Social and Affordable Housing – 2 Flide Street, Caringbah

Noise and Vibration Impact Assessment

Prepared for: Homes NSW

Project No: SYD3634
Date: 17 September 2025
Revision: 01

Project:	Social and Affordable Housing – 2 Flide Street, Caringbah
Location:	2 Flide Street Caringbah, NSW, 2229
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Project No:	SYD3634
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Rev	Date	Comment	Author	Signature	Technical Review	Signature	Authorisa-tion & QA	Signature
00	18/08/2025	SSDA	MJ	MJ	JK	JK	SY	SY
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Project Team	
Client / Principal	Homes NSW
Architect	Bates Smart

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1. Context

This noise and vibration impact assessment has been prepared by ADP Consulting on behalf of Homes NSW for a concurrent State Significant Development Application (SSD-84862461) and Planning Proposal for the redevelopment of existing social housing (the Project) at 2 Flide Street, Caringbah (the Site). The project involves the construction of two residential flat buildings—one rising to part 13 and part 14 storeys, and the other to 8 storeys—comprising a total of 164 social and affordable housing apartments. The development also includes a communal room and a two-level basement car park. To support the Proposal, adjustments to the permissible building height and floor space ratio (FSR) via an amendment to the Sutherland Shire Local Environment Plan 2015 are required.

The purpose of this noise and vibration impact assessment is to:

- Assess noise intrusion to the proposed development from existing environmental noise sources.
- Assess noise emissions from the development's mechanical plant to the surrounding area.
- Provide deemed-to-satisfy construction methods for compliance with Volume One Part F7 of the Building Code of Australia.
- Assess construction noise and vibration impacts on the surrounding area.

This noise and vibration impact assessment is also to address:

1. The Secretary's Environmental Assessment Requirements (SEARs) for the Project issued on 6 June 2025
2. The Requirements for State Assessed Rezoning Proposal issued for the Project by Department of Planning, Housing and Infrastructure on 12 June 2025.

1.1 The Site

The Site is located within the Sutherland Shire local government area (LGA) and is zoned R4 High Density Residential under the *Sutherland Shire Local Environmental Plan* (SSLEP) *2015*.

The Site has a total area of approximately 3,596 square metres (sqm) and is bound by Flide Street to the north, Gardere Street to the west, Willawong Road to the east and the rail corridor for the T4 Eastern Suburbs & Illawarra Line to the south. Refer to Figure X.

The site is accessible by public transport, being within 400m of the entrance to Caringbah Station and bust stops on the Kingsway which have frequent services to Sutherland, Miranda and Cronulla.

The Site currently comprises 38 social housing units within two 3 storey buildings with a single level basement car park.

Figure 1 Site Location – Source: Google Earth

1.2 Proposed Development

The proposed development comprises the construction of two residential flat buildings—one rising to part 13 and part 14 storeys, and the other to 8 storeys—comprising a total of 164 social and affordable housing apartments. The development also includes a communal room and a two-level basement car park.

The proposal includes bulk earthworks, tree removal and associated landscaping and public domain works.

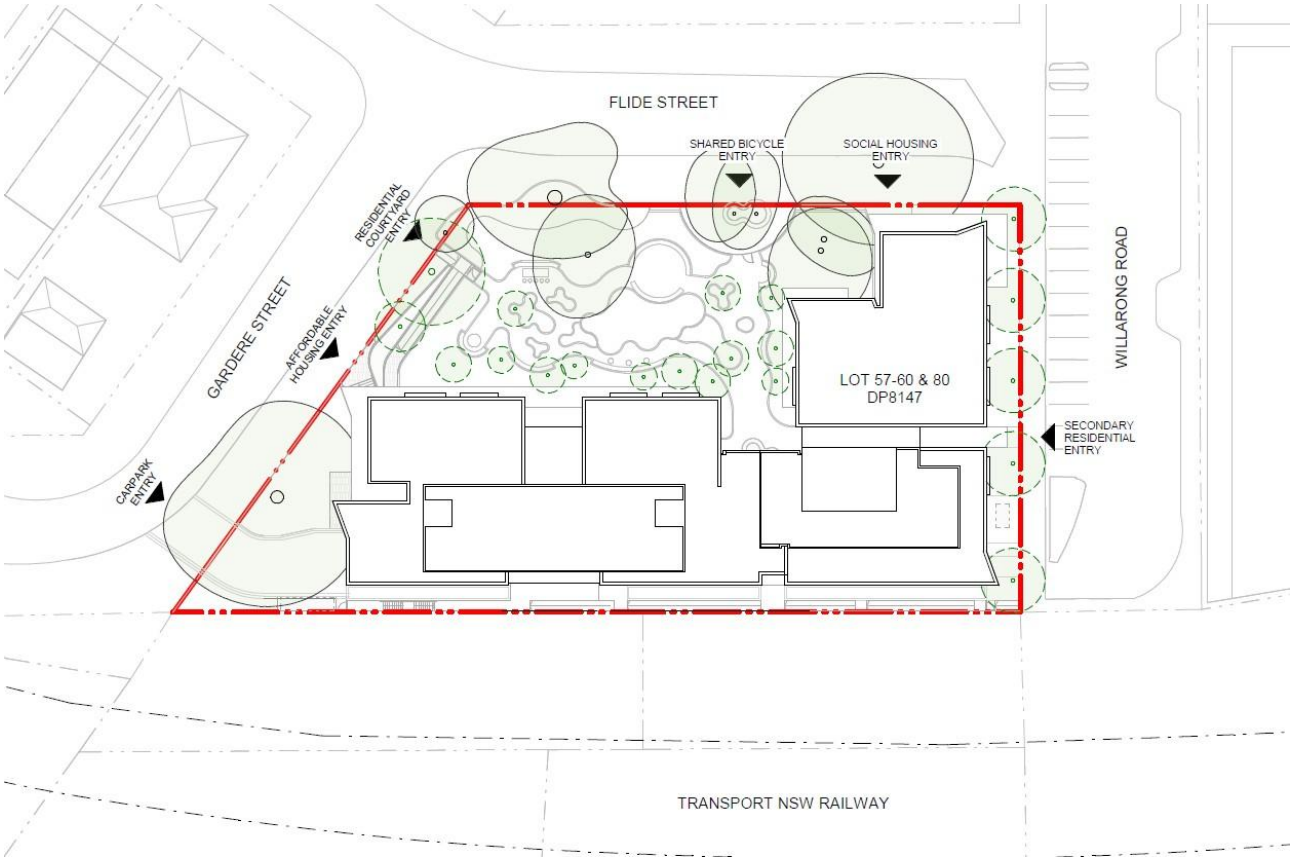
To support the Proposal, a concurrent Planning Proposal seeks amendments to the development standards within SSLEP as follows:

- Building Height – Increase the maximum building height development standard from 16m to 50m; and
- FSR – Increase the maximum FSR development standard from 1.2:1 to 4:1.

The existing buildings on the Site were approved for demolition under Division 5.1 of the *Environmental Planning and Assessment Act 1979,* and does not form part of this proposal. This included removal of all trees on top of the existing basement.

Refer to the Site Plan below.

Figure 2 Site Plan – Image Source: Bates Smart



1.3 Site Analysis

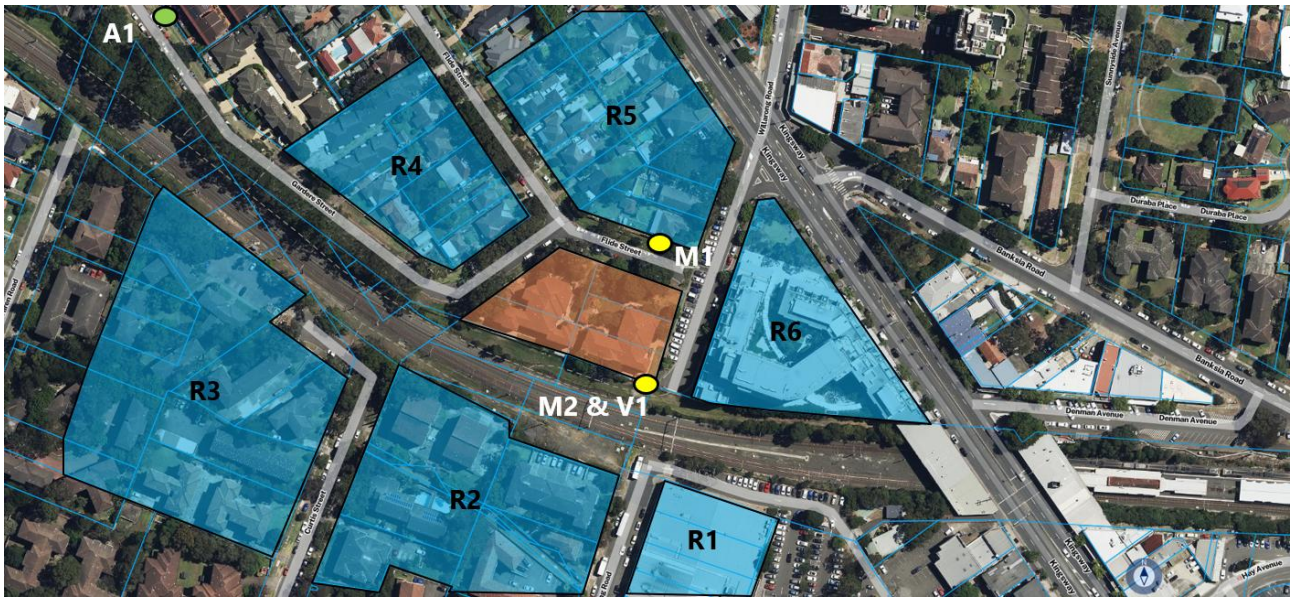
The project site is located at the R4 'High Density Residential' land zone at 2 Flide Street, Caringbah. A site investigation has been carried out to identify noise sources that will potentially impact the project development and the nearest noise-sensitive receivers.

The subject site is bounded by the following noise sources:

- Rail pass-by events from the T4 Eastern Suburbs & Illawarra rail corridor to the south.
- Road traffic noise from Kingsway to the northeast.
- Local residential activity and mechanical plant systems.

Figure 1 below presents an aerial photo of the project site, the nearest noise-sensitive receivers and the location of long-term noise monitoring.

Figure 3 Subject site, surrounding area and noise monitoring location – Image Source: SixMaps



= Development area

= Nearest residential receivers

= Attended noise monitoring locations

= Unattended noise logger location / Attended vibration location

1.4 Referenced Drawings, Codes, and Standards

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

- Architectural drawings prepared by Bates Smart with project number S12899.
- The Sutherland Shire Council Local Environmental Plan (LEP) and Development Control Plan.
- AS/NZS 2107:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors (AS 2107).
- NSW EPA's Noise Policy for Industry dated October 2017 (NPfI).
- Protection of the Environment Operations Act 1997 – Offensive Noise Definition (POEO 1997).
- Protection of the Environment Operations Regulation 2017 (POEO 2017).
- NSW EPA Noise Guide for Local Government 2023 (NGfLG).
- National Construction Code 2022 – Volume One, Building Code of Australia.
- State Environmental Planning Policy (Transport and Infrastructure) 2021.
- NSW Department of Planning '*Development Near Rail Corridors and Busy Roads*' – Interim Guideline 2008.
- NSW Department of Environment and Climate Change NSW, "*Interim Construction Noise Guideline*," (ICNG), Sydney, 2009.
- AS 2436:2016 *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*.

- Department for Environment Food and Rural Affairs (United Kingdom) *Noise Database for Prediction of Noise on Construction and Open Sites,* 2005.
- NSW Department of Environment and Conservation "*Assessing Vibration: A technical guideline*," Sydney, 2006.
- Australian Standard AS2670.2:1990 *Evaluation of Human Exposure to Whole-Body Vibration Part 2: Continuous and Shock-Induced Vibration in Buildings* (1 to 80 Hz) (AS 2670.2).
- DIN 4150-3 (1992-02) *Structural vibration – Effects of vibration on structures*.
- BS 7385.2:1993 *Evaluation and Measurement for Vibration in Buildings Part 2: Guide to Damage Levels from Ground-borne Vibration (BS 7385.2:1993).*
- Dept of Environment and Conservation (DEC) NSW *Assessing Vibration: A Technical Guideline* (AVTG) 2006.

2. Noise Surveys

Unattended and attended noise and vibration surveys were conducted at the site to determine the noise emission criteria and noise intrusion requirements for the proposed development. This Section presents a summary of the noise surveys conducted for this assessment.

2.1 Noise Measurement Equipment

The following instrumentation was used for noise measurement and analysis:

> Bruel and Kjaer Sound calibrator Type 4231

> Two Convergence Instruments Type 1 Noise Sentry Data Loggers NSRT MK3.

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

2.2 Attended Vibration Measurements

An attended vibration survey was conducted at 2 Flide Street, Caringbah on 30th May 2025. Rail vibration levels were measured with a Vibrock 901 seismograph. Vibration levels were recorded in the x-, y- and z-axes as unweighted rms acceleration (root mean square). The survey data was subsequently analysed as per ISO2631-2:2003 to determine a Vibration Dose Value (VDV) in $m/s^{1.75}$ for each measured train pass-by event.

The calculated VDV's for all recorded events were averaged. The average VDV for a single train pass-by event was then used to calculate the total Day and Night period VDV for all rail pass-bys. A summary of the surveyed data is included below.

Table 1 Rail Noise and Vibration Survey Results

Description	Value	Measurement Result [$m/s^{1.75}$]
Vibration from train pass-by	VDV	0.046

2.3 Unattended Noise Measurements

Unattended background and traffic noise monitoring was conducted in the period between Friday, 23rd May, to Thursday, 29th May 2025. At the locations as identified in Section 1.3.

The microphones were placed approximately 2 m above the natural ground level.

The measured background noise levels have been corrected for meteorological conditions (excessive wind and/or rain), as required by section 3.4 of the EPA Noise Policy for Industry. Exceedances of the 5m/s average wind speed limit of the EPA were noted and corrected for in determining the background noise levels.

Appendix B – Unattended Noise Monitoring Data provides the results of the unattended noise monitoring.

Measured background and equivalent continuous sound levels at locations M1 and M2 are summarised below.

Table 2 Unattended Noise Logging Results

Location	Period	Ambient Noise Level[1] (L_{Aeq})	Rating Background Noise Level[1] – RBL (L_{A90})	Traffic Noise Level[2] ($L_{Aeq, Period}$)
M1	Day	62	52	60
	Evening	59	50	
	Night	54	38	54
M2	Day	63	51	61
	Evening	59	47	
	Night	54	41	54
Notes:	1. Day periods are outlined below: Daytime: 7 am – 6 pm (Monday-Saturday) Daytime: 8 am – 6 pm (Sundays and Public Holidays) Evening: 6 pm – 10 pm Nighttime: 10 pm – 7 am (Mondays-Saturdays) Nighttime: 10 pm – 8 am (Sundays and Public Holidays) 2. 15-hour and 9-hour traffic levels outlined per NSW Department of Planning guidelines.			

3. Criteria

3.1 Noise Intrusion Criteria

3.1.1 The Sutherland Shire Development Control Plan (DCP) 2015

Chapter 6 of the Sutherland Shire Development Control Plan (DCP) 2015 provides objectives and design principles for the acoustic amenity of new residential development. The following are provided regarding noise and vibration intrusion to the proposed development.

"Residential development adjacent to a rail corridor or a busy road as identified on the Road and Rail Noise Buffer Map should be sited and designed to include noise and vibration attenuation measures to minimise noise and vibration impacts. Refer to State Environmental Planning Policy (Infrastructure) 2007 and the NSW Department of Planning's Development near Rail Corridors and Busy Roads – Interim Guidelines."

3.1.2 State Environmental Planning Policy (Transport & Infrastructure) 2021

Due to the proximity of a railway corridor to the proposed development, the State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP) must be considered.

Clause 2.100 of the State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP), specifies indoor noise level requirements for non-rail developments that are for residential use. The following are stated:

> *(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.*

The SEPP also states the following:

> *(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.*

3.1.3 NSW Department of Planning Interim Guidelines

Further to the above, Section 3.6.1 of the DoP interim guideline (now the Department of Planning, Housing and Infrastructure) outlines that habitable rooms inside a residential building should comply with the following:

Table 3 NSW DoP Internal Noise Criteria – [dB(A)]

Type of Occupancy	Noise Level	Applicable Time Period
Sleeping area (bedroom)	35	Night [10 pm – 7 am]
Other habitable rooms	40	Any time

Further to this, the Interim Guidelines make allowances of 10 dBA above the SEPP internal noise criteria for rooms with windows and doors open. Outdoor noise levels in exceedance of 10 dBA above the internal noise level criteria will require the room to be ventilated by alternative methods. Therefore, the target internal noise levels for apartments that require open doors and windows may be presented as:

a) *In any bedroom in the building – 45 dB(A) at any time between 10.00pm and 7.00am,*

b) *Anywhere else in the building (other than a garage, kitchen, bathroom or hallway) – 50 dB(A) at any time.*

3.1.4 AS/NZS 2107:2016

Indoor background noise levels in terms of Sound Pressure Level (SPL) and reverberation times (seconds) deemed acceptable to most occupants are published in AS/NZS 2107 and have been referred to in this assessment for non-habitable areas, where SEPPTI or the NSW Department of Planning, Housing and Infrastructure do not provide criteria. The table below summarises the recommended indoor noise levels and reverberation times for the proposed development in Table 4.

Furthermore, the façade should be designed to achieve the noise levels presented in Table 4.

Table 4 Internal design sound pressure levels and reverberation time recommendations

Type of occupancy	Design SPL, L_{Aeq}, dB(A)
Washrooms and toilets	45 to 50
Enclosed carparks	< 65

3.1.5 DEC NSW Assessing Vibration: A Technical Guideline

The NSW Department of Environment and Conservation's document Assessing Vibration: A Technical Guideline provides acceptable vibration dose values from intermittent vibration to various types of building uses.

The follow extract details acceptable vibration levels for residential areas, which have been used in this assessment:

Figure 4 Acceptable Vibration Levels – Image Source: NSW DEC Assessing Vibration: A Technical Guideline

Table 2.4 Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas.
Source: BS 6472–1992

Assessing vibration: a technical guideline

3.2 Noise Emission Criteria

3.2.1 The Sutherland Shire Development Control Plan (DCP) 2015

Chapter 6 of the Sutherland Shire Development Control Plan (DCP) 2015 provides objectives and design principles for the acoustic amenity of new residential development. The following are provided regarding noise emissions from the proposed development.

"*All noise generating equipment such as mechanical plant or equipment, air conditioning units, swimming pool filters, fixed vacuum systems, mechanical ventilation from carparks, driveway entry shutters, garbage collection areas or similar must be designed to protect the acoustic privacy of residents and neighbours. All such noise generating equipment must be acoustically screened. The noise level generated by any equipment must not exceed an LAeq (15min) of 5dB(A) above background noise at the property boundary*".

Based on the above, the following criteria apply:

- R4, R5 and Northern Half of R6
  - Day: **$L_{Aeq,\ 15\ minutes}$ 57 dB**
  - Evening: **$L_{Aeq,\ 15\ minutes}$ 55 dB**
  - Night: **$L_{Aeq,\ 15\ minutes}$ 43 dB**
- R1-R3 and Southern Half of R6
  - Day: **$L_{Aeq,\ 15\ minutes}$ 56 dB**
  - Evening: **$L_{Aeq,\ 15\ minutes}$ 52 dB**
  - Night: **$L_{Aeq,\ 15\ minutes}$ 46 dB**

3.2.2 Noise Policy for Industry, EPA NSW (NPfI)

The NPfI requires compliance with specific *project noise trigger levels*, which provide a benchmark or objective for assessing a proposal or site. The project noise trigger level is not a mandatory requirement but rather indicates a potential noise impact on the community, and so 'triggers' a management response, for example, further investigation of mitigation measures.

The *project trigger levels* are determined from the lower (that is, the more stringent) value of the project *intrusiveness noise level* and *project amenity noise level*. The NPfI also includes the application of modifying factors for undesirable noise characteristics such as tonality or impulsiveness, up to a maximum of 10dB.

Noise intrusiveness

The NPfI states that the intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level (L_{A90}) measured in the absence of the source by more than 5 dB.

Amenity noise levels

The NPfI describes a methodology to limit gradual increases in noise levels from the introduction of new noise sources in an area, sometimes referred to as 'background noise creep'.

The *recommended amenity noise levels* represent the objective for total noise at a receiver location, whereas the *project amenity noise level* represents the objective for noise from this project. The *project amenity noise level* for developments = *recommended amenity noise level* (Table 2.2) minus 5 dB(A). 3 dB is then added to convert from an L_{Aeq}, period to $L_{Aeq,\ 15min}$.

NPfI Table 2.2 specifies amenity noise levels for different types of receivers.

Modifying Factors

Undesirable characteristics such as tonality, low frequency, impulsiveness and intermittency, adjustments (as per Fact Sheet C of the NPfI) shall be assessed. These modifying factors include a 5dB penalty for each undesirable characteristic. A maximum penalty of 10dB for 2 or more undesirable characteristics applies.

Considering the noise-sensitive receivers surrounding the site are subject to different noise environments, the relative difference between the simultaneous attended noise measurements and the 15-minute samples from the unattended noise monitoring during the same period has been used to extrapolate RBLs at monitoring Locations L1 and L2. This has been done to derive more accurate and reasonable noise emission criteria.

Summary of NPfI environmental noise criteria

A summary of noise emission criteria that apply at residential receivers from the use of the proposed development is presented in the following table.

The 'project trigger levels' are the most stringent noise criteria of the intrusive and amenity noise levels that apply in each instance.

Table 5 EPA NPfI Planning Levels – $L_{Aeq,\ 15\text{-}minutes}$ [dBA]

Period	Intrusive		Amenity					Project Noise Trigger Level
	RBL	RBL + 5 dB	Area Classification	Recommended Amenity Noise Level	High Traffic Area	Project Amenity Noise Level	+3 dB Correction	
R4, R5 and the Northern Half of R6								
Day	52	57	Urban	60	No	55	58	**57**
Evening	50	55	Urban	50	No	45	48	**48**
Night	38	43	Urban	45	No	40	43	**43**
R1-R3 and the Southern Half of R6								
Day	51	56	Urban	60	No	55	58	**56**
Evening	47	52	Urban	50	No	45	48	**48**
Night	41	46	Urban	45	No	40	43	**43**
Other noise-sensitive receivers								
Commercial	--	--	Commercial	65	--	60	63	**63**
Notes:	1. Periods as defined by EPA are outlined below: Daytime: 7 am – 6 pm (Monday-Saturday) Daytime: 8 am – 6 pm (Sundays and Public Holidays) Evening: 6 pm – 10 pm Nighttime: 10 pm – 7 am (Mondays-Saturdays) Nighttime: 10 pm – 8 am (Sundays and Public Holidays)							

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

Clause 45 of the POEO 2017 Regulation states that all air-conditioning units installed on residential premises must not emit a noise that is audible inside a habitable room of an adjoining residential premise during the nighttime period. The following has been extracted and reproduced from the regulation:

"*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"

The inaudibility criteria have been taken as 5-8 dB below the existing nighttime background noise level, when assessed externally at neighbouring building facades. In this regard, the inaudibility criterion that applies to this development is:

> M1: **$L_{Aeq,\ 15\ minutes}$ 30-33 dB**

> M2: **$L_{Aeq,\ 15\ minutes}$ 33-36 dB**

3.3 Inter-tenancy Noise Criteria – BCA/NCC

The Building Code of Australia (BCA) as part of the National Construction Code (NCC) outlines the minimum performance requirements of buildings to protect the occupants, surrounding area and infrastructure in terms of safety, amenity, accessibility and sustainability. Sound insulation requirements for Class 2, 3 or 9c buildings are outlined in the BCA to protect occupants from loss of amenity due to excessive noise transfer.

The proposed development is a Class 2 building; thus, BCA Volume 1 applies to this project.

The NCC requirements can be achieved through either a deemed-to-satisfy or performance solution. A performance solution is satisfied using either of the following:

- Evidence of suitability, using an accredited laboratory test, per BCA 2022 Schedule 1.
- Expert judgement.
- Compliance with an acceptable form of construction (Specification 28).

The deemed-to-satisfy requirements for this development are outlined in the Table below.

Table 6 BCA/NCC Acoustic Design Requirements

Element	Description	Airborne Sound	Impact Sound
Walls	Separating any two sole occupancy units	$R_w + C_{tr} \geq 50$	N/A
	Separating a habitable room in one SOU and a laundry, kitchen, bathroom or toilet in another SOU	$R_w + C_{tr} \geq 50$	Discontinuous construction
	Separating a sole occupancy unit and a stairway, public corridor, public lobby or the like, or parts of a different classification	$R_w \geq 50$	N/A
	Separating a sole occupancy unit and a plant room or lift shaft	$R_w \geq 50$	Discontinuous construction
Doors	Door that separates a sole occupancy unit from a stairway, public corridor, public lobby or the like	$R_w \geq 30$	N/A
Floors	Separating any two sole occupancy units, or separating a sole occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification	$R_w + C_{tr} \geq 50$	$L_{n,w} \leq 62$
Services	If the adjacent room is a habitable room	$R_w + C_{tr} \geq 40$	N/A
	If the adjacent room is a non-habitable (wet) room	$R_w + C_{tr} \geq 25$	N/A
	Access panel in acoustical walls and acoustical barrier ceilings	$R_w + C_{tr} \geq 25$	N/A
	If a stormwater pipe passes through a sole-occupancy unit, it must be separated as stated above.		
	A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating or other pump.		
Notes	1. Discontinuous construction means a wall having a minimum 20mm cavity between 2 separate leaves and: a. For masonry walls where ties are required between leaves, they are to be of the resilient type, and		

Element	Description	Airborne Sound	Impact Sound
	b. For walls other than masonry, no mechanical linkage between the leaves, except at the perimeter.		

3.4 Construction Noise and Vibration Criteria

3.4.1 Construction Noise Emission Criteria

The *Draft Construction Noise Guideline, dated 2020,* was produced by EPA to replace the Interim Guideline, dated 2009. It sets out a framework for the management of construction noise through feasible and reasonable mitigation measures. The key objective of the Guideline is to ensure that noise impacts from construction are adequately controlled.

The framework outlines the following steps:

- Identify sensitive land uses and construction hours.
- Select the assessment method between a qualitative assessment and a quantitative assessment. A qualitative assessment involves a simplified procedure appropriate for noise sources unlikely to cause significant noise impacts, while a quantitative assessment predicts noise from activities at noise-sensitive receivers and is required for projects where the expected construction duration will exceed 3 weeks.
- For a quantitative assessment, the procedures in Section 5 of the Guideline should be followed to predict construction noise levels; the predicted levels should be compared against the relevant noise management levels set out in Tables 3, 4 and 6 of the Guideline, to identify feasible and reasonable mitigation.

Section 5.3 of the Guideline presents Noise Management Levels (NMLs) for airborne noise at residences and provides supplementary mitigation measures. These are presented in the following Table.

- The 'noise affected' level represents the point above which there may be **some community reaction** to noise.
- The 'highly noise affected' level represents the point above which there may be **strong community reaction** to noise.

Table 7 Noise management levels to residences (Tables 3 and 4 of the EPA Draft Construction Noise Guideline)

Time of Day	Management level, $L_{Aeq\ (15\ min)}$	How to apply
Recommended Standard Hours Monday to Friday: 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or Public Holidays	Noise affected level RBL[1] + 10 dB	Where the predicted or measured $L_{Aeq,\ 15min}$ is greater than the noise-affected management level, the proponent shall apply all feasible and reasonable work practices to meet this level. As a matter of good practice, noise should be reduced as far as reasonably practicable. The proponent should notify all potentially impacted residents.
	Highly noise-affected level 75 dB(A)	Where noise is above the highly noise-affected management level, all feasible and reasonable mitigation shall be applied as well as engagement with the consent authority or regulator to identify other measures to manage noise impacts. Where appropriate, engagement with the community is encouraged to determine the preferred mitigation approach, such as: > negotiated agreements and/or respite periods to restrict work activity.

		> identification of times when the community is less sensitive to noise, including options for longer periods of construction in exchange for restrictions on construction times.
Outside recommended standard hours:	Noise affected level: RBL + 5 dB	Strong justification is required for works outside the recommended standard hours. The proponent shall apply all feasible and reasonable work practices to meet the noise-affected management level. Where this cannot be met, residual impacts should be quantified, and potentially impacted residents notified. The supplementary mitigation described in Table 5 of the Guideline must also be considered, subject to the application notes in Section 5.4.
	Highly noise-affected level 65 dB(A)	The highly noise-affected management level represents the point above which the supplementary mitigation described in Table 5 must be considered, subject to the application notes in Section 5.4. The proponent must justify the selection of feasible and reasonable mitigation, including the supplementary mitigation, with emphasis on consultation with the community and the consent authority or regulator, and community views on work scheduling and respite periods, as described in Section 5.4.

Notes:

1. RBL as defined in *Noise Policy for Industry*

Section 5.5 of the Guideline also presents noise management levels for construction noise at non-residential noise-sensitive receivers. A summary is presented in the following Section of this report.

3.4.1.1 Summary of Construction Noise Criteria

Using the methodology outlined above and the Rating Background Levels determined in Section 2.3, Noise Management Levels for all receivers are presented below.

Table 8 Noise Management Levels

Time of Day	Land Use	Noise Management Level $L_{Aeq\ (15\ min)}$ dB(A)	
		Noise affected	Highly noise-affected
Recommended standard hours: Monday to Friday: 7:00 am to 6:00 pm	**Residential** *R4, R5 and the Northern Half of R6*	62	75
Saturday 8:00 am to 1:00 pm No work on Sundays or Public Holidays	**Residential** *R1-R3 and the Southern Half of R4 and R6*	61	75
Outside of recommended standard hours*	**Residential** *R4, R5 and the Northern Half of R6*	57	65

	Residential		
	R1-R3 and the Southern Half of R6	56	65

3.4.2 Construction Vibration Emission Criteria

EPA *Draft Construction Noise Guideline* does not include criteria for vibration generated from construction works. Vibration shall be measured and assessed in accordance with *Assessing Vibration: A Technical Guideline* (AVTG).

The criteria outlined in the AVTG is based on BS 6472-1992. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent'.

Vibration is assessed in the following categories:

- Human comfort
- Structural damage
- Ground-borne noise

3.4.2.1 Human Comfort

Human comfort due to exposure to vibrations is dependent on duration and magnitude. Vibration assessed for human comfort can be classified as continuous, impulsive, or intermittent and can enter the body along different orthogonal axes, i.e. x-axis (back to chest), y-axis (right side to left side), or z-axis (foot to head).

The AVTG refers to BS6472:1992 for human comfort criteria, which are outlined in the following sections.

3.4.2.2 Continuous and Impulsive Vibration

Allowable magnitudes for continuous and impulsive exposure to building vibration (summarised from Table 2.2 of AVTG) with respect to human response are presented in the following table.

Table 9 Continuous and impulsive vibration criteria, m/s^2

Location	Time of Construction	Preferred (rms)		Maximum (rms)	
		z-axis	x & y-axis	z-axis	x & y-axis
Continuous vibration					
Residences	Day (7 am – 10 pm)	0.010	0.0071	0.020	0.014
	Night (10 pm – 7 am)	0.007	0.005	0.014	0.010
Impulsive vibration					
Residences	Day (7 am – 10 pm)	0.30	0.21	0.60	0.42
	Night (10 pm – 7 am)	0.10	0.071	0.20	0.14

3.4.2.3 Intermittent Vibration

The VDV criteria recommended in AVTG are summarised in Table 10. To quantify the cumulative effects of several vibration events based on human exposure due to duration and magnitude, the Vibration Dose Value (VDV) descriptor is used.

Table 10 Intermittent vibration criteria, vibration dose values (VDV), $m/s^{1.75}$

Location	Time of Construction	Preferred (rms)	Maximum (rms)
Residences	Day (7 am – 10 pm)	0.20	0.40
	Night (10 pm – 7 am)	0.13	0.26

3.4.2.4 Structural Damage

BS 7385.2:1993 sets structural damage limits for during both the excavation and construction phases, and for both heritage and non-heritage buildings. No heritage buildings were identified in the vicinity of the project site.

The vibration limits in buildings associated with cosmetic damage in BS7385.2:1993 for non-heritage buildings are summarised in the Table below. Heritage buildings have not been identified in the vicinity of the proposed development.

Table 11 Transient vibration guide values for cosmetic damage for non-heritage buildings

Type of Building	Peak component particle velocity in frequency range of predominant pulse	
	4Hz to 15Hz	15Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50mm/s at 4Hz and above	
Unreinforced or light-framed structures Residential or light commercial-type buildings	15mm/s at 4Hz increasing to 20 mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above
	At frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded	

3.4.2.5 Ground-Borne Noise

Ground-borne noise is generated by vibration through the ground affecting structures through activities such as rock breaking or excavations. The EPA *Draft Construction Noise Guideline* (ICNG) states that noise management actions should be implemented (which may include community consultation and respite) when the following levels are exceeded:

- Evening (18:00-22:00) – Internal: $L_{Aeq\ 15min}$ – 40 dB(A)
- Night-time (22:00-07:00) – Internal: $L_{Aeq\ 15min}$ – 35 dB(A)

There are no criteria presented in the ICNG for ground-borne noise during the daytime hours (7:00 am-6:00 pm), when it is expected that construction work will take place. Therefore, we recommend that ground-borne noise levels in the adjacent buildings do not exceed the levels presented in Table 12 during the daytime period. These recommendations are in accordance with the internal noise levels adopted from AS/NZS 2107:2016 for use under construction intrusion noise conditions for consistency.

Table 12 Daytime ground-borne noise criteria

Type of receiver	Type of room	Ground borne noise, $L_{Aeq, 15min}$ dB(A)
Residential	Any	45
Commercial, educational institutions and places of worship	General office areas/meeting rooms/classrooms	45

4. Noise Intrusion Assessment

The noise intrusion assessment is based on the following:

- The external noise level at the building.
- Sound insulation performance of the building envelope (external walls, glazing, etc.).
- Reverberation control inside the building.

The dominant noise sources affecting the proposed development is road traffic noise from the Kingsway and rail noise from the T4 rail corridor. External noise measurements outlined in Section 2 have been used to determine the external façade noise level, which in turn informs the selection of external construction materials for the building.

4.1 External walls

The external walls will generally be comprised of masonry elements such as brick veneer, double brick, block work, concrete, etc. These wall types are not expected to require additional acoustic treatment, provided they achieve a minimum sound insulation of $R_w \geq 45$.

4.2 Roofing

Roofing constructions shall achieve a minimum sound insulation rating of $R_w \geq 40$. This can be achieved through a concrete roof slab as proposed.

4.3 Glazing

The minimum requirements apply to external glazing:

Table 13 Glazing Recommendations

Room	Glazing	Seals
All windows	6.38 mm laminated glass OR 6.38 mm laminated glass/ 12 mm air gap/ 6 mm glass	Compressed neoprene seals

In addition to the minimum glazing thickness outlined above, the windows should also achieve the following minimum ratings:

- Rw 32 for 6.38 mm laminated glass.
- Rw 34 for 6.38 mm laminated glass/ 12 mm air gap/ 6 mm glass.

The following should also be noted:

- The glazing outlined above is the minimum required to comply with the relevant noise intrusion standards.
- Other window configurations may be considered provided they are reviewed before selection.
- Glazing should be built into a solid frame with compressed neoprene seals.
- All windows that can be opened should be air-tight when closed.

4.4 Ventilation

Based on the unattended noise surveys, all rooms may be naturally ventilated.

4.5 Vibration

Vibration levels (VDV) for individual pass-by events have been calculated from site survey results and are included in Table 3 of this report. Where the individual VDV values for train pass-bys are corrected for the cumulative impact throughout the day and night periods based on the expected rail movements summarised above in Section 5.1, the total VDV for the day and night periods calculated for the future development are:

- Daytime total VDV (commuter and freight trains): 0.087m/s$^{1.75}$
- Nighttime total VDV (commuter and freight trains): 0.060m/s$^{1.75}$

These values are significantly below the preferred human comfort thresholds of 0.2 during the day and 0.13 during the night as recommended in the Department of Environment and Conservation NSW (DEC), Assessing Vibration: a technical guideline. As such, a low probability of vibration impact on the development is expected.

5. Noise Emission Assessment

Mechanical services drawings and equipment schedules have not been finalised at this stage and therefore, the following advice is intended as a guide and will be reviewed and confirmed during the detailed design phase as the design progresses. The following table outlines general mechanical plant recommendations that shall be allowed for.

Table 14 Mechanical Plant and Equipment Recommendations

Equipment	Potential Noise Attenuation Measures
Car park supply / exhaust fans	> Plant should be selected considering the noise output. > Speed controllers may be required if used, should be of good quality and compatible with the motor model. Poor quality controllers can result in a significant increase in motor noise. > Attenuators between the fan and outdoor environment may be required. > Internal duct lining between the fan and outdoor environment may also be required. Duct lining (*where required*) should have a density of at least 24 kg/m^3. > Vibration isolators to reduce vibration to the building structure will be required. > Acoustic screens for external plant exhaust areas may be required. > Acoustic louvres may be required to control noise emissions.
Garbage exhaust fan	> Plant should be selected considering the noise output. > Attenuators between the fan and exhaust outlet may be required. > Internal duct lining between the fan and exhaust outlet may be required. Duct lining (*where required*) should have a density of at least 24 kg/m^3. > Vibration isolators to reduce vibration to the building structure will be required. > Acoustic screens for external plant exhaust areas may be required. > Sound absorptive treatments in plant room spaces may be required. > Acoustic louvres may be required to control noise emissions.
Basement supply / exhaust fans	> Plant should be selected considering the noise output. > Internal duct lining between the fan and outdoor environment may be required. Duct lining (*where required*) should have a density of at least 24 kg/m^3. > Vibration isolators to reduce vibration to the building structure will be required. > Acoustic louvres may be required to control noise emissions.
Air-conditioning condenser units	> Condenser units should be selected considering the noise output. > Selecting condenser units with night quiet mode availabilities to lower the noise level during nighttime hours. > Acoustic screens or enclosures may be required.
Kitchen exhaust fans	> No acoustic treatment is likely due to intermittent use and inherently low noise levels.

Equipment	Potential Noise Attenuation Measures
Bathroom exhaust fans	> No acoustic treatment is likely due to intermittent use and inherently low noise levels.

A detailed mechanical plant noise assessment shall be included as a condition within the development consent as part of the Construction Certificate requirements.

Services plant and equipment installed within the development must not emit noise levels that exceed the EPA's NPfI project noise trigger levels at nearby residential premises. An example of a development condition for services plant noise is included below:

> *"Services plant and equipment must be located, designed and/or acoustically attenuated so that noise emitted from the plant and equipment does not exceed the adopted Project Noise Trigger Levels as defined by the EPA's Noise Policy for Industry 2017 at surrounding residential premises."*

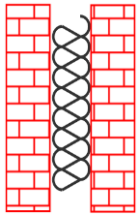
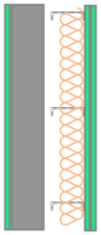
6. Inter-tenancy Noise

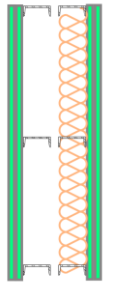
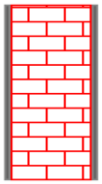
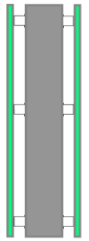
The development shall be designed and constructed to meet the design criteria outlined in Section 3.3 of this report and required by the BCA Volume One 2022. The proposed construction of all systems within the building shall be coordinated with the design teams during the detailed design phase as the project progresses.

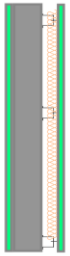
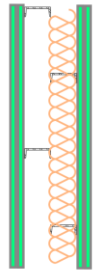
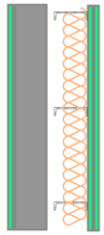
This Section presents potential constructions, based on either Deemed to Satisfy construction methods as outlined in the BCA or recommended systems predicted to achieve the required performance ratings for relevant areas.

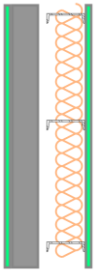
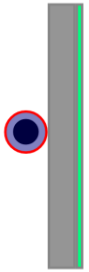
6.1 Walls

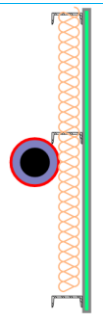
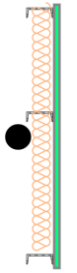
Table 15 Deemed-to-Satisfy Construction Details – BCA 2022, Volume One

Wall Type	BCA Sound Insulation Design Requirement	Construction Details [BCA 2022 Volume One Deemed-to-Satisfy] OR Recommended Wall Type	
Inter-tenancy wall	$R_w + C_{tr} \geq 50$	**Masonry** Two leaves of 110 mm clay brick with – - A cavity of not less than 50 mm between leaves; and - 50 mm thick glass wool insulation with a density of 11 kg/m^3 or 50 mm polyester insulation with a density of 20 kg/m^3 in the cavity. **Concrete** 150 mm thick concrete panel, OR A 100 mm thick concrete panel with (*Discontinuous*) – - A row of 64 mm steel studs (600 mm centres), 25 mm from the concrete panel, and - 80 mm thick polyester insulation or 50 mm thick glass wool insulation with a density of 11 kg/m^3, positioned between studs, and - Two layers of 13 mm plasterboard fixed to the outside face of studs and one layer of 13 mm plasterboard fixed to the outside face of the concrete panel. **Autoclaved Aerated Concrete** A 75 mm thick autoclaved aerated concrete panel with (*Discontinuous*) – - A row of 64 mm steel studs (600 mm centres), 20 mm from the concrete panel, and - 75 mm thick glass wool insulation with a density of 11 kg/m3 positioned between studs, and - One layer of 10 mm moisture-resistant plasterboard or 13 mm fire-protective grade plasterboard fixed to the outside face of studs and outside face of autoclaved aerated concrete wall panel.	 

Wall Type	BCA Sound Insulation Design Requirement	Construction Details [BCA 2022 Volume One Deemed-to-Satisfy] OR Recommended Wall Type	
		Lightweight Two rows of 70 x 35 mm timber studs (450 mm centres) with (*Discontinuous*) - An air gap of not less than 20 mm between rows of studs, and - 75 mm thick glass or mineral wool insulation with a density of 8 kg/m³ or 60 mm thick polyester insulation with a density of 11 kg/m³ positioned between one row of studs, and - Two layers of 13 mm fire-protective grade plasterboard or one layer of 6 mm fibre-cement sheet and one layer of 13 mm fire-protective grade plasterboard, fixed to the outside face of studs.	
Corridor and Stairwell Walls	$R_w \geq 50$	**Masonry** As per $R_w + C_{tr}$ 50 wall types, OR A single lead of 150 mm brick masonry with 13 mm cement render on each face.	
		Concrete As per $R_w + C_{tr}$ 50 wall types, OR A single 200 mm concrete slab, OR A 150 mm concrete panel with one layer of 10 mm plasterboard fixed to 28 mm metal furring channels on each face.	

Wall Type	BCA Sound Insulation Design Requirement	Construction Details [BCA 2022 Volume One Deemed-to-Satisfy] OR Recommended Wall Type	
		Autoclaved Aerated Concrete As per $R_W + C_{tr}$ 50 wall types, OR A 75 mm thick autoclaved aerated concrete panel with – - One layer of 10 mm moisture-resistant plasterboard on one face, and - 28 mm metal furring channels and resilient mounts, 75 mm polyester insulation with a density of 9 kg/m^3 and 13 mm fire-protective grade plasterboard fixed to the other face	
		Lightweight One row of 70 x 35 mm staggered timber studs, without noggings between adjacent studs (450 mm centres), fixed with 90 mm x 35 mm wall plates with - 75 mm thick glass or mineral wool insulation with a density of 8 kg/m^3 positioned between the studs, and - Two layers of 13 mm fire-protective grade plasterboard, fixed to the outside face of studs.	
Lift Shaft Walls Discontinuous	$R_w \geq 50$	**Concrete** A 100 mm thick concrete panel with (*Discontinuous*) – - A row of 64 mm steel studs (600 mm centres), 25 mm from the concrete panel, and - 80 mm thick polyester insulation or 50 mm thick glass wool insulation with a density of 11 kg/m^3, positioned between studs, and - Two layers of 13 mm plasterboard fixed to the outside face of studs and one layer of 13 mm plasterboard fixed to the outside face of the concrete panel.	

Wall Type	BCA Sound Insulation Design Requirement	Construction Details [BCA 2022 Volume One Deemed-to-Satisfy] OR Recommended Wall Type	
		Autoclaved Aerated Concrete A 75 mm thick autoclaved aerated concrete panel with (*Discontinuous*) – - A row of 64 mm steel studs (600 mm centres), 20 mm from the concrete panel, and - 75 mm thick glass wool insulation with a density of 11 kg/m3 positioned between studs, and - One layer of 10 mm moisture-resistant plasterboard or 13 mm fire-protective grade plasterboard fixed to the outside face of studs and outside face of autoclaved aerated concrete wall panel.	
Services Walls	$R_w + C_{tr} \geq 40$ (*Habitable*) $R_w + C_{tr} \geq 25$ (*Non-Habitable*)	**Habitable Rooms** Lagged pipes with: - 75 mm Hebel Powerpanel, OR - 110 mm brick, OR - 100 mm concrete, with - 13 mm plasterboard lining OR	

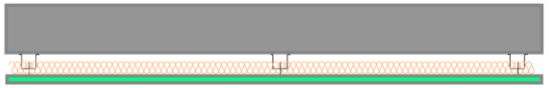
Wall Type	BCA Sound Insulation Design Requirement	Construction Details [BCA 2022 Volume One Deemed-to-Satisfy] OR Recommended Wall Type	
		Lagged pipes with: - 64 mm steel studs, - 24 kg/m^3 insulation batts, - 13 mm plasterboard lining	
		Non-Habitable Rooms Unlagged pipes with: - 75 mm Hebel Powerpanel, OR - 110 mm brick, OR - 100 mm concrete, with - 13 mm plasterboard lining OR	
		Unlagged pipes with: - 64 mm steel studs, - 13 mm plasterboard lining	

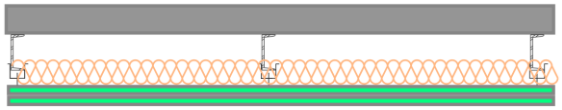
6.2 Floors

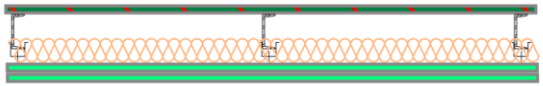
The following Table presents potential floor constructions, based on either Deemed to Satisfy construction methods as outlined in the BCA Volume One 2022 or recommended floor systems predicted to achieve the required performance ratings for ceiling/floor systems.

Table 16 Deemed-to-Satisfy Construction Details – BCA 2022, Volume One

Floor Type	BCA Sound Insulation Design Requirement	Construction Details [BCA 2022 Volume One Deemed-to-Satisfy] OR Recommended Floor Type
Inter-tenancy floor	$R_w + C_{tr} \geq 50$	**Concrete** 200 mm concrete slab with carpet-on-carpet underlay, OR A 100 mm thick concrete panel with – - 28 mm furring channels with isolation mounts at 600 mm centres, - 65 mm polyester insulation with a density of at least 8 kg/m^3 - One layer of 13 mm plasterboard **Autoclaved Aerated Concrete** 75 mm thick autoclaved concrete floor panel with – - Timber joists at 600 mm centres, - R1.5 glass wool insulation between the joists, - 28 mm furring channels with resilient mounts fixed to the underside of the joints, - Two layers of 13 mm plasterboard fixed to the furring channels





Floor Type	BCA Sound Insulation Design Requirement	Construction Details [BCA 2022 Volume One Deemed-to-Satisfy] OR Recommended Floor Type	
		Lightweight 19 mm thick particleboard sheeting with – - 190 mm x 45 mm timber joists at 450 mm centres, - R2.5 glass or mineral wool insulation positioned between the joists, - 28 mm furring channels with resilient mounts fixed to the underside of the joints (*resilient mounts to be natural rubber with a dynamic factor of ≤ 1.1 and static deflection of ≥ 3 mm at actual operating load*), - Two layers of 16 mm fire-protective grade plasterboard fixed to furring channels	

6.3 Doors

Entry doors that are incorporated into a common wall that separate an SOU from a common area (*e.g. lobby/foyer/stairwell, etc.*) are required to achieve ≥ R_w 30. Entry doors are recommended to be a minimum of 35 mm thick solid-core timber entry doors with appropriate acoustic drop and perimeter seals.

Table 17 Deemed-to-Satisfy Construction Details – BCA 2022, Volume One

Floor Type	BCA Sound Insulation Design Requirement	Recommended Door Type	
Entry Doors	R_w ≥ 30	- 35 mm thick solid core timber entry door - Acoustic drop seals (*Raven/Kilargo or similar*) - Acoustic perimeter seals (*Raven/Kilargo or similar*)	 *(Example door seal – Image Source: Raven)*

7. Construction Noise and Vibration Management Plan

This section presents a construction noise and vibration assessment for the proposed DA development. The proposed construction works will include some excavation and typical construction activities.

7.1 Construction Methodology

The following noise and vibration sources and events are expected during construction.

- **Demolition**
  - Demolition of existing structures.
- **Piling & Excavation**
  - Soil and potential sandstone are expected to be excavated using conventional hydraulic excavators, and possibly with some ripping.
  - Large dozers, rock breakers and rock saws are expected to be required for trimming the rock excavation.
- **Construction**
  - Installing hoarding to site perimeter.
  - Pouring concrete foundations and suspended post-tensioned slabs.
  - Installing window wall and pre-cast concrete façade.
  - Installation of soft and hard landscaping.
  - General trucks entering and exiting.
  - Tower electric cranes.
  - High-pressure concrete stationary pumps, material hoists, forklifts and electric hand tools.

7.2 Construction Noise Assessment

An assessment of the construction noise levels has been undertaken with respect to the Noise Management Levels (NMLs). Noise emissions from the proposed construction works were calculated at the most noise-affected boundary location of all nearest noise-sensitive receivers.

The exact location of each construction activity is unknown at this stage and will likely change throughout the construction process. As such, to calculate the construction noise levels at surrounding receivers, the distance between the boundary of the subject site and the most noise-affected location on the receiver site has been used. 10 m has been used as a minimum distance.

A summary of the predicted construction noise levels is presented in the Table below. Appendix C of this report outlines predicted construction noise levels against the construction noise emission criteria established in Section 3.4 of this report.

Table 18 Summary of Predicted Construction Noise Levels – $L_{Aeq, 15\ minutes}$ dB

Equipment	R1	R2	R3	R4	R5	R6
Truck	70	72	67	77	77	77
22-tonne excavator	58	60	55	65	65	65
Excavator breaking rubble	69	71	66	76	76	76
Pilling Rig (bored)	70	72	67	77	77	77
Rock breaker	77	79	74	84	84	84
Rock saw	74	76	71	81	81	81
Excavator (ground removal)	58	60	55	65	65	65
Tree Removal	67	69	64	74	74	74
Excavator loading a truck (brick rubble)	76	78	73	83	83	83
Concrete pump truck	71	73	68	78	78	78
Circular saw	71	73	68	78	78	78
Angle grinder	67	69	64	74	74	74
Hand tools (pneumatic)	75	77	72	82	82	82
Concrete pump	62	64	59	69	69	69
Concrete truck and pump	54	56	51	61	61	61
Handheld pneumatic jackhammer	75	77	72	52	52	52
Handheld demolition saws	79	81	76	86	86	86
Forklift	65	67	62	72	72	72
Tower crane	64	66	61	71	71	71
Single hoist (man and materials)	57	59	52	62	62	62
Handheld drill	47	49	44	54	54	54
Nail gun	60	62	57	67	67	67

Outcomes include some 'Noise Affected' receivers and 'Highly Noise Affected' receivers, per the ICNG definitions:

- The 'noise affected' level represents the point above which there may be **some community reaction** to noise.
- The 'highly noise affected' level represents the point above which there may be a **strong community reaction** to noise.

Results show that construction noise is predicted to exceed 'highly noise-affected' levels in some instances during standard hours at residential receivers.

The relevant authority (consent, determining or regulatory) may therefore require respite periods by restricting the hours that the very noisy activities can occur to times identified by the community as less

sensitive to noise. Similarly, the community may be prepared to accept a longer period of construction in exchange for restrictions on construction times.

The magnitude of construction noise impacts depends on several key factors, including:

- Intensity and location of construction activities
- Type of equipment used during works
- Ambient background noise levels throughout the construction period

Given these variables, predicted construction noise levels are conservative estimates and do not reflect a constant noise emission experienced by the community daily throughout the project's duration. Instead, noise levels will only be elevated for limited periods when specific activities occur and are unlikely to persist across full daytime, evening, or night periods.

The noise levels have been derived from standard equipment noise levels outlined in the Department for Environment, Food and Rural Affairs (DEFRA) Noise Database (UK, 2005), which is recognised in Australian Standards.

Accurate noise output for specific equipment and methodologies cannot be determined until:

- A head contractor is appointed
- The construction methodology is confirmed
- Noise levels of specific equipment are measured.

When a head contractor is appointed, a detailed site-specific construction noise and vibration management plan should be prepared; this is further detailed in Section 7.4 of this report.

In general, construction works are temporary; therefore, potential noise impact on the community and the surrounding environment will not be permanent or continuous. However, where the predicted noise level is greater than the noise management levels, all feasible and reasonable work practices should be applied; it is unlikely that mitigation measures would reduce the received noise levels below the noise management levels in all cases.

As this work is undertaken within standard construction hours, if, after implementing all 'feasible and reasonable' controls, noise levels at the site still exceed the noise affected level, the ICNG does not require any further action, since there is no further scope for noise mitigation. Where the risk of Noise Affected or Highly Noise Affected receivers is predicted, the contractor shall prepare a detailed Construction Noise and Vibration Management Plan (CNVMP) as outlined in Section 7.4.1. The layout and operation of equipment on site are subject to change; therefore, this assessment is provided as a guide to where acoustic mitigation or consideration is more likely to be required.

7.3 Construction Vibration Assessment

7.3.1 Vibration Buffer Distances

Buffer distances can be used to indicate safe distances of activities from adjacent buildings to meet vibration criteria. Indicative best-practice buffer distances are presented in the following Table. At this stage, the equipment for construction has not been finalised and the buffer distances are intended as a guide only for the contractor.

Table 19 Vibration buffer distances, day period

Criterion	Descriptor		Handheld jack-hammer	Rock-breaker			Rotary cutter
				Light (300kg)	Medium (900kg)	Heavy (1600kg)	
Tactile vibration – residential	VDV & rms	Continuous	10m	25m	35m	55m	5m
		Impulsive	< 1m	1m	5m	20m	< 1m
Tactile vibration – commercial	VDV & rms	Continuous	5m	10m	20m	40m	2m
		Impulsive	< 1m	< 1m	5m	15m	< 1m
Cosmetic damage	Peak particle velocity		< 1m	2m	7m	22m	< 1m

7.3.2 Vibration Assessment

The vibration buffer distances in the section above and the distance to the nearest sensitive receiver locations (as close as 10 metres to the nearest residential and commercial locations) indicate the potential for excavation work to result in adverse vibration impacts at some off-site receivers.

During the development of the detailed Construction Noise and Vibration Management Plan, an investigation of vibration impact on existing buildings on the subject site and on nearby sensitive receivers should take place. Vibration monitoring may be required under the CNVMP.

7.4 Construction Noise and Vibration Recommendations

This section presents recommendations to mitigate the potential noise and vibration impacts from the proposed development construction works. The mitigation measures are intended to represent 'feasible and reasonable' mitigation measures suitable for implementation during construction of the project.

7.4.1 Construction Noise and Vibration Management Plan

For all construction works, the contractor would be expected to prepare a detailed Construction Noise and Vibration Management Plan (CNVMP). This plan should include but not be limited to the following:

- Roles and responsibilities
- Noise and vibration-sensitive receiver locations
- Areas of potential impact
- Mitigation strategy
- Noise and Vibration Monitoring methodology
- Community engagement strategy.

General guidance on the control of construction noise and vibration impacts relevant to this study are discussed in the following sections, which may be used when developing the specific CNVMP.

7.4.2 General Noise and Vibration Controls

The following general management controls should be implemented:

- The scheduling of construction activities should be undertaken to reasonably minimise noise impacts to all surrounding land uses.

- In this regard, highly noise-intrusive works should not be conducted before 8 am where noise levels would significantly exceed the noise criteria at residential receivers. This would typically apply to hammering operations and use of excavators within 50 m of a residence.
- Additionally, a respite period is to be implemented where excavator-mounted hydraulic hammering works are required and will generate noise levels exceeding the highly noise-affected levels.
- The recommended hours for use of excavator-mounted hydraulic hammering are:
  - Monday to Friday: 9 am – 12 pm and 2 pm – 5 pm.
  - Saturday: 4 hours between the hours of 9 am – 12 pm and 2 pm – 5 pm.
- The above hours may be modified in consultation with the surrounding receivers (in particular, with residential receivers) to minimise impact while not reducing the overall allowable hours per day.
- Notification to receivers immediately bounding the site should be provided (via flyer or similar), informing occupiers of the expected duration of the noisy activities should be conducted.
- Where reasonable and feasible, pulverisers and other non-percussive methods should be used to demolish concrete structures (where proposed).
- Before the commencement of any activity likely to generate significant ground vibration (typically hammering and dropping of objects), attended vibration monitoring is to be undertaken to establish "safe" working distances from the structures around the site.
- Attended noise measurements shall be conducted at the surrounding properties, at the beginning of the demolition works, to quantify the level of noise typically emitted from the site and confirm the predictions/respite periods applied.
- Materials handling/vehicles:
  - Trucks and forklifts in general use on site are to use a non-tonal reversing beacon where possible (subject to OH&S requirements) to minimise potential disturbance of surrounding receivers.
  - Trucks, trailers and delivery vehicles are to turn off engines when idling to reduce noise impacts (unless required for concrete pumping or similar).
- Complaints handling:
  - An after-hours contact number is displayed outside of the building site, so that in the event that surrounding development believes that a noise breach is occurring, they may contact the site.
- The noise and vibration management plan should be reviewed and revised as appropriate by the contractor carrying out the work to ensure it is relevant to the work methods selected and the programme adopted.

Equipment Selection

Equipment mitigation measures (developed from AS 2436 *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites* (AS2436)) shall be considered to reduce noise emission from construction equipment.

Where practicable, alternative quieter methodology should be employed to reduce the impacts of the construction, i.e. using saws instead of jackhammers near adjacent structures where vibration is easily transferable, such as in bedrock.

Table 20 Equipment mitigation measures from AS2436:2010

Equipment Plant	Possible Remedies
Handheld Pneumatic Jack Hammer Handheld Demolition Saws	Tool muffler or silencer Dampened bit Enclosure barrier Maintain saw sharpness
5-tonne excavator (with hammer attachment)	Engine exhaust silencer Portable acoustic enclosure Tool muffler or silencer Dampened bit
Concrete pump	Enclosure barrier where feasible and reasonable Letterbox drop (notification) for dates of pouring Acoustic silencer on engine

Plant Operation

Careful selection and maintenance of plant equipment will minimise noise impact on nearby sensitive receivers.

The following are some techniques for quiet and efficient plant operation:

- Where practical, undertake the noisiest work during less sensitive times.
- Turn off plant and equipment at times that it is not being used.
- Implement, where feasible and reasonable, alternative work practices that generate less air-borne and ground-borne noise – for example:
  - use electric equipment instead of diesel or petrol-powered equipment
  - use sawing methods that reduce ground-borne noise
- Use silenced equipment and noise shielding around stationary plant (such as generators) where possible.
- Ensure plant and equipment is regularly maintained, and repair or replace equipment that becomes noisy.
- Configure the work site to minimise the use of movement alarms on vehicles and mobile plant.
- Locate noisy plant away from noise-affected neighbours or behind barriers, such as sheds or walls.
- Ensure that the site foreman or representative is trained in taking noise measurements and logs noisy activities during construction at the closest affected receivers and on-site.

Barriers

A solid barrier could be installed around the perimeter of the construction site to control construction noise. A barrier along the site boundaries can reduce the noise emission levels by up to 15 dB to ground-level receivers during the excavation and construction of the first level of the proposed development. Acoustic barriers or hoardings may also be strategically placed around noisy equipment, such as hand-held pneumatic jackhammers and hand-held demolition saws.

Worker Conduct

Workers should also be involved in noise mitigation through the following methods:

- Regularly train workers and contractors (such as at toolbox talks) to use equipment in ways that minimise noise. Avoid dropping materials from a height.
- Avoid the use of radios and stereos outdoors.
- Avoid the overuse of public address systems.
- Avoid shouting and minimise talking loudly and slamming vehicle doors.
- Turn off all plant and equipment when not in use.

7.4.3 Community Consultation

Section C2 of the *Draft Construction Noise Guideline* states:

"The proponent should ensure those affected by the work are informed about the project, including:

- *When the work will take place and its expected duration.*
- *The likely noise impact of the work without understanding its effect.*
- *Any work activities or equipment that will be particularly noisy or noticeable.*
- *Mitigation measures to manage noise impacts, including complaints handling procedures."*

"Any notification should be provided before and during construction through an appropriate method, within reasonable timeframes and commensurate to the risk of noise impact. Where appropriate, information should also be provided on a site information board displayed in a prominent location with the name and contact details of the organisation responsible for the site. Include:

- *after-hours contact details, including a contact phone number and email address for enquiries and complaints.*
- *basic information on the conditions of approval, such as the hours of work.*
- *contact details for the consent authority responsible for regulating environmental issues, such as the local council or the EPA Environment Line".*

"A complaints procedure can be a helpful tool to manage community concerns and may be required as part of a project consent, approval or licence. Proponents should:

- *Provide a prompt response to complaints.*
- *Ensure complaint handling staff have a good knowledge of the project and its environmental and noise management procedures.*
- *Provide feedback to the complainant on the actions taken to investigate and address noise problems.*
- *Maintain a register of complaints to include the name of the person making the complaint.*
  - *the date and time the complaint was made.*
  - *a description of the complaint o action taken to respond to and address the complaint.*

7.4.4 Complaints Handling

The following recommendations should be put in place to respond to complaints:

- Site staff with the displayed complaints phone number will be informed of current and upcoming works and the relevant contacts for these works.
- Respond to complaints in a prompt and responsive manner

- Once a complaint is received, undertake and assess noise measurements accordingly.
- Where there are complaints about noise from an identified work activity, review and implement, where feasible and reasonable, actions additional to those described above to minimise noise output.

7.4.5 Specific Vibration Recommendations

It is the contractor's responsibility to ensure that the vibration levels do not exceed the criteria in Section 4.

Dilapidation Reports

We recommend that dilapidation reports be prepared on the adjacent and surrounding buildings before project commencement. This should be done to achieve an understanding of the structural integrity of the buildings in question and to assess any impacts that vibration from construction activities may have on nearby receivers.

Vibration Monitoring

Vibration buffer distances scheduled in Table 19 indicate that the proposed construction activities associated with heavy equipment may exceed the Vibration Criteria in Section 3.4.2. In these instances, we recommend that vibration monitoring be undertaken to observe and identify when the vibration limits are at risk of exceedance (particularly during excavation and piling works).

Vibration monitors could be installed at the boundary of the nearest residential receivers. The vibration monitors should be set up to inform site staff of the risks of exceeding the limits The monitors may be relocated to a different monitoring location depending on the proximity of the nearest vibration-intensive excavation activity. As further information is provided by the contractors, the above monitoring methodology may be revised accordingly. Monitoring equipment should be configured in such a way that alarms are triggered at a level below the values described in Section 3.4.2.

8. Summary of Mitigation Measures

Based on the assessments and recommendations in this report, the following measures are recommended to mitigate the identified noise and vibration impacts of the development.

Table 21 Summary of Noise Control Recommendations

No.	Item	Recommended Noise Control
Noise and Vibration Intrusion		
1	Environmental noise and vibration intrusion	Internal noise levels can be achieved with a sealed façade and following the construction recommendations as outlined in Section 4 of this report. Based on vibration measurements conducted at the site, there is a low probability of vibration impact from rail pass-by events.
Mechanical Plant Noise Emission		
2	Mechanical plant and equipment noise emission	Plant and equipment shall be treated to comply with the noise emission targets as outlined in Section 3.2 of this report. Treatments include the use of acoustically lined ductwork and ductwork configurations, acoustic louvres, enclosures, barriers or attenuators. Appropriate vibration isolators to control vibration to the building structure and beyond. Details of recommendations are outlined in Section 5 of this report.
Inter-tenancy Noise Transmission		
3	Acoustic separation [NCC/BCA]	Internal partitions are to comply with the minimum acoustic separation targets as outlined in Section 3.3 of this report. Deemed-to-satisfy construction methods are outlined in Section 6 of this report.
Construction Noise and Vibration		
4	Noise and vibration management plan	A detailed construction noise and vibration management plan shall be prepared when a head contractor is appointed, specifying the actual equipment to be used and will include updated estimates of the likely levels of noise and the scheduling of activities.
5	Scheduling	The CNMVP shall include details of community consultation, complaints handling and strategies for monitoring noise and vibration.
6	Equipment	Further details are outlined in Section 7.
7	Respite	Schedule of construction activities shall be undertaken to minimise noise and vibration to receivers during more sensitive times.
8	Monitoring	Further details are outlined in Section 7.4.5

9. Summary

This report presents a noise impact assessment for the proposed development at 2 Flide Street, Caringbah, NSW.

The assessment was prepared in accordance with the architectural drawings and relevant noise control standards, policies and guidelines as outlined in Section 1.1 of this report.

This assessment has concluded:

- Internal noise levels in habitable areas of the development can comply with the relevant noise intrusion criteria through the selection of glazing and a sealed façade. Provided treatments as outlined in Section 4 are implemented correctly, required internal noise levels are expected to be achieved.
- Mechanical plant noise emissions can comply with the noise control guidelines; however, a detailed mechanical plant noise assessment shall be conducted at the detailed design stage.
- Deemed-to-satisfy construction methods are outlined in Section 6 to comply with relevant NCC/BCA requirements; a detailed review of the proposed internal partitions should be conducted as the design progresses.
- Where relevant recommendations are adopted as per Section 7 of this report, noise and vibration impacts on surrounding sensitive receivers as a result of the construction of the development are expected to be minimised. A detailed construction noise and vibration management plan should be conducted by the contractor upon engagement.

The assessment concluded that the proposed development can satisfy the relevant noise standards, policies and guidelines.

Based on the assessment conducted in this report, there is sufficient scope within the building design to satisfy the noise control guidelines/requirements.

Appendix A
Glossary of Acoustic Terms

Air-borne sound

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

Ambient sound

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

Background noise level

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

dB(A)

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

Decibel scale

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

Examples of decibel levels of common sounds are as follows:

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

Frequency

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

L_{90}, L_{10}, etc

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

$L_{Aeq,T}$

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

L_{Amax}

The maximum sound pressure level measured over the measurement period.

L_{Amin}

The minimum sound pressure level measured over the measurement period.

Day

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

Evening

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

Night

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

Assessment background level (ABL)

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

Rating background level (RBL)

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

Reverberation

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

Sound isolation

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

Sound pressure level, L_p, dB of a sound

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

Appendix B
Unattended Noise Logger Graphs

Appendix C
Predicted Construction Noise Levels

Table 22 Construction Noise Levels at Surrounding Northern Receivers, $L_{Aeq, 15\text{-}minute}$ dB – R4-R6

Equipment	Predicted Noise Level	Criteria	Comments
Truck	R4, R5 & R6: 77	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
22-tonne excavator	R4, R5 & R6: 65	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Excavator breaking rubble	R4, R5 & R6: 76	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Pilling Rig (bored)	R4, R5 & R6: 77	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Rock breaker	R4, R5 & R6: 84	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Rock saw	R4, R5 & R6: 81	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Excavator (ground removal)	R4, R5 & R6: 65	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Tree Removal	R4, R5 & R6: 74	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Excavator loading a truck (brick rubble)	R4, R5 & R6: 83	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Concrete pump truck	R4, R5 & R6: 78	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Circular saw	R4, R5 & R6: 78	Standard hours: ≤ 62 Non-standard hours: ≤ 57	See Section 7.4 for recommendations

Equipment	Predicted Noise Level	Criteria	Comments
		Highly noise-affected level: ≥ 75	
Angle grinder	R4, R5 & R6: 74	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Hand tools (pneumatic)	R4, R5 & R6: 82	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Concrete pump	R4, R5 & R6: 69	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Concrete truck and pump	R4, R5 & R6: 61	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations
Handheld pneumatic jackhammer	R4, R5 & R6: 52	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations
Handheld demolition saws	R4, R5 & R6: 86	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Forklift	R4, R5 & R6: 72	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Tower crane	R4, R5 & R6: 71	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Single hoist (man and materials)	R4, R5 & R6: 62	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations
Handheld drill	R4, R5 & R6: 54	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations
Nail gun	R4, R5 & R6: 67	Standard hours: ≤ 62 Non-standard hours: ≤ 57 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations

Table 23 Construction Noise Levels at Surrounding Southern Receivers, $L_{Aeq, 15\text{-}minute}$ dB – R1-R3 and the Southern Half of R4 & R6

Equipment	Predicted Noise Level	Criteria	Comments
Truck	R1: 70 R2: 72 R3: 67 R4: 77 R6: 77	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
22-tonne excavator	R1: 58 R2: 60 R3: 55 R4: 65 R6: 65	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations
Excavator breaking rubble	R1: 69 R2: 71 R3: 66 R4: 76 R6: 76	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Pilling Rig (bored)	R1: 70 R2: 72 R3: 67 R4: 77 R6: 77	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Rock breaker	R1: 77 R2: 79 R3: 74 R4: 84 R6: 84	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Rock saw	R1: 74 R2: 76 R3: 71 R4: 81 R6: 81	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Excavator (ground removal)	R1: 58 R2: 60 R3: 55 R4: 65 R6: 65	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations
Tree Removal	R1: 67	Standard hours: ≤ 61	

Equipment	Predicted Noise Level	Criteria	Comments
	R2: 69 R3: 64 R4: 74 R6: 74	Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Excavator loading a truck (brick rubble)	R1: 76 R2: 78 R3: 73 R4: 83 R6: 83	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Concrete pump truck	R1: 71 R2: 73 R3: 68 R4: 78 R6: 78	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Circular saw	R1: 71 R2: 73 R3: 68 R4: 78 R6: 78	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Angle grinder	R1: 67 R2: 69 R3: 64 R4: 74 R6: 74	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Hand tools (pneumatic)	R1: 75 R2: 77 R3: 72 R4: 82 R6: 82	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Concrete pump	R1: 62 R2: 64 R3: 59 R4: 69 R6: 69	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations
Concrete truck and pump	R1: 54 R2: 56 R3: 51 R4: 61 R6: 61	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations

Equipment	Predicted Noise Level	Criteria	Comments
Handheld pneumatic jackhammer	R1: 75 R2: 77 R3: 72 R4: 52 R6: 52	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Handheld demolition saws	R1: 79 R2: 81 R3: 76 R4: 86 R6: 86	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Forklift	R1: 65 R2: 67 R3: 62 R4: 72 R6: 72	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Tower crane	R1: 64 R2: 66 R3: 61 R4: 71 R6: 71	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	See Section 7.4 for recommendations
Single hoist (man and materials)	R1: 59 R2: 57 R3: 52 R4: 62 R6: 62	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations
Handheld drill	R1: 47 R2: 49 R3: 44 R4: 54 R6: 54	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations
Nail gun	R1: 60 R2: 62 R3: 57 R4: 67 R6: 67	Standard hours: ≤ 61 Non-standard hours: ≤ 56 Highly noise-affected level: ≥ 75	Complies/See Section 7.4 for recommendations

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