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SPECTRUM ACOUSTICS
NOISE AND VIBRATION CONSULTANTS

Spectrum Acoustics Pty Limited
ABN: 40 106 435 554
8 Penylan Street, Cardiff NSW 2285
Phone: (02) 4954 2276
email: neil@spectrumacoustics.com.au

Noise Impact Assessment
LAHC Seniors Housing Development
36-38 Birdwood Avenue, Pagewood, NSW

Prepared for:
NSW Land and Housing Corporation
c/- CKDS Architecture
Level 3, 23 Watt Street
Newcastle NSW 2300

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PROJECT PERSONNEL				
Name	**Qualifications**	**Associations***	**Position**	**Signature**
Neil Pennington	B.Sc.(Phys.), B.Math. (Hons)	MAIP, MAAS, MASA	Principal/Director	

*MAIP: Member, Australian Institute of Physics
MAAS: Member, Australian Acoustical Society
MASA: Member, Acoustical Society of America

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EXECUTIVE SUMMARY

A Noise Impact Assessment (NIA) for a proposed Seniors Housing Development at 36 – 38 Birdwood Avenue, Pagewood, NSW, has been conducted.

The site is impacted by moderate traffic noise levels and lies on the ANEF 20 contour for Sydney Kingsford Smith Airport. The assessment has found that minor glazing upgrades will be required for some rooms to satisfy requirements for aircraft noise intrusion.

Based on the results of this assessment, it is our professional opinion that adoption of the recommendations within this report will result in compliance with noise design criteria contained in the SEPP (Transport and Infrastructure) 2021, Clause 6.8 of Bayside LEP 2021 and AS/NZS 2021-2015.

1.0 INTRODUCTION

1.1 The Proposal

CKDS Architecture, on behalf of NSW Land and Housing Corporation (LAHC), has commissioned Spectrum Acoustics to prepare a Noise Impact Assessment (NIA) for a proposed Seniors Housing Development at 36-38 Birdwood Avenue, Pagewood, NSW.

1.2 Project Description

Under the proposal there would be eight one-bed and two two-bed adaptable housing units constructed over two levels with associated accessible driveways. The site is surrounded by several significant collector/arterial roads (i.e Bunnerong Road, Banks Avenue), large sporting fields, and a golf course. It is therefore likely that there will be relatively high levels of traffic at the subject site and being a noise sensitive development, an assessment of traffic noise impacts is required. The assessment is based on the typical Council requirements as contained in the SEPP (Transport and Infrastructure) 2021 and the NSW Noise Policy for Industry (2017). The site is also between the ANEF 20 and ANEF 25 contours for the Sydney Kingsford Smith Airport, which is an area defined as conditionally acceptable for residential building in Table 2.1 of AS/NZS 2021-2015. Botany Bay City Council (Council) Development Control Plan 2013 Part 3J contains the following provisions for such lands:

"C2 Where the building site is classified as "conditional" under Table 2.1 of AS2021-2015, development may take place, subject to Council consent and compliance with the requirements of AS2021-2015."

The location of the subject site within the 20-25 ANEF contour is shown below in **Figure 1.**

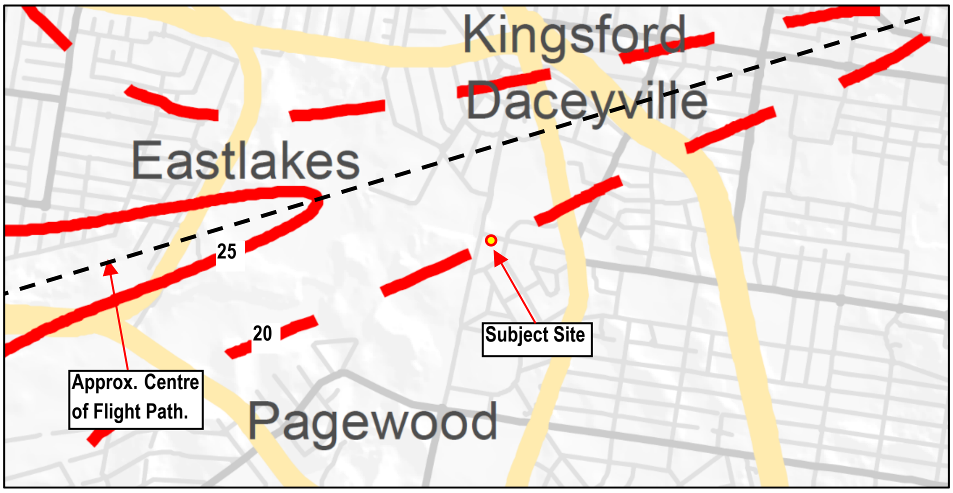


Figure 1: Site location on 2033 Sydney Airport ANEF Contour Map

1.3 Description of Terms

Table 1 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

Table 1: Definition of acoustical terms

Term	Definition
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L10	Average Maximum Noise Level - the level exceeded for 10% of the monitoring period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level. In this instance, the L90 percentile level is representative of the noise level generated by the surrounds of the residential area.

2.0 NOISE ASSESSMENT

2.1 Traffic Noise

2.1.1 Ambient Noise Levels

Ambient noise levels were measured at the Bonnie Doon Golf Club from 12-19 October 2022 using an ARL Ngara environmental noise logger. The measurements were conducted in accordance with relevant EPA guidelines and AS 1055-1997 "Acoustics – Description and Measurement of Environmental Noise". The noise logger used complies with the requirements of AS 1259.2-1990 "Acoustics – Sound Level Meters", and has current NATA calibration certification, included in **Appendix A**.

The logger was programmed to continuously register environmental noise levels over the 15 minute intervals, with internal software calculating and storing Ln percentile noise levels for each sampling period. Calibration of the logger was performed as part of the instrument's initialisation procedures, with calibration results being within the allowable ± 0.5 dB(A) range.

The logger was located on the northern boundary north of the carpark of the Bonnie Doon Golf Club, as shown in **Figure 2**. The road traffic noise at the monitoring location is representative of the noise impacts from Banks Avenue experienced at the project site.

Figure 2: Site location and monitoring location

Ambient L_{Aeq} and background (L_{A90}) noise levels obtained from the loggers are summarised below in **Table 2** and shown graphically in **Appendix A**. Table 1 includes the background (L90) levels, and the Leq over the full day (11 hour, 7am-6pm), evening (4 hour, 6pm-10pm) and night (9 hour, 10pm-7am).

Table 2: Measured ambient noise levels, 12-19 October 2022

Location	Day	Evening	Night
Bonnie Doon Golf Club	42 dB(A) L90	42 dB(A) L90	34 dB(A) L90
	57 dB(A) Leq (11hr)	54 dB(A) Leq (4hr)	49 dB(A) Leq (9hr)

2.1.2 Noise Criteria

The development is for residential use and as such the internal traffic noise criteria given in Section 3.5 of the Interim Guideline are:

- In any bedroom in the building: **35 dB(A),L_{eq}** at any time 10pm – 7am, and
- Anywhere else in the building (other than a garage, kitchen, bathroom or hallway): **40dB(A),L_{eq}** at any time.

These criteria originated from the Rail Infrastructure Corporation (RIC) publication "Consideration of Rail Noise and Vibration in the Planning Process" (2003) where it is explicit that the criteria apply with windows and doors closed. The criteria correspond to those in AS/NZS 2107, where the noise is considered to be "quasi-continuous" in nature.

2.1.3 Assessment Methodology

Figure 3 is a reproduction of Figure B2 from the Interim Guideline (2008) showing a typical situation of a dwelling adjacent to a busy road and calculated internal noise levels relative to external noise levels using the UK Calculation of Road Traffic Noise (CoRTN) methodology. Figure 2 shows a traffic noise level of 68 dB(A) at windows W1 and W2 directly facing the road. Windows W3 and W4 are on facades perpendicular to the road, thereby being shielded from 50% of the traffic noise by the building structure, and noise levels are 2-3 dB below the traffic noise level at W1 and W2. Window W5 is approximately twice the distance from the road as W4 and experiences an external traffic noise level 4 dB below the level at W4.

Figure 2 also gives the traffic noise loss for three constriction scenarios labelled A, B and C. The following specifications for these construction scenarios are reproduced from the Guideline. The specification for walls includes insulation in the wall cavity, however brick veneer achieves Rw >45 without insulation, which will not reduce the overall noise insulation of the room as a whole, since windows are the acoustically weakest elements. Any recommendations regarding the following construction specifications assume no insulation in facade walls.

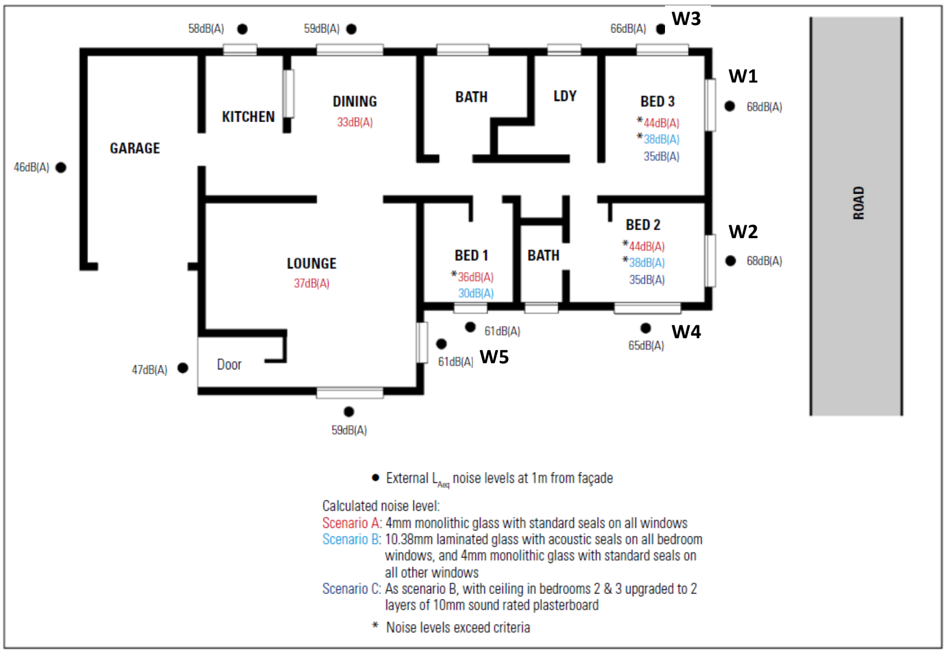


Figure 3: Traffic noise reduction for various construction types.

Specification A

Windows	standard 4mm monolithic glass with standard weather seals on all windows	(Rw 25)
Doors	30mm solid core timber – lounge room aluminium framed glass sliding door – lounge and dining rooms	(Rw 24)
Walls	brick-veneer and standard plasterboard on timber studs with insulation in cavity	(Rw 52)
Roof	tiled roof and standard plasterboard ceiling with insulation	(Rw 43)
Floor	concrete slab	

Note: 'Rw' is the weighted sound reduction index of a building element

Specification B

Windows	10.38mm laminated glass with acoustic seals on all bedroom windows, standard 4mm monolithic glass with standard seals on all other windows	(Rw 35)
Doors	30mm solid core timber – lounge room aluminium framed glass sliding door – lounge and dining rooms	(Rw 24)
Walls	brick-veneer and standard plasterboard on timber studs with insulation in cavity	(Rw 52)
Roof	tiled roof and standard plasterboard ceiling with insulation	(Rw 43)
Floor	concrete slab	

Note: 'Rw' is the weighted sound reduction index of a building element

Specification C

Windows	10.38mm laminated glass with acoustic seals on all bedroom windows, standard 4mm monolithic glass with standard seals on all other windows	(Rw 35)
Doors	30mm solid core timber – lounge room aluminium framed glass sliding door – lounge and dining rooms	(Rw 24)
Walls	brick-veneer and standard plasterboard on timber studs with insulation in cavity	(Rw 52)
Roof	as per Specification B, except the single layer of standard plasterboard ceiling is replaced with a double-layer of 10mm sound-rated plasterboard ceiling	(Rw 52)
Floor	concrete slab	

Note: 'Rw' is the weighted sound reduction index of a building element

Table 3 summarises the traffic noise reduction provided by each construction scenario for the cases in Figure 2 where a room contains either one or two windows.

Table 3: Traffic Noise reduction levels

Construction scenario	Noise reduction (2 windows)	Noise reduction (1 window)
Scenario A	23	25
Scenario B	29	31
Scenario C	32	34 (estimated)

Between the minimum 23 dB reduction for Scenario A and minimum 29 dB reduction for Scenario B lies what will be called Scenario A/B in which 23-28 dB traffic noise reduction is required[1]. This will be achieved with the same construction as scenario B except using 6.5mm Vlam Hush (or equivalent) in lieu of the 10.38mm glazing (8.5mm Vlam Hush provides the same acoustic rating as 10.38mm). This conservative measure is based on adopting the 23 dB noise reduction for 4mm glass, whether there are one or two windows in the room.

2.2 Aircraft Noise

2.2.1 Noise Criteria

The "conditional" stature of the location requires that attenuation of Lmax (maximum) aircraft noise levels should be considered in the design of the building. **Table 4** shows design indoor aircraft noise levels as specified in Table 3.3 of the Standard. Compliance with the requirements of AS/NZS2021-2015 is required in Clause 6.8 of the Bayside LEP 2021.

[1] The value of 23dB has been included in the Scenario A/B category as a measure of conservatism.

TABLE 4 Extract from Table 3.3 of AS 2021-2000	
Building type and activity	**Indoor design sound level, dB(A),Lmax**
Houses, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathrooms, toilets, laundries	60

2.2.2 Assessment Methodology

The subject site is 3,330m northeast of the eastern end of the 07/25 east-west runway, which is the only runway with significant potential to impact the subject site. This runway, which only carries approximately 10% of Sydney Airport's fights when fully operational, was closed from approximately May 2020 to May 2021 and used to store aircraft grounded due to the COVID-19 pandemic. Sydney Airport has published Australian Noise Exposure Index (ANEI) contours calculated from actual flights for the period Q1 2018 to Q2 2022. Whereas the 2033 ANEF in Figure 1 shows the subject site on the ENEF 20 contour, the historical ANEI contours for the times when the runway was operating show the subject site well outside the ENEI 20 contour.

The subject site is also in the lowest N70 (number of flights per day exceeding 70 dB(A)) region with only 10-20 events per day. Being at the lowest ANEF level necessitating assessment of aircraft noise impacts and experiencing only a small number of maximum events per day exceeding 70 dB(A), this assessment has conservatively adopted 80 dB(A) as the maximum aircraft noise level experienced at the subject site.

Based on the design sound levels in Table 4 and the adopted maximum aircraft noise level, the required aircraft noise reduction (ANR) for each space is:

Sleeping areas, dedicated lounges:	30dB
Other habitable spaces:	25 dB
Bathrooms, toilets, laundries:	20 dB

Equation G7 in Section G2.7 of the Standard calculates the aircraft noise attenuation required for each building component (ANA_c) based on physical parameters of the room/component being assessed and an orientation factor K_c which is set to a value of -6 dB for facades facing away from the flight path as a first approximation in accordance with Section G2.6.1 of the Standard. The required weighted sound reduction index (R_w) of each component is equal to ANA_c + 5 dB.

3.0 RESULTS AND RECOMMENDATIONS

3.1 Traffic Noise

Figures 4 and 5 show measured daytime and night time traffic noise levels applied at the building facades of the proposed ground and first floors of the development. Facade traffic noise levels are shown outside windows, as glazing is always the most critical noise intrusion element in a building façade.

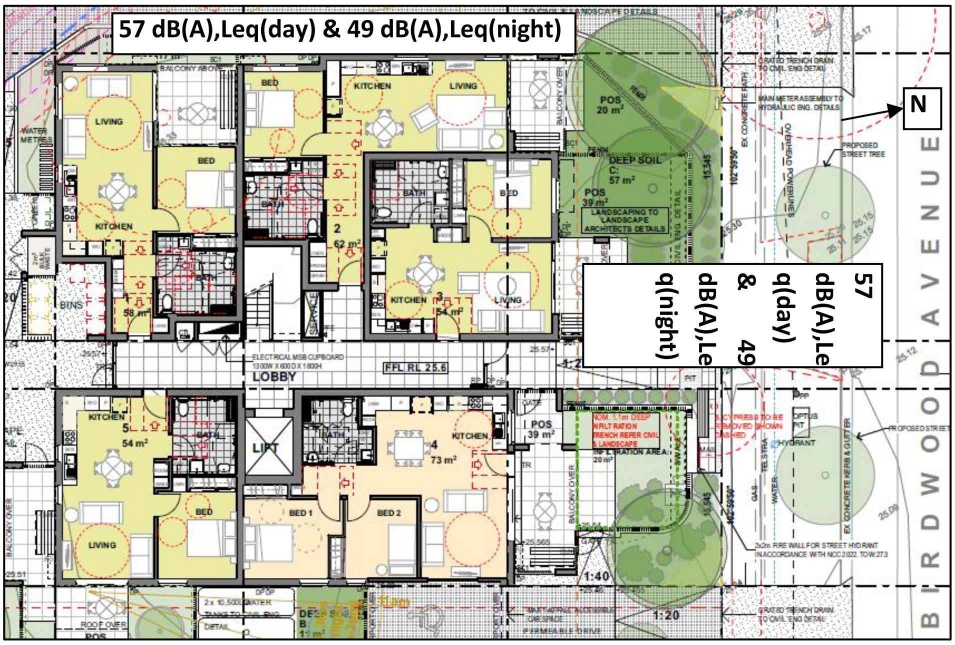


Figure 4: Proposed ground floor and traffic noise levels.

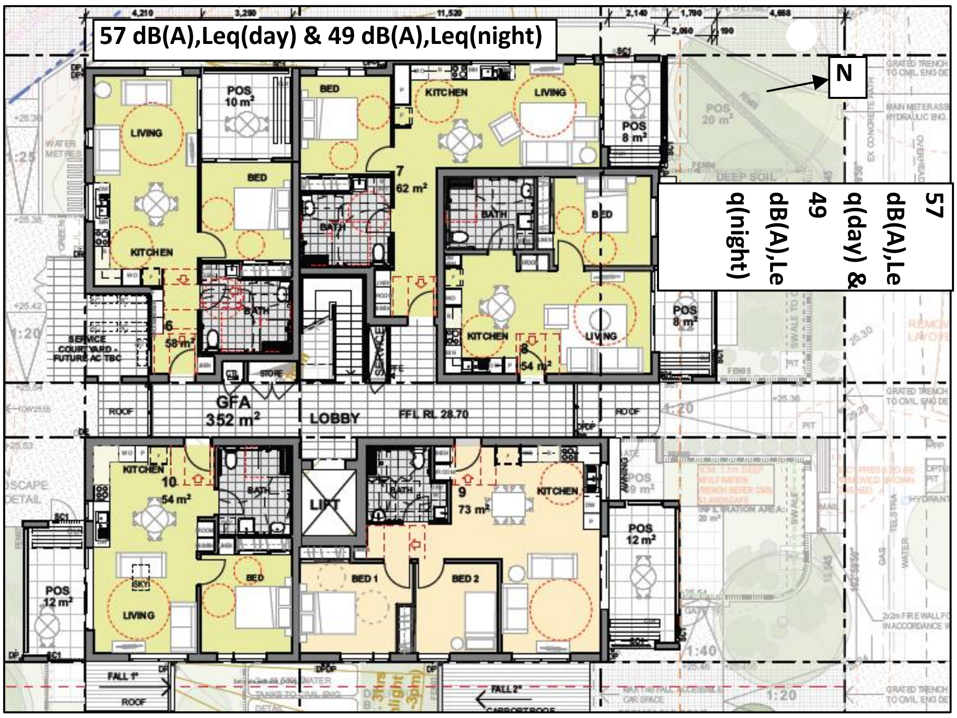


Figure 5: Proposed first floor and traffic noise levels.

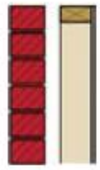
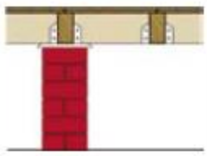
The required noise loss through the building facades on the assessed units is no more than 17 dB for living rooms and 14 dB for bedrooms.

A fully worked noise intrusion calculation in Section B2 from the Interim Guideline (2008) finds that standard building construction achieves 24 dB noise reduction. This is significantly greater than the noise reduction required of the proposed dwellings. Consequently, the internal noise levels in the SEPP (Transport and Infrastructure) 2021 will be achieved by Category 1 minimum construction requirements as per the Interim Guideline (2008).

Table 4 provides the minimum Rw values for the various construction categories in the Guideline and **Figure 6** gives typical examples of construction methods and materials to achieve the construction categories applicable to the project.

Table 4: DPE Guideline Construction Category RW requirements

Category of Noise Control Treatment	R_w of Building Elements (minimum assumed)				
	Windows/Sliding Doors	Frontage Facade	Roof	Entry Door	Floor
Category 1	24	38	40	28	29
Category 2	27	45	43	30	29
Category 3	32	52	48	33	50
Category 4	35	55	52	33	50
Category 5	43	55	55	40	50

Category No.	Building Element	Standard Constructions	sample
1	**Windows/Sliding Doors**	Openable with minimum 4mm monolithic glass and standard weather seals	
	Frontage Facade	**Timber Frame or Cladding:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally	
		Brick Veneer: 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally	
		Double Brick Cavity: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10mm plasterboard ceiling fixed to ceiling joists, R1.5 insulation batts in roof cavity.	
	Entry Door	35mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	1 layer of 19mm structural floor boards, timber joist on piers	
		Concrete slab floor on ground	

NOTES:
1. Some of the samples are indicative only and exceed the required Rw rating.
2. For walls, the required Rw rating will be achieved by 70mm timber studs in lieu of the 90mm timber or 92mm metal studs mentioned in the examples.
3. Internal plasterboard may be 10mm for Category 1.
4. The spacing of both brick veneer and cavity brick walls can be any industry value standard and not necessarily 50mm.
5. Roofs may also be metal sheeting over insulation.

Figure 6: Category 1 minimum construction requirements.

3.2 Aircraft Noise

Figures 7 and **8** below show the proposed ground & first floor layouts and their positioning relative to the flightpath from Sydney Kingsford Smith Airport.

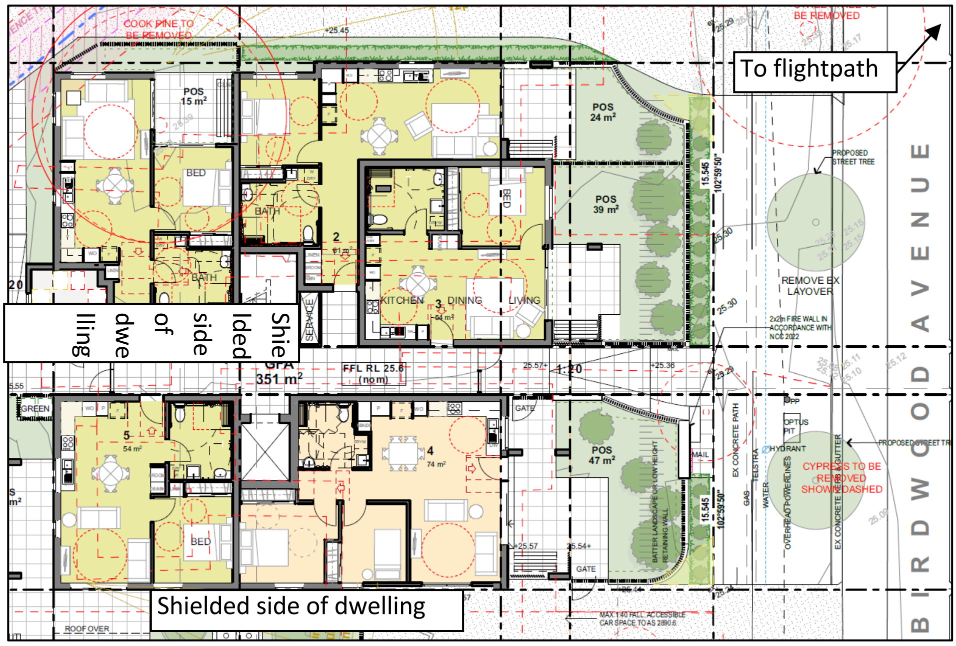


Figure 7: Proposed ground floor relative to flightpath.

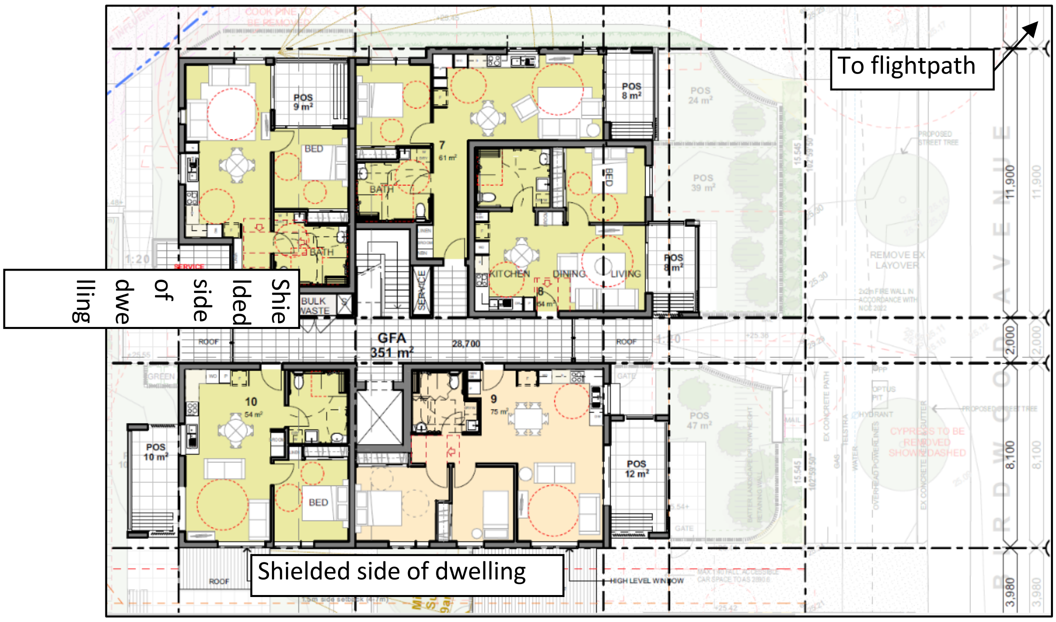


Figure 8: Proposed ground floor relative to flightpath.

3.2.1 Windows

In all standard housing construction, the acoustically 'weak' elements are the glazed windows and doors, which usually require upgrading from standard 4mm glazing in order to achieve the required internal noise levels. Minimum Rw ratings for glazing for the various rooms, as calculated in accordance with AS2021-2015, are summarised below:

Northern and eastern facades

Sleeping areas, dedicated lounges:	Rw 33
Other habitable spaces:	Rw 28
Bathrooms, toilets, laundries:	Rw 23

Southern and western facades

Sleeping areas, dedicated lounges:	Rw 27
Other habitable spaces:	Rw 22
Bathrooms, toilets, laundries:	Rw 17

Note that these ratings exceed the requirements for traffic noise attenuation discussed in Section 3.1.

3.2.2 External Walls

The Rw requirements of external walls vary in the range from 26 to 34 depending upon the room being assessed. The highest rating is required for all living and sleeping areas on the northern and eastern facades.

The external walls of the development are proposed to be of masonry construction. Standard brick veneer and timber framing lined with 10mm plasterboard and insulation as required for thermal performance will achieve the acoustic rating. The proposed double brick construction to ground floor will exceed the minimum acoustic requirement.

3.2.3 Roof/Ceiling

The requirement for the roof/ceiling of the development is for building elements with Rw in the range 27 to 35. This can be achieved with the proposed metal roof sheeting over 10 mm plasterboard ceilings with insulation as required for thermal performance.

3.2.4 Doors

Solid core external doors must be fitted, where timber doors are specified. A 38-40mm solid core door will achieve an Rw of approximately 30. Glazed doors must also meet the minimum Rw 30 rating.

APPENDIX A

CALIBRATION CERTIFICATE

Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter

IEC 61672-3.2013

Calibration Certificate

Calibration Number C19451

Client Details Acoustic Research Labs Pty Ltd
Unit 36, 14 Loyalty Road
North Rocks NSW 2151

Equipment Tested/ Model Number : ARL Ngara S-Pack
Instrument Serial Number : 87807B
Microphone Serial Number : 317325
Pre-amplifier Serial Number : 28419

Pre-Test Atmospheric Conditions
Ambient Temperature : 24.6°C
Relative Humidity : 40%
Barometric Pressure : 100.75kPa

Post-Test Atmospheric Conditions
Ambient Temperature : 24.3°C
Relative Humidity : 40%
Barometric Pressure : 100.79kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 29 Jul 2019

Secondary Check: Max Moore
Report Issue Date : 29 Jan 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*N/A*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*N/A*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.2dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.11dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

NATA
WORLD RECOGNISED ACCREDITATION

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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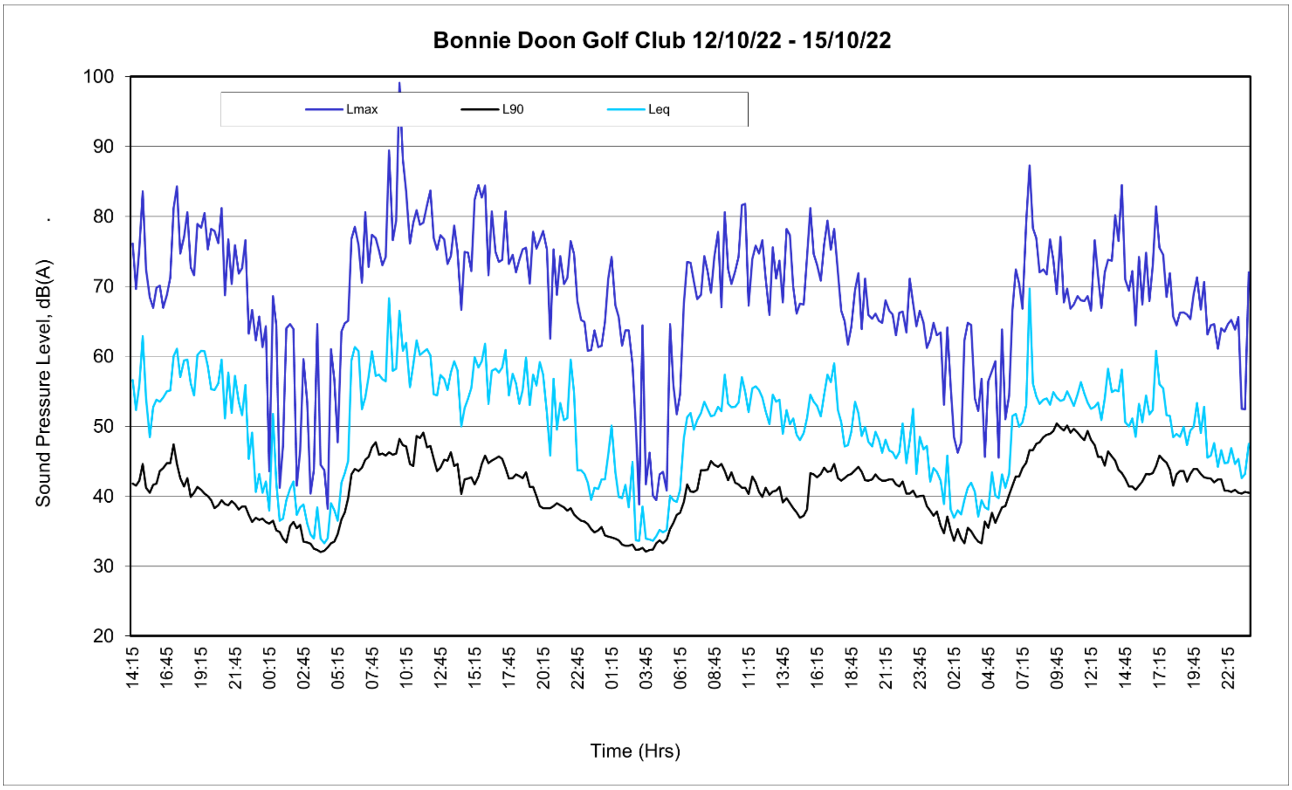
APPENDIX B

NOISE LOGGER DATA CHART


Bonnie Doon Golf Club 12/10/22 - 15/10/22
Lmax
L90
Leq
Sound Pressure Level, dB(A)
100
90
80
70
60
50
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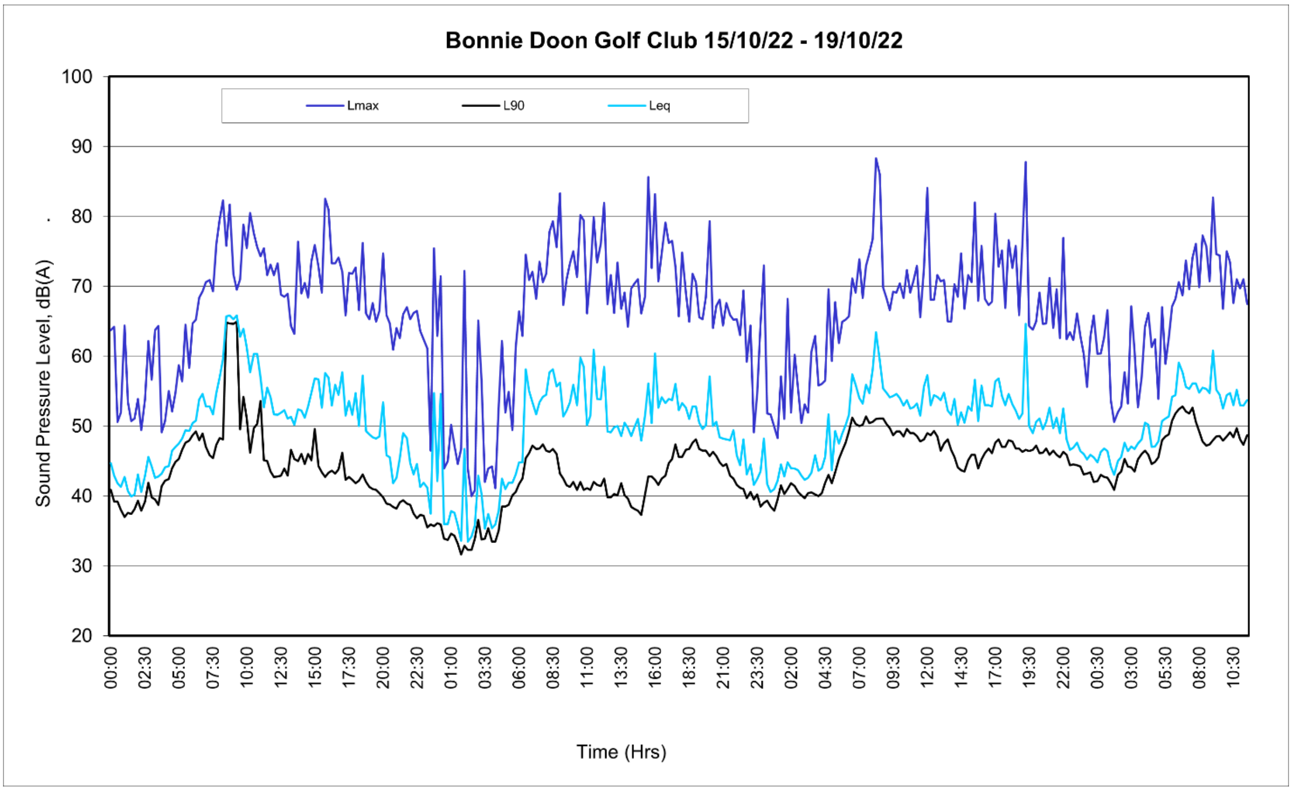
Time (Hrs)


Bonnie Doon Golf Club 15/10/22 - 19/10/22
Lmax
L90
Leq
Sound Pressure Level, dB(A)
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