



REPORT R230418R2

Revision 4

Noise Impact Assessment
Proposed Mixed-Use Development
15a, 15b Moseley St & 25 - 31 Donald St, Carlingford

PREPARED FOR:
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Noise Impact Assessment

Proposed Mixed-Use Development

15a, 15b Moseley St & 25 – 31 Donald St, Carlingford

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1 INTRODUCTION

Rodney Stevens Acoustics Pty Ltd (RSA) has been engaged by Captag Investments Pty Ltd to prepare a Noise Impact Assessment for the proposed Mixed-Use Development to be located at 15a, 15b Moseley Street and 25 –31 Donald Street, Carlingford.

This DA noise impact report includes the following details:

- The results of a noise survey undertaken on site
- The assessment of the likely impact of noise (principally from traffic noise) incident upon the proposed Child Care Centre as well as noise from the proposed Child Care Centre on Level 2 upon nearby residential premises.
- Establishes the noise criteria for noise emission from the proposed development, including carpark activities and mechanical plant.
- Outlines the architectural acoustic design requirements in accordance with the relevant Australian Standard and the National Construction Code (NCC).
- Construction Noise and Vibration Management Plan (CNVMP) prepared in accordance with NSW Environment Protection Authority's (EPA) *Interim Construction Noise Guideline* (ICNG, 2009).

Specific acoustic terminology is used in this report. An explanation of common acoustic terms is provided in Appendix A.

2 PROPOSED DEVELOPMENT

2.1 Existing Site

The development site is bounded by residential dwellings to the east, south and west side, with additional residential properties across the road of Donald Street (south-west). The site is also bounded by Moseley Street to the north. The existing site consists of four residential dwellings on five separate lots.

2.2 Proposed Development

The application seeks development consent for the development of an in-fill affordable housing development at 15A-15B Moseley Street and 25-31 Donald Street, Carlingford. Specifically, the SSDA seeks development consent for:

- Demolition of all existing buildings and structures.
- Staged construction of two residential flat buildings and a child care centre, with a maximum building height of up to 31.7 metres, including:
 - Stage 1 – Buildings A1 and A2 including a total of 60 apartments.
 - Stage 2 – Building B including a 76-place child care centre and 76 apartments.
- A total of approx. 136 residential apartments, including:
 - 106 market apartments
 - 30 affordable housing apartments to be managed by a CHP for 15 years (equivalent to at least 15% affordable housing based on the total proportion of all floor space)
- A total gross floor area (GFA) of approximately 14,044 m² (equating to an FSR of approx. 2.36:1), including:
 - A child care centre comprising approx. 413 m² GFA



- Total residential GFA of approx. 13,631 m²

2.3 Enrolment Numbers

The proposed Child Care Centre plans to cater for up to 76 children between the ages of 0 and 5 years of age. The number of children and their age groups are as follows:

- 0-2 years old - 20 Children
- 2-3 years old - 18 Children
- 3-5 years old - 38 Children

2.4 Outdoor Play Activities

In RSA's experience with Child Care Centres, potential noise issues occur primarily when children are engaged in outdoor play activities, in terms of intrusive environmental noise to the play areas and play area noise to nearby sensitive receivers.

2.5 Surrounding Receivers

There are a number of sensitive receivers surrounding the proposed development, these receivers would potentially be affected by noise generated from the proposed development. The following table shows the nearest receivers.

Table 2-1 Sensitive Receivers

Receiver	Number of Floor	Sensitive Receiver's Address
R1	Six single storey dwellings	14 – 22 Young Road, Carlingford
R2	Double storey	23 and 23A Donald Street, Carlingford
R3	Three single storeys	24, 26, 26A Donald Street, Carlingford
R4	Single Storey	33 Donald Street, Carlingford
PW1	Three storey	Place of Worship – 32 Donald Street, Carlingford



Figure 2-1 Aerial Map of the Site, Noise Logger Locations (NL1 and NL2) and nearby receivers

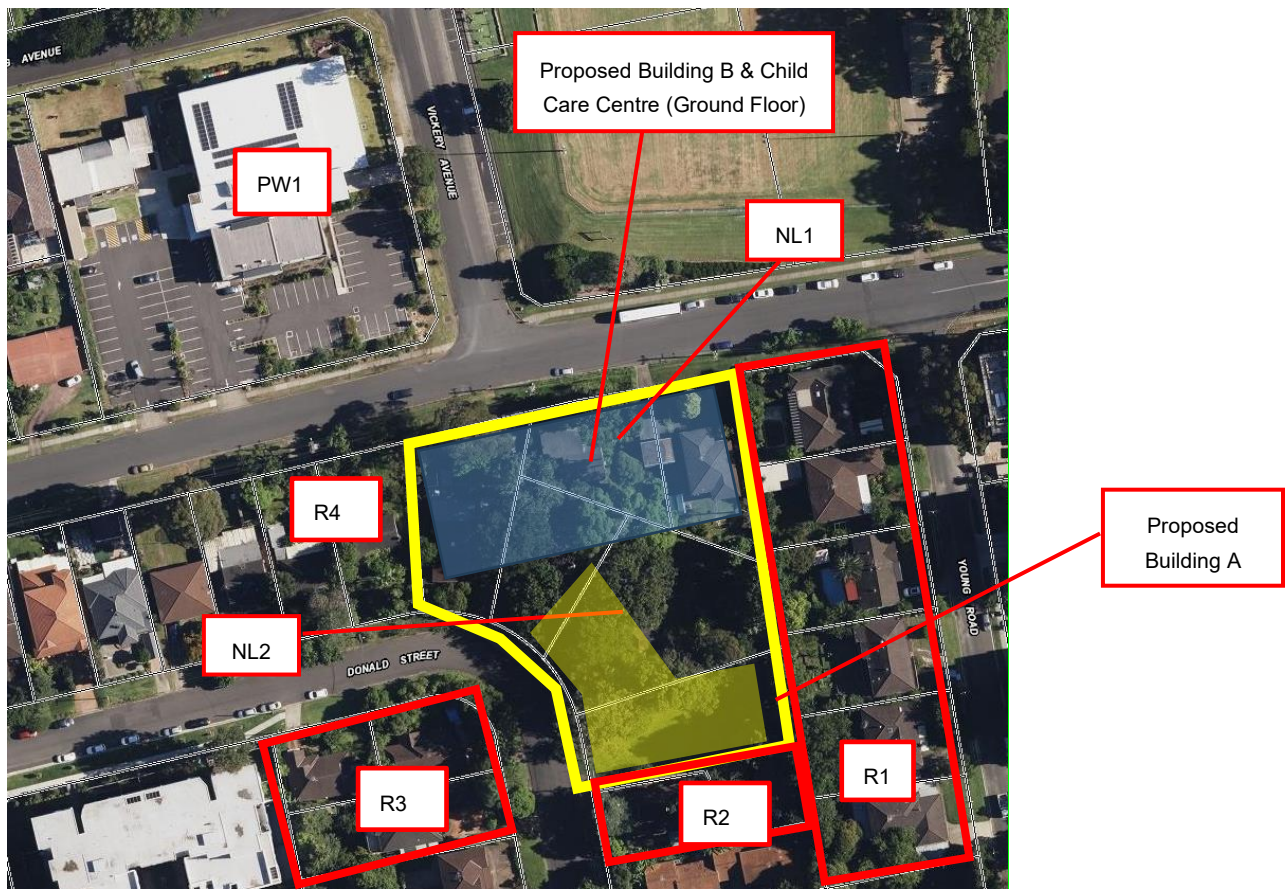
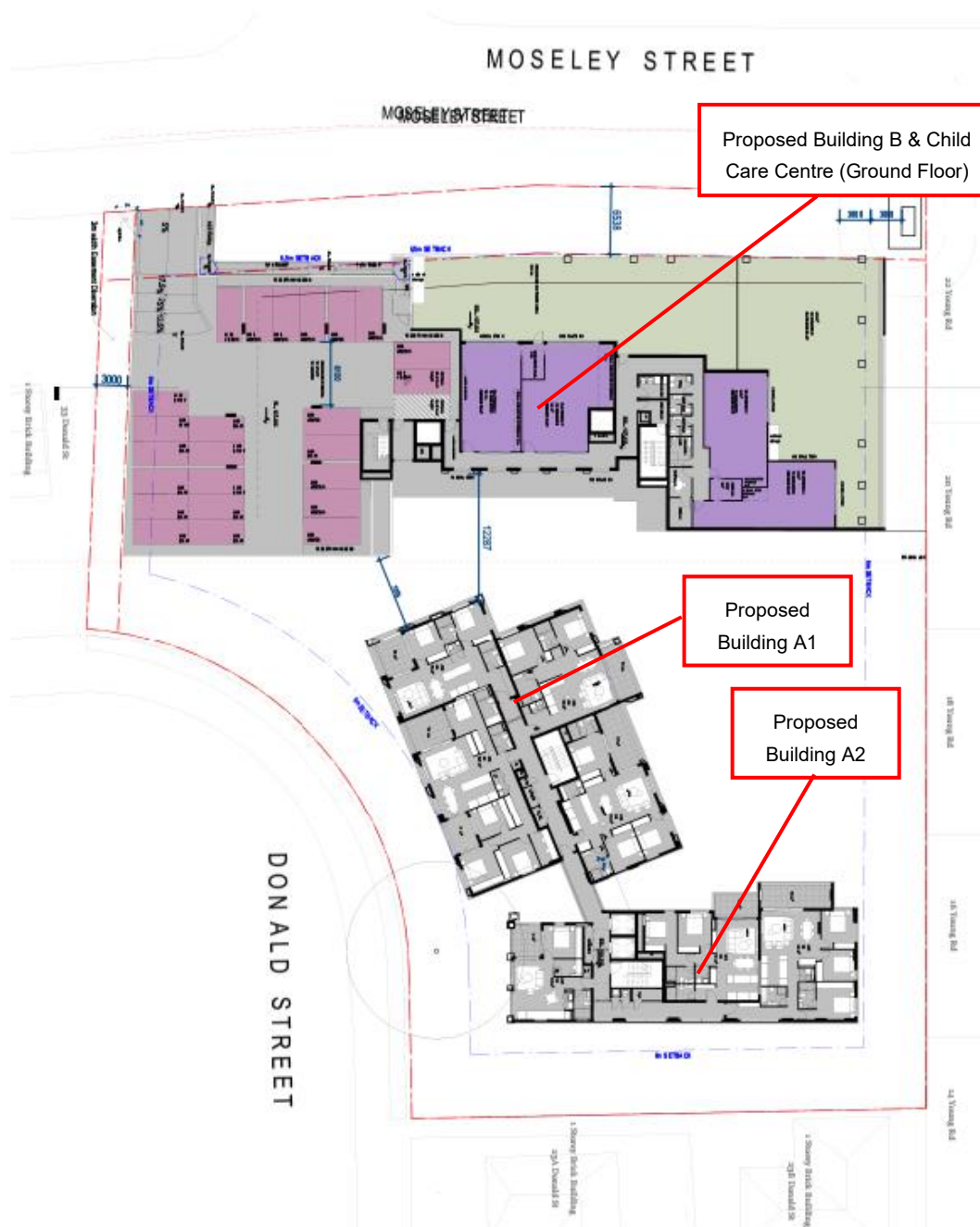


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Figure 2-2 Child Care Centre on Level 2 of Overall Plan



3 BASELINE NOISE SURVEY

3.1 Unattended Noise Monitoring

In order to characterise the existing acoustical environment of the area unattended noise monitoring was conducted between the dates of Thursday 13th and Thursday 20th July 2023 at the logging locations shown in Figure 2-1.

Two noise loggers were set up at the project site. The first logger (NL1) was located in the frontyard of the 15b Moseley Street and monitored the road traffic noise from Moseley Street. The second logger was located at the 25 Donald Street, this logger provides the baseline background noise level of residential receiver backyard between R1 to R4.



Logger locations were selected with consideration to other noise sources which may influence readings, security issues for noise monitoring equipment and gaining permission for access from residents and landowners.

Instrumentation for the survey comprised of two RION NL-42 environmental noise loggers (serial numbers 810712 and 572559) fitted with microphone windshields. Calibration of the logger was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dB(A). All equipment carried appropriate and current NATA (or manufacturer) calibration certificates. Noise data affected by significant weather conditions (i.e. heavy rain and strong winds) was removed from the noise analysis; this includes measurement taken on the 18th July 2023.

The logger determines L_{A1} , L_{A10} , L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1} , L_{A10} , L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary for definitions in Appendix A). Detailed results at the monitoring location are presented in graphical format in Appendix B. The graphs show measured values of L_{A1} , L_{A10} , L_{A90} and L_{Aeq} for each 15-minute monitoring period.

3.2 Data Processing

3.2.1 Noise Intrusion (*Road Noise Policy*)

To assess noise intrusion into the outdoor play areas, internal areas of the Child Care Centre, and the inside of the proposed residential units the data obtained from the logger location has been processed to establish representative ambient noise levels from Moseley Street and Donald Street. The time periods used for this assessment are as defined in the EPA's *Road Noise Policy* (RNP, 2011). Results are presented below in Table 3-1.

Table 3-1 Ambient Noise Levels Corresponding to Defined RNP Periods

Location	Period	External Noise Levels dB(A)
Front yard of 15a Moseley Street, Carlingford	1 Hour	$L_{Aeq(1hour)}$ 54 dB
	Day (7am to 10pm)	$L_{Aeq(15hour)}$ 52 dB
	Night (10pm to 7am)	$L_{Aeq(19hour)}$ 46 dB
25 Donald Street, Carlingford	1 Hour	$L_{Aeq(1hour)}$ 53 dB
	Day (7am to 10pm)	$L_{Aeq(15hour)}$ 53 dB
	Night (10pm to 7am)	$L_{Aeq(19hour)}$ 47 dB

3.2.2 Noise Emission (Noise Policy for Industry)

In order to assess noise emission from the proposed Child Care Centre and onsite noisy sources, the data obtained from the noise logger has been processed in accordance with the procedures contained in the NSW Environmental Protection Authority's (EPA) *Noise Policy for Industry* (NPfI, 2017) to establish representative noise levels that can be expected in the residential vicinity of the site. The monitored baseline noise levels are detailed in Table 3-2.

Table 3-2 Measured Baseline Noise Levels Corresponding to Defined NPfI Periods

Location	Measurement Descriptor	Measured Noise Level – dB(A) re 20 μ Pa
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		Morning Shoulder 5 am – 7 am	Daytime 7 am - 6 pm	Evening 6 pm – 10 pm	Night-time 10 pm – 7 am
NL1 – Frontyard of Moseley Street	L_{Aeq}	49	52	51	46
	RBL (Background)	40	40	39	32
NL2 – 25 Donald Street	L_{Aeq}	48	53	47	46
	RBL (Background)	38	38	37	32

L_{Aeq} Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.

L_{A90} Noise level present for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).

4 CHILDCARE CENTRE NOISE IMPACT ASSESSMENT

4.1 Operational Noise From Child Care Centre

A guideline for the assessment of noise from child care centres has been prepared by the Association of Australian Acoustical Consultants (AAAC). The document, *AAAC Technical Guideline Child Care Centre Noise Assessment V3.0*, provides criteria for the assessment of noise intrusion into and noise emissions from Child Care Centres and also provides recommendations for treatment to minimise acoustical impacts upon neighbouring premises.

4.1.1 Outdoor Play Area

Since the time in which children are involved in outdoor play can be limited, the potential impact associated with these noise emissions reduces. The AAAC considers a total limit of 4 hours outdoor play per day (typically 2 hour in the morning and 2 hour in the afternoon) reasonable to apply a criterion of $L_{Aeq(15minute)}$ noise level emitted from the outdoor play area not exceed the background noise level by more than 10 dB at the assessment location. However, if the proposed outdoor play time is more than 4 hours per day, the $L_{Aeq(15minute)}$ noise level emitted from the outdoor play area must not exceed the background noise level by more than 5 dB at the assessment location.

We have assumed that the proposed child care centre will operate more than 4 hours of outdoor play time per day, therefore, the noise criterion for noise emissions from outdoor activities to all surrounding residential receivers is day time background $L_{A90} + 5dB$.

Where the measured ambient noise level of a particular area is below 40 dB(A), the AAAC provides a specific base criterion in Section 3.2.1 of the guidelines. A base criterion of a contributed $L_{eq,15min}$ 45 dB(A) for the assessment of outdoor play is recommended in locations where the background noise level is less than 40 dB(A). In this case the noise criteria for outdoor play area noise is 45 dB(A).

Where appropriate, assessment should include consideration of noise emission to other sensitive uses including schools, hospitals, places of worship and parks (active and passive). The AAAC requires that either state or territory requirement be sourced to include noise criteria for such receivers. Therefore, the NSW NPfl is used to establish the noise criteria for the place of worship receiver. Table 2.2 of the NPfl provide noise amenity level for various types of receivers. The amenity for receivers other than residential are presented below:

- Place of Worship L_{Aeq} 40 dB(A) inside and 50 dB(A) outside. The outdoor noise limit is based on open window with an outdoor to indoor noise reduction of 10dB.



4.1.2 Other Noise Emissions

Based on Section 3.2.2 of the AAAC guidelines, the cumulative $L_{eq,15 \text{ minute}}$ noise emission level resulting from the use and operation of the child care centre, with the exception of noise emission from outdoor play shall not exceed the background noise level by more than 5dB. This includes the noise emission resulting from:

- Indoor play
- Mechanical plant
- Drop off and pick up
- Other activities/operations (not including outdoor play).
- The noise criteria for nearby school will be the same as the noise criteria within Section 4.1.1.

4.1.3 Sleep Disturbance

Staff members may enter before 7.00am (and not before 5.00am). Therefore, noise assessment in relation to sleep disturbance is considered. The L_{Amax} noise level emitted from vehicles arriving and parking shall not exceed the background noise level by more than 15 dB during the morning shoulder period outside the nearest habitable room window.

4.1.4 Summary of Noise Emission Criteria

Based on the AAAC guideline and the NPfl amenity noise level, the noise criteria for noise emission from the child care centre on surrounding receivers are presented in Table 4-1.

Table 4-1 Summarised Noise Emission Criteria

Receiver	Noise Type (Assessed Separately)	Noise Criteria			
		Morning Shoulder L_{Aeq} dB(A)	Day Time L_{Aeq} dB(A)	Evening Time L_{Aeq} dB(A)	Morning Shoulder Sleep Disturbance L_{Max} dB(A)
Residential Receivers R1 – R3	Indoor play, mechanical, drop off and pick up and other activities and operations	43	43	42	53
	Outdoor Play	-	45	-	-
Residential Receivers R4	Indoor play, mechanical, drop off and pick up and other activities and operations	45	45	44	55
	Outdoor Play	-	45	-	-
Place of Worship PW1	Outdoor, Indoor play, mechanical, drop off and pick up and other activities and operations	50	50	50	-



4.1.5 Road Noise Intrusion to Outdoor Playground

For the assessment of road traffic noise impact on the outdoor play areas, the AAAC *Technical Guideline Child Care Centre Noise Assessment V3.0* has been used to determine the appropriate noise level. In accordance with the AAAC guideline, the noise criterion for outdoor play areas is as follow:

- Outdoor play areas – $L_{Aeq,(1hour)}$ 55 dB(A) (external).

4.1.6 Noise Intrusion to Indoor Areas

The assessment of road traffic noise impact on the outdoor play areas is assessed against the AAAC *Technical Guideline Child Care Centre Noise Assessment V3.0*. Based on these documents, the noise criteria for the indoor play areas are as follows:

- Indoor play areas – $L_{Aeq,(1hour)}$ 40 dB(A) (internal)
- Sleeping areas – $L_{Aeq,(1hour)}$ 35 dB(A) (internal)

4.2 Child Care Centre Noise Impact Prediction Results

4.2.1 Outdoor Play Activities Noise Impact

Potential noise management issues occur primarily when children are engaged in outdoor play activities. The Association of Australian Acoustical Consultants (AAAC) technical guideline for Child Care Centre Noise Assessment V3.0 provides the following sound power levels (L_w) for various age groups of children.

Table 4-2 Effective Sound Power Levels ($L_{Aeq, 15min}$) for Groups of 10 Children Playing

Noise Descriptor	Noise Level (dB) at Octave Band Centre Frequency (Hz)								Overall dB(A)
	63	125	250	500	1 k	2 k	4 k	8 k	
0 to 2 Years	54	60	66	72	74	71	67	64	78
2 to 3 Years	61	67	73	79	81	78	74	70	85
3 to 5 Years	64	70	75	81	83	80	76	72	87

If applicable, an adjustment to the SPL of -6 dB could be applied in each age group for children involved in passive play.

Calculations have been made based on the spectra above assuming 49 children within the outdoor play area. The following assumptions have been made in the noise modelling of the Outdoor Play areas noise impacts on the neighbouring residences:

- Maximum of 49 children within the outdoor play area. The maximum number of children considered in the noise prediction is outlined below:

Table 4-3 Maximum Number of Children Outside at One Time

Outdoor Play Area	Maximum Number of Children Outside at one time
Outdoor Play Area	20 x 0-2 year old within the north outdoor area
	10 x 2-3 year olds within the north-western area of the outdoor play area
	19 x 3-6 year olds – 14 children in the active play area and 5 in the passive play area (southern area)



- The height of the surrounding residential receivers has been assumed to be 1.5 metres for residential buildings on their respective level. The receiver locations for the proposed onsite receiver are modelled to be on their respective balcony;
- The following noise barriers have been included in the noise prediction model (which is also presented in Figure 5-2):
 - The eastern outdoor play area should have a 3m high solid on the north-eastern boundary and a 2.6m along the south-eastern outdoor play boundary. It should be noted that if the playground boundary fence meet these fence height and the surface density requirements then the boundary fence can be used as a noise barrier.
 - The western outdoor play area should have a 2.6m high wall on the western side of the boundary.

Additional noise barriers are in place to minimise other noise emissions from the development including:

- A 2.1m along the western boundary of the site, adjacent to the Child Care Centre carpark; and
- 2.1m along the southern boundary of the site and south-eastern area of the site.

The predicted noise levels experienced by nearest residential receivers are presented in Table 4-4 below. Noise levels have been calculated at the most affected boundary heights. The noise levels presented below are representative of the worst case scenarios for receiver.

Table 4-4 Predicted Outdoor Play Activities Noise Emission

Receiver	Predicted Outdoor Play Activities Noise at Neighbouring Residents – dB(A)	Criteria	Compliance
R1	45	45	Yes
R2	30	45	Yes
R3	24	45	Yes
R4	45	45	Yes
PW5	38	45	Yes
Building B North Balconies	40	45	Yes
Building B East Balconies	40	45	Yes
Building B South Balconies	42	45	Yes
Building B West Balconies	29	45	Yes
Building A North Balconies	39	45	Yes
Building A South Balconies	22	45	Yes

Noise emission from the childcare centre outdoor play is predicted to comply with the relevant noise limits.

4.3 Noise Emissions from Indoor Activities

Calculations have been carried out to ascertain the noise breakout from indoor activities to the neighbouring premises. It is assumed that all indoor play area windows and doors are closed during intensive play activities, except for Indoor Play room 1. Intensive play is considered to be children screaming or singing and/or the use



of speakers/music. The configuration of the sliding doors and windows to be closed is shown in Figure 5-2 resulting noise levels at each noise receivers are presented in Table 4-5 below.

Table 4-5 Predicted Indoor Play Activities Noise Emission

Receiver	Predicted Indoor Play Activities Noise at Neighbouring Residents – dB(A)	Criteria	Compliance
R1	29	43	Yes
R2	18	43	Yes
R3	19	43	Yes
R4	42	45	Yes
PW5	38	45	Yes
Building B North Balconies	40	45	Yes
Building B East Balconies	33	45	Yes
Building B South Balconies	30	43	Yes
Building B West Balconies	25	45	Yes
Building A North Balconies	28	43	Yes
Building A South Balconies	22	43	Yes

Noise from the indoor play activities at the surrounding receivers is predicted to comply with the relevant noise limits.

4.4 Carpark Emission

The proposed childcare centre car park is located in an enclosed carpark space on the ground floor and has a capacity of 24 parking spaces – 10 visitors and 13 staff. Calculations of noise from the carpark activities have been based on typical noise generating events within a carpark such as, door slams, engine starts and cars driving away. RSA has assumed a scenario where 20 vehicles entering/leaving the Child Care Centre car park all within a 15-minute assessment period.

The calculated noise levels from the activities carried out within the carpark are presented in the Table 4-6 below. It should be noted, the noise prediction also consider the noise control measures outlined in Section 5.3

Table 4-6 Calculated Carpark Noise Levels

Receiver	Predicted Carpark Activities Noise at Neighbouring Residents – dB(A)	Criteria L _{Aeq}	Compliance
R1	28	43	Yes
R2	17	43	Yes
R3	29	43	Yes



Receiver	Predicted Carpark Activities Noise at Neighbouring Residents – dB(A)	Criteria L_{Aeq}	Compliance
R4	37	45	Yes
PW5	30	45	Yes
Building B North Balconies	37	45	Yes
Building B East Balconies	19	45	Yes
Building B South Balconies	19	43	Yes
Building B West Balconies	37	45	Yes
Building A North Balconies	42	43	Yes
Building A South Balconies	21	43	Yes

Car park noise at the surrounding receiver locations is predicted to comply with the relevant noise limits.

Table 4-7 presents the L_{Max} noise prediction of a single staff vehicle entering the child care centre car park during the morning shoulder period. The noise prediction takes into the vehicle movement on the driveway and the noise control measures outlined in Section 5.3. Noise prediction results are compared against the L_{Amax} Sleep Disturbance criterion.

Table 4-7 Car Park Sleep Disturbance Noise Prediction

Receiver	Predicted Carpark Activities Noise at Neighbouring Residents – dB(A)	Criterion L_{Amax}	Compliance
R1	38	53	Yes
R2	36	53	Yes
R3	45	53	Yes
R4	52	55	Yes
Building B North Balconies	55	55	Yes
Building B East Balconies	39	55	Yes
Building B South Balconies	49	53	Yes
Building B West Balconies	49	55	Yes
Building A North Balconies	53	53	Yes
Building A South Balconies	37	53	Yes

Noise from vehicle movement on the driveway towards the underground carpark is predicted to achieve the sleep disturbance criterion.



4.5 Road Traffic Noise Intrusion into Centre

4.5.1 Outdoor Play Area

Road noise on the north side of the site is influenced by road traffic along Moseley Street and was measured to be 54dB(A) $L_{Aeq(1hour)}$ at the front yard.

The predicted traffic noise impacts at the outdoor play areas are presented Table 4-8 below. The predicted noise level includes the noise barrier as noted in Section 5.4.

Table 4-8 Predicted Road Traffic Noise Levels Into Outdoor Play Areas

Area	Predicted L_{Aeq} Road Traffic Noise Level – dB(A)	Noise Criterion L_{Aeq} – dB(A)	Compliance (Yes / No)
Western Outdoor Play Area	53	55	Yes

Existing road traffic noise levels in the Outdoor Play areas are predicted to comply with the $L_{Aeq(1hour)}$ 55 dB(A) (external) criterion stipulated in Section 4.5.1. Based on this assessment no additional noise control measures will be required.

4.5.2 Indoor Areas

The typical outdoor to indoor noise reductions provided by most standard glazed facades (i.e. without special acoustical treatment) is generally accepted as being 10dB through an open window. A closed window is likely to provide at least 20dB noise reduction or more depending on the acoustic performance of the glazing.

It was noted that some windows are fixed and not operable. Determination of closing window/doors is only for the operable glazed window/doors. Taking into account the distance, shielding and glazing performance, the resultant indoor noise levels for opened and closed windows at the northern facade, corresponding to the typical noise reductions are as follow:

Table 4-9 Predicted Road Traffic Noise Levels Into Indoor Areas

Area	Predicted L_{Aeq} Road Traffic Noise Level – dB(A)		Rw Glazing Requirement	Noise Criterion L_{Aeq} – dB(A)	Compliance (Open / Closed)
	Windows Open	Windows Closed			
Playroom 1 (68m ²)	43	33	30	40	Closed
Playroom 2 (58m ²)	43	33	30	40	Closed
Playroom 3 (62m ²)	43	33	30	40	Closed
Playroom 4 (62m ²)	40	30	30	40	Open

The glazing acoustic requirement for windows/doors outlined above can be standard glazing, with an acoustic rating of R_w 30. We note that the R_w rating is required for the complete glazing and frame assembly. The minimum glazing thicknesses will not necessarily meet the required R_w rating without an appropriate frame system. It will be necessary to provide a window glass and frame system having a laboratory tested acoustic performance meeting the specified requirements.



5 CHILD CARE CENTRE NOISE CONTROL RECOMMENDATIONS

The following recommendations must be implemented in order to achieve compliance with the noise requirements from the AAAC noise guideline.

5.1 Outdoor Play Areas

In order to achieve compliance with AAAC's noise requirements for outdoor play, the following must be implemented:

- The Table below outlines the maximum number of children within the outdoor area at one time:

Table 5-1 Maximum Number of Children Outside at one time:

Outdoor Play Area	Maximum Number of Children Outside at one time
	20 x 0-2 year old within the north-eastern outdoor area
	10 x 2-3 year olds within the northern area of the outdoor play area
Outdoor Play Area	19 x 3-6 year olds – 14 children in the active play area (mid area) and 5 in the passive play area (southern area)

- The southern area of the playground is to be designated as passive play area, as shown in Figure 5-2. The passive play area should comprise of passive activities such as painting, garden exploration, reading, block-playing or drawing. Maximum of 14 children can play in the active play area and a maximum of 5 children are permitted in the passive play area at one time.
- The building ceiling above the outdoor play area and the carpark should be lined with absorption material/panels with a Noise Reduction Coefficient (NRC) 0.7.
- No music is to be played in the outdoor areas.
- Children must be supervised at all times.

5.2 Indoor Play Areas

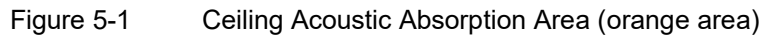
In order to achieve compliance with council's noise requirements for outdoor play, the following must be implemented:

- The windows marked orange in Figure 5-2 must be closed during intensive indoor play time (e.g. children screaming or singing and/or the use of speakers/music).
- All glazing at the childcare Centre should consist of at least a standard Rw 30 rating window/door.

5.3 Car Park Noise Control Measures

The following noise control measures and management plan should be implemented for the carpark space:

- Parents and guardians should be informed of the importance of noise minimisation when entering the site, dropping off or picking up children. This includes avoiding raising your voice within the centre's carpark area or beeping car horn.
- The ceiling in the basement driveway area, as shown in Figure 5-1, should be fitted with absorption material/panels with a Noise Reduction Coefficient (NRC) of 0.7 to absorb noise emission from the carpark.



The following noise barriers are to be constructed on site:

- The eastern outdoor play area should have a 3m high solid on the north-eastern boundary and a 2.6m along the south-eastern outdoor play boundary.
- The western outdoor play area should have a 2.6m high wall on the western side of the boundary.
- A 2.1m along the western boundary of the site, adjacent to the Child Care Centre carpark; and
- 2.1m along the southern boundary of the site and south-eastern area of the site on the natural ground level.
- Layout of the noise barriers are shown in Figure 5-2.

Acoustic barrier is required to provide the adequate noise attenuation; the construction material of the barriers must have a surface density of 10-15 kg/m² and be free from holes and gaps. Some suitable materials include:

- 25 mm thick plywood timber panelling
- 9 mm thick fibre cement sheet
- 75mm thick Hebel Powerpanel
- 12 mm thick Perspex, polycarbonate or Danpalon
- 6 mm toughened laminated safety glass



- Any other approved material which meets the above surface density specification

A typical material used in childcare centres is Perspex, which is a polycarbonate material. The use of the 12 mm thick Perspex or 6 mm glass for this purpose which has a surface mass of 11 kg/m² will meet the mass requirements detailed above and be suitable for use as it is transparent and will not unduly restrict light or vision.

All barriers must be free of gaps and penetrations and it is particularly important to ensure that the gap at the bottom of the barrier is minimised as far as practicable. The base of the barriers should be well sealed at the junction where the barrier meets the floor, but still be designed to allow proper water drainage

Figure 5-2 Proposed Child Care Centre Noise Control Layout





6 ROAD TRAFFIC NOISE ASSESSMENT

6.1 Road Traffic Noise Criteria

6.1.1 State Environmental Planning Policy (Infrastructure) 2007

The NSW Government's State Environmental Planning Policy (Infrastructure) 2007 (SEPP (Infrastructure) 2007) was introduced to facilitate the delivery of infrastructure across the State by improving regulatory certainty and efficiency. In accordance with the SEPP, Table 3.1 of the NSW Department of Planning and Infrastructure's "*Development near Rail Corridors and Busy Roads - Interim Guideline*" (the DP&I Guideline) of December 2008 provides noise criteria for residential and non-residential buildings. These criteria are summarised in Table 6-1.

Table 6-1 DP&I Interim Guideline Noise Criteria

Type of occupancy	Noise Level dB(A)	Applicable time period
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40	At any time

Note 1: Airborne noise is calculated as $L_{Aeq(15hour)}$ daytime and $L_{Aeq(9hour)}$ night-time

The following guidance is also provided in the DP&I Guideline:

"These criteria apply to all forms of residential buildings as well as aged care and nursing home facilities. For some residential buildings, the applicants may wish to apply more stringent design goals in response to market demand for a higher quality living environment.

The night-time "sleeping areas" criterion is 5 dB(A) more stringent than the "living areas" criteria to promote passive acoustic design principles. For example, designing the building such that sleeping areas are less exposed to road or rail noise than living areas may result in less onerous requirements for glazing, wall construction and acoustic seals. If internal noise levels with windows or doors open exceed the criteria by more than 10 dB(A), the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia."

The noise criteria presented in Table 6-1 apply to a 'windows closed condition'. Standard window glazing of a building will typically attenuate noise ingress by 20 dB(A) with windows closed and 10 dB(A) with windows open (allowing for natural ventilation). Accordingly, the external noise threshold above which a dwelling will require mechanical ventilation is an $L_{Aeq(9hour)}$ of 55 dB(A) for bedrooms and $L_{Aeq(15hour)}$ of 60 dB(A) for other areas.

Where windows must be kept closed, the adopted ventilation systems must meet the requirements of the Building Code of Australia and Australian Standard 1668 – The use of ventilation and air conditioning in buildings



6.2 Traffic Noise Assessment

In order to ascertain the existing traffic noise levels from Moseley Street and Donald Street, the measured noise logger data was processed in accordance with the NSW Department of Planning and Infrastructure's "*Development near Rail Corridors and Busy Roads - Interim Guideline*" assessment time periods as shown in Table 3-1.

The final façade noise levels were predicted for each time period taking into account the distance attenuation from each respective source, virtual source, façade's orientation and any barrier effects. Recommendations within Sections 6.3.1 to 6.3.5 are provided to satisfy the internal noise level requirements outlined in Section 6.1.

The required noise reduction via the building façade for each respective room for each time period will be compared to determine the appropriate design criteria levels.

It is typically accepted that an open window (fractionally open to meet ventilation requirements) results in an attenuation of external noise by 10 dB(A). This reduction has been used to predict the room noise level in the window open condition..

Figure 6-1 presents the layout of the residential units for references for acoustic recommendations.

Figure 6-1 Proposed Residential Layout





6.3 Recommended noise control treatment

The calculation procedure establishes the required noise insulation performance of each surface component such that the internal noise level is achieved whilst an equal contribution of traffic and ambient noise energy is distributed across each component. Building envelope components with a greater surface area must therefore offer increased noise insulation performance.

The recommended acoustic treatment is based on the following floor finishes:

- Bedrooms: Carpet and underlay
- Living Room Hard Flooring
- Kitchen/Wet Areas: Tiles

The acoustic requirements shown in this report will increase further where the bedroom floor finishes are tiled or timber.

All recommendations must be checked by others to ensure compliance with other non-acoustic requirements that Council or other authority may impose (e.g. Thermal requirements for BASIX compliance).

6.3.1 Glazing

The R_w rating required for each window will vary from room to room. Recommendations for windows also apply to any other item of glazing located on the external facade of the building in a habitable room unless otherwise stated.

Note that the R_w rating is required for the complete glazing and frame assembly. The minimum glazing thicknesses will not necessarily meet the required R_w rating without an appropriate frame system. It will be therefore necessary to provide a window glass and frame system having a laboratory tested acoustic performance meeting the requirements below.

The window systems must be tested in accordance with both of the following:

- Australian Window Association Industry Code of Practice Window and Door – Method of Acoustic Testing; and
- AS 1191 Acoustics – Method for laboratory measurement of airborne sound insulation of building elements.

It is necessary to submit such Laboratory certification for the proposed glazing systems (i.e. windows and framing systems) (e.g. NAL or CSIRO) for approval by RSA prior to ordering or commitment.

The entire frame associated with the glazing must be sealed into the structural opening using acoustic mastics and backer rods. Normal weather proofing details do not necessarily provide the full acoustic insulation potential of the window system. The manufacturers' installation instructions for the correct acoustic sealing of the frame must be followed.

It is possible that structural demands for wind loading or fire rating or the like may require more substantial glass and framing assemblies than nominated above. Where this is the case the acoustic requirements must clearly be superseded by the structural or fire rating demands.

Table 6-2 presents the minimum recommended R_w (weighted noise reduction) for glazing elements.



Table 6-2 Minimum Acoustic Rating (R_w) Required for Glazing Elements

Building	Room	Window	Glazed Door/Door
Building B – North and East Side	Bedroom	35	35
	Living Area	35	35
Building B – South and West Side	Bedroom	32	32
	Living Area	32	32
Building A (1)	Bedroom	30	30
	Living Area	30	30
Building A (2)	Bedroom	30	30
	Living Area	30	30

The following table presents the R_w ratings of different glass thicknesses, please note that these are shown as a guide only, all final glazing system selections must comply with the requirements in Section 6.3.1. The glazing installer must certify that all systems have been installed as per manufacturer's instructions.

Table 6-3 Glass Thickness Guideline

Glass Thickness	R_w Rating (Glass Pane Only)
6mm	28
6.38mm Laminated	32
8.38 Laminated	34
10.38 Laminated	36
12.38 Laminated	37
4mm – 50mm Airgap – 6mm Double Glazed	41

6.3.2 Roof/Ceiling

The overall acoustic rating required is R_w 50. The roof of the development will consist of at least a 200mm concrete slab. No further acoustic requirements are needed.

6.3.3 External Walls

The following wall construction recommendations are given as guidance only. It is understood that the proposed wall will consist of brick/masonry with internal stud plasterboard system. The masonry external walls will be required to achieve a rating of R_w 50. This R_w rating is generally achieved with a standard construction with insulation. No further acoustic requirements are needed.



6.3.4 Ventilation Requirements

Table 6-2 presents the ventilation requirement for the bedroom and habitable spaces in order to achieve the internal noise limit while providing ventilation to the room in question. The ventilation may consist of either mechanical ventilation (i.e. air conditioning units), acoustic wall vents (e.g. products from Acoustica AeroPac), or natural ventilation (i.e. windows/doors open).

Table 6-4 Minimum Acoustic Rating (R_w) Required for Glazing Elements

Level	Room	Ventilation Requirement
Building B – North	Bedroom	Mechanical/ acoustic wall-vent/ natural ventilation
	Living	Mechanical/ acoustic wall-vent/ natural ventilation
Building B – East, South and West Side	Bedroom	Mechanical/ acoustic wall-vent/ natural ventilation
	Living	Mechanical/ acoustic wall-vent/ natural ventilation
Building A (1)	Bedroom	Mechanical/ acoustic wall-vent/ natural ventilation
	Living	Mechanical/ acoustic wall-vent/ natural ventilation
Building A (2)	Bedroom	Mechanical/ acoustic wall-vent/ natural ventilation
	Living	Mechanical/ acoustic wall-vent/ natural ventilation

6.3.5 Detailing

Note that well-detailed construction and careful installation is needed to achieve the required R_w acoustic ratings. All gaps are to be minimised and fully sealed with an acoustic rated sealant, such as FireBan One by Bostik or Sikaflex Pro 2HP by Sika.

7 MECHANICAL NOISE ASSESSMENT

7.1 Mechanical Noise Criteria – Noise Policy for Industry

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the EPA. The EPA oversees the Noise Policy for Industry (NPfI) October 2017 which provides a framework and process for deriving project trigger noise level. The NPfI project noise levels for industrial noise sources have two (2) components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level amenity for particular land uses for residents and sensitive receivers in other land uses.



7.1.1 Intrusiveness Noise Levels

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness noise level essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dB(A) above the measured Rated Background Level (RBL), over any 15-minute period.

7.1.2 Amenity Noise Levels

The amenity noise level is based on land use and associated activities (and their sensitivity to noise emission). The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. The noise levels relate only to other industrial-type noise sources and do not include road, rail or community noise. The existing noise level from industry is measured.

To prevent increases in industrial noise due to the cumulative effect of several developments, the project amenity noise level for each new source of industrial noise is set at 5dBA below the recommended amenity noise level.

The NPfI, project trigger noise levels and limits are assessed on a 15-minute assessment period. The NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level to standardise the time periods:

$$L_{Aeq,15minute} = L_{Aeq,period} + 3dBA$$

7.1.3 Area Classification

The NPfI characterises the “Suburban” noise environment as an area with an acoustical environment that:

- has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry.
- This area often has the following characteristic: - evening ambient noise levels defined by the natural environment and human activity

The area surrounding the proposed development falls under the “Suburban” area classification.

7.1.4 Project Noise Trigger Levels

Having defined the area type, the processed results of the unattended noise monitoring have been used to determine the Project Noise Trigger Levels (PNTL). The intrusive and amenity criteria for nearby residential premises are presented in Table 7-1. The bold noise level figures in the Intrusive and Amenity column denote the established PTNL for the proposed development.



Table 7-1 Operational Project Trigger Noise Levels

Receiver	Time of Day	ANL ¹ L _{Aeq}	Measured		Project Trigger Noise Levels	
			RBL ² L _{A90(15min)}	Existing L _{Aeq(Period)}	Intrusive L _{Aeq(15min)}	Amenity L _{Aeq(15min)}
Onsite and Surrounding Residential Receivers	Day	55	38	59	43	(55-5+3) 58
	Evening	45	38	52	43	(45-5+3) 43
	Night	40	32	51	37	(40-5+3) 38
Place of Worship (PW1)	All	40 Internal 50 External ³	-	-	-	(50-5+3) 48

Note 1: ANL = "Amenity Noise Level" for residences in Suburban Areas.

Note 2: RBL = "Rating Background Level".

Note 3: Section 2.6 of the NPfI states: 'In cases where gaining internal access for monitoring is difficult, then external noise levels 10 dB(A) above the internal levels apply.' Therefore, 10dB is added to the external façade of the Place of Worship

7.2 Mechanical Noise Assessment

Mechanical ventilation may be installed at the proposed Child Care Centre, the operation of such mechanical plant must be in accordance with the relevant regulations such as the Building Code of Australia (BCA Vol.1, Part 4.5 *Ventilation of rooms*) and AS1668.2-2002 *The use of ventilation and air conditioning in buildings* will be required.

A specific mechanical plant selection for the proposed development has not been supplied at this stage. It is anticipated that the building will be serviced by typical mechanical ventilation/air conditioning equipment.

It is likely that the relevant noise criteria may be met through the use of conventional noise control methods (e.g. selection of equipment on the basis of quiet operation and, where necessary, providing enclosures, localised barriers, silencers and lined ductwork).

An appropriately qualified acoustic consultant should review the mechanical plant associated with the development at the detailed design stage when final plant selections have been made.



8 NATIONAL CONSTRUCTION CODE (NCC) GUIDELINE

It is necessary to safeguard future occupants from loss of amenity as a result of undue sound being transmitted between adjoining sole-occupancy premises and also from common spaces into sole-occupancy premises. NCC deemed to satisfy sound insulation requirements for inter-tenancy walls for Class 2 buildings are summarised in Table 8-1.

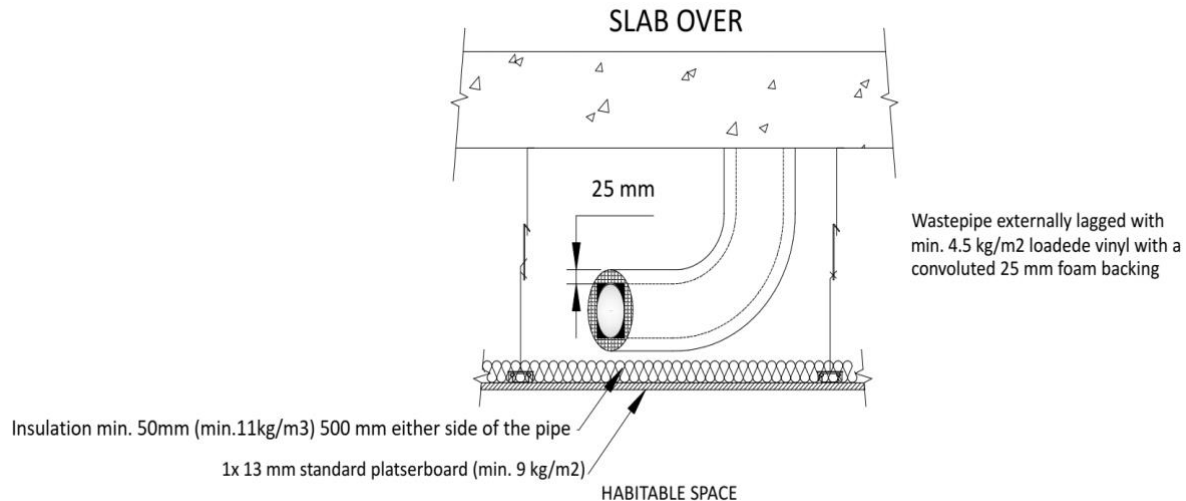
Table 8-1 Part F7 of NCC Acoustic Requirements

Separating Partitions	Minimum NCC Requirement
Walls and Floors	
Walls between habitable spaces of sole occupancy	Rw + Ctr 50
Walls between habitable spaces and stairway, public corridors, public lobby or the like	Rw 50
Walls between wet areas (bathrooms, sanitary compartment, laundry or kitchen) and a habitable room (other than kitchen) in adjoining apartments	Rw 50 and of discontinuous construction
Walls between a plant room or lift shaft and a sole occupancy unit	Rw 50 and of discontinuous construction
Doors assemblies located in a wall between an apartment and a stairway, public corridor, public lobby or the like	Rw 30
Doors	
Door assemblies located in a wall between an apartment and a stairway, public corridor, public lobby or the like	Rw 30
Services	
A duct, soil, waste or water supply pipe including a duct or pipe that is located in a wall or floor cavity serves or passes through more than one sole occupancy unit	
(i) if the adjacent room is a habitable room (other than a kitchen); or	Rw + Ctr 40
(ii) if the room is a non-habitable room	Rw + Ctr 25
(b) a storm water pipe passes through a sole occupancy unit	
(i) if the adjacent room is a habitable room (other than a kitchen); or	Rw + Ctr 40
(ii) if the room is a non-habitable room	Rw + Ctr 25

8.1 Treatment for Wastepipes in Habitable Spaces

The minimum NCC requirement for ceiling insulation for soil and waste pipes passing through/above habitable spaces is to achieve minimum $R_w + C_{tr}$ 40. Wherever soil and waste pipes pass through/above habitable spaces they should be acoustically treated as shown in Figure 8-1.

Figure 8-1 Wastepipes in Habitable Ceiling Spaces



It should be noted that where a kitchen adjoins a common living area, the kitchen shall be deemed to be part of the habitable space and this treatment should also apply to kitchens in this instance – see Table 8-2.

Table 8-2 Wastepipes in Riser Adjacent to Habitable Spaces – Externally Lagged

R_w	$R_w + C_{tr}$	O(Opinion), T(Test) M(Manufacturer)	Requirement
50	42	O	$R_w + C_{tr}$ 40
Habitable side of apartment – 1x13mm plasterboard on steel stud. Wastepipe externally lagged with 4.5kg/m³ loaded vinyl with a convoluted 25mm foam backing. Cavity – 75 mm thick Polyester insulation (or equivalent with a density of 11kg/m³). No penetrations through riser except above ceiling.			

8.2 Treatment for Wastepipes in Non-Habitable Spaces

In terms of ceiling insulation for soil and waste pipes passing through/above non-habitable spaces, NCC requirement is to achieve $R_w + C_{tr}$ 25 as a minimum.

Figure 8-2 shows the recommended constructions where $R_w + C_{tr}$ 25 can be achieved.

Figure 8-2 Wastepipes on non-habitable spaces

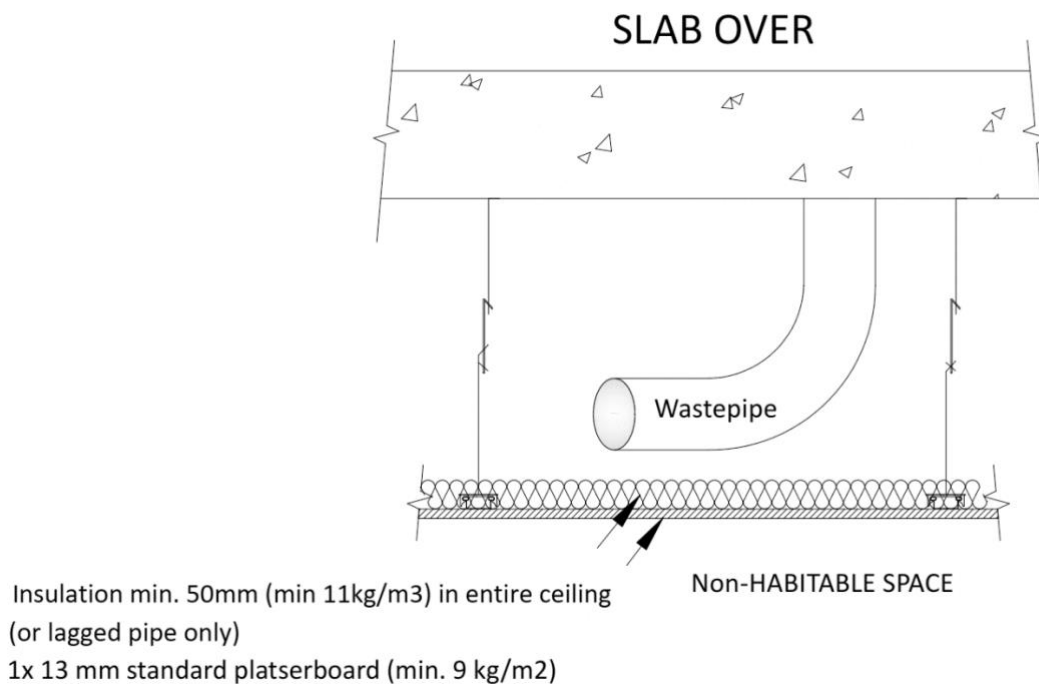


Table 8-3 Wastepipes in Riser Adjacent to Non-Habitable (Wet) Spaces

R_w	$R_w + C_{tr}$	O(Opinion), T(Test) M(Manufacturer)	Requirement
30	27	O	$R_w + C_{tr}$ 25
Non-habitable (wet) apartment side – 1x13mm plasterboard on steel stud. Wastepipe is un lagged. Cavity – 75 mm thick Polyester insulation (or equivalent with a density of 11kg/m ³). No penetrations through riser except above ceiling.		50mm gap 	

8.3 Entry Doors

To comply with the NCC requirements, entry doors separating tenancies from common areas are to achieve an R_w not less than 30. A 45 mm solid core with medium acoustic seals will achieve this requirement. Suggested systems include:

- Lorient LE1212 and IS8010si (R_w 31) or the Lorient IS7025 and IS8011si (R_w 32) (both recommended with threshold plate IS4130).



- Raven RP10 and RP38 drop seal with a threshold plate.

Alternatives to the above should be reviewed by RSA, prior to final approval, with test data provided.

8.4 Recessed Lights

RSA recommends that where bulkheads and ceilings above habitable areas contain wastepipes and A/C units, light fittings to be provided with acoustic covers behind. Alternatives should be reviewed by RSA prior to final approval.

8.5 Acoustic Sealants

Where acoustic constructions are provided, all joints should be overlapped and penetrations and gaps are to be fully sealed with acoustic sealant similar to:

- Bostik Fireban 1 or Seal'n'Flex;
- Hilti CP606 Firestop;
- CSR Gyprock Firemastic;
- Sika Firerate;
- Ramset Blaze Brake 201;
- Any other acoustic sealant that is polyurethane (non-hardening) with a minimum specific gravity $sg > 1.5$.

If a different option is to be used, it should be reviewed by RSA prior to installation.

8.6 Seals and Gaps

Junctions are required to be sealed airtight to achieving the required acoustic ratings between spaces. General guidelines for acoustic seals are as follows:

- All junctions and penetrations should be sealed air tight and seals are to extend continuously along the length of the junction – to both sides of the partition;
- Where more than one layer of wall linings are required to walls, all linings should be overlapped to minimise potential gaps between linings;
- It is recommended that plasterboard or other wall linings are cut such that the junction is as close a flush fit as possible. The maximum gap between joints in wall linings is 3mm.

For air gaps, the following detailing should be applied to maintain an adequate airtight seal through acoustic rated elements. For the following air gaps, the following details are recommended:

- Gaps $< 5\text{mm}$ – hard pack with glass wool insulation (minimum 32kg/m^3) and apply mastic.
- Gaps $> 5\text{mm}$ and up to 20mm : Pack with backing rods and dense insulation (50mm , 48kg/m^3 glass wool) to seal and mastic.
- Gaps $> 20\text{mm}$ – pack with insulation, and patch with Plasterboard (the same thickness and number of layers as the base partition (applied either side) leaving small gap ($\sim 5\text{mm}$), which can be sealed with mastic.
- Recommended Mastic Sealants, are as follows:
 - Sikaflex “Pro”;



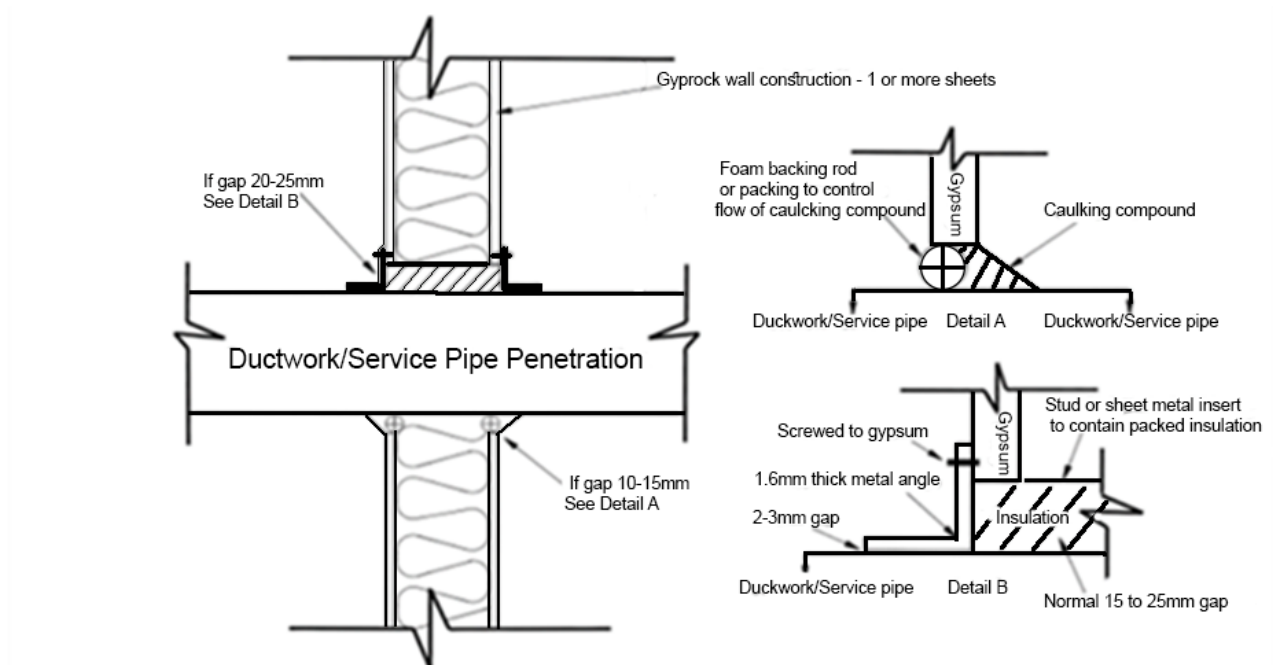
- Bostik “Fireban One”;
- Gyprock “Seal ‘n Flex”.

8.7 Services / Hydraulic Piping

Hot and cold water pipes do not need to be treated when penetrating an acoustic rated wall; however the gaps around the piping are required to be treated as per Section 8.6. All pipes, fittings and fixtures need to be isolated from the partitions by means of resilient sleeves or mounts.

For partitions, R_w 45 or greater, services piping should be caulked at the penetration on both sides. The gap between the pipe and the gypsum board should not exceed 20 mm, where gaps exceed 20 mm the gap should be reduced to 20 mm by adding an additional piece of gypsum/plasterboard, or a sheet metal disk to cover the gap, as shown in Figure 8-3.

Figure 8-3 Duct/services pipe penetration detailing



**NB: Details A+B are alternative sealing methods
Ductwork or pipe must not be supported by wall**

8.8 Access Panels

All ceiling access panels that are required to gain access to plant and equipment mounted in the ceiling cavity are required to be acoustic rated access panels, with the exception of access panels required in the open plan office or similar spaces. The minimum acoustic rating of the access hatch is R_w 30-35. Recommended panels are Rondo or Trafalgar STC Series rated R_w 30-35, or similar.



9 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

9.1 Construction Noise Management Levels

Construction noise is managed in accordance with the EPA *Interim Construction Noise Guideline* (ICNG, 2009) which provides management objectives for construction noise at residential and other sensitive land uses.

The ICNG airborne noise goals are to be applied to assess noise impacts and determine requirement for the reasonable and feasible management of construction noise to minimise potential for disturbance.

9.1.1 Residential Receivers

Table 9-1 details the ICNG guidelines for determining construction noise management levels at residential receivers.

Table 9-1 Construction airborne noise management levels for residences (ICNG)

Time of Day	Noise Management Level. L_{Aeq} dB(A)	How to Apply
Recommended standard hours (SH): Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected Rating Background Level (RBL) + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured L_{Aeq} (15 min) 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 residents 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, 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 (OOH) - All other times including Public Holidays	Noise affected Rating Background Level (RBL) + 5 dB(A)	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 of the ICNG.

Site specific L_{Aeq} construction NML in Table 9-2 have been established adopting measured existing baseline L_{A90} noise levels (Rating Background Level, RBL) and the ICNG corrections for the time of construction work.

Table 9-2 Adopted Construction Noise Management Levels for Residential Receivers

Receiver	Daytime NML dB(A)	Highly Noise Affected Level dB(A)
R1 – R4	48	75

9.1.2 Commercial and Industrial Premises

Due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories. The external noise levels should be assessed at the most-affected occupied point of the premises:

- Industrial premises: external $L_{Aeq}(15\text{ min})$ 75 dB(A)
- Offices, retail outlets: external $L_{Aeq}(15\text{ min})$ 70 dB(A)
- Other businesses that may be very sensitive to noise, where the noise level is project specific as discussed below.

Examples of other noise-sensitive businesses are theatres and childcare centres. The proponent should undertake a special investigation to determine suitable noise levels on a project-by-project basis; the recommended 'maximum' internal noise levels in AS 2107 Acoustics – Recommended design sound levels and reverberation times for building interiors may assist in determining relevant noise levels (Standards Australia 2000).

The proponent should assess construction noise levels for the project and consult with occupants of commercial and industrial premises prior to lodging an application where required.

During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work

9.1.3 Vibration Damage Criteria - Surface Structures

Most commonly specified "safe" structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have potential to cause damage to the main structure.

9.1.3.1 British Standard 7385: Part 2 - 1993

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187: Part 2-2006 "*Explosives - Storage and Use - Part 2: Use of Explosives*" recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 "*Evaluation and measurement for vibration in buildings Part 2*" as they "are applicable to Australian conditions".



The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 9-3 and graphically in Figure 9-1.

Table 9-3 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

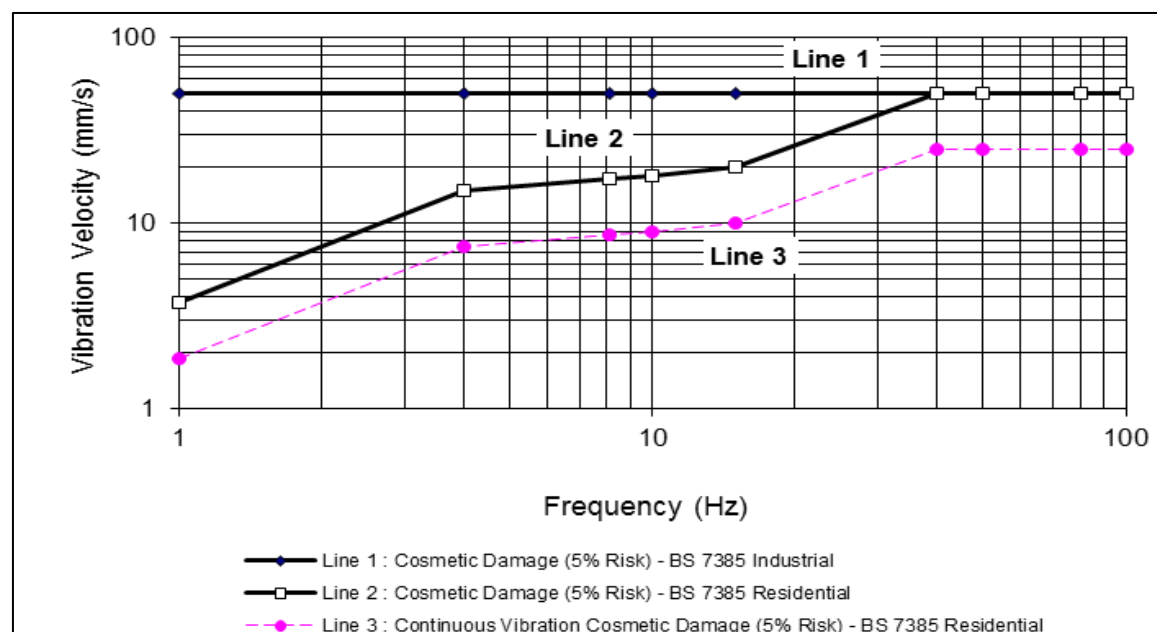
Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

The standard states that the guide values in Table 9-3 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 9-3 may need to be reduced by up to 50%.

Note: rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures (e.g. residences) and it may therefore be appropriate to reduce the transient values by 50%.

Figure 9-1 Graph of Transient Vibration Guide Values for Cosmetic Damage





In order to assess the likelihood of cosmetic damage due to vibration, AS 2187 specifies that vibration measured should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 9-3.

9.1.4 Human Comfort Vibration Criteria

9.1.4.1 General

Humans are far more sensitive to vibration than is commonly realised. They can detect vibration levels which are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not, in itself, be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 9-4.

Table 9-4 Peak Vibration Levels and Human Perception of Motion

Approximate Vibration Level	Degree of Perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hz to 80 Hz.

Table 9-4 suggests that people will just be able to feel floor vibration at levels of about 0.15 mm/s and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

9.1.5 Human Comfort Criteria for Construction Vibration

British Standard 6472-2008 "*Guide to evaluation of human exposure to vibration in building*" nominates criteria for various categories of disturbance, the most stringent of which are the levels of building vibration associated with a "low probability of adverse comment" from occupants. The "low probability of adverse comment" level for residential buildings is:



- 0.4 to 0.8 m/s^{1.75} (16 hour daytime Vibration Dose Value)
- 0.2 to 0.4 m/s^{1.75} (8 hour night-time Vibration Dose Value)

BS 6472-2008 provides criteria for continuous, transient and intermittent (in the case of road traffic) events that are based on a Vibration Dose Value (VDV), rather than a continuous vibration level. The vibration dose value is dependent upon the level and duration of the short-term vibration event, as well as the number of events occurring during the daytime or night-time period.

The criteria presented in BS 6472 supersede the EPA's "Assessing Vibration: A Technical Guideline".

9.1.5.1 Vibration Dose Limits

The permissible rms particle velocity levels corresponding to the vibration dose value vary according to the duration of exposure. Table 9-5 shows the range of satisfactory vibration dose values for which various degrees of adverse comment may be expected in the buildings surrounding the project.

Table 9-5 Vibration Dose Values (m/s^{1.75}) above which Various Degrees of Adverse Comment May Be Expected in Residential Buildings, Offices and Workshops

Location	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential buildings 16 hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Offices 16 hour day	0.4 to 0.8	0.8 to 1.6	1.6 to 3.2
Workshops 16 hour day	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

Situations exist where motion magnitudes above the dose levels given in BS 6472 can be acceptable, particularly for temporary disturbances and infrequent events of short-term duration. An example is a construction project.

When short-term works such as piling, demolition or compaction give rise to impulsive vibrations, it should be considered that undue restriction on vibration levels can significantly prolong these operations and result in greater annoyance.

In certain circumstances, the use of higher magnitudes of acceptability may be considered, e.g. for projects having social worth or broader community benefits or in view of the economic or practical feasibility of reducing vibration to the recommended levels. In such cases, best management practices should be employed to reduce levels as far as practical.

9.2 Construction Noise Calculations

9.2.1 Typical Equipment Noise Levels

The construction works are divided into four construction phases:

1. Demolition



2. Excavation & Compacting
3. Piling
4. Construction of the multistorey development

A detailed construction assumed various tools/machines for each construction phase. We have used equipment noise levels in accordance to Australian Standard AS2436-2010, Construction Noise and Vibration Strategy (CNVS) Transport for NSW and the RSA noise library. The following table presents the sound power levels (SWL) from the related equipment.

Table 9-6 Typical Sound Levels of Construction Equipment

Plant Description	SWL	Quantity	Stage
20t Excavator with hydraulic hammer	118	1	1
20t Excavator	105	3	1 & 2
Compacter	106	2	2
Vibratory Piling Rig	126 Lmax	1	3
Mobile Crane	113	1	2 & 3
Concrete Truck	114	1	3
Hand Tools	102	10	3 & 4
Crane	113	1	4
Forklift	94	2	4
Delivery Truck	110	1	1 - 4

9.2.2 Construction Noise Impact Results

Calculations of the minimum and maximum noise levels at the nearest sensitive receivers when all construction equipment are operating are presented in Table 9-7, below. We note that all noise levels are external $L_{Aeq}(15min)$. It is unlikely that all construction equipment will operate at the same time or will operate continuously within a 15-minute period; however, this has been considered to assess the worst-case noise impact.

A minimum and maximum range has been provided in the table below. The range is based on the location of the works, nearest to the boundary and farthest from the boundary.



Table 9-7 Calculated Noise Level Results

Receiver	Predicted Noise Level dB(A)				Criteria		
	Demolition	Excavation	Piling	Construction	Day NML	Highly Noise Affected	Complies
R1	73	69	73	69	48	75	No
R2	72	69	73	68	48	75	No
R3	77	73	77	73	48	75	No
R4	72	68	72	68	48	75	No
PW5	69	66	70	65	55	75	No

The predicted noise level during each construction stage exceed the day time NML and most noise impact exceed the Highly Noise Affected Level of 75dB(A). Noise impact is highly likely to cause annoyance to residents next door. The major noise workings during the is the hydraulic hammer and operation of the mobile crane.

9.2.3 Noise Impact Discussion

As shown in Section 9.2.2, all four stages of construction works exceed the day time noise criterion. It should be noted that the surrounding receivers, particularly R1, R2 and R4, are close to the construction site. The use of hydraulic hammer and the vibratory piling rig are likely to cause the most annoyance to the neighbouring receivers, as these machines have the highest Sound Power Level. Noise control measures should focus mainly on these machine/tools. Mitigation to minimise the construction noise impact is provided in Section 6.

9.2.4 Vibration Impact

Piling rig and an excavator with hydraulic hammer may emit vibration level and may be of concern if these sources are in close proximity to a residential structure.

The Transport for NSW (TfNSW) Construction Noise and Vibration Strategy (CNVS, 4.2 2019) provides minimum safe working distances for various vibration intensive plant items. The working distance guide is provided to avoid cosmetic damage to property and to minimise human annoyance.

The minimum safe working distance for the piling rig and hydraulic hammer are presented in Table 9-8.

Table 9-8 Recommended Minimum Working Distance from Intensive Plant

Equipment	Minimum Distance for Cosmetic Damage	Minimum Distance for Human Annoyance
Piling rig – hammer 12 t down force	15 m	50 m
12 - 18t Excavator with Hydraulic Hammer	7 m	23 m
18 - 34t Excavator with Hydraulic Hammer	22 m	73 m

If the proposed vibration sources outlined in the table above are operating within or near the minimum distance for cosmetic damage, then vibration monitoring at the nearest potentially affected receiver should be undertaken during the vibration works.



9.3 Cumulative Construction Noise Impact Review

A review of the approved and likely future developments within the Carlingford area near the proposed site was reviewed to determine the likely construction noise contribution from the proposed site and the approved and likely future development on receivers near the proposed site. Table 9-9 presents a list of review of the approved and likely future developments within the Carlingford considered in the construction noise contribution review.

Table 9-9 Approved and Likely Future Development in Carlingford

DA Reference	Development Description	Current Status
Development Applications		
DA/545/2024 263-281 Pennant Hills Road, Carlingford	Mixed-use development comprising 2 residential flat buildings (12 & 15 storeys) and a new library and community facility (to be dedicated to Council), basement and landscaping. This application is integrated development under Section 90(2) of the Water Management Act 2000. This application will be determined by the Sydney Central City Planning Panel.	Under assessment
DA/555/2024 263-281 Pennant Hills Road, Carlingford	Addition of 16, 18 and 18 storeys respectively (additional 301 units) to Buildings A, B and C along Pennant Hills Road to the existing approved mixed use development consent DA/53/2022.	Approved
DA/53/2022/E 263-281 Pennant Hills Road, Carlingford	Section 4.56 modification to development consent DA/53/2022 granted by the NSW Land and Environment Court for a mixed-use development, seeking amendments to Building D, including amendments to structural and service elements, façade details, internal layout and an increase to on-site basement parking.	Under assessment
DA/53/2022/F 263-281 Pennant Hills Road, Carlingford	Section 4.56 modification to development consent DA/53/2022 granted by the NSW Land and Environment Court for a mixed-use development, seeking amendments to ground floor of Building C to provide for a supermarket, increase in car parking space within the basement, and other internal, facade and structural adjustments to Buildings A, B C and G.	Under assessment
DA/53/2022/G 263-281 Pennant Hills Road, Carlingford	Section 4.56 modification to development consent DA/53/2022 granted by the NSW Land and Environment Court for a mixed-use development, seeking amendment to Condition 141 to allow extended hours of construction work for a 6-month period.	Under assessment



DA Reference	Development Description	Current Status
State Significant Development Applications		
SSD-84699461 241-245 Pennant Hills Road, Pennant Hills	A part 3, 14 and 18 storey mixed-use development with in-fill affordable housing. It will comprise 135 residential apartments, commercial uses and a child care centre.	Prepare EIS
SSD-43065987 183 Pennant Hills Road and 57- 73 Felton Street, Carlingford	Upgrade including construction of three new buildings up to four storeys and student capacity of 1610 at Carlingford West Public School and construction of three new buildings, up to five storeys and student capacity of 2040 at Cumberland High School	Approved
SSD-43065987-Mod 1 183 Pennant Hills Road and 57- 73 Felton Street, Carlingford	General reconfiguration of internal and roof layout of buildings, fencing and general amendments to facades, and amended staging plans	Approved
SSD-43065987-Mod 2 183 Pennant Hills Road and 57- 73 Felton Street, Carlingford	Minor architectural and tree removal and planting changes	Approved
SSD-43065987-Mod 3 183 Pennant Hills Road and 57- 73 Felton Street, Carlingford	Amendments to the approved flood wall, removal of bund wall and realignment of the bus link exit at Pennant Hills Road.	Under assessment
SSD-43065987-Mod 4 183 Pennant Hills Road and 57- 73 Felton Street, Carlingford	Modification to staging details to allow early occupation of high school buildings	Approved

The nearest approved/under-assessment site nearest to the proposed site is 263-281 Pennant Hills Road, Carlingford, located approximately 400m south from the proposed site. The other sites are located 800m or more away.

It is assumed that the construction equipment at 263-281 Pennant Hills Road, Carlingford would be similar to the proposed site's construction plan. Based on this assumption, the likely noise impact on receivers near the proposed site from 263-281 Pennant Hills Road, Carlingford would be 10dB less than the predicted construction noise from the proposed site. It is understood if an additional noise source is less than 10dB than an existing noise source then it would not increase the existing noise level.

Therefore, it is the professional opinion of RSA that the surrounding approved and likely future developments outlined in Table 9-9 would not contribute additional construction noise.



10 MONITORING OF CONSTRUCTION NOISE & VIBRATION

10.1 Noise Monitoring

Noise monitoring will be performed in the event of a complaint received by the construction contractor, by an Acoustical Consultant engaged directly by the client.

Noise monitoring would be undertaken using statistical noise loggers supplemented by attended monitoring (where necessary) in order to differentiate between construction noise sources and other sources (such as road traffic and aircraft noise) and also in order to observe and identify any abnormally noisy construction equipment or operations.

During attended monitoring, typical maximum noise levels associated with particular operations and/or plant items will be noted. Where possible, extraneous noise events such as road and air traffic noise will be excluded from the results or highlighted in accompanying notes.

Noise monitoring will, if required, be undertaken by the Acoustical Consultant and reported weekly. Equipment and methods will comply with AS 1055.1-1989. The statistical parameters to be measured will be the L_{Amin} , L_{A90} , L_{A10} , L_{A1} , L_{Amax} and L_{Aeq} evaluated over consecutive 15 minute periods.

10.2 Vibration Monitoring

Vibration monitoring, will be performed in the event of a complaint received by the construction contractor. Additionally, vibration monitoring will be performed where sensitive assets are identified, these include but are not limited to heritage buildings, infrastructure utilities i.e. water and gas pipes and the like. Monitoring will be carried out by an Acoustical Consultant engaged directly by the client. Vibration monitoring would be carried out continuously on the closest, potentially most affected structures during any works considered to potentially generate significant levels of vibration.

A single geophone mounting plate would be installed on the adjacent buildings/structures. The monitoring locations would be on a stiff part of the structures (at the foundations) on the side of the structures adjacent to the subject excavation works, in accordance with BS 7385:1993 Part 2.

The vibration monitoring system will be configured to record the peak vibration levels and to trigger an audible/visual alarm when predetermined vibration thresholds are exceeded. The thresholds correspond to an "Operator Warning Level" and an "Operator Halt Level", where the Warning Level is 75% of the Halt Level

The vibration threshold will be set to an "Operator Warning Level" of 6 mm/s (ppv) and an "Operator Halt Level" of 8 mm/s (ppv), the exceedance of which will be indicated by the audible/visual alarm in the construction site.

Based on the foregoing information, the nominated site control vibration criteria are presented in Table 10-1 and correspond to the minimal risk of cosmetic damage criterion from BS 7385.

Table 10-1 Nominated Site Control Vibration Criteria (ie Operator Warning and Halt Levels)

Structure	Site Control Criteria	
	Operator Warning Level	Operator Halt Level
Nearest Potentially Affected	6 mm/s	8 mm/s

Exceedance of the "Operator Warning Level" does not require excavation activity to cease but rather alerts the construction contractor to proceed with caution at reduced force or load. An exceedance of the "Operator Halt



Level” requires the construction contractor to implement an alternative excavation technique. The vibration monitoring equipment would be downloaded on a weekly basis by the Acoustical Consultant.

Weekly reports of the measured vibration levels and their likely impacts would be prepared by the Acoustical Consultant and distributed by the Project Manager.

Attended vibration monitoring will, if considered necessary, be conducted by the Acoustical Consultant. Attended vibration monitoring (structural damage and/or human comfort) will also be carried out in response to complaints or to structural damage criterion exceedances. This monitoring will provide direct feedback to the operators in order to allow appropriate modification of excavation techniques.

11 CONSTRUCTION NOISE MITIGATION MEASURES

The following noise mitigation measures will be implemented by the construction contractor, where reasonable and feasible, apply best practice noise mitigation measures including:

- Maximising the offset distance between noisy plant items and nearby noise sensitive receivers.
- Avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers.
- Minimising consecutive works in the same locality.
- Orienting equipment away from noise sensitive areas.
- Carrying out loading and unloading away from noise sensitive areas.

Further, in order to minimise noise impacts during the works, the construction contractor will take all reasonable and feasible measures to mitigate noise effects.

The contractor will also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers. Silenced air compressors fitted with noise labels indicating a maximum (L_{Amax}) sound pressure level of not more than 75 dB(A) at 7 m will be used on site. The sound pressure level of noise emitted from a compressor used will comply with noise label requirements.

12 VIBRATION MITIGATION MEASURES

The following vibration mitigation measures will be implemented by the construction contractor:

- Relocate any vibration generating plant and equipment to areas within the site in order to lower the vibration impacts.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of excavation plant and equipment e.g. smaller capacity rock breaker hammers.
- Minimise consecutive works in the same locality (if applicable).
- Schedule a minimum respite period of at least 0.5 hour before activities commence which are to be undertaken for a continuous 4 hour period.



- Use only dampened rock breakers and/or “city” rock breakers to minimise the impacts associated with rock breaking works.

13 SUMMARY OF CONSTRUCTION MITIGATION MEASURES

The noise and vibration mitigation measures to be implemented by the construction contractor are summarised in Table 13-1.

Table 13-1 Noise and Vibration Mitigation Measures

Item	Description
Construction Hours	Works will be carried out within the approved construction hours.
Deliveries	Deliveries will be carried out within the approved construction hours.
Site Layout	Where possible, plant and equipment will be located and orientated to direct noise away from sensitive receivers.
Quietest Suitable Equipment	Plant and equipment will be selected to minimise noise emission, where possible, whilst maintaining efficiency of function. Residential grade silencers will be fitted and all noise control equipment will be maintained in good order.
Reversing Alarms	Mobile plant and trucks operating on site for a significant portion of the project will have reversing alarm noise emissions minimised, where possible, recognising the need to maintain occupational safety standards.
PA System	No public address system will be used at this site.
Vibration Monitoring	Vibration monitoring will be carried during the demolition, excavation and piling works should be carried out where there is considered to be a risk that vibration levels may exceed the relevant structural damage criteria.
Truck Noise (off site)	All trucks regularly used for the project are to have mufflers and all noise control equipment will be maintained in good working order. Trucking routes will use main roads, where feasible.
Community Liaison	A programme of community liaison and complaint response will be implemented.
Training	Site induction training will include a noise awareness component.



14 IDENTIFYING AND MANAGING FUTURE NOISE AND VIBRATION ISSUES

If additional activities or plant are found to be necessary that will emit noise and/or vibration emissions significantly exceeding those assumed for this assessment, these will be assessed by the Acoustical Consultant on a case-by-case basis and appropriate mitigation measures will be implemented.

Progressive impact assessments will be conducted as the works proceed in the event that works significantly deviate from those originally planned.

15 NON COMPLIANCE AND CORRECTIVE ACTION

Where the noise and/or vibration monitoring identifies non-compliance with the relevant criteria, the construction contractor will plan and carry out corrective action. The corrective action may involve supplementary monitoring in order to identify the source of the non-conformance and/or may involve modification of the construction techniques or program to avoid any recurrence or minimise its adverse effects.

16 COMPLAINT HANDLING

The construction contractor will adopt the following protocol for handling complaints. This protocol is intended to ensure that the issues are addressed and that appropriate corrective action is identified and implemented as necessary:

- The construction contractor will record all verbal and telephone complaints in writing and will forward all complaints to the Project Manager together with details of the circumstance leading to the complaint and all subsequent actions.
- Complaints received by the Project Manager will, as an initial step, be referred to the construction contractor. The construction contractor will respond as described above.
- The Project Manager will investigate the complaint in order to determine whether a criterion exceedance has occurred or whether noise and/or vibration have occurred unnecessary.
- If excessive or unnecessary noise and/or vibration have been caused, corrective action will be planned and implemented by the construction contractor.
- Complainants will be informed by the Project Manager that their complaints are being addressed, and (if appropriate) that corrective action is being taken.
- Follow up monitoring or other investigations will be carried out by the Project Manager and the construction contractor to confirm the effectiveness of the corrective action.
- Complainants will be informed of the implementation of the corrective action that has been taken to mitigate the adverse effects.



17 COMMUNITY CONSULTATION AND LIAISON

Community consultation will be undertaken via the construction contractor and will include:

- Advising the community of work to be undertaken.
- Recording and managing any complaints.

These and other elements of the community consultation will be addressed under the relevant procedures for the subject works.

18 CONCLUSION

RSA has conducted an acoustic assessment of the proposed Mixed-Use Development to be located at 15a, 15b Moseley Street and 25 – 31 Donald Street, Carlingford. The assessment has comprised the establishment of noise criteria and predicted noise from the proposed Child Care Centre and other noise emitting sources, as well as addressing other noise ingress and egress issues that may potentially arise.

Noise emissions from the outdoor area play activities to the nearest residential receivers have been calculated to comply with the noise criterion, where all children are playing outside at any given time. The following noise barriers are to be constructed on site:

- The eastern outdoor play area should have a 3m high solid on the north-eastern boundary and a 2.6m along the south-eastern outdoor play boundary.
- The western outdoor play area should have a 2.6m high wall on the western side of the boundary.
- A 2.1m along the western boundary of the site, adjacent to the Child Care Centre carpark; and
- 2.1m along the southern boundary of the site and south-eastern area of the site.

Noise emissions from the indoor play activities to the nearest residential receivers have been calculated to comply with the noise criterion, with the configurations shown in Section 5.4.

Noise emissions from the carpark to the nearest residential receivers have been calculated to comply with the noise criterion, a 2.1 metre solid barrier on the southern boundary must be erected and the ceiling in the basement driveway area should be fitted with absorption material/panels.

Criteria for noise emissions from mechanical plant have been established, a further acoustic survey by a qualified acoustic consultant will be required once mechanical plant schedules have been selected.

This assessment has also addressed the potential direct and cumulative construction noise impacts of the project and found that noise impacts have been predicted to exceed the noise management level at the majority of considered receiver locations. Consequently, feasible and reasonable work practices and best practice methods utilised on construction and demolition sites have been recommended to avoid, mitigate and manage any adverse noise throughout the work activities for the proposed site.



Based on our assessment the proposed Mixed-Use Development to be located at 15a, 15b Moseley Street and 25 – 31 Donald Street, Carlingford is deemed to comply with the established noise criteria at the residences provided that the noise control measures recommended is implemented. It is therefore recommended that planning approval be granted for the proposed development on the basis of acoustics.

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Approved by:

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Director

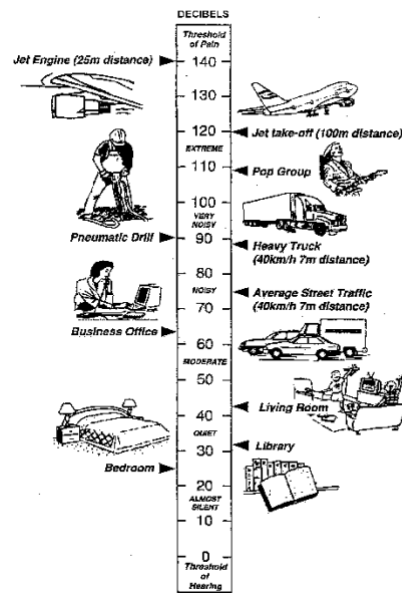


Appendix A – Acoustic Terminology

A-weighted sound pressure	The human ear is not equally sensitive to sound at different frequencies. People are more sensitive to sound in the range of 1 to 4 kHz (1000 – 4000 vibrations per second) and less sensitive to lower and higher frequency sound. During noise measurement an electronic ' <i>A-weighting</i> ' frequency filter is applied to the measured sound level <i>dB(A)</i> to account for these sensitivities. Other frequency weightings (B, C and D) are less commonly used. Sound measured without a filter is denoted as linear weighted <i>dB(linear)</i> .
Ambient noise	The total noise in a given situation, inclusive of all noise source contributions in the near and far field.
Community annoyance	Includes noise annoyance due to: ■ character of the noise (e.g. sound pressure level, tonality, impulsiveness, low-frequency content) ■ character of the environment (e.g. very quiet suburban, suburban, urban, near industry) ■ miscellaneous circumstances (e.g. noise avoidance possibilities, cognitive noise, unpleasant associations) ■ human activity being interrupted (e.g. sleep, communicating, reading, working, listening to radio/TV, recreation).
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Cumulative noise level	The total level of noise from all sources.
Extraneous noise	Noise resulting from activities that are not typical to the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Feasible and reasonable measures	Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors: ■ Noise mitigation benefits (amount of noise reduction provided, number of people protected). ■ Cost of mitigation (cost of mitigation versus benefit provided). ■ Community views (aesthetic impacts and community wishes). ■ Noise levels for affected land uses (existing and future levels, and changes in noise levels).
Impulsiveness	Impulsive noise is noise with a high peak of short duration or a sequence of these peaks. Impulsive noise is also considered annoying.



Low frequency	Noise containing major components in the low-frequency range (20 to 250 Hz) of the frequency spectrum.
Noise criteria	The general set of non-mandatory noise levels for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (e.g. noise levels for various land use).
Noise level (goal)	A noise level that should be adopted for planning purposes as the highest acceptable noise level for the specific area, land use and time of day.
Noise limits	Enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.
Performance-based goals	Goals specified in terms of the outcomes/performance to be achieved, but not in terms of the means of achieving them.
Rating Background Level (RBL)	The rating background level is the overall single figure background level representing each day, evening and night time period. The rating background level is the 10 th percentile min L _{A90} noise level measured over all day, evening and night time monitoring periods.
Receptor	The noise-sensitive land use at which noise from a development can be heard.
Sleep disturbance	Awakenings and disturbance of sleep stages.
Sound and decibels (dB)	Sound (or noise) is caused by minute changes in atmospheric pressure that are detected by the human ear. The ratio between the quietest noise audible and that which should cause permanent hearing damage is a million times the change in sound pressure. To simplify this range the sound pressures are logarithmically converted to decibels from a reference level of 2×10^{-5} Pa. The picture below indicates typical noise levels from common noise sources.



dB is the abbreviation for decibel – a unit of sound measurement. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

Sound power Level (SWL)

The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in $dB(A)$.

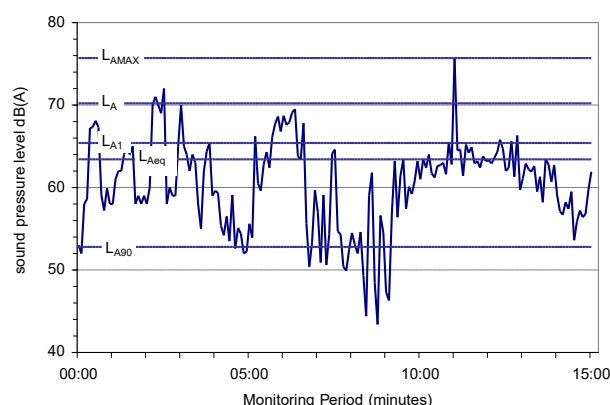
Sound Pressure Level (SPL)

The level of noise, usually expressed as SPL in $dB(A)$, as measured by a standard sound level meter with a pressure microphone. The sound pressure level in $dB(A)$ gives a close indication of the subjective loudness of the noise.

Statistic noise levels

Noise levels varying over time (e.g. community noise, traffic noise, construction noise) are described in terms of the statistical exceedance level.

A hypothetical example of A weighted noise levels over a 15 minute measurement period is indicated in the following figure:



Key descriptors:

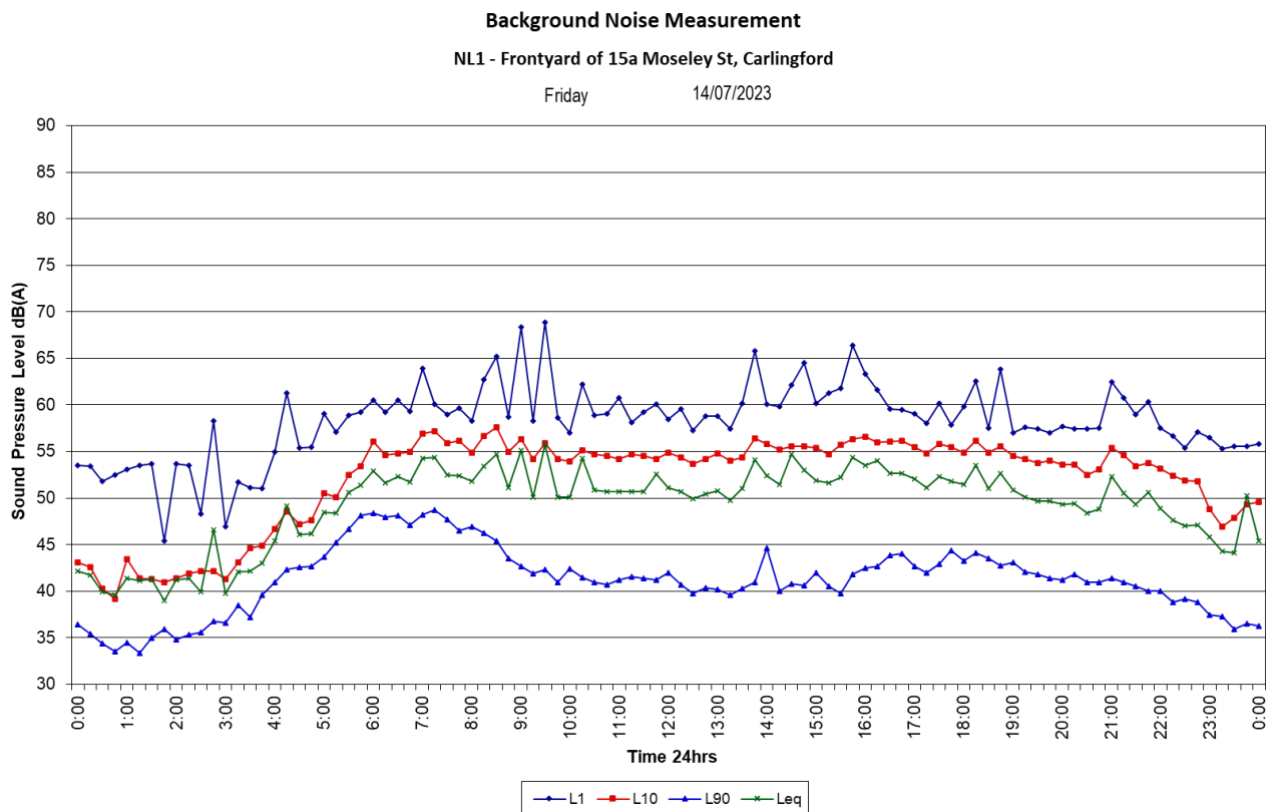
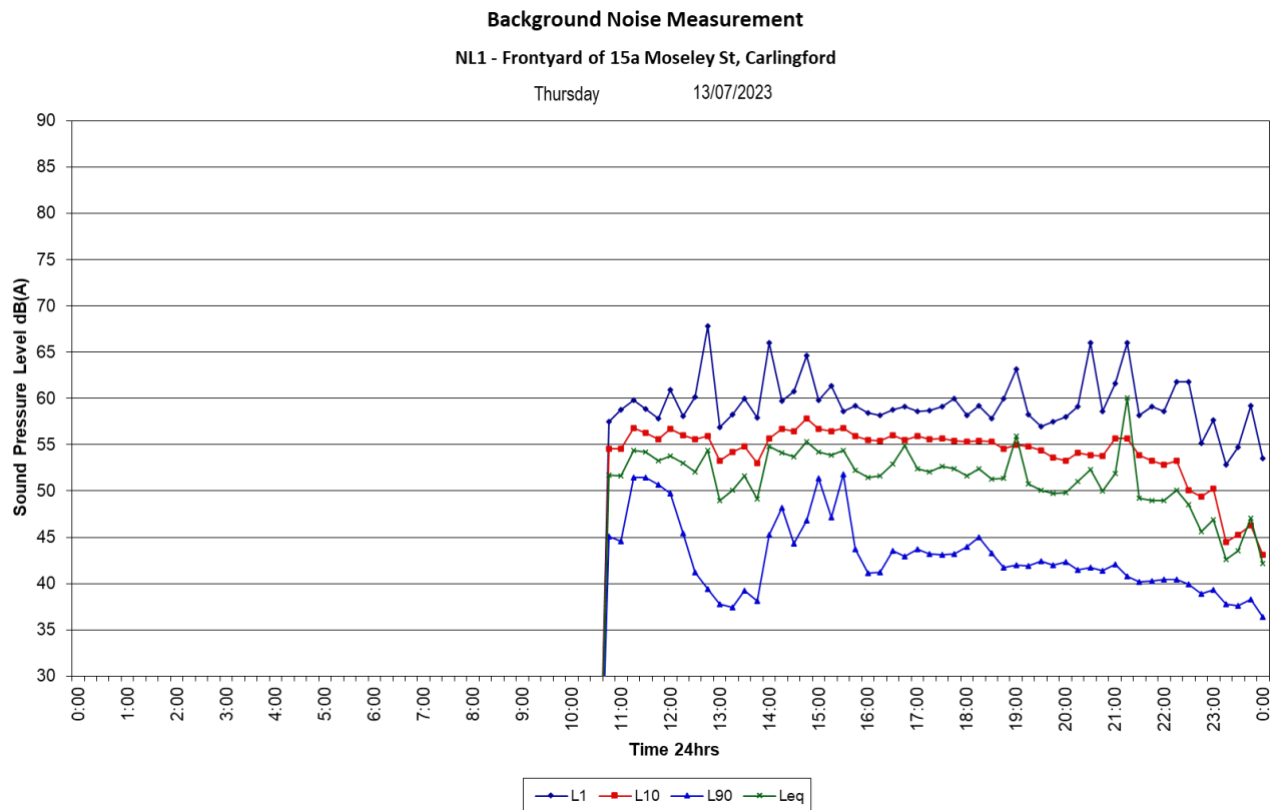
L_{max} Maximum recorded noise level.

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

	L_{A10} Noise level present for 10% of the 15 minute interval. Commonly referred to the average maximum noise level. L_{Aeq} Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound. L_{A90} Noise level exceeded for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).
Threshold	The lowest sound pressure level that produces a detectable response (in an instrument/person).
Tonality	Tonal noise contains one or more prominent tones (and characterised by a distinct frequency components) and is considered more annoying. A 2 to 5 dB(A) penalty is typically applied to noise sources with tonal characteristics



Appendix B – Logger Graphs



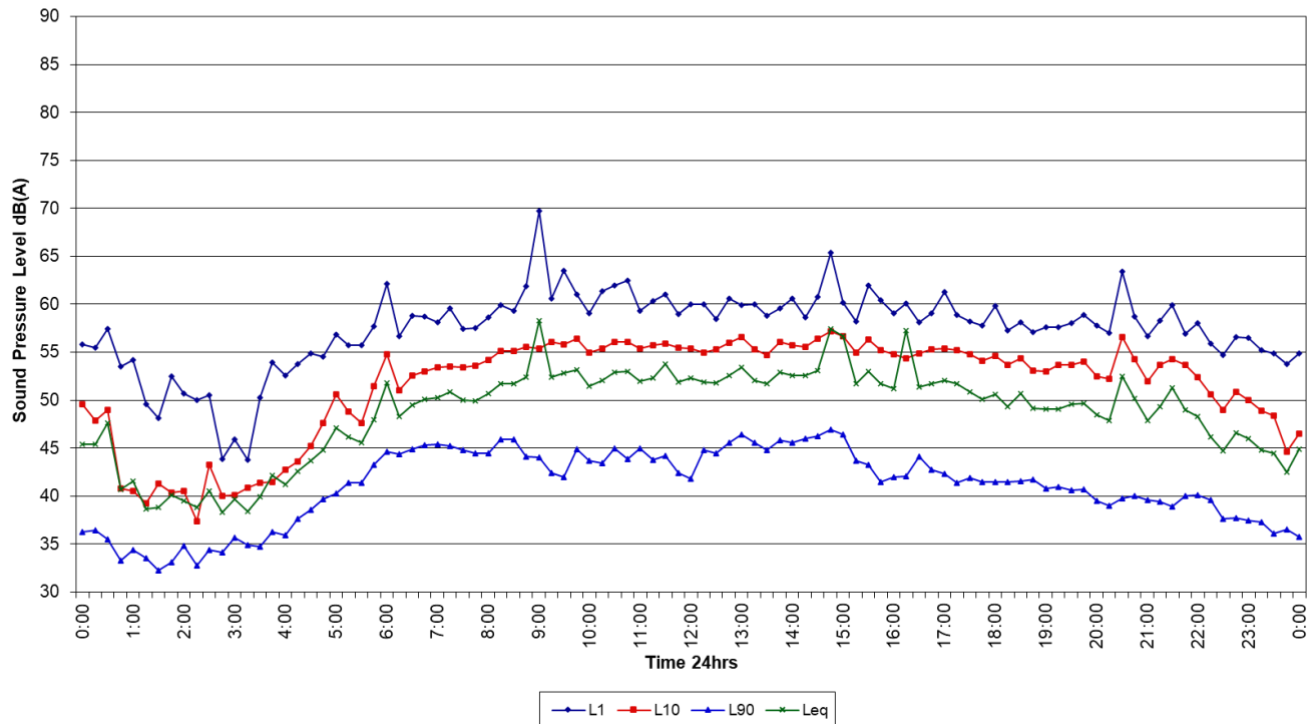


Background Noise Measurement

NL1 - Frontyard of 15a Moseley St, Carlingford

Saturday

15/07/2023

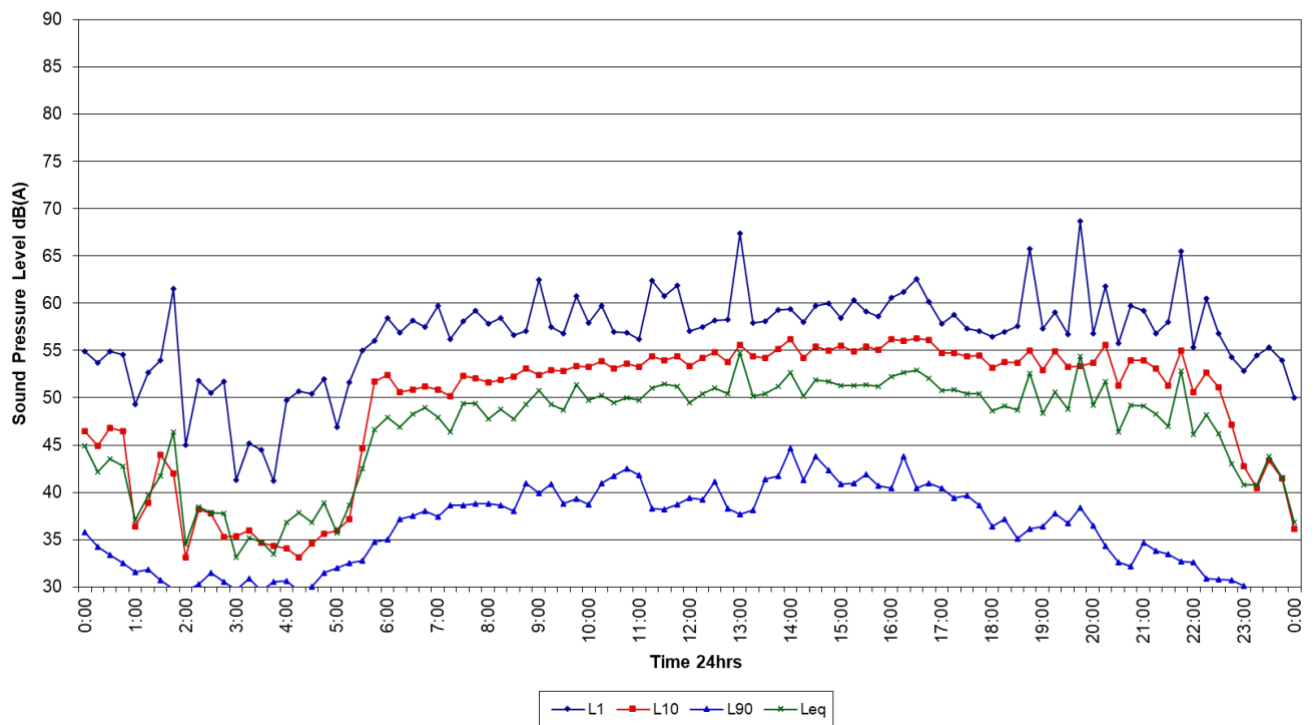


Background Noise Measurement

NL1 - Frontyard of 15a Moseley St, Carlingford

Sunday

16/07/2023



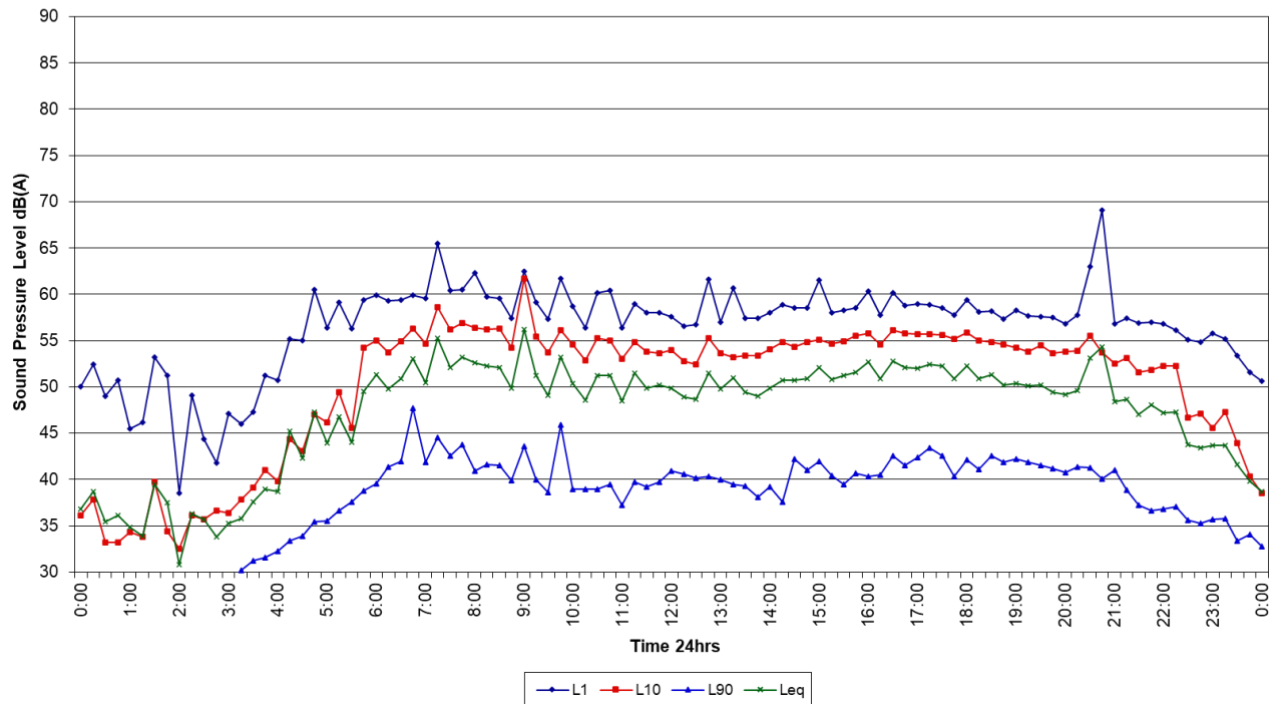


Background Noise Measurement

NL1 - Frontyard of 15a Moseley St, Carlingford

Monday

17/07/2023

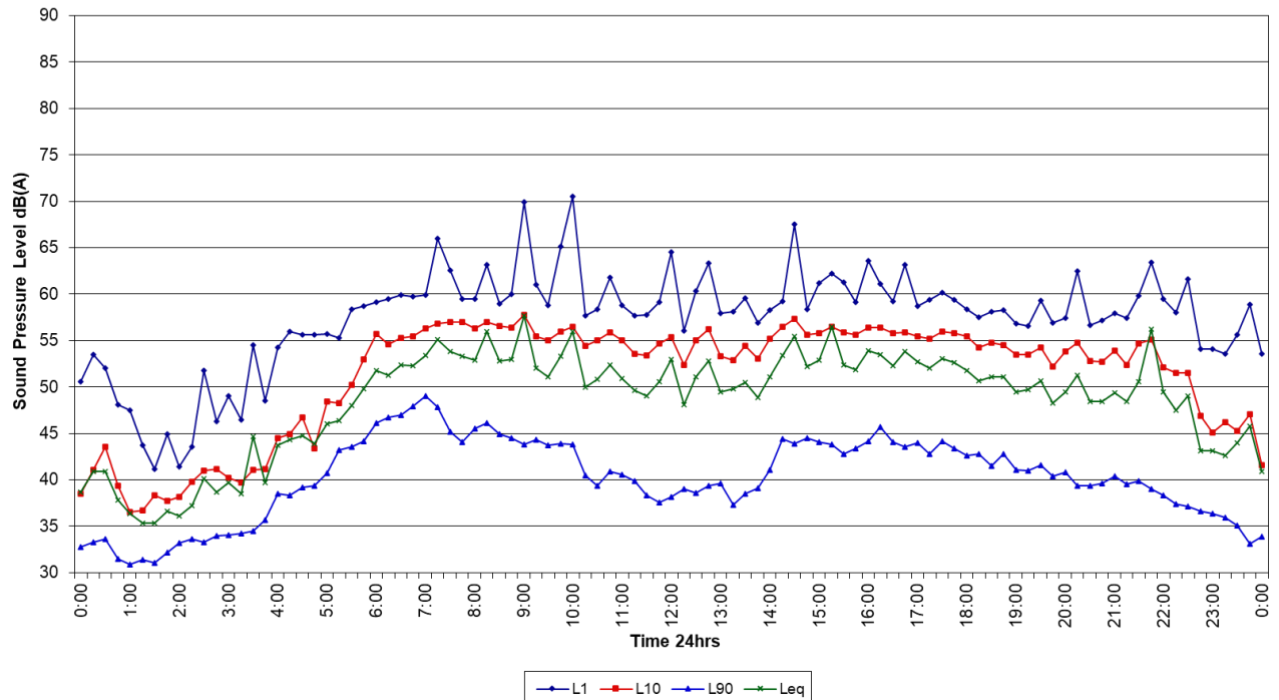


Background Noise Measurement

NL1 - Frontyard of 15a Moseley St, Carlingford

Tuesday

18/07/2023



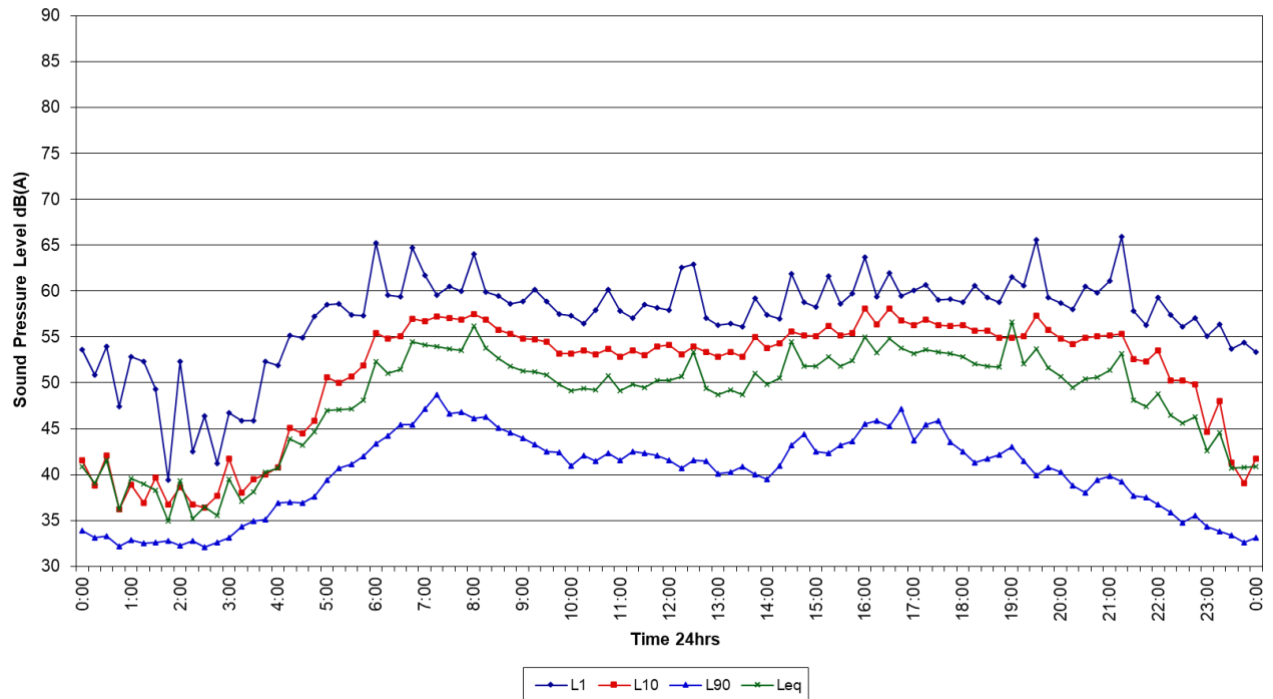


Background Noise Measurement

NL1 - Frontyard of 15a Moseley St, Carlingford

Wednesday

19/07/2023

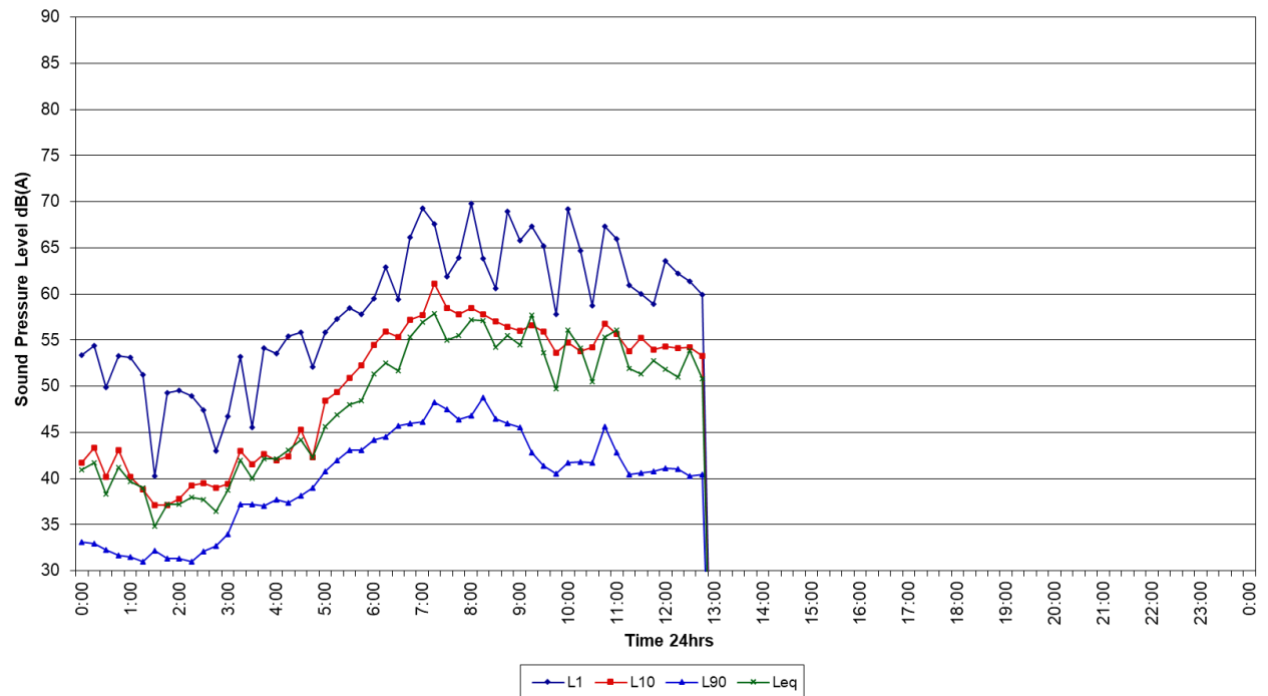


Background Noise Measurement

NL1 - Frontyard of 15a Moseley St, Carlingford

Thursday

20/07/2023



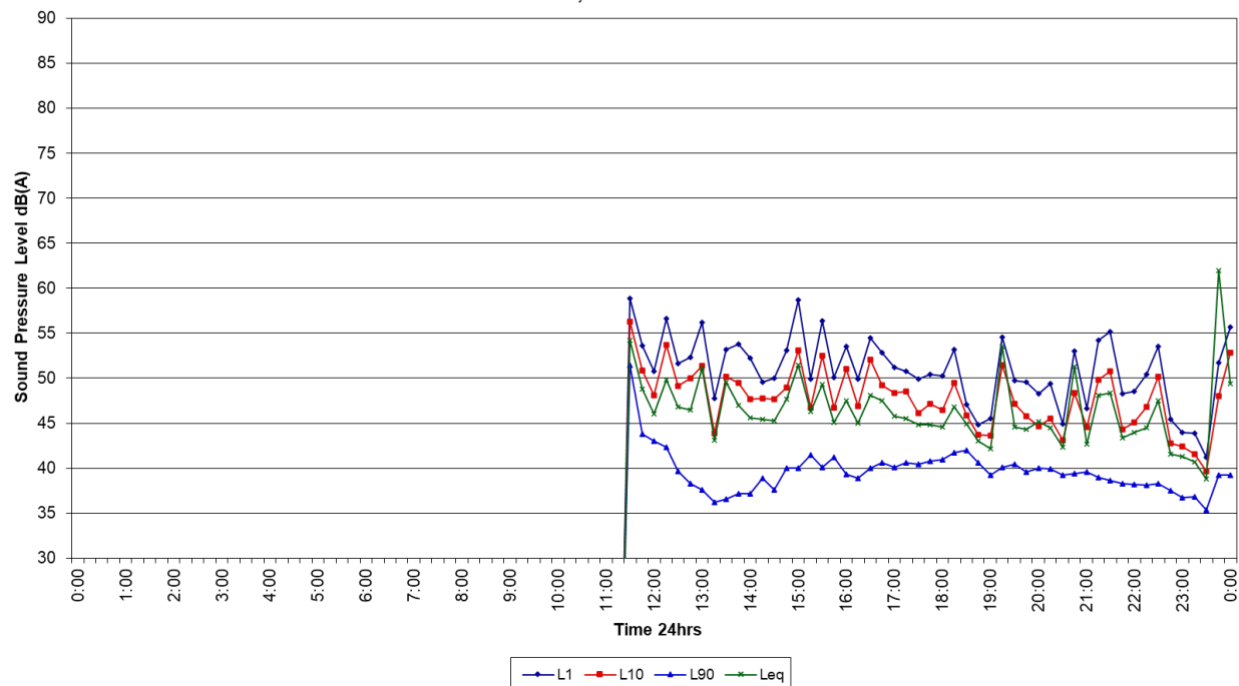


Background Noise Measurement

NL2 - 25 Donald Street, Carlingford

Thursday

13/07/2023

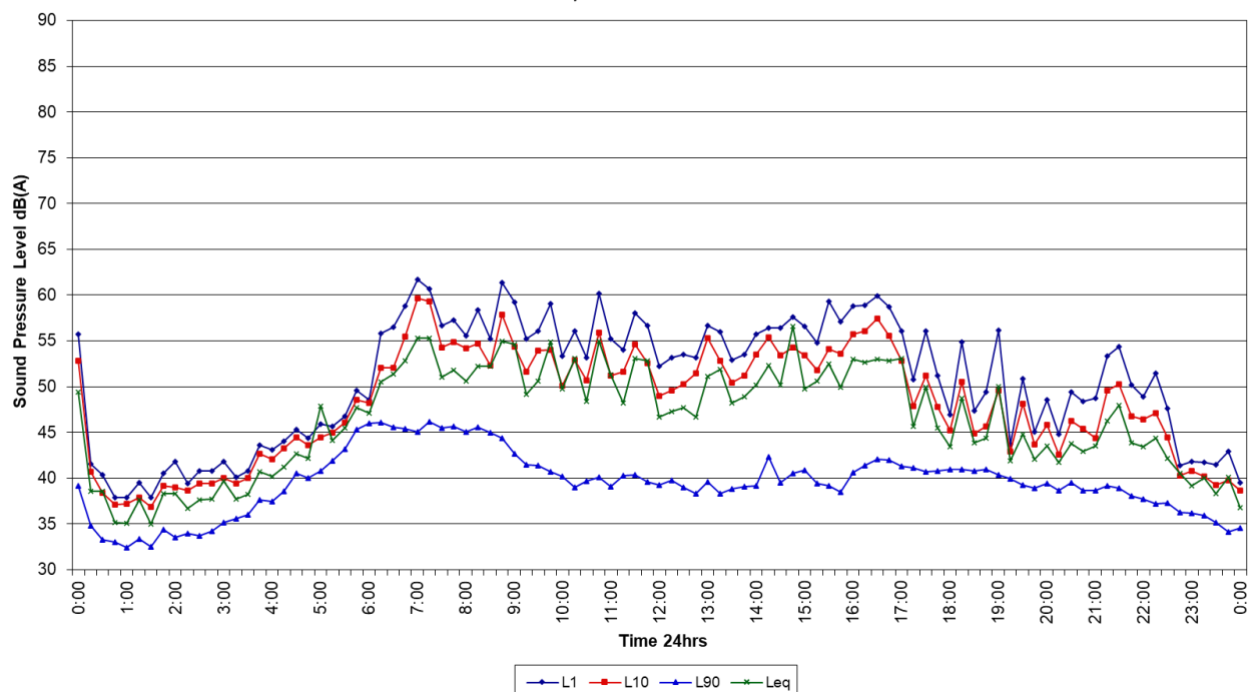


Background Noise Measurement

NL2 - 25 Donald Street, Carlingford

Friday

14/07/2023



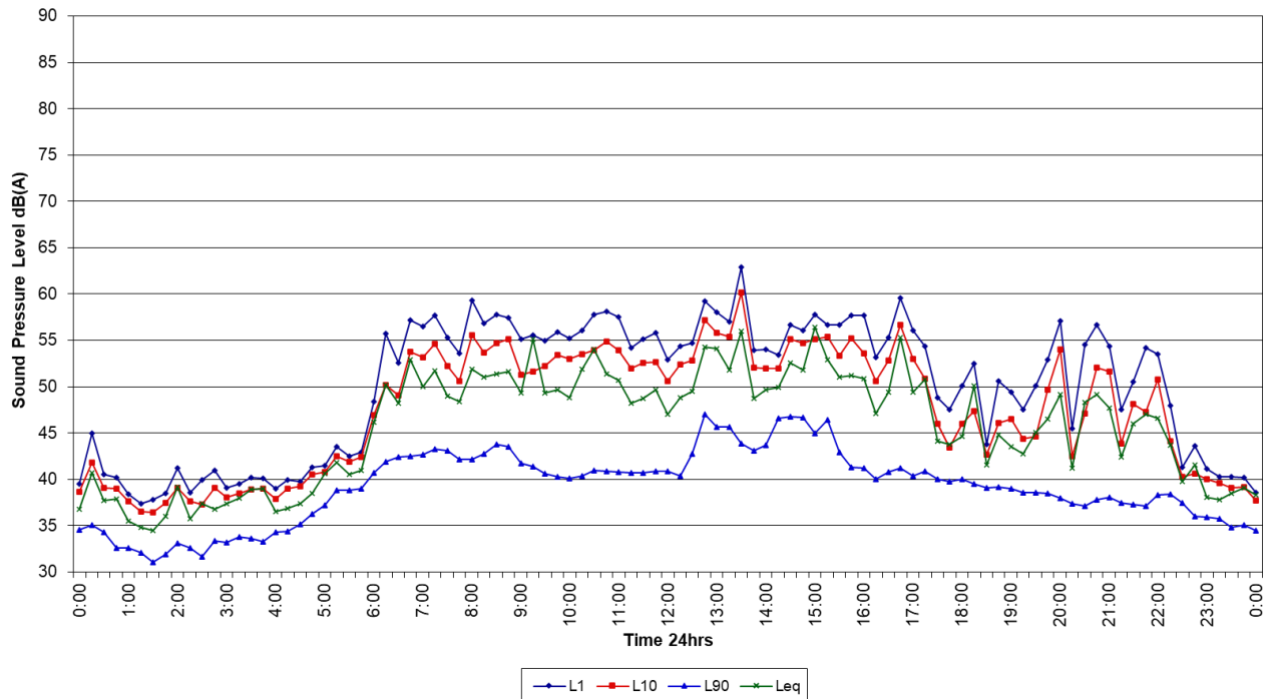


Background Noise Measurement

NL2 - 25 Donald Street, Carlingford

Saturday

15/07/2023

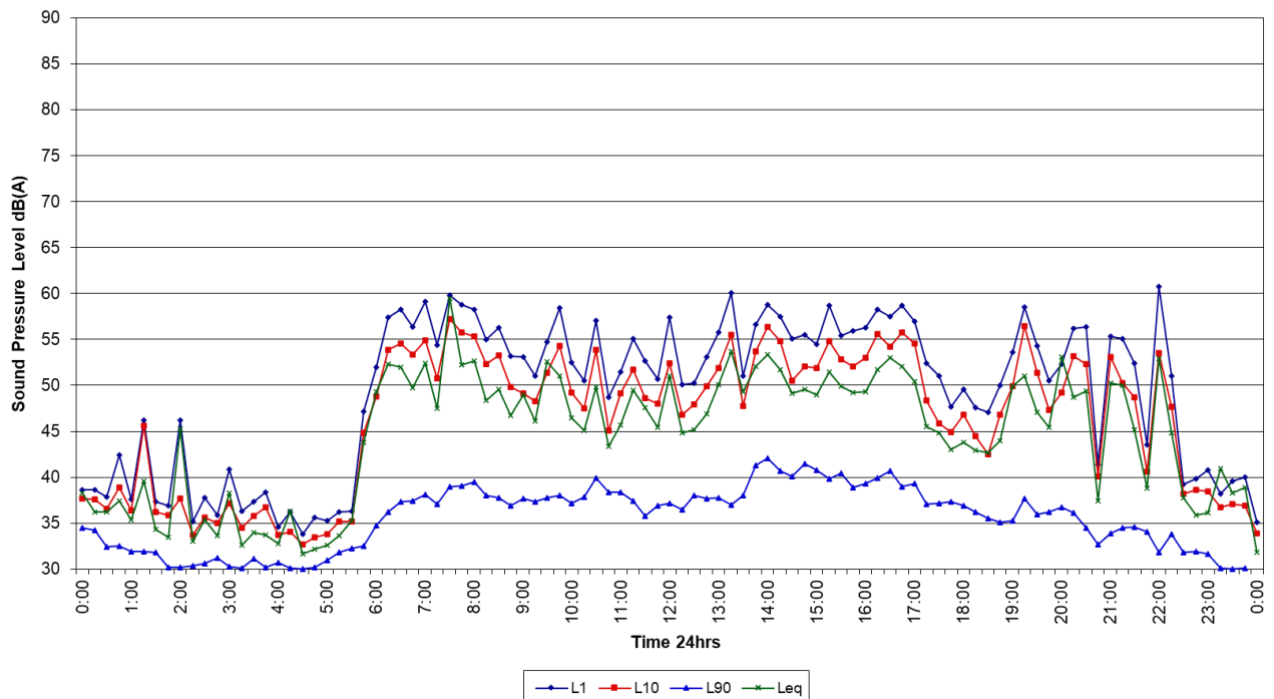


Background Noise Measurement

NL2 - 25 Donald Street, Carlingford

Sunday

16/07/2023



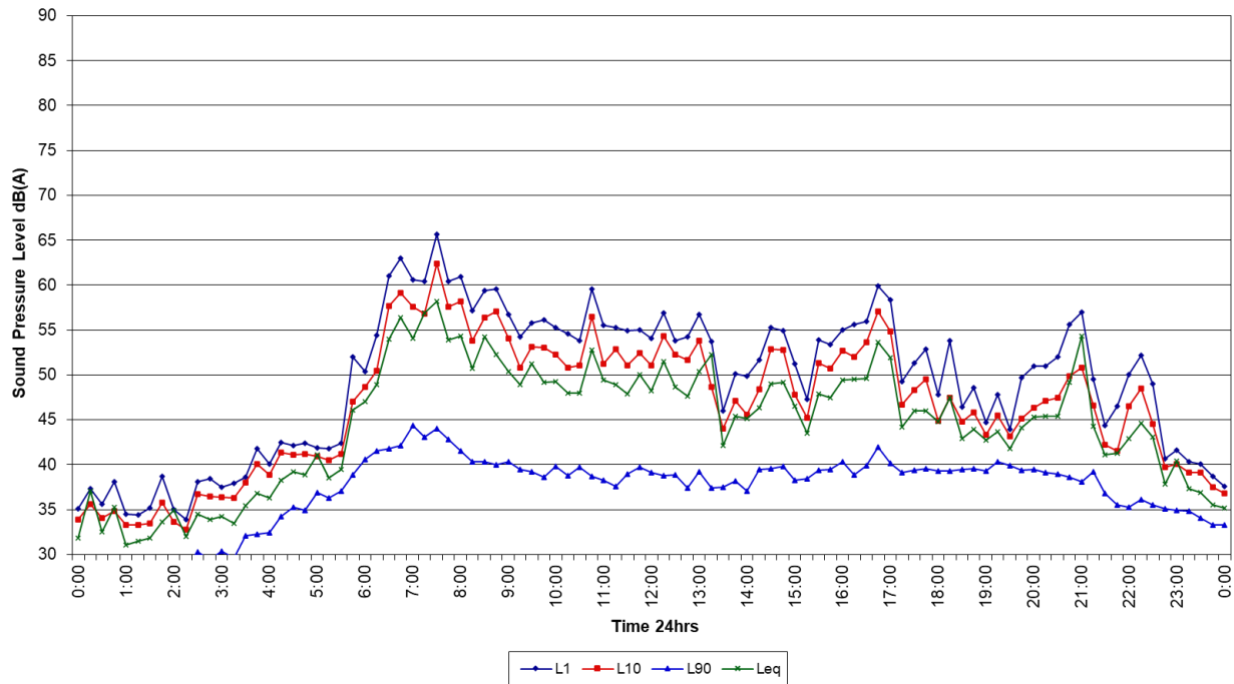


Background Noise Measurement

NL2 - 25 Donald Street, Carlingford

Monday

17/07/2023

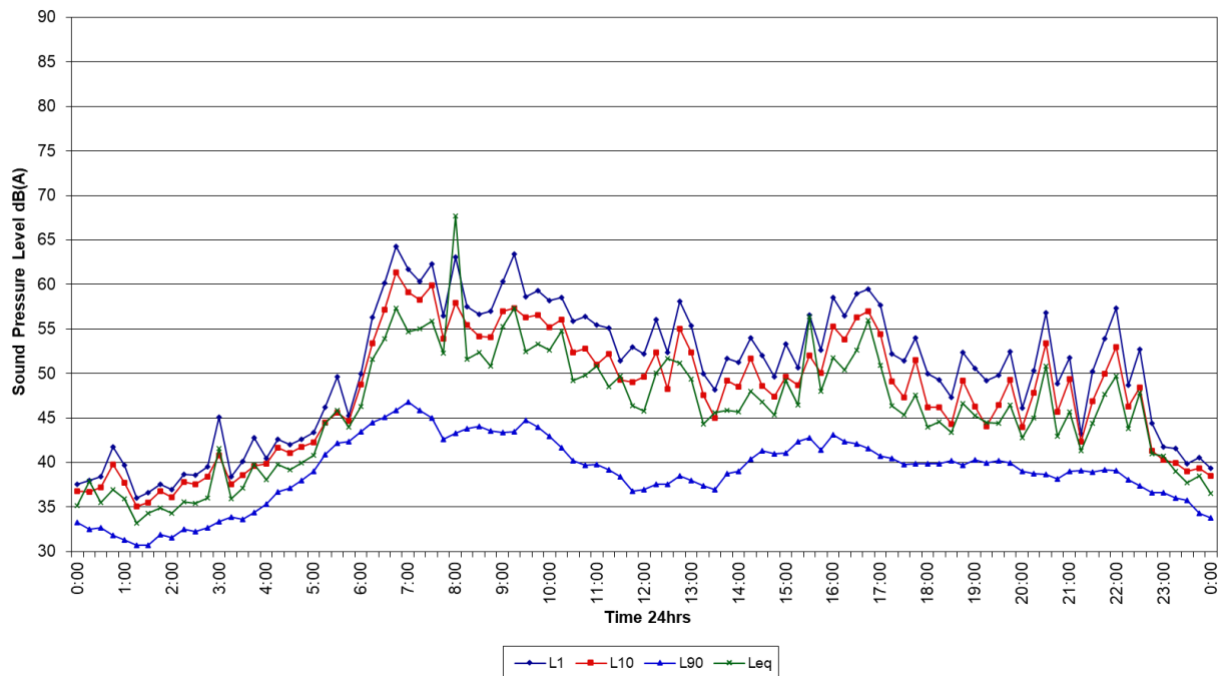


Background Noise Measurement

NL2 - 25 Donald Street, Carlingford

Tuesday

18/07/2023



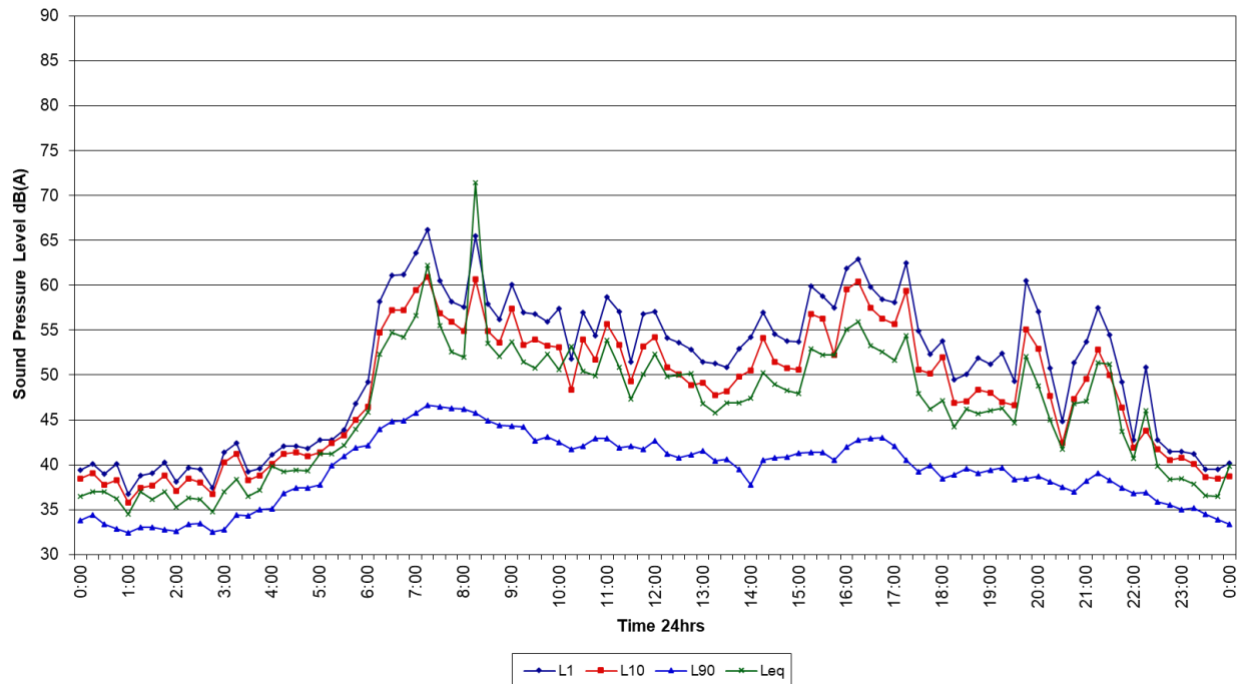


Background Noise Measurement

NL2 - 25 Donald Street, Carlingford

Wednesday

19/07/2023

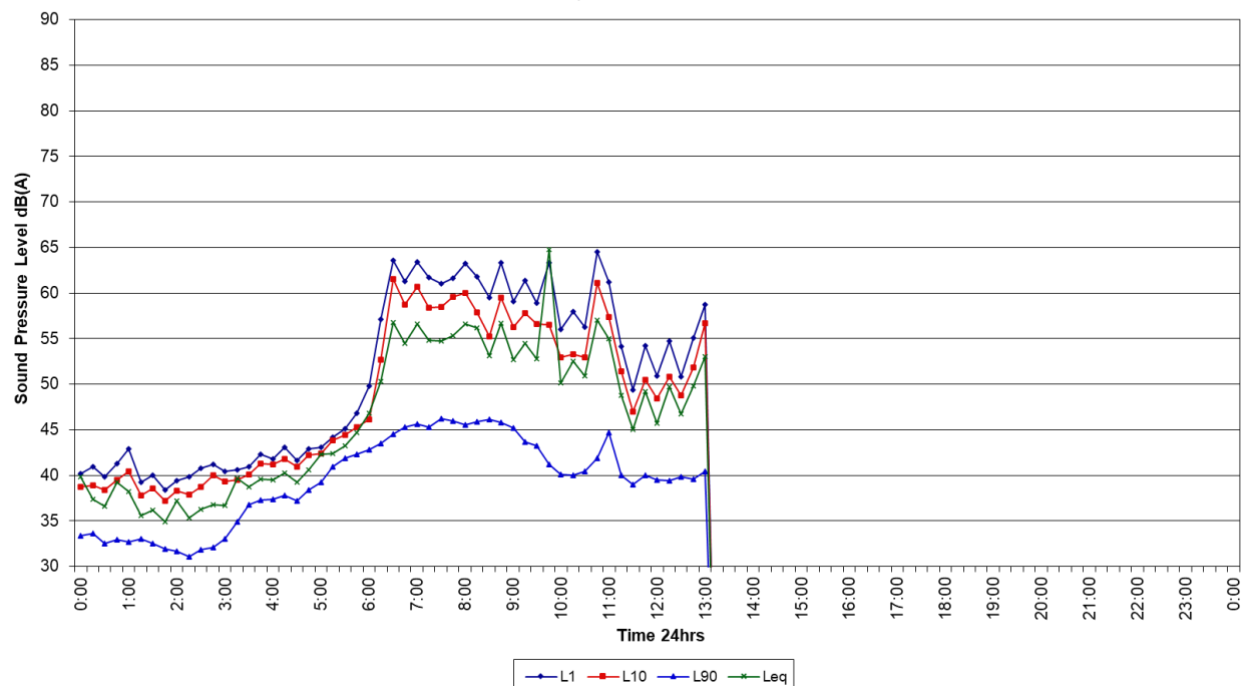


Background Noise Measurement

NL2 - 25 Donald Street, Carlingford

Thursday

20/07/2023





Appendix C – Calibration Certificates



**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 C21744

Client Details Acoustic Research Labs Pty Ltd 36/14 Loyalty Road North Rocks NSW 2151	
Equipment Tested/ Model Number : Rion NL-42EX Instrument Serial Number : 00810712 Microphone Serial Number : 172452 Pre-amplifier Serial Number : 10713	
Pre-Test Atmospheric Conditions Ambient Temperature : 23.6°C Relative Humidity : 44.8% Barometric Pressure : 101.5kPa	Post-Test Atmospheric Conditions Ambient Temperature : 23.6°C Relative Humidity : 44.2% Barometric Pressure : 101.5kPa
Calibration Technician : Lucky Jaiswal Calibration Date : 1 Nov 2021	Secondary Check: Harrison Kim Report Issue Date : 4 Nov 2021
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	Pass
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	Pass
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 2 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	
125Hz	±0.13dB	Temperature	±0.2°C
1kHz	±0.13dB	Relative Humidity	±2.4%
8kHz	±0.14dB	Barometric Pressure	±0.015kPa
Electrical Tests	±0.10dB		

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.

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 SI units.

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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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 C21680

Client Details	Rodney Stevens Acoustics Pty Ltd 1 Majura Close St Ives Chase NSW 2075
Equipment Tested/ Model Number :	Rion NL-42EX
Instrument Serial Number :	00572559
Microphone Serial Number :	192152
Pre-amplifier Serial Number :	72897
Pre-Test Atmospheric Conditions	Post-Test Atmospheric Conditions
Ambient Temperature : 22.8°C	Ambient Temperature : 22.8°C
Relative Humidity : 51.2%	Relative Humidity : 51.2%
Barometric Pressure : 100.3kPa	Barometric Pressure : 100.3kPa
Calibration Technician : Lucky Jaiswal	Secondary Check: Harrison Kim
Calibration Date : 13 Oct 2021	Report Issue Date : 14 Oct 2021
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	Pass
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	Pass
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 2 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	
125Hz	±0.13dB	Temperature	±0.2°C
1kHz	±0.13dB	Relative Humidity	±2.4%
8kHz	±0.14dB	Barometric Pressure	±0.015kPa
Electrical Tests	±0.10dB		

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



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Appendix D – Noise Complaint Handling Strategy

In the absence of a pre-existing noise complaint handling strategy the following strategy may be adopted for all noise enquiries / complaints. The strategy provides guidance on actions to be undertaken by site management or nominated personnel to actively address complaints received from the surrounding community.

- [1]. On receipt of a noise enquiry/complaint, site management or nominated personnel will complete a Record of Construction Noise Complaint, including specific details as follows:
 - full name and contact details of the complainant;
 - time and date of the incident;
 - details of the complainant's location;
 - description of construction noise;
 - any other details the complainant may wish to provide; and
 - whether the complainant requests further action.
- [2]. The noise enquiry is then referred to site management for investigation. Upon completion of the investigation, the complainant will be contacted by site management or nominated personnel to discuss the event that caused the noise enquiry. Contact with the complainant should take place as soon as practicable, but no later than 1 day from when the complaint was recorded.
- [3]. If the complaint requires further action, or site management believes the matter warrants further investigation, an independent acoustic consultant should be engaged to undertake attended noise measurements at the location of the complainant during works identified as giving rise to the complaint.
- [4]. In the event that attended noise measurements reveal that construction noise levels comply with the applicable noise criteria for the location, no further action is required however it is advised to provide the complainant with relevant information about the construction works.
- [5]. Should the attended noise measurements reveal that construction noise levels exceed the applicable noise criteria for the location, all feasible, reasonable and practical work practices must be investigated and implemented in order to reduce the current level of construction noise. Noise levels should then be re-measured in order to evaluate the level of reduction achieved.
- [6]. If the construction noise levels have been satisfactorily reduced to comply with the applicable noise criteria no further action is required. If the construction noise levels continue to exceed the applicable noise criteria for the location number 5 should be repeated in order to further reduce construction noise levels.