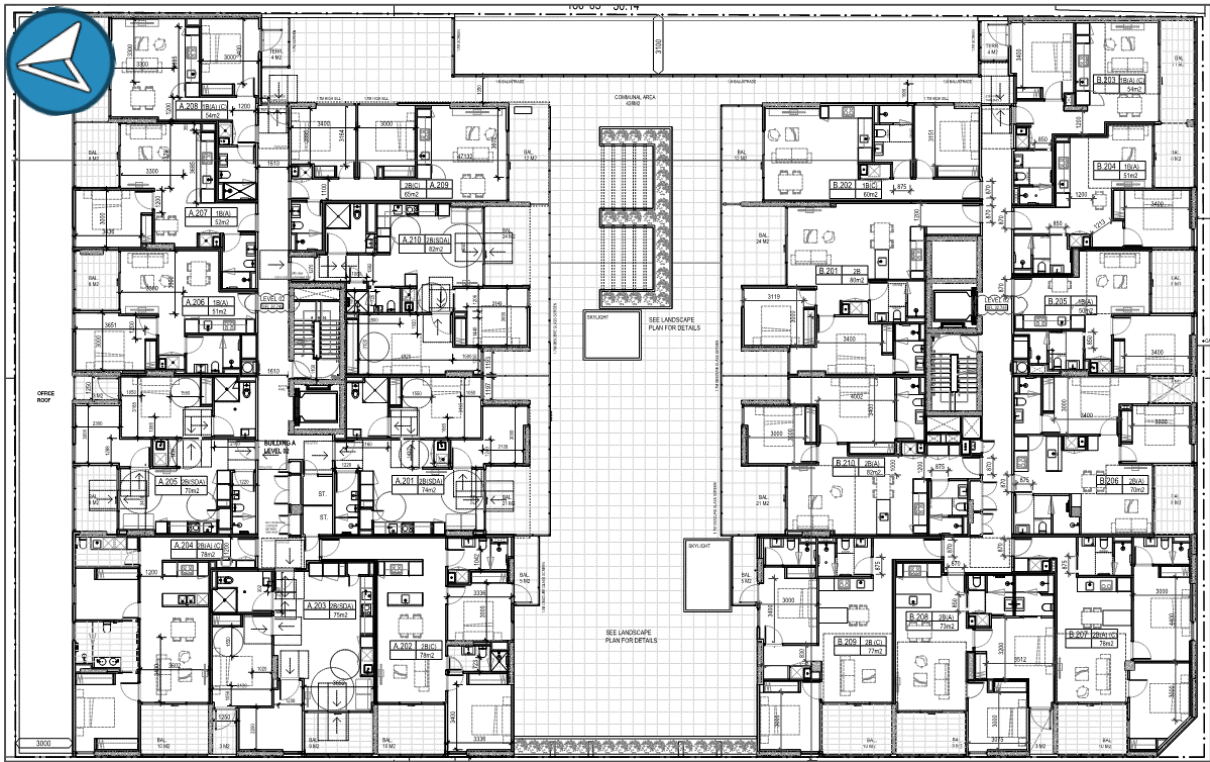


Figure 16 Proposed Floor Plans – Level 2 (Image Source: Artisan Architects)

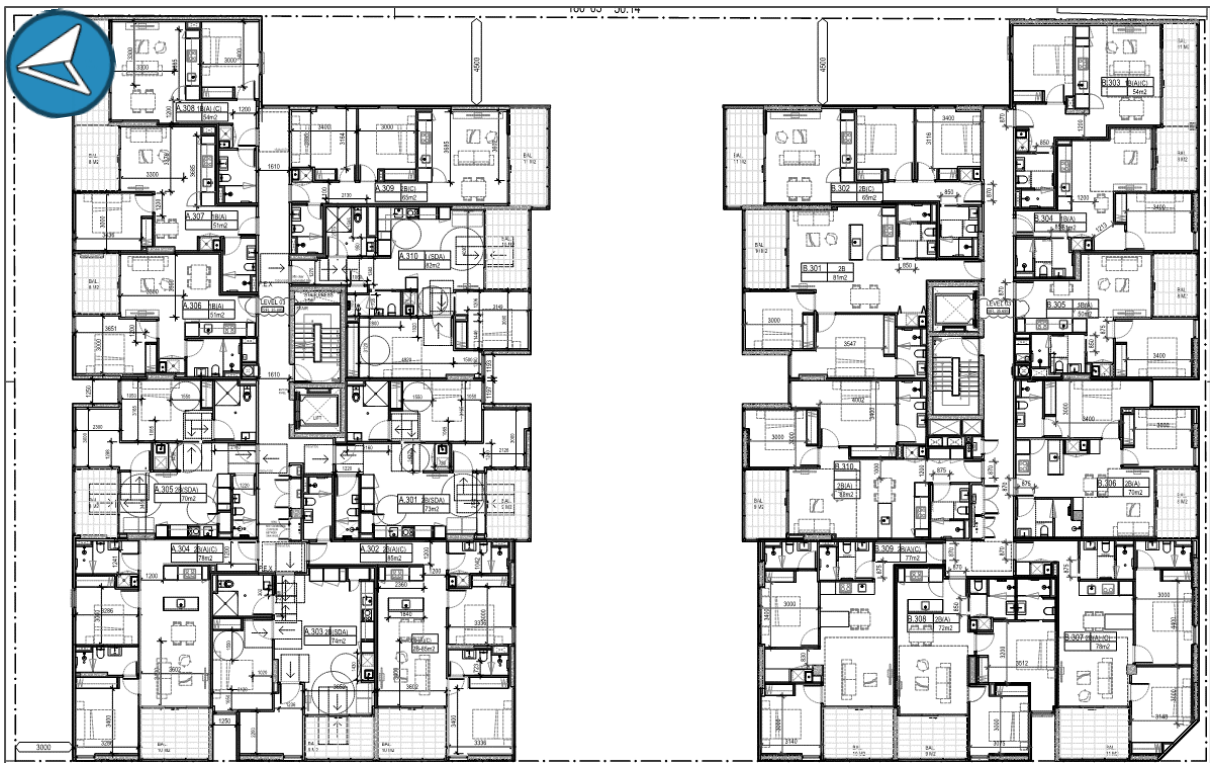


Figure 17 Proposed Floor Plans – Level 3 (Image Source: Artisan Architects)



Figure 18 Proposed Floor Plans – Level 4 (Image Source: Artisan Architects)

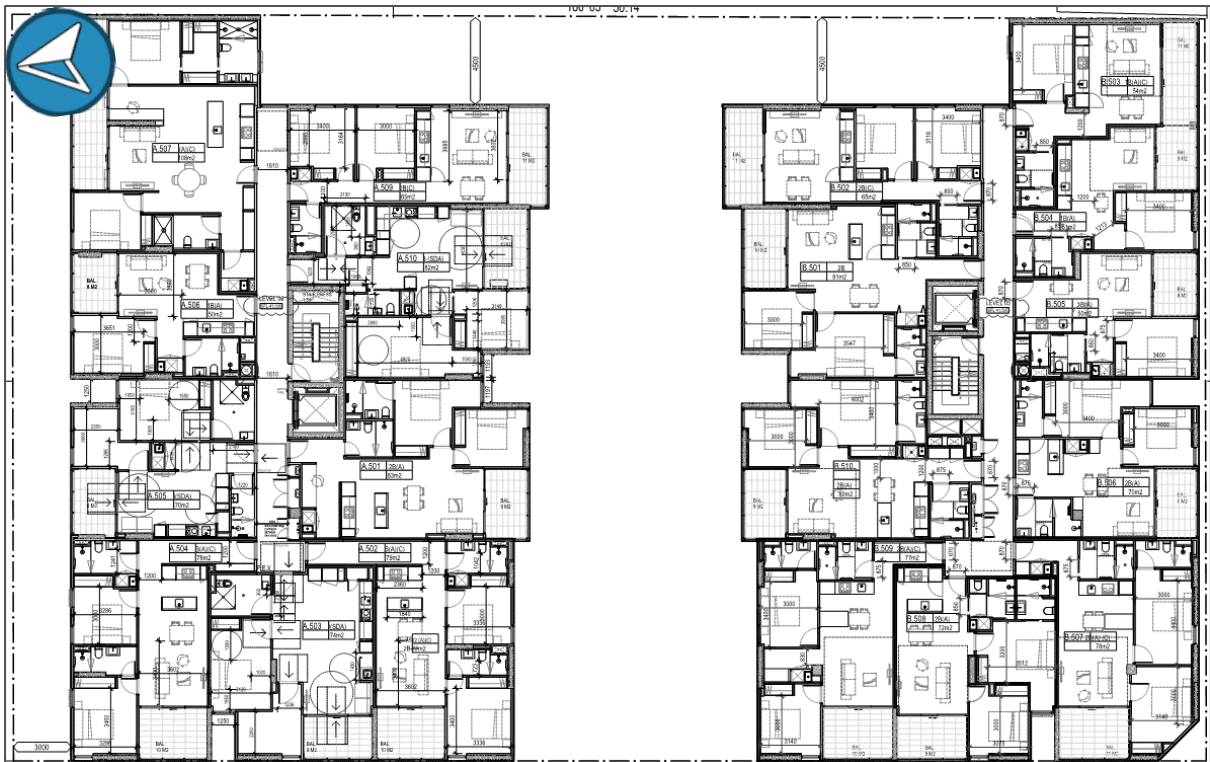


Figure 19 Proposed Floor Plans – Level 5 (Image Source: Artisan Architects)

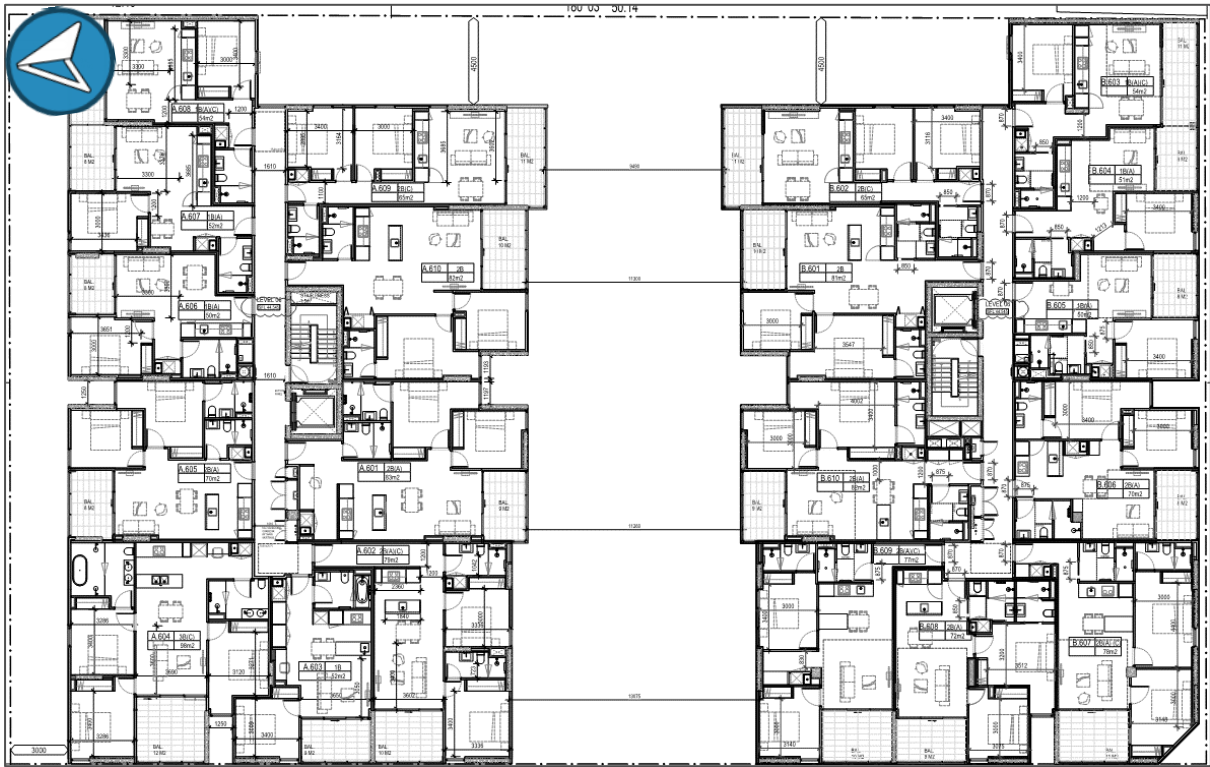


Figure 20 Proposed Floor Plans – Level 6 (Image Source: Artisan Architects)

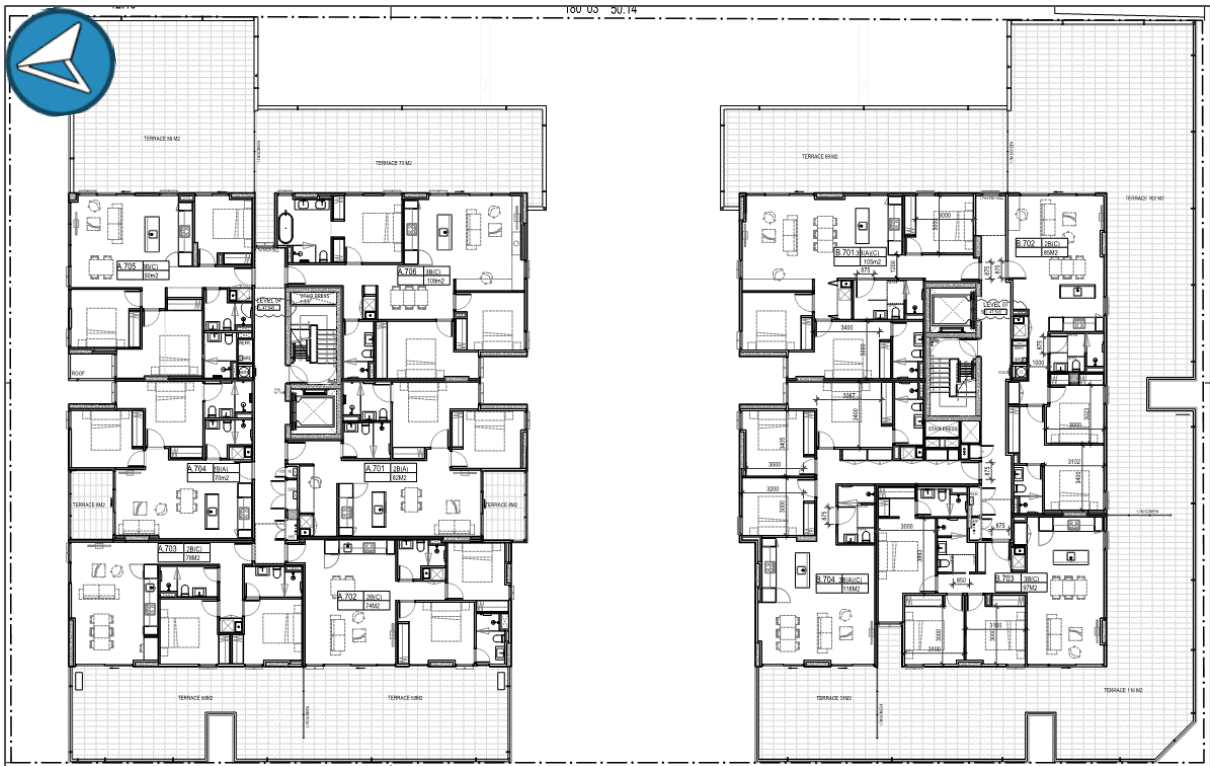


Figure 21 Proposed Floor Plans – Level 7 (Image Source: Artisan Architects)

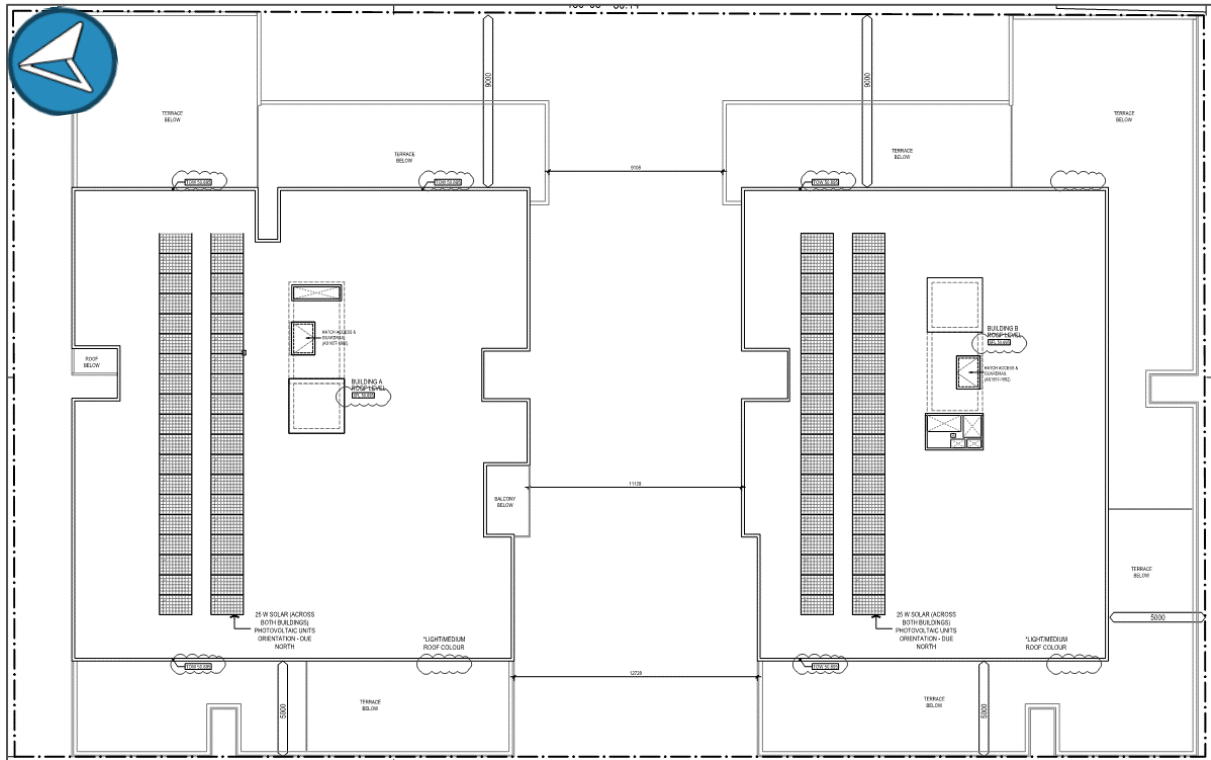


Figure 22 Proposed Roof Plan (Image Source: Artisan Architects)

Appendix C Noise Measurement Methodology

Measurement Location

Table 21 presents details of the noise measurement locations. Figure 23 to Figure 25 present a map and photographs of the noise measurement locations.

Table 21 Noise Measurement Location Details

Location Reference	Measurement Description	Microphone Height Above Ground Level
1	Environmental noise logging – Cross Street	2.5 m
1	Attended Noise Measurements – Cross Street	1.5 m
2	Attended Noise Measurements – Hocking Street	1.5 m

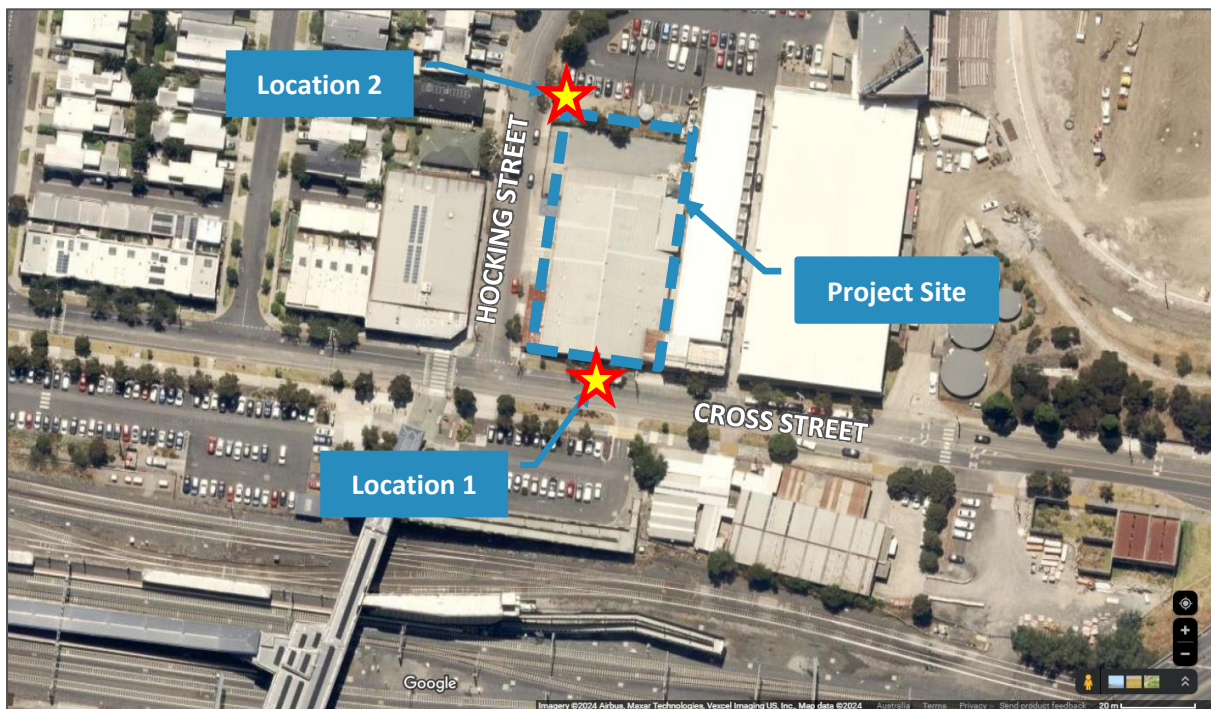


Figure 23 Noise Measurement Locations (Aerial Photo Source: Google Maps)



Figure 24 Noise Measurement Location 1 – Photo Facing South



Figure 25 Noise Measurement Location 2 – Photo Facing West

Measurement Procedure

Noise measurements were performed at the site to establish the environmental noise levels. Table 22 presents details of each measurement:

Table 22 Details of Measurement Period

Location Ref.	Measurement Type		Start Time	Start Date	End Time	End Date
	Attended	Unattended				
1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4:38 PM	Wednesday 8/06/2022	4:00 PM	Wednesday 15/06/2022
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4:38 PM	Wednesday 8/06/2022	4:43 PM	Wednesday 8/06/2022
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4:46 PM	Wednesday 8/06/2022	4:51 PM	Wednesday 8/06/2022

The equipment was configured to provide the measurement results as a continuous series of 1 second A- and Z-weighted Sound Pressure Levels. Metrics used for the assessment were then post-processed from this data.

A foam windscreen was installed on each microphone to minimise the effect of wind-induced pressure fluctuations on the measurements.

Instrumentation

All acoustic instrumentation used for the measurements held a current certificate of calibration from a National Association of Testing Authorities (NATA) accredited laboratory or from the manufacturer at the time of the measurements.

A field check to confirm correct calibration of the instrumentation was performed at the beginning and end of the measurement period using a laboratory calibrated portable Sound Level Calibrator. At the time of each check the instrumentation was found to be reading correctly and the deviation between consecutive checks was found to be less than 1 dB.

Details of the acoustic instrumentation used for measurements are presented in Table 23.

Table 23 Acoustic Instrumentation Details

Location Reference	Instrument Description	Serial No.	Date of Last Laboratory Calibration*
1	Convergence Instruments NSRT_mk2 Type 1 Sound Level Meter	Atp+jdUYcf2VgLHiyyr5ND	14/06/2018
1, 2	SvanteK 979 Class 1 Sound Level Meter	92946	8/10/2021
-	SvanteK SV33B Portable Sound Level Calibrator	112496	15/09/2021

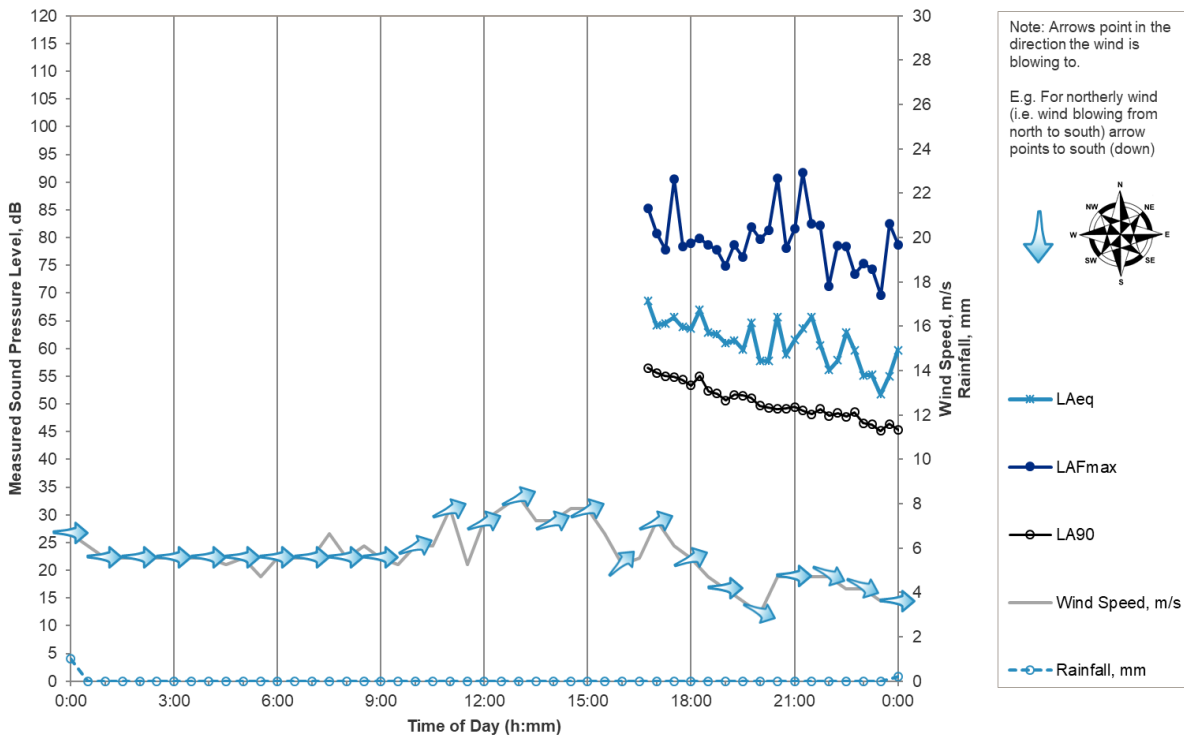
* In accordance with AS 1055.1-1997 and National Association of Testing Authorities Guidelines, Sound Level Calibrators require calibration annually.

Meteorological Data

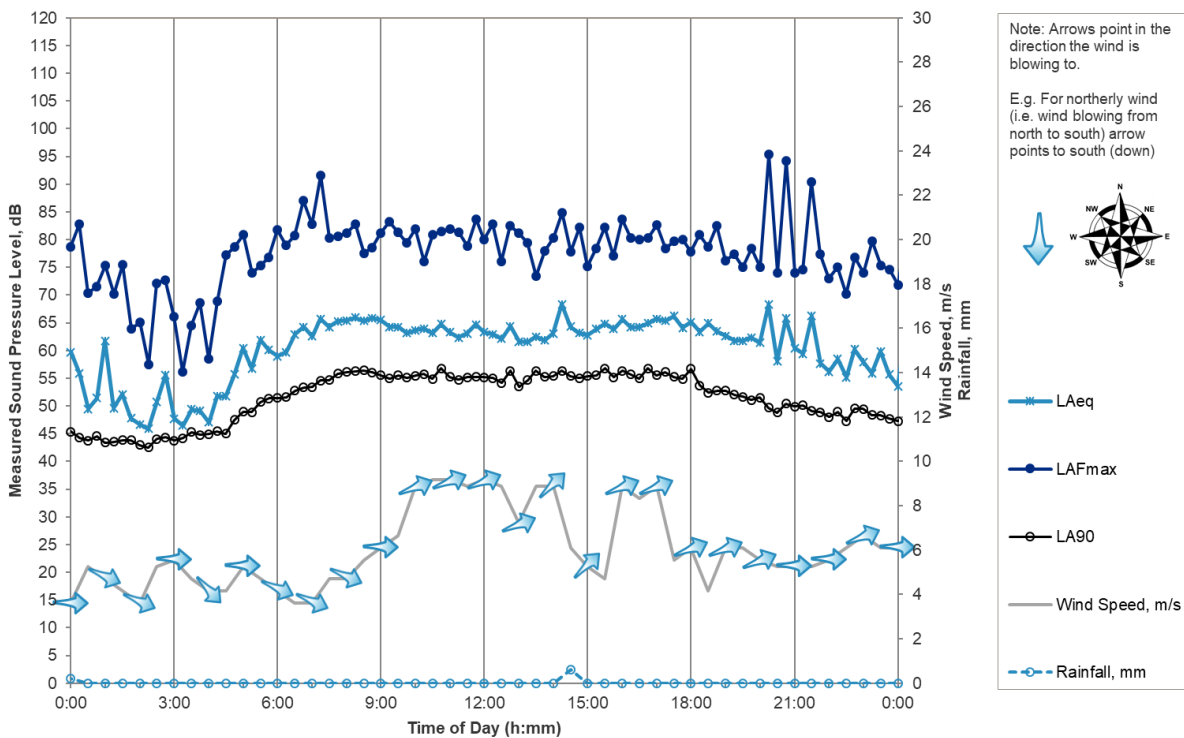
Weather observations during the monitoring period were taken from the Bureau of Meteorology Weather Station at Essendon Airport, approximately 8 km away. Appendix D shows the meteorological observations plotted against the measured L_{Aeq} , L_{A90} , L_{AFmax} Sound Pressure Levels for the duration of the measurement period.

Appendix D Graphed Noise Measurement Results

Wednesday, 8 June 2022

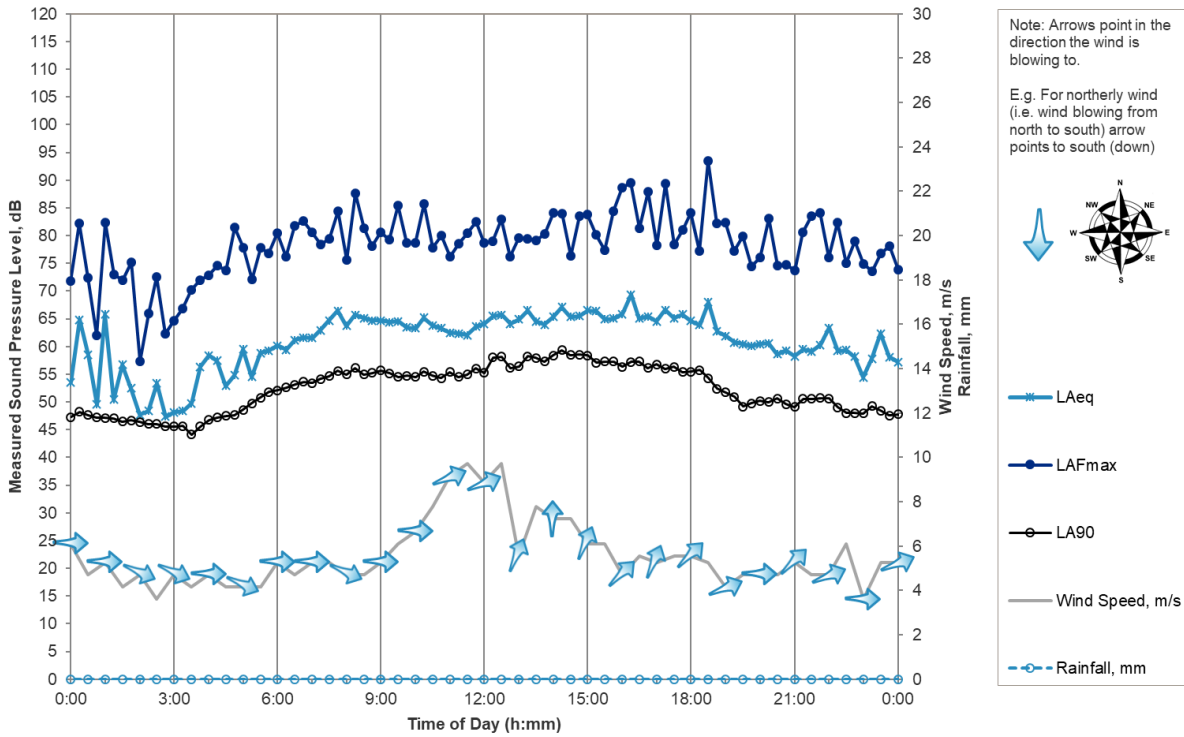


Thursday, 9 June 2022

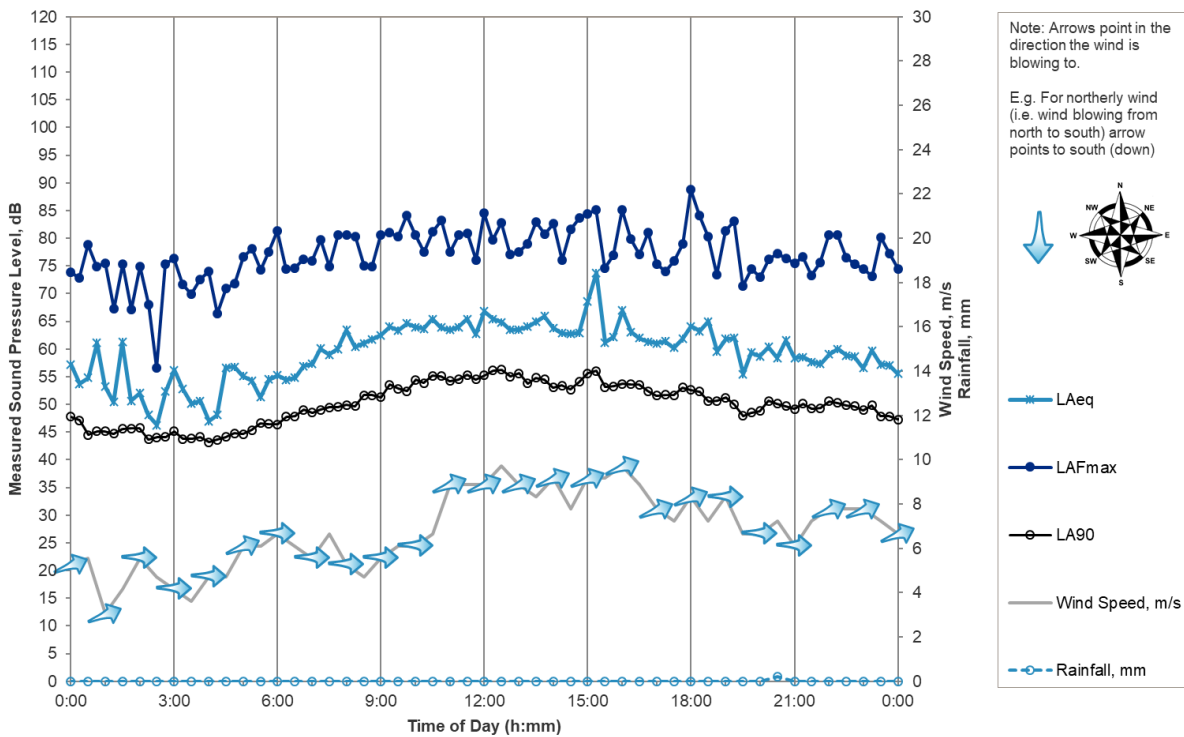


No adjustment for acoustic reflections off nearby acoustically reflective surfaces has been applied to the Sound Pressure Levels presented in this appendix.

Friday, 10 June 2022

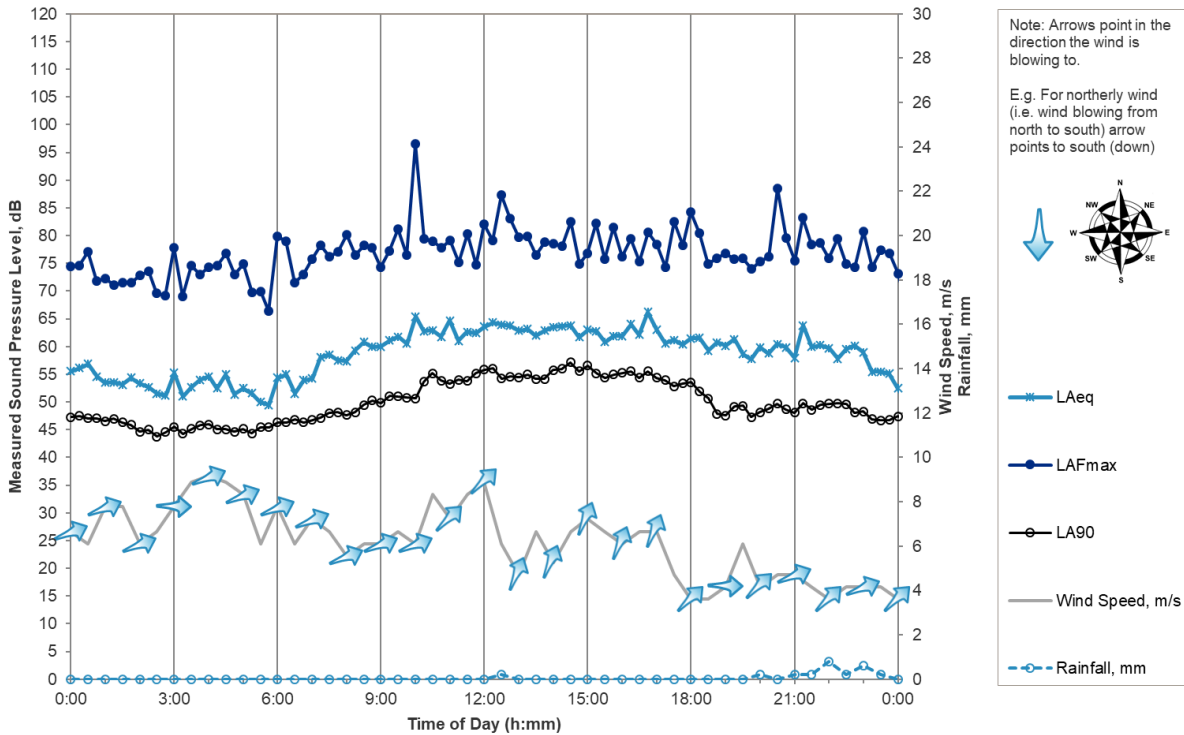


Saturday, 11 June 2022

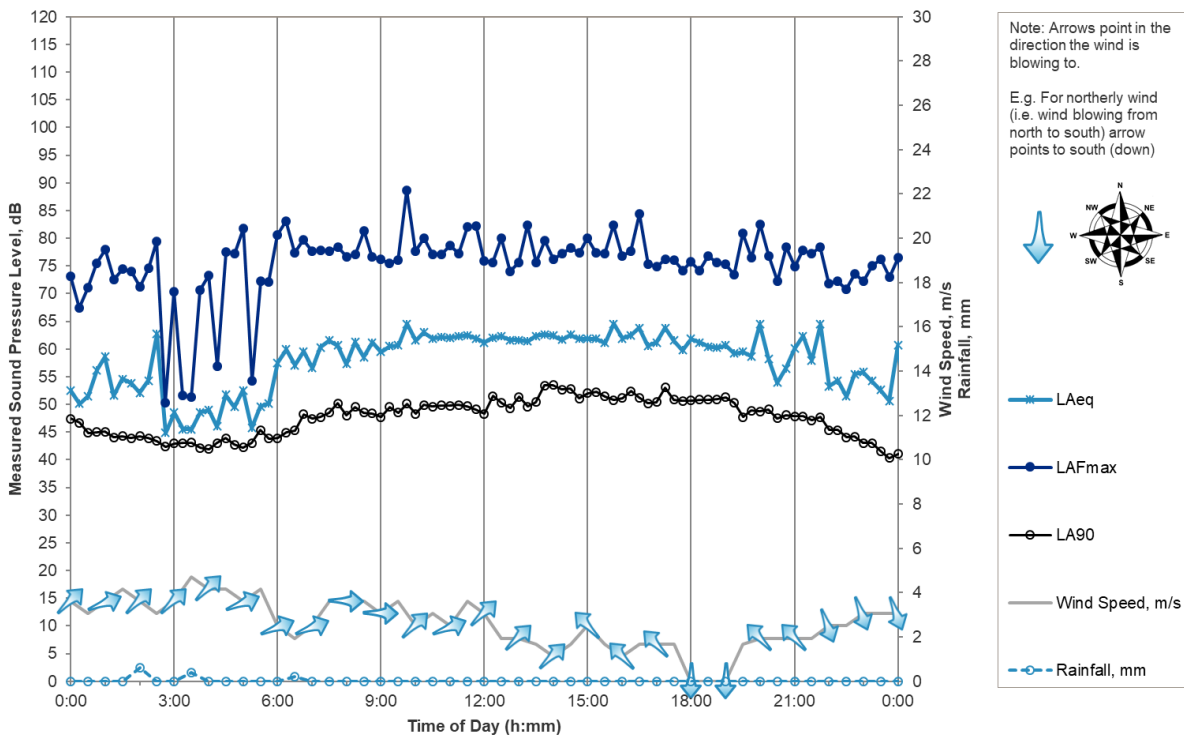


No adjustment for acoustic reflections off nearby acoustically reflective surfaces has been applied to the Sound Pressure Levels presented in this appendix.

Sunday, 12 June 2022

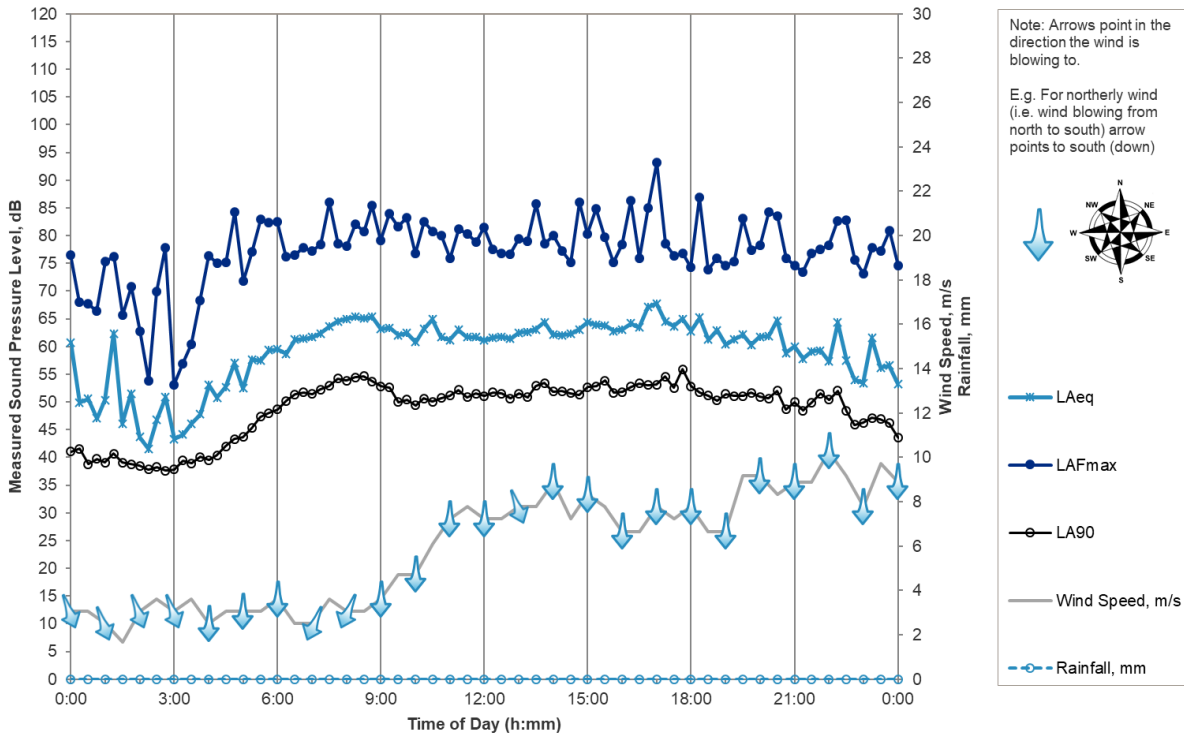


Monday, 13 June 2022

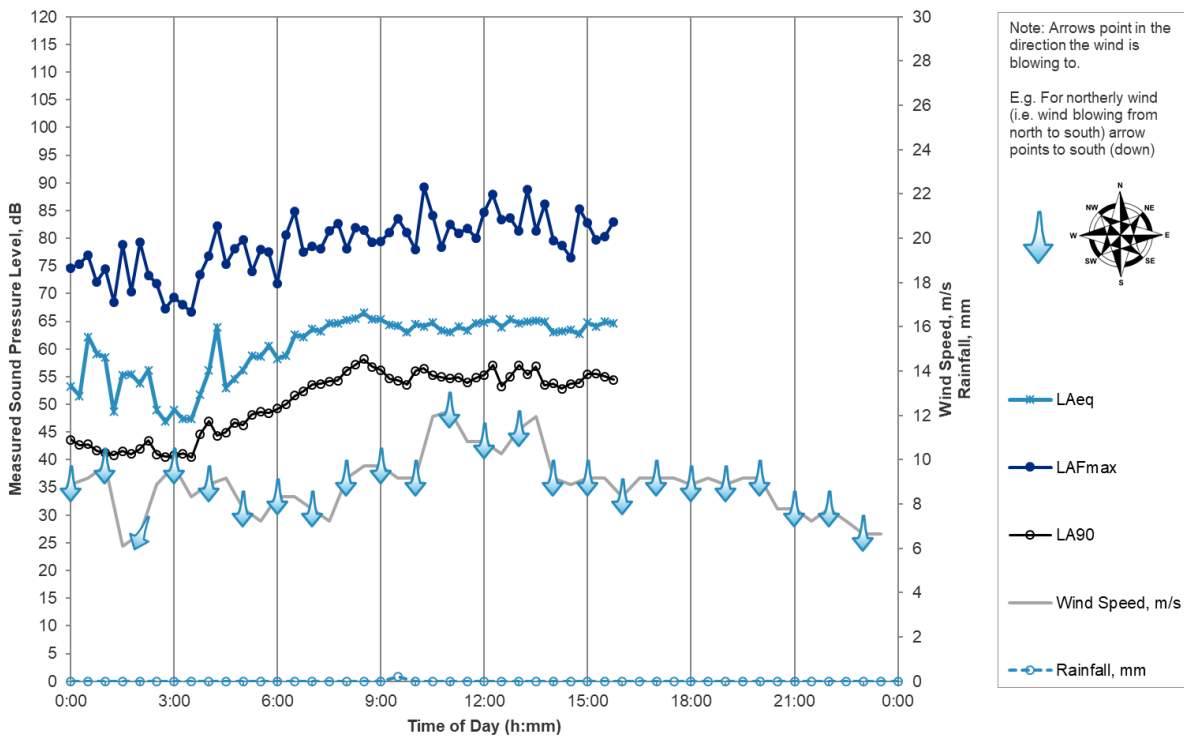


No adjustment for acoustic reflections off nearby acoustically reflective surfaces has been applied to the Sound Pressure Levels presented in this appendix.

Tuesday, 14 June 2022



Wednesday, 15 June 2022



No adjustment for acoustic reflections off nearby acoustically reflective surfaces has been applied to the Sound Pressure Levels presented in this appendix.

Appendix E EPA Noise Protocol Zoning Level and Noise Limit Calculations

6 Cross Street, Footscray

Zoning Map

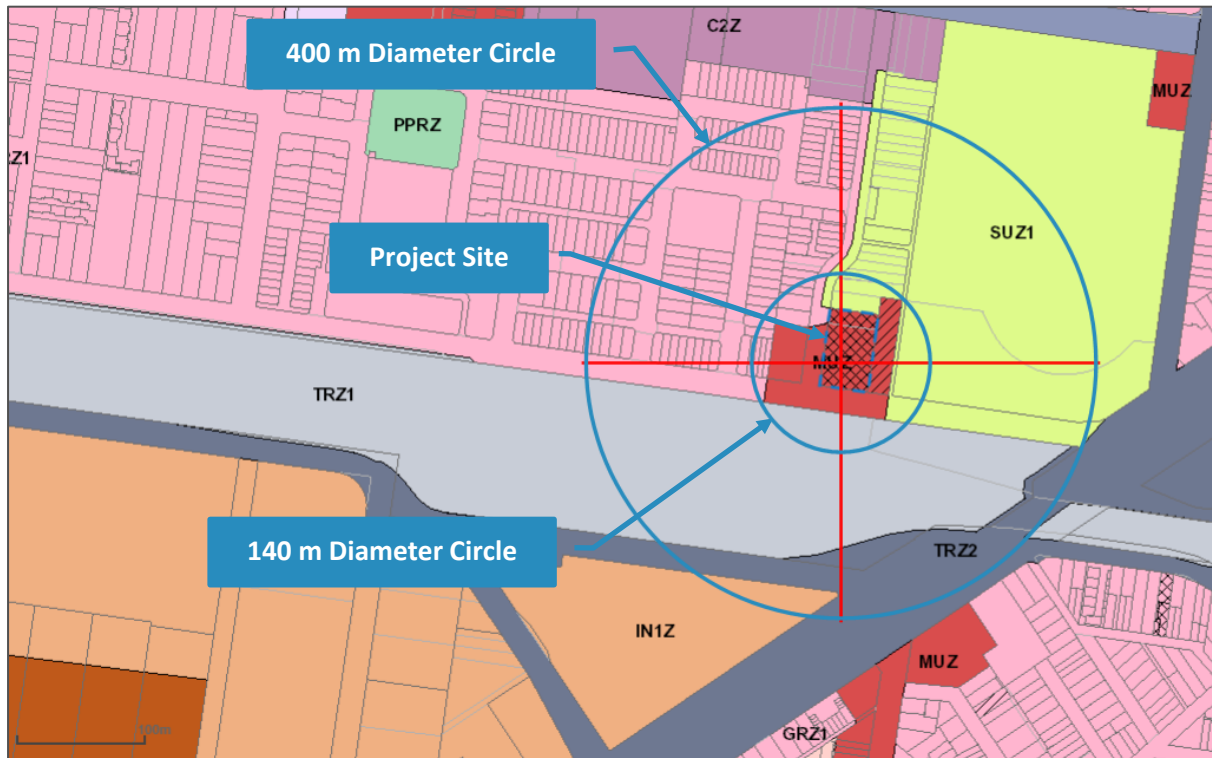


Figure 26 Zoning Circles (Image Source: <https://mapshare.vic.gov.au/vicplan/>)

Zone Areas

Zone Type Designation	Applicable Zones	% Area of 140m Circle	% Area of 400m Circle
Type 1	SUZ1, GRZ1	57%	52%
Type 2	TRZ1	29%	40%
Type 3	C2Z, IN1Z, TRZ2	14%	8%

Influencing Factor: 0.30

Zoning Levels and Noise Limits

Period	Zoning Level, dB(A)	L _{A90} Background Noise Level, dB(A)	Background Noise Classification	EPA Noise Protocol Noise Limits, dB(A)
Day	55	52	High	58
Evening	49	50	High	53
Night	44	42	High	45

50 Hocking Street, Footscray

Zoning Map

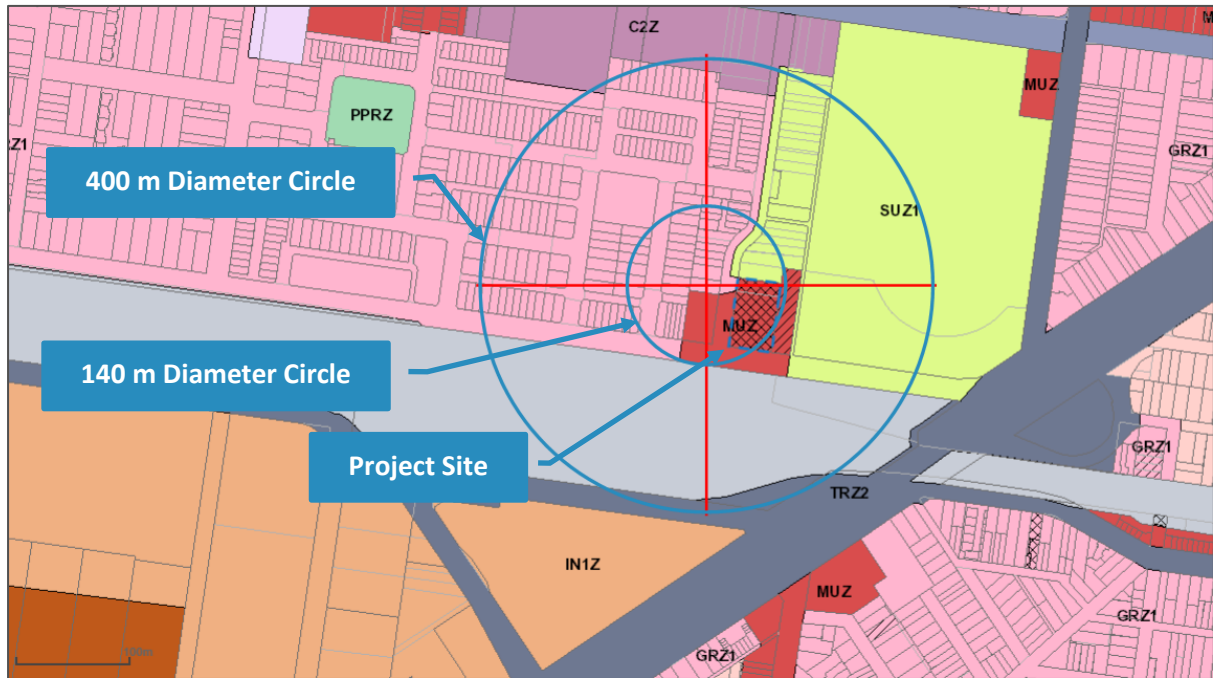


Figure 27 Zoning Circles (Image Source: <https://mapshare.vic.gov.au/vicplan/>)

Zone Areas

Zone Type Designation	Applicable Zones	% Area of 140m Circle	% Area of 400m Circle
Type 1	SUZ1, GRZ1	86%	68%
Type 2	TRZ1	0%	26%
Type 3	C2Z, TRZ2	14%	6%

Influencing Factor: 0.17

Zoning Levels and Noise Limits

Period	Zoning Level, dB(A)	L _{A90} Background Noise Level, dB(A)	Background Noise Classification	EPA Noise Protocol Noise Limits, dB(A)
Day	53	46	Neutral	53
Evening	47	44	Neutral	47
Night	42	36	Neutral	42

Explanatory Notes to EPA Noise Protocol Noise Limit Derivation

In accordance with the EPA Noise Protocol, the Influencing Factor (IF) for an assessment location is calculated as follows:

$$IF = 0.25(\text{Sum of Type 2 fractions for both circles}) + 0.5(\text{Sum of Type 3 fractions for both circles})$$

The Zoning Levels are calculated according to the following equations:

$$\begin{aligned} \text{Day Period Zoning Level} &= 18 \times IF + 50 \\ \text{Evening Period Zoning Level} &= 17 \times IF + 44 \\ \text{Night Period Zoning Level} &= 17 \times IF + 39 \end{aligned}$$

The Background Noise Levels are classified as follows:

Period	Classification Criteria	Background Noise Classification
Day	Background Noise Level > Zoning Level - 6 dB(A)	High
	Background Noise Level < Zoning Level - 12 dB(A)	Low
	Otherwise	Neutral
Evening and Night	Background Noise Level > Zoning Level - 3 dB(A)	High
	Background Noise Level < Zoning Level - 9 dB(A)	Low
	Otherwise	Neutral

The noise limits are determined based on the background noise classification, according to the following equations:

Period	Classification	Noise Limit
Day	High	Background Noise Level + 6 dB(A)
	Neutral	Zoning Level
	Low	0.5 x (Zoning Level + Background Noise Level) + 4.5 dB(A)
Evening and Night	High	Background Noise Level + 3 dB(A)
	Neutral	Zoning Level
	Low	0.5 x (Zoning Level + Background Noise Level) + 3 dB(A)

The Environment Protection Regulations 2021 specify that the noise limits may not be less than 45 dB(A) for the Day period, 40 dB(A) for the Evening period, and 35 dB(A) for the Night period.