

## 11 GIBBONS STREET, REDFERN

### Acoustic Assessment for Development Application

26 September 2018

St George Community House (SGCH)

TK332-01F02 Acoustic report for DA (r4)

## Document details

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| 26.09.2018 | Update criteria, predicted noise levels and include assessment with future buildings |                     | 4               | TW       |            | TW         |

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# 1 Introduction

Renzo Tonin & Associates was commissioned by St George Community Housing (SGCH) to undertake an environmental noise assessment of the proposed mixed-use development at 11 Gibbons Street, Redfern to accompany an application for Development Application.

From our assessment of site location, the following potential acoustic and vibration issues were identified:

- Road traffic noise associated with Gibbons and Regent Street
- Rail vibration associated with the commuter trains on the Eastern Suburbs & Illawarra Line (T4) located in an underground tunnel adjacent to the site western boundary

Renzo Tonin & Associates attended the site on 27/06/18 from 11:00am to 5:00pm to measure the existing levels of rail vibration potentially affecting the site. A long-term noise monitor was installed on site at facing Gibbons Street from 19/06/18 to 27/06/18 to establish the existing levels of ambient noise surrounding the site. In addition, a short-term traffic noise survey was also carried out on 27/06/18 at corner of Regent and Marian Street. The results of the noise and vibration surveys were used to predict noise and vibration levels within the dwellings, and then assessed against the recommended internal noise and vibration criteria for the project. Recommendations are made where necessary for noise and vibration mitigation.

External facade treatments are recommended in Section 5 of this report to comply with the relevant acoustic criteria. All windows and exterior doors shall incorporate full perimeter acoustic seals.

The following architectural drawings prepared by DKO Architecture were reviewed during the assessment;

**Table 1: Schedule of Architectural Drawings Reviewed**

| Drawing No. | Date           | Revision | Title                   |
|-------------|----------------|----------|-------------------------|
| DA2000      | September 2018 | P2       | Ground Level            |
| DA2001      | September 2018 | P2       | Level 1                 |
| DA2002      | September 2018 | P2       | Level 2                 |
| DA2003      | September 2018 | P2       | Level 3                 |
| DA2004      | September 2018 | P2       | Level 4                 |
| DA2005      | September 2018 | P2       | Levels 5-16 Typical     |
| DA2006      | September 2018 | P2       | Level 17                |
| DA2007      | September 2018 | P2       | Roof Level              |
| DA3000      | September 2018 | P2       | West & North Elevations |
| DA3001      | September 2018 | P2       | East & South Elevations |

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 Acoustic Criteria

Renzo Tonin & Associates attended the site on 27/06/18 from 11:00am to 5:00pm to measure the existing levels of rail vibration from an underground rail tunnel. Unattended long-term noise survey was also conducted on site from 19/06/18 to 27/06/18 to determine the existing level of ambient and background noise surrounding the site. The results of the noise and vibration surveys were used to calculate noise and vibration levels within the residential spaces and assessed against the relevant internal noise and vibration criteria describe below.

### 2.1 Noise and Vibration Criteria

The airborne noise criteria for this development are based on the following documents:

1. Apartment Design Guide (June 2015)
2. State Environmental Planning Policy 65 – Design Quality of Residential Apartment Development (SEPP65)
3. State Environment Planning Policy (Infrastructure) 2007
4. Department of Planning publication “Development Near Rail Corridors & Busy Roads – Interim Guideline” 2008
5. Australian Standard AS/NZS 2107:2016 “Acoustics – Recommended design sound pressure levels and reverberation times for building interior”

The Roads and Maritime Services (RMS) has identified Gibbons and Regent Street as roads that is mandatory for acoustic assessment in accordance with the State Environment Planning Policy (Infrastructure) 2007, meaning that the average annual daily traffic (AADT) volumes are greater than 40,000 vehicles per day - refer to RMS ISEPP Map 16 attached in APPENDIX B . Therefore, an acoustic assessment in accordance with the ISEPP 2007 is mandatory for subject development

#### 2.1.1 Road Traffic and Airborne Rail Noise Criteria

The internal noise criteria for this development as per ISEPP 2007 is presented in Table 2 below and defined in APPENDIX A of this report. Criteria for occupancies not covered under ISEPP 2007 such as offices are adopted from the Australian Standard AS/NZS 2107:2016.

**Table 2: Maximum Internal Noise Criteria for Road Traffic Noise and Airborne Rail Noise**

| Type of Occupancy                                                           | Windows & Doors Condition | Design Noise Level      |                          |
|-----------------------------------------------------------------------------|---------------------------|-------------------------|--------------------------|
|                                                                             |                           | Day, $L_{Aeq}$ (15hour) | Night, $L_{Aeq}$ (9hour) |
| Sleeping areas                                                              | Closed                    | -                       | 35dB(A)                  |
|                                                                             | Open                      | -                       | 45dB(A)                  |
| Other habitable rooms (excluding garages, kitchens, bathrooms and hallways) | Closed                    | 40dB(A)                 | 40dB(A)                  |
|                                                                             | Open                      | 50dB(A)                 | 50dB(A)                  |

| Type of Occupancy                                                                                                                          | Windows & Doors Condition | Design Noise Level             |                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------------------------------|---------------------------------|
|                                                                                                                                            |                           | Day, L <sub>Aeq</sub> (15hour) | Night, L <sub>Aeq</sub> (9hour) |
| Bathrooms                                                                                                                                  | Closed                    | 45dB(A) <sup>1</sup>           | 45dB(A) <sup>1</sup>            |
| Residential lobbies & communal internal areas                                                                                              | Closed                    | 50dB(A) <sup>1</sup>           | 50dB(A) <sup>1</sup>            |
| Retail / Commercial                                                                                                                        | Closed                    | 50dB(A) <sup>1</sup>           | -                               |
| General offices                                                                                                                            | Closed                    | 45dB(A) <sup>1</sup>           | -                               |
| Notes:                                                                                                                                     |                           |                                |                                 |
| 1. Based on Australia Standard AS2107 "Acoustics – Recommended design sound pressure levels and reverberation times for building interior" |                           |                                |                                 |

## 2.1.2 Ground-borne Rail Noise Criteria

The Department of Planning publication "Development near Rail Corridors & Busy Roads – Interim Guideline" 2008 provides recommended criteria for ground-borne or regenerated rail noise. Table 3 summaries these noise limits for sleeping and living spaces.

**Table 3: Recommended Internal Noise Criteria for Regenerated Rail Noise**

| Occupancy                                                                   | Period     | L <sub>Amax</sub> Noise Limit <sup>1</sup> |
|-----------------------------------------------------------------------------|------------|--------------------------------------------|
| Sleeping areas (Bedrooms)                                                   | 10pm – 7am | 35 dB(A)                                   |
| Other habitable rooms (excluding garages, kitchens, bathrooms and hallways) | 7am – 10pm | 40 dB(A)                                   |

Notes: 1. L<sub>Amax</sub> – is a-weighted maximum sound pressure level measures using "Slow" response time

## 2.1.3 Rail Tactile Vibration Criteria

In addition to regenerated rail noise, Section 3.6.3 of the Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline", also provides recommended vibration criteria documents to refer to when establishing train vibration criteria for residential buildings.

1. Assessing Vibration: A technical guideline (DECC 2006)
2. German Standard DIN 4150, Part 3 - 1999
3. British Standard BS 7385 - 1992
4. Australian Standard AS 2670.2 - 1990

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

- Assessing Vibration: A technical guideline (DECC 2006)
- British Standard BS6472: 1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)"

It is noted that DECC guideline "Assessing Vibration: A technical guideline (DECC 2006)" is based on the British Standard BS6472:1992. The criteria curves presented in BS6472:1992 are identical to those in Australian Standard AS2670.2 1990 and the International Standard 2631-2:1989.

Criteria for continuous vibration from the British Standard BS6472:1992 for residential spaces, offices and commercial workshop environments are shown in Figure 1 below.

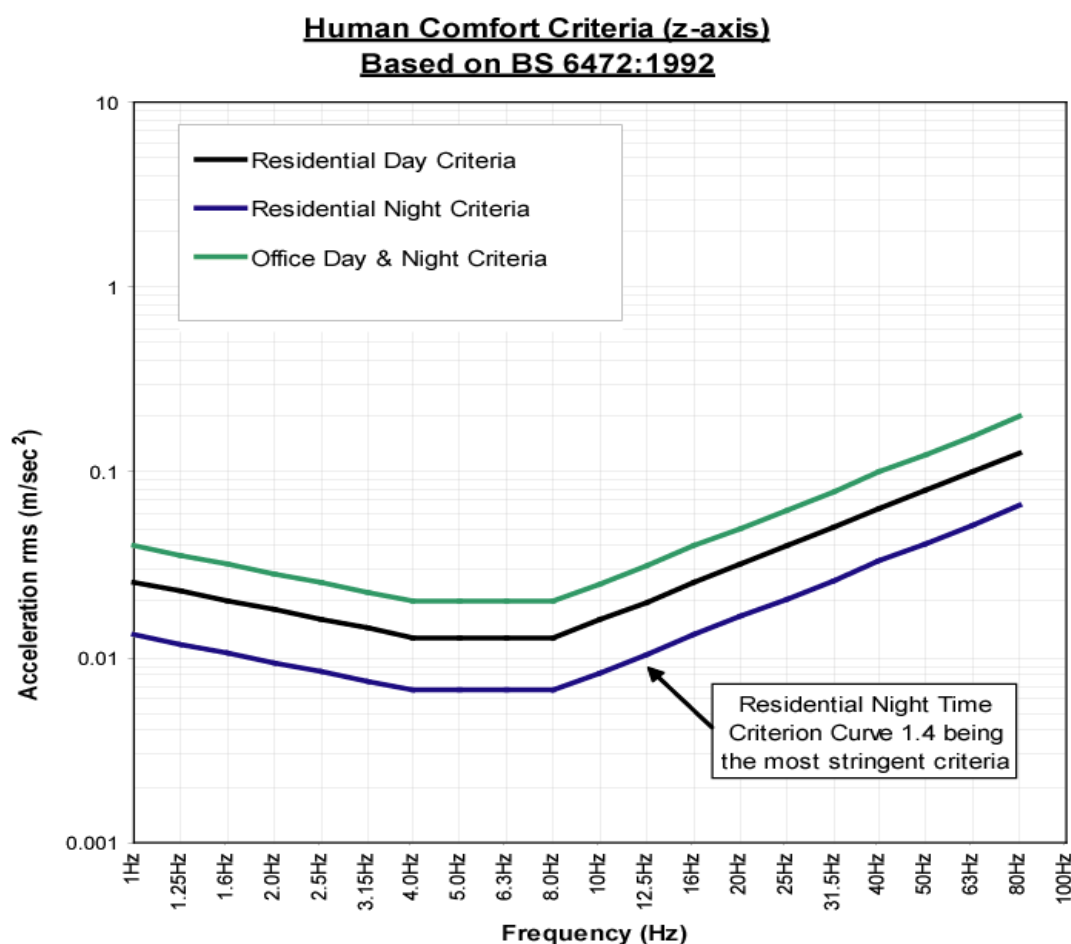


Figure 1: Tactile Vibration Criteria for Residential Buildings

Table 2.4 of the Department of Environment Climate Change's document "Assessing Vibration: A technical guideline (DECC 2006)" presents acceptable vibration dose values for intermittent vibration. Table 4 below outlines DECC's requirements.

Table 4: Acceptable VDV for intermittent vibration in residential buildings m/s1.75

| Location  | Period                  | Preferred VDV m/s1.75 |
|-----------|-------------------------|-----------------------|
| Residence | Day time (7am – 10pm)   | 0.20                  |
|           | Night time (10pm – 7am) | 0.13                  |

## 3 Noise & Vibration Survey

### 3.1 Project Description

The subject site is located at the corner of Gibbons Street and Marian Street, Redfern and is approximately 100m southeast of the above ground station platforms at Redfern station. The rail corridor nearest to subject site consists of two operational tracks in an underground tunnel located approximately 17m west of the site boundary and 12m below the ground. The two tracks services commuter trains on the Eastern Suburbs & Illawarra Line (T4) between Redfern and Sydenham station.

The proposed mixed-use development comprises of the following:

- Retail/commercial, community hub and office tenancies on the Ground floor
- Apartments on Levels 1 & 2
- Mixed of apartments and community spaces on Level 3
- Apartments on Levels 4 to 16
- Apartments and communal open space on level 17

### 3.2 Train Noise and Vibration Monitoring Locations

An operator-attended rail vibration survey was conducted inside the existing 2-storey building on site at the corner of Gibbons and Marian Street on 27/06/18 from 11:00am to 5:00pm. Refer to Figure 2 and APPENDIX G for details of monitoring location. The monitoring location was representative of the nearest proposed facade to the underground rail corridor. The survey captured passenger train pass-bys between Redfern and Sydenham Station.



Figure 2: Site Boundary and Noise and Vibration Monitoring Locations

### 3.3 Instrumentation

Train vibration levels were measured using the Sinus SoundBook multi-channel analyser and PCB accelerometers on the ground floor of the 2-storey building on site (Location 2) as shown in figure above. Three accelerometers (x, y & z) were magnetically fixed to a steel bracket that has been glue fixed to bare concrete slab.

Intermittent rain was observed during the first hour of the operator-attended train vibration survey, however it did not affect the measured results. The weather condition during remaining of noise & vibration survey was fine. All instruments were calibrated before and after measurement. No significant drift in calibration was observed.

The recorded ground vibration levels of train pass-bys are shown in Section 3.6 below together with the vibration criteria from British Standard BS6472-1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80 Hz)" and DECC intermittent vibration dosage criterion.

### 3.4 Long-term Ambient and Background Noise Survey

The proposed development is potentially affected road traffic noise from Gibbons Street on western boundary and Regent Street to approximately 40m to the east. An environmental noise monitor was installed 1.2m inside the site boundary facing Gibbons Street indicated in Figure 2 above for the ambient and background noise survey from 19/06/18 to 27/06/18. A short-term noise survey was also conducted on Regent Street on 27/06/18.

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 results of the background and ambient noise monitoring conducted on site are presented in APPENDIX G.

### 3.5 Measured Road Traffic Noise

The design traffic 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 noise levels are presented Table 5 below.

**Table 5: Representative Day and Night Road Traffic Noise Levels**

| Monitoring Location                                         | Survey Period                                    | Measured Traffic Noise Levels  |                                |
|-------------------------------------------------------------|--------------------------------------------------|--------------------------------|--------------------------------|
|                                                             |                                                  | $L_{Aeq,15\text{hours}}^{1,2}$ | $L_{Aeq,9\text{ hours}}^{1,2}$ |
| Location 1 – Gibbons Street at 1.2m from site west boundary | Day time (7am to 10pm)<br>19/06/18 to 27/06/18   | 71 dB(A)                       | -                              |
|                                                             | Night time (10pm to 7am)<br>19/06/18 to 27/06/18 | -                              | 68 dB(A)                       |

Notes:

- Noise levels presented are facade values.
- Representative external noise levels in measured  $L_{Aeq}$  over 15 hour and 9 hour day and night period respectively (ISEPP 2007)

Table 6 below presents results of the short-term traffic noise survey conducted at corner of Regent and Marian Street.

**Table 6: Representative Day and Night Road Traffic Noise Levels**

| Monitoring Location                                                                                | Survey Period                          | Measured Traffic and Background Noise Levels |                             |
|----------------------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------------|-----------------------------|
|                                                                                                    |                                        | L <sub>Aeq</sub> , 15minute                  | L <sub>A90</sub> , 15minute |
| Location 2 – Corner of Regent & Marian Street at 2.5m from building façade and 0.5m from road kerb | 3:15pm to 3:30pm on Wednesday 27/06/18 | 72 dB(A)                                     | 59dB(A)                     |

Notes:

1. Noise levels presented are facade values.

### 3.6 Measured Tactile Train Vibration & Assessment to BS6472 and DECC

Results of the train vibration survey were plotted against night and day criterion of British Standard BS6472-1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" as show in Figure 3 and Figure 6 below. In addition, the measured train vibration levels were used to calculate the vibration dosage values (VDV) and then compared to the acceptable levels from the Table 2.4 of DECC guideline.

The graphs below demonstrate that the floor induced vibration within the proposed building from each of the measured train pass-bys were in compliance with the British Standard BS6472:1997 for human comfort in a residential environment during the day and night. Similarly, the calculated vibration dosage values (VDV) from our measurements complied with the preferred day and night VDV criterion as defined in the DECC guideline.

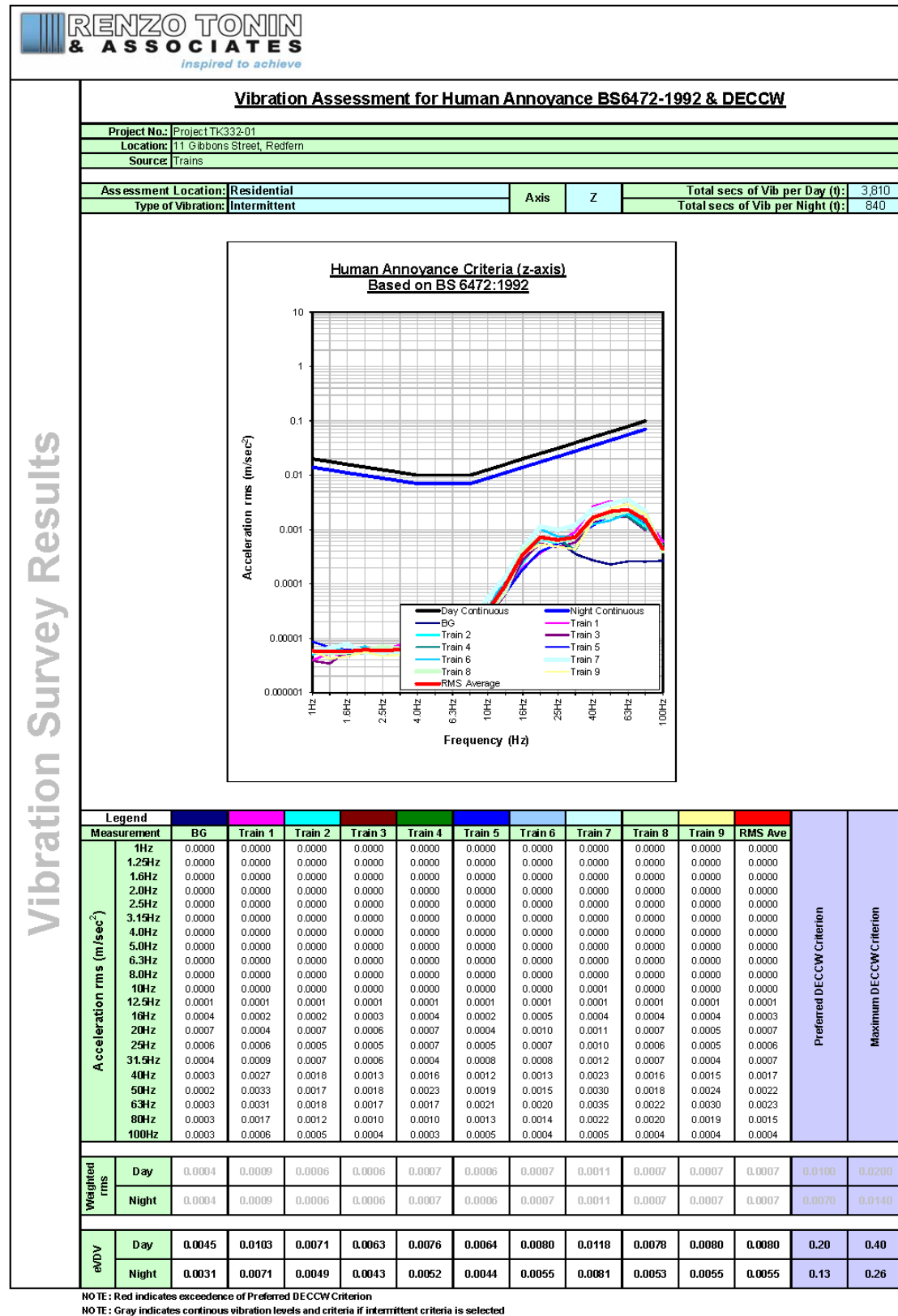


Figure 3: Vibration Assessment (Survey 1) for Human Annoyance BS6472 in Horizontal Plane

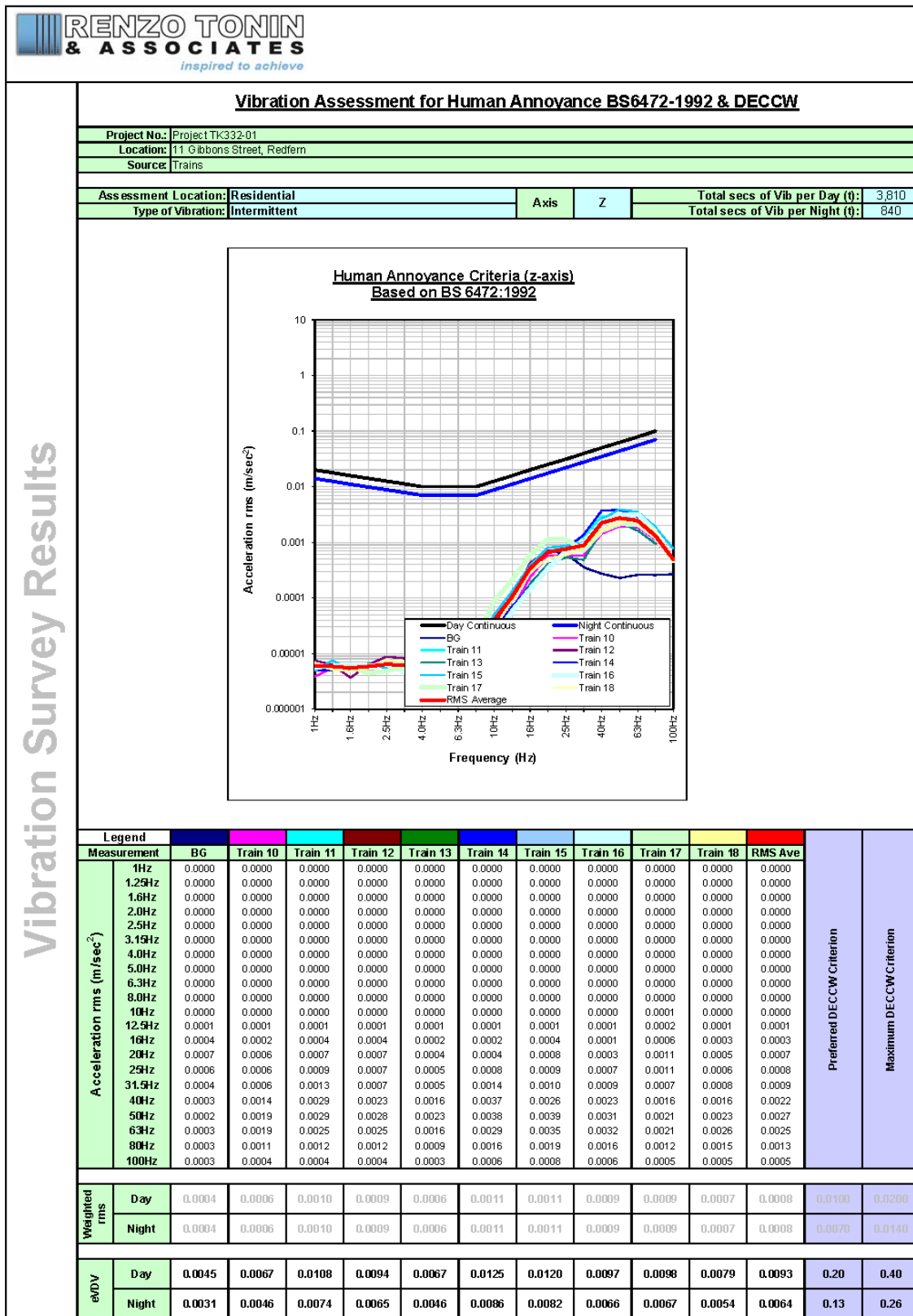
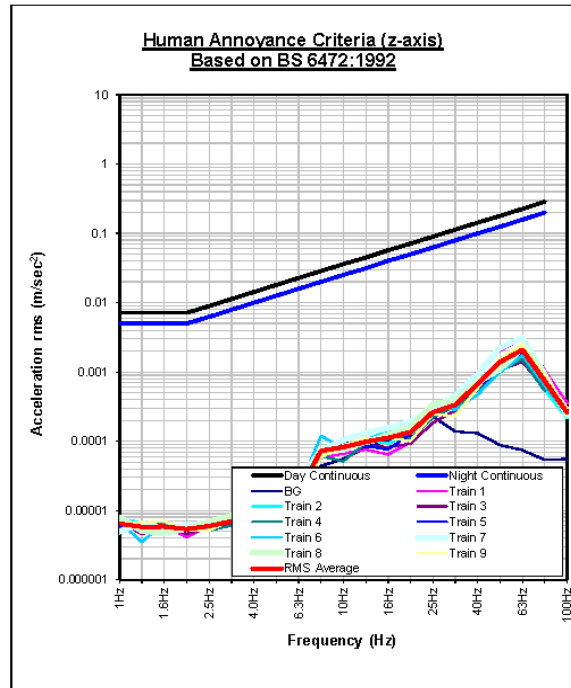


Figure 4: Vibration Assessment (Survey 2) for Human Annoyance BS6472 in Horizontal Plane

# Vibration Survey Results

## Vibration Assessment for Human Annoyance BS6472-1992 & DECCW

|                      |                                 |                            |     |                                  |       |
|----------------------|---------------------------------|----------------------------|-----|----------------------------------|-------|
| Project No.:         |                                 | Project TK332-01           |     |                                  |       |
| Location:            |                                 | 11 Gibbons Street, Redfern |     |                                  |       |
| Source:              |                                 | Trains                     |     |                                  |       |
|                      |                                 |                            |     |                                  |       |
| Assessment Location: | Residential                     | Axis                       | X&Y | Total secs of Vib per Day (t):   | 3,810 |
|                      | Type of Vibration: Intermittent |                            |     | Total secs of Vib per Night (t): | 840   |



| Legend                    |        | Measurement | BG     | Train 1 | Train 2 | Train 3 | Train 4 | Train 5 | Train 6 | Train 7 | Train 8 | Train 9 | 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  | 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  | 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  | 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  | 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  | 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  | 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  | 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  | 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  | 0.0000  |                           |                         |
|                           | 8.0Hz  | 0.0001      | 0.0001 | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  |                           |                         |
|                           | 10Hz   | 0.0001      | 0.0001 | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  |                           |                         |
|                           | 12.5Hz | 0.0001      | 0.0001 | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  |                           |                         |
|                           | 16Hz   | 0.0001      | 0.0001 | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0002  | 0.0001  | 0.0001  | 0.0001  |                           |                         |
|                           | 20Hz   | 0.0001      | 0.0001 | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0002  | 0.0002  | 0.0002  | 0.0001  | 0.0001  |                           |                         |
|                           | 25Hz   | 0.0002      | 0.0002 | 0.0002  | 0.0002  | 0.0002  | 0.0003  | 0.0003  | 0.0003  | 0.0003  | 0.0003  | 0.0002  | 0.0003  |                           |                         |
|                           | 31.5Hz | 0.0001      | 0.0005 | 0.0004  | 0.0003  | 0.0003  | 0.0003  | 0.0003  | 0.0003  | 0.0005  | 0.0004  | 0.0002  | 0.0003  |                           |                         |
|                           | 40Hz   | 0.0001      | 0.0010 | 0.0006  | 0.0006  | 0.0005  | 0.0006  | 0.0005  | 0.0009  | 0.0007  | 0.0006  | 0.0006  | 0.0007  |                           |                         |
|                           | 50Hz   | 0.0001      | 0.0020 | 0.0013  | 0.0011  | 0.0011  | 0.0011  | 0.0010  | 0.0022  | 0.0011  | 0.0015  | 0.0015  | 0.0014  |                           |                         |
|                           | 63Hz   | 0.0001      | 0.0031 | 0.0015  | 0.0014  | 0.0015  | 0.0015  | 0.0019  | 0.0017  | 0.0031  | 0.0022  | 0.0025  | 0.0021  |                           |                         |
|                           | 80Hz   | 0.0001      | 0.0011 | 0.0005  | 0.0006  | 0.0005  | 0.0008  | 0.0006  | 0.0009  | 0.0009  | 0.0009  | 0.0009  | 0.0008  |                           |                         |
|                           | 100Hz  | 0.0001      | 0.0004 | 0.0002  | 0.0002  | 0.0002  | 0.0002  | 0.0003  | 0.0002  | 0.0003  | 0.0002  | 0.0003  | 0.0003  |                           |                         |
| Weighted rms              | Day    | 0.0000      | 0.0001 | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0002  | 0.0001  | 0.0001  | 0.0001  | 0.0071                    | 0.0140                  |
|                           | Night  | 0.0000      | 0.0001 | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0001  | 0.0002  | 0.0001  | 0.0001  | 0.0001  | 0.0050                    | 0.0100                  |
| eVDV                      | Day    | 0.0004      | 0.0016 | 0.0010  | 0.0009  | 0.0009  | 0.0011  | 0.0010  | 0.0017  | 0.0012  | 0.0013  | 0.0012  | 0.0012  | 0.20                      | 0.40                    |
|                           | Night  | 0.0003      | 0.0011 | 0.0007  | 0.0006  | 0.0006  | 0.0007  | 0.0007  | 0.0012  | 0.0008  | 0.0009  | 0.0008  | 0.0008  | 0.13                      | 0.26                    |

NOTE: Red indicates exceedance of Preferred DECCW Criterion

NOTE: Gray indicates continuous vibration levels and criteria if intermittent criteria is selected

QTS-01 (rev 12) Human Annoyance Vibration Assessment BS6472-DEC - z axis

Figure 5: Vibration Assessment (Survey 1) for Human Annoyance BS6472 in Vertical Plane

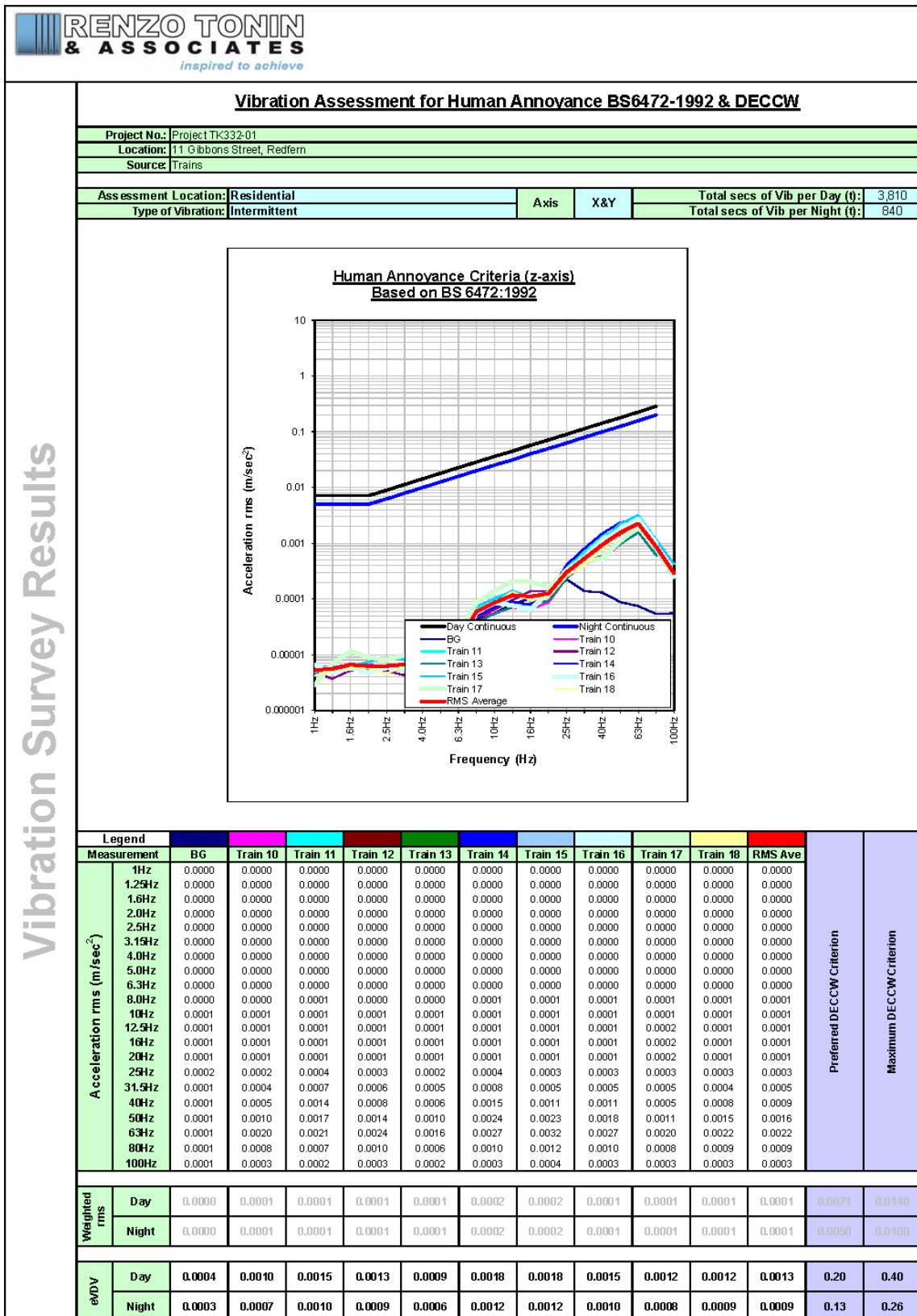


Figure 6: Vibration Assessment (Survey 2) for Human Annoyance BS6472 in Vertical Plane

## 4 Predicted Noise Levels

### 4.1 Predicted Ground-borne Rail Noise Inside Proposed Building

Regenerated or ground-borne rail noise is the low rumble heard inside buildings with vicinity of railway tunnels or railway tracks due to ground vibration generated by passing trains which propagate through soil and rock up into building elements such as foundation, wall and floors which re-radiates as audible sound.

Train vibration levels measured on site on 27/06/18 were used to predict the regenerated rail noise inside the proposed building from train pass-bys in underground rail tunnel adjacent to site. These calculated noise levels inside apartments are summarised in Table 7 below and compared to ground-borne noise criteria defined in Table 3.

**Table 7: Predicted Ground-borne Rail Noise Levels**

| Floor Level    | Proposed Occupancy                         | Calculated <sup>1</sup> Ground-borne Rail Noise $L_{Amax}$ (Slow) inside Apartments for 95% of rail pass-by events | DOP Criteria for Ground-borne Rail Noise $L_{Amax}$ (Slow) | Comply? (Yes/No)  |
|----------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-------------------|
| Levels 6 to 17 | Living, dining and kitchen                 | Equal to or less than 30 dB(A)                                                                                     | 40 dB(A)                                                   | Yes               |
|                | Sleeping areas                             | Equal to or less than 30 dB(A)                                                                                     | 35 dB(A)                                                   | Yes               |
| Levels 4 & 5   | Living, dining and kitchen                 | 31-33 dB(A)                                                                                                        | 40 dB(A)                                                   | Yes               |
|                | Sleeping areas                             |                                                                                                                    | 35 dB(A)                                                   | Yes               |
| Level 3        | Living, dining and kitchen                 | 36 <sup>2</sup> dB(A)                                                                                              | 40 dB(A)                                                   | Yes               |
|                | Sleeping areas                             |                                                                                                                    | 35 dB(A)                                                   | Yes <sup>2</sup>  |
|                | Commercial                                 |                                                                                                                    | N/A                                                        | N/A               |
| Level 2        | Living, dining and kitchen                 | 38 dB(A)                                                                                                           | 40 dB(A)                                                   | Yes               |
|                | Sleeping areas                             |                                                                                                                    | 35 dB(A)                                                   | No. Exceed by 3dB |
|                | Commercial/community room                  |                                                                                                                    | N/A                                                        | N/A               |
| Level 1        | Living, dining and kitchen                 | 40 dB(A)                                                                                                           | 40 dB(A)                                                   | Yes               |
|                | Sleeping areas                             |                                                                                                                    | 35 dB(A)                                                   | No. Exceed by 5dB |
|                | Commercial/community room                  |                                                                                                                    | N/A                                                        | N/A               |
| Ground         | Retail/commercial, offices & community hub | 34 dB(A)                                                                                                           | N/A                                                        | N/A               |

Notes:

1. Ground-borne noise calculations were based upon the measured  $L_{Amax}$  (Slow) of 95% of train pass-events as per DOP Guideline 2008
2. Exceedance of 1dB is insignificant and not discernible.

The above assessment demonstrates ground-borne rail noise level inside habitable rooms of the development due train pass-bys on the adjacent rail tunnel (Eastern Suburbs & Illawarra Line) to exceed the  $L_{Amax}$  (Slow) criteria stipulated in the DOP Guideline 2008 by **3dB to 5dB**.

## 4.2 Predicated Traffic Noise Levels at Building Facades

The major sources of external noise intrusion for the proposed development has been identified as traffic on Gibbons Street and Regent Street.

The level of road traffic noise impacting on the each of the proposed building façades were predicted by modelling road noise sources, existing surrounding buildings, intervening structures and ground topography using the internationally recognised environmental noise prediction computer program CadnaA (version 4.5). Results of the long-term and short-term traffic noise surveys were used to calibrate and fine tune the acoustic model.

In addition, acoustic modelling has also been conducted to demonstrate the sound-shielding effects of future 18-storey towers to the south, east and north-east of subject site. Table 8 below is summary of predicted façade traffic noise levels with current and future surrounding buildings.

Graphical representation of the predicated noise levels on the proposed building facades are shown in APPENDIX E.

**Table 8: Predicted Existing and Future Traffic Noise Levels**

| Facade                                                          | Floor              | Day Traffic Noise Level <sup>1,2</sup> L <sub>Aeq</sub> ,<br>15 Hour | Night Traffic Noise Level <sup>1,2</sup><br>L <sub>Aeq</sub> , 9 Hour |
|-----------------------------------------------------------------|--------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------|
|                                                                 |                    |                                                                      |                                                                       |
| Façade Traffic Noise Levels with Existing Surrounding Buildings |                    |                                                                      |                                                                       |
| Gibbons Street (West)                                           | Ground to Level 10 | 69 to 72dB(A)                                                        | 66 to 69dB(A)                                                         |
|                                                                 | Levels 11 to 17    | 66 to 68dB(A)                                                        | 63 to 65dB(A)                                                         |
| William Lane (East)                                             | Ground to Level 10 | 50 to 62dB(A)                                                        | 47 to 59dB(A)                                                         |
|                                                                 | Levels 11 to 17    | 63 to 65dB(A)                                                        | 60 to 62dB(A)                                                         |
| Façade Traffic Noise Levels with Future Surrounding Buildings   |                    |                                                                      |                                                                       |
| Gibbons Street (West)                                           | Ground to Level 10 | 69 to 72dB(A)                                                        | 66 to 69dB(A)                                                         |
|                                                                 | Levels 11 to 17    | 66 to 68dB(A)                                                        | 63 to 65dB(A)                                                         |
| William Lane (East)                                             | Ground to Level 10 | 47 to 59dB(A)                                                        | 44 to 56dB(A)                                                         |
|                                                                 | Levels 11 to 17    | 60 to 62dB(A)                                                        | 57 to 59dB(A)                                                         |

Notes:

1. L<sub>Aeq,15hour</sub> is traffic noise level over 15-hour period from 7am to 10pm and L<sub>Aeq,9hour</sub> is traffic noise level over 9-hour period from 10pm to 7am next day as defined in ISEPP 2007 and DoP Guideline.
2. Predicted façade noise levels are 1m from façade or window.
3. Predicted traffic noise with future buildings is based on current traffic volume

The predicted traffic noise levels from the acoustic model with existing surrounding buildings were then used to calculate internal noise levels within the proposed residential and non-residential spaces to determine façade and glazing requirements to comply noise goals defined in Table 2 above. Internal noise calculations and predications were conducted using the Outside-In Glazing Spreadsheet developed in this office which takes into account façade noise levels, glazing and facade transmission loss and room sound absorption characteristics.

External facade and glazing constructions required to comply with the project noise criteria outlined in Table 2 above are presented in Section 5 below.

In addition to sound proofing of facades, a number of noise mitigation measures has been incorporated into the building design which are as follows;

- Winter gardens proposed for Levels 1 & 2 apartments where units are worst-affected by traffic noise from Gibbons Street
- Alcoves on Gibbons Street façade to create quiet zones for bedroom windows
- Double glazing proposed for bedrooms located at building corners overlooking Gibbon Street
- Size of bedroom windows overlooking the main noise source has been kept to a minimum to reduce ingress of external noise.

## 5 Recommendations

### 5.1 Glazing Design Requirements

Table 9 below presents recommended glazing treatment for the building facades to achieve compliance with the maximum noise levels nominated in Table 2 above.

**Table 9: Recommended Glazing Treatment**

| Level                                                                                     | Facade      | Occupancy Type                        | Recommended Minimum Sound Insulation Rating of Glazing Assembly | Typical Compliance Glazing Configuration                                                                                                                                        | Laboratory Test Reference |
|-------------------------------------------------------------------------------------------|-------------|---------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Ground<br>Refer to<br>glazing mark-up floor plans in APPENDIX F for further details       | All facades | Retail/commercial/lobby/community hub | R <sub>w</sub> 32                                               | 6.38mm laminated glass or equivalent                                                                                                                                            | ESTIMATE                  |
|                                                                                           | North       | SGCH Offices                          | R <sub>w</sub> 32                                               | 6.38mm laminated glass or equivalent                                                                                                                                            | ESTIMATE                  |
|                                                                                           | East        |                                       | R <sub>w</sub> 27                                               | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                  |
| Levels 1 & 2<br>Refer to<br>glazing mark-up floor plans in APPENDIX F for further details |             | Open plan living/dining/kitchen       | R <sub>w</sub> 38                                               | Winter garden consisting of 6mm standard float glass and 6.38mm laminated                                                                                                       | ESTIMATE                  |
|                                                                                           |             |                                       | R <sub>w</sub> 40                                               | 12.5mm Viridian VLam Hush laminated glass<br>or<br>Double glazing consisting of 5mm standard float glass/16mm air gap/8.5mm Viridian VLam Hush laminated glass<br>or equivalent | ESTIMATE                  |
|                                                                                           |             |                                       | R <sub>w</sub> 40                                               | Winter garden consisting of 6mm standard float glass and 6.38mm laminated                                                                                                       | ESTIMATE                  |
|                                                                                           |             |                                       | R <sub>w</sub> 38                                               | 10.5mm Viridian VLam Hush laminated glass                                                                                                                                       | ESTIMATE                  |
|                                                                                           | North       | Bedrooms                              | R <sub>w</sub> 38                                               | 10.5mm Viridian VLam Hush laminated glass                                                                                                                                       | ESTIMATE                  |
|                                                                                           |             |                                       | R <sub>w</sub> 32                                               | 6.38mm laminated glass or equivalent                                                                                                                                            | ESTIMATE                  |
|                                                                                           | South       | Bedrooms                              | R <sub>w</sub> 38                                               | 10.5mm Viridian VLam Hush laminated glass                                                                                                                                       | ESTIMATE                  |
|                                                                                           |             |                                       | R <sub>w</sub> 35                                               | 10.38mm laminated glass or equivalent                                                                                                                                           | ESTIMATE                  |
|                                                                                           |             |                                       | R <sub>w</sub> 32                                               | 6.38mm laminated glass or equivalent                                                                                                                                            | ESTIMATE                  |
|                                                                                           |             | Bathroom                              | R <sub>w</sub> 27                                               | 6mm standard float glass                                                                                                                                                        | ESTIMATE                  |

| Level                                                                             | Facade                                                                             | Occupancy Type                  | Recommended Minimum Sound Insulation Rating of Glazing Assembly | Typical Compliance Glazing Configuration                                                                                                                                        | Laboratory Test Reference             |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
|                                                                                   | East                                                                               | Open plan living/dining/kitchen | Rw27                                                            | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                              |
|                                                                                   |                                                                                    | Bedrooms                        | Rw32                                                            | 6.38mm laminated glass or equivalent                                                                                                                                            | ESTIMATE                              |
| Level 3<br>Refer to glazing mark-up floor plans in APPENDIX F for further details | West & north                                                                       | Community room                  | Rw32                                                            | 6.38mm laminated glass or equivalent                                                                                                                                            | ESTIMATE                              |
|                                                                                   | West facing Gibbons St                                                             | Open plan living/dining/kitchen | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                              |
|                                                                                   |                                                                                    | Bedrooms                        | Rw38                                                            | 10.5mm Viridian VLam Hush laminated glass                                                                                                                                       | ESTIMATE                              |
|                                                                                   | North                                                                              | Bedrooms                        | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                              |
|                                                                                   | South                                                                              | Bedrooms                        | Rw38                                                            | 10.5mm Viridian VLam Hush laminated glass                                                                                                                                       | ESTIMATE                              |
|                                                                                   |                                                                                    |                                 | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                              |
|                                                                                   |                                                                                    | Bathroom                        | Rw27                                                            | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                              |
|                                                                                   | East                                                                               | Open plan living/dining/kitchen | Rw27                                                            | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                              |
|                                                                                   |                                                                                    | Bedrooms                        | Rw32                                                            | 6.38mm laminated glass or equivalent                                                                                                                                            | ESTIMATE                              |
|                                                                                   | Levels 4<br>Refer to glazing mark-up floor plans in APPENDIX F for further details | West facing Gibbons St          | Open plan living/dining/kitchen                                 | Rw35                                                                                                                                                                            | 10.38mm laminated glass or equivalent |
| Bedrooms                                                                          |                                                                                    |                                 | Rw40                                                            | 12.5mm Viridian VLam Hush laminated glass<br>or<br>Double glazing consisting of 5mm standard float glass/16mm air gap/8.5mm Viridian VLam Hush laminated glass<br>or equivalent | ESTIMATE                              |
|                                                                                   |                                                                                    |                                 |                                                                 |                                                                                                                                                                                 |                                       |
|                                                                                   |                                                                                    | Rw38                            | 10.5mm Viridian VLam Hush laminated glass                       | ESTIMATE                                                                                                                                                                        |                                       |
| North                                                                             |                                                                                    | Bedrooms                        | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                              |
| South                                                                             |                                                                                    | Bedrooms                        | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                              |
|                                                                                   |                                                                                    |                                 | Rw38                                                            | 10.5mm Viridian VLam Hush laminated glass                                                                                                                                       | ESTIMATE                              |
|                                                                                   |                                                                                    | Bathroom                        | Rw27                                                            | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                              |
| East                                                                              |                                                                                    | Open plan living/dining/kitchen | Rw27                                                            | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                              |
|                                                                                   |                                                                                    | Bedrooms                        | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                              |

| Level                                                                                    | Facade                                                                                    | Occupancy Type                  | Recommended Minimum Sound Insulation Rating of Glazing Assembly | Typical Compliance Glazing Configuration                                                                                                                                        | Laboratory Test Reference            |
|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Levels 5 to 10<br>Refer to glazing mark-up floor plans in APPENDIX F for further details | West facing Gibbons St                                                                    | Open plan living/dining/kitchen | Rw35                                                            | 10.38mm laminated glass or equivalent                                                                                                                                           | ESTIMATE                             |
|                                                                                          |                                                                                           | Bedrooms                        | Rw40                                                            | 12.5mm Viridian VLam Hush laminated glass<br>or<br>Double glazing consisting of 5mm standard float glass/16mm air gap/8.5mm Viridian VLam Hush laminated glass<br>or equivalent | ESTIMATE                             |
|                                                                                          |                                                                                           |                                 |                                                                 | 10.5mm Viridian VLam Hush laminated glass                                                                                                                                       |                                      |
|                                                                                          | North                                                                                     | Bedrooms                        | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                             |
|                                                                                          |                                                                                           | South                           | Bedrooms                                                        | Rw35                                                                                                                                                                            | 10.38 laminated glass or equivalent  |
|                                                                                          | Rw38                                                                                      |                                 |                                                                 | 10.5mm Viridian VLam Hush laminated glass                                                                                                                                       | ESTIMATE                             |
|                                                                                          | Bathroom                                                                                  |                                 | Rw27                                                            | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                             |
|                                                                                          | East                                                                                      | Open plan living/dining/kitchen | Rw27                                                            | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                             |
|                                                                                          |                                                                                           | Bedrooms                        | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                             |
|                                                                                          | Levels 11 to 17<br>Refer to glazing mark-up floor plans in APPENDIX F for further details | West facing Gibbons St          | Open plan living/dining/kitchen                                 | Rw32                                                                                                                                                                            | 6.38mm laminated glass or equivalent |
| Bedrooms                                                                                 |                                                                                           |                                 | Rw38                                                            | 10.5mm Viridian VLam Hush laminated glass                                                                                                                                       | ESTIMATE                             |
| North                                                                                    |                                                                                           | Bedrooms                        | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                             |
| South                                                                                    |                                                                                           | Bedrooms                        | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | ESTIMATE                             |
|                                                                                          |                                                                                           | Bathroom                        | Rw27                                                            | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                             |
| East                                                                                     |                                                                                           | Open plan living/dining/kitchen | Rw27                                                            | 6mm standard float glass or equivalent                                                                                                                                          | ESTIMATE                             |
|                                                                                          |                                                                                           | Bedrooms                        | Rw35                                                            | 10.38 laminated glass or equivalent                                                                                                                                             | 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.

| Level | Facade | Occupancy Type | Recommended Minimum Sound Insulation Rating of Glazing Assembly | Typical Compliance Glazing Configuration | 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 development approval 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.

## 5.2 Building Ventilation

Table 10 and Table 11 below shows the assessment of external noise intrusion to the "Windows Open" noise criteria nominated in Table 2 for living and bedrooms. Predicted façade noise levels with and without future surrounding building are summarised in Table 8 above.

**Table 10: Noise Assessment to Windows Open Criteria for Living Areas (Day Time Traffic)**

| Façade                                                                 | Occupancy                        | Floor           | Predicted Noise Level $L_{Aeq, 15\text{hours}}$ in dB(A) |                                                   | ISEPP Windows Open Internal Noise Criteria $L_{Aeq}$ in dB(A) | Compliance (Yes/No) |
|------------------------------------------------------------------------|----------------------------------|-----------------|----------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------|---------------------|
|                                                                        |                                  |                 | At facade <sup>1</sup>                                   | Inside Apartment with Windows Open <sup>2,3</sup> |                                                               |                     |
| Assessment of window open criteria with existing surrounding buildings |                                  |                 |                                                          |                                                   |                                                               |                     |
| Gibbons Street (West)                                                  | Open-plan Living/Dining/ Kitchen | Levels 1 to 10  | 69 to 72                                                 | 57 to 60                                          | 50 or less                                                    | No                  |
|                                                                        |                                  | Levels 11 to 17 | 66 to 68                                                 | 54 to 56                                          | 50 or less                                                    | No                  |

| Façade                                                                                | Occupancy                                                                                            | Floor           | Predicted Noise Level $L_{Aeq, 15\text{hours}}$ in dB(A) |                                                   | ISEPP Windows Open Internal Noise Criteria $L_{Aeq}$ in dB(A) | Compliance (Yes/No) |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-----------------|----------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------|---------------------|
|                                                                                       |                                                                                                      |                 | At facade <sup>1</sup>                                   | Inside Apartment with Windows Open <sup>2,3</sup> |                                                               |                     |
| William Lane (East)                                                                   | Open-plan Living/Dining/ Kitchen                                                                     | Levels 1 to 10  | 50 to 62                                                 | 38 to 40                                          | 50 or less                                                    | Yes                 |
|                                                                                       |                                                                                                      | Levels 11 to 17 | 63 to 65                                                 | 51 to 53                                          | 50 or less                                                    | No                  |
| Assessment of window open criteria with consideration of future surrounding buildings |                                                                                                      |                 |                                                          |                                                   |                                                               |                     |
| Gibbons Street (West)                                                                 | Proposed future neighbouring buildings does not provide noise shielding to Gibbons Street apartments |                 |                                                          |                                                   |                                                               |                     |
| William Lane (East)                                                                   | Open-plan Living/Dining/ Kitchen                                                                     | Levels 1 to 10  | 47 to 59                                                 | 35 to 47                                          | 50 or less                                                    | Yes                 |
|                                                                                       |                                                                                                      | Levels 11 to 17 | 60 to 62                                                 | 48 to 50                                          | 50 or less                                                    | Yes                 |

Notes:

1. Predicted façade noise levels are 1m from window or sliding door
2. Assumes open-plan living/dining/kitchen has timber floor finish and furnished providing typical reverberation time of no greater than 0.7seconds.
3. Opening area of window or sliding door is no greater than 5% of floor area

**Table 11: Noise Assessment to Windows Open Criteria for Bedrooms (Night Time Traffic)**

| Façade                                                                                | Occupancy                                                                                            | Floor           | Predicted Noise Level $L_{Aeq, 9\text{hours}}$ in dB(A) |                                                   | ISEPP Windows Open Internal Noise Criteria $L_{Aeq}$ in dB(A) | Compliance (Yes/No) |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------|---------------------|
|                                                                                       |                                                                                                      |                 | At facade <sup>1</sup>                                  | Inside Apartment with Windows Open <sup>2,3</sup> |                                                               |                     |
| Assessment of window open criteria with existing surrounding buildings                |                                                                                                      |                 |                                                         |                                                   |                                                               |                     |
| Gibbons Street (West)                                                                 | Bedrooms                                                                                             | Levels 1 to 10  | 66 to 69                                                | 52 to 55                                          | 45 or less                                                    | No                  |
|                                                                                       |                                                                                                      | Levels 11 to 17 | 63 to 65                                                | 49 to 51                                          | 45 or less                                                    | No                  |
| William Lane (East)                                                                   | Bedrooms                                                                                             | Levels 1 to 10  | 47 to 59                                                | 33 to 45                                          | 45 or less                                                    | Yes                 |
|                                                                                       |                                                                                                      | Levels 11 to 17 | 60 to 62                                                | 46 to 48                                          | 45 or less                                                    | No                  |
| Assessment of window open criteria with consideration of future surrounding buildings |                                                                                                      |                 |                                                         |                                                   |                                                               |                     |
| Gibbons Street (West)                                                                 | Proposed future neighbouring buildings does not provide noise shielding to Gibbons Street apartments |                 |                                                         |                                                   |                                                               |                     |
| William Lane (East)                                                                   | Bedrooms                                                                                             | Levels 1 to 10  | 44 to 56                                                | 30 to 45                                          | 45 or less                                                    | Yes                 |
|                                                                                       |                                                                                                      | Levels 11 to 17 | 57 to 59                                                | 43 to 45                                          | 45 or less                                                    | Yes                 |

Notes:

1. Predicted façade noise levels are 1m from window or sliding door
2. Assumes bedrooms are carpeted and furnished providing typical reverberation time of no greater than 0.4seconds
3. Opening area of window or sliding door is no greater than 5% of floor area

The above assessment has shown once the future neighbouring multi-storey buildings are built all apartments within the proposed development that faces William Lane can be naturally ventilated and achieve compliance with ISEPP internal noise criteria outlined Table 2.

### 5.3 Facade & Roof Sound Insulation

In principle advice is provided below for the acoustic requirements of the roof and external walls for this proposed development.

#### 5.3.1 External Walls

The dominate path of external noise ingress into building interior is via window and doors. Assessment and recommendations in regard to external noise intrusion has accordingly been made with respect to the windows and doors. It is therefore recommended that the external walls have a sound isolation rating ( $R_w$ ) at least 15dB higher than that of the glazing specified in Table 9 above, to maintain the acoustic integrity of the overall facade system.

#### 5.3.2 Roof and Ceiling

Similar to the external wall design, the roof/ceiling construction can generally provide acoustic performances well in excess of glazing or doors. The roof construction should have a sound isolation rating ( $R_w$ ) at least 10dB higher than that of the glazing on its facade.

#### 5.3.3 Glazing Assembly Requirements

The following acoustic measures should also be incorporated into the building design:

- s1. All operable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the  $R_w$  rating performance of the glazing to not be reduced.
- s2. The glazing thicknesses outlined in Table 9 should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.
- s3. The glazing supplier shall ensure that installation techniques will not diminish the  $R_w$  performance of the glazing when installed on site. Sliding door meeting stiles should form an airtight seal when closed and locked.
- s4. The perimeter of all window and door frames are to be sealed airtight in the external facade using the following methods:
  - For gaps less than 10mm - Fill all gaps around the window perimeter with an acoustic mastic sealer (minimum specific gravity 1.6sg) equivalent to Promat Promaseal. The depth of sealer shall be at least equal to the width of the gap.
  - If the gap is greater than 10mm, fill the cavity with polyester insulation and a backing rod. Seal the gap airtight an acoustic mastic sealer (min specific gravity 1.6sg) equivalent to Promat Promaseal. The depth of sealer shall be at least equal to the width

of the gap. The gaps between frames shall also be sealed using aluminium angle brackets (approximately 25 x 25 x 3mm).

## 6 Operational Noise Emission from Development

### 6.1 Existing Noise Environment at Development Site

The results of the long-term noise monitoring have been summarised in accordance with Industrial Noise Policy requirements published by the NSW Environmental Protection Authority (EPA) and are presented in Table 12 below.

**Table 12: Measured Site Ambient & Background Noise Levels**

| Noise Monitoring Location                                       | Representative Ambient & Background Noise Levels in dB(A) | Day <sup>1</sup> | Evening <sup>2</sup> | Night <sup>3</sup> |
|-----------------------------------------------------------------|-----------------------------------------------------------|------------------|----------------------|--------------------|
| Location 1 – 1.2m from site boundary facing Gibbons St, Redfern | Background Noise Level $L_{A90}$                          | 56               | 52                   | 43                 |
|                                                                 | Ambient Noise Level $L_{Aeq}$                             | 69               | 67                   | 64                 |

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

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 Office of Environment and Heritage (formally Department of Environment, Climate Change and Water).

### 6.2 EPA Requirements

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 13: NPfl Amenity Noise Levels - Recommended  $L_{Aeq}$  Amenity Noise Levels from Industrial Noise Sources [EPA NPfl 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                                                                                                                   |
|                                                                                               | 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  $L_{Aeq}$  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 14: L<sub>Aeq</sub> design criterion for noise production from mechanical plant (EPA NPfI)**

|                       | Column 1                                       | Column 2                        | Column 3                           | Column 4                                       | Column 5                                                      | Column 6                                           | Column 7                             | Column 8                                                    |
|-----------------------|------------------------------------------------|---------------------------------|------------------------------------|------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------|--------------------------------------|-------------------------------------------------------------|
| Time of Day           | Rating Background Level (RBL) L <sub>A90</sub> | Intrusiveness Criterion (RBL+5) | Project Amenity Noise Level (PANL) | Measured L <sub>Aeq</sub> Ambient Noise Levels | Is PANL 10dB, or more, lower than measured L <sub>Aeq</sub> ? | Existing noise level likely to decrease in future? | Exceptions to PANL? ^                | Project Noise Trigger Level L <sub>Aeq</sub> , period dB(A) |
| Day (7am to 6pm)      | 56                                             | 61                              | 55                                 | 69                                             | Yes                                                           | No                                                 | Existing L <sub>Aeq</sub> minus 15dB | 54                                                          |
| Evening (6pm to 10pm) | 52                                             | 57                              | 45                                 | 67                                             | Yes                                                           | No                                                 | Existing L <sub>Aeq</sub> minus 15dB | 52                                                          |
| Night (10pm to 7am)   | 43                                             | 48                              | 40                                 | 64                                             | Yes                                                           | No                                                 | Existing L <sub>Aeq</sub> minus 15dB | 49                                                          |

Explanatory notes:

Column 1 – RBL measured in accordance with the NPfI and outlined in Table 4 above

Column 3 – 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 4 – Measured in accordance with the NPfI and outlined in Table 5 above

Column 7 - Determined in accordance with Section 2.4 of the NPfI.

Column 8 – Project Noise Trigger Level is the lower value of project intrusiveness noise level and project amenity noise level

^ - In accordance with Section 2.4.1 of the NPfI, the project amenity noise level is derived from measured L<sub>Aeq</sub> where measured traffic noise is 10dB or more above the recommended amenity noise level for the area

Where necessary, noise amelioration treatment will be incorporated in the design to ensure that noise levels comply with the recommended EPA's INP noise emission criteria noted above.

### 6.3 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 be required 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 in Table 9.
- 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 Internal Sound Insulation between Tenancies

Internal walls and floors shall comply with the National Construction Code of Australia 2016 (formally Building Code of Australia). All services and doors shall comply with the requirements of the NCC 2016.

APPENDIX B presents a summary of acoustic provisions outlined in Part F5 of the NCC 2016.

## 8 Construction Noise

The nature of the construction processes proposed for the development does not present difficulties in ensuring that the associated noise limits at surrounding properties are achieved. The major construction activities proposed on this site are demolition works, excavation works, concrete pours and general building works.

Construction and building work will be adequately managed so as to minimise disruption to the local community and the environment.

The NSW Interim Construction Noise Guideline sets out management noise levels and time restrictions for construction activities. The aims of the guideline are to control and manage noise on all building sites within the local area.

Since detail of the construction equipment such as exact type, size, number and operating time are not known at this stage, in-principle noise control measures are provided in Section 8.1 below which may be implemented to minimise any noise exceedances to the noise sensitive receptors where that may occur.

### 8.1 General Engineering Noise Control

Implementation of noise control measures, such as those suggested in Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites", are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-1981, Appendix E, Table E1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table E2 in Appendix E presents typical examples of noise reductions achievable after treatment of various noise sources. Table E3 in Appendix E presents the relative effectiveness of various forms of noise control treatment.

Table 15 below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

**Table 15: Relative Effectiveness of Various Forms of Noise Control, dBA**

| Noise Control Method | Practical Examples                                                            | Typical noise reduction possible in practice |                      | Maximum noise reduction possible in practice |                      |
|----------------------|-------------------------------------------------------------------------------|----------------------------------------------|----------------------|----------------------------------------------|----------------------|
|                      |                                                                               | AS 2436                                      | Renzo Tonin & Assoc. | AS 2436                                      | Renzo Tonin & Assoc. |
| Screening            | Acoustic barriers such as earth mounds, temporary or permanent noise barriers | 7 to 10                                      | 5 to 10              | 15                                           | 15                   |
| Acoustic Enclosures  | Engine casing lagged with acoustic insulation and plywood                     | 15 to 30                                     | 10 to 20             | 50                                           | 30                   |
| Engine Silencing     | Residential class mufflers                                                    | 5 to 10                                      | 5 to 10              | 20                                           | 20                   |

| Noise Control Method                | Practical Examples                                    | Typical noise reduction possible in practice |                      | Maximum noise reduction possible in practice |                      |
|-------------------------------------|-------------------------------------------------------|----------------------------------------------|----------------------|----------------------------------------------|----------------------|
|                                     |                                                       | AS 2436                                      | Renzo Tonin & Assoc. | AS 2436                                      | Renzo Tonin & Assoc. |
| Substitution by alternative process | Use electric motors in preference to diesel or petrol | 15 to 25                                     | 15 to 25             | 60                                           | 40                   |

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436, for this assessment.

Table 16 below identifies possible noise control measures which are applicable on the construction plant likely to be used on site.

**Table 16: Noise Control Measures for Likely Construction Plant**

| Plant Description              | Screening | Acoustic Enclosures | Silencing | Alternative Process |
|--------------------------------|-----------|---------------------|-----------|---------------------|
| Concrete Saw                   | ✓         | ✓                   | x         | x                   |
| Jack hammers                   | ✓         | x                   | ✓         | x                   |
| Mobile Crane                   | ✓         | ✓                   | ✓         | x                   |
| Front End Loader               | ✓         | x                   | ✓         | x                   |
| Pneumatic Hand Tools (general) | ✓         | ✓                   | ✓         | ✓                   |
| Bulldozer                      | ✓         | x                   | ✓         | x                   |
| Tracked Excavator              | ✓         | x                   | ✓         | x                   |
| Concrete Trucks                | ✓         | x                   | ✓         | x                   |
| Delivery Trucks                | ✓         | x                   | ✓         | x                   |
| Dump Trucks                    | ✓         | x                   | ✓         | x                   |
| Truck (> 20 tonne)             | ✓         | x                   | ✓         | x                   |
| Welders                        | ✓         | ✓                   | x         | x                   |
| Cherry Picker                  | ✓         | x                   | ✓         | x                   |
| Concrete Pump                  | ✓         | ✓                   | ✓         | ✓                   |
| Power Generator                | ✓         | ✓                   | ✓         | x                   |
| Light commercial vehicles      | ✓         | x                   | ✓         | x                   |
| Silenced Air Compressor        | ✓         | ✓                   | ✓         | ✓                   |

To ensure efficient noise attenuation performance is achieved using any of the methods listed above, it is recommended acoustic engineers work closely with the construction contractors and carry out preliminary testing prior to commencement of works.

In addition to physical noise controls, the following general noise management measures should be followed:

- Plant and equipment should be properly maintained

- Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel
- Avoid unnecessary noise when carrying out manual operations and when operating plant
- Any equipment not in use for extended periods during construction work should be switched off
- Noise compliance monitoring for all major equipment and activities on site should be undertaken prior to their commencement of work on site.
- In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would 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 should be adequately trained and experienced in such matters.

Where noise level exceedances cannot be avoided, then consideration should be given to implementing time restrictions and/or providing periods of repose for neighbouring receptors.

## 9 Conclusion

Renzo Tonin & Associates have completed an assessment of the road traffic and rail vibration impacts on the proposed mixed-use development at 11 Gibbons Street, Redfern.

Our assessment has shown floor induced vibration within the proposed residential spaces due to train pass-bys to comply with British Standard BS6472:1992 *"Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)"* and day and night VDV values to be within the acceptable values set by the DECC guideline as required by the Department of Planning Interim Guideline 2008.

Based on the measured rail vibration levels on site, our acoustic modelling anticipates ground-borne rail noise to exceed the Department of Planning Guideline by 3 to 5dB on Levels 1 & 2. For apartments facing Gibbon Street which are dominated by constant traffic noise, this exceedance would not be an issue. However, for apartments facing William Lane which are shielded from surrounding traffic noise, this exceedance may be an issue. As this exceedance is of a low degree, we recommend that further in-depth study at detail design stage is carried out, to minimise this potential noise risk for occupants on Levels 1 and 2, to determine if any vibration isolation or attenuation is required to mitigate the exceedance. Alternately, undertaking rail vibration measurements after concrete slab floor construction may reveal that regenerated rail noise levels is not an issue.

To control the ingress of traffic noise into the proposed development and to comply with the nominated noise criteria recommendations have been provided in Section 5 of the report.

## APPENDIX A      Assessment and Design Methodology

### A.1      Apartment Design Guide (June 2015)

The Apartment Design Guide is a support document to the State Environmental Planning Policy 65 – Design Quality of Residential Apartment Development (SEPP65). Relevant section of the guide is reiterated below.

*"4J Noise and pollution*

*...*

*Development near rail corridors and busy roads*

*The NSW Government's Development near Rail Corridors and Busy Roads - Interim Guideline as called up by State Environmental Planning Policy (Infrastructure) 2007 assists in the planning, design and assessment of development in, or adjacent to, rail corridors and busy roads. SEPP 65 development in these locations must have regard to this Guideline.*

*"*

It is noted that the ADG recommends developments near busy roads and rail corridors to undertake assessment in accordance with the "Development near Rail Corridors and Busy Roads – Interim Guideline" published by Department of Planning and discussed in sections below.

### A.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*
- 5.    *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.*

6. *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.*
7. *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:*
  - e. *in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,*
  - f. *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*

8. *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:*
  - g. *a building for residential use,*
  - h. *a place of public worship,*
  - i. *a hospital,*
  - j. *an educational establishment or child care centre.*
9. *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.*
10. *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:*
  - k. *in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,*
  - l. *anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.*
11. *In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the Roads Act 1993*

#### **A.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.

## A.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 17 presents the ISEPP internal noise criteria along with the equivalent external noise criteria for residential premises.

**Table 17: ISEPP noise criteria for new residential development**

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

Notes: \* Requisite for 40,000AADT 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 2011 requirements.

### A.3 Australian/New Zealand Standard AS/NZS 2107:2016

As traffic noise levels are not constant, the  $L_{eq}$  noise level descriptor is used when assessing this type of noise source. The  $L_{eq}$  is the mean energy level of the noise being measured and has been found to accurately describe the level of annoyance caused by traffic noise.

This standard provides recommended noise levels for steady state such as noise from building services and quasi-steady state sounds, such as traffic and industrial noise. The noise levels recommended in AS/NZS 2107:2016 take into account the function of the area and apply to the sound level measured within the space unoccupied although ready for occupancy.

This standard recommends the following noise levels for residential buildings.

**Table 18: Recommended design sound levels for different areas of occupancy in buildings**

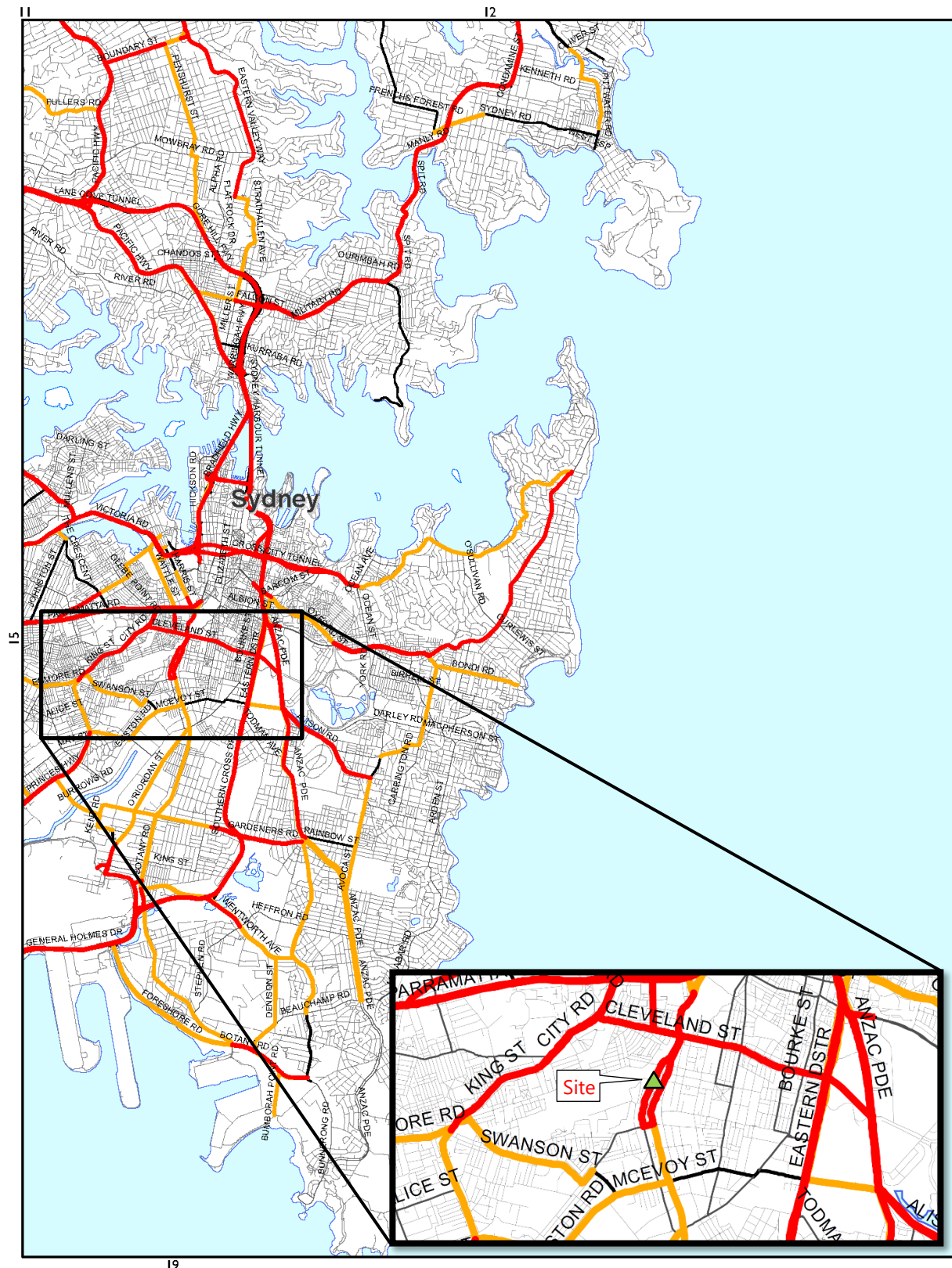
| Type of occupancy/ activity                         | Recommended design sound level, $L_{Aeq}$ , dB(A) |         | Recommended reverberation time (T),s |
|-----------------------------------------------------|---------------------------------------------------|---------|--------------------------------------|
|                                                     | Satisfactory                                      | Maximum |                                      |
| 5 OFFICE BUILDINGS                                  |                                                   |         |                                      |
| General office areas                                | 40                                                | 45      | 0.4 to 0.6                           |
| Private offices                                     | 35                                                | 40      | 0.6 to 0.8                           |
| Public spaces                                       | 40                                                | 50      | 0.5 to 1.0                           |
| Reception areas                                     | 40                                                | 45      | 0.6 to 0.8                           |
| Rest rooms and break-out spaces                     | 40                                                | 45      | 0.4 to 0.6                           |
| Toilets                                             | 45                                                | 55      | -                                    |
| Undercover car parks                                | -                                                 | <65     | -                                    |
| 7 RESIDENTIAL BUILDINGS (see Note 7 and Clause 5.2) |                                                   |         |                                      |
| Houses in areas with negligible transportation -    |                                                   |         |                                      |
| Sleeping areas                                      | 25                                                | 30      | -                                    |
| Houses and apartments near minor roads -            |                                                   |         |                                      |
| Living areas                                        | 30                                                | 40      | -                                    |
| Sleeping areas                                      | 30                                                | 35      | -                                    |
| Work areas                                          | 35                                                | 40      | -                                    |
| Apartment common areas (e.g. foyer, lift lobby)     | 45                                                | 50      | -                                    |
| Houses and apartments near major roads -            |                                                   |         |                                      |
| Living areas                                        | 35                                                | 45      | -                                    |
| Sleeping areas                                      | 35                                                | 40      | -                                    |
| Work areas                                          | 35                                                | 45      | -                                    |
| Apartment common areas (e.g. foyer, lift lobby)     | 45                                                | 50      | -                                    |
| 8 SHOP BUILDINGS                                    |                                                   |         |                                      |
| Enclosed car parks                                  | -                                                 | <65     | -                                    |
| Show rooms                                          | -                                                 | <50     | See Note 3                           |

| Type of occupancy/ activity                                              | Recommended design sound level, $L_{Aeq}$ , dB(A) |         | Recommended reverberation time (T),s |
|--------------------------------------------------------------------------|---------------------------------------------------|---------|--------------------------------------|
|                                                                          | Satisfactory                                      | Maximum |                                      |
| Small retails stores (general)                                           | -                                                 | <50     | See Note 3                           |
| Specialty Shops (where detailed discussion is necessary in transactions) | -                                                 | <45     | See Note 3                           |

## NOTES:

1. The recommended design sound levels are for a fully fitted out and completed building. Attention is drawn to the additive noise effect of many machines within the same area and adjacent areas. Allowance for the total number and type of noise sources should therefore be made in the selection of equipment and in the design of building spaces. A building owner or developer may consider an allowance of 3-5 dB(A) to be appropriate.
2. Recommended reverberation time is 10 percent to 20 percent higher than Curve 1 of Appendix A.
3. Reverberation time should be minimized as far as practicable for noise control.
4. Certain teaching spaces, including those intended for students with learning difficulties and students with English as a second language, should have reverberation times at the lower end of the specified range.
5. Specialist advice should be sought for these spaces.
6. A very wide range of noise levels can occur in the occupied state in spaces housing manufacturing processes, and the levels are primarily subject to control as part of a noise management program (see AS/NZS 1269.2). The possibilities for segregating very noisy processes from quieter ones by partitioning vary between particular industries and plants. For reasons such as these, it is difficult to make generalized recommendations for desirable, or even maximum, design levels for the unoccupied state, but one guiding principle may still be observed - when the activity in one area of a manufacturing plant is halted, it is desirable that the local level should if possible drop to 70 dB(A) or lower to permit speech communication without undue effort.
7. In situations where traffic noise levels may vary widely over a 24-hour period, measurements to assess compliance with this Standard should be taken at the relevant time and for an appropriate measurement period according to the area of occupancy or activity in the building. Where traffic noise fluctuates rapidly with the passage of individual vehicles, the community reaction may not correlate well with the equivalent continuous noise level as measured.
8. The overall sound pressure level in dB(A) should conform to the recommended design sound level given in Table 1. In these spaces, a balanced sound pressure level across the full frequency range is essential. These spaces should therefore be evaluated in octave bands across the full frequency spectrum. The recommended maximum sound pressure levels for the individual octave bands corresponding to the overall dB(A) value are given in Appendix C.
9. In spaces in which high quality sound recordings are to be made, the levels set for low frequency octave bands should not be exceeded (see Appendix C). Subsequent replay of the recordings may cause an amplification of the ambient sound resulting in an overemphasis of its low-frequency components. Specialist advice should always be sought when these spaces are being designed. In some circumstances, for purposes of very high quality recording, lower levels than those specified in Table 1 may be required.

## APPENDIX B Traffic Volume Map for Noise Assessment



Scale 1:100,000



Map produced by RTA, RIAMT, SLS Unit  
Map data copyright (c) 2006 Roads & Traffic Authority NSW  
Some spatial data courtesy of NSW Department of Lands

### TRAFFIC VOLUME MAPS FOR NOISE ASSESSMENT FOR BUILDING ON LAND ADJACENT TO BUSY ROADS

#### LEGEND

- Mandatory under clause 102 of the Infrastructure SEPP (Freeways, tollways, transitways and >40,000 AADT)
- Recommended (> 20,000 and < 40,000 AADT)

#### Roads

- Local Roads
- Regional Roads
- State Roads

Map: 16



Monday, November 24, 2008 2:49:46 PM  
H:\projects\SEPP map\UTS\_BA\_Mapbook.mxd

## APPENDIX C Internal Sound Insulation

### C.1 National Construction Code of Australia 2016

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 Insulation Provision of NCC of Australia 2016

The acoustic provisions for inter-tenancy walls and floors 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 –*

- a. have the required value for weighted sound reduction index ( $R_w$ ) or weighted sound reduction index with spectrum adaptation term ( $R_w + C_{tr}$ ) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or
- b. comply with Specification F5.2.

#### *F5.3 Determination of impact sound insulation ratings*

- a. 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 with spectrum adaptation term ( $L_{n,w}$ ) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or
  - ii. comply with Specification F5.2.
- b. A wall in a building required to have an impact sound insulation rating must –
  - i. for a Class 2 or 3 building be of discontinuous construction;
- c. For the purposes of this part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and
  - i. for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and
  - ii. for other than masonry, there is no mechanical linkage between leaves except at the periphery.

#### *F5.4 Sound insulation rating of floors*

- a. A floor in a Class 2 or 3 building must have an  $R_w + C_{tr}$  (airborne) not less than 50 and an  $L_{n,w}$  (impact) not more than 62 if it separates –
  - i. sole-occupancy units; or
  - ii. 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 walls*

- a. A wall in a Class 2 or 3 building must –
  - i. have an  $R_w + C_{tr}$  (airborne) not less than 50, if it separates sole-occupancy units; and
  - ii. have an  $R_w$  (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
  - iii. comply with F5.3(b) if it separates:
    - (A) 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

- (B) a sole-occupancy unit from a plant room or lift shaft.*
- b. 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  $R_w$  not less than 30.*
  - c. Where a wall required to have sound insulation has a floor above, the wall must continue to –*
    - i. the underside of the floor above; or*
    - ii. a ceiling that provides the sound insulation required for the wall.*

#### *F5.6 Sound insulation rating of services*

- a. 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  $R_w + C_{tr}$  (airborne) not less than –*
  - i. 40 if the adjacent room is a habitable room (other than a kitchen); or*
  - ii. 25 if the adjacent room is a kitchen or non-habitable room.*
- b. If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (a)(i) and (ii).*

#### *F5.7 Sound insulation of pumps*

*A flexible coupling must be used at the point of connection between the services pipes in a building and any circulating or other pumps."*

## 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 19 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 19: Noise management levels at residential receivers**

| Time of day                                                                                                                       | Management level<br>L <sub>Aeq</sub> (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><br>Where the predicted or measured L <sub>Aeq</sub> (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><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><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><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><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><br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br><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><br>For guidance on negotiating agreements see section 7.2.2 of the ICNG.                                                                                                                                                                                        |

## Sensitive Land Use

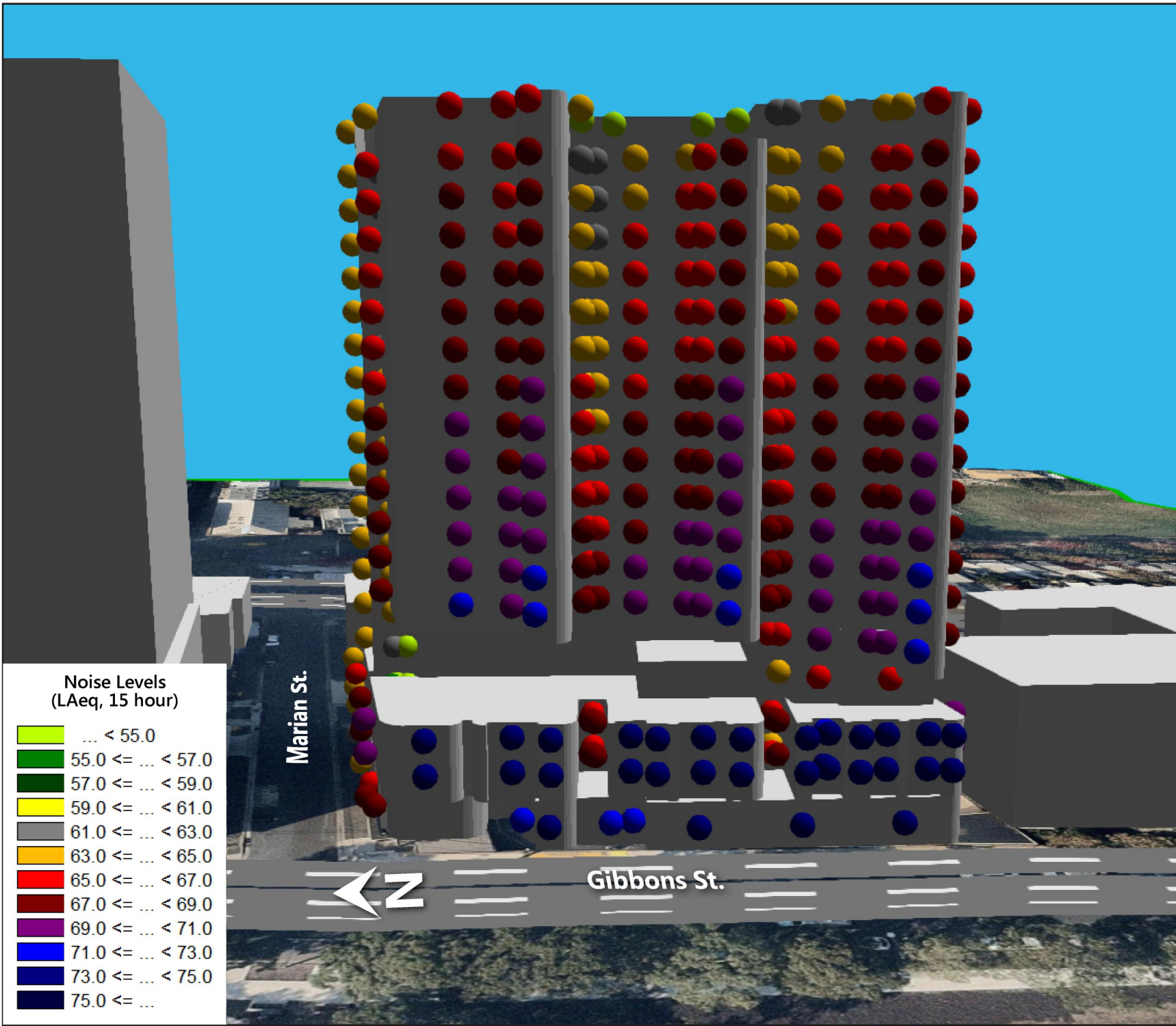
Table 20 below (reproduced from Table 3 of the ICNG) sets out the noise management levels for various sensitive land use developments.

**Table 20: Noise management levels at other noise sensitive land uses**

| Land use                                                 | Where objective applies                    | Management level L <sub>Aeq</sub> (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      Predicted Traffic Noise Levels ( $L_{Aeq, 15\text{hour}}$ Day)



**Project :**  
11 Gibbons St., Redfern

**Title :**  
Predicted traffic noise levels on  
proposed building facades  
during day time without future  
buildings

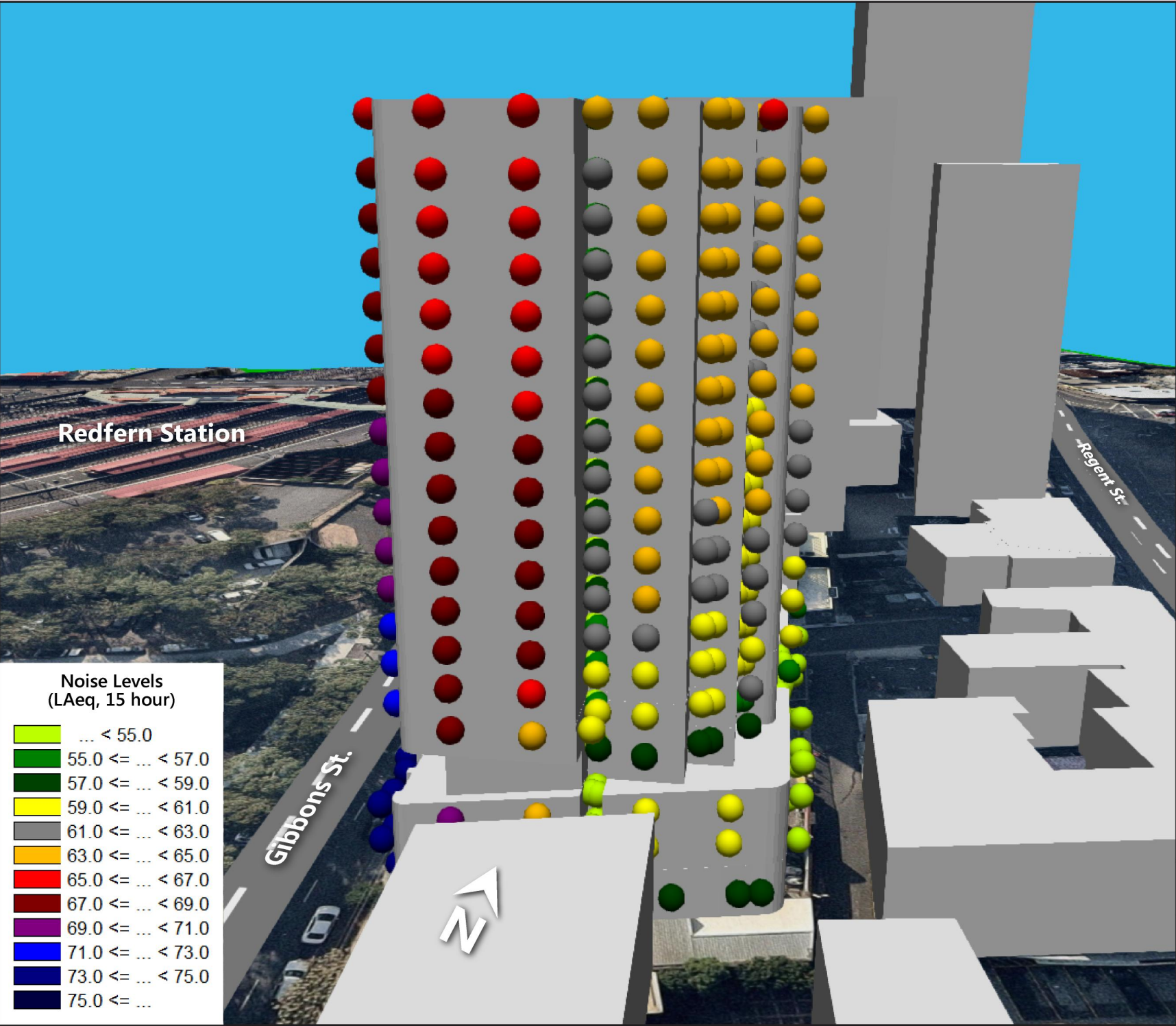
**Ref :**  
West Facade

**Note :**

**Date :** 26/09/2018

**Scale :** NTS

**Ref :** TK332-01P05A



**Project :**  
11 Gibbons St., Redfern

**Title :**  
Predicted traffic noise levels on  
proposed building facades  
during day time without future  
buildings

**Ref :**  
South Facade

**Note :**

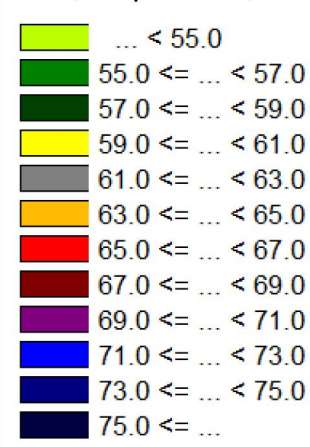
**Date :** 26/09/2018

**Scale :** NTS

**Ref :** TK332-01P05B



Noise Levels  
(LAeq, 15 hour)



**Project :**  
11 Gibbons St., Redfern

**Title :**  
Predicted traffic noise levels on  
proposed building facades  
during day time without future  
buildings

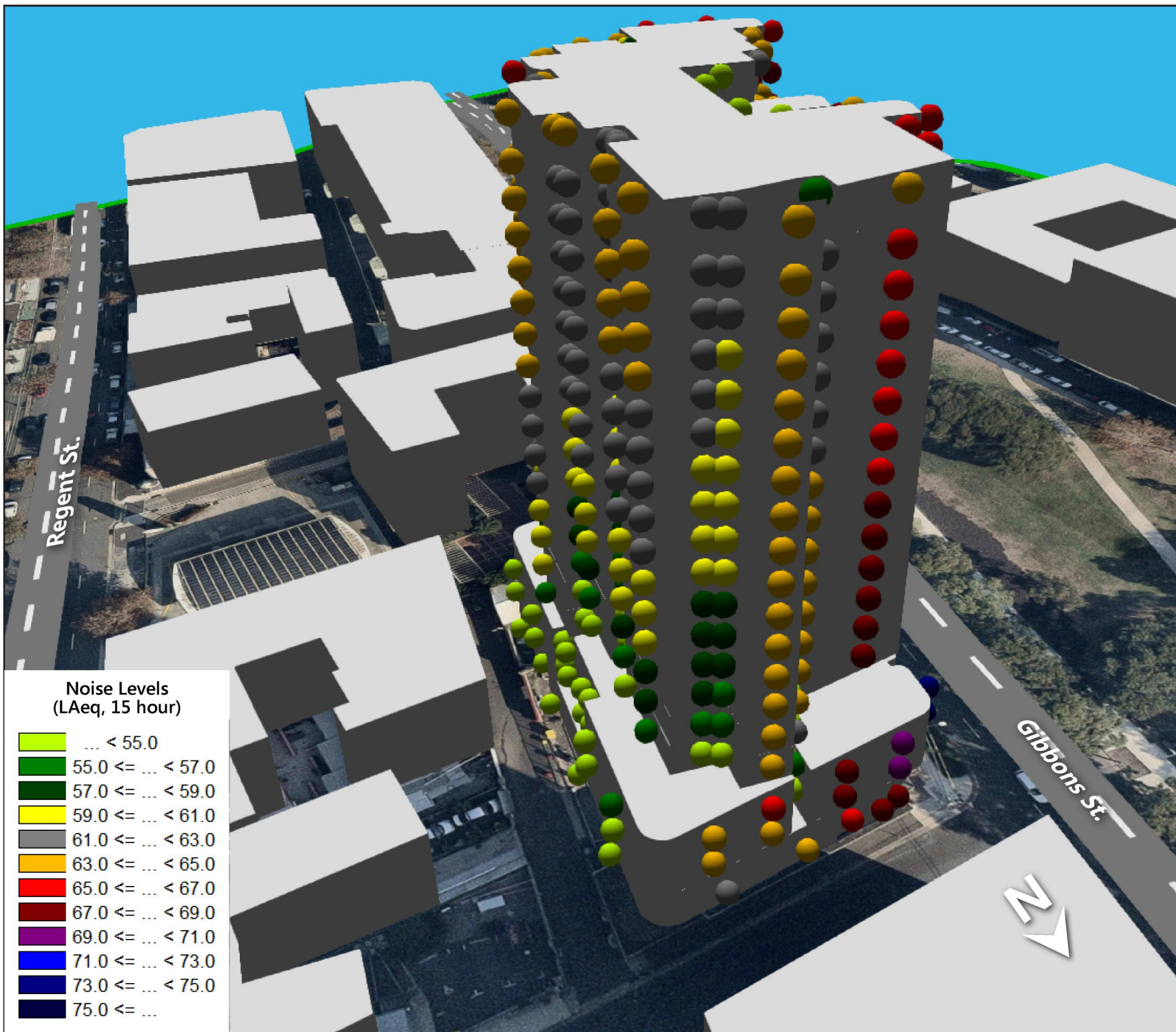
**Ref :**  
East Facade

**Note :**

**Date :** 26/09/2018

**Scale :** NTS

**Ref :** TK332-01P05C



**Project :**

11 Gibbons St., Redfern

**Title :**

Predicted traffic noise levels on proposed building facades during day time without future buildings

**Ref :**

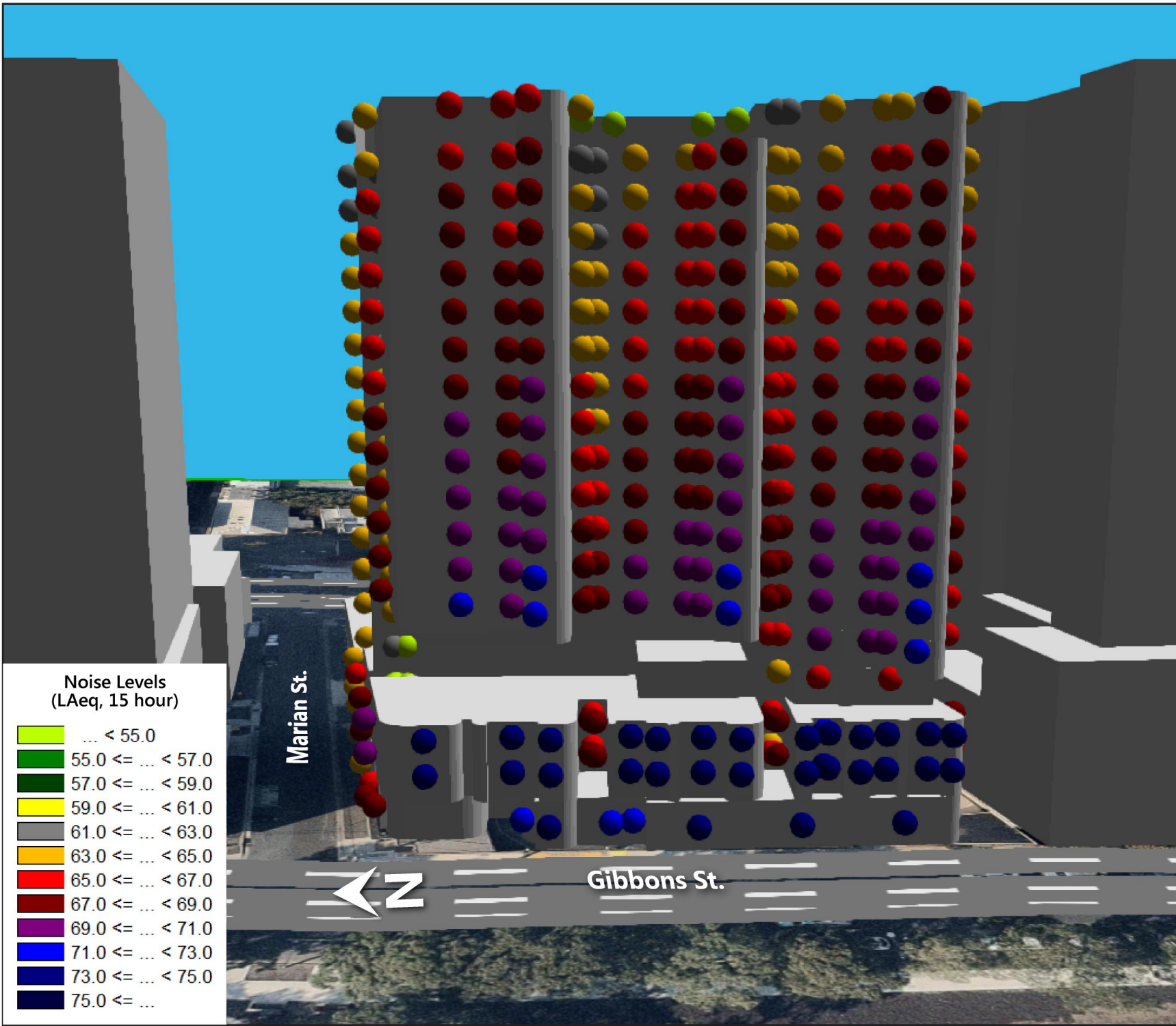
North East Perspective

**Note :**

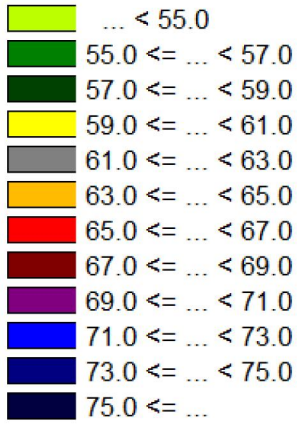
**Date :** 26/09/2018

**Scale :** NTS

**Ref :** TK332-01P05D



Noise Levels  
(LAeq, 15 hour)



**Project :**  
11 Gibbons St., Redfern

**Title :**  
Predicted traffic noise levels on  
proposed building facades  
during day time with future  
buildings

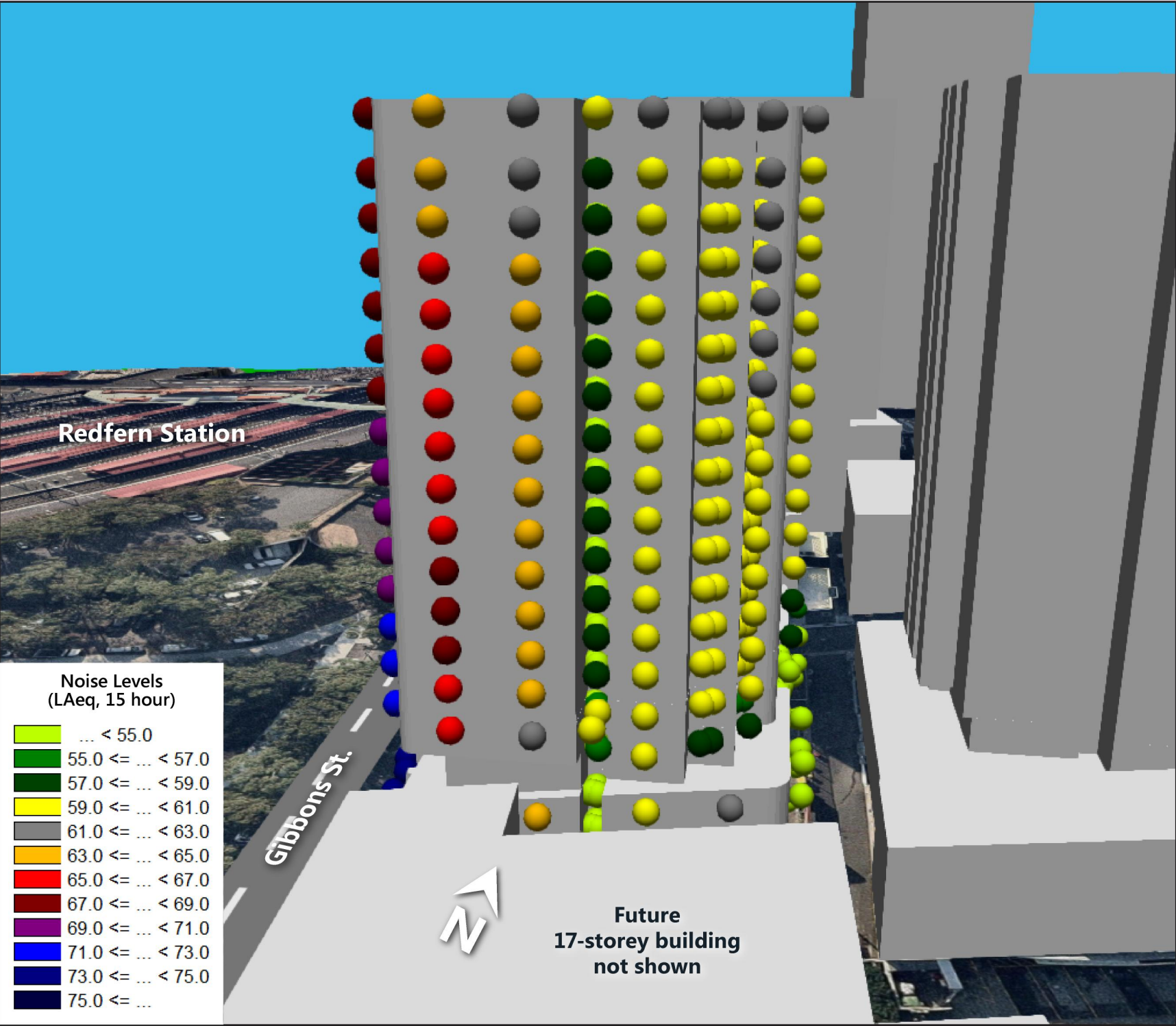
**Ref :**  
West Facade

**Note :**  
Based on current total traffic  
volumes and includes shielding  
effect of proposed 17-18  
storey building to the East,  
South and North East of  
development.

**Date :** 26/09/2018

**Scale :** NTS

**Ref :** TK332-01P05E



**Project :**  
11 Gibbons St., Redfern

**Title :**  
Predicted traffic noise levels on  
proposed building facades  
during day time with future  
buildings

**Ref :**  
South Facade

**Note :**  
Based on current total traffic  
volumes and includes shielding  
effect of proposed 17-18  
storey building to the East,  
South and North East of  
development.

**Date :** 26/09/2018

**Scale :** NTS

**Ref :** TK332-01P05F



**Project :**

11 Gibbons St., Redfern

**Title :**

Predicted traffic noise levels on proposed building facades during day time with future buildings

**Ref :**

East Facade

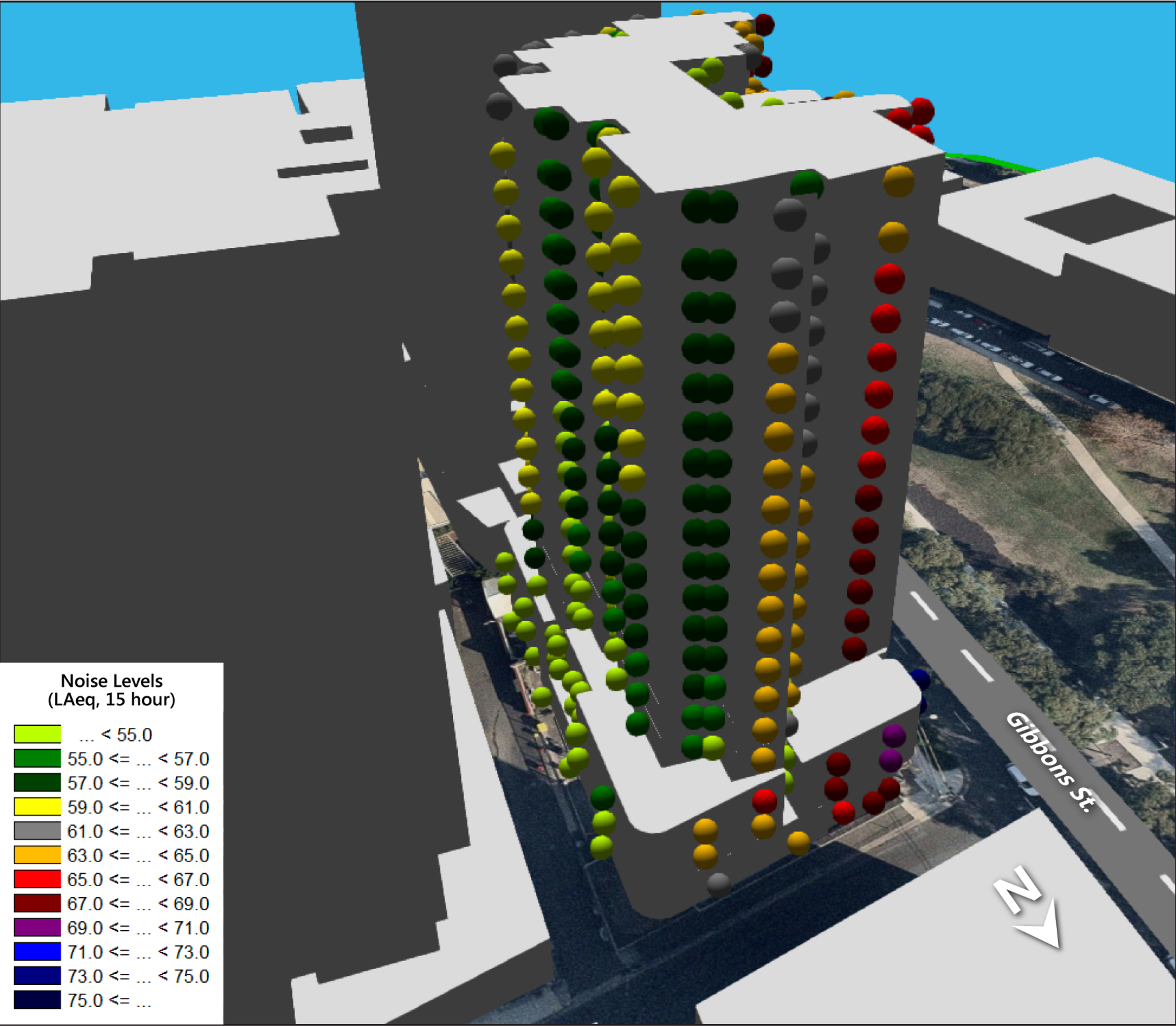
**Note :**

Based on current total traffic volumes and includes shielding effect of proposed 17-18 storey building to the East, South and North East of development.

**Date :** 26/09/2018

**Scale :** NTS

**Ref :** TK332-01P05G



**Project :**  
11 Gibbons St., Redfern

**Title :**  
Predicted traffic noise levels on  
proposed building facades  
during day time with future  
buildings

**Ref :**  
North East Perspective

**Note :**  
Based on current total traffic  
volumes and includes shielding  
effect of proposed 17-18  
storey building to the East,  
South and North East of  
development.

**Date :** 26/09/2018

**Scale :** NTS

**Ref :** TK332-01P05H

## APPENDIX F      Recommend Glazing Requirments (Rw)



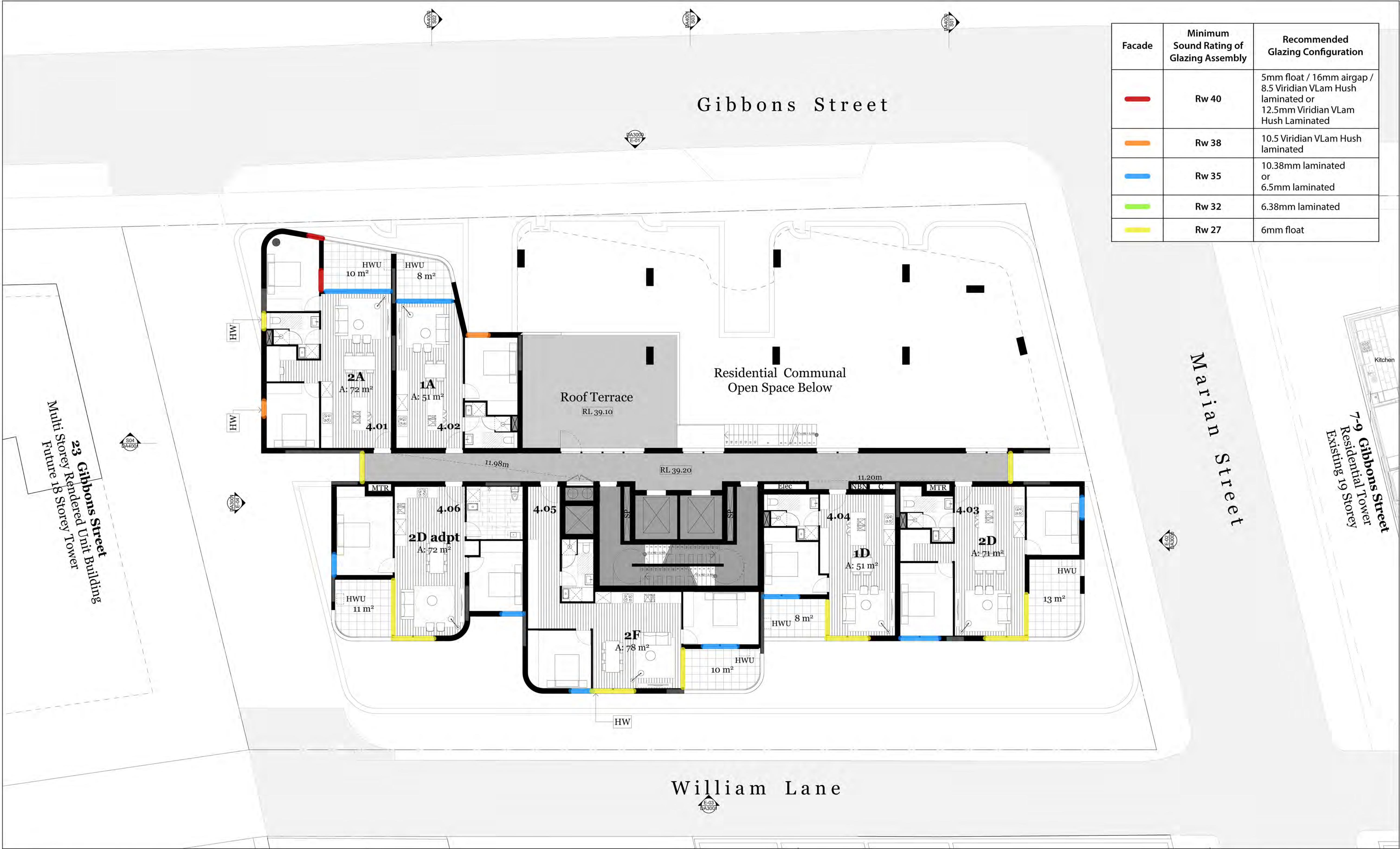


| Facade | Minimum Sound Rating of Glazing Assembly | Recommended Glazing Configuration                                                                 |
|--------|------------------------------------------|---------------------------------------------------------------------------------------------------|
|        | Rw 40                                    | 5mm float / 16mm airgap / 8.5 Viridian VLam Hush laminated or 12.5mm Viridian VLam Hush Laminated |
|        | Rw 38                                    | 10.5 Viridian VLam Hush laminated                                                                 |
|        | Rw 35                                    | 10.38mm laminated or 6.5mm laminated                                                              |
|        | Rw 32                                    | 6.38mm laminated                                                                                  |
|        | Rw 27                                    | 6mm float                                                                                         |

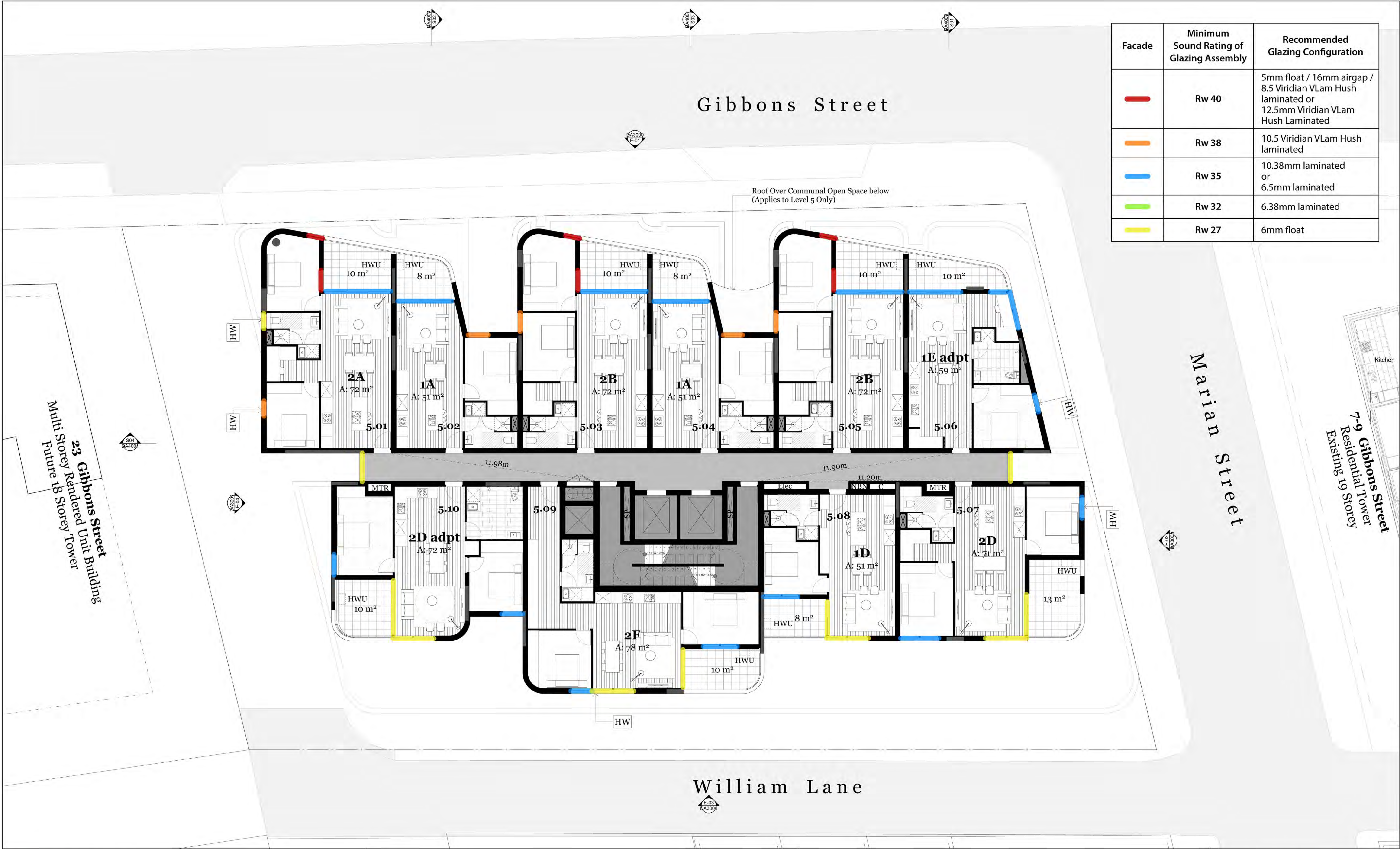


| Facade                                | Minimum Sound Rating of Glazing Assembly | Recommended Glazing Configuration                                                                 |
|---------------------------------------|------------------------------------------|---------------------------------------------------------------------------------------------------|
| <span style="color: red;">—</span>    | Rw 40                                    | 5mm float / 16mm airgap / 8.5 Viridian VLam Hush laminated or 12.5mm Viridian VLam Hush Laminated |
| <span style="color: orange;">—</span> | Rw 38                                    | 10.5 Viridian VLam Hush laminated                                                                 |
| <span style="color: blue;">—</span>   | Rw 35                                    | 10.38mm laminated or 6.5mm laminated                                                              |
| <span style="color: green;">—</span>  | Rw 32                                    | 6.38mm laminated                                                                                  |
| <span style="color: yellow;">—</span> | Rw 27                                    | 6mm float                                                                                         |



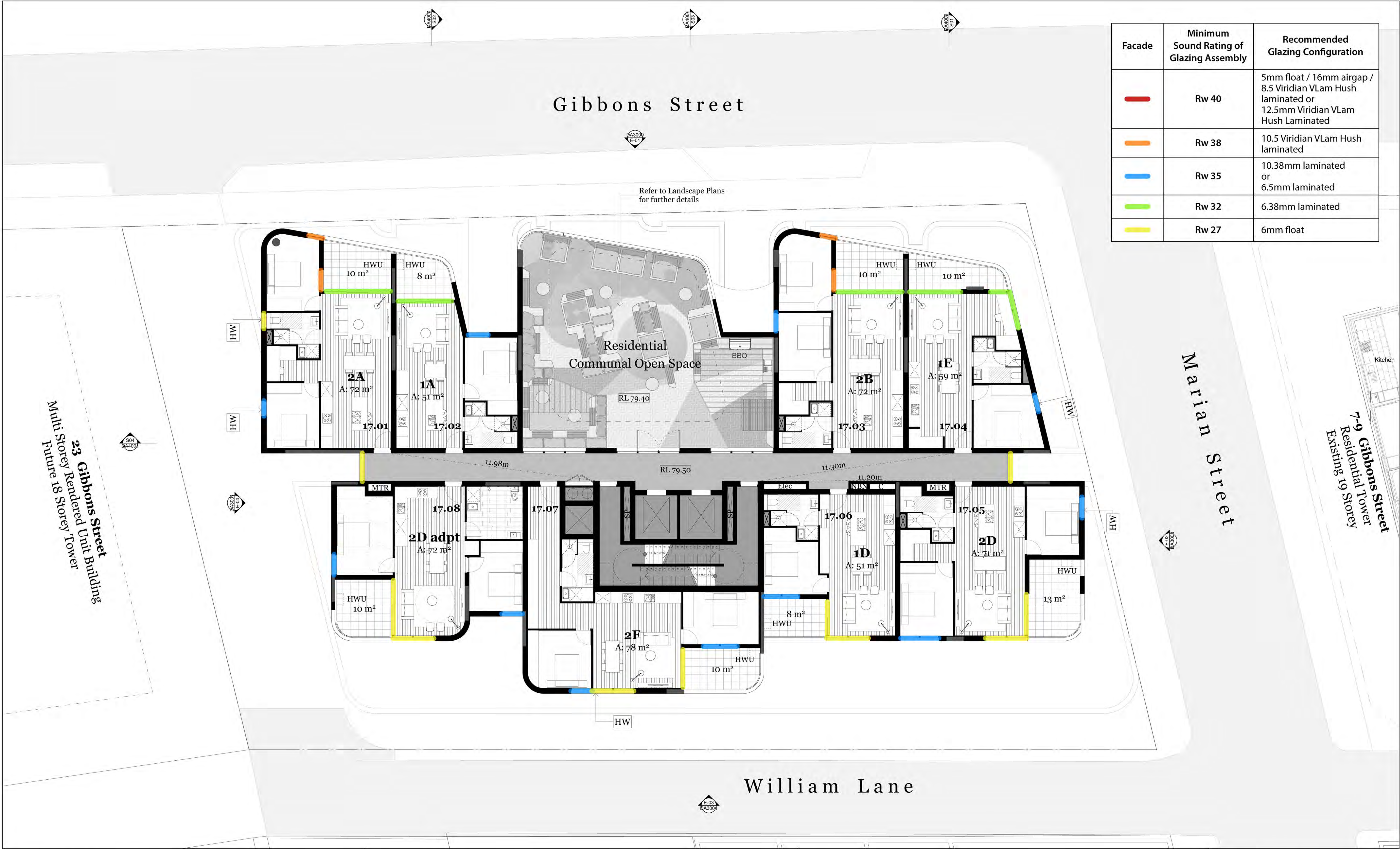


| Facade | Minimum Sound Rating of Glazing Assembly | Recommended Glazing Configuration                                                                 |
|--------|------------------------------------------|---------------------------------------------------------------------------------------------------|
|        | Rw 40                                    | 5mm float / 16mm airgap / 8.5 Viridian VLam Hush laminated or 12.5mm Viridian VLam Hush Laminated |
|        | Rw 38                                    | 10.5 Viridian VLam Hush laminated                                                                 |
|        | Rw 35                                    | 10.38mm laminated or 6.5mm laminated                                                              |
|        | Rw 32                                    | 6.38mm laminated                                                                                  |
|        | Rw 27                                    | 6mm float                                                                                         |



| Facade | Minimum Sound Rating of Glazing Assembly | Recommended Glazing Configuration                                                                 |
|--------|------------------------------------------|---------------------------------------------------------------------------------------------------|
|        | Rw 40                                    | 5mm float / 16mm airgap / 8.5 Viridian VLam Hush laminated or 12.5mm Viridian VLam Hush Laminated |
|        | Rw 38                                    | 10.5 Viridian VLam Hush laminated                                                                 |
|        | Rw 35                                    | 10.38mm laminated or 6.5mm laminated                                                              |
|        | Rw 32                                    | 6.38mm laminated                                                                                  |
|        | Rw 27                                    | 6mm float                                                                                         |





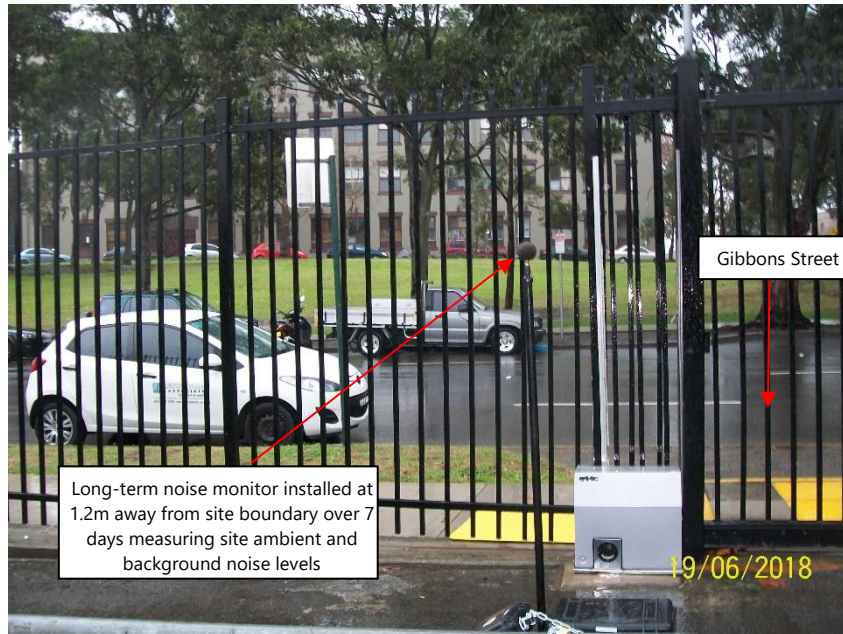
| Facade                                | Minimum Sound Rating of Glazing Assembly | Recommended Glazing Configuration                                                                 |
|---------------------------------------|------------------------------------------|---------------------------------------------------------------------------------------------------|
| <span style="color: red;">—</span>    | Rw 40                                    | 5mm float / 16mm airgap / 8.5 Viridian VLam Hush laminated or 12.5mm Viridian VLam Hush Laminated |
| <span style="color: orange;">—</span> | Rw 38                                    | 10.5 Viridian VLam Hush laminated                                                                 |
| <span style="color: blue;">—</span>   | Rw 35                                    | 10.38mm laminated or 6.5mm laminated                                                              |
| <span style="color: green;">—</span>  | Rw 32                                    | 6.38mm laminated                                                                                  |
| <span style="color: yellow;">—</span> | Rw 27                                    | 6mm float                                                                                         |

## APPENDIX G Locations & Results of Long-term Noise Survey

### G.1 Noise & Vibration Monitoring Locations

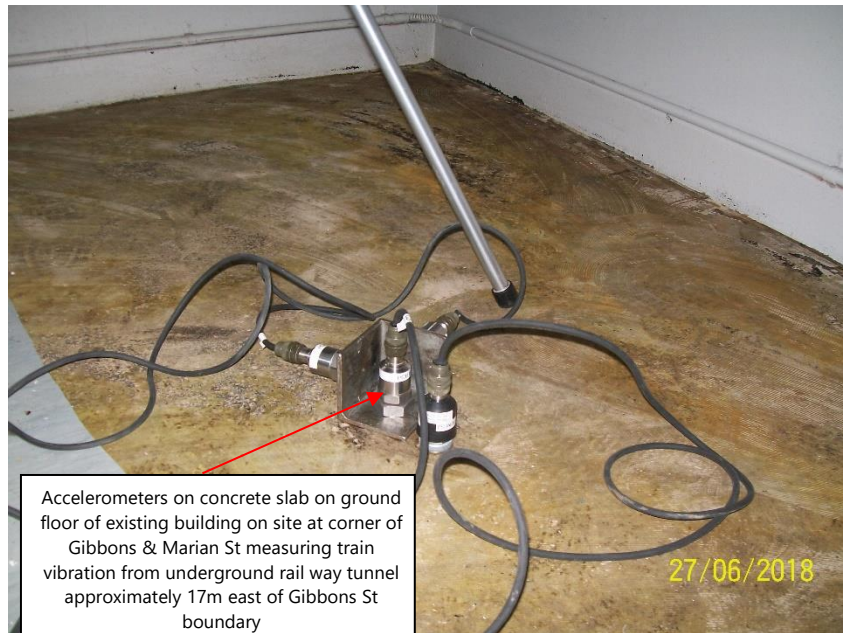
Location 1: Unattended road traffic noise monitoring at 1.2m away from site boundary facing Gibbons Street.

Survey Period: Friday 19/06/2018 to Thursday 27/06/2018



Location 2: Operator-attended rail vibration survey conducted at on existing concrete slab at corner of Gibbons Street and Marian Street, Redfern.

Survey Period: 11:00am to 5:00pm on Wednesday 27/06/2018



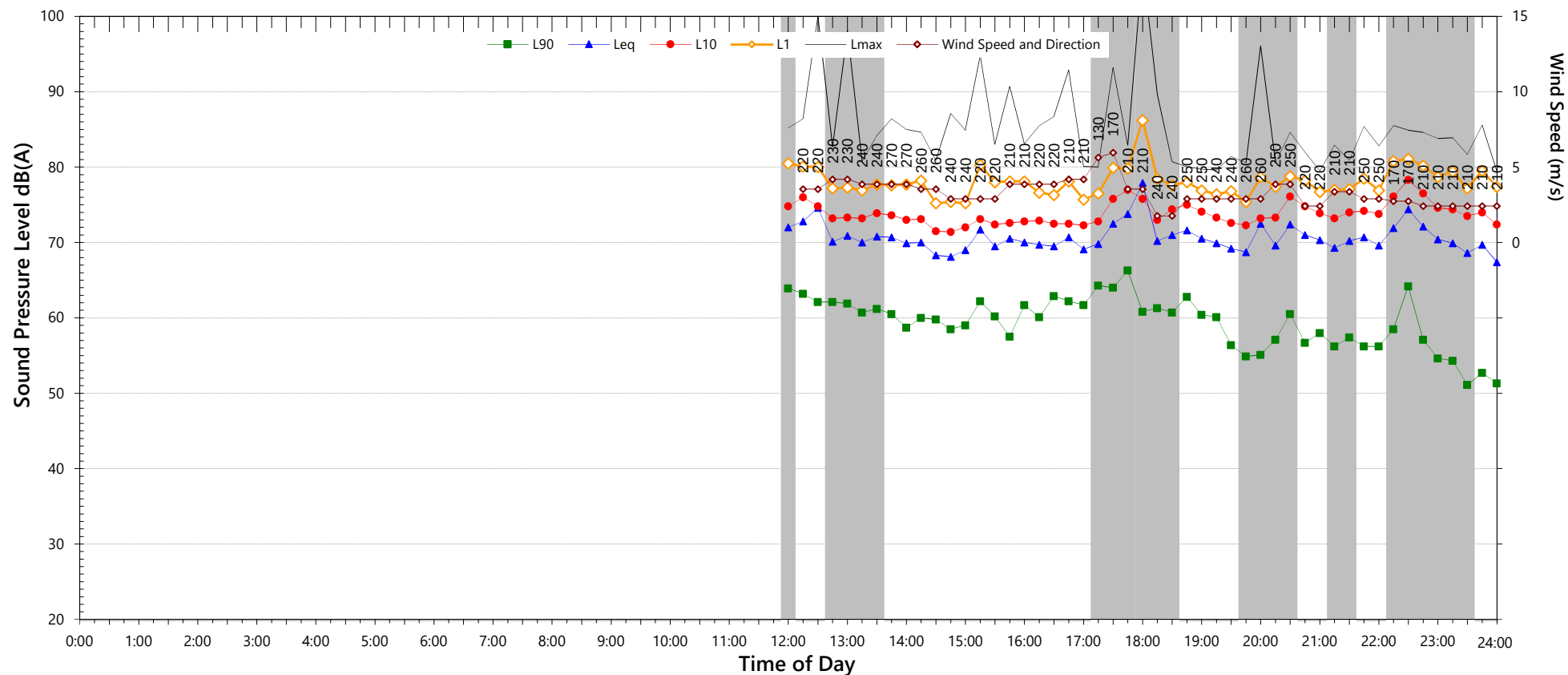
Location 3: Operator-attended traffic noise survey conducted at corner of Regent and Marian Street, Redfern.  
Survey Period: 3:15am to 3:30pm on Wednesday 27/06/2018



# Unattended Noise Monitoring Results

1.2m from site boundary facing Gibbons St, Redfern

Tuesday, 19 June 2018



| NSW Industrial Noise Policy (Free Field) |                  |                      |                      |
|------------------------------------------|------------------|----------------------|----------------------|
| Descriptor                               | Day <sup>2</sup> | Evening <sup>3</sup> | Night <sup>4,5</sup> |
| L <sub>90</sub>                          | -                | -                    | -                    |
| LA <sub>eq</sub>                         | -                | -                    | -                    |

| Night Time Maximum Noise Levels            |      | (see note 7) |      |
|--------------------------------------------|------|--------------|------|
| L <sub>Max</sub> (Range)                   | 81.7 | to           | 89.2 |
| L <sub>Max</sub> - L <sub>eq</sub> (Range) | 16.0 | to           | 20.3 |

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured in free-field; tabulated results facade corrected

4. "Night" relates to the remaining periods

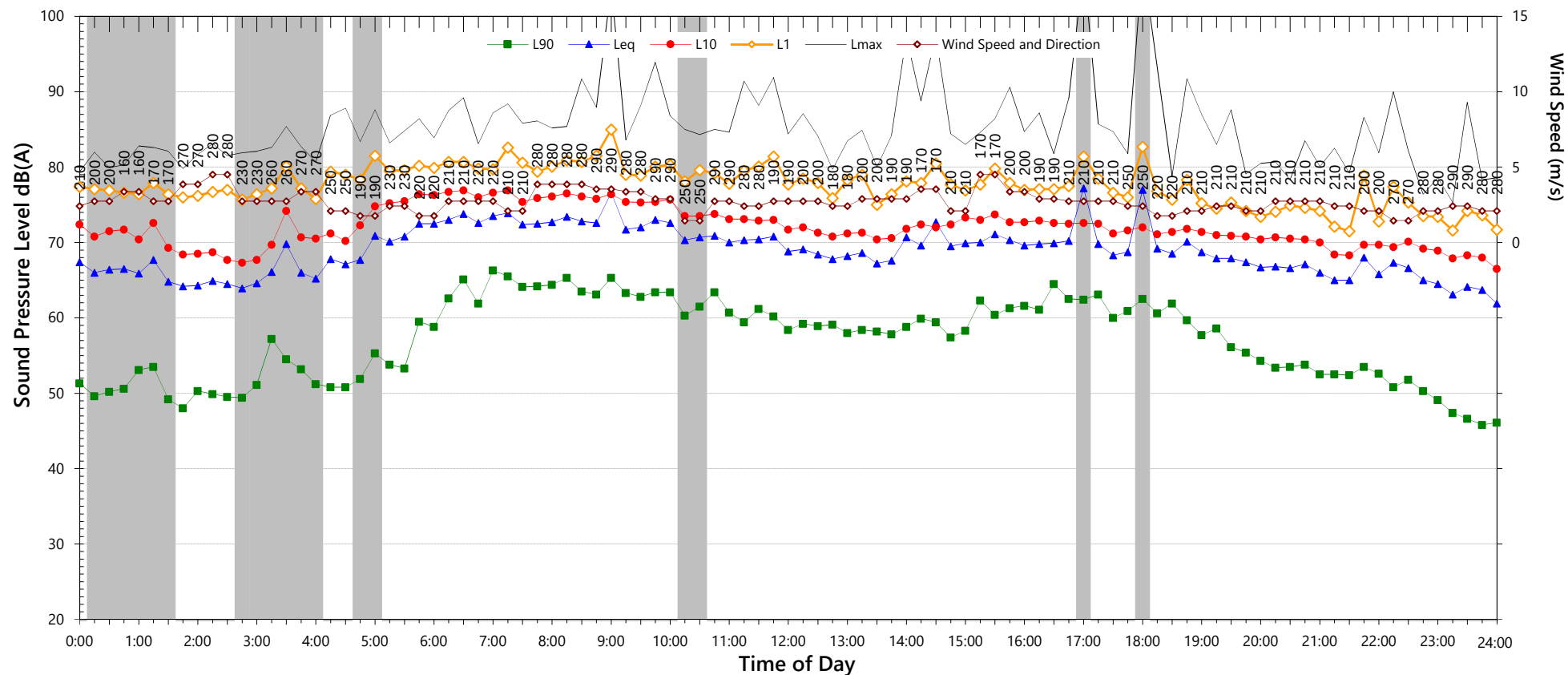
7. Night time L<sub>Max</sub> values are shown only where L<sub>Max</sub> > 65dB(A) and where L<sub>Max</sub> - L<sub>eq</sub> ≥ 15dB(A)

| NSW Road Noise Policy (1m from facade) (see note 6) |          |                    |
|-----------------------------------------------------|----------|--------------------|
| Descriptor                                          | Day      | Night <sup>5</sup> |
|                                                     | 7am-10pm | 10pm-7am           |
| L <sub>eq</sub> 15 hr and L <sub>eq</sub> 9 hr      | 73.0     | 73.0               |
| L <sub>eq</sub> 1hr upper 10 percentile             | 76.3     | 75.7               |
| L <sub>eq</sub> 1hr lower 10 percentile             | 71.4     | 66.8               |

# Unattended Noise Monitoring Results

1.2m from site boundary facing Gibbons St, Redfern

Wednesday, 20 June 2018



| NSW Industrial Noise Policy (Free Field) |                  |                      |                      |
|------------------------------------------|------------------|----------------------|----------------------|
| Descriptor                               | Day <sup>2</sup> | Evening <sup>3</sup> | Night <sup>4,5</sup> |
| L <sub>90</sub>                          | 58.3             | 52.5                 | -                    |
| LA <sub>eq</sub>                         | 71.1             | 67.5                 | -                    |

| Night Time Maximum Noise Levels            |      | (see note 7) |      |
|--------------------------------------------|------|--------------|------|
| L <sub>Max</sub> (Range)                   | 79.4 | to           | 90.0 |
| L <sub>Max</sub> - L <sub>eq</sub> (Range) | 17.9 | to           | 25.3 |

Notes:

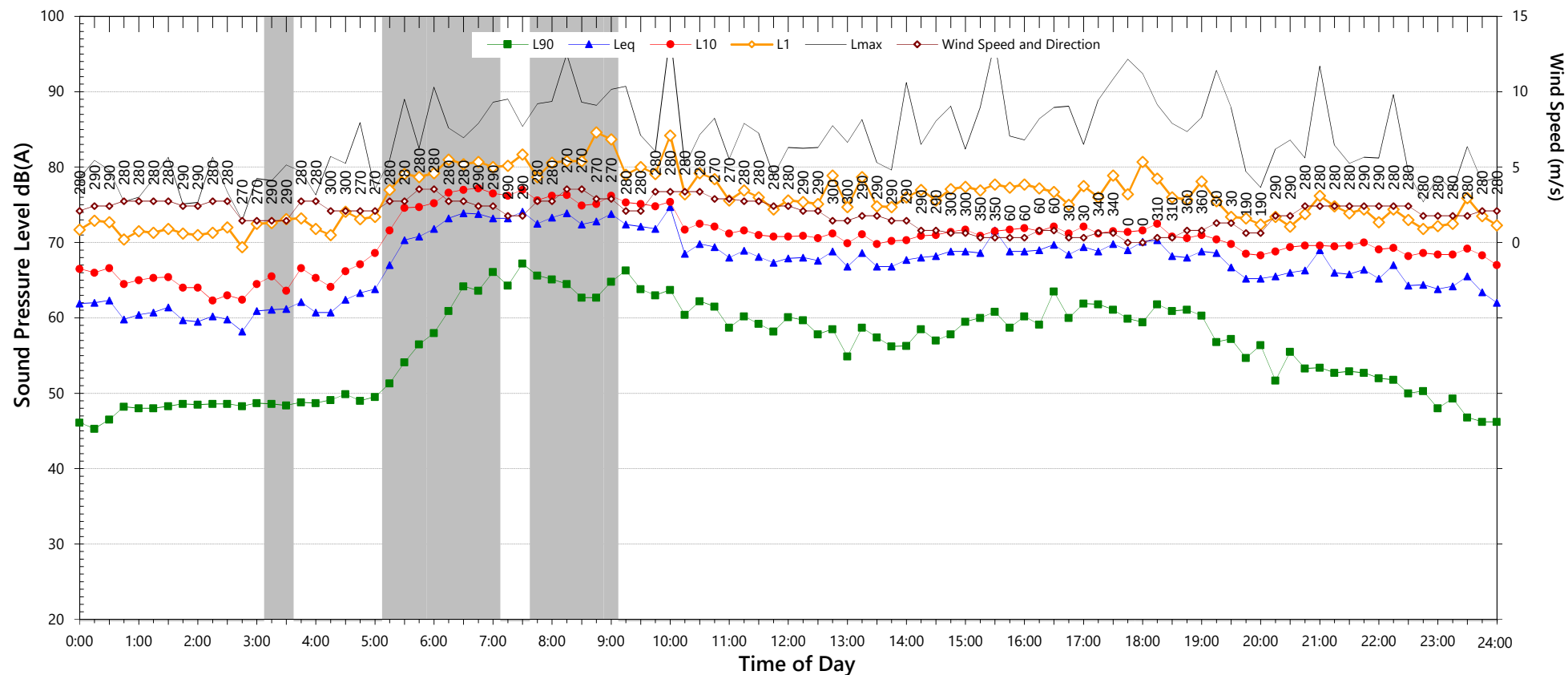
- Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
- "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
- "Evening" is the period from 6pm till 10pm
- "Night" relates to the remaining periods
- "Night" relates to period from 10pm on this graph to morning on the following graph.
- Graphed data measured in free-field; tabulated results facade corrected
- Night time L<sub>Max</sub> values are shown only where L<sub>Max</sub> > 65dB(A) and where L<sub>Max</sub> - L<sub>eq</sub> ≥ 15dB(A)

| NSW Road Noise Policy (1m from facade) (see note 6) |          |                    |
|-----------------------------------------------------|----------|--------------------|
| Descriptor                                          | Day      | Night <sup>5</sup> |
|                                                     | 7am-10pm | 10pm-7am           |
| L <sub>eq</sub> 15 hr and L <sub>eq</sub> 9 hr      | 72.8     | 65.2               |
| L <sub>eq</sub> 1hr upper 10 percentile             | 76.1     | 68.5               |
| L <sub>eq</sub> 1hr lower 10 percentile             | 68.9     | 62.4               |

# Unattended Noise Monitoring Results

1.2m from site boundary facing Gibbons St, Redfern

Thursday, 21 June 2018



| NSW Industrial Noise Policy (Free Field) |                  |                      |                      |
|------------------------------------------|------------------|----------------------|----------------------|
| Descriptor                               | Day <sup>2</sup> | Evening <sup>3</sup> | Night <sup>4,5</sup> |
| L <sub>90</sub>                          | 57.0             | 52.0                 | 43.8                 |
| LA <sub>eq</sub>                         | 69.8             | 67.3                 | 65.1                 |

| Night Time Maximum Noise Levels            |      | (see note 7) |       |
|--------------------------------------------|------|--------------|-------|
| L <sub>Max</sub> (Range)                   | 78.3 | to           | 101.6 |
| L <sub>Max</sub> - L <sub>eq</sub> (Range) | 18.6 | to           | 30.9  |

Notes:

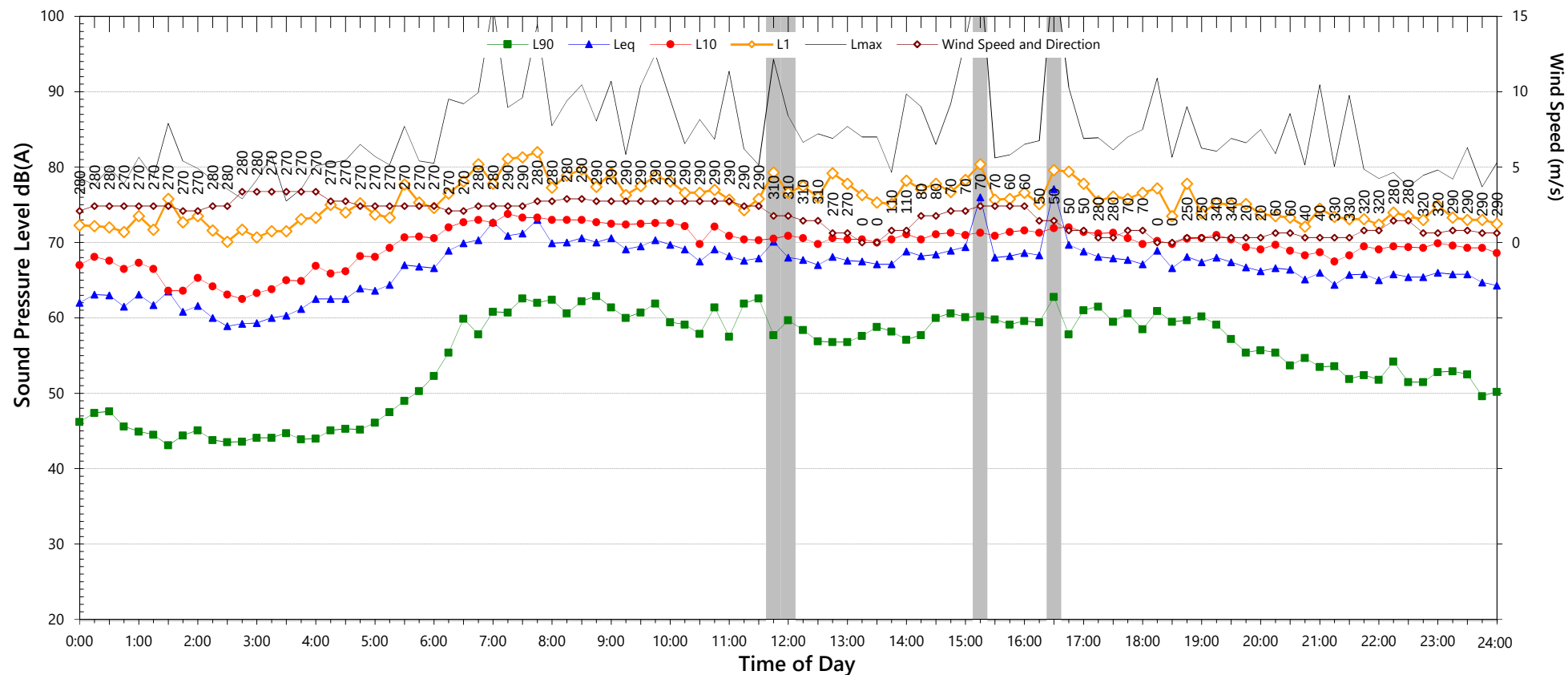
- Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
- "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
- "Evening" is the period from 6pm till 10pm
- "Night" relates to the remaining periods
- "Night" relates to period from 10pm on this graph to morning on the following graph.
- Graphed data measured in free-field; tabulated results facade corrected
- Night time L<sub>Max</sub> values are shown only where L<sub>Max</sub> > 65dB(A) and where L<sub>Max</sub> - L<sub>eq</sub> ≥ 15dB(A)

| NSW Road Noise Policy (1m from facade) (see note 6) |          |                    |
|-----------------------------------------------------|----------|--------------------|
| Descriptor                                          | Day      | Night <sup>5</sup> |
|                                                     | 7am-10pm | 10pm-7am           |
| L <sub>eq</sub> 15 hr and L <sub>eq</sub> 9 hr      | 71.7     | 67.6               |
| L <sub>eq</sub> 1hr upper 10 percentile             | 75.9     | 73.2               |
| L <sub>eq</sub> 1hr lower 10 percentile             | 68.7     | 61.9               |

# Unattended Noise Monitoring Results

1.2m from site boundary facing Gibbons St, Redfern

Friday, 22 June 2018



| NSW Industrial Noise Policy (Free Field) |                  |                      |                      |
|------------------------------------------|------------------|----------------------|----------------------|
| Descriptor                               | Day <sup>2</sup> | Evening <sup>3</sup> | Night <sup>4,5</sup> |
| L <sub>90</sub>                          | 57.3             | 51.9                 | 45.9                 |
| LA <sub>eq</sub>                         | 69.0             | 66.7                 | 63.5                 |

| Night Time Maximum Noise Levels            |      | (see note 7) |      |
|--------------------------------------------|------|--------------|------|
| L <sub>Max</sub> (Range)                   | 77.1 | to           | 84.2 |
| L <sub>Max</sub> - L <sub>eq</sub> (Range) | 16.7 | to           | 24.1 |

Notes:

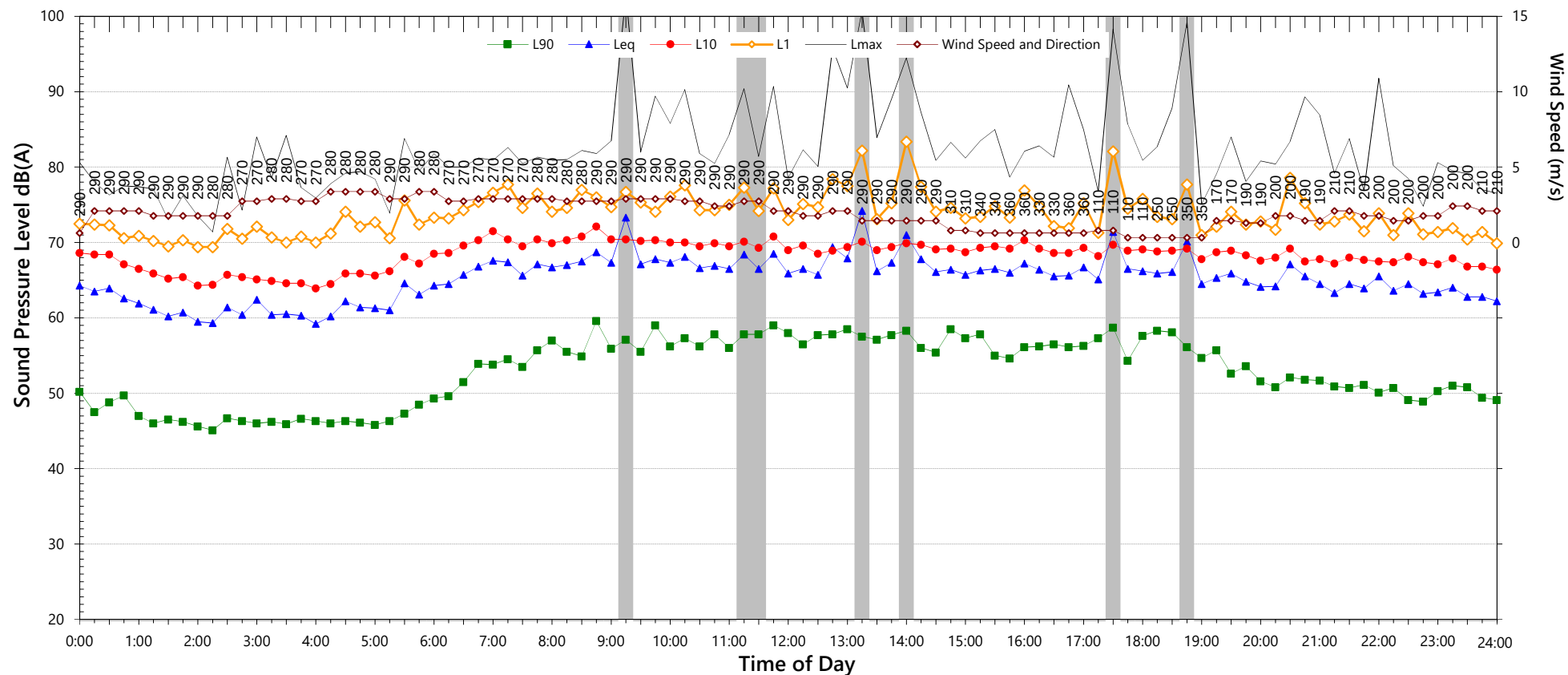
- Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
- "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
- "Evening" is the period from 6pm till 10pm
- "Night" relates to the remaining periods
- "Night" relates to period from 10pm on this graph to morning on the following graph.
- Graphed data measured in free-field; tabulated results facade corrected
- Night time L<sub>Max</sub> values are shown only where L<sub>Max</sub> > 65dB(A) and where L<sub>Max</sub> - L<sub>eq</sub> ≥ 15dB(A)

| NSW Road Noise Policy (1m from facade) (see note 6) |          |                    |
|-----------------------------------------------------|----------|--------------------|
| Descriptor                                          | Day      | Night <sup>5</sup> |
|                                                     | 7am-10pm | 10pm-7am           |
| L <sub>eq</sub> 15 hr and L <sub>eq</sub> 9 hr      | 71.0     | 66.0               |
| L <sub>eq</sub> 1hr upper 10 percentile             | 73.4     | 68.8               |
| L <sub>eq</sub> 1hr lower 10 percentile             | 68.2     | 62.6               |

# Unattended Noise Monitoring Results

1.2m from site boundary facing Gibbons St, Redfern

Saturday, 23 June 2018



| NSW Industrial Noise Policy (Free Field) |                  |                      |                      |
|------------------------------------------|------------------|----------------------|----------------------|
| Descriptor                               | Day <sup>2</sup> | Evening <sup>3</sup> | Night <sup>4,5</sup> |
| L <sub>90</sub>                          | 54.6             | 50.7                 | 44.5                 |
| LA <sub>eq</sub>                         | 66.9             | 65.1                 | 61.7                 |

| Night Time Maximum Noise Levels            |      | (see note 7) |      |
|--------------------------------------------|------|--------------|------|
| L <sub>Max</sub> (Range)                   | 75.1 | to           | 93.5 |
| L <sub>Max</sub> - L <sub>eq</sub> (Range) | 15.3 | to           | 31.8 |

Notes:

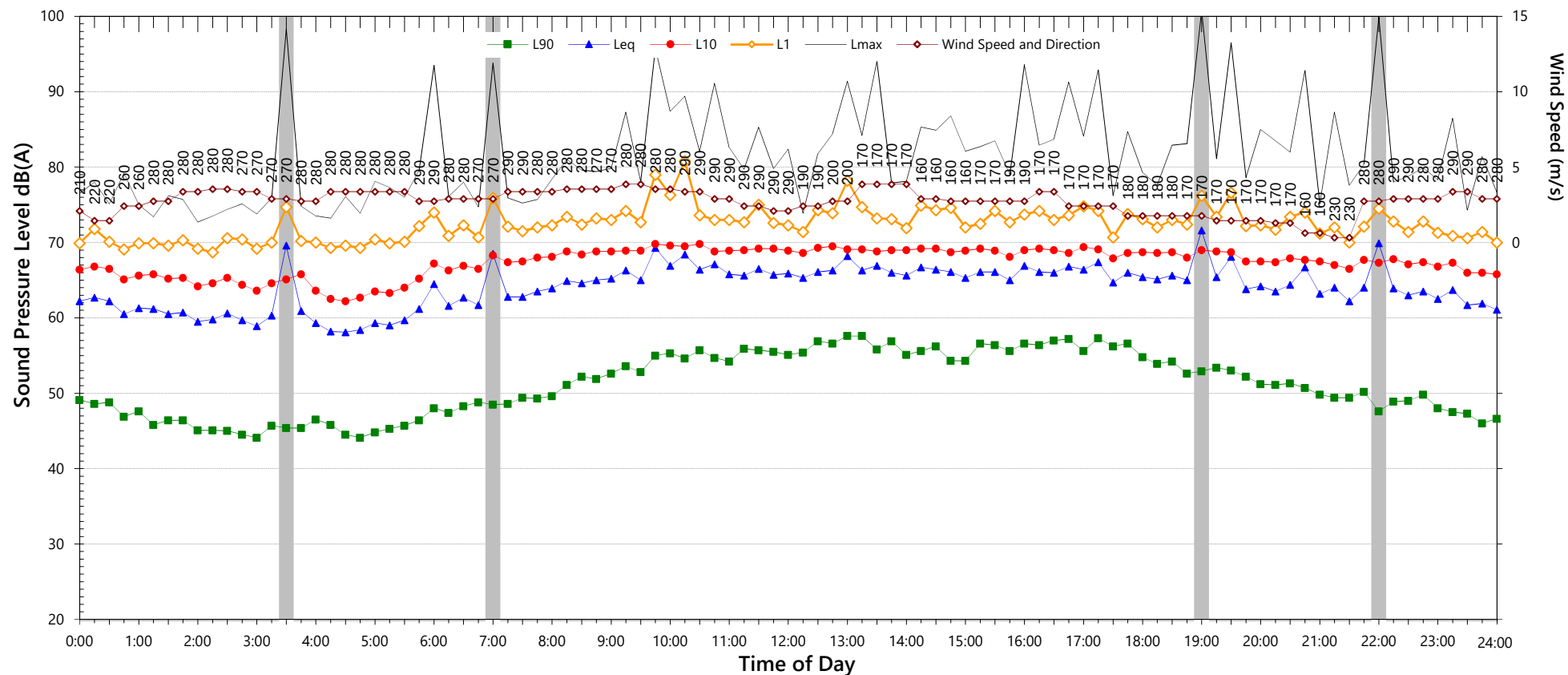
- Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
- "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
- "Evening" is the period from 6pm till 10pm
- "Night" relates to the remaining periods
- "Night" relates to period from 10pm on this graph to morning on the following graph.
- Graphed data measured in free-field; tabulated results facade corrected
- Night time L<sub>Max</sub> values are shown only where L<sub>Max</sub> > 65dB(A) and where L<sub>Max</sub> - L<sub>eq</sub> ≥ 15dB(A)

| NSW Road Noise Policy (1m from facade) (see note 6) |          |                    |
|-----------------------------------------------------|----------|--------------------|
| Descriptor                                          | Day      | Night <sup>5</sup> |
|                                                     | 7am-10pm | 10pm-7am           |
| L <sub>eq</sub> 15 hr and L <sub>eq</sub> 9 hr      | 69.0     | 64.0               |
| L <sub>eq</sub> 1hr upper 10 percentile             | 70.1     | 66.2               |
| L <sub>eq</sub> 1hr lower 10 percentile             | 67.2     | 61.0               |

# Unattended Noise Monitoring Results

1.2m from site boundary facing Gibbons St, Redfern

Sunday, 24 June 2018



| NSW Industrial Noise Policy (Free Field) |                  |                      |                      |
|------------------------------------------|------------------|----------------------|----------------------|
| Descriptor                               | Day <sup>2</sup> | Evening <sup>3</sup> | Night <sup>4,5</sup> |
| L <sub>90</sub>                          | 52.7             | 49.4                 | 43.3                 |
| LA <sub>eq</sub>                         | 66.3             | 64.9                 | 64.0                 |

| Night Time Maximum Noise Levels            |      | (see note 7) |      |
|--------------------------------------------|------|--------------|------|
| L <sub>Max</sub> (Range)                   | 79.3 | to           | 89.5 |
| L <sub>Max</sub> - L <sub>eq</sub> (Range) | 16.6 | to           | 24.3 |

Notes:

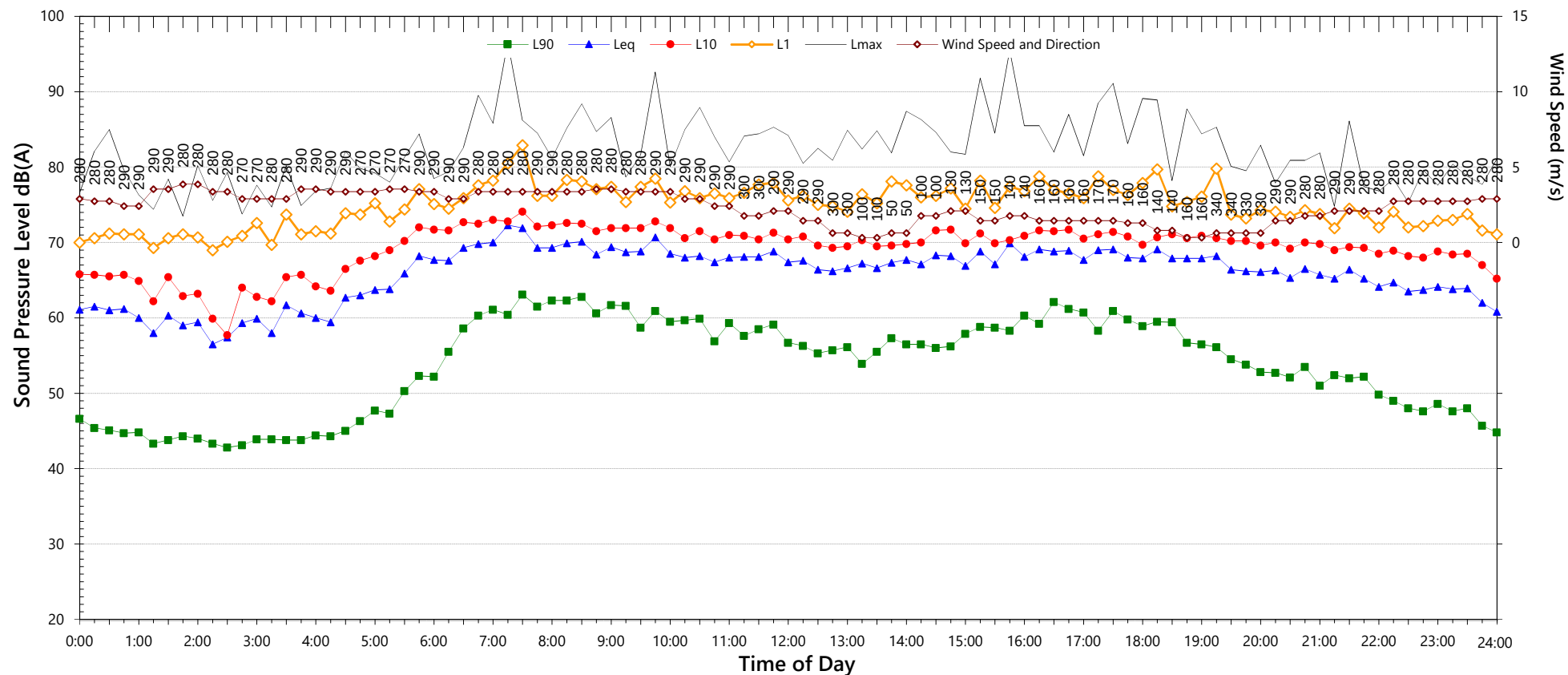
- Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
- "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
- "Evening" is the period from 6pm till 10pm
- "Night" relates to the remaining periods
- "Night" relates to period from 10pm on this graph to morning on the following graph.
- Graphed data measured in free-field; tabulated results facade corrected
- Night time L<sub>Max</sub> values are shown only where L<sub>Max</sub> > 65dB(A) and where L<sub>Max</sub> - L<sub>eq</sub> ≥ 15dB(A)

| NSW Road Noise Policy (1m from facade) (see note 6) |          |                    |
|-----------------------------------------------------|----------|--------------------|
| Descriptor                                          | Day      | Night <sup>5</sup> |
|                                                     | 7am-10pm | 10pm-7am           |
| L <sub>eq</sub> 15 hr and L <sub>eq</sub> 9 hr      | 68.3     | 66.5               |
| L <sub>eq</sub> 1hr upper 10 percentile             | 69.6     | 71.8               |
| L <sub>eq</sub> 1hr lower 10 percentile             | 65.9     | 61.0               |

# Unattended Noise Monitoring Results

1.2m from site boundary facing Gibbons St, Redfern

Monday, 25 June 2018



| NSW Industrial Noise Policy (Free Field) |                  |                      |                      |
|------------------------------------------|------------------|----------------------|----------------------|
| Descriptor                               | Day <sup>2</sup> | Evening <sup>3</sup> | Night <sup>4,5</sup> |
| L <sub>90</sub>                          | 56.0             | 51.0                 | 43.7                 |
| LA <sub>eq</sub>                         | 68.6             | 66.7                 | 64.0                 |

| Night Time Maximum Noise Levels            |      | (see note 7) |      |
|--------------------------------------------|------|--------------|------|
| L <sub>Max</sub> (Range)                   | 78.9 | to           | 86.3 |
| L <sub>Max</sub> - L <sub>eq</sub> (Range) | 15.6 | to           | 25.6 |

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured in free-field; tabulated results facade corrected

4. "Night" relates to the remaining periods

7. Night time L<sub>Max</sub> values are shown only where L<sub>Max</sub> > 65dB(A) and where L<sub>Max</sub> - L<sub>eq</sub> ≥ 15dB(A)

| NSW Road Noise Policy (1m from facade) (see note 6) |          |                    |
|-----------------------------------------------------|----------|--------------------|
| Descriptor                                          | Day      | Night <sup>5</sup> |
|                                                     | 7am-10pm | 10pm-7am           |
| L <sub>eq</sub> 15 hr and L <sub>eq</sub> 9 hr      | 70.7     | 66.5               |
| L <sub>eq</sub> 1hr upper 10 percentile             | 72.8     | 71.9               |
| L <sub>eq</sub> 1hr lower 10 percentile             | 68.2     | 61.6               |

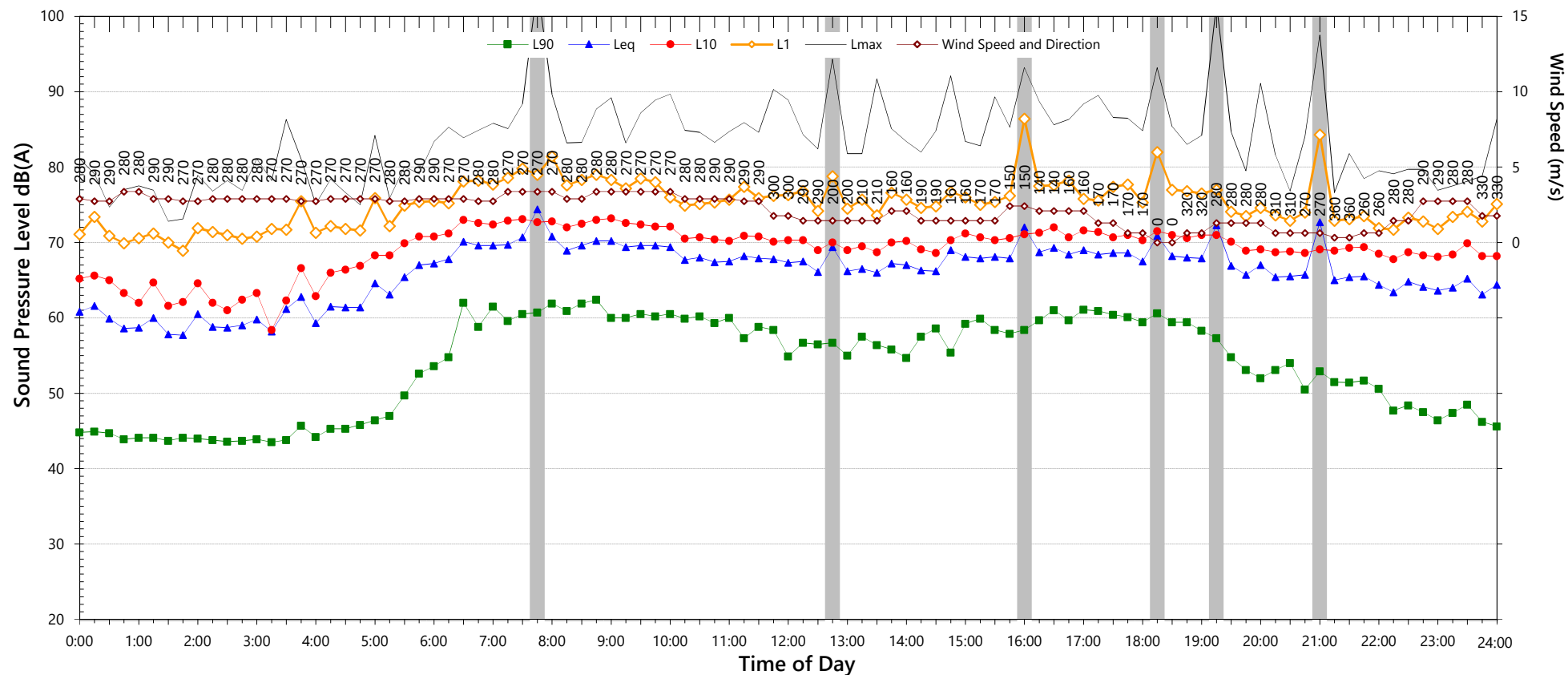
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

# Unattended Noise Monitoring Results

1.2m from site boundary facing Gibbons St, Redfern

Tuesday, 26 June 2018



| NSW Industrial Noise Policy (Free Field) |                  |                      |                      |
|------------------------------------------|------------------|----------------------|----------------------|
| Descriptor                               | Day <sup>2</sup> | Evening <sup>3</sup> | Night <sup>4,5</sup> |
| L <sub>90</sub>                          | 55.8             | -                    | 43.3                 |
| LA <sub>eq</sub>                         | 68.4             | -                    | 64.9                 |

| Night Time Maximum Noise Levels            |      | (see note 7) |      |
|--------------------------------------------|------|--------------|------|
| L <sub>Max</sub> (Range)                   | 79.7 | to           | 86.4 |
| L <sub>Max</sub> - L <sub>eq</sub> (Range) | 15.7 | to           | 23.7 |

Notes:

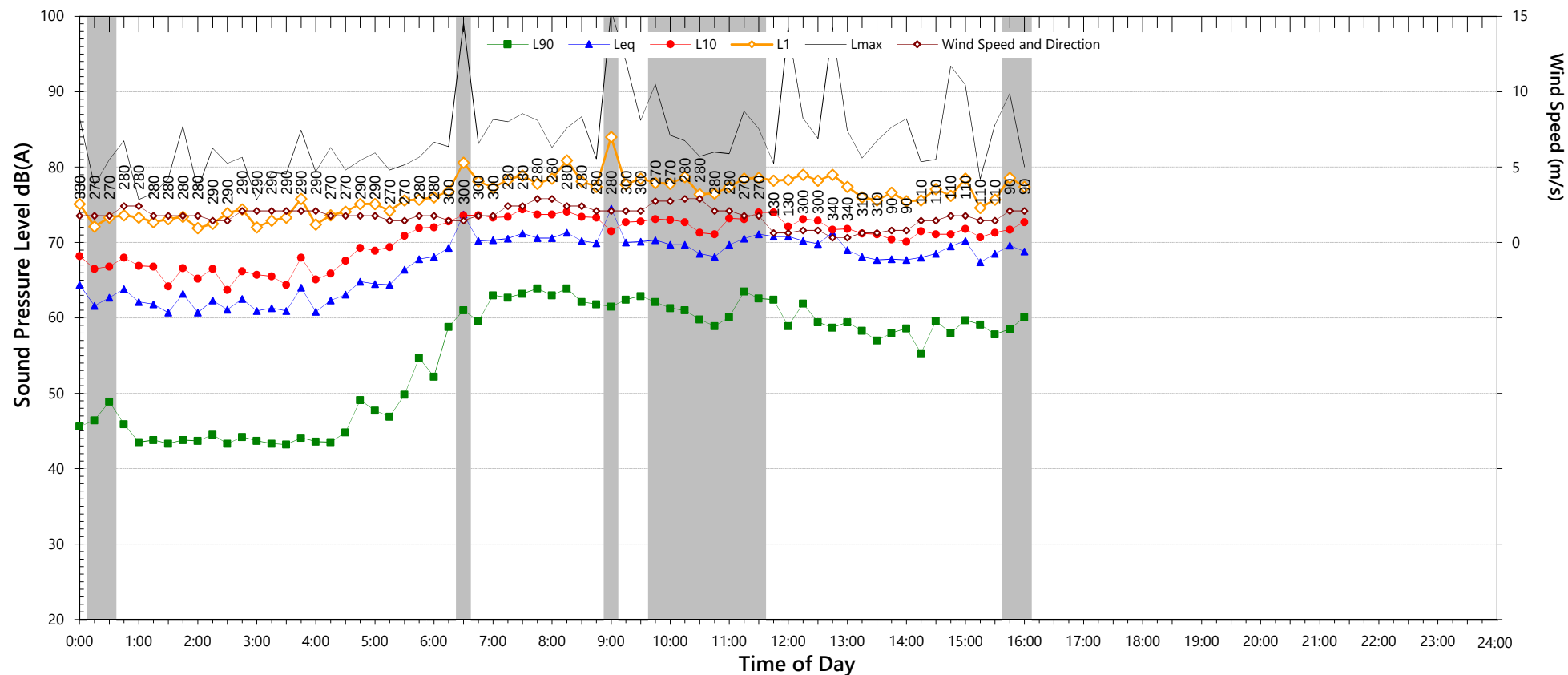
- Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
- "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
- "Evening" is the period from 6pm till 10pm
- "Night" relates to the remaining periods
- "Night" relates to period from 10pm on this graph to morning on the following graph.
- Graphed data measured in free-field; tabulated results facade corrected
- Night time L<sub>Max</sub> values are shown only where L<sub>Max</sub> > 65dB(A) and where L<sub>Max</sub> - L<sub>eq</sub> ≥ 15dB(A)

| NSW Road Noise Policy (1m from facade) (see note 6) |          |                    |
|-----------------------------------------------------|----------|--------------------|
| Descriptor                                          | Day      | Night <sup>5</sup> |
|                                                     | 7am-10pm | 10pm-7am           |
| L <sub>eq</sub> 15 hr and L <sub>eq</sub> 9 hr      | 70.5     | 67.4               |
| L <sub>eq</sub> 1hr upper 10 percentile             | 72.6     | 72.5               |
| L <sub>eq</sub> 1hr lower 10 percentile             | 67.8     | 64.2               |

# Unattended Noise Monitoring Results

1.2m from site boundary facing Gibbons St, Redfern

Wednesday, 27 June 2018



| NSW Industrial Noise Policy (Free Field) |                  |                      |                      |
|------------------------------------------|------------------|----------------------|----------------------|
| Descriptor                               | Day <sup>2</sup> | Evening <sup>3</sup> | Night <sup>4,5</sup> |
| L <sub>90</sub>                          | -                | -                    | -                    |
| LA <sub>eq</sub>                         | -                | -                    | -                    |

| Night Time Maximum Noise Levels (see note 7) |   |    |   |
|----------------------------------------------|---|----|---|
| L <sub>Max</sub> (Range)                     | - | to | - |
| L <sub>Max</sub> - L <sub>eq</sub> (Range)   | - | to | - |

Notes:

- Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
- "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
- "Evening" is the period from 6pm till 10pm
- "Night" relates to the remaining periods
- "Night" relates to period from 10pm on this graph to morning on the following graph.
- Graphed data measured in free-field; tabulated results facade corrected
- Night time L<sub>Max</sub> values are shown only where L<sub>Max</sub> > 65dB(A) and where L<sub>Max</sub> - L<sub>eq</sub> ≥ 15dB(A)

| NSW Road Noise Policy (1m from facade) (see note 6) |          |                    |
|-----------------------------------------------------|----------|--------------------|
| Descriptor                                          | Day      | Night <sup>5</sup> |
|                                                     | 7am-10pm | 10pm-7am           |
| L <sub>eq</sub> 15 hr and L <sub>eq</sub> 9 hr      | 72.3     | -                  |
| L <sub>eq</sub> 1hr upper 10 percentile             | 73.3     | -                  |
| L <sub>eq</sub> 1hr lower 10 percentile             | 70.3     | -                  |