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# 8 WILSON STREET, CHATSWOOD (LOT 1/DP1189541) & 849-859 PACIFIC HIGHWAY AND 2 WILSON STREET, CHATSWOOD

## Acoustic Assessment for Planning Proposal - 5 site amalgamation

19 October 2021

Sanctuary Partners

TL682-02F02 Acoustic Assessment 5 site amalgamation (r2)

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# 1 Introduction

Renzo Tonin & Associates was engaged to assess noise impacts onto the proposed development site at 8 Wilson Street, Chatswood (Lot 1/DP1189541) & 849-859 Pacific Highway and 2 Wilson Street, Chatswood to support the planning proposal submission for the site.

The new scheme consists of a 5 site amalgamation of 8 Wilson Street, Chatswood (Lot 1/DP1189541) & 849-859 Pacific Highway and 2 Wilson Street, Chatswood.

This report assesses noise intrusion and noise emission from the residential component of the proposed mixed-use development. Acoustic assessment for noise emission from the retail component fit outs shall be addressed in a separate report.

This report is intended to support the planning proposal only and is not to be used for submission with the Development Application for the site.

This study examines the effects of external noise intrusion onto the proposed development from road traffic noise and rail noise. A noise survey was carried out on site by Renzo Tonin & Associates from 9th October to 16th October 2020 to establish the existing levels of external noise affecting the development. This was supplemented by attended measurements on the 9th October 2020. These noise levels were used to predict noise levels inside the future residential spaces and then assessed against the recommended internal noise criteria for the project.

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.

The information contained in the conceptual design for each scheme from PBD Architects have been reviewed as part of this assessment.

# 2 Site and surrounds

The 5-site amalgamation plan is to consist of 8 Wilson Street, 2 Wilson Street and 849-859 Pacific Highway, Chatswood, and is currently occupied by four apartment buildings and a commercial premises. The site adjoins the rail corridor to the west. Residential apartments and houses are located to the north, south and west of the proposed development site.

The north shore rail line lies approximately 10m from the eastern boundary of the site, with the entry to the rail corridor tunnel to the south.

The proposed development is to consist of two 27 storey residential towers with ground and first floor commercial podium space and 5 levels of basement parking.

Long-term and short-term noise monitoring has been undertaken on site as indicated in Figure 1 below to determine the existing acoustic environment.

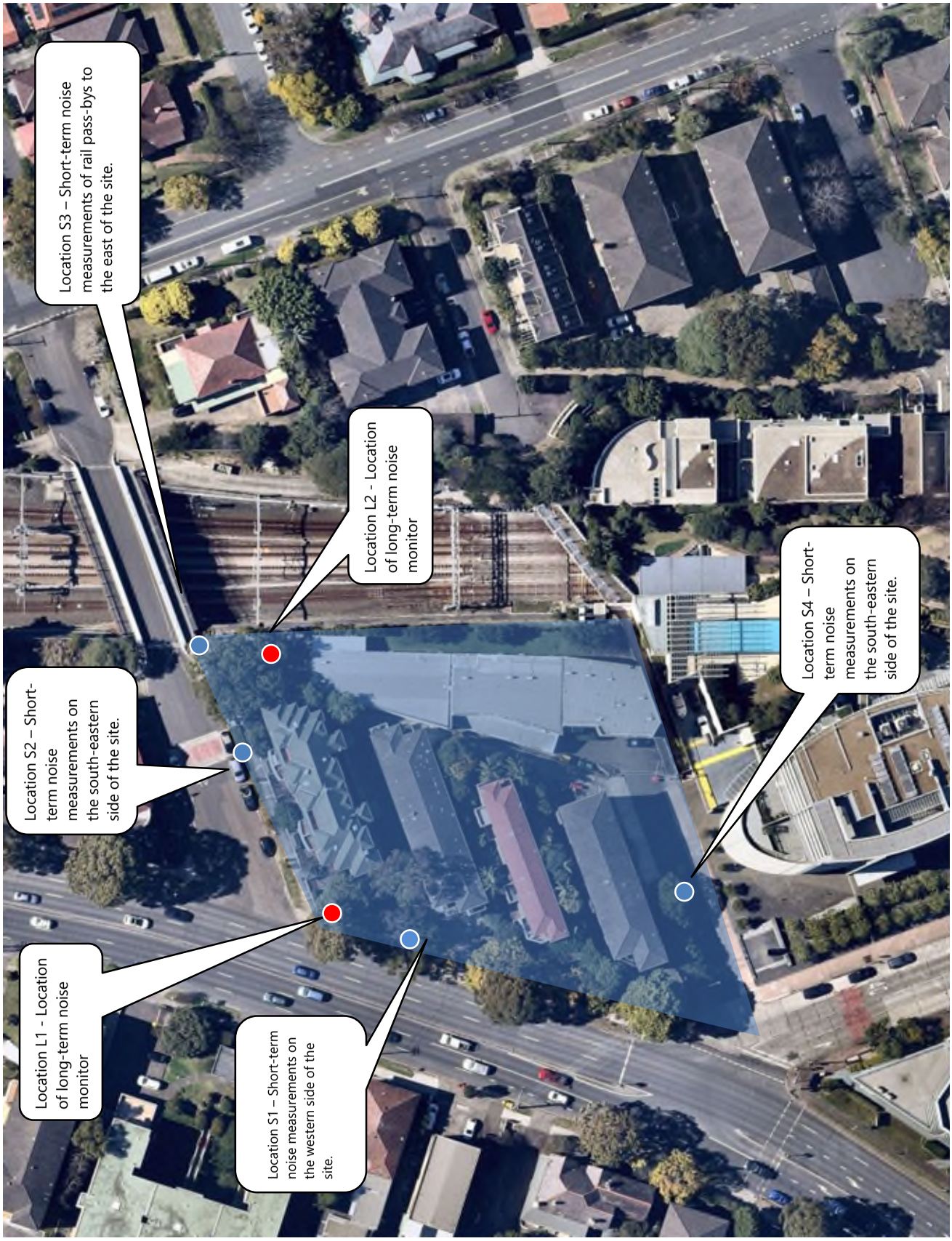



Figure 1: Aerial photograph showing site and surrounds – 5 -site amalgamation

# 3 Noise Assessment

## 3.1 Internal noise criteria

Long-term noise surveys were conducted on site from 9th October 2020 to 16th October 2020 to determine existing levels of ambient and background noise surrounding the site. Attended noise measurements were undertaken on site on the 9th October 2020. These unattended and attended measurements were used to predict noise levels within the residential spaces and assessed against the internal noise criteria recommended for this development.

### 3.1.1 Road traffic and rail noise criteria

The Standards, Government Policies, Guidelines and Council Development Control Plans (DCP) relevant to this development are as follows:

1. Willoughby City Council Development Control Plan 2006
2. State Environment Planning Policy (Infrastructure 2007) or ISEPP 2007
3. Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008

In accordance with the Willoughby Council DCP, design internal noise levels from the ISEPP2007, Department of Planning publication 2008 and AS/NZS 2107 has been recommended for this development and is outlined in Table 1 below.

Pacific Highway is identified as a road with mandatory assessment (greater than AADT 40,000) on the Roads and Maritime Services (RMS) Traffic Volume Maps for ISEPP.

**Table 1: Recommended Maximum Internal Traffic Noise Level**

| Type of Occupancy | Windows Condition | Design Noise Level | |
|---|---|---|---|
| | | Day, $L_{Aeq}$ (15hour) | Night, $L_{Aeq}$ (9hour) |
| Bedrooms | Closed | - | 35dB(A) |
| | Open | - | 45dB(A) |
| Open-plan Living/Dining/Kitchen | Closed | 40dB(A) | 40dB(A) |
| | Open | 50dB(A) | 50dB(A) |

Relevant sections of the ISEPP, Department of Planning Documentation and Council DCP are presented in APPENDIX B of this report. Results of the background and ambient noise monitoring conducted on site are presented in Appendix F.

## 3.2 Measured noise levels

### 3.2.1 Long-term noise survey

The proposed development is affected by road traffic noise from Pacific Highway to the west. A long-term noise monitor was installed at 2 Wilson Street (on the Pacific Highway boundary of the existing site)y as indicated in Figure 1 for an ambient and background noise survey from 9th October 2020 to 16th October 2020.

A second logger was installed at the rear boundary of the existing property at 2 Wilson Street in order to capture ambient noise levels and existing rail noise levels at the proposed development site. The logger was in the location identified in Figure 1, above from 9th October 2020 to 16th October 2020

The noise logger records noise levels on a continuous basis and stores data every fifteen minutes. The noise loggers were 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 results of the background and ambient noise monitoring conducted on site are presented in Appendix E

### 3.2.2 Short-term noise survey

#### 3.2.2.1 Road traffic noise

To establish a correlation in noise levels between the highly affected western facade and the eastern facade, short-term noise measurements were undertaken on the south-eastern corner and north-eastern corner of the site boundary, shown as *Location S1, S2, S3 and S4* in Figure 1 above.

Results from the measurements are presented in Table 2 below.

**Table 2: Summary of Short-term Noise Measurements**

| Location (see Figure 1) | Measurement date and time | $L_{eq,\ 15min}$ dB(A) |
|---|---|---|
| Location S1 – footpath at the Western boundary, along Pacific Highway (1.5m from road curb) | 9/10/2020 845am to 9.00am | 75 |
| Location S2 – footpath along Wilson Street (site midpoint) – northern boundary (1.5m from road curb) | 9/10/2020 9.00am to 9.15am | 65 |
| Location S3 – Corner of the boundary, at railway overpass, overlooking rail line | 9/10/2020 9.15am to 9.30am | 68 |
| Location S4 – O'Brien Street footpath | 9/10/2020 9.40am to 9.55am | 66 |

#### 3.2.2.2 Rail noise

The measured external noise levels from rail are presented in Table 3 below.

**Table 3: Representative Day and Night Rail Noise Levels**

| Location | Period | Predicted Rail Noise Level $L_{Aeq,\,T}$ [1,2] at the Worst Affected Facade |
|---|---|---|
| Location L2 – approximately 10m west of the rail corridor at the boundary of the site | Day time (7am to 10pm) | 67 dB(A) |
| | Night time (10pm to 7am) | 64 dB(A) |

Notes:

Noise levels presented are façade corrected values.

Representative external noise levels, LAeq over 15 hour and 9 hour day and night period respectively,

### 3.2.3 Measured traffic and rail noise levels

The design road traffic and rail combined noise levels are taken from the representative $L_{Aeq}$ for the week for both the day time (7am to 10pm) and night time (10pm-7am) periods.

The design external traffic and rail noise levels are presented Table 4 below.

**Table 4: Representative Day and Night Traffic and Rail Noise Levels**

| Monitoring Location | Survey Period | Measured Traffic and Rail Noise Level $L_{Aeq,\,T}$ [1,2] at Monitoring Location | Predicted Traffic and Rail Noise Level $L_{Aeq,\,T}$ [1,2] at Worst Affected Residential Façade – Level 2 |
|---|---|---|---|
| Front boundary of 2 Wilson Street, at the Pacific Highway facade. | Day time (7am to 10pm) | 74 dB(A) | 68 dB(A) |
| | Night time (10pm to 7am) | 71 dB(A) | 65 dB(A) |
| Side boundary – Wilson Street facade | Day time (7am to 10pm) | 65 dB(A) | 65 dB(A) |
| | Night time (10pm to 7am) | 62 dB(A) | 62 dB(A) |
| Rear boundary – facing rail line | Day time (7am to 10pm) | 67 dB(A) | 67 dB(A) |
| | Night time (10pm to 7am) | 64 dB(A) | 64 dB(A) |
| O'Brien Street facade | Day time (7am to 10pm) | 66 dB(A) | 66 dB(A) |
| | Night time (10pm to 7am) | 63 dB(A) | 63 dB(A) |

Notes:

1. Noise levels presented are façade values.
2. Representative road traffic noise level in $L_{Aeq}$ over 15 hour and 9 hour day and night period respectively.

### 3.2.4 Existing noise environment at development site

The results of the long-term noise monitoring have been summarised in accordance with the Industrial Noise Policy requirements published by NSW Environment Protection Authority (EPA) and are presented in Table 5 below.

Note: The NSW EPA Industrial Noise Policy (INP) was superseded by the NSW EPA Noise Policy for Industry (NPfI) in October 2017. In this case, where the bulk of the work for this assessment had already been completed prior to October 2017, the NPfI allows continued use of the Industrial Noise Policy.

**Table 5: Measured Site Background Noise Level**

| Noise Monitoring | | Representative $L_{A90}$ Background Noise Levels in dB(A) | | |
|---|---|---|---|---|
| **Location** | **Duration** | **Day[1]** | **Evening[2]** | **Night[3]** |
| Front gardens of 2 Wilson Street, Chatswood | 9th October 2020 to 16th October 2020 | 61 | 57 | 44 |
| Rear of site, 2 Wilson Street, Chatswood | 9th October 2020 to 16th October 2020 | 50 | 47 | 38 |

Notes:

Day, Evening & Night assessment periods are defined in accordance NSW EPA's Noise Policy for Industry 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

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 to the EPA Noise Policy for Industry.

### 3.2.5 Calculated internal noise levels

Results from the noise surveys were used to calculate internal noise levels within the proposed development. Noise calculations were conducted using the *OutsideIn Glazing Spreadsheet* developed in this office which take into account external noise levels, facade transmission loss and room sound absorption characteristics. Noise levels were calculated for each building facade to account for any variation in the external noise levels affecting different parts of the building.

Glazing constructions required to comply with the nominated noise criteria are presented in the body of this report.

## 3.3 Control of external noise – window glazing

### 3.3.1 Glazing design requirements – 5-site amalgamation

Table 6 below presents likely in principle glazing treatments for the building facades to assist with the planning proposal.

The assessment considers the widening of the Pacific Highway, the set back of the residential levels from the Pacific Highway, and the reduced glazed areas of bedrooms on the Pacific Highway and Rail Line facades. Further analysis is required at the detailed design phase of the project.

**Table 6: Recommended Glazing Treatment – 5 site amalgamation**

| Façade | Level | Occupancy Type | Likely treatments | Required Acoustic Rating of Glazing Assembly | Laboratory Test Reference |
|---|---|---|---|---|---|
| **Retail/ commercial** | | | | | |
| West (facing Pacific Highway) | Ground – Level 1 | General office areas | 10.38mm laminated glazing in commercial frames with full-perimeter acoustic seals | Rw 35 | ESTIMATE |
| All other facades | Ground – Level 1 | General office areas | 10.38mm laminated glazing in commercial frames with full-perimeter acoustic seals | Rw 35 | ESTIMATE |
| **Residential** | | | | | |
| West (facing Pacific Highway) | Level 2 to Level 8 | Habitable spaces | 10.38mm laminated glazing in commercial frames with full-perimeter acoustic seals | Rw 35 | ESTIMATE |
| | Level 9 to Level 28 | Habitable spaces | 6.38mm laminated glass in commercial frames with full-perimeter acoustic seals | Rw 32 | ESTIMATE |
| East (facing rail line | Level 2 to Level 8 | Habitable spaces | 10.38mm laminated glazing in commercial frames with full-perimeter acoustic seals | Rw 35 | ESTIMATE |
| | Level 9 to Level 28 | Habitable spaces | 6.38mm laminated glass in commercial frames with full-perimeter acoustic seals | Rw 32 | ESTIMATE |
| North (facing Wilson Street) | Level 2 to Level 8 | Habitable spaces | 10.38mm laminated glazing in commercial frames with full-perimeter acoustic seals | Rw 35 | ESTIMATE |
| | Level 9 to Level 28 | Habitable spaces | 6.38mm laminated glass in commercial frames with full-perimeter acoustic seals | Rw 32 | ESTIMATE |
| South | Level 2 to Level 8 | Habitable spaces | 10.38mm laminated glazing in commercial frames with full-perimeter acoustic seals | Rw 35 | ESTIMATE |
| | Level 9 to Level 28 | Habitable spaces | 6.38mm laminated glass in commercial frames with full-perimeter acoustic seals | Rw 32 | ESTIMATE |

By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the partition, a higher rating implying a higher sound reduction performance.

Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.

| Façade | Level | Occupancy Type | Likely treatments | Required Acoustic Rating of Glazing Assembly | Laboratory Test Reference |
|---|---|---|---|---|---|

LEGEND where no appropriate test certificate exists:

1. ESTIMATE: 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.
2. ESTIMATE – APPROVED FOR CONSTRUCTION: Use of the form of construction is approved prior to laboratory certification. To complete the quality control of the design process and confirm the acoustical performance of the construction, we recommend testing in a laboratory to confirm the Rw rating as soon as practicable. In the case of impact rating for floor systems, no particular impact rating is guaranteed to comply with either the Building Code of Australia or Strata Scheme Management Act and hence carpet runners may still be required.
3. ESTIMATE – TEST NOT REQUIRED: Use of the form of construction is approved without laboratory certification. The STC/Rw of the form of construction exceeds the project requirements.
4. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

NOTES FOR GLAZING CONSTRUCTIONS:

5. 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.
6. The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.
7. 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.
8. The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.
9. 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.
10. 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.

GENERAL

11. The sealing of all gaps in partitions is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
12. Check design of all junction details with acoustic consultant prior to construction.
13. Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
14. The information provided in this table is subject to modification and review without notice.
15. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

With the installation of the recommended glazing outlined in Table 6 above and windows and doors closed, internal traffic noise levels inside dwellings are expected to comply with the indoor noise goals set in Council DCP and ISEPP 2007 as outlined in Table 1 of this report.

#### 3.3.1.1 Ventilation

In accordance with the Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008:

*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*

However, the Department of Planning's Apartment Design Guide, July 2015 Objective 4B-1 requires that all habitable rooms are naturally ventilated, within an apartment complex.

Section 4J, *Noise and Pollution*, of the Apartment Design Guide nominates design solutions that may assist with delivering both the natural ventilation requirements and the internal noise levels (windows open) through careful design solutions. These may include wintergardens with operable facades, partially shielded and insulated balconies, building design and orientation, apartment setbacks and selection of acoustic materials for the building construction.

It has long been industry standard to assume a 10dB loss of noise from external to internal through an opened window in a building facade. It is based on the average results of a number of test cases, experimental data and published papers. This assumption has been well documented in The Roads and Traffic Authority (RTA) publications, including the RTA's Environmental Noise Management Manual (ENMM), Table 4.2.

Recent studies on noise reduction through facades with open windows[1] have shown that noise transmission through an open window can vary greatly based on the construction of the facades and noise flanking paths, including exposed floors and roof constructions.

The study indicates that noise loss through an open window of a development consisting of masonry construction with no exposed flooring and a concrete roof will be in the range of 11-15dB.

Alternative ventilation solutions are to be considered for single aspect apartments facing Pacific Highway and the rail line.

Further assessment of internal noise levels with windows opened is required at the detailed design phase of the project to consider facade design, opening sizes, balcony materials, room volumes, room finishes and shielding.

[1] Ryan, Lanchester and Pugh, 2011

# 4 Vibration Assessment

## 4.1 Vibration Criteria

The Department of Planning Guideline "Development Near Rail Corridors & Busy Roads – Interim Guideline", Section 3.6.3 outlines the following documents which recommend train vibration criteria for residential buildings.

- Assessing Vibration: A technical guideline (Department of Environment and Conservation, 2006)
- German Standard DIN 4150, Part 3 1999
- British Standard BS 7385 Part 2 1993
- Australian Standard AS2670.2 1990

The above documents have been reviewed and the criterion for assessment of vibration from train pass-bys affecting the proposed development is quantified using the following Standard:

- Assessing Vibration: A technical guideline (EPA 2006)

Table 2.4 of the Department of Environment and Conservation NSW's document "Assessing Vibration: A technical guideline (EPA 2006)" presents acceptable vibration dose values for intermittent vibration.

**Table 7: Acceptable VDVs for intermittent vibration m/s1.75**

| Period | Preferred VDV m/s1.75 |
|---|---|
| Day time (7am – 10pm) | 0.2 |
| Night time (10pm – 7am) | 0.13 |

Figure 3.2 of the Department of Planning Guideline identifies vibration assessment zones whereby developments within the zone will require a vibration assessment. For residential flat building developments, a vibration assessment is required if the site is located within a distance of 60m from the nearest operational track, unless a specific vibration issue is known.

As the site is located at distances of 10-20m from the nearest operational track, a rail vibration assessment is required in accordance with the Department of Planning Guideline "Development Near Rail Corridors & Busy Roads – Interim Guideline".

**Figure 2: Vibration assessment zone (Figure 3.2 of the Department of Planning Guideline "Development Near Rail Corridors & Busy Roads – Interim Guideline")**

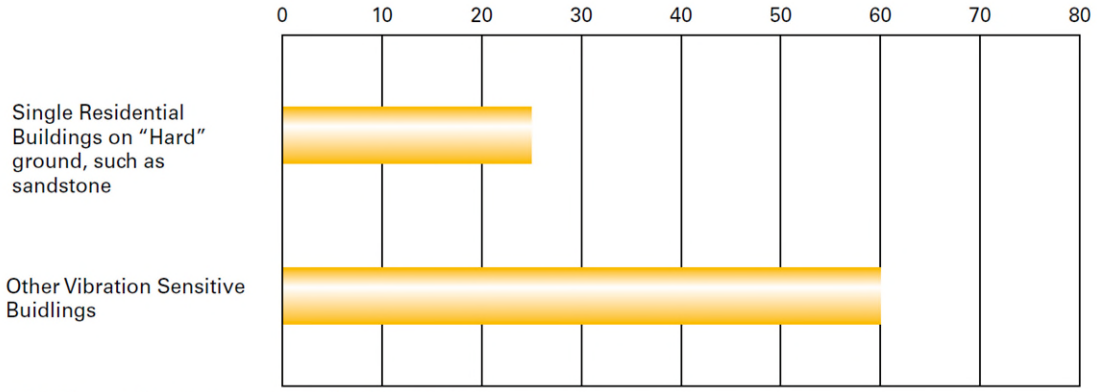



**Figure 3.2:** Distance from the nearest operational track (m)

### 4.1.1 Ground-borne Noise

Ground-borne noise propagates through the ground as vibration and is then radiated as noise by vibrating wall and floor surfaces. The ISO Standard 14837 Mechanical vibration – Ground-borne noise and vibration arising from rail systems defines ground borne noise as noise generated inside a building by ground-borne vibration generated from the pass-by of rolling stock on rail.

It is normally noticeable only in areas that are well protected from airborne noise, such as buildings adjacent to railway tunnels. Ground-borne noise is also often referred to as 'regenerated' noise.

The Department of Planning guideline presents the criteria for assessing ground-borne noise impacts on a development.

> *Residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground-borne LAmax noise limit of 40dB(A) (daytime) or 35dB(A) (night-time) measured using the "slow" response time setting on a sound level meter.*

All apartments at the proposed development site are exposed to airborne noise paths from the rail line or the Pacific Highway. In accordance with the Department of Planning Guideline, airborne noise is calculated as Leq (9h) at night and Leq (15h) during the day, whereas ground-borne noise is calculated as Lmax (slow) for 95% of rail pass-by events. During a rail pass-by event, the airborne Leq noise levels far exceed the ground-borne Lmax noise levels, making the ground-borne noise indiscernible.

Table 8 presents the airborne LASmax noise levels of train pass-by events recorded during the rail vibration survey described in Section 0. All the LASmax noise levels from the vibration survey were compiled and adjusted to accurately represent the daytime period (7am-10pm). From this, the 95th percentile value was taken and used determine if ground-borne noise contributes to the airborne noise.

If the LASmax airborne noise exceeds the ground-borne noise by 10dB(A), then it can be concluded that the ground-borne noise does not contribute to the airborne noise.

Because the LASmax noise level of a train pass-by event will not vary during the day or night, the airborne noise levels will be compared to the 35dB(A) criteria.

**Table 8: Determining ground-borne noise contribution**

| Facade | Airborne LASmax (dB(A)) | | Greater than ground-borne criteria of 35dB(A) by more than 10dB(A)? |
|---|---|---|---|
| | External* | Internal with windows closed* | |
| North Façade (facing rail line) | 81 | 51 | Yes |

Note: *Noise levels are predicted to 1m from the facade

Therefore, it is unlikely that ground borne noise will be detectable over the airborne noise.

## 4.2 Rail Vibration Survey

Train vibration levels were measured using the Sinus SoundBook multi-channel analyser and Endevco accelerometers. An accelerometer was fixed to the concrete ground along the west boundary of the site. This location allowed for shortest distance from the rail corridor to be measured, the worst case scenario (Location V01) as shown in Appendix C.

The table below shows the calculated Vibration Dose Value (VDV) measured at the proposed development site due to existing operations.

**Table 9: Calculated Vibration Dose Value (VDV)**

| Location | Assessment Period | Calculated VDV m/s1.75 |
|---|---|---|
| Eastern boundary of the site boundary facing rail line | Day time (7am - 10pm) | 0.08 |
| | Night time (10pm - 7am) | 0.05 |

The calculated VDV at the boundary of the site is below both the daytime and night time criteria as presented in Table 7.

Details of location and survey periods are included in Appendix F.

# 5 Internal sound insulation between tenancies

Internal walls and floors shall comply with the National Construction Code of Australia 2019 (formally Building Code of Australia). All services and doors shall comply with the requirements of the NCC 2019. APPENDIX C presents a summary of acoustic provisions outlined in Part F5 of the NCC 2019.

# 6 External noise emission from building services

## 6.1 EPA Requirements

The NSW Environment Protection Authority (EPA) sets out noise criteria in its Noise Policy for Industry (NPfI) to control the noise emission from industrial sources.

The NPfI sets project noise trigger level to protect noise amenity for residential receivers. The project noise trigger level is set as the lower value of the following two assessment components:

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

Noise intrusiveness ensures that industrial noise does not exceed the background noise level by an excessive margin, preventing significant changes in the noise characteristic pertinent to the development site and surrounds. This is commonly referred to as the 'background plus 5' criterion. That is, the noise level from new industrial development, assessed in periods of 15 minutes, should not exceed the existing background noise level (measured in the absence of that development) by more than 5dB(A).

Noise amenity ensures that industrial noise levels do not increase without limit, for if a number of industrial noise sources are permitted to increase the background noise level by 5dB(A), in turn there would be a point where the ultimate noise level is unacceptable. A limit on the ultimate acceptable noise level is therefore included in the NPfI as a way of ensuring that cumulative noise impact from industrial growth is curtailed. This limit is referred to as the project amenity noise level. The appropriate limit in any circumstance relates to the land use category, for example, there are different limits for rural, suburban and urban areas.

The table below presents the recommended amenity noise level relevant to the receivers surrounding the proposed development site. The project amenity noise level is defined as the recommended amenity noise level minus 5dB(A).

**Table 10: NPfI Amenity Noise Levels - Recommended $L_{Aeq}$ Amenity Noise Levels from Industrial Noise Sources [EPA NPfI Table 2.1]**

| Receiver | Noise amenity area | Time of day | $L_{Aeq}$, dB(A) |
|---|---|---|---|
| | | | Recommended amenity noise level |
| Residential | Rural | Day | 50 |
| | | Evening | 45 |
| | | Night | 40 |
| | Suburban | Day | 55 |
| | | Evening | 45 |
| | | Night | 40 |

| Receiver | Noise amenity area | Time of day | $L_{Aeq}$, dB(A) Recommended amenity noise level |
|---|---|---|---|
| | Urban | Day | 60 |
| | | Evening | 50 |
| | | Night | 45 |
| Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks | See column 4 | See Column 4 | 5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day |
| School classroom - internal | All | Noisiest 1-hour period when in use | 35 |
| Hospital ward - internal | All | Noisiest 1-hour | 35 |
| Hospital ward - external | All | Noisiest 1-hour | 50 |
| Place of worship - internal | All | When in use | 40 |
| Area specifically reserved for passive recreation (e.g. national park) | All | When in use | 50 |
| Active recreation area (e.g. school playground, golf course) | All | When in use | 55 |
| Commercial premises | All | When in use | 65 |
| Industrial premises | All | When in use | 70 |
| Industrial interface (applicable only to residential noise amenity areas) | All | All | Add 5dB(A) to recommended noise amenity |

Notes:

- Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am
- On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
- The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

In accordance with Section 2.4 of the NPfI, the following **exceptions** to the above method to derive the project amenity noise level apply:

1. In areas with high traffic noise levels (see Section 2.4.1 of the NPfI).
2. In proposed developments in major industrial clusters (see Section 2.4.2 of the NPfI).
3. Where the resultant project amenity noise level is 10dB, or more, lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.
4. Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for the development.

The following table presents the site-specific noise production criteria from industrial noise sources, namely mechanical plant.

**Table 11: Project noise trigger level for noise emission from mechanical plant (EPA NPfI)**

| Time of Day | Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 | Column 7 | Column 8 | Column 9 |
|---|---|---|---|---|---|---|---|---|---|
| | Rating Background Level (RBL) $L_{A90}$ | Intrusive-ness Trigger Level, $L_{Aeq, 15minute}$ (RBL+5) | Recommended Amenity Noise Level (RANL), $L_{Aeq, period}$ | Project Amenity Noise Level (PANL), $L_{Aeq, period}$ | Measured $L_{Aeq, period}$ existing noise levels | Traffic noise exceed the RANL by more than 10dB? | Existing noise level likely to decrease in future? | Exceptions to PANL $L_{Aeq, period}$? | Project Noise Trigger Level, $L_{Aeq, 15minute}$ |
| Day (7am to 6pm) | 50 | 55 | 60 | 55 | 64 | No | No | None | 55 |
| Evening (6pm to 10pm) | 47 | 52 | 50 | 45 | 64 | Yes | No | Yes, LAeq – 10 | 52 |
| Night (10pm to 7am) | 38 | 43 | 45 | 40 | 61 | Yes | No | Yes, LAeq-10 | 43 |

Explanatory notes:

Column 1 – RBL measured in accordance with the NPfI and outlined in the results of the long-term noise monitoring has been summarised in accordance with NPfI requirements and are presented in Table 5 above. Where the evening time criterion is greater than the daytime criterion, the evening time goal is amended to be the same as the daytime criteria.

Column 4 – Project Amenity Noise Level determined based on 'Residential - urban' area in Table 2.2 (Amenity noise levels) of the EPA's NPfI minus 5dB

Column 5 – Measured in accordance with the NPfI

Column 8 - Determined in accordance with Section 2.4 of the NPfI.

Column 9 – Project Noise Trigger Level is the lower value of project intrusiveness noise level and project amenity noise level. In accordance with Section 2.2 of the NPfI, $L_{Aeq, 15minute}$ is calculated as $L_{Aeq, period}$ + 3dB(A)

Notes: Intrusiveness noise level for Evening must be set at no greater than the intrusiveness level for daytime in accordance with NPfI Section 2.3.

Where necessary, noise amelioration treatment to mechanical plant such as carpark exhaust fans and air conditioning systems will be incorporated in the design to ensure that noise levels comply with the recommended NPfI noise emission criteria noted above. Noise from air-conditioning and building services will be examined in detail at the design stage.

## 6.2 Recommended noise control measures for mechanical plant

Mechanical plant such as exhaust systems, air-conditioning, mechanical ventilation and refrigeration associated with the development has the potential to impact on nearby residential and commercial properties. As details of mechanical plant are not available at this stage of the development the following in principle noise control advice are provided.

- Acoustic assessment of mechanical services equipment will require to be undertaken during the detail design phase of the development to ensure that they shall not either singularly or in total emit noise levels which exceed the noise limits in established above.
- 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 roof and balcony plant equipment away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises
- installation of commercially available silencers or acoustic attenuators for air discharge and air intakes of plant
- acoustically lined and lagged ductwork
- provide acoustic screens and/or acoustic louvres between plant and sensitive neighbouring premises
- provide partially enclosed or fully enclosed acoustic enclosure over plant
- Mechanical plant shall have their noise specifications and proposed locations checked prior to installation
- Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 "Rotating and Reciprocating Machinery - Mechanical Vibration"

# 7 Conclusion

Renzo Tonin & Associates have completed an acoustic assessment of external noise impacts onto the residential component of the proposed mixed-use development at the 5-site amalgamation scheme for 8 Wilson Street, Chatswood (Lot 1/DP1189541) & 849-859 Pacific Highway and 2 Wilson Street, Chatswood as part of the planning proposal for the site.

The study of external noise intrusion into the subject development has found that appropriate controls can be incorporated into the building design to achieve a satisfactory accommodation environment consistent with the intended quality of the building and relevant standards.

# 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:<br>0dB The faintest sound we can hear<br>30dB A quiet library or in a quiet location in the country<br>45dB Typical office space. Ambience in the city at night<br>60dB CBD mall at lunch time<br>70dB The sound of a car passing on the street<br>80dB Loud music played at home<br>90dB The sound of a truck passing on the street<br>100dB The sound of a rock band<br>115dB Limit of sound permitted in industry<br>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 Assessment and design methodology

## B.1 Willoughby City Council Development Control Plan

Willoughby City Councils is the regulatory authority for the proposed development. Council's DCP 2006 refers to the State Environmental Planning Policy (Infrastructure) 2007 and Department of Planning publication "Development near rail corridors and busy roads – Interim Guidelines" as design guide for residential development near busy roads or rail corridor. The guide applies to developments within proximity of rail corridor or are potentially impacted by roads with annual daily traffic volume of greater than 20,000. Although the site does not fall under these two categories we recommend the Department of Planning's guideline to be adopted for this development.

Relevant sections of Council's DCP are re-iterated below.

*"C.14 Development near Railway Corridors or Busy Roads*

*Controls*
*Development located in the vicinity of a rail corridor or busy road needs to take into consideration the provisions of the State Environmental Planning Policy (Infrastructure) 2007 and the NSW Department of Planning "Development Near Rail Corridors and Busy Roads- Interim Guideline"*

*Performance Criteria*
*Development should be designed and constructed so as to:*

- *Protect the safety and integrity of key transport infrastructure; and*
- *Ensure that the development achieves an appropriate acoustic amenity by meeting the internal noise criteria as specified in the State Environmental Planning Policy (Infrastructure) 2007."*

## B.2 State Environmental Planning Policy (Infrastructure) 2007

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. 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.

Pertinent to noise assessment, the ISEPP includes the following clauses:

*87 Impact of rail noise or vibration on non-rail development*

*1. This clause applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration:*

*a. a building for residential use,*

*b. a place of public worship,*

*c. a hospital,*

*d. an educational establishment or child care centre.*

*2. Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*

*3. If the development is for the purposes of a building for residential use, 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 building - 35 dB(A) at any time between 10 pm and 7am,*

*e. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.*

*102 Impact of road noise or vibration on non-road development*

*1. This clause 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 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*

*f. a building for residential use,*

*g. a place of public worship,*

*h. a hospital,*

*i. an educational establishment or child care centre.*

*4. Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*

*5. If the development is for the purposes of a building for residential use, 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 building - 35 dB(A) at any time between 10 pm and 7am,*

*j. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.*

*6. In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the Roads Act 1993*

### B.2.1 Department of Planning publication 'Development near rail corridors and busy roads – Interim guideline'

To support the Infrastructure SEPP, the NSW Department of Planning released the *Development in Rail Corridors and Busy Roads – Interim Guideline* (December 2008). The Guideline assists in the planning, design and assessment of developments in, or adjacent to, major transport corridors in terms of noise, vibration and air quality. While the ISEPP applies only to roads with an AADT greater than 40,000 vehicles, the guideline is also recommended for other road traffic noise affected sites.

### B.2.2 Clarification of ISEPP noise limits

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 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 ISEPP. The equivalent external goals have been determined on the following basis:

- The ISEPP 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 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 Building Code of Australia (BCA) ventilation requirements.

Table 12 presents the ISEPP internal noise criteria along with the equivalent external noise criteria for residential premises.

**Table 12: ISEPP noise criteria for new residential development**

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

| Room | Location | $L_{Aeq,\ 15hr}$ Day 7am – 10pm | $L_{Aeq\ 9hr}$ Night 10pm – 7am |
|---|---|---|---|
| | Internal, windows open | 50 | 45 |
| | External free-field (allowing windows to remain open)^ | 60 | 55 |

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

^ ISEPP Guideline states that where internal noise criteria are exceeded by more than 10dB(A) with windows open mechanical ventilation is required. External goals have been calculated 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 BCA requirements.

# APPENDIX C Internal sound insulation

## C.1 National Construction Code of Australia 2019

The National Construction Code of Australia (NCC) outlines minimum requirements for inter-tenancy (party) walls and ceiling/ floors to maintain privacy. This includes the incorporation of penetration of a service through a floor or through more than one sole-occupancy unit.

NCC nominates required Weighted Sound Reduction Indexes ($R_w$) and spectrum adaptation factor ($C_{tr}$) for partition constructions, of different space/ activity types in adjoining units. The $R_w$ and $R_w + C_{tr}$ are single number descriptors for quantifying the attenuating performance of partitions for typical intrusive noises produced inside residences. The higher the rating, the greater the isolation provided by the partition.

Spectrum adaptation factors are commonly used to compensate for the fact that certain kinds of sounds are more readily transmitted through insulating materials than others insulate.

The adaptation factor $C_{tr}$ has now been introduced for most building elements which require an airborne sound insulation rating. The only exception is a wall which separates a dwelling from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification. Therefore, both the $C_{tr}$ factor and the $R_w$ of the building element will need to be considered in most cases.

The $C_{tr}$ factor takes into account lower frequency level sounds, and has been chosen in large part, in recognition of the problem of the high bass frequency outputs of modern home theatre systems and music reproduction equipment.

The Deemed-to-Satisfy Provisions also have impact sound insulation requirements for floors. The terms to describe the impact sound insulation of the floor is the weighted normalised impact sound pressure level ($L_{n,w}$). The lower the $L_{n,w}$ of the floor, the better the performance of the floor in terms of impact sound insulation.

The following section represents a summary of acoustic provisions outlined in the Part F5 of the NCC.

## C.2 Sound insultion provision of NCC of Australia

The acoustic provisions for inter-tenancy walls in Class 2 and 3 buildings are outlined in the National Construction Code of Australia and the following is an extract from the NCC:

*F5.2 Determination of airborne sound insulation ratings*

*A form of construction required to have an airborne sound insulation rating must –*

*k. have the required value for weighted sound reduction index (Rw) or weighted sound reduction index with spectrum adaptation term (Rw + Ctr) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or*

*l. comply with Specification F5.2.*

*F5.3 Determination of impact sound insulation ratings*

*m. A floor in a building required to have an impact sound insulation rating must –*

*i. have the required value for weighted normalised impact sound pressure level (Ln,w) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or*

*ii. comply with Specification F5.2.*

*n. A wall in a building required to have an impact sound insulation rating must –*

*iii. for a Class 2 or 3 building be of discontinuous construction;*

*o. For the purposes of this part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and*

*iv. for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and*

*v. for other than masonry, there is no mechanical linkage between leaves except at the periphery.*

*F5.4 Sound insulation rating of floors*

*p. A floor in a Class 2 or 3 building must have an Rw + Ctr (airborne) not less than 50 and an Ln,w (impact) not more than 62 if it separates –*

*vi. sole-occupancy units; or*

*vii. a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.*

*F5.5 Sound insulation rating of floors*

*q. A wall in a Class 2 or 3 building must –*

*viii. have an Rw + Ctr (airborne) not less than 50, if it separates sole-occupancy units; and*

*ix. have an Rw (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and*

*x. comply with F5.3(b) if it separates:*

*a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or*

xi. *a sole-occupancy unit from a plant room or lift shaft.*

*r. A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, provided the door assembly has an Rw not less than 30.*

*s. Where a wall required to have sound insulation has a floor above, the wall must continue to –*

xii. *the underside of the floor above; or*

xiii. *a ceiling that provides the sound insulation required for the wall.*

*F5.6 Sound insulation rating of services*

*t. If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, 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 –*

xiv. *40 if the adjacent room is a habitable room (other than a kitchen); or*

xv. *25 if the adjacent room is a kitchen or non-habitable room.*

*u. If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (a).*

# APPENDIX D Construction noise

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

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

- Use of $L_{Aeq}$ as the descriptor for measuring and assessing construction noise.

  NSW noise policies, including the INP, RNP and RING have moved to the primary use of $L_{Aeq}$ over any other descriptor. As an energy average, $L_{Aeq}$ provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the $L_{A10}$ descriptor.

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

The ICNG provides two methods 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 duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Table 13 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied for residential receivers. 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 13: Noise management levels at residential receivers**

| Time of day | Management level $L_{Aeq\ (15\ min)}$ | How to apply |
|---|---|---|
| Recommended standard hours:<br>Monday to Friday<br>7 am to 6 pm<br>Saturday 8 am to 1 pm<br>No work on Sundays or public holidays | Noise affected<br>RBL + 10dB(A) | The noise affected level represents the point above which there may be some community reaction to noise.<br>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.<br>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<br>75dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>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:<br>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<br>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<br>RBL + 5dB(A) | A strong justification would typically be required for works outside the recommended standard hours.<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>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.<br>For guidance on negotiating agreements see section 7.2.2 of the ICNG. |

**Sensitive Land Use**

Table 14 below (reproduced from Table 3 of the ICNG) sets out the noise management levels for various sensitive land use developments.

**Table 14: Noise management levels at other noise sensitive land uses**

| Land use | Where objective applies | Management level $L_{Aeq\ (15\ min)}$ |
|---|---|---|
| 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. |
| Commercial premises | External noise level | 70 dB(A) |
| Industrial premises | External noise level | 75 dB(A) |

Notes: Noise management levels apply when receiver areas are in use only.

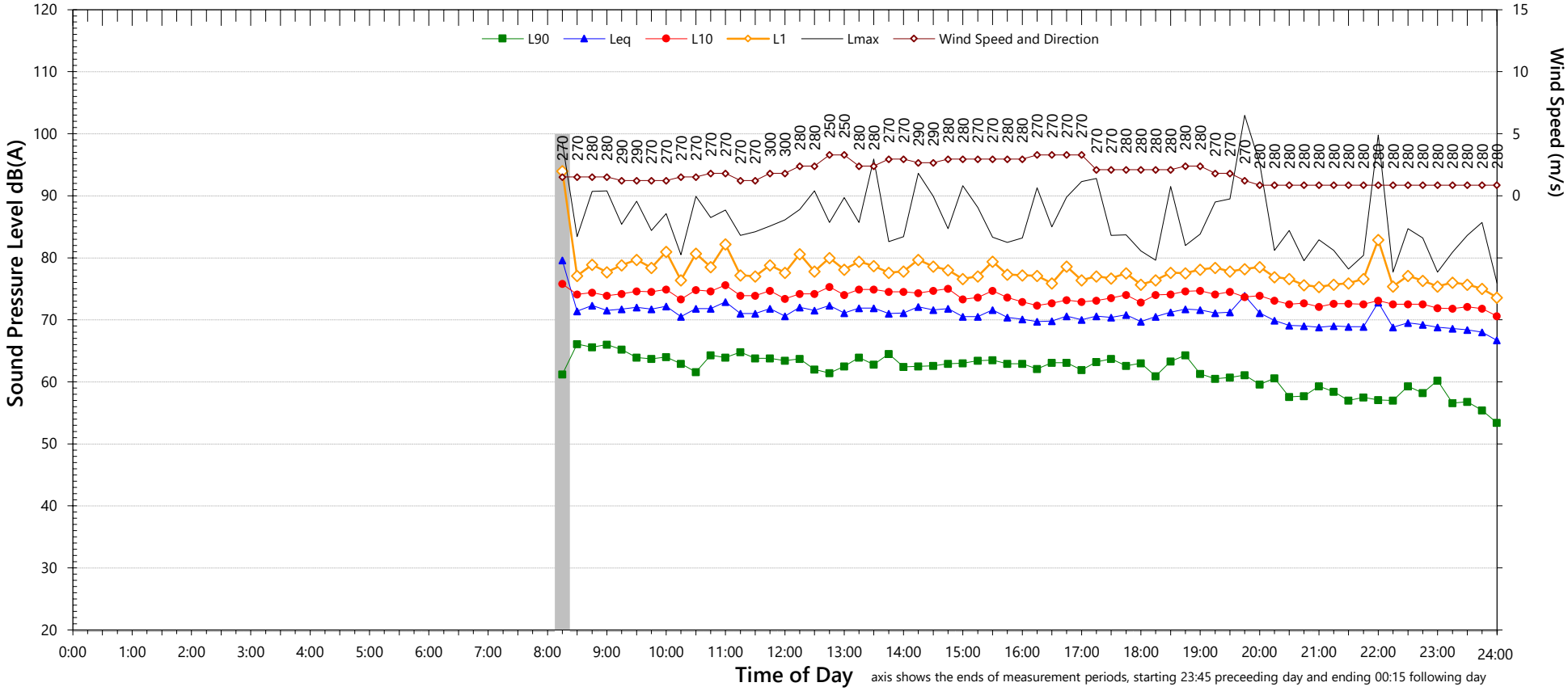
# APPENDIX E Noise Monitoring Locations and Results

Logger locations

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Front)

## Friday, 9 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 62 | 57 | 46 |
| LAeq | 71 | 71 | 67 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 81 | to | 89 |
| $L_{Max}$ - $L_{eq}$ (Range) | 16 | to | 22 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 74 | 70 |
| $L_{eq\ 1hr}$ upper 10 percentile | 74 | 72 |
| $L_{eq\ 1hr}$ lower 10 percentile | 73 | 67 |

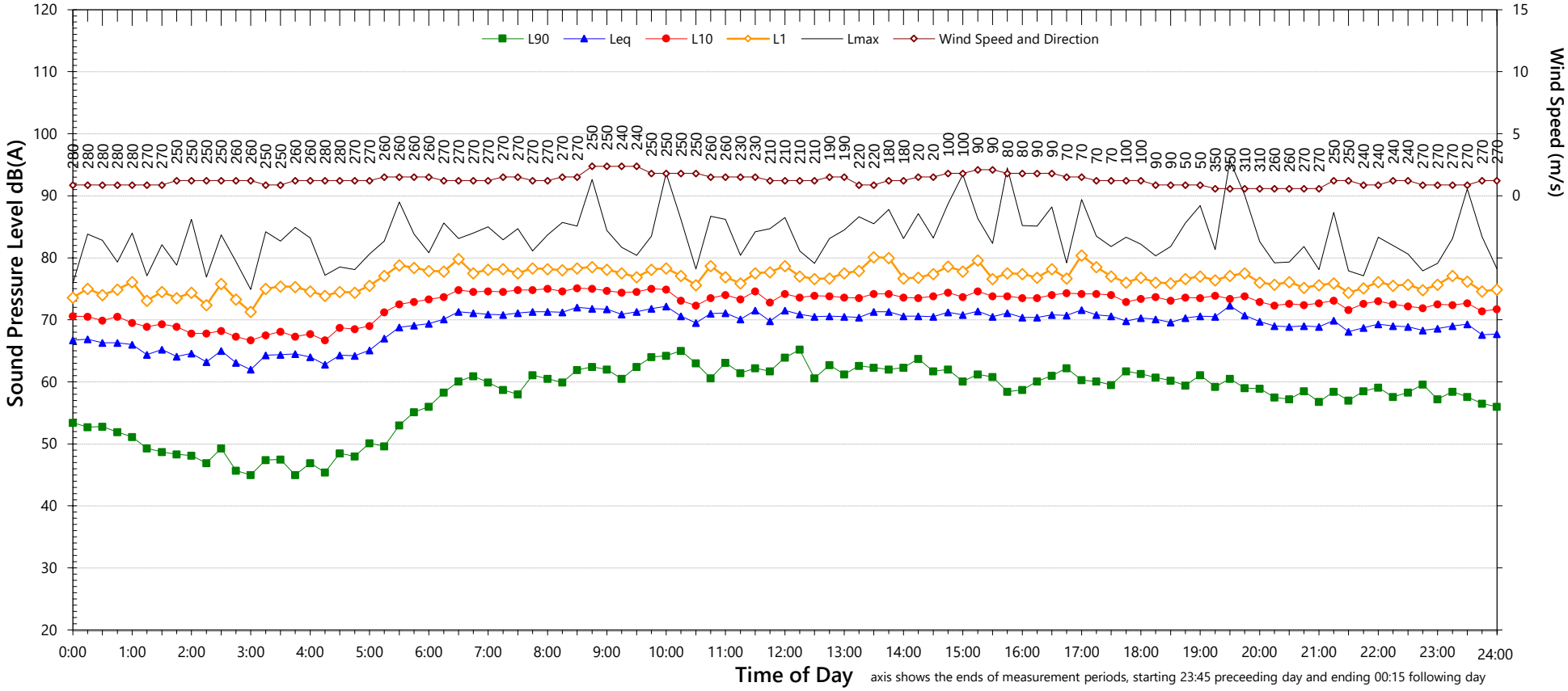
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Front)

## Saturday, 10 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 60 | 57 | 45 |
| LAeq | 71 | 70 | 67 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 82 | to | 91 |
| $L_{Max}$ - $L_{eq}$ (Range) | 16 | to | 23 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 73 | 69 |
| $L_{eq\ 1hr}$ upper 10 percentile | 74 | 71 |
| $L_{eq\ 1hr}$ lower 10 percentile | 72 | 65 |

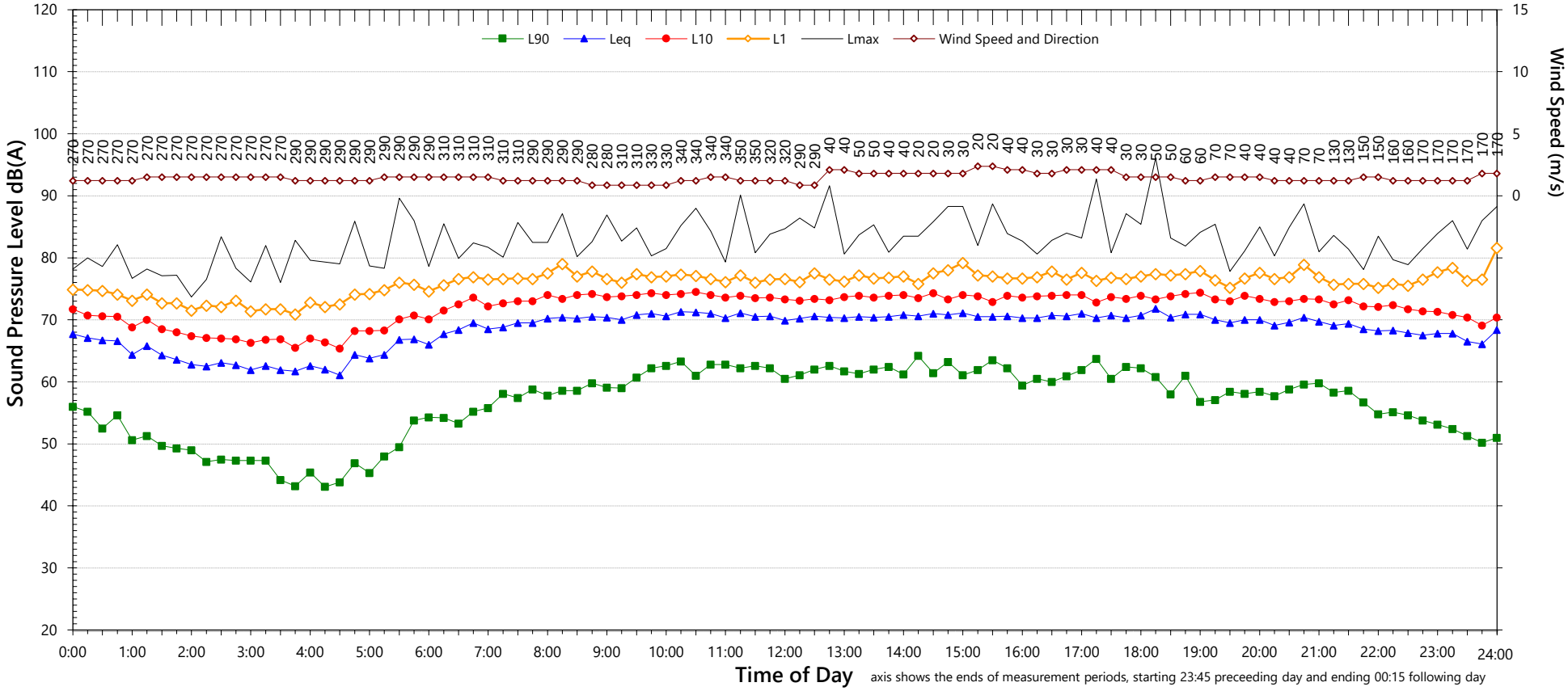
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Front)

## Sunday, 11 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 59 | 57 | 44 |
| LAeq | 71 | 70 | 68 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 84 | to | 93 |
| $L_{Max}$ - $L_{eq}$ (Range) | 16 | to | 27 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 73 | 71 |
| $L_{eq\ 1hr}$ upper 10 percentile | 73 | 75 |
| $L_{eq\ 1hr}$ lower 10 percentile | 72 | 66 |

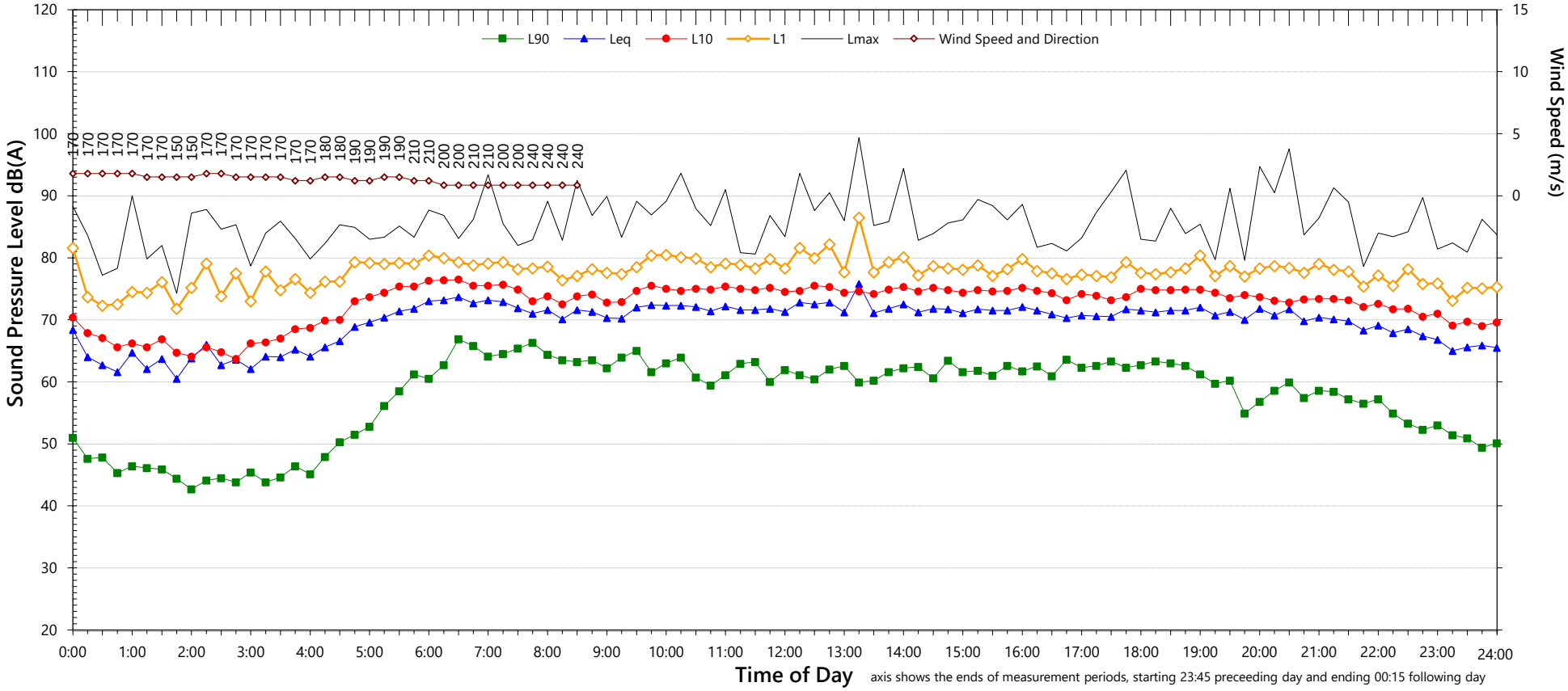
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Front)

## Monday, 12 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 60 | 57 | 42 |
| LAeq | 72 | 71 | 68 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 83 | to | 90 |
| $L_{Max}$ - $L_{eq}$ (Range) | 16 | to | 26 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 74 | 71 |
| $L_{eq\ 1hr}$ upper 10 percentile | 75 | 75 |
| $L_{eq\ 1hr}$ lower 10 percentile | 73 | 66 |

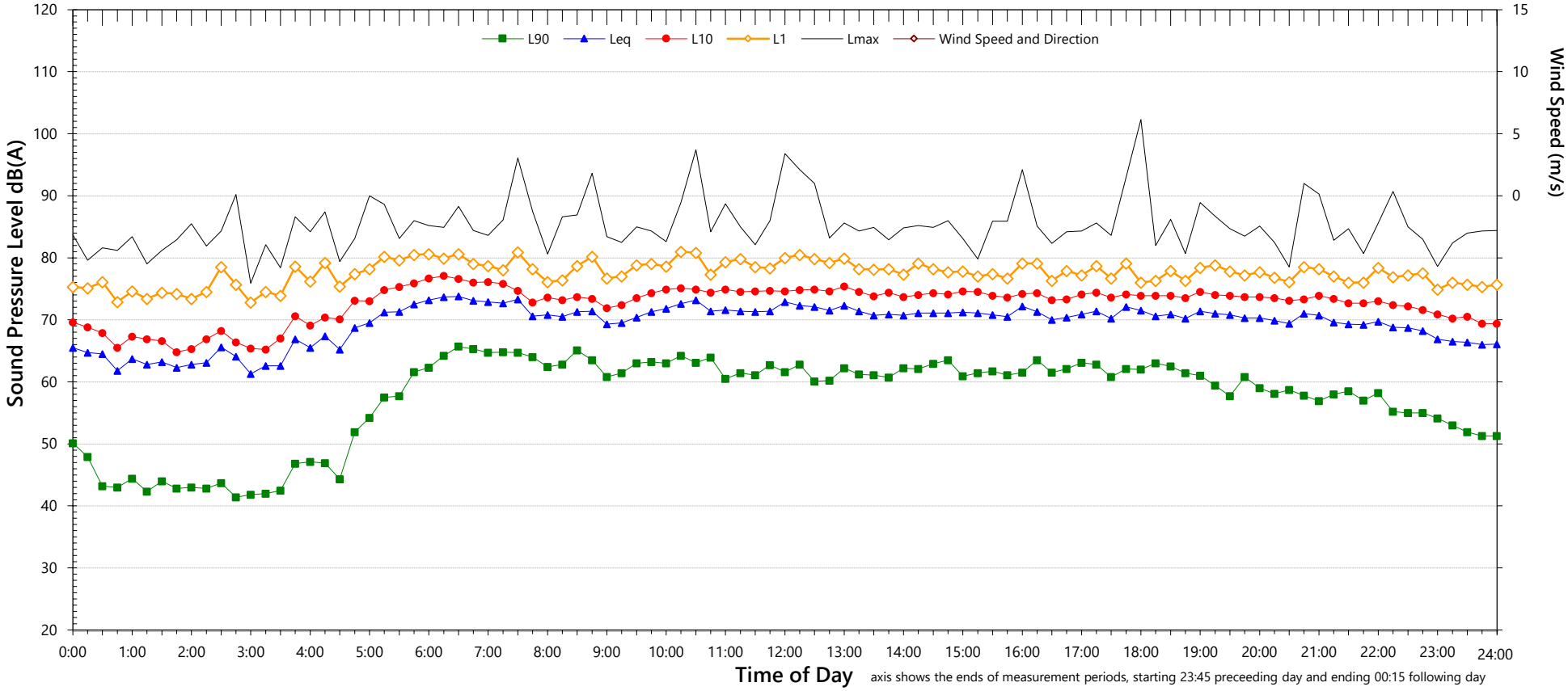
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Front)

## Tuesday, 13 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 61 | 57 | 44 |
| LAeq | 71 | 70 | 69 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 82 | to | 104 |
| $L_{Max}$ - $L_{eq}$ (Range) | 18 | to | 30 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 74 | 71 |
| $L_{eq\ 1hr}$ upper 10 percentile | 75 | 75 |
| $L_{eq\ 1hr}$ lower 10 percentile | 73 | 66 |

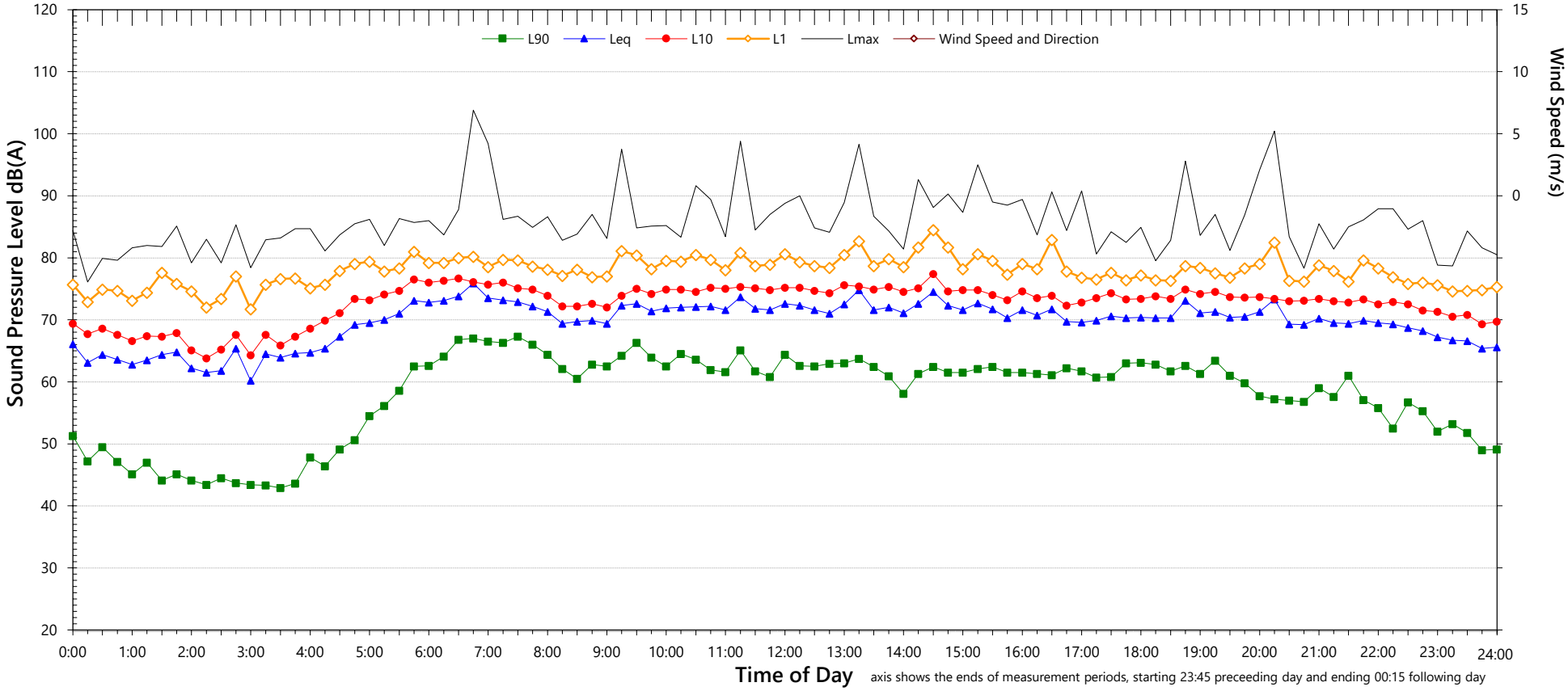
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Front)

## Wednesday, 14 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| **Descriptor** | **Day[2]** | **Evening[3]** | **Night[4 5]** |
| $L_{90}$ | 61 | 57 | 43 |
| LAeq | 72 | 71 | 69 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 82 | to | 98 |
| $L_{Max}$ - $L_{eq}$ (Range) | 18 | to | 33 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| **Descriptor** | **Day** | **Night[5]** |
| | **7am-10pm** | **10pm-7am** |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 74 | 71 |
| $L_{eq\ 1hr}$ upper 10 percentile | 75 | 75 |
| $L_{eq\ 1hr}$ lower 10 percentile | 72 | 67 |

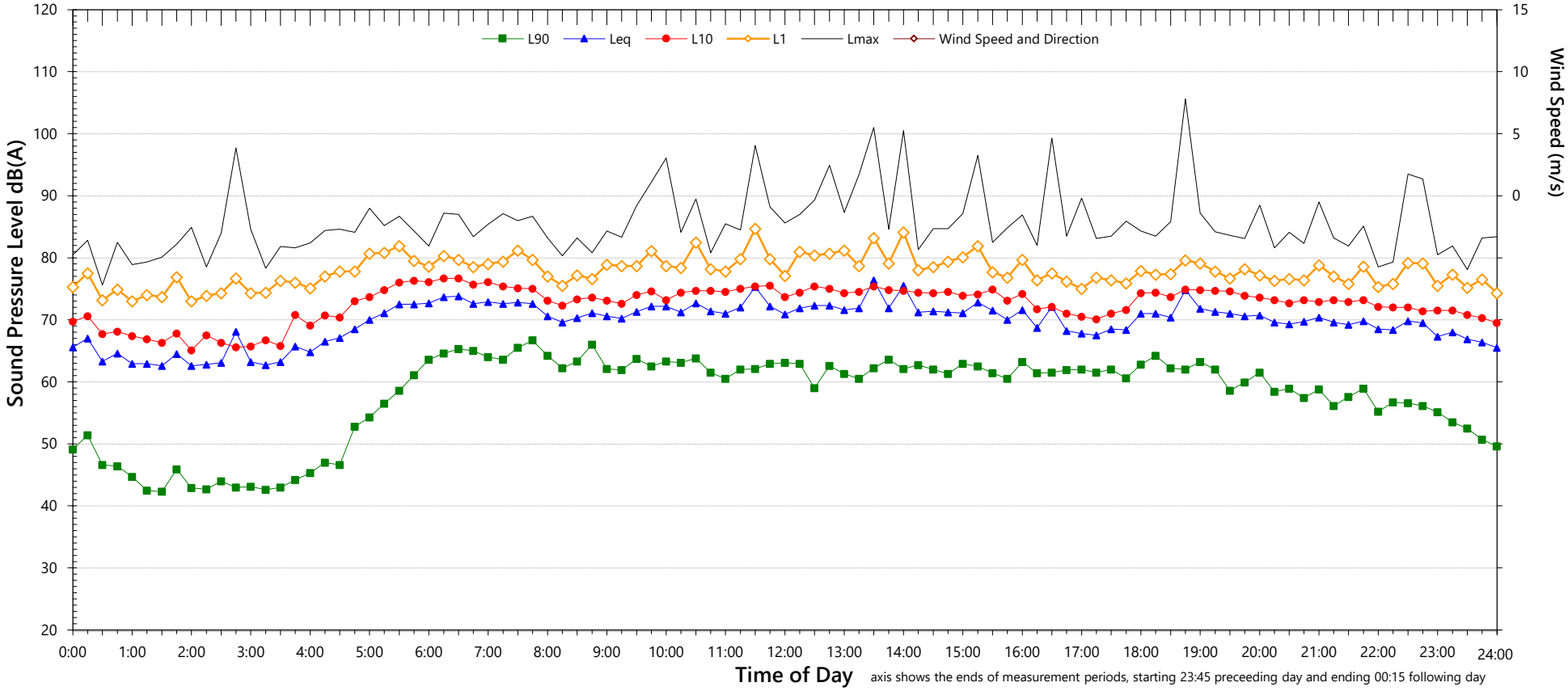
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Front)

## Thursday, 15 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 61 | 57 | 46 |
| LAeq | 72 | 71 | 69 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 83 | to | 94 |
| $L_{Max}$ - $L_{eq}$ (Range) | 16 | to | 25 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 74 | 71 |
| $L_{eq\ 1hr}$ upper 10 percentile | 75 | 75 |
| $L_{eq\ 1hr}$ lower 10 percentile | 72 | 66 |

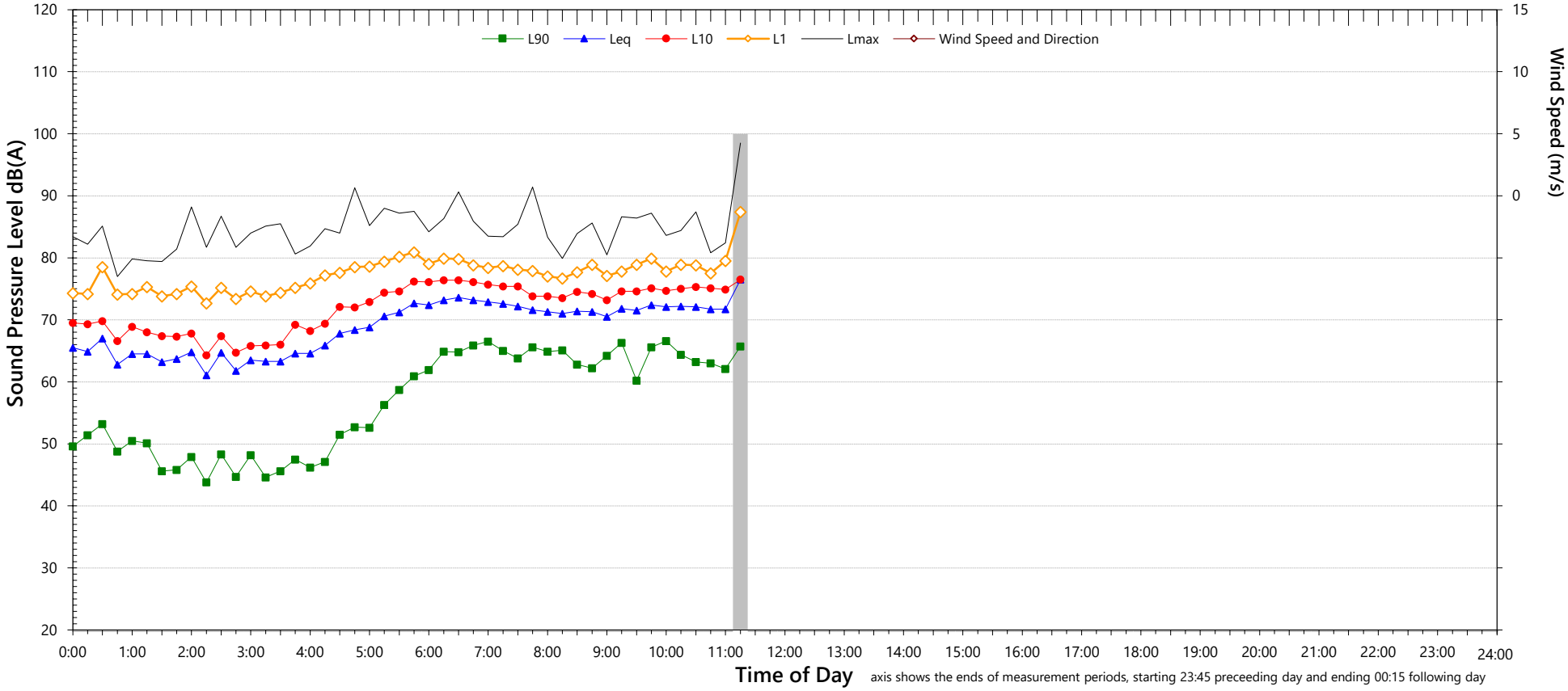
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Front)

## Friday, 16 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | - | - | - |
| LAeq | - | - | - |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | - | to | - |
| $L_{Max}$ - $L_{eq}$ (Range) | - | to | - |

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

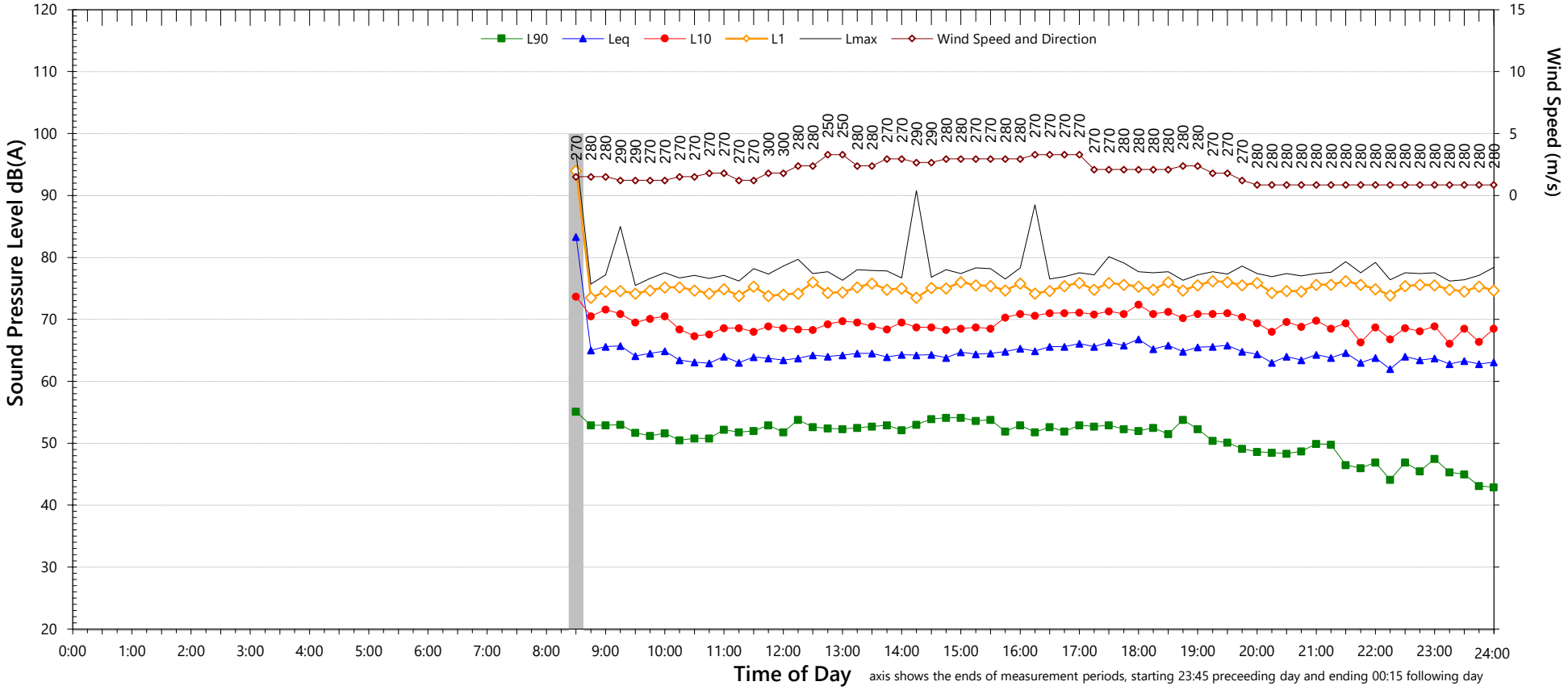
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Rear)

## Friday, 9 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 51 | 47 | 39 |
| LAeq | 65 | 65 | 61 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 73 | to | 78 |
| $L_{Max}$ - $L_{eq}$ (Range) | 15 | to | 23 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 67 | 64 |
| $L_{eq\ 1hr}$ upper 10 percentile | 68 | 66 |
| $L_{eq\ 1hr}$ lower 10 percentile | 66 | 56 |

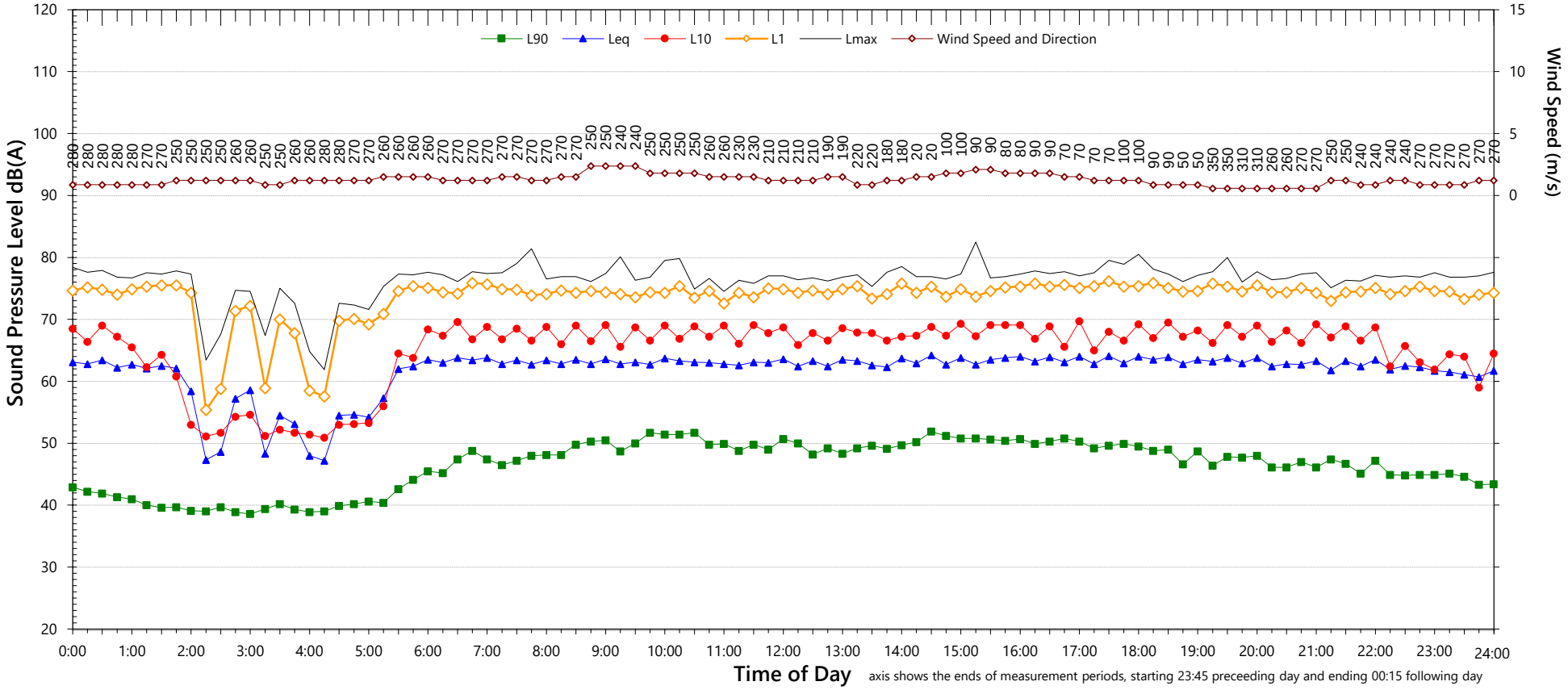
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Rear)

## Saturday, 10 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 48 | 46 | 38 |
| LAeq | 63 | 63 | 61 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 72 | to | 78 |
| $L_{Max}$ - $L_{eq}$ (Range) | 15 | to | 23 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 66 | 63 |
| $L_{eq\ 1hr}$ upper 10 percentile | 66 | 65 |
| $L_{eq\ 1hr}$ lower 10 percentile | 65 | 55 |

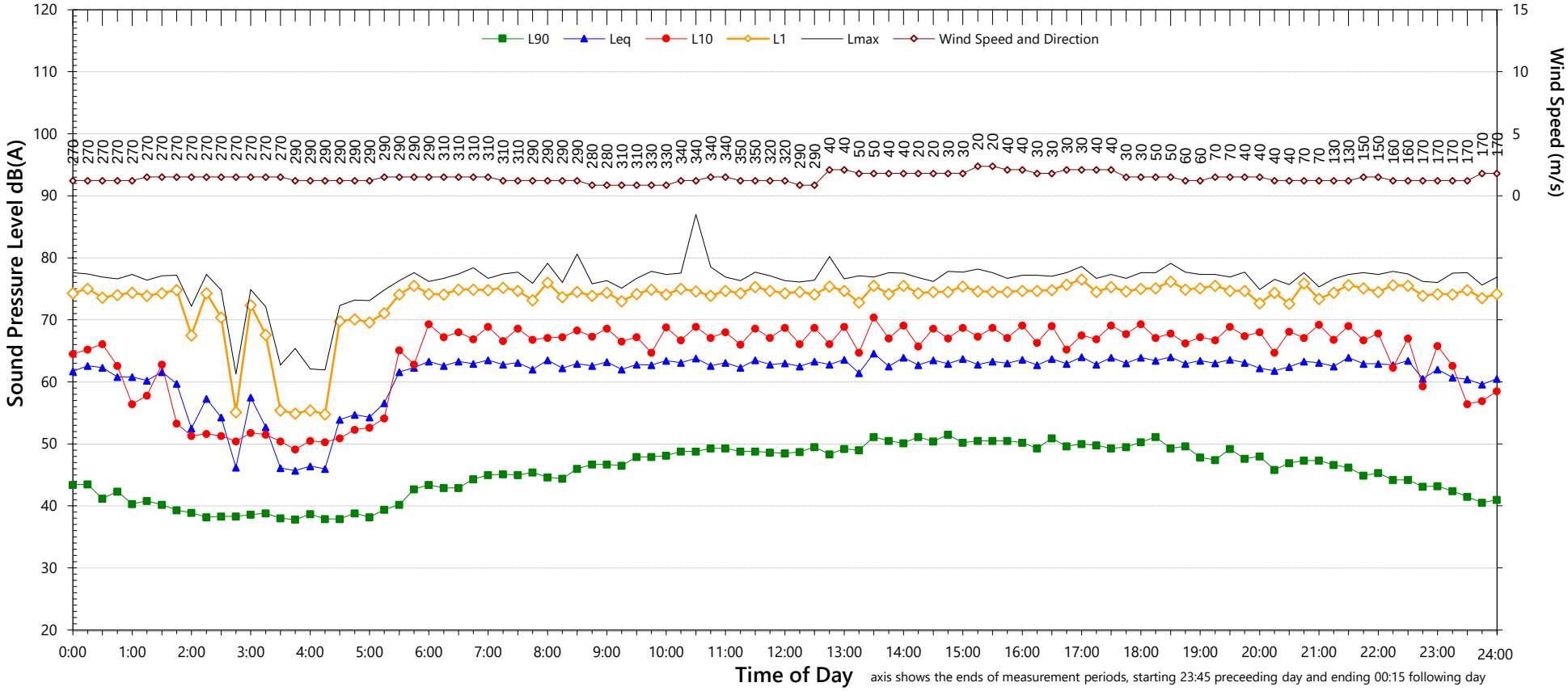
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Rear)

## Sunday, 11 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 47 | 46 | 39 |
| LAeq | 63 | 63 | 60 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 68 | to | 82 |
| $L_{Max}$ - $L_{eq}$ (Range) | 16 | to | 24 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 66 | 63 |
| $L_{eq\ 1hr}$ upper 10 percentile | 66 | 66 |
| $L_{eq\ 1hr}$ lower 10 percentile | 65 | 50 |

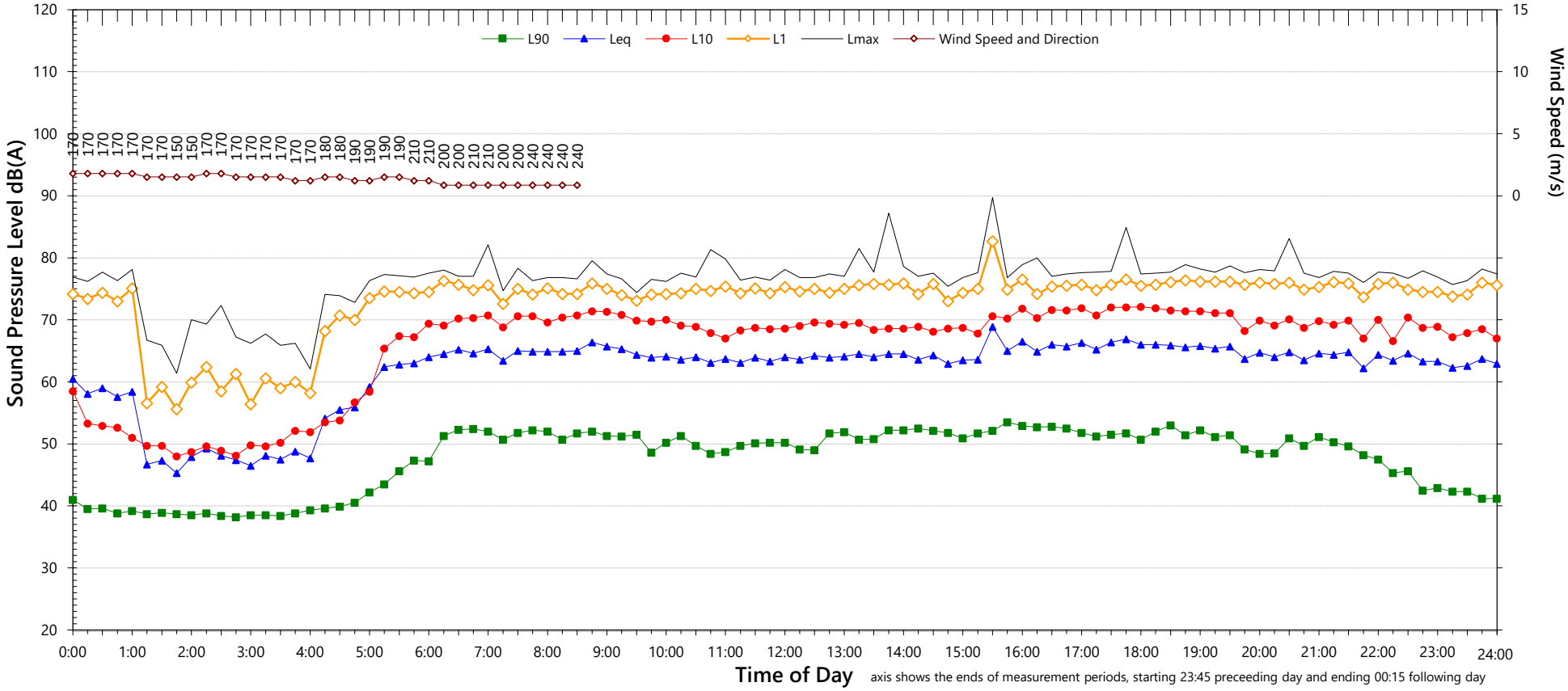
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Rear)

## Monday, 12 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 49 | 48 | 38 |
| LAeq | 65 | 65 | 61 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 67 | to | 78 |
| $L_{Max}$ - $L_{eq}$ (Range) | 15 | to | 24 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 67 | 64 |
| $L_{eq\ 1hr}$ upper 10 percentile | 69 | 66 |
| $L_{eq\ 1hr}$ lower 10 percentile | 66 | 52 |

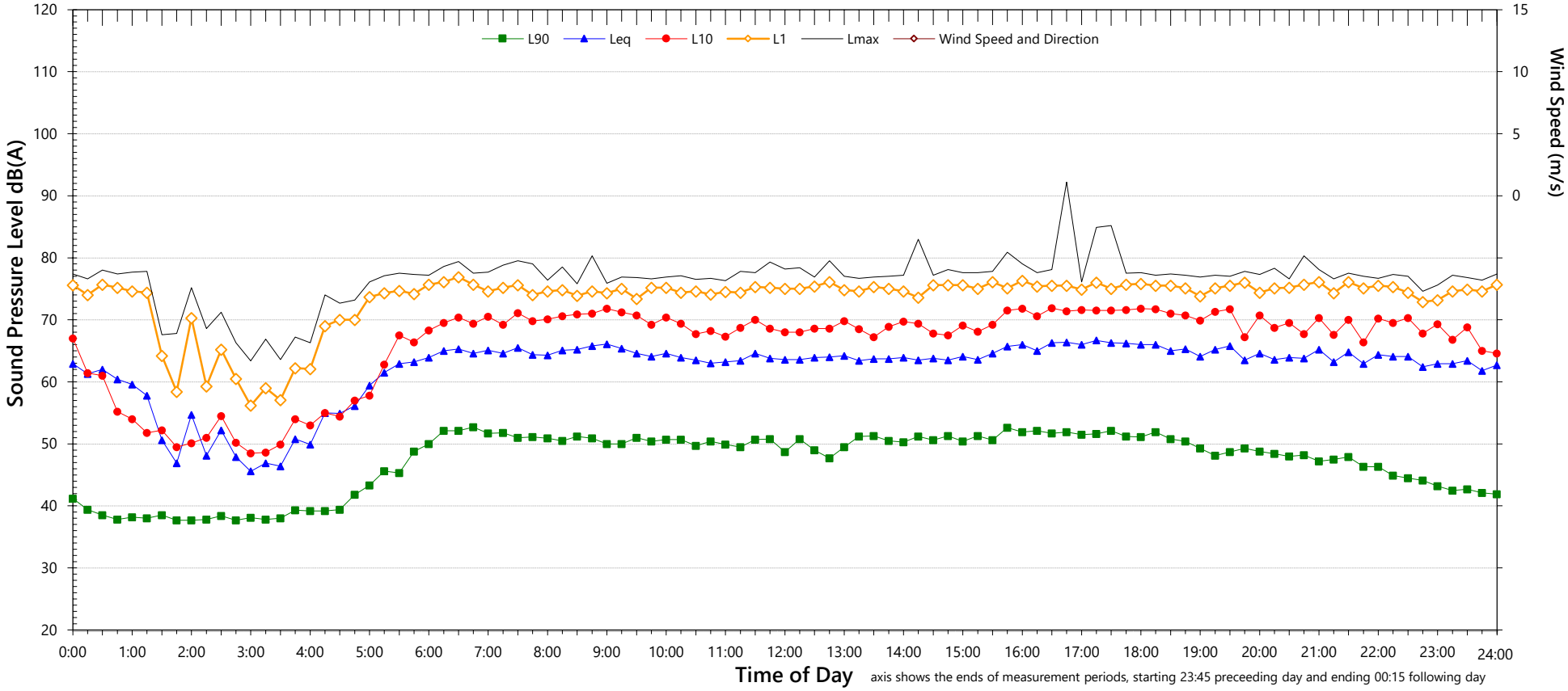
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Rear)

## Tuesday, 13 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 50 | 47 | 38 |
| LAeq | 65 | 65 | 61 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 68 | to | 82 |
| $L_{Max}$ - $L_{eq}$ (Range) | 16 | to | 26 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 67 | 63 |
| $L_{eq\ 1hr}$ upper 10 percentile | 68 | 66 |
| $L_{eq\ 1hr}$ lower 10 percentile | 66 | 51 |

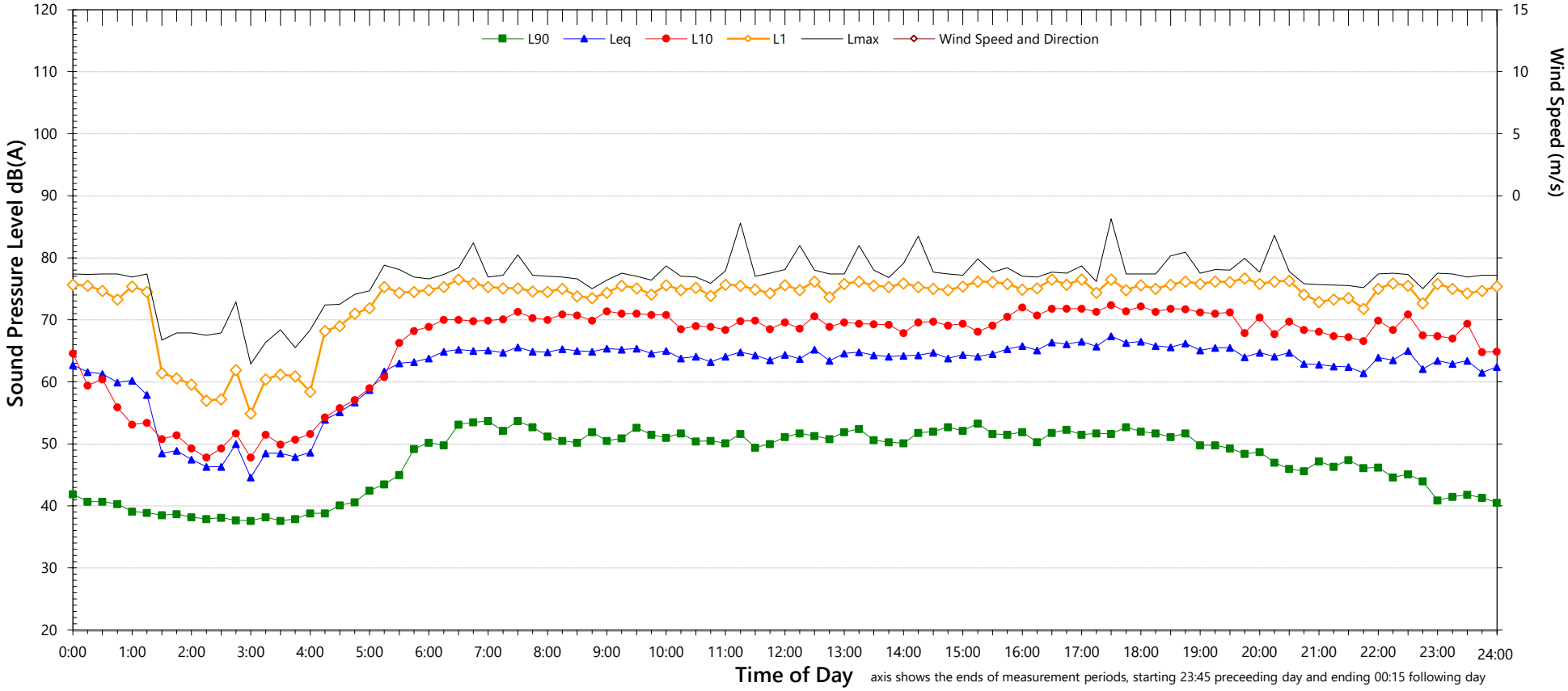
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Rear)

## Wednesday, 14 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 50 | 46 | 38 |
| LAeq | 65 | 64 | 61 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 68 | to | 85 |
| $L_{Max}$ - $L_{eq}$ (Range) | 18 | to | 31 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 67 | 64 |
| $L_{eq\ 1hr}$ upper 10 percentile | 68 | 66 |
| $L_{eq\ 1hr}$ lower 10 percentile | 66 | 51 |

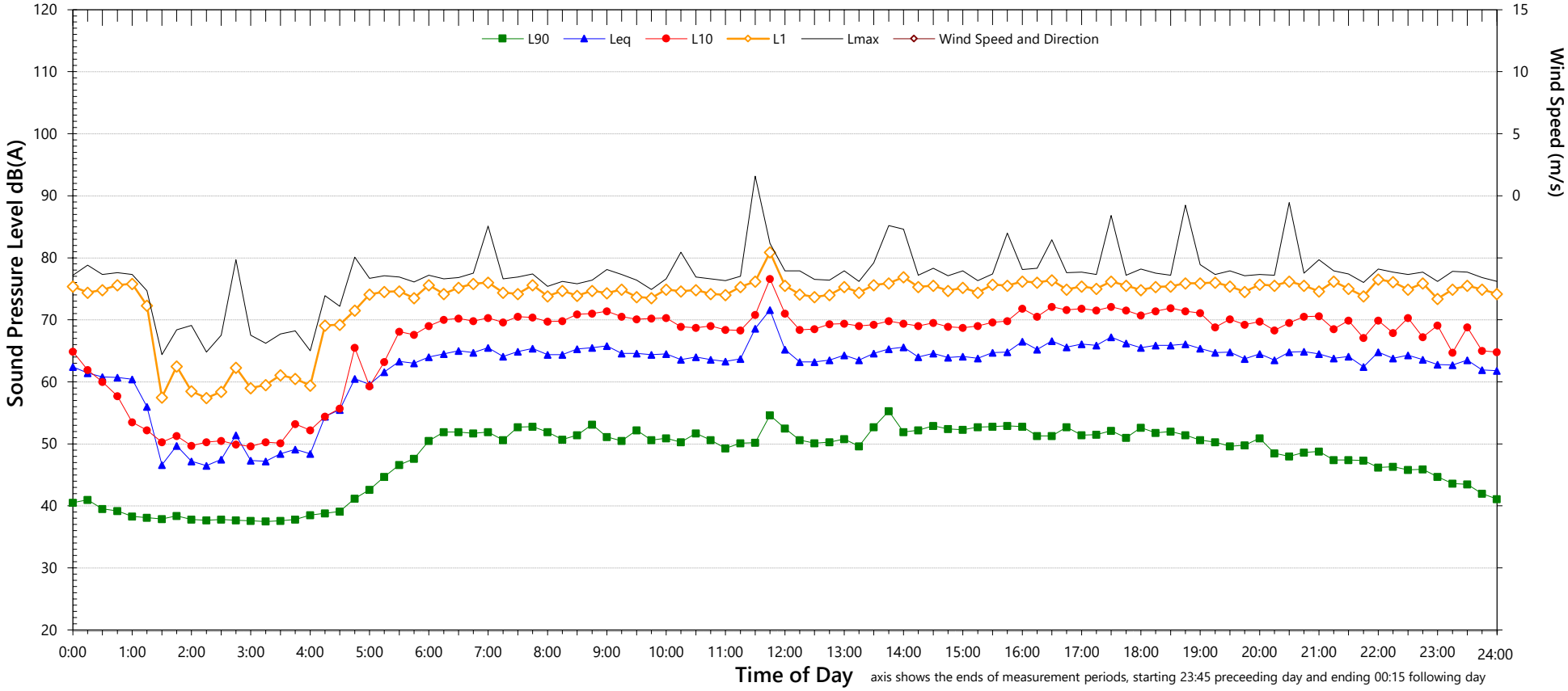
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Rear)

## Thursday, 15 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | 50 | 47 | 38 |
| LAeq | 65 | 65 | 61 |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | 69 | to | 82 |
| $L_{Max}$ - $L_{eq}$ (Range) | 15 | to | 24 |

| NSW Road Noise Policy (1m from facade) | | (see note 6) |
|---|---|---|
| Descriptor | Day | Night[5] |
| | 7am-10pm | 10pm-7am |
| $L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$ | 68 | 63 |
| $L_{eq\ 1hr}$ upper 10 percentile | 69 | 66 |
| $L_{eq\ 1hr}$ lower 10 percentile | 66 | 51 |

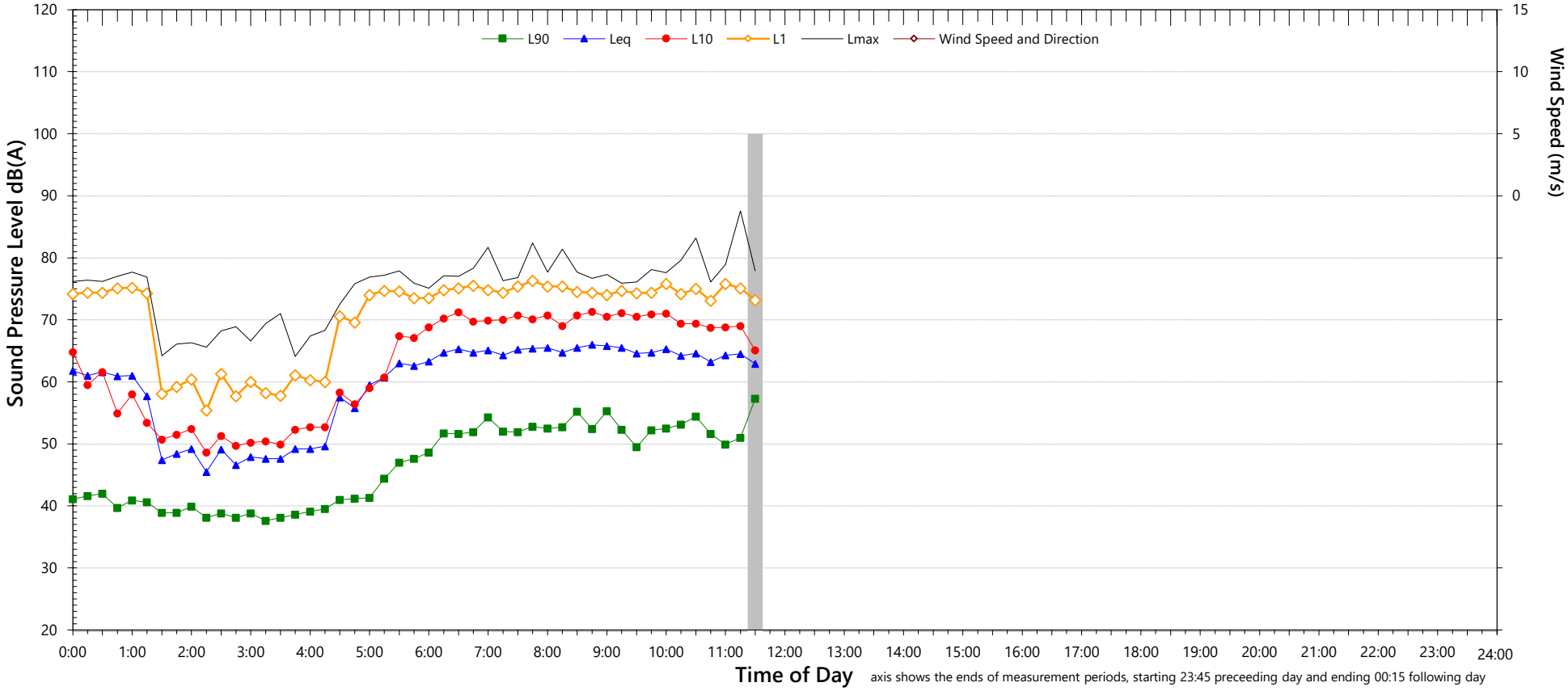
Notes:

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# Unattended Noise Monitoring Results

## 2 Wilson Street, Chatswood (Rear)

## Friday, 16 October 2020




| NSW Noise Policy for Industry (Free Field) | | | |
|---|---|---|---|
| Descriptor | Day[2] | Evening[3] | Night[4 5] |
| $L_{90}$ | - | - | - |
| LAeq | - | - | - |

| Night Time Maximum Noise Levels | | | (see note 7) |
|---|---|---|---|
| $L_{Max}$ (Range) | - | to | - |
| $L_{Max}$ - $L_{eq}$ (Range) | - | to | - |

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

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 til 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. Night time $L_{Max}$ values are shown only where $L_{Max}$ >65dB(A) and where $L_{Max}$- Leq ≥15dB(A)

# APPENDIX F Vibration Monitoring Locations and Results

Vibration monitoring location

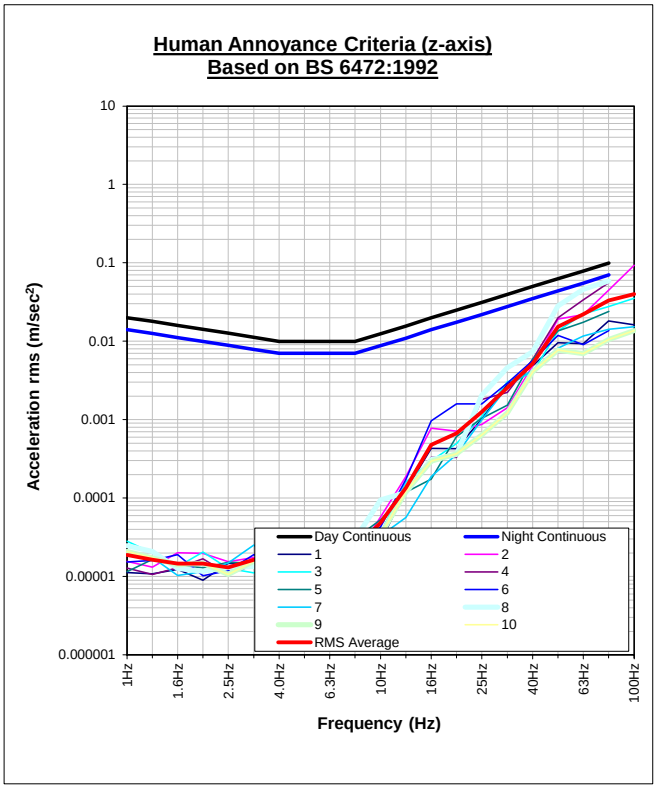
RENZO TONIN & ASSOCIATES
inspired to achieve

Vibration Survey Results

# Vibration Assessment for Human Annoyance BS6472-1992 & DECCW

| | |
|---|---|
| **Project No.:** | Project TL682-01 |
| **Location:** | 2 Wilson Street, Chatswood |
| **Source:** | Trains |

| | | | | | |
|---|---|---|---|---|---|
| **Assessment Location:** | **Residential** | **Axis** | **Z** | **Total secs of Vib per Day (t):** | 14,520 |
| **Type of Vibration:** | **Intermittent** | | | **Total secs of Vib per Night (t):** | 2,940 |




| Legend | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Measurement** | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **RMS Ave** | **Preferred DECCW Criterion** | **Maximum DECCW Criterion** |
| **Acceleration rms (m/sec²)** | **1Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **1.25Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **1.6Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **2.0Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **2.5Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **3.15Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **4.0Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **5.0Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **6.3Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **8.0Hz** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | |
| | **10Hz** | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | | |
| | **12.5Hz** | 0.0001 | 0.0002 | 0.0002 | 0.0001 | 0.0001 | 0.0002 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | | |
| | **16Hz** | 0.0004 | 0.0008 | 0.0003 | 0.0003 | 0.0002 | 0.0010 | 0.0002 | 0.0003 | 0.0003 | 0.0003 | 0.0005 | | |
| | **20Hz** | 0.0004 | 0.0007 | 0.0005 | 0.0003 | 0.0006 | 0.0016 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0007 | | |
| | **25Hz** | 0.0010 | 0.0009 | 0.0011 | 0.0018 | 0.0010 | 0.0016 | 0.0010 | 0.0020 | 0.0006 | 0.0006 | 0.0013 | | |
| | **31.5Hz** | 0.0029 | 0.0014 | 0.0031 | 0.0022 | 0.0015 | 0.0029 | 0.0026 | 0.0046 | 0.0012 | 0.0012 | 0.0026 | | |
| | **40Hz** | 0.0049 | 0.0049 | 0.0039 | 0.0059 | 0.0059 | 0.0057 | 0.0043 | 0.0073 | 0.0041 | 0.0041 | 0.0052 | | |
| | **50Hz** | 0.0095 | 0.0192 | 0.0135 | 0.0200 | 0.0136 | 0.0118 | 0.0082 | 0.0283 | 0.0077 | 0.0077 | 0.0153 | | |
| | **63Hz** | 0.0093 | 0.0219 | 0.0223 | 0.0336 | 0.0174 | 0.0090 | 0.0116 | 0.0458 | 0.0070 | 0.0070 | 0.0221 | | |
| | **80Hz** | 0.0181 | 0.0448 | 0.0277 | 0.0563 | 0.0242 | 0.0138 | 0.0142 | 0.0587 | 0.0105 | 0.0105 | 0.0330 | | |
| | **100Hz** | 0.0161 | 0.0928 | 0.0353 | 0.0425 | 0.0217 | 0.0116 | 0.0153 | 0.0546 | 0.0137 | 0.0137 | 0.0402 | | |
| **Weighted rms** | **Day** | 0.0029 | 0.0062 | 0.0047 | 0.0079 | 0.0041 | 0.0031 | 0.0027 | 0.0096 | 0.0021 | 0.0021 | 0.0052 | 0.0100 | 0.0200 |
| | **Night** | 0.0029 | 0.0062 | 0.0047 | 0.0079 | 0.0041 | 0.0031 | 0.0027 | 0.0096 | 0.0021 | 0.0021 | 0.0052 | 0.0070 | 0.0140 |
| **eVDV** | **Day** | **0.0453** | **0.0956** | **0.0717** | **0.1212** | **0.0637** | **0.0475** | **0.0413** | **0.1481** | **0.0317** | **0.0317** | **0.0793** | **0.20** | **0.40** |
| | **Night** | **0.0304** | **0.0641** | **0.0481** | **0.0813** | **0.0427** | **0.0318** | **0.0277** | **0.0993** | **0.0213** | **0.0213** | **0.0532** | **0.13** | **0.26** |

**NOTE: Red indicates exceedence of Preferred DECCW Criterion**
**NOTE: Gray indicates continous vibration levels and criteria if intermittent criteria is selected**



 9/11/2020