

WESTERN SYDNEY UNIVERSITY, MILPERRA MASTERPLAN – 7 STAGES

DA Acoustic Assessment

Mirvac Residential Developments (NSW)

TN579-07 F02 DA Acoustic Report - Masterplan (7 Stages) Acoustic Assessment (r3)

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Prepared for:	Mirvac Residential Developments (NSW)
Address:	Level 28, 200 George Street Sydney NSW 2000
Attention:	Nibraas Ahmad

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Supplementary professional advice should be sought in respect of these issues.

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1 Introduction

Renzo Tonin & Associates was commissioned to undertake an environmental noise impact assessment of existing road traffic, and nearby industrial premises on to the future residential developments at Western Sydney University (WSU) Milperra Campus.

This report is to be submitted to the Department of Planning, Housing and Infrastructure (the Department) on behalf of Mirvac Residential (NSW) Pty Ltd (the Applicant) in support of a State Significant Development Application (SSDA) for a staged residential development at 2 and 2A Bullecourt Avenue (the site).

Acoustic modelling and anticipated impacts of the proposed development with a total dwelling yield of 430 dwellings have been assessed and represented in the Planning Proposal modelling referenced in the Acoustic Report prepared for the Planning Proposal. Further acoustic modelling has been carried out based on the latest Master Staging Plan, Revision O, prepared by Beveridge Williams, which identifies a total provision of approximately 385 dwellings. This indicative layout plan is based on the Structure Plan (Figure 2: Concept Plan) of the Canterbury-Bankstown Development Control Plan 2023, Chapter 11.13.

As detailed design for the internal dwellings are still underway, the exact dwelling yield for SSDA 2 is not yet confirmed. The proponent is refining the design in the lead up to SSDA lodgement 2 to deliver a mix of typologies and a dwelling count consistent with the Housing Delivery Authority Expression of Interest. Notwithstanding, updated traffic modelling will be completed at SSDA lodgement 2 using the final dwelling yield.

The report quantifies external noise (i.e. road traffic and industrial noise) impact on following proposed Stages:

- Stage 1 – 22 residential lots
- Stage 2 – 40 residential lots
- Stage 4 – 107 residential lots
- Stage 5 – 65 residential lots
- Stage 6 – 92 residential lots
- Stage 7 – 59 residential lots

In addition to above, this report also quantifies additional noise emissions from the 67 kids pre-existing child care centre (Stage 3A & 3B) on to the future residential development and Construction noise impacts regulated with reference to the EPA Interim Construction Noise Guidelines.

Unattended long-term noise monitoring was undertaken in December 2019 to establish background and ambient noise levels around the site. These results were subsequently verified through short-term attended noise measurements conducted in July 2022, and again in September 2024, confirming that background and ambient noise conditions remain unchanged.

The noise and vibration impacts have been assessed in accordance with the requirements of the relevant guidelines as specified below and assessed in detail in the respective report sections.

SEARs Request	Noise source	Guideline/Policy/Standard	Section
The noise and vibration impact assessment must be prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	Road traffic and industrial noise impacts	State Environmental Planning Policy (Infrastructure) 2021 (SEPP T&I) (Used for Road traffic noise impacts) Development in Rail Corridors and Busy Roads - Interim Guideline (December 2008) (Used for Road traffic noise impacts) Australian Standard AS2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors (Used for industrial noise impacts)	Sections 4 and 5
	Childcare Centre noise impacts	Bankstown Development Control Plan 2023 – Chapter 10.1 Association Of Australasian Acoustical Consultants (AAAC)	Section 6
	Construction noise impacts	NSW Interim Construction Noise Guideline (ICNG, 2009) NSW 'Environmental Noise Management Assessing Vibration: A Technical Guideline' (AVTG) British Standard 7385 Part 2 German Standard DIN4150-3	Section 8

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

APPENDIX A contains a glossary of acoustic terms used in this report.

2 Project description

2.1 Site description and development overview

The site is currently owned by Western Sydney University and is located within the Canterbury Bankstown LGA at 2 and 2A Bullecourt Avenue, Milperra, being legally described as Lot 2 in DP1291984 and Lot 1 in DP101147 (refer Figure 2-1).

The total site has an area of approximately 19.64ha and is the subject of numerous easements affecting the site, including two easements to drain water, easements for electricity and other purposes, and a right of carriageway.

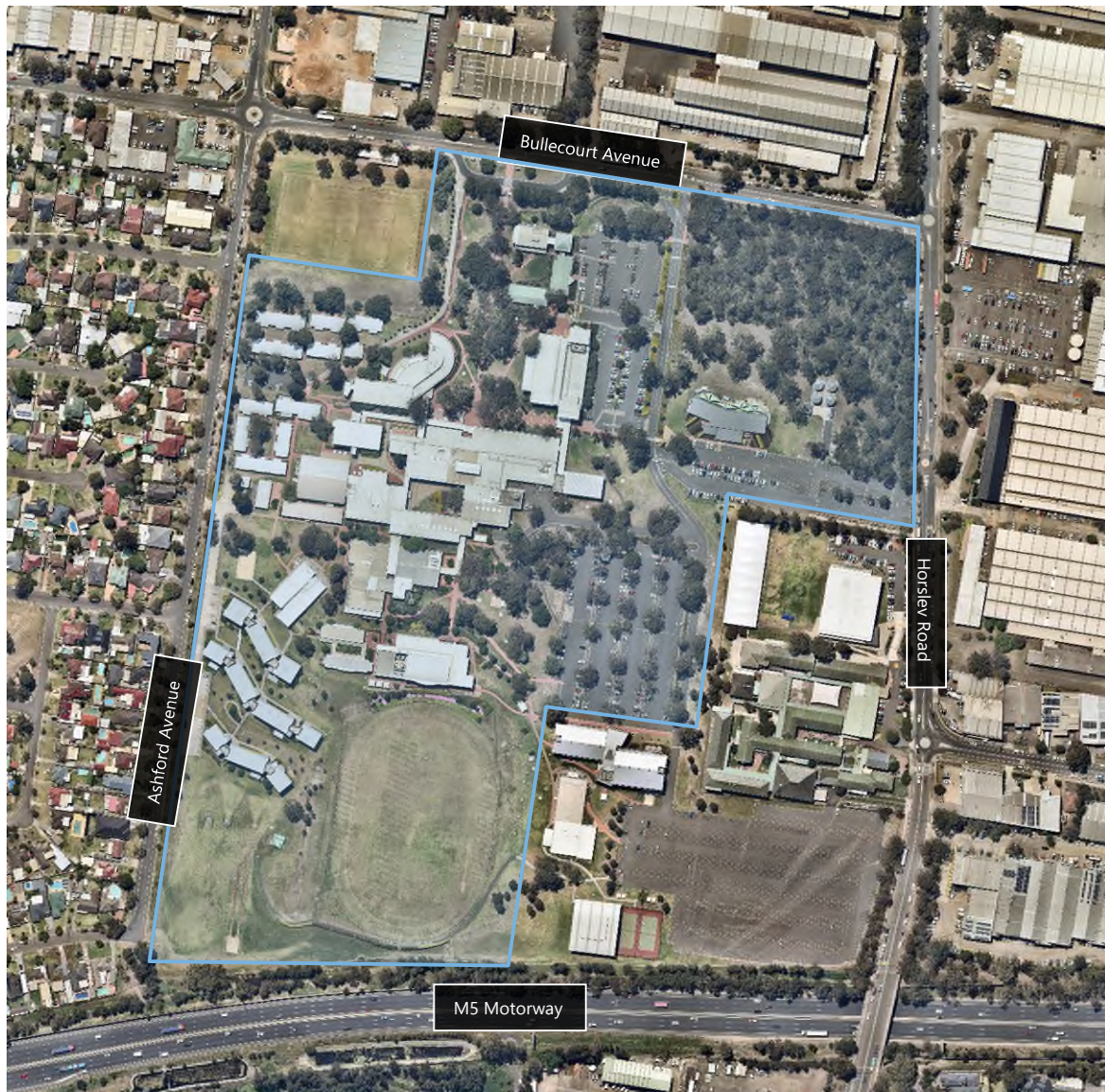
Since the demolition of the previous buildings on the site, the site currently comprises:

- Existing at-grade car park (within Zone 4) repurposed as parking and hardstand area for the temporary sales office.
- Existing at-grade car park for the Childcare Centre (generally within the location of the future Road 2B).
- At-grade roads off Bullecourt Avenue.
- A large oval to the south.
- The Western Sydney University Early Learning Centre (Child-care centre).
- Vegetation of varying significance, including Cumberland Plain Woodland.

The site is bound by industrial premises to the east, across Horsley Road (Heatcraft Australia), and to the north, across Bullecourt Avenue (Southern Steel Cash & Carry). To the west, across Ashford Avenue, are existing residential dwellings.

Additionally, there are commercial and retail premises, as well as a sports ground (Milperra Reserve), located to the northwest near the intersection of Ashford and Bullecourt Avenues. The southeastern corner of the site includes an existing school, with plans for expansion, and there is a childcare facility (Western Sydney University Early Learning) on the eastern part of the site (see Figure 2-1).

Regarding road traffic, the subdivision is subject to the road traffic along the M5 Motorway to the south.

Figure 2-1: Subject site

The site is proposed to be developed in stages, as identified below:

Figure 2-2: Milperra WSU Masterplan

2.2 Assessment methodology

In order to assess the potential noise impact on the subdivision site, the following methodology was used:

- Determine existing road traffic noise levels impacting on-site.
- Determine the extent of noise impacts at proposed residential lots using the results of the noise monitoring and predictive noise modelling.
- Identify where road traffic noise intrusion onto the site may exceed the relevant criteria.
- Identify industrial noise impacts on proposed residential lots using the results of the attended and unattended noise monitoring.
- Where external noise levels are predicted to exceed the noise criteria, in-principal recommendations are provided for building envelope design to achieve internal noise criteria.

2.3 Reference material

The following documentation was referenced for this report:

- Milperra WSU Overall Subdivision Plan prepared by Beveridge Williams [ref: 2301879-320-020-LAYOUT PLAN, dated 11 July 2025]

3 Existing noise environment

Long-term noise monitoring was conducted at the subject site between Wednesdays 27 November and Monday, 13 December 2019 to determine existing ambient noise levels from road traffic, industrial activity, and school playground. The long-term noise monitoring methodology is detailed in APPENDIX B, and noise level-vs-time graphs of the data are included in APPENDIX C.

The section below details the results of traffic and ambient noise conditions. In addition, a survey of the impact of existing industrial noise in the vicinity of the site was undertaken. This is detailed in section 5.

3.1 Noise measurement location

The long-term measurement locations are outlined in Table 3-1 and shown in Figure 3-1.

Table 3-1: Noise monitoring locations

ID	Location	Description
Long-term noise monitoring		
L1	WSU Oval South	The noise monitor was located on the southern boundary of the Masterplan and approximately 27m to the north of the closest lane of the M5 Motorway. The noise environment was dominated by road traffic from the M5 Motorway to the south. It is advised that the noise monitor was located behind the existing noise barrier in the free field.
L2	WSU East Parking - Horsley Road	The noise monitor was located on the eastern boundary of the Masterplan and approximately 9m to the west of Horsley Road. The noise environment was dominated by road traffic from the Horsley Road to the east. It is advised that the noise monitor was located in the free field.
L3	WSU Entrance - Bullecourt Avenue	The noise monitor was located on the northern boundary of the Masterplan and approximately 9m to the south of Bullecourt Avenue. The noise environment was dominated by road traffic and industrial premises from the Bullecourt Avenue to the north. It is advised that the noise monitor was located in the free field.
L4	Mount St Joseph School Sports Playground	The noise monitor was located on the north boundary of the existing school adjacent to the Masterplan. It was located approximately 11m to the north of the school's sports field. The noise environment was dominated by school activities and distant road traffic from the Horsley Road to the east. It is advised that the noise monitor was located in the free field.
L5	WSU Village Entrance - Ashford Avenue	The noise monitor was located on the western boundary of the Masterplan and approximately 11m to the east of Ashford Avenue. The noise environment was dominated by road traffic from the Ashford Avenue to the west. It is advised that the noise monitor was located in the free field.

Figure 3-1: Long-term noise monitoring locations



3.2 Long-term noise measurement results and discussion

Results from long-term noise monitoring are presented in Table 3-2 below.

Table 3-2: Long-term noise monitoring results

Monitoring location	L _{A90} background noise levels			L _{Aeq} ambient noise levels	
	Day ¹	Evening ¹	Night ¹	Day ²	Night ²
L1 - WSU Oval South	52	50	43	60	57
L2 - WSU East Parking - Horsley Road	49	45	41	64	59
L3 - WSU Entrance - Bullecourt Avenue	53	47	39	70	65
L4 - Mount St Joseph Catholic School Playground	43	44	39	57	50
L5 - WSU Village Entrance - Ashford Avenue	52	50	43	59	57

Notes: 1. Day: 07:00-18:00, Evening: 18:00-22:00, Night: 22:00-07:00
 2. Day: 7:00am to 10:00pm; Night: 10:00pm to 7:00am

The noise environment at logger locations L2 and L3 were dominated by road traffic and subjectively the noise emission from the industrial facilities from across the roads are deemed not to contribute to the existing measured L_{Aeq}. Therefore, further assessment against the NSW EPA NPfl is not deemed necessary.

The unattended long-term noise monitoring was undertaken in December 2019 to establish background and ambient noise levels around the site. These results were subsequently verified through short-term attended noise measurements conducted in July 2022, and again in September 2024, confirming that background and ambient noise conditions remain unchanged.

4 Road traffic noise assessment noise impact study

4.1 Canterbury-Bankstown Council Development Control Plan (DCP) 2023

Canterbury-Bankstown Council DCP 2023 Chapter 5.2 States:

2.12 Acoustic privacy Objectives

O1 To ensure reasonable levels of acoustic privacy are available for residents, externally and internally, during the day and at night.

O2 To minimise the effect of excessive ambient noise through siting and architectural design and detailing.

O3 To minimise the impact of rail and road noise and vibration for dwelling occupants.

O4 To protect new and existing dwellings from intrusive noise.

There is no specific noise goal set out by the DCP, because of this *State Environmental Planning Policy (Transport and Infrastructure) 2021* and *Development Near Rail Corridors & Busy Roads – Interim Guideline* will be adopted.

4.2 State Environmental Planning Policy (Transport and Infrastructure) 2021 noise limits

Section 2.119 of the SEPP (T&I) 2021 states:

(1) This section applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 20,000 vehicles (based on the traffic volume data published on the website of TfNSW) and that the consent authority considers is likely to be adversely affected by road noise or vibration—

- (a) residential accommodation,*
- (b) a place of public worship,*
- (c) a hospital,*
- (d) an educational establishment or centre-based childcare facility.*

(2) Before determining a development application for development to which this section applies, the consent authority must take into consideration any guidelines that are issued by the Secretary for the purposes of this section and published in the Gazette.

(3) If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded—

- (a) in any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am,*
- (b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom, or hallway)—40 dB(A) at any time.*

4.2.1 NSW Department of Planning Guideline

To support the SEPP, the NSW Department of Planning released the *Development in Rail Corridors and Busy Roads – Interim Guideline* (December 2008) (the Guideline). The Guideline assists in the planning, design, and assessment of developments in, or adjacent to, major transport corridors in terms of noise, vibration and air quality.

The Guideline clarifies the time period of measurement and assessment. As stated in the Guideline in Section 3.4 'What Noise and Vibration Concepts are Relevant' and Table 3.1 of Section 3.6.1, noise measurements are determined over the following relevant time periods:

- Daytime 7am - 10pm $L_{Aeq(15hr)}$
- Night-time 10pm - 7am $L_{Aeq(9hr)}$

L_{Aeq} is the Equivalent Continuous Noise Level and accounts for both the level of fluctuating noise and the number of noise events over the time period. The noise criteria nominated in the SEPP (T&I) are internal noise levels with windows and doors closed and the requirements are stated in the following table.

Table 4-1: SEPP (T&I) internal road traffic noise criteria

Internal space	Time period	Noise metric	Internal criteria [^]
Bedrooms	7am - 10pm	$L_{Aeq(15hrs)}$	40*
	10pm - 7am	$L_{Aeq(9hrs)}$	35
Other Habitable Rooms	Any Time	$L_{Aeq(15hrs)}$ and $L_{Aeq(9hrs)}$	40

Notes: [^] With windows and doors closed.

* Whilst not specified in the ISEPP, daytime criteria for bedrooms are set to 40dB(A), as per the other habitable rooms.

The Guideline in Section 3.6.1 'Airborne Noise' states as follows:

"If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, 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."

As noise modelling is undertaken for external locations, the above criteria and guidelines have been used to establish equivalent external noise criteria. This external noise criterion is used to determine which building facades may require specific acoustic treatment to meet the requirements of the SEPP. External goals have been calculated based on nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the NCC 2019 requirements.

Table 4-2: SEPP (T&I) road and rail traffic noise criteria for new residential development

Room	Location	L _{Aeq, 15hr} Day 7am - 10pm	L _{Aeq 9hr} Night 10pm - 7am
Living rooms*	Internal, windows closed	40	40
	Internal, windows open	50	50
	External free field (allowing windows to remain open) ^	60	60
Bedrooms*	Internal, windows closed	40	35
	Internal, windows open	50	45
	External free field (allowing windows to remain open) ^	60	55

Notes:

* Requisite for 40,000 AADT Roads only under ISEPP 2007.

^ ISEPP Guideline states that where internal noise criteria are exceeded by more than 10dB(A) with windows open mechanical ventilation is required. External goals have been calculated based on nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the National Construction Code (NCC) 2019 requirements.

4.3 Noise sources

Road traffic noise sound power levels were determined from the noise monitoring results. The following L_{Aeq(9hrs)} sound power levels were used, which were validated to both logger locations in the noise modelling.

Table 4-3: Road traffic noise 9-hour equivalent sound power levels PWL/metre (re 1 Picowatt)

Noise source	Overall dB(A)	Octave band centre frequency - Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
M5 Motorway	91	94	98	93	84	87	88	83	71	63
Horsley Road	73	73	77	73	64	67	68	62	51	43
Ashford Avenue	71	72	76	71	62	65	66	61	50	41
Bullecourt Avenue	78	78	82	78	69	72	73	67	56	48

4.4 Prediction methodology

The noise propagation calculations were carried out in accordance with ISO9613 as implemented by CadnaA computer modelling program (version 2024). The software considers sound radiation patterns, acoustic shielding and potential reflections from intervening building elements, and noise attenuation due to distance.

The noise prediction model was run for two (2) different receiver heights, 1.5m above ground level for ground floor and 4.5m above ground level for 1st floor.

The measured night-time road traffic noise levels indicate a significant impact. Therefore, noise predictions were assessed based on night-time criteria, as compliance with more stringent night-time criteria ensures compliance to daytime noise limits.

4.5 Road traffic noise prediction results

The noise prediction results are set out in a graphical format in APPENDIX D of this report. The contour maps in APPENDIX D show that noise levels at some facades on the boundary of the Masterplan do not comply with the ISEPP noise limits. Noise control treatments to mitigate road traffic noise are discussed in Section 7.

5 Industrial noise impact study

In order to ensure that noise from pre-existing industrial development is considered in the design of new dwellings a survey of industrial noise at the site was undertaken.

5.1 Condition from the Department of Planning Housing and Infrastructure

Department of Planning's has made the following comment with respect to acoustics:

- f. Address potential noise impacts from nearby industrial uses, and if there are significant impacts outline how these impacts will be mitigated by the future residential development.*

5.2 Internal noise level goals

AS2107:2016 internal noise goals will be adopted in setting noise targets for new residential development in areas impacted by industrial noise.

Section 5 and Table 1 of the Australian Standard 2107 states the recommended A-weighted sound pressure level ranges for the design of the spaces in buildings.

The noise criteria nominated in the Australian Standard 2107 are internal noise levels with windows and doors closed and the requirements are stated in the following table. The table below presents target internal noise levels within dwellings based on AS2107 because of external industrial noise intrusion.

Table 5-1: AS2107 internal noise criteria

Type of occupancy	Internal space	Internal criteria (L _{Aeq})
Houses and apartments in suburban areas	Sleeping Areas	35
	Living Areas	40
	Apartment Common Areas	50

5.2.1 Equipment Used for Noise Assessment

Sound level measurements were undertaken in general accordance with AS1055.1-1997 "Acoustics – Description and Measurement of Environmental Noise" using an NTi Audio Type XL2 precision sound level analyser which is a class 1 instrument having accuracy suitable for field and laboratory use. Statistical noise levels were acquired in both overall and octave band frequencies. The instrument was calibrated prior to and after measurements were taken, using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed. All instrumentation complies with IEC 61672 (parts 1-3) 'Electroacoustics - Sound Level Meters' and IEC 60942 'Electroacoustics - Sound calibrators' and carries current NATA certification (or if less than 2 years old, manufacturers certification).

5.2.2 Noise Measurement results

As part of this noise assessment, short term attended noise measurements were undertaken during the early morning of Wednesday, 27 July 2022, to determine the industrial noise contribution on the future residential development. The measurement locations were 1.5m above the ground level on 6 different locations around WSU Milperra Campus.

The above measurements were repeated on 13/09/2024 between 7am and 9am to ensure that noise from pre-existing industrial development is unchanged. The measurement locations were 1.5m above the ground level on 6 different locations around WSU Milperra Campus as shown in Figure 5-1.

A summary of measured L_{Aeq} noise levels is presented in below Table 5-2 and Table 5-3 for specified locations shown in Figure 5-1.

To assist, the L_{Aeq} noise levels presented in below Table 5-2 compares industrial noise contribution measured on Wednesday, 27 July 2022 and Friday, 13 September 2024 and unattended noise monitor traffic noise levels as documented in Table 3-2.

Figure 5-1: Short-term noise monitoring locations

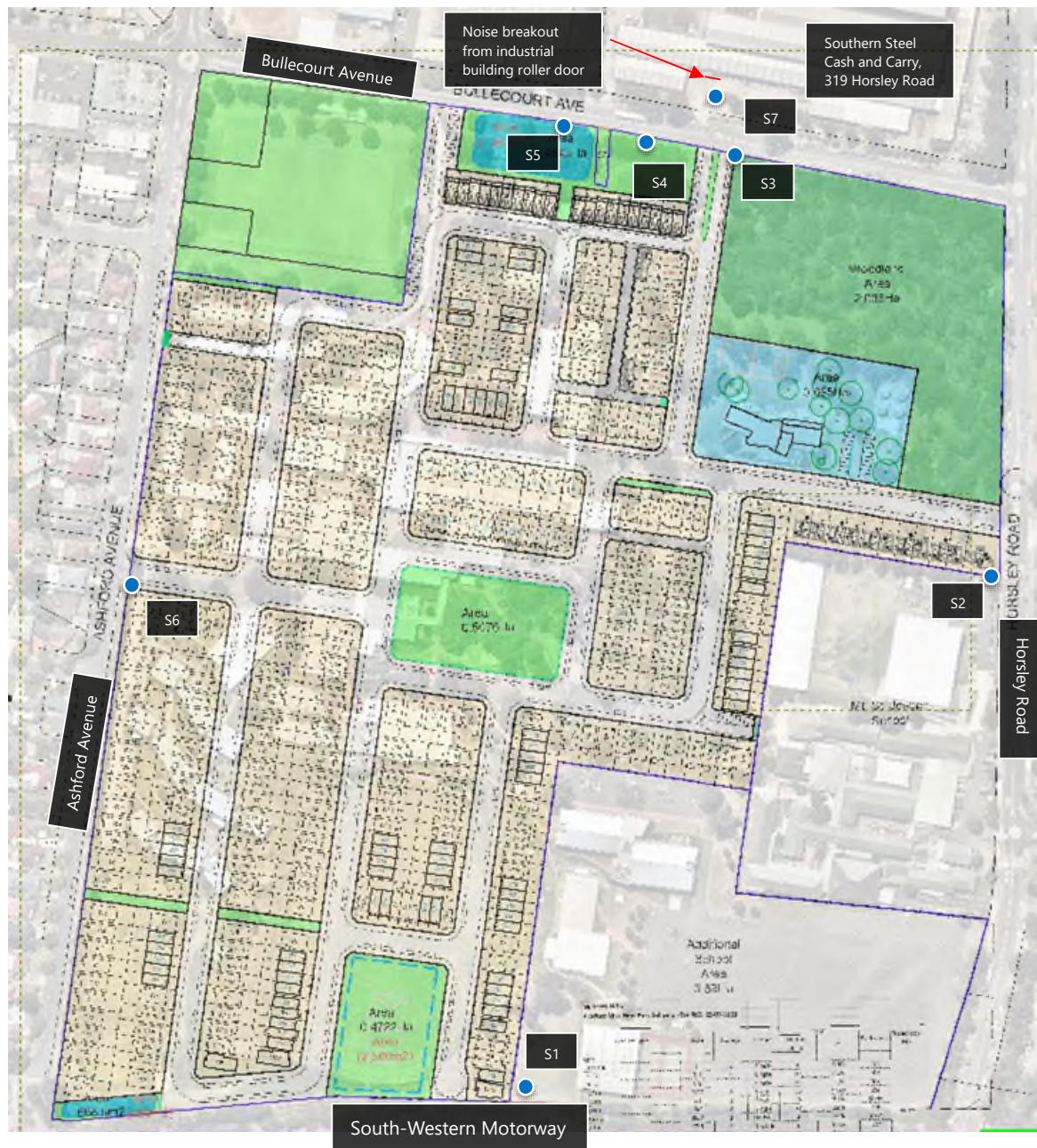


Table 5-2: Industrial noise levels (L_{Aeq}) compared to traffic noise levels (L_{Aeq})

Measurement Location number	Measurement Location description	Date/time	Industrial noise levels (L_{Aeq})	Traffic noise levels (L_{Aeq})	Comment
S1	South-east corner of WSU Oval (Approximately 30m from South-Western Motor Way)	27/07/2022 01:11-01:26	N/A	57	L_{Aeq} was driven by traffic noise from South-Western Motorway. No industrial activity from 260-270 Horsley Road, Milperra was seen/heard. These industrial sites are approximately within 150m of location S2.
		13/09/2024 07:10-07:15	N/A		
S2	In WSU carpark 2 near Mount St Joseph School, 273 Horsley Road (Approximately 8m away from Horsley Road)	27/07/2022 01:37-01:52	N/A	59	L_{Aeq} was driven by distinct traffic noise from South-Western Motorway. No industrial activity from 260-270 Horsley Road, Milperra was seen/heard. These industrial sites are approximately within 150m of location S2.
		13/09/2024 07:43-07:48	N/A		
S3	On WSU footpath facing Southern Steel Cash and Carry, 319 Horsley Rd, Milperra (Approximately 5m away from Bullecourt Avenue and 54m away from the Southern Steel Cash and Carry, building roller door)	27/07/2022 01:59-02:14	48	65	L_{Aeq} was mostly driven by distinct traffic noise from South-Western Motorway and Bullecourt Avenue. Activities associated within the Southern Steel Cash and Carry, 319 Horsley Road building such as lifting long and heavy structural steel pipes and unloading them on the truck($53L_{Amax}$) and truck moving($53L_{Amax}$) can be faintly heard at locations S3 and S4.
		13/09/2024 07:30-07:35	54		
S4	In WSU carpark 1 (Approximately 35m from Bullecourt Avenue and 75m away from the Southern Steel Cash and Carry, building roller door)	27/07/2022 02:17-02:32	48	65	L_{Aeq} was mostly driven by distinct traffic noise from South-Western Motor Way and Bullecourt Avenue. Activities associated within the Southern Steel Cash and Carry, 319 Horsley Road building such as lifting long and heavy structural steel pipes and unloading them on the truck($53L_{Amax}$) and truck moving($53L_{Amax}$) can be faintly heard at locations S3 and S4.
		13/09/2024 07:10-07:15	54		
S5	In WSU carpark 1 (Approximately 35m from Bullecourt Avenue and 86m away from the Southern Steel Cash and Carry, building roller door)	27/07/2022 02:34-02:49	47	65	L_{Aeq} was mostly driven by distinct traffic noise from South-Western Motorway and Bullecourt Avenue. Some of the traffic noise from South-Western Motorway was masked by
		13/09/2024 07:17-07:22	53		
S6	On WSU west footpath facing 150 Ashford Ave, Milperra (Approximately 5m from Ashford Avenue)	27/07/2022 02:55-03:10	N/A	57	L_{Aeq} was driven by distinct traffic noise from South-Western Motorway and Ashford Avenue. This measurement was taken to determine noise from industrial sites located to the north of WSU Milperra campus.
		13/09/2024 08:24-08:30	N/A		

Table 5-3 represents an additional measurement that was recorded to determine the noise from the mechanical plant associated with the Southern Steel Cash and Carry, 319 Horsley Road building breaking out from the roller door which is located on the opposite side of Bullecourt Avenue.

Table 5-3: L_{Aeq} noise measurement result for mechanical plant associated with the Southern Steel Cash and Carry, 319 Horsley Road

Measurement Location number	Measurement Location description	Date/time	Measured L_{Aeq}	Comment
S7	Standing 5m from the industrial building roller door on opposite side of Bullecourt Avenue	27/07/2022 03:11-03:26	46	L_{Aeq} was driven by mechanical plant associated with the Southern Steel Cash and Carry, 319 Horsley Road building.
		13/09/2024 08:40-08:45	57	

5.2.3 Discussion

Based on the above, road traffic noise levels are higher than industrial noise levels at the site.

- In abovementioned Table 5-2, measured noise levels at locations S1(south of WSU Milperra Campus) S2(east of WSU Milperra Campus) and S6(west of WSU Milperra Campus) demonstrates no activity from the industrial sites that are in proximity.
- Noise levels at locations S3(i.e., $48L_{Aeq}$ and $54L_{Aeq}$), S4(i.e., $48L_{Aeq}$ and $54L_{Aeq}$) and S5(i.e., $47L_{Aeq}$ and $53L_{Aeq}$), demonstrates noise levels that are well below the measured traffic noise level (i.e., $65L_{Aeq}$). Noting that there were activities associated within the Southern Steel Cash and Carry, 319 Horsley Road building such as lifting long and heavy structural steel pipes and unloading them on the truck($53L_{Amax}$) and truck moving($53L_{Amax}$) were recorded.
- Noise from 319 Horsley Road building roller door (which is located on the opposite side of Bullecourt Avenue to WSU Campus) is lower than the road traffic noise levels on Bullecourt Avenue.

Overall, the industrial noise levels are much lower with respect to road traffic noise levels and hence, façade systems detailed in Section 7 are sufficient to address road noise and industrial noise intrusion.

Provided that the recommendations in Section 8 are adopted, road traffic noise and industrial noise will be attenuated such that suitable internal noise levels within dwellings will be achieved.

6 Existing Childcare Centre noise impact study

To ensure that noise from the pre-existing childcare centre is appropriately considered in the design of the new dwellings, an acoustic assessment has been undertaken. This assessment addresses operational noise emissions from the 67-place childcare centre and includes the following:

- Identification of relevant noise emission requirements.
- Prediction of noise associated with the operation of the childcare centre.
- Identification of management controls, where necessary, to ensure ongoing compliance with noise emission requirements.

In determining acceptable noise emission limits, the assessment has utilised the results of long-term noise logging conducted at the site (refer to Section 3).

6.1 Existing Childcare Centre Description

The pre-existing childcare centre is located within Stage 3A&3B as marked in the Figure 2-2.

The pre-existing childcare centre is bounded as follows:

- To the north by open area within the campus. Further north is Bullecourt Avenue and industrial development.
- To the east by Horsley Road by open area/vegetation within the subdivision. Further east is industrial development.
- To the south by future residential development within the campus sub-division. Further south is Mount Saint Joseph Collage Milperra.
- To the west is an internal roadway and then future residential development within the campus subdivision.

6.2 Childcare Centre Acoustic Criteria

The noise criteria are as follows:

6.2.1 Outdoor Areas of the Child Care Centre – Canterbury-Bankstown Council DCP

Chapter 10.1 Outdoor Areas of the Child Care Centre of Council's '*Canterbury-Bankstown Development Control Plan 2023*' (Council DCP) applies to childcare centre type developments. Section 5 of this chapter of the DCP outlines the following relevant development controls related to acoustic privacy:

Acoustic privacy

5.1 *Air conditioning, mechanical ventilation or any other continuous noise source must not exceed the ambient level at any specified boundary by more than 5dB(A).*

5.2 *The location and design of child care facilities must consider the projection of noise from various activities to avoid any adverse impacts on the residential amenity of adjoining land. For the purpose of this clause, Council requires development applications to submit an Acoustic Report prepared by a suitably qualified acoustic consultant to determine:*

- (a) existing noise levels at the identified sensitive receiver locations;*
- (b) likely noise levels to emanate from the child care facility at the identified sensitive receiver locations;*
- (c) whether the development must apply measures to ensure the noise of children playing in outdoor areas does not exceed 10dB(A) above the background noise level;*
- (d) whether the location and setbacks of the development are sufficient to protect the acoustic privacy of adjacent dwellings;*
- (e) whether the location of outdoor areas should avoid living areas and bedrooms of adjacent dwellings; and*
- (f) whether the development must install certain noise attenuation measures to protect the acoustic privacy of adjacent dwellings.*

The Acoustic Report must measure the noise readings over a 15 minute period and must provide details of all modelling assumptions including source noise data, noise monitoring positions, receiver heights and locations, prevailing meteorological conditions during the monitoring, confirmation of the methodology adopted along with a copy of the model input and output data.

5.3 *The maximum height for noise attenuation walls and fences along the boundary of the site is 2m.*

Canterbury-Bankstown Council DCP 2023 Chapter 10.1 Section 5.2 (c) states that noise emissions from children playing outside must not exceed 10dB(A) above the background noise level.

6.2.2 Indoor Areas of the Child Care Centre/Plant and Equipment Noise - Association of Australasian Acoustical Consultants (AAAC)

The Council DCP does not detail any provisions for other operational noise sources typically associated with childcare centre facilities, i.e. indoor playrooms and drop off and pick up. The AAAC Guideline is referenced for guidance.

Using this criterion, the applicable noise limit for each receiver location is presented in the Table 6-1 below.

Section 3.2.2 of the AAAC Guideline nominates a cumulative assessment for operational noise impacts associated childcare centre facilities for all noise sources with the exception of activity noise from external play areas. Cumulative noise emissions ($L_{eq,15\text{minutes}}$) are recommended to not exceed the background noise level by more than 5 dB at the most affected point on or within any residential property boundary.

6.2.3 Summary Noise Emission Goals

The noise emission goals for outdoor play areas are as follows:

Table 6-1: Noise Criteria for Outdoor Play Areas.

Receiver Location	Noise Emission Goal
Future Residential Receivers	$43BG + 10 = 53\text{dB(A)}_{L_{eq}(15\text{min})}$

The noise emission goals for indoor areas/plant and equipment are as follows:

Table 6-2: Noise Criteria for Indoor Play Areas, Mechanical Plant and Equipment.

Receiver Location	Noise Emission Goal
Future Residential Receivers	$43BG + 5 = 48\text{dB(A)}_{L_{eq}(15\text{min})}$

6.3 Assumptions Relied on for Noise Emission Predictions

The critical noise receivers are the top floor windows of the proposed future residences to the west (which would overlook any boundary fencing of the outdoor play area).

Noise emissions are predicted based on the following assumptions:

- Assumed that all 67 children are outside at once.
- Noise source height for the children is generally assumed to be 1m above ground level, which is consistent with AAAC guidelines.
- The sound power for children playing outside is as per AAAC guidelines, as detailed below. For conservatism, all children outside will be assumed to be 3-5 years (the loudest group).

Table 6-3: AAAC Sound Power Levels ($L_{Aeq, 15\text{min}}$) for Groups of 10 Children Playing

Number and Age of Children	Sound Power Level (dB re. 1pW)								
	Overall dB(A)	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10 children ages 0 to 2 years	78	54	60	66	72	74	71	67	64
10 children aged 2 to 3 years	85	61	67	73	79	81	78	74	70
10 children aged 3 to 6 years	87*	64	70	75	81	83	80	76	72

Note: This becomes 95dB(A) when considering a group of 67.

- For internal areas:
 - o It is assumed that the sound pressure level within the space is 85dB(A)_{Leq}, (typical of a noisy indoor playroom) and
 - o The windows/doors are left open (5% of floor area of the room, to enable natural ventilation of the space – approx. 10m² open area).
- For vehicle noise:
 - o It is assumed that the sound pressure level of a car driving within the car park is 80dB(A)_{Leq}, which is typical for a vehicle travelling at 5–10 km/h.
 - o Based on advice from the traffic consultant (TTPP), 77 vehicle movements are expected within a one-hour period, equivalent to the car park filling and emptying once over a one-hour period.
- In all cases, it is assumed that the acoustic treatments/management controls set out in Section 7 are adopted.

6.4 Noise Emission Predictions – Child Care Centre

Noise emissions are predicted and assessed against relevant criteria below.

In each case, the predictions are made to the level 1 windows of the future residences within the sub-division. A level 1 window has the least benefit of noise screening provided by boundary fencing or for the Child Care Centre building itself, and so prediction to Level 1 windows represent a worst-case scenario.

Predicted noise emissions are as follows:

Table 6-4: Predicted Noise Emissions from children playing outdoors to Receivers, dB(A)

Receiver Location / Noise Source	Predicted Noise Emission	Allowable Noise Level	Complies?
Noise to Future Residences (West of site):			
-Noise from Outdoor Areas:	50dB(A) _{Leq(15min)}	53dB(A) _{Leq(15min)}	Yes
-Noise from Indoor Areas:	47dB(A) _{Leq(15min)}	48dB(A) _{Leq(15min)}	Yes
-Noise from Car Park	32dB(A) _{Leq(15min)}	48dB(A) _{Leq(15min)}	Yes
Noise to Future Residences (South of site):			
-Noise from Outdoor Areas:	47dB(A) _{Leq(15min)}	53dB(A) _{Leq(15min)}	Yes
-Noise from Indoor Areas:	<40dB(A) _{Leq(15min)}	48dB(A) _{Leq(15min)}	Yes
-Noise from Car Park	35dB(A) _{Leq(15min)}	48dB(A) _{Leq(15min)}	Yes

Noise emissions from the operation of the existing childcare centre are predicted to comply at the nearest future residential receivers, and no mitigation measures are required for the childcare centre.

7 Noise control treatment recommendations for road traffic noise impacts

The following provides noise control recommendations to reduce noise intrusion for the future residential premises. The recommendations are based on several assumptions relating to the built form. The advice provided here is in respect of acoustics only. Supplementary professional advice should be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

The recommendations consider the benefit provided by noise screens along the southern boundary of the site (approximately **4.8m high**) and around the playground of Mount St Joseph Catholic College Milperra school (approximately **1.8m high**).

7.1 Indicative building construction

Based on the noise modelling, and in accordance with internal noise criteria set out in Section 4.2, recommendations for building element constructions are presented for the room types outlined in Table 6-1.

The required acoustic treatment categories are presented graphically in APPENDIX E. The acoustic treatment corresponding to each category is specified in Table 7-1.

Table 7-1: Acoustic constructions for treatment categories (SEPP)

Category	Room	Construction element	Indicative treatment	
Category 1 (Alternative ventilation not required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than 4m ² = R _w 24 4m ² – 8m ² = R _w 27	No specific glass thickness required 6mm float glass with acoustic seals
		Walls/roof/ceiling	Standard constructions	
	Lounge/living rooms	Windows/glazed doors*	Less than 8m ² = R _w 29 8m ² – 16m ² = R _w 32	6mm float glass with acoustic seals 6.38mm laminated glass with acoustic seals
		Timber doors	35mm solid core timber - acoustic seals	
		Walls/roof/ceiling	Standard constructions	
Category 2 (Alternative ventilation required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than 2m ² = R _w 24 2m ² – 4m ² = R _w 27 4m ² – 8m ² = R _w 30	No specific glass thickness required 6mm float glass with acoustic seals 6.38mm laminated glass with acoustic seals
		Walls/roof/ceiling	Standard constructions	
	Lounge/living rooms	Windows/glazed doors*	Less than 4m ² = R _w 29 4m ² – 8m ² = R _w 32 8m ² – 16m ² = R _w 35	6mm float glass with acoustic seals 6.38mm laminated glass with acoustic seals 10.38mm laminated glass with acoustic seals
		Timber doors	40mm solid core timber - acoustic seals	
		Walls/roof/ceiling	Standard constructions	
Category 3 (Alternative ventilation required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than 2m ² = R _w 30 Greater than 2m ² = R _w 35	6.38mm laminated glass with acoustic seals 10.38mm laminated glass with acoustic seals
		Roof/ceiling	Standard constructions	
		Walls	R _w 45	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 2 layers of 13mm plasterboard inside, metal or FC external cladding, R1.5 wall batts Or 75mm Hebel panel with 90mm timber stud, R1.5 wall batts and 2 layers of 13mm plasterboard inside

Category	Room	Construction element	Indicative treatment	
	Lounge/living rooms	Windows/glazed doors*	Less than 4m ² = R _w 32 4m ² – 10m ² = R _w 35 Greater than 10m ² = R _w 36	6.38mm laminated glass with acoustic seals 10.38mm laminated glass with acoustic seals 12.38mm laminated glass with acoustic seals
		Timber doors	45mm solid core timber - acoustic seals	
		Roof/ceiling	Standard constructions	
		Walls	R _w 45	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 2 layers of 13mm plasterboard inside, metal or FC external cladding, R1.5 wall batts Or 75mm Hebel panel with 90mm timber stud, R1.5 wall batts and 2 layers of 13mm plasterboard inside
Category 4 (Alternative ventilation required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than 2m ² = R _w 30 Greater than 2m ² = R _w 35	6.38mm laminated glass with acoustic seals 10.38mm laminated glass with acoustic seals
		Roof/ceiling	Tiled or metal pitched roof with 2 x 13mm plasterboard ceiling or 16mm heavy gauge plasterboard ceiling with bulk insulation in cavity	
		Walls	R _w 45	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 2 layers of 13mm plasterboard inside, metal or FC external cladding, R1.5 wall batts Or 75mm Hebel panel with 90mm timber stud, R1.5 wall batts and 2 layers of 13mm plasterboard inside
	Lounge/living rooms	Windows/glazed doors*	Less than 2m ² = R _w 30 2m ² -7m ² = R _w 35 Greater than 7m ² = R _w 36	6.38mm laminated glass with acoustic seals 10.38mm laminated glass with acoustic seals 12.38mm laminated glass with acoustic seals
		Timber doors	45mm solid core timber - acoustic seals	

Category	Room	Construction element	Indicative treatment	
		Roof/ceiling	Tiled or metal pitched roof with 2 x 13mm plasterboard ceiling or 16mm heavy gauge plasterboard ceiling with bulk insulation in cavity	
		Walls	R _w 45	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 2 layers of 13mm plasterboard inside, metal or FC external cladding, R1.5 wall batts Or 75mm Hebel panel with 90mm timber stud, R1.5 wall batts and 2 layers of 13mm plasterboard inside

Notes: * Area of windows and doors shall be the total of all glazing for the given room.

The acoustic requirements for windows and doors have been provided on an R_w basis to allow flexibility with the developer and variations in design due to other design requirements such as thermal performance. The R_w rating sets the basis of the recommended acoustic performance, and the constructions are provided for guidance only. The acoustic performance of specific building components should be confirmed by manufactures or suitably qualified professional prior to installation.

Unless otherwise specified, the base building envelope of dwellings is of standard constructions which are assumed to consist of the following:

- Walls of brick veneer construction, double brick, or light weight clad construction which could consist of fibre-cement cladding or 75mm Hebel panel on the outside of 90mm timber stud walls and internal 13mm plasterboard lining. All walls are assumed to have minimum R1.5 insulation in the cavity. It is noted that both brick veneer and cavity double brick construction are of significantly higher acoustic performance than light weight cladding systems. In higher road traffic noise areas, there may be a requirement to upgrade light weight systems. These instances will be noted in the acoustic recommendations.
- Roof to be pitched, with concrete or terracotta tile or sheet metal roof with sarking, R3.0 insulation in the roof space (combination of below roof and above ceiling), and one layer of 13mm thick standard plasterboard fixed to ceiling joists.
- External doors to be solid core timber or glazed, fitted with acoustic seals around the perimeter. Pivot style doors are not recommended as full perimeter acoustic seals are not readily incorporated. The performance of any external doors should have the same acoustic performance as that required for general glazing.

7.2 Alternative ventilation

Where facades have been identified for acoustic treatment in Section 7.1, windows are to be kept closed to meet the internal noise goals. It is noted that windows are not required to be sealed shut/fixed and can be operable.

It is recommended that a mechanical engineer is consulted to ensure the ventilation requirements of the Building Code of Australia and Australian Standard 1668 *"The use of ventilation and air-conditioning in buildings"* are achieved. The internal noise goals are to be met with mechanical ventilation systems not operating.

Where alternative forms of ventilation are to be provided, it must be ensured that the solution does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring premises.

7.3 Scope of acoustic recommendations

The recommended mitigation measures for road traffic noise cannot consider the specific design of each dwelling as those details are not available at this stage of development. The recommendations have been developed for the approvals process and cost planning, and to provide the indicative measures required for each dwelling. Whilst it is the intent for the recommendations and this report to minimise the need for detailed acoustic assessment of each dwelling, it is recommended that an individual acoustic review of the 'Construction' drawings be carried out for each noise affected lot to ensure correct interpretation and application of the recommendations.

7.4 Boundary fences

To achieve the required levels of acoustic privacy in private open spaces, as outlined in Chapter 5.2 Section 2.1 (Acoustic Privacy) of the Canterbury-Bankstown Council DCP 2023, it is recommended that a minimum of 1.8m high lapped and capped timber, masonry, or Colourbond fence be installed at each lot along the dwelling's sides and backyard boundary.

The noise mitigation measures stated in Table 7-1 consider the benefit provided by noise screens along the southern boundary of the site (approximately **4.8m high**) and around the playground of Mount St Joseph Catholic College Milperra school (approximately **1.8m high**).

An acoustically rated fence can be constructed of common building materials but needs to be from a durable material with sufficient mass (min. 10kg/m²) to prevent direct noise transmission e.g., masonry, fibrous cement, lapped and capped timber fence, polycarbonate, or any combination of such materials, provided they withstand the weather elements. The boundary fence should be continuous with no gaps between panels or underneath panels (other than that required for gates).

8 Construction Noise and Vibration Assessment

8.1 Construction noise objectives

Construction noise impacts are assessed with reference to the EPA Interim Construction Noise Guidelines.

8.1.1 Noise management levels (NMLs)

The NSW Interim Construction Noise Guideline (ICNG, 2009) provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.
- Application of reasonable and feasible noise mitigation measures.
- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice and is practical to build given the project constraints.
- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods described for the assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration and involves the measurement and prediction of noise levels and assessment against set criteria. A qualitative assessment is recommended for small projects with duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification. Given the scale and duration of the construction works proposed, a quantitative assessment is carried out herein, consistent with the ICNG requirements.

The table below reproduced from the ICNG, sets out the airborne noise management levels and how they are to be applied for residential receivers.

Table 8-1: Noise management levels at residential receivers

Time of day	Management level L _{Aeq} (15 min) *	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	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/ after school for works near schools, or mid-morning or mid-afternoon for works near residences - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	- 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 5dB(A) above the noise affected level, the proponent should negotiate with the community. - For guidance on negotiating agreements see ICNG section 7.2.2.

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

The table below sets out the ICNG noise management levels for other noise sensitive receiver locations.

Table 8-2: Noise management levels at other noise sensitive land uses

Land use	Time of day	Where objective applies	Management level L _{Aeq} (15 min)
Industrial premises	When in use	Outdoor noise level	75
Commercial premises (including Child Care Centre)	When in use	Outdoor noise level	70
School (teaching space)	When in use	Indoor noise level	45

8.1.2 Summary of construction noise management levels

A summary of construction Noise Management Levels is presented below. In the event these Noise Management Levels are exceeded, reasonable and feasible construction noise mitigation is required.

Table 8-3: Construction noise management levels

ID	Location description	Noise management level $L_{Aeq(15min)}^1$
		Monday to Fridays (7:00am to 6:00pm) Saturdays (8:00am to 1:00pm)
R1 / R2	Residential receivers – Ashford Ave	52 + 10 = 62
	Mount St Joseph Catholic School	45 (Classrooms – internal noise target)
	Commercial interim construction noise receiver (WSU Child Care Centre)	70 (also - 40dB(A) internal noise level to be adopted as guidance for sleeping areas).

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

8.2 Construction vibration objectives

Construction vibration is associated with three main types of impact:

- disturbance to building occupants
- potential damage to buildings, and
- potential damage to sensitive equipment in a building.

Generally, if disturbance to building occupants is controlled, there is limited potential for structural damage to buildings.

Vibration amplitude may be measured as displacement, velocity, or acceleration.

- Displacement (x) measurement is the distance or amplitude displaced from a resting position. The International System of Units (SI unit) for distance is the metre (m), although common industrial standards include mm.
- Velocity ($v = \Delta x / \Delta t$) is the rate of change of displacement with respect to change in time. The SI unit for velocity is metres per second (m/s), although common industrial standards include mm/s. The Peak Particle Velocity (PPV) is the greatest instantaneous particle velocity during a given time interval. If measurements are made in 3-axis (x, y, and z) then the resultant PPV is the vector sum (i.e., the square root of the summed squares of the maximum velocities) regardless of when in the time history those occur.

- Acceleration ($a=\Delta v/\Delta t$) is the rate of change of velocity with respect to change in time. The SI unit for acceleration is metres per second squared (m/s^2). Construction vibration goals are summarised below.

Construction vibration goals are summarised below.

8.2.1 Disturbance to buildings occupants

The acceptable vibration values to assess the potential for human annoyance from vibration are set out in the NSW 'Environmental Noise Management Assessing Vibration: A Technical Guideline' (AVTG).

To assess the potential for vibration impact on human comfort, an initial screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. The screening test is based on the continuous vibration velocity (i.e., vibration that continues uninterrupted for a defined period). If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e., eVDV) will be determined based on the level and duration of the vibration event causing exceedance.

The initial screening test values and VDV's recommended in BS 6472-1992 for which various levels of adverse comment from occupants may be expected, are presented below. The 'Low probability of adverse comment eVDV' represent the preferred and maximum value presented in the AVTG.

Table 8-4: Vibration management levels for disturbance to building occupants

Place and Time	Initial screening test Velocity, PEAK, mm/s (> 8Hz)	Low probability of adverse comment eVDV $m/s^{1.75}$	Adverse comment possible eVDV $m/s^{1.75}$	Adverse comment probable eVDV $m/s^{1.75}$
Critical areas (day or night) ¹	0.28	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Residential buildings 16 hr day ²	0.56	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night ²	0.40	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Offices, schools, educational institutions, and places of worship (day or night)	1.10	0.4 to 0.8	0.8 to 1.6	1.6 to 2.4
Workshops (day or night)	2.20	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

- Notes:
3. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above
 4. Daytime is 7am to 10pm and night-time is 10pm to 7am

8.2.2 Building damage

Potential structural damage of buildings because of vibration is typically managed by ensuring vibration induced into the structure does not exceed certain limits and standards, such as British Standard 7385 Part 2 and German Standard DIN4150-3. Currently there is no existing Australian Standard for assessment of structural building damage caused by vibration energy.

It is noted that vibration levels required to cause minor cosmetic damage are typically 10 times higher than levels that will cause disturbance to building occupants. Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.

Within British Standard 7385 Part 1, different levels of structural damage are defined:

- *Cosmetic - The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.*
- *Minor - The formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.*
- *Major - Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.*

The vibration limits in Table 1 of British Standard 7385 Part 2 are for the protection against cosmetic damage, however guidance on limits for minor and major damage is provided in Section 7.4.2 of the Standard:

7.4.2 Guide values for transient vibration relating to cosmetic damage

Limits for transient vibration, above which cosmetic damage could occur are given numerically in Table 1 and graphically in Figure 1. In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for the building types corresponding to line 2 are reduced. Below a frequency of 4 Hz, where a high displacement is associated with a relatively low peak component particle velocity value a maximum displacement of 0.6 mm (zero to peak) should be used.

Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 1, and major damage to a building structure may occur at values greater than four times the tabulated values.

Within DIN4150-3, damage is defined as "any permanent consequence of an action that reduces the serviceability of a structure or one of its components" (p.4). The Standard also outlines:

"For buildings as in lines 2 and 3 of Tables 1, 4 or B.1, the serviceability is considered to have been reduced if, for example

- *cracks form in plastered or rendered surfaces of walls;*
- *existing cracks in a structure are enlarged;*
- *partitions become detached from load-bearing walls or floor slabs.*

These effects are deemed 'minor damage.' (DIN4150.3:2016, p.6)

While the DIN Standard defines the above damage as 'minor', based on the definitions provided in BS7385, the DIN standard is considered to deal with cosmetic issues rather than major structural failures.

8.2.2.1 British Standard

British Standard 7385: Part 2 'Evaluation and measurement of vibration in buildings', can be used as a guide to assess the likelihood of building damage from ground vibration. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

The cosmetic damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain building types. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

BS7385 is based on peak particle velocity and specifies damage criteria for frequencies within the range 4Hz to 250Hz, being the range usually encountered in buildings. At frequencies below 4Hz, a maximum displacement value is recommended. The values set in the Standard relate to transient vibrations and to low-rise buildings. Continuous vibration can give rise to dynamic magnifications due to resonances and may need to be reduced by up to 50%. Table 8-5 sets out the BS7385 criteria for cosmetic, minor, and major damage.

Regarding heritage buildings, British Standard 7385 Part 2 (1993) notes that "a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive" (p.5).

Table 8-5: BS 7385 structural damage criteria

Group	Type of structure	Damage level	Peak component particle velocity, mm/s		
			4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	Cosmetic	50		
		Minor*	100		
		Major*	200		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	Cosmetic	15 to 20	20 to 50	50
		Minor*	30 to 40	40 to 100	100
		Major*	60 to 80	80 to 200	200

Notes: Peak Component Particle Velocity is the maximum Peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer.

* Minor and major damage criteria established based on British Standard 7385 Part 2 (1993) Section 7.4.2

8.2.2.2 German Standard

German Standard DIN 4150 - Part 3 (2016) 'Vibration in buildings - Effects on Structures' (DIN 4150-3:2016), also provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are generally recognised to be conservative.

DIN 4150-3:2016 presents the recommended maximum limits over a range of frequencies (Hz), measured at the foundations, in the plane of the uppermost floor of a building or structure or vertically on floor slabs. The vibration limits at the foundations increase as the frequency content of the vibration increases. The criteria are presented in the table below.

Table 8-6: DIN 4150-3:2016 structural damage criteria

Group	Type of structure	Vibration velocity, mm/s				
		At foundation in all directions at frequency of			Plane of floor uppermost storey in horizontal direction	Floor slabs, vertical direction
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that because of their particular sensitivity to vibration, cannot be classified under Groups 1 and 2 and are of great intrinsic value (eg listed buildings)	3	3 to 8	8 to 10	8	20

8.2.3 Damage to buried services

Section 5.3 of DIN 4150-3:2016 also sets out guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework. These values, which apply at the wall of the pipe, are reproduced, and presented in the table below.

Table 8-7: DIN 4150-3:1999 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on buried pipework

Line	Pipe Material	Guideline values for vibration velocity measured on the pipe, mm/s
1	Steel (including welded pipes)	100
2	Vitrified clay, concrete, reinforced concrete, prestressed concrete, metal (with or without flange)	80
3	Masonry, plastics	50

For long-term vibration the guideline levels presented in the table above should be halved.

Recommended vibration goals for electrical cables and telecommunication services such as fibre optic cables range from between 50 mm/s and 100 mm/s. It is noted however that although the cables may sustain these vibration levels, the services they are connected to, such as transformers and switch blocks, may not. It is recommended that should such equipment be encountered during the construction process an individual vibration assessment should be carried out. This may include a specific vibration impact statement addressing impact on the utility and consultation with the utility provider to confirm specific vibration requirements.

8.3 Construction noise assessment

Construction noise and vibration impacts on nearby residential receivers have been assessed below.

8.3.1 Construction noise sources

The schedule of items of plant and equipment likely to be used during the bulk earth works and construction of the proposed development is presented in the table below.

Table 8-8: Typical construction equipment & sound power levels, dB(A) re 1pW

Plant item	Plant description	Sound power levels
Bulk Earth Works		
1.	Excavator with Hydraulic Hammer	115
2.	Excavator with bucket	105
3.	Truck	105
4.	Piling (Bored)	105
Construction		
5.	Delivery Trucks	105
6.	Powered Hand tools	100
7.	Concrete Pump/Vibrator	105
8.	Tower Crane (Electric)	95

The sound power levels for the majority of construction plant and equipment presented in the above table are based on maximum noise levels given in Table A1 of Australian Standard 2436 - 2010 'Guide to Noise Control on Construction, Demolition and Maintenance Sites', the Interim Construction Noise Guideline (ICNG), information from past projects and/or information held in our library files.

8.3.2 Predicted Construction Noise Levels

The noise levels at any receiver location resulting from bulk earth works/construction works would depend on the location of the receiver with respect to the area of construction, shielding from intervening topography and structures, and the type and duration of construction being undertaken.

The table below presents noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant and equipment associated with the proposed site.

Predicted noise levels and assessment with reference to noise emission criteria is presented below.

Table 8-9: Predicted dB(A)_{L_{eq}(15min)} noise levels for typical construction plant

Noise Criteria	Time	Criteria Noise Levels (dB(A) _{L_{eq}(15min)})			
		R1 (south of Zonnebeke Cres)	R2 (north of Zonnebeke Cres)	Child Care Centre	Mount St Joseph Catholic School
EPA Interim Construction Noise Guideline	Daytime – 7:00am to 6:00pm	62dB(A) _{L_{eq}15min}	62dB(A) _{L_{eq}15min}	70dB(A) _{L_{eq}15min}	45dB(A) _{L_{eq}15min} (Internal Noise Level)
	Highly Affected Noise Level	75dB(A) _{L_{eq}15min}	75dB(A) _{L_{eq}15min}	N/A	N/A
Predicted Construction Noise Levels (dB(A) _{L_{eq}(15min)})					
Plant Item	Plant Description	R1 (south of Zonnebeke Cres)	R2 (north of Zonnebeke Cres)	Child Care Centre	Mount St Joseph Catholic School (Internal Level)
Bulk Earth Works					
1.	Excavator with Bucket	42-69	43-67	26-57 (Inside) 46-77 (Outside)	26-49
2.	Excavator with Hydraulic Hammer/Saw	52-79	53-77	36-67 (Inside) 55-87 (Outside)	36-59
3.	Truck	42-69	43-67	26-57 (Inside) 46-77 (Outside)	26-49
4.	Piling (Bored)	42-69	43-67	26-57 (Inside) 46-77 (Outside)	26-49
Construction					
5.	Delivery Trucks	42-69	43-67	26-57 (Inside) 46-77 (Outside)	26-49
6.	Powered Hand tools (Assumed 4 operational at any time)	43-70	45-68	22-53 (Inside) 47-78 (Outside)	22-49
7.	Concrete Pump/Vibrator	42-69	43-67	26-57 (Inside) 46-77 (Outside)	26-49
8.	Tower Crane (Electric) (Assumed 7 operational at any time - 1 per each Stage)	42-66	43-66	21-41 (Inside) 46-66 (Outside)	21-42

Intermittent exceedances of the "Background+5dB(A)" target in AS2436 is unavoidable, given the proximity of nearby development.

In light of the predicted noise levels above, it is recommended that a feasible and reasonable approach towards noise mitigation measures be applied to reduce noise levels as much as possible to mitigate the impact from construction noise.

Further details on construction noise mitigation and management measures are provided in Section 8.5.

8.4 Construction vibration assessment

Initial minimum working distances for vibration intensive plant are presented below.

Table 8-10: Recommended minimum working distances for vibration intensive equipment

Plant item	Minimum working distance, m					
	Cosmetic damage			Human disturbance		
	Commercial and industrial buildings (Including school and Child Care)	Dwellings and similar structures ¹	Sensitive structures (e.g., heritage) ¹	Residences Day ²	Offices (Including School)	Workshops
Excavator w/Hydraulic Breaker	10	15	10	20	15	10

Notes: 1. Vibration limits referenced from DIN 4150 Structural Damage - Safe Limits for Short-term Building Vibration.
2. Daytime is 7 am to 10 pm.

Once works commence, site specific buffer distances for vibration significant plant items must be measured to determine if any works will be located sufficiently close to nearby development such that the vibration goals will be exceeded. This should be done for any hydraulic hammer (and vibratory roller if proposed).

For an excavator with hydraulic breaker, in the event that it will be necessary to work in areas within the buffer distance, vibration monitoring is recommended.

8.5 Recommendations For Construction Noise and Vibration

The noise management measures are recommended for all receiver locations:

- General bulk earth works methods:
 - o Use of excavator with bucket should be used whenever feasible in order to conduct bulk earth works of buildings and hard stand areas.
 - o Use of hydraulic hammers should be adopted only when use of excavators with bucket is not feasible (e.g. breaking of ground slabs or similar).
 - o Any equipment not in use for extended periods during construction work must be switched off.

- o The offset distance between noisy fixed plant (if any) and adjacent sensitive receivers is to be maximised where practicable.
- o Avoid stockpiling spoil within 50m of the Child Care Centre or St Joseph Catholic School.
- Noise Mitigation and Respite Periods:
 - o Residences on Ashford Ave – given the risk of exceedance of Highly Noise Affected Levels when using hydraulic hammers on the western edge of the site. it is recommended that works within 30m of the western boundary of the site should not commence prior to 8am.
 - o Unless agreed otherwise with the school, work within 50m of the school buildings using a hydraulic hammer is not recommended during class times.
 - o Unless agreed otherwise with the Childcare centre, work within 50m of the buildings using a hydraulic hammer is not recommended during sleeping times (this will apply to works at stages 5 & 6).
- Notification:
 - o Ashford Ave Residences:

Given the risk of exceedance of the Noise Management Level, these residences should be notified with respect to work on western edge of the site. The notification should detail:

 - Proposed start and finish date for each of the stages.
 - Typical daily start time.
 - Proposed start time (8am) for use of a hydraulic hammer when working on western boundary.
 - o Child Care Centre:

Given the risk of exceedance of the Noise Management Level, the Childcare centre should be notified with respect to works in Stages 5 and 6 (Stages 1, 2, 3, 4 and 7 are highly unlikely to result in noise and vibration impacts on the childcare centre). The notification should detail:

 - Proposed start and finish date for each of the stages.
 - Proposed respite period with respect to use of Hydraulic Hammer during sleep times.
 - o Mount St Joseph Catholic School:

Given the risk of exceedance of the Noise Management Level, the school should be notified with respect to work in Stages 5 and 4. The notification should detail:

 - Proposed start and finish date for each of the stages.
 - Proposed respite period with respect to use of Hydraulic Hammer during class times.

8.5.1 Vibration Management Measures

The following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers and to meet the relevant human comfort and building damage vibration limits:

- Dilapidation surveys should be carried out for Buildings 17–19, the childcare centre, and the school buildings located along the western edge of the Mount St Joseph Catholic School grounds if a hydraulic hammer is to be used within the buffer distances specified in Table 8-10.
- Notification by letterbox drop would be carried out for all occupied buildings within 50m of the construction site. These measures are to address potential community concerns that perceived vibration may cause damage to property.
- Establishment of buffer distances between construction equipment and the School and Childcare centre as detailed in Section 6. In the event that works will be required within the safe buffer distance, vibration monitoring should be conducted during those works. The monitor should be capable of providing SMS notification to contractor in the event that vibration levels reach designated thresholds.
- Where vibration is found to exceed threshold limits with respect to building/infrastructure damage, management measures should be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller equipment (hammer size), use of concrete saws/munchers in place of hammers, and use of non-vibratory compaction rollers.

8.5.2 Complaints Handling

In addition to the noise mitigation measures outlined above, a management procedure will need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint will need to be investigated, and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is more than allowable limits.

Owners and occupants of nearby affected properties are to be informed by direct mail of a direct telephone line and contact person where any noise and/or vibration complaints related to the operation of the construction activities are to be reported.

On receipt of a complaint, the procedure and complaint form in Appendix C should be followed.

9 Conclusion

Renzo Tonin & Associates has completed an environmental noise assessment for the DA of the Milperra WSU Masterplan Stages 1, 2, 4, 5, 6 and 7. The report has quantified the noise impact from existing noise sources around the project site. The report has been prepared in accordance with the relevant objectives as detailed in Section 1.

Unattended long-term noise monitoring was undertaken in December 2019 to establish background and ambient noise levels around the site. These results were subsequently verified through short-term attended noise measurements conducted in July 2022, and again in September 2024, confirming that background and ambient noise conditions remain unchanged

The results of the noise modelling indicate that:

- For facades that are exposed to noise levels above the standards outlined in the SEPP (T&I), acoustic constructions for treatment are required to achieve the internal noise level criteria.
- As the industrial noise levels are much lower with respect to road traffic noise levels, façade systems detailed in Section 7 above are sufficient to address road noise and industrial noise intrusion.
- The operational noise impact from the existing childcare centre on the future residences has been assessed and is predicted to comply, with no mitigation measures required.
- Where the internal criteria can only be achieved with windows closed, then mechanical ventilation or air conditioning that meets the requirements of the Building Code of Australia must also be provided to ensure fresh airflow inside the dwelling. It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring residential premises. It is noted that windows are not required to be sealed shut/fixed and can be operable.

In addition to above, Bulk Earth Works and Construction Noise and vibration impacts are assessed in Section 8.3 and 8.4 and management recommendations are provided in Section 8.5.

- Noise impact from the works will potentially exceed EPA Interim Construction Noise Guidelines Noise Management Levels in some instances, however, will not typically reach the Highly Noise Impacted threshold.
- Reasonable and feasible noise management should be implemented (as detailed in Section 8.5).
- Vibration is not expected to reach levels where damage could occur to nearby industrial, residential and school buildings. Vibration monitoring/management methods to ensure this is the case as detailed in Section 8.5.

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of everyday sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A-weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz) but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch, and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L _{Max}	The maximum sound pressure level measured over a given period.
L _{Min}	The minimum sound pressure level measured over a given period.

L ₁	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L ₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L ₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L _{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L _{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Long-term noise monitoring methodology

B.1 Noise monitoring equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the following instrumentation:

Description	Type	Octave band data	Logger location
RTA06 & RTA07 (NTi Audio XL2, with low noise microphone)	Type 1	1/1	L1, L2, L3, L4, and L5

Note: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table and are suitable for field use.

The equipment was calibrated prior and after the measurement period using a Brüel & Kjær Type 4230 calibrator. No significant drift in calibration was observed.

B.2 Meteorology during monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the NSW INP. Determination of extraneous meteorological conditions was based on data provided by the Bureau of Meteorology (BOM), for a location considered representative of the noise monitoring location(s). However, the data was adjusted to account for the height difference between the BOM weather station, where wind speed and direction is recorded at a height of 10m above ground level, and the microphone location, which is typically 1.5m above ground level (and less than 3m). The correction factor applied to the data is based on Table C.1 of ISO 4354:2009 '*Wind actions on structures*'.

B.3 Noise vs time graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the L_{10} , L_{90} , and L_{eq} levels. The statistical descriptors L_{10} and L_{90} measure the noise level exceeded for 10% and 90% of the sample measurement time. The L_{eq} level is the equivalent continuous noise level, or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels, as presented in this report, illustrate these concepts for the broadband dB(A) results.

APPENDIX C

Long-term noise monitoring results

WSU Oval South, Milperra

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

Date	L _{A90} Background Noise Levels ⁴			L _{Aeq} Ambient Noise Levels		
	Day ¹	Evening ²	Night ³	Day ¹	Evening ²	Night ³
Wednesday-27-November-2019	-	50	44	-	57	55
Thursday-28-November-2019	53	51	43	58	56	54
Friday-29-November-2019	53	51	43	58	56	53
Saturday-30-November-2019	52	48	40	58	53	51
Sunday-01-December-2019	50	49	41	56	54	55
Monday-02-December-2019	54	51	43	59	56	55
Tuesday-03-December-2019	52	50	42	59	55	55
Wednesday-04-December-2019	52	-	-	57	-	-
Representative Weekday⁵	53	51	43	58	56	54
Representative Weekend⁵	51	49	41	57	54	53
Representative Week⁵	52	50	43	58	56	54

Notes:

- Day is 8:00am to 6:00pm on Sunday and 7:00am to 6:00pm at other times
- Evening is 6:00pm to 10:00pm
- Night is the remaining periods
- Assessment Background Level (ABL) for individual days
- Rating Background Level (RBL) for LA90 and logarithmic average for LAeq
- Leq is calculated in the free field. 2.5dB is subtracted from results if logger is placed at façade
- Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

WSU Oval South, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

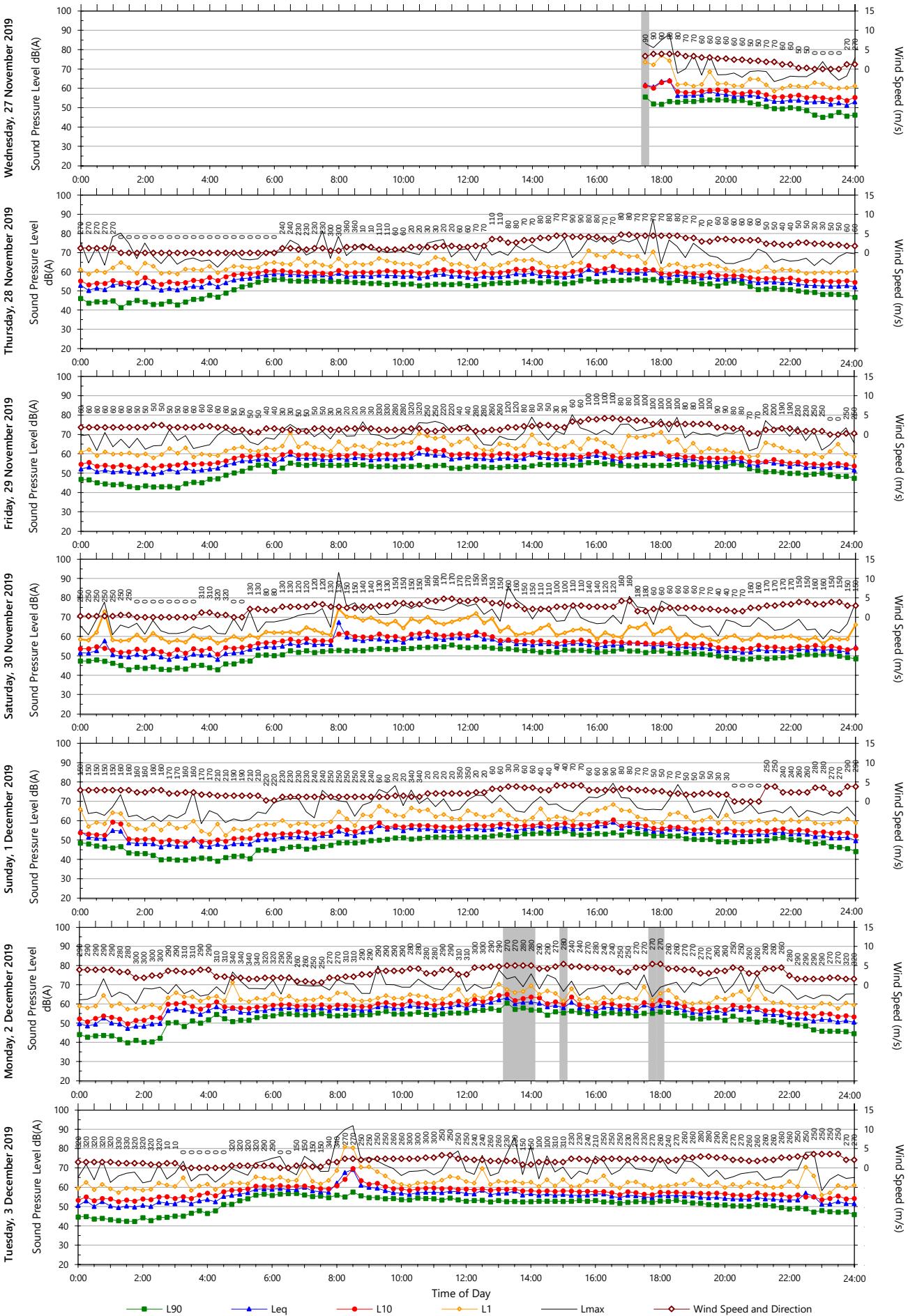
Date	L _{Aeq} Noise Levels		L _{Aeq 1hr} Noise Levels			
	Day ¹	Night ²	Day - Up ⁴	Day - Low ⁵	Night - Up ⁴	Night - Low ⁵
Wednesday-27-November-2019	61	57	64	57	61	54
Thursday-28-November-2019	61	57	62	59	59	53
Friday-29-November-2019	60	55	61	58	57	52
Saturday-30-November-2019	60	54	62	55	56	50
Sunday-01-December-2019	58	57	59	56	60	53
Monday-02-December-2019	60	57	62	59	61	53
Tuesday-03-December-2019	61	57	61	57	61	53
Wednesday-04-December-2019	59	-	60	58	-	-
Representative Weekday³	61	57	61	58	61	53
Representative Weekend³	59	55	60	56	58	51
Representative Week³	60	57	61	58	60	53

Notes:

- Day is 7:00am to 10:00pm
- Night is 10:00pm to 7:00am
- Median of daily L_{Aeq}
- Upper 10th percentile L_{Aeq 1hr}
- Lower 10th percentile L_{Aeq 1hr}
- Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

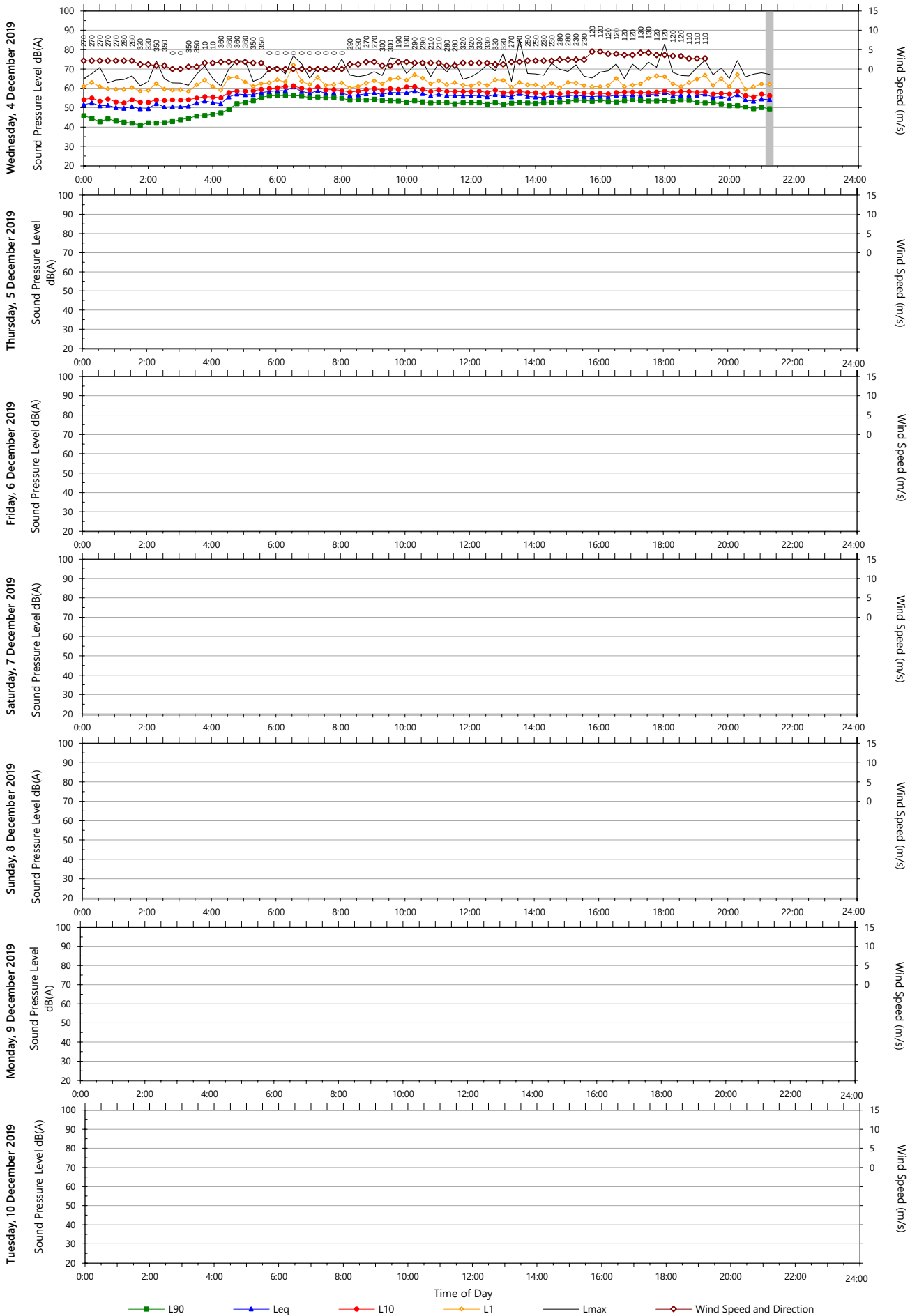
Unattended Monitoring Results

Location: WSU Oval South, Milperra



Data File: 2019-11-27_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)



Horsley Road, Milperra

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

Date	L _{A90} Background Noise Levels ⁴			L _{Aeq} Ambient Noise Levels		
	Day ¹	Evening ²	Night ³	Day ¹	Evening ²	Night ³
Wednesday-27-November-2019	-	45	42	-	62	58
Thursday-28-November-2019	49	46	41	62	61	57
Friday-29-November-2019	49	47	42	62	60	56
Saturday-30-November-2019	48	41	37	63	59	55
Sunday-01-December-2019	44	40	38	60	58	57
Monday-02-December-2019	51	47	-	62	60	-
Representative Weekday⁵	49	46	42	62	61	57
Representative Weekend⁵	46	41	37	61	59	56
Representative Week⁵	49	45	41	62	60	57

Notes:

- Day is 8:00am to 6:00pm on Sunday and 7:00am to 6:00pm at other times
- Evening is 6:00pm to 10:00pm
- Night is the remaining periods
- Assessment Background Level (ABL) for individual days
- Rating Background Level (RBL) for LA90 and logarithmic average for LAeq
- Leq is calculated in the free field. 2.5dB is subtracted from results if logger is placed at façade
- Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

Horsley Road, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

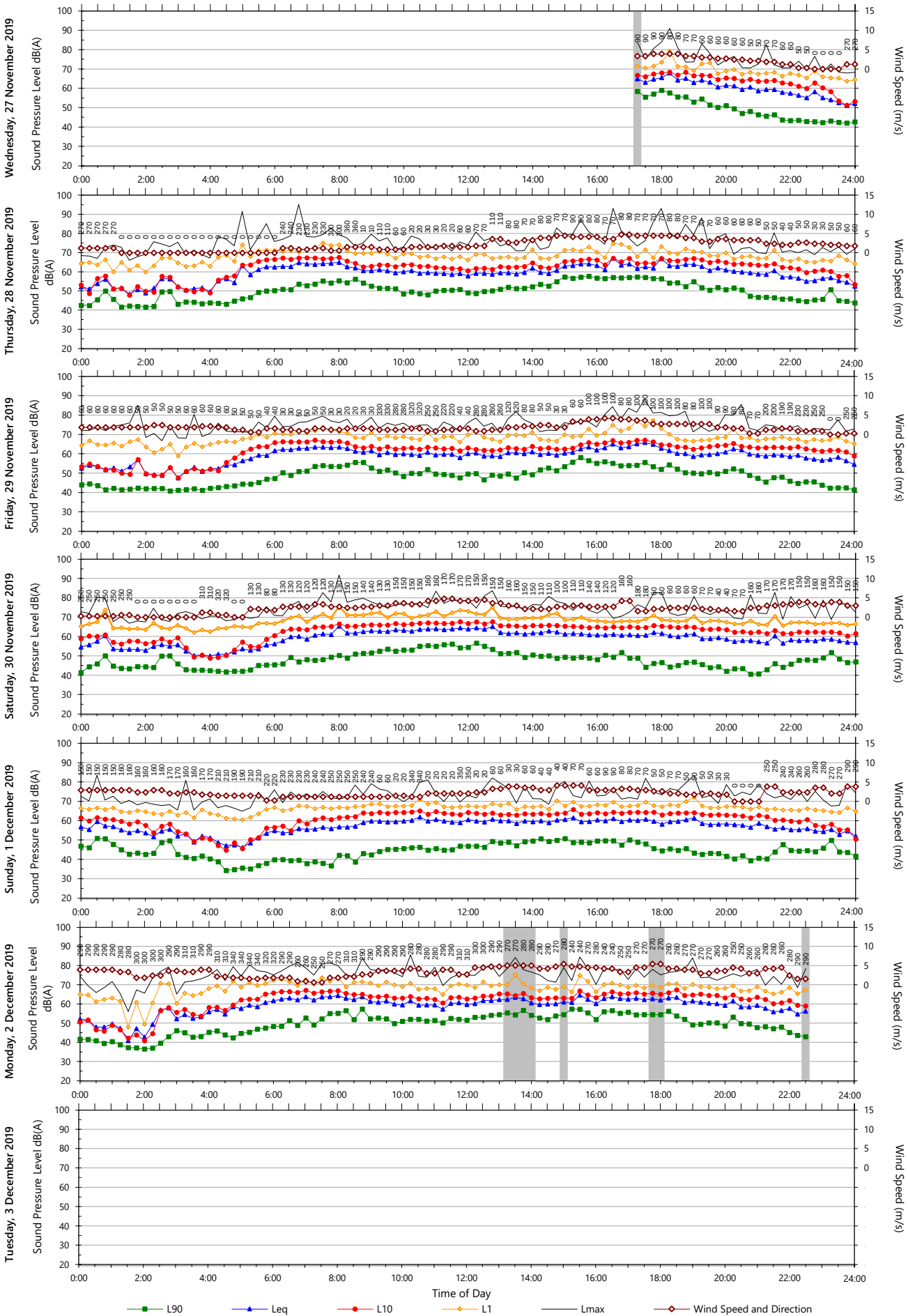
Date	L _{Aeq} Noise Levels		L _{Aeq 1hr} Noise Levels			
	Day ¹	Night ²	Day - Up ⁴	Day - Low ⁵	Night - Up ⁴	Night - Low ⁵
Wednesday-27-November-2019	65	61	68	62	64	53
Thursday-28-November-2019	64	59	67	61	63	54
Friday-29-November-2019	64	58	66	62	61	54
Saturday-30-November-2019	64	58	66	61	60	53
Sunday-01-December-2019	62	60	63	59	63	51
Monday-02-December-2019	64	57	65	62	57	57
Representative Weekday³	64	59	66	62	62	54
Representative Weekend³	63	59	65	60	62	52
Representative Week³	64	59	66	62	62	54

Notes:

- Day is 7:00am to 10:00pm
- Night is 10:00pm to 7:00am
- Median of daily L_{Aeq}
- Upper 10th percentile L_{Aeq 1hr}
- Lower 10th percentile L_{Aeq 1hr}
- Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Monitoring Results

Location: Horsley Road, Milperra



Data File: 2019-11-27_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

Bullecourt Avenue, Milperra

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

Date	L _{A90} Background Noise Levels ⁴			L _{Aeq} Ambient Noise Levels		
	Day ¹	Evening ²	Night ³	Day ¹	Evening ²	Night ³
Wednesday-27-November-2019	-	47	40	-	66	63
Thursday-28-November-2019	53	48	39	68	67	63
Friday-29-November-2019	54	45	38	68	66	60
Saturday-30-November-2019	48	41	35	66	63	59
Sunday-01-December-2019	43	40	38	65	63	62
Monday-02-December-2019	54	50	40	68	65	63
Tuesday-03-December-2019	52	47	39	68	65	63
Wednesday-04-December-2019	-	-	-	-	-	-
Representative Weekday⁵	53	47	39	68	66	62
Representative Weekend⁵	46	40	36	66	63	61
Representative Week⁵	53	47	39	67	65	62

Notes:

- Day is 8:00am to 6:00pm on Sunday and 7:00am to 6:00pm at other times
- Evening is 6:00pm to 10:00pm
- Night is the remaining periods
- Assessment Background Level (ABL) for individual days
- Rating Background Level (RBL) for LA90 and logarithmic average for LAeq
- Leq is calculated in the free field. 2.5dB is subtracted from results if logger is placed at façade
- Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

Bullecourt Avenue, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

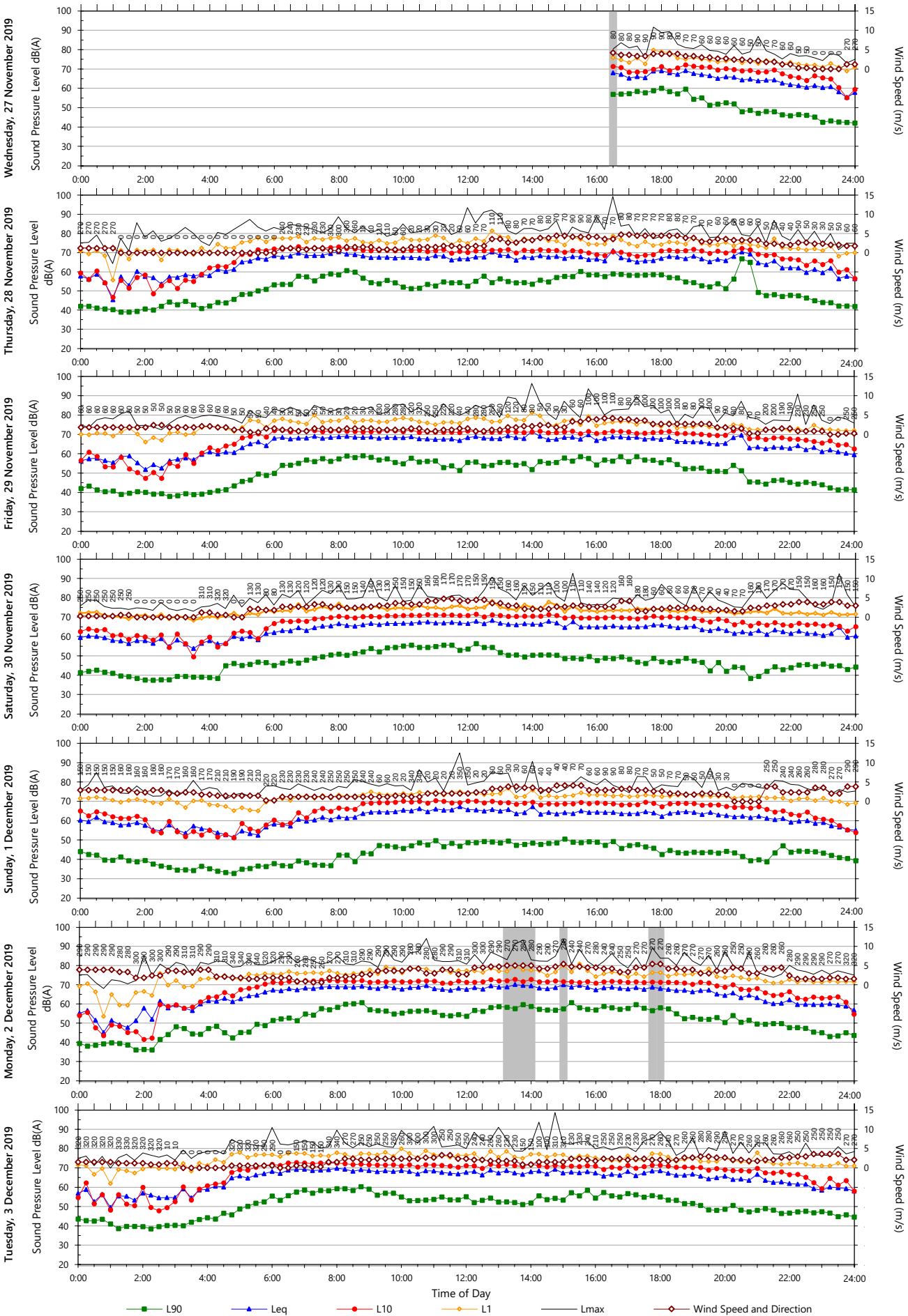
Date	L _{Aeq} Noise Levels		L _{Aeq 1hr} Noise Levels			
	Day ¹	Night ²	Day - Up ⁴	Day - Low ⁵	Night - Up ⁴	Night - Low ⁵
Wednesday-27-November-2019	69	66	70	67	70	59
Thursday-28-November-2019	70	65	71	69	69	59
Friday-29-November-2019	70	63	71	69	65	60
Saturday-30-November-2019	68	61	70	65	64	58
Sunday-01-December-2019	67	65	68	64	69	56
Monday-02-December-2019	70	65	71	67	70	58
Tuesday-03-December-2019	70	66	71	67	70	59
Wednesday-04-December-2019	71	-	72	71	-	-
Representative Weekday³	70	65	71	68	70	59
Representative Weekend³	67	63	69	65	66	57
Representative Week³	70	65	71	67	69	59

Notes:

- Day is 7:00am to 10:00pm
- Night is 10:00pm to 7:00am
- Median of daily L_{Aeq}
- Upper 10th percentile L_{Aeq 1hr}
- Lower 10th percentile L_{Aeq 1hr}
- Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Monitoring Results

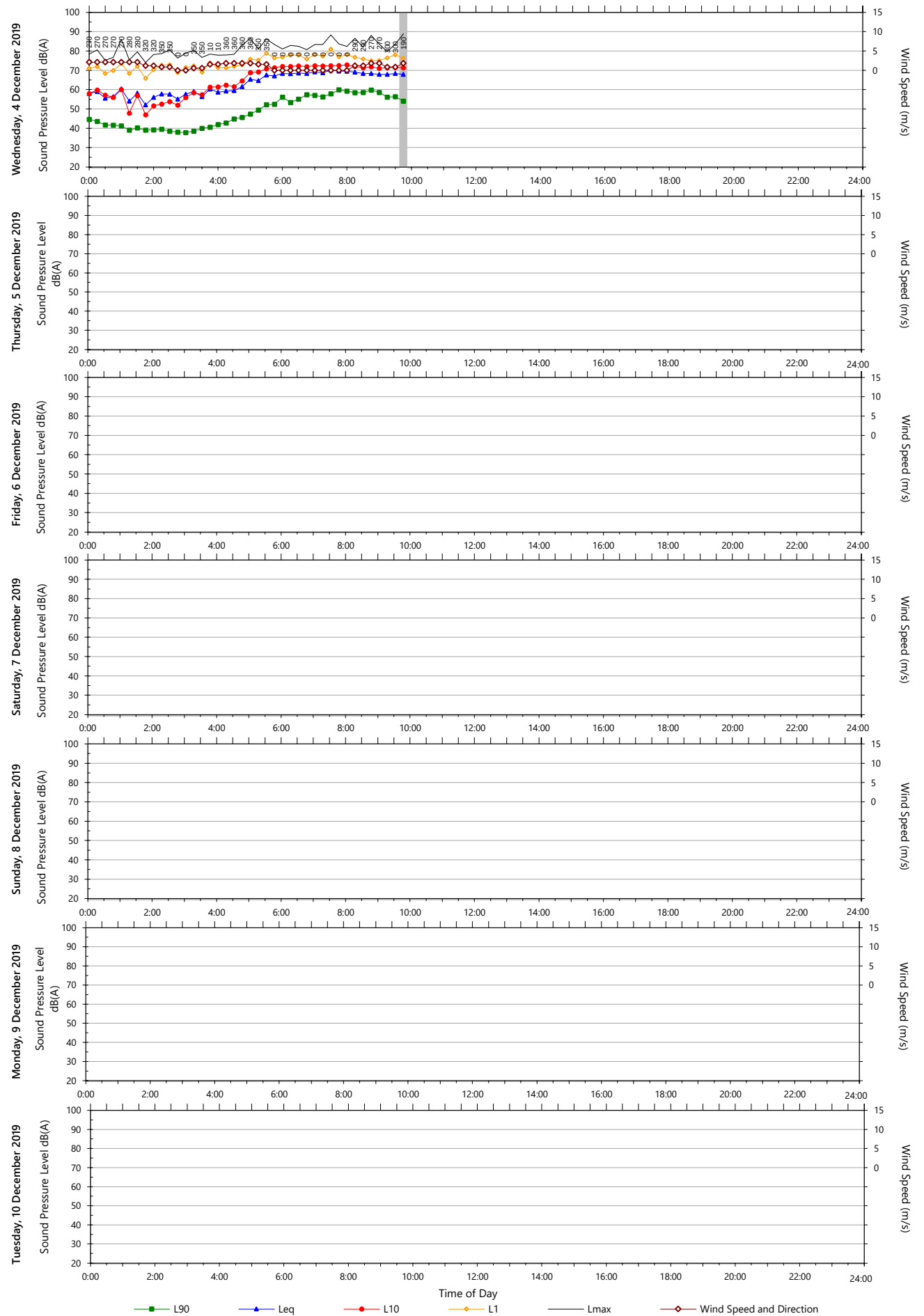
Location: Bullecourt Avenue, Milperra



Data File: 2019-11-27_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

Location: Bullecourt Avenue, Milperra



Data File: 2019-11-27_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

Mount St Joseph Sports Field, Milperra

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

Date	L _{A90} Background Noise Levels ⁴			L _{Aeq} Ambient Noise Levels		
	Day ¹	Evening ²	Night ³	Day ¹	Evening ²	Night ³
Friday-06-December-2019	-	-	39	-	-	47
Saturday-07-December-2019	43	45	38	54	51	47
Sunday-08-December-2019	44	43	39	52	51	47
Monday-09-December-2019	47	43	40	55	50	49
Tuesday-10-December-2019	-	47	40	-	53	48
Wednesday-11-December-2019	47	44	38	56	53	48
Thursday-12-December-2019	-	-	-	-	-	-
Representative Weekday⁵	47	44	40	55	52	48
Representative Weekend⁵	43	44	39	53	51	47
Representative Week⁵	45	44	39	54	52	48

Notes:

- Day is 8:00am to 6:00pm on Sunday and 7:00am to 6:00pm at other times
- Evening is 6:00pm to 10:00pm
- Night is the remaining periods
- Assessment Background Level (ABL) for individual days
- Rating Background Level (RBL) for LA90 and logarithmic average for LAeq
- Leq is calculated in the free field. 2.5dB is subtracted from results if logger is placed at façade
- Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

Mount St Joseph Sports Field, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

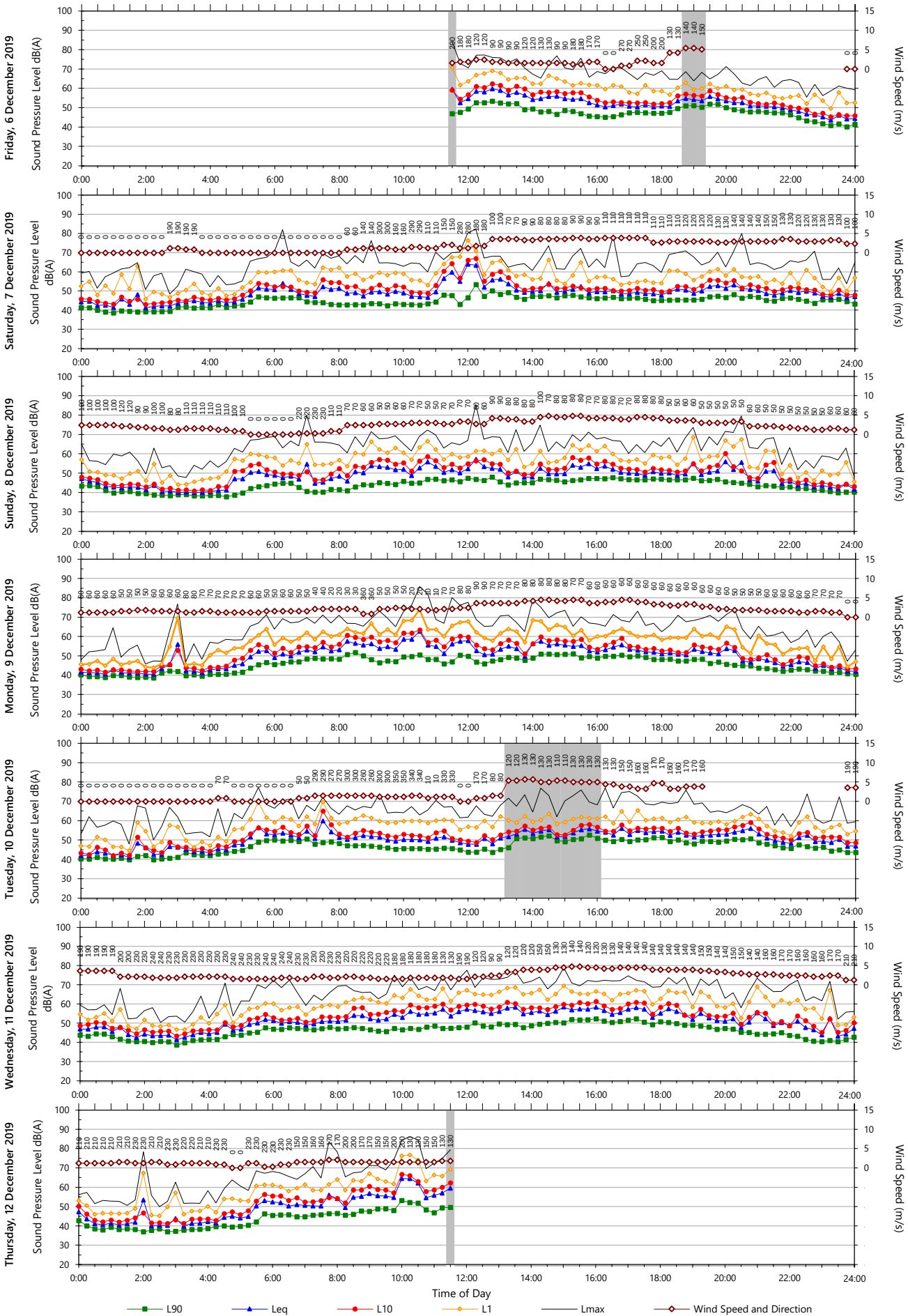
Date	L _{Aeq} Noise Levels		L _{Aeq 1hr} Noise Levels			
	Day ¹	Night ²	Day - Up ⁴	Day - Low ⁵	Night - Up ⁴	Night - Low ⁵
Friday-06-December-2019	57	49	59	53	53	45
Saturday-07-December-2019	56	49	59	51	53	44
Sunday-08-December-2019	54	50	56	51	54	44
Monday-09-December-2019	57	51	59	53	56	45
Tuesday-10-December-2019	55	51	57	52	53	46
Wednesday-11-December-2019	58	50	59	54	53	44
Thursday-12-December-2019	61	-	63	56	-	-
Representative Weekday³	57	50	59	53	53	45
Representative Weekend³	55	50	57	51	53	44
Representative Week³	57	50	59	53	53	45

Notes:

- Day is 7:00am to 10:00pm
- Night is 10:00pm to 7:00am
- Median of daily L_{Aeq}
- Upper 10th percentile L_{Aeq 1hr}
- Lower 10th percentile L_{Aeq 1hr}
- Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Monitoring Results

Location: Mount St Joseph Sports Field, Milperra



Data File: 2019-12-06_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

Ashford Avenue, Milperra

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

Date	L _{A90} Background Noise Levels ⁴			L _{Aeq} Ambient Noise Levels		
	Day ¹	Evening ²	Night ³	Day ¹	Evening ²	Night ³
Wednesday-27-November-2019	-	52	41	-	57	54
Thursday-28-November-2019	53	49	45	57	55	54
Friday-29-November-2019	52	49	44	56	55	55
Saturday-30-November-2019	54	50	40	58	56	52
Sunday-01-December-2019	52	50	43	56	55	51
Monday-02-December-2019	-	48	39	-	54	53
Tuesday-03-December-2019	52	53	46	56	63	56
Wednesday-04-December-2019	-	-	-	-	-	-
Representative Weekday⁵	52	49	44	57	58	55
Representative Weekend⁵	53	50	41	57	56	52
Representative Week⁵	52	50	43	57	57	54

Notes:

1. Day is 8:00am to 6:00pm on Sunday and 7:00am to 6:00pm at other times
2. Evening is 6:00pm to 10:00pm
3. Night is the remaining periods
4. Assessment Background Level (ABL) for individual days
5. Rating Background Level (RBL) for LA90 and logarithmic average for LAeq
6. Leq is calculated in the free field. 2.5dB is subtracted from results if logger is placed at façade
7. Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

Ashford Avenue, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

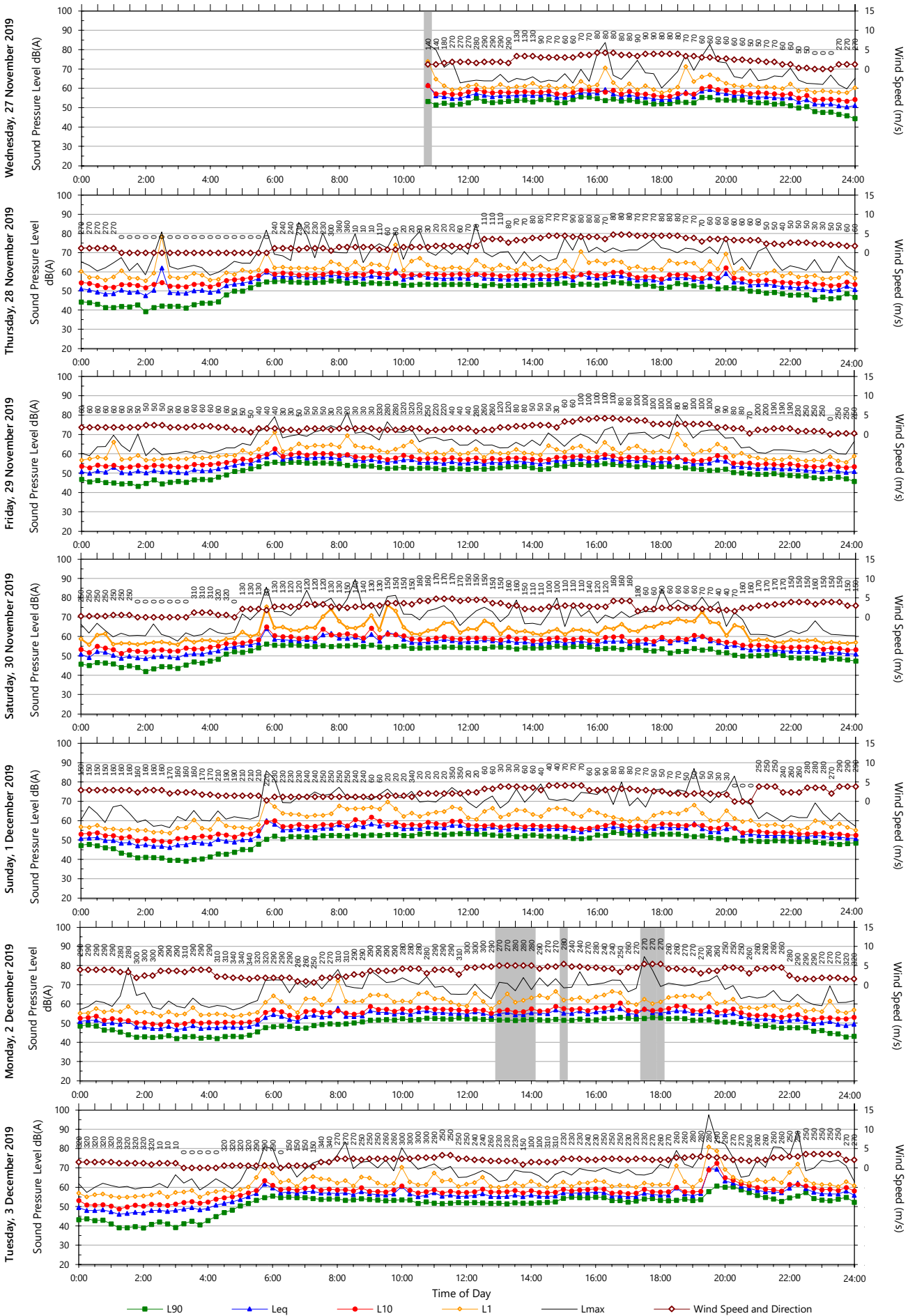
Date	L _{Aeq} Noise Levels		L _{Aeq 1hr} Noise Levels			
	Day ¹	Night ²	Day - Up ⁴	Day - Low ⁵	Night - Up ⁴	Night - Low ⁵
Wednesday-27-November-2019	59	57	60	58	60	52
Thursday-28-November-2019	59	57	60	57	60	53
Friday-29-November-2019	59	57	60	56	61	52
Saturday-30-November-2019	60	55	62	58	58	50
Sunday-01-December-2019	59	53	60	57	55	50
Monday-02-December-2019	58	56	58	56	60	50
Tuesday-03-December-2019	62	59	62	58	61	54
Wednesday-04-December-2019	61	-	61	60	-	-
Representative Weekday³	59	57	60	57	60	52
Representative Weekend³	59	54	61	57	56	50
Representative Week³	59	57	60	57	60	52

Notes:

1. Day is 7:00am to 10:00pm
2. Night is 10:00pm to 7:00am
3. Median of daily L_{Aeq}
4. Upper 10th percentile L_{Aeq 1hr}
5. Lower 10th percentile L_{Aeq 1hr}
6. Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Monitoring Results

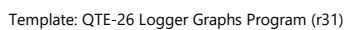
Location: Ashford Avenue, Milperra



Data File: 2019-11-19_SLM_000_123_Rpt_Report.txt

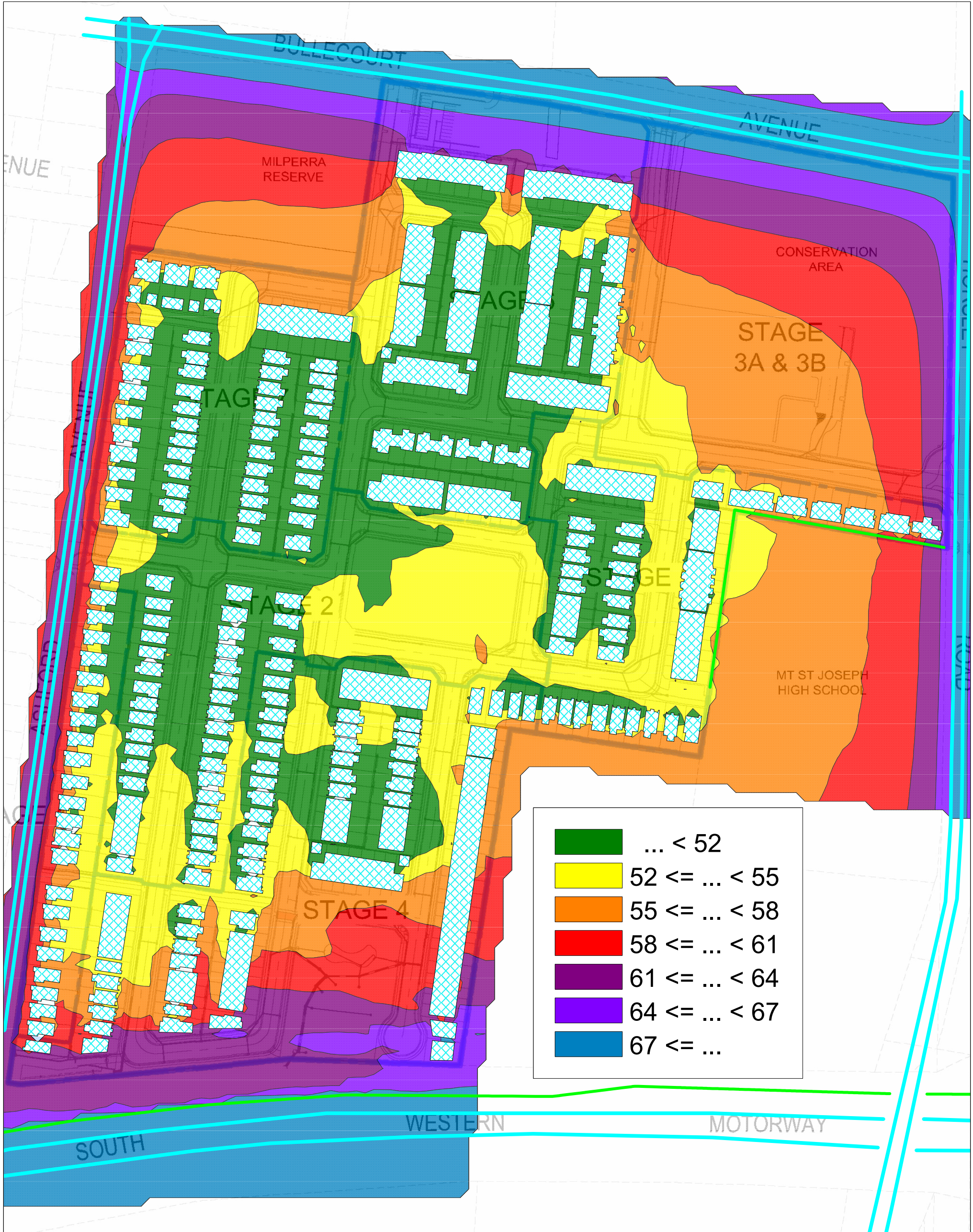
Template: QTE-26 Logger Graphs Program (r31)

Location: Ashford Avenue, Milperra

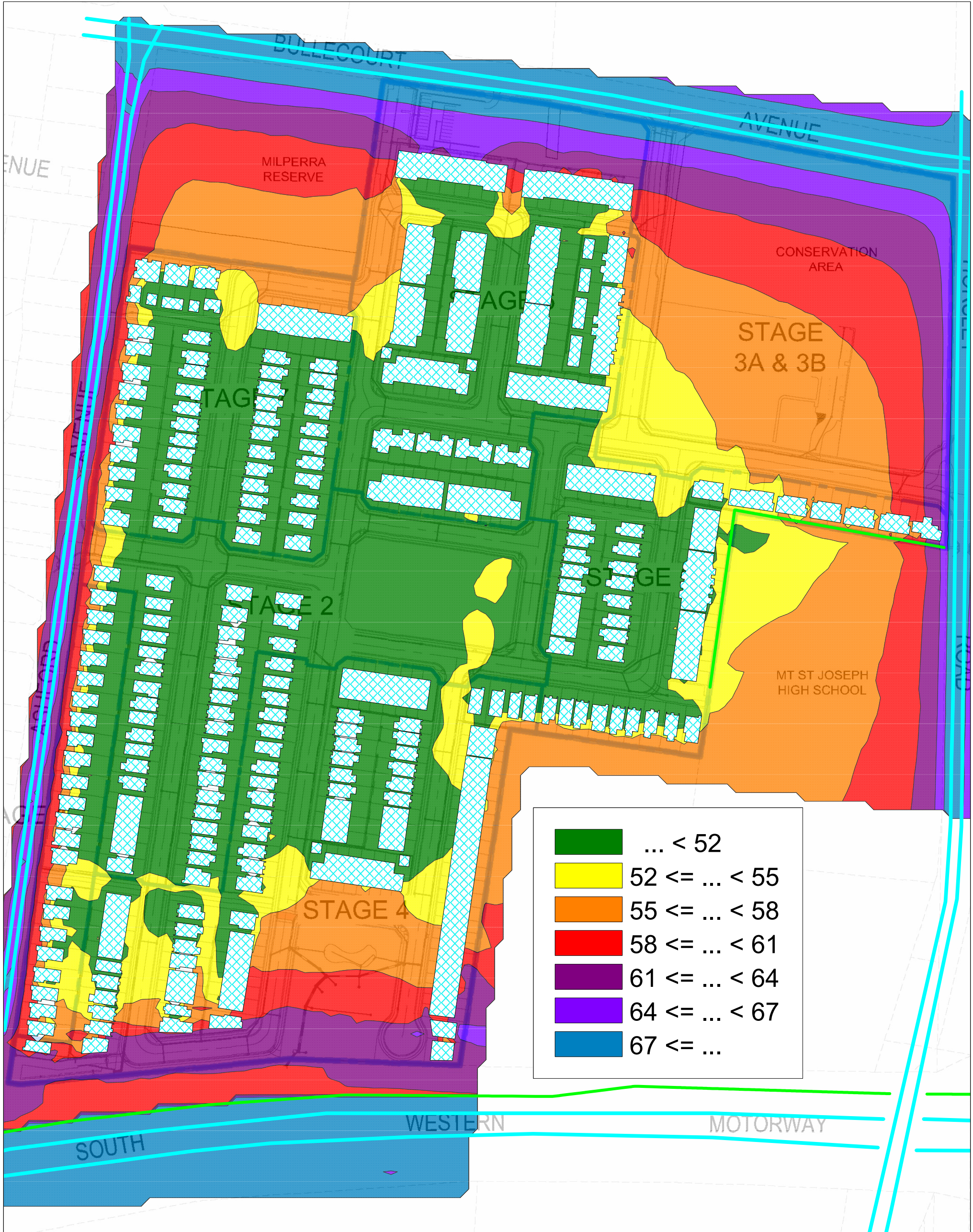


APPENDIX D

Noise modelling results - Road Traffic Noise



Legend: Anticipated Building Footprint Existing Road Barrier 	Client: 	Project: WESTERN SYDNEY UNIVERSITY MILPERRA SUBDIVISION	Description: NOISE CONTOURS STAGES 1, 2, 4, 5, 6 & 7 - FIRST FLOOR DAY - LAeq, 15hour	
	Consultant:  1/418A Elizabeth Street, SURRY HILLS NSW 2010 P: 02 8218 0500 F: 02 8218 0501	Noise levels are approximate due to interpolation of contours and should be used for reference only. For information only and not for construction. This information is protected by copyright.	Project No.: TN579-07 Date: 01.08.2025	Produced by: MSK Scale: 1: 2100 A3



Legend:

- Anticipated Building Footprint
- Existing Road
- Barrier

Client:



Consultant:



1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Project:

WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

Noise levels are approximate due to interpolation of contours and should be used for reference only.

For information only and not for construction.

This information is protected by copyright.

Description:

NOISE CONTOURS

STAGES 1, 2, 4, 5, 6 & 7 - GROUND FLOOR

DAY - LAeq, 15hour

Project No.:

TN579-07

Date:

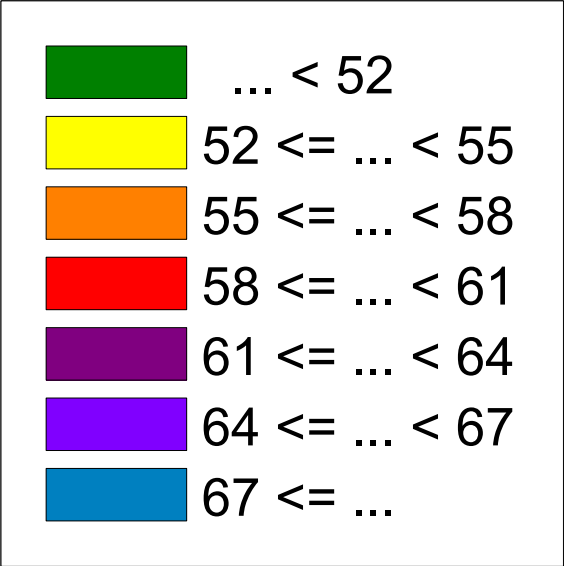
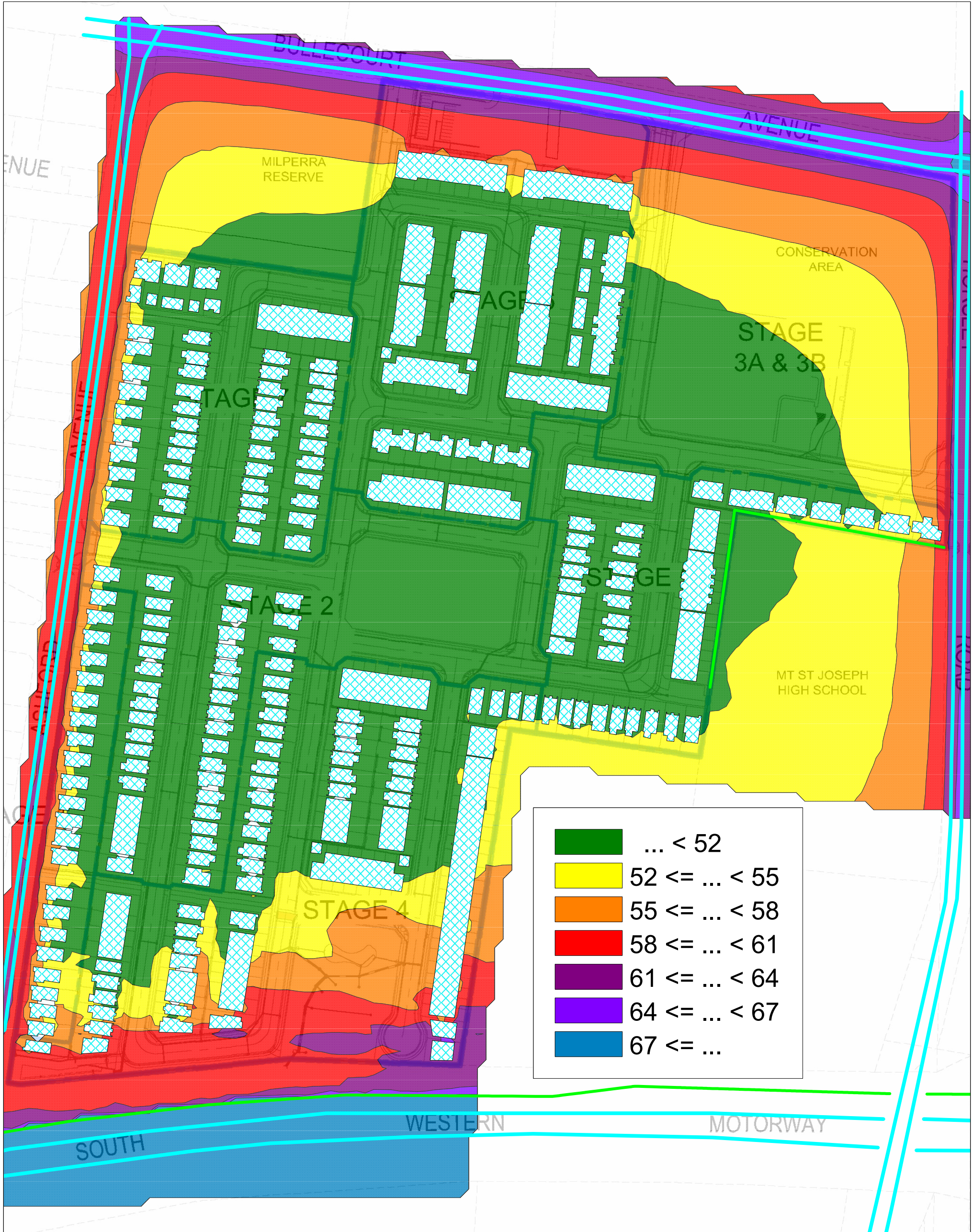
01.08.2025

Produced by:

MSK

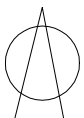
Scale:

1: 2100 A3



Legend:

- Anticipated Building Footprint
- Existing Road
- Barrier



Client:



Consultant:



1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Project:

WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

Noise levels are approximate due to interpolation of contours and should be used for reference only.

For information only and not for construction.

This information is protected by copyright.

Description:

NOISE CONTOURS
STAGES 1, 2, 4, 5, 6 & 7 - FIRST FLOOR
NIGHT - LAeq, 9hour

Project No.:

TN579-07

Date:

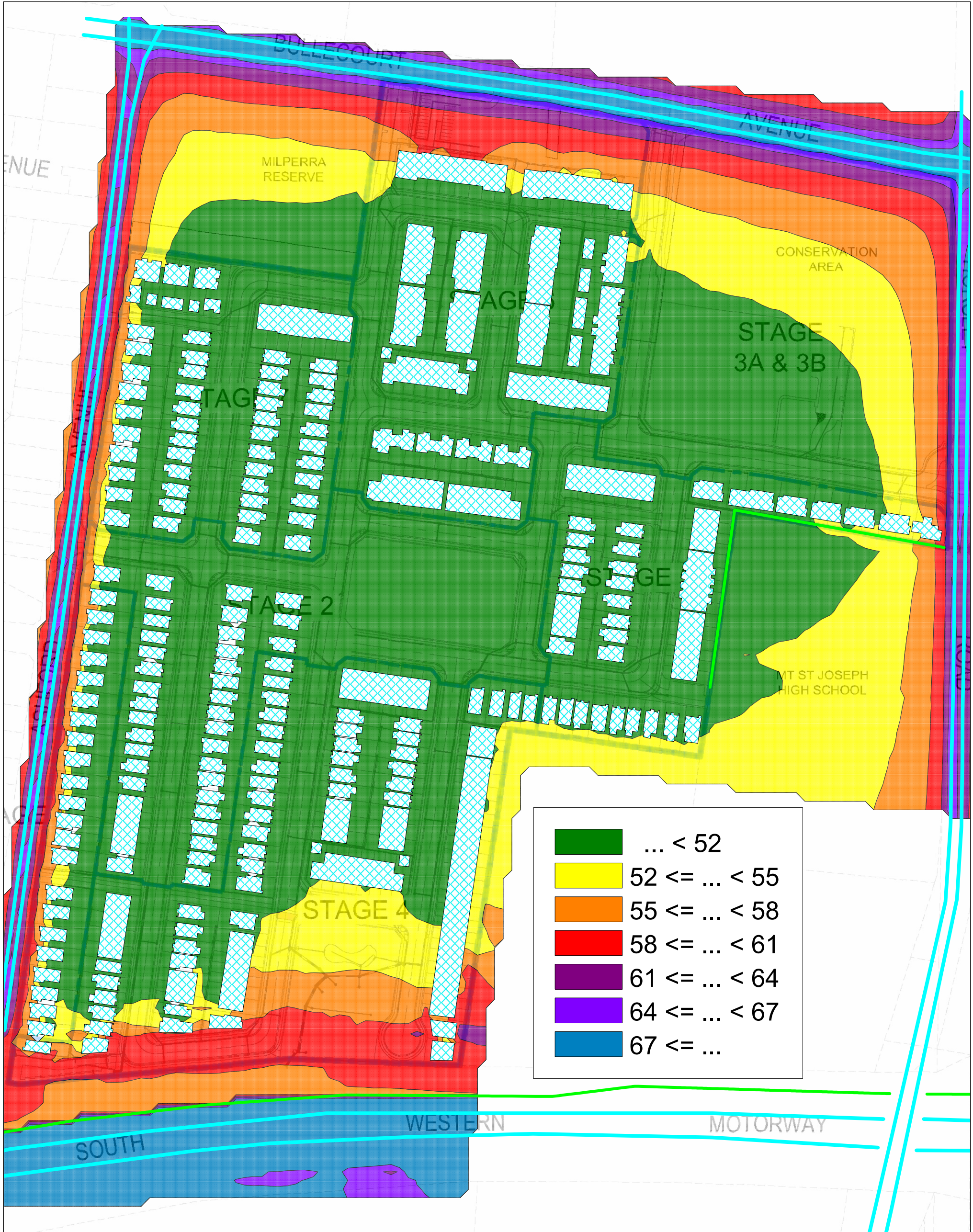
01.08.2025

Produced by:

MSK

Scale:

1: 2100 A3



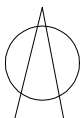
Legend: Anticipated Building Footprint Existing Road Barrier	Client: mirvac	Project: WESTERN SYDNEY UNIVERSITY MILPERRA SUBDIVISION	Description: NOISE CONTOURS STAGES 1, 2, 4, 5, 6 & 7 - GROUND FLOOR NIGHT - LAeq, 9hour	
	Consultant: RENZO TONIN & ASSOCIATES inspired to achieve 1/418A Elizabeth Street, SURRY HILLS NSW 2010 P: 02 8218 0500 F: 02 8218 0501	Noise levels are approximate due to interpolation of contours and should be used for reference only. For information only and not for construction. This information is protected by copyright.	Project No.: TN579-07 Date: 01.08.2025	Produced by: MSK Scale: 1: 2100 A3

APPENDIX E

Acoustic treatment categories



- Legend:
- Anticipated Building Footprint
 - Existing Road
 - Barrier



Client:



Consultant:



1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Project:

WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

Noise levels are approximate due to interpolation
of contours and should be used for reference
only.

For information only and not for construction.

This information is protected by copyright.

Description:

FACADE TREATMENT

STAGES 1, 2, 4, 5, 6 & 7 - FIRST FLOOR

Project No.:

TN579-07

Date:

01.08.2025

Produced by:

MSK

Scale:

1: 2100 A3



Legend:
Anticipated Building Footprint

Existing Road
Barrier

Client:



Consultant:



1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Project:

WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

Noise levels are approximate due to interpolation
of contours and should be used for reference
only.

For information only and not for construction.

This information is protected by copyright.

Description:

FACADE TREATMENT

STAGES 1, 2, 4, 5, 6 & 7 - GROUND FLOOR

Project No.:

TN579-07

Date:

01.08.2025

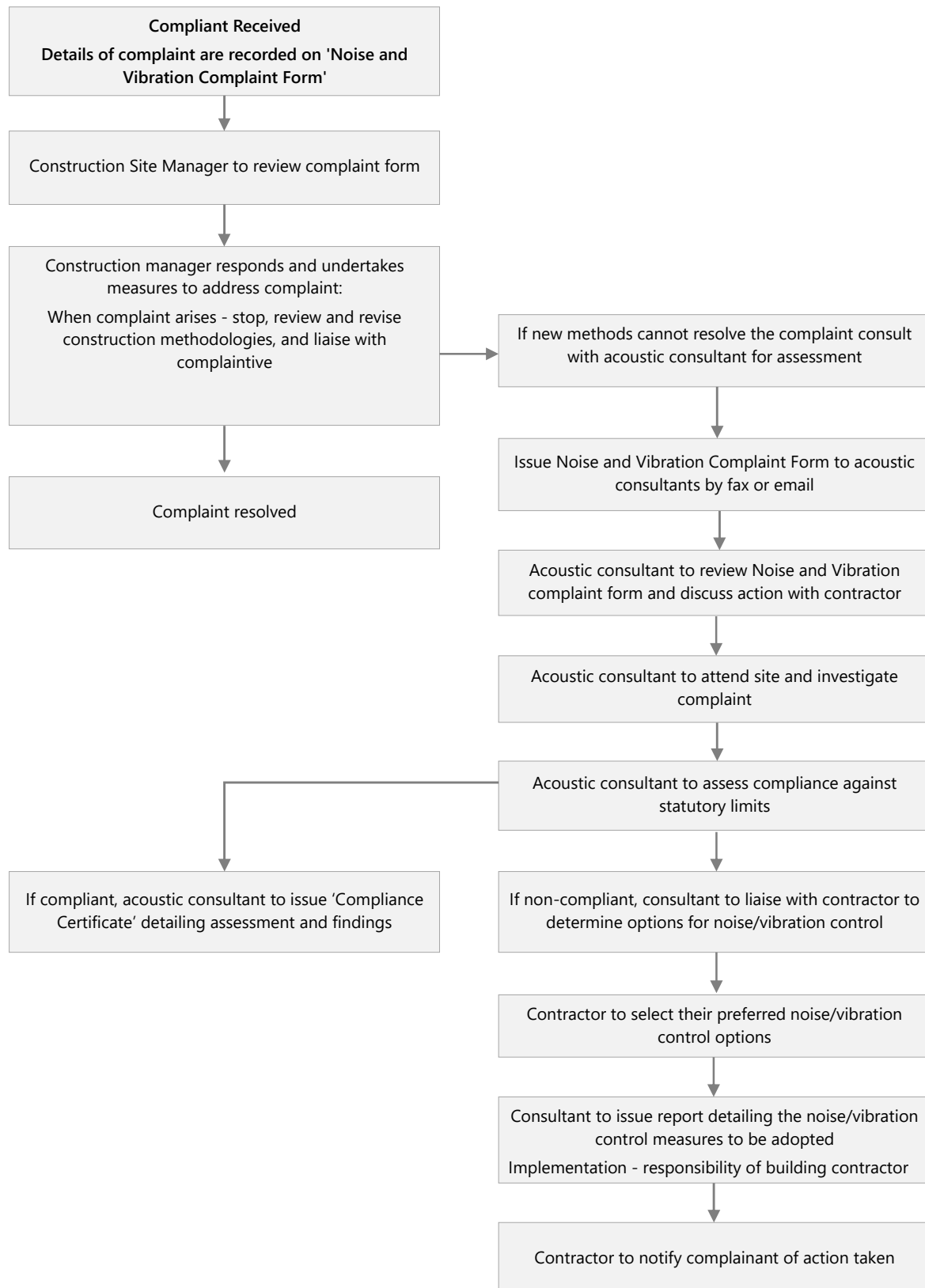
Produced by:

MSK

Scale:

1: 2100 A3

APPENDIX F Noise/Vibration Complaint Management Procedure



NOISE/ VIBRATION COMPLAINT FORM

Project title:	_____	Date:	_____
Site contractor:	_____	Phone:	_____
Site contact:	_____	Email:	_____

Complaint details

Received by (circle): Phone / Email / In person / Other: _____

Name: _____ **H Ph:** _____

Address: _____ **W Ph** _____

Email: _____ **M Ph** _____

Describe when the problem occurred (date and time), what equipment caused the complaint (if known) and where person was standing when he/she experienced the noise/vibration:

Investigation

Question foreman responsible on site and obtain information on what equipment or processes would most likely have caused the complaint:

Following approval from the Project Manager, email/fax this form to Renzo Tonin & Associates