WOOD & GRIEVE ENGINEERS

41 McLaren Street North Sydney

Acoustic Report
Development Application

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Project No. 31166
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Revision

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1	18/08/2017	Final Issue	**ORFG**

Contents

1. Introduction

As part of the DA documentation process, Wood & Grieve Engineers has been engaged by Harry Seidler Architects to provide an acoustic assessment for the proposed mixed use development located at the 41 McLaren Street, North Sydney.

The proposed re-development will consist of:

- Approximately 224 residential apartments.
- Approximately 175 car parkings.
- Approximately 8,020m^2 office area.
- Communal open space.

This assessment discusses the likely noise impact of the development on the potentially nearest most-affected receivers surrounding the site.

This assessment has been prepared considering the following documents:

- North Sydney Council Development Control Plan (DCP 2013).
- NSW EPA Industrial Noise Policy (INP 2000).
- NSW EPA Road Noise Policy (RNP 2011).
- NSW EPA Interim Construction Noise Guidelines (ICNG 2009).
- NSW EPA "Assessing vibration: A technical Guideline" (2006).
- AS/NZS 2107:2016 – Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors.

This report provides:

- A statement of compliance with the North Sydney council requirements for the proposed mixed-use development within the vicinity of the nearest potentially most affected residential receivers.
- Recommendations for noise mitigation measures for the proposed development in order to meet the relevant criteria when compliance is not achieved.

This noise assessment is based on noise data collected by a combination of attended noise measurements and unattended noise loggers at representative locations around the site over 10 days.

This report is based on our understanding of the proposed project, application of the relevant state guidelines and professional experience within the acoustic field. Therefore, this report shall not be relied upon as providing any warranties or guarantees.

2. Project Overview

2.1 Information Sources

The following documentation has been used for the preparation of this report:

- Site drawings presenting the location of the proposed development in relation to the nearest receivers.
- Architectural drawings issue A, provided by Harry Seidler & Associates dated 24.07.17
- Noise data collected on site through the use of noise loggers and a hand held Type 1 sound level meter.
- Traffic report provided by asongroup ("Traffic Impact Assessment Report") dated 03rd August 2017.

2.2 Site description

The proposed residential-use development is to be located at 41 McLaren Street, North Sydney. The site is bound by commercial units across McLaren St to the north; residential properties to the east; commercial properties to the south; and residential properties across Harnett St to the west.

The acoustic issues relating to the development are as follows:

- Noise intrusion from vehicle movements on Cowper and Wentworth Street into the developments habitable areas.
- Noise emissions from mechanical plant from the development to the surrounding receivers.

The nearest potentially affected noise receivers (shown in Figure 1) have been identified as follows:

- Receiver North, commercial properties across McLaren St.
- Receiver East, residential properties along McLaren St.
- Receiver West, residential properties across Harnett St.
- Receiver South, commercial properties

The nearest noise sensitive residential receivers are the apartment buildings located at 37 McLaren Street (labeled as R1), and 45 McLaren Street (R2). The surrounding commercial receivers to the north, east, and west are also considered.

The site location, measurement positions and surrounding commercial and residential receivers are shown in Figure 1.

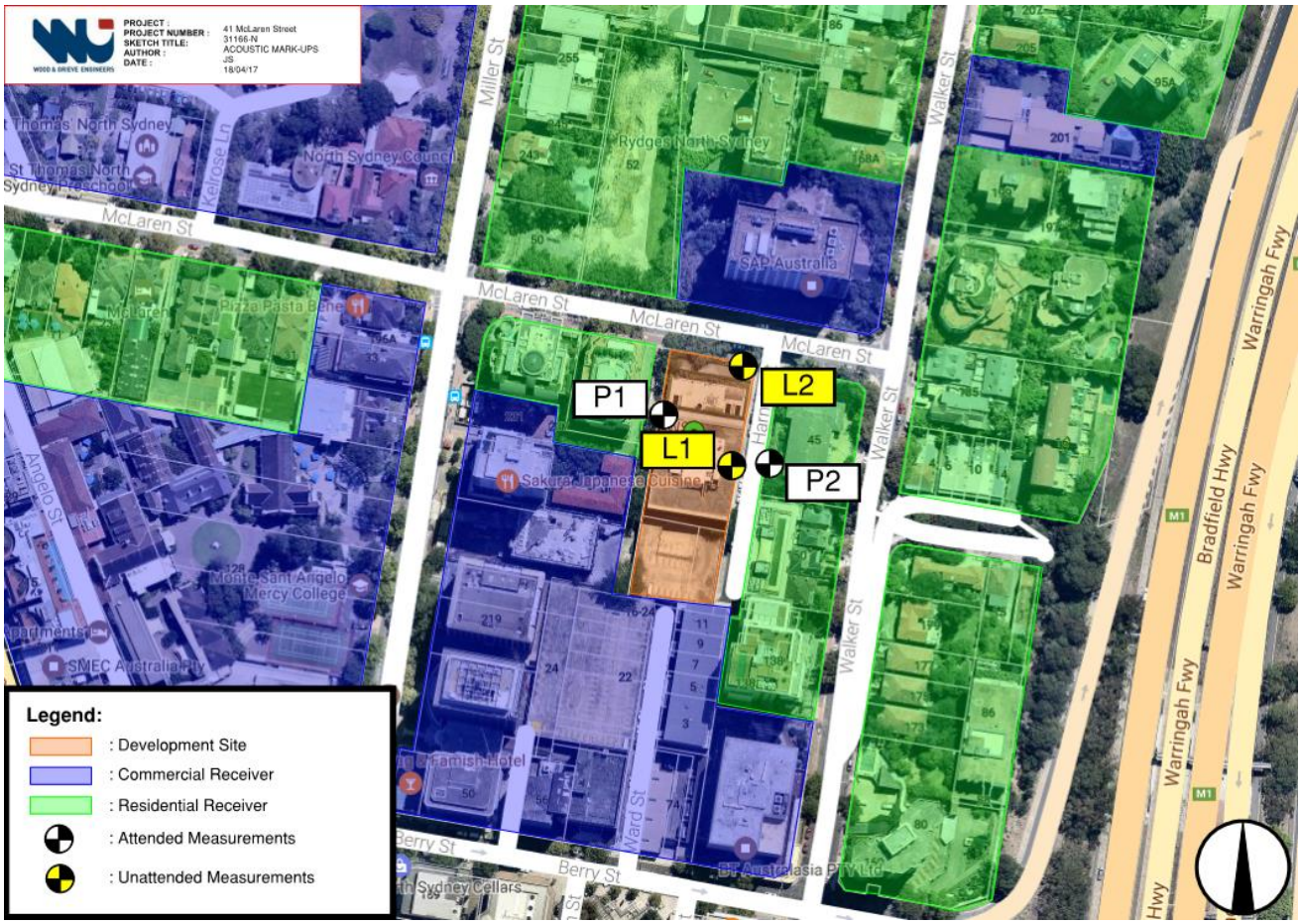
2.2.1 Acoustic Issues

The acoustic issues relating to the development are as follows:

- Noise intrusion from vehicle movements on Warringah Freeway, Bradfield Highway, McLaren Street, and Harnett Street
- Noise intrusion from surrounding mechanical plant noise from existing buildings
- Noise emissions from mechanical plant for the residential and retail/commercial spaces
- Traffic noise generation from vehicle movements accessing / exiting the proposed apartment and loading dock activities

Project Overview

Figure 1: Overview of the site and measurement locations



Source: nearmap.com

3. Noise Survey

3.1 Instrumentation

The equipment used for the noise survey was the following:

- CASELLA, CEL-63X, S/N 4257387
- CASELLA, CEL-63X, S/N 0166013
- Hand-held sound spectrum analyzer B&K 2250, S/N 2709742
- Sound Calibrator B&K Type 4231, S/N 2709826

All equipment was calibrated before and after the measurements and no significant drift was found. All equipment carries current traceable calibration certificates that can be provided upon request.

3.2 Attended Noise Survey Results

Attended noise measurements of 15-minute duration were conducted around the site to characterise the acoustic environment for noise intrusion into the development, and to determine the background noise environment at the surrounding residential receivers for establishing the noise criteria and conducting the noise impact assessment. The measurement positions are shown in Figure 1, and a summary of the attended noise measurements taken on site are presented in Table 1.

Table 1: Attended noise measurements

Measurement Location	Measurement Time	$L_{Aeq,15mins}$ - dB(A)	$L_{A90,15mins}$ – dB(A)	Comments
P1	07/04/17 – 01:08 PM	70.2 ($L_{Aeq,10mins}$)	65.5($L_{A90,10mins}$)	Dominated by construction noise from nearby development
P2	07/04/17 – 01:30 PM	59.1	55.0	Background noise on the street level

3.3 Unattended Noise Survey Results

The NSW EPA Industrial Noise Policy defines background and ambient noise for the daytime, evening and night time periods as follows:

Day: is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.

Evening: is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.

Night: is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays.

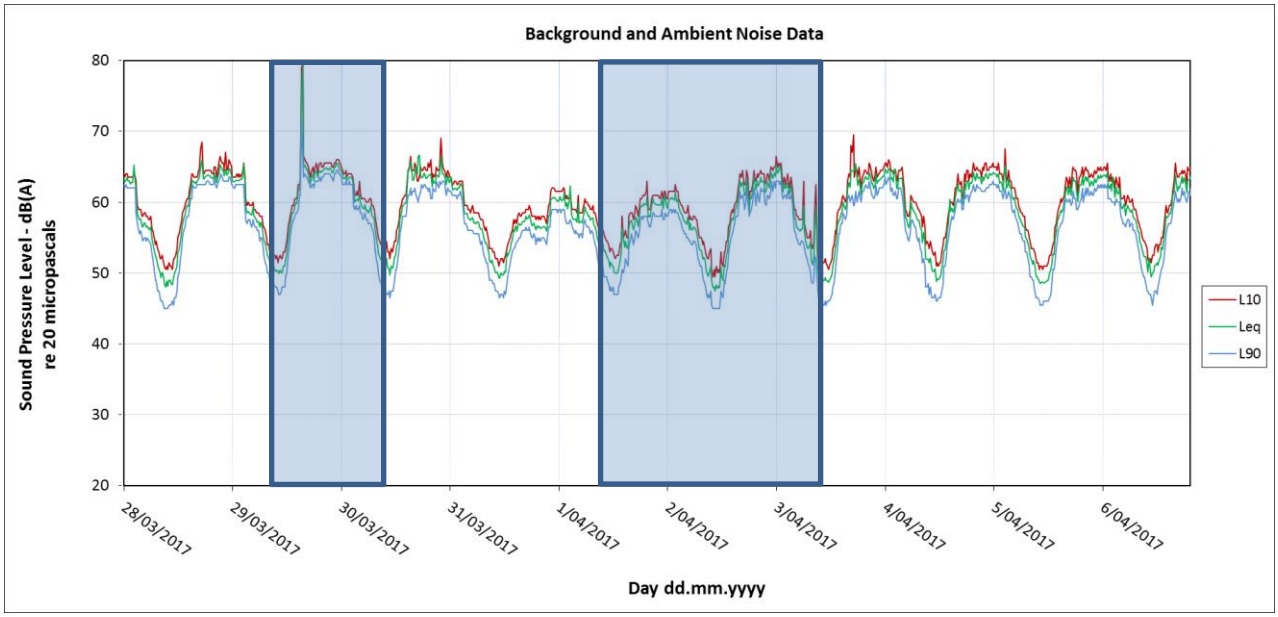
The noise logger at position L1 is representative of the noise level at the site and surrounding commercial receivers. A noise logger was placed at position L2 as shown in Figure 1 to measure the ambient and background noise that is representative of the nearest most affected residential receiver. The results of the unattended noise survey are shown in Table 2 below.

Table 2: Unattended noise measurements

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)			Background Noise Level RBL- dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	63	61	55	58	57	45
L2	63	63	55	55	51	45

Refer to Figure 2 and Figure 3 for the noise data of logger L1 and L2 at the nearest residential receiver.

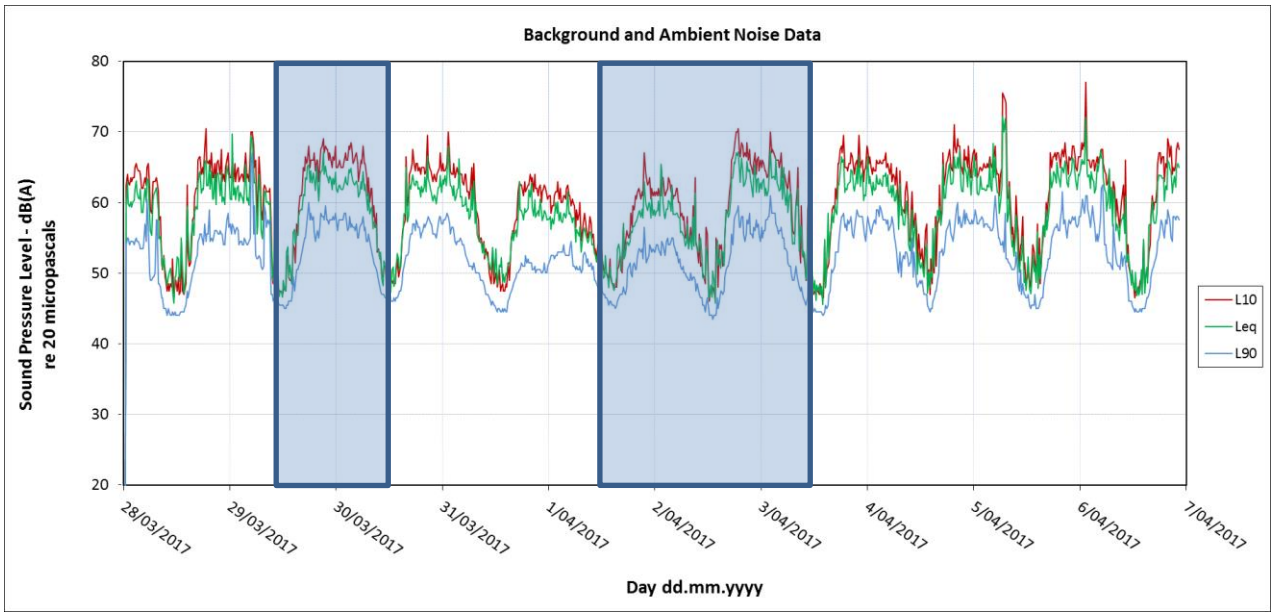
Figure 2: Unattended noise monitor data for L1



Note:

: Data excluded due to heavy rainfall

Figure 3: Unattended noise monitor data for L2



Note:

: Data excluded due to heavy rainfall

4. Noise and Vibration Criteria

4.1 Site noise emission

The following section presents the criteria applicable for noise emissions from the development.

4.1.1 North Sydney DCP

In regards to noise emissions associated with the non-residential components of the development, the 2013 North Sydney DCP states the following:

> *"The noise emission associated with the operation of non-residential premises or non-residential components of a building must not exceed 5 dB(A) above the background maximum 1 hour noise level (LAeq 1 Hour) during the day and evening and not exceeding the background level at night when measured at the boundary of the property."*

In addition, the DCP states that the following 1-hour noise levels are not to be exceeded at the boundary of the nearest residential premises.

Table 3: North Sydney DCP noise limits (Table B-2.3-Noise emission limits)

Day	Week	Time	Max 1 hour noise level (LAeq 1 hour)
Weekday	Day	7am-6pm	60dB(A)
	Evening	6pm-10pm	50dB(A)
	Night	10pm-7am	45dB(A)
Weekend	Day	8am-7pm	60dB(A)
	Evening	7pm-10pm	50dB(A)
	Night	10pm-8am	45dB(A)

4.1.2 NSW EPA Industrial Noise Policy

The NSW Environment Protection Authority (EPA) Industrial Noise Policy sets out noise criteria to control noise emissions from industrial noise sources. The external noise due to mechanical services from the proposed development is also addressed following the guideline in the NSW EPA's INP.

The calculation is based on the results of the ambient and background noise unattended monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

Once both criteria are established the most stringent for each considered assessment period (day, evening, night) is adopted as the project-specific noise level (PSNL).

Noise and Vibration Criteria

Intrusiveness Criteria

The NSW EPA INP states the following:

> *"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 LAeq descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A)."*

The intrusiveness criterion can be summarised as L_{Aeq}, 15 minute ≤ RBL background noise level plus 5 dB(A).

Table 4: EPA INP intrusiveness criteria

Period	Noise Descriptor – dB(A)	Noise Criteria – dB(A)
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	60
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	56
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	50

Amenity Criteria

The NSW INP states the following:

> *"To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the INP. Meeting the acceptable noise levels in table 2.1 will protect against noise impacts such as speech interference, community annoyance and to some extent sleep disturbance. These levels represent best practice for assessing industrial noise sources, based on research and a review of assessment practices used overseas and within Australia."*

The applicable parts of Table 2.1: Recommended L_{Aeq} Noise Levels from Industrial Noise Sources - dB(A) which are relevant to the project are reproduced below:

Table 5: Amenity criteria for external noise levels

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Adjusted Acceptable L_{Aeq} Levels
Residential	All	Day	53
	All	Evening	51
	All	Night	45
Commercial	All	When in use	65

*Urban area as defined in EPA INP 2. 2.1.6.

'Modifying Factor' Adjustments

The NSW INP also states:

> *"Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level."*

In order to take into account, the potential annoying character of the noise an adjustment of 5 dB(A) for each annoying character aspect and cumulative of up to a total of 10 dB(A), is to be added to the measured value to penalise the noise for its potentially greater annoyance aspect.

Noise and Vibration Criteria

Table 4.1 of Chapter 4 of the NSW DECCW INP (see Table 6 below) provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

Table 6: Table 4.1 NSW DECCW INP – Modifying factor corrections

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Tonal Noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: - **5 dB** or more if the centre frequency of the band containing the tone is above 400 Hz - **8 dB** or more if the centre frequency band containing the tone is 160 to 400 Hz inclusive - **15 dB** or more if the centre frequency of the band containing the tone is below 160 Hz	5 dB[2]	Narrow-band frequency analysis may be required to precisely detect occurrence.
Low Frequency Noise	Measurement of C-weighted and A-weighted level	Measure / assesses C- and A-weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more	5 dB[2]	C-weighting is designed to be more responsive to low-frequency noise, especially at higher overall levels
Impulsive Noise	A-weighted fast response and impulsive response	If difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB	Apply difference in measured levels as the correction, up to a maximum of 5 dB.	Characterised by a short rise time of 35 milliseconds (ms) and decay time of 1.5 s.
Intermittent Noise	Subjectively assessed	Level varies by more than 5 dB	5 dB	Adjustment to be applied for **night-time only.**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	On event in any 24-hour period	0 to – 20 dB(A)	The acceptable noise level may be increased by an adjustment depending on duration of noise.
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10dB(A)[2] (excluding duration correction)	

Notes:

1. Corrections to be added to the measured or predicted levels.
2. Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range.

4.2 Project-Specific Noise Levels (PSNL)

North Sydney Council DCP condition P8 under the section discussing noise for mixed-use development stipulates that: "developments must comply with the EPA Industrial Noise Policy 2000 in particular the modification requires for acceptable noise level (ANL)."

Table 7 below displays the project-specific noise levels PSNL for the project. Any operational or mechanical noise emissions from the development must comply with the PSNL provided at the surrounding receivers.

Table 7: Project specific noise levels, LAeq

Period	Descriptor	PSNL dB(A)
Residential Areas		
Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	53
Evening (6:00pm to 10:00pm)	$L_{Aeq,Evening}$	50
Night (10:00pm to 7:00am)	$L_{Aeq,Night}$	45
Commercial		
When in use	$L_{Aeq,Day,Evening}$	65

Where necessary, noise mitigation measures will be incorporated in the design to ensure that noise levels comply with the recommended noise emission criteria noted above.

4.3 Internal Noise Levels

This section details the criteria used to define the internal noise goals for spaces in the development.

4.3.1 North Sydney DCP

North Sydney DCP specified the maximum noise intrusion criteria from external sources with windows and doors closed. The maximum noise intrusion criteria can be seen on Table 8 below.

Table 8: North Sydney DCP Noise intrusion criteria from external sources (Table B-1.3)

Internal Spaces	Time Period	Max 1 hour noise level (LAeq 1 hour)
Living areas	Day or Night	≤ 40dB(A)
Sleeping Areas	Day or Night	≤ 35dB(A)

In regards to noise emissions associated with the non-residential components of the development, the 2013 North Sydney DCP states the following:

In regards to noise emissions associated with the non-residential components of the development, the 2013 North Sydney DCP states the following:

> *"The noise emission associated with the operation of non-residential premises or non-residential components of a building must not exceed 5 dB(A) above the background maximum 1 hour noise level (LAeq 1 Hour) during the day and evening and not exceeding the background level at night when measured at the boundary of the property."*

In addition, the DCP states that the following 1-hour noise levels are not to be exceeded at the boundary of the nearest residential premises.

Table 9: North Sydney DCP noise limits (Table B-2.3-Noise emission limits)

Day	Week	Time	Max 1 hour noise level (LAeq 1 hour)
All-day	Day	7am-6pm	60dB(A)
	Evening	6pm-10pm	50dB(A)
	Night	10pm-7am	45dB(A)

AS/NZS2107:2016 will be used to assign internal noise level criteria to the other spaces within the development.

4.3.2 AS/NZS2107:2016 Recommended Design Sound Levels

Australian Standard (AS/NZS) 2107:2016 – *'Acoustics- Recommended design sound levels and reverberation times for building interiors'* specifies target noise levels for internal spaces and values corresponding to the relevant types of spaces that are expected to be at the proposed development, as summarised below Table 10.

Table 10: Recommended Noise Levels according to AS/NZS 2107:2016

Type of occupancy/activity	Recommended design sound level, $L_{eq,\ dB(A)}$		Recommended Reverberation Time, s
	Satisfactory	Maximum	
5. OFFICE BUILDINGS (see Note 5 and Clause 5.2)			
Board and conference rooms	30	40	0.6 – 0.8
General office areas	40	45	0.1 – 0.4
Open plan office	40	45	0.4 (See Note 1)
Meeting room (small)	40	45	<0.6
Reception areas	40	45	0.6 – 0.8
Restrooms and breakout spaces	40	45	0.4 – 0.6
7. RESIDENTIAL BUILDINGS (see Note 5 and Clause 5.2)			
Houses and apartments near major roads -			
Living areas	35	45	-
Sleeping areas (night time)	35	40	-
Work areas	35	45	-
Apartment common areas (e.g. foyer, lift lobby)	45	55	-
Enclosed car park	-	65	-
8. SHOP BUILDINGS (see Note 5 and Clause 5.2)			
Small retail stores (general)	-	50	See Note 1
Supermarkets	-	55	See Note 1
Speciality shops (where detailed discussion is necessary in transactions)	-	45	See Note 1

Note:

1. Reverberation time should be minimised for noise control.

4.4 Traffic Noise Generation Criteria

The L_{Aeq} noise level or the "equivalent continuous noise level" correlates best with the human perception of annoyance associated with traffic noise.

Road traffic noise impact is assessed in accordance with NSW Road Noise Policy published by Department of Environment Climate Change and Water (DECCW) which now part of NSW Environment Protection Authority (NSW EPA). This document supersedes the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN, Department of Environment Climate Change and Water 1999).

The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is shown below:

Table 11: NSW Road Noise Policy – traffic noise assessment criteria

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway/arterial/Sub-arterial roads	Existing Residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,15\ hour}$ 60 (external)	$L_{Aeq,9\ hour}$ 55 (external)

In the event that the traffic noise at the site is already in excess of the criteria noted above, the NSW RNP states that the primary objective is to reduce the existing level through feasible and reasonable measures to meet the criteria above.

If this is not achievable, Section 3.4.1 Process for applying the criteria – Step 4 states that for existing residences affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise should be limited to 2dB above that of the corresponding 'no build option'.

4.5 Construction Noise Criteria

Noise criteria for construction sites are established in accordance with the Interim Construction Noise Guideline (*ICNG July 2009*) by the Department of Environment and Climate Change currently part of NSW Environment Protection Authority (NSW EPA). It is important to note that the recommended criteria are for planning purposes only. Numerous other factors need to be considered when assessing potential noise impacts from construction works.

However, in undertaking the assessment of potential noise intrusion associated with the proposed construction activities, Chapter 4 of the NSW EPA ICNG (July 2009) were specifically referenced. The noise limits are presented in Table 12, and are applicable to the development.

Table 12: NSW DECCW ICNG Construction Noise Criteria

Time of Day	Management Level $L_{Aeq,15min}$ *	How to Apply
Recommended Standard Hours: Mon – Fri (7am – 6pm) Sat (8am – 1pm) No work on Sunday & Public Holidays	Noise Affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residences of the nature of works to be carried out, the expected noise levels and duration as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur in, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school, for works near schools, or mid-morning or mid-afternoon for works near residences) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise Affected RBL + 5dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2.

Note: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Source: Chapter 4 (Table 2 Sec 4.1.1) of NSW EPA ICNG.

4.6 Construction Vibration Criteria

The Office of Environment and Conservation currently part of NSW Environment Protection Authority (NSW EPA) developed a document, "Assessing vibration: A technical Guideline" in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. The guideline does not however address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent.

4.6.1 Human Comfort – Continuous and Impulsive Vibration Criteria

Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day.

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 13. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Table 13: Preferred and maximum weighted RMS values for continuous and impulsive vibration acceleration (m/s2) 1-80Hz

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and place of worship	Day or night time	0.020	0.014	0.040	0.028
Impulsive vibration					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and place of worship	Day or night time	0.64	0.46	1.28	0.92

Human Comfort – Intermittent Vibration Criteria

Disturbance caused by vibration will depend on its duration and its magnitude. This methodology of assessing intermittent vibration levels involves the calculation of a parameter called the Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of intermittent vibration. Various studies support the fact that VDV assessment methods are far more accurate in assessing the level of disturbance than methods which is only based on the vibration magnitude.

Table 14: Acceptable Vibration Dose Values for Intermittent Vibration (m/s1.75)

Location	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and place of worship	0.40	0.80	0.40	0.80

4.6.2 Structural Damage – Vibration Criteria

Ground vibration criteria are defined in terms of levels of vibration emission from the construction activities which will avoid the risk of damaging surrounding buildings or structures. It should be noted that human comfort criteria are normally expressed in terms of acceleration whereas structural damage criteria are normally expressed in terms of velocity.

Most commonly specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 "Structural vibration in buildings – Effects on structures" and British Standard BS7385-Part 2: 1993 "Evaluation and Measurement for Vibration in Buildings". Table 15 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn't occur.

Table 15: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
*For frequencies above 100Hz, at least the values specified in this column shall be applied					

Table 16 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Table 16: Transient vibration guide values for cosmetic damage

Type of Building	Peak Particle Velocity in frequency range of predominant pulse (PPV)	
	4 Hz to 15 Hz	15 Hz and above
Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

4.6.3 Construction Vibration Objectives

Table 17 indicates the construction vibration criteria applicable to the residential and commercial properties located adjacent to the development site.

Table 17: Construction vibration criteria summary

Location	Period	Human Comfort Vibration Objectives			Building damage Objectives – Velocity (mm/s)
		Continuous mm/s² (RMS)		Intermittent mm/s$^{1.75}$ (VDV)	
		z-axis	x- and y-axis		
Residential	Daytime	10-20	7-14	0.2-0.4	5
	Night time	7-14	5-10	0.13-0.26	5
Commercial	Day or night	20-40	14-28	0.4-0.8	20

5. Noise Impact Assessment

The following sections detail the acoustic requirements for the building glazing, and present the results of the noise impact assessments to the nearest potentially affected receivers due to noise generating activities from the apartments (residential component) and retail/office components from the development.

5.1 External Glazing

The general limiting factor of the performance of a building façade in term of noise attenuation is the glazing. In the case of the proposed development, the surrounding traffic noise form McLaren St and Harnett Street and mechanical plant located on the roof of the retail spaces will provide most of the external noise sources driving the design of the offices/apartments façade and its acoustic performance.

In order to achieve the internal noise levels specified in the North Sydney DCP and AS/NZS 2107:2016, the minimum recommended glazing selection for the façades of the proposed development is presented in the following Table 18.

The data presented in this table is based on the worst case scenario of external noise obtained from attended and unattended noise measurements. The glazing thicknesses presented below should be considered as the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading, etc.

Table 18: Recommended acoustic typical performance of glazing system (residential tower)

Façade	Level	Glass System	Required Acoustic Rating of Glazing Assembly, Rw
East	1-10	12.38mm laminated	37
	11-20	10.38mm laminated	35
	21-37	8.38mm laminated	34
South	1-10	12.38mm laminated	37
	11-20	10.38mm laminated	35
	21-37	8.38mm laminated	34
West	1-10	12.38mm laminated	37
	11-20	10.38mm laminated	35
	21-37	8.38mm laminated	34
North	1-10	12.38mm laminated	37
	11-20	10.38mm laminated	35
	21-37	8.38mm laminated	34

NOTES:

The Required Acoustic Rating of Glazing Assembly, refers to the acoustic performance of the glazing once installed on site (including the frame)

The final glazing details will be subject to further site investigation and design development of the facade

During the detailed design stage of the project the acoustic performance of the glazing facade should be reviewed as the combined noise from external sources (such as patron noises from level 9 recreational area) and mechanical services will be more accurately defined and could result in the internal noise level exceeding the recommended design sound level ($L_{Aeq,T}$ dB(A)) specified in the AS/NZS 2107:2016.

5.2 Noise Emission from Mechanical Plant

The following noise sources are associated with the site operation, and details about expected noise levels from these sources are given in the ensuing sub-sections. Noise sources from general operations at the site typically include mechanical services noise from air-conditioning equipment, pumps, exhaust fans, etc. servicing the apartments and car parks. For the commercial / retail components, sources include chilled water air conditioning (AC) units, condenser units, kitchen exhaust fans, garbage exhaust fans, toilet exhaust fans, etc.

These noise sources have been used to predict the worst case scenario in terms of noise impact of the proposed site to the nearby residential and commercial receivers.

The main mechanical sources associated with the development will include:

- 26 Daikin VRV systems on the lower level plant room servicing level 1 to level 18 of residential tower
- 29 Daikin VRV system on roof level plant room of the tower servicing level 19 to level 37 of residential tower
- Kitchen, Carpark, and Toilets exhaust fan (assumed externally roof mounted)
- 2 Cooling towers located on the roof top plant room

In order to assess the worst case scenario, it was assumed that the air conditioning units associated with development run at any time throughout a 24hr period. As the night time is the most stringent period for the noise generated by the operation of mechanical plant; therefore, this criterion was used as the noise target at the boundary of the nearest residential sensitive receivers for the project. The nearest commercial receivers were also considered in the noise impact assessment based on the criterion established in section 5.2 of this report.

5.2.1 Proposed Noise Levels

Table 19 presents the maximum allowable sound power levels for the mechanical units such that compliance is achieved to the nearest most affected commercial and residential receiver with the acoustic mitigation measures detailed in the following section. The nearest sensitive receivers are also noted. Refer to Figure 1 for the site map. Mechanical plant locations have been determined based on drawing dated 07/03/17.

Table 19: Proposed acoustic power for AC units

Proposed Item	Lw re 1pW								
	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	Overall dB(A)
Air Condenser Unit	65	64	66	64	59	56	52	45	65
Air Handling Unit	79	78	80	78	73	70	66	59	79
Cooling Towers	92	88	87	83	81	78	74	89	94
Kitchen Exhaust Fan	60	64	62	43	41	35	25	25	55
Toilet Exhaust Fan	60	64	62	43	41	35	25	25	55
Stairs Relieve Fan	61	60	65	59	60	57	51	46	64
Stairs Pressurised Fan	61	60	65	59	60	57	51	46	64

Note: Other exhausts will be present on site such as garbage exhaust fans, toilet exhaust fans, etc… which will be assessed when further information is available. We don't anticipate that these exhausts will contribute to the established criteria to be exceeded.

5.2.2 Mitigation Measures

It is our opinion that the project specific noise levels at the boundaries of the surrounding receivers can be met by treating the rooftop plant equipment with standard acoustic treatment. This acoustic treatment might include the followings:

- Acoustic attenuators
- Acoustic louvers or screens
- Internal lining of duct work

Note that this is a preliminary solution as the design is yet to be finalized. A detailed acoustic assessment will be required as more information becomes available regarding performance data of specific mechanical equipment or any further mechanical information required for progressing the design for the project. Treatment will be proposed to ensure the North Sydney DCP 2013 criteria for mechanical, electrical and hydraulic services noise at the site boundary is complied with.

5.3 Traffic Noise Impact Assessment

The road traffic noise assessment has been conducted based on the traffic report provided by asongroup for the existing traffic count and predicted vehicle generation from the development. This data has been used to calculate the expected traffic noise level increase along McLaren Street, due to traffic associated with the apartment and the retail re-development. Note that the predicted vehicle generation has been based on the existing vehicle count plus a predicted vehicle generation for the development with a maximum of additional 19 vehicles per hour in both peak periods. This is based on the assumption that the existing vehicle movements from the car park will remain the same. The results are summarized in Table 20.

Table 20: Existing and predicted traffic flow volumes (peak hour)

Street	Existing		Predicted Increase		Noise Level Increase	
	AM	PM	AM	PM	AM	PM
McLaren Street	437	414	19	17	0.2	0.2

As Table 20 shows, the potential increase in noise levels due to additional traffic from the proposed site is less than 1dB and is considered negligible. Considering the predicted increase in noise level is 0.2dB at most, this would result in a negligible increase in overall traffic noise. Therefore, it is predicted that the proposed development will comply with the requirements of the NSW RNP in both the scenario that the existing noise level is below the assessment criteria of 60dB(A), and when the existing noise level exceeds the assessment criteria and is limited by the 2dB increase.

6. Conclusion

An acoustic assessment for the proposed development at 41 McLaren Street, North Sydney has been conducted. This document forms part of the documentation package to be submitted to local authorities as part of the DA process.

- This report has provided criteria, in-principle treatment and design requirements which aim to achieve the statutory criteria discussed in section 4.

  In terms of noise criteria, we have provided the following:
  - Noise criteria for emissions from the development to receivers in accordance with the North Sydney DCP and the NSW EPA INP provided in section 4.1.
  - Noise criteria for internal noise levels according to the North Sydney DCP and AS/NZS2107, provided in section 4.3.
  - Construction noise criteria provided in section 4.5.

- The predicted noise levels presented in this report show that the day, evening and night time criteria would be met with the selection of plant achieving the proposed sound power levels or sound pressure at the boundaries. Further detailed assessment and design will be conducted once more information becomes available about equipment and equipment locations.

- Following advice from the traffic engineer and the traffic report, and based on our predictions, it is predicted that the development will comply with the requirements of the NSW Road Noise Policy in regards to an increase in traffic noise levels.

- Glazing for the building has been recommended to achieve internal noise levels in accordance with the requirements of the North Sydney DCP and AS/NZS2107. The glazing recommendations are presented in section 5.1 for DA purposes; nevertheless further analysis will be conducted during the detailed design phase of the project.

Even though no assessment can be considered as being thorough enough to preclude all potential environmental impacts, having given regard to the above listed conclusions, it is the finding of this assessment that the development application should not be refused on the grounds of excessive noise generation.

The information presented in this report shall be reviewed if any modifications to the features of the development specified in this report occur, including and not restricted to selection of air-conditioning units, layout of equipment, modifications to the building and introduction of any additional noise sources.

Appendix 1 - Glossary of Acoustic Terms

NOISE	
Acceptable Noise Level:	The acceptable LAeq noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
LAmax	The maximum A-weighted sound pressure level measured over a period.

Appendix 1 - Glossary of **Acoustic Terms**

LAmin	The minimum A-weighted sound pressure level measured over a period.
LA1	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
LA10	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
LA90	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq	The A-weighted "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
LAeqT	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R-w:	The Sound Insulation Rating R-w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.