acousticdynamics

Acoustic Design and Construction Advice

Proposed Mixed-Use Development

1-5 Rickard Rd, North Narrabeen, NSW

Client:

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Association of Australasian Acoustical Consultants

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GLOSSARY

NOISE

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

NOISE DESCRIPTORS

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

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

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

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

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

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

A-WEIGHTING

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

NOISE CHARACTER, NOISE LEVEL AND ANNOYANCE

The perception of a given sound to be deemed annoying or acceptable is greatly influenced by the character of the sound and how it contrasts with the character of the background noise. A noise source may be measured to have only a marginal difference to the background noise level but may be perceived as annoying due to the character of the noise.

Acoustic Dynamics' analysis of noise considers both the noise level and sound character in the assessment of annoyance and impact on amenity.

1 INTRODUCTION

1.1 EXECUTIVE SUMMARY

Acoustic Dynamics has been engaged by **ALDA Properties** to assess external (road traffic and surrounding commercial and mechanical plant) noise intrusion, external noise emission and provide advice on internal acoustic privacy for the proposed mixed-use development located at 1-5 Rickard Rd, North Narrabeen, NSW, for the purposes of submission as part of a Development Application.

This document provides a technical assessment, as well as recommendations for construction materials and methods to achieve compliance with the relevant acoustic design criteria and requirements of:

(a) Northern Beaches Council;
(b) The NSW Department of Planning and Environment;
(c) The NSW Environment Protection Authority;
(d) The Australian Building Codes Board; and
(e) Australian Standards.

1.2 PROJECT DESCRIPTION

The site is located at 1-5 Rickard Rd, North Narrabeen, situated within a Local Centre (E1) land zone in the Northern Beaches Council area of NSW. The proposal is for the construction of a mixed-use development consisting of the following:

- Ground floor carpark;
- First floor for carpark and commercial tenancies;
- Second floor for residential units and common courtyard; and
- Third floor for residential units.

The proposed development site is shown in the location map, aerial image and drawings presented within **Appendix A**.

1.3 SCOPE OF WORKS

Acoustic Dynamics is engaged to provide an assessment of the acoustic design as part of a Development Application, **suitable for submission to the relevant authorities**, confirming the proposed development will satisfy the clients design goals and comply with the various relevant acoustic criteria.

The scope of the assessment is to include the following:

- Review of legislation, Council criteria and Australian Standards relevant to noise emission, noise intrusion and internal acoustic privacy for the proposed development;

- Conduct unattended noise monitoring within the vicinity of the subject site to determine existing environmental noise levels and to establish project specific noise criteria;
- Predict likely noise emission from proposed mechanical plant, vehicle movements, residential common areas and various other sources at the development site;
- Examination of architectural drawings, review of the proposed external construction and calculation of the sound transmission reduction required to satisfy the criteria;
- Assessment of the proposed construction of internal partitions and building services, and provision of internal acoustic privacy advice;
- Recommendation of noise management measures, construction materials and techniques to achieve compliance with the relevant acoustic requirements and criteria.

2 ASSESSMENT CRITERIA AND STANDARDS

Acoustic Dynamics has reviewed local planning and development control instruments, government policies and legislation, standards and guidelines that are applicable to the proposal. The relevant sections of this review and the most stringent criteria applicable to this assessment are presented below.

2.1 LOCAL GOVERNMENT AND COUNCIL CRITERIA

2.1.1 DEVELOPMENT CONSENT

Acoustic Dynamics has reviewed Council's conditions of consent and the following conditions relevant to this assessment are included below:

"***PITTWATER 21 DEVELOPMENT CONTROL PLAN (P21DCP)***

P21DCP can be viewed at https://eservices.northernbeaches.nsw.gov.au/ePlanning/live/Pages/Plan/Book.aspx?exhibit=PDCP

The following notes the identified non-compliant areas of the proposal only.

Control	***Permitted***	***Proposed***
C1.6 Acoustic Privacy	*Noise-sensitive rooms, such as bedrooms, should be located away from noise sources, including main roads, parking areas, living areas and communal and private open space areas and the like.*	*See below*

	Walls and/or ceilings of dwellings that are attached to another dwelling/s shall have a noise transmission rating in accordance with Part F(5) of the Building Code of Australia. (Walls and ceilings of attached dwellings must also comply with the fire rating provisions of the Building Code of Australia). *Noise generating plants including pool/spa motors, air conditioning units and the like shall not produce noise levels that exceed 5dBA above the background noise when measured from the nearest property boundary.* *Developments must comply in all respects with the Protection of the Environment Operations Act 1997, and other relevant legislation.*	
<u>Response</u>: Refer to C1.5 above. *In addition, any future application shall be supported with an acoustic report to assess the impacts of the commercial use and plant on residential amenity. Refer to the comments from Council's Health Officer below.*		

Specialist Advice
Environmental Health
… *<u>Noise</u>* *An acoustic report will need to be completed by a suitably qualified person to assess potential noise impacts from the development on surrounding residential receivers and on the residential receivers in this development.* *Location and noise impact considerations to be reviewed in the acoustic report;* *-Plants rooms, service rooms, air con units, windows of residential receivers* *- Roof top terrace – is it to be accessed 24hrs.* *- Mechanical ventilation location. Commercial tenancies will require their own DA. If food premises were to occupy the spaces, then consideration at this stage should be given to space/void for mechanical extraction vent through the building to the roof.* *- Increase in vehicle movement close to 3 Rickard Road – any increase in noise?"*

2.1.2 LOCAL PLANNING AND DEVELOPMENT CONTROL INSTRUMENTS

Acoustic Dynamics has conducted a review of the relevant local planning and development control instruments, including the following documents:

- *Pittwater Local Environmental Plan 2014* (LEP); and
- *Pittwater Development Control Plan 2021* (DCP).

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

Acoustic Dynamics' review of the Pittwater DCP indicated the following information relevant to this assessment:

> *"**C1.6 Acoustic Privacy***
>
> ***Outcomes***
> *Noise is substantially contained within each dwelling and noise from any communal or private open space areas are limited. (S)*
> *Noise is not to be offensive as defined by the Protection of the Environment Operations Act 1997, including noise from plant, equipment and communal or private open space areas (S)*
>
> ***Controls***
> *Noise-sensitive rooms, such as bedrooms, should be located away from noise sources, including main roads, parking areas, living areas and communal and private open space areas and the like.*
>
> *Walls and/or ceilings of dwellings that are attached to another dwelling/s shall have a noise transmission rating in accordance with Part F(5) of the Building Code of Australia. (Walls and ceilings of attached dwellings must also comply with the fire rating provisions of the Building Code of Australia).*
>
> *Noise generating plants including pool/spa motors, air conditioning units and the like shall not produce noise levels that exceed 5dBA above the background noise when measured from the nearest property boundary.*
>
> *Developments must comply in all respects with the Protection of the Environment Operations Act 1997, and other relevant legislation."*

Council can enforce the requirements within the relevant local planning and development control instruments under the *Environmental Planning and Assessment Act of 1979*.

2.2 STATE GOVERNMENT POLICIES AND LEGISLATION

Acoustic Dynamics has conducted a review of the relevant state environmental planning policies, legislative acts and statutory instruments, including the following documents:

- *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008*;
- *State Environmental Planning Policy (Transport and Infrastructure) 2021*;

- *Protection of the Environment Operations Act 1997*; and
- *Protection of the Environment Operations (Noise Control) Regulation 2017*.

References to various acoustic requirements applicable to this assessment are summarised below.

2.2.1 STATE ENVIRONMENTAL PLANNING POLICY (EXEMPT AND COMPLYING DEVELOPMENT CODES) 2008

The Codes SEPP includes noise related development standards for the installation of air conditioners, water heaters and pumps on residential premises.

Noise related standards for the installation of air conditioning units include:

*"**2.6 Development standards***

(1) The standards specified for that development, if for residential uses only, are that the development must—

(f1) be designed so as not to operate—

(i) during peak time—at a noise level that exceeds 5 dB(A) above the ambient background noise level measured at any property boundary, or
(ii) during off peak time—at a noise level that is audible in habitable rooms of adjoining residences"

The following definitions are also included:

*"**peak time** means–*

(a) the time between 8:00 am and 10:00 pm on any Saturday, Sunday or public holiday, or
(b) the time between 7:00 am and 10:00 pm on any other day."

*"**off peak time** means any time other than peak time."*

2.2.2 STATE ENVIRONMENTAL PLANNING POLICY (TRANSPORT AND INFRASTRUCTURE) 2021

The TI SEPP provides information and criteria for the assessment of infrastructure development within NSW and identifies matters to be considered for development adjacent to various infrastructure projects.

The policy details the following issues to be considered when assessing the impact of road traffic and vibration on residential developments:

*"**2.120 Impact of road noise or vibration on non-road development***

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

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

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

(3) If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded—

(a) in any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am,
(b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

(3A) Subsection (3) does not apply to a building to which State Environmental Planning Policy (Housing) 2021, Chapter 3, Part 7 applies.

*(4) In this section, **freeway**, **tollway** and **transitway** have the same meanings as they have in the Roads Act 1993."*

2.2.3 PROTECTION OF THE ENVIRONMENT OPERATIONS ACT 1997

The POEO Act provides generic regulatory instruments that can be applied to manage noise emission from a development site. Acoustic Dynamics advises that the operation of building services and other sources associated with the development not generate *"offensive noise"*, as defined within the Act:

*"**offensive noise** means noise–*

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or
(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations."

2.2.4 PROTECTION OF THE ENVIRONMENT OPERATIONS (NOISE CONTROL) REGULATION 2017

The Noise Control Regulation provides a regulatory response to control noise emission from air conditioning units on residential premises:

> ***"45 Use of air conditioners on residential premises***
>
> *A person is guilty of an offence if–*
>
> *(a) the person causes or permits an air conditioner to be used on residential premises in such a manner that it emits noise that can be heard within any room in any other residential premises (that is not a garage, storage area, bathroom, laundry, toilet or pantry) whether or not any door or window to that room is open–*
>
> *(i) before 8 am or after 10 pm on any Saturday, Sunday or public holiday, or*
> *(ii) before 7 am or after 10 pm on any other day"*

2.3 NSW DEPARTMENT OF PLANNING AND ENVIRONMENT

Acoustic Dynamics has reviewed various planning and assessment guidelines published by the NSW Department of Planning and Environment (DPE), including the following documents:

- *Development Near Rail Corridors and Busy Roads – Interim Guideline 2008* (DNRCBR).

References to applicable acoustic guidelines and requirements are summarised below.

2.3.1 DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS INTERIM GUIDELINE 2008

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

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

> *"**3.6 WHAT NOISE AND VIBRATION CRITERIA SHOULD BE APPLIED***
>
> ***3.6.1 Airborne Noise***
>
> *The noise criteria for residential buildings in Table 3.1 for both road and rail are specified in the Infrastructure SEPP. Other values in Table 3.1 are based on the Environmental Criteria for Road Traffic Noise (EPA 1999).*

These criteria apply to all forms of residential buildings as well as aged care and nursing home facilities. For some residential buildings, the applicants may wish to apply more stringent design goals in response to market demand for a higher quality living environment.

The night-time 'sleeping areas' criterion is 5dBA more stringent than the 'living areas' criteria to promote passive acoustic design principles. For example, designing the building such that sleeping areas are less exposed to road or rail noise than living areas may result in less onerous requirements for glazing, wall construction and acoustic seals. If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia."

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

Residential Buildings		
Type of Occupancy	***Noise Levels dB(A)***	***Applicable Time Period***
Sleeping areas (bedroom)	*35*	*Night 10 pm to 7 am*
Other habitable rooms (excl. Garages, kitchens, bathrooms & hallways)	*40*	*At any time*

2.4 NSW ENVIRONMENT PROTECTION AUTHORITY

Acoustic Dynamics has reviewed various assessment guidelines and criteria published by the NSW Environment Protection Authority (EPA), including the following documents:

- *Noise Policy for Industry 2017* (NPfI);
- *Road Noise Policy 2011* (RNP); and
- *Noise Guide for Local Government 2013* (NGLG).

References to applicable acoustic guidelines and requirements are summarised below.

2.4.1 NOISE POLICY FOR INDUSTRY 2017

The NPfI outlines and establishes noise criteria for industrial and other noise sources in various zoning areas. The following criteria have been applied for the assessment of noise emission associated with the use and operation of the development.

PROJECT INTRUSIVENESS NOISE LEVEL

The intrusiveness noise level is determined as follows:

$L_{Aeq, 15min}$ = rating background noise level + 5 dB	
where:	
$L_{Aeq, 15min}$	represents the equivalent continuous (energy average) A-weighted sound pressure level of the source over 15 minutes.
and	
Rating background noise level	represents the background level to be used for assessment purposes, as determined by the method outlined in Fact Sheets A and B.

PROJECT AMENITY NOISE LEVEL

The recommended amenity noise levels represent the objective for **total** industrial noise at a receiver location, whereas the **project amenity noise level** represents the objective for a noise from a **single** industrial development at a receiver location.

To ensure industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows:

Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB(A)

2.4.2 ROAD NOISE POLICY 2011

The RNP document provides road traffic noise criteria for proposed roads as well as other developments with the potential to have an impact in relation to traffic noise generation.

The noise criteria applicable to the subject site is presented below.

Table 2.2 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of project / land use	Assessment Criteria [dB]	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway/ arterial/ sub-arterial roads	3. Existing residences affected by additional traffic on existing freeways /arterial/sub-arterial roads generated by land use developments	$L_{Aeq, (1\ hour)}$ 60 (external)	$L_{Aeq, (1\ hour)}$ 55 (external)

Accepted application of the Section 2.4 of the RNP is that where road traffic noise levels already exceed the assessment criteria, an increase of less than 2 dB represents a minor impact that is barely perceptible to the average person.

2.4.3 SLEEP DISTURBANCE CRITERION

Acoustic Dynamics advises that sleep disturbance is a complex issue, and the potential for sleep disturbance to occur depends on both the level of noise at a residential receiver, and the number of events that occur.

The NSW EPA has investigated overseas and Australian research on sleep disturbance. The assessment of noise for sleep disturbance relies on the application of a screening that indicates the potential for this to occur. The EPA's NGLG provides the following guidance for such a screening test:

> *"Currently, there is no definitive guideline to indicate a noise level that causes sleep disturbance and more research is needed to better define this relationship. Where likely disturbance to sleep is being assessed, a screening test can be applied that indicates the potential for this to occur. For example, this could be where the subject noise exceeds the background noise level by more than 15 dB(A). The most appropriate descriptors for a source relating to sleep disturbance would be $L_{A1(1\ minute)}$ (the level exceeded for 1% of the specified time period of 1 minute) or L_{Amax} (the maximum level during the specified time period) with measurement outside the bedroom window."*

Additionally, the guidelines of the NPfI provide the following additional information:

> *"Where the subject development/premises night-time noise levels at a residential location exceed:*
> - *$L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater; and/or*
> - *L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is greater".*

Further to the above information, the following summarizes the sleep disturbance criterion:

$L_{Aeq,15min} \leq 40$ dB or $L_{Aeq,15min} \leq$ (RBL + 5 dB), whichever is greater

AND

L_{Amax} or $L_{A1(1\ minute)} \leq L_{A90}$ + 15 dB or 52 dB(A), whichever is greater

In addition to the above, the EPA has previously published the following additional information relating to findings of significant research carried out for sleep disturbance:

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

2.5 AUSTRALIAN BUILDING CODES BOARD

The Australian Building Codes Board (ABCB) produces and maintains the *National Construction Code 2022* (NCC), Australia's primary set of technical design and construction provisions for buildings.

NCC Volume One, the *Building Code of Australia* (BCA), provides minimum performance level requirements regarding the design and construction of multi-residential buildings to ensure the safety, health and amenity of occupants.

2.5.1 BCA MINIMUM FLOOR REQUIREMENTS

The BCA provides the following minimum requirement for insulation rating of floors:

*"**F7D4 Determination of impact sound insulation ratings***

(1) A floor in a building required to have an impact sound insulation rating must—

(a) have the required value for weighted normalised impact sound pressure level ($L_{n,w}$) determined in accordance with AS ISO 717.2 using results from laboratory measurements; or
(b) comply with Specification 28."

*"**F7D5 Sound insulation rating of floors***

(1) A floor in a Class 2 or 3 building must have an $R_w + C_{tr}$ (airborne) not less than 50 and an $L_{n,w}$ (impact) not more than 62 if it separates—

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

2.5.2 BCA MINIMUM PARTITION WALL REQUIREMENTS

The BCA provides the following minimum requirements for insulation rating of walls:

*"**F7D4 Determination of impact sound insulation ratings***

(2) A wall in a building required to have an impact sound insulation must—

(a) for a Class 2 or 3 building be of discontinuous construction and

(3) For the purposes of this Part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and—

(a) for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and
(b) for other than masonry, there is no mechanical linkage between leaves, except at the periphery."

*"**F7D6 Sound insulation rating of walls***

(1) A wall in a Class 2 or 3 building must—

(a) have an $R_w + C_{tr}$ (airborne) not less than 50, if it separates sole-occupancy units; and
(b) have an R_w (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and

*(c) comply with **F7D4(2)** if it separates:*

(i) A bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or

(ii) A sole-occupancy unit from a plant room or lift shaft.

(2) A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby, or the like, provided the door assembly has an R_w not less than 30.

(5) Where a wall required to have sound insulation has a floor above, the wall must continue to—

(a) the underside of the floor above; or

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

(6) Where a wall required to have sound insulation has a roof above, the wall must continue to—

(a) the underside of the roof above; or

(b) a ceiling that provides the sound insulation required for the wall."

2.5.3 BCA MINIMUM SERVICES REQUIREMENTS

The BCA provides the following minimum requirement for insulation rating of services:

*"**F7D7 Sound insulation rating of services***

(1) If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole occupancy unit by construction with an $R_w + C_{tr}$ (airborne) not less than—

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

(b) 25 if the adjacent room is a kitchen or non-habitable room."

*"**F7D8 Sound isolation of pipes***

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

2.6 AUSTRALIAN STANDARDS

Acoustic Dynamics has conducted a review of relevant Australian Standards in relation to the acoustic design of the development, including the following standards:

- *AS 3671:1989 "Acoustics – Road traffic noise intrusion – Building siting and construction"*; and
- *AS 2107:2016 "Acoustics – Recommended design sound levels and reverberation times for building interiors".*

References to various applicable acoustic standards are summarised below.

2.6.1 AS 2107:2016 "ACOUSTICS – RECOMMENDED DESIGN SOUND LEVELS AND REVERBERATION TIMES FOR BUILDING INTERIORS"

AS 2107 recommends satisfactory and maximum design sound levels for various types of occupancy within buildings. The following satisfactory and maximum design sound levels for the relevant types of occupancies and areas within the development are detailed.

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

Type of occupancy / activity	*Design sound level, ($L_{Aeq,t}$) range [dB (A)]*
5 Office Buildings	
General office areas	*40 to 45*
7 RESIDENTIAL BUILDINGS	
Houses and apartments in suburban areas or near minor roads –	
Living areas	*30 to 40*
Sleeping areas	*30 to 35*
Work areas	*35 to 40*

Acoustic Dynamics advises that any levels of airborne noise transmitted into various areas of occupancy adjacent or within proximity to the development should not exceed the relevant design sound levels presented above.

2.6.2 AS 3671:1989 "ACOUSTICS – ROAD TRAFFIC NOISE INTRUSION – BUILDING SITING AND CONSTRUCTION"

AS 3671 concerns the reduction of road traffic noise intrusion in buildings in areas near new or upgraded freeways, tollways, major roads and national routes or other roads carrying more than 2,000 vehicles per day.

AS 3671 may also be used to assess the acoustical adequacy of existing buildings in similar areas. The Standard provides methodology for the assessment of noise intrusion from road traffic and guidance for determining the type of building construction necessary to achieve acceptable noise levels indoors, for different types of occupancy.

An assessment of road traffic noise intrusion has been conducted and presented in accordance with AS 3671 in **Section 4**.

3 NOISE MEASUREMENT EQUIPMENT AND STANDARDS

All measurements were conducted in general accordance with AS 1055.1:2018 *Acoustics – Description and Measurement of Environmental Noise Part 1: General Procedures*. Sound measurements were carried out using precision sound level meters conforming to the requirements of IEC 61672.1:2002 *Electroacoustics: Sound Level Meters – Part 1: Specifications*. The instrumentation used during the survey is set out in **Table 3.1**.

Table 3.1 Noise Survey Instrumentation

Type	Serial Number	Instrument Description
2270	2664115	Brüel & Kjaer Modular Precision Sound Level Meter
4189	2385698	Brüel & Kjaer 12.5 mm Prepolarised Condenser Microphone
4230	623588	Brüel & Kjaer Acoustic Calibrator
2250	2679541	Brüel & Kjaer Modular Precision Sound Level Meter
4189	2670479	Brüel & Kjaer 12.5 mm Prepolarised Condenser Microphone
4230	1234136	Brüel & Kjaer Acoustic Calibrator
NGARA	878028	ARL Real Time Sound Acquisition System
4230	1234148	Brüel & Kjaer Acoustic Calibrator

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

4 EXTERNAL NOISE INTRUSION ASSESSMENT

The following section provides an assessment of external noise intrusion into the proposed development against the various noise criteria and objectives outlined in **Section 2**.

4.1 ROAD TRAFFIC NOISE INTRUSION PROJECT CRITERIA

To determine the existing road traffic noise levels in accordance with the calculation methods detailed in AS 3671, Acoustic Dynamics has conducted long-term unattended noise monitoring at a representative location within the subject site from 13 June 2024 until 20 June 2024. The measurement location is marked in **Appendix A**.

Based on the results of the unattended noise monitoring data, Acoustic Dynamics advises the following maximum $L_{Aeq\ (15hr/9hr)}$ noise levels have been determined for the facades of the proposed development direct to Rickard Road, as per the criteria and guidelines outlined in **Section 2**.

Table 4.1 Determined Maximum Noise Levels at Development Facade

Location	Period	Measured Noise Levels [dB]
		Maximum $L_{Aeq\ (15hr/9hr)}$
Rickard Rd Development Facade	Day (7am[1] to 10pm)	62
	Night (10pm to 7am[1])	58

Note: 1) 8am on Sundays and public holidays.

The following internal design sound levels applicable to the critical areas of the development, with external windows and doors closed, have been determined in accordance with the applicable criteria and guidelines outlined in **Section 2**.

Table 4.2 Internal Design Sound Levels

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

4.2 ROAD TRAFFIC NOISE REDUCTION AND REQUIRED NOISE ATTENUATION

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

The TNR is determined by subtracting the **internal design sound level** for the internal spaces from the **maximum external noise level** (including mechanical, road and/or rail traffic) at the facade of each area.

Note is made that, as the existing environment has numerous external noise sources, the development is assessed under the AS 3671 procedure to determine the type of building construction necessary to achieve acceptable internal noise levels. This is considered to be a conservative approach.

The likely Traffic Noise Attenuation (TNA_c) and Weighted Sound Reduction Index (R_W) for required components for the development have been determined in accordance with the guidelines set out in AS 3671 and are presented below.

The traffic noise reduction and required noise attenuation levels are presented below.

Table 4.3 Noise Attenuation & Sound Reduction Index Requirements for Building Components

Area	Indoor Design Sound Level [dB(A)]	Calculated Max External Noise Level [dB(A)][1]	Req'd TNR [dB(A)]	Required Component Noise Attenuation[2]			
				Walls / Roof		Windows / Doors	
				TNA_c	R_w	TNA_c	R_w
Northern Facade							
Sleeping	35	58	23	28	34	27	33
Living	40	62	22	10	16	20	26
Western Facade							
Sleeping	35	58	23	24	30	23	29
Living	40	62	22	9	15	15	21
Eastern Facade							
Sleeping	35	58	23	12	18	24	30

Area	Indoor Design Sound Level [dB(A)]	Calculated Max External Noise Level [dB(A)][1]	Req'd TNR [dB(A)]	Required Component Noise Attenuation[2]			
				Walls / Roof		Windows / Doors	
				TNA_c	R_w	TNA_c	R_w
Living	40	62	22	17	23	18	24
Southern Facade							
Sleeping	35	58	23	25	31	16	22
Upper Facade / Roof							
Sleeping	35	58	23	28	34	N/A	N/A
Living	40	62	22	28	34	24	30

Note: 1) Maximum External Noise Levels are based on measured noise levels and include adjustments to account for distance losses and shielding.

2) Maximum indoor design sound level based on AS 2107 maximum recommended design sound level for apartments near major roads. These values are also consistent with the Transport and Infrastructure SEPP criteria.

Further, AS 3671 provides the following note:

> *"Either STC or R_W may be used as a guide to the selection of components able to provide a desired TNA_c value, provided that approximate allowance is made for the spectral composition of the noise as follows-*

$$TNA_c \approx R_w - 6 \text{ or } R'_w - 6$$

During peak periods of high traffic noise levels, the calculated noise levels within some of the rooms **may** exceed the relevant internal noise level criteria by more than 10 dB, with the windows and/or glass doors open.

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

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

5 INTERNAL ACOUSTIC PRIVACY ASSESSMENT

Acoustic Dynamics has reviewed the architectural drawings for the proposed development to determine compliance with the acoustic requirements of the BCA, outlined in **Section 2**

Our assessment of the construction of the walls, floors, ceilings and building services applicable to internal acoustic privacy are presented below.

5.1 INTERNAL ACOUSTIC DESIGN CRITERIA

The following table details the minimum acoustic performance requirements applicable to the various partitions within residential parts of residential developments, in accordance with the requirements of the BCA.

Table 5.1 BCA Sound Transmission Performance Requirements for Partitions (Class 2 or 3 Buildings)

Partition Type	Areas Separated	Airborne Sound Transmission Requirements	Impact Sound Transmission Requirements
Class 2 or 3 Buildings			
Floor	Sole-occupancy units, and a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification	$R_w + C_{tr} \geq 50$	$L_{n,w} \leq 62$
Wall Type 1	Habitable room of one unit; to Bathroom or wet area of another unit	$R_w + C_{tr} \geq 50$	Be of discontinuous construction
Wall Type 2	Equivalent areas of different units (such as a habitable room of one unit; to habitable room of another unit)	$R_w + C_{tr} \geq 50$	N/A
Wall Type 3	Unit to Plant room or lift shaft	$R_w \geq 50$	Be of discontinuous construction
Wall Type 4	Unit to Stairway, public corridor, public lobby, etc	$R_w \geq 50$	N/A
Wall/Ceiling Type 5	Wall or floor cavity containing common services/pipework; to Habitable room of one unit	$R_w + C_{tr} \geq 40$	N/A
Wall/Ceiling Type 6	Wall or floor cavity containing common services/pipework; to Non-habitable room of other unit	$R_w + C_{tr} \geq 25$	N/A
Entry Door	Entry door of a unit (unit to common area, lobby, etc)	$R_w \geq 30$	N/A

5.2 INTERNAL ACOUSTIC DESIGN REVIEW

Acoustic Dynamics understands that specific materials and construction specifications of internal partitions are yet to be determined and will be finalised prior to obtaining construction certification.

To achieve compliance with the minimum sound transmission performance requirements outlined above, Acoustic Dynamics provides recommendations and design advice for the construction of all wall and floor types in **Section 8**. The location of all wall types that are required to comply with the NCC are presented and labelled in **Appendix A**.

Given the complexity of coupling discontinuous walls to non-discontinuous walls and the relatively small length of these walls for this development, Acoustic Dynamics recommends **all Type 1 and Type 2 wall systems be constructed to be discontinuous**, thus marginally achieving improved acoustic performance at these locations.

Similarly, given the complexity of coupling service partition walls, ceilings and risers separating services from both habitable and non-habitable areas, Acoustic Dynamics also recommends **all Type 5 and Type 6 wall systems be constructed to achieve a minimum $R_w + C_{tr} \geq 40$**, marginally achieving improved acoustic performance at these locations.

6 OPERATIONAL NOISE EMISSION ASSESSMENT

The following section provides an assessment of environmental noise impacts and operational noise emission associated with the use of the development at the closest receiver properties, against the various noise criteria and objectives.

6.1 PROJECT NOISE EMISSION CRITERIA AND OBJECTIVES

To establish the acoustic environment at the subject site in accordance with the guidelines of the NPfI, unattended noise monitoring was conducted between 13 June 2024 and 20 June 2024 within the backyard of 3 Rickard Rd, North Narrabeen. The noise logger was shielded from direct noise associated with vehicular traffic or mechanical plant associated with the development.

Acoustic Dynamics advises the measurement location, shown in **Appendix A**, is representative of the existing noise environment of the nearest sensitive receivers. Results from the long-term noise monitoring are presented in **Appendix B**.

Following the general procedures of the NPfI outlined in **Section 2.4**, a summary of the established noise environment is presented below.

Table 6.1 Determined External Noise Levels and Project Noise Objectives for Nearest Receivers

Location	Assessment Period	L_{A90} Rating Background Noise Level (RBL) [dB]	Measured L_{Aeq} Noise Level [dB]	Project Intrusiveness Noise Level $L_{Aeq,15min}$ [dB]	Project Amenity Noise Level $L_{Aeq,15min}$ [dB][2]	Project Noise Trigger Level $L_{Aeq,15min}$ [dB][3]
Residential Receivers	Day (7am[1] to 6pm)	39	61	44	53	**44**
	Evening (6pm to 10pm)	39	62	44	43	**43**
	Night (10pm to 7am[1])	34	58	39	38	**38**
Commercial Receivers	At any time	—	—	—	63	**63**
Industrial Receivers	At any time	—	—	—	68	**68**

Note: 1) 8:00am on Sundays and public holidays.

2) Amenity adjustment based on "*Suburban*" residential receiver type, "*Commercial"* and *"Industrial"* receiver types (NPfI Table 2.2). The noise emission objective has been modified in accordance with the recommendations detailed within the NPfI Section 2.2, for time standardisation of the intrusiveness and amenity noise levels ($L_{Aeq,15min}$ will be taken to be equal to the **$L_{Aeq,\ period}$ + 3 dB**).

3**)** Project Noise Trigger Level is the lowest value of Project Intrusiveness or Project Amenity Noise Level after conversion to the L_{Aeq} equivalent value.

Acoustic Dynamics advises that external emission from additional road traffic on surrounding roads must not exceed the following noise levels, in accordance with the NSW EPA's RNP outlined in **Section 2.4**:

Table 6.2 Road Traffic Noise Assessment Criteria for Residential Land Uses

Receiver Location	Assessment Criteria [dB]	
	Day (7am – 10pm)	Night (10pm – 7am)
Nearest property boundary of residential receiver	$L_{Aeq,\ (1\ hour)}$ 60 (external)	$L_{Aeq,\ (1\ hour)}$ 55 (external)

In accordance with the NSW EPA's NGLG and NPfI guidelines outlined in **Section 2.4**, the following sleep disturbance screening criterion has been applied for this project:

Sleep Disturbance Criteria:
$L_{Aeq,15min}$ ≤ 45 **dB**
AND
L_{Amax} or $L_{A1(1\ minute)}$ ≤ 52 **dB**

Acoustic Dynamics advises that achieving compliance with the relevant noise emission objectives applicable at the boundaries of the nearest sensitive receivers will adequately protect the acoustic amenity of all nearby receivers.

6.2 NOISE EMISSION ASSESSMENT METHODOLOGY

Acoustic modelling was undertaken using noise modelling software *(CadnaA Version 2023)*. CadnaA calculates environmental noise propagation according to the applicable international and ISO standards, including the ISO 9613 algorithm.

Within our calculations and acoustic modelling, noise emission contributions from the development have been considered taking the following factors into account:

- Airborne noise losses due to distance and ground topography;
- Losses due to direction and diffraction;
- Increases due to reflections; and
- Acoustic shielding.

The following assumptions were made regarding the noise model configuration:

1. All development facades are constructed to be of hard, reflective surfaces;

2. Residential units will be serviced by shared ducted air-conditioning systems located on rooftop;

3. A car park exhaust fan will be located within the basement, with discharge on the development rooftop;

4. The car park exhaust fan will be programmed to operate only when carbon monoxide levels exceed a set point and is unlikely to operate at night-time;

5. An estimated maximum of 20 resident and/ or commercial vehicles will enter or leave the residential and commercial car park within any 60-minute period; and

6. The communal open space will be open to residents for passive recreational use, with an estimated conservative maximum of 20 occupants using the space use at any time between the hours of 7:00am and 10:00pm.

6.3 NOISE SOURCES AND OPERATIONS

Acoustic Dynamics has assessed the following noise sources and operations. The noise data presented below has been established based on information provided by the proponent, short-term measurements and inspections conducted on-site, or referenced from our database of nearfield measurements at similar developments.

Acoustic Dynamics advises that mechanical plant information was not available at the time this report was prepared and has assumed that any mechanical plant servicing the development will be appropriately selected and located prior to obtaining construction certification.

Table 6.3 Associated Noise Sources and Operations

Source	Quantity	Source Sound Power Level L_w [dB(A)]
Communal Areas		
Groups of five residents talking normally	4	68
Mechanical Equipment		
Car park exhaust fan discharge on rooftop	1	85
Garbage room exhaust fan discharge on rooftop	2	60
Residential kitchen exhaust fan discharge on rooftop	16	70
Residential toilet exhaust fan discharge on rooftop	16	60
Large (double fan) condenser unit	8	83
Commercial Movements		
Two patrons, walking at a speed of 5 km/h	10 / 1 hr	61
Vehicle Movements		
Garbage truck, driving at a speed of 5 km/h	1 / 15 min	92
Resident vehicles, driving at a speed of 5 km/h	10 / 1 hr	81
Vehicles associated with commercial premises, driving at speed of 5 km/h	10 / 1 hr	81

6.4 NEAREST RECEIVERS

The cumulative noise impact has been assessed to the potentially most affected point at the adjacent sensitive receiver properties and presented below.

Table 6.4 Nearest Sensitive Receiver Locations

Source	Location	Direction
Residential Receivers		
R_1	1473 Pittwater Road	East
R_2	2-6 Rickard Road	North
R_3	7 & 7A Rickard Road	West
Commercial Receivers		
B_1	2/4 Windsor Parade	East

Acoustic Dynamics advises that by achieving compliance with the nearest sensitive receiver locations, compliance will also be achieved at all other sensitive receiver locations further away.

6.5 EXTERNAL NOISE EMISSION LEVELS

The calculated maximum external noise emission levels at the nearest receiver locations are presented against the relevant noise emission criteria below.

The assessment location for **external noise emission** is defined as the most affected point on or within any sensitive receiver property boundary. Examples of this location may be:

- 1.5m above ground level;
- On a balcony at 1.5m above floor level; and
- Outside a window on the ground or higher floors, at a height of 300mm below the head of the window.

Acoustic Dynamics advises the calculated **external** noise emission levels are conservatively based on **maximum capacity** operations at the development. Acoustic Dynamics advises that such a scenario is unlikely to occur and noise levels are likely to be below those calculated for the majority of the time.

Table 6.5 Calculated External Noise Emission Levels & Relevant Noise Criteria (Daytime and Evening)

Receiver	Assessment Period	Noise Source[2]	Maximum $L_{Aeq(1hr/15min)}$ Noise Emission Level [dB][3,4]	Noise Emission L_{Aeq} Criterion [dB]	Complies ?
R_1	Day & Evening (7:00am[1] to 10:00pm)	Communal Areas	17	**43**	**Yes**
		Mechanical Plant	30		
		Occupant Movements	18		
		Vehicle Movements	26		
		Cumulative Total	**32**		
R_2		Communal Areas	15	**43**	**Yes**
		Mechanical Plant	24		
		Occupant Movements	17		
		Vehicle Movements	Negligible		
		Cumulative Total	**25**		
R_3		Communal Areas	31	**43**	**Yes**
		Mechanical Plant	19		
		Occupant Movements	25		
		Vehicle Movements	Negligible		
		Cumulative Total	**32**		

Receiver	Assessment Period	Noise Source[2]	Maximum $L_{Aeq(1hr/15min)}$ Noise Emission Level [dB][3,4]	Noise Emission L_{Aeq} Criterion [dB]	Complies ?
B_1	At any Time	Communal Areas	37	**63**	**Yes**
		Mechanical Plant	18		
		Occupant Movements	Negligible		
		Vehicle Movements	3		
		Cumulative Total	**37**		

Note: 1) 8:00am on weekends and public holidays.
2) Scenario operations, noise sources and modelling assumptions are detailed in **Section 6.2** and **Section 6.3**.
3) Acoustic Dynamics assumes noise sources will operate continuously over the assessment period.
4) Includes the benefits of recommendations outlined in **Section 8**.

Table 6.6 Calculated External Noise Emission Levels & Relevant Noise Criteria (Night-time)

Receiver	Assessment Period	Noise Source[1]	Maximum $L_{Aeq(1hr/15min)}$ Noise Emission Level [dB][2,3]	Noise Emission L_{Aeq} Criterion [dB]	Complies ?
R_1	Night (10:00pm to 7:00am)	Mechanical Plant	30	**38**	**Yes**
		Vehicle Movements	26		
		Cumulative Total	**32**		
R_2		Mechanical Plant	24	**38**	**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**24**		
R_3		Mechanical Plant	19	**38**	**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**19**		

Note: 1) Scenario operations, noise sources and modelling assumptions are detailed in **Section 6.2** and **Section 6.3**.
2) Acoustic Dynamics assumes noise sources will operate continuously over the assessment period.
3) Includes the benefits of recommendations outlined in **Section 8**.

6.6 ROAD TRAFFIC NOISE LEVELS

Acoustic Dynamics understands that residents and visitors who drive will access the development via surrounding local roads. Vehicles utilising local roads are assessed in consideration of the relevant RNP criteria established in **Section 6.1**.

The calculated maximum noise emission levels at the nearest residential receivers, due to vehicles utilising surrounding local roads, are presented below. The predicted noise levels are based on an estimated maximum number of 20 vehicles along Rickard Rd during the night-time period.

Acoustic Dynamics advises that by achieving compliance with the nearest sensitive receiver locations, compliance will also be achieved at all other sensitive receiver locations further away.

Table 6.7 Calculated Road Traffic Noise Emission Levels & Relevant Noise Criteria

Sensitive Receiver	Predicted Maximum $L_{Aeq,1hr}$ Sound Pressure Level [dB][1]	Relevant $L_{Aeq,1hr}$ Criterion [dB][2,3]	Complies?
Residential receivers along Rickard Rd	33	55	**Yes**

Note: 1) Predicted L_{Aeq} noise level is the maximum noise level measured within a 1-hour period.
2) Measured noise level within a 1-hour period during the night-time assessment period (10:00pm until 7:00am on weekdays, or 8:00am on weekends and public holidays).
3) Compliance with this most sensitive assessment period criterion ensures compliance during all other less stringent assessment periods.

6.7 SLEEP DISTURBANCE

Acoustic Dynamics has determined the potential maximum $L_{A1(60\,Sec)}$ **external** noise emission level from the development resulting from car door slams, when measured at the nearest residential receivers during the night-time assessment period.

Table 6.8 Calculated Maximum Instantaneous External Noise Levels & Relevant Noise Criteria

Sensitive Receiver	Source	Predicted Maximum L_{Amax} Sound Pressure Level [dB][1]	L_{Amax} Sleep Disturbance Criterion [dB][2]	Complies?
Residential Receivers along Rickard Rd	Car Door Slams	46	52	**Yes**

Note: 1) Predicted L_{Amax} noise level is the maximum instantaneous measured noise level.
2) Maximum instantaneous noise level measured during the night-time assessment period (10:00pm until 7:00am on weekdays, or 8:00am on weekends and public holidays).

Acoustic Dynamics advises that instantaneous noise events that exceed the external sleep disturbance criterion at the nearest residential receivers are unlikely to cause awakening reactions, following incorporation of the recommendations provided in **Section 8**.

7 DISCUSSION

Our assessment of the various acoustic impacts associated with the proposed development indicate the following:

1. Noise intrusion from external sources such as road traffic, mechanical plant and industrial noise into the various internal areas of the development has been assessed and is **predicted to comply** with the relevant acoustic criteria of Northern Beaches Council, the TI SEPP, the NSW DPIE and Australian Standards, following the incorporation of the construction and design recommendations in **Section 8**;

2. Sound transmission through the various internal wall and floor partitions separating residential lots from other internal areas of the development has been assessed against the minimum acoustic requirements of the NCC's BCA, and recommendations have been provided in **Section 8** to ensure compliance with the relevant requirements is achieved;

3. Noise intrusion from internal mechanical, hydraulic and other building services into residential lots within the development has been assessed against the minimum acoustic requirements of the NCC's BCA, and recommendations have been provided in **Section 8** to ensure compliance with the relevant requirements is achieved;

4. Noise emission resulting from the ongoing use and operations of the proposed development is **predicted to comply** with the relevant noise emission criteria of Northern Beaches Council, the NSW EPA and applicable legislation during the proposed hours of operation when assessed at the nearest sensitive receivers, following the incorporation of the construction and design recommendations in **Section 8**;

5. Noise emission associated with additional traffic on surrounding local roads is **predicted to comply** with the NSW EPA when assessed at the nearest sensitive receivers;

6. Maximum instantaneous external noise events are **predicted to comply** with the NSW EPA's guidelines on sleep disturbance when assessed at the nearest sensitive receivers;

7. Acoustic Dynamics has identified the outdoor common area as a potential issue, if inadequately managed. Acoustic Dynamics advises that, following the implementation of certain restrictions regarding use of this area, these issues can be appropriately managed and acoustic disturbance to the residents directly adjacent at 7 Rickard Rd can be minimised. Acoustic Dynamics provides certain management measures in **Section 8**;

8. There is **low risk** of acoustic disturbance to the nearest sensitive residential and commercial receivers during the proposed hours of operation;

9. To ensure the assessment is conducted in a conservative manner, noise emission has been assessed as a **worst-case** scenario (i.e. all noise generating activities and noise sources occurring simultaneously and at maximum capacity). Generally, noise emission associated with the operation of the facility is **predicted to be lower** than the calculations presented; and

10. The noise calculations and operational assumptions should not be considered prescriptive. They are modelling assumptions that have been used to demonstrate typical noise sources and operations associated with the facility **can be designed to achieve compliance** with the relevant criteria;

8 RECOMMENDATIONS AND DESIGN ADVICE

The following recommendations are provided to ensure the development is designed and constructed to achieve compliance with the relevant acoustic requirements.

Acoustic Dynamics advises the following recommendations are general in nature and understands that specific acoustic aspects of the development will be reviewed and finalised through the design development stages.

The following recommendations may be adjusted during the preparation of construction documentation once detailed information for the project has been prepared and reviewed by an appropriately qualified acoustic consultant.

8.1 FACADE ELEMENTS

Acoustic Dynamics' analysis and prediction calculations indicate the following recommendations for the construction of facade elements should be incorporated, as a minimum, to ensure the internal design sound levels are achieved.

8.1.1 EXTERNAL WALL SYSTEMS

Where external wall constructions are proposed to be of masonry or lightweight construction, Acoustic Dynamics recommends the wall system be constructed to the following specifications:

Table 8.1 Recommended Masonry External Wall Construction ($R_w + C_{tr} \geq 51$)[1]

External Wall Leaf
1. Fire rated masonry veneer wall; with 2. Minimum 40mm air gap; to 3. One (1) layer of Bradford Enviroseal™ Wall Wrap (or equivalent); to
Framing & Insulation
4. Minimum 90mm Steel Studs at 600mm maximum centres (0.75 BMT)[2]; with 5. Minimum 90mm Bradford Gold Batts™ R2.5 Insulation (or equivalent); to
Internal Lining
6. One (1) layer of 13mm Gyprock Plus™ Plasterboard (or equivalent).

Note: 1) Wall system number CSR 5403 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.

2) The acoustic performance may be adversely affected by using studs with a different base metal thickness or closer spacing than specified.

Table 8.2 Recommended Lightweight Precast External Wall Construction ($R_w + C_{tr} \geq 41$)[1]

External Wall Leaf
1. 75mm Hebel PowerPanel™ Wall; screw fixed to 2. 50mm Rondo™ Top Hats (or equivalent) at 900mm maximum centres; to 3. One (1) layer of Bradford Enviroseal ™ Wall Wrap (or equivalent); to
Frame & Insulation
4. Minimum 90mm Steel Studs at 600mm maximum centres (0.75 BMT)[2]; with 5. Minimum 90mm Bradford Gold Batts™ R2.5 Insulation (or equivalent); to
Internal Finish
6. One (1) layer of 13mm Gyprock Standard™ Plasterboard (or equivalent).

Note: 1) Wall system number HEBEL 1347 from *CSR Redbook (2020)*. Refer to *CSR Redbook 2020* for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.
2) The acoustic performance may be adversely affected by using studs with a different base metal thickness or closer spacing than specified.

Table 8.3 Recommended Lightweight External Wall Construction ($R_w + C_{tr} \geq 41$)[1]

External Wall Leaf
1. Cemintel ExpressPanel™, Barestone™ or Surround™ system (or equivalent); to 2. Minimum 15mm Rondo™ Top Hat (or equivalent); to 3. One (1) layer of Bradford Enviroseal ™ Wall Wrap (or equivalent); to 4. One (1) layer of 16mm Gyprock Fyrchek MR™ Plasterboard (or equivalent); to
Framing & Insulation
5. Minimum 90mm Steel Studs at 600mm maximum centres (0.75 BMT)[2]; with 6. Minimum 90mm Bradford Gold Batts™ R2.5 Insulation (or equivalent); to
Internal Lining
7. One (1) layer of 16mm Gyprock Fyrchek™ Plasterboard (or equivalent).

Note: 1) Wall system number CSR 5345 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.
2) The acoustic performance may be adversely affected by using studs with a different base metal thickness or closer spacing than specified.

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

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

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

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

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

8.1.2 ROOF SYSTEMS

Where roof systems are proposed to be of pitched and low-pitched steel construction, Acoustic Dynamics recommends the roof system be constructed to the following specifications:

Table 8.4 Recommended Low Pitched Steel Roof System (R_w + C_{tr} 38)[1]

Roofing
1. Low slope sheet metal roof minimum 0.42mm BMT; over 2. 60mm Bradford Anticon™ R1.3 roof blanket (or equivalent); over
Framing & Insulation
3. Minimum 150mm timber or steel purlins; with 4. Minimum 215mm Bradford Gold Batts™ R4.1 Insulation (or equivalent); to 5. Rondo Furring Channel at 600mm maximum centres; to
Internal Lining
6. One (1) layer of 10mm Gyprock Superchek™ Plasterboard (over living areas); or One (1) layer of 10mm Gyprock Aquachek™ Plasterboard (over wet areas).

Note: 1) Roof system adapted from system number CSR 6628 in *CSR Redbook (2020)*. Refer to CSR Redbook for more information.

Table 8.5 Recommended Concrete Roof System (R_w + C_{tr} 52)[1]

Roofing
1. Minimum 200mm thick Concrete Slab; direct fixed to
Framing & Insulation
2. Clips at 1200mm Centres; with 3. Minimum 50mm GW Acoustigard 11kg Insulation (or equivalent); to 4. Rondo Furring Channel at 600mm maximum centres; to
Internal Lining
5. One (1) layer of 10mm Gyprock Supaceil™ Plasterboard (over living areas); or One (1) layer of 10mm Gyprock Aquachek™ Plasterboard (over wet areas).

Note: 1) Roof system adapted from system number CSR 6905 in *CSR Redbook (2020)*. Refer to CSR Redbook for more information.

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

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

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

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

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

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

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

8.1.3 WINDOWS AND GLAZED ELEMENTS

The following specifications for glazed components associated with the development have been recommended based on the architectural drawings and specifications provided.

Table 8.6 Recommended Glazing Schedule Requirements for Windows and Glass Doors

Window/ Door	Min. Required $R_w + C_{tr}$ of Glazing	Minimum Recommended Glazing	
		Single Glazed	Double Glazed
Bedrooms Facing Rickard Rd	33	12.38mm Laminated	6mm VFloat™ / 12mm Gap / 6.5mm VLam Hush™
Eastern Facade & Skylights	30	8.38mm Laminated	4mm VFloat™ / 12mm Gap / 6.5mm VLam Hush™
All Other Windows	≤ 29	6.38mm Laminated	6mm Annealed / 12mm Gap / 6.38mm Laminated

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

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

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

2. Glazed sliding components should have a high performing acoustic wipe seal installed to form an **airtight** seal between the sliding component and the adjacent fixed glazing;

3. It is advised that the acoustic performance of the selected glazing frames be confirmed with the suppliers, to ensure that the glazing and frame systems will achieve the minimum acoustic performance levels ($\mathbf{R_w + C_{tr}}$) recommended above.

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

8.2 ARCHITECTURAL ELEMENTS

Acoustic Dynamics provides the following minimum recommendations for the construction of internal architectural elements, to ensure sound transmission is appropriately managed and internal acoustic privacy is maintained.

8.2.1 INTERTENANCY WALLS (TYPE 1 & TYPE 2 WALLS)

Acoustic Dynamics advises that intertenancy wall partitions separating habitable areas of one unit from wet areas of another unit (Type 1 Walls) must comply with the minimum sound transmission performance requirements in *Section F7D4* and *Section F7D6* of the BCA, as detailed in **Section 5**.

The following Type 1 Wall construction systems are recommended.

Table 8.7 Recommended Lightweight Construction for Type 1 Wall Systems ($R_w + C_{tr} \geq 50$)[1,2] (Discontinuous)

First Layer of Construction
1. One (1) layer of 13mm Gyprock Fyrchek™ Plasterboard (or equivalent); to 2. One (1) layer of 6mm Cemintel CeminSeal™ Wallboard (or equivalent); to
Framing & Insulation
3. Minimum 64mm Steel Studs at 600mm maximum centres; to 4. Minimum 20mm Air Gap; to 5. Minimum 64mm Steel Studs at 600mm maximum centres; with 6. Minimum 75mm Bradford Acoustigard 14™ Insulation (or equivalent); to
Second Layer of Construction
7. One (1) layer of 6mm Cemintel CeminSeal™ Wallboard (or equivalent); to 8. One (1) layer of 13mm Gyprock Fyrchek™ Plasterboard (or equivalent).

Note: 1) Wall system number CSR 1330 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.

2) Acoustic Dynamics notes this wall system is discontinuous and satisfies the relevant impact sound transmission requirements of *Section F7D4* of the BCA.

Table 8.8 Recommended Precast Construction for Type 1 Wall Systems ($R_w + C_{tr} \geq 50$)[1,2] (Discontinuous)

First Layer of Construction
1. One (1) layer of 13mm Gyprock Standard™ Plasterboard (dry areas); or One (1) layer of 13mm Gyprock Aquachek™ Plasterboard (wet areas); to
Framing & Insulation
2. Minimum 75mm Hebel PowerPanel™; to 3. Minimum 20mm Air Gap; to 4. Minimum 64mm Steel Studs at 600mm maximum centres; with 5. Minimum 50mm Bradford Acoustigard 11™ Insulation (or equivalent); to
Second Layer of Construction
6. One (1) layer of 13mm Gyprock Standard™ Plasterboard (dry areas); or One (1) layer of 13mm Gyprock Aquachek™ Plasterboard (wet areas); to

Note: 1) Wall system adapted from number HEBEL 1072 and 1075 from *Hebel High Rise Apartments, Student Accommodation, Hotels and Commercial – Corridor, Intertenancy, Shaft & Service Walls Design & Installation Guide (2016)*. Refer to Hebel Design Guide for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.

2) Acoustic Dynamics notes this wall system is discontinuous and satisfies the relevant impact sound transmission requirements of *Section F7D4* of the BCA.

Table 8.9 Recommended Masonry Construction for Type 1 Wall Systems ($R_w + C_{tr} \geq 50$)[1,2] (Discontinuous)

First Layer of Construction
1. One (1) layer of 13mm Gyprock Standard™ Plasterboard (or equivalent); to
Framing & Insulation
2. Minimum 110mm Brick Veneer with minimum area density 170 kg/m^2; or Minimum 90mm Core-filled or Solid Blockwork with minimum area density 150 kg/m^2; to 3. Minimum 20mm Air Gap; to 4. Minimum 92mm Steel Studs at 600mm maximum centres; with 5. Minimum 90mm Bradford Gold Batts™ R2.5 Insulation (or equivalent); to
Second Layer of Construction
6. One (1) layer of 13mm Gyprock Soundchek™ Plasterboard (or equivalent).

Note: 1) Wall system number CSR 4025 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.

2) Acoustic Dynamics notes this wall system is discontinuous and satisfies the relevant impact sound transmission requirements of *Section F7D4* of the BCA.

Acoustic Dynamics advises that intertenancy wall systems separating equivalent areas of separate residential units (Type 2 Walls) must comply with the minimum sound transmission performance requirements in *Section F7D6* of the BCA, as detailed in **Section 5**.

The following Type 2 Wall construction systems are recommended.

Table 8.10 Recommended Lightweight Construction for Type 2 Wall Systems ($R_w + C_{tr} \geq 50$)[1]

First Layer of Construction
1. Two (2) layers of 13mm Gyprock EC08 Complete™ Plasterboard (or equivalent); to
Framing & Insulation
2. Minimum 92mm Rondo Quiet Stud™ at 600mm maximum centres; with 3. Minimum 88mm Bradford Soundscreen™ R2.5 Insulation (or equivalent); to
Second Layer of Construction
4. Two (2) layers of 13mm Gyprock EC08 Complete ™ Plasterboard (or equivalent).

Note: 1) Wall system number CSR 3082 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.

Acoustic Dynamics recommends the above partition wall construction systems be installed to continue the full wall height, continuing from the concrete floor slab to the underside of the soffit slab above and is required to be well sealed (i.e. no gaps). Extreme care should be exercised during construction to ensure that acoustic performance of the constructed wall partition system is not compromised.

Given the complexity of coupling discontinuous walls to non-discontinuous walls and the relatively small length of these walls for this development, Acoustic Dynamics recommends **all Type 1 and Type 2 wall systems be constructed to be discontinuous**, thus marginally achieving improved acoustic performance at these locations.

The location of Type 1 and Type 2 walls that are required to comply with the BCA are presented and labelled in **Appendix A**.

8.2.2 LIFT SHAFTS AND PLANT ROOM WALLS (TYPE 3 WALLS)

Acoustic Dynamics advises that bounding tenancy walls separating residential units from lift shafts or plant rooms (Type 3 Walls) must comply with the minimum sound transmission performance requirements in *Section F7D4* and *Section F7D6* of the BCA, as detailed in **Section 5**.

The following Type 3 Wall construction systems are recommended.

Table 8.11 Recommended Masonry Construction for Type 3 Wall Systems ($R_w + C_{tr} \geq 50$)[1,2] (Discontinuous)

First Layer of Construction
1. Minimum 120mm Concrete Wall with minimum area density 270 kg/m^2; to
Framing & Insulation
2. Minimum 20mm Air Gap; to 3. Minimum 64mm Steel Studs at 600mm maximum centres; with 4. Minimum 90mm Bradford Gold Batts™ R2.0 Insulation (or equivalent); to
Second Layer of Construction
5. One (1) layer of 13mm Gyprock Standard™ Plasterboard (or equivalent).

Note: 1) Wall system number CSR 4065 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.
2) Acoustic Dynamics notes this wall system is discontinuous and satisfies the relevant impact sound transmission requirements of *Section F7D4* of the BCA.

Acoustic Dynamics recommends the above partition wall construction system be installed to continue the full wall height, continuing from the concrete floor slab to the underside of the soffit slab above and is required to be well sealed (i.e. no gaps). Extreme care should be exercised during construction to ensure that the acoustic performance of the constructed wall partition system is not compromised.

The location of Type 3 walls that are required to comply with the BCA are presented and labelled in **Appendix A**.

8.2.3 CORRIDORS, STAIRWAYS AND COMMON AREA WALLS (TYPE 4 WALLS)

Acoustic Dynamics advises that bounding tenancy walls separating residential units from corridors, stairways and common areas (Type 4 Walls) must comply with the minimum sound transmission performance requirements in *Section F7D6* of the BCA, as detailed in **Section 5**.

The following Type 4 Wall construction systems are recommended.

Table 8.12 Recommended Lightweight Construction for Type 4 Wall Systems ($R_w \geq 50$)[1]

First Layer of Construction
1. One (1) layer of 13mm Gyprock Fyrchek™ Plasterboard (or equivalent); to 2. One (1) layer of 6mm Cemintel CeminSeal™ Wallboard (or equivalent); to
Framing & Insulation
3. Minimum 64mm Steel Studs at 600mm maximum centres; with 4. Minimum 75mm Bradford Acoustigard 11™ Insulation (or equivalent); to
Second Layer of Construction
5. One (1) layer of 6mm Cemintel CeminSeal™ Wallboard (or equivalent); to 6. One (1) layer of 13mm Gyprock Fyrchek™ Plasterboard (or equivalent).

Note: 1) Wall system number CSR 1072 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.

Table 8.13 Recommended Precast Construction for Type 4 Wall Systems ($R_w \geq 50$)[1]

First Layer of Construction (Corridor)
1. One (1) layer of 13mm Gyprock Standard™ Plasterboard (dry areas);
Framing & Insulation
2. Minimum 75mm Hebel PowerPanel™; to 3. Minimum 15mm Air Gap; to 4. Minimum 64mm Steel Studs at 600mm maximum centres; with 5. Minimum 50mm Bradford Acoustigard 11™ Insulation (or equivalent); to
Second Layer of Construction (Apartment)
6. One (1) layer of 13mm Gyprock Standard™ Plasterboard (dry areas); or One (1) layer of 13mm Gyprock Aquachek™ Plasterboard (wet areas); to

Note: 1) Wall system number HEBEL 1168 and 1169 from *Hebel High Rise Apartments, Student Accommodation, Hotels and Commercial – Corridor, Intertenancy, Shaft & Service Walls Design & Installation Guide (2016)*. Refer to Hebel Design Guide for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.

Acoustic Dynamics recommends the above partition wall construction system be installed to continue the full wall height, continuing from the concrete floor slab to the underside of the soffit slab above and is required to be well sealed (i.e. no gaps). Extreme care should be exercised during construction to ensure that the acoustic performance of the constructed wall partition system is not compromised.

The location of Type 4 walls that are required to comply with the BCA are presented and labelled in **Appendix A**.

8.2.4 INTERNAL SERVICES WALLS (TYPE 5 & TYPE 6 WALLS)

Acoustic Dynamics advises that walls and ceilings separating a duct, soil waste or water supply pipes servicing one residential unit from a habitable room of another unit (Type 5 Walls) must comply with the minimum sound transmission performance requirements in *Section F7D7(1)(a)* of the BCA, as detailed in **Section 5**.

Walls and ceilings separating a duct, soil waste or water supply pipes servicing one residential unit from a non-habitable room of another unit (Type 6 Walls) must comply with the minimum sound transmission performance requirements in *Section F7D7(1)(b)* of the BCA, as detailed in **Section 5**.

Given the complexity of coupling service partition walls, ceilings and risers separating services from both habitable and non-habitable areas, Acoustic Dynamics recommends **all Type 5 and Type 6 wall systems be constructed to achieve a minimum $R_w + C_{tr} \geq 40$**, thus marginally achieving improved acoustic performance at these locations.

The following minimum construction systems are recommended for Type 5 and Type 6 wall systems to ensure compliance with the relevant acoustic performance requirements.

Table 8.14 Recommended Construction for Hydraulic Services Partition ($R_w + C_{tr} \geq 40$)

Pipework
1. Pipes lagged with 25mm Bradford Acoustilag™ (4.5 kg/m^2) Pipe Wrap (or equivalent); to
Framing & Insulation
2. Steel studs or angles (for walls and risers), or steel joists or furring channel (for ceilings); with 3. Minimum 75mm Bradford Acoustigard 14™ Insulation (or equivalent); to
Internal Lining
4. One (1) layer of 13mm Gyprock Soundchek™ Plasterboard (dry areas) (or equivalent); or One (1) layer of 13mm Gyprock Aquachek™ Plasterboard (wet areas) (or equivalent).

Note: 1) System adapted from system number CSR 7025 and CSR 7225 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.

Table 8.15 Recommended Construction for Internal Services Shaft Wall ($R_w + C_{tr} \geq 40$)

Framing & Insulation
1. 102mm Rondo Steel C-H Stud™ at 60mm maximum centres; with 2. One (1) layer of 25mm Gyprock Shaft Liner Panel™ (or equivalent); and 3. Minimum 75mm Bradford Acoustigard 11™; to
Internal Lining
4. Two (2) layers 13mm Gyprock Fyrchek™ Plasterboard (or equivalent).

Note: 1) System number CSR 7670 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB.

Acoustic Dynamics advises that the above constructions will sufficiently reduce noise transmission into the relevant areas of the development and are designed to achieve compliance with the various relevant acoustic criteria and design objectives.

The location of Type 5 and Type 6 walls that are required to comply with the BCA are presented and labelled in **Appendix A**.

8.2.5 FLOOR AND CEILING PARTITIONS

Acoustic Dynamics advises that all floors separating residential units from another sole-occupancy unit, lift shaft or plant room, stairway, or other public area must comply with the minimum airborne and impact sound transmission performance requirements in *Section F7D5* of the BCA, as detailed in **Section 5**.

Where hard floors are proposed above or directly adjacent to internal areas of residential units (**including** tile floors located above bathrooms, kitchens and wet areas), the following floor/ceiling partition construction is recommended.

Table 8.16 Recommended Minimum Construction for Hard Floors ($R_w + C_{tr} \geq 50$)($L_{n,w} \leq 62$)[1]

Flooring
1. Selected engineered timber, hardwood, porcelain, or ceramic tile flooring; to 2. One (1) layer of Regupol 99-101™ waterproof barrier (see manufacturer specifications); to 3. One (1) layer of Regupol 40-203™ adhesive (see manufacturer specifications); to 4. One (1) layer of Regupol Sonus Curve 8™ acoustic underlay (or equivalent); to 5. One (1) layer of Regupol 40-203™ adhesive (see manufacturer specifications); to
Concrete Slab
6. Minimum 200mm reinforced concrete slab; to
Framing & Insulation
7. Rondo™ Suspended Ceiling System (or equivalent) with minimum 150mm air cavity; with 8. Minimum 75mm Bradford Acoustigard 14™ Insulation (or equivalent); to
Internal Ceiling Lining
9. One (1) layer of 13mm Gyprock Standard™ Plasterboard (or equivalent).

Note: 1) Ceiling/floor system adapted from system number CSR 6940 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB and $L_{n,w} \pm 3$ dB.

2) A minimum 10mm isolation air gap is required between the above floor components and the walls, at all wall/floor junctions. The gap to the wall is to be treated with installation of a foam backing rod and flexible coloured polyurethane sealant.

Where carpet floors are proposed above or directly adjacent to internal areas of residential units, the following floor/ceiling partition construction is recommended.

Table 8.17 Recommended Minimum Construction for Carpet Floors ($R_w + C_{tr} \geq 50$)($L_{n,w} \leq 62$)[1]

Flooring
1. Selected carpet; to 2. One (1) layer of 10mm Dunlop Springtred™ carpet underlay (or equivalent);
Concrete Slab
3. Minimum 200mm reinforced concrete slab; to
Framing
4. Rondo Furring Channel Nº129™ (or equivalent) at 600mm maximum centres; with 5. Minimum 50mm Bradford Acoustigard 14™ Insulation (or equivalent); to
Internal Ceiling Lining
6. One (1) layer of 13mm Gyprock Standard™ Plasterboard (or equivalent).

Note: 1) Ceiling/floor system adapted from system number CSR 6910 from *CSR Redbook (2020)*. Refer to CSR Redbook for more information. Acoustic Dynamics notes a margin of error is generally within $R_w \pm 3$ dB and $L_{n,w} \pm 3$ dB.

8.2.6 RESIDENTIAL UNIT ENTRY DOORS

Acoustic Dynamics advises that all doors separating a residential unit from a stairway, corridor or public area must comply with the minimum sound transmission performance requirements in *Section F7D6(2)* of the BCA, as detailed in **Section 5**.

Accordingly, the following recommendations are provided for residential unit entry doors:

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

2. Acoustic **perimeter seals** are required to be installed around the head and jambs of all residential unit entry doors. Compression type, silicon rubber seals such as Raven RP47Si™ or Kilargo IS7025Si™ are effective perimeter seals and likely to achieve the required sound transmission performance;

3. Acoustic **door bottom seals** are required to seal the gap between the bottom of the door and the floor underneath. Automatic, mechanically spring-loaded seals such as Raven RP38Si™ or Kilargo IS8011Si™ are effective door bottom seals and likely to achieve the required sound transmission performance; and

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

8.3 MECHANICAL SERVICES

Acoustic Dynamics provides the following recommendations for mechanical services to ensure noise emission and transmission from the operation of mechanical equipment is minimised.

8.3.1 MECHANICAL EQUIPMENT

Acoustic Dynamics understands that specific items of mechanical plant have not yet been selected. To achieve compliance with the relevant noise emission criteria, Acoustic Dynamics advises that mechanical plant should be selected such that the overall sound power levels of items do not exceed the levels specified below:

Table 8.18 Recommended Maximum Sound Power Levels for Mechanical Plant

Source	Recommended Maximum Sound Power Level L_w [dB(A)]
Car park exhaust fan	85
Garbage room exhaust fan	60
Residential kitchen exhaust fan	70
Residential toilet exhaust fan	60
Small (single fan) residential condenser unit	65

Acoustic Dynamics also recommends that a full **mechanical noise emission assessment** be completed by an appropriately qualified acoustical consultant prior to obtaining construction certification.

8.3.2 AIR CONDENSER UNITS

The following recommendations apply to all proposed roof condenser units:

1. All condenser units shall be located on the roof and isolated from any walls and supporting structure with rubber pads to prevent the transmission of vibration from the condenser units to the structure;

8.3.3 FANS

The following recommendations apply to all fans to be installed:

1. All fans shall be supported and isolated from the building structure by incorporating impact isolation mounts (spring mounts, seismic mounts or rubber mounts);

2. Access doors to fans located within plant rooms shall be sealed with neoprene gaskets to provide an airtight seal between the door and frame;

3. All connections between fans, ductwork, pipes and pipe connectors shall be properly aligned using a suitable flexible material, and all penetrations shall be acoustically sealed;

4. Where feasible, Acoustic Dynamics recommends all domestic exhaust fans be ducted to the rooftop to minimise noise emission to surrounding receivers; and

5. Acoustic Dynamics recommends the ductwork connecting all domestic exhaust fans to the exhaust grilles must be lined internally with rockwool of minimum thickness 25 mm, or equivalent.

8.3.4 PUMPS

The following recommendations apply to all pumps to be installed:

1. All pumps and motor assemblies shall be selected with the highest efficiency and fitted with efficient muffler or silencer design. Where feasible, consider using quieter engines, such as electric instead of internal combustion;

2. Where feasible, all pumps and motor assemblies shall be mounted on a concrete filled inertia block and completely isolated from the supporting building structure;

3. Where necessary, consider using efficient pump enclosures to minimise noise emission.

8.3.5 VIBRATION ISOLATION

Acoustic Dynamics advises that the various items of mechanical plant and equipment throughout the development shall be isolated from the building structure by incorporating impact isolation mounts such as spring mounts, seismic mounts or rubber mounts.

Suppliers of appropriate impact isolation systems are:

- Embelton and Co Pty Ltd; and
- Mason Mercer Pty Ltd.

8.4 HYDRAULICS AND FIRE SERVICES

The following recommendations are made to achieve compliance with the relevant acoustic provisions of the BCA for noise intrusion from hydraulic and other internal services:

1. The building contractor shall ensure that all duct, soil waste or water supply pipes, including ducts or pipes that are located in walls, wall cavities or ceiling cavities are separated from the various areas of the proposed development by construction achieving the minimum sound reduction performance ratings presented in **Section 5**;

2. All inter-tenancy walls constructed around bathrooms, laundry, kitchens and any other room or riser containing soil and waste pipes serving a different tenancy, in the ceiling space or riser (as the case may be) shall be constructed full height to the soffit slab or substrate above;

3. The walls shall be sealed at the soffit on both sides with approved acoustic mastic sealant. Sealants should be flexible, durable and maintain acoustic performance for the life of the design;

4. Penetrations in the wall shall be acoustically treated to ensure that the sound reduction rating of the wall is not diminished;

5. Acoustic Dynamics recommends Raupiano™ pipework be considered for use. Review of available information indicates this pipework has superior acoustic performance to normal PVC pipework, however, to ensure excellent acoustic performance is achieved, the recommendations for lagging and partition construction should be maintained;

6. Water velocities in hot and cold water pipes shall not exceed 1.5 m/s and water pressure shall not exceed 550 kPa;

7. Where services pipes are to be acoustically lagged, we advise that the following minimum acoustic treatments are to be installed:

Table 8.19 Minimum Acoustic Treatments for Soil and Waste Pipework

Service	Location	Lagging Treatment
Waste & Stormwater Pipes	Bathroom, ensuites, toilets, laundry ceiling cavity & risers	Pipe wrap using a 4 kg/m^2 loaded vinyl sheet bonded with 25 mm foam equivalent to Pyrotek 4525C™ or Acoustop Flexilagg AFL/4-24™
	Residential unit ceiling cavity & risers (all areas other than bathrooms, ensuites, toilets, laundries)	
	Common areas, lobbies and foyers ceiling cavity & risers	

8. All hot and cold water pipes, gas pipes, soil and waste pipes located in risers and ceiling cavities shall be isolated from the adjoining construction with Flexistrut S Series™ or Erico Barracol Macrofix™ Acoustic Pipe Clips (or equivalent), and wrapped with 10 mm Thermotec™ Lagging; and

9. All soil, water or hydraulic pipe work shall be separated from all ceilings, bulkheads, walls or risers by minimum 15 mm; and

10. Where there is an acoustic rated ceiling or wall, the access panel through that partition shall achieve an equivalent acoustic rating, and shall be installed with compressible gasket seals that form an airtight seal when closed.

8.5 LIFT SYSTEMS

The following minimum recommendations are provided to ensure adequate control of noise and vibration associated with the use of residential lifts:

1. The lift shaft, lift frame and rails/guides must be acoustically isolated from the adjacent building structure. Acoustic Dynamics advises installation of resilient ties between the lift shaft and the adjacent building structure to prevent the transmission of structure-borne noise and vibration. Suitable resilient ties would be Matrix SB06™ resilient wall ties (or equivalent);

2. The rails/guides for the subject lifts are required to be isolated from the structure of the building via commercially available vibration isolation mounts;

3. All perimeter joints of the lift shaft must be sealed airtight using a suitable flexible sealant. Sealants must be flexible, durable and have capacity to retain acoustic properties for the life of the design. Appropriate sealants are polyurethane or silicone based;

4. Any access panels or hatches must be installed with a compressible rubber perimeter seal or gasket to ensure an airtight seal when closed;

5. Acoustic Dynamics recommends the lift motor and associated equipment should be located on an isolated platform. The platform should be isolated from the building structure using suitable vibration mounts. Alternatively, a resilient layer such as Embelton Supershearflex™ can be installed between the motor and the basement garage structural slab or mounting bracket;

6. Passive ventilation to the motor enclosure can be supplied via an acoustic vent installed through the wall of the enclosure. An appropriate acoustic vent is the Silenceair™ 64 mm Passive Acoustic Wall Ventilator (or equivalent); and

7. Reduce mechanical plant vibration through regular inspection and, where necessary, maintenance and repair of the motor and hydraulic systems. Inspection and maintenance should include the motor, lift shaft, bearings, belts, pulleys and tightening of any loose parts or connections.

8.6 GROUND LEVEL CAR PARK

The following recommendations are provided to minimise structural vibration transmission and floor slab excitation to the various areas of the development and surrounding area:

1. Vehicular crossing points and access driveways should be smooth and free of deformities to avoid impact noises. A broom floor finish is recommended to minimise squealing or traction noise from vehicle tyres;

2. Expansion joints at vehicle circulation paths shall be minimised, where feasible;

3. Speed bumps and wheel stops should be avoided, where feasible. Where speed bumps and wheel stops are required, resilient rubber wheel stops shall be installed; and

4. All car park roller door components such as the motor, roller tracks and guides or other mountings should be decoupled from the building structure through the use of resilient pads, mounts and fittings.

8.7 BUILDING NOISE MANAGEMENT PLAN

Acoustic Dynamics recommends the consideration of a building noise management plan incorporating best management practices and procedures to protect the acoustic amenity of building occupants and the surrounding area.

Such a management plan should outline policies and procedures to ensure noise emission from the development is kept to a minimum, including:

1. Noise and vibration induction of all site staff, including the explanation of noise and vibration control and a discussion of project specific reduction strategies;

2. All guests should be made aware of the potential for causing disturbance to neighbours and that they are to conduct themselves in a manner that does not adversely impact the amenity of neighbouring residents;

3. Ensure guests arrive and leave in a quiet and sensible manner to minimise any potential impacts on the surrounding amenity, including signage reminding guests to be aware of their neighbours and to conduct themselves in a quiet manner;

4. All common areas will require careful management to ensure guests are not engaging in behaviour that could cause offence to neighbouring residents. Types of potentially offensive behaviour may include:

    - Excessively loud talking;
    - Excessive loud laughter;
    - Inadequate control or supervision of children;
    - Mobile phone conversations in external areas of the property;
    - Playing of music (stereo/hi-fi, phone speaker, boom box, guitars or similar); or
    - Any other similar types of behaviour;

    Signs must be displayed notifying occupants to be respectful of the neighbouring residents and to adhere to the guidelines above;

5. Outdoor common areas should be restricted to daytime and evening hours only (i.e. no use prior to 7:00am or after 10:00pm);

6. A night-time noise curfew should be implemented for the internal areas of the development (i.e. no loud noise generating activities to occur in internal areas after 10:00pm or prior to 7:00am. This would include excessive television volume, music or conversations);

7. The idling of cars or lengthy conversations/phone calls within the driveway area, particularly during the early morning and late-night period is to be strictly discouraged;

8. Impact noise due to entry doors and gates closing should be suitably addressed. Gates should have an anti-gate slammer to prevent forced closing of the gate. All entry doors should be securely fastened to ensure vibration or rattling noise is reduced with rubber seals installed to reduce surface impact noise; and

9. Implementation of an appropriate community liaison procedure, including a noise and vibration complaint procedure and means of ongoing communication with nearby potentially affected receivers once development operations begin.

8.8 BUILDING MATERIAL CERTIFICATION

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

9 CONCLUSION

Acoustic Dynamics has conducted an acoustic assessment of external noise intrusion, internal acoustic privacy and operational noise emission for the proposed mixed-use development located at 1-5 Rickard Rd, North Narrabeen, NSW.

A review of the applicable local planning and development control instruments, government policies and legislation, and various standards and guidelines was conducted in accordance with the requirements of:

(a) Northern Beaches Council;
(b) The NSW Department of Planning and Environment;
(c) The NSW Environment Protection Authority;
(d) The Australian Building Codes Board; and
(e) Australian Standards.

Recommendations and construction advice for external facades and glazing have been provided in **Section 8**. Should alternative construction systems and materials be selected, they must meet the required objective design noise reduction shown in **Table 4.3** for the respective areas within the development.

Architectural design advice has also been provided in **Section 8** for material selection to be used in construction for internal partitions and services. Should alternative construction systems be selected, they must meet the minimum BCA sound transmission performance requirements shown in **Table 5.1.**

Further to our calculations and noise modelling in **Section 6**, Acoustic Dynamics advises that noise emission associated with the proposed development is predicted to comply with the relevant requirements of Northern Beaches Council and the NSW EPA and that the acoustic amenity of all nearby receivers will be adequately protected, following the implementation of the recommendations provided within **Section 8**.

Acoustic Opinion

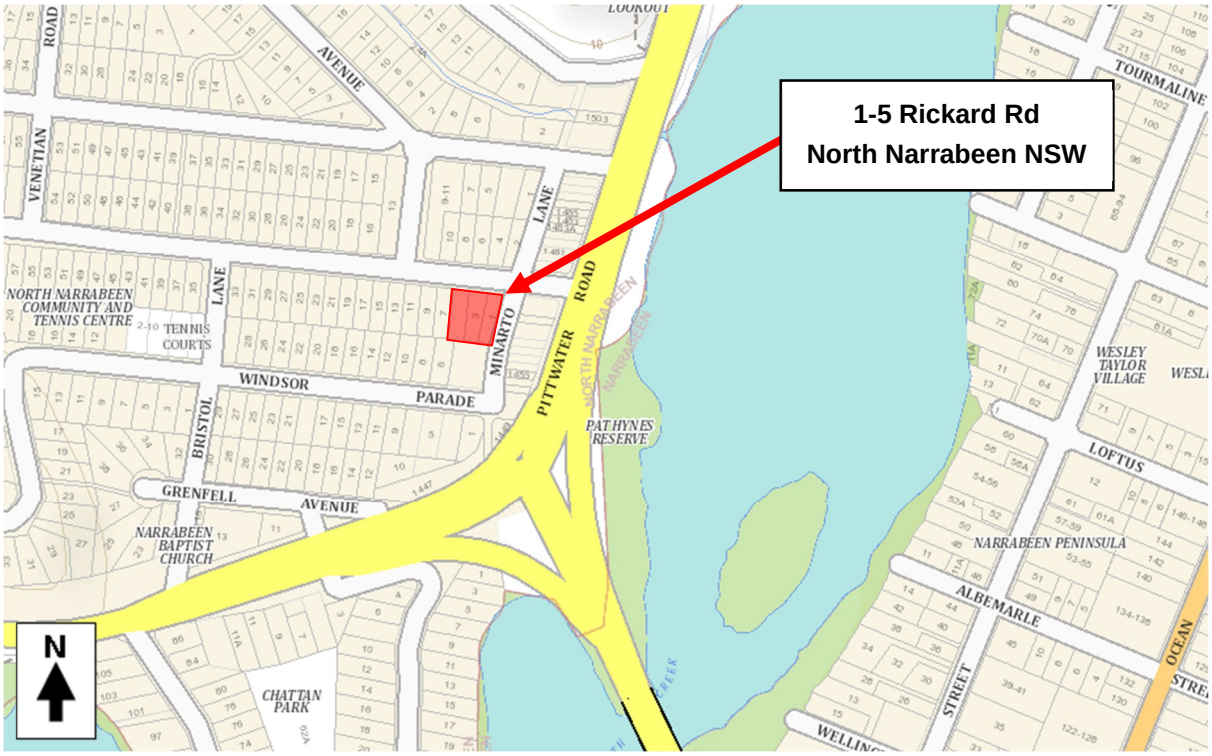
Further to our site survey, noise monitoring and measurements, our review of the relevant acoustic criteria and requirements, and our calculations, Acoustic Dynamics advises that the proposal can be designed to comply with the relevant acoustic criteria of Northern Beaches Council, the NSW DPIE, the NSW EPA, the ABCB and Australian Standards with the incorporation of our recommendations detailed within this report.

It is our opinion that the acoustic risks associated with the proposal can be adequately controlled and the amenity of all residents and neighbouring properties can be satisfactorily protected.

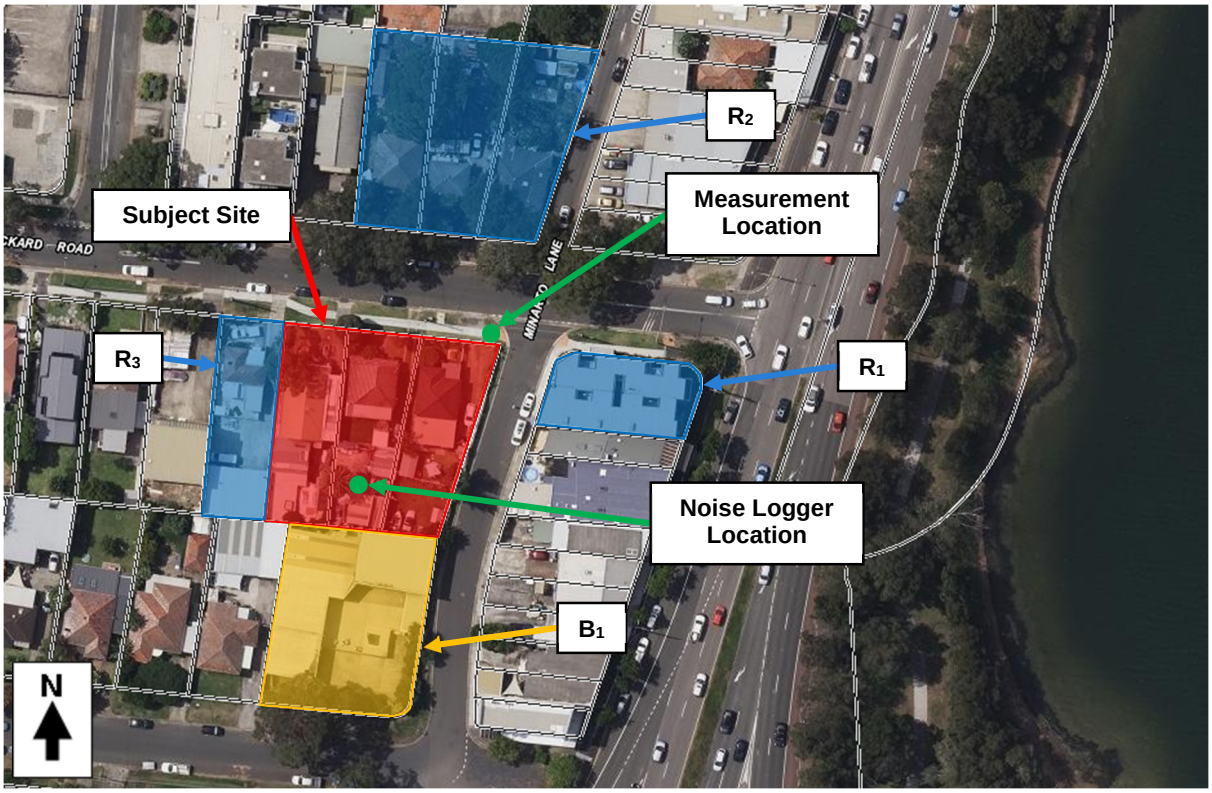
We trust that the above information meets with your present requirements and expectations. Please do not hesitate to contact us on 02 9908 1270 should you require more information.

APPENDIX A – LOCATION MAP, AERIAL IMAGE, PLANS & DRAWINGS

A.1 LOCATION MAP



A.2 AERIAL IMAGE (COURTESY OF SIX MAPS)



A.3 ARCHITECTURAL PLANS

A.3.1 SITE PLAN

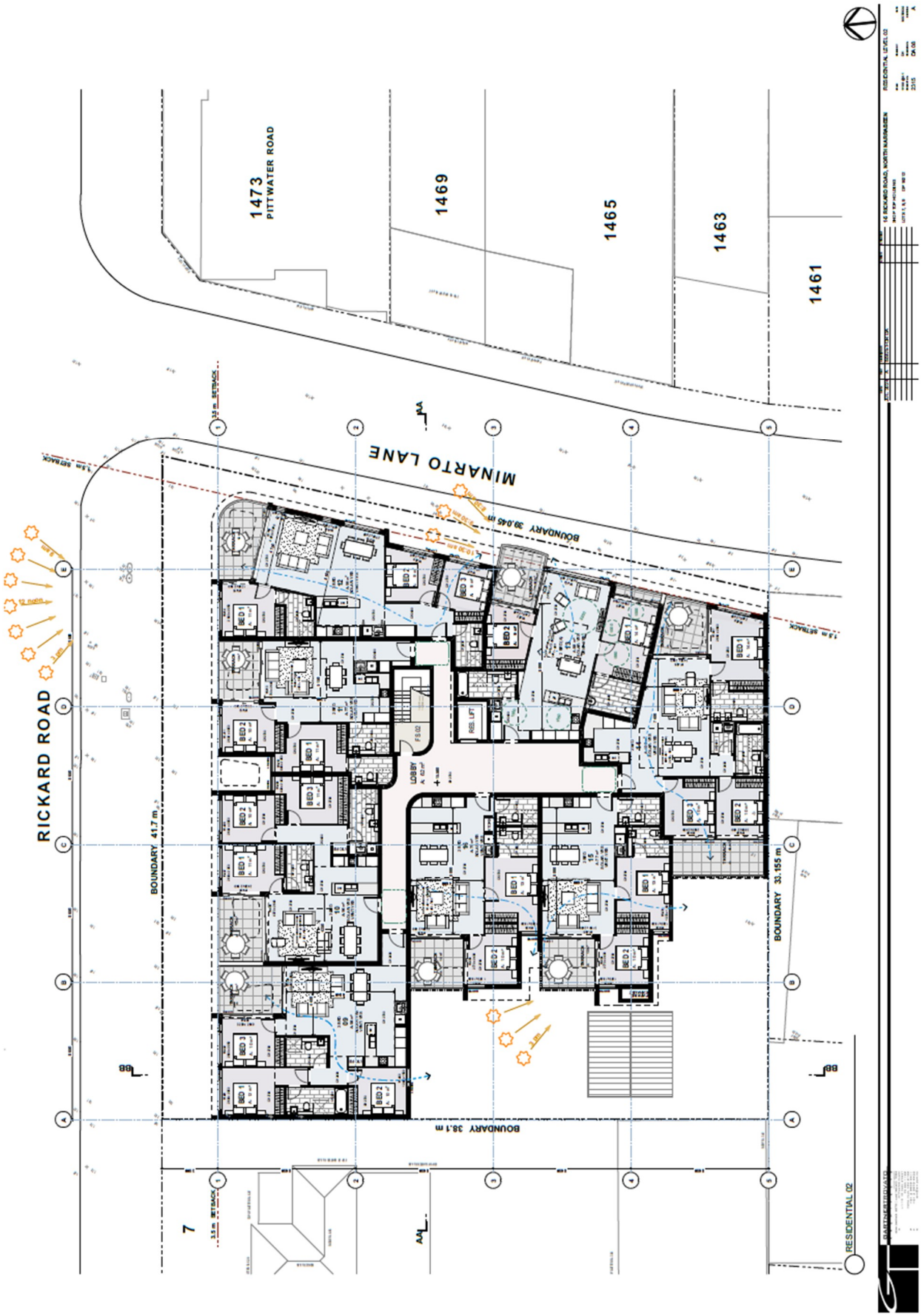
A.3.2 SUB-GROUND FLOOR PLAN

A.3.3 GROUND PARKING FLOOR PLAN

A.3.4 COMMERCIAL/ RETAIL LEVEL 1 FLOOR PLAN

A.3.5 RESIDENTIAL LEVEL 2 FLOOR PLAN

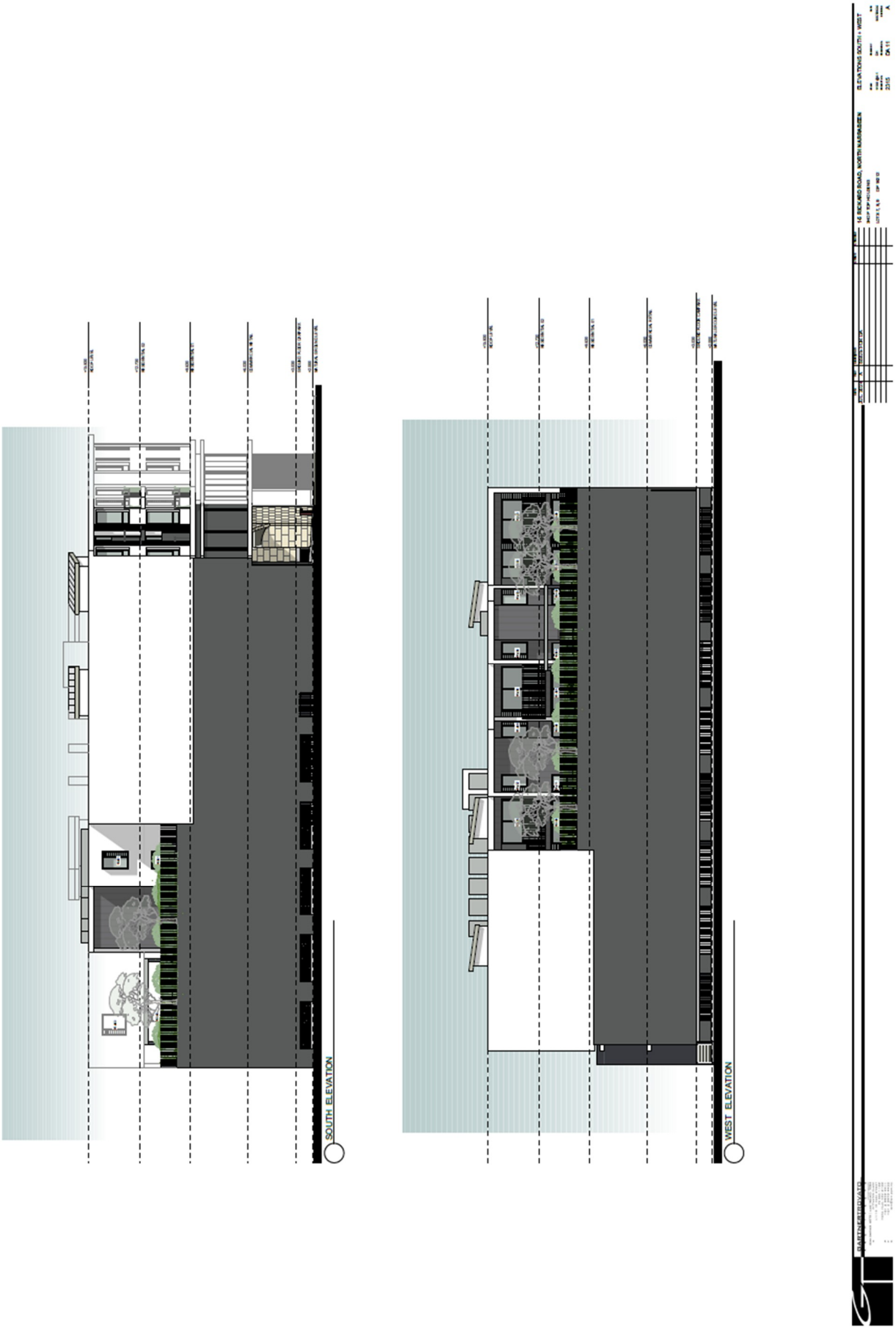
A.3.6 RESIDENTIAL LEVEL 3 FLOOR PLAN



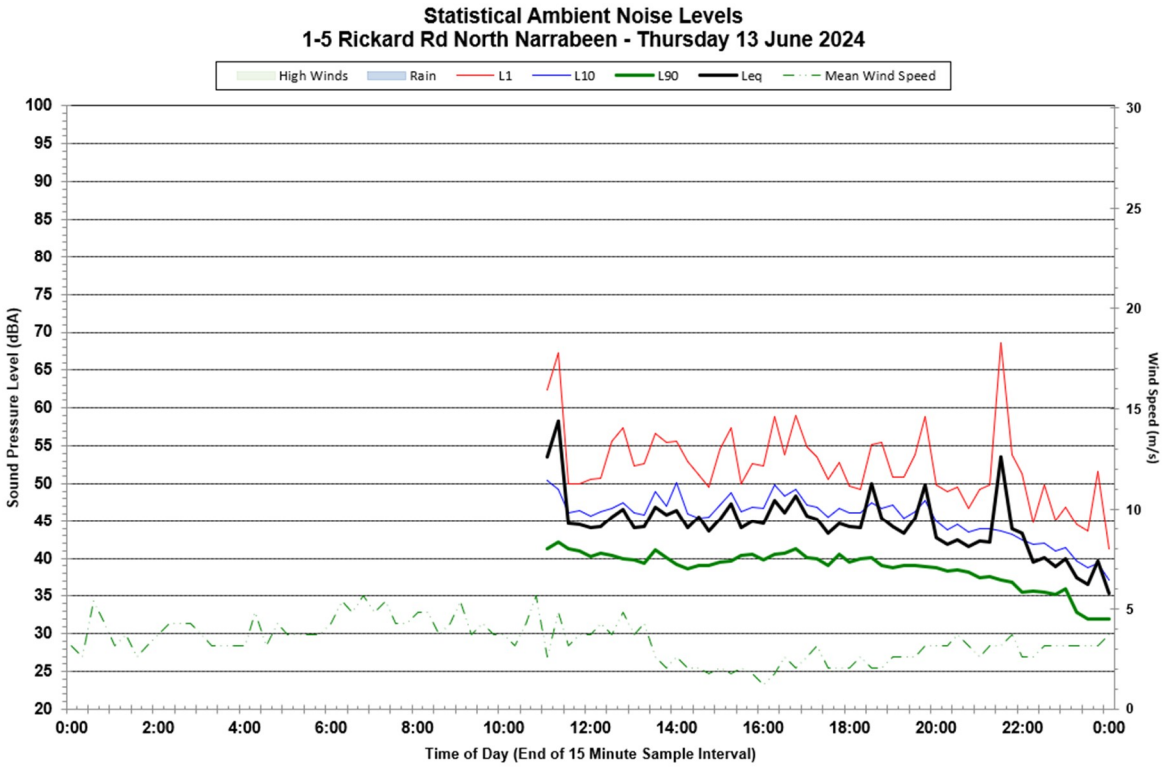
A.3.7 ROOF PLAN

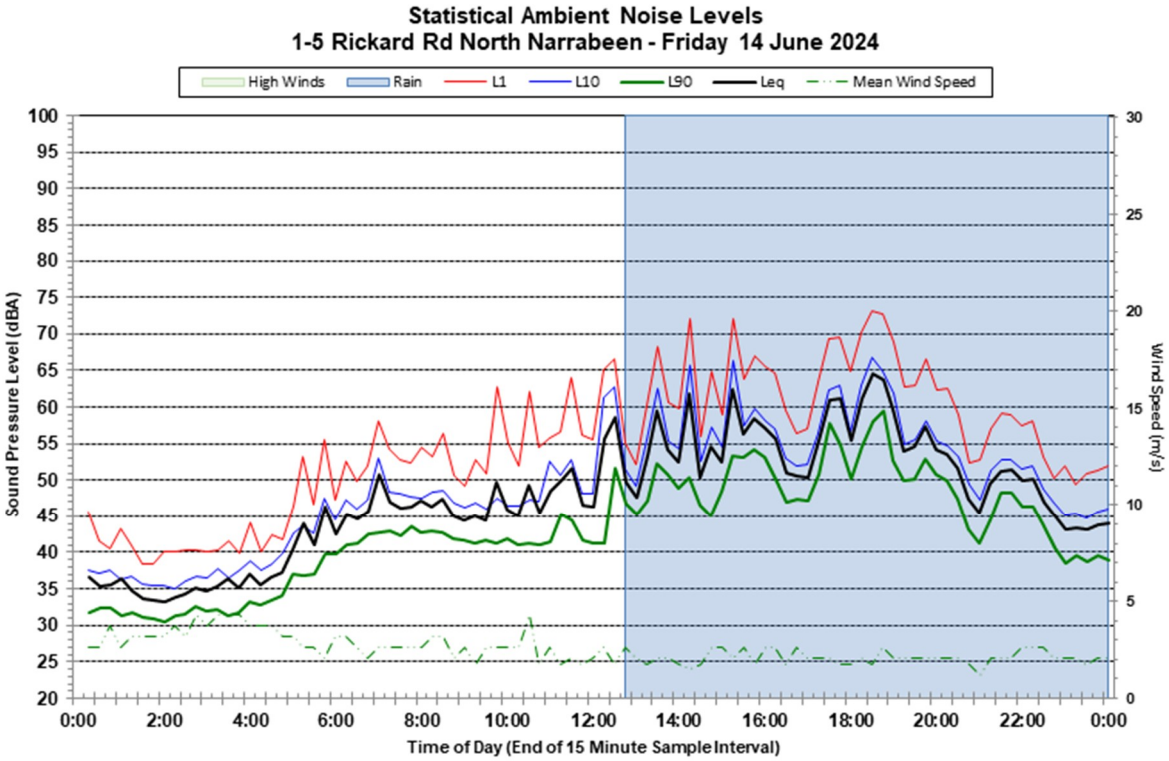
A.3.8 ELEVATIONS

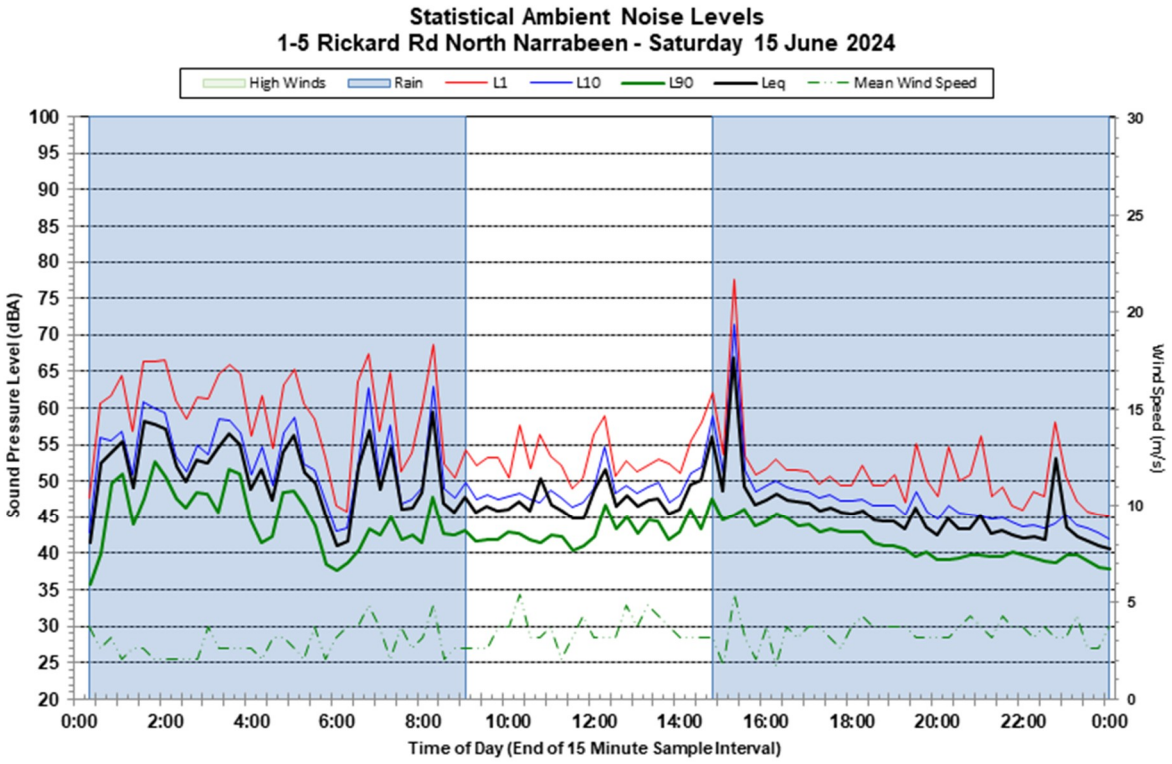
A.3.9 ELEVATIONS (CONT.)

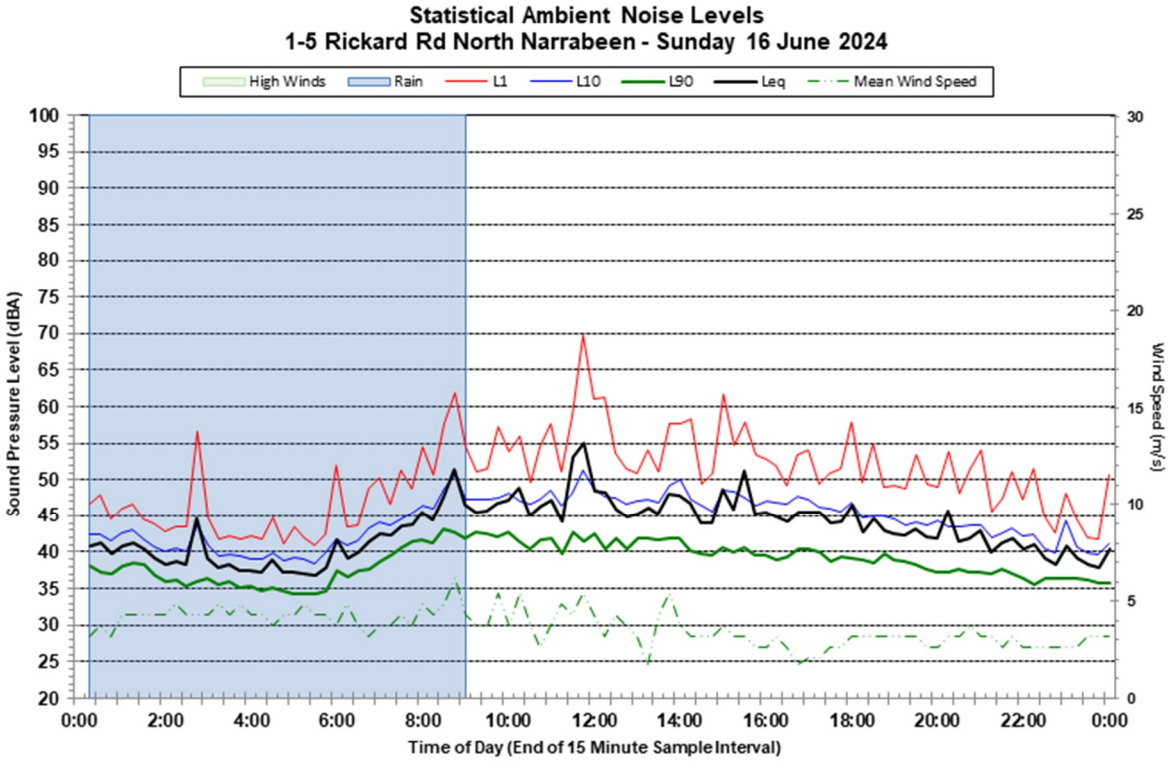


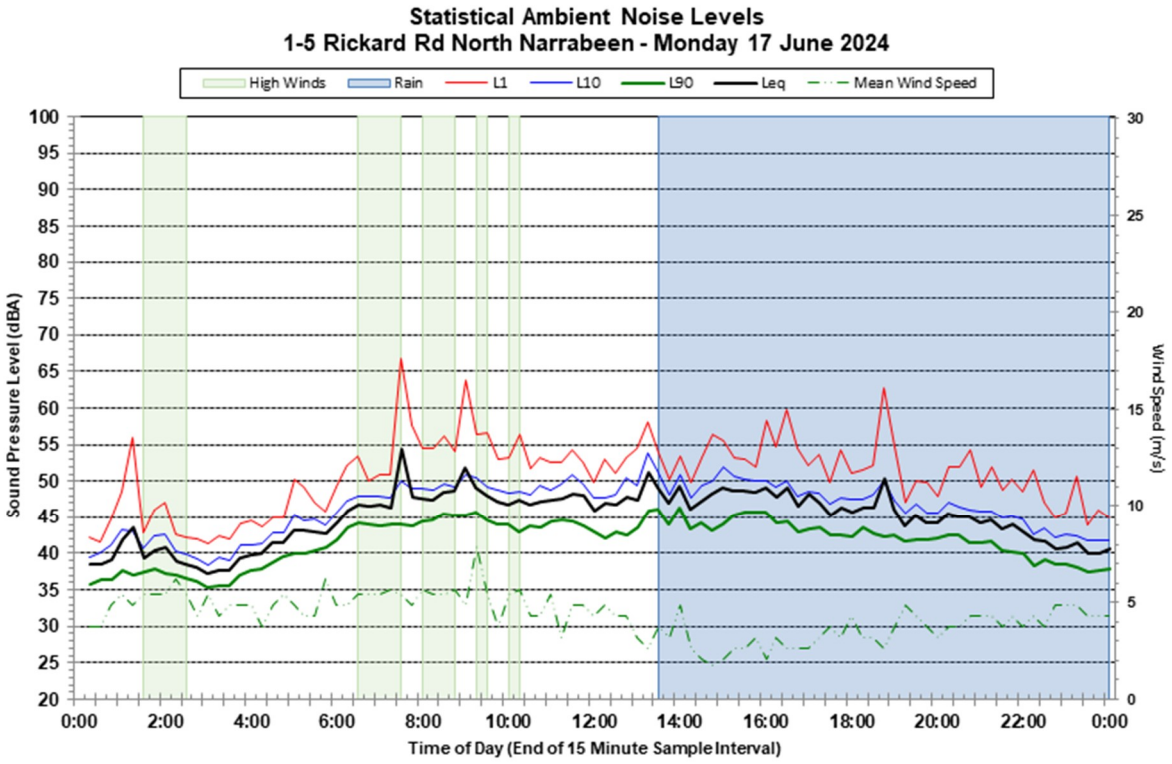
APPENDIX B – UNNATTENDED NOISE LOGGING STATISTICAL GRAPHS

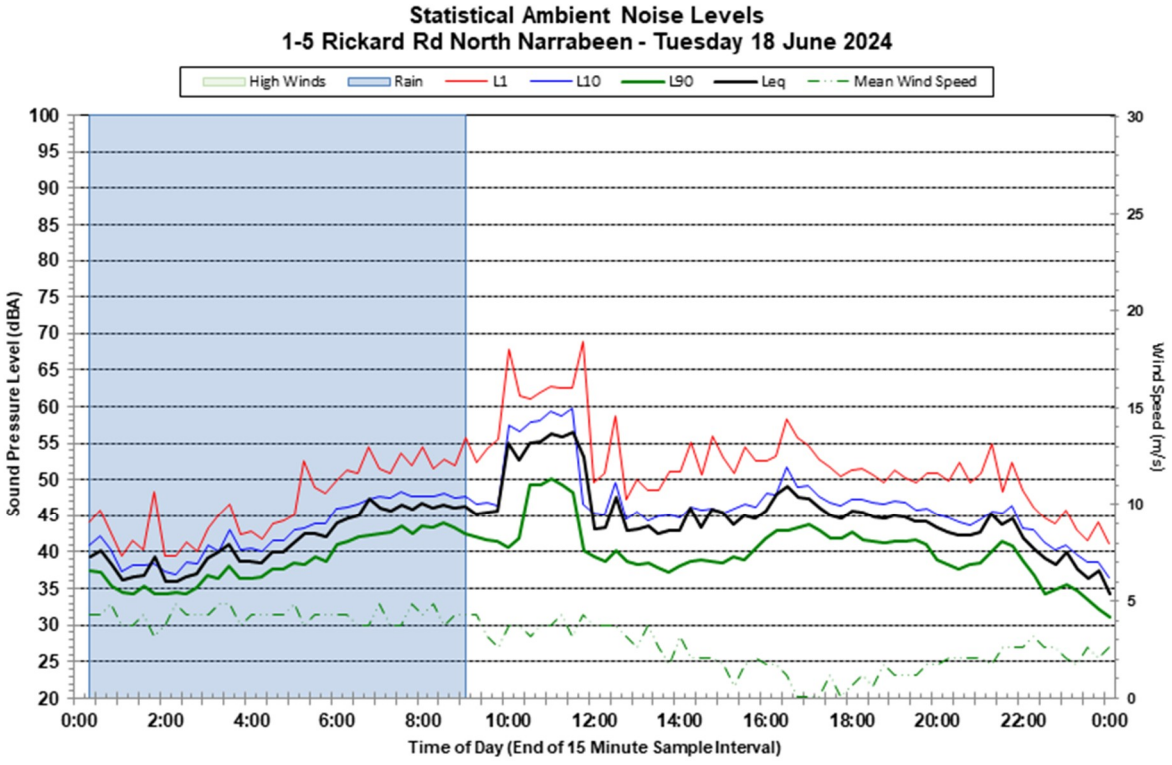


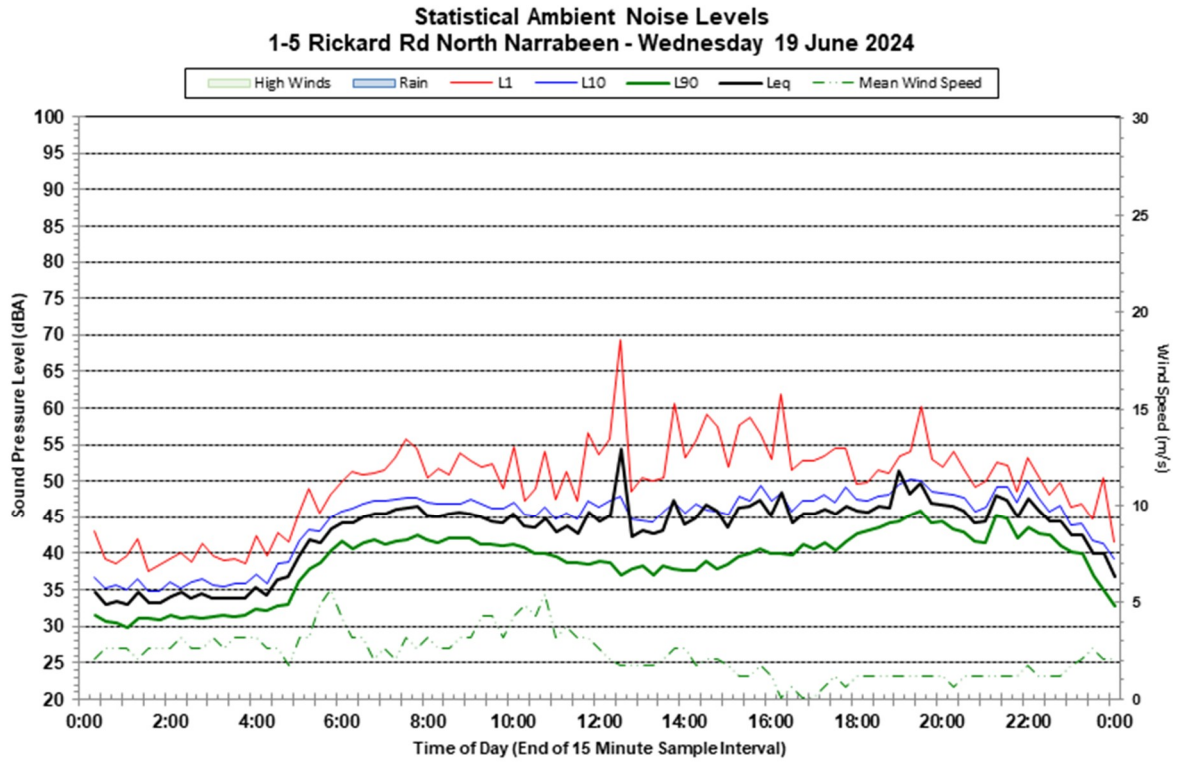


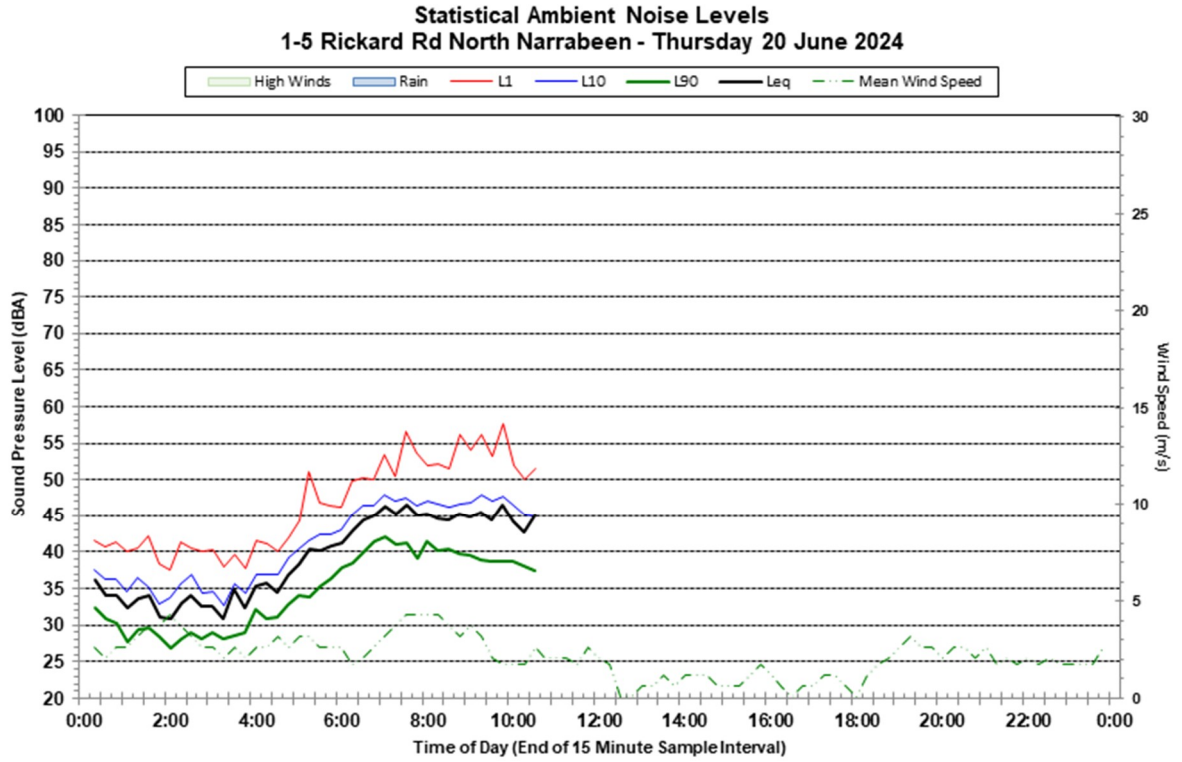

Statistical Ambient Noise Levels
1-5 Rickard Rd North Narrabeen - Saturday 15 June 2024
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
1-5 Rickard Rd North Narrabeen - Sunday 16 June 2024
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
1-5 Rickard Rd North Narrabeen - Monday 17 June 2024
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
1-5 Rickard Rd North Narrabeen - Tuesday 18 June 2024
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
1-5 Rickard Rd North Narrabeen - Wednesday 19 June 2024
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
1-5 Rickard Rd North Narrabeen - Thursday 20 June 2024
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)