acousticdynamics

Acoustic Design and Construction Advice

Proposed Residential Development
1-5 Nelson Road, Lindfield, NSW

Client:
Castle Hill No. 3 Pty Ltd

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 is engaged by **Castle Hill No. 3 Pty Ltd** to conduct an assessment of the acoustic design and construction of the proposed residential development located at 1-5 Nelson Road, Lindfield, for the purposes of submission as part of a State Significant Development Application (SSDA).

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) Ku-ring-gai 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 project site is located at 1-5 Nelson Road, Lindfield, situated within a Low Density Residential (R2) land zone within the Ku-ring-gai Council area of NSW. The site is bounded by Nelson Road to the west, and residential developments to the north, east and south. Access to the development shall be via Nelson Road.

The project proposal is to include the following:

- Demolition of existing improvements, tree removal and site clearing;
- Construction of a new residential flat building comprising of 167 residential apartments (inclusive of affordable housing apartment) and basement car parking; and
- External landscaping works.

The project site, adjacent receivers and surrounding area are shown in the Location Map and Aerial Image 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 on-site to determine existing environmental noise levels and to establish project specific noise criteria;
- Prediction of 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 LOCAL PLANNING AND DEVELOPMENT CONTROL INSTRUMENTS

Acoustic Dynamics has reviewed the relevant local planning and development control instruments, including the following documents:

- *Ku-ring-gai Local Environmental Plan 2015* (LEP); and
- *Ku-ring-gai Development Control Plan 2022* (DCP).

Acoustic Dynamics' review of the Ku-ring-gai DCP indicated the following information relevant to acoustic privacy for multi-residential apartment buildings:

*"**PART 6 MULTI-DWELLING HOUSING***

6C.12 VISUAL AND ACOUSTIC PRIVACY

Objectives

1 To ensure high standards of visual and acoustic privacy to habitable rooms and private open space both within the development and to neighbouring developments.

2 To ensure building elements are well designed and integrated into the overall building form.

*"**Controls***

1 Buildings are to be designed to ensure privacy to other onsite dwellings and to neighbouring properties. In addition to design options outlined in Part 23.8 and Part 23.9, design measures may also include:

i) off-setting balconies in relation to adjacent balconies;
ii) using recessed balconies and/or vertical fins between adjacent private balconies;
iii) using louvres/screen panels to windows and balconies;
iv) incorporating planter boxes into walls or balustrades to increase the visual separation between areas;
v) utilising pergolas or shading devices to limit overlooking of lower building levels or common and private open space.

2 Continuous transparent or translucent balustrades to private open spaces are not permitted to balconies/terraces/courtyards.

3 Screening between dwellings is to be integrated into the overall building design.

4 Landscaped screening is to be provided to neighbouring properties.

5 Any screens for achieving visual privacy to habitable rooms cannot be fixed in place and impede their function of the opening to provide daylight, ventilation or outlook from the internal space.

6 For requirements on noise levels associated with air conditioning, kitchen, bathroom, laundry ventilation, or other mechanical ventilation systems and other plant refer to Part 23.8 of this DCP."

*"**PART 23 GENERAL BUILDING DESIGN AND SUSTAINABILITY***

23.8 GENERAL ACOUSTIC PRIVACY

Objectives

1 To ensure high standards of acoustic privacy for all occupants of the development.

2 To minimise the impact of the development on the acoustic privacy of neighbouring developments.

3 To ensure housing adjoining main roads is designed and constructed to minimise the impact of external noise and facilitate comfortable living conditions for residents.

4 To ensure measures to address acoustic privacy have regard to the existing or desired future character of the street.

*"**Controls***

1 Development is to be designed to minimise the impact of external noise sources (eg busy roads, railways, swimming pools, heavy vehicle entries) on the internal and external spaces used by occupants.

2 *Balconies and other external building elements are to be designed and located to minimise infiltration and reflection of noise onto the facade.*

3 *Buildings must be designed to minimise noise transmission by, but not limited to:*

i) careful siting and orientation of the building;
ii) locating bedrooms away from both internal and external noise generators of a development, eg by using storage or circulation areas as a buffer or grouping room uses according to the noise level generated.

***Note**: Internal noise generators include, but are not limited to - kitchens, laundries and living areas*

External noise generators include, but are not limited to - traffic, railway line, vehicle entries and mechanical equipment; pool pumps, air conditioning units, garbage collection areas, tennis courts.

iii) fitting out building services with appropriate acoustic insulation;
iv) incorporating appropriate noise shielding or attenuation techniques into the design and construction of the development.

4 *Measures such as mounding or high solid fencing will only be permitted where they are compatible with the streetscape.*

5 *When designing and siting active open space areas (eg BBQ areas, swimming pools, communal areas etc) regard must be paid to potential noise impacts on adjacent rooms and buildings, such as bedrooms.*

6 *Noise levels associated with air conditioning, kitchen, bathroom, laundry ventilation, or other mechanical ventilation systems and plant either as an individual piece of equipment or in combination shall not be audible within any habitable room in any residential premises before 7am and after 10pm. Outside of these restricted hours noise levels associated with air conditioning, kitchen, bathroom, laundry ventilation, or other mechanical ventilation systems and plant either as an individual piece of equipment or in combination shall not emit a noise level greater than 5dB(A) above the background noise (LA90, 15 min) when measured at the boundary of the nearest potentially affected neighbouring properties. The background (LA90, 15 min) level is to be determined without the source noise present.*

***Note**: Council requires an acoustic assessment be undertaken for multidwelling housing, residential flat buildings, mixed-use development, non-residential buildings, and child care centres. Council may require an acoustic assessment be undertaken for dwelling houses and secondary dwellings. Assessment must be undertaken by a suitably qualified acoustic consultant to assess compliance with the above criteria. Recommended noise attenuation measures must be included in this report where applicable."*

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 (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 rail noise and vibration on residential developments:

*"**2.100 Impact of rail noise or vibration on non-rail development***

(1) This section applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration—

(a) residential accommodation
(b) a place of public worship,
(c) a hospital,
(d) an educational establishment or centre-based child care 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 10.00 pm and 7.00 am,
(b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time."

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."*

Acoustic Dynamics advises the site is located more than 250 metres from the Northern Suburbs railway line and more than 320 metres from the Pacific Highway.

In any case, Acoustic Dynamics has assessed the impacts of external noise intrusion from surrounding local roads on the acoustic amenity of building occupants.

2.2.2 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."*

2.2.3 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)
Local roads	6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq,\ (1\ hour)}$ 55 (external)	$L_{Aeq,\ (1\ hour)}$ 50 (external)

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)]***
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*

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
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
XL2	A2A-06858-E0	NTI Audio XL2 Noise Logger
XL2	A2A-20579-E0	NTI Audio XL2 Noise Logger
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 the western boundary of 3 Nelson Road from Friday 23 May 2025 until Friday 30 May 2025. The measurement location is marked in **Appendix A**.

Based on the results of the unattended noise monitoring data, Acoustic Dynamics advises the following maximum $\mathbf{L_{Aeq\ (1\ hour)}}$ and $\mathbf{L_{Aeq\ (15hr/9hr)}}$ noise levels have been determined for the facades of the proposed development direct to Nelson Road, and most affected by noise from commercial industry to the west, as per the criteria and guidelines outlined in **Section 2**.

Table 4.1 Established Maximum Noise Levels at Development Facade

Location	Period	Measured Noise Levels [dB]	
		Maximum $L_{Aeq\ (1\ hour)}$	Maximum $L_{Aeq\ (15hr/9hr)}$
Western Boundary 3 Nelson Road	Day (7am[1] to 10pm)	58	56
	Night (10pm to 7am[1])	50	49

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.

Acoustic Dynamics advises that, as the specific internal layout of apartments is yet to be determined, the following calculations are based on typical floor areas and ceiling heights for residential units of this size.

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]	
				TNA_c	R_w
Front Facade (West)					
Sleeping	35	50	15	21	27
Living	40	58	18	22	28
Side Facades (North and South)					
Sleeping	35	47	12	18	24
Living	40	55	15	19	25
Rear Facade (East)					
Sleeping	35	44	9	15	21
Living	40	52	12	16	22

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
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

Partition Type	Areas Separated	Airborne Sound Transmission Requirements	Impact Sound Transmission Requirements
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 in the front and rear yard of 3 Nelson Road between Friday 23 May 2025 and Friday 30 May 2025.

Acoustic Dynamics advises the measurement locations, shown in **Appendix A**, are 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 at each location is presented below. For conservatism, Acoustic Dynamics has adopted the lowest Project Noise Trigger Level for each period.

Table 6.1 Likely 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][4]
3 Nelson Rd (Front Yard)	Day (7am[1] to 6pm)	40	57	45	53	**45**
	Evening (6pm to 10pm)	37	54	42	43	**42**
	Night (10pm to 7am[1])	31	49	36	38	**36**
3 Nelson Rd (Rear Yard)	Day (7am[1] to 6pm)	39	51	44	53	**44**
	Evening (6pm to 10pm)	38	46	43	43	**43**
	Night (10pm to 7am[1])	36	44	41	38	**38**

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.

The following criteria applies to noise emission from a residential air conditioning unit to comply with the noise emission requirements of the POEO (Noise Control) Regulation 2017.

Table 6.2 Measured External Noise Levels and Project Noise Objectives for Nearest Receivers

External Location	Assessment Period	Background Noise Level L_{A90} [dB]	Criteria (Calculation)	Project Noise Trigger Level $L_{Aeq,15min}$ [dB]
Residential Facade	Night (10pm to 7am[1])	31	POEO (RBL – 10 dB)	**21**

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

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 6.3 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	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (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:
$L_{Aeq,15min}$ **≤ 40 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.

As no details of mechanical plant have been determined at this early stage of the project, likely sources of mechanical noise from the proposed development have been assumed as follows:

1. A car park supply and exhaust fan will be located within the basement, with the air intake and discharge vents located on the development rooftop;

2. The car park exhaust fan will be programmed to operate on carbon monoxide (CO) monitors and at variable speed, only when CO levels exceed a set point and is unlikely to operate at night-time;

3. All other supply and exhaust fans for plant rooms will be located within the basement, with the air intake and discharge vents located on the development rooftop;

4. Stair pressurisation mechanical plant will be located on the roof and appropriately positioned to maximise the distance between the plant and the adjacent residential boundaries and balconies;

5. Domestic exhaust fans will be positioned within the ceiling cavity above the wet areas they area servicing and ducted to the facades of the unit;

6. Residential units will be serviced by individual condenser units located on resident balconies, which will operate at maximum capacity between 7:00am and 10:00pm on weekdays, and at a reduced capacity between 10:00pm and 8:00am on weekends and public holidays;

7. Air condenser units will be appropriately positioned behind structures that may provide shielding and are oriented away from the edges of balconies and neighbouring windows of residential receivers;

8. Acoustic Dynamics has conservatively assumed that only one in three condenser units on each facade will operate during the night-time period, which is considered to be a highly conservative assumption;

9. The attenuation performance of fan silencers is to be determined during the detailed design stage when the exhaust fans have been selected;

10. Noise from mechanical plant located in the basement will be contained within the building structure and can be appropriately controlled easily during the development and review of construction documentation;

11. An estimated maximum of 42 resident vehicles will enter or leave the residential car park within any 60-minute period between 7:00am and 10:00pm (0.25 cars per unit), and a maximum of 21 resident vehicles between 10:00pm and 7:00am (0.125 cars per unit); and

12. An estimated one Council garbage vehicle will enter the development into the loading dock and waste area collection zone no earlier than 7:00am on weekdays.

Acoustic Dynamics advises that noise from mechanical plant will be appropriately controlled during the development and review of mechanical design and construction documentation.

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 6.4 Associated Noise Sources and Operations

Source	Quantity	Source Sound Power Level L_w [dB(A)]
Mechanical Equipment		
Car park exhaust fan discharge on rooftop	1	60
Car park supply fan intake on rooftop	1	60
Plant room fan discharge outlet on rooftop	2	60
Domestic exhaust fan outlet at facade	167	40
Small (single fan) residential condenser unit	167	65
Vehicle Movements		
Resident vehicle, driving at a speed of 5 km/h	1	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 6.5 Nearest Sensitive Receiver Locations

Source	Location	Direction
R_1	7 Nelson Road	North
R_2	9A Nelson Road	North
R_3	6-8 Lightcliff Ave	East
R_4	2-4 Lightcliff Ave	East
R_5	36-40 Tryon Road	South
R_6	30-34 Tryon Road	South
R_7	12-16 Nelson Road	West

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 6.6 Calculated External Noise Emission Levels & Relevant Noise Criteria (Scenario A)

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)	Mechanical Plant	35	**42**	**Yes**
		Vehicle Movements	25		
		Cumulative Total	**35**		
R_2		Mechanical Plant	36		**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**36**		
R_3		Mechanical Plant	35		**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**35**		
R_4		Mechanical Plant	35		**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**35**		
R_5		Mechanical Plant	34		**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**34**		

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_6	Day & Evening (7:00am[1] to 10:00pm)	Mechanical Plant	35	**42**	**Yes**
		Vehicle Movements	20		
		Cumulative Total	**35**		
R_7		Mechanical Plant	32		**Yes**
		Vehicle Movements	30		
		Cumulative Total	**34**		

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 6.7 Calculated External Noise Emission Levels & Relevant Noise Criteria (Scenario B)

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	Night (10:00pm to 7:00am[1])	Mechanical Plant	28	**36**	**Yes**
		Vehicle Movements	22		
		Cumulative Total	**29**		
R_2		Mechanical Plant	28		**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**28**		
R_3		Mechanical Plant	25		**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**25**		
R_4		Mechanical Plant	28		**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**28**		

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_5	Night (10:00pm to 7:00am[1])	Mechanical Plant	29	**36**	**Yes**
		Vehicle Movements	Negligible		
		Cumulative Total	**29**		
R_6		Mechanical Plant	29		**Yes**
		Vehicle Movements	17		
		Cumulative Total	**29**		
R_7		Mechanical Plant	28		**Yes**
		Vehicle Movements	27		
		Cumulative Total	**30**		

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**.

To comply with the requirements of Clause 45 of the POEO Regulation and be inaudible within any habitable room of any adjacent residence, noise emission from an air condenser unit on a residential premises must be at least **10 dB** below the ambient background noise level when measured externally at the window of an adjacent residential premises.

Therefore, noise emission from an operating air conditioning unit on a residential premises is likely to be required to be below **21 dB(A)** when measured at the window of an adjacent residential premises (within the residential development or at an adjacent development).

Recommendations to achieve compliance with the requirements of Clause 45 of the POEO regulation are provided in **Section 8.3.2** below.

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 nose levels are based on an estimated maximum number of 42 vehicles along Nelson Road during the morning and evening peak hour periods.

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 6.8 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 on surrounding streets	36	**50**	**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 doors closing on the driveway, when measured at the nearest residences on Nelson Road during the night-time assessment period. Acoustic Dynamics advises this is unlikely to occur, as cars are likely to utilise resident or visitor car spaces provided within the basement.

Table 6.9 Calculated Maximum Instantaneous External Noise Levels & Relevant Noise Criteria

Nearest Sensitive Receiver	Source	Predicted Maximum L_{Amax} Sound Pressure Level [dB][1]	L_{Amax} Sleep Disturbance Criterion [dB][2]	Complies?
Receivers along Nelson Road	Car doors closing	51	**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).

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 Ku-ring-gai 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 marginally comply** with the relevant noise emission criteria of Ku-ring-gai Council, the NSW EPA and applicable legislation during the proposed hours of operation when assessed at the nearest sensitive receivers;

5. Acoustic Dynamics advises that an assessment of noise emission from air condenser units should be carefully conducted during the development of mechanical plant and equipment documentation. Where feasible, and to avoid any onerous restrictions on the operation of condenser units, it is **highly recommended** to consider installing units within a basement plant room(s) or a rooftop plant deck(s), particularly for units located in close proximity to other residential windows (i.e for the lower levels of the building);

6. Noise emission is predicted to be lower than the predicted maximum noise emission levels in **Section 6** following the following the incorporation of our construction and design recommendations in **Section 8**;

7. 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;

8. 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;

9. 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 our recommendations in **Section 9**;

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

11. 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.

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 glazing elements should be incorporated, as a minimum, to ensure the internal design sound levels are achieved.

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

- 8.38mm laminated glazing for all bedrooms and habitable areas on the western facade;
- 6.38mm laminated glazing for all bedrooms and habitable areas; and
- Standard glazing for all wet areas.

Further to these minimum glazing specifications, Acoustic Dynamics advises **all 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** with appropriate **acoustic seals** 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 understands that specific materials and construction specifications of internal architectural elements are yet to be determined and will be finalised prior to obtaining construction certification.

The following basic measures are recommended to be adopted into the design and construction of the development:

- Masonry and/or plasterboard walls with appropriate acoustic insulation;
- Suitable impact isolation insulation installed below hard flooring;
- Concrete floor slabs with suspended ceilings and acoustic insulation within cavities; and
- Acoustic treatment and/or lagging of waste water pipe work and other hydraulic services.

At this stage of the design, Acoustic Dynamics considers that the development can be designed to achieve compliance with the BCA during the finalisation of construction documentation.

It is recommended that a full **internal acoustic privacy assessment** be conducted by an appropriately qualified acoustical consultant to certify that the sound transmission performance of proposed internal architectural elements will satisfy the internal acoustic privacy requirements outlined in **Section 4** of this report, prior to obtaining construction certification.

8.3 MECHANICAL SERVICES

Acoustic Dynamics understands that specific items of mechanical equipment and the layout of mechanical services are yet to be determined and will be finalised prior to obtaining construction certification.

It is recommended that a full **mechanical noise emission assessment** be completed by an appropriately qualified acoustical consultant to certify that noise emission levels resulting from the use and operation of mechanical services will not exceed the noise emission objectives outlined in **Section 6** of this report at, prior to obtaining construction certification.

Sound power levels shall not exceed the sound power levels provided at the critical locations identified in **Table 6.5** of **Section 6**. Acoustic Dynamics provides the following general recommendations for mechanical services to ensure noise emission and transmission from the operation of mechanical equipment is minimised.

8.3.1 ATTENUATORS

Where required (including, but not limited to the car park exhaust and supply fans), the following recommendations apply to all attenuators:

1. Attenuators shall be purpose-built and constructed by a specialist manufacturer such as Fantech™ and be suitably matched to the equipment to be installed;

2. All attenuators shall be reviewed by an appropriately qualified acoustical and mechanical consultant for suitability.

8.3.2 AIR CONDENSER UNITS

At this stage of the assessment, Acoustic Dynamics has demonstrated that noise emission from air condenser units, if located on balconies, is likely to comply with the applicable environmental noise emission criteria for air conditioning units on residential premises.

Given the low levels of background noise at the site Acoustic Dynamics advises that an assessment of noise emission from air condenser units should be carefully conducted during the development of mechanical plant and equipment documentation.

Where feasible, and to avoid any onerous restrictions on the operation of units, it is **highly recommended** to consider installing units within a basement plant room(s) or a rooftop plant deck(s), particularly for units located in close proximity to other residential premises, including:

- Condenser units on residential balconies on or below **Level 3**; and
- Condenser units on residential balconies that have direct line of site to other residential balconies within the same development (i.e. on the three inner facades of the development).

If units are to be installed on residential balconies, and to assist the mechanical design of the development the following recommendations apply to all proposed condenser units on or below **Level 3**:

1. Units must not exceed a sound pressure level of **50 dB(A)** when measured at 1 metre from the unit. This may require each unit to be programmed to operate with a “night mode” reducing noise emission from the outdoor condenser unit during the night-time period;

2. Unit dimensions must not be greater than 1 metre in height;

3. Units must be positioned a minimum 2 metres from the edge of the balcony;

4. Units must be oriented at a position of no less than 90-degrees to the edge of the balcony;

5. Balcony balustrades must be of a **solid** construction, minimum 1.2 metres high, with surface density no less than **15 kg/m^2**, and must contain **no gaps** along the surface or at the edges of the construction; and

6. Units shall be isolated from the wall and supporting structure with rubber pads to prevent the transmission of vibration from the condenser units to the structure.

If feasible, it is **highly recommended** to consider installing condenser units servicing apartments on or below **Level 3** at an appropriate location within a basement or rooftop plant room/area.

The following recommendations apply to all proposed condenser units servicing **Level 4** and above:

1. Units must not exceed a sound pressure level of **53 dB(A)** when measured at 1 metre from the unit. This may require each unit to be programmed to operate with a “night mode” reducing noise emission from the outdoor condenser unit during the night-time period;

2. Unit dimensions must not be greater than 1 metre in height;

3. Units must be positioned a minimum 2 metres from the edge of the balcony;

4. Units must be oriented at a position of no less than 90-degrees to the edge of the balcony;

5. Units shall be isolated from the wall and supporting structure with rubber pads to prevent the transmission of vibration from the condenser units to the structure.

NB: An appropriately qualified acoustic consultant shall be engaged to confirm the above recommendations will ensure compliance is achieved at the nearest receiver locations, during the development design phase.

8.3.3 FANS

The following recommendations apply to all fans to be installed:

1. Car park, plant room and stair pressurisation fans shall be appropriately designed such that the sound pressure level at **all rooftop fan inlets and outlets** does not exceed a recommended level of **50 dB(A)** when measured at 1 metre;

2. Domestic exhaust fans shall be appropriately designed such that the sound pressure level at the ventilation grilles at the facade does not exceed a recommended level of **35 dB(A)** when measured at 1 metre;

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

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

5. 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.

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 BASEMENT 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.

8.5 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. 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;
    - Loud mobile phone conversations in external areas of the property;
    - Loud music (stereo/hi-fi, phone speaker, boom box, guitars or similar); or
    - Any other similar types of behaviour;

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

5. 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

6. 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.

8.6 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 residential development located at 1-5 Nelson Road, Lindfield, 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) Ku-ring-gai 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 8.1**. 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 8.2** 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 Ku-ring-gai 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

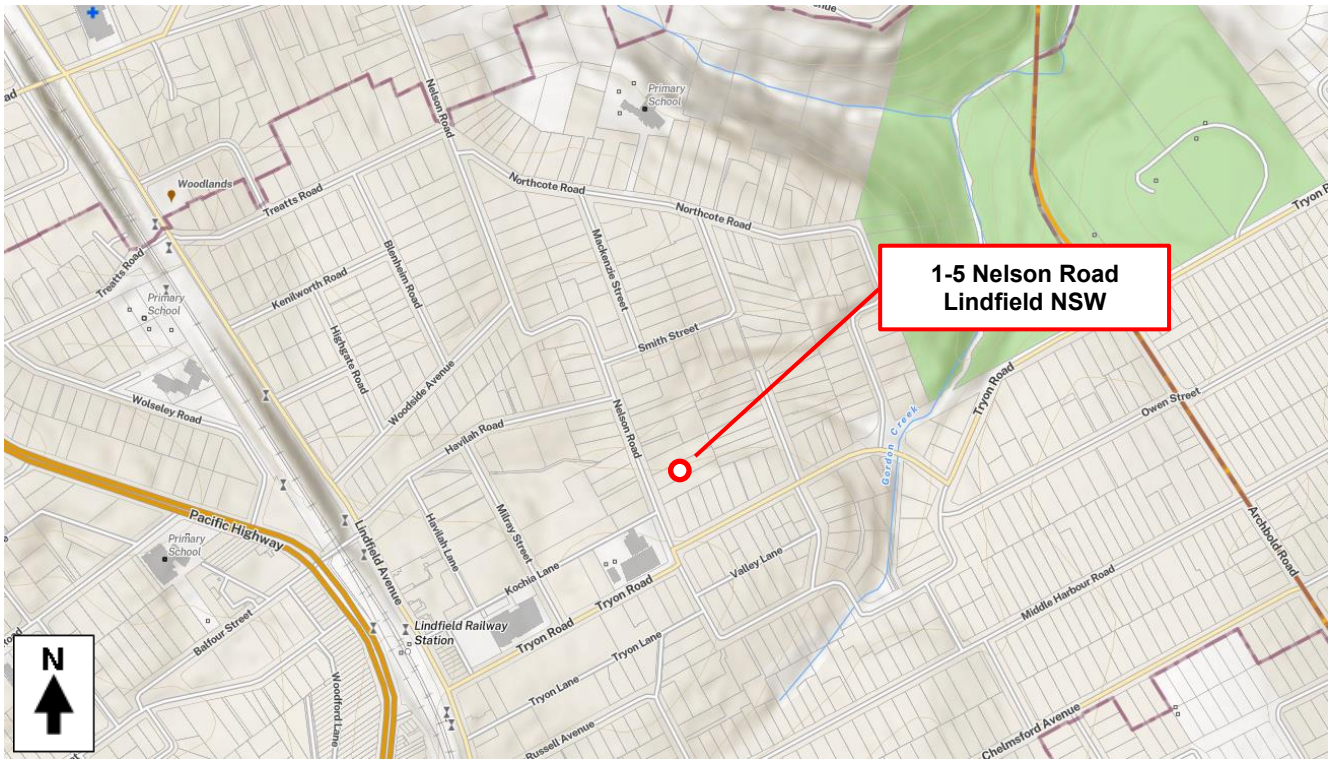
Further to our site survey, noise monitoring and measurements, our review of the relevant acoustic criteria and requirements, and our calculations, Acoustic Dynamics advises that the proposal can be designed to comply with the relevant acoustic criteria of Ku-ring-gai Council, the NSW DPIE, the NSW EPA, 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.

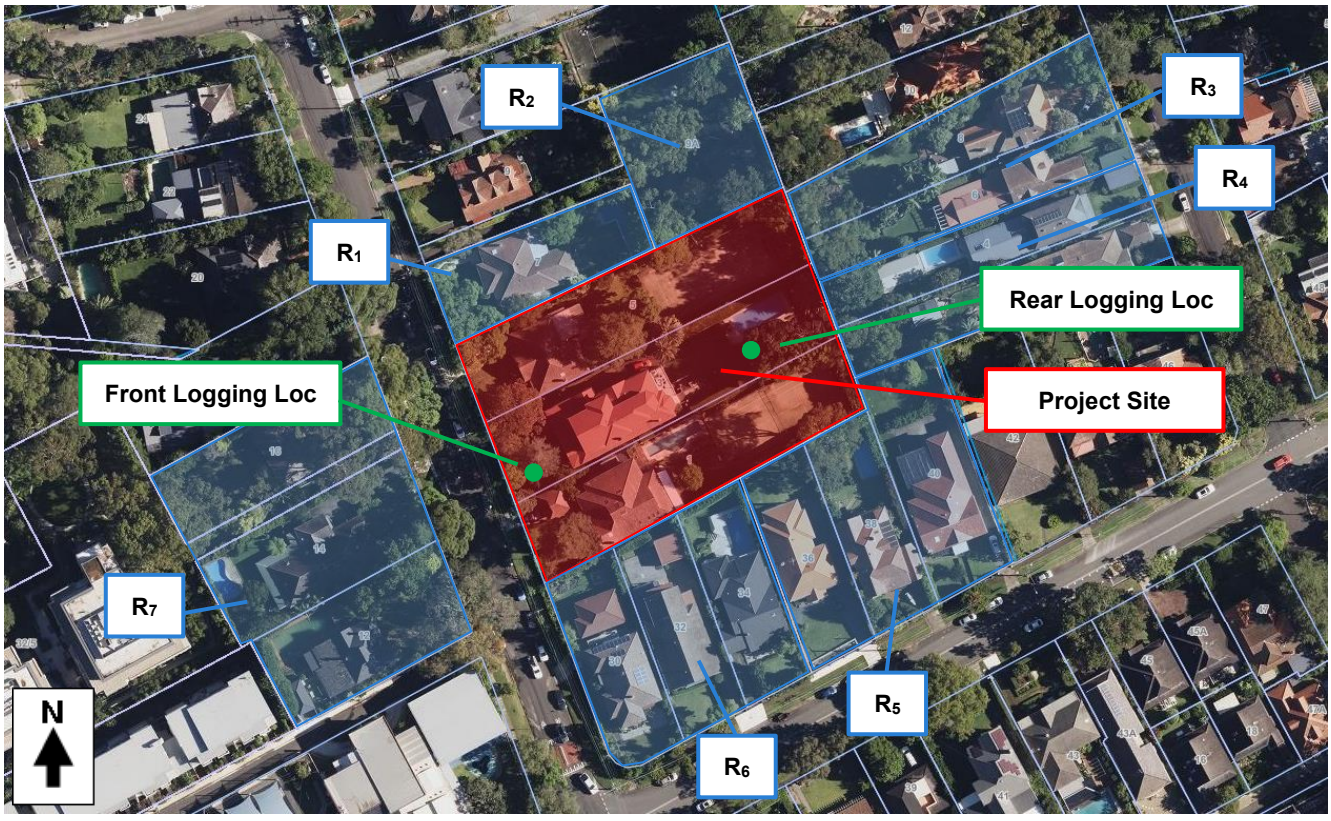
We trust that the above information meets with your present requirements and expectations. Please do not hesitate to contact us on 02 9908 1270 should you require more information.

APPENDIX A — LOCATION MAP, AERIAL IMAGE AND DRAWINGS

A.1 LOCATION MAP (COURTESY OF SIX MAPS)

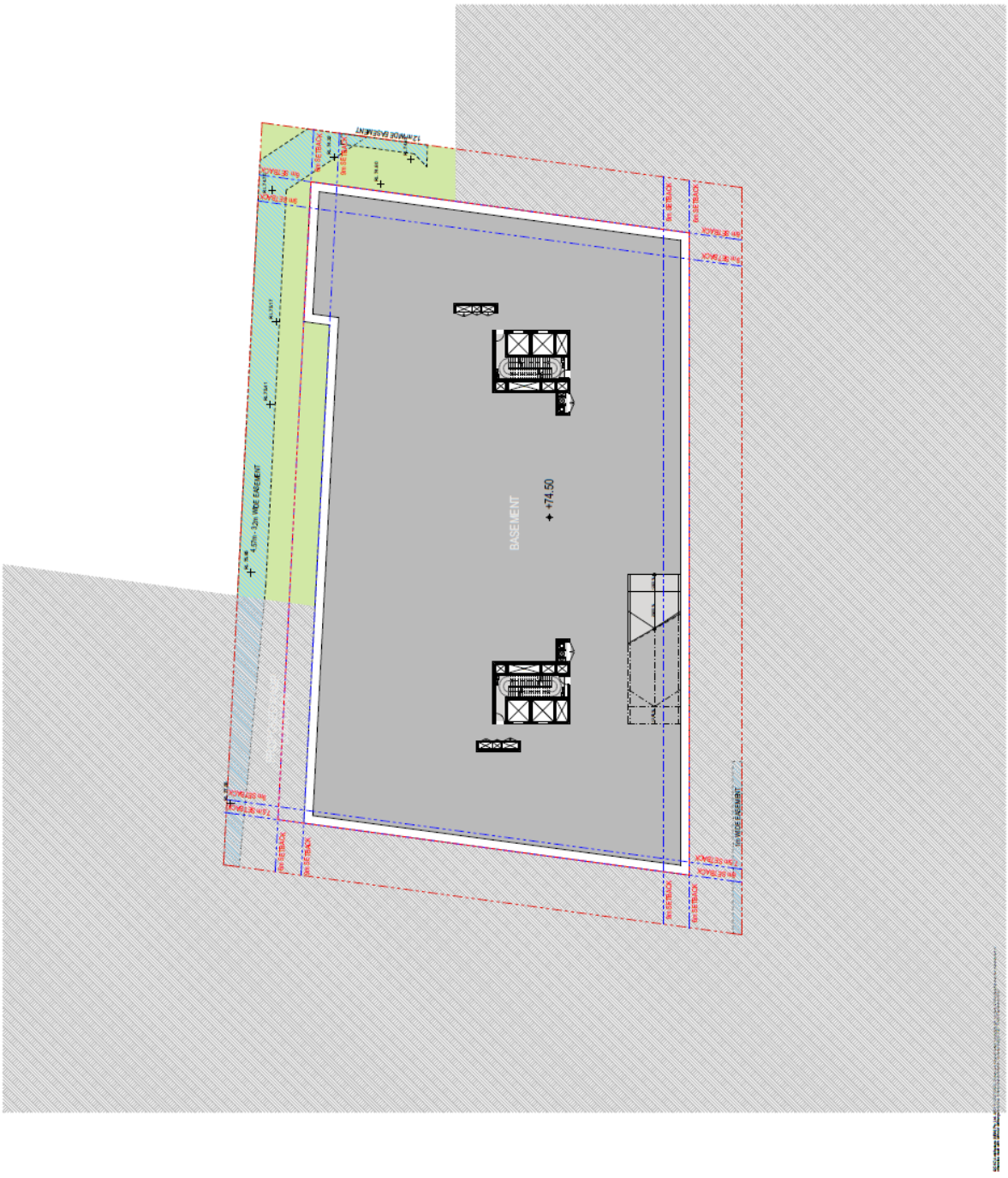


A.2 AERIAL IMAGE (COURTESY OF SIX MAPS)

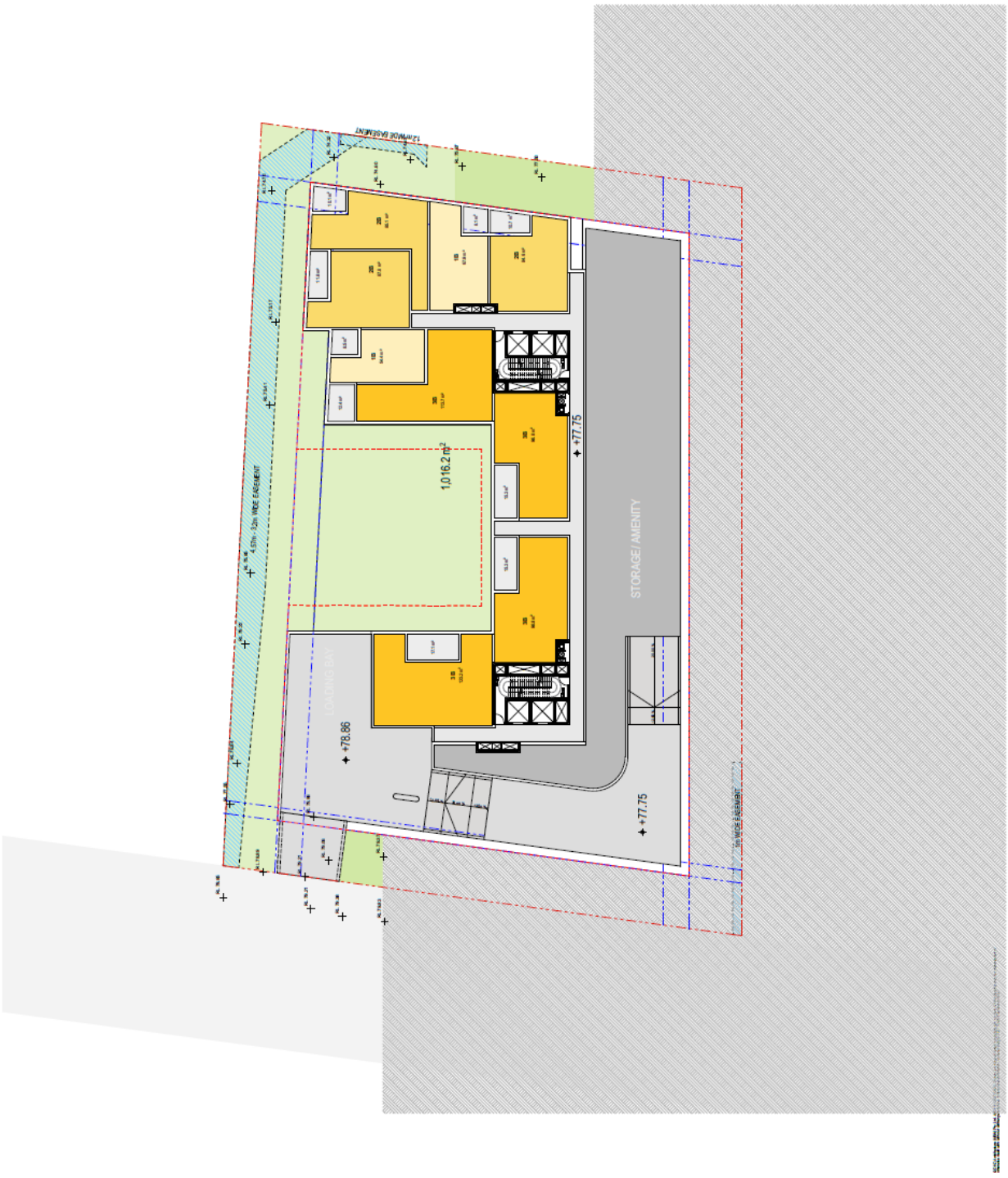


A.3 ARCHITECTURAL PLANS (COURTESEY OF DKO ARCHITECTURE)

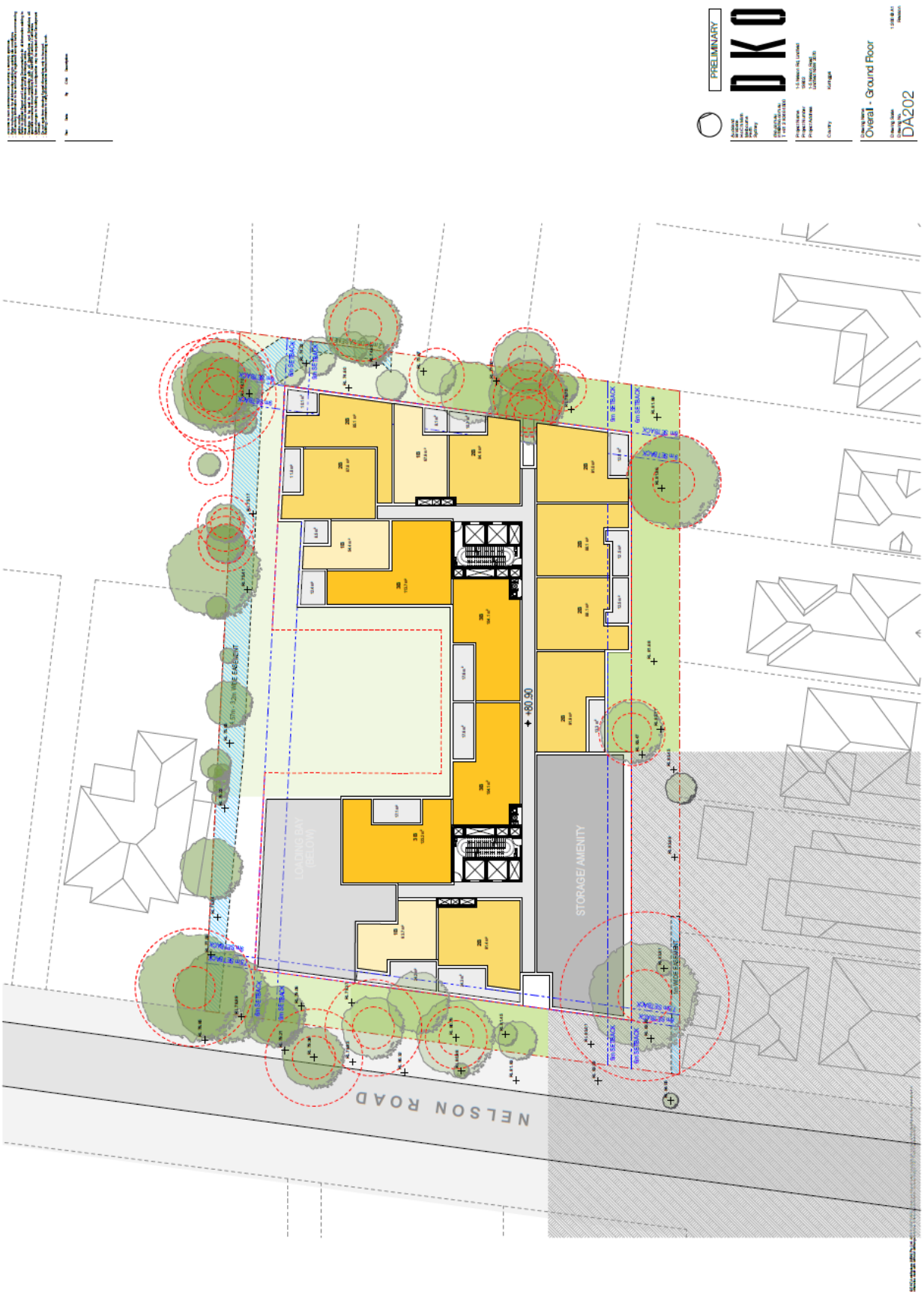
A.3.1 BASEMENT 2 PLAN



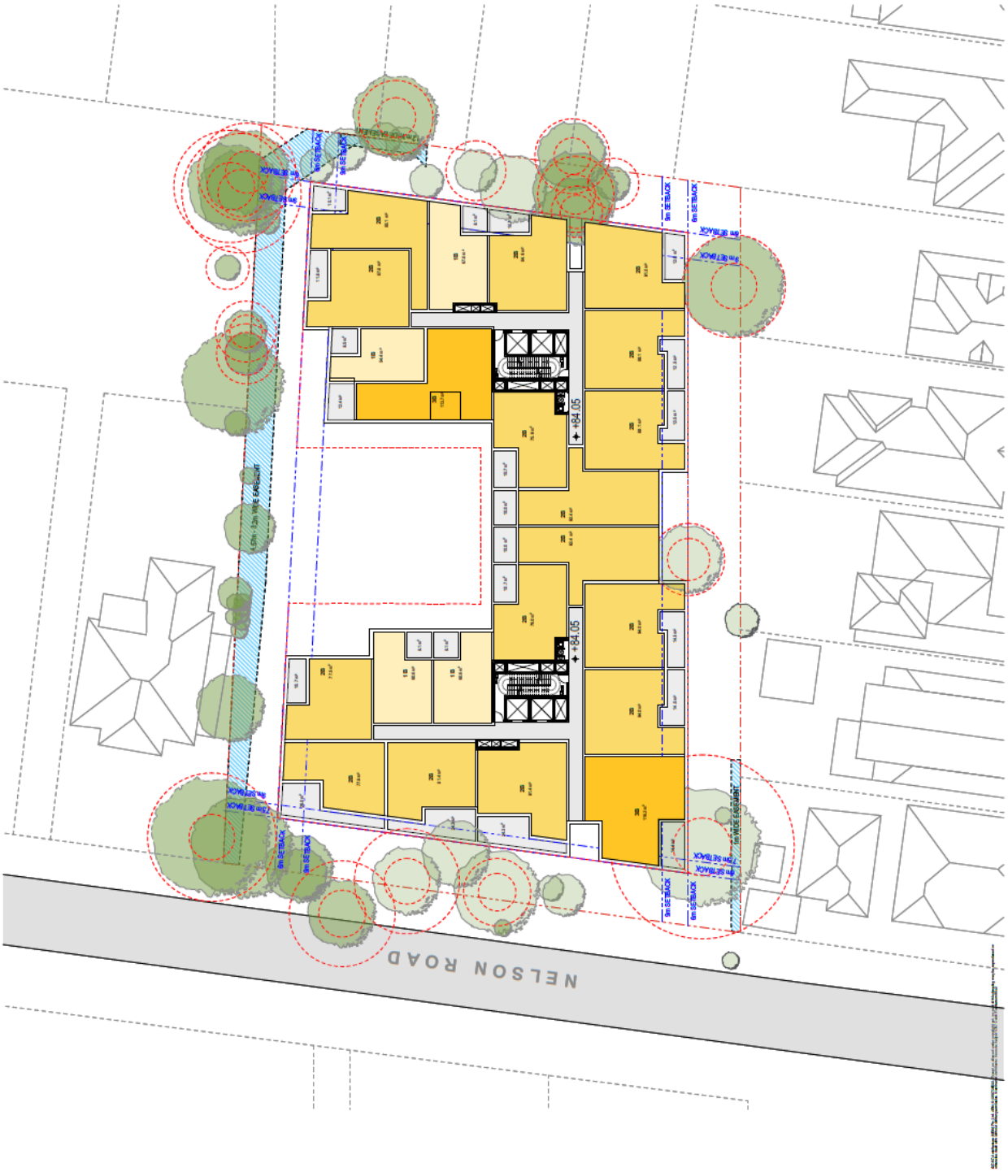
A.3.2 BASEMENT 1 PLAN



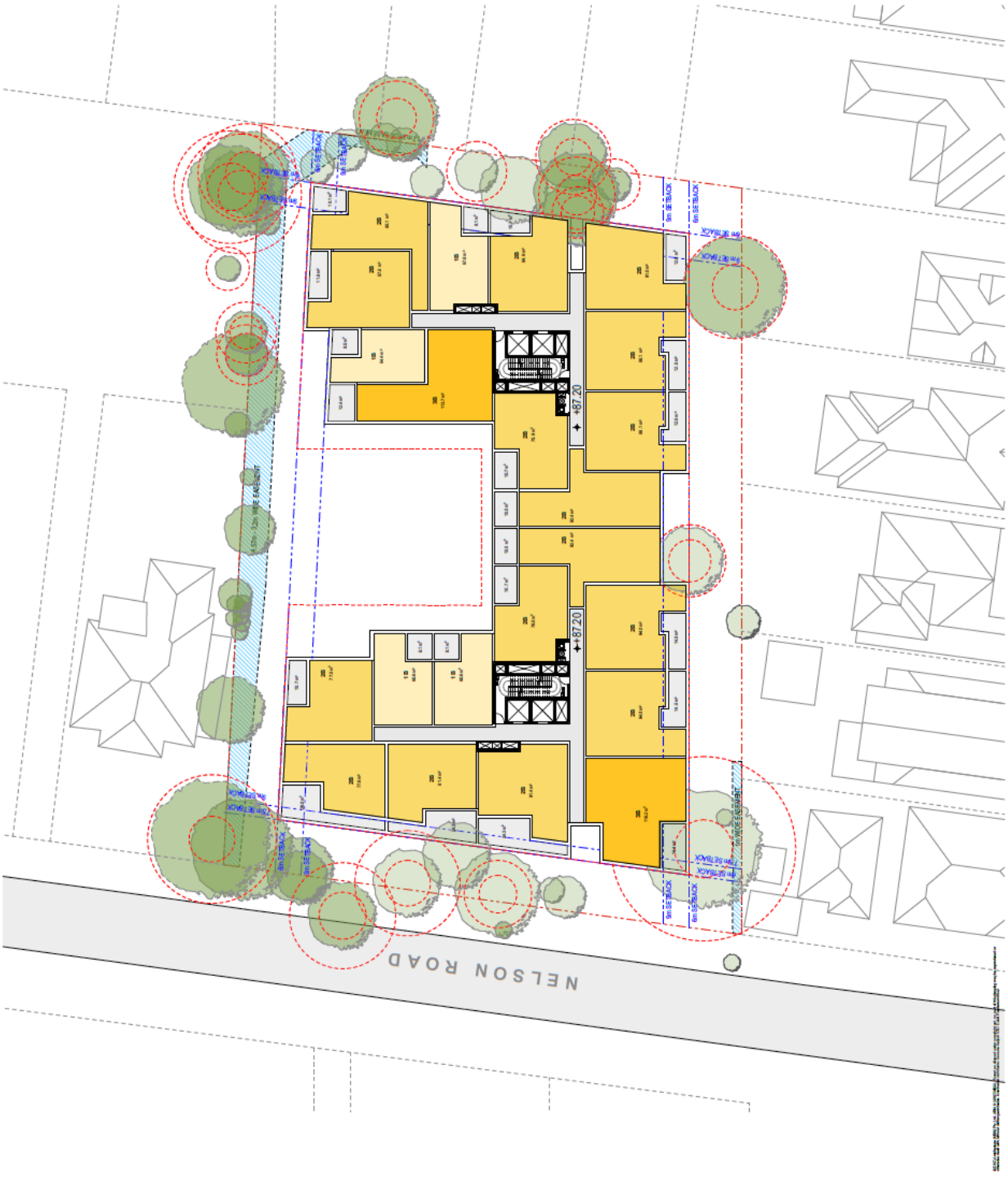
A.3.3 GROUND FLOOR PLAN



A.3.4 LEVEL 1 PLAN

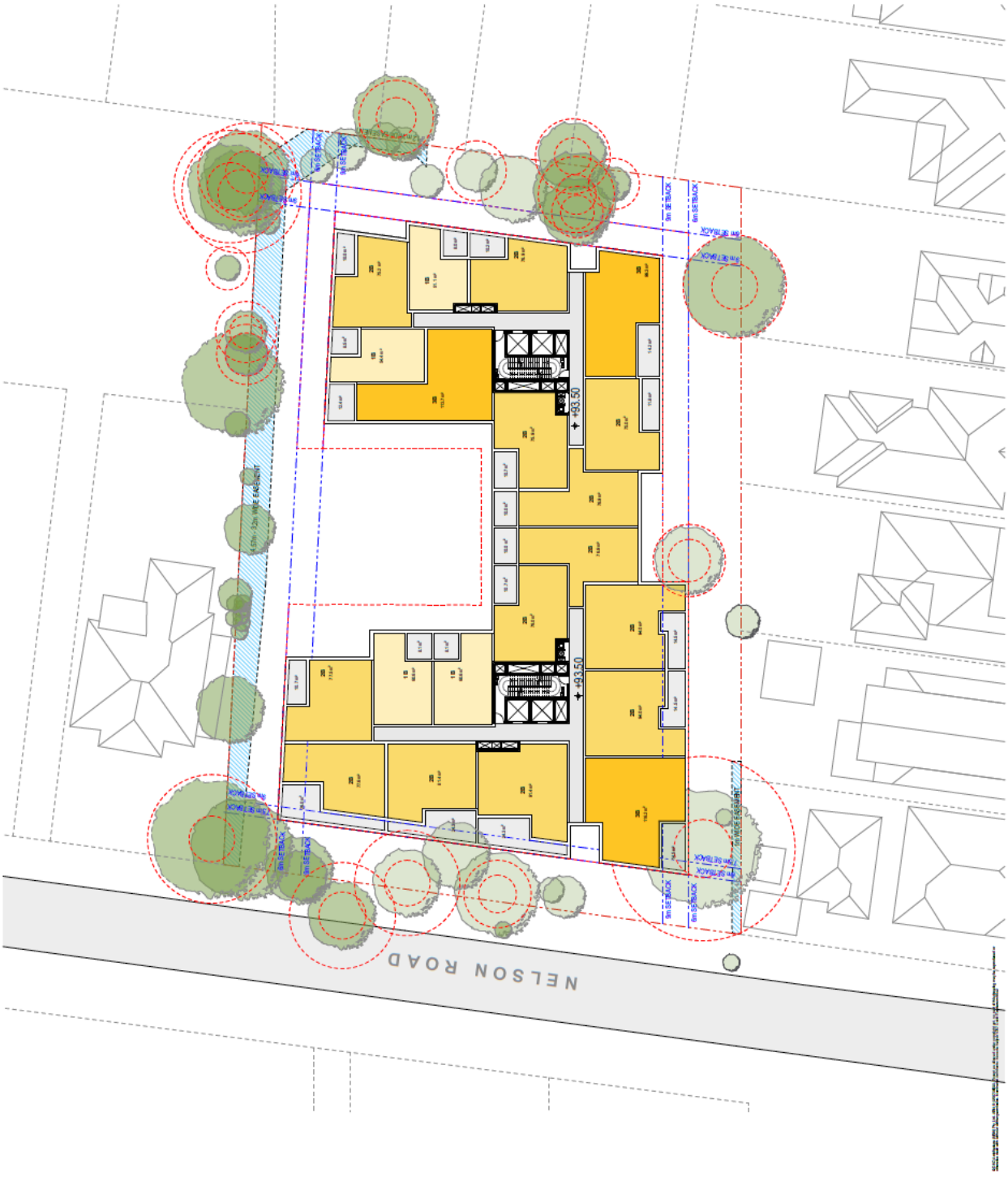


A.3.5 LEVEL 2 PLAN



A.3.6 LEVEL 3 PLAN

A.3.7 LEVEL 4 PLAN

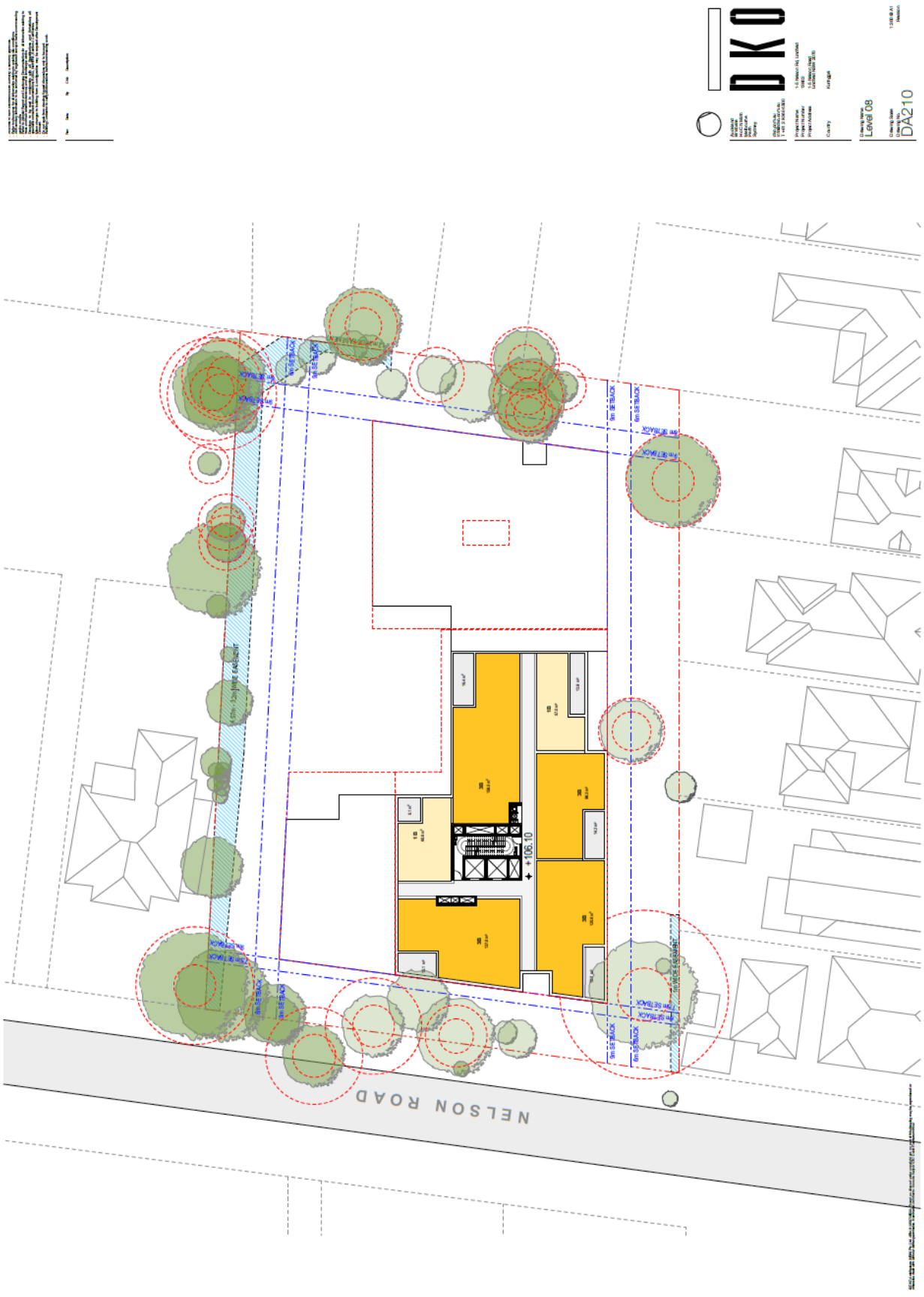


A.3.8 LEVEL 5 PLAN

A.3.9 LEVEL 6 PLAN

A.3.10 LEVEL 7 PLAN

A.3.11 LEVEL 8 PLAN



APPENDIX B — ACOUSTIC ISOLATION AND PRIVACY REQUIREMENTS

B.1 SUMMARY OF INTERNAL ACOUSTIC PRIVACY RATINGS / LEGEND

The following table details the minimum acoustic performance requirements applicable to the various partitions within the development.

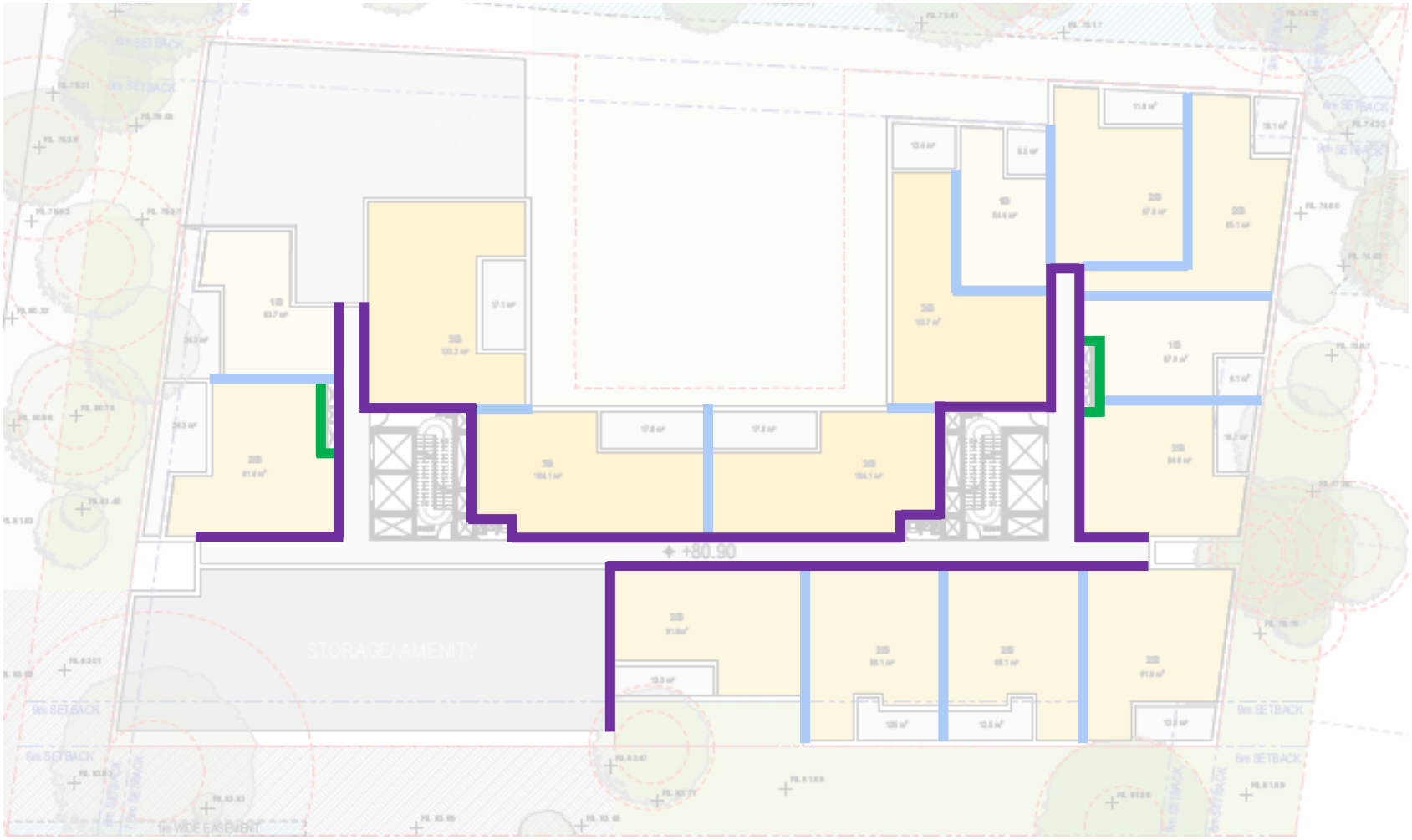
Table B.1 BCA Sound Transmission Performance Requirements for Partitions

Partition Type	Areas Separated	Airborne Sound Transmission Requirements	Impact Sound Transmission Requirements
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	$R_w + C_{tr} \geq 50$	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	$R_w + C_{tr} \geq 40$	N/A
Wall/Ceiling Type 6	Wall or floor cavity containing common services/pipework; to non-habitable room	$R_w + C_{tr} \geq 25$	N/A
Entry Door	Entry door of a unit (unit to common area, lobby, etc)	$R_w \geq 30$	N/A

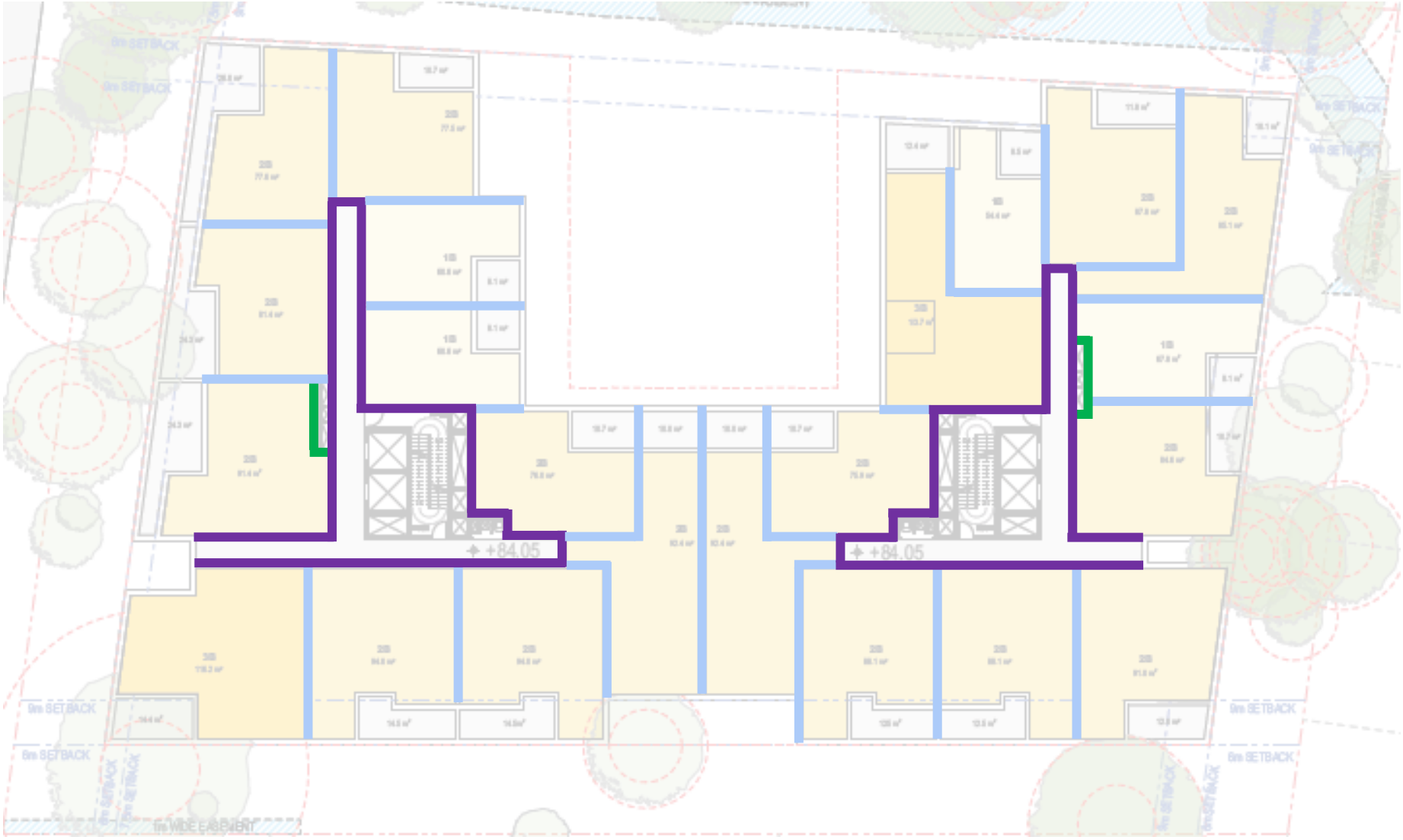
The location of all wall types that are required to achieve an internal acoustic privacy rating are marked below.

B.2 INTERNAL ACOUSTIC PRIVACY WALL TYPE MARK-UP

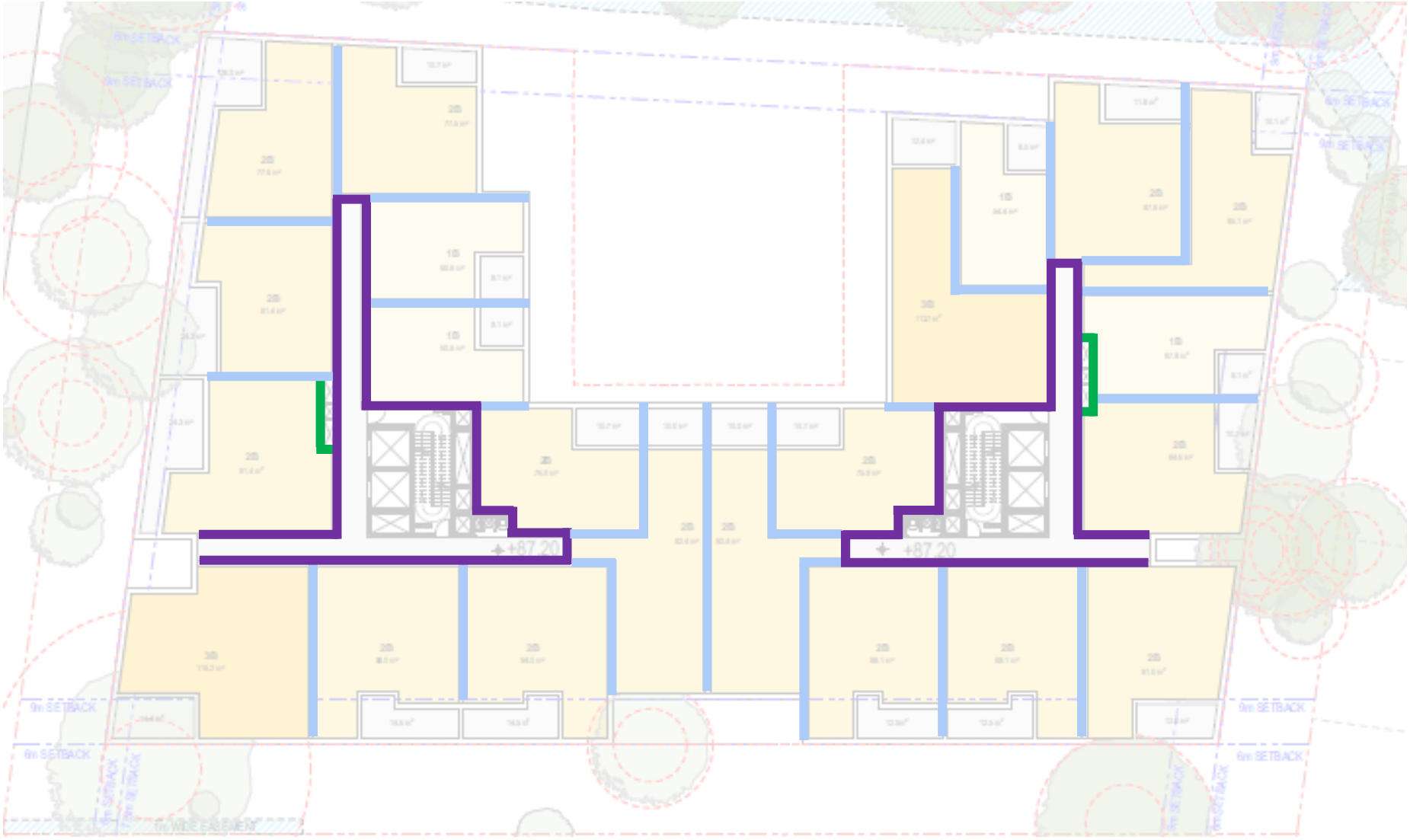
B.2.1 GROUND FLOOR



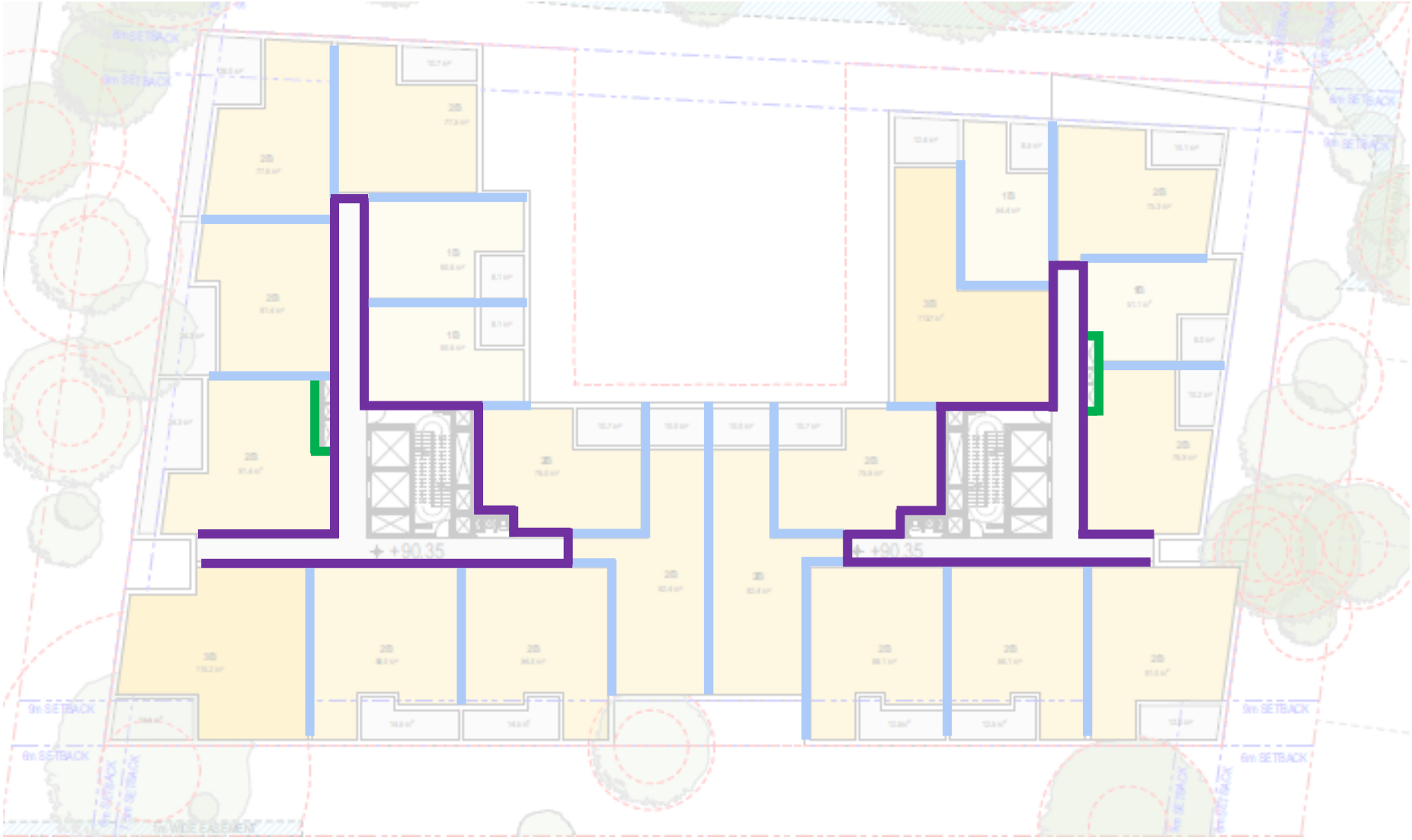
B.2.2 LEVEL 1



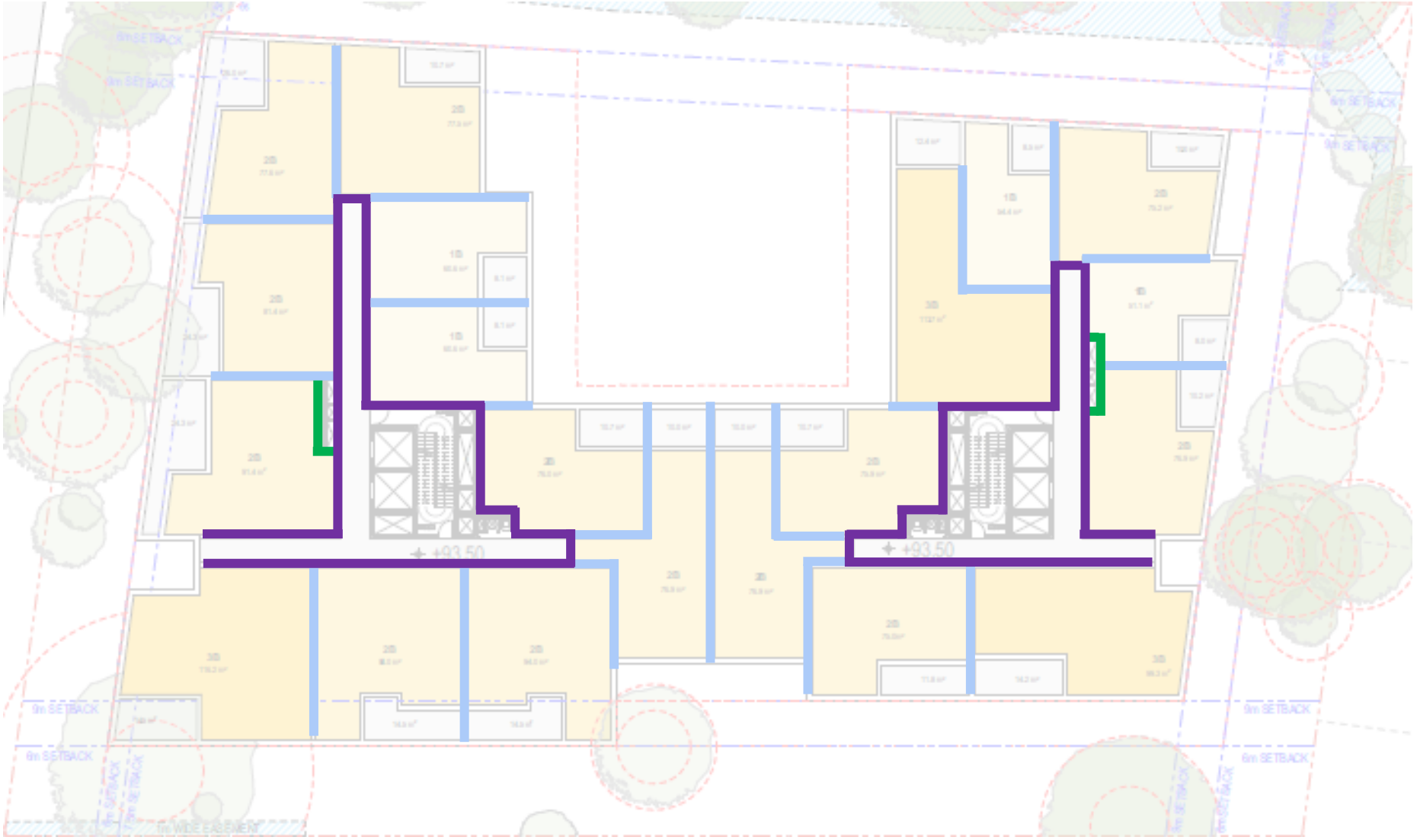
B.2.3 LEVEL 2



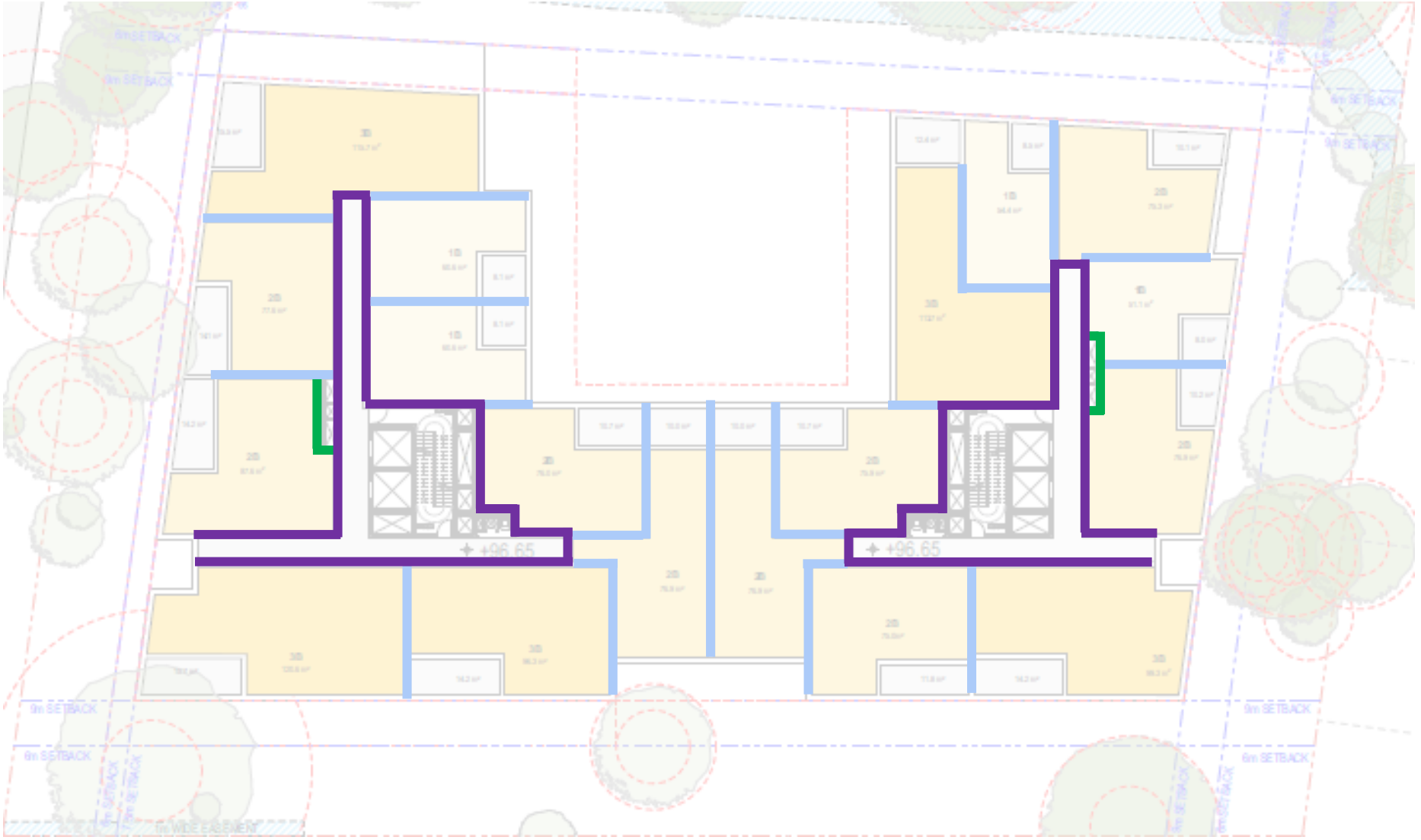
B.2.2.4 LEVEL 3



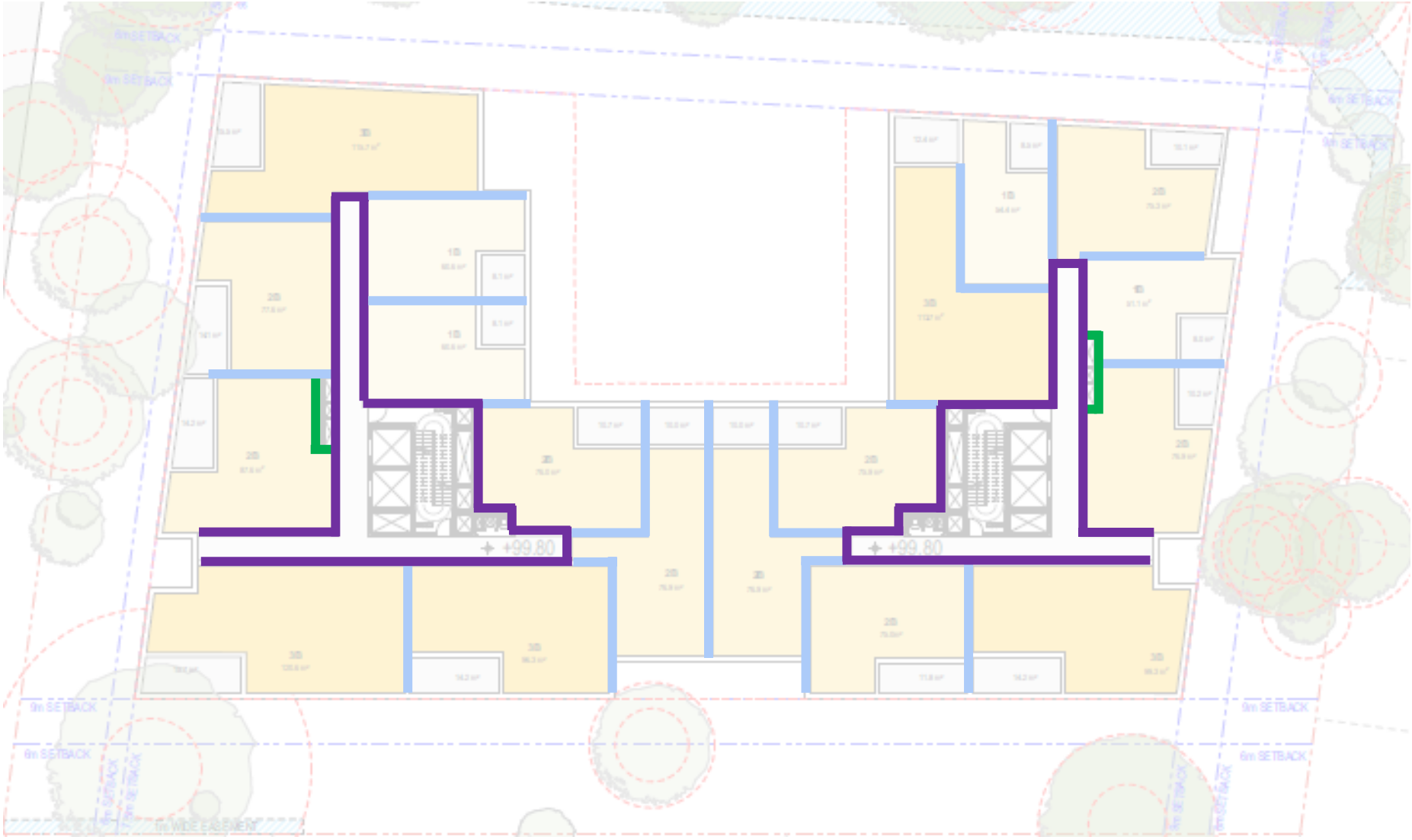
B.2.5 LEVEL 4



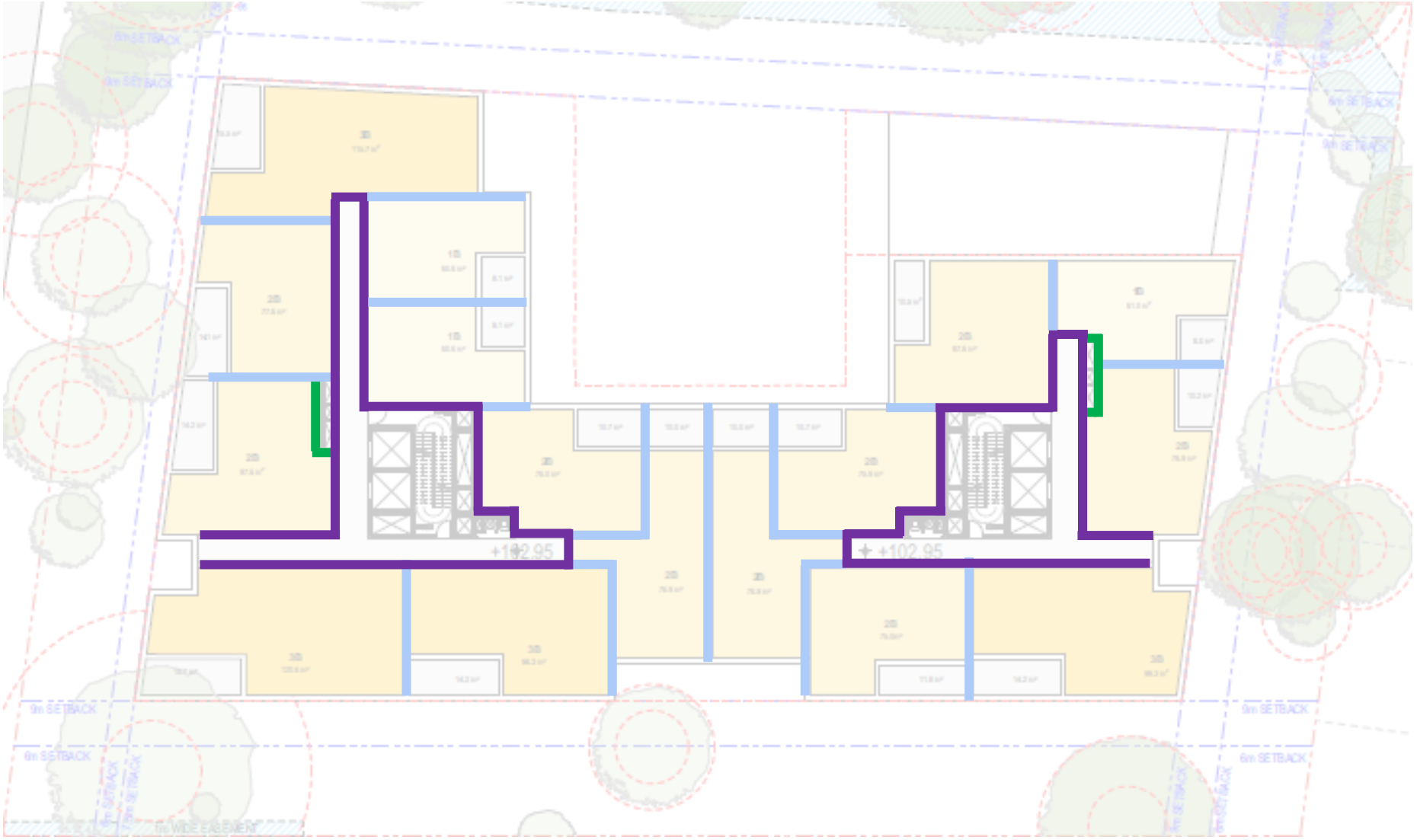
B.2.6 LEVEL 5



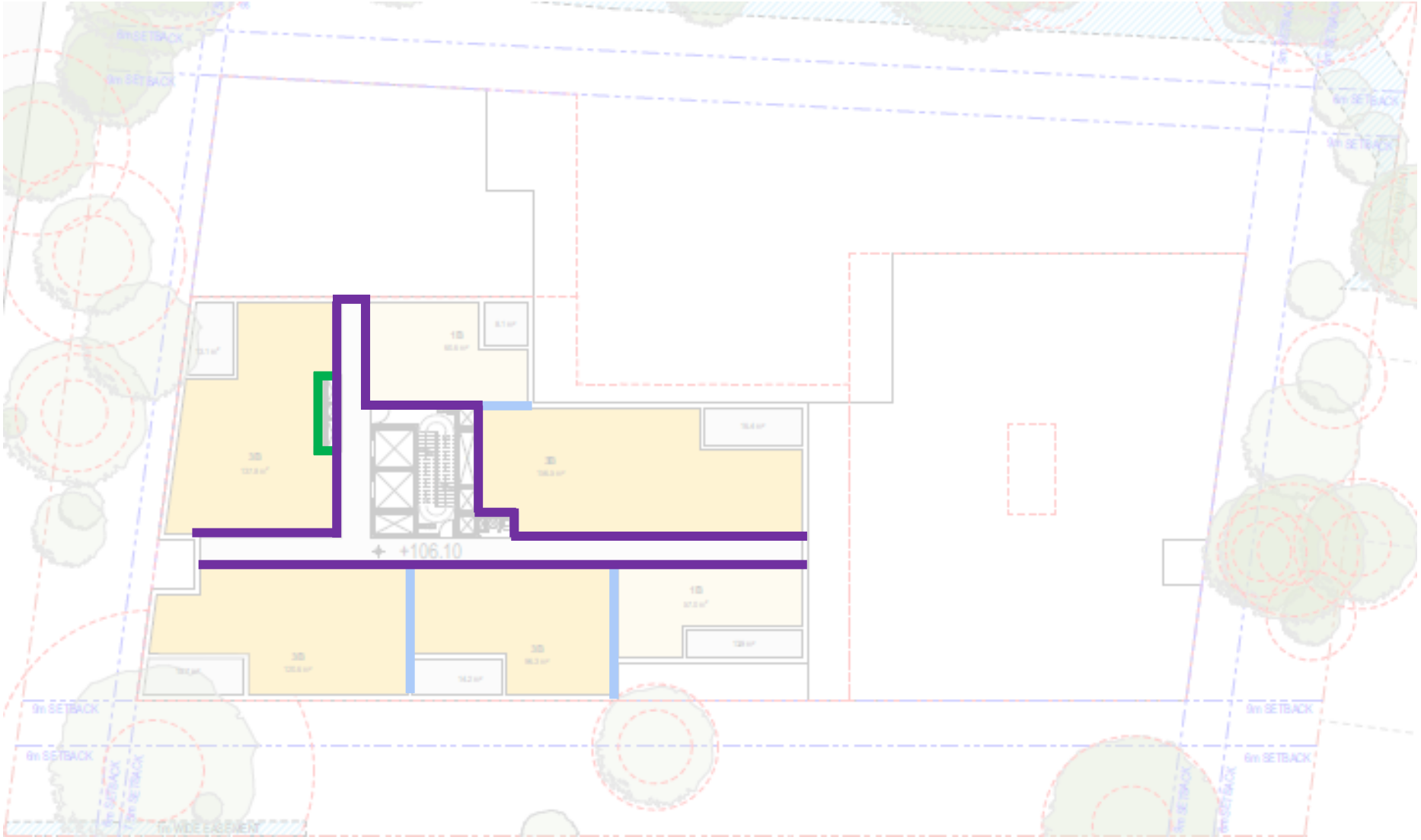
B.2.7 LEVEL 6



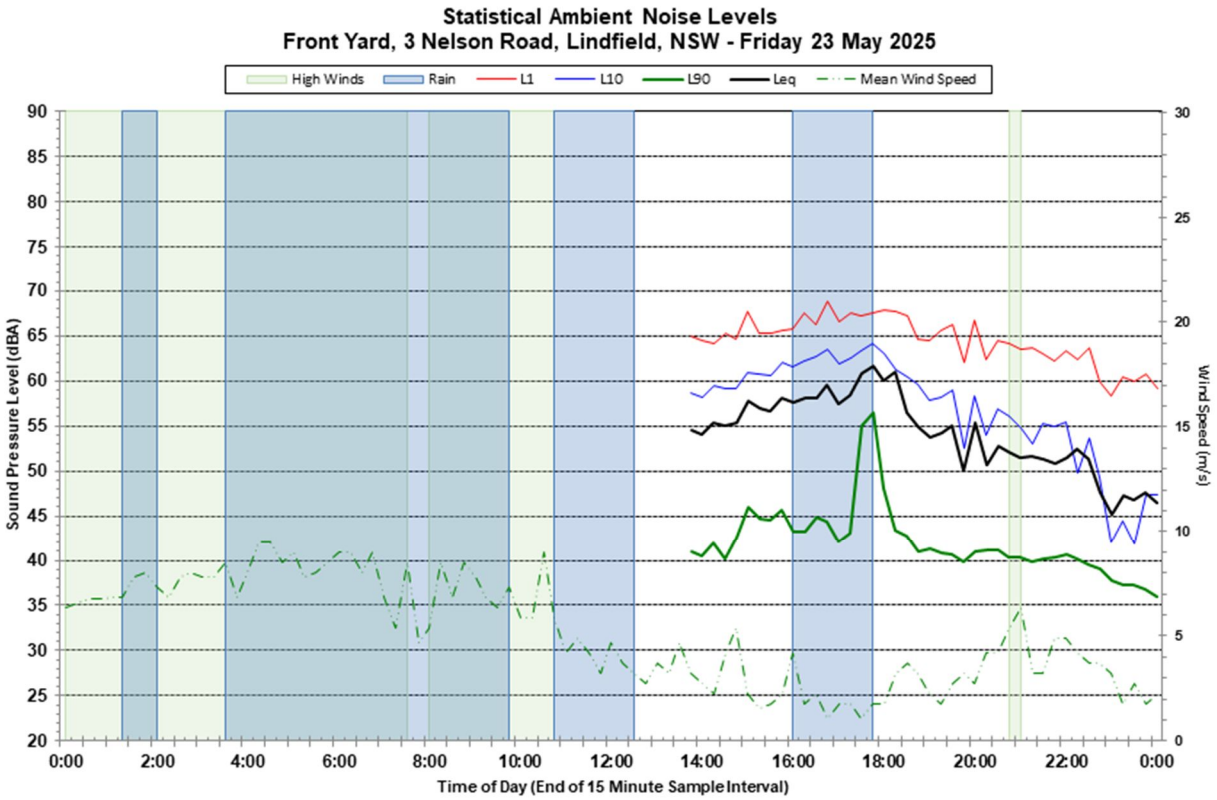
B.2.8 LEVEL 7

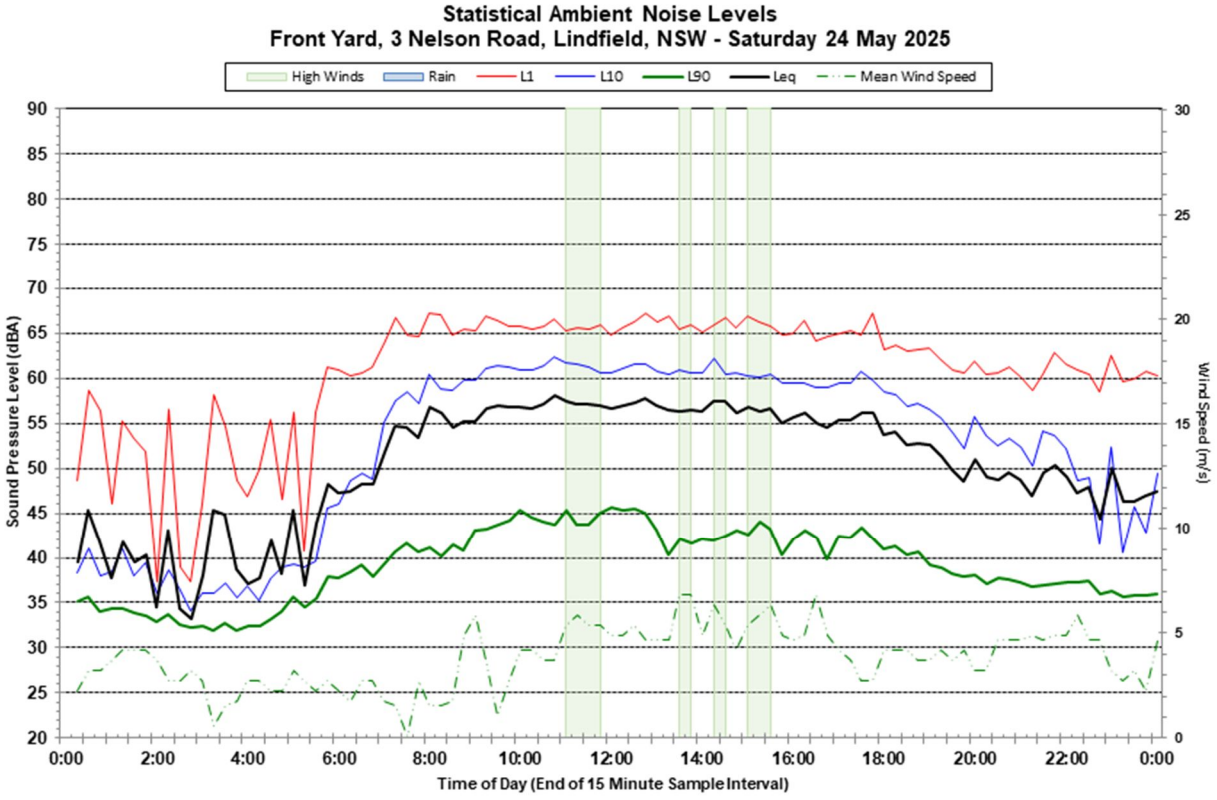

9m SETBACK
9m SETBACK
9m SETBACK
9m SETBACK
+102.95
+102.95
9m SETBACK
9m SETBACK
6m SETBACK
6m SETBACK
6m WIDE EASEMENT

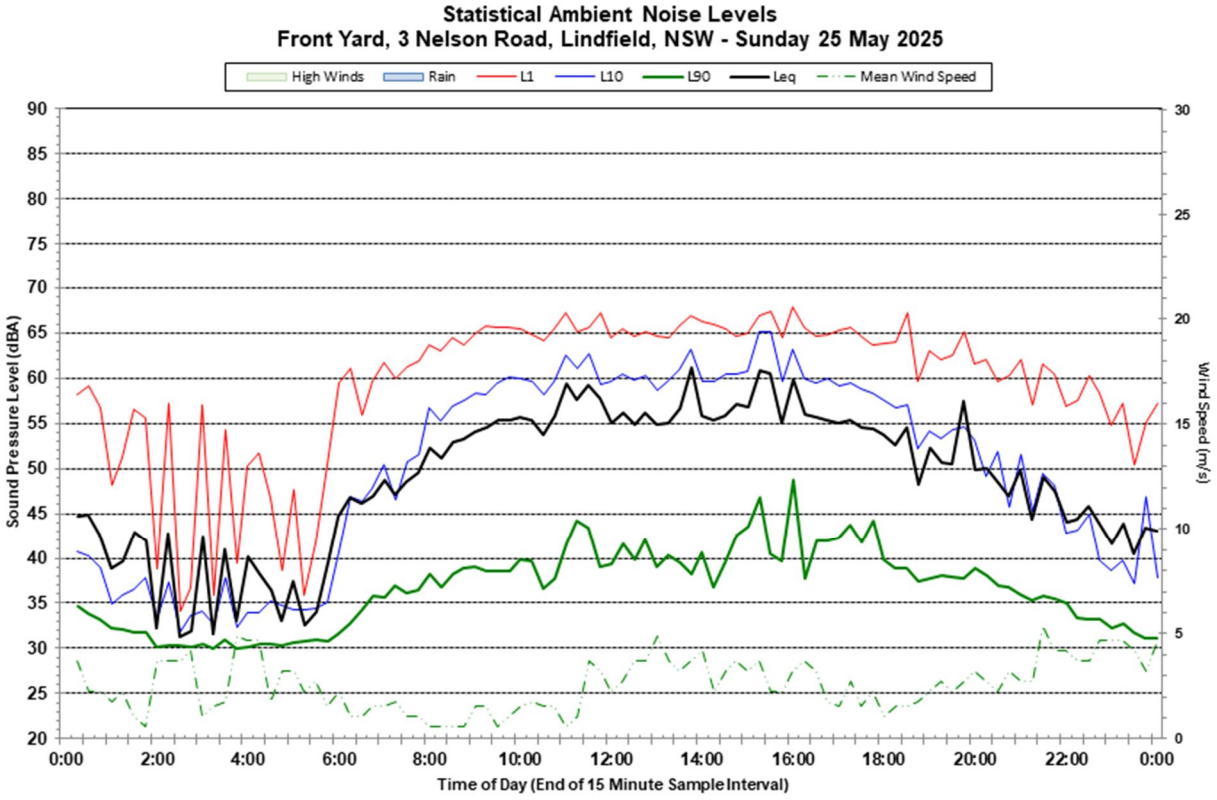
B.2.9 LEVEL 8

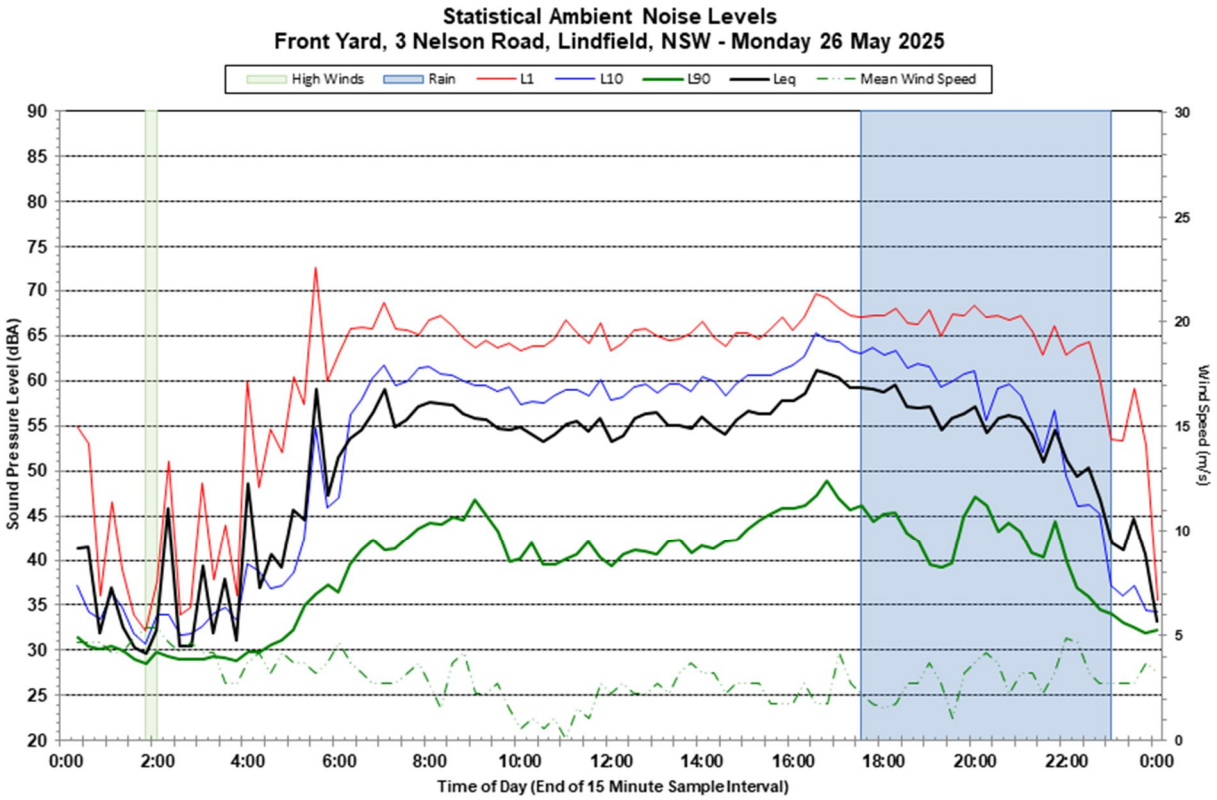


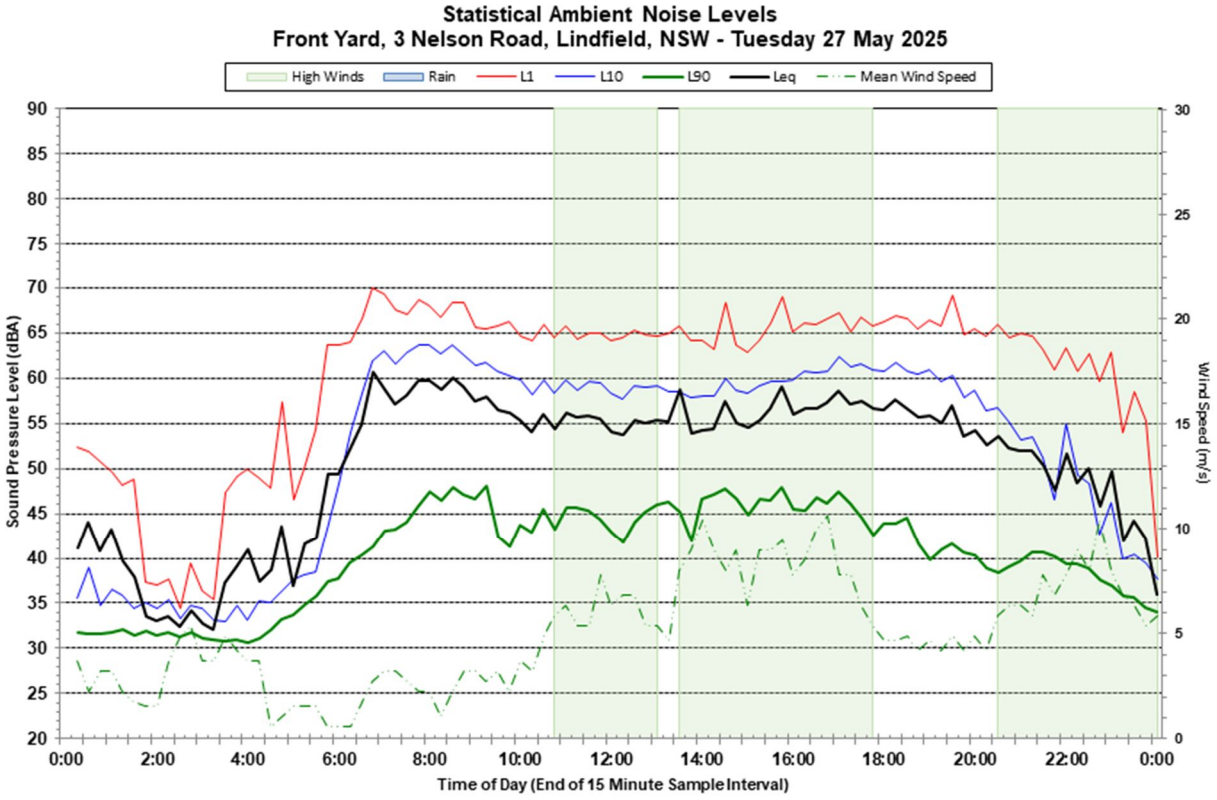
APPENDIX C — UNATTENDED NOISE MONITORING STATISTICAL GRAPHS

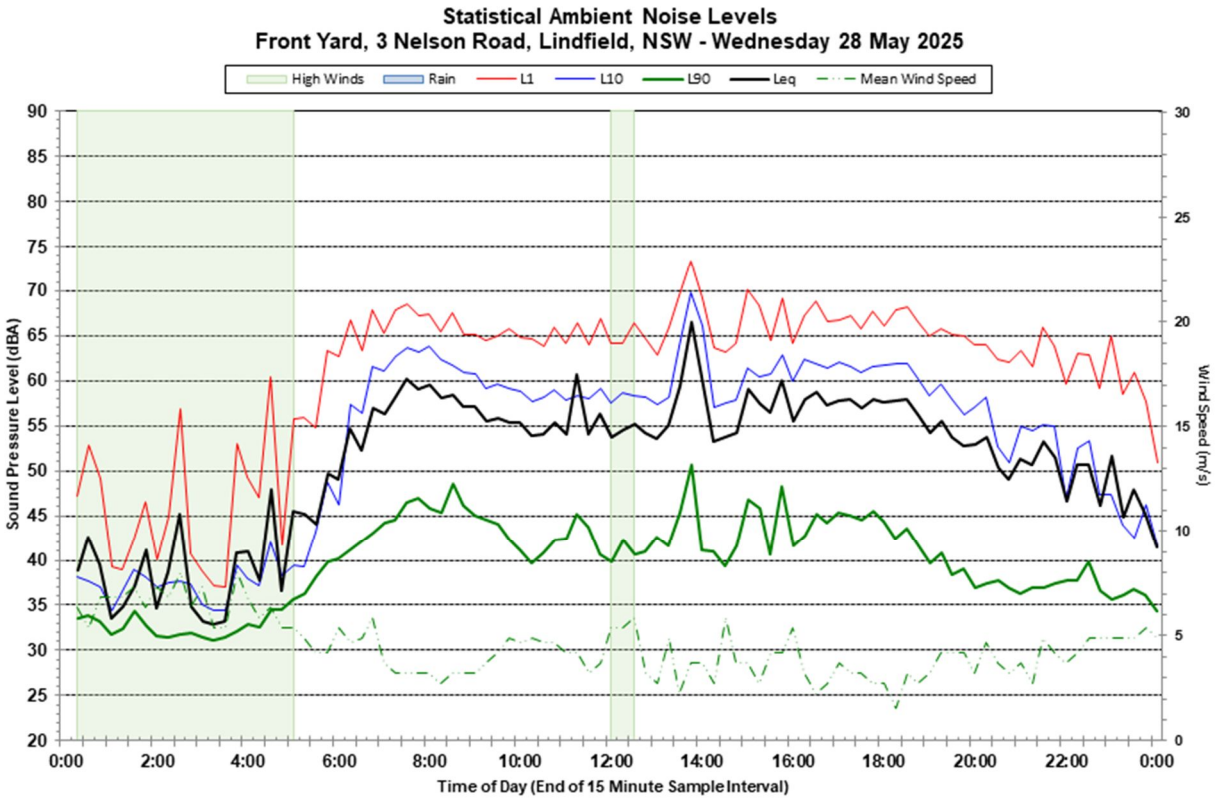


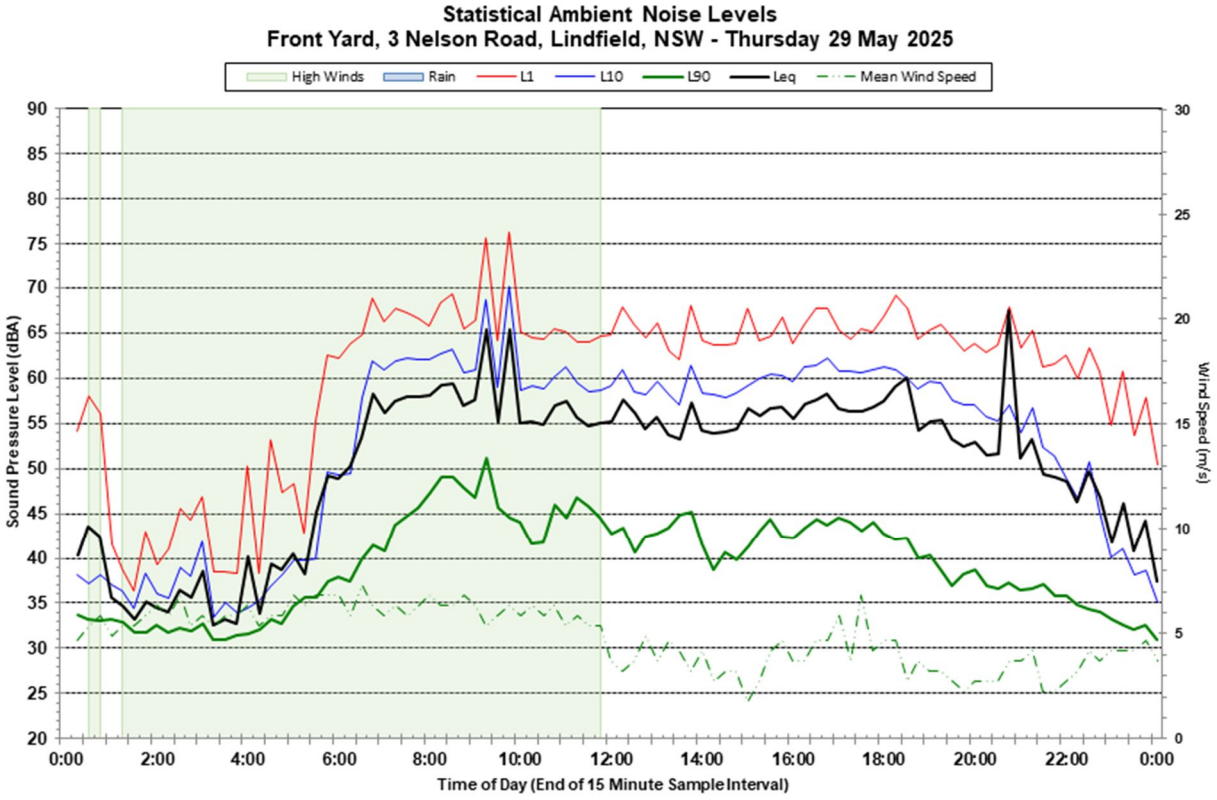



Statistical Ambient Noise Levels
Front Yard, 3 Nelson Road, Lindfield, NSW - Sunday 25 May 2025
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Front Yard, 3 Nelson Road, Lindfield, NSW - Monday 26 May 2025
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
Front Yard, 3 Nelson Road, Lindfield, NSW - Tuesday 27 May 2025
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
Front Yard, 3 Nelson Road, Lindfield, NSW - Wednesday 28 May 2025
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
Front Yard, 3 Nelson Road, Lindfield, NSW - Thursday 29 May 2025
High Winds
Rain
L1
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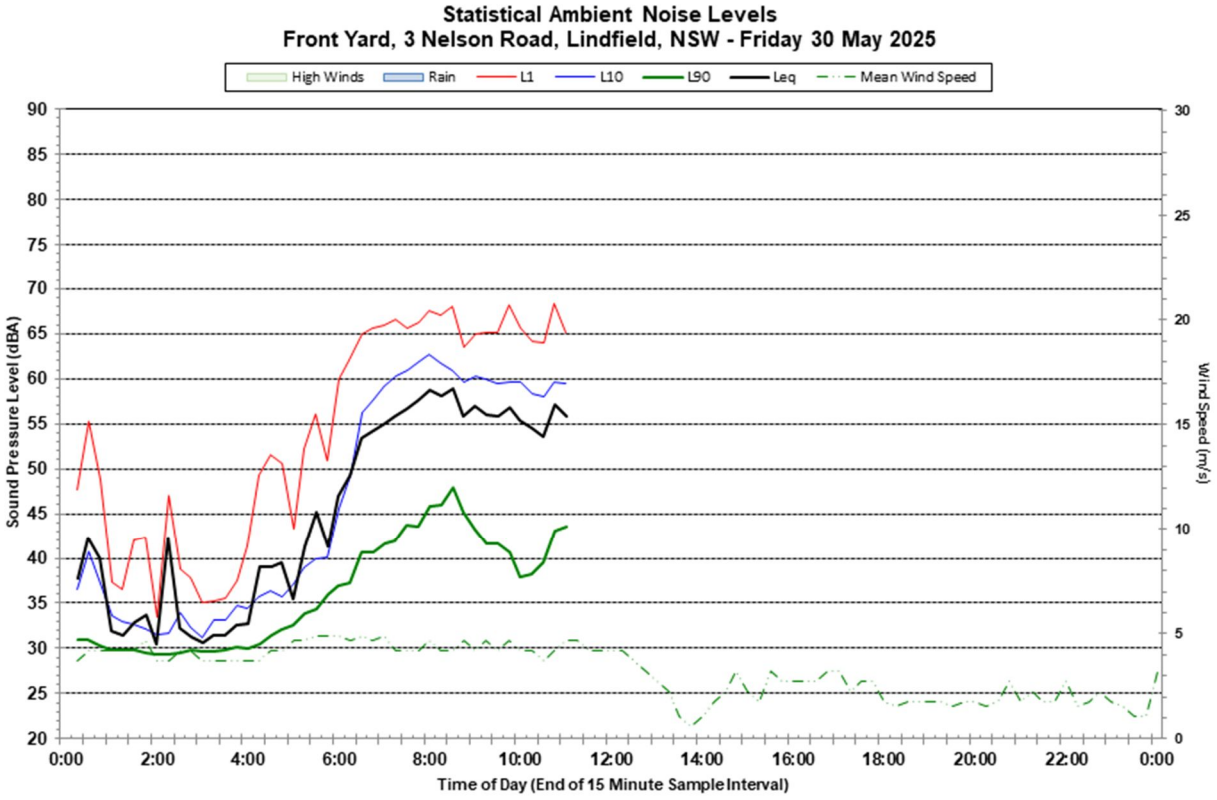
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Front Yard, 3 Nelson Road, Lindfield, NSW - Friday 30 May 2025
High Winds
Rain
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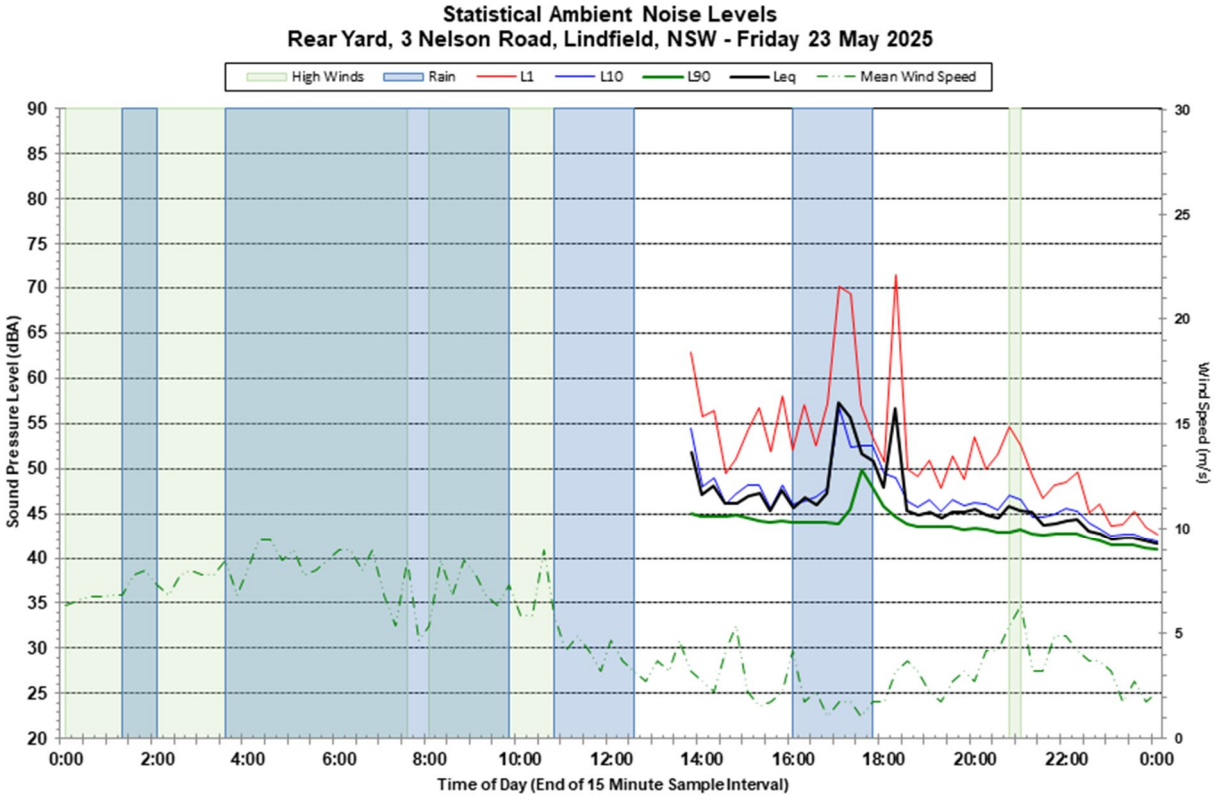
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Rear Yard, 3 Nelson Road, Lindfield, NSW - Friday 23 May 2025
High Winds
Rain
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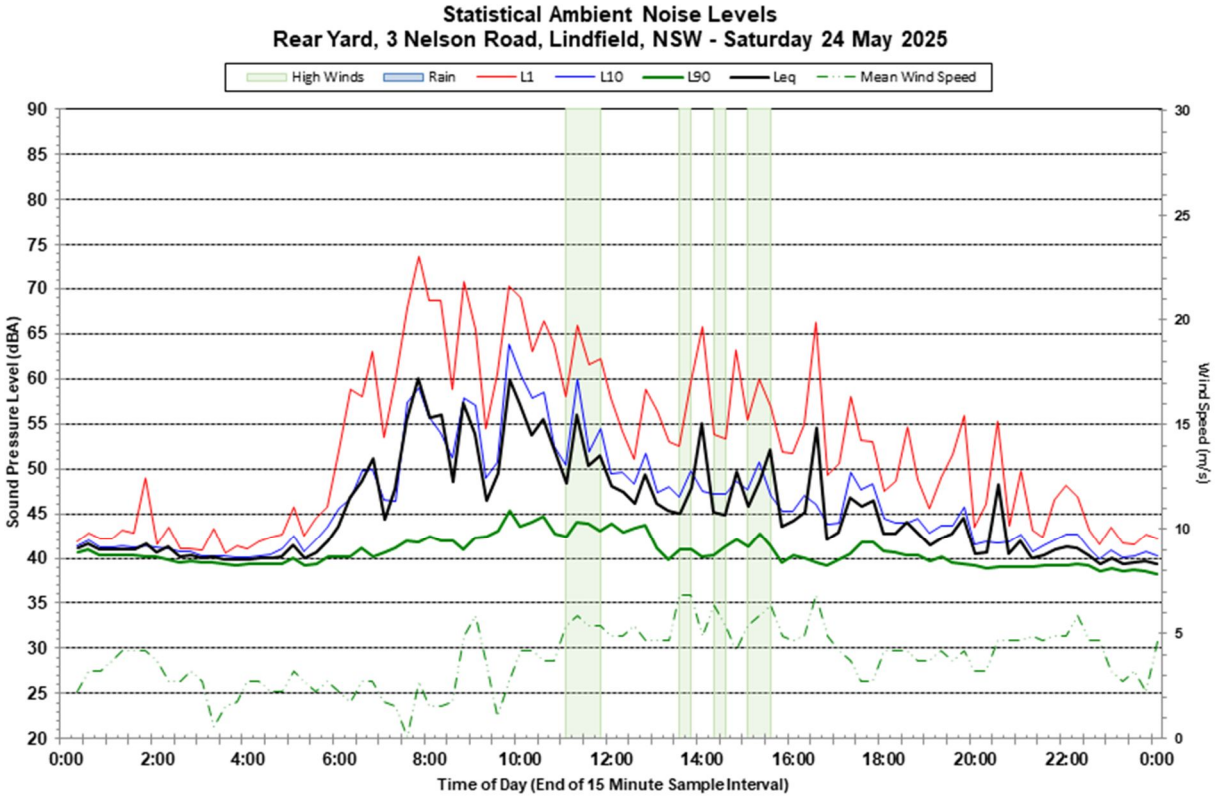
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
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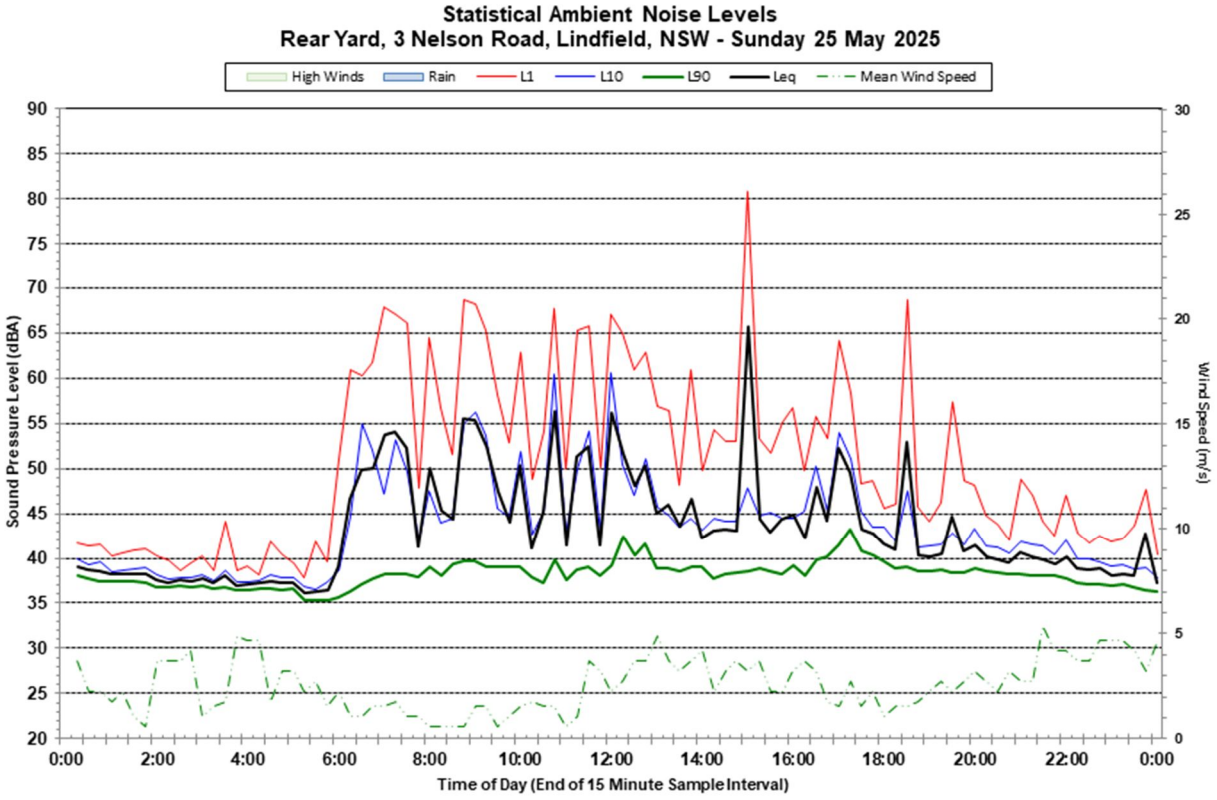
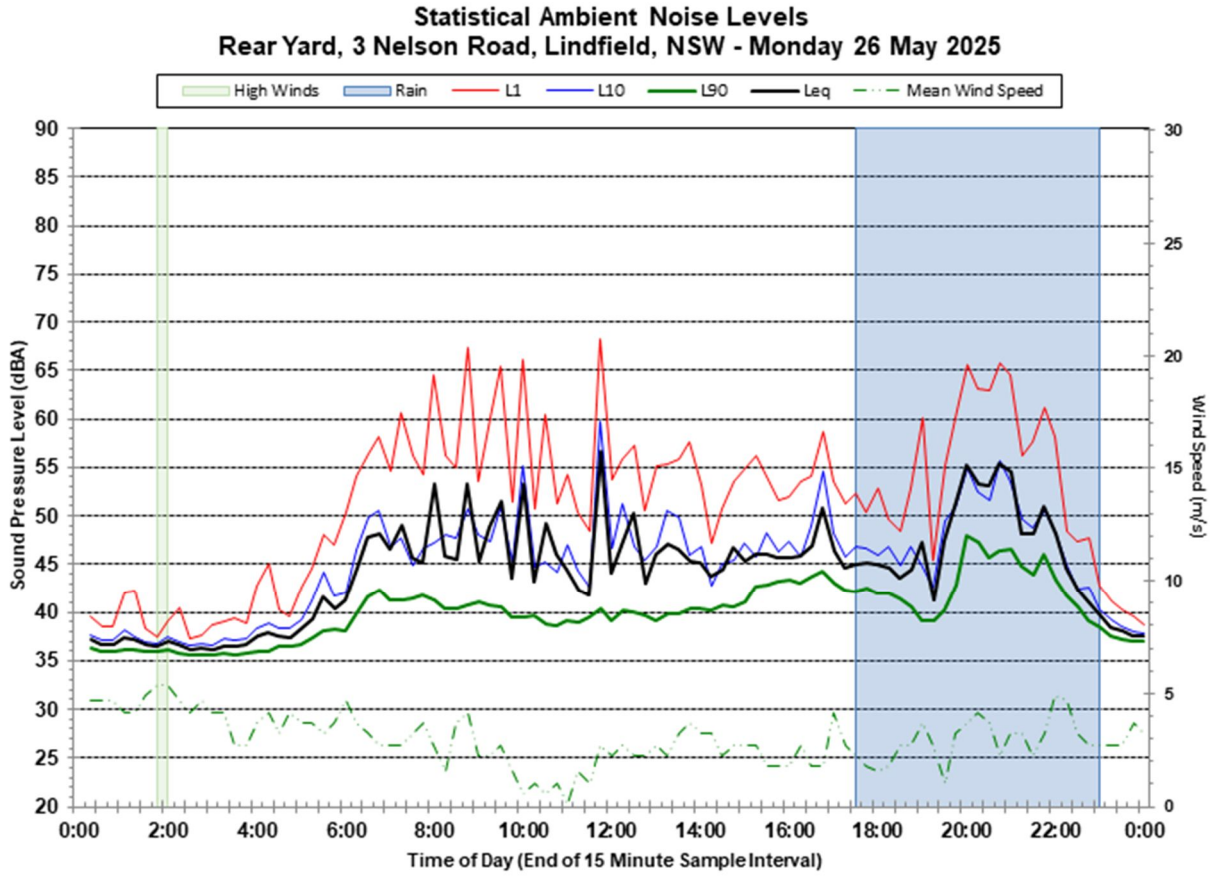
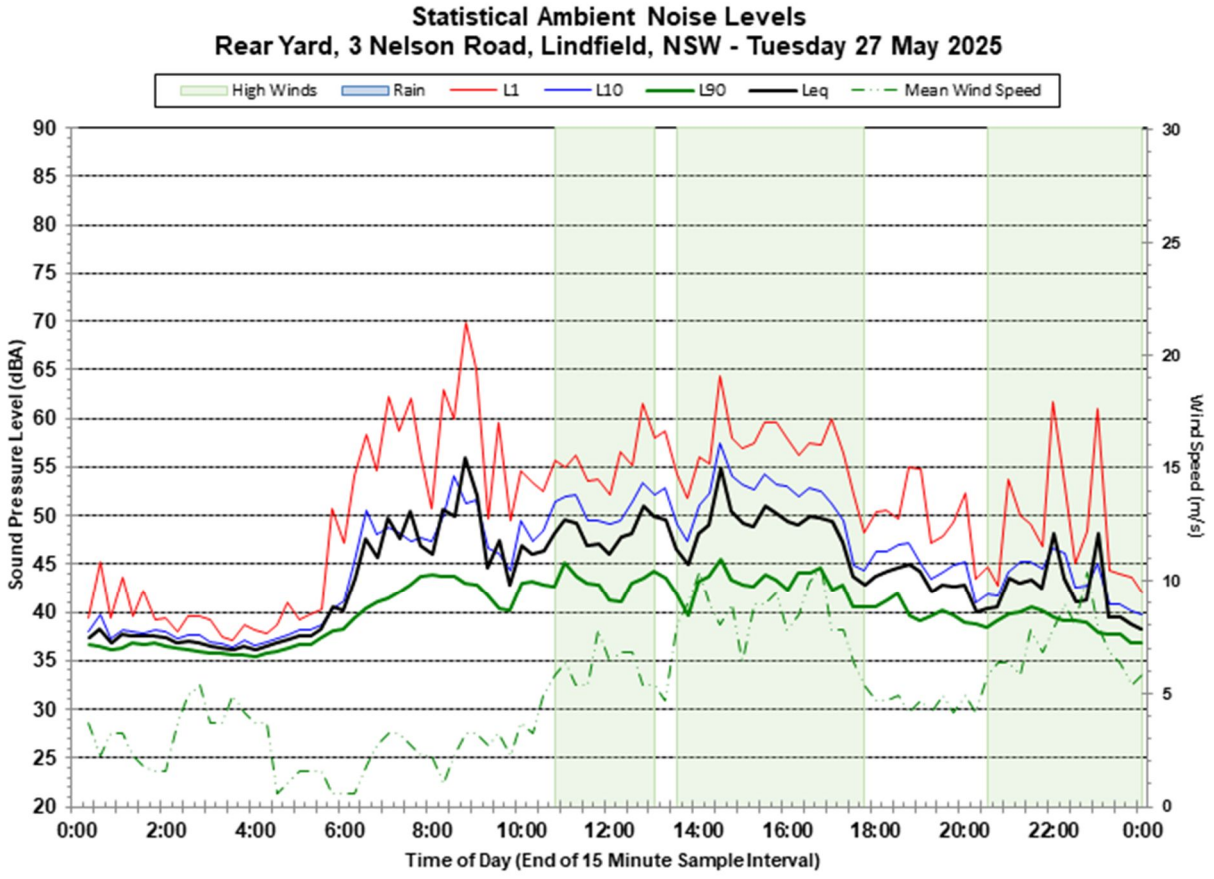
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Rear Yard, 3 Nelson Road, Lindfield, NSW - Sunday 25 May 2025
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
Rear Yard, 3 Nelson Road, Lindfield, NSW - Monday 26 May 2025
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
Rear Yard, 3 Nelson Road, Lindfield, NSW - Tuesday 27 May 2025
High Winds
Rain
L1
L10
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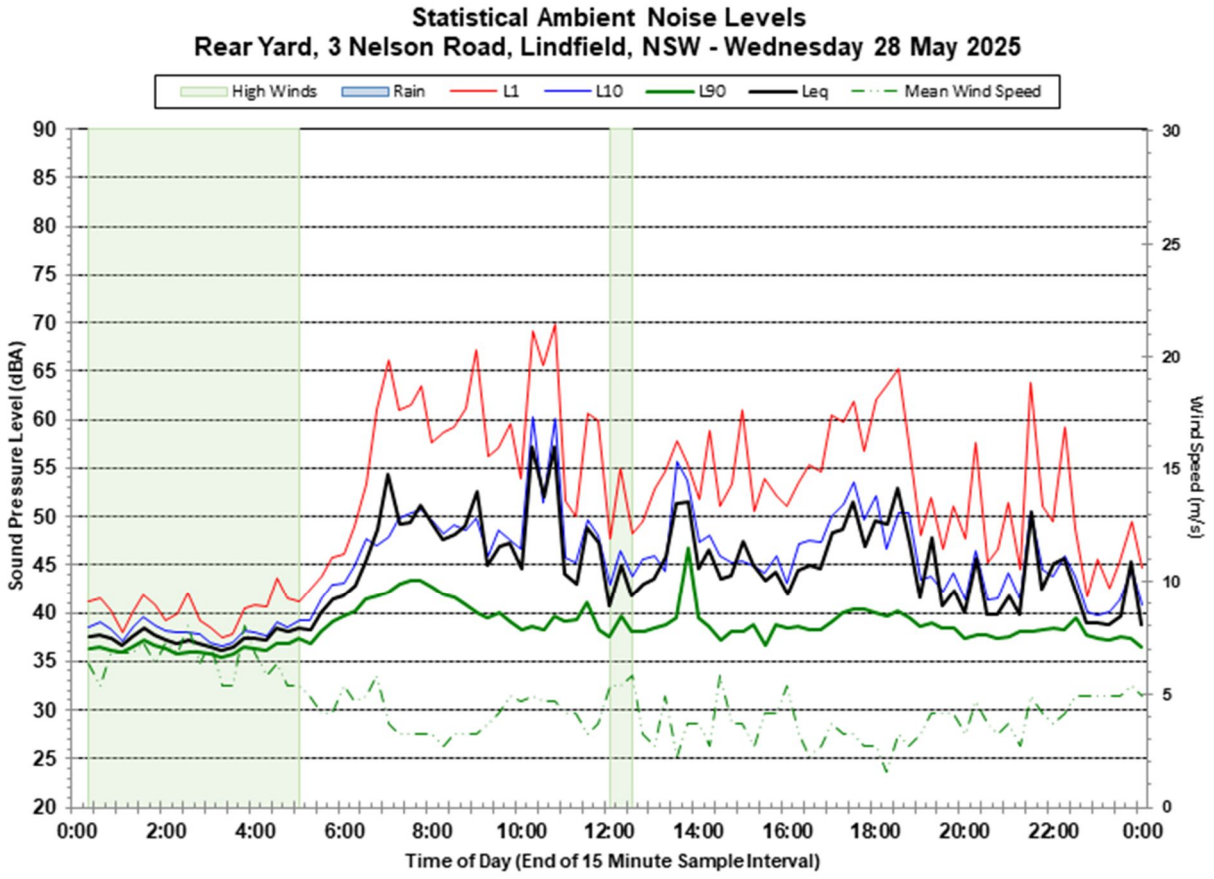
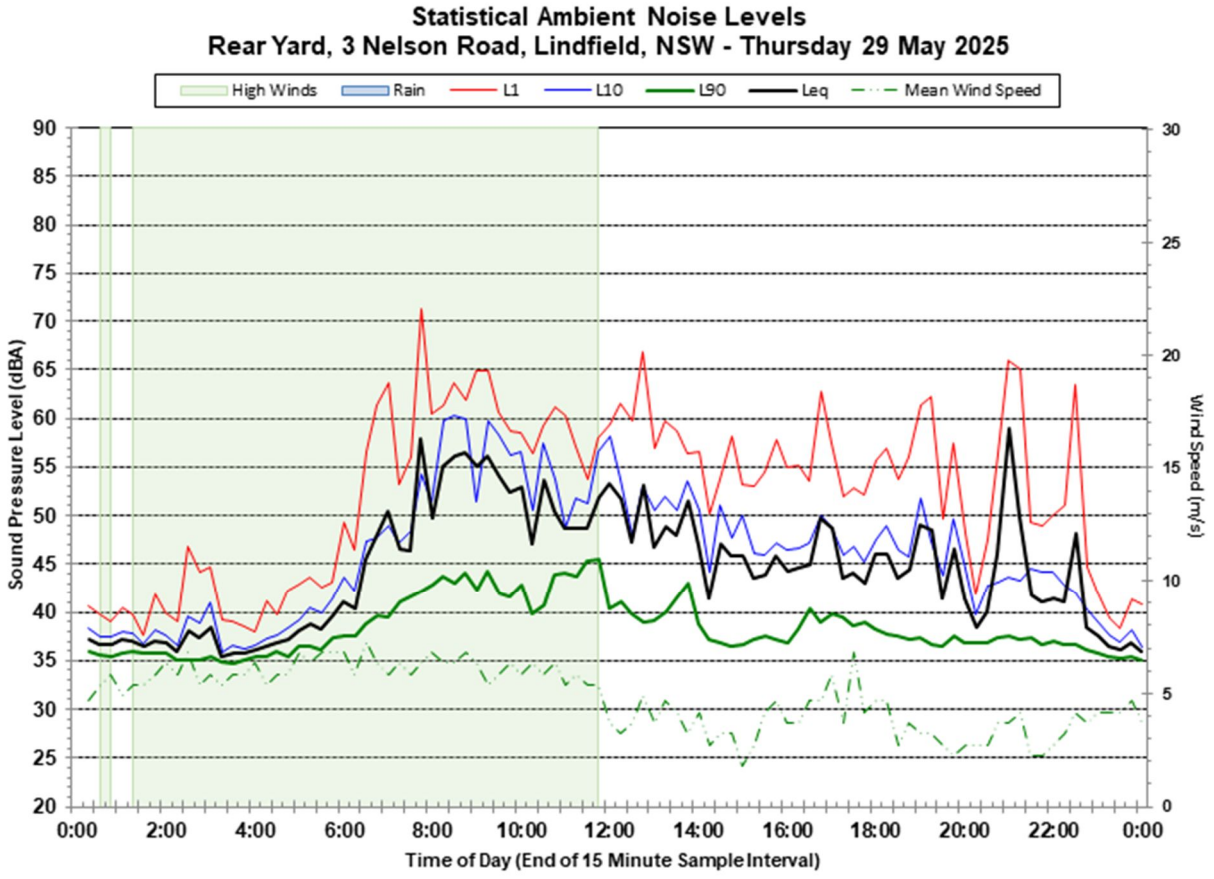
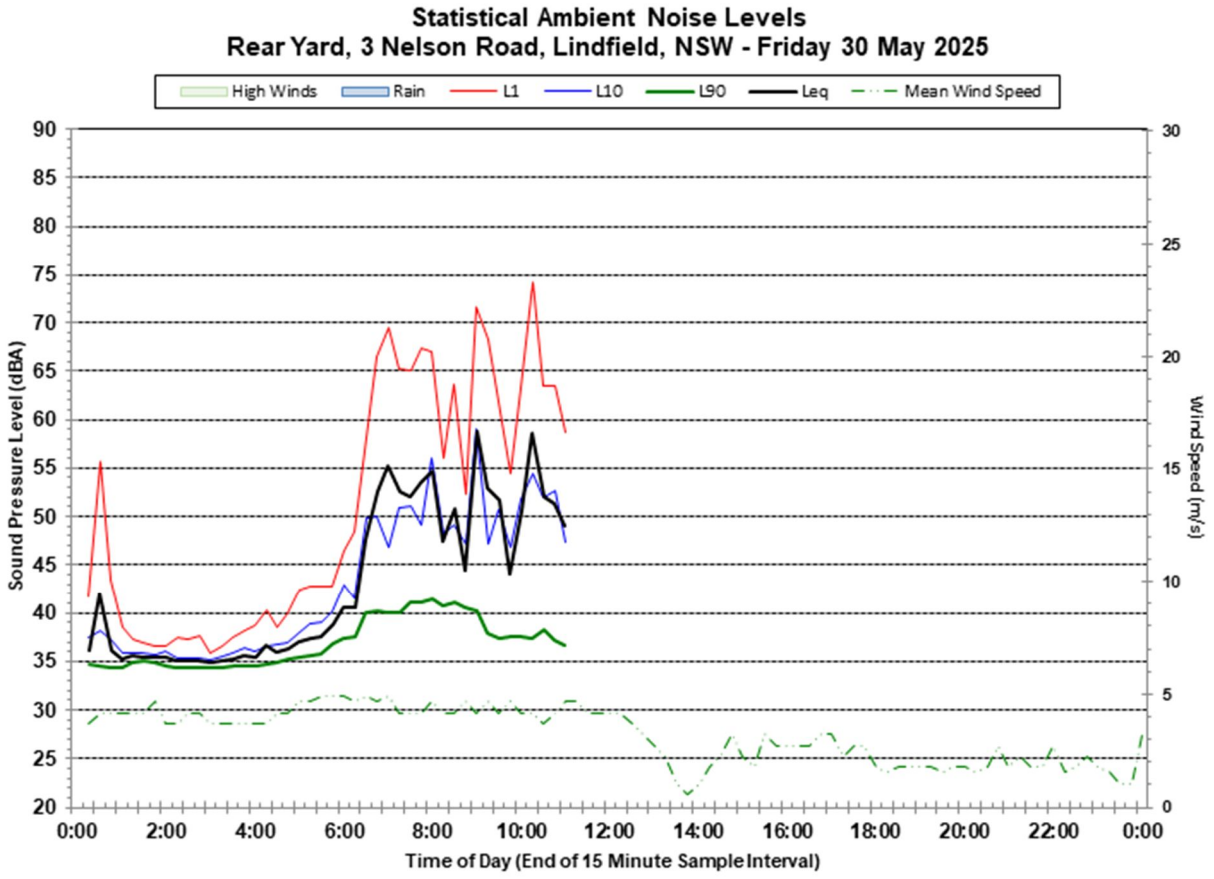
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Rear Yard, 3 Nelson Road, Lindfield, NSW - Wednesday 28 May 2025
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
Rear Yard, 3 Nelson Road, Lindfield, NSW - Thursday 29 May 2025
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
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