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ST IVES BOTANICA - RESIDENTIAL AGED CARE FACILITY

SSDA Noise and Vibration Impact Assessment

17 April 2024

Opal c/- Midson Group

TM935-02F02 SDDA Acoustic Report (r2)

35 1982-2017 ACOUSTIC ENGINEERING EXCELLENCE

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1 Introduction

This report presents an acoustic assessment of the residential care facility (RCF) proposed at 285, 287, 287A and 289 Mona Vale Road and 1 Flinders Avenue, St Ives.

The site is bound to the North-West by Mona Vale Road and except for a portion of the Eastern boundary which adjoins Flinders Avenue, the remaining boundaries adjoin residential lots.

This is a noise impact assessment which assesses the noise emissions from the site to the neighbours, the noise impact from the environment onto the development, and sets up the framework for the internal acoustic separation and the management of construction noise and vibration. Indicative measures are proposed for the mitigation of noise emissions, noise intrusion and internal acoustic separation, but these will be further developed during detailed design.

Noise surveys were conducted on site by Renzo Tonin & Associates between Monday the 11th of October 2022 to Wednesday 19th October 2022 to determine the existing traffic and ambient noise levels at the development site. These levels were used to set the project noise emission goals.

As a result of our assessment, the following potential acoustic items were identified:

1. Noise emission targets from proposed mechanical plant impacting on existing residences;
2. Noise emissions from use of the site including use of the on site loading dock;
3. External noise from road traffic on Mona Vale Road impacting the receivers on site; and
4. Noise from traffic generated by the development impacting existing residential receivers.

Under the NSW Planning Secretary's Environmental Assessment Requirements, a noise and vibration assessment is required in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. This report presents an assessment of the above acoustic components in terms of the NSW State Environmental Planning Policy (Transport & Infrastructure) 2021, NSW Environmental Protection Authority (EPA) Noise Policy for Industry (NPfI) (2017), Australian Standard AS2107:2016 and NSW EPA Interim Construction Noise Guideline (ICNG) (2009).

In regard to acoustic privacy, this is generally satisfied through the requirements set by the National Construction Codes - Building Code of Australia with which all new residential aged care developments would need to comply.

Further detailed discussion of the identified acoustic factors is set out within this report.

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 Site and Surrounds

The residential care facility is to be located at 285-289 Mona Vale Road and 1 Flinders Avenue, St Ives.

The north west boundary adjoins Mona Vale Road, which carries high volumes of traffic during the daytime. The majority of the north west façade is used to accommodate the common services such as reception, café and wellness, whereas the accommodation rooms are well set back from the road. The nearest bedroom is 15m from the north west boundary, and is on the side of the building rather than facing toward the road.

Long term noise monitoring has been undertaken at the site to determine the existing acoustic environment – both in areas affected by road traffic noise as well at the rear of the site which is well shielded from traffic noise. Logger Location L1 (near Mona Vale Road) is representative of the background noise levels at R1, R2 and R8, whilst Logger Location L2 is representative of receivers R3, R4, R5, R6 and R7 which are well shielded from road traffic noise.

Figure 1 - Site plan and monitoring locations

3 Measured and Predicted Noise Levels

3.1 Long-Term Noise Survey

Two RTA Technology Environmental Noise Loggers was set up for the ambient noise survey from Monday the 11th of October 2022 to Wednesday 19th October 2022. Refer to Figure 1 for monitoring locations.

- One logger was installed near the north west boundary of the site to capture the existing traffic noise on Mona Vale Road as well as the background noise at traffic-affected receivers.
- The second logger was placed at the rear of the site, well screened from road traffic noise to capture the background noise at receivers in that protected location.

The noise logger records noise levels on a continuous basis and stores data every fifteen minutes. The noise logger was calibrated before and after measurements and no significant deviation in calibration was noted. The noise monitoring equipment used here complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as Type 2 instruments suitable for field use. The dates of measurement and the results obtained from the logger survey are shown in Appendix B.

Results from the unattended noise survey were used to calculate noise emission goals.

3.2 Results of long-term noise monitoring

The results of the long-term noise monitoring have been summarised in accordance with the Noise Policy for Industry requirements published by NSW Environmental Protection Authority (EPA) and are presented in Table 3-1 below.

Table 3-1: Measured Site Background (L_{A90}) and Ambient (L_{Aeq}) Noise Levels dB(A)

Noise Monitoring		Descriptor	Day[1]	Evening[2]	Night[3]	Early Morning Shoulder[4]
Location	Duration					
L1 – North West Boundary, appx 7m to kerb	11/10/22 to 19/10/22	L_{A90}	60	51	31	54
		L_{Aeq}	70	66	64	70
L2 – rear of site	11/10/22 to 19/10/22	L_{A90}	39	34	30 (27)[5]	35
		L_{Aeq}	50	45	42	49

Notes: Day, Evening & Night assessment periods are defined in accordance NSW EPA's Industrial Noise Policy as follows.

1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays. As results were affected by construction noise weekend day and Saturday morning, Sunday results have been presented for the Day time period
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays
4. Early morning shoulder is 6:00am – 7:00am Monday to Saturday and 6:00am to 8:00 Sundays & Public Holidays
5. 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.

Logger Location L1 (near Mona Vale Road) is representative of the background noise levels at R1, R2 and R8, whilst Logger Location L2 is representative of receivers R3, R4, R5, R6 and R7 which are well shielded from road traffic noise.

The representative background noise levels (L_{A90}) are used in defining external noise emission from the development such as mechanical ventilation and air-conditioning systems in accordance with the EPA Noise Policy for Industry (NPfI) (2017).

Table 3-2 - Measured Road Traffic Noise Levels at North-West Boundary – including façade reflection

Noise Monitoring Location	Duration	Day[1]	Night[3]
L1 – North West Boundary	11/10/22 to 19/10/22	71	66

Notes: Day is 7am to 10pm; Night is 10pm to 7am; Quoted values include 2.5dB façade correction

3.3 Short term attended noise measurements

Short term attended noise measurements were undertaken at each logger location, whilst the loggers were still running.

Table 3-3 - Short term attended measurements at each logger

Noise Monitoring Location	Duration		Logger at 1.5m height	Hand-held at 4.5m height
L2 – East of site	19/10/22 10:15am to 10:30am	L_{A90}	37	40
		L_{Aeq}	47	48
L1 – North West Boundary	19/10/22 10:47am to 11:02am	L_{A90}	62	64
		L_{Aeq}	70	73

3.4 Assessment traffic noise levels

For the North West boundary, the attended measurements indicated that there was a small degree of shielding between the logger location and the noise from Mona Vale Road. A 2.1dB correction shall be applied to the logger-measured level in determining the assessment traffic noise level. The resultant period average traffic noise levels are shown in the following table:

Table 3-4 - Assessment Road Traffic Noise Levels near North-West Boundary – including façade reflection

Noise Monitoring		Day[1]	Night[3]
Location	**Duration**		
L1 – North West near Boundary	11/10/22 to 19/10/22	74	69

Notes: Day is 7am to 10pm; Night is 10pm to 7am; Quoted values include 2.5dB façade correction

4 Noise Intrusion Assessment

This section presents the assessment of environmental noise impacts onto the site from its surroundings and the mitigation measures that are proposed to achieve appropriate internal noise levels in accordance with the necessary standards / statutory requirements.

4.1 Noise Intrusion Criteria

4.1.1 State Environmental Planning Policy (Housing) 2021

Part 5 of the State Environmental Planning Policy (Housing) 2021 (HSEPP) relates to Seniors Living.

Section 100 is as follows:

> *100 Visual and acoustic privacy*
>
> *Seniors housing should be designed to consider the visual and acoustic privacy of adjacent neighbours and residents by—*
>
> *(a) using appropriate site planning, including considering the location and design of windows and balconies, the use of screening devices and landscaping, and*
>
> *(b) ensuring acceptable noise levels in bedrooms of new dwellings by locating them away from driveways, parking areas and paths.*

4.1.2 State Environmental Planning Policy (Transport & Infrastructure) 2021

The NSW State Environmental Planning Policy (Infrastructure) 2007 (known as 'ISEPP') came into force in NSW on 1 January 2008 to facilitate the effective delivery of infrastructure across the State. This has since been superseded by the State Environment Planning Policy (Transport & Infrastructure) 2021, effective 1 March 2022 (T&ISEPP). The aim of the policy includes identifying the environmental assessment category into which different types of infrastructure and services development fall and identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure.

The subject site faces Mona Vale Road, which carries in excess of 20000 vehicles, thus triggering the T&ISEPP.

Clause 2.120 applies to the subject site as it relates to noise impacts from a busy road on residential accommodation.

> *2.120 Impact of road noise or vibration on non-road development*

(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 child care 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 Planning 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.

(3A) Subsection (3) does not apply to a building to which State Environmental Planning Policy (Housing) 2021, Chapter 3, Part 7 applies.

(4) In this section, freeway, tollway and transitway have the same meanings as they have in the Roads Act 1993.

Note: In respect of Item 3A) above, SEPP (Housing) 2021, Chapter 3, Part 7 relates to serviced apartments and so the exclusion is not relevant to this project. The development shall be designed for compliance with Item 3 internal noise levels.

In respect of Item 2 above, under the previous SEPP (Infrastructure) 2007, the Department of Planning published the Developments Near Rail Corridors and Busy Roads – Interim Guideline (2008) (ISEPP Guideline), which was published in the Gazette on 22/12/08. The Guideline has not been re-gazetted under the T&ISEPP and so from a technical perspective may not be strictly applicable (Planners to advise). However, Planning Circular PS 21-018 was issued 02 December 2021 which requires a consent authority to "take into consideration this interim guideline to minimised the impacts of busy roads and railway corridors on residential and other sensitive developments". On that basis, the recommendations

and clarifications contained within the ISEPP Guideline are still valid except where directly contradicted by the T&ISEPP (e.g. under the T&ISEPP it is mandatory to assess road traffic noise for roads carrying >20000 vehicles per day, whereas ISEPP and ISEPP Guideline refer to mandatory assessment for >40000 vehicles per day and only recommend assessment for >20000 vehicles per day).

4.1.3 Development near rail corridors and busy roads – interim guideline

The Guideline clarifies the time period of measurement and assessment. Section 3.4 '*What Noise and Vibration Concepts are Relevant*' and Table 3.1 of Section 3.6.1 confirms that noise assessment is based over the following time periods:

- Daytime 7:00am - 10:00pm $L_{Aeq(15hr)}$
- Night-time 10:00pm - 7:00am $L_{Aeq(9hr)}$

The noise criteria nominated in the T&ISEPP apply to internal noise levels with windows and doors closed. However as the preliminary noise assessment is based on measurements/predictions at external locations, equivalent external noise criteria has been established. The equivalent external noise criterion is used to determine which areas of the development may require acoustic treatment in order to meet the internal noise requirements of the T&ISEPP. The equivalent external goals have been determined on the following basis:

- The Department of Planning publication 'Development near rail corridors and busy roads – Interim guideline' states: "*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*." The internal criteria with windows open is therefore 10dB(A) above the criteria explicitly outlined in the T&ISEPP.
- The generally accepted noise reduction through an open window from a free-field external position is 10dB(A). Windows/doors are assumed to be open no more than 5% of room floor area, in accordance with the National Construction Code, Building Code of Australia (BCA) ventilation requirements.

Table 4-1 presents the T&ISEPP internal noise criteria along with the equivalent external noise criteria for residential premises.

Table 4-1: T&ISEPP noise criteria for new residential development

Room	Location	$L_{Aeq,\ 15hr}$ Day 7am – 10pm	$L_{Aeq\ 9hr}$ Night 10pm – 7am
Living rooms[1]	Internal, windows closed	40	40
	Internal, windows open	50	50
	External free-field (allowing windows to remain open)[2]	60	60
Bedrooms[1]	Internal, windows closed	40[3]	35
	Internal, windows open	50[3]	45

Room	Location	$L_{Aeq,\ 15hr}$ Day 7am – 10pm	$L_{Aeq\ 9hr}$ Night 10pm – 7am
	External free-field (allowing windows to remain open) [2]	-	55

Notes: 1. Requisite for 20,000AADT Roads only under T&ISEPP 2021.

2.Department of Planning's 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 on the basis of 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/BCA requirements.

3. T&ISEPP does not define internal goals in Bedrooms during the daytime (only at night). In view of project quality, we have elected to apply the Living Room goals to Bedrooms during the daytime.

4.1.4 Australian Standard AS/NZS 2107-2016

For the residential portion, compliance with the T&ISEPP internal goals will also achieve compliance with AS2107:2016. The community facilities within the centre are not governed by the T&ISEPP and so guidance is sought from Australian Standard AS2107:2016. The applicable criteria shall be based on AS/NZS 2107-2016 are presented below in Table 4-2. These goals are applicable to both road traffic noise and mechanical services noise. Mechanical noise impacts on bedrooms and private living spaces from central building equipment (which the resident has no control over) shall be designed to less than 30dB(A) Leq.

Table 4-2: Recommended design sound levels for different areas of occupancy in buildings

Type of occupancy/ activity	Design sound level (LAeq,t) range[8]
7 RESIDENTIAL BUILDING	
Retirement homes/villages See Houses and apartments; Hostels; and Clause 5.2	
Houses and apartments near major roads-	
Living Areas	35 to 45
Sleeping Areas (night time)	35 to 40
Work Areas	35 to 45
Hostels, residential halls and barracks -	
Cafeterias	45 to 50
Common rooms	40 to 45
Games rooms	45 to 50
Kitchens and service areas	45 to 55
2-HEALTH BUILDINGS	
Corridors and lobby spaces	< 50
Consulting rooms	40 to 45
Dining areas	40 to 45
Geriatric rehabilitation	40 to 45
Kitchen, sterilizing and service areas	< 55
Maintenance workshops	< 60
Nurses' stations	40 to 45
Office areas	35 to 45

Type of occupancy/ activity	Design sound level (LAeq,t) range[8]
Patient lounge	40 to 45
Staff rooms	40 to 45
Surgeries/treatment/procedure rooms	40 to 45
Utility rooms	50 to 60
Board and conferences rooms	30 to 40
Executive office	35 to 40
General office areas	40 to 45
Undercover Carpark	<65

In accordance with the NSW EPA Noise Policy for Industry (2017) (NPfI), the target noise level for courtyards within the development shall be 50dB(A) Leq(period) when in use.

4.2 Noise intrusion assessment

The main noise impact onto the site is from road traffic noise on Mona Vale Road. In addition, to address of Clause 100 of the HSEPP, noise emissions from use of the on-site driveway and underground loading dock has been considered. Given the number of vehicle movements is relatively small and the nearest Bedroom on site is at least 10m from the driveway without direct line of sight, the mitigation treatments for control of Mona Vale Road noise will also protect the resident from driveway noise. Noise emissions from use of the driveway to neighbouring receivers is assessed in Section 5.

Noise calculations were performed using glazing design software developed in this office which take into account external noise levels, facade transmission loss and room sound absorption characteristics. The forms of constructions presented below are recommended to comply with the nominated acoustic criteria for the development.

The North West portion of the site is most affected by noise from Mona Vale Road. The following section presents the indicative treatments for compliance with the project internal noise goals as defined in section 4.1.

To capture the impact of changes during detailed design, a review of environmental noise intrusion is to be undertaken during detailed design prior to construction documentation.

4.2.1 Glazing

To achieve the criteria outlined in Table 4-1 with windows closed, the following table presents the recommended glazing acoustic performances for the proposed development. There is no restriction on ability to open windows/doors. For the noise affected facades, they need to be closed to comply.

Table 4-3: Recommended acoustic performance of indicative glazing assembly

Zone	Room Description	Required Acoustic Rating of Glazing Assembly, R_w
Front of house communal facilities	Gym/Wellness, Lobby, Café, Seating – North and West facing (except where limited by accessibility requirements e.g. automatic doors)	R_w 35
Home F	Bedrooms–North Facing, West of Fire Stair 1B	R_w 35
	Bedrooms– North Facing, East of Fire Stair 1B	R_w 32
	Bedrooms and Living Areas of SOUs – South Facing (courtyard)	R_w 32
	Lounge/Activity/Dining	R_w 28
Homes I & J	Bedrooms and Living Areas of SOUs– West facing and North Facing where West of Fire Stair 1B	R_w 35
	Bedrooms and Living Areas of SOUs – North Facing where East of Tree D	R_w 32
	Bedrooms – South Facing where West of Fire Stair 1B	R_w 35
	Bedrooms – South Facing where East of Fire Stair 1B	R_w 32
	Home I - Western end Sitting Home J – South façade West End Sitting	R_w 35
	Home I – South sitting	R_w 32
	Level 3 Central Activity/Lounge/Dining	R_w 35
Remaining Homes	Bedrooms	R_w 28
	Activity/Lounge/Dining	R_w 28
	Lounge/Activity/Dining	R_w 28
Offices, Interview, Training, Hot Desk, Exec Offices	Office and training spaces	R_w 35

Notes:

The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.

The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.

The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.

Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.

The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.

All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.

The above glazing thicknesses should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

4.2.1.1 Typical Glazing Constructions to Achieve Acoustic Ratings

The following table presents typical glazing constructions to achieve the minimum acoustic ratings presented in Table 4-3 above.

Table 4-4: Typical Glazing Constructions to Achieve Acoustic Ratings

R_w Rating	Typical Glazing System
R_w 28	Minimum 6mm float or toughened glass in an aluminium sliding window frame. Q-on seals full perimeter seals shall be installed, or acoustic equivalent to be determined in Detailed Design.
R_w 32	Minimum 6.38mm laminated glass in an aluminium sliding window frame. Q-lon seals full perimeter seals shall be installed, or acoustic equivalent to be determined in Detailed Design.
R_w 35	Minimum 10.38mm laminated glass in an aluminium sliding window frame. Q-lon seals full perimeter seals shall be installed, or acoustic equivalent to be determined in Detailed Design.

The table presented above is intended as a guide only and should not be used for construction. It is the responsibility of the sub-contractor to provide laboratory test reports for the glazed systems proposed for installation at the development site to show compliance with the acoustic ratings presented in Table 4-3.

4.2.2 Roof

To achieve the criteria outlined in Section 4.1 with windows closed, the following table presents the recommended roof acoustic performances for the proposed development. There is no restriction on ability to open windows/doors. For the noise affected facades, they need to be closed to comply.

In the development, some roofs are concrete, whilst others are metal deck with an insulated cavity and plasterboard ceiling below.

Table 4-5: Recommended acoustic performance of indicative roof/ceiling construction

SPACE	Room Description	Required Acoustic Rating of Roof Assembly, R_w
Metal Roof - Home J, Suites West of Stair 1B	Bedrooms	R_w 43
	Living / Dining	R_w 43
	Bathrooms	R_w 38
Metal Roof - Home J, Suites West of Stair 1B	Bedrooms	R_w 38
	Living / Dining	R_w 38
	Bathrooms	Standard construction
Metal Roof - Home J, Single Rooms Facing Courtyard	Bedrooms	R_w 38
	Bathrooms	Standard construction
Metal Roof – L3 communal areas (south west)	Lounge, Activity, Dining	R_w 43
Metal Roof – L2 Office Space	CM &CCC, Lifestyle	R_w 38
Concrete roof	All	R_w 50

Notes:

The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.

The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.

The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.

Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.

The supplier shall ensure that installation techniques will not diminish the Rw performance of the system when installed on site.

4.2.2.1 Typical Roofing Constructions to Achieve Acoustic Ratings

The following table presents typical roofing constructions to achieve the minimum acoustic ratings presented in Table 4-5 above.

Table 4-6: Typical Roof Constructions to Achieve Acoustic Ratings

R_w Rating	Typical Roofing System
Standard construction	Flat Roof 0.42mm Metal deck roof, with R3 insulation and flat min 10mm plasterboard ceiling, or acoustic equivalent to be determined in Detailed Design.
R_w 38	Flat Roof 0.42mm Metal deck roof, with R3 insulation and flat 13mm fire resistant (for habitable rooms) or moisture resistant (for wet areas) plasterboard ceiling, or acoustic equivalent to be determined in Detailed Design.
R_w 43	Flat Roof 0.42mm Metal deck rood, with R3 insulation and flat 2x16mm fire rated plasterboard ceiling, or acoustic equivalent to be determined in Detailed Design.
R_w 50	Concrete roof, min 150mm thick, or acoustic equivalent to be determined in Detailed Design.

The table presented above is intended as a guide only and should not be used for construction. It is the responsibility of the sub-contractor to provide laboratory test reports for the roof/ceiling systems proposed for installation at the development site to show compliance with the acoustic ratings presented in Table 4-5.

4.2.3 External walls

To achieve the criteria outlined in Section 4.1 with windows closed, the following table presents the recommended external wall acoustic performances for the proposed development. There is no restriction on ability to open windows/doors. For the noise affected facades, they need to be closed to comply.

Table 4-7: Recommended acoustic performance of indicative external wall construction

Building	Room Description	Required Acoustic Rating of Wall Assembly, R_w
All	West Façade and North Façade of Suites and Single Rooms West of Stair 1B West, North and South facades of L3 Activity and Lounge; and L2 Hot Desk, GM, CSM&AO offices	R_w 50
	Homes F, I and J, North façade - suites and single rooms West of Stair 1B Reception, Lobby, Café, Gym, Treatment	R_w 47
	Rooms with glass Rw28 or less	R_w 43

Notes:

The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality

control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.

The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.

The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.

Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.

The supplier shall ensure that installation techniques will not diminish the Rw performance of the system when installed on site.

Table 4-8: Typical Wall Constructions to Achieve Acoustic Ratings

R_w Rating	Typical Roofing System
R_w 43	Masonry (i.e. brick veneer, or concrete); or Minimum 9mm compressed fibre cement cladding or 20mm sandstone cladding, on minimum 92mm studwork with 13mm plasterboard internally and 75mm thick 11kg/m3 glass or mineral wool insulation, or acoustic equivalent determined during detailed design.
R_w 47	Masonry (i.e. brick veneer, or concrete); or Minimum 16mm compressed fibre cement cladding or minimum 20mm sandstone cladding, on minimum 92mm studwork with 13mm plasterboard internally and 75mm thick 11kg/m3 glass or mineral wool insulation, or acoustic equivalent determined during detailed design.
R_w 50	Masonry (i.e. brick veneer, or concrete); or Minimum 16mm compressed fibre cement cladding or minimum 20mm stone cladding on steel studwork with furring channels/tophats (minimum air cavity 92mm), with 75mm thick 11kg/m3 glass or mineral wool insulation and 2x16mm fire rated plasterboard; or Acoustic equivalent determined during detailed design.

The table presented above is intended as a guide only and should not be used for construction.

It is the responsibility of the sub-contractor to provide laboratory test reports for the roof/ceiling systems proposed for installation at the development site to show compliance with the acoustic ratings presented in Table 4-5.

4.2.4 Ventilation

Office, front of house and common areas (such as dining and activity rooms) are mechanically ventilated.

Suites and Single Rooms on the West and North facades of Homes F, I and J need to be provided with alternative ventilation, as internal noise levels with windows open for natural ventilation exceed the SEPP (T&I) internal noise goals.

Remaining Houses may be naturally ventilated from a noise intrusion perspective.

5 Noise Emission Assessment

Under the NSW Planning Secretary's Environmental Assessment Requirements, a noise and vibration assessment is required in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. This section outlines the noise emission assessment.

5.1 Noise Emission Requirements

Noise emissions from vehicles being driven on the site and from mechanical plant and equipment, shall be managed in accordance with the NSW EPA Noise Policy for Industry 2017 (NPfI).

Noise from additional traffic on the public road will be assessed in accordance with the NSW EPA Road Noise Policy 2011 (RNP).

Noise emissions from the use of the on-site café, wellness centre and pergola shall be assessed to Background + 5dB(A) screening criteria. Given they are not industrial type noises, it is not appropriate to assess them to the NPfI. However, it is reasonable to undertake a high-level assessment for their use to ensure the amenity of neighbours is maintained.

5.1.1 NSW EPA Noise Policy for Industry

The NSW EPA Noise Policy for Industry (2017) assessment has three main components:

- Controlling *intrusive* noise impacts in the short-term for residences;
- Maintaining noise level amenity for particular land uses for residences and other land uses (*amenity*); and
- Assessing night-time noise impacts on residential receivers for the potential for sleep disturbance.

In the event that particular assessment is undertaken, and trigger levels are found to be exceeded even after application of feasible and reasonable treatments, additional analysis would be required to determine the impact of the residual.

5.1.1.1 Intrusive noise trigger level

The intrusiveness trigger level is applicable to residential premises only. According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A).

The intrusiveness criterion is summarised as follows:

- $L_{Aeq,15minute} \leq$ Rating Background Level (RBL) plus 5dB

Table 5-1: Measured Site Background (L_{A90}) and associated NPfI Intrusive trigger

Receiver Location	Descriptor	Day[1]	Evening[2]	Night[3]	Early Morning Shoulder[4]
R1, R2, R8	Background L_{A90}	60	51	31	54
	Intrusive Trigger, Background + 5dB(A) $L_{Aeq(15min)}$	65	56	36	59
R3, R4, R5, R6, R7	Background L_{A90}	39	34	30 (27)[5]	35
	Intrusive Trigger, Background + 5dB(A) $L_{Aeq(15min)}$	44	39	35	40

Notes: Day, Evening & Night assessment periods are defined in accordance NSW EPA's Industrial Noise Policy as follows.

1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays. As results were affected by construction noise weekend day and Saturday morning, Sunday results have been presented for the Day time period
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays
4. Early morning shoulder is 6:00am to 7:00am Monday to Saturday and 6:00am to 8:00 Sundays & Public Holidays
5. 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.

5.1.1.2 Amenity noise trigger levels

The NPfI amenity trigger levels are designed to maintain noise level amenity for particular land uses, including residential and other land uses. The NPfI recommends base acceptable noise levels for various receivers, including residential, commercial, industrial receivers and other sensitive receivers in Table 2.2 of the NPfI. For this project, the neighbouring receivers are classified as Suburban residential receivers. Despite the heavy traffic noise, application of the Urban category is not appropriate due to the development mix and rating background noise level at night.

Table 5-2: NPfI Amenity Criteria - Recommended L_{Aeq} noise levels from industrial noise sources [NSW NPfI Table 2.2]

Type of receiver	Indicative Noise Amenity Area	Time of day	Recommended amenity noise level $L_{Aeq(Period)}$
Residence	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Passive Recreation	-	When in use	50

Type of receiver	Indicative Noise Amenity Area	Time of day	Recommended amenity noise level $L_{Aeq(Period)}$

Notes: The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as follows:

• suburban residential – see Table 2.3

• urban residential – see Table 2.3

Time of day is defined as follows:

• day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays

• evening – the period from 6 pm to 10 pm

• night – the remaining periods.

(These periods may be varied where appropriate, for example, see A3 in Fact Sheet A.)

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area a project amenity noise level applies for each new source of industrial noise as follows:

- Project amenity noise level for industrial developments = recommended amenity noise level (NPfI Table 2.2) minus 5 dB(A)
- Project amenity trigger noise level $L_{Aeq(15min)}$ = Project amenity noise level for industrial developments $L_{Aeq(period)}$ plus 3dB(A). (Note: this is a screening test and the policy still permits period average assessment by review of particular operations)

The NPfI, Section 2.4.1 notes that the level of road traffic noise may provide acoustic masking to operational noise impacting receivers. It is only applicable where traffic noise is identified as the dominant noise source at the site; the existing traffic noise level is 10dB or more above the recommended amenity noise level for the area; and it is highly unlikely traffic noise levels will decrease in the future.

Based on the on-site monitoring, this is applicable to the residential receivers fronting to Mona Vale Road, specifically receivers R1, R2 and R8.

Taking into account the additional distance between the logging location and receiver R2 using CoRTN calculation method, the traffic noise level at that receiver is predicted to be 58dB(A)$L_{eq(Day)}$ 54 dB(A) $L_{eq(Evening)}$ 52 dB(A)$L_{eq(Night)}$ and 58 dB(A)L_{eq} over the early morning shoulder period. The site is therefore eligible for application of the high traffic noise to receiver R2 and therefore also for R1 and R8 (which are marginally worse affected by traffic) for the Night period and Morning Shoulder.

On that basis, the Project Amenity Noise Levels are as shown in the following table.

Table 5-3 - Determination of Project Amenity Noise Levels and Project Amenity Trigger Levels

Receiver Reference	Description	Time of day			
		Day	Evening	Night	Shoulder
R1, R2, R8	Recommended amenity noise level $L_{Aeq(Period)}$	55	45	**52-15 =37**	**58-15 = 43**
	Project amenity trigger level $L_{Aeq(15min)}$	55-5+3 =53	45-5+3=43	**52-15+3 = 40**	**58-15+3 = 47**
R3, R4, R5, R6, R7	Recommended amenity noise level $L_{Aeq(Period)}$	55	45	40	40
	Project amenity trigger level $L_{Aeq(15min)}$	55-5+3 =53	45-5+3=43	40-5+3=38	40-5+3=38

Notes: **Bold** indicates use of the High Traffic correction to the project amenity noise level.

The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Time of day is defined as follows (These periods may be varied where appropriate, for example, see A3 in Fact Sheet A.):

1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays. As results were affected by construction noise weekend day and Saturday morning, Sunday results have been presented for the Day time period
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays
4. Early morning shoulder is 6:00am to 7:00am Monday to Saturday and 6:00am to 8:00 Sundays & Public Holidays

Table 5-4 - Determination of Project Noise Trigger Levels (more stringent of intrusive and amenity)

Receiver Location	Descriptor	Day[1]	Evening[2]	Night[3]	Early Morning Shoulder[4]
R1, R2, R8	Intrusive Trigger, Background + 5dB(A) $L_{Aeq(15min)}$	65	56	36	59
	Project Amenity trigger level $L_{Aeq(15min)}$	53	43	40	47
	Project Noise Trigger Level $L_{Aeq(15min)}$	53	43	36	47
R3, R4, R5, R6, R7	Intrusive Trigger, Background + 5dB(A) $L_{Aeq(15min)}$	44	39	35	36
	Project Amenity trigger level $L_{Aeq(15min)}$	53	43	38	38
	Project Noise Trigger Level $L_{Aeq(15min)}$	44	39	35	36

Notes: Day, Evening & Night assessment periods are defined in accordance NSW EPA's Industrial Noise Policy as follows.

1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays.
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays
4. Early morning shoulder is 5:00am Monday to Saturday and 5:00am to 8:00 Sundays & Public Holidays

5.1.1.3 Maximum noise level event assessment

Where the subject development/premises night time noise levels at a residential location exceed:

- $L_{Aeq,\ 15min}$ 40dB(A) or the prevailing rating background noise level (RBL) plus 5dB, whichever is greater, and/or
- L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB(A), whichever is greater,

a detailed maximum noise level event assessment should be undertaken.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy.

Where there are noise events found to exceed the initial screening level, further analysis is made to identify:

- the likely number of events that might occur during the night assessment period
- Whether events exceed an 'awakening reaction' level of $L_{A1(1min))}$ 65 dB(A).

The only use of the site that is anticipated could result in noise events with the potential for sleep disturbance are from use of the driveway and loading dock from trucks. This is proposed to be limited to the period 5am to 7am, except in the event of an emergency. As such, the night time background noise level is defined by the early morning shoulder period 5am to 7am.

The sleep disturbance criteria for the project are presented in Table 5-5.

Table 5-5: Sleep disturbance criteria

Loc ID	Address	Sleep disturbance screening tests, 10pm - 7am,	
		$L_{A1,1min}$ (or L_{Amax}) = $L_{A90(15min)}$ + 15 dB(A) or 52dB(A) whichever is greater	$L_{Aeq,\ 15min}$ = $L_{A90(15min)}$ + 5 dB(A) or 40dB(A) whichever is greater
R1, R2, R8	283 and 289 Mona Vale Road	49+15=64	49+5=54
R3-R7	Rear of 283 Mona Vale Road, 2 and 6 Flinders Ave, 293 Mona Vale Road	52 (31+15=46)	40 (31+5=36)

5.1.2 NSW Road Noise Policy

This section presents the criteria for assessment of noise from traffic generated by the development.

Table 5-6 sets out the assessment criteria for residences to be applied to particular types of project, road category and land use. These criteria are for assessment against façade corrected noise levels when measured in front of a building façade. In Table 5-6, freeways, arterial roads and sub-arterial roads are grouped together and attract the same criteria.

Table 5-6: Road traffic noise assessment criteria for residential land uses

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day 7:00am-10:00pm	Night 10:00pm-7:00am
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	$L_{Aeq,(15\ hour)}$ 55 (external)	$L_{Aeq,(9\ hour)}$ 50 (external)
	2. Existing residences affected by noise from redevelopment of existing freeway / arterial / sub-arterial roads	$L_{Aeq,(15\ hour)}$ 60 (external)	$L_{Aeq,(9\ hour)}$ 55 (external)
	3. Existing residences affected by additional traffic on existing freeways / arterial / sub-arterial roads generated by land use developments	$L_{Aeq,(15\ hour)}$ 60 (external)	$L_{Aeq,(9\ hour)}$ 55 (external)
Local roads	4. Existing residences affected by noise from new local road corridors	$L_{Aeq,(1\ hour)}$ 55 (external)	$L_{Aeq,(1\ hour)}$ 50 (external)
	5. Existing residences affected by noise from redevelopment of existing local roads		
	6. Existing residences affected by additional traffic on existing local roads generated by land use developments		

Note: Land use developers must meet internal noise goals in the Infrastructure SEPP (Department of Planning NSW 2007) for sensitive developments near busy roads (see Appendix C10).

Where existing traffic noise levels are above the noise assessment criteria (as is the case for this project), the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.

In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

For existing residences and other sensitive land uses affected by *additional traffic on existing roads generated by land use developments*, any increase in the total traffic noise level (where the assessment criteria cannot be achieved) should be limited to 2 dB above that of the corresponding 'no build option'.

In this instance, vehicles entering and exiting the site will do so from Mona Vale Road and based on the monitoring conducted on site, the existing residential receivers on Mona Vale Road already experience noise levels in excess of 60dB(A) $L_{eq\ (15hour,\ day)}$ and 55dB(A) $L_{eq\ (9hour,\ night)}$. Based on the site measurements, the noise level at 281 Mona Vale Road (which is locally nearest to the road) is predicted to be 71dB(A) $L_{eq\ (15hour,\ day)}$ and 66dB(A) $L_{eq\ (9hour,\ night)}$ at 1m from the façade (including façade reflection) and the development should not result in an increase in those noise levels of more than 2dB.

The traffic flows predicted to be generated by the proposed development will not result in any noticeable increase in noise from the public road to the nearest residential receivers.

5.2 NPfI Noise Emission Assessment

This section presents the outcomes of the assessment of noise emissions from vehicles being driven on the site and noise from mechanical plant and equipment, which shall be managed in accordance with the NPfI.

In the event that particular assessment is undertaken and trigger levels are found to be exceeded after application of feasible and reasonable treatments, additional analysis would be required to determine the impact of the residual. The Noise Trigger Levels are named so that they trigger an appropriate response but are not to be viewed as hard and fast targets.

Where necessary, noise amelioration treatment has been incorporated in the design to ensure that noise levels comply with the recommended EPA's INP noise emission criteria noted above. Indicative assessment of the mechanical plant noise emissions has been included in Section 5.2.1.1 and noise from use of the carpark and loading dock is included in Section 5.2.2

5.2.1 Mechanical plant

Mechanical plant noise emission can be controllable by appropriate mechanical system design and implementation of common engineering methods that may include any of the following:

- Procurement of 'quiet' plant;
- Strategic positioning of plant away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises;
    - This has been done as much as usually feasible given the stage. JHA have provided initial spatial planning and equipment noise levels. The indicative treatment advice (to be refined during detailed design for CC is shown in the following section);
    - Provision has been made for rooftop plant decks for air-conditioning services in the centre of the site with provision for acoustic perimeter screening to the decks;
    - Carpark exhaust fan located in a dedicated plant room, with ductwork to roof exhaust;
    - Placement of loading dock in the basement, along with the site laundry away from residential receivers and utilising electric equipment, thus mitigating the need for flues;
- Commercially available silencers or acoustic attenuators for air discharge and air intakes of plant;
- Acoustically lined and lagged ductwork;
- Acoustic screens and barriers between plant and sensitive neighbouring premises;

All mechanical plant shall have the cumulative noise emissions reviewed prior to CC to ensure ongoing compliance; and

Identified mechanical equipment shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 "Rotating and Reciprocating Machinery – Mechanical Vibration".

We recommend a full and detailed assessment with fully documented acoustic treatments be undertaken at the detailed design phase of the development, followed by construction/installation supervision of mechanical plant and equipment acoustic treatment. Compliance testing following the installation of the plant should also be undertaken.

We do not anticipate any significant vibration from the use of the site impacting surrounding receivers. Vibration isolation will be nominated as required for the comfort of the occupants of the site (typically for mechanical plant and equipment).

All mechanical plant shall comply with the criteria set hereby in this report and in accordance with SEARs.

5.2.1.1 Indicative assessment

Mechanical

The development is served by a partial level of basement. The majority of mechanical plant and equipment is planned to be located on the roof, including rooftop condensers and fans (including energy recovery units).

Based on the preliminary selections from JHA, the rooftop condensers are predicted to have sound power levels of 67dB(A) to 79dB(A), each.

Initial calculations performed in Strutt (proprietary software for acoustic calculations), indicate that solid acoustic screens, in the order of 2.2m high, will be required around the perimeter of the condenser decks to mitigate mechanical plant noise to neighbours. This is based on the assumption of Night Quiet mode being used at night time and a diversity factor of 50% at night time.

The majority of rooftop fans are in the order 40-52dB(A) at 3m. Most of these fans will not require additional acoustic treatment individually. When grouped together, or when the larger fans are near the building edge, they will require additional treatment such as silencers, lined ductwork, or cladding of the fan casing and the specific details will be determined in detailed design stage. The acoustic screens are shown on the architectural plans.

Indicatively (subject to confirmation in detailed design), the carpark exhaust fan, laundry exhaust fan and the kitchen supply and exhaust would require in the order of a 2D unpodded circular or rectangular silencer on both the intake and exhaust sides of the fan (kitchen will need wrapping of the silencer internally with melinex/mylar for cleanability), and one bend internally lined 50mm thick. Discharge shall point vertically and/or away from nearby residential receivers. A VSD shall be fitted to reduce the fan speed at night time to 60% duty to reduce acoustic output.

In-principle treatment for the ERV is an acoustic screen around the perimeter of the plant deck of nominally 1.8m, and a 50mm thick internally lined bend on the fresh air intake and exhaust points. The supply and return air connections will require additional acoustic treatments for internal noise levels, indicatively minimum of 50mm thick internal duct lining in the main ductwork, reducing to 25mm thick internal lining for the runs ultimately serving the resident rooms. All EA and OA offtakes to resident rooms shall include a minimum of 1.5m internally lined acoustic flexible ductwork, or acoustic equivalent.

Indicatively, the loading dock exhaust fan and the laundry supply and exhaust would require in the order of a 1D unpodded circular or rectangular silencer on both the intake and exhaust sides of the fan (laundry will need wrapping of the silencer internally with melinex/mylar for cleanability). Depending on the final selections, treatment of the fan casing may also be required subject to detailed design. However, if possible, it is recommended that a VSD could be used at least on the loading dock fan (if not the laundry) to reduce the fan speed at night time to 60% duty to reduce acoustic output.

Hydraulic plant

The indicative equipment and associated noise levels (as provided by JHA) are as follows:

- Roof Level in North West – Electric air to water heat pump, Lp 69dB(A) @3m. 2.2m high acoustic screen around the perimeter of the plant deck. Pumps may require acoustic enclosure for noise to neighbours.
- Ground Level- Fire Pump Room – Diesel hydrant pump – indicatively 100dB(A) @ 3m – tested monthly for approx. 2 minutes - unit on vibration isolation mounts. Given the high noise level, there is a risk of exceeding 65dB(A) in the occupied space when the building is in fire mode. Acoustic review to be refined in detailed design when the final pump selection is available with associated acoustic data.
- Ground Level - Fire Pump Room – Electric Fire Sprinkler Pump – Approx 80 dB(A) – tested monthly for approx. 2 minutes - unit on vibration isolation mounts. Treatments suitable for the diesel hydrant pump will not require upgrade due to the contribution from the Electric Fire Sprinkler Pump.
- Ground Level – Fire Pump Room – Domestic Booster Pump Set - <55 dB(A) – unit on vibration isolation mounts. It is unlikely these pumps would need additional treatment for airborne noise to adjacent spaces.

Electrical services

The indicative equipment and associated noise levels (as provided by JHA) are as follows:

- Kiosk sub – 62dB(A) sound power level, no treatment necessary for compliance with noise emissions to neighbours.
- Backup power – no generator is provided to the site, but the site is to be constructed to allow for connection to a replacement power generator if required. It is proposed that a hired generator would be brought in for extended outages in excess of 12 hours. It is proposed that if required, a hired generator would be placed at ground level to the North of the main entry.

- JHA advised the average outage in NSW is 160min, but noting that metro regions are usually under the state average.
- We are advised that 12 hour outages are exceedingly rare in St Ives and so whilst provision is being made to allow for a generator, it is likely that one would not be required in the useful life of the building.

5.2.2 Noise from vehicles and trucks being driven on driveway

In addition, to address of Clause 100 of the HSEPP, noise emissions from use of the on-site driveway and loading dock has been considered.

In terms of passenger vehicle movements:

- Onsite driveway movements in the order of 20 inbound and 4 outbound in morning peak, (based on data provided by PTC Consultants, traffic engineers from Table 12 of their Transport Impact Assessment dated 12 April 2024).

In addition, calculations have included noise from the use of the on-site driveway from use of the loading dock in the basement, which is suitable for a Medium Rigid Vehicle. The dock can only accommodate one truck at a time and so it is assumed that there would only be one truck in any 15-minute period (but it might go in and out in 15-minutes).

In respect of service vehicle movements to/from the site, the following are anticipated:

- Waste removal – waste vehicle servicing will be undertaken between 9am and 5pm twice per week, with occasional on-call services as may be required from time to time (such as at Christmas). On average waste services are anticipated to be not more than one truck visits per day, undertaken between 9am and 5pm;
- Laundry – the facility includes an on site laundry and so laundry deliveries would be limited to deliveries of new supplies on an as-required basis, delivered by courier van or small truck, undertaken between 7am and 6pm. Linen deliveries would be infrequent;
- Kitchen, currently anticipated deliveries are as follows –
    - Bidfood: 2-3 deliveries per week typically between 7am and 6pm;
    - Fruit and vegetables: 3 deliveries per week typically between 7am and 6pm;
    - Butcher: 2-3 deliveries per week typically between 7am and 6pm;
    - Chicken supplier: 3 deliveries per week typically between 7am and 6pm;
    - Dairy: 6 deliveries per week 6am to 6pm;
    - Bread: 6 deliveries per week 6am to 6pm;
    - Whilst each supplier will be responsible for the vehicle type servicing the site, based on similar sites, no more than half the deliveries is expected to be delivered by truck or large van

- Mini-van – two trips out and in, on average per day using a Sprinter type van;
- In summary, the total daily heavy vehicle movements is anticipated to be up to 14 (seven in and seven out – 1xWaste, up to 3xKitchen, 2xResident Transport, 1xOther).
- It is proposed that the medium trucks would be permitted to attend between 6am and 6pm only, with movements in the Early Morning shoulder period to be limited to those operationally required, as distinct from preferred (we anticipate bread/milk to be likely the only early morning movement).
- 3.3m high acoustic barrier to the southern edge of the driveway. Absorptive material to part of the northern wall of the basement driveway ramp (along the external wall of the building, which shall extend a minimum band of 2.4m in height, but spaced nominally 1.5m above the floor of the driveway and starting at the South West corner of the building and continuing to the basement entry. Absorptive material shall have an NRC of not less than 0.6 – architect to advise material, but nominally it could be Reapor, or 50mm thick Stratocell Whisper UV faced with perforated metal (min 25% open area) or acoustically approved alternative to be determined during detailed design.

Using internally developed calculation software, the predicted peak hour (7am – 8am) noise emission to the nearest residential receivers external to the site is 42dB(A) $L_{eq(15min)}$ at receivers R1 or R2, based on one delivery truck in and out and 6 cars coming in or out in a 15-minute period (equivalent to 24 in the worst hour). This is compliant with the NPfI project trigger noise levels for the day, evening and early morning shoulder. The noise from the truck is the dominant source of noise, the cars contributing only <30dB(A), meaning that staff car movements at night time would still be compliant with the NPfI.

Waste retrieval is to be undertaken during the daytime (9am -5pm) twice per week with additional visits on an 'as needs' basis. Predicted noise level at the nearest neighbouring receivers external to the site (to the South) is 49dB(A) (including peak hour car use of the driveway). This is compliant with the project noise emission goals during the daytime.

In respect of sleep disturbance, considering one truck movement in a 15minute period prior to 7am, the predicted noise level at the worst affected residential receiver is 64dB(A) L_{max} (54dB(A) L_{max} internally assuming a window open for natural ventilation) at the nearest dwelling being the villas at 283 Mona Vale Road. This is compliant with the NPfI sleep disturbance screening test, and the predicted internal noise level of less than 55dB(A) L_{max} and is only predicted to exceed 45dB(A) L_{max} internally twice per night on average (when the truck goes in and then out) and so is unlikely to cause an awakening in accordance with the ECRTN or loss of sleep quality. Further, night-time L_{max} greater than or equal to 64dB(A) were recorded every night of the unattended noise monitoring, when predicted to the same receiver location.

Noise emissions from the use of the driveway by heavy vehicles and passenger vehicles have been considered in the noise intrusion assessment for the site.

In respect of noise from vehicles being driven through the porte cochere, it is anticipated that the primary use would be for drop-off/pickup of residents during the daytime/evening; that its use would

not be particularly frequent or regular (unlike staff arrival/departures to/from the parking or loading dock deliveries etc). Its use would not result in a loss of amenity to neighbouring receivers, particularly when considered in context of the noise from adjacent Mona Vale Road.

5.3 RNP -Noise from traffic generated by the development

The developed flows on Mona Vale Road already exceed the daytime and night time RNP objectives. On that basis, the development should not cause an increase of traffic noise in excess of 2dB. Noise from traffic generated by the site (being 24 vehicles movements per peak hour and an estimated 7 trucks per day) is predicted to result in an overall increase in traffic on Mona Vale Road of less than 1dB which is acoustically acceptable.

Opal have conducted staff mode of travel surveys on similar sites, which indicate that staff vehicle numbers may be less than predicted by the traffic engineers and would not be greater than predicted by the traffic engineers.

5.4 Noise from use of communal facilities (wellness, café, covered pavilion)

5.4.1 Wellness centre

The wellness centre is proposed to operate from 8:30am to 5:30pm, 5 days a week. The wellness centre is used by mainly residents but anticipate some external users with staff supervision.

Due to traffic noise impacts, the external doors of the wellness centre would need to be closed when wellness activities are underway. Wellness activities may include exercise to background music but that would be relatively low in level to permit staff instructions to be understood over the music. Assuming doors and windows closed, noise emissions are predicted to comply with the project goals for the proposed hours of use.

5.4.2 Café

The proposed hours of use are 7 days from 8:30am to 4pm.Use of the café has been assessed as follows:

- Given the clientele, background music would be light at best (nominally 65dB(A) Leq sound pressure level in the space);
- Assuming 20 patrons in the café and associated terrace;
- Taking into account line of sight from the building shell;

The noise level to 283 Mona Vale Road, would be 45dB(A) $L_{eq(15min)}$. This would comply for the whole of the daytime and evening period (7am - 10pm), even though the normal hours for the café would be Daytime, nominally 8:30am to 4pm.

5.4.3 Level 2 North West Communal Open Space

Access to the Level 3 Communal Open Space would be available 24/7 for residents to step outside as is the case for any private balcony in a residential development to facilitate freedom of movement as is required. However, we anticipate that it is highly unlikely to be used at night due to the frail nature of residents who will require rest and the reduced team members to provide supervision during the evening shift. Further, if it were to be used at night, that it would be limited to quiet reflection which would not result in any significant noise emissions to neighbours.

The terrace area could be used by the residents and staff for small gatherings. Formal gatherings organised by the facility can be managed within appropriate hours of the day. This terrace would be impacted by road traffic noise, particularly in the commuter peaks.

5.4.4 Level 3 West Communal Open Space

Access to the Level 3 outdoor area would be available 24/7 for residents to step outside as is the case for any private balcony in a residential development to facilitate freedom of movement as is required. As above, it is unlikely this space would be used at night and if it were to be used at night, that it would be limited to quiet reflection which would not result in any significant noise emissions to neighbours.

The communal open space could be used by the residents and staff for small gatherings. Formal gatherings organised by the facility can be managed within appropriate hours of the day. This terrace would be impacted by road traffic noise, particularly in the commuter peaks.

For gatherings, assuming 1 person per $2m^2$, the space could accommodate approximately 28 people (given varying levels of mobility, it is potentially less, but this would be conservative). Assuming one in three speaking simultaneously and a 1m high balustrade (constructed of solid material such as brick, concrete, min 9mm fibre cement, lapped and capped timber, or min 6mm glass, or a combination), the predicted noise level to receiver R2 (283 Mona Vale Rd) is 47dB(A)Leq(15min), which complies with the screening test for the day and evening periods.

6 Internal Acoustic Separation

As a minimum requirement, walls and floors and separation of services around sole occupancy units shall comply with the National Construction Code (NCC) / Building Code of Australia (BCA) 2022 or later, as relevant to the date of submission of the Construction Certificate.

Internal partitioning for staff offices, breakout spaces, utilities, back of house, wellness etc are not governed by the NCC and will be determined/refined in consultation with the client during the detailed design phase.

6.1 NCC 2022 requirements - Class 9C

The National Construction Code Series (NCC) 2022 - Volume 1, Building Code of Australia sets out the following acoustic provisions for Class 9c buildings:

F7P3 Performance Requirement for Sound transmission through floors in a residential care building:

A floor separating sole-occupancy units must minimise the transmission of airborne and impact generated sound such that the separating floor, including the effect of services and their penetrations, has—

a) a weighted standardised level difference (DnT,w) not less than 40 for airborne sound; and

b) a weighted standardised impact sound pressure level (LnT,w) not more than 62 for impact generated sound.

F7P4 Performance Requirement for Sound transmission through walls in a residential care building:

(1) A wall separating sole-occupancy units, or a sole-occupancy unit from a kitchen, bathroom, sanitary compartment (not being an associated ensuite), laundry, plant room or utilities room, including the effect of services and their penetrations, must minimise the transmission of— airborne sound such that the wall has a weighted standardised level difference (DnT,w) not less than 40; and impact generated sound, if the wall separates a sole-occupancy unit from a kitchen or laundry.

(2) Sound insulation required by (1) must be sufficient to prevent illness or loss of amenity to the occupants.

F7D7 Deemed to Satisfy Provision for Sound insulation rating of internal services:

(1) If a duct or soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole-occupancy unit by construction with an Rw + Ctr (airborne) not less than—

40 if the adjacent room is a habitable room (other than a kitchen); or 25 if the adjacent room is a kitchen or non-habitable room.

(2) If a stormwater pipe passes through a sole-occupancy unit, it must be separated in accordance with (1)(a) and (b).

F7D8 Deemed to Satisfy Provision for Sound isolation of pumps:

A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating or other pump.

NSW F6D4 Ventilation of rooms:

A habitable room, office, shop, factory, workroom, sanitary compartment, bathroom, shower room, laundry and any other room occupied by a person for any purpose must have—

a) natural ventilation complying with F6D7; or

b) a mechanical ventilation or air-conditioning system complying with AS 1668.2.

NCC 2022, Specification 28 outlines a number of different "Acceptable forms of constructions for walls and floors". Use of Acceptable forms of constructions is not mandatory. The design team will determine the particular constructions during the detailed design stage (to be finalised prior to Construction Certificate), however based on previous projects it is anticipated that internal partitions around sole occupancy units will likely be steel stud with plasterboard (or equivalent) linings and insulation in the cavity.

6.2 Project design criteria

This section sets out the partition requirements for walls not governed by the NCC. The following table gives an indication of current intentions; however these will be refined during detailed design.

Table 6-1 - Indicative partition ratings

Source Room	Receiving Room	Proposed Rating (Rw)
General staff office	Other enclosed space	38
Store	Store	-
Nurse Station	Corridor	None, usually bench is open to hall for casual observation
Resident Kitchen	Dining	None, usually bench is open to serve
Accessible WC	Adjacent enclosed space	40-45 (impact control for sensitive spaces)
Accessible WC	Open area	38-40 wall 28-30 door

Source Room	Receiving Room	Proposed Rating (Rw)
Dirty Utility	Adjacent enclosed space – non-sensitive	45
Dirty Utility	Adjacent enclosed space – sensitive	50 + impact control
Dirty Utility	Corridor	38-40 wall 28-30 door
Laundry	Carpark / BOH corridor	Nominally 45, but as required for control of mech services
Maintenance	Carpark / Laundry	Nominally 45, but as required for control of activity
Kitchen	Team Room	55 + Impact control
Kitchen	Laundry chute	50
Kitchen	Men's Shed	50
Kitchen	Scullery	None
Kitchen	BOH corridor	45
Male WC	Female WC/Acc	45
Holding room	Adjacent enclosed	45
Holding room (in BOH)	Corridor	35 wall 25 door
BOH Stores	Lobby	45
BOH corridor	Lobby	28-30 door
Nurse Station + Meds	FOH Corridor (solid wall)	45
BOH corridor	FOH Corridor	40
Comms	Adjacent enclosed	50 28-30 door, only to BOH corridor
Consult /Health Consult	Consult/Salon	50
Consult / Health consult	Waiting	40 wall (solid partition) 30 door
Consult	Acc WC/Café kitchen	50 + Impact control
Health Consult	Wellness	50 + Impact control
Wellness	Stair	45
Staff WC	FOH corridor/Acc WC	45
Staff WC	BOH corridor	38 wall 25 door
Dining	FOH corridor	45
Interview	Hotdesk	50
Interview	Waiting	40 wall (solid partition) 30 door
Hotdesk	Corridor	30 door
CM&CCC	Training/Lifestyle	50
CM&CCC / Lifestyle	Corridor	40 wall (solid partition) 30 door
CSM & AO	Printer/sit	50

Source Room	Receiving Room	Proposed Rating (Rw)
CSM & AO	Corridor	40 wall (solid partition) 30 door
GM	CSM & AO	50
GM	Corridor	40 wall (solid partition) 30 door
GM	Hotdesk	50

7 Internal acoustic amenity –reverberation

7.1 AS2107 targets

This section presents the target criteria for reverberant noise from AS2107:2016 along with the rooms design sound level internally. Compliance with Australian Standard AS2107 is not mandatory, however failure to comply could result in adverse amenity impacts.

Table 7-1: Design sound levels and reverberation times for different areas of occupancy in buildings

Item	Type of occupancy/activity	Design reverberation time (T) range, s
2	**HEALTH BUILDINGS**	
	Corridors and lobby spaces	See Note 1
	Consulting rooms	0.4 to 0.6
	Dining areas	See Note 1
	Geriatric rehabilitation	< 0.6
	Kitchen, sterilizing and service areas	< 0.8 (see Note 8)
	Nurses' stations	0.4 to 0.7
	Office areas	0.4 to 0.7
	Patient lounge	0.4 to 0.6
	Staff rooms	0.4 to 0.6
	Surgeries/treatment/procedure rooms	0.4 to 0.7
	Utility rooms	-
	Ward bedrooms	
	Single bed	0.4 to 0.7
	Multiple beds	0.4 to 0.7 (see Note 8)
	Waiting rooms, reception areas	< 0.7
5	**OFFICE BUILDINGS**	
	Board and conferences rooms	0.6 to 0.8
	Corridors and lobbies	< 1.0
	Executive office	0.4 to 0.6
	General office areas	0.4 to 0.6
	Meeting room (small)	< 0.6
	Open plan office	0.4 (see Note 1)
	Reception areas	0.6 to 0.8
	Rest rooms and break-out spaces	0.4 to 0.6
	Toilets	-
	Undercover carparks	-

7.2 Indicative treatment

This section presents indicative reverberation control treatments in key spaces. These will be reviewed during detailed design with the actual proposed finishes.

7.2.1 Bedrooms

For resident bedrooms, a carpeted floor, the resident's belongings, including the bed with bedding and a chair is usually sufficient to achieve the reverberant noise target without needing to add extra finishes.

In Home B, vinyl floors are required for hygiene and so absorptive lining equivalent to NRC 0.7 for an extent of 50% of the ceiling (or equivalent, evenly distributed evenly on 2 perpendicular walls) is recommended to offset the absence of carpet absorption.

7.2.2 General Offices, and Consultation Rooms

General open offices with carpeted floors and ceiling equal to a mineral fibre tile ceiling with an NRC of not less than 0.7 is usually sufficient. If the spaces are smaller, then absorptive lining to one long wall is usually required. Treatments are to be further defined in Detailed Design.

7.2.3 GM Office

GM Office shall have carpeted floors and ceiling equal to a mineral fibre tile ceiling with an NRC of not less than 0.7 and absorptive wall lining to two perpendicular walls is usually required. Treatments are to be further defined in Detailed Design.

7.2.4 Corridors

Lining to a minimum of 60% of the ceiling space with NRC 0.7.

7.2.5 Communal spaces – Dining, Activity, Lounge, Wellness, Salon, Cafe

Lining to a minimum of 60% of the ceiling space with NRC 0.7 and carpeted floors where practical from an operational perspective. Where not possible, investigate additional ceiling treatments and possibly additional wall treatments where necessary.

8 Construction noise

A detailed Excavation and Construction Management Plan should be prepared for the site prior to the issue of Construction Certificate detailing the site specific plant and equipment to be used, expected periods of construction, and noise and vibration management treatments and procedures to be implemented.

8.1 Environmental Protection Authority's Construction Noise Guidelines

The Environmental Protection Authority (EPA) released its Interim Construction Noise Guideline (ICNG) in 2009. This document is being referred to as EPA's standard policy for assessing construction noise on new projects.

The key components of the ICNG that can be incorporated into this assessment include:

1. Use of LAeq as the descriptor for measuring and assessing construction noise.

In recent years NSW noise policies including EPA's NSW Industrial Noise Policy (INP) and the NSW Environmental Criteria for Road Traffic Noise (ECRTN) have moved to the primary use of LAeq over any other descriptor. As an energy average, LAeq provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the LA10 descriptor.

Consistent with the latest guideline (ICNG) the use of LAeq as the key descriptor for measuring and assessing construction noise may follow a 'best practice' approach.

2. Application of feasible and reasonable 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, including the cost of the measure.

3. Quantitative and qualitative assessment

The ICNG provides two methods for 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 a short-term duration where works are not likely to affect an individual or sensitive land use for more than three weeks in total. It focuses on

minimising noise disturbance through the implementation of feasible and reasonable work practices, and community notification.

Given the significant scale of the construction works proposed for this Project, a quantitative assessment is carried out herein, consistent with the ICNG's requirements.

4. Management Levels

Residences

Table 8-1 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied. The guideline intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

Table 8-1: Noise at residences using quantitative assessment

Time of Day	Management Level $L_{Aeq\ (15\ min)}$*	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (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 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

* 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 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Table 8-2: Noise Affected Noise Management Levels - Standard Construction Hours

Receiver	RBL, L_{A90} Day (7am - 6pm)	Noise Management Level, $L_{Aeq(15min)}$
R1, R2, R8	60	RBL + 10 = 70
R3, R4, R5, R6, R7	39	RBL + 10 = 49

Sensitive Land Use

Table 8-3 below (reproduced from Table 2 of the ICNG) sets out the noise management levels for various sensitive land use developments.

Table 8-3: Noise at other sensitive land uses using quantitative assessment

Land use	Management level, LAeq (15 min) – applies when land use is being utilised
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	**Internal noise level 45 dB(A)**
Active recreation areas	External noise level 65 dB(A)
Passive recreation areas	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the 'maximum' internal levels in AS2107 for specific uses.

The uniting Church is opposite the site on the corner of Douglas Street and Mona Vale Road. The ICNG recommends an internal noise level of 45dB(A) when the Church is in use.

8.2 Construction source noise levels

A detailed assessment of construction noise will need to be undertaken at the conclusion of the detailed design phase when there is more certainty on the equipment and methodologies that will be used to construct the building. However, this section presents a preliminary assessment of noise emissions from the construction stage.

Table 8-4 Typical construction equipment & sound power levels, dB(A) re 1pW

Plant item	Plant description	Sound power levels
Demolition, Excavation and Piling		
1.	Concrete saw	120*
2.	Excavator with hammer	120*
3.	Excavator with bucket	108
4.	Piling drilling rig	111
5.	Truck – cement mixer	108
6.	Concrete pump	102
7.	Concrete vibrator	100
8.	Bobcat	102
9.	Dump Truck	108
Construction		
10.	Powered hand tools	110*
11.	Delivery trucks	106
12.	Truck – cement mixer	108
13.	Cherry picker	102
14.	Concrete pump	105
15.	Concrete vibrator	100
16.	Tower Crane (Diesel)	105
17.	Air compressor - silenced	95

*Inclusive of 5dB(A) penalty for tonality/impulsiveness.

8.3 Predicted Noise Levels

Noise levels at any receiver location resulting from 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. Furthermore, noise levels at receivers would vary significantly over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Table 8-5 and Table 8-6 present 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. Levels are presented when the plant is located on both the far side of the site and the near side of the site (relative to the receiver)

Noise levels were calculated taking into consideration the distance between the construction works and the receiver locations but intervening structures have not been included in this preliminary study.

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

Table 8-5 Predicted $L_{Aeq(15min)}$ noise levels for typical construction plant, Standard construction hours, Receivers R1, R2, R8

Plant item	Plant description	Noise Management Level, $L_{Aeq(15min)}$	Predicted Construction Noise Levels, $L_{Aeq(15min)}$; Far side – Near Side
Demolition, Excavation and Piling			
1.	Concrete saw	70	72-102
2.	Excavator with hammer	70	72-102
3.	Excavator with bucket	70	60-90
4.	Piling drilling rig	70	63-93
5.	Truck – cement mixer	70	60-90
6.	Concrete pump	70	54-84
7.	Concrete vibrator	70	52-82
8.	Bobcat	70	54-84
9.	Dump Truck	70	60-90
Construction			
10.	Powered hand tools	70	62-92
11.	Delivery trucks	70	58-88
12.	Truck – cement mixer	70	60-90
13.	Cherry picker	70	54-84
14.	Concrete pump	70	57-87
15.	Concrete vibrator	70	52-82
16.	Tower Crane (Diesel)	70	57-87
17.	Air compressor - silenced	70	47-77

The predictions above show that for the majority of plant items, noise emissions to receivers will comply with the Noise Management Level when equipment is working on the far side of the site (approximately 100m away). All equipment working on the near side (3m from receiver) would result in the receivers being Highly Affected. On that basis, in accordance with the Interim Construction Noise Guideline, the builder should apply feasible and reasonable work practices to reduce the construction noise to the receivers. In addition, the detailed construction noise management plan (prepared after approval, with input from the building contractor on their methodologies, schedules, and equipment) should consider consultation with the Highly Affected receivers to determine less sensitive periods for noisy works and the consideration of respite periods (without that resulting in unreasonable extension of the construction period).

Table 8-6 Predicted $L_{Aeq(15min)}$ noise levels for typical construction plant, Standard construction hours, Receivers R3, R4, R5, R6, R7

Plant item	Plant description	Noise Management Level, $L_{Aeq(15min)}$	Predicted Construction Noise Levels, $L_{Aeq(15min)}$; Far side – Near Side
Demolition, Excavation and Piling			
1.	Concrete saw	49	72-102

Plant item	Plant description	Noise Management Level, $L_{Aeq(15min)}$	Predicted Construction Noise Levels, $L_{Aeq(15min)}$; Far side – Near Side
2.	Excavator with hammer	49	72-102
3.	Excavator with bucket	49	60-90
4.	Piling drilling rig	49	63-93
5.	Truck – cement mixer	49	60-90
6.	Concrete pump	49	54-84
7.	Concrete vibrator	49	52-82
8.	Bobcat	49	54-84
9.	Dump Truck	49	60-90
Construction			
10.	Powered hand tools	49	62-92
11.	Delivery trucks	49	58-88
12.	Truck – cement mixer	49	60-90
13.	Cherry picker	49	54-84
14.	Concrete pump	49	57-87
15.	Concrete vibrator	49	52-82
16.	Tower Crane (Diesel)	49	57-87
17.	Air compressor - silenced	49	47-77

The predictions above show that for the vast majority of plant items, noise emissions to receivers will exceed the Noise Management Level at receivers. On that basis, the builder should apply all feasible and reasonable work practices to reduce the construction noise to the receivers. The particular measures would be determined in the detailed construction noise management plan.

In addition, the detailed construction noise management plan should also consider consultation with the Highly Affected receivers to determine less sensitive periods for noisy works and the consideration of respite periods (without that resulting in unreasonable extension of the construction period).

Table 8-7 Predicted $L_{Aeq(15min)}$ noise levels for typical construction plant, Standard construction hours, Church Receiver Opposite

Plant item	Plant description	Noise Management Level, internally when in use $L_{Aeq(15min)}$	Predicted Construction Noise Levels, $L_{Aeq(15min)}$; Far side – Near Side Inside Windows Open	Predicted Construction Noise Levels, $L_{Aeq(15min)}$; Far side – Near Side Inside Windows Closed
Demolition, Excavation and Piling				
1.	Concrete saw	45	57-70	42-55
2.	Excavator with hammer	45	57-70	42-55
3.	Excavator with bucket	45	45-58	30-43
4.	Piling drilling rig	45	48-61	33-46
5.	Truck – cement mixer	45	45-58	30-43
6.	Concrete pump	45	39-52	24-37

Plant item	Plant description	Noise Management Level, internally when in use $L_{Aeq(15min)}$	Predicted Construction Noise Levels, $L_{Aeq(15min)}$; Far side – Near Side Inside Windows Open	Predicted Construction Noise Levels, $L_{Aeq(15min)}$; Far side – Near Side Inside Windows Closed
7.	Concrete vibrator	45	37-50	22-35
8.	Bobcat	45	39-52	24-37
9.	Dump Truck	45	45-58	30-43
Construction				
10.	Powered hand tools	45	47-60	32-45
11.	Delivery trucks	45	43-56	28-41
12.	Truck – cement mixer	45	45-58	30-43
13.	Cherry picker	45	39-52	24-37
14.	Concrete pump	45	42-55	27-40
15.	Concrete vibrator	45	37-50	22-35
16.	Tower Crane (Diesel)	45	42-55	27-40
17.	Air compressor - silenced	45	32-45	17-30

The above predictions indicate that the majority of demolition, excavation, and construction would comply internally within the Church when the windows are closed (assuming an outside to inside noise reduction of 25dB(A)). Given the proximity of the Church to road traffic noise from Mona Vale Road, it is likely that services would be conducted with windows closed. However, the detailed construction noise management plan should take into account the times of services and uses of the Church particularly in respect of the noisier construction activities i.e. schedule hammering outside of service times.

8.4 General noise management measures

The following general noise management measures are recommended for all receiver locations:

- Use less noisy plant and equipment, where feasible and reasonable.
- Plant and equipment must be properly maintained.
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel where feasible and reasonable.
- Avoid any unnecessary noise when carrying out manual operations and when operating plant.
- Any equipment not in use for extended periods during construction work must be switched off.
- Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be limited/avoided where possible.
- The offset distance between noisy plant and adjacent sensitive receivers is to be maximised where practicable.

- Plant used intermittently to be throttled down or shut down when not in use where practicable.
- Noise-emitting plant to be directed away from sensitive receivers where possible.
- Staging of construction works so as to erect solid external walls first and utilising them to provide noise shielding to the noise sensitive receivers. However, the structural integrity of the external walls should be investigated prior to implementing this measure and should be prioritised over the noise benefits.
- 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 in excess of allowable limits.
- Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community must be adequately trained and experienced in such matters.

9 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/s2). Construction vibration goals are summarised below.

Construction vibration goals are summarised below.

A detailed construction vibration management plan shall be prepared toward the conclusion of the detailed design phase with input from the building contractor, so that it can take into account the proposed construction methodologies and equipment.

9.1 Disturbance to Buildings Occupants

Assessment of potential disturbance from vibration on human occupants of buildings is made in accordance with the DECC '*Assessing Vibration; a technical guideline*' (DECC, 2006). The guideline provides criteria which are based on the British Standard BS 6472-1992 '*Evaluation of human exposure to vibration in buildings (1-80Hz)*'. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent'. Table 9-1 provides definitions and examples of each type of vibration.

Table 9-1: Types of vibration

Type of vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

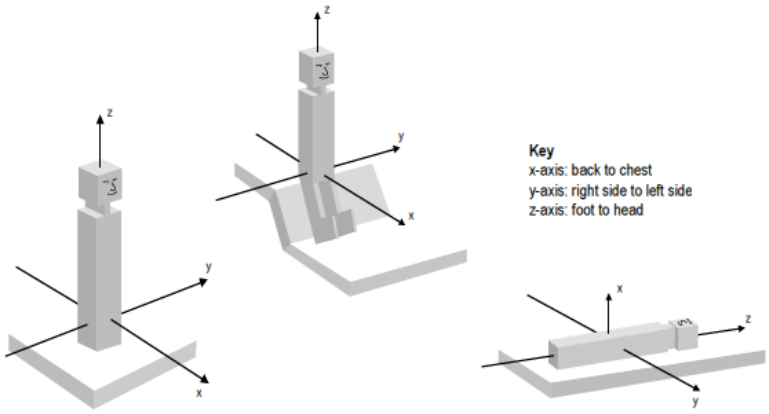
Source: Assessing Vibration; a technical guideline, Department of Environment & Climate Change, 2006

The vibration criteria are defined as a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

> *'Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472).'*

When applying the criteria, it is important to note that the three directional axes are referenced to the human body, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head). Vibration may enter the body along different orthogonal axes and affect it in different ways. Therefore, application of the criteria requires consideration of the position of the people being assessed, as illustrated in Figure 2. For example, vibration measured in the horizontal plane is compared with x- and y-axis criteria if the concern is for people in an upright position, or with the y- and z- axis criteria if the concern is for people in the lateral position.

Figure 2: Orthogonal axes for human exposure to vibration



The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced in Table 9-2.

Table 9-2: Preferred and maximum levels for human comfort

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Critical areas[2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
Impulsive vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Critical areas[2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92

Notes:
5. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am
6. 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. Stipulation of such criteria is outside the scope of their policy and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472-1992

The acceptable vibration dose values (VDV) for intermittent vibration are defined in Table 2.4 of the guideline and are reproduced in Table 9-3

Table 9-3: Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes:
7. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am
8. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous of impulsive criteria for critical areas.
Source: BS 6472-1992

9.2 Building Structural Damage

Potential structural damage of buildings as a result 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 x 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: 1990, 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 (1993) 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.

9.2.1.1 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 particular 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 9-4 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 9-4: 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

9.2.1.2 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 Table 9-5.

Table 9-5: 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

9.2.2 Damage to vibration sensitive equipment

Some high technology manufacturing facilities, hospitals and laboratories utilise equipment that is highly sensitive and susceptible to vibration, for example scanning electron microscopes and micro-electronic manufacturing facilities. In addition, buildings housing sensitive computer or telecommunications equipment may require assessment against stricter criteria than those nominated for building damage.

Given that the adjacent premises are dwelling houses, it is highly unlikely any would contain vibration sensitive equipment.

9.2.3 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 Table 9-6 below.

Table 9-6: DIN 4150-3:2016 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 at the pipe, mm/s
1	Steel, welded	100
2	Vitrified clay, concrete, reinforced concrete, prestressed concrete, metal (with or without flange)	80
3	Masonry, plastics	50

Note: For gas and water supply pipes within 2 m of buildings, the levels given in Table 9-5 should be applied. Consideration must also be given to pipe junctions with the building structure as potential significant changes in mechanical loads on the pipe must be considered.

For long-term vibration the guideline levels presented in Table 9-6 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 CNVIS addressing impact on the utility and consultation with the utility provider to confirm specific vibration requirements.

9.3 Construction vibration assessment

The vibration generated from construction works will vary depending on the level and type of activity carried out at each site during each activity.

Potential vibration generated at receivers for this project will be dependent on separation distances, the intervening soil and rock strata, dominant frequencies of vibration and the receiver building's construction and structure. The recommended minimum working distances for vibration intensive plant are presented in Table 9-7, however these should be verified with site measurements

Table 9-7 Recommended minimum working distances for vibration intensive equipment

Plant item	Minimum working distance, m			
	Cosmetic damage			Human disturbance
	Commercial and industrial buildings[1]	Dwellings and similar structures[1]	Sensitive structures (e.g. heritage) [1]	Residences Day[2]
Pneumatic Hammer	5-10	10	20	10
Bored Piling	5	5	10	10

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

Site specific buffer distances for vibration significant plant items must be measured on site where plant and equipment is likely to operate close to or within the minimum working distances for cosmetic damage.

Unlike noise, vibration from construction activities is difficult to predict due to many variables from site to site, for example soil type and conditions; sub surface rock; building types and foundations; and actual plant on site. The data relied upon in this assessment (tabulated above) is taken from a database of vibration levels measured at various sites or obtained from other sources (eg. BS5228-2:2009). They are not specific to this project as final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver.

The Church receivers are >40m away from the construction activities and so it is unlikely they will be impacted by vibration from the site.

Some neighbouring residential receiver dwellings are within the safe working distances (e.g. 6 Flinders Ave, 283 Mona Vale Road etc) and so on site measurements will be required prior to/at the commencement of work to determine the site specific vibration impacts. Further, a detailed construction vibration management plan will need to be prepared as part of the detailed design phase, once more detail is known of the particular equipment to be used on site. It is likely that vibration monitoring will be required during excavation and the construction of the building structure (would not be required during fitout).

10 Conclusion

Renzo Tonin & Associates have completed an assessment of the potential noise impacts to and from the proposed residential care facility at 285, 287, 287A and 289 Mona Vale Road and 1 Flinders Avenue, St Ives in accordance with the SEARs for Seniors Housing for a residential care facility.

In order to control traffic noise intrusion and comply with the nominated criteria, glazing and external building shell recommendations have been made in Section 4 above. A follow up assessment of noise intrusion will be required prior to construction certificate.

Recommendations to comply with noise emission criteria for the site, including mechanical plant (including vibration isolation for reciprocating plant), noise from traffic generated by the development and noise from use of café, pavilion and wellness centre have been presented in Section 5 of this report. A review of noise emission and refinement of particular treatments will be required prior to construction certificate.

Ratings are nominated for the internal acoustic separation within the building in Section 6 and reverberant noise goals for acoustic amenity are presented in Section 7, along with indicative treatments for compliance with same. These treatments will be refined during detailed design.

In conclusion, the proposed site is capable of complying with all relevant acoustic criteria through means of some standard and other specialised acoustic treatment and management.

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 every day 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 Leq 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 Results of unattended noise monitoring

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

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Front yard facing traffic - 289 Mona Vale Road, St Ives

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

Periods with insufficient results excluded	L_{A90} Background Noise Levels[4]			L_{Aeq} Ambient Noise Levels		
Date	**Day[1]**	**Evening[2]**	**Night[3]**	**Day[1]**	**Evening[2]**	**Night[3]**
Monday-10-October-2022	-	47	28	-	67	63
Tuesday-11-October-2022	58	50	29	69	66	64
Wednesday-12-October-2022	60	51	32	70	66	64
Thursday-13-October-2022	61	53	34	69	67	64
Friday-14-October-2022	61	53	32	70	66	62
Saturday-15-October-2022	61	53	31	69	67	62
Sunday-16-October-2022	59	50	31	69	66	64
Monday-17-October-2022	61	49	28	71	66	64
Tuesday-18-October-2022	60	52	30	70	66	64
Wednesday-19-October-2022	-	-	-	-	-	-
Representative Weekday[5]	**60**	**51**	**30**	**70**	**66**	**64**
Representative Weekend[5]	**60**	**52**	**31**	**69**	**66**	**63**
Representative Week[5]	**60**	**51**	**31**	**70**	**66**	**64**

Notes:

1. Day is 7:00am to 6:00pm on all days except Sundays and Public Holidays when it is 8:00am to 6:00pm 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 L_{A90} and logarithmic average for L_{Aeq} 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.

Front yard facing traffic - 289 Mona Vale Road, St Ives

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

Periods with insufficient results excluded	L_{Aeq} Noise Levels		$L_{Aeq\ 1hr}$ Noise Levels			
Date	**Day[1]**	**Night[2]**	**Day - Up[4]**	**Day - Low[5]**	**Night - Up[4]**	**Night - Low[5]**
Monday-10-October-2022	-	66	-	-	69	59
Tuesday-11-October-2022	71	66	72	68	69	59
Wednesday-12-October-2022	72	66	73	68	70	60
Thursday-13-October-2022	71	66	72	68	71	60
Friday-14-October-2022	71	65	73	68	67	59
Saturday-15-October-2022	71	64	72	69	67	59
Sunday-16-October-2022	71	67	72	68	70	58
Monday-17-October-2022	72	67	74	68	70	59
Tuesday-18-October-2022	72	67	73	68	70	60
Wednesday-19-October-2022	-	-	-	-	-	-
Representative Weekday[3]	**72**	**66**	**73**	**68**	**70**	**59**
Representative Weekend[3]	**71**	**65**	**72**	**68**	**68**	**58**
Representative Week[3]	**71**	**66**	**73**	**68**	**70**	**59**

Notes:

1. Day is 7:00am to 10:00pm 2. Night is 10:00pm to 7:00am 3. Median of daily L_{Aeq}

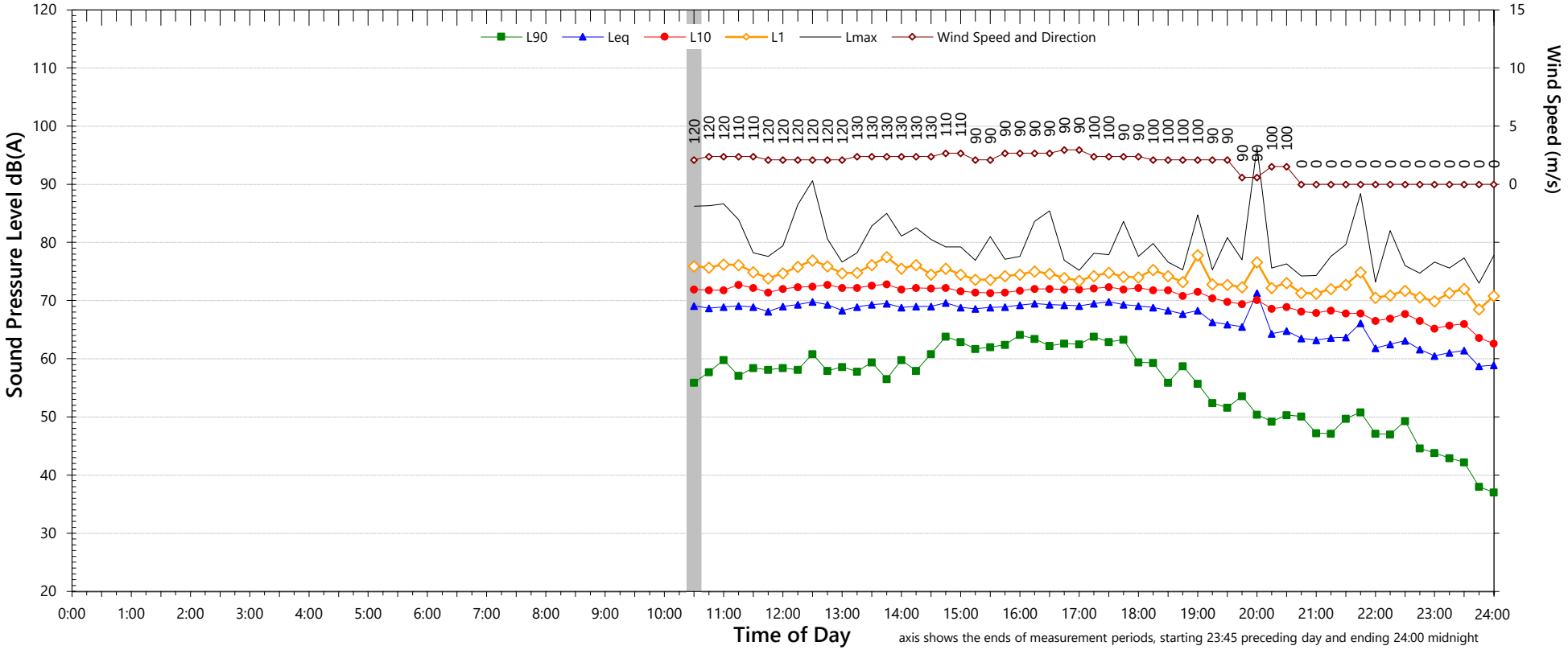
4. Upper 10th percentile $L_{Aeq\ 1hr}$ 5. Lower 10th percentile $L_{Aeq\ 1hr}$

6. Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Monday, 10 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	-	47	28
L_{Aeq}	-	67	63

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	-	66
$L_{Aeq\ 1hr}$ upper 10 percentile	-	69
$L_{Aeq\ 1hr}$ lower 10 percentile	-	59

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	77	to	86
L_{AFMax} - L_{Aeq} (Range)	16	to	25

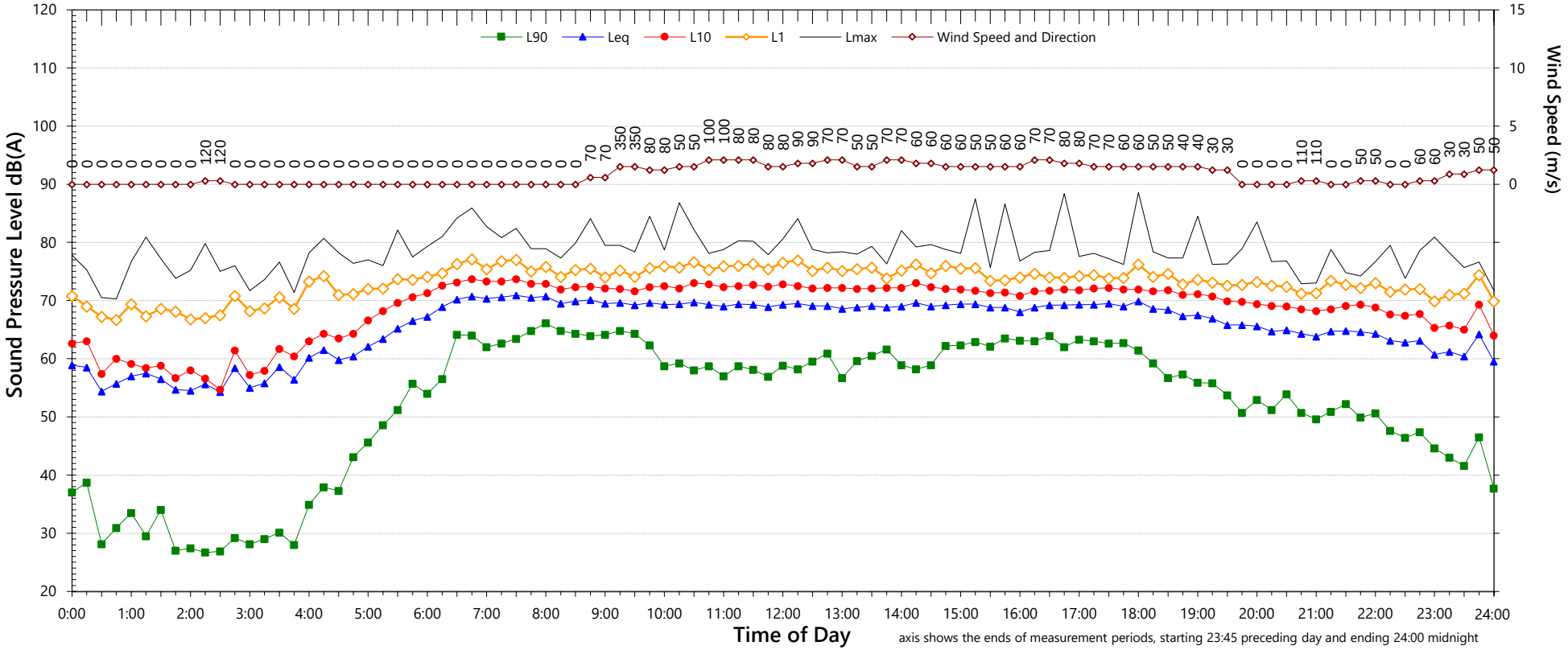
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Tuesday, 11 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	58	50	29
L_{Aeq}	69	66	64

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	77	to	84
L_{AFMax} - L_{Aeq} (Range)	16	to	25

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	71	66
$L_{Aeq\ 1hr}$ upper 10 percentile	72	69
$L_{Aeq\ 1hr}$ lower 10 percentile	68	59

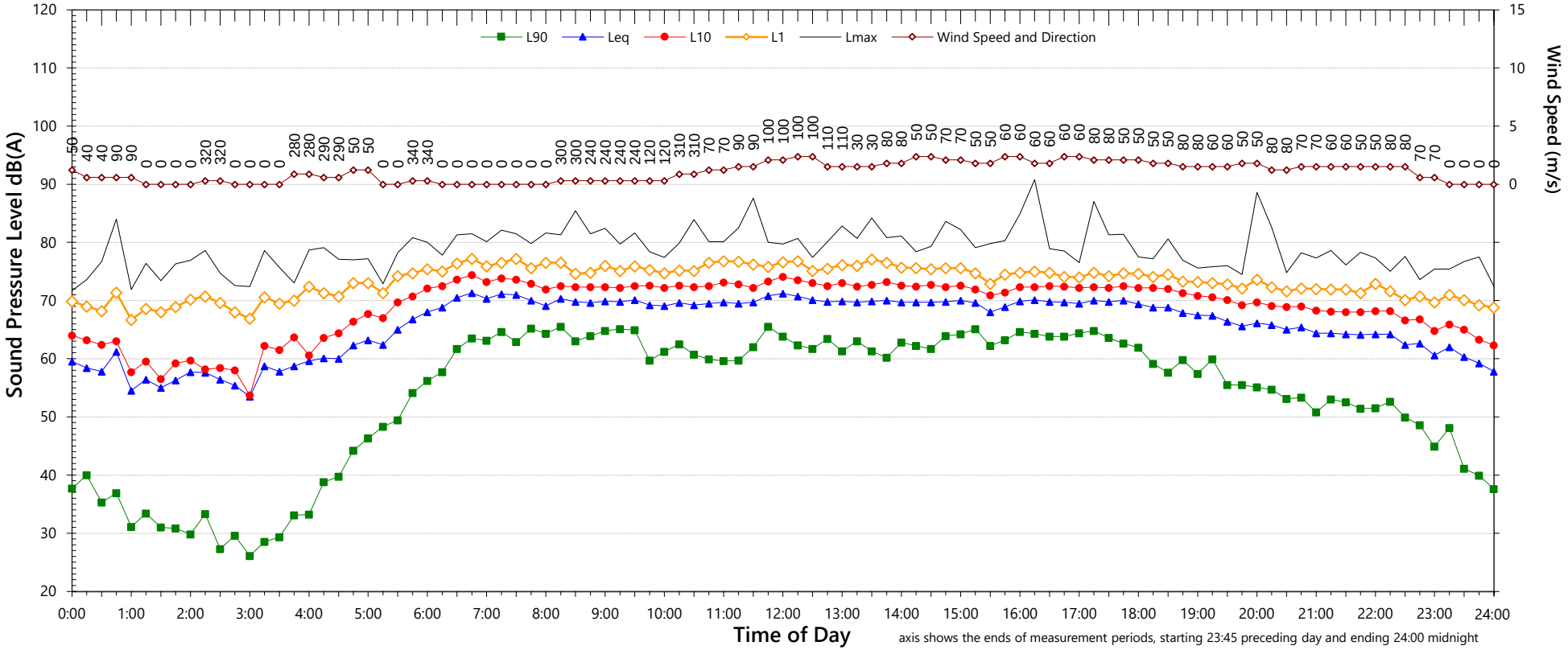
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Wednesday, 12 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{A90} ABL	60	51	32
L_{Aeq}	70	66	64

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	78	to	83
L_{AFMax} - L_{Aeq} (Range)	17	to	26

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	72	66
$L_{Aeq\ 1hr}$ upper 10 percentile	73	70
$L_{Aeq\ 1hr}$ lower 10 percentile	68	60

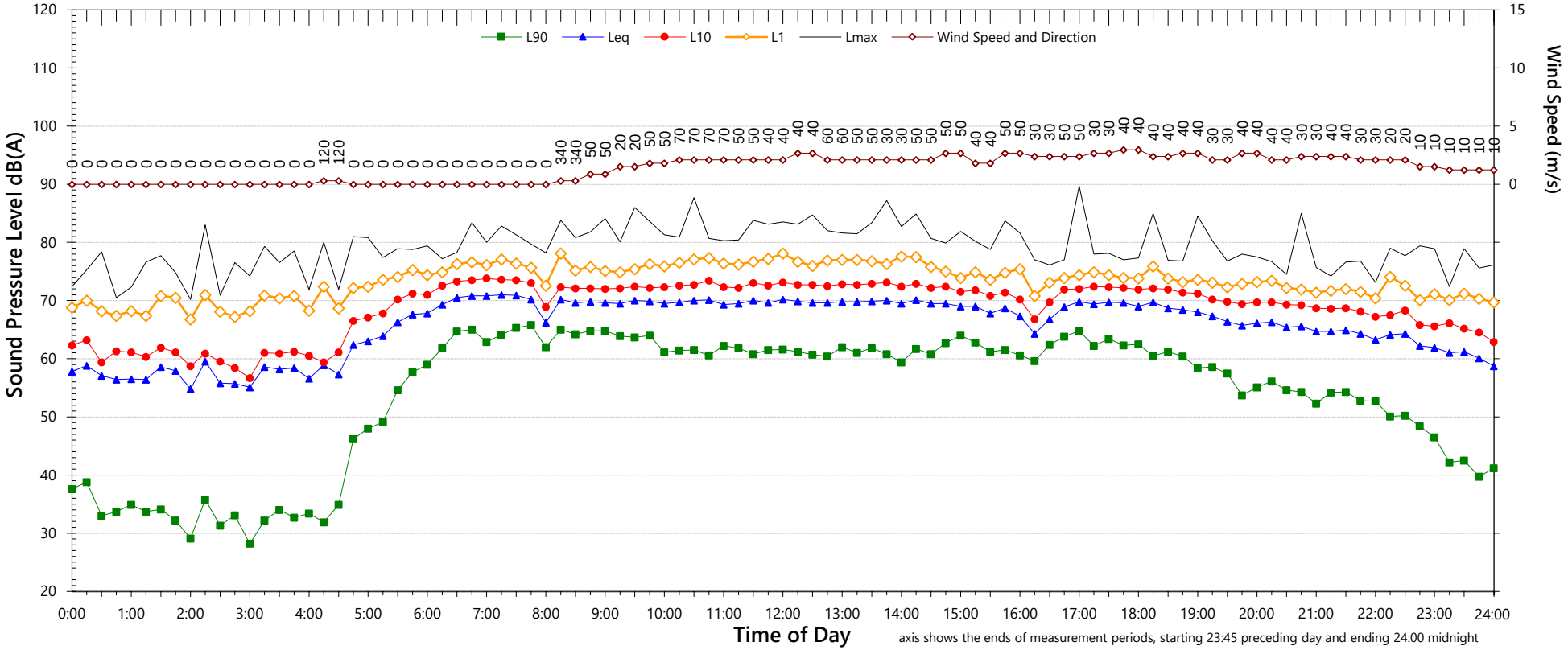
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Thursday, 13 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	61	53	34
L_{Aeq}	69	67	64

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	77	to	84
L_{AFMax} - L_{Aeq} (Range)	16	to	27

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	71	66
$L_{Aeq\ 1hr}$ upper 10 percentile	72	71
$L_{Aeq\ 1hr}$ lower 10 percentile	68	60

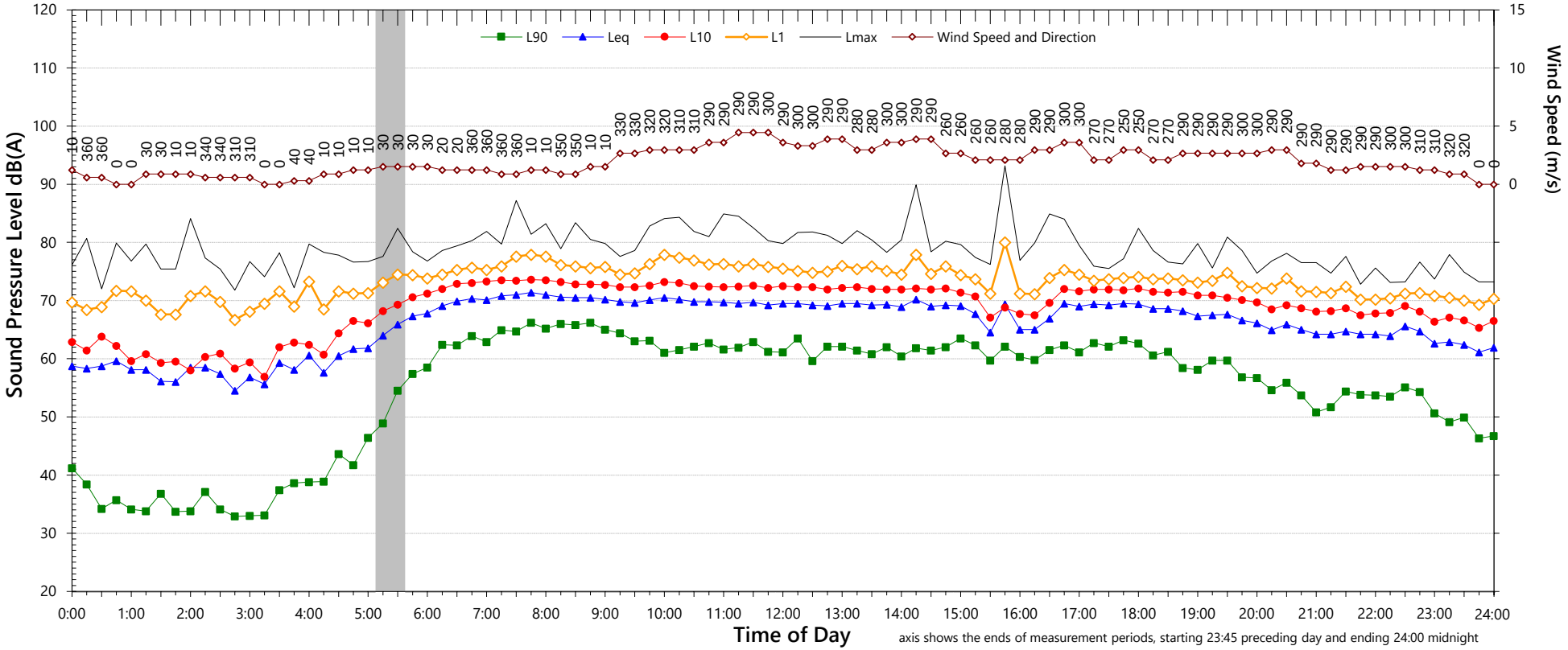
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Friday, 14 October 2022



NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	61	53	32
L_{Aeq}	70	66	62

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	71	65
$L_{Aeq\ 1hr}$ upper 10 percentile	73	67
$L_{Aeq\ 1hr}$ lower 10 percentile	68	59

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	77	to	82
L_{AFMax} - L_{Aeq} (Range)	16	to	23

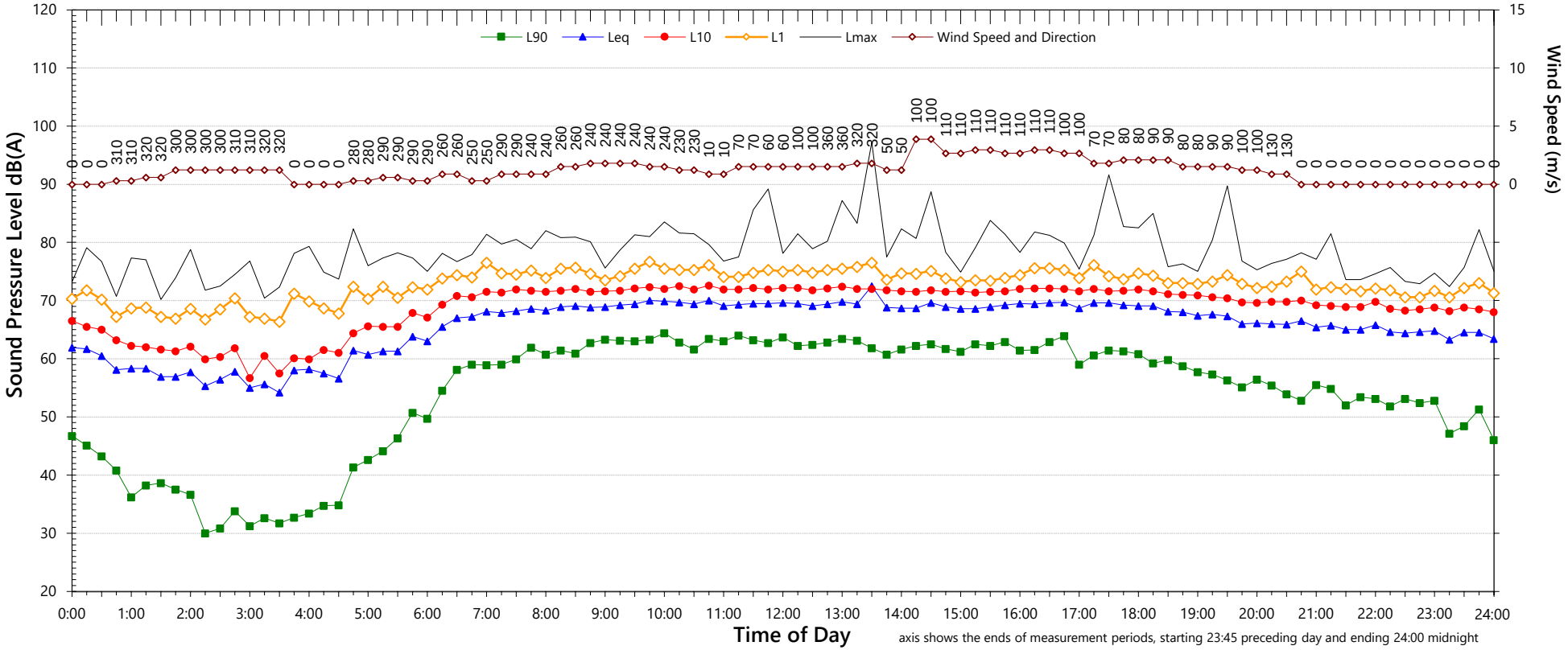
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Saturday, 15 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	61	53	31
L_{Aeq}	69	67	62

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	74	to	86
L_{AFMax} - L_{Aeq} (Range)	17	to	26

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	71	64
$L_{Aeq\ 1hr}$ upper 10 percentile	72	67
$L_{Aeq\ 1hr}$ lower 10 percentile	69	59

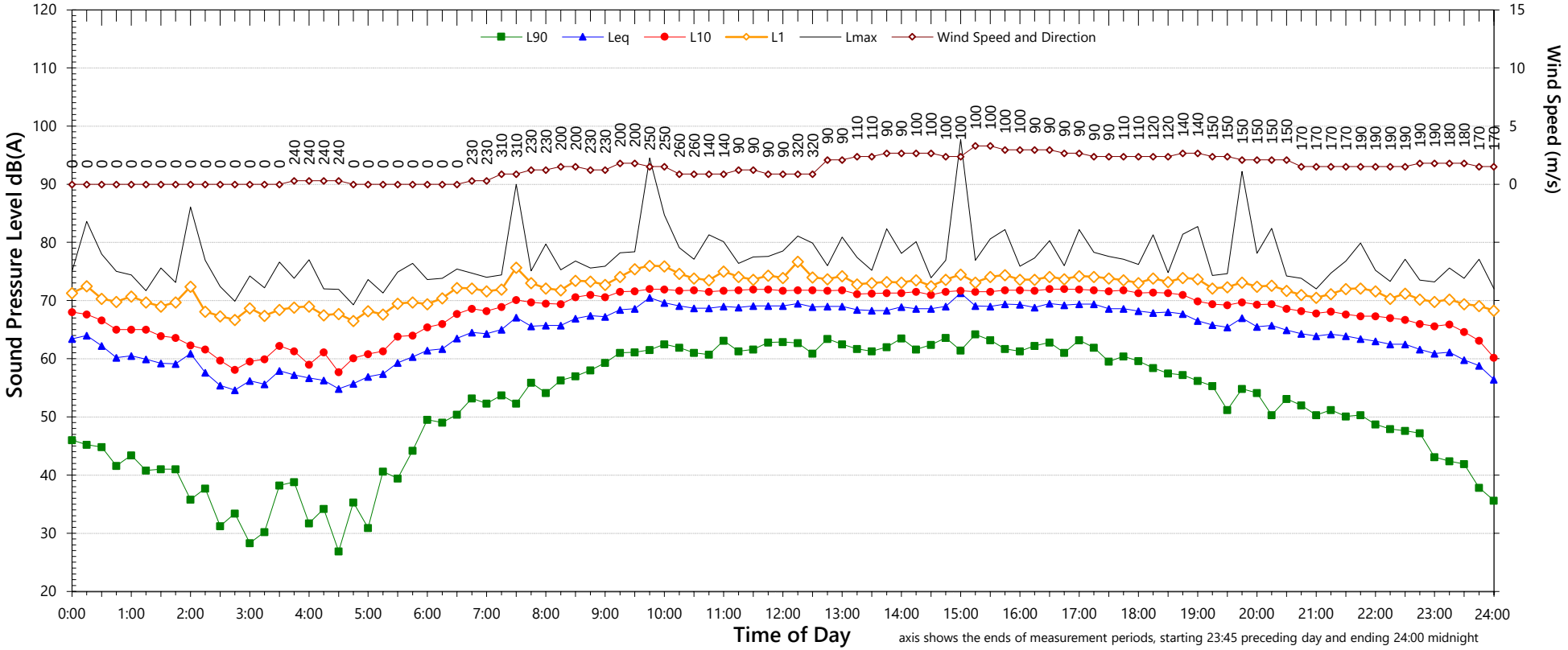
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Sunday, 16 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	59	50	31
L_{Aeq}	69	66	64

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	71	67
$L_{Aeq\ 1hr}$ upper 10 percentile	72	70
$L_{Aeq\ 1hr}$ lower 10 percentile	68	58

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	74	to	79
L_{AFMax} - L_{Aeq} (Range)	15	to	23

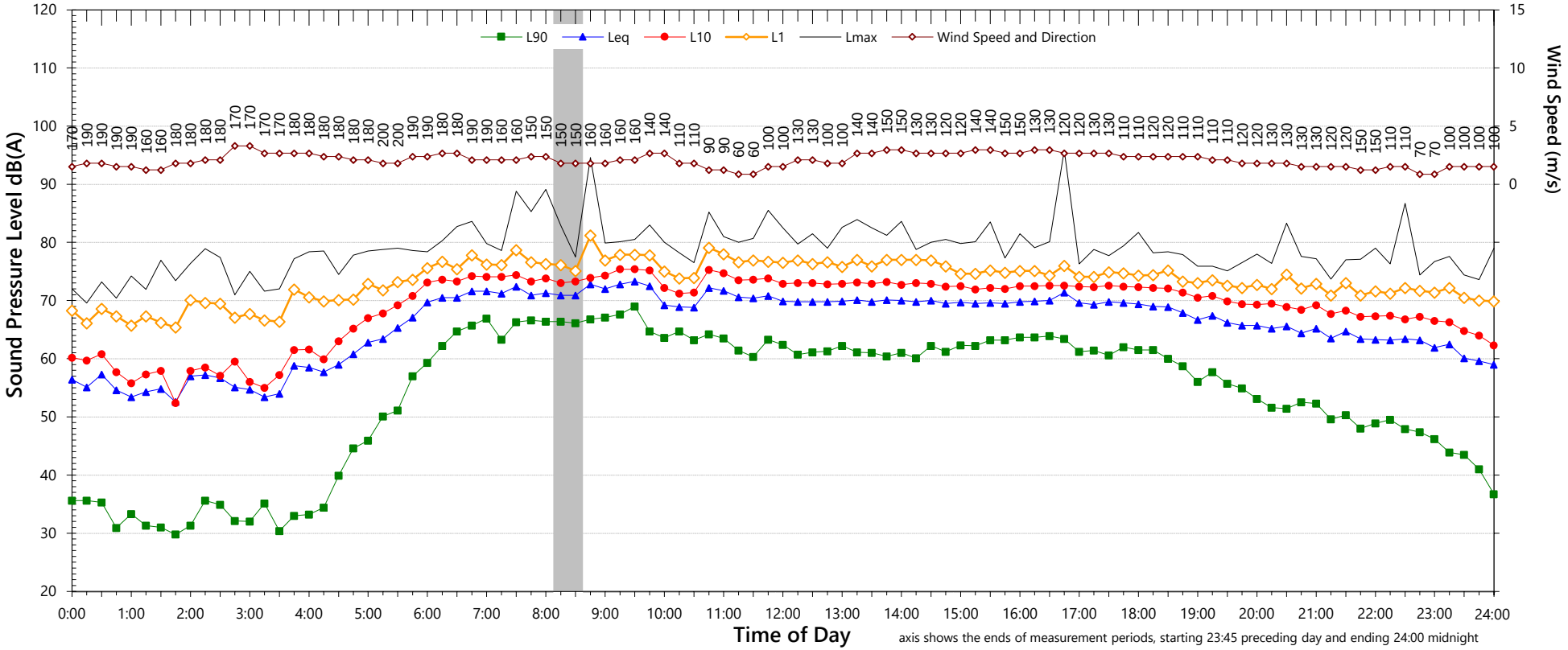
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Monday, 17 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	61	49	28
L_{Aeq}	71	66	64

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	72	67
$L_{Aeq\ 1hr}$ upper 10 percentile	74	70
$L_{Aeq\ 1hr}$ lower 10 percentile	68	59

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	77	to	87
L_{AFMax} - L_{Aeq} (Range)	18	to	24

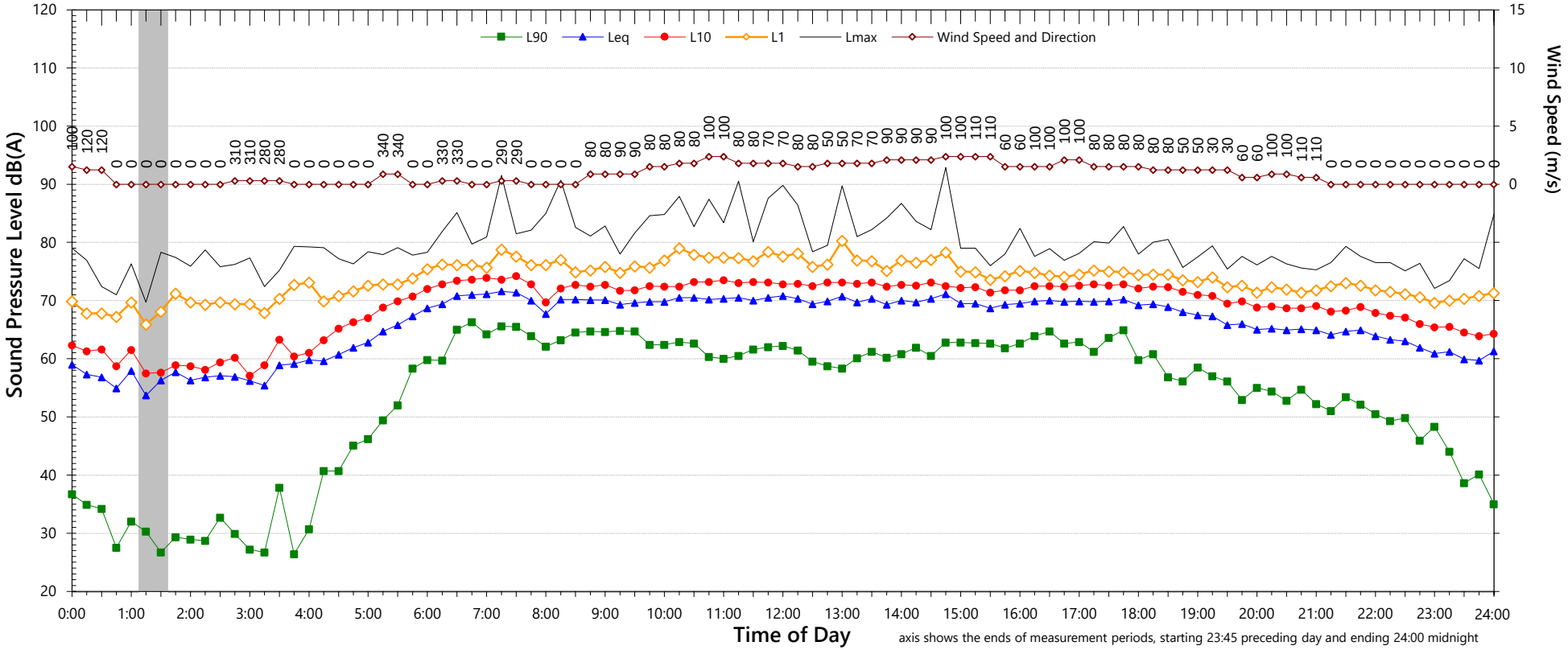
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Tuesday, 18 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	60	52	30
L_{Aeq}	70	66	64

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	78	to	86
L_{AFMax} - L_{Aeq} (Range)	16	to	24

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	72	67
$L_{Aeq\ 1hr}$ upper 10 percentile	73	70
$L_{Aeq\ 1hr}$ lower 10 percentile	68	60

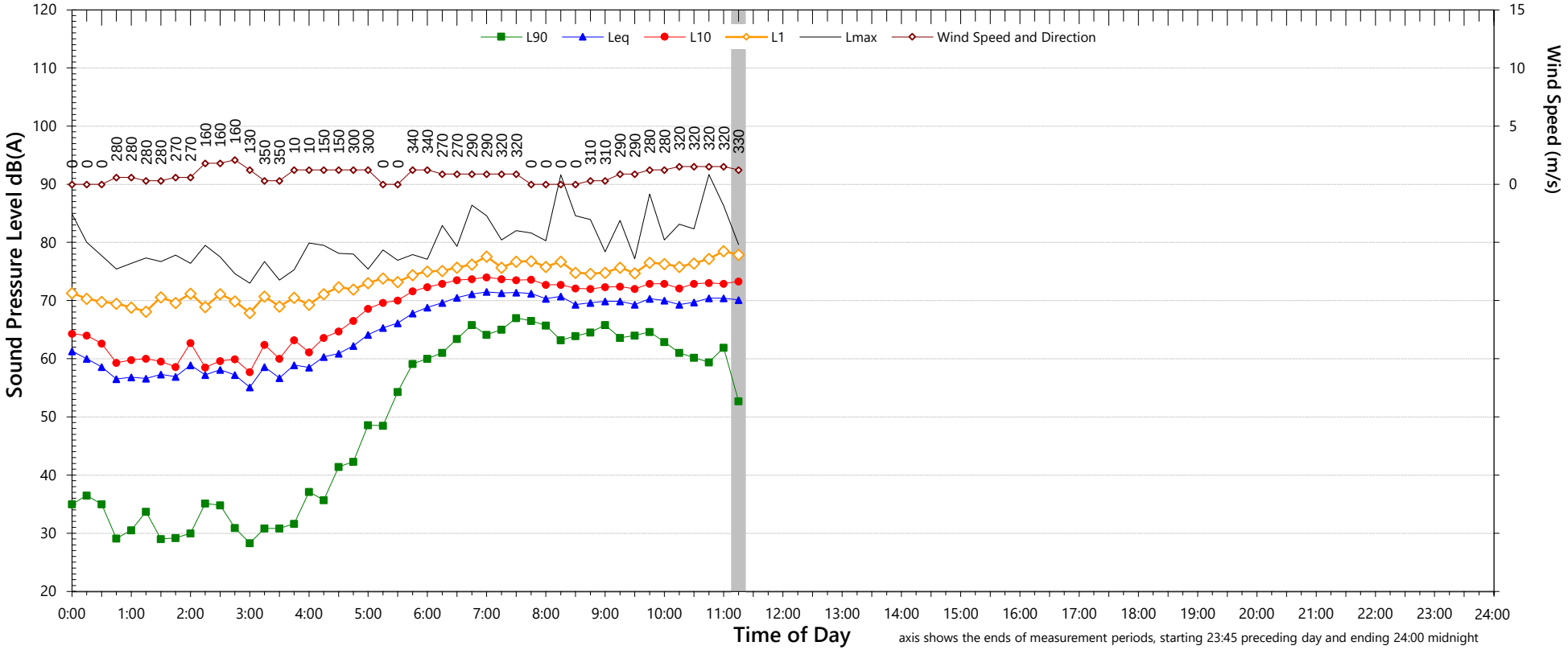
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Front yard facing traffic - 289 Mona Vale Road, St Ives

Wednesday, 19 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	-	-	-
L_{Aeq}	-	-	-

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	-	to	-
L_{AFMax} - L_{Aeq} (Range)	-	to	-

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	-	-
$L_{Aeq\ 1hr}$ upper 10 percentile	-	-
$L_{Aeq\ 1hr}$ lower 10 percentile	-	-

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

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Rear Yard 285 Mona Vale Road, St Ives

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

Periods with insufficient results excluded	L_{A90} Background Noise Levels[4]			L_{Aeq} Ambient Noise Levels		
Date	**Day[1]**	**Evening[2]**	**Night[3]**	**Day[1]**	**Evening[2]**	**Night[3]**
Monday-10-October-2022	-	34	25	-	45	39
Tuesday-11-October-2022	39	36	26	47	42	39
Wednesday-12-October-2022	38	36	28	48	44	45
Thursday-13-October-2022	41	40	31	48	47	43
Friday-14-October-2022	41	37	28	56	46	42
Saturday-15-October-2022	37	34	25	49	43	43
Sunday-16-October-2022	35	34	29	48	44	42
Monday-17-October-2022	40	32	25	49	46	41
Tuesday-18-October-2022	38	34	27	50	44	40
Wednesday-19-October-2022	-	-	-	-	-	-
Representative Weekday[5]	**40**	**36**	**30[7] (27)**	**51**	**45**	**42**
Representative Weekend[5]	**36**	**34**	**30[7] (27)**	**49**	**44**	**43**
Representative Week[5]	**39**	**34**	**30[7] (27)**	**50**	**45**	**42**

Notes:

1. Day is 7:00am to 6:00pm on all days except Sundays and Public Holidays when it is 8:00am to 6:00pm 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 L_{A90} and logarithmic average for L_{Aeq} 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.

Rear Yard 285 Mona Vale Road, St Ives

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

Periods with insufficient results excluded	L_{Aeq} Noise Levels		$L_{Aeq\ 1hr}$ Noise Levels			
Date	**Day[1]**	**Night[2]**	**Day - Up[4]**	**Day - Low[5]**	**Night - Up[4]**	**Night - Low[5]**
Monday-10-October-2022	-	41	-	-	44	32
Tuesday-11-October-2022	49	42	52	44	45	33
Wednesday-12-October-2022	50	47	52	46	53	36
Thursday-13-October-2022	51	45	52	48	48	37
Friday-14-October-2022	57	45	56	47	49	35
Saturday-15-October-2022	51	43	53	44	45	31
Sunday-16-October-2022	50	45	52	45	49	36
Monday-17-October-2022	51	43	54	47	49	31
Tuesday-18-October-2022	51	43	54	46	47	33
Wednesday-19-October-2022	-	-	-	-	-	-
Representative Weekday[3]	**51**	**43**	**53**	**47**	**48**	**33**
Representative Weekend[3]	**50**	**44**	**52**	**45**	**47**	**34**
Representative Week[3]	**51**	**43**	**52**	**46**	**48**	**33**

Notes:

1. Day is 7:00am to 10:00pm 2. Night is 10:00pm to 7:00am 3. Median of daily L_{Aeq}

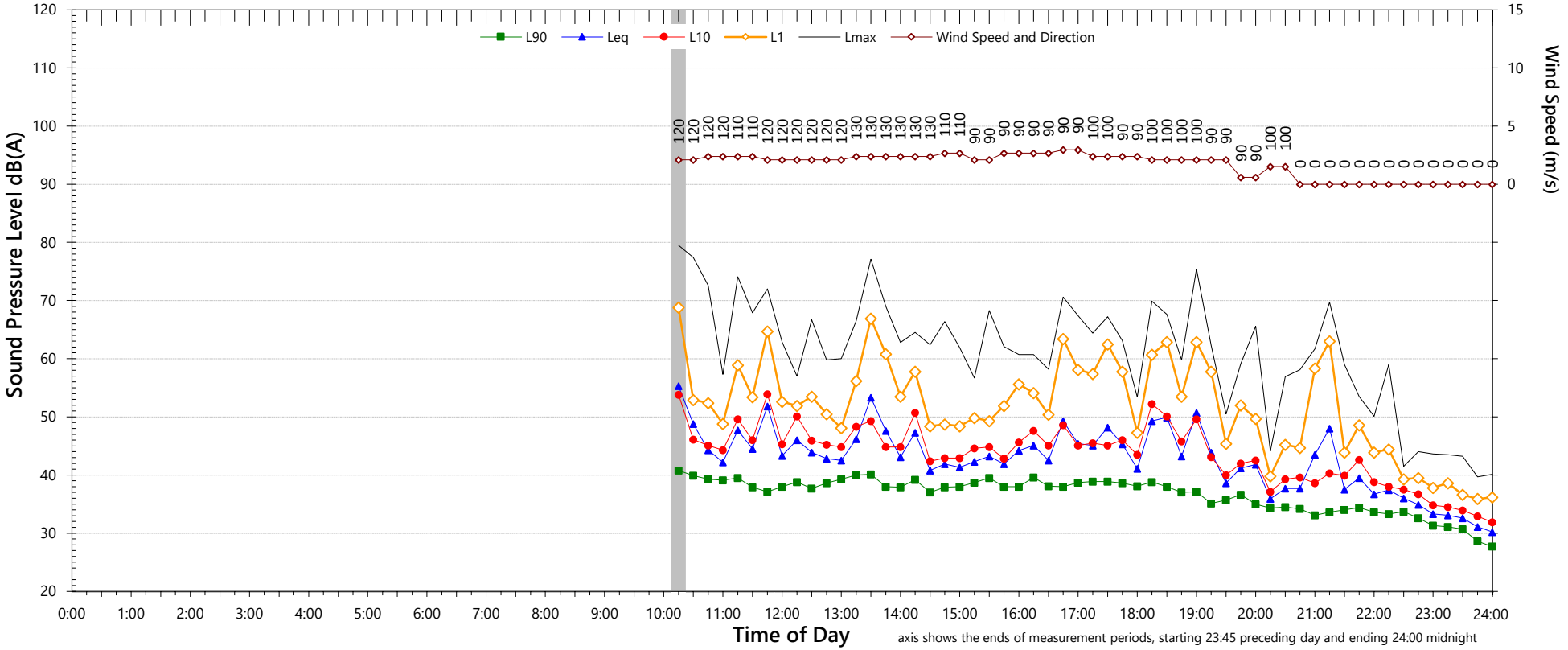
4. Upper 10th percentile $L_{Aeq\ 1hr}$ 5. Lower 10th percentile $L_{Aeq\ 1hr}$

6. Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Monday, 10 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{A90} ABL	-	34	25
L_{Aeq}	-	45	39

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	68	to	74
L_{AFMax} - L_{Aeq} (Range)	23	to	30

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	-	41
$L_{Aeq\ 1hr}$ upper 10 percentile	-	44
$L_{Aeq\ 1hr}$ lower 10 percentile	-	32

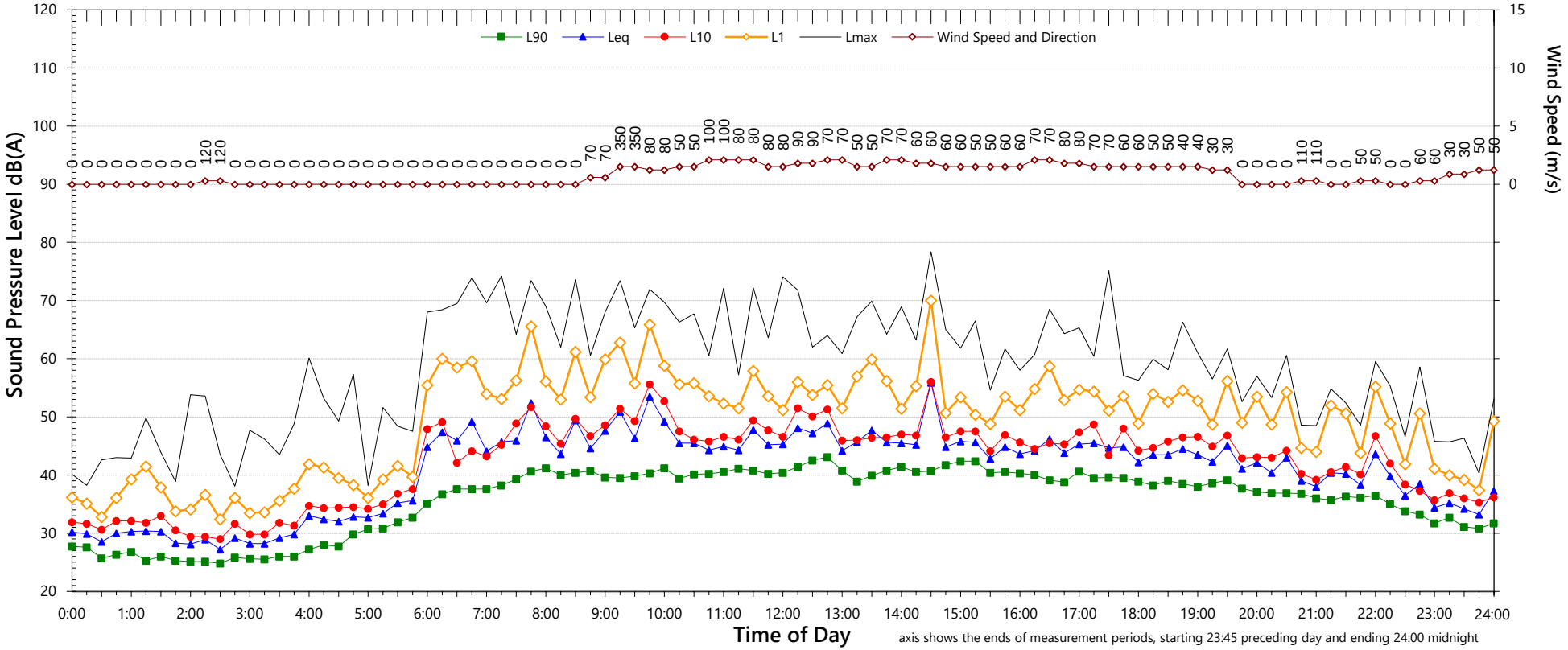
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Tuesday, 11 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	39	36	26
L_{Aeq}	47	42	39

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	49	42
$L_{Aeq\ 1hr}$ upper 10 percentile	52	45
$L_{Aeq\ 1hr}$ lower 10 percentile	44	33

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	71	to	71
L_{AFMax} - L_{Aeq} (Range)	15	to	24

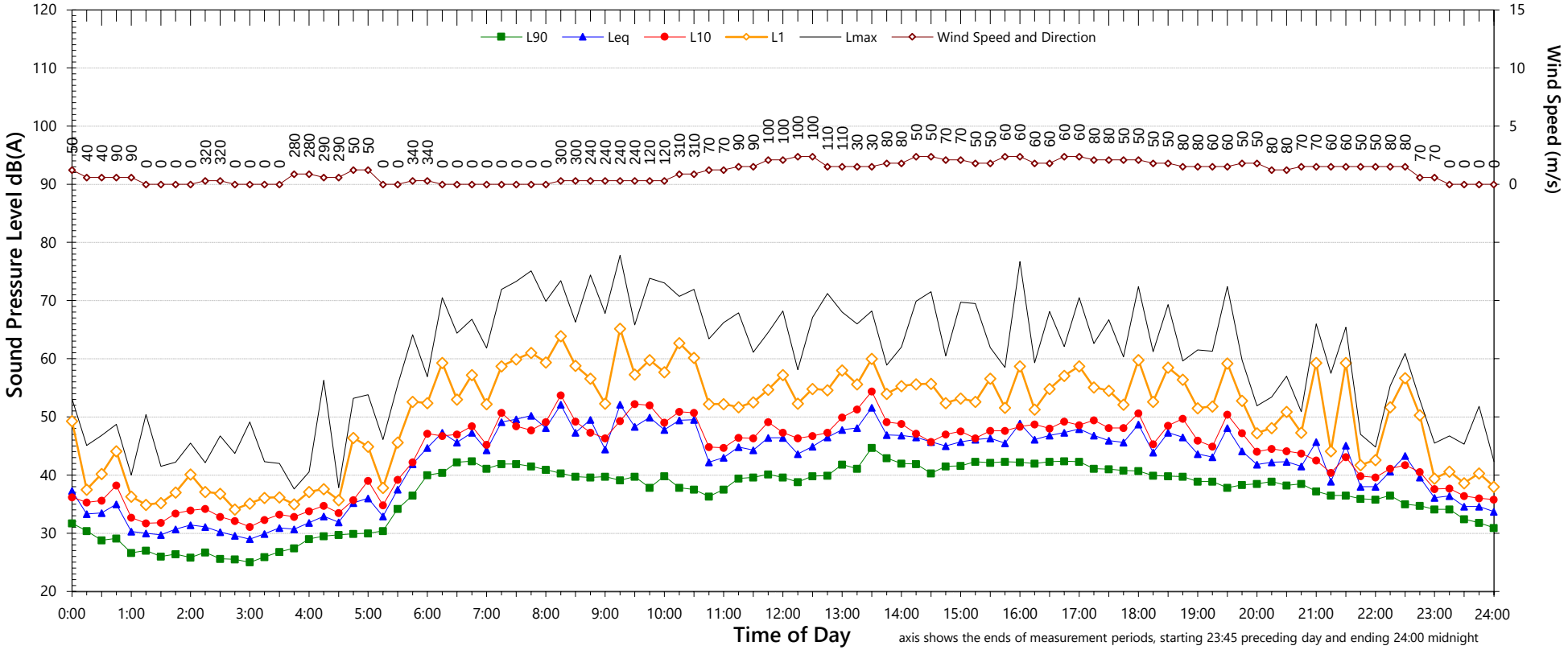
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Wednesday, 12 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{A90} ABL	38	36	28
L_{Aeq}	48	44	45

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	66	to	86
L_{AFMax} - L_{Aeq} (Range)	17	to	35

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	50	47
$L_{Aeq\ 1hr}$ upper 10 percentile	52	53
$L_{Aeq\ 1hr}$ lower 10 percentile	46	36

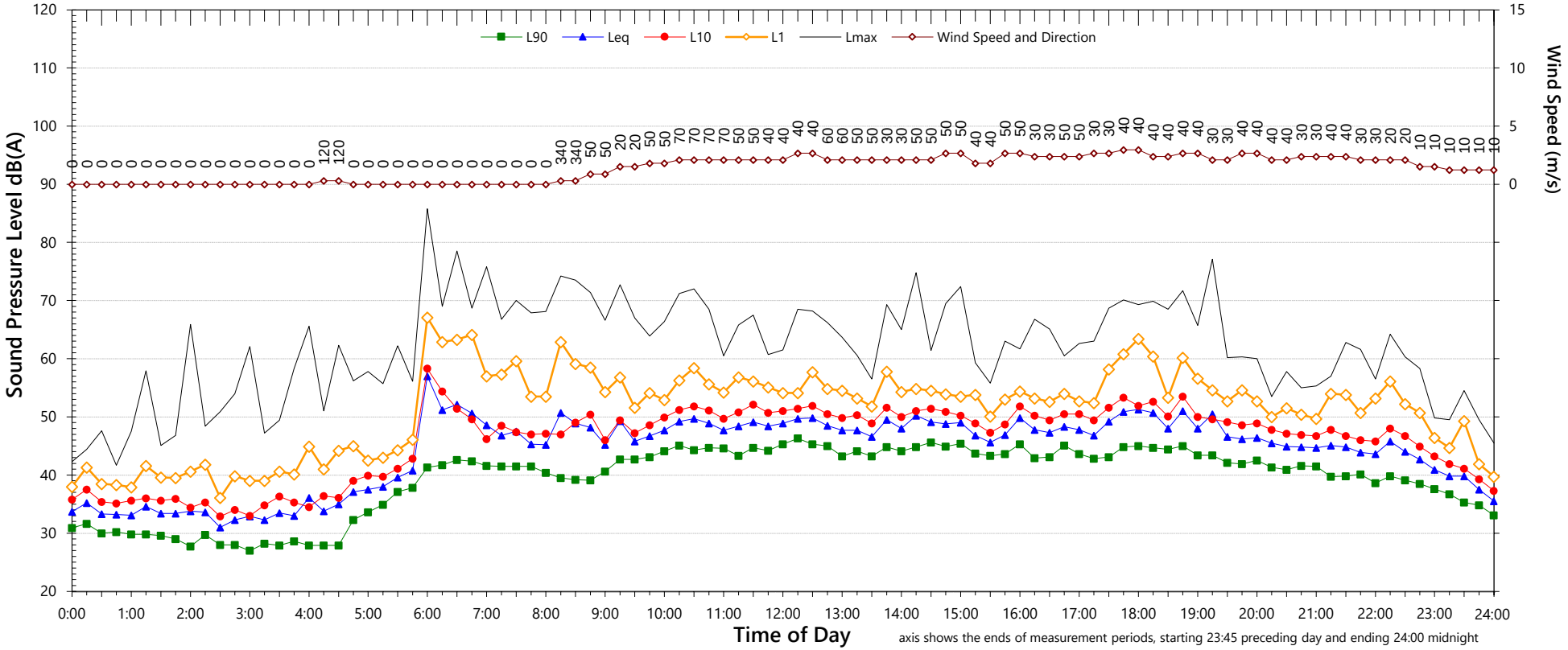
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Thursday, 13 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	41	40	31
L_{Aeq}	48	47	43

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	72	to	72
L_{AFMax} - L_{Aeq} (Range)	15	to	23

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	51	45
$L_{Aeq\ 1hr}$ upper 10 percentile	52	48
$L_{Aeq\ 1hr}$ lower 10 percentile	48	37

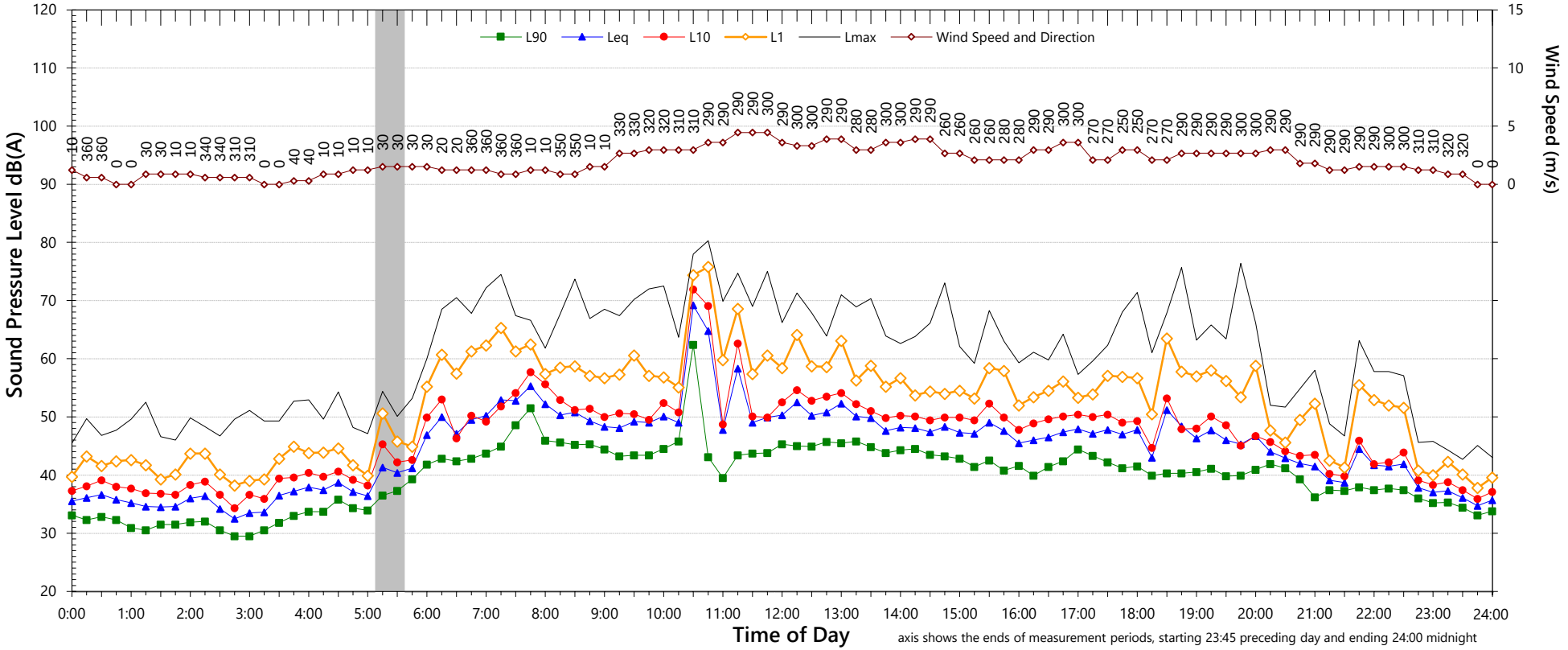
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Friday, 14 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	41	37	28
L_{Aeq}	56	46	42

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	57	45
$L_{Aeq\ 1hr}$ upper 10 percentile	56	49
$L_{Aeq\ 1hr}$ lower 10 percentile	47	35

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	77	to	79
L_{AFMax} - L_{Aeq} (Range)	18	to	32

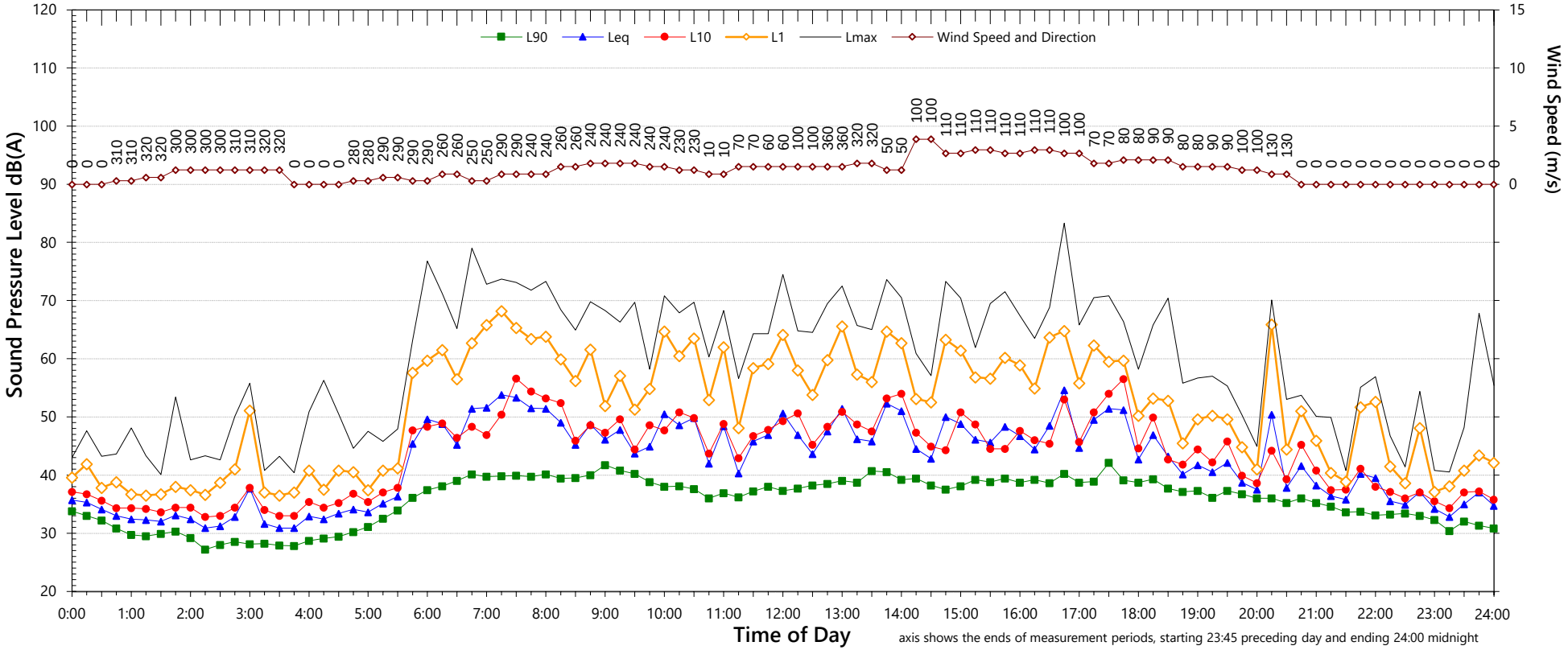
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Saturday, 15 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{A90} ABL	37	34	25
L_{Aeq}	49	43	43

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	68	to	77
L_{AFMax} - L_{Aeq} (Range)	17	to	33

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	51	43
$L_{Aeq\ 1hr}$ upper 10 percentile	53	45
$L_{Aeq\ 1hr}$ lower 10 percentile	44	31

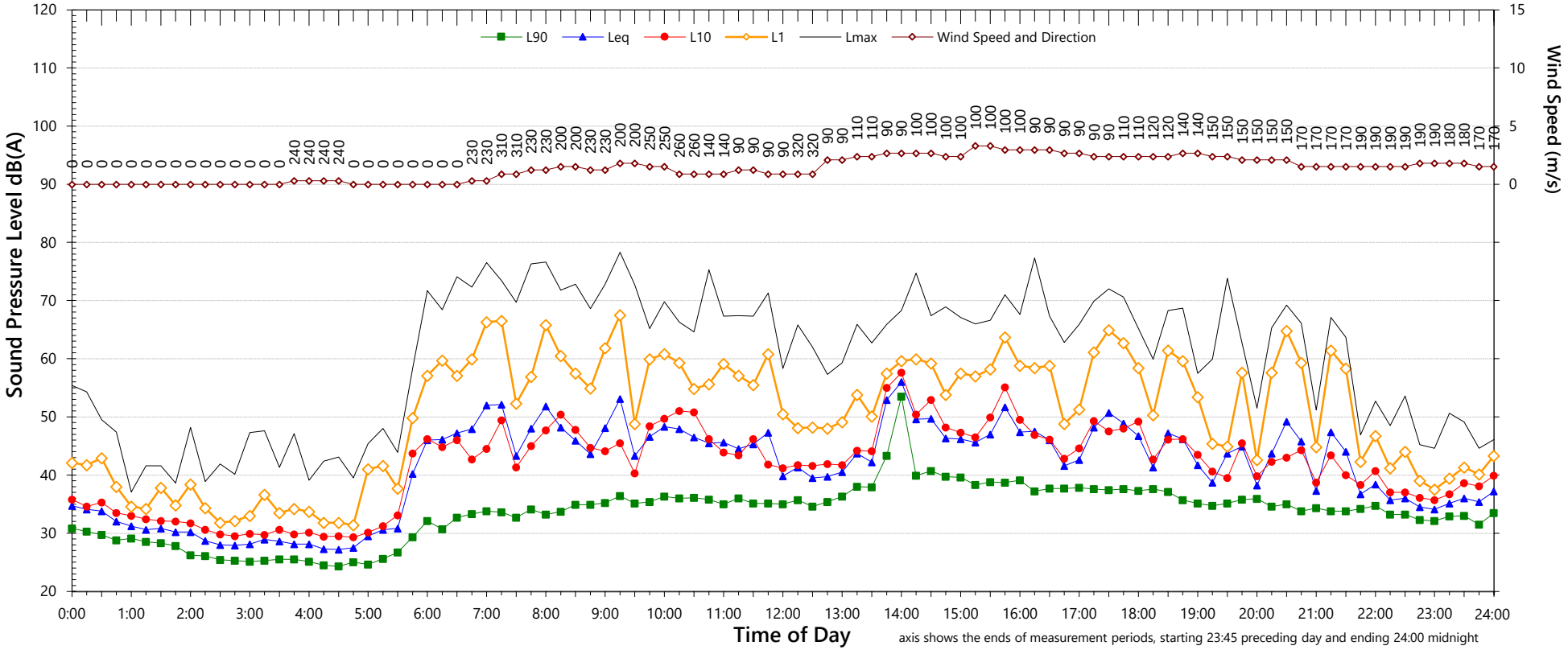
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Sunday, 16 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	35	34	29
L_{Aeq}	48	44	42

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	50	45
$L_{Aeq\ 1hr}$ upper 10 percentile	52	49
$L_{Aeq\ 1hr}$ lower 10 percentile	45	36

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	67	to	73
L_{AFMax} - L_{Aeq} (Range)	18	to	24

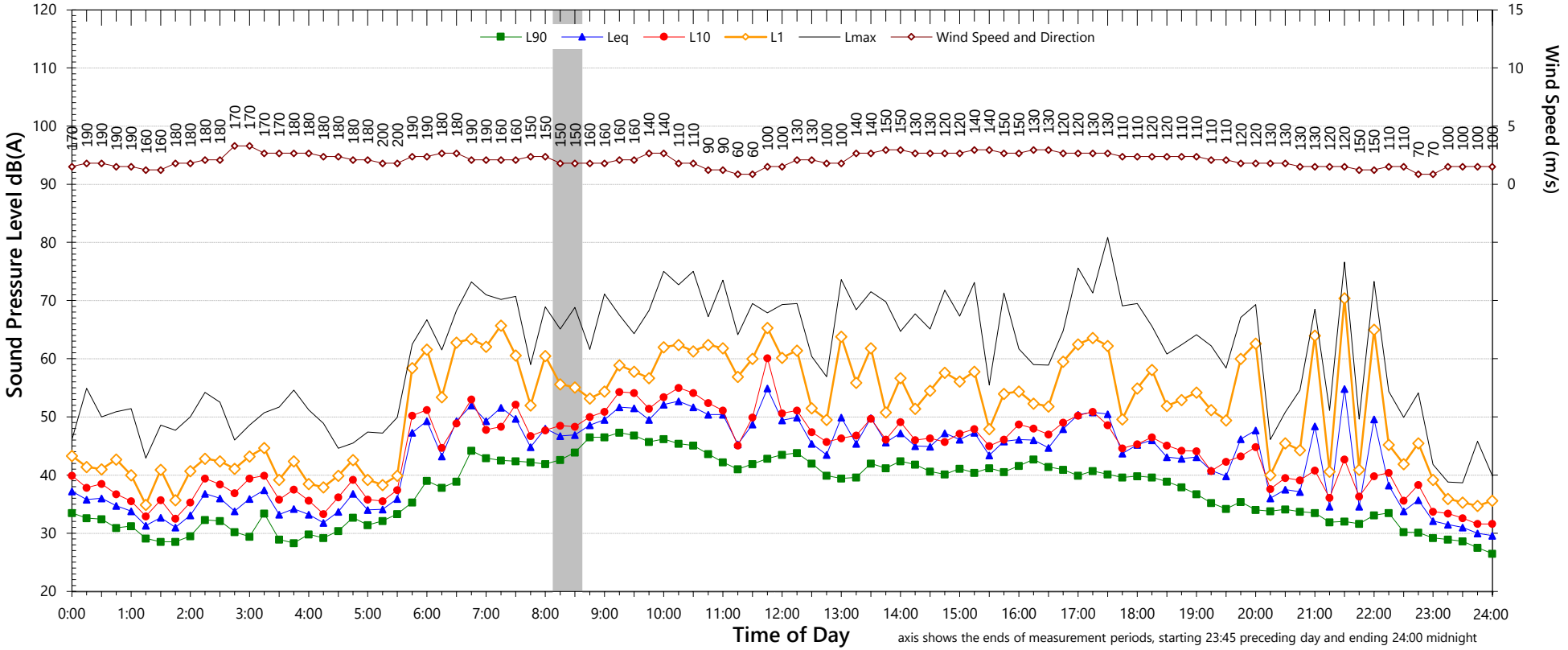
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Monday, 17 October 2022



NSW Noise Policy for Industry (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{A90} ABL	40	32	25
L_{Aeq}	49	46	41

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	51	43
$L_{Aeq\ 1hr}$ upper 10 percentile	54	49
$L_{Aeq\ 1hr}$ lower 10 percentile	47	31

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	66	to	72
L_{AFMax} - L_{Aeq} (Range)	15	to	28

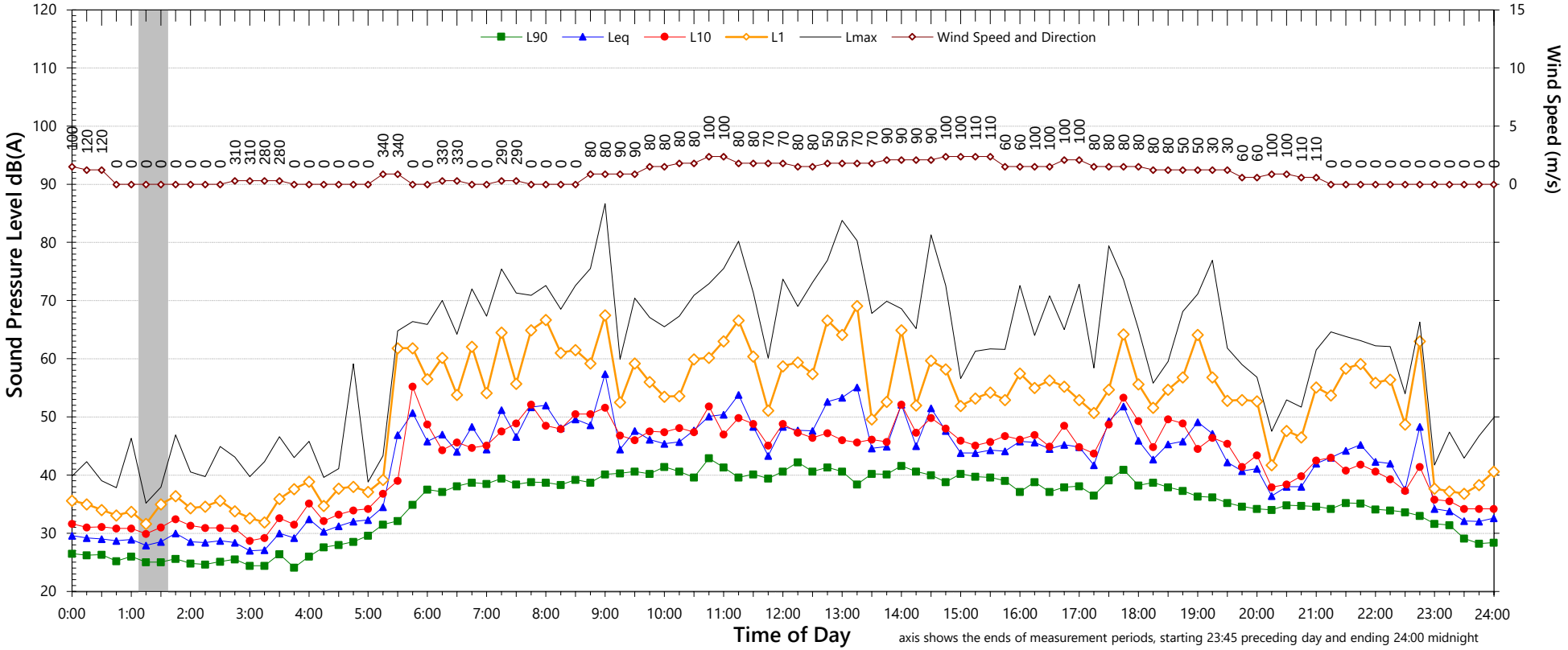
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Tuesday, 18 October 2022



NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	38	34	27
L_{Aeq}	50	44	40

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	51	43
$L_{Aeq\ 1hr}$ upper 10 percentile	54	47
$L_{Aeq\ 1hr}$ lower 10 percentile	46	33

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	66	to	73
L_{AFMax} - L_{Aeq} (Range)	16	to	27

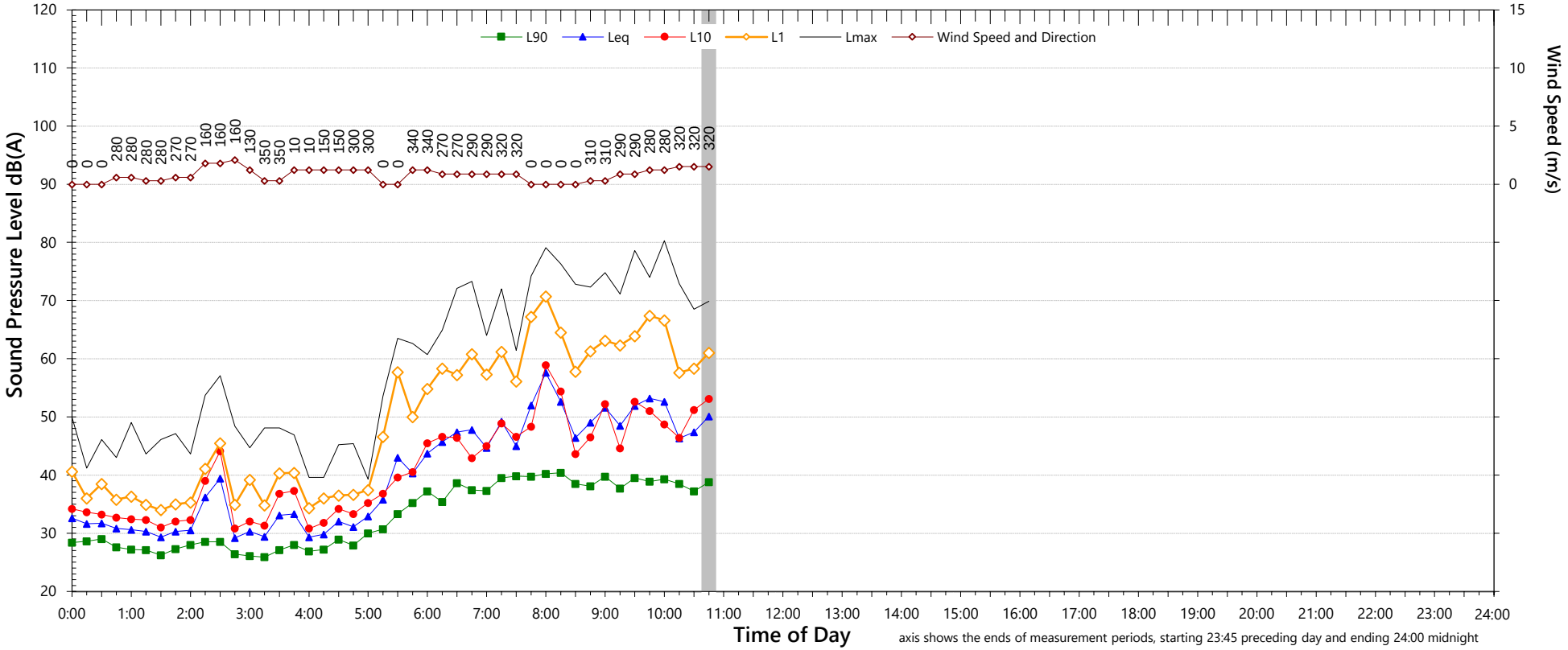
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured in free-field; tabulated results facade corrected
7. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

Rear Yard 285 Mona Vale Road, St Ives

Wednesday, 19 October 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{A90} ABL	-	-	-
L_{Aeq}	-	-	-

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	-	to	-
L_{AFMax} - L_{Aeq} (Range)	-	to	-

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	-	-
$L_{Aeq\ 1hr}$ upper 10 percentile	-	-
$L_{Aeq\ 1hr}$ lower 10 percentile	-	-

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
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