NORTHROP

ACOUSTICS REPORT

90 Northbourne Braddon

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Acoustics Report

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Table of Contents

1. Introduction

Northrop Consulting Engineers Pty Ltd (Northrop) Acoustics have been engaged by Liebke and Co to provide an acoustic assessment for Development Application (DA) for the proposed development at 90 Northbourne Avenue, Braddon, ACT (the Project). This report is part of documentation to be submitted with the DA application.

A noise assessment was conducted to establish the noise criteria and possible noise impacts. Based on ACT regulations and Australian standards the noise criteria were established. The report takes into account noise emissions from the Project to the surrounding neighbourhood. It also considers noise intrusions from the surrounding noise sources into the development. The report assess vehicular noise impact on the neighbouring buildings and upon the surrounding road network. The existing vibration levels from the light rail were measured to quantify the vibration impacts on the Project. In each case, recommendations were provided where exceedances occurred.

Providing our recommendations are implemented it is anticipated that noise emissions from the Project will comply with the acoustic requirements set out in ACT regulations and relevant Australian standards and guidelines.

2. The Site

The proposed development will be located at 90 Northbourne Avenue, Braddon. The site is bound by Northbourne Avenue on the west, Elouera Street on the north, Mort Street on the east and residential apartments on the south.

The Site location is shown in Figure 1.

Figure 1: Site location and nearby sensitive receivers

2.1 Site Zoning

The development zone is defined by The Territory Plan zone as “CZ2 Business Zone” and is located within the City Hill Precinct (Land in the Central National Area). From an acoustic perspective, the site is located within Noise Zone B.

Note that part of the Northbourne Avenue opposite the site is on the borderline of noise zones C and G. The residential receivers to the west of Northbourne Avenue are located within Noise Zone G.

The noise zoning for the site and surrounding is shown in Figure 2.

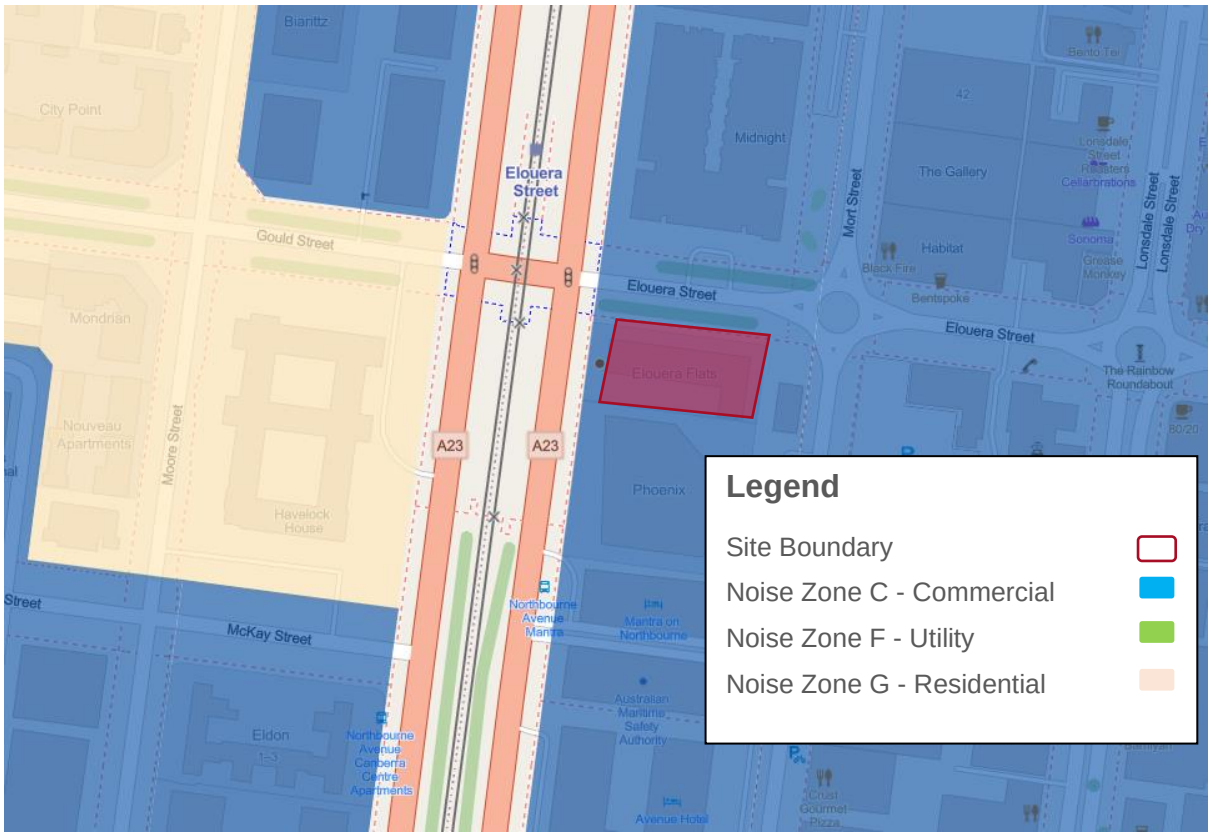

Figure 2: Noise Standard Zoning Map

2.2 Sensitive Receivers

The nearest sensitive receivers which have potential for noise impact are listed in Table 1 and shown in

Table 1: Nearby sensitive receivers

Receiver ID	Address	Land Use	Noise Zone	Location
R01	88 Northbourne Ave	Residential apartments	B	South of the site
R02	85 Northbourne Ave (Havelock House)	Residential apartments	G	West of the site, across Northbourne Ave.
R03	92 Northbourne Ave	Commercial (hotel)	B	North east of the site, across Elouera Street
R04	38 Mort Street	Commercial units & shops within the building	B	East of the site, across Mort Street, and to the north

3. Project Appreciation

The proposed development will be on 9 levels overground and three levels of basement carpark. The building will be mixed use comprising of SOHO, retail and office spaces on the lower levels and residential units on the upper floors.

The ground floor plan is shown in Figure 3.

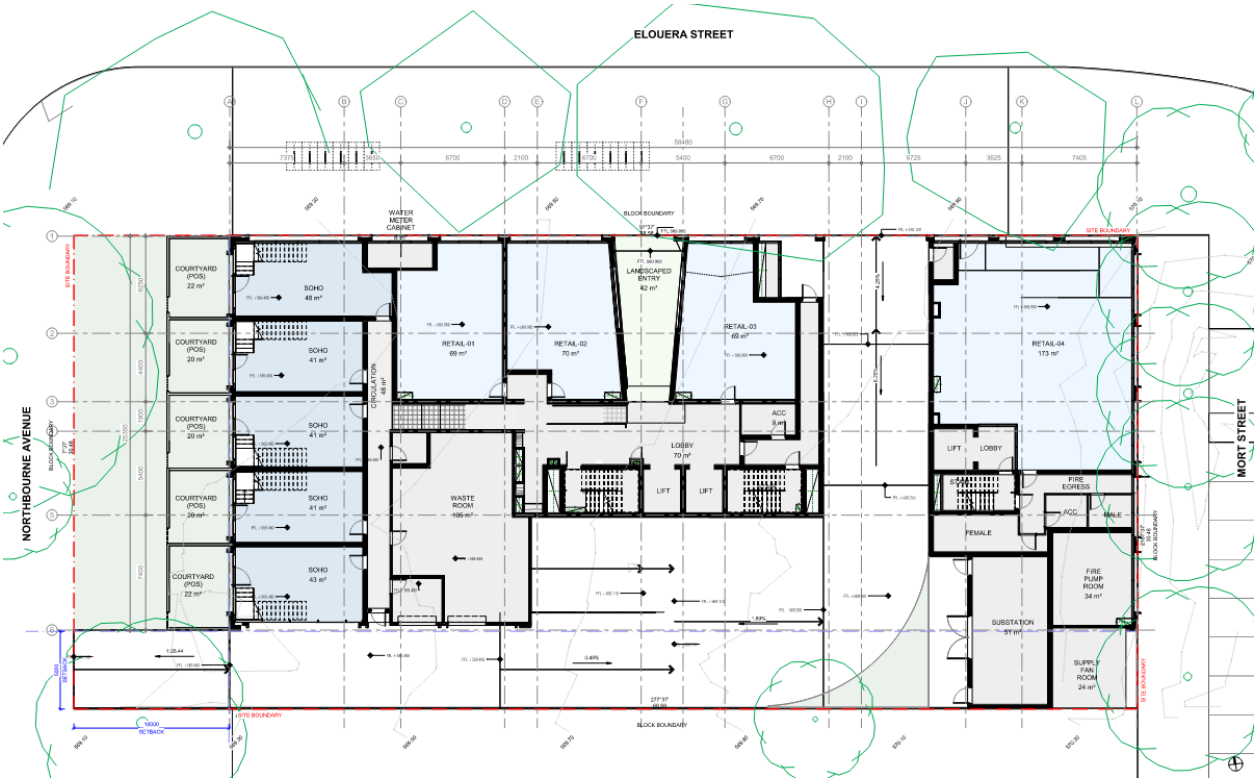

Figure 3: Ground floor plan

4. Existing Environment

4.1 Operator Attended Vibration Measurements

Operator attended vibration measurements were taken at the site to quantify the vibration impact upon the site from the existing light rail. Vibration measurements were taken on the 15 May 2023 at a point in line with the building front façade (see Figure 1). Measurements were performed using a SVAN 958A with an SV-84 triaxle accelerometer.

Vibration measurement results are shown in Table 2 below.

Table 2 Operator attended train vibration measurements and passby noise levels results

Time	Weighted rms values for vibration acceleration (m/s^2) 1–80 Hz		
	X-Axis	Y-Axis	Z-Axis
17:23	5.4325E-05	5.40132E-05	0.000164437
17:25	5.48277E-05	6.18728E-05	0.000225944
17:29	5.26017E-05	5.42625E-05	0.000167687
17:31	5.94292E-05	6.44911E-05	0.000225165
17:34	5.82103E-05	5.41377E-05	0.000169629
17:38	5.3889E-05	5.06991E-05	0.000163682
17:40	5.84117E-05	7.32825E-05	0.000248028
17:43	5.53988E-05	5.42625E-05	0.000173181
17:47	5.30274E-05	5.17011E-05	0.000138676
17:49	5.32108E-05	5.31496E-05	0.000156135
17:54	6.53131E-05	5.25412E-05	0.000191205
17:55	6.61455E-05	9.24698E-05	0.000339234
17:58	6.58415E-05	5.30274E-05	0.000213059
18:01	5.99791E-05	5.72137E-05	0.000192975

5. Project Criteria

The criteria for the development can be separated into the following:

- Environmental noise emission criteria (noise from the development impacting nearby sensitive receivers) – Section 5.1
- Noise intrusion criteria (external noise impacting the development) – Section 5.2
- Road traffic noise from public roads – Section 5.3
- Acoustic separation – Section 5.4
- Rail vibration – Section 5.5

5.1 Environmental Noise Emission Criteria

The environmental noise emission criteria aim to control noise emissions from the development to maintain the acoustic amenity at the surrounding receivers.

5.1.1 ACT Commercial Zones Development Code (CZDC)

Element 6 of CZDC addresses noise and provides details for noise assessment requirements. Section 6.1 states that the following potentially noisy uses require a Noise Management Plan (NMP). The NMP will be an acoustic assessment conducted by a suitably qualified person and endorsed by EPA, to ensure compliance with the Noise Zone Standard as detailed in the Environment Protection Regulation 2005. The following activity types will need the Noise Management Plan:

a) Club
b) Drink establishment
c) Emergency services facility
d) Hotel
e) Indoor recreation facility
f) Industry (except light industry)
g) Indoor entertainment facility
h) Outdoor recreation facility
i) Restaurant

At the later stages, the activity type of the commercial spaces will be known and if any tenancy has one of the above uses, a NMP will be required.

5.1.2 Environment Protection Regulation 2005 (EPR)

Schedule 2.1 of Environmental Protection Regulations defines different noise zones in ACT.

Table 2.2 of Schedule 2 of the regulation provides the noise standards for each zone. This is presented in Table 3.

Table 3: Environmental Protection Regulation – Noise zones and corresponding noise standards

Noise zone	ACT Land	Noise standard $L_{10,T}$ dBA	
		Day time Mon-Sat: 7am-10 pm Sun & Pub. Hols : 8am-10pm	Night time Mon-Sat: 10 pm-7am Sun & Pub. Hols: 10pm-8am
Zone A	Land in industrial zone	65	55
Zone B	-Land in the city centre and town centres -Land in the Central National Area (City Hill Precinct)	60	50
Zone C	-Land in group centres, corridor sites and office sites -Land in the Central National Area (Parliamentary zones and other areas)	55	45
Zone D	Land (other than land in the city centre, town centres and group centres) in a commercial CZ4 zone	50	35
Zone E	-Land (other than land in the city centre, town centres and group centres) in: -A restricted access recreation zone -A broadacre zone	50	40
Zone F	-Land (other than land in the city centre, town centres and group centres in: -A commercial CZ5 zone -A TSZ2 service zone -A community facility zone -A leisure and accommodation zone	Same as noise standard for the adjoining noise zone with the loudest noise standard for the time period	
Zone G	All other land other than land in the Central National Area (Fairbairn)	45	35

5.1.3 Noise Environment Protection Policy 2010 (NEPP)

The NEPP provides guidance on how the EPR is applied and how to meet the legislative requirements. More specifically, the NEPP provides further guidance on the following matters:

- Determining noise standards for boundaries between multiple zones
- Determining the compliance point
- Measurement of noise for compliance

5.1.3.1 Noise Standards for the Boundary Between Two or More Zones

The NEPP provides further guidance for noise standards for boundaries between two or more noise zones.

The NEPP suggests that people living adjacent to a commercial area should expect to be exposed to some increase in noise levels above the noise standard which applies in a purely residential area.

The NEPP states that:

The Regulation (EPR) recognises that occupiers of land which is at the boundary between two noise zones need to make allowances for the differing land use on the other side of the boundary. This is achieved by setting the standard at the boundary to the average, rounded up to the nearest dB(A), of standards applying to the two zones at the time the noise was emitted (Section 24(2)(c) of the Regulation).

Furthermore, it is noted that the averaging only applies to the boundary which is common to both zones. The normal zone noise limit applies to the other boundaries of the properties.

5.1.3.2 Compliance Point

Section 8.1 of the NEPP defines the compliance point as the following.

Unless otherwise specified in an environmental authorisation or approval, measurements for determining compliance with Act and Regulation are to be taken at a compliance point on, or as close as practicable to a straight line between the source of the sound and the location where the sound is causing or is likely to cause environmental harm.

5.1.3.3 Measurement of Noise

Section 8.2 of the NEPP details the index for noise measurements in the ACT. This is reproduced in Table 4.

Table 4: Noise Environment Protection Policy - Index for noise measurements or assessment

Measurement Index	Length of measurement time	Adjusted measures for tonality, Impulsiveness or fluctuation
L10 (Level of exceedance for 10% of time)	Representative measurement of the noise, not less than 5 minutes or greater than 15 minutes	+ 5 dBA

5.1.4 Summary of Noise Emission Criteria

Based on the noise emission criteria stipulated above, the noise standards for the surrounding noise receivers were determined and are presented in Table 5.

Table 5: Noise standard for the surrounding noise receivers

Receiver ID	Address	Land Use/Noise zone	Boundary[3]	Noise standard $L_{10,T}$ dBA[1]	
				Day time Mon-Sat: 7am-10 pm Sun & Pub. Hols : 8am-10pm	Night time Mon-Sat: 10 pm-7am Sun & Pub. Hols: 10pm-8am
R01	88 Northbourne Ave	Residential apartments/B	North	60	50
R02 [2]	85 Northbourne Ave (Havelock House)	Residential apartments/G	East	45	35
R03	92 Northbourne Ave	Commercial (hotel)/B	South	60	50
R04	38 Mort Street	Commercial units & shops within the building/B	West and south	60	50

1. Time interval 'T' is defined as a time period not less than 5 minutes or greater than 15 minutes
2. It is noted that the noise zones of the development and the receiver are different. As the two do not have a common boundary, averaging between the two noise standards is not required
3. Refers to the boundary of the noise receiver

5.2 Noise Intrusion Criteria

External noise intrusion from road traffic and surrounding commercial activities should be controlled to meet the internal noise level criteria within the development. The Guidelines for the Preparation of Noise Management Plans for Development stipulates that for residential developments within a noise standard higher than zone G, the development must meet the 'design sound level ranges' recommended for residential buildings in Australian New Zealand Standard AS/NZS 2107:2016 "Acoustics – Recommended design sound levels and reverberation times for building interiors". Section 5.2.1 details the internal noise levels provided by the standard.

5.2.1 Australian New Zealand Standard AS/NZS 2107:2016

AS/NZS 2107 provides recommended noise level and reverberation times for different areas of occupancy in buildings. The recommended noise levels are given in terms of an equivalent continuous A-weighted noise level (L_{Aeq}). The Standard gives recommended noise level and reverberation times for different areas of occupancy in buildings.

The AS/NZS 2107 recommended values for the internal design sound levels are shown in Table 6.

Table 6: Australian standard AS/NZS 2107 – Recommended design sound levels for internal spaces

Type of Occupancy/Activity	Recommended Design Sound Level range – LAeq dBA
Residential buildings in inner city areas:	
Living area	35-45

Sleeping area	35-40
Office Buildings:	
Work areas, General office area	40 – 45
Enclosed carpark	< 65

5.3 Roads ACT Noise Management Guidelines 2018 (NMG)

The NMG provides guidelines for the management of road traffic noise. The NMG sets out a framework for assessing the impacts of road traffic noise for land uses sensitive to noise intrusion.

Section 8 of the NMG is on Noise Management on Existing Roads in Existing Areas and provides details on noise limits and management of traffic noise levels.

Table 1.4 of the NMG provides noise limits for noise sensitive land use. The noise levels are presented in the following Table 7.

Table 7:Target traffic noise levels for noise sensitive land use in existing areas, expressed as LAeq dB(A)

Situation	Traffic noise level at adjacent buildings
Target level LAeq(15 hrs) dBA for estates established after 1996	60
Nighttime LAeq(9 hrs) dBA Target level- for estates established after 1996	55
Target level LAeq(15 hrs) dBA for commercial facilities	72

The traffic noise from public roads following the completion and operation of the development should comply with the noise criteria stipulated in Table 7.

The NSW Road Noise Policy (RNP), provides a screening criteria to assess increases in traffic noise levels. The RNP states that new developments should not increase the traffic noise level of the surrounding road network by more than 2 dB(A). This criteria will be used as an additional guide for the assessment of vehicular noise impact.

5.4 Acoustic separation (NCC 2022)

The residential parts of this development are classified as Class 2 under the National Construction Code (formerly BCA):

> *"A building containing 2 or more sole-occupancy units each being a separate dwelling."*

As such, Part F7 of the NCC (summarised in Table 8 below) applies to building elements for acoustic insulation. Recommended constructions to achieve these ratings will be provided at the detailed design stage.

Table 8: BCA required acoustic insulation performance

Building element separating:			Required acoustic performance
Floors	Sole-occupancy unit (including ensuite)	Sole-occupancy unit (SOU), plant room, lift shaft, stairway, public corridor, public lobby or the like; parts of a different classification.	Min. $R_w + C_{tr}$ 50 Max. $L_{n,w} + C_I$ 62
Walls	Sole-occupancy unit	Sole-occupancy unit	Min. $R_w + C_{tr}$ 50
		Stairway, public corridor, public lobby or the like; parts of a different classification.	Min. R_w 50, with min. R_w 30 door
		Plant room, lift shaft	Min. R_w 50 Discontinuous construction
	Habitable room (other than a kitchen)	Bathroom, sanitary compartment, laundry or kitchen in an adjoining unit	Min. $R_w + C_{tr}$ 50 Discontinuous construction
Services	Habitable room in a sole-occupancy unit	Duct, soil pipe, waste pipe, water supply pipe, storm water pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one SOU	Min. $R_w + C_{tr}$ 40
	Non-habitable room or kitchen in a sole-occupancy unit		Min. $R_w + C_{tr}$ 25

5.5 Rail Vibration

Vibration associated with rail operations can result in impacts on human comfort or the damage of the physical structures such as dwellings.

In the ACT there are no standards or guidelines that specify vibration criteria for rail lines. In lieu of ACT vibration criteria, the NSW Assessing Vibration: a Technical Guideline (AVaTG) has been adopted to assess the vibration impacts associated with the light rail.

It is noted that the human comfort criteria are more stringent than the structural damage criteria. Therefore, for a conservative assessment, the human comfort criteria have been adopted for the Project.

The AVaTG human comfort vibration criteria are presented in Table 9 below.

Table 9: Preferred VDVs for intermittent vibration ($m/s^{1.75}$)

Location	Day time	Night time
Residences	0.2	0.13

6. Assessment

6.1 Noise intrusion into the development

Noise intrusion into the internal spaces of commercial and residential units should be controlled by designing the façade elements.

The traffic on Northbourne Avenue has a moderate-high volume therefore traffic noise intrusion should be considered.

Considering the traffic volumes provided by the traffic consultant report (see Appendix C), the noise levels on Northbourne Avenue were calculated using CoRTN (Calculation of Road Traffic Noise) software. Using the highest hourly volume of vehicles, traffic noise levels were calculated to the west façades of the building and had a level of 65 dBA. Calculating the noise levels on all facades, the acoustic performance of the elements were checked and appropriate glazing was designed. Based on the outdoor ambient/traffic noise levels, calculations have been made to design the glazing so that the internal noise level of bedrooms will be 35 dBA and for living rooms 40 dBA, as recommended in AS/NZS 2107 standard.

The outer walls of the building will be masonry. The acoustic performance of masonry walls is in excess of Rw 45. This value was used in the calculations and the design of the glazing.

The glazing schedule is presented in Table 10.

Table 10:Glazing schedule

Level	Facade	Space	Recommended glazing	
			Rw (glass+frame)	Glazing type
Ground	West	SOHO 01-05	32	6.38 lam
	North	Retail	32	6.38 lam
1	West	SOHO 01-05	32	6.38 lam
	North	Bed	30	6 mono
		Living	30	6 mono
2-7	West	Bed	32	6.38 lam
		Living	32	6.38 lam
	North/South	Bed	30	6 mono
		Living	25	4-5 monolithic
	East	Bed	30	6 mono
		Living	25	4-5 monolithic
8 (Penthouse)	West	Bed	32	6.38 lam
		Living	32	6.38 lam
	North/South/East	Bed	30	6 mono
		Living	30	6 mono

The above glass thicknesses can be increased for the reasons of fire, safety or section J, as required.

6.2 Noise breakout

The following noise sources could contribute to the noise breakout from the development:

- Plant noise of commercial and residential units
- Operational noise from the commercial units. This includes noise emissions from the loading dock
- Vehicular noise impact of the commercial and residential units.

All noise emissions should comply with the limits provided in ACT Environmental Protection Regulation.

6.2.1 Plant noise

Any external mechanical plant should be selected or treated such that the total accumulated noise complies with the noise limits shown in Table 5. For residential noise receivers located in zone G the noise exposure limit will be 45 dBA during the hours of day and 35 dBA during night time. For noise receivers within noise zone B the daytime limit is 60 and night time limit is 50 dBA.

The plant noise assessment should be conducted once the mechanical plant is finalised and equipment noise is known. If exceedances occur, acoustic treatments will be required. The amount of treatment will depend on the exceedance level above the noise limits.

It is anticipated that mechanical plant noise can be controlled using standard engineering control measures. Our general recommendations for attenuation of mechanical noise are as follows:

- Locating the equipment at the location away from the neighbouring sensitive receivers – reducing the line of sight from the equipment to the receiver can providing acoustic shielding and may reduce the overall noise level at the receiver
- Enclosures – housing of plant and equipment inside the plant room, typically 20 to 30 dB(A) reduction
- Acoustic louvers and acoustically treated intakes and discharges – to acoustically treat air intakes into plant rooms using acoustic louvers, lined intakes/discharges and attenuators
- Barriers – use of acoustic barriers or screens to shield sensitive receivers.

6.2.2 Operational noise

All operational noise levels perceived by surrounding noise receivers should comply with the noise limits presented in Table 4.

The operational noise from the commercial units will be known after the tenants and their activity types are known. At the discretion of the council, a noise assessment may be required at later stages when the activity types are known.

Details of “Noise Environmental Protection Policy” should be considered if any noise measurements or assessments are required. The noise measurement should be in the form of L10 and should be conducted at a location between the noise and receiver at a location where environmental harm is likely to occur. This could be the boundary or the most affected point of the receiver building.

6.2.3 Vehicular noise impact

The vehicular noise impact could be from the following:

- Noise emissions from the carpark and loading areas
- Noise from the generated traffic affecting the surrounding road network

The traffic data were obtained from the traffic consultant report prepared by Quantum Traffic (ref: *Traffic Impact Assessment Report* dated May 2023). The report has provided figures for generated traffic and existing vehicle counts of Northbourne Avenue. The data of the existing traffic volumes are provided in Appendix C.

6.2.3.1 Noise emissions from the carpark and loading area

The carpark is on three levels in the basement and is fully enclosed therefore it is anticipated that the noise emissions/impacts from the carpark would be minimal. The entry/exit point of the carpark is on Elouera Street and should be considered for possible noise impact upon the neighbouring buildings.

Additionally, the noise from the use of the ground level loading / waste removal area have been considered.

The following assumptions have been made in the calculation of the noise emission levels.

- 1 x heavy vehicle movement occurring within a 15 minute period
- 30 x light vehicle movements occurring within a 15 minute period
- Heavy vehicles having a sound power level of 106 dBA $L_{10,15min}$
- Light vehicles having a sound power level of 87 dBA $L_{10,15min}$
- Heavy and light vehicle movements travelling at 20km/h
- Waste disposal activities having a sound power level of 77 dBA $L_{10,15min}$

The noise emissions from the carpark were predicted using 3D acoustic modelling program (Cadna A version 2023). The noise model considers the following:

- Distance between the source and the receiver
- Ground attenuation
- Acoustic shielding from nearby buildings and the proposed 1.8m fence located along the southern boundary

The predicted noise levels at the nearest affected receivers are presented in Table 11.

Table 11: Noise emissions from carpark

Receiver location	Time period	Criteria	Predicted noise level $L_{10,15min}$ dBA	Complies
R1	Day	55	54	Yes
	Night	45	29	Yes
R2	Day	45	34	Yes
	Night	35	< 20	Yes
R3	Day	55	37	Yes
	Night	45	29	Yes
R4	Day	55	30	Yes
	Night	45	22	Yes

The above results indicate that noise emissions from the carpark and loading area will comply with the day and night criteria provided that the following mitigation measures are incorporated into the design.

- Switching off heavy vehicles during loading and unloading activities
- Limiting loading/ waste removal to the day time only (Mon-Sat: 7am-10 pm, Sun & Public holidays: 8am-10pm)
- 1.8m southern boundary fence with no gaps. The material of the boundary fence will be determined at the detailed design stage and will be approved by an acoustic consultant.

6.2.3.2 Noise from generated traffic affecting surrounding roads

Traffic data were used to predict the impact of noise from the generated traffic. The data indicate that at Northbourne Avenue, the highest hourly traffic volumes will be in the afternoon peak between 4:30 and 5:30 pm. Calculations indicate that the existing noise levels are higher than the recommended levels therefore consideration will be given to the relative noise increase. The values for existing traffic, generated traffic and the relative increase due to generated traffic are shown in the following Table 12.

Table 12: Noise emissions from generated traffic

Period	Direction	Existing traffic vol (v/h)	Projected traffic vol (v/h)	Relative increase in noise level, dBA
PM peak hour	Northbound	1272	36	0.12
	Southbound	742	21	0.12

The values in the summary Table 12 above indicate that the relative increase in noise level will be 0.12 dBA. This level of noise increase is not discernable to the average listener and therefore the increase in noise levels is considered acceptable. Note that for a similar situation in NSW, the NSW Road Noise Policy allows a limit of 2 dBA for relative noise increase.

6.3 Sound Insulation Provisions

The NCC provides acoustic details and requirements for the internal walls /partitions/floors of the residential units as presented in Section 5.4. Details of internal walls and surfaces will be determined later at the detailed design stage.

6.4 Rail Vibration

The eVDV is calculated based on the expected exposure to vibration for the day and night time period. The number of light rail pass-bys were obtained from the light rail timetable. It was identified that there are 232 train pass-bys during the day time and 16 train pass-bys at night.

Table 13 presents the calculated eVDV for each pass-by in each direction.

Table 13: Train passby eVDV

Weighted rms values for vibration acceleration (m/s^2) 1–80 Hz			Calculated eVDV						Criteria (preferred) (m/s1.75)		Exceedance
			Day			Night					
Z-Axis	X-Axis	Y-Axis	X	Y	Z	X	Y	Z	Day	Night	
5.4325E-05	5.40132E-05	0.000164437	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
5.48277E-05	6.18728E-05	0.000225944	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
5.26017E-05	5.42625E-05	0.000167687	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
5.94292E-05	6.44911E-05	0.000225165	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
5.82103E-05	5.41377E-05	0.000169629	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
5.3889E-05	5.06991E-05	0.000163682	0.001	0.000	0.002	0.000	0.000	0.001	0.2	0.13	No
5.84117E-05	7.32825E-05	0.000248028	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
5.53988E-05	5.42625E-05	0.000173181	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
5.30274E-05	5.17011E-05	0.000138676	0.001	0.001	0.001	0.000	0.000	0.001	0.2	0.13	No
5.32108E-05	5.31496E-05	0.000156135	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
6.53131E-05	5.25412E-05	0.000191205	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
6.61455E-05	9.24698E-05	0.000339234	0.001	0.001	0.003	0.000	0.000	0.002	0.2	0.13	No
6.58415E-05	5.30274E-05	0.000213059	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No
5.99791E-05	5.72137E-05	0.000192975	0.001	0.001	0.002	0.000	0.000	0.001	0.2	0.13	No

From Table 13, the calculated eVDV is below the preferred VDV limits detailed in Table 9.

Therefore, no vibration mitigation measures are required.

7. Conclusion

This report is part of DA documentation for the proposed development at 90 Northbourne Avenue, Braddon.

A noise assessment was conducted to establish the noise criteria and possible noise impacts. Based on ACT regulations and Australian standards the noise criteria were established. The report takes into account possible noise emissions from the proposed site to the surrounding neighbourhood. It also considers noise intrusions from the surrounding noise sources into the development. The report also considers vehicular noise impact on the neighbouring buildings and upon the surrounding road network. In each case, recommendations were provided where exceedances occurred.

The existing vibration levels from the light rail were measured and were found to be below the human comfort vibration limits. Therefore, no vibration mitigation measures were required.

Providing our recommendations are implemented, it is anticipated that noise emissions from the Project will comply with the acoustic requirements set out in ACT regulations and relevant Australian standards and guidelines.

Appendix A: Architectural Drawings

The following drawings produced by Cox Architects were used in the assessment:

Drawing number	Revision	Drawing title
DA21-01	7	GA-basement 3 floor plan
DA21-02	7	GA-basement 2 floor plan
DA21-03	7	GA-basement 1 floor plan
DA21-04	9	GA-ground floor plan
DA21-05	6	GA-level 1 floor plan
DA21-06	6	GA-level 2-6 floor plan
DA21-07	6	GA-level 3 floor plan
DA21-08	6	GA-level 4 floor plan
DA21-09	6	GA-level 5 floor plan
DA21-10	6	GA-level 6 floor plan
DA21-11	6	GA-level 7 floor plan
DA21-12	6	GA-level 8 floor plan
DA21-13	3	GA-roof floor plan

Appendix B: Glossary of Acoustic Terms

- Decibel – dB – Unit of Acoustic measurements for power, pressure and intensity. Expressed in dB relative to standard levels.
- A-weighted decibel – dB(A) – Unit of acoustic measurement weighted approximately to human hearing to sound.
- SPL – Sound Pressure Level – 20 times the logarithm to the base 10 of the ratio of r.m.s. sound pressure to the reference pressure of 20 micro Pascals, sound pressure level is measured using a microphone and a sound level meter and varies with distance from the source.
- SWL – Sound Power Level – 10 times the logarithm to base 10 of the ratio of the sound power of the source to the reference sound power of 1 Pico Watt. Sound power level cannot be directly measured using a microphone and a sound level meter, and it does not change with distance. The sound power of a machine will vary depending on the operation conditions or load.
- Rw – Weighted Sound Reduction Index – Measured sound reduction of a building element in a laboratory, corrected for room volume and reverberation time, the higher values correspond to better sound insulation.
- LAmax – The Maximum Noise Level over a sample period is the maximum level, measured on fast response, during the sample period.
- LA10 – The noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the LA10 level for 90% of the time. The LA10 is a common noise descriptor for environmental noise and road traffic noise.
- LAeq – The equivalent continuous sound level is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.
- LA90 – The noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the LA90 level for 10% of the time. This measure is commonly referred to as the background noise level or RBL.
- LAmin – The Minimum Noise Level over a sample period is the minimum level, measured on fast response, during the sample period.

Appendix C: Traffic count data

The following traffic count data was provided by traffic consultant and was used in the calculations.

		Gould Street / Northbourne Avenue										Adjacent to Site					
	Time	North: Northbourne Avenue				West: Gould Street				Total		Northbound		Southbound		Both Directions	
		Left-Turn	Through	Right-Turn	U-Turn	Left-Turn	Through	Right-Turn	U-Turn	15-min	Hourly	15-min	Hourly	15-min	Hourly	15-min	Hourly
Tuesday, 9 August 2022	7:00	4	103	2	2	1	6	3	0			48	272	128	853	176	1,125
	7:15	6	154	3	2	1	5	4	0			58	338	176	1,012	234	1,350
	7:30	7	222	1	1	1	14	1	0			85	381	247	1,132	332	1,513
	7:45	16	273	2	5	4	13	7	0			81	435	302	1,141	383	1,576
	8:00	20	243	6	8	8	13	9	0			114	489	287	1,072	401	1,561
	8:15	21	235	6	2	9	17	19	0			101	465	296	997	397	1,462
	8:30	13	221	6	4	9	26	6	0			139	473	256	918	395	1,391
	8:45	16	181	8	5	9	12	12	0			135	451	233	880	368	1,331
	9:00	13	174	4	4	5	9	8	0			90	428	212	817	302	1,245
	9:15	10	186	4	5	6	12	5	2			109	440	217	767	326	1,207
	9:30	9	193	3	0	4	5	2	0			117	426	218	739	335	1,165
	9:45	8	152	3	2	4	4	1	0			112	415	170	663	282	1,078
	10:00	8	133	1	2	4	5	6	0			102	415	162	658	264	1,073
	10:15	5	166	2	2	1	4	3	0			95	420	189	667	284	1,087
	10:30	8	123	1	0	2	8	4	0			106	453	142	630	248	1,083
	10:45	5	147	0	2	1	0	2	0			112	490	165	640	277	1,130
	11:00	3	146	2	1	2	8	3	0			107	506	171	606	278	1,112
	11:15	7	134	0	2	1	11	2	0			128	534	152	586	280	1,120
	11:30	5	136	1	0	0	1	4	0			143	541	152	592	295	1,133
	11:45	7	114	1	0	1	6	2	1			128	524	131	580	259	1,104
	12:00	8	130	0	0	2	5	3	0			135	529	151	586	286	1,115
	12:15	6	136	0	1	1	3	1	0			135	516	158	566	293	1,082
	12:30	3	114	3	1	1	4	5	0			126	516	140	541	266	1,057
	12:45	13	120	3	1	2	7	0	0			133	535	137	564	270	1,099
	13:00	7	113	3	1	1	6	4	0			122	556	131	556	253	1,112
	13:15	6	112	4	3	5	7	2	0			135	584	133	556	268	1,140
	13:30	8	141	2	4	3	2	2	0			145	615	163	572	308	1,187
	13:45	3	112	0	3	5	6	4	1			154	662	129	567	283	1,229
	14:00	9	103	1	2	1	6	4	0			150	658	131	574	281	1,232
	14:15	1	117	4	3	2	3	2	0			166	674	149	586	315	1,260
	14:30	8	119	2	3	2	4	7	0			192	690	158	572	350	1,262
	14:45	7	104	0	0	4	3	7	0			150	670	136	551	286	1,221
	15:00	7	113	4	0	3	6	4	0			166	719	143	547	309	1,266
	15:15	7	120	3	1	1	10	3	0			182	782	135	557	317	1,339
	15:30	8	119	2	1	7	8	0	0			172	833	137	557	309	1,390
	15:45	10	105	1	1	2	4	3	0			199	923	132	566	331	1,489
	16:00	8	119	1	0	4	8	3	0			229	1,021	153	603	382	1,624
	16:15	11	108	3	3	2	9	4	0			233	1,090	135	642	368	1,732
	16:30	6	119	1	2	4	8	4	0			262	1,171	146	716	408	1,887
	16:45	8	137	1	2	7	12	10	0			297	1,272	169	742	466	2,014
	17:00	5	130	6	0	10	15	6	0			298	1,255	192	739	490	1,994
	17:15	7	166	1	4	9	18	8	1			314	1,185	209	694	523	1,879
	17:30	8	127	8	2	3	13	4	0			363	1,098	172	643	535	1,741
	17:45	10	126	6	0	2	12	5	0			280	862	166	580	446	1,442
	18:00	13	122	1	2	5	9	4	0			228	755	147	529	375	1,284
	18:15	8	128	2	0	2	6	1	0			227		158		385	
	18:30	10	88	2	0	3	5	5	0			127		109		236	
	18:45	6	94	3	1	0	7	4	0			173		115		288	

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