Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

59 Goulburn Street, Sydney NSW 2000

Prepared by:

SLR Consulting Australia

SLR Project No.: 610.031388.00001

26 June 2024

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Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.1	26 June 2024	Jason Rasquinha Mark Irish	Aaron McKenzie	Mark Irish
1.0	13 June 2024	Jason Rasquinha Mark Irish	Aaron McKenzie	Mark Irish

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Bridge Housing (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

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1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Bridge Housing to prepare a noise and vibration impact assessment for a proposed mixed-use development at 600-660 Elizabeth Street, Redfern ('the proposal').

This report accompanies a detailed State Significant Development Application (SSDA) that seeks approval for a mixed-use development at 600-660 Elizabeth Street, Redfern (Redfern Place). The development proposes four buildings comprising community facilities, commercial/office, affordable/social/specialist disability housing apartments and new public links and landscaping.

This report summarises the assessment of the potential construction and operational noise and vibration impacts associated with the proposal.

SLR is suitably qualified and endorsed by the Planning Secretary to produce SSDA noise impact assessments. SLR consultants are members of the Australian Acoustical Society (AAS) and SLR is a member firm of the Association of Australasian Acoustical Consultants (AAAC).

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

1.1 Proposal Description

The subject site is located in the inner-city suburb of Redfern, within the City of Sydney LGA. The project site comprises Lot 1 in DP 1249145. It has an area of approximately 10,850m2. Part of the site currently accommodates the existing Police Citizens Youth Club (PCYC) (to be demolished and replaced). The remaining portion of the site is vacant with remnant vegetation.

The SSDA seeks approval for redevelopment of the site, including:

- Demolition of existing buildings.
- Tree removal.
- Bulk earthworks including excavation.
- Construction of a community facility building known as Building S1.
- Construction of two residential flat buildings (known as Buildings S2 and S3) up to 14 and 10 storeys respectively, for social and affordable housing.
- Construction of a five-storey mixed use building (known as Building S4) comprising commercial uses on the ground level and social and specialist disability housing above.
- Construction of one basement level below Buildings S2, S3 and part of S4 with vehicle access from Kettle Street.
- Site-wide landscaping and public domain works including north-south and east-west pedestrian through-site link.

For a detailed project description refer to the Environmental Impact Statement prepared by Ethos Urban.

The site is located approximately 3km from the Sydney CBD and is bound by Kettle Street to the north, Phillip Street to the south, Walker Street to the east and Elizabeth Street to the west. Across Elizabeth Street to the west is Redfern Oval, a significant outdoor sporting

facility. The site is well served by numerous transport links including bus routes along Elizabeth Street, Redfern Station (1.2 km away) and the new Waterloo Metro Station which is expected to be operational in 2024 (1.1 km away).

To the north and east of the site are residential developments, along Kettle Street and Walker Street respectively. To the south of the site, along Phillip Street, are residential and mixed-use developments. The Redfern Oval lies to the west of the site.

The ground floor site plan indicating the positions of the four buildings is shown in **Figure 1** below.

The square footage and apartment count of each building on the site's is as follows:

- Building S1 – Approximately 3,500sqm GFA
- Building S2 – Approximately 14,500sqm GFA and 197 apartments.
- Building S3 – Approximately 7,500sqm GFA and 109 apartments.
- Building S4 – Approximately 3,500sqm GFA with 39 apartments for Bridge Housing, 10 apartments for Specialist Disability Accommodation, 1 Carer's apartment, 850sqm of commercial office GFA, and 300-400 sqm Community Hub (not contributing to GFA).

The proposed layout of Buildings S1 to S4 is shown in **Figure 2**, **Figure 3**, **Figure 4** and **Figure 5**.

Figure 1 Site by Section

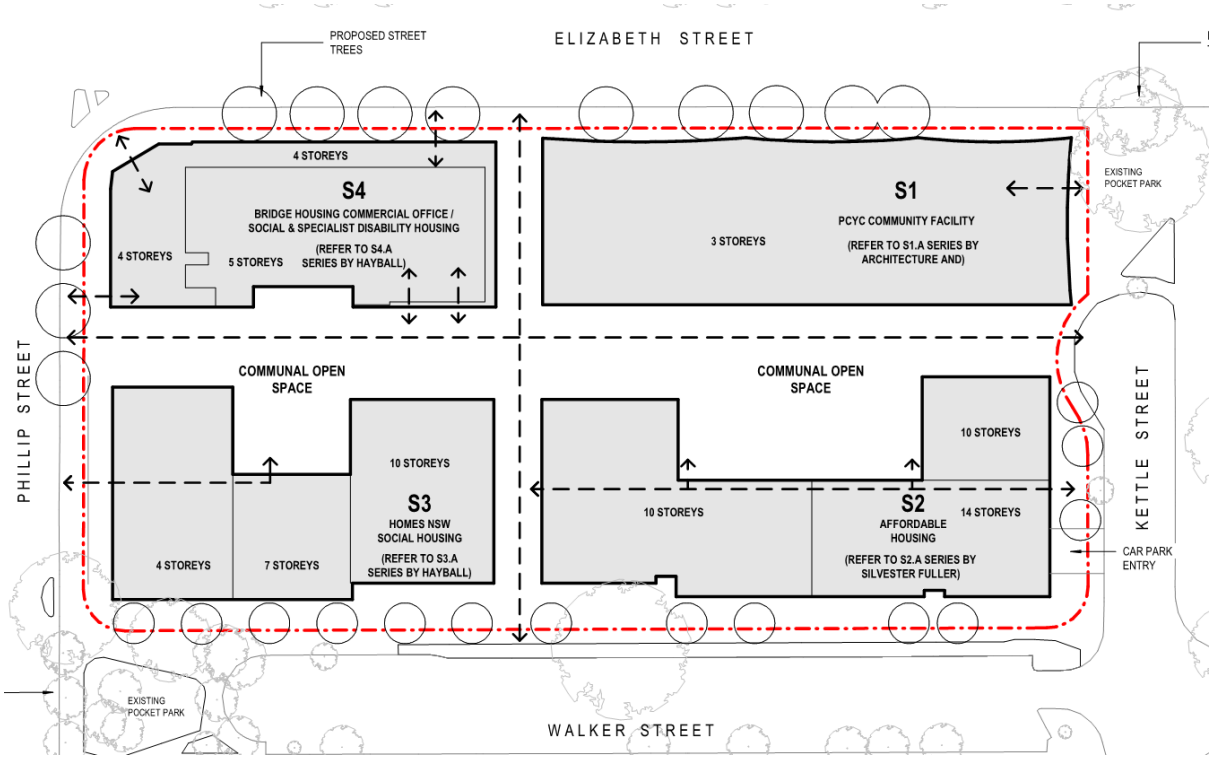


Figure 2 Proposed Ground Floor Layout – Building S1

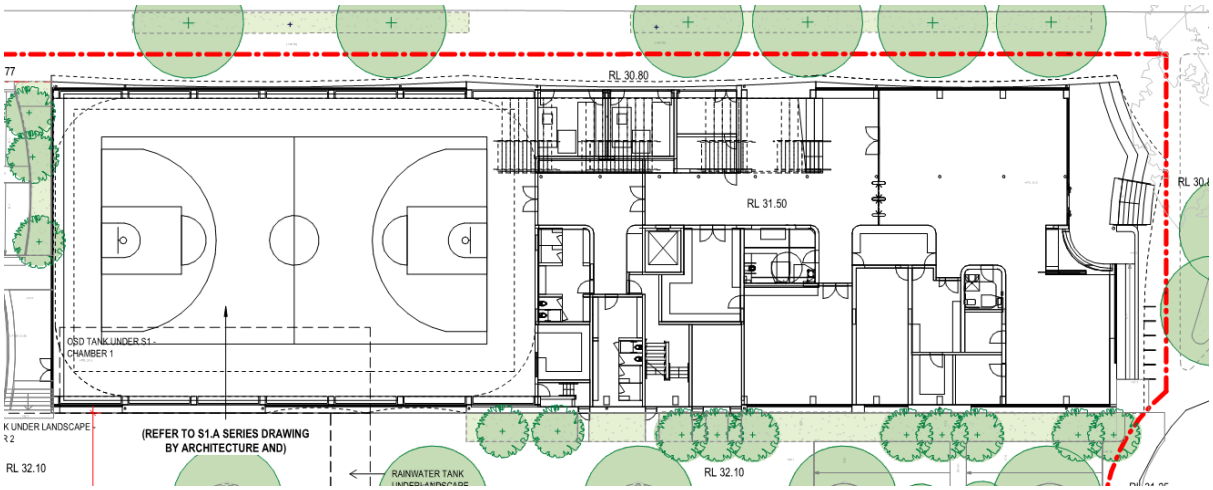


Figure 3 Proposed Ground Floor Layout – Building S2

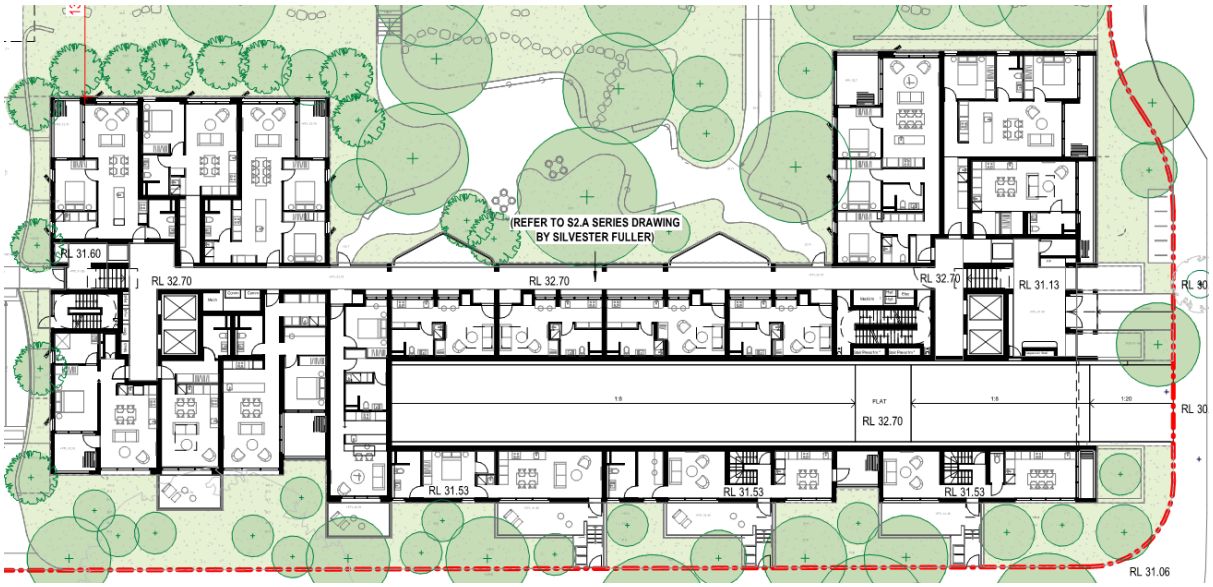


Figure 4 Proposed Ground Floor Layout – Building S3

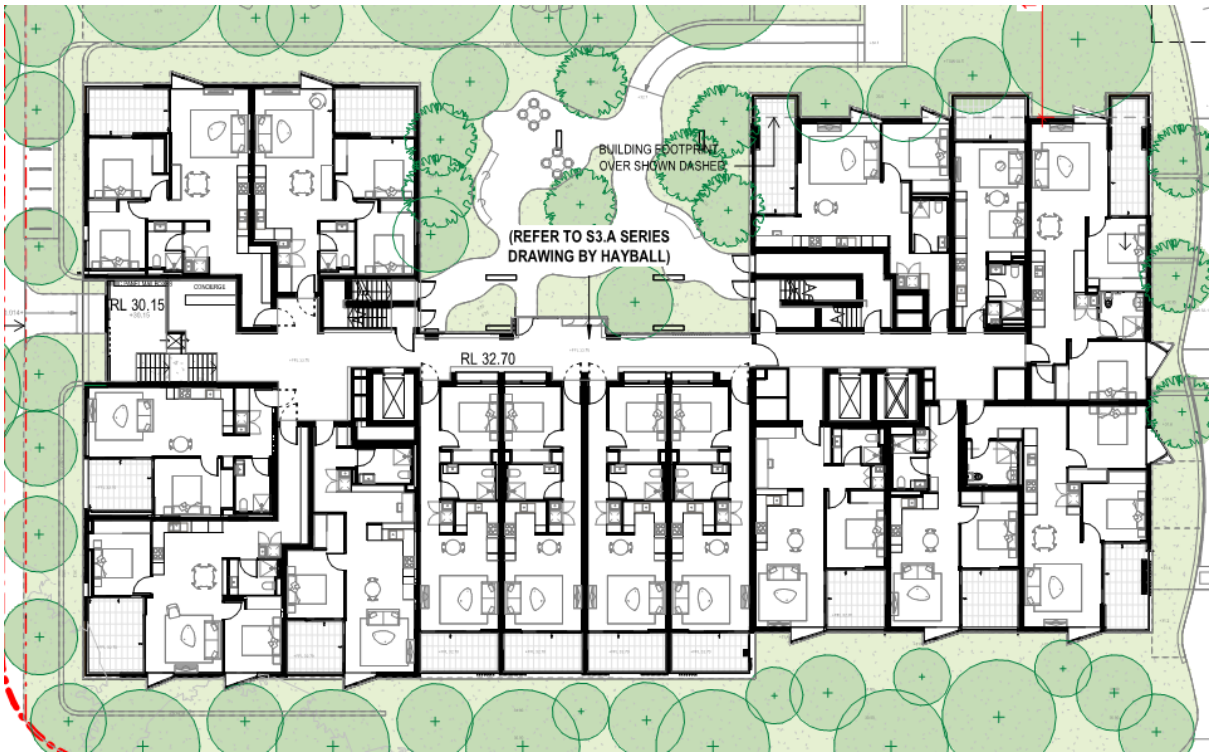
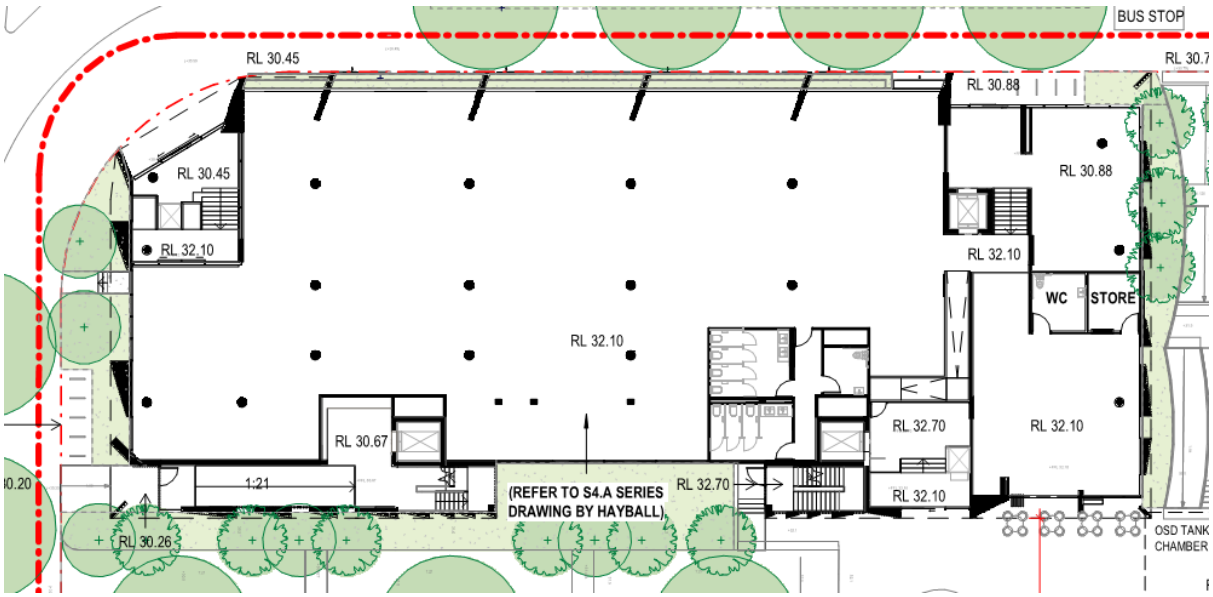


Figure 5 Proposed Ground Floor Layout – Building S4



1.2 Nearest Receivers

The closest developments to the site are multi-storey residential uses which are located approximately 30 m to the north, 40 m to the north east, 20 m to the east and 20 m to the south.

The buildings to the north have three storeys, those to the north east have ten storeys, those to the east of the site have up to three storeys and those to the south have up to two storeys.

The site location and surrounding noise-sensitive receivers are shown in **Figure 6.** Details for the nearest noise-sensitive are shown in **Table 1**.

Table 1 Surrounding Sensitive Receivers

Receiver Area	Address	Type	Distance (m)	Direction
North and East Residential	Residences along Kettle Street and Walker Street	Residential	20 to 30	North and East
South Residential	Residences along Phillip Street	Residential	20	South

Scale: 1:3,000 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

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SLR

SITE LOCATION
600-660 ELIZABETH ST, REDFERN

FIGURE 1

1.3 Assessment Requirements

This report has been prepared to address the requirements of the Secretary's Environmental Assessment Requirements (SEARs) for Lot 1 in DP 1249145 issued 29 February 2024 and the NSW Government Design Guide for 600-660 Elizabeth Street, Redfern issued by NSW Department of Planning and Environment in October 2023 (Design Guide).

The SEARs requirement relating to noise and vibration and the sections where the requirement is addressed is shown in **Table 2**.

The Design Guide requirements relating to noise and vibration and the sections where the requirement is addressed is shown in **Table 3**.

Table 2 Secretary's Environmental Assessment Requirements

Item	Description of Requirement	Section Reference (this report)
Noise and Vibration	Provide a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	**Noise and Vibration Criteria:** **Section 4.0** **Construction Impacts:** **Section** , **5.1**, **6.1** and **6.2** **Operational Noise Impacts:** **Section 5.2** and **6.3, Appendix D** **Mitigation:** **Section 8.0**, **Appendix H** and **I**

Table 3 NSW Government Design Guide Requirements

Section	Description of Requirement	Section Reference (this report)
3.8	Ensure the siting and layout of apartments facing Elizabeth Street respond to the noisy environment	**Section 5.3** and **6.4**, **Appendix E**, **F** and **G**
3.10	**Objectives:** a) Minimise the impact of noise on sensitive receivers. **Guidance:** 1) Noise from the community facility must be attenuated within the development so it does not affect adjacent sensitive receivers including apartments on the site. This includes structure borne noise. 2) Development for the purposes of residential accommodation, must ensure that the following LAeq levels are not exceeded: (a) in any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am, (b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time	**Noise and Vibration Criteria:** **Section 4.0** **Construction noise impacts:** **Section 5.1**, **6.1** and **6.2** **Operational noise impacts:** **Section 5.2** and **6.3**, **Appendix D** **Traffic noise impacts:** **Section 5.3** and **6.4**, **Appendix E**, **F** and **G**

1.4 Drawings Referenced

This assessment is based on the following architectural drawings:

- Building S1: SSDA (Rev A) issued on 19 June 2024 by Architecture AND
- Building S2: SSDA (Rev A) issued on 19 June 2024 by Silvester Fuller
- Building S3 and S4: SSDA (Rev A) issued on 19 June 2024 by Hayball

2.0 Existing Noise Environment

2.1 Existing Noise Sources

2.1.1 Road Traffic Noise

The existing noise environment across the project site is generally controlled by road traffic noise.

The main arterial road to the west of the site is Elizabeth Street, with Phillip Street adjoining the south of the site. During site inspections, it was noted that these roads become congested during peak hours.

2.1.2 Aircraft Noise

The site is not located directly under the flight path and is not directly impacted by aircraft noise.

The Australian Noise Exposure Index (ANEI) is a parameter used to describe the noise impact by airports in Australia. The ANEI is an equal energy noise index, similar to the L_{eq} from 7 pm to 7 am. The Australian Noise Exposure Forecast (ANEF) is the future predicted ANEI. Typically the ANEF 20 contour and higher defines an area where additional noise mitigation may be required for new residential buildings.

As the site is located outside the ANEF 20 contour, noise mitigation from aircraft noise would not be required for the project site.

The N70 noise contours illustrate the number of events above 70 dBA for an annual average day. These maps indicate the likelihood of annoyance from aircraft noise. The N70 chart for Sydney Airport in 2016 indicates less than 10 noise events of greater than 70 dBA were experienced on an average day. This exposure is very small compared to other regions in Sydney and is not considered to be appreciably noise-affected. Additionally, Sydney Airport only operates between the hours of 0600 h to 2300 h and as such, noise events greater than 70 dBA would generally occur during the less sensitive daytime period.

2.1.3 Sports Ground

A sports ground is located across Elizabeth Street to the west of the project site. It is considered likely that noise from events would be audible at the proposal site when the sports ground is in use. However, it is not anticipated that noise from sporting events would have a significant impact on the overall noise environment at the proposal site. The results from the noise monitoring indicate that traffic noise remained the dominant noise source during the monitoring period.

2.2 Ambient Noise Surveys

In order to characterise the existing ambient noise environment, unattended and attended noise monitoring was conducted at the site. The measured noise levels have been used to establish existing road traffic noise impacts and to understand the existing ambient noise environment of the site and the surrounding areas.

Noise monitoring equipment was deployed in three locations across the site with consideration of existing noise sources that may influence the measurements, accessibility and security. The selected noise monitoring locations (L01, L02 and L03) are shown in **Figure 1**.

2.2.1 Unattended Noise Monitoring

Unattended noise monitoring was completed in May 2018 as part of the previous Noise & Vibration Impact Assessment (2018 NVIA), as documented in SLR report 610.17905-R01-v4.0 dated 18 February 2020.

Additional unattended noise monitoring was conducted during November 2023 to validate current noise levels across the site. Noise monitors were deployed at similar locations to those in the 2018 assessment. However, due to vandalism of monitors placed within the undeveloped part of the site, only one complete day and night of noise data was measured at a location 35 m from Elizabeth Street and 22 m from Walker Street. Noise monitoring at L03 (see **Figure 1**) was successful and data from this location has been used for the assessment. Noise monitoring results at L01 and L02 from 2018 were validated against the 2023 results measured within the undeveloped part of the site and a summary is provided in **Section 2.2.3**.

The noise loggers continuously measured noise levels in 15-minute sampling periods to determine the existing L_{Aeq}, L_{A90} and other relevant statistical noise levels during the daytime, evening and night-time periods.

The noise measurements were carried out using Svan 957 and 977 noise loggers. The equipment was set up with microphones at 1.5 metres above the ground level. All microphones were fitted with windshields.

All noise measurement instrumentation used in the surveys was designed to comply with the requirements of Australian Standard AS IEC 61672.1—2004 - Electroacoustics—Sound level meters, Part 1: Specifications and carried appropriate and current National Association of Testing Authorities (NATA) calibration certificates. The calibration of the loggers was checked both before and after each measurement survey and the variation in calibration at all locations was found to be within acceptable limits.

The results of the noise monitoring have been processed to exclude noise identified as extraneous and/or data affected by adverse weather conditions (such as strong wind or rain) to establish representative noise levels in each area.

The results of the unattended ambient noise surveys conducted in 2018 and 2023 are summarised in **Table 4** and **Table 5**. The Rating Background Level (RBL) and the ambient noise levels ($L_{Aeq(period)}$) for the NPfI daytime, evening and night-time periods are presented in **Table 4**. The L_{Aeq} (energy averaged) noise levels for the Road Noise Policy (RNP) daytime and night-time periods are presented in **Table 5**.

Daily graphs representing the measured noise levels are contained in **Appendix B**. The graphs represent each 24-hour period during the survey period and show the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise levels in 15-minute periods.

Table 4 Unattended Noise Monitoring Summary - NPfI

Location ID	Location Description	Noise Levels dBA					
		RBL[1]			$L_{Aeq(period)}$[2]		
		Daytime	Evening	Night-time	Daytime	Evening	Night-time
L01[3]	Adjacent to Elizabeth Street, Redfern	52	49	40	65	64	60
L02[3]	Adjacent to Walker Street, Redfern	48	46	41	58	55	51

Location ID	Location Description	Noise Levels dBA					
		RBL[1]			$L_{Aeq(period)}$[2]		
		Daytime	Evening	Night-time	Daytime	Evening	Night-time
L03[4]	Adjacent to Phillip Street, Redfern	53	47	38	63	61	57

Note 1: The RBL noise level is representative of the 'average minimum background sound level', or simply the background level.

Note 2: The L_{Aeq} is essentially the 'average sound level'. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

Note 3: Data for this location was measured in 2018 and validated with additional measurements in 2023.

Note 4: Data for this location was measured in 2023.

In order to assess road traffic noise impacts on the site, the data obtained from the noise logging has also been processed to establish average day ($L_{Aeq(15hour)}$) and night ($L_{Aeq(9hour)}$) noise levels over the time periods as required by the City of Sydney Council Development Control Plan 2012. The results are presented in **Table 5**.

Table 5 Unattended Noise Monitoring Summary - RNP

Monitoring Location	Daytime (7am to 10pm)[1]		Night-time (10pm to 7am)[1]	
	$L_{Aeq(15hour)}$[2]	$L_{Aeq(1hour)}$[3]	$L_{Aeq(9hour)}$[2]	$L_{Aeq(1hour)}$[3]
L01[4]	64	66	60	62
L02[4]	58	59	51	53
L03[5]	63	64	58	60

Note 1: The "Daytime" represents the period between 7:00 am to 10:00 pm and "Night time" represents the period between 10:00 pm to 7:00 am.

Note 2: The L_{Aeq} (15 hour) and L_{Aeq} (9 hour) descriptors represent the average L_{Aeq} noise level for the period 7am.–10pm and from 10pm to 7am respectively.

Note 3: The maximum repeatable $L_{Aeq(1hour)}$ descriptor represents the highest tenth percentile hourly A-weighted Leq during the specific period.

Note 4: Data for this location was measured in 2018 and validated with additional measurements in 2023.

Note 5: Data for this location was measured in 2023.

2.2.2 Attended Airborne Noise

Attended measurements of ambient noise were completed at the end of the noise logging survey in 2018 and 2023 to determine the various noise sources that influence the existing noise environment. During each measurement, the observer noted the various noise sources and the contributing noise level.

At each location. the attended measurements were performed for 15-minutes using a calibrated Brüel and Kjær 2270 Precision Sound Level Meter (S/N:3008204). Wind speeds were less than 5 m/s at all times, and all measurements were performed at a height of 1.5 metres above ground level.

The calibration of the sound level meter was checked before and after each measurement and the variation in calibration at all locations was found to be within acceptable limits at all times.

Table 6 Summary of Attended Noise Monitoring Results

Measurement Location	Date/Time/ Measurement Duration	Measured Noise Levels (dBA)			Description of Ambient Noise Source - Typical Lamax Levels
		LA90	LAeq	Lamax	
L01	08/05/2018 9:36 am 15-minutes	58	65	77	Traffic: 65 – 77 dBA Birds: 75 dBA Plane: 71 dBA
L02	08/05/2018 9:52 am 15-minutes	53	61	80	Birdsong: 69 – 80 dBA Bus: 65 – 68 dBA Plane: 60 - 66 dBA
L03	03/11/2023 9:44 am 15-minutes	53	65	81	Traffic: 60 - 67 dBA Bus: 70 - 81 dBA Motor Bike: 65 dBA

2.2.3 Noise Data Validation

Ambient Noise Levels - L_{Aeq}

The L_{Aeq} data measured between 9:00 am on 3 November 2023 and 4:00 pm on 4 November2023 within the undeveloped part of the site (35 m from Elizabeth Street) indicated that Elizabeth Street was the dominant noise source. This data was distance corrected to 12 m from Elizabeth Street i.e. to the same position as L01. The comparison of the measured L_{Aeq} noise levels at L01 in 2018 and the corrected 2023 levels are presented in **Table 7**.

Table 7 Comparison of Ambient Noise Levels (L_{Aeq}) – L01

Period	Parameter	Measured Noise Levels (dBA)		
		2018 (L01)	2023 (Corrected)	Difference
Daytime	$L_{Aeq(15\ hour)}$	65	61	-4
	$L_{Aeq(1\ hour)}$	67	62	-5
Night-time	$L_{Aeq(9\ hour)}$	60	56	-4
	$L_{Aeq(1\ hour)}$	63	57	-5

The results in **Table 7** indicates that the 2018 L_{Aeq} noise levels at L01 are higher than the equivalent 2023 noise levels. Hence, the 2018 L_{Aeq} noise levels have been used for the facade noise ingress assessment in order to be more conservative.

Background Noise Levels - RBL

The Rating Background Level (RBL) measured between 9:00 am on 3 November 2023 and 4:00 pm on 4 November 2023 within the undeveloped part of the site (35 m from Elizabeth Street and 43 from Walker Street) indicated that traffic noise was driving the RBLs. A comparison of this data to the measured RBLs at L02(located 57 m from Elizabeth Street and 23 from Walker Street) in 2018 is presented in **Table 8**.

Table 8 Comparison of Background Noise Levels (RBL)– L02

Period	Measured Noise Level RBL (dBA)	
	2018 (L02)	2023
Daytime	48	47
Evening	46	44
Night-time	41	38

The above indicates that the RBLs measured in 2018 at L02 are marginally (up to 3 dB) higher than the 2023 noise levels measured within the undeveloped part of the site. Due to the difference in the measurement locations and a lack of data available in 2023, a comprehensive comparison of noise levels is not possible. However, it is considered that the available data indicates that background noise levels in the project area have not significantly changed. Hence, the data measured at L02 in 2018 has been used to determine the construction and operational noise criteria.

3.0 Existing Vibration Environment

3.1 Existing Vibration Environment

There are currently no major existing vibration sources in the project area.

3.2 Future Vibration Environment

The future vibration environment is not anticipated to significantly change from that of the existing situation.

4.0 Assessment Criteria

4.1 Construction Noise Criteria

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage impacts from construction noise on residences and other sensitive land uses in NSW.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area. The 'worst-case' noise levels from construction of a proposal are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impact of the proposal.

The NMLs are not mandatory limits, however, where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

4.1.1 Residential Receivers

The ICNG approach for determining NMLs at residential receivers is shown in **Table 9**.

Table 9 ICNG NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Standard Construction Hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected RBL[1] + 10 dB	• The noise affected level represents the point above which there may be some community reaction to noise • Where the predicted or measured $L_{Aeq(15minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dBA	• The Highly Noise Affected (HNA) level represents the point above which there may be strong community reaction to noise • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account: o 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 o If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Standard Construction Hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: RBL is the Rating Background Level and the ICNG refers to the calculation procedures in the NSW Industrial Noise Policy (INP). The INP has been superseded by the NSW EPA Noise Policy for Industry (NPfI).

4.1.2 NML Summary

The construction NMLs for the proposal have been determined using the results from the unattended noise monitoring and are shown in **Table 10**.

Out of hours NMLs would be applicable should works be required to be undertaken outside ICNG standard construction hours.

Table 10 Project Specific Noise Management Levels

Receiver Area	Monitoring Location	Noise Management Level ($L_{Aeq(15minute)}$ – dBA)			
		Standard Construction (RBL +10 dB)[1]	Out of Hours (RBL +5 dB)		
		Daytime	Daytime[2]	Evening	Night-time
North and East Residential	L02	58	53	51	46
South Residential	L03	63	58	52	43

Note 1: RBL = Rating Background Level.

Note 2: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

4.2 Construction Vibration Criteria

The effects of vibration from construction works can be divided into three categories:

- Those in which the occupants of buildings are disturbed (human comfort)
- Those where building contents may be affected (building contents)
- Those where the integrity of the building may be compromised (structural or cosmetic damage).

4.2.1 Human Comfort Vibration

People can sometimes perceive vibration impacts when vibration generating construction works are located close to occupied buildings.

Vibration from construction works tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDVs for human comfort impacts are shown in **Table 11**.

Table 11 Vibration Dose Values for Intermittent Vibration

Building Type	Assessment Period	Vibration Dose Value[1] ($m/s^{1.75}$)	
		Preferred	Maximum
Critical Working Areas (eg operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26

Building Type	Assessment Period	Vibration Dose Value[1] (m/s$^{1.75}$)	
		Preferred	Maximum
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note 1: The VDV accumulates vibration energy over the daytime and night-time assessment periods, and is dependent on the level of vibration as well as the duration.

4.2.2 Effects on Building Contents

People perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents.

Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes, are located in buildings near to construction works. No such items of equipment have been identified in the proposal area.

4.2.3 Structural and Cosmetic Damage Vibration

If vibration from construction works is sufficiently high it can cause damage to structural elements of affected buildings. The levels of vibration required to cause cosmetic damage tend to be at least an order of magnitude (10 times) higher than those at which people can perceive vibration.

Examples of damage that can occur includes cracks or loosening of drywall surfaces, cracks in supporting columns and loosening of joints. Structural damage vibration limits are contained in British Standard BS 7385 and German Standard DIN 4150.

BS 7385

British Standard BS 7385 recommends vibration limits for transient vibration judged to give a minimal risk of vibration induced damage to affected buildings. The limits for residential and industrial buildings are shown in **Table 12**.

Table 12 BS 7385 Transient Vibration Values for Minimal Risk of Damage

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

Note 1: Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50%.

For heritage buildings, the standard states that "*a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive*".

DIN 4150

German Standard DIN 4150 also provides guideline vibration limits for different buildings. Damage is not expected to occur where the values are complied with and the values are generally recognised to be conservative. The DIN 4150 values for buildings and structures are shown in **Table 13**.

Table 13 DIN 4150 Guideline Values for Short-term Vibration on Structures

Group	Type of Structure	Guideline Values Vibration Velocity (mm/s)				
		Foundation, All Directions at a Frequency of			Topmost Floor, Horizontal	Floor Slabs, Vertical
		1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified as Group 1 or 2 **and** are of great intrinsic value (eg heritage listed buildings)	3	3 to 8	8 to 10	8	20[1]

Note 1: It may be necessary to lower the relevant guideline value markedly to prevent minor damage.

4.2.4 Minimum Working Distances for Vibration-intensive Works

Minimum working distances for typical vibration-intensive construction equipment are provided in the Roads and Maritime (now Transport for NSW) *Construction Noise and Vibration Guideline* (CNVG) and are shown in **Table 14**. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from the NSW EPA Vibration Guideline). They are based on empirical data which suggests that where works are further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 14 Recommended Minimum Working Distances from Vibration-intensive Equipment

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Vibratory Roller	<50 kN (1–2 tonne)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 tonne)	6 m	13 m	20 m
	<200 kN (4–6 tonne)	12 m	25 m	40 m
	<300 kN (7–13 tonne)	15 m	31 m	100 m
	>300 kN (13–18 tonne)	20 m	40 m	100 m
	>300 kN (>18 tonne)	25 m	50 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

The minimum working distances are indicative and will vary depending on the particular item of equipment and local geotechnical conditions. The distances apply to cosmetic damage of typical buildings under typical geotechnical conditions.

4.3 Operational Noise Criteria

The NSW *Noise Policy for Industry* (NPfI) was released in 2017 and sets out the requirements for the assessment and management of operational noise from industry in NSW.

The NPfI defines how to determine 'trigger levels' for noise emissions from industrial developments. Where a development is likely to exceed the trigger levels at existing noise-sensitive receivers, feasible and reasonable noise management measures are required to be considered to reduce the impacts.

There are two types of trigger levels – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses:

- The **intrusiveness** of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source, measured over a period of 15-minutes, does not exceed the representative background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended **amenity** levels specified in the NPfI for that particular land use.

Intrusive and amenity noise levels are not used directly as regulatory limits. They are used to assess the potential impact of noise, assess feasible and reasonable mitigation options and subsequently determine achievable noise requirements.

The NPfI provides guidance on assigning residential receiver amenity noise categories based on the site-specific features shown in **Table 15**.

Table 15 Residential Receiver Amenity

Receiver Category	Typical Planning Land Use Zoning	Typical Existing Background Noise Levels (RBL)	Description
Rural	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime <40 dBA Evening <35 dBA Night <30 dBA	Rural – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.

Receiver Category	Typical Planning Land Use Zoning	Typical Existing Background Noise Levels (RBL)	Description
Suburban residential	RU5 – village RU6 – transition R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Daytime <45 dBA Evening <40 dBA Night <35dBA	Suburban – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.
Urban residential	R1 – general residential R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime >45 dBA Evening >40 dBA Night >35 dBA	Urban – an area with an acoustical environment that: • Is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources • Has through-traffic with characteristically heavy and continuous traffic flows during peak periods • Is near commercial districts or industrial districts • Has any combination of the above.

Amenity noise categories for the surrounding receivers have been determined with reference to the NPfI. The assessment is shown in **Table 16**.

Table 16 Residential Receiver Amenity Category Assessment

Receiver Area	Land Use Zoning	Existing Background Noise Levels RBL (dBA)			Resulting Amenity Classification	Discussion
		Day	Eve	Night		
North and East Residential	No zoning	48	47	41	Urban	Land use classification is not provided for the residential area adjacent to Walker and Kettle Street. The existing noise levels are relatively high and controlled by road traffic noise and urban hum. This residential area has therefore been classified as urban.

Receiver Area	Land Use Zoning	Existing Background Noise Levels RBL (dBA)			Resulting Amenity Classification	Discussion
		Day	Eve	Night		
South Residential	R1 – General residential	53	47	38	Urban	The residences fronting Phillip Street (South Residential) are zoned as R1 – General Residential. The existing noise levels are relatively high and controlled by road traffic noise and urban hum. This residential area has therefore been classified as urban.

4.3.1 Project Noise Trigger Levels

The trigger levels for industrial noise from the proposal are summarised in **Table 17**. They are based on the previously measured background noise levels, where appropriate. The Project Noise Trigger Levels (PNTL) are the most stringent of the intrusiveness and amenity trigger level for each period and are highlighted in the table below.

Table 17 Project Noise Trigger Levels – Industrial Noise

Receiver Area	Representative Noise Logger	Period	Amenity Noise Level L_{Aeq} (dBA)	Measured Noise Level (dBA)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)	
				RBL[1]	L_{Aeq} (period)	Intrusive-ness	Amenity[2,3]
North and East Residential	L02	Day	60	48	58	**53**	58
		Evening	50	46	55	51	**48**
		Night	45	41	51	46	**43**
South Residential	L03	Day	60	53	63	**58**	58
		Evening	50	47	61	52	**49**[4]
		Night	45	38	57	**43**	45[4]

Note 1: RBL = Rating Background Level.

Note 2: The recommended amenity noise levels have been reduced by 5 dB, where appropriate, to give the project amenity noise levels due to other sources of industrial noise being present in the area, as outlined in the NPfI.

Note 3: The project amenity noise levels have been converted to a 15-minute level by adding 3 dB, as outlined in the NPfI.

Note 4: Area is dominated road traffic noise and the project amenity level was set at 15 dB below the existing road traffic noise level, as outlined in the NPfI.

4.3.2 Community/Patron Activities in Building S1

Noise breakout from sporting/community activities within the various spaces of Building S1 is not assessed in accordance with the NPfI PNTLs and is not assessed cumulatively with other industrial noise sources (eg mechanical plant, on-site vehicle movements).

Specific guidance with regards to noise from sporting activities is not provided in the City of Sydney DCP 2012. The NSW EPA *Noise Guide for Local Government* (NGLG) includes the concept of assessing 'intrusive noise' for a variety of noise sources including sporting activities in Section 2.2.1. The definition of intrusive noise is consistent with the methodology used in the NPfI, hence the trigger level for the assessment of the noise impacts from sporting/community activities within Building S1 is based on the NPfI 'intrusiveness' trigger level (discussed in **Section 4.0),** and is presented in **Table 18**.

Table 18 Intrusive Noise Trigger Levels – Community Activity Noise

Receiver Area	Period	Measured RBL[1] (dBA)	Intrusiveness Trigger Level $L_{Aeq(15minute)}$ (dBA)
North and East Residential (including all site buildings)	Day	48	53
	Evening	46	51
	Night	41	46
South Residential	Day	53	58
	Evening	47	52
	Night	38	43

Note 1: RBL = Rating Background Level.

4.3.3 Cumulative Noise Impacts

The NSW Government *Cumulative Impact Assessment Guidelines for State Significant Projects* requires that the potential combined effect of cumulative impacts from all nearby industrial developments to be considered when assessing potential noise impacts from state significant projects. The guideline references the NPfI when determining the approach to assessing the cumulative industrial noise impacts.

The NPfI states that it aims to limit continuing increases in cumulative industrial noise through the application of amenity noise levels, which are applicable to all industrial noise sources in an area.

The NPfI requires that the amenity noise levels which are applied to an individual project be reduced by 5 dB to allow for the potential cumulative impact from multiple sources of industrial noise in an area (including existing and new).

By doing this, the policy accounts for potential cumulative impacts by lowering the criteria for each individual development to ensure that the ambient noise level within an area from all industrial noise sources combined remains below the recommended amenity noise levels, where feasible and reasonable. The NPfI states that *"where the project amenity noise level applies and it can be met, no additional consideration of cumulative industrial noise is required"*.

The potential cumulative impacts from tthe proposal and other sources of industrial noise in the area are therefore accounted for in the proposal-specific PNTLs (see **Table 17**) and have not been considered further.

4.3.4 Sleep Disturbance

The potential for sleep disturbance from maximum noise level events from the proposal during the night-time period is required to be considered. This is applicable only to residential receivers.

The NPfI defines the sleep disturbance screening level as 52 dBA L_{AFmax} or the prevailing background level plus 15 dB, whichever is greater.

The sleep disturbance screening levels for the proposal are shown in **Table 19**.

Table 19 Sleep Disturbance Screening Levels

Location	Noise Level (dBA)	
	Measured Prevailing Night-time Background Level	Sleep Disturbance Screening Level[1]
North and East Residential	41	56
South Residential	38	53

Note 1: The sleep disturbance screening level as 52 dBA LAFmax or the prevailing background level plus 15 dB, whichever is greater.

A detailed maximum noise level event assessment should be completed where the sleep disturbance screening level is exceeded. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night-time period.

The NPfI refers to the *Road Noise Policy* (RNP) for additional information regarding sleep disturbance. enHealth Council studies are referenced which indicate that for short-term or transient noise events, for good sleep over eight hours the indoor L_{AFmax} sound pressure level should ideally not exceed around 45 dBA more than 10 or 15 times per night.

The RNP goes on to conclude that from the research on sleep disturbance to date:

- Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to awaken people from sleep
- One or two events per night with maximum internal noise levels of 65-70 dBA are not likely to affect health and wellbeing significantly.

4.3.5 Corrections for Annoying Noise Characteristics

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NPfI specifies the following modifying factor corrections, shown in **Table 20**, which are to be applied where annoying characteristics are present. The corrections are to be added to the noise level at the receiver before comparison with the Project Noise Trigger Levels.

Table 20 NPfI Modifying Factor Corrections

Factor	Assessment/ Measurement	When to Apply	Correction[1]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NPfI.	5 dB[2]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third	Measure/assess source contribution C and A weighted $L_{eq,t}$ levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level to which the thresholds defined in the NPfI are exceeded.	2 or 5 dB[2]

Factor	Assessment/ Measurement	When to Apply	Correction[1]
	octave measurements		
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	The source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible. The NPfI further defines intermittent noise as noise where the level suddenly drops/increases several times during the assessment period, with a noticeable change in source noise level of at least 5 dB, for example, equipment cycling on and off. The EPA has confirmed[4] that the intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms. The intermittency correction is not intended to be applied to changes in noise level due to meteorology.	5 dB[3]
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated.	Maximum correction of 10 dB[2] (excluding duration correction)

Note 1: Corrections to be added to the measured or predicted levels.

Note 2: Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Note 3: Adjustment to be applied to night-time only.

Note 4: How to Apply the Noise Policy for Industry Intermittent Modifying Factor Corrections, NSW Environment Protection Authority, Acoustics Australia Vol. 50, No. 3, September 2022.

Details of the modifying factor corrections applied in the assessment are provided in **Section 0**.

4.3.6 Residual Impacts

The NPfI defines residual noise impacts as exceedances of the Project Noise Trigger Levels which remain after all feasible and reasonable source and pathway mitigation measures have been considered.

The significance of residual noise impacts, as defined in the NPfI, is shown in **Table 21.** Examples of receiver-based treatments that can be used to mitigate residual impacts are shown in **Table 22**.

Table 21 NPfI Significance of Residual Noise Impacts

If the Predicted Noise Level minus the Project Noise Trigger Level is:	And the Total Cumulative Industrial Noise Levels is:	Then the Significance of the Residual Noise Level is:
≤ 2 dBA	Not applicable	Negligible

If the Predicted Noise Level minus the Project Noise Trigger Level is:	And the Total Cumulative Industrial Noise Levels is:	Then the Significance of the Residual Noise Level is:
≥ 3 but ≤ 5 dBA	< recommended amenity noise level or > recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from the development is less than or equal to 1dB	Marginal
≥ 3 but ≤ 5 dBA	> recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is more than 1 dB	Moderate
> 5 dBA	≤ recommended amenity noise level	Moderate
	> recommended amenity noise level	Significant

Table 22 NPfI Examples of Receiver-based Treatments to Mitigate Residual Noise Impacts

Significance of Residual Noise Impact	Example of Potential Treatment
Negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls.
Marginal	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
Moderate	As for 'marginal', but also upgraded facade elements, such as windows, doors or roof insulation, to further increase the ability of the building facade to reduce noise levels.
Significant	May include suitable commercial agreements where considered feasible and reasonable.

4.3.7 Traffic on Surrounding Roads

The potential impacts from proposal-related traffic on the surrounding public roads are assessed using the NSW EPA *Road Noise Policy* (RNP).

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB. Where this is considered likely, further assessment is required using the RNP criteria shown in **Table 23**.

Table 23 RNP/NCG Criteria for Assessing Traffic on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	Night-time (10 pm – 7 am)
Freeway/ arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	Night-time (10 pm – 7 am)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

4.4 Internal Noise Criteria – Residential

4.4.1 NSW Government Design Guide Requirements

The Design Guide for the proposal highlights the following internal noise level requirements for spaces within the proposed development:

> *Development for the purposes of residential accommodation, must ensure that the following LAeq levels are not exceeded:*
>
> *a. in any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am,*
>
> *b. anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.*

These noise requirements align with those in the Department of Planning's (DoP) *Development near Rail Corridors and Busy Roads – Interim Guideline* (see **Section 4.4.3**).

It is understood that the project should be designed to meet the requirements of DPIE's *Apartment Design Guide* (ADG) Objective 4B-1 for natural ventilation where possible. As the Design Guide does not state the requirements for an open windows noise assessment, the following concession from the *Development near Rail Corridors and Busy Roads – Interim Guideline* has been applied (see **Section 4.4.3**):

> "*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 noise level requirements based on the Design Guide and the DoP *Development near Rail Corridors and Busy Roads – Interim Guideline* have been summarised in **Table 24**. Residential areas should comply with the "windows open" noise criteria**Table 25**. The criteria presented below form the basis of the assessment of noise impacts from road traffic and development-related mechanical plant on the development's three residential buildings.

Table 24 Acoustic Amenity

Type of habitable space	Applicable Time Period	Assessment Noise Metric	Windows/Doors Closed Criteria – dB(A)	Windows/Doors Open Criteria – dB(A)
Sleeping areas (bedrooms)	10:00pm – 7:00am	$L_{Aeq,9hour}$	35	45

Type of habitable space	Applicable Time Period	Assessment Noise Metric	Windows/Doors Closed Criteria – dB(A)	Windows/Doors Open Criteria – dB(A)
Living rooms	At any time	$L_{Aeq,9hour}$/$L_{Aeq,15hour}$	40	50

4.4.2 City of Sydney Council Development Control Plan 2012

The City of Sydney Council DCP highlights the following internal noise levels requirements for spaces within the proposed development:

Table 25 Table 2-2.6: Acoustic Amenity

Type of habitable space	Applicable Time Period	Assessment Noise Metric	Windows/Doors Closed Criteria – dB(A)	Windows/Doors Open Criteria – dB(A)
Sleeping areas (bedrooms)	10:00pm – 7:00am	$L_{Aeq,1hour}$	35	45
Living rooms	At any time	$L_{Aeq,1hour}$	45	55

The site-specific Design Guide noise requirements are understood to take precedence over the City of Sydney Council DCP requirements. Hence, the DCP requirements have not been considered further in the assessment.

4.4.3 Department of Planning: Development Near Rail Corridors and Busy Roads – Interim Guideline

The DoP's *Development near Rail Corridors and Busy Roads – Interim Guideline* governs the required maximum internal noise levels averaged over certain periods within bedrooms and living areas of apartments in tthe proposal. The guideline details the application of clause 102 of the State Environmental Planning Policy (SEPP) Infrastructure which states the following for residential developments:

> *"If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:*
>
> - *In any bedroom in the residential accommodation – 35 dBA at any time between 10.00 pm and 7.00 am,*
>
> - *Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway) – 40 dBA at any time."*

The DoP's *Development near Rail Corridors and Busy Roads – Interim Guideline* also states the following in regards to an open windows assessment:

"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."

4.5 Internal Noise Criteria – Non-residential uses

All internal non-residential areas should be designed to mitigate external noise intrusion to the recommended internal noise criteria based upon their use in AS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors as summarised in **Table 26**.

Table 26 Internal Noise Criteria – Non-residential uses

Type of space	Applicable Time Period	Assessment Noise Metric	Internal Noise Criteria – dB(A)
S4 Commercial - Office	When in use	$L_{Aeq,1hour}$	45
S1 Community – Indoor Sports	When in use	$L_{Aeq,1hour}$	45
S1 Community – Meeting/Multi-Purpose Room	When in use	$L_{Aeq,1hour}$	40

5.0 Methodology

5.1 Construction Noise and Vibration Assessment

A noise model of the study area has been used to predict noise levels from the proposed construction work to all surrounding receivers. The model uses ISO 9613-2 algorithms in SoundPLAN software.

Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the construction sites and surrounding areas.

5.1.1 Construction Activities

Representative scenarios have been developed to assess the likely impacts from the various construction phases of the proposal. These scenarios are shown in **Table 27**.

The assessment uses 'realistic worst-case' scenarios to determine the impacts from the noisiest 15-minute period that are likely to occur for each work scenario, as required by the ICNG. The impacts represent construction noise levels without mitigation applied.

The sound power levels for the construction equipment used in each scenario are presented in **Appendix D.**

Table 27 Construction Equipment

Scenario	Works Activity	Equipment
W.01	Demolition	mobile crane, tracked excavator (20 t), elevated work platform, electric hand tools, excavator (10 t) with hydraulic hammer, generator, truck and dog, light vehicles
W.02	Vegetation clearing	Chainsaw, chipper, dozer, tracked excavator (20 t), front end loader (23 t), medium rigid truck, dump truck, water truck, bobcat (0.5t)
W.03	Earthworks	Tracked excavator (20 t), dozer, dump truck, excavator (10 t) with hydraulic hammer, front end loader (23 t), grader
W.04	Shoring works	Sheet piling rig (vibratory), tracked excavator (20 t), bobcat (0.5 t), medium rigid truck, vibratory roller (10 t), generator, mobile crane
W.05	Piling	Mobile crane, tracked excavator (20 t), elevated work platform, electric hand tools, piling rig (bored), concrete pump, concrete truck, medium rigid truck, light vehicles
W.06	Structure works	Tower crane, electric hand tools, concrete pump, concrete truck, generator, medium rigid truck, light vehicles
W.07	Fit-out	Electric hand tools, mobile crane, elevated working platform, medium rigid truck, light vehicles

5.1.2 Hours of Construction

Construction activities for the proposal would only be undertaken during the following hours:

- 7:00 am to 6:00 pm, Mondays to Fridays
- 8:00 am to 1:00 pm on Saturdays

- At no time on Sundays or Public Holidays.

5.2 Operational Noise Emission Assessment

The potential operational noise levels from the proposal have been predicted to the surrounding receivers using the ISO 9613-2 algorithm in SoundPLAN V8.1, implemented in accordance with ISO 17534.

ISO 9613-2 is an industry-standard algorithm that is considered suitable for use in the prediction of noise from industrial sources where intervening objects provide acoustic shielding, such as at the subject site and surrounding area.

The ISO 9613-2 algorithm predicts continuous A-weighted sound pressure levels under noise-enhancing meteorological conditions favourable to downwind propagation, or equivalently, propagation under a well-developed, moderate, ground-based temperature inversion, such as commonly occurs on clear calm nights.

Downwind propagation conditions include wind from source to receiver, with wind speeds of around 1 to 5 m/s, measured at a height of 3 to 11 m above the ground. These propagation conditions are considered consistent with the noise-enhancing weather conditions specified in *Fact Sheet D: Accounting for noise-enhancing weather conditions* of the NPfI.

ISO 9613-2 has been used extensively on industrial projects in Australia over several decades and has been accepted previously by NSW DPE (now DPHI) in numerous environmental noise assessments.

The noise model includes ground topography, ground type (ground absorption modelled at 0.5 in the residential area and 0.0 elsewhere), buildings and representative worst-case noise sources from the proposal.

The potential impacts have been determined by comparing the predicted worst-case noise levels to the NPfI PNTLs in a 15-minute assessment period.

5.2.1 Operational Noise Sources

The proposal is in the early design stages and assumptions have been made regarding the likely sources of noise. These assumptions have been used to develop representative worst-case noise modelling scenarios that reflect the expected highest noise emissions that the proposal would likely emit.

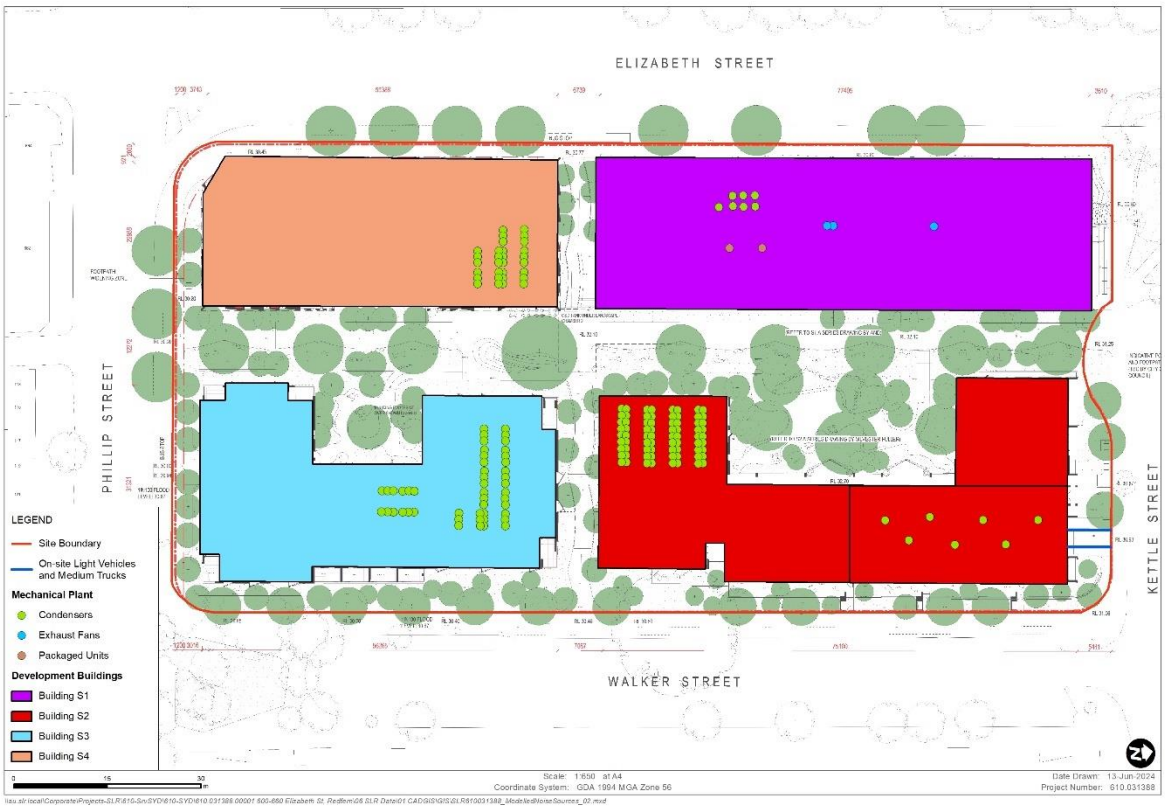
Light vehicle and medium rigid truck access to the basement car park level would be from Kettle Street. Heavy vehicles larger than medium rigid trucks are currently not expected to be required at the site.

The main sources of operational noise at the proposal are expected to include:

- Rooftop and other externally located items of mechanical plant
- On-site light and heavy vehicles accessing the basement carpark
- Noise breakout from internal community activities in Building S1
- Off-site vehicle movements.

A summary of the expected noise sources and representative worst-case assessment scenarios associated with the operation of the proposal is provided below. The location of the modelled noise sources is shown in **Figure 7**.

Figure 7 Modelled Noise Sources



On-Site Traffic

On-site vehicles have been modelled using the data provided by the project's traffic consultant in **Table 28**. The volumes are representative of the expected worst-case 15-minute period for the daytime, evening and night-time. The volumes conservatively assume that light and heavy vehicles access the site concurrently during the worst-case 15-minute assessment period. In reality, vehicle access would be unlikely to occur concurrently, particularly during the night-time.

Heavy vehicle deliveries would be limited to medium rigid trucks due to site constraints.

Table 28 Vehicle Traffic Data – Worst-case 15-Minute Period

Vehicle Type	Location	Sound Power Level (dBA)	Vehicle Speed (km/h)	Number of Vehicles in Worst-case 15-Minute Period[1]		
				Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 7am)
Medium trucks	Vehicle entry and hardstand	95[2]	20	1	1	1
Light vehicles	Vehicle entry and carpark	90[2]	20	5	5	5

Note 1: Total vehicles include both inbound and outbound vehicles. Volumes are rounded up to whole numbers for display purposes.

Note 2: Sound power level based on SLR measurement data.

Mechanical Plant

The main sources of externally located mechanical plant noise at the proposal would be the various rooftop plant areas located on each building.

The mechanical plant used in the assessment, together with corresponding sound power levels and number of units and locations, are detailed in **Table 29**.

Table 29 Mechanical Plant

Noise Source	Location	Sound Power Level (dBA) (Cumulative)	Operational Hours
Building S1			
AC Condensers	Roof	89	Assumed operational 24/7
Exhaust Fans		67	
Packaged Units		89	
Building S2			
AC Condensers	Roof	93	Assumed operational 24/7
	Level 10 terrace	88	
Building S3			
AC Condensers	Roof	84	Assumed operational 24/7
	Level 7 Terrace	77	
Building S4			
AC Condensers	Roof	81	Assumed operational 24/7

The exact requirements for all items of mechanical plant would be determined as the project progresses. Further noise modelling of all items of mechanical plant would be completed during the Detailed Design Stage when the selected mechanical plant and the number of units are defined.

Building S1 Noise Breakout

The main sources of operational noise due to community uses are from the various activity spaces of Building S1. The assumed sound power levels for these activities are listed in **Table 30** and the location of the various activity spaces are shown in **Figure 8, Figure 9** and **Figure 10**

Table 30 Building S1 Activities

Activity	Location	Sound Power Level (dBA)
Indoor Sports Court - Basketball	Ground Floor	94
Gymnastics/parkour	Level 1	88
Gymnasium/boxing	Level 2	98

Note: Sound power level is based on noise data for similar activities taken from “Architectural Acoustics” by M. David Egan (published 2007).

The activity spaces on all three levels of Building S1 have windows on the following elevations:

- Indoor Sports Court: East, West and South
- Gymnastics/parkour: East, West and North
- Gymnasium/boxing room: East, West and South

For the break-out assessment, it was assumed that all internal surfaces of the activity spaces are hard and reflective. The dimensions of the spaces are as per the architectural drawings issued for the SSDA.

Figure 8 Building S1 Activities – Indoor Sports Court (Ground Floor)

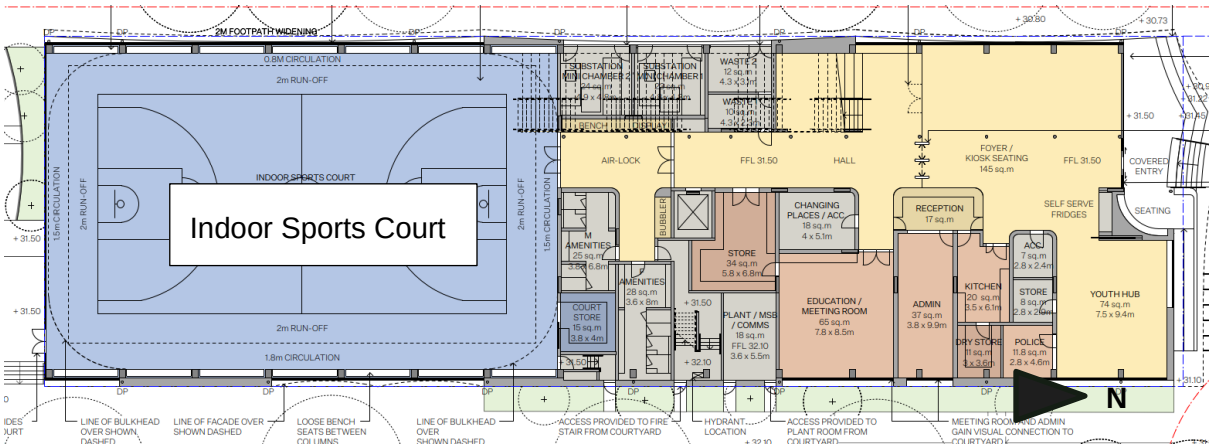


Figure 9 Building S1 Activities – Gymnastics/Parkour (Level 1)

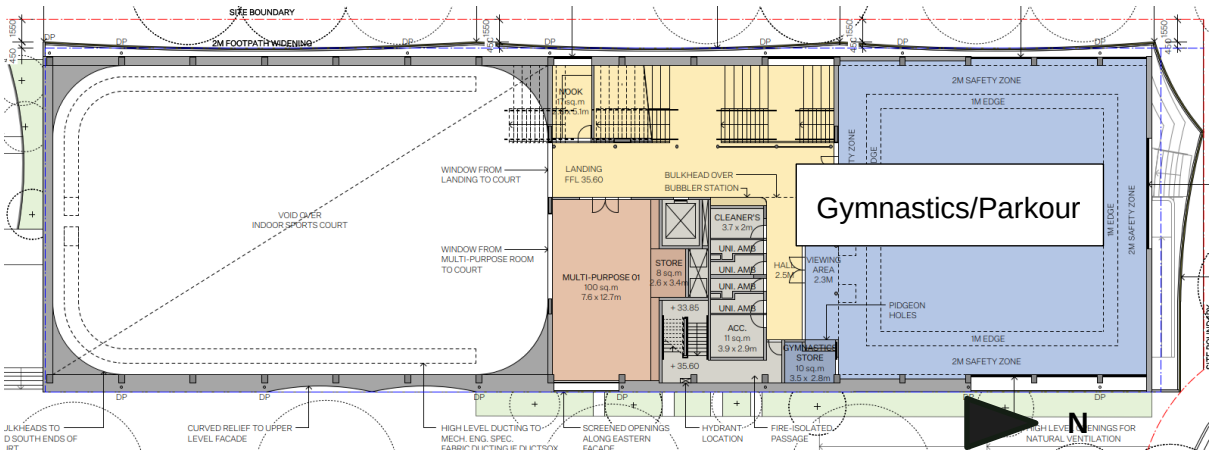
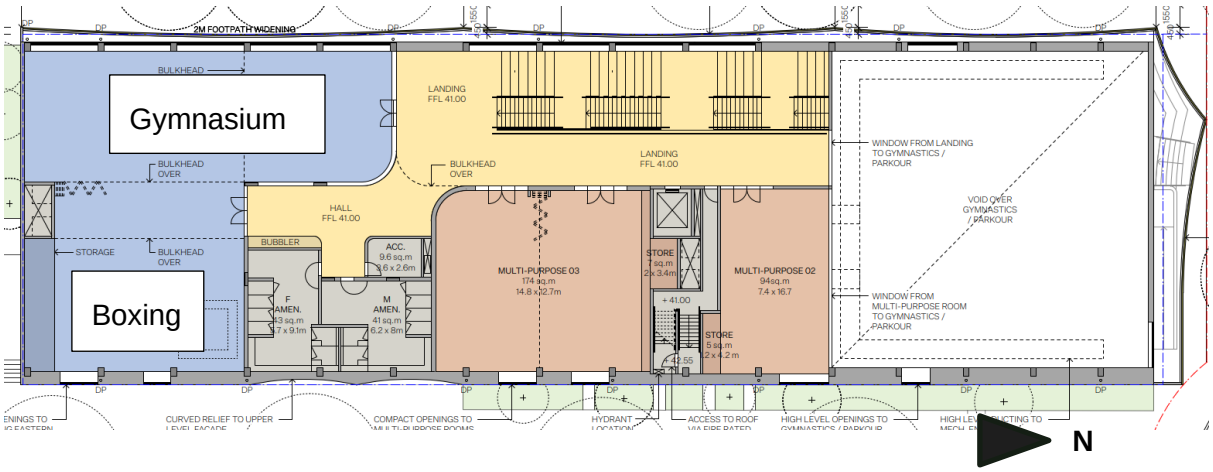


Figure 10 Building S1 Activities – Gymnasium/Boxing (Level 2)



5.2.2 Operational Scenarios

Representative scenarios have been developed to assess the likely impacts from the operation of the proposal. These scenarios are shown in **Table 31**.

Table 31 Operational Assessment Scenarios

Scenario	Name	Description
OP.01	Industrial Noise Emission	• All mechanical plant operating at full capacity. • Vehicles accessing the basement car park • Assessed during daytime, evening and night-time periods.
OP.02	Community/Patron Noise Emission	• Noise breakout from sports hall, gymnasium, boxing room. • Assessed during daytime, evening and night-time periods.

5.2.3 Corrections for Annoying Noise Characteristics

The potential annoying noise characteristics and modifying factor corrections relevant to the proposal are:

- **Tonality** – The likely vehicles to use reversing alarms are service vehicles (assumed to be medium trucks). These vehicles are expected to occasionally access the site carpark, however, they are not expected to reverse externally within the site. Hence it is unlikely that this noise source would result in tonal noise impacts at the receivers and no corrections have been applied.
- **Low frequency noise** – noise levels from development-related mechanical plant are not expected to result in low frequency noise impacts at residential receivers and no corrections have been applied.
- **Intermittent noise** – the NPfI defines intermittent noise as noise heard at the receiver where the level suddenly drops or increases several times during the assessment period, with a noticeable change of at least 5 dB. The intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have mechanical plant or vehicle movements at occurring night, including audible reversing alarms. Hence, the various operational noise sources are nor likely

to result in intermittent noise impacts at the receivers and no corrections have been applied.

5.2.4 Noise Sources with Potential for Sleep Disturbance

As the development is proposed to operate 24-hours a day, noise emissions during the night-time require assessment for potential sleep disturbance at the nearest residential receivers. The details of typical activities with the potential to cause sleep disturbance are shown in **Table 32**.

These sources have been modelled at the carpark access ramp (see **Figure 7**).

Table 32 Sleep Disturbance Noise Events – L_{Amax} Sound Power Levels

Noise Source	Sound Power Level L_{Amax} (dBA)
Medium truck movements	100
Light vehicle movements	100

5.2.5 Off-site Road Traffic

Development vehicles would travel down Walker Street and access the site via the carpark entrance on Kettle Street. Traffic surveys conducted by Trans Traffic Survey indicate that the surrounding road network has high existing traffic volumes. Given that the development has 66 basement car parking spaces, it is not likely to generate a significant number of vehicle movements and the impact on the broader road network is expected to be minimal, hence potential noise impacts from development-related traffic on public roads are expected to be negligible. As such, no further assessment of off-site traffic noise is required.

5.2.6 Weather Conditions

Fact Sheet D of the NPfI requires noise assessments to consider the potential effects of noise-enhancing weather conditions, such as wind from the source to the receiver and/or temperature inversions.

The nearest sensitive receivers are within 200 m of the proposal site and the effects of weather on noise levels are expected to be minimal. Notwithstanding, the noise prediction modelling uses ISO 9613-2 algorithms which include noise-enhancing weather conditions including downwind propagation, or equivalently, propagation under a well-developed moderate ground-based temperature inversion.

As such, the assessment has conservatively applied noise-enhancing weather conditions for all periods as per Option 1 of Fact Sheet D of the NPfI.

5.3 Facade Noise Intrusion

A noise model has been used to predict road traffic noise impacts to future residential receivers within the development. Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the proposed development and surrounding areas.

Indicative heights of buildings in the development were taken from the architectural drawings provided.

The major roads surrounding the project site (Elizabeth Street and Phillip Street) have been modelled using SoundPLAN 8.1 and validated to the measured L_{Aeq} noise levels during the ambient noise surveys.

For each of the proposed buildings, single point receivers were positioned at the facades of the development buildings. The receivers were located at each discrete floor height to predict the potential impact of road traffic noise levels at different facade heights.

A correction calculated in the noise model was included in the predicted receiver levels to account for facade reflections.

The model has been used to predict the noise levels across the site from these sources and allows for a detailed analysis of the noise impacts.

6.0 Assessment of Impacts

6.1 Construction Noise

The predicted noise levels at the most-affected sensitive receivers surrounding the site are shown in **Table 33** and exceedances of the NMLs are shown in **Table 34**.

The predictions represent a realistic worst-case scenario where the equipment in each scenario is working concurrently and the nearest location to each receiver. It is expected that noise levels would frequently be lower than the worst-case levels presented.

Table 33 Predicted Construction Noise Levels – Standard Daytime Construction Hours

Receiver Area	NML	Predicted Noise Level – $L_{Aeq(15minute)}$ (dBA)						
		W.01 – Demolition	W.02 – Vegetation Clearing	W.03 – Excavation	W.04 – Shoring Works	W.05 – Piling	W.06 – Structure Works	W.07 - Fitout
North and East Residential	58	91	90	92	90	88	84	87
South Residential	63	89	88	90	88	86	82	85

Table 34 Predicted Exceedance at Nearest Receivers – Standard Daytime Construction Hours

Receiver Area	NML	Predicted Exceedance (dB)						
		W.01 – Demolition	W.02 – Vegetation Clearing	W.03 – Excavation	W.04 – Shoring Works	W.05 – Piling	W.06 – Structure Works	W.07 - Fitout
North and East Residential	58	33	32	34	32	30	26	29
South Residential	63	26	25	27	25	23	19	22
Legend (NML exceedances)		= Minor to marginal (1 to 10 dB)		= Moderate (11 to 20 dB)		= High (>20 dB)		

The above worst-case predictions show the following:

- Construction noise levels are predicted to exceed the NMLs at all the adjacent residential receivers during the assessed work scenarios. This is due to the proximity of these receivers to the site.
- High exceedances of up to 33 dB are predicted in the North and East Residential Area and moderate exceedances of up to 26 dB in the South Residential Area.
- The worst-case exceedances in both residential areas are predicted during Demolition (W.01) when excavators with hydraulic hammers are in use, Vegetation Clearing (W.02) when mulchers and bulldozers are in use, Excavation (W.03) when excavators with hydraulic hammers are in use and Shoring works (W.04) when a vibratory sheet piling rig is in use.
- The receivers adjacent to the site in both residential areas are predicted to be Highly Noise Affected (ie. Noise predictions are >75 dBA) during all construction works.
- As per the ICNG, for receivers where construction noise levels exceed 75 dBA, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account:
    - Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences
    - If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

It is noted that works would only occur during Standard Daytime Construction Hours. There is no expectation that evening or night-time work would be required.

The presented impacts would only be expected to occur when noisy work is being completed close to the site boundaries, relative to each receiver. When work is further from the receiver, or when less noise-intensive equipment is being used, the noise levels and potential impacts would be lower.

Feasible and reasonable construction noise mitigation measures should be applied where exceedances of the NMLs are predicted. Construction noise mitigation and management measures are discussed in **Section 8.1**.

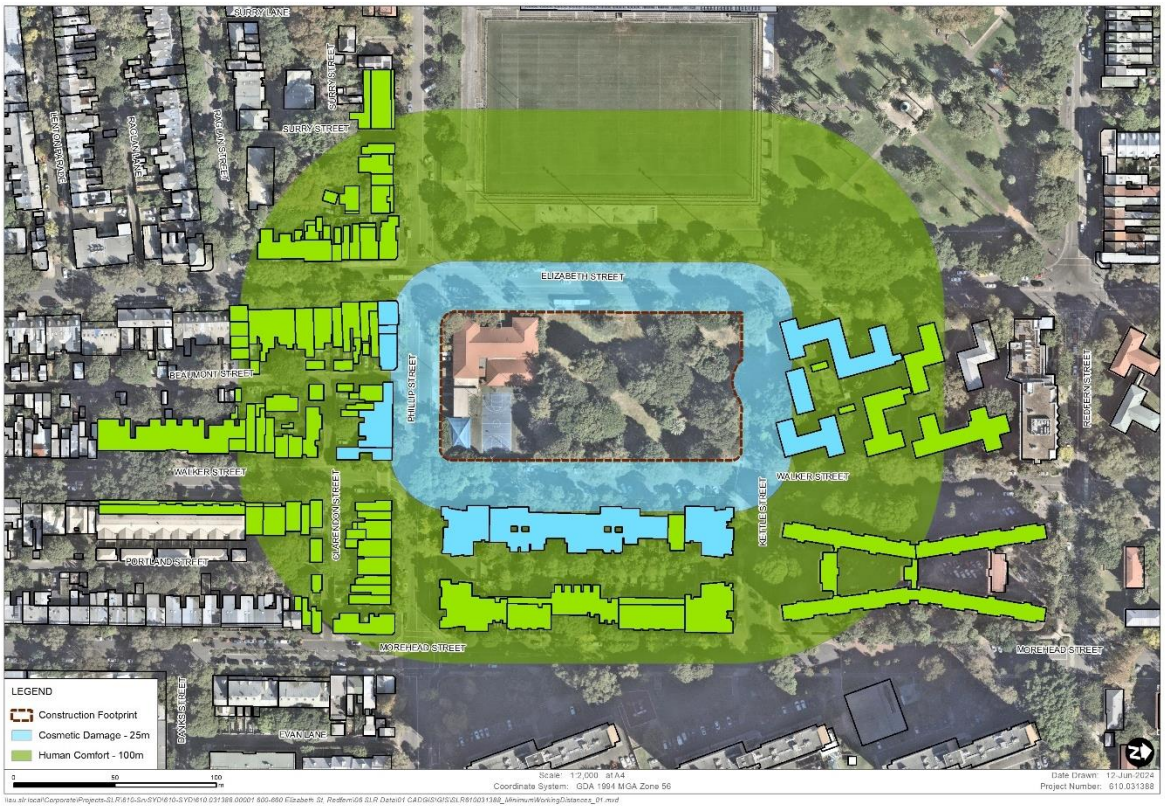
6.2 Construction Vibration

The major potential sources of vibration from the proposed construction activities would likely be during:

- ‘Demolition’ when rockbreakers are being used.
- ‘Earthworks’ when vibratory rollers are being used
- ‘Shoring’ when vibratory pile drivers are being used
- ‘Piling’ when bored piling rigs are being used

Vibration offset distances have been determined from the CNVG minimum working distances for cosmetic damage and human comfort (see **Table 14**) and the assessment is summarised in **Figure 11** for the potential worst-case scenario, which is during the use of a large vibratory roller (>18 tonnes). Buildings within the minimum working distance buffers are highlighted in the figure.

Figure 11 Construction Vibration – Large Vibratory Roller



Cosmetic Damage Assessment

The above figure shows that the neighbouring residential buildings to the north, east and south are likely to be within the minimum working distance for cosmetic damage when vibratory rollers are in use at the northern, eastern and southern boundaries of the construction site.

Human Comfort Vibration Assessment

The above figures indicate that several of the nearest residential receivers surrounding the site are within the human comfort minimum working distance and occupants of these buildings may be able to perceive vibration impacts at times when vibratory rollers or rockbreakers are in use nearby. Where impacts are perceptible, they would likely only be apparent for relatively short durations when vibration-intensive equipment is in use.

Feasible and reasonable construction vibration mitigation measures should be applied where vibration-intensive works are required within the minimum working distances. Construction mitigation and management measures are discussed further in **Section 8.1**.

6.3 Operational Noise

6.3.1 Predicted Noise Levels – Operational Scenario OP.01

Operational noise impacts from industrial noise emissions (eg. mechanical plant and on-site vehicles) on the off-site receivers have been assessed against the NPfI. The noise impact from these sources on the on-site receivers has been assessed against the internal noise criteria presented in **Section 4.4** and **Section 4.5**.

Feasible and reasonable mitigation measures have been investigated for the development with the aim of reducing noise levels to the PNTLs (off-site receivers) and the internal noise criteria for the on-site receivers. A detailed investigation of all potential feasible and reasonable mitigation measures is provided in **Section 8.2**.

In summary, the following key measures have been applied to reduce noise emissions from the mechanical plant:

- Building S1
  - 3.3 m noise barrier around the rooftop plant area containing the Packaged Units. The base of the barrier is at RL 44.2.
  - 3.3m noise barrier to the east and a 2.3m noise barrier to the west of the rooftop plant area containing the Condensers. The base of the barrier is at RL 44.2.
- Building S2
  - 1.2 m noise barrier around the condensers on the Level 10 Terrace
  - Awnings over the rows of condensers on the Level 10 Terrace.
  - Lining the underside of the awnings with acoustic absorption with a minimum NRC of 0.8.
- Building S3 and S4
  - 1.5 m noise barrier around all plant areas.

The predictions are shown in **Table 35** and **Table 36** and they include the recommended mitigation measures.

Table 35 Operational Noise Assessment – Off-Site Receivers

Receiver Area	Period	Noise Level $L_{Aeq\ (15\ minute)}$ (dBA)			Compliance
		Noise Criteria	Predicted[1]	Exceedance	
North and East Residential	Day	53	39	-	Yes
	Evening	48		-	Yes
	Night	43		-	Yes
South Residential	Day	58	36	-	Yes
	Evening	49		-	Yes
	Night	43		-	Yes

Note 1: The predicted noise levels are for the 'worst-case' impacted receiver for a given area. This includes predictions to receivers on upper floors of multi-storey buildings.

Table 36 Operational Noise Assessment – On-Site Receivers

Building	Usage	Period	Noise Level $L_{Aeq\ (15\ minute)}$ (dBA)			Compliance
			Noise Criteria	Predicted[2]	Exceedance	
Building S1	Non-Residential	When in use	50[1]	49	-	Yes
Building S2	Residential	Night	55[1]	51	-	Yes
Building S3		Night	55[1]	50	-	Yes
Building S4		Night	55[1]	46	-	Yes

Note 1: The noise predictions are at external receiver points. As the noise criteria (see **Section 4.4** and **Section 4.5**) for the on-site buildings in an internal target, 10 dB has been added to derive the corresponding external criteria to account for reduction achieved due to open windows.

Note 2: The predicted noise levels are for the 'worst-case' impacted receiver for a given building. This includes predictions to receivers on upper floors of multi-storey buildings.

The above assessment indicates that the mitigated noise levels are expected to comply with the relevant noise criteria for the off-site and on-site receivers.

It is noted that the details of the mechanical plant used in this assessment are indicative, including the unit types, sound power levels, number of units and locations of equipment. All mechanical plant items should be reviewed during later acoustic assessments during the detailed design stage of the project to confirm compliance with the noise criteria. It is expected that compliance is achievable through a combination of appropriate mechanical plant selection, noise barriers and acoustic louvres where appropriate.

Noise contours of the predicted worst-case operational noise impacts with mitigation are in **Appendix D**.

6.3.2 Predicted Noise Levels – Operational Scenario OP.02

Operational noise impacts from community/patron noise emissions from Building S1 on the off-site and on-site receivers have been assessed against noise criteria presented in **Section 4.3.2**.

The predictions are shown in **Table 35** and **Table 36** and they include the recommended mitigation measures.

Table 37 Operational Noise Assessment – Off-Site Receivers

Receiver Area	Period	Predicted Noise Level $L_{Aeq\ (15\ minute)}$ (dBA)			Exceedance (dB)	
		Noise Criteria	Windows Open[1]	Windows Closed (East, South, West)[1]	Windows Open	Windows Closed (East, South, West)
North and East Residential (Off-site)	Day	53	39	36	-	-
	Evening	51			-	-
	Night	46			-	-

Receiver Area	Period	Predicted Noise Level $L_{Aeq\ (15\ minute)}$ (dBA)			Exceedance (dB)	
		Noise Criteria	Windows Open[1]	Windows Closed (East, South, West)[1]	Windows Open	Windows Closed (East, South, West)
North and East Residential (On-site)	Day	53	52	42	-	-
	Evening	51			-	-
	Night	46			**6**	-
South Residential (Off-site)	Day	58	40	31	-	-
	Evening	52			-	-
	Night	43			-	-

Note 1: The predicted noise levels are for the 'worst-case' impacted receiver for a given area.

Note 2: Predicted exceedances are shown in **red**.

The above assessment shows the following:

- Break-out noise from Building S1, when all windows are open, complies with the noise criteria during the day and evening periods.
- Exceedances of up to 6 dB during the night-time are predicted at the on-site buildings. These exceedances are generally at the west-facing facades of Building S2 and the north-facing facades of Building S4.
- In order for break-out noise to comply with the nominated noise criteria at night, the east, south and west-facing windows of S1 would need to remain closed between 10 pm and 7 am.

6.3.3 Sleep Disturbance – Off-Site receivers

The predicted night-time maximum noise levels at the nearest residential receivers are shown in **Table 38**. These include the mitigation measures specified in **Section 8.2**.

The predictions include noise-enhancing weather conditions as discussed in **Section 5.2.6**.

Table 38 Sleep Disturbance Assessment

Receiver Area	Source	Maximum Noise Level L_{Amax} (dBA)			Below Screening Level
		Sleep Dist. Screening Level	Predicted	Exceedance	
North and East Residential	Medium Truck movements	56	67	11	**No**
	Light vehicle movements		67	11	**No**
South Residential	Medium Truck movements	53	44	-	Yes
	Light vehicle movements		44	-	Yes

The above assessment indicates the following:

- Maximum noise levels from light vehicles and medium trucks are predicted to comply with the sleep disturbance screening level at the nearest residential receivers to the south.
- Maximum noise levels at most affect receivers in the North and East Residential Area are expected to exceed the sleep disturbance screening level for both sources by up to 11 dB. This results from the close proximity of these receivers to the carpark access ramp.

The NPfI requires a detailed maximum noise level assessment to be completed where night-time noise levels exceed the screening level.

6.3.3.1 Detailed Maximum Noise Level Assessment

The detailed maximum noise level assessment is summarised in **Table 39**

Table 39 Detailed Maximum Noise Level Assessment – Residential Receivers

Receiver	Maximum Noise Level L_{Amax} (dBA)					Comments
	Sleep Disturbance Goals (dBA)		Development Related Maximum Noise Events		Existing Maximum Noise Levels	
	Awakening Response[1]	Good Sleep[2]	Predicted	Frequency of Occurrence		
North and South Residential	65	Around 55 (10 to 15 times per night)	67	Infrequent	55 – 75 (L02)	The maximum noise levels from on-site vehicle movements are predicted to be above the 'awakening response' and good sleep' levels. Vehicles would access the development via Kettle Street and Walker Street. While the expected on-site night-time vehicle movements are not known, it is expected that the development carpark will be used mostly by light vehicles. The unattended noise monitoring conducted at L02 (near Walker Street) showed that night-time maximum noise levels at this location were frequently measured to be in the order of 55 to 75 dBA. Attended measurements at this location indicated that the noise environment is typically dominated by vehicle movements on surrounding roads. The development-related maximum noise levels at the

Receiver	Maximum Noise Level L_{Amax} (dBA)					Comments
	Sleep Disturbance Goals (dBA)		Development Related Maximum Noise Events		Existing Maximum Noise Levels	
	Awakening Response[1]	Good Sleep[2]	Predicted	Frequency of Occurrence		
						nearest residences are expected to be comparable to the existing maximum noise levels. Additionally, vehicles are the existing dominant noise source at the nearest residences. Hence, sleep disturbance impacts from development-related vehicles would be considered to be unlikely.

Note 1: Based on RNP guidance that maximum internal noise levels below 50 dBA to 55 dBA are unlikely to awaken people from sleep. This equates to an external noise level of 65 dBA when assuming a 10 dB loss for partially open windows for ventilation.

Note 2: Based on RNP guidance that for a good sleep over eight hours the indoor LAmax sound pressure level should not exceed around 45 dBA more than 10 or 15 times per night. This equates to an external noise level of around 55 dBA when assuming a 10 dB loss for partially open windows for ventilation.

The maximum noise levels from vehicle movements into the underground carpark are predicted to exceed the 'awakening response' and 'good sleep' levels at the nearest residential receivers to the north and east. However, development-related maximum noise levels at the nearest residences are expected to be comparable to the existing maximum noise levels. Additionally, vehicles are the existing dominant noise source at the nearest residences. Hence, the predicted sleep disturbance exceedances are considered relatively low significance and do not warrant any specific mitigation measures.

6.3.4 Sleep Disturbance – On-Site receivers

Potential maximum noise level impacts at the on-site residential buildings are likely to be due to patron activity noise breakout from Building S1 that may occur during the night-time period (i.e. before 07.00am and after 10.00pm). However, it is expected that with the eastern, southern and western windows closed and suitable operational noise management measures in place, sleep disturbance impacts from these activities on the on-site residences would be mitigated.

6.4 Facade Noise Ingress

Proposed facade noise mitigation based on the modelled noise levels are indicated on the layout plans included in **Appendix E**. Predicted noise levels for each floor of the buildings are included in **Appendix F** (daytime) and **Appendix G** (night-time).

6.4.1 Facade Glazing

To determine the necessary acoustic rating of individual glazing elements on the facade, modelling of the internal spaces has been conducted. The acoustic rating of façade elements is expressed as a Weighted Sound Reduction Index (Rw). Calculations take into consideration room volume, room use and furnishings, the area of each facade element, and the orientation of the facade with respect to noise from the road.

The following performance ratings and proposed typical glazing constructions are recommended for the development. Glazing requirements are stipulated in **Table 40** below.

Table 40 Facade Recommendations

Building	Facade	Occupancy Type	Minimum Sound Insulation Performance, Rw	Example glazing to achieve the recommended rating	Ventilation Requirement [1]
S1	All	Community Use - Sports	34	10.38mm laminated	Mechanical
S2	All	Residential	32	6mm float	Natural [1]
S3	South	Residential	36	10.38mm laminated	Natural [1]
S3	North, West, East	Residential	32	6mm float	Natural [1]
S4	All	Commercial	34	10.38mm laminated	Mechanical
S4	North, West, South	Residential	36	12.76mm laminated	Natural [1]
S4	East	Residential	32	6mm float	Natural [1]

Note 1: Natural ventilation requirements are outlined in **Section 6.4.2** below.

It is expected that the required R_W ratings of windows and doors would be achieved using conventional proprietary systems. There are numerous manufacturers/suppliers of window or door systems that produce proprietary systems capable of achieving the nominated Rw ratings.

The supplier/manufacturer would be responsible for providing test data or similar confirming satisfactory performance of window/glazing systems, including alternatives to those in **Table 40**.

6.4.2 Ventilation Requirements

Table 40 includes natural ventilation requirements for residential spaces which are discussed further below. Commercial and community spaces are to be mechanically ventilated.

The following natural ventilation strategy has been applied as indicated in **Appendix E**:

- All the external windows/doors on facades coloured red or yellow are assumed to be fully closed in order to achieve the internal noise level requirements for that space.

- Acoustically treated natural ventilation plenums are provided to supply fresh air and service the spaces where cross ventilation cannot achieve the ventilation requirement (indicated in red).
- Facades coloured in yellow are habitable spaces that can be naturally ventilated from alternative facades which are more distant and/or shielded from the road traffic noise on Elizabeth Street and Phillip Street (refer Hayball '*ADG Compliance (X Vent + Solar*) drawings S3.A40.20 and S4.A40.20).
- Windows are assumed openable on other facades (coloured green) to enhance natural ventilation.

6.4.3 Acoustic Ventilation Plenums

Acoustic and ventilation modelling calculations have been conducted to design the attenuated ventilation required for the Elizabeth Street and Phillip Street façades, in order to achieve the requirements of the Design Guide (refer **Section 4.4.1)**.

The natural ventilation assessment is detailed further in Windtech Consultants report 'WE086-08F01(rev0)- NV Letter' dated 24 June 2024 (included in **Appendix J**).

The required minimum transmission loss of the open plenums located on Elizabeth Street and Phillip Street facade is shown in **Table 41**.

Table 41 Transmission loss required for acoustic plenums – Elizabeth Street and Phillip Street Facade

	Transmission Loss (dB) @ Octave Band Centre Frequency, Hz							
	63	125	250	500	1k	2k	4k	8k
Bedroom Plenum	9	10	18	30	30	21	18	17

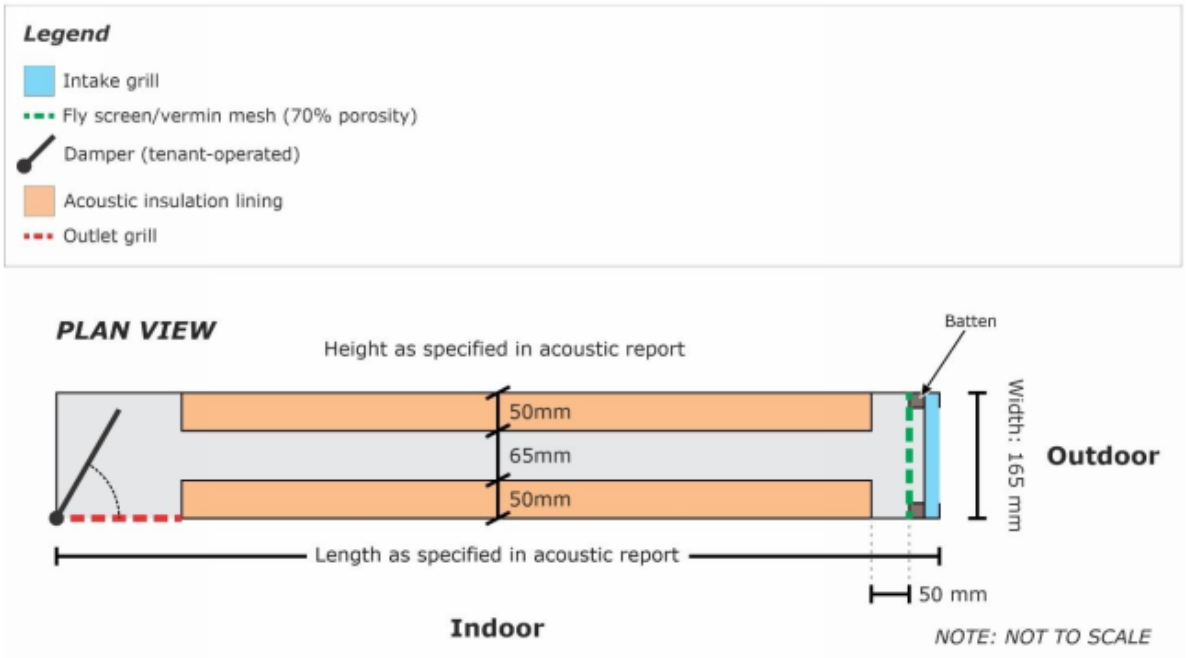
To achieve the acoustic attenuation requirements the acoustic plenums are to be installed in accordance with the architectural drawings, with the minimum dimensions specified in **Table 42**.

Table 42 Natural Ventilation Vertical Plenum Design for Elizabeth Street and Phillip Street Facade

Room Type	External Plenum Dimensions	Attenuation Path Length	Louvre Opening
Bedroom (Straight Louvre)	2.0m (H) by 0.165m (W) internal (open area 0.4m^2), lined with 50mm acoustic insulation to top and bottom as shown in **Figure 12**	2.3m total plenum length, inlet and outlet configured as shown in **Figure 12**	50% open area weatherproof louvre
Bedroom (Louvre with 90 degree bend)	2.0m (H) by 0.165m (W) internal (open area 0.4m^2), lined with 50mm acoustic insulation to top and bottom as shown in **Figure 12**	1.6m minimum plenum length plus one acoustically lined 90 degree bend.	50% open area weatherproof louvre

The proposed vertical plenum arrangement (refer **Appendix J**) is included in **Figure 12**.

Figure 12 Ventilation Arrangement – Vertical Plenum



Community spaces in Building S1 are to be mechanically ventilated to permit windows to remain closed to mitigate noise breakout when required. Further information on the noise breakout assessment is included in **Section 6.3.2**.

7.0 Cumulative Impacts

The NSW Government *Cumulative Impact Assessment Guidelines for State Significant Projects* requires that the potential combined effect of cumulative impacts on all nearby industrial developments be considered when assessing potential noise impacts from state-significant projects.

Cumulative impacts can be caused by the compounding effects of multiple projects in an area, and by the accumulation of effects from past, current and future activities as they arise.

7.1 Construction Noise

Cumulative construction noise impacts can occur where multiple work activities are being completed near a particular receiver at the same time. Construction works have been identified for a development at 207-229 Young Street and 881-885 and 887-893 Bourke Street, Waterloo (D/2020/45) that may coincide with works associated with the proposal. This site is located approximately 250 m from the proposal and 150 m from the nearest sensitive receiver impacted by the proposal. Hence, there is potential for cumulative construction impacts from multiple construction activities being completed in different areas of the proposal.

Where concurrent construction work is being completed near a particular area, the worst-case noise levels could theoretically increase by around 3 dB (i.e. a logarithmic adding of two sources of noise at the same level). The likelihood of worst-case noise levels being generated by two different work activities at the same time is, however, considered low and rather than increase construction noise levels, the impact of concurrent construction work would generally be limited to a potential increase in the duration, and annoyance, of noise impacts on the affected receivers.

In practice, construction noise levels in any one location would vary and would frequently be much lower than the worst-case scenario assessed due to construction staging moving work around within the study area and, in many cases, only a few items of equipment being used at any one time.

The use of the various construction sites by overlapping or successive contractors may also result in consecutive impacts (i.e. ‘construction fatigue’) at the surrounding receivers due to construction work being in the area for an extended period.

Mitigation measures aimed at short-term construction work may be less effective where receivers are affected by longer-duration impacts from several projects, especially where extensive night-time work is required. Where receivers are affected by ‘construction fatigue’, it may be necessary to consider specific mitigation and management measures to minimise the impacts.

The potential cumulative impacts from the proposal and other projects would continue to be considered as the project progresses when detailed construction planning is developed.

7.2 Operational Noise

The *Noise Policy for Industry* states that it aims to limit continuing increases in cumulative industrial noise through the application of amenity noise levels, which are applicable to all industrial noise sources in an area.

The policy accounts for potential cumulative impacts by lowering the criteria for each individual development to ensure that the ambient noise level within an area from all industrial noise sources combined remains below the recommended amenity noise levels, where feasible and reasonable. As such (as discussed in **Section 4.3.3**), the potential cumulative impacts from the proposal and other potential sources of industrial noise in the area are accounted for in the proposal-specific PNTLs and, therefore, do not require further consideration.

8.0 Mitigation and Management Measures

8.1 Construction Impacts

The impacts during the construction of the proposal are predicted to be consistent with major construction work near sensitive receivers. No works outside of Standard Construction Hours are currently proposed.

The use of standard mitigation measures to minimise the impacts is considered sufficient to control the majority of the impacts. Examples of measures that could be applied to the work are provided in the Transport for NSW *Construction Noise and Vibration Guideline* (see **Appendix H**).

A Construction Noise and Vibration Management Plan (CNVMP) would be prepared before any work begins. This would identify all potentially impacted receivers, assess the potential noise and vibration impacts from the proposal and provide details regarding how the impacts would be minimised through the use of all feasible and reasonable mitigation measures. The CNVMP would also contain procedures for handling complaints, should they occur, and detail any compliance monitoring requirements.

8.2 Operational Noise Impacts

Where operational noise impacts from the development are predicted to exceed the relevant noise criteria, feasible and reasonable operational noise mitigation and management measures should be considered, with the aim of reducing noise emissions to the relevant criteria.

The typical hierarchy for mitigation and management of industrial noise sources is as follows:

- Reducing noise emissions at the source (ie noise source control)
- Reducing noise in transmission to the receiver (ie noise path control)
- Reducing noise at the receiver (ie at-receiver control).

A detailed assessment of potential feasible and reasonable mitigation measures that can be applied to the development to minimise the operational noise impacts has been completed and is summarised in **Table 43**.

The measures should be regarded as indicative and would be further refined during detailed design when more details regarding specific tenants are known.

Table 43 Operational Noise Mitigation Options

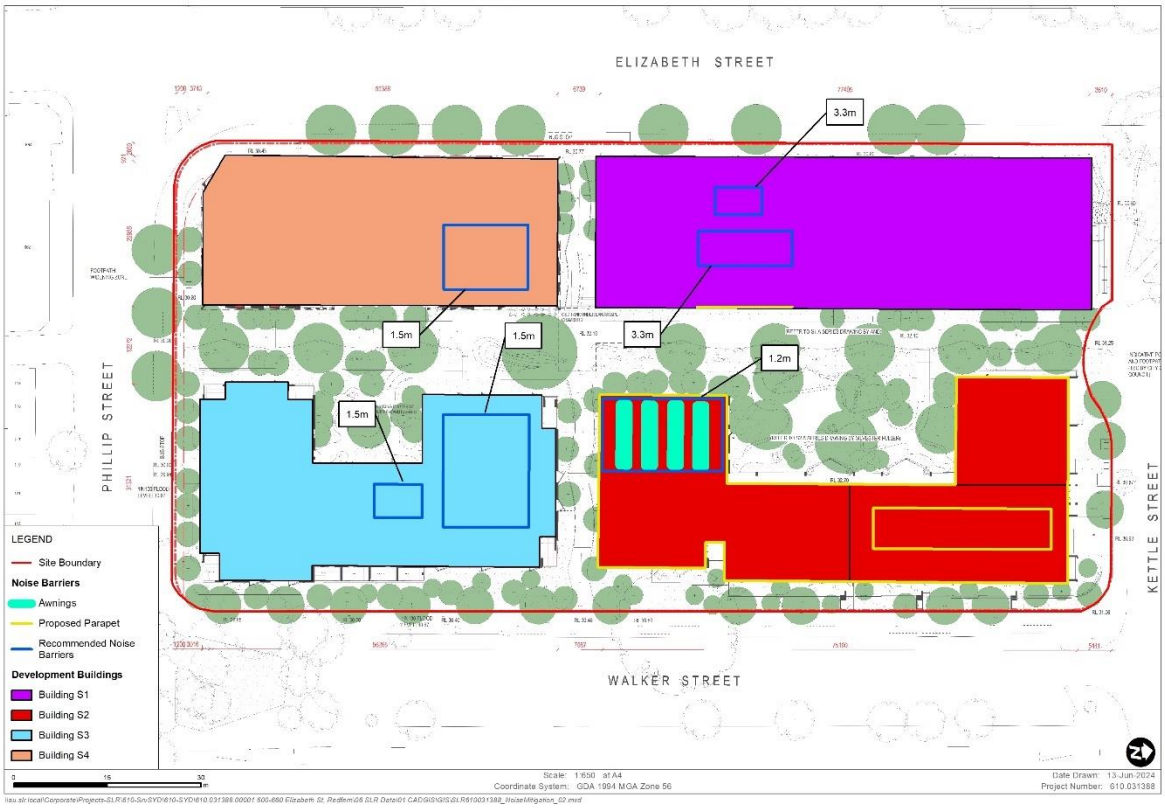
Ref.	Mitigation Option	Noise Impact/Benefit	Feasible and Reasonable to Apply
Source Control			
S1	Optimised site layout to minimise noise emissions from the site	Where possible, the site layout has been designed so that the buildings screen the noisier areas of the development from the nearest receivers.	Yes – applied during design of the concept.
S2	Use broadband and/or ambient sensing alarms on heavy vehicles where they are required to reverse during the night-time.	Reduce potential for annoying noise emissions during the night-time.	No – The likely vehicles to use reversing alarms are service vehicles (assumed to be medium trucks). Although medium trucks are expected to occasionally access the development carpark, they are not expected to reverse externally within the development and are not likely to result in tonal noise impacts.
S3	Appropriate specification and location of mechanical plant during detailed design.	Potential noise impacts from mechanical plant have been identified based on the indicative unit selections presented by the project team. The following mitigation measures have been used in the assessment: -A majority of the mechanical plant for all of the development buildings would be located on the roofs or terraces. -The 'maximum' cumulative sound power levels of the roof-top mechanical plant have been determined to achieve compliance.	Yes – the specified mitigation measures are required to minimise noise impacts from mechanical plant. Locating majority of the development's mechanical plant on the roofs of the buildings would increase separation from the on-site and off-site buildings. Additionally, the roofs and terraces of the building provide additional shielding. Together, these factors help reduce noise impacts. The noise impacts from all items of mechanical plant would be investigated further during the detailed design stage to confirm mitigation requirements.
S4	Production of an Operational Noise Management Plan for Building S1.	This would detail the measures that could be used by the various patrons to minimise general noise emissions from the site. Reference can be made to the Best Management Practice (BMP) measures listed in the NPfI (see **Appendix E**). This plan would specify the time of day that the east, south and west-facing windows of	Yes – the ONMP would detail any operational requirements for the development.

Ref.	Mitigation Option	Noise Impact/Benefit	Feasible and Reasonable to Apply
		Building S1 would need to remain closed.	
Path Control			
P1	Noise Barriers	Construction of noise barriers (see **Figure 13**) is required around the rooftop plant areas to mitigate noise impacts on the residences within the development: The following mitigation measures have been used in the assessment: <u>Building S1:</u> - 3.3 m noise barrier around the rooftop plant area containing the Packaged Units. The base of the barrier is at RL 44.2. - 3.3m noise barrier to the east and a 2.3m noise barrier to the west of the rooftop plant area containing the Condensers. The base of the barrier is at RL 44.2. <u>Building S2:</u> -1.2 m noise barrier around the condensers on the Level 10 Terrace. -Awnings over the rows of condensers on the Level 10 Terrace. -Lining the underside of the awnings with acoustic absorption with a minimum NRC of 0.8. <u>Building S3 and S4:</u> -1.5 m noise barrier around all plant areas. In addition to these, the designs indicate that Building S2 includes a 1 m parapet around the plant area of the Level 10 terrace.	Yes – the specified mitigation measures are required to minimise noise impacts from mechanical plant. The requirements for this would be confirmed during the detailed design stage of the project.
Receiver Control			
R1	Not considered required	n/a	n/a

Exact details relating to operational noise sources within the site is not known at this time and several assumptions have been made regarding the likely future uses and sources of

noise. The noise predictions in this report should be regarded as indicative for planning purposes and are required to be confirmed at a later stage when detailed information is available.

Figure 13 Location of Noise Barriers



9.0 Conclusion

SLR has been engaged to assess the potential construction and operational noise emissions and external noise intrusion for the proposed development at Redfern Place, 600-660 Elizabeth Street, Redfern. The proposal includes a mixed-use development including residential, commercial and community uses.

The potential impacts from the proposal have been assessed against the Secretary's Environmental Assessment Requirements relating to noise and vibration.

Construction noise levels are expected to exceed the management levels, and moderate to high noise impacts are predicted at a the nearest sensitive receivers during most of the construction scenarios particularly when noise-intensive items of equipment, such as rock breakers, bulldozers, chainsaws, mulchers, vibratory sheet and bored piling rigs are in use. Cosmetic damage and human comfort vibration impacts can be expected at the nearest receivers when vibratory rollers, rockbreakers and vibratory pile drivers are in use. Mitigation measures have been recommended to address the potential construction impacts.

The operational noise assessment indicates that feasible and reasonable mitigation measures are likely required to control the impacts from the development. The recommended measures include a 1.2 m noise barrier around the plant located on the Level 10 terrace of S2 along with awnings with absorptive treatment above these units, additional 1.5 m noise walls around the roof-top and terrace plant areas of S1, S3 and S4 and closing the east, south and west facing windows of Building S1 during the night-time. With the inclusion of the proposed mitigation, operational noise levels are expected to comply with the trigger levels at the nearest receivers. The potential operational impacts and requirements for mitigation would be confirmed during further acoustic assessments completed during detailed design when tenant requirements are known.

Appendix A Acoustic Terminolgy

Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

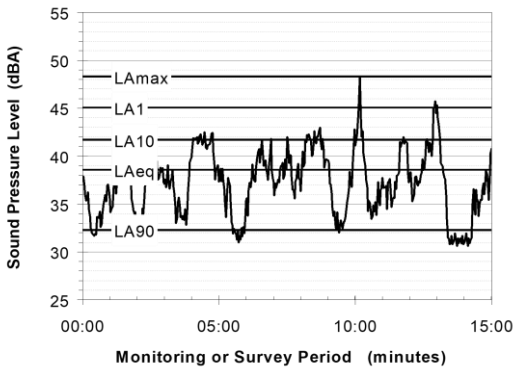
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

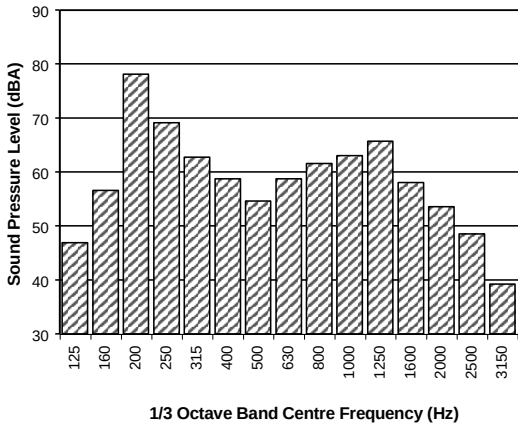
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

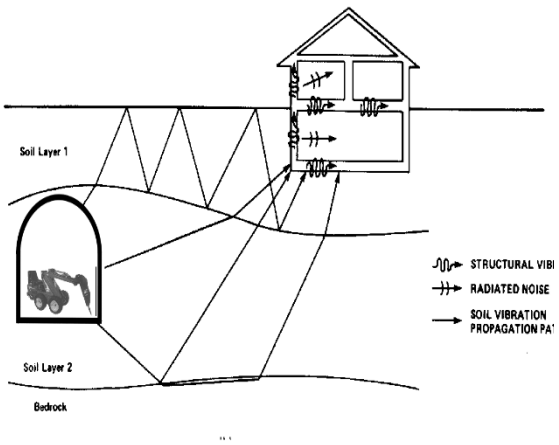
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

Appendix B Noise Monitoring Results

Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024

Noise Monitoring Location	L01
Noise Monitoring Address	**Adjacent to Elizabeth Street, Redfern**

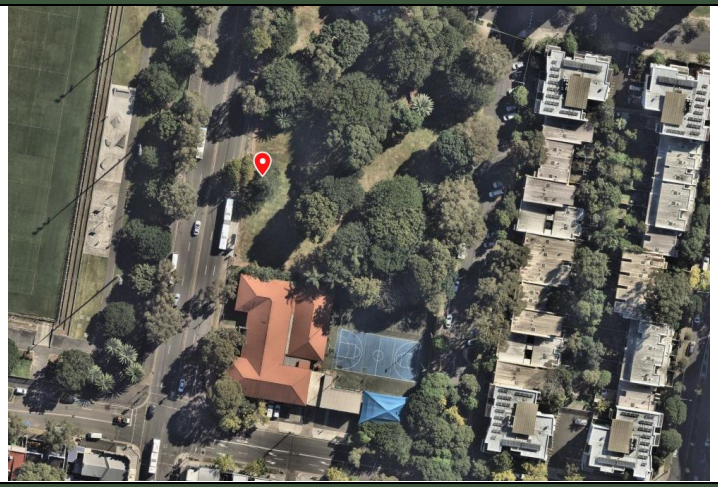
Logger Device Type: Svantek 957, Logger Serial No: 20663
Sound Level Meter: Brüel and Kjær 2270, Sound Level Meter Serial No: 3008204

Ambient noise monitor located within the development, adjacent to Elizabeth Street.

Attended noise measurements indicate the ambient noise environment at this location is dominated by steady-state road traffic. Local fauna (birds) also contributes to the noise at this location.

Measured Attended Noise Levels (LAmax):
18/05/2018: Traffic: 65 – 77 dBA, Birds: 75 dBA, Plane: 71 dBA

Map of Noise Monitoring Location



Ambient Noise Logging Results – ICNG/NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	L_{Aeq}	L_{10}	L_{1}
Daytime	52	65	68	73
Evening	49	64	67	71
Night-time	40	60	63	68

Ambient Noise Logging Results – RNP Defined Time Periods

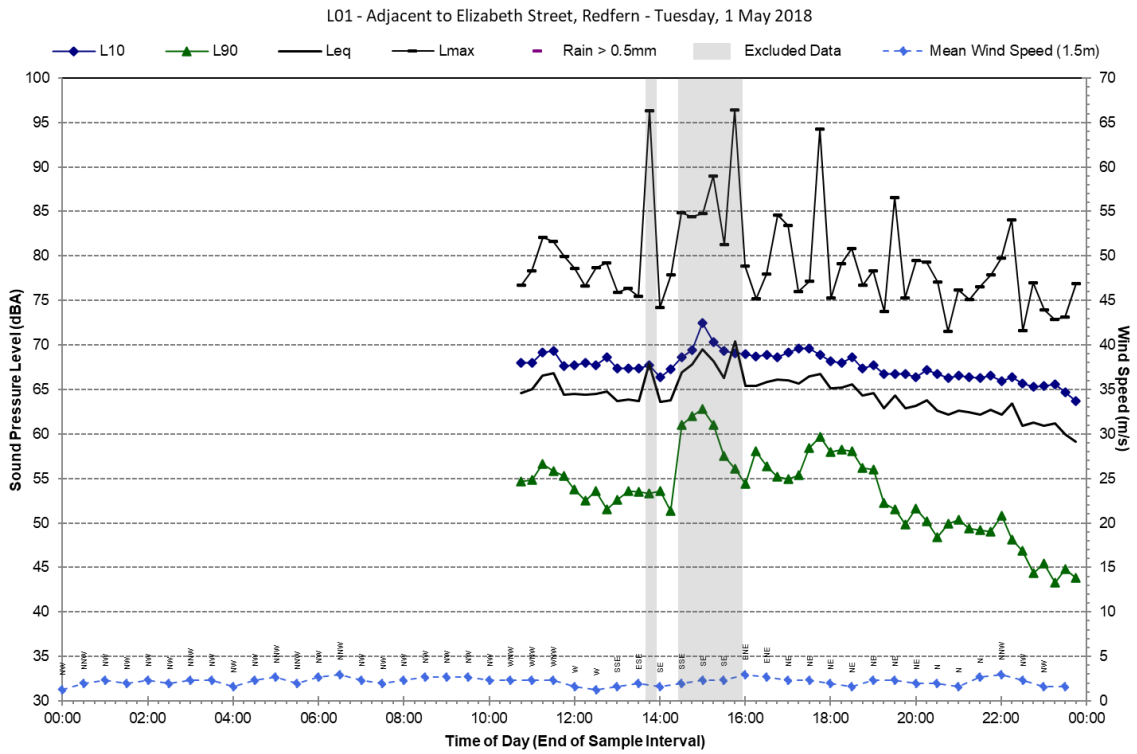
Monitoring Period	Noise Level (dBA)	
	$L_{Aeq(period)}$	$L_{Aeq(1hour)}$
Daytime (7 am-10 pm)	64	66
Night-time (10 pm-7 am)	60	62

Attended Noise Measurement Results

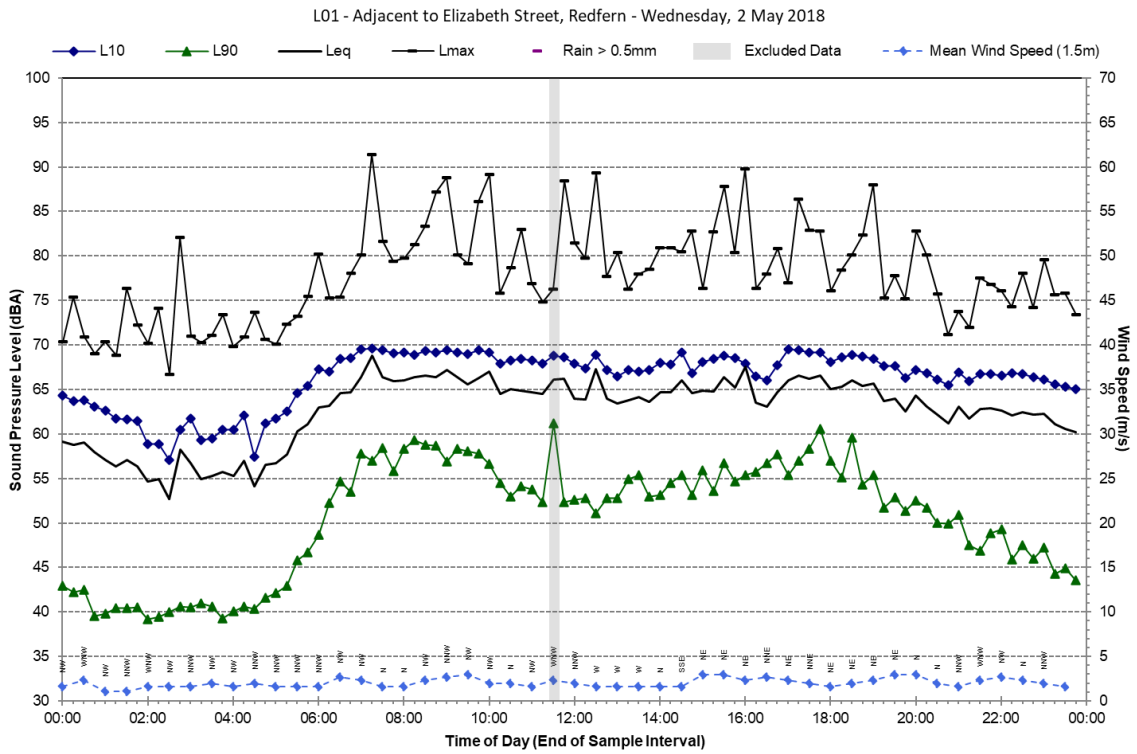
Date	Start Time	Measured Noise Level (dBA)		
		L_{A90}	L_{Aeq}	L_{Amax}
18/05/2018	9:36	58	65	77

Photo of Noise Monitoring Location

Statistical Ambient Noise Levels

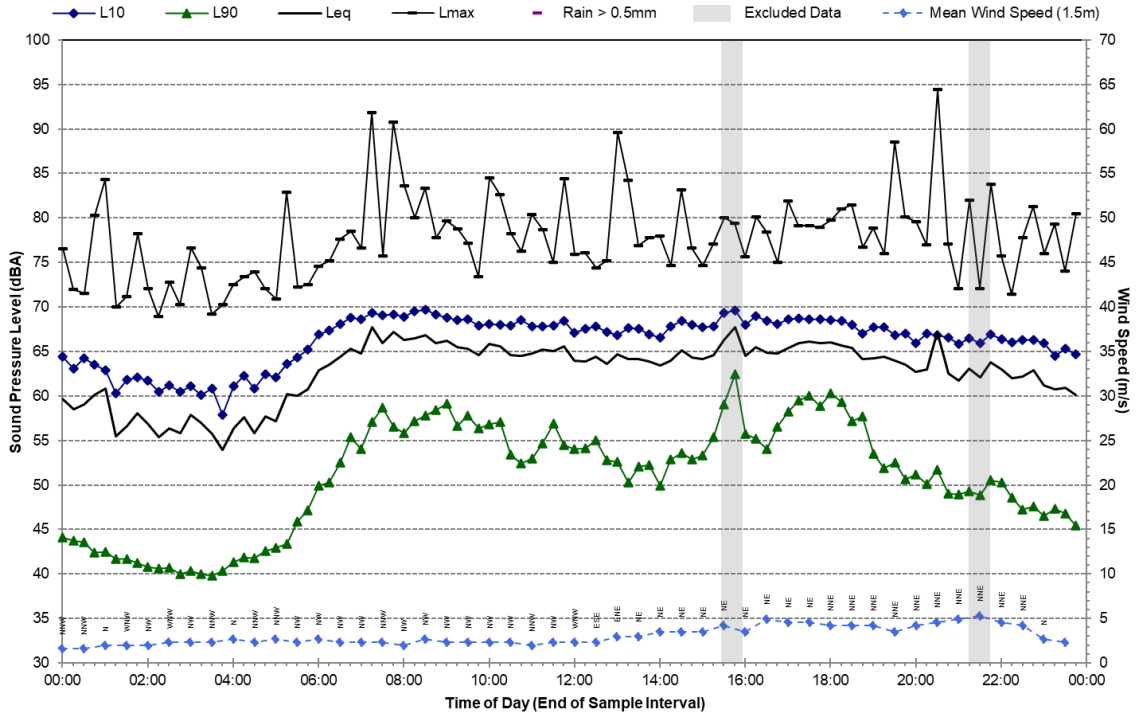


Statistical Ambient Noise Levels



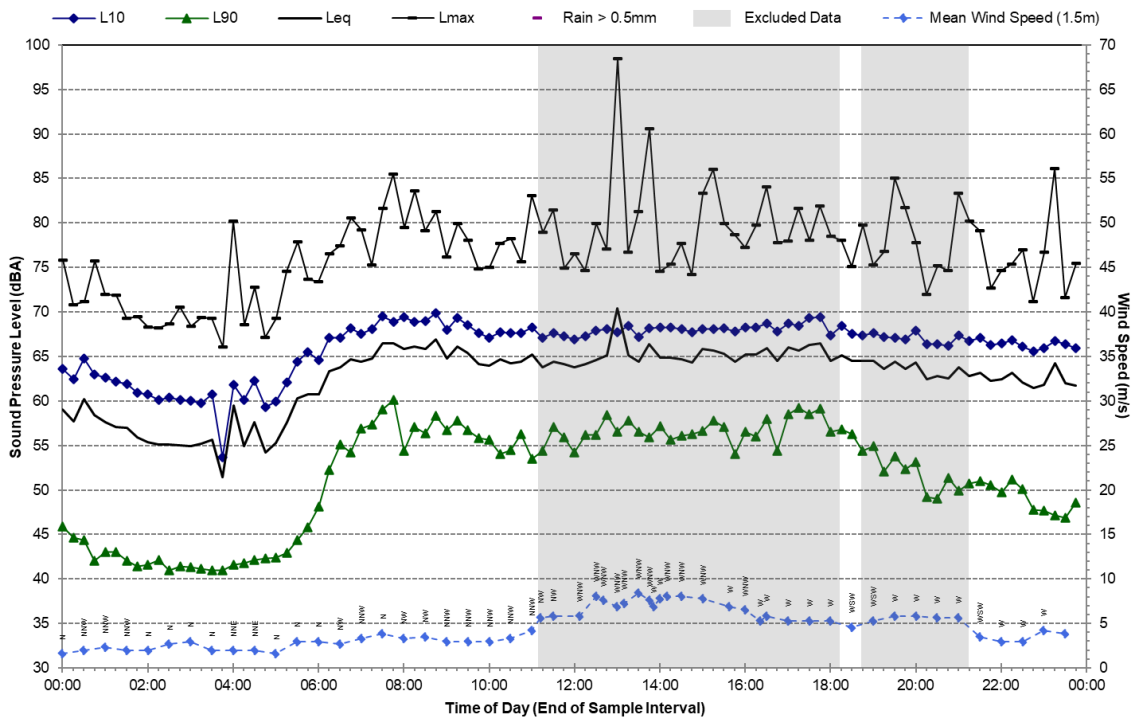
Statistical Ambient Noise Levels

L01 - Adjacent to Elizabeth Street, Redfern - Thursday, 3 May 2018

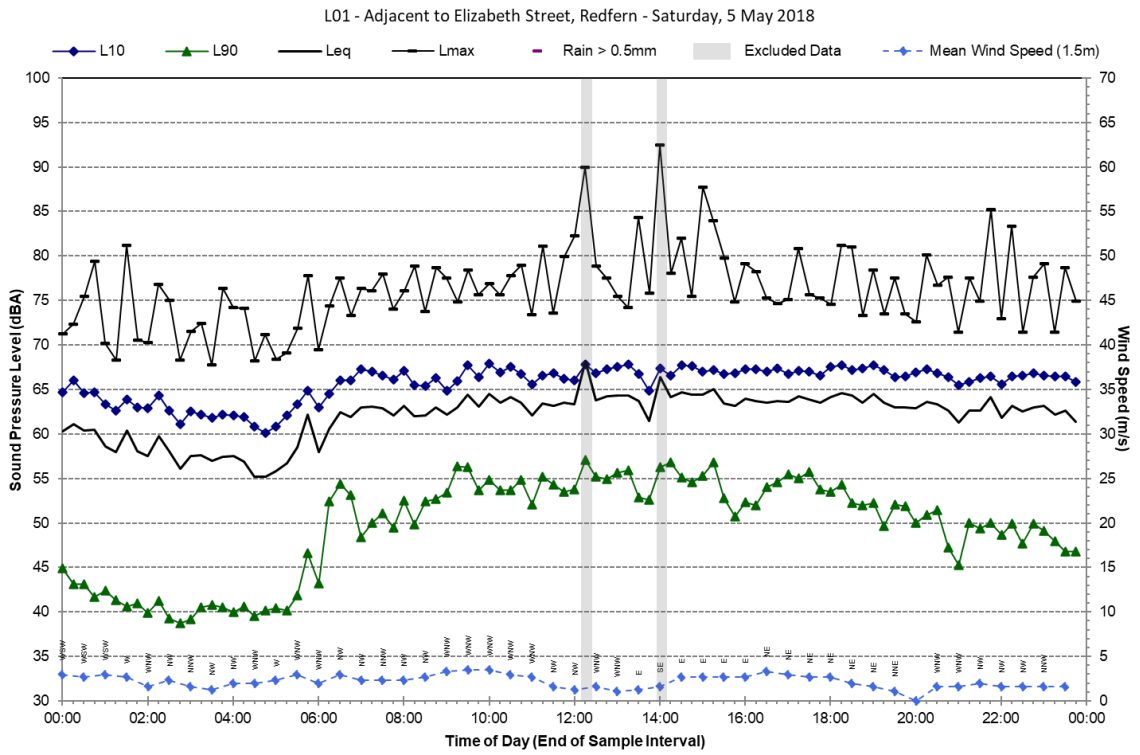


Statistical Ambient Noise Levels

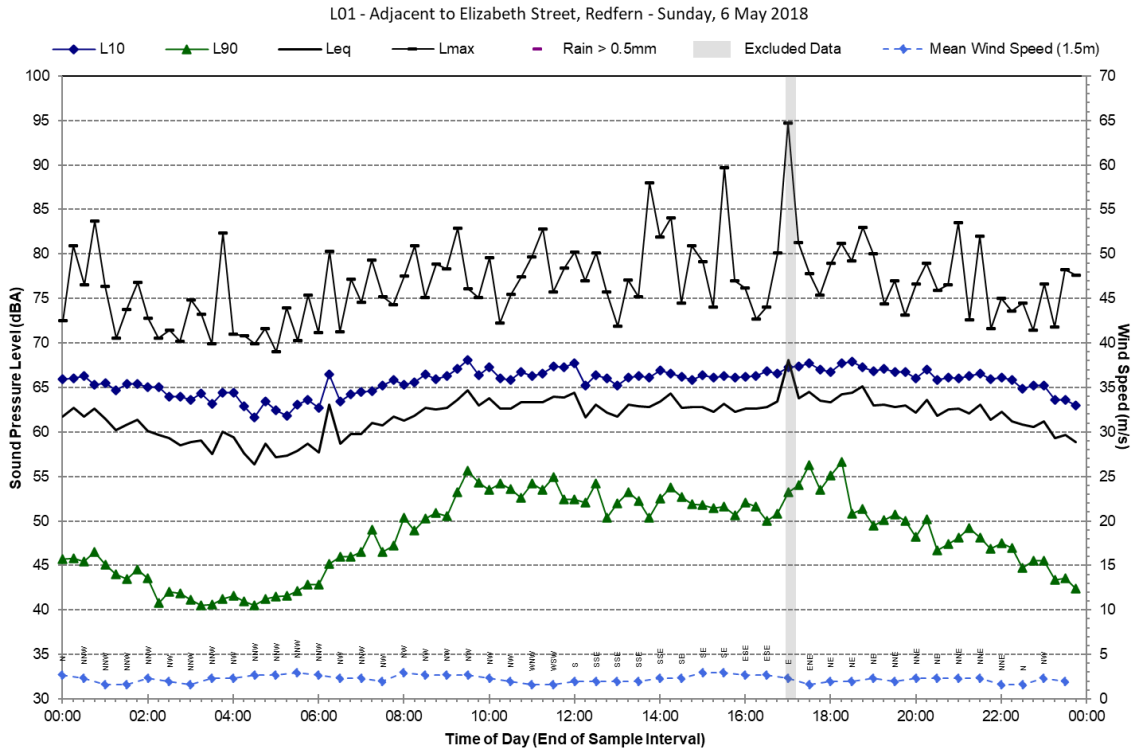
L01 - Adjacent to Elizabeth Street, Redfern - Friday, 4 May 2018



Statistical Ambient Noise Levels

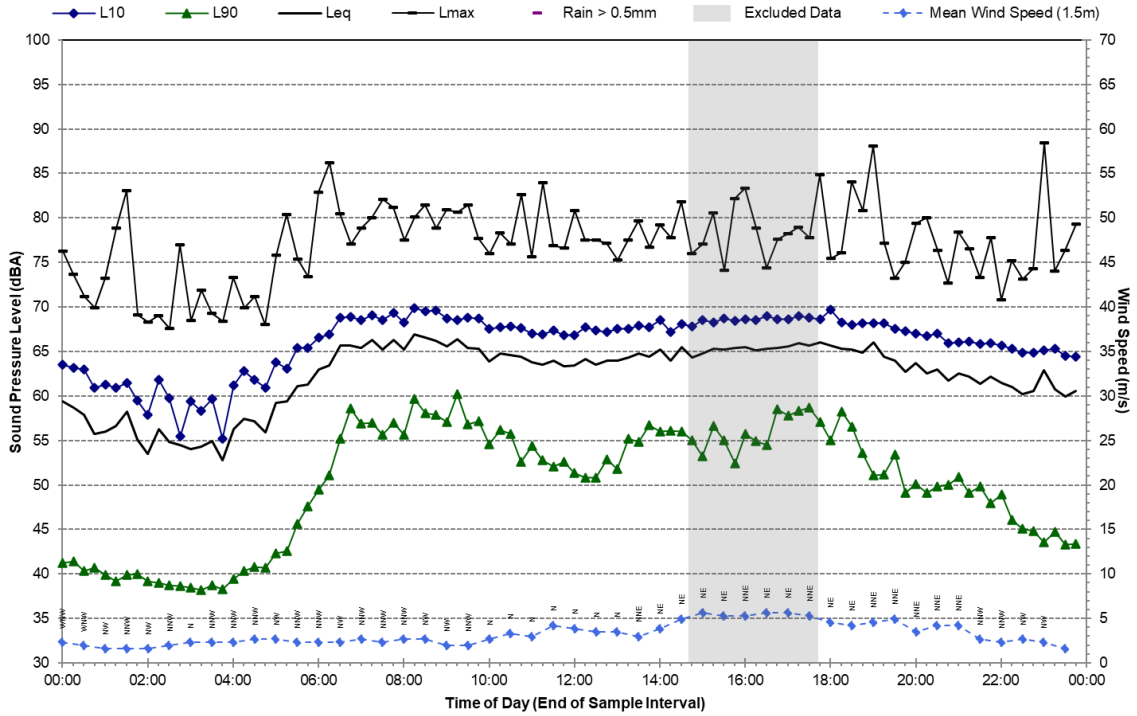


Statistical Ambient Noise Levels



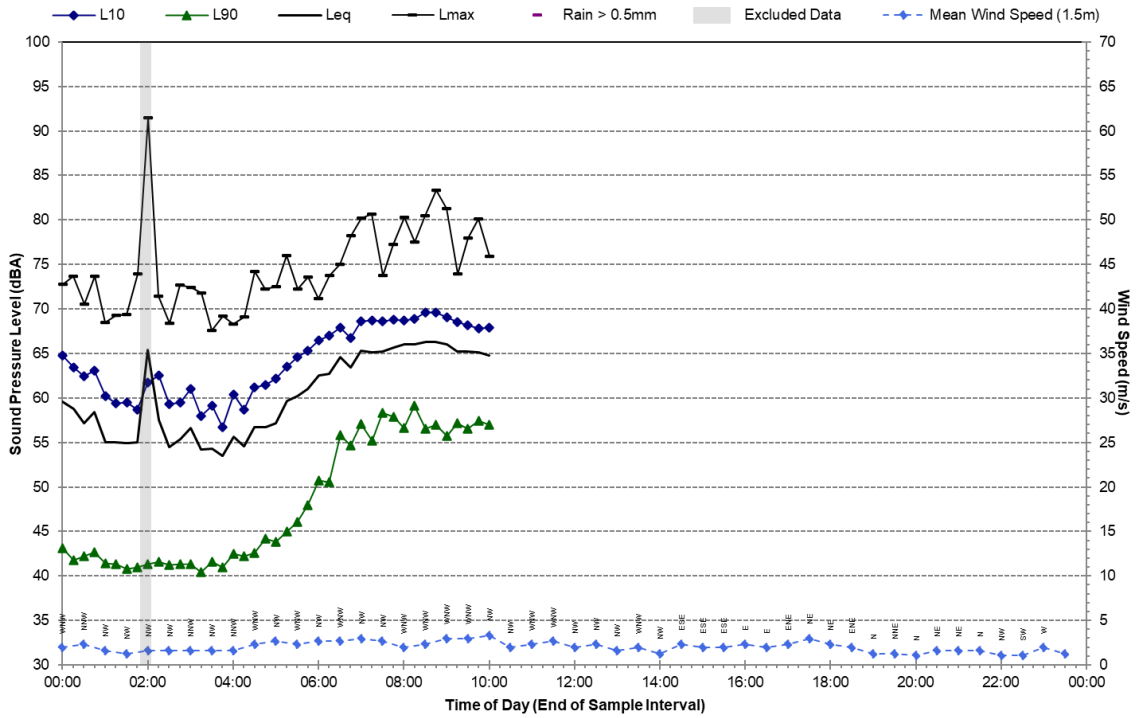
Statistical Ambient Noise Levels

L01 - Adjacent to Elizabeth Street, Redfern - Monday, 7 May 2018



Statistical Ambient Noise Levels

L01 - Adjacent to Elizabeth Street, Redfern - Tuesday, 8 May 2018



Noise Monitoring Location	L02
Noise Monitoring Address	**Adjacent to WalkerStreet, Redfern**

Logger Device Type: Svantek 957, Logger Serial No: 23815
Sound Level Meter: Brüel and Kjær 2270, Sound Level Meter Serial No: 3008204

Ambient noise monitor located within the development, adjacent to Walker Street.

Attended noise measurements indicate the ambient noise environment at this location is dominated by local fauna (birds), traffic on Elizabeth Street also contributes to the noise at this location.

Measured Attended Noise Levels (LAmax):

18/05/2018: Birdsong: 69 – 80 dBA, Bus: 65 – 65 dBA, Plane: 60 - 66 dBA, Traffic: 58 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG/NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	L_{Aeq}	L_{10}	L_{1}
Daytime	48	58	60	68
Evening	46	55	57	63
Night-time	41	51	52	56

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	$L_{Aeq(period)}$	$L_{Aeq(1hour)}$
Daytime (7 am-10 pm)	58	59
Night-time (10 pm-7 am)	51	53

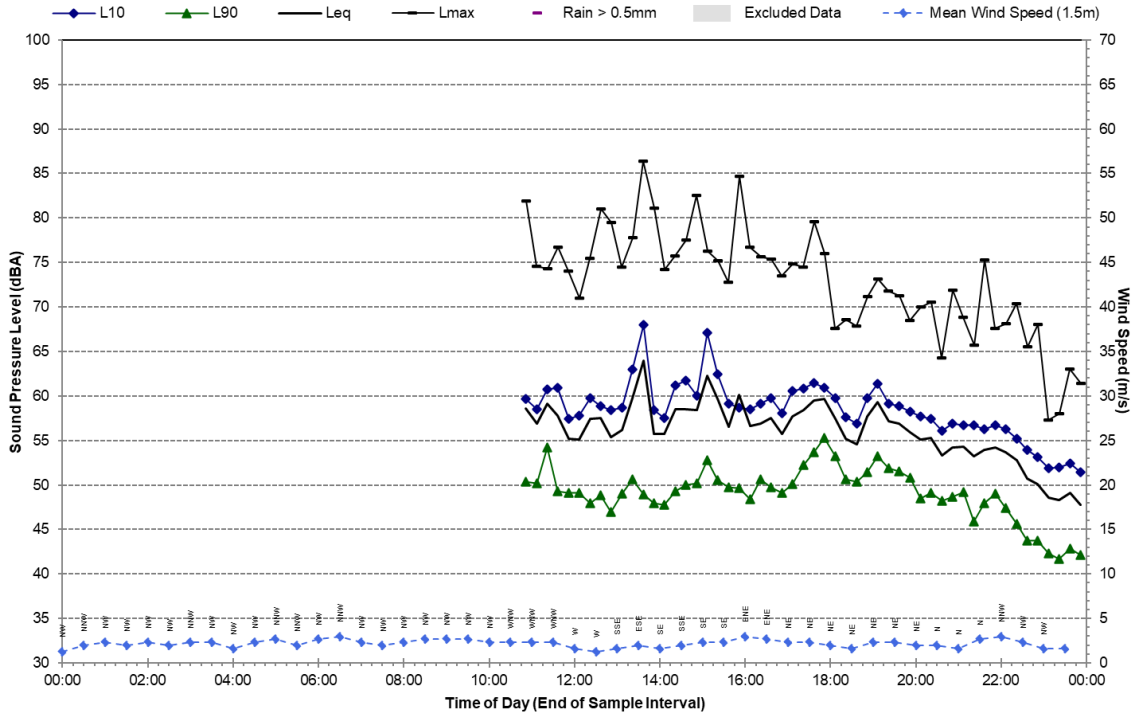
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		L_{A90}	L_{Aeq}	L_{Amax}
18/05/2018	9:52	53	61	80

Photo of Noise Monitoring Location

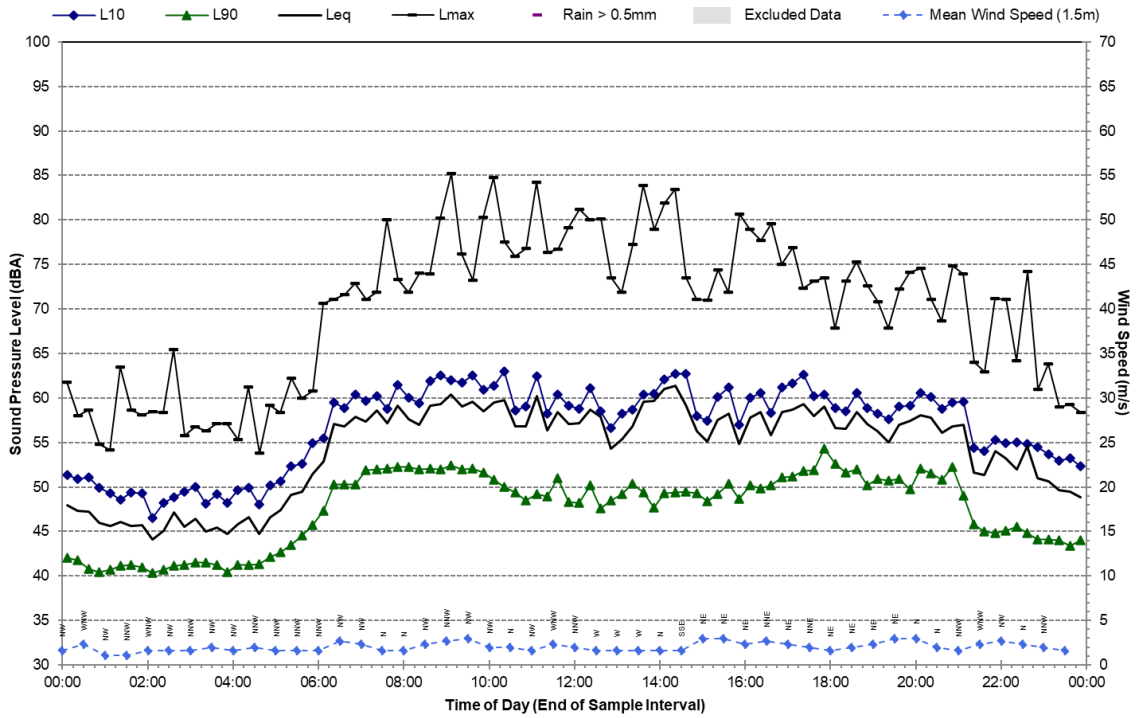
Statistical Ambient Noise Levels

L02 - Adjacent to Walker Street, Redfern - Tuesday, 1 May 2018

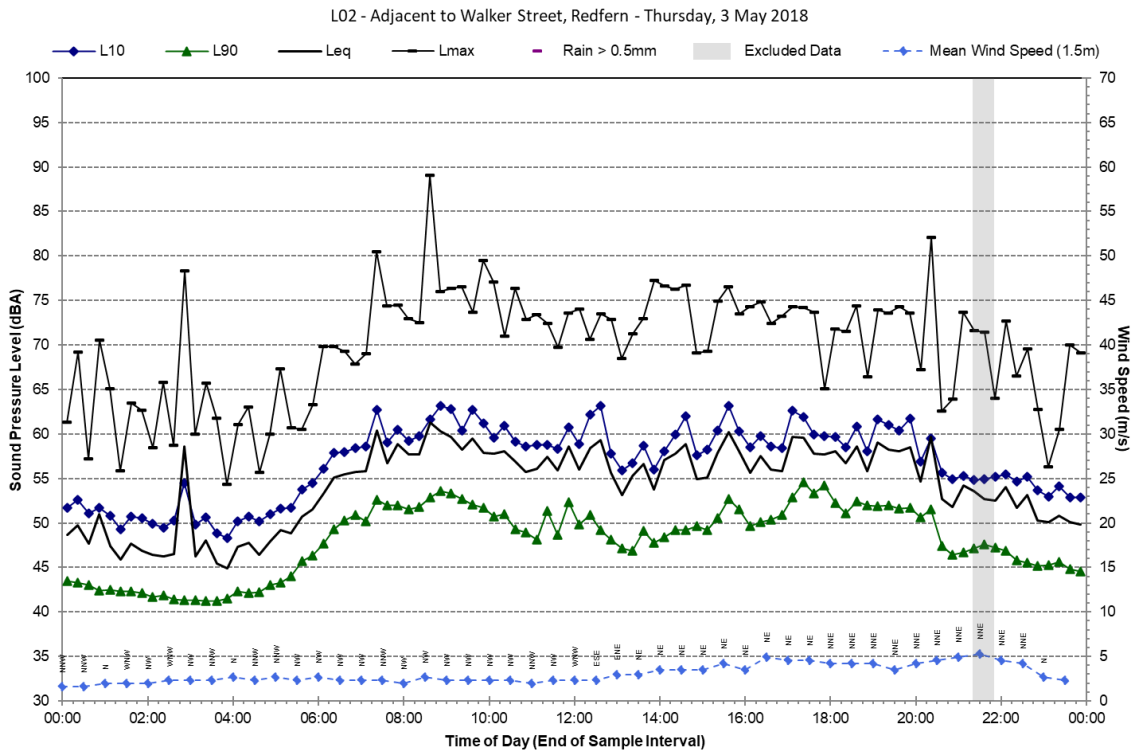


Statistical Ambient Noise Levels

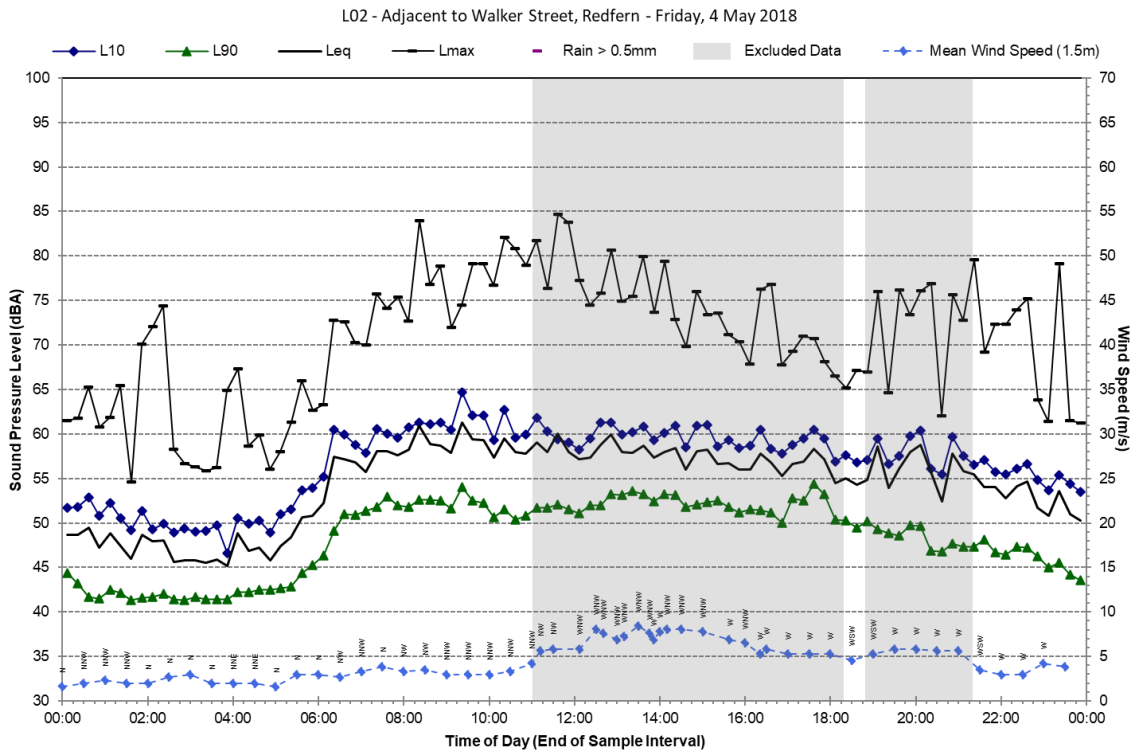
L02 - Adjacent to Walker Street, Redfern - Wednesday, 2 May 2018



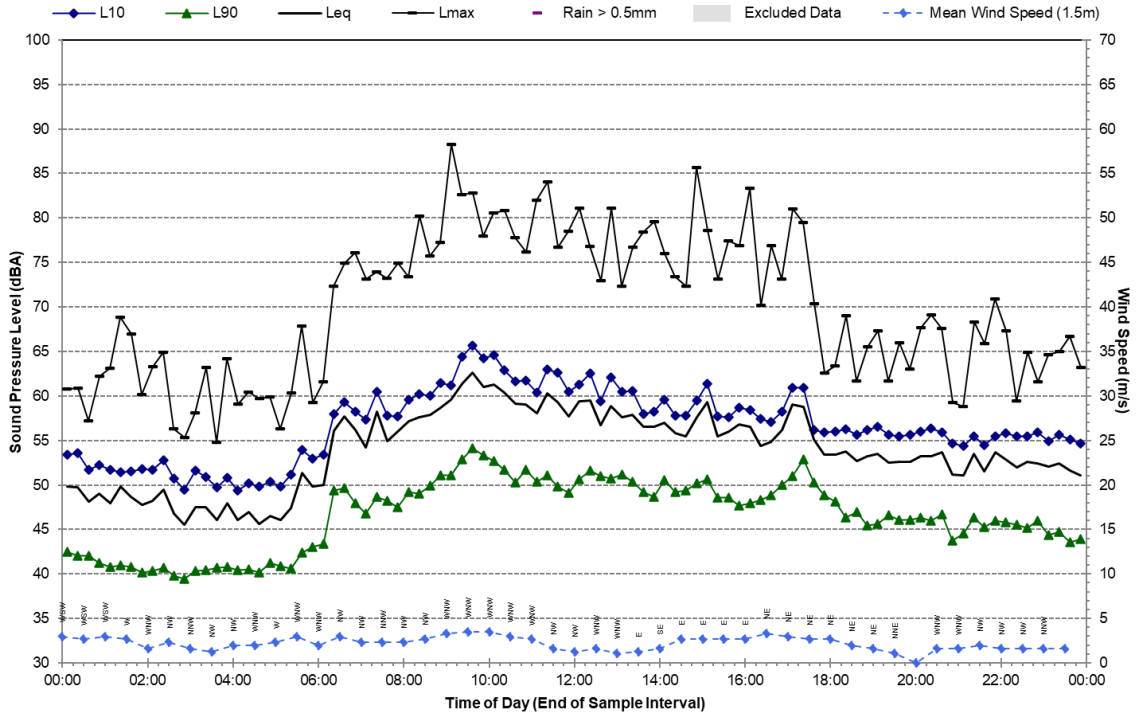
Statistical Ambient Noise Levels



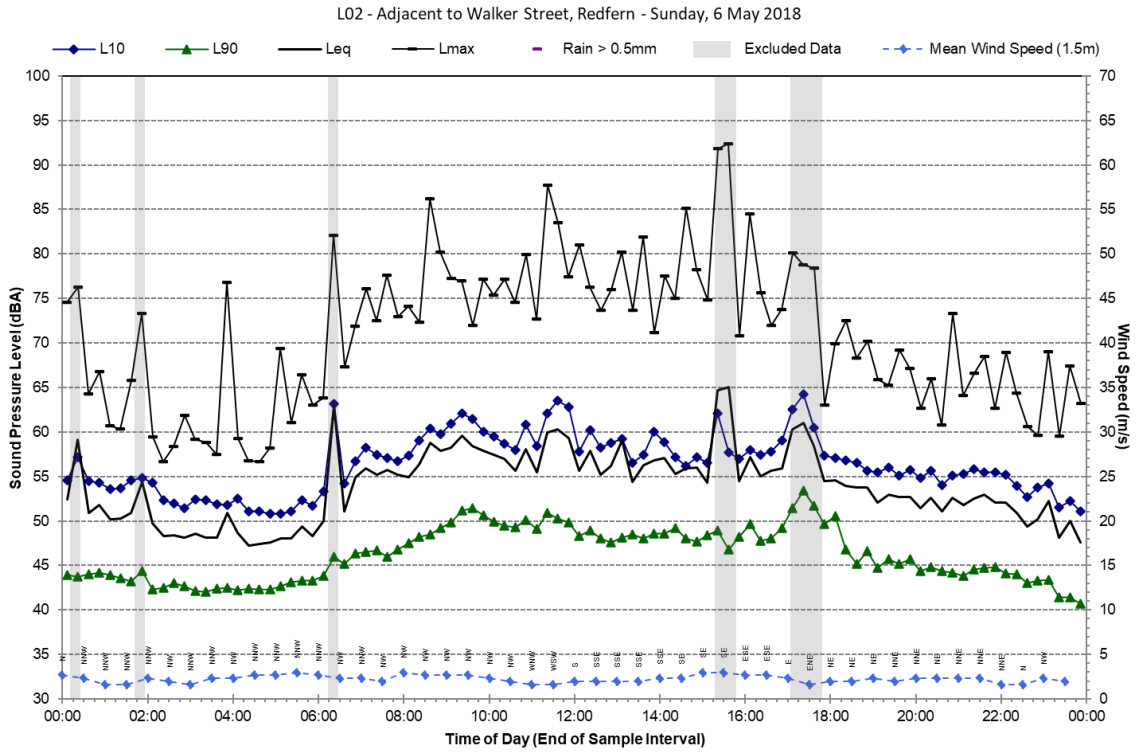
Statistical Ambient Noise Levels



Statistical Ambient Noise Levels

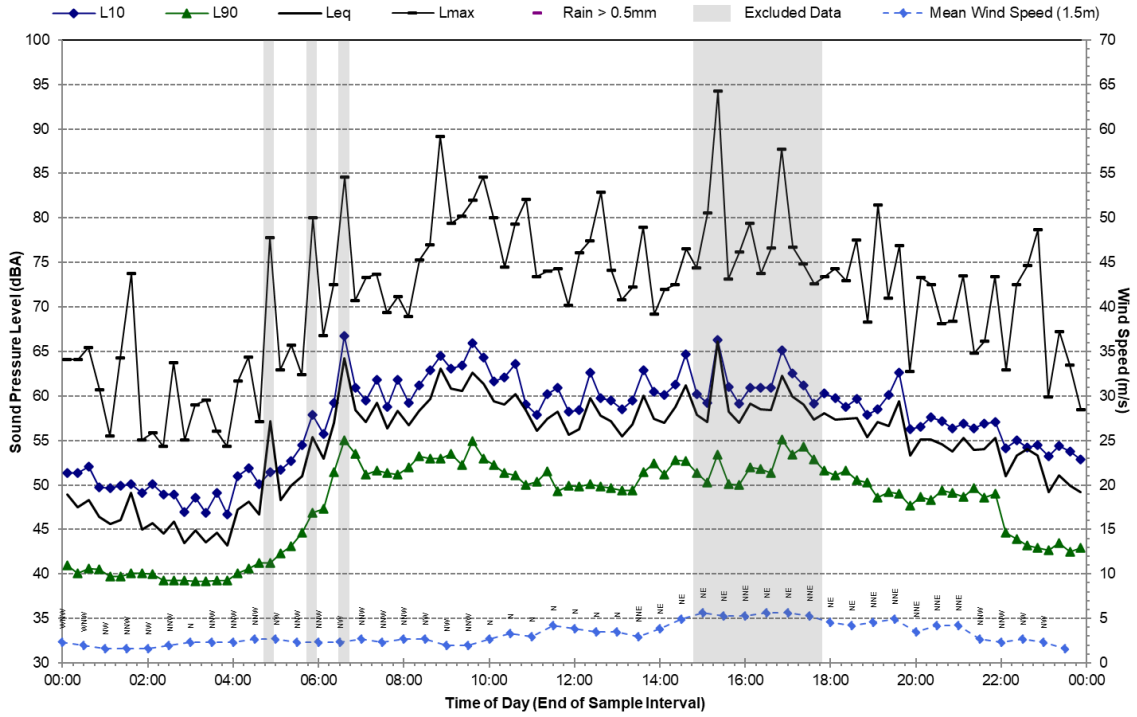


Statistical Ambient Noise Levels



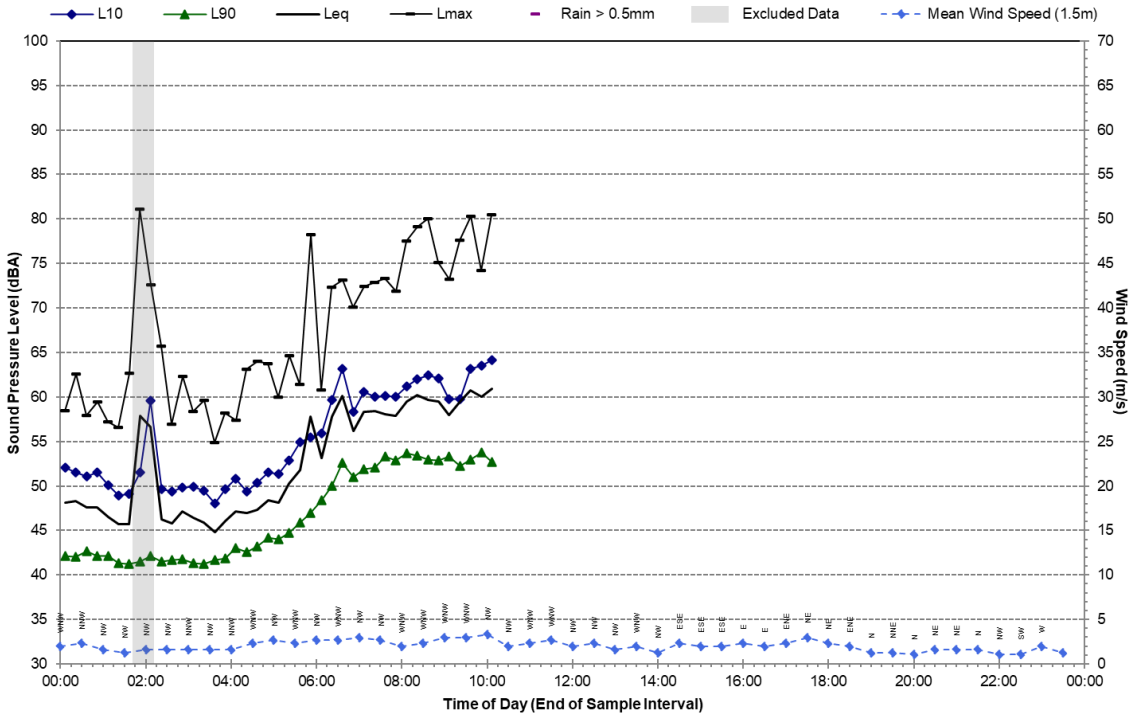
Statistical Ambient Noise Levels

L02 - Adjacent to Walker Street, Redfern - Monday, 7 May 2018



Statistical Ambient Noise Levels

L02 - Adjacent to Walker Street, Redfern - Tuesday, 8 May 2018



Noise Monitoring Location	L03
Noise Monitoring Address	**Adjacent to WalkerStreet, Redfern**

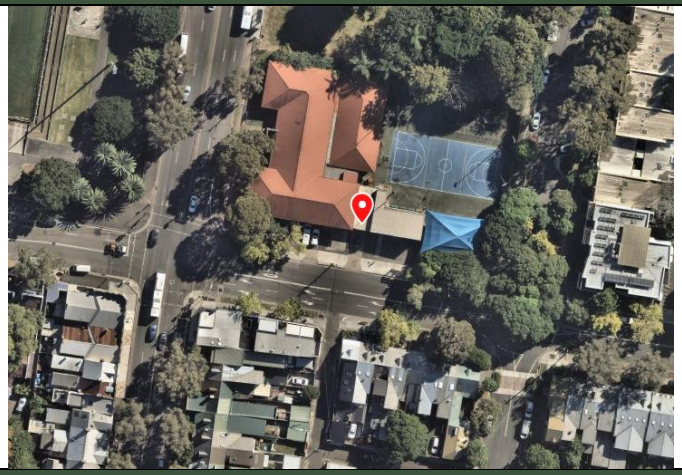
Logger Device Type: Svantek 977, Logger Serial No: 98070
Sound Level Meter: Brüel and Kjær 2270, Sound Level Meter Serial No: 3008204

Ambient noise monitor located within the development, adjacent to Walker Street.

Attended noise measurements indicate the ambient noise environment at this location is dominated by traffic on Phillip Street.

Measured Attended Noise Levels (L_{Amax}):
3/11/2023: Traffic: 60 - 67 dBA, Bus: 70 - 81 dBA, Motor Bike: 65 dBA

Map of Noise Monitoring Location



Ambient Noise Logging Results – ICNG/NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	L_{Aeq}	L_{10}	L_1
Daytime	53	63	65	71
Evening	47	61	63	69
Night-time	38	57	59	65

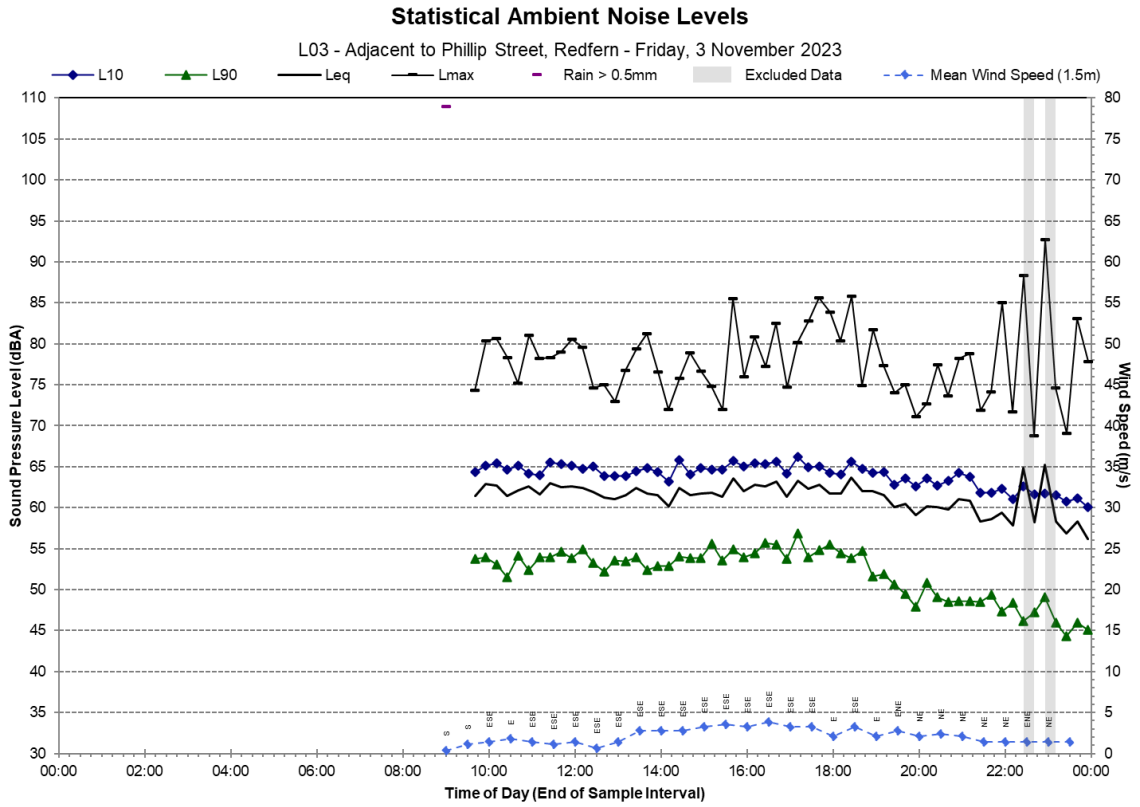
Ambient Noise Logging Results – RNP Defined Time Periods

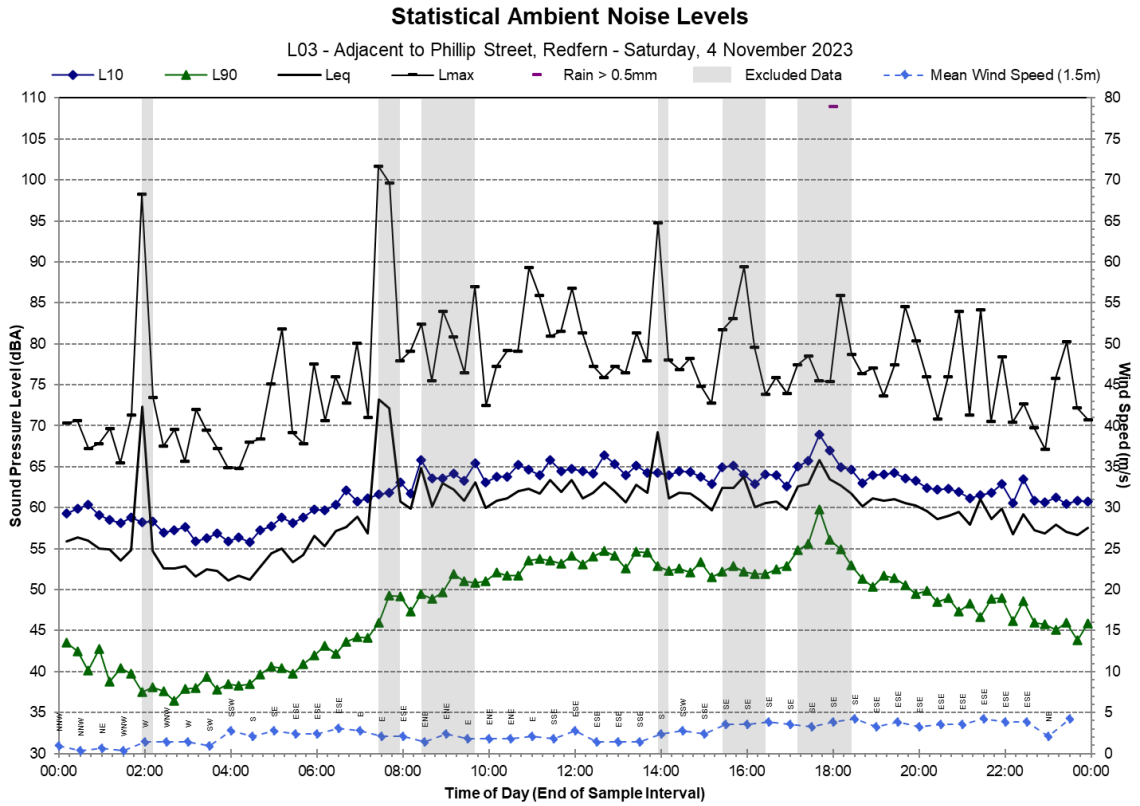
Monitoring Period	Noise Level (dBA)	
	$L_{Aeq(period)}$	$L_{Aeq(1hour)}$
Daytime (7 am-10 pm)	63	64
Night-time (10 pm-7 am)	58	60

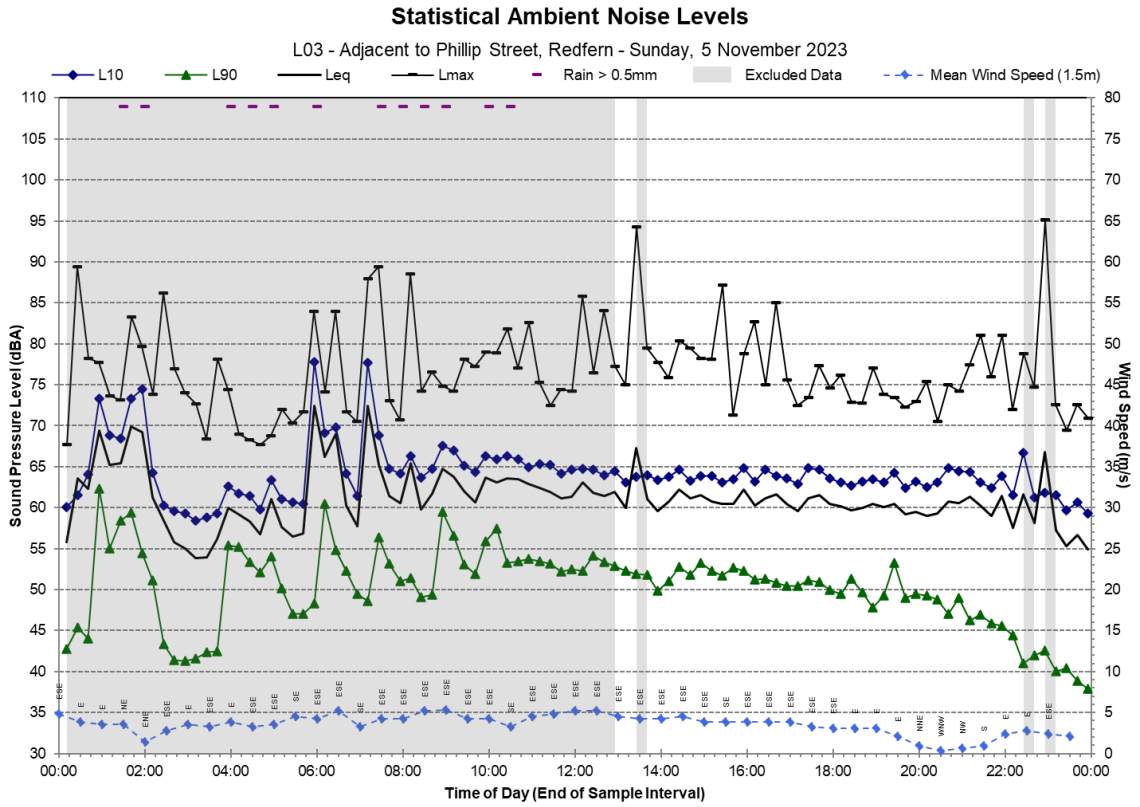
Attended Noise Measurement Results

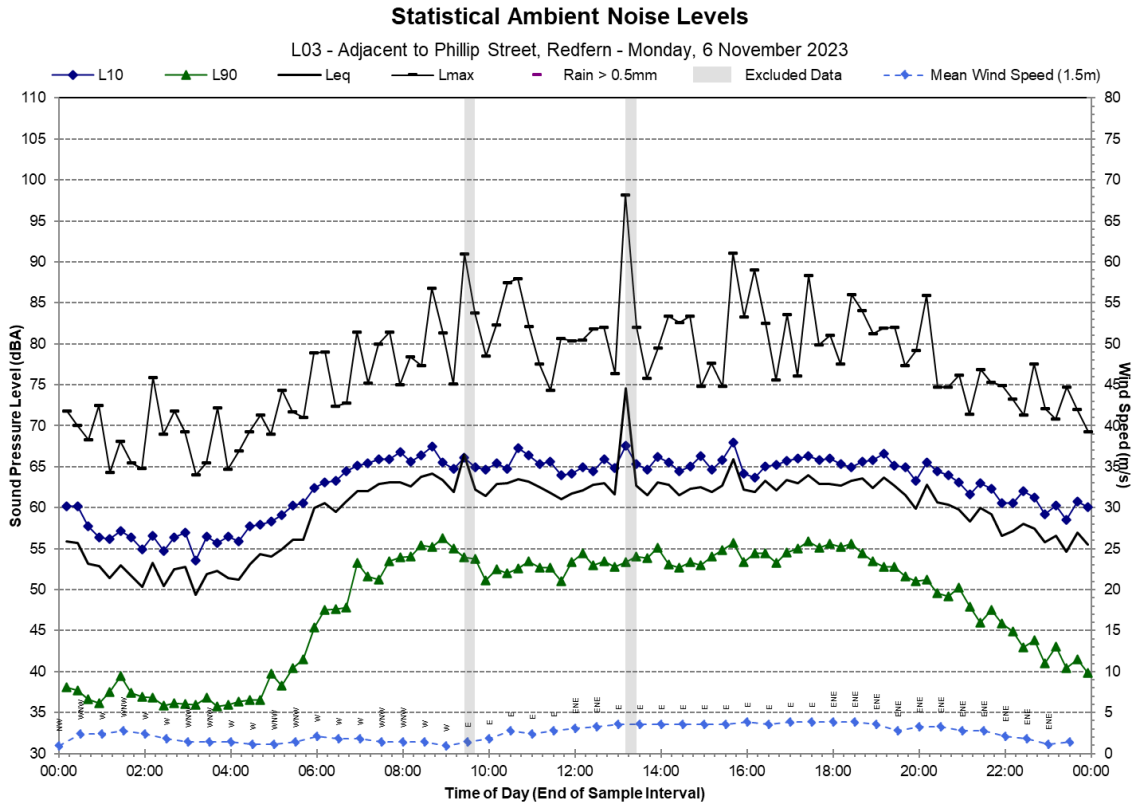
Date	Start Time	Measured Noise Level (dBA)		
		L_{A90}	L_{Aeq}	L_{Amax}
3/11/2023	9:49	53	65	81

Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Friday, 3 November 2023
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Saturday, 4 November 2023
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Sunday, 5 November 2023
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Monday, 6 November 2023
L10
L90
Leq
Lmax
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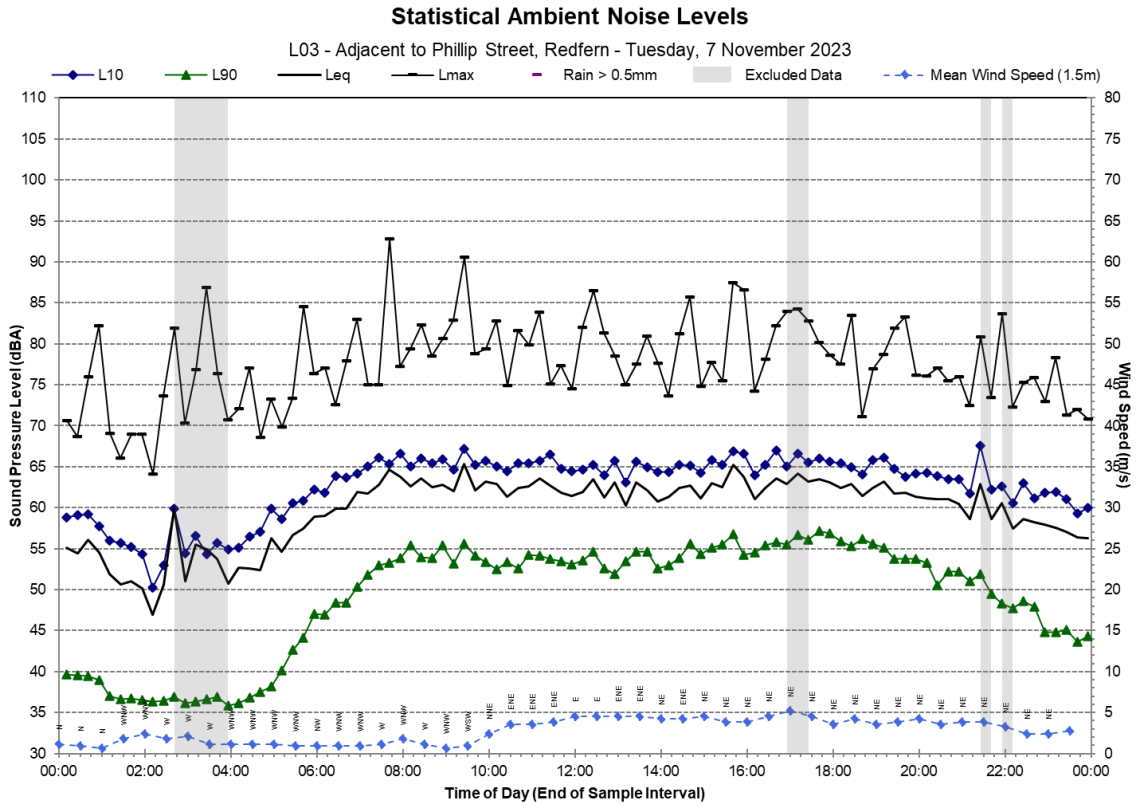
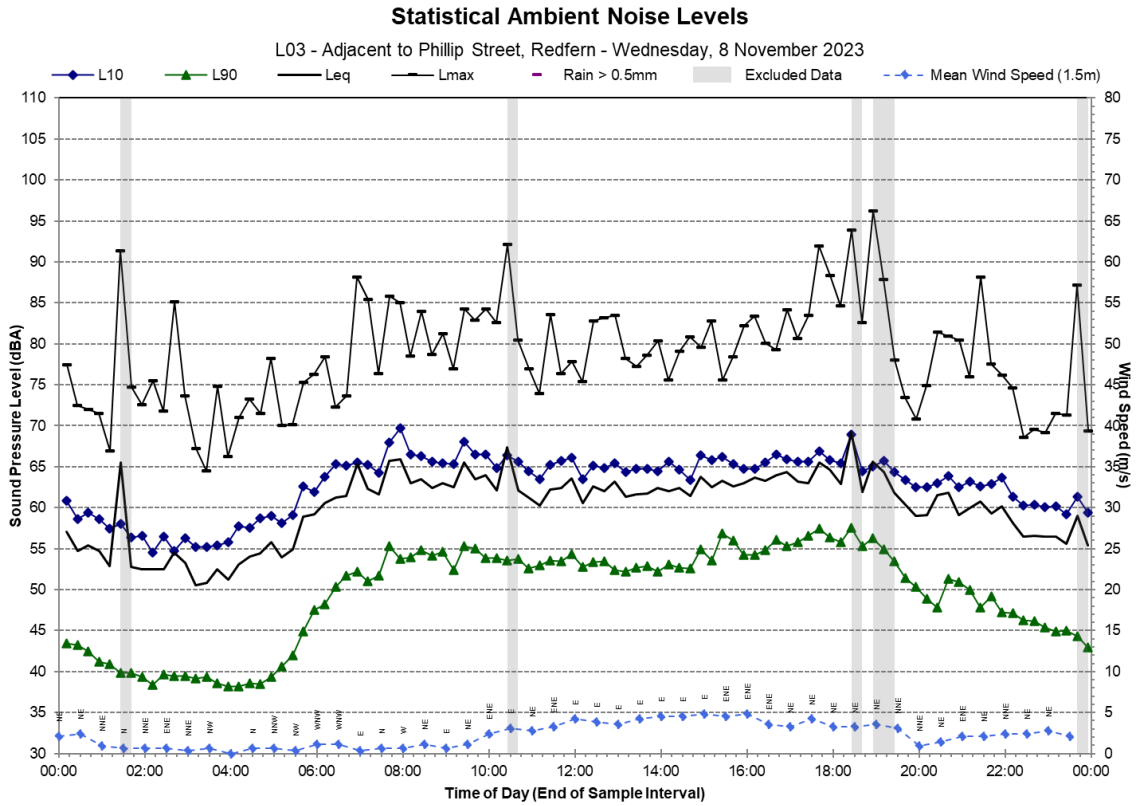
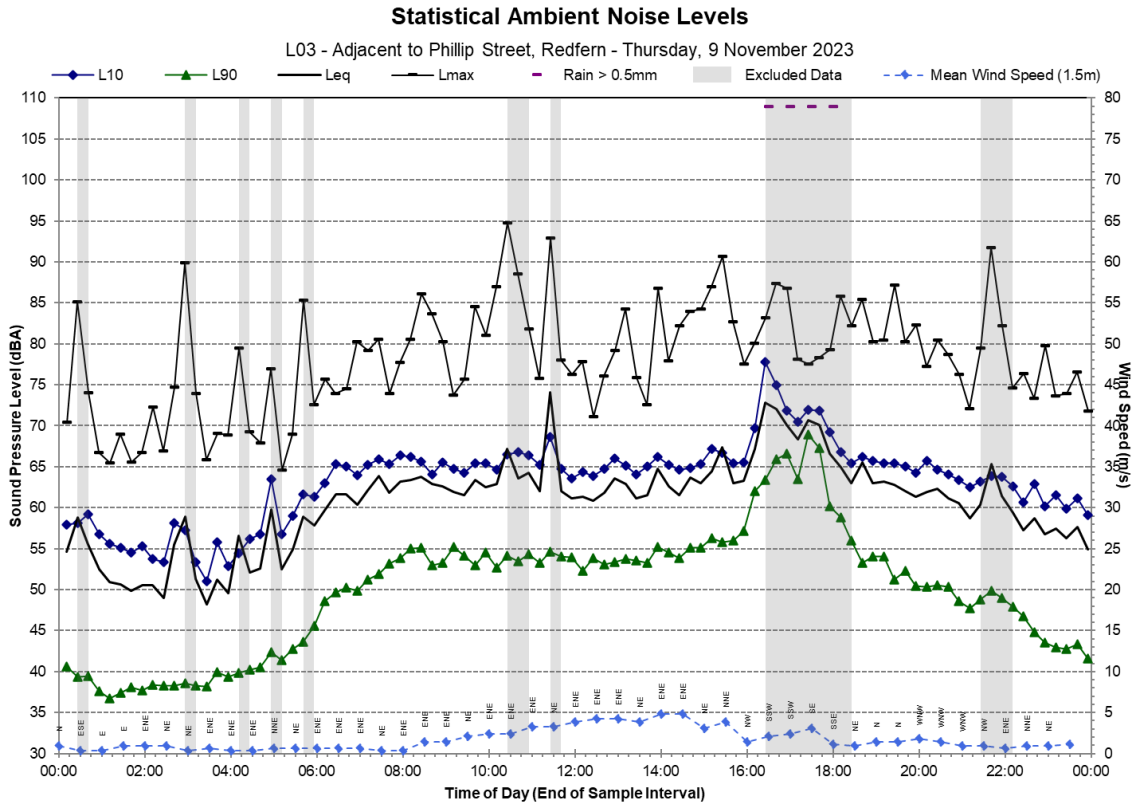
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Tuesday, 7 November 2023
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Wednesday, 8 November 2023
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Thursday, 9 November 2023
L10
L90
Leq
Lmax
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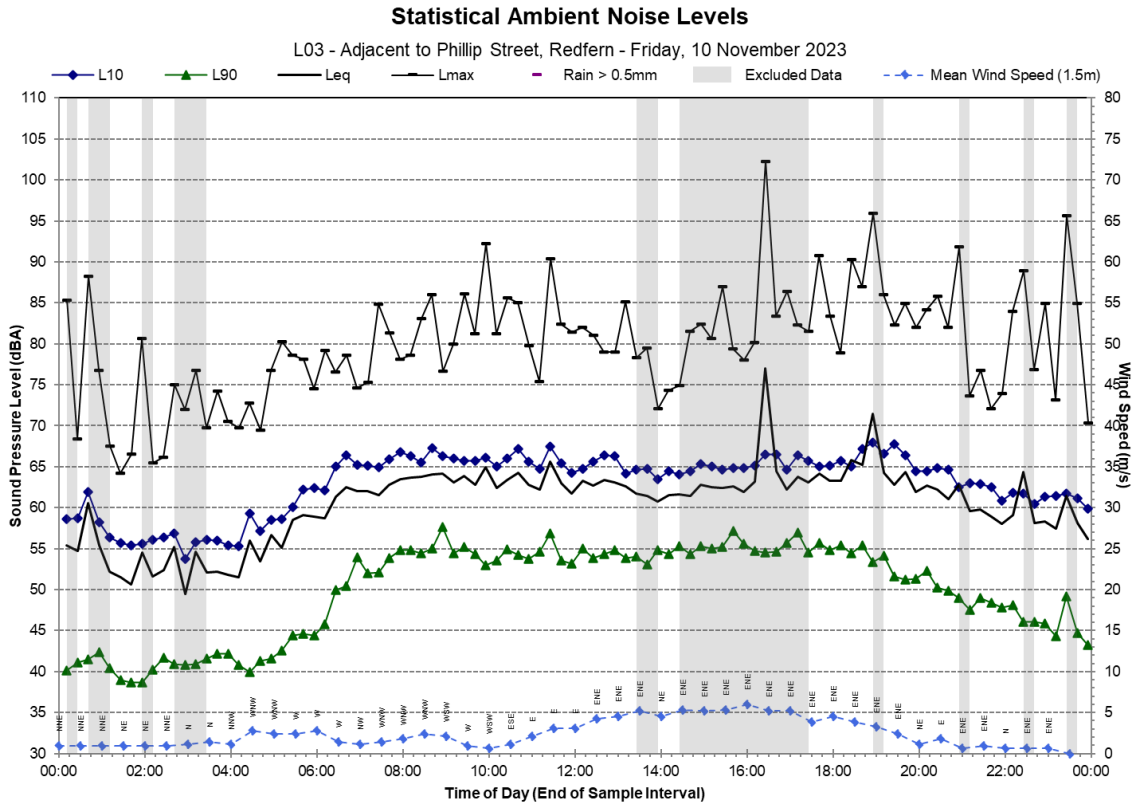
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Friday, 10 November 2023
L10
L90
Leq
Lmax
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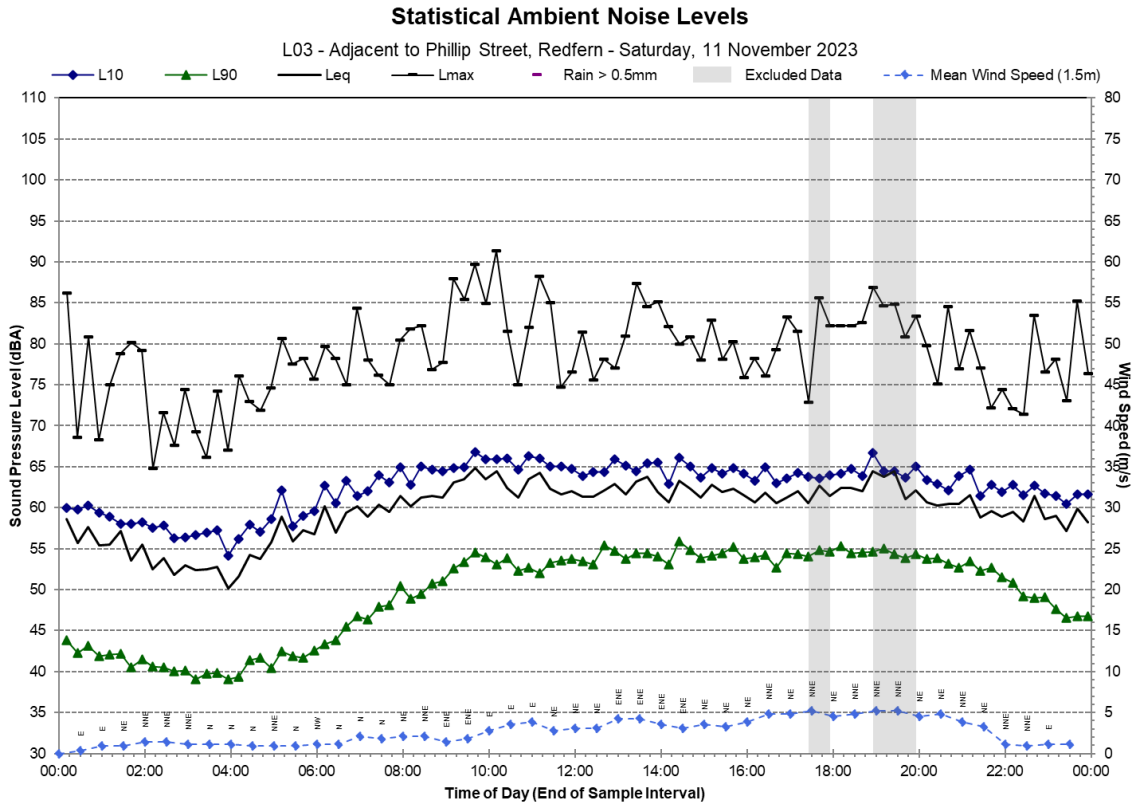
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Saturday, 11 November 2023
L10
L90
Leq
Lmax
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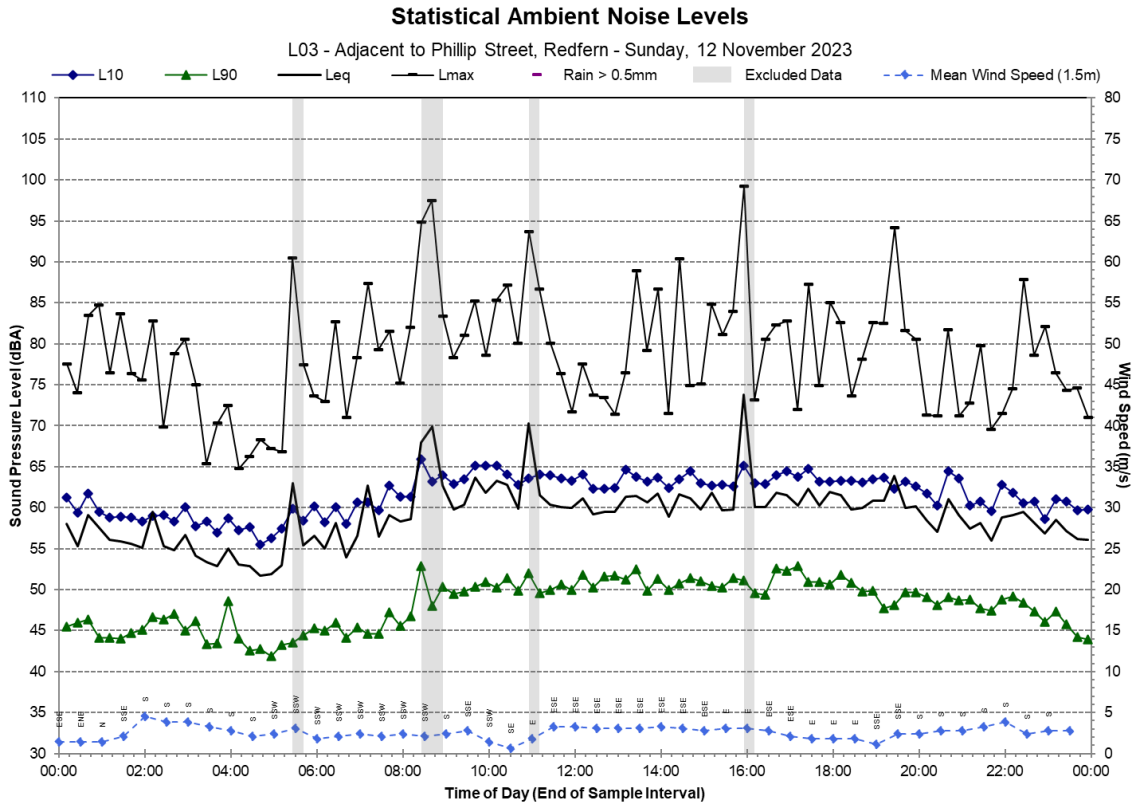
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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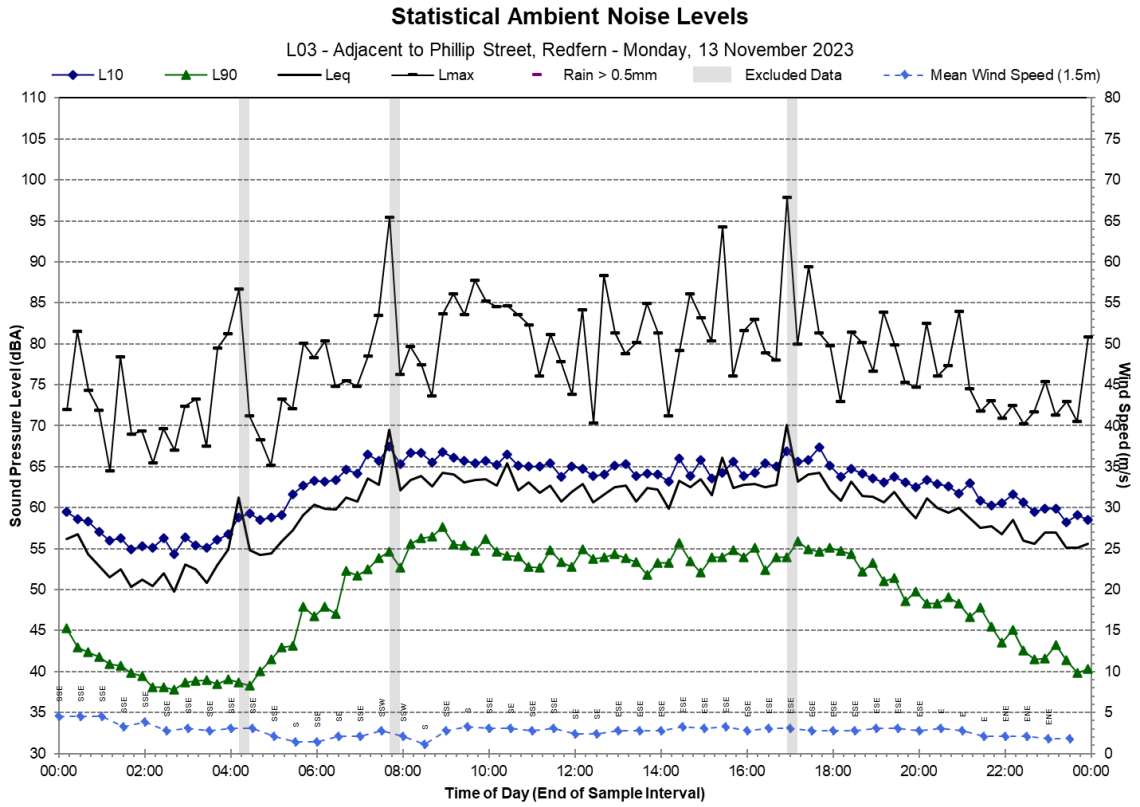
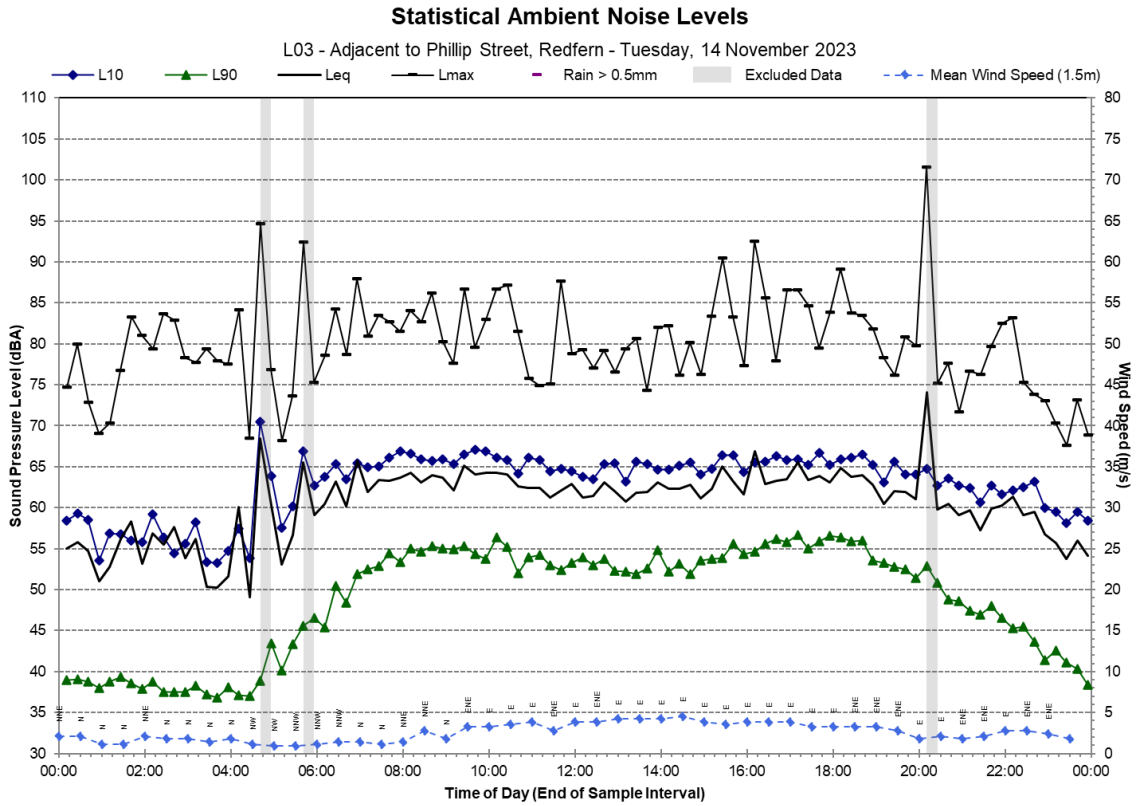
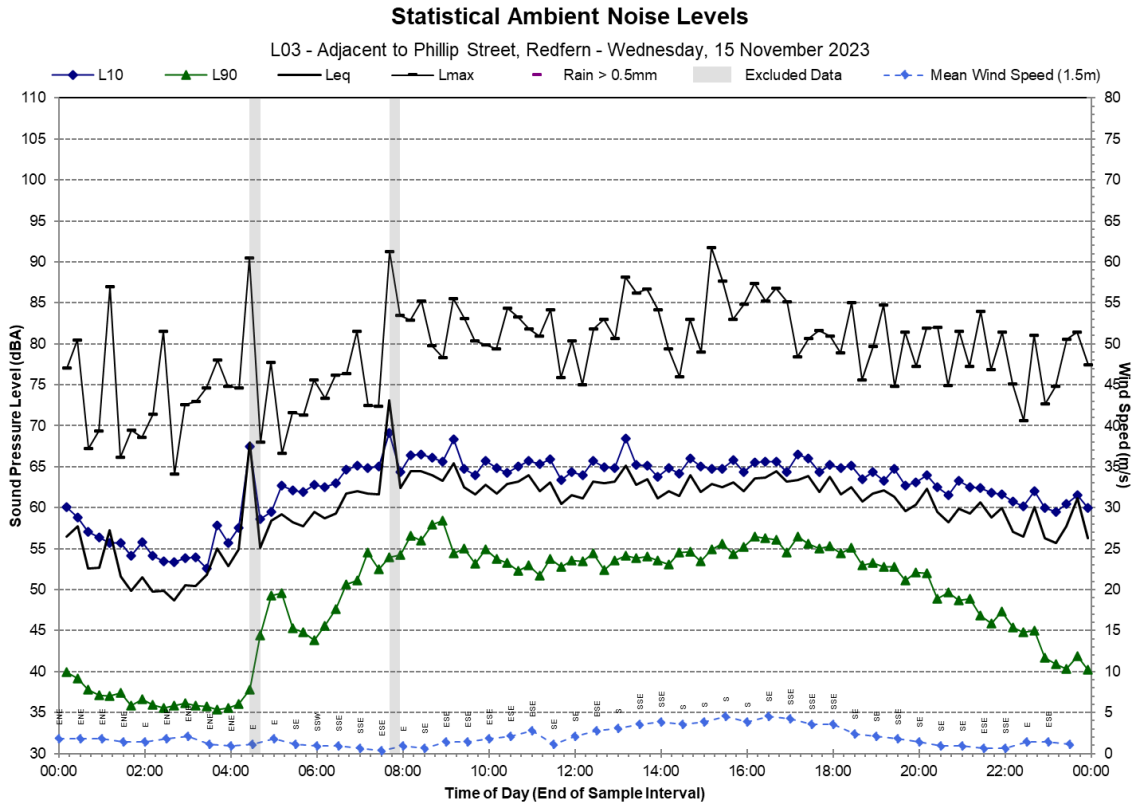
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Monday, 13 November 2023
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Tuesday, 14 November 2023
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Wednesday, 15 November 2023
L10
L90
Leq
Lmax
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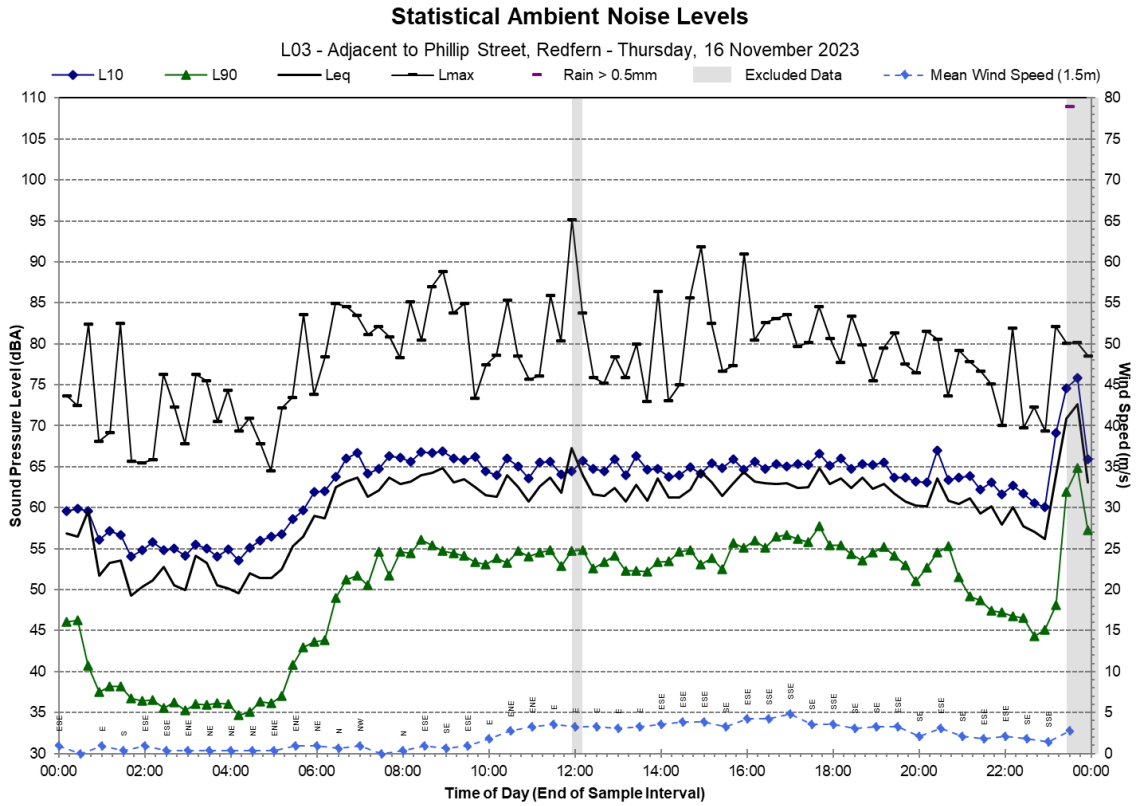
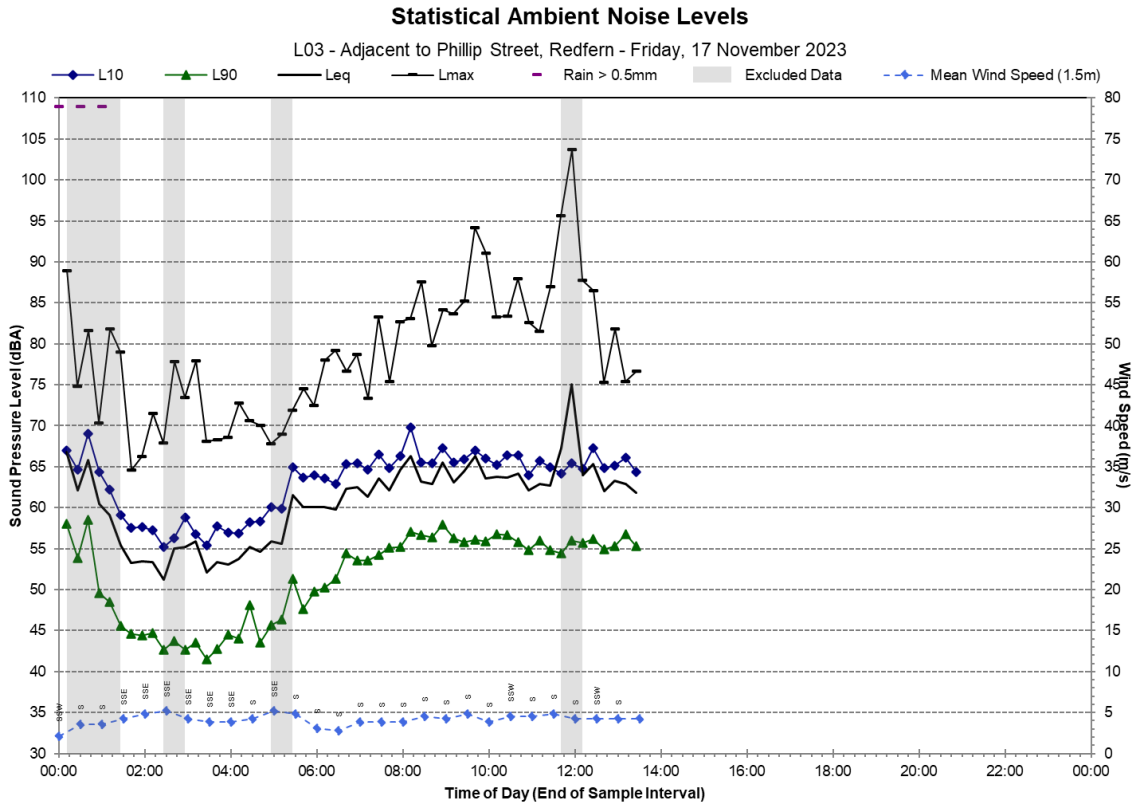
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Thursday, 16 November 2023
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Adjacent to Phillip Street, Redfern - Friday, 17 November 2023
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Appendix C Construction Noise Sources

Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024

Equipment	Total SWL	Chainsaw[1]	Crane – Mobile	Elevated Work Platform	Excavator – 20t	Excavator + Hydraulic Hammer[1] - 10t	Generator – Attenuated	Grader	Light Vehicles	Mulcher	Piling - Bored	Pump – Concrete	Roller - Vibratory[1]	Small Power Tools	Truck - Concrete	Truck - Dump	Truck - road truck/ truck & dog	Water Cart	Front end loader 23t
Sound Power Level[2]		114	113	107	105	122	92	113	103	116	111	109	114	104	109	110	108	107	112
Estd. on-time in any 15 minutes		7.5	7.5	7.5	7.5	7.5	15	15	7.5	15	7.5	7.5	15	15	7.5	7.5	7.5	15	15
Demolition	121		X	X	X	X	X							X			X		
Vegetation clearing	121	X			X					X						X		X	X
Earthworks	121				X	X		X								X			X
Shoring works	120		X		X		X						X				X		

Equipment	Total SWL	Chainsaw[1]	Crane – Mobile	Elevated Work Platform	Excavator – 20t	Excavator + Hydraulic Hammer[1] - 10t	Generator – Attenuated	Grader	Light Vehicles	Mulcher	Piling - Bored	Pump – Concrete	Roller - Vibratory[1]	Small Power Tools	Truck - Concrete	Truck - Dump	Truck - road truck/ truck & dog	Water Cart	Front end loader 23t
Piling	118		X	X	X				X		X	X		X	X		X		
Structure works	114						X		X			X		X	X		X		
Fit-out	117		X	X					X					X			X		

Note 1: Equipment classed as ‘annoying’ in the ICNG and requires a 5 dB correction.

Note 2: Sound power level data is taken from the DEFRA Noise Database, RMS *Construction and Vibration Guideline* and TfNSW *Construction Noise and Vibration Strategy*.

Appendix D Operational Noise Contours

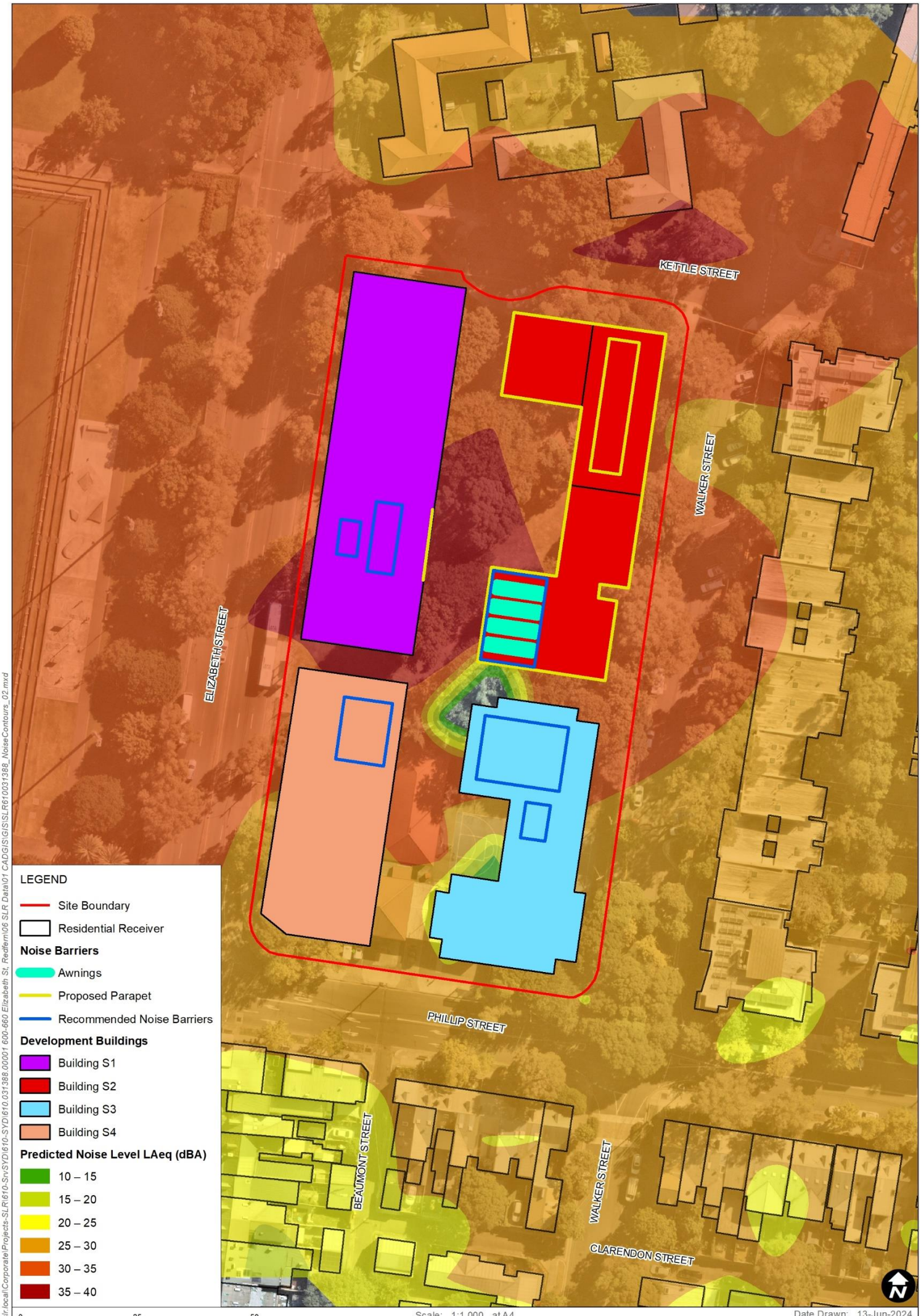
Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024



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Scale: 1:1,000 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Appendix E Facade Mitigation

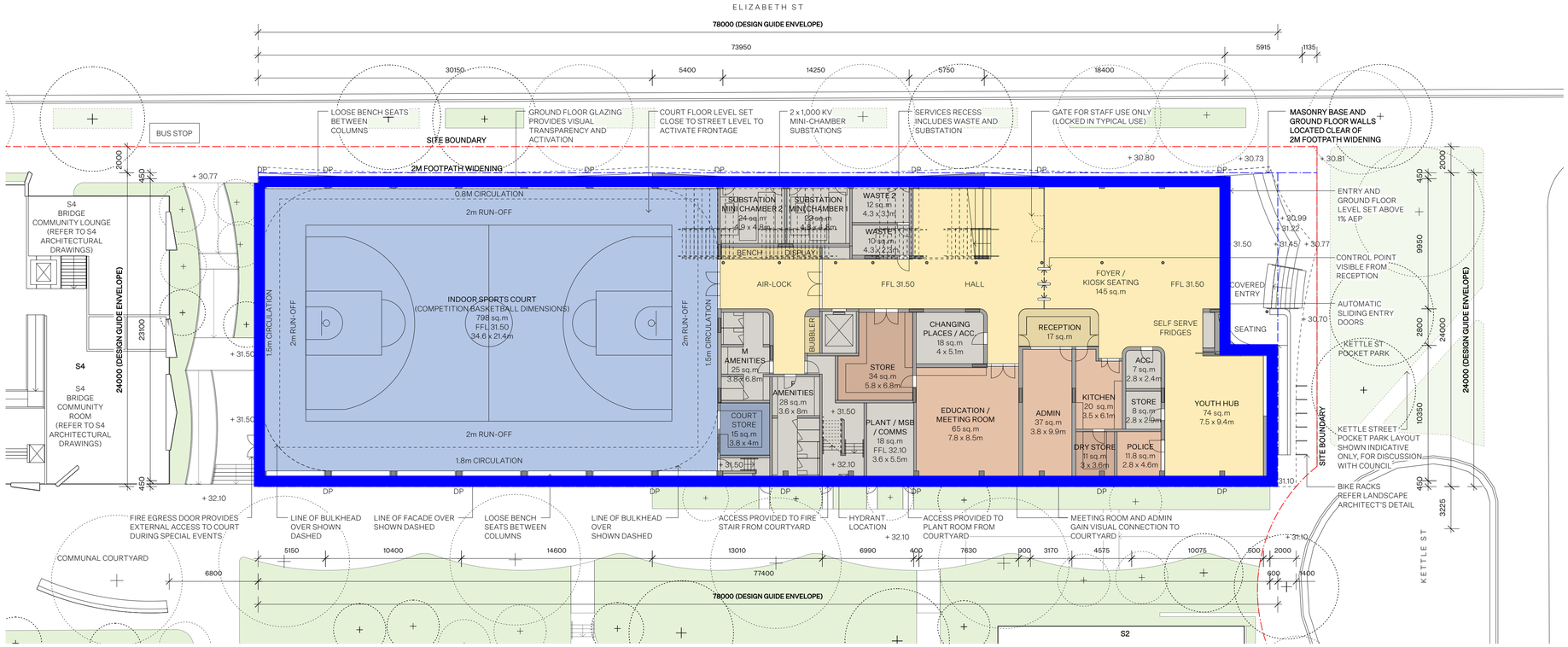
Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

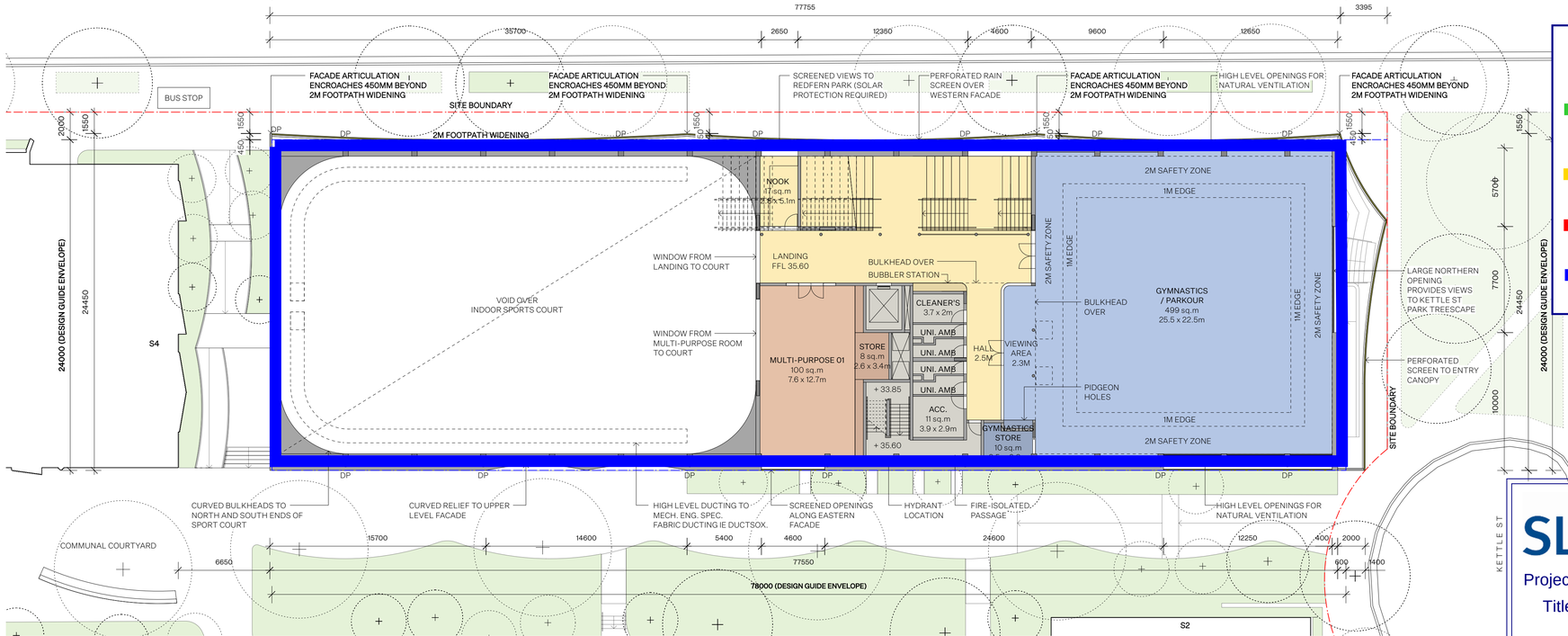
Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024



01 - S1 PLAN - GROUND FLOOR 1:200



02 - S1 PLAN - FIRST FLOOR 1:200

LEGEND

- Open windows
- Closed window and cross ventilated
- Closed window and treated plenums
- Mechanically ventilated

SLR

Project:

Title:

Date:

By: Reviewed:

Project Title:

Redfern Place

600-660 Elizabeth St, Redfern NSW 2106

Sheet drawn by:

ARCHITECTURE AND

REGISTERED ARCHITECT
NSW #7447
VIC #9560
TAS #1030
ACT #2607

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A SUITE 1, 67 ELIZABETH ST REDFERN NSW 2016

Project Architectural Team:

Architecture AND — S1 Lead Architect

SILVESTERFULLJAMES — S2 Lead Architect

hayball — Precinct + S3 + S4 Lead Architect

Notes:

Compliance:

- COMPLY WITH ALL RELEVANT AUTHORITIES REQUIREMENTS.
- COMPLY WITH THE BUILDING CODE OF AUSTRALIA.
- COMPLY WITH ALL RELEVANT AUSTRALIAN STANDARDS.
- DIMENSIONS IN MILLIMETRES.
- DO NOT SCALE. USE FIGURED DIMENSIONS ONLY.
- NOTIFY ARCHITECT IF DISCREPANCY EXISTS.

Drawn By	JS
Checked By	AB
Date Printed	03/05/2024
Scale	NA @ A1

0 1 2 3 5 m

Rev	Date	Description
-	06/06/2024	SSDA

SSDA

Drawing Title:

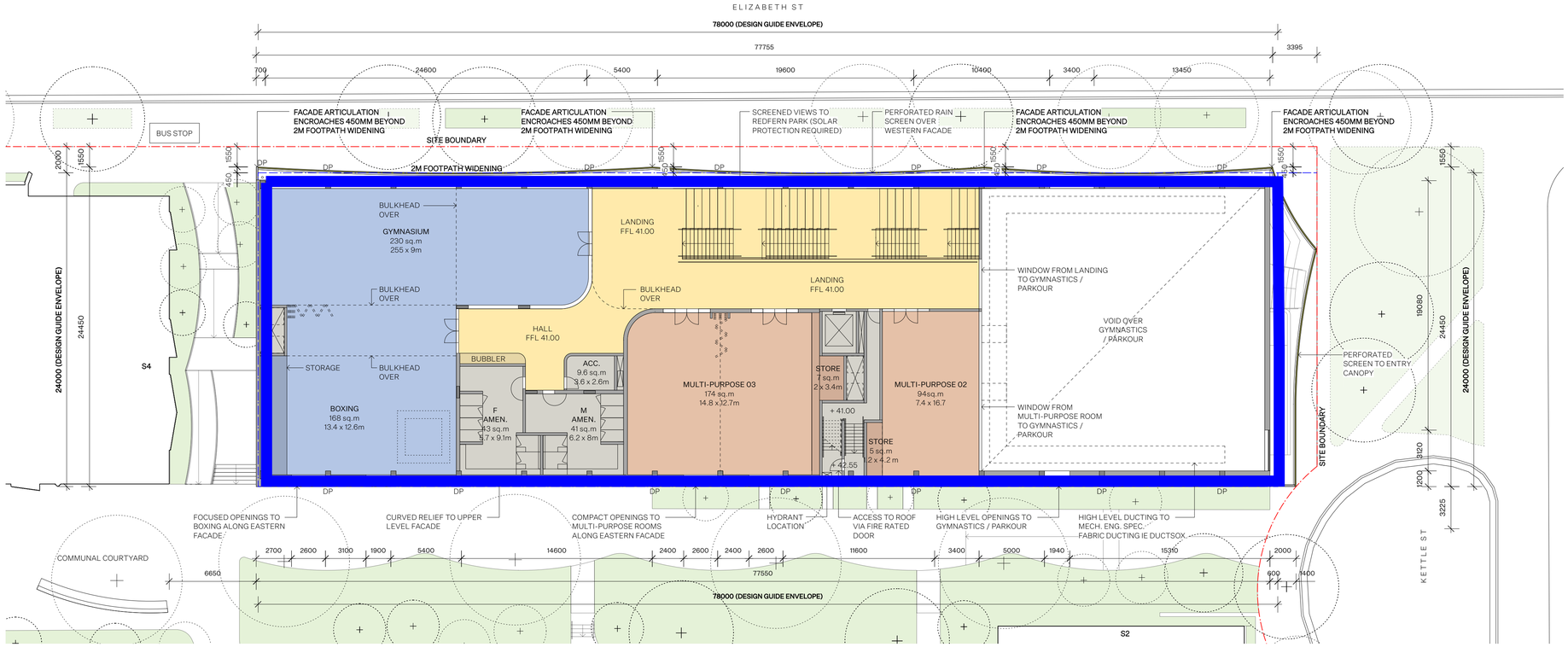
S1 PLAN - GROUND FLOOR / LEVEL 1

Project No. 2314

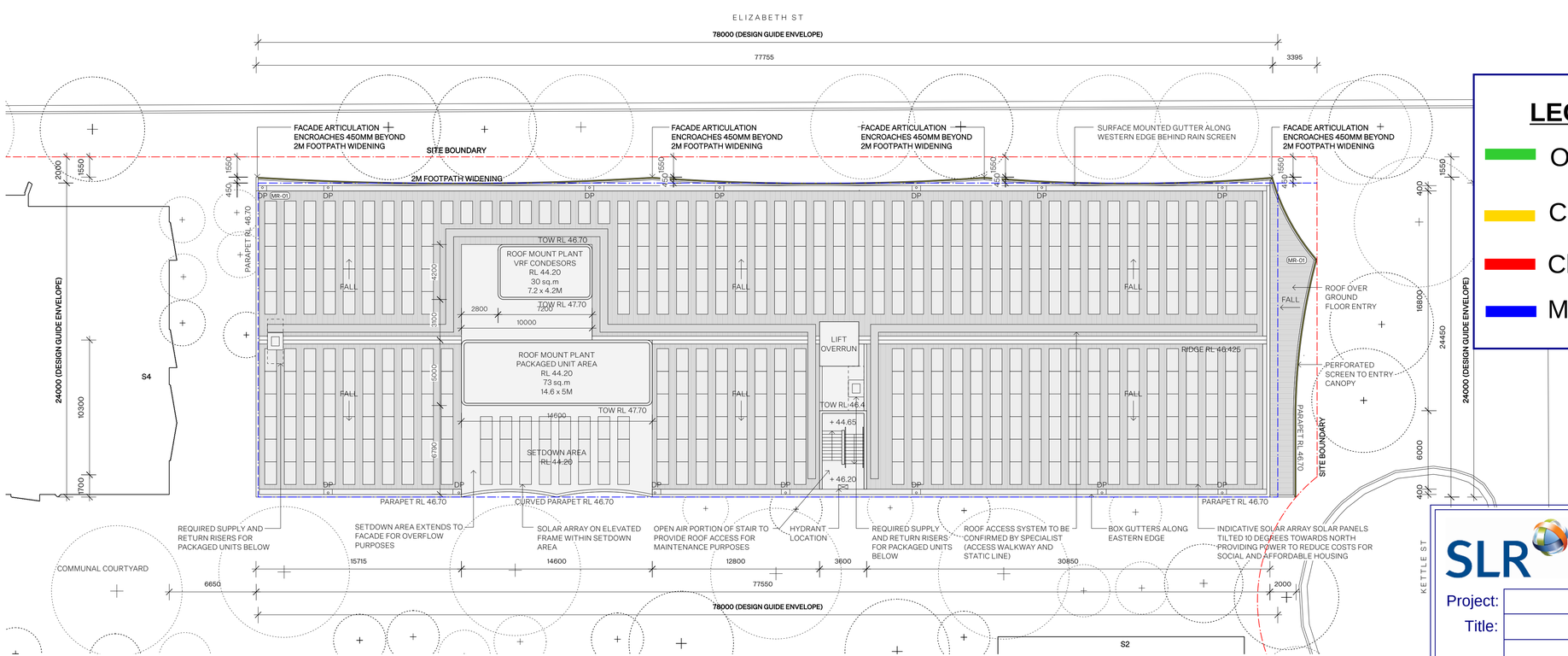
Revision -

Drawing No. S1.A02.01

Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.



01 - S1 PLAN - LEVEL 2 1:200



02 - S1 PLAN - ROOF 1:200

LEGEND

- Open windows
- Closed window and cross ventilated
- Closed window and treated plenums
- Mechanically ventilated

SLR

Project:

Title:

Date:

By: Reviewed:

Project Title:

Redfern Place

600-660 Elizabeth St, Redfern NSW 2106

Sheet drawn by:

ARCHITECTURE AND

REGISTERED ARCHITECT
NSW #7447
VIC #9560
TAS #1030
ACT #2607

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W architecture-and.au
A SUITE 1, 67 ELIZABETH ST REDFERN NSW 2016

Project Architectural Team:

Architecture AND — S1 Lead Architect

SILVESTERRELLI — S2 Lead Architect

hayball — Precinct + S3 + S4 Lead Architect

Notes:

Compliance:

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- COMPLY WITH THE BUILDING CODE OF AUSTRALIA.
- COMPLY WITH ALL RELEVANT AUSTRALIAN STANDARDS.
- DIMENSIONS IN MILLIMETRES.
- DO NOT SCALE. USE FIGURED DIMENSIONS ONLY.
- NOTIFY ARCHITECT IF DISCREPANCY EXISTS.

Drawn By	JS
Checked By	AB
Date Printed	03/05/2024
Scale	NA @ A1

0 1 2 3 5 m

Rev	Date	Description
-	06/06/2024	SSDA

SSDA

Drawing Title:

S1 PLAN - LEVEL 2 / ROOF

Project No. 2314

Revision -

Drawing No. S1.A02.01

Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.

LEGEND

- Open windows (green)
- Closed window and cross ventilated (yellow)
- Closed window and treated plenums (red)
- Mechanically ventilated (blue)

SLR

Project:	
Title:	
Date:	
By:	Reviewed:

Project Title:
Redfern Place
600-660 Elizabeth St,
Redfern NSW 2106

Sheet drawn by: SILVESTER FULLER
Silvester Fuller Pty Ltd
12 Little Riley Street
Surry Hills NSW 2010 Australia
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Penny Fuller NSW ARB 7889
Jad Silvester NSW ARB 8027
ABN 31 127 430 719

Project Architectural Team:
Architecture AND — S1 Lead Architect
SILVESTER FULLER — S2 Lead Architect
hayball — Precinct + S3 + S4 Lead Architect

Drawn By	RF
Checked By	PF
Date Printed	06.06.2024
Scale	1:200 @ A1

Rev	Date	Description
A	6/6/2024	Issued For SSDA

Status:
STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title:
GA Plan - Ground

Project No. 180
Revision A
Drawing No. S2.A02.01

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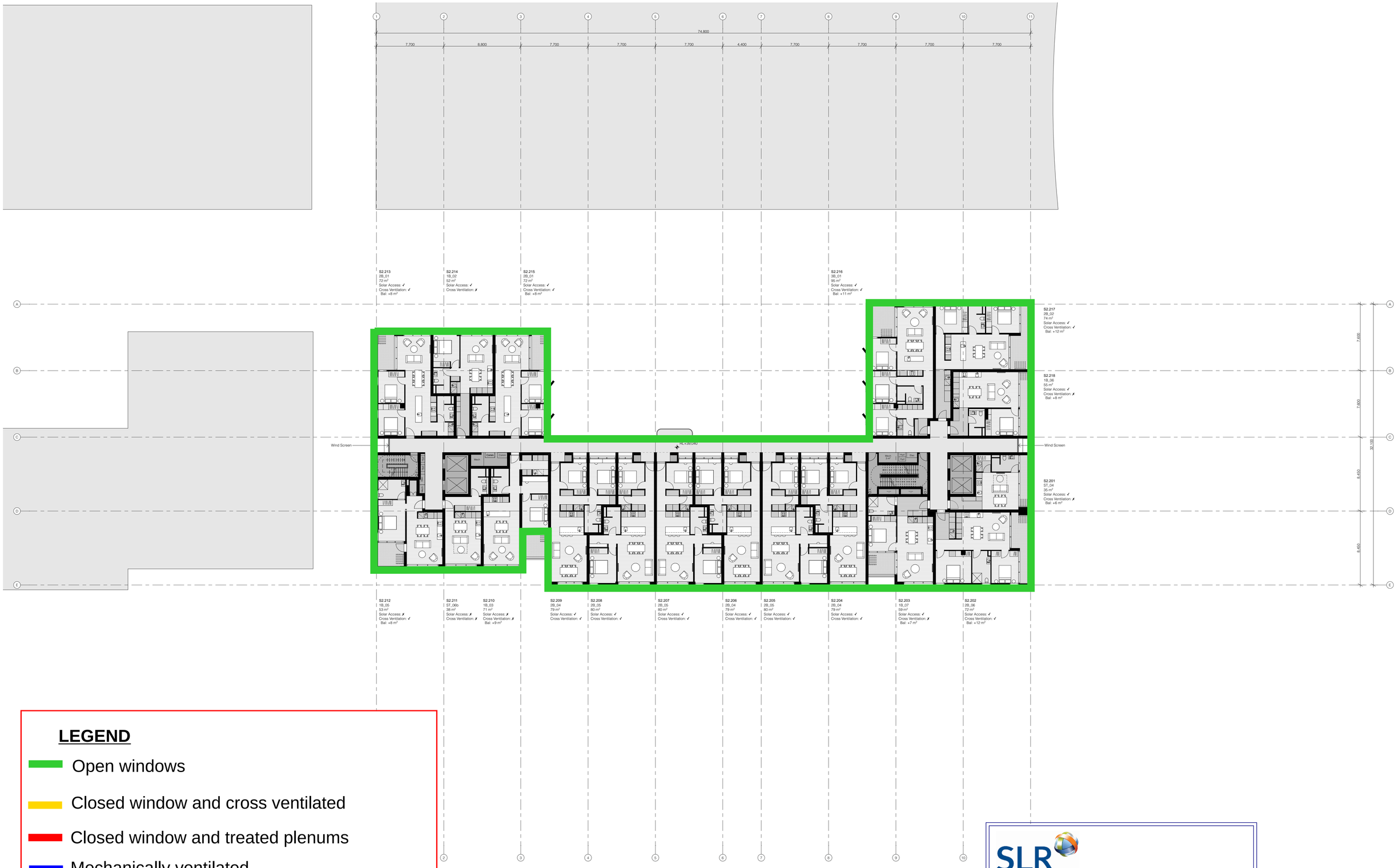

LEGEND

- Open windows
- Closed window and cross ventilated
- Closed window and treated plenums
- Mechanically ventilated

Project Title:

Redfern Place

600-660 Elizabeth St,
Redfern NSW 2106

Sheet drawn by:

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Jad Silvester NSW ARB 8027

ABN 31 127 430 719

Project Architectural Team:

Architecture AND — **S1 Lead Architect**

SILVESTER FULLER — **S2 Lead Architect**

hayball — **Precinct + S3 + S4 Lead Architect**

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Rev	Date	Description
A	6/6/2024	Issued For

SLR

Project:

Title:

Date:

By: Reviewed:

Project No. 180

Revision A

Drawing No. S2.A02.03

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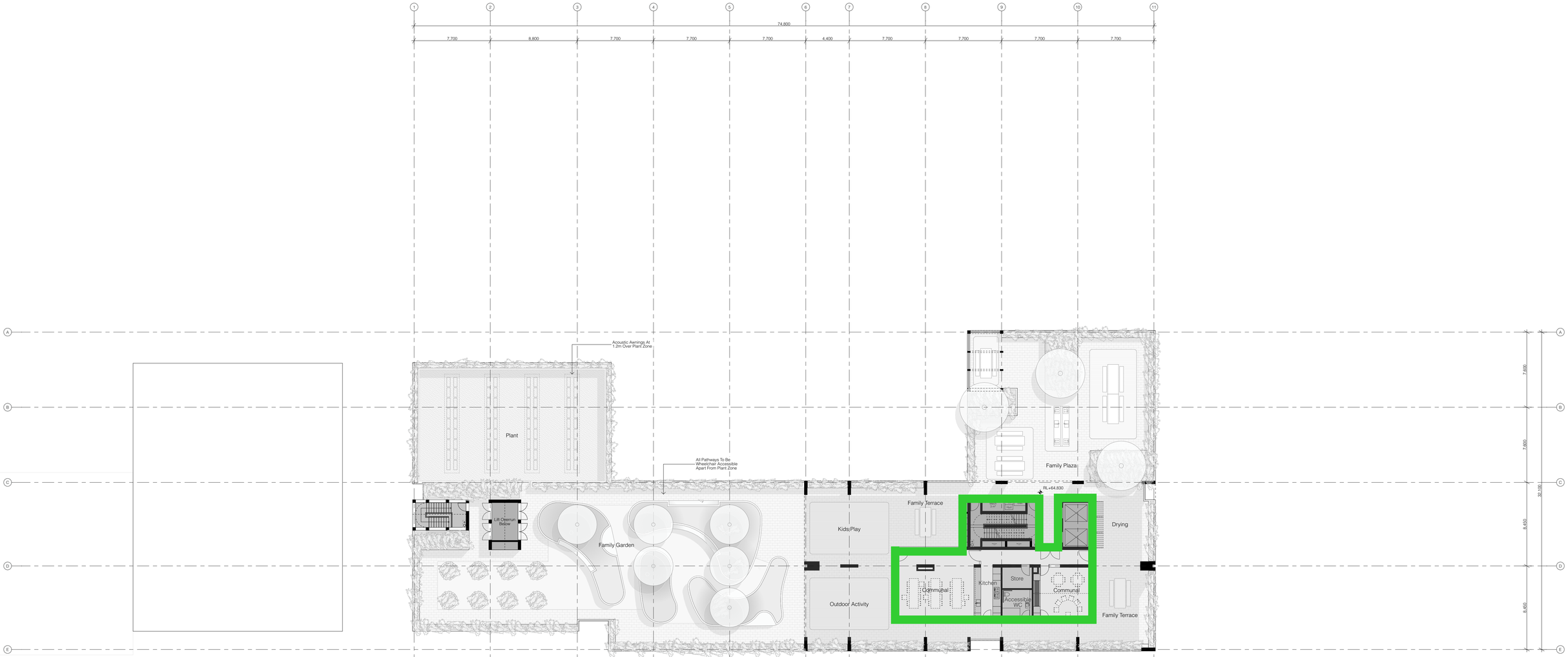

LEGEND

- Open windows
- Closed window and cross ventilated
- Closed window and treated plenums
- Mechanically ventilated

SLR

Project:

Title:

Date:

By: Reviewed:

Project Title:

Redfern Place

600-660 Elizabeth St,
Redfern NSW 2106

Sheet drawn by:

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Jad Silvester NSW ARB 8027

ABN 31 127 430 719

Project Architectural Team:

Architecture AND — **S1 Lead Architect**

SILVESTER FULLER — **S2 Lead Architect**

hayball — **Precinct + S3 + S4 Lead Architect**

Notes:

Drawn By	RF
Checked By	PF
Date Printed	06.06.2024
Scale	1:200 @ A1

Rev	Date	Description
A	6/6/2024	Issued For SSDA

Status:
STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title:
GA Plan - Level 10

Project No. 180

Revision A

Drawing No. S2.A02.11

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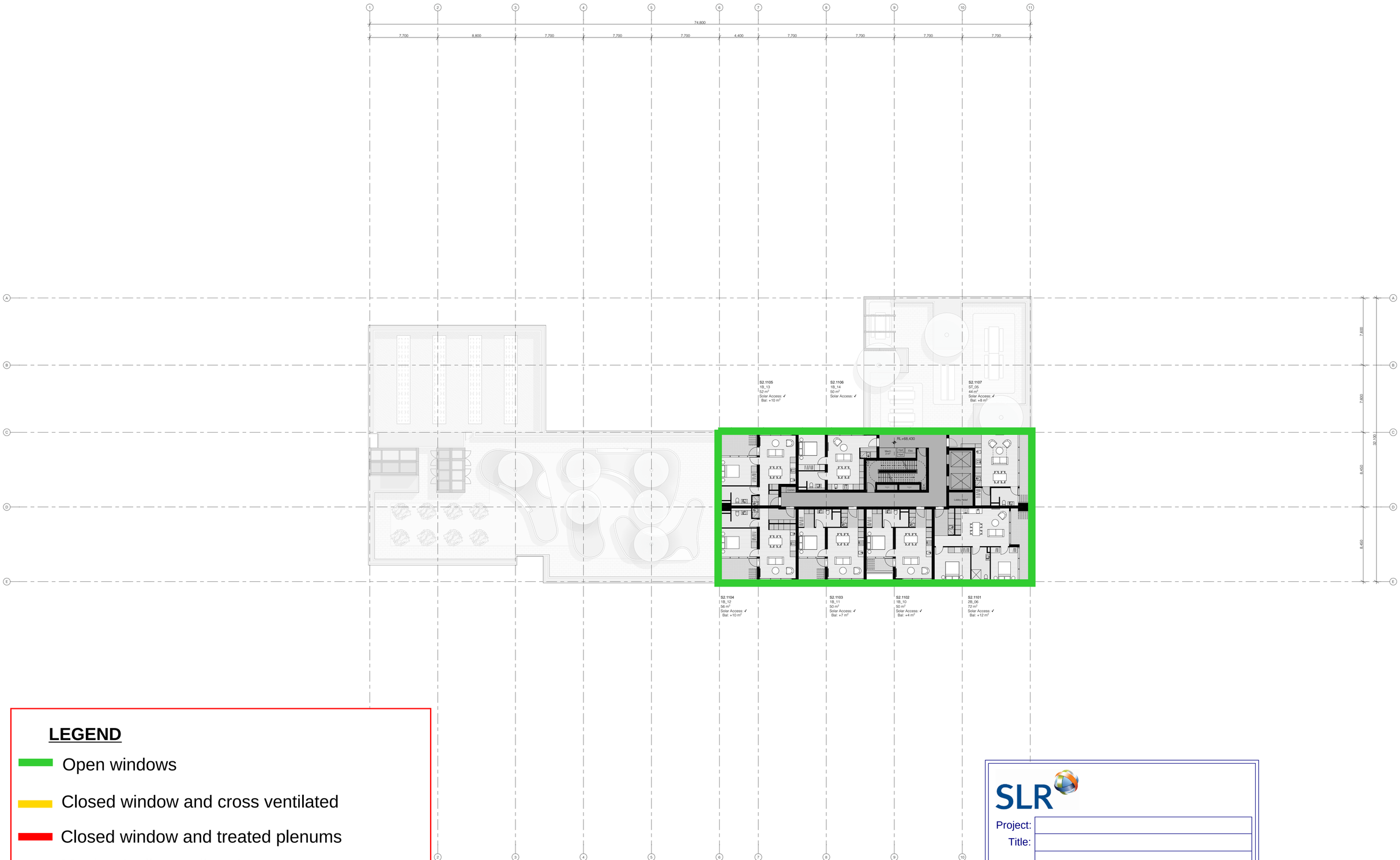

LEGEND

- Open windows
- Closed window and cross ventilated
- Closed window and treated plenums
- Mechanically ventilated

SLR

Project:

Title:

Date:

By: Reviewed:

Project Title:

Redfern Place

600-660 Elizabeth St,
Redfern NSW 2106

Sheet drawn by:

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Architecture AND — S1 Lead Architect

SILVESTER FULLER — S2 Lead Architect

hayball — Precinct + S3 + S4 Lead Architect

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Status:

STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title:

GA Plan - Level 11

Project No. 180

Revision A

Drawing No.

S2.A02.12

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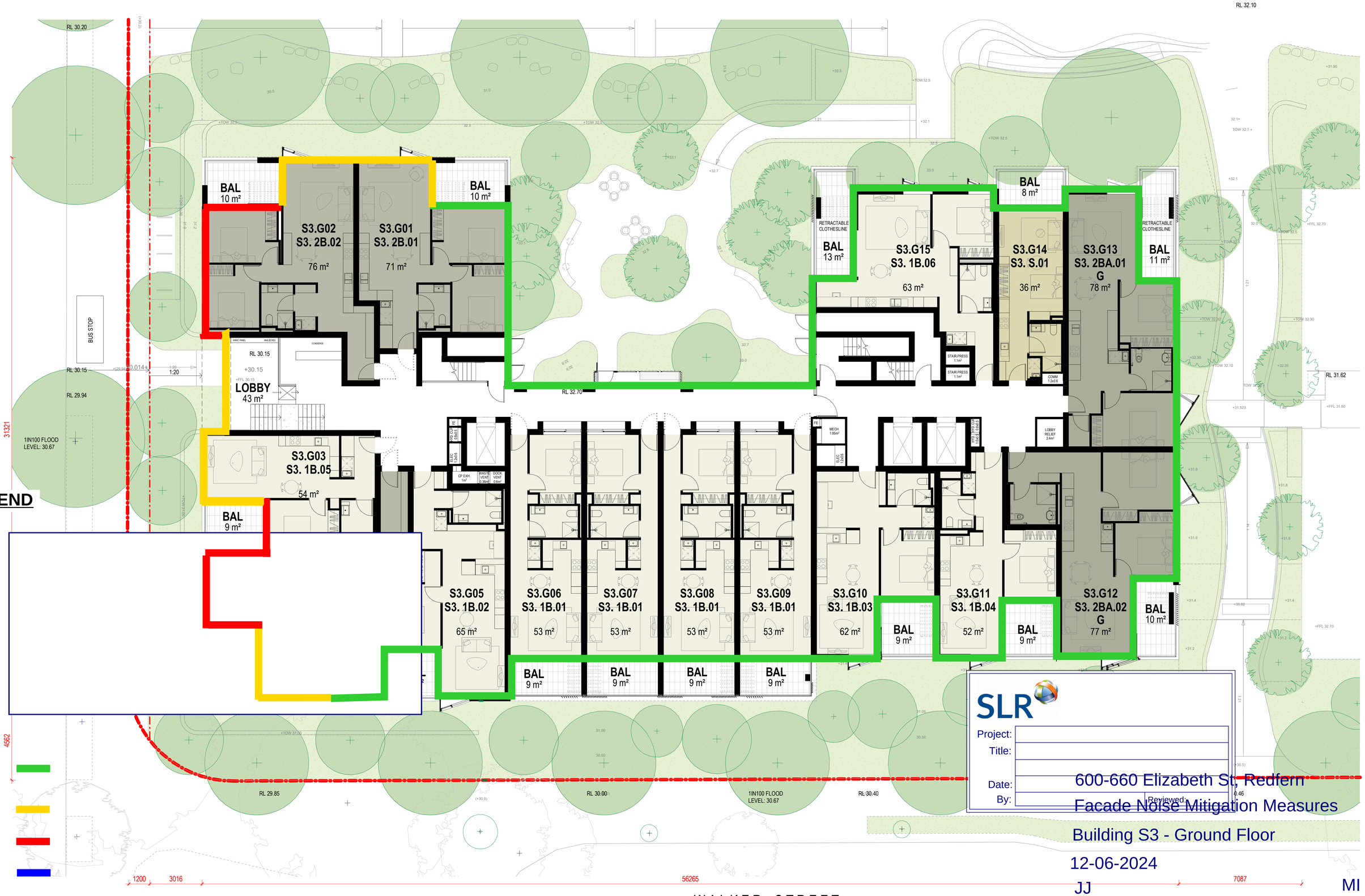

LEGEND

SLR

Project: 600-660 Elizabeth St, Redfern

Title: Facade Noise Mitigation Measures

Date: Building S3 - Ground Floor

By: 12-06-2024 Reviewed: JJ MI

Project Title:
600-660 Elizabeth Street, Redfern (Redfern Place)

Sheet drawn by:
hayball

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Sydney: Ground Floor, 11-17 Buckingham Street, Surry Hills NSW 2010, T +61 2 9660 9329
Brisbane: Level 5, 293 Queen Street, Brisbane Qld 4000, T +61 7 3211 9821
Canberra: Level 1, 33 Allara Street, Canberra ACT 2601, T +61 2 9660 9329
ABN: 84006394261 NSW Nominated Architects: David Tordoff 8028

Project Architectural Team:
Architecture AND — S1 Lead Architect
SILVESTERFULLER — S2 Lead Architect
hayball — Precinct + S3 + S4 Lead Architect

Notes:

Drawn By	JC
Checked By	DT
Date Printed	7/06/2024 3:20:59 PM
Scale	1 : 100@ A1

0 1 2 3 5 m

Rev	Date	Description
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P2	20/05/2024	SSDA Draft
P3	06/06/2024	SSDA Draft

Status:
STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title:
S3 PLAN - GROUND FLOOR

Project No. 2610 **Revision** P3

Drawing No. S3.A02.00

LEGEND

SLR

Project:

Title:

Date:

By:

Reviewed:

600-660 Elizabeth St, Redfern

Facade Noise Mitigation Measures

Building S3 - Level 1

12-06-2024

Project Title:
600-660 Elizabeth Street, Redfern (Redfern Place)

Sheet drawn by:
hayball

Melbourne: Level 1, 250 Flinders Lane, Melbourne VIC 3000, T +61 3 9699 3644
Sydney: Ground Floor, 11-17 Buckingham Street, Surry Hills NSW 2010, T +61 2 9660 9329
Brisbane: Level 5, 293 Queen Street, Brisbane Qld 4000, T +61 7 3211 9821
Canberra: Level 1, 33 Allara Street, Canberra ACT 2601, T +61 2 9660 9329
ABN: 84006394261 NSW Nominated Architects: David Tordoff 8028

Project Architectural Team:
Architecture AND — S1 Lead Architect
SILVESTERFULLER — S2 Lead Architect
hayball — Precinct + S3 + S4 Lead Architect

Notes:

Drawn By	JC
Checked By	DT
Date Printed	7/06/2024 3:21:07 PM
Scale	1 : 100@ A1

0 1 2 3 5 m

Rev	Date	Description
P1	07/05/2024	SSDA Draft
P2	20/05/2024	SSDA Draft
P3	06/06/2024	SSDA Draft

Status:
STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title:
S3 PLAN - LEVEL 1

Project No. 2610

Revision P3

Drawing No. S3.A02.01

Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.

LEGEND

WALKER STREET

SLR

Project:

Title:

Date:

By: Reviewed:

600-660 Elizabeth St, Redfern

Facade Noise Mitigation Measures

Building S3 - Level 2 and Level 3

12-06-2024

MI

Project Title:
600-660 Elizabeth Street, Redfern (Redfern Place)

Sheet drawn by: hayball

Melbourne: Level 1, 250 Flinders Lane, Melbourne VIC 3000, T +61 3 9699 3644
Sydney: Ground Floor, 11-17 Buckingham Street, Surry Hills NSW 2010, T +61 2 9660 9329
Brisbane: Level 5, 293 Queen Street, Brisbane Qld 4000, T +61 7 3211 9821
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hayball — Precinct + S3 + S4 Lead Architect

Notes:

Drawn By	JC
Checked By	DT
Date Printed	7/06/2024 3:21:07 PM
Scale	1 : 100@ A1

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Rev	Date	Description
P1	07/05/2024	SSDA Draft
P2	20/05/2024	SSDA Draft
P3	06/06/2024	SSDA Draft

Status: STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title: S3 PLAN - LEVEL 1

Project No. 2610

Revision P3

Drawing No. S3.A02.01

LEGEND

SLR

Project:

Title:

Date:

By:

Reviewed:

600-660 Elizabeth St, Redfern

Facade Noise Mitigation Measures

Building S3 - Level 4

12-06-2024

Project Title:
600-660 Elizabeth Street, Redfern (Redfern Place)

Sheet drawn by:

hayball

Melbourne
Level 1
250 Flinders Lane
Melbourne VIC 3000
T +61 3 9699 3644

Sydney
Ground Floor
11-17 Buckingham Street
Surry Hills NSW 2010
T +61 2 9660 9329

Brisbane
Level 5,
293 Queen Street,
Brisbane Qld 4000
T +61 7 3211 9821

Canberra
Level 1,
33 Allara Street,
Canberra ACT 2601
T +61 2 9660 9329

ABN: 84006394261 NSW Nominated Architects: David Tordoff 8028

Project Architectural Team:

Architecture AND — S1 Lead Architect

SILVESTERFULLER — S2 Lead Architect

hayball — Precinct + S3 + S4 Lead Architect

Notes:

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P2	20/05/2024	SSDA Draft
P3	06/06/2024	SSDA Draft

Status:
STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title:
S3 PLAN - LEVEL 4

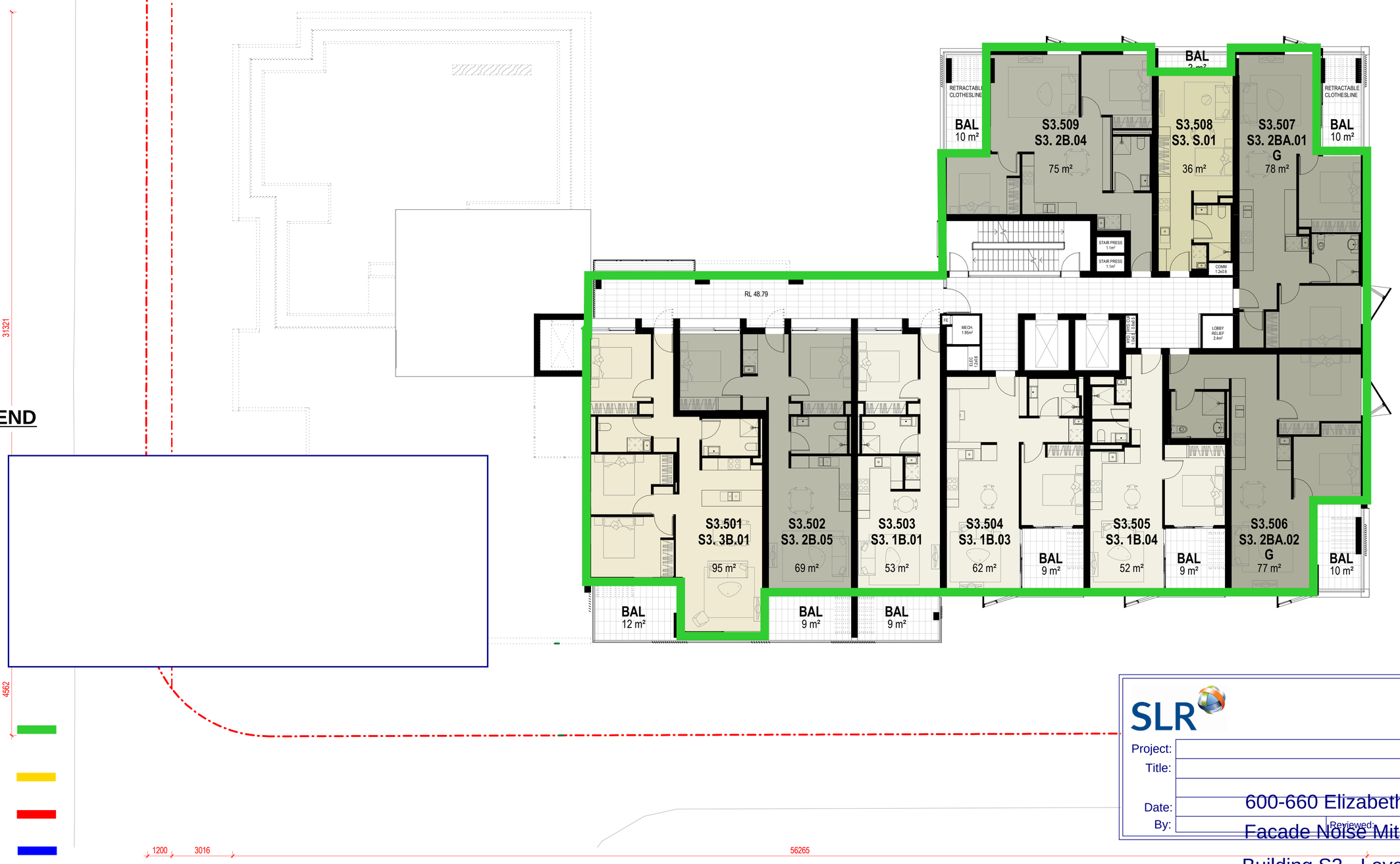
Project No. 2610

Revision P3

Drawing No. S3.A02.04

MI

Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.



LEGEND

SLR

Project:

Title:

Date:

By:

Reviewed:

600-660 Elizabeth St, Redfern

Facade Noise Mitigation Measures

Building S3 - Level 5 to Level 6

Project Title:
600-660 Elizabeth Street, Redfern (Redfern Place)

Sheet drawn by:

hayball

Melbourne: Level 1, 250 Flinders Lane, Melbourne VIC 3000, T +61 3 9699 3644
Sydney: Ground Floor, 11-17 Buckingham Street, Surry Hills NSW 2010, T +61 2 9660 9329
Brisbane: Level 5, 293 Queen Street, Brisbane Qld 4000, T +61 7 3211 9821
Canberra: Level 1, 33 Allara Street, Canberra ACT 2601, T +61 2 9660 9329

ABN: 84006394261 NSW Nominated Architects: David Tordoff 8028

Project Architectural Team:

Architecture AND — S1 Lead Architect
SILVESTERFULLER — S2 Lead Architect
hayball — Precinct + S3 + S4 Lead Architect

Notes:

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Checked By	DT
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Rev	Date	Description
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P2	20/05/2024	SSDA Draft
P3	06/06/2024	SSDA Draft

Status: STATE SIGNIFICANT DEVELOPMENT APPLICATION

12-06-2024

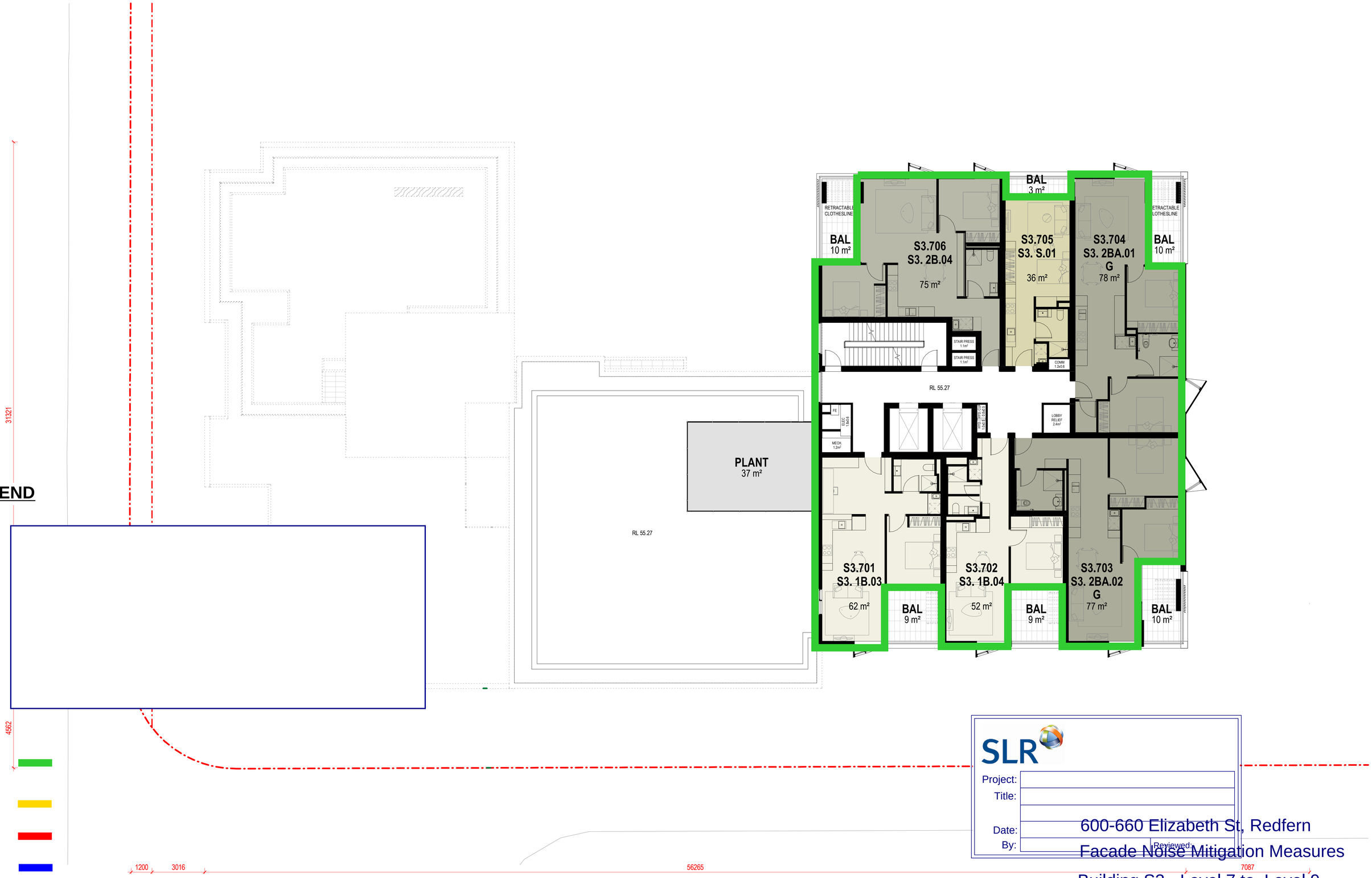
Drawing Title: S3 PLAN - LEVEL 5

Project No. 2610

Revision P3

Drawing No. S3.A02.05

Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.



LEGEND

SLR

Project:

Title:

Date:

By:

Reviewed:

600-660 Elizabeth St, Redfern
Facade Noise Mitigation Measures
Building S3 - Level 7 to Level 9

12-06-2024

Project Title:
600-660 Elizabeth Street, Redfern (Redfern Place)

Sheet drawn by:

hayball

Melbourne: Level 1, 250 Flinders Lane, Melbourne VIC 3000, T +61 3 9699 3644
Sydney: Ground Floor, 11-17 Buckingham Street, Surry Hills NSW 2010, T +61 2 9660 9329
Brisbane: Level 5, 293 Queen Street, Brisbane Qld 4000, T +61 7 3211 9821
Canberra: Level 1, 33 Allara Street, Canberra ACT 2601, T +61 2 9660 9329

ABN: 84006394261 NSW Nominated Architects: David Tordoff 8028

Project Architectural Team:

Architecture AND — S1 Lead Architect
SILVESTERFULLER — S2 Lead Architect
hayball — Precinct + S3 + S4 Lead Architect

Notes:

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Checked By	DT
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Rev	Date	Description
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P2	20/05/2024	SSDA Draft
P3	06/06/2024	SSDA Draft

Status: STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title: S3 PLAN - LEVEL 7

Project No. 2610

Revision P3

Drawing No. S3.A02.07

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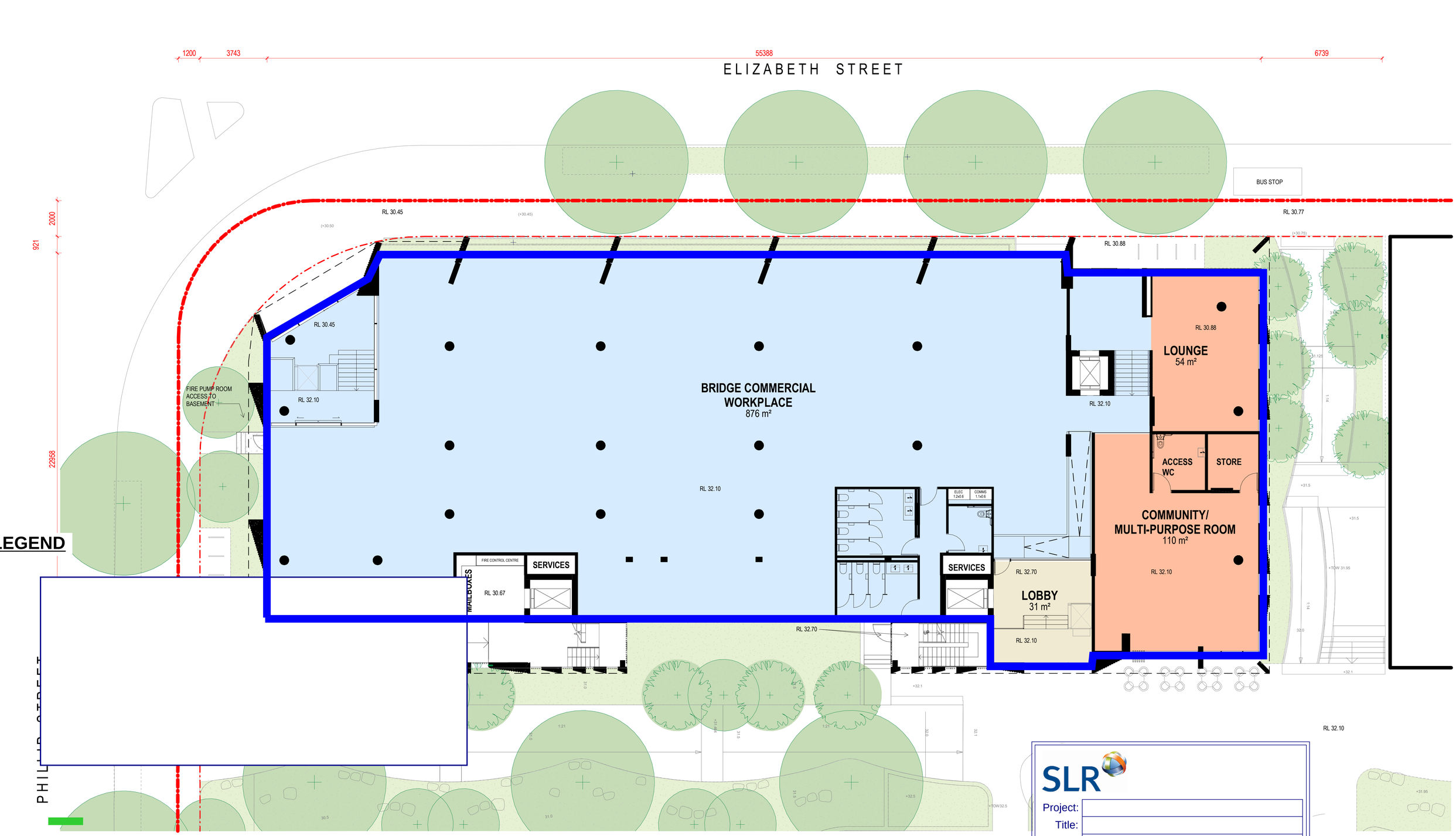
Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.



LEGEND

SLR

Project:

Title:

Date:

By:

Reviewed:

600-660 Elizabeth St, Redfern

Facade Noise Mitigation Measures

Building S4 - Ground Floor

12-06-2024

JJ

MI

Project Title:
600-660 Elizabeth Street,
Redfern (Redfern Place)

Sheet drawn by:

hayball

Melbourne	Sydney	Brisbane	Canberra
Level 1 250 Flinders Lane Melbourne VIC 3000 T +61 3 9699 3644	Ground Floor 11-17 Buckingham Street Surry Hills NSW 2010 T +61 2 9660 9329	Level 5, 293 Queen Street, Brisbane Qld 4000 T +61 7 3211 9821	Level 1, 33 Allara Street, Canberra ACT 2601 T +61 2 9660 9329

ABN: 84006394261 NSW Nominated Architects: David Tordoff 8028

Project Architectural Team:

Architecture AND — S1 Lead Architect

SILVESTERFULLER — S2 Lead Architect

hayball — Precinct + S3 + S4 Lead Architect

Notes:

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Checked By	DT
Date Printed	7/06/2024 3:29:01 PM
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Rev	Date	Description
P1	07/05/2024	SSDA Draft
P2	20/05/2024	SSDA Draft
P3	06/06/2024	SSDA Draft

Status:
STATE SIGNIFICANT
DEVELOPMENT APPLICATION

Drawing Title:
S4 PLAN - GROUND FLOOR

Project No.
2610

Revision
P3

Drawing No.
S4.A02.00

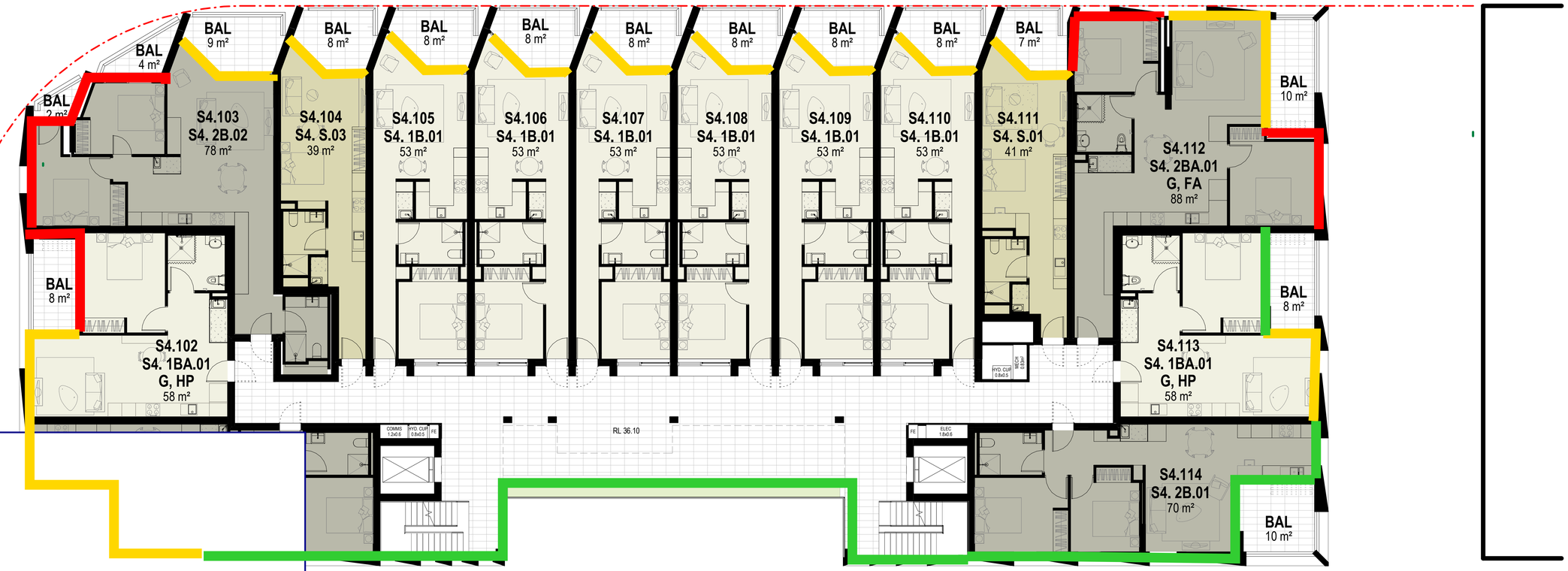
Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.

1200 3743 55388 6739

ELIZABETH STREET

921 2000 22958

PHILLIP STREET



LEGEND

SLR

Project:

Title:

Date:

By: Reviewed:

600-660 Elizabeth St, Redfern

Facade Noise Mitigation Measures

Building S4 - Level 1

12-06-2024

JJ MI

Project Title:
600-660 Elizabeth Street, Redfern (Redfern Place)

Sheet drawn by:
hayball

Melbourne
Level 1
250 Flinders Lane
Melbourne VIC 3000
T +61 3 9699 3644

Sydney
Ground Floor
11-17 Buckingham Street
Surry Hills NSW 2010
T +61 2 9660 9329

Brisbane
Level 5
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Brisbane Qld 4000
T +61 7 3211 9821

Canberra
Level 1
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Canberra ACT 2601
T +61 2 9660 9329

ABN: 84006394261 NSW Nominated Architects: David Tordoff 8028

Project Architectural Team:
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SILVESTERFULLER — S2 Lead Architect
hayball — Precinct + S3 + S4 Lead Architect

Notes:

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Checked By	DT
Date Printed	7/06/2024 3:29:12 PM
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Rev	Date	Description
P1	07/05/2024	SSDA Draft
P2	20/05/2024	SSDA Draft
P3	06/06/2024	SSDA Draft

Status:
STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title:
S4 PLAN - LEVEL 1

Project No. 2610

Revision P3

Drawing No. S4.A02.01

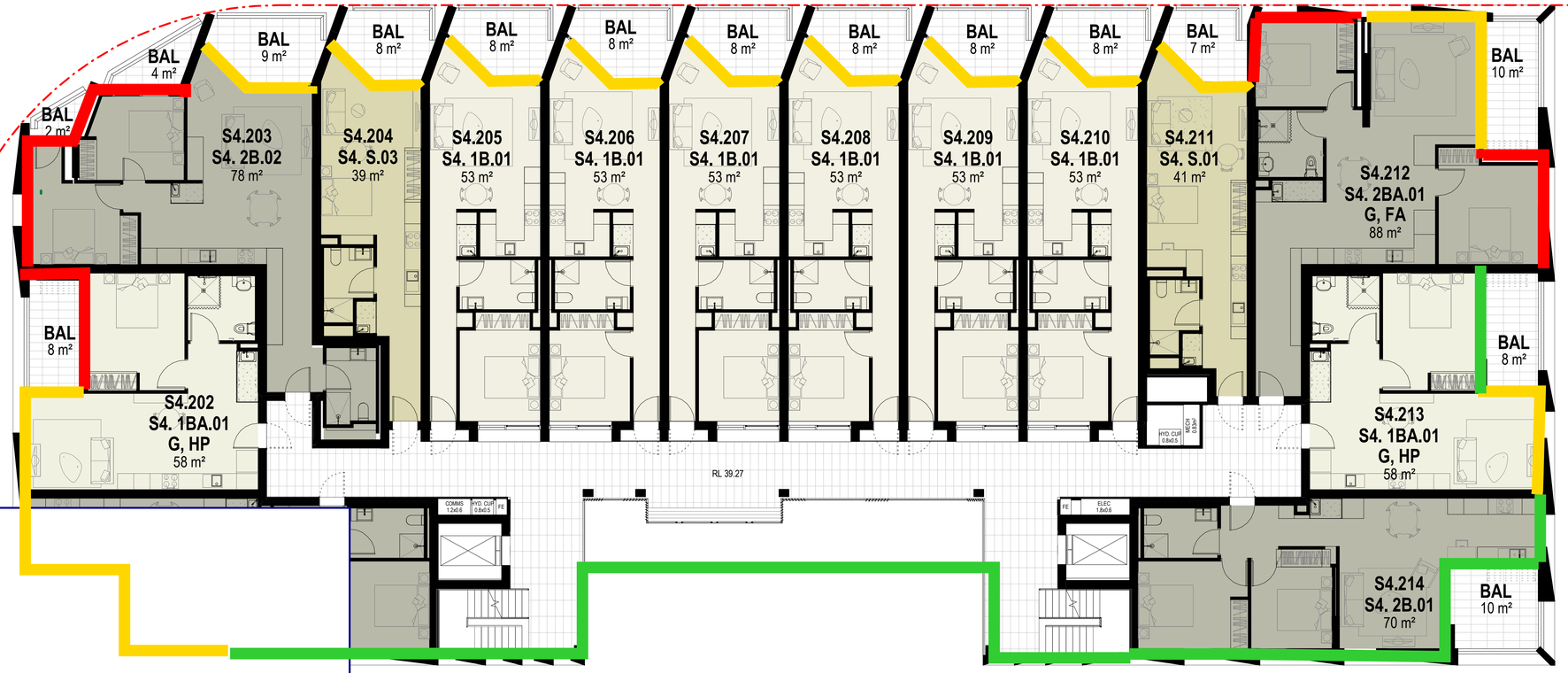
Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.

1200 3743 55388 6739

ELIZABETH STREET

2000 921 22958

PHILLIP STREET



LEGEND

SLR

Project:

Title:

Date:

By: Reviewed:

600-660 Elizabeth St, Redfern

Facade Noise Mitigation Measures

Building S4 - Level 2 and Level 3

12-06-2024

JJ MI

Project Title:
600-660 Elizabeth Street, Redfern (Redfern Place)

Sheet drawn by:
hayball

Melbourne
Level 1
250 Flinders Lane
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T +61 3 9699 3644

Sydney
Ground Floor
11-17 Buckingham Street
Surry Hills NSW 2010
T +61 2 9660 9329

Brisbane
Level 5,
293 Queen Street,
Brisbane Qld 4000
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Canberra ACT 2601
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ABN: 84006394261 NSW Nominated Architects: David Tordoff 8028

Project Architectural Team:
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SILVESTER FULLER — S2 Lead Architect
hayball — Precinct + S3 + S4 Lead Architect

Notes:

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Checked By	DT
Date Printed	7/06/2024 3:29:23 PM
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Rev	Date	Description
P1	07/05/2024	SSDA Draft
P2	20/05/2024	SSDA Draft
P3	06/06/2024	SSDA Draft

Status:
STATE SIGNIFICANT DEVELOPMENT APPLICATION

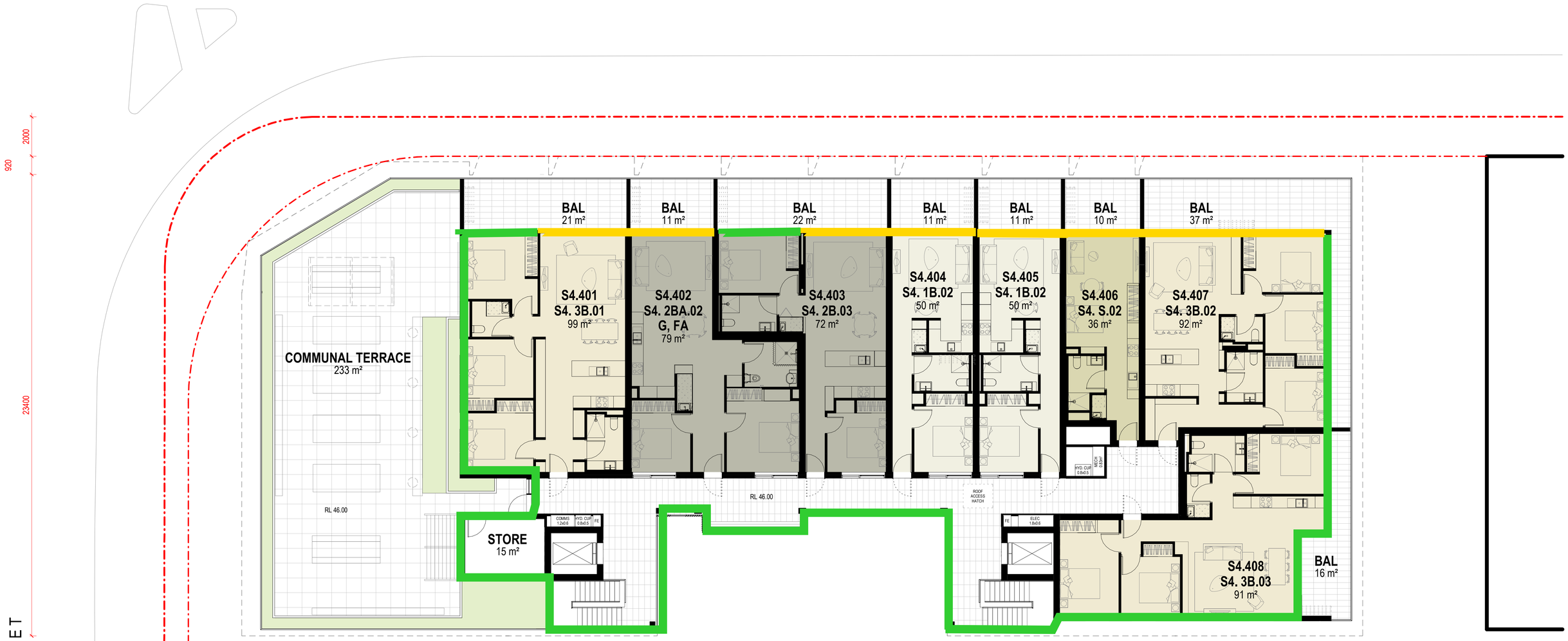
Drawing Title:
S4 PLAN - LEVEL 2

Project No. 2610

Revision P3

Drawing No. S4.A02.02

Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.



LEGEND

- Open windows
- Closed window and cross ventilated
- Closed window and treated plenums
- Mechanically ventilated

SLR

Project:	600-660 Elizabeth St, Redfern
Title:	Facade Noise Mitigation Measures
	Building S4 - Level 4
Date:	25-06-2024
By:	JJ ☐ Reviewed: MI ☐

Project Title:
600-660 Elizabeth Street, Redfern (Redfern Place)

Sheet drawn by:

hayball

Melbourne: Level 1, 250 Flinders Lane, Melbourne VIC 3000, T +61 3 9699 3644
Sydney: Ground Floor, 11-17 Buckingham Street, Surry Hills NSW 2010, T +61 2 9660 9329
Brisbane: Level 5, 293 Queen Street, Brisbane Qld 4000, T +61 7 3211 9821
Canberra: Level 1, 33 Allara Street, Canberra ACT 2601, T +61 2 9660 9329

ABN: 84006394261 NSW Nominated Architects: David Tordoff 8028

Project Architectural Team:
Architecture AND — S1 Lead Architect
SILVESTERFULLER — S2 Lead Architect
hayball — Precinct + S3 + S4 Lead Architect

Notes:

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Checked By	DT
Date Printed	26/06/2024 11:46:15 AM
Scale	1 : 100@ A1

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Rev	Date	Desc
A	19/06/2024	SSD

STATE SIGNIFICANT DEVELOPMENT APPLICATION

Drawing Title:
S4 PLAN - LEVEL 4

2610 **A**

Drawing No.
S4.A02.04

Verify all figured dimensions on site before undertaking any works. Do not scale dimensions off drawings.

Appendix F Predicted Facade Levels (Day)

Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024

Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

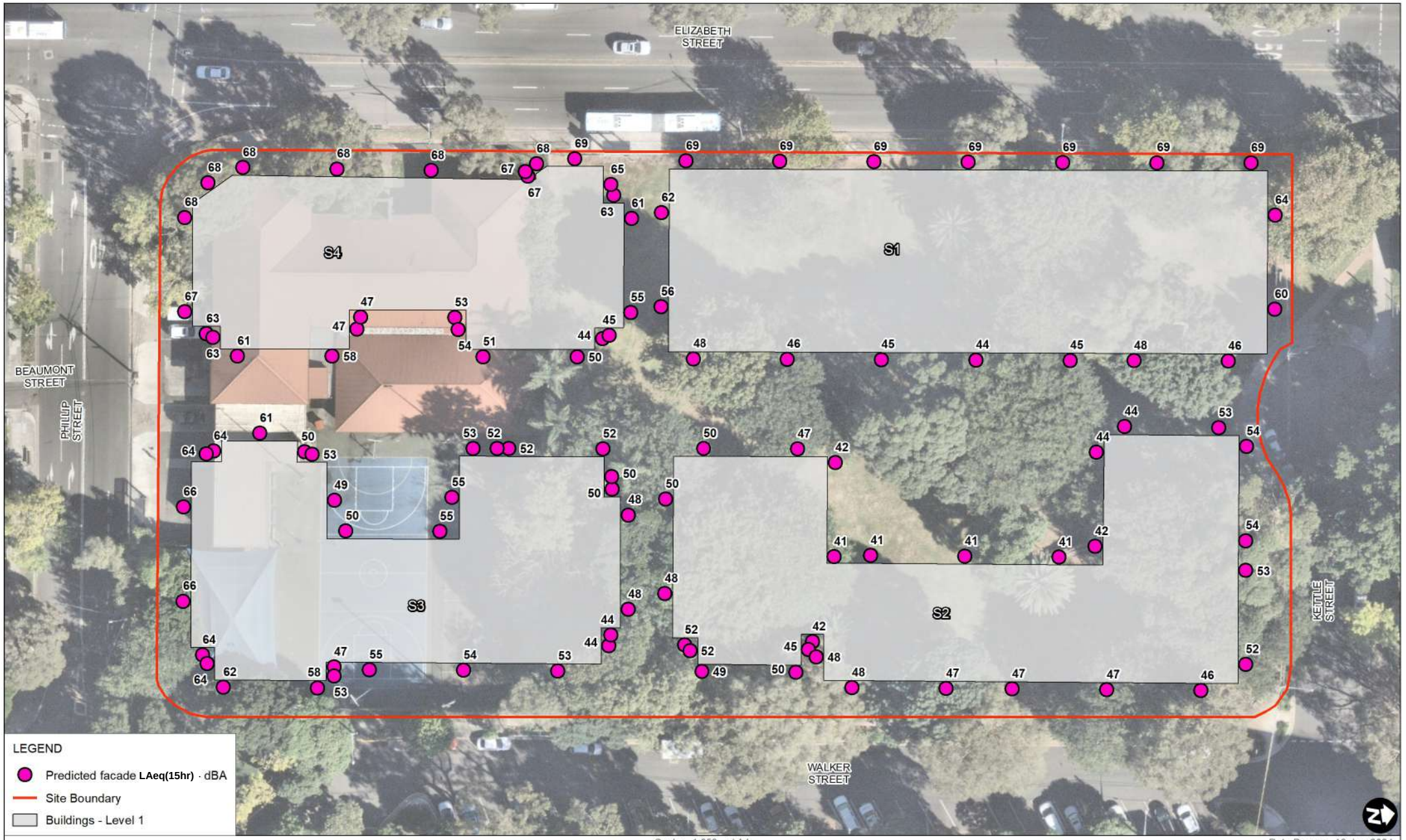
Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

GROUND FLOOR FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

\\au.slr.local\Corporate\Projects-SLR\610-SrvSYD\610-SYD\610.031388.00001 600-660 Elizabeth St, Redfern\06 SLR Data\01 CADGIS\GIS\SLR610031388_Day_GF_02.mxd



Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 1 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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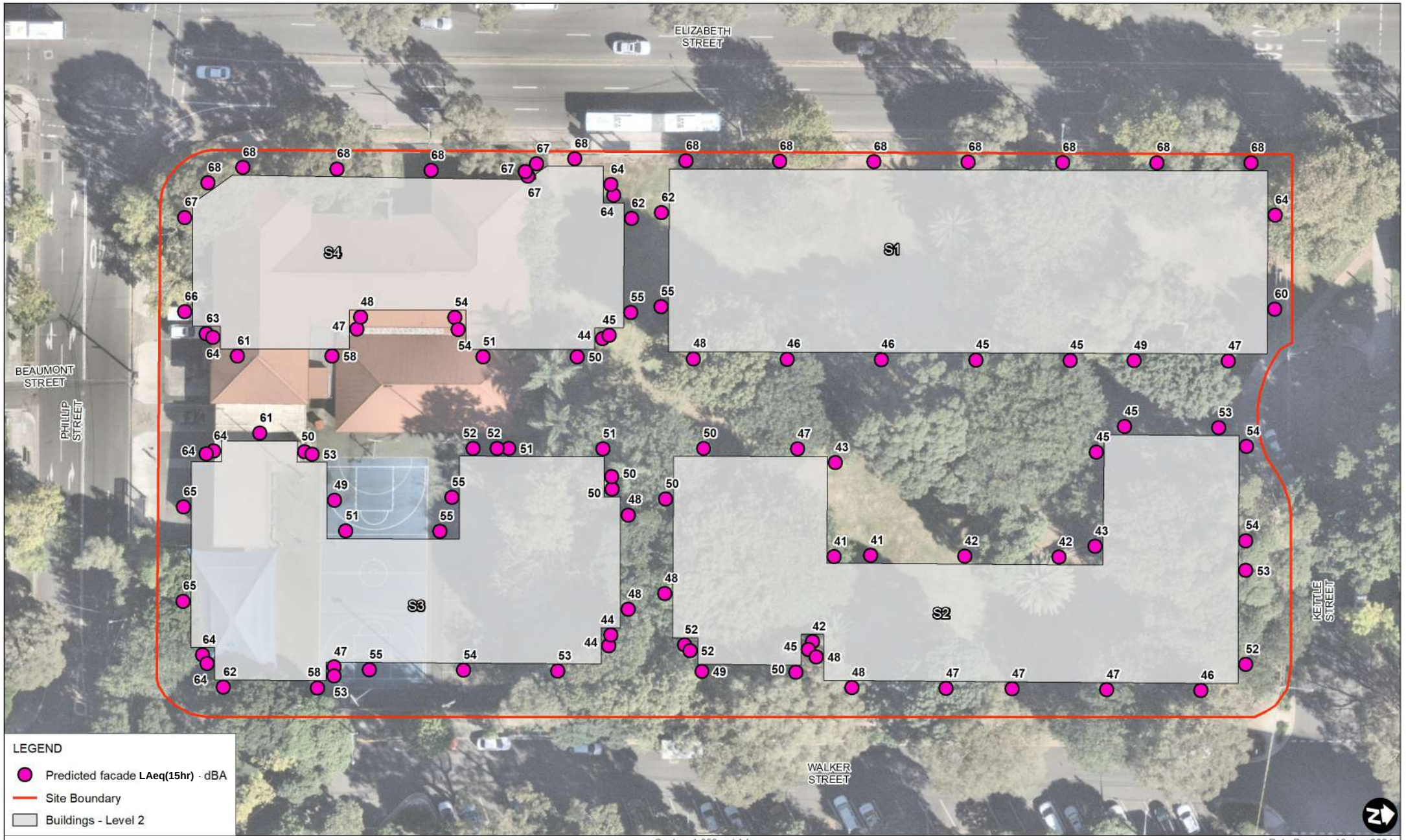

Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 2 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 3 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

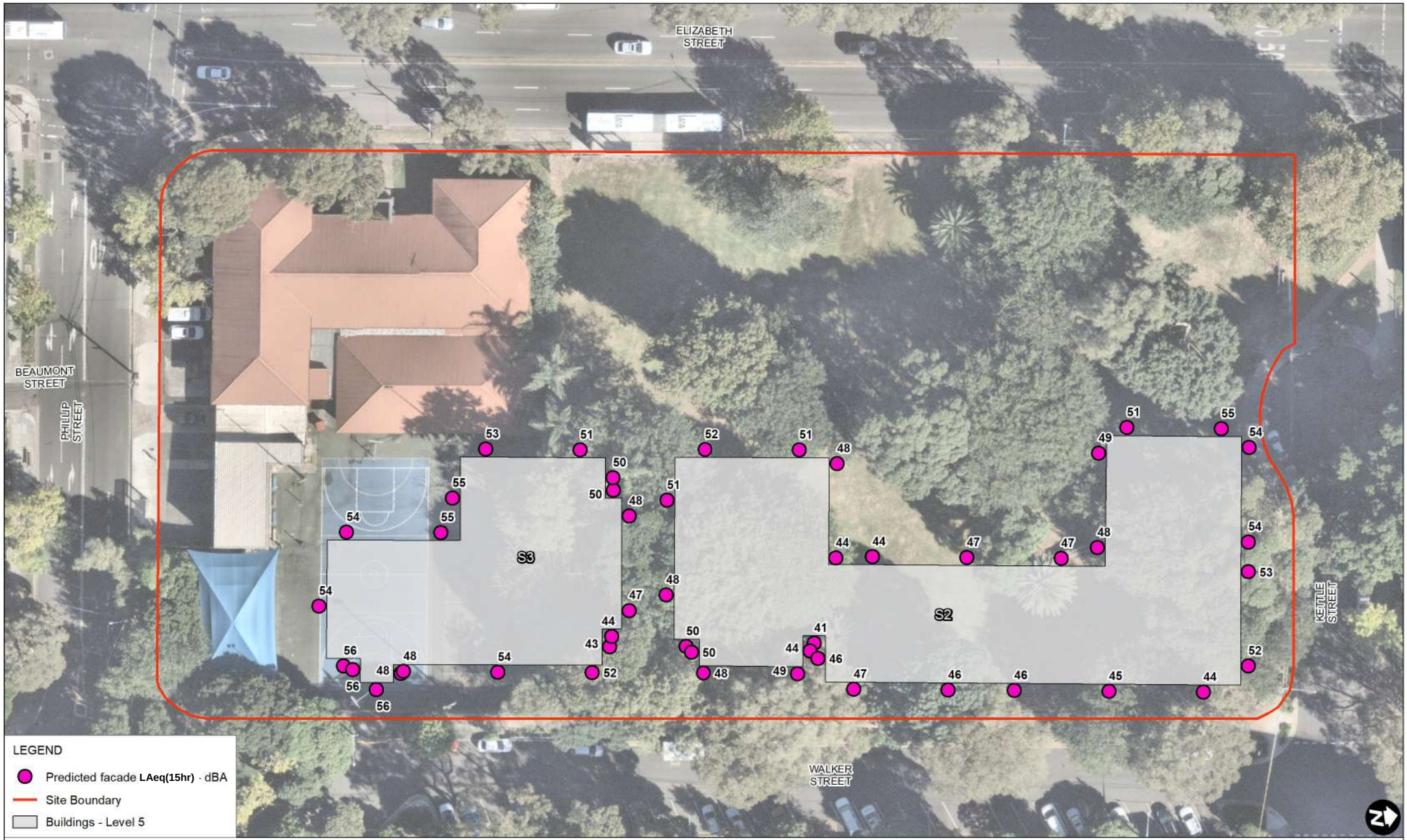
Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 4 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

\\au.slr.local\Corporate\Projects-SLR\610-SrvSYD\610-SYD\610.031388.00001 600-660 Elizabeth St, Redfern\06 SLR Data\01 CADGIS\GIS\SLR610031388_Day_F4_02.mxd



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Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 5 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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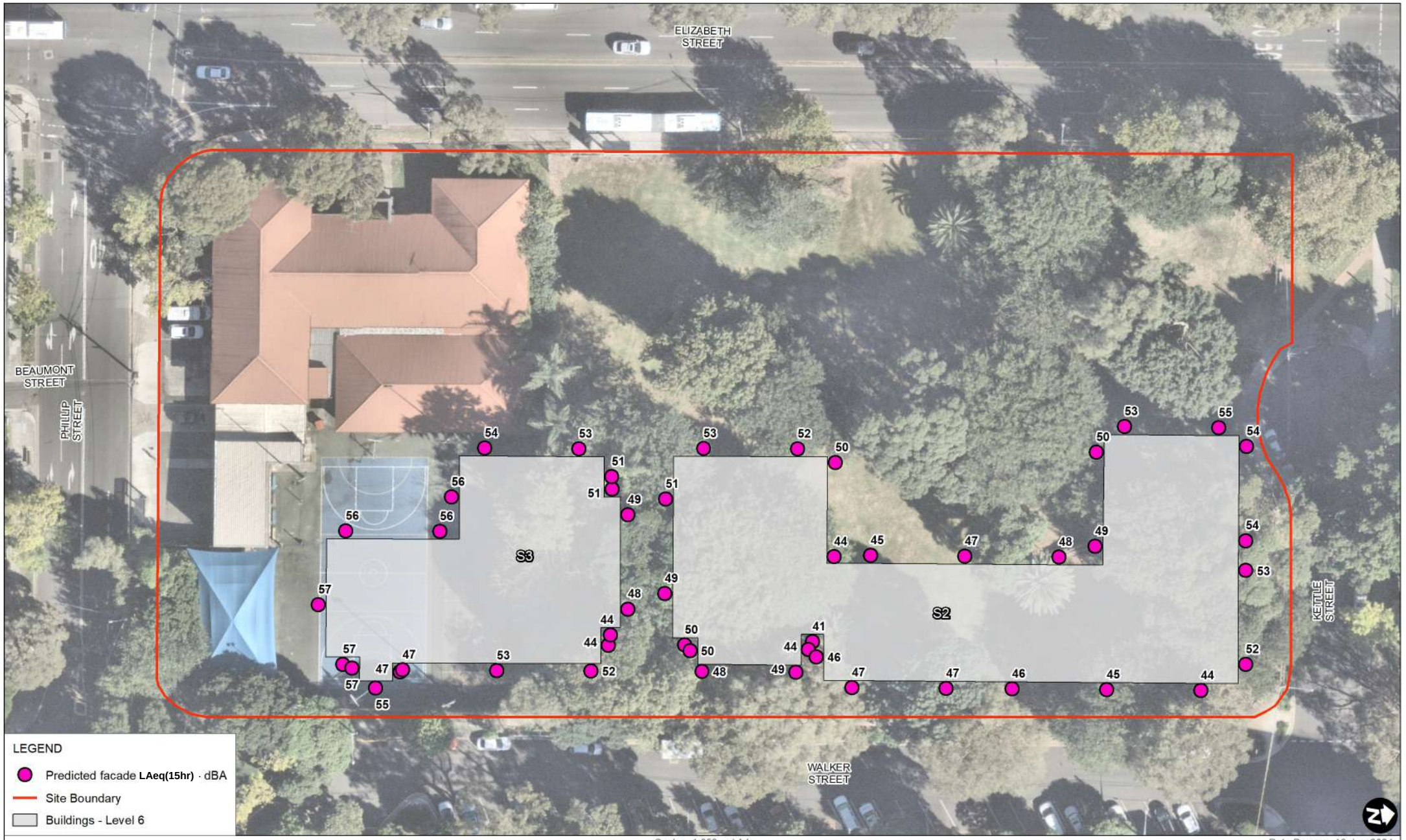

Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 6 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 7 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 8 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 9 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 10 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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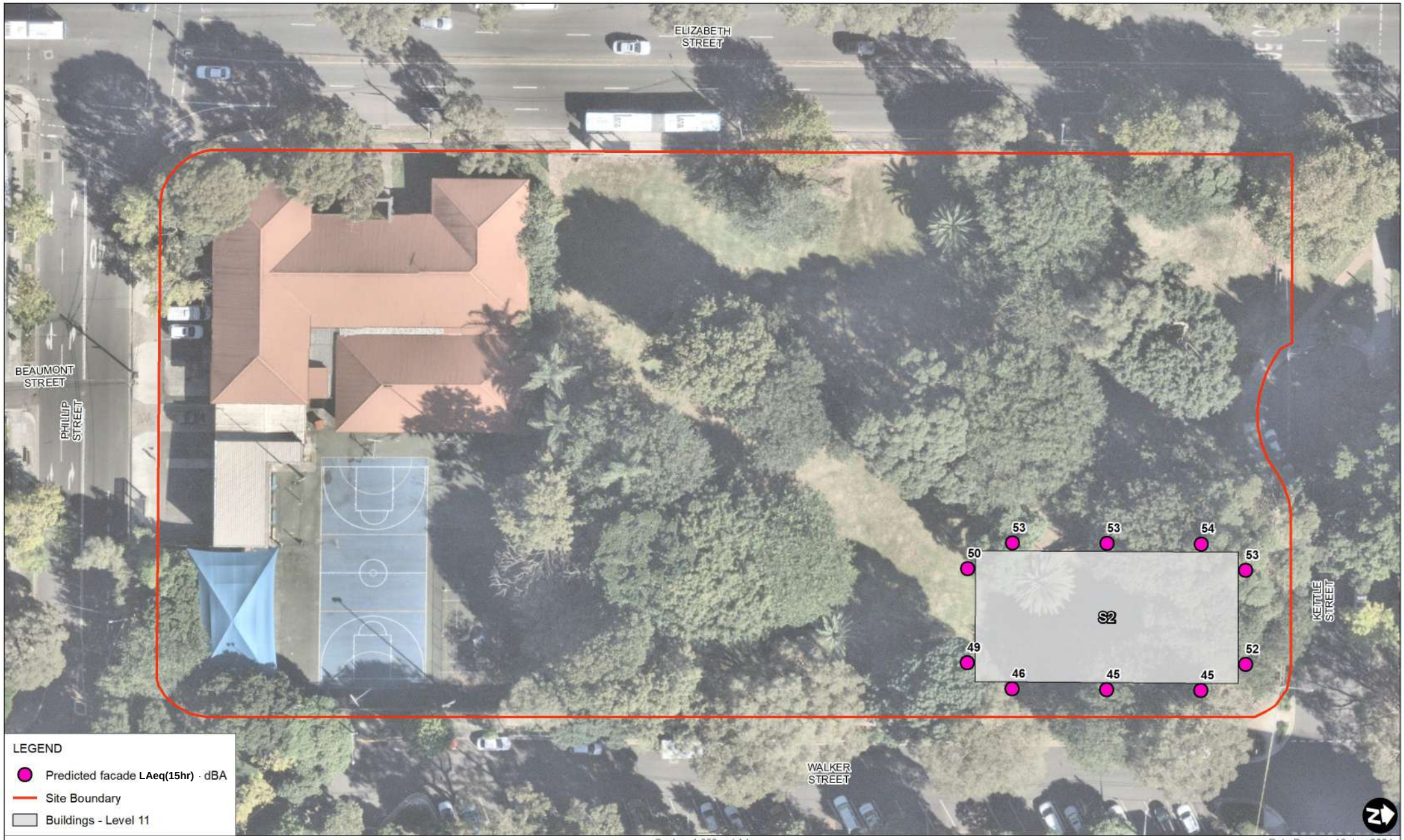

Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 11 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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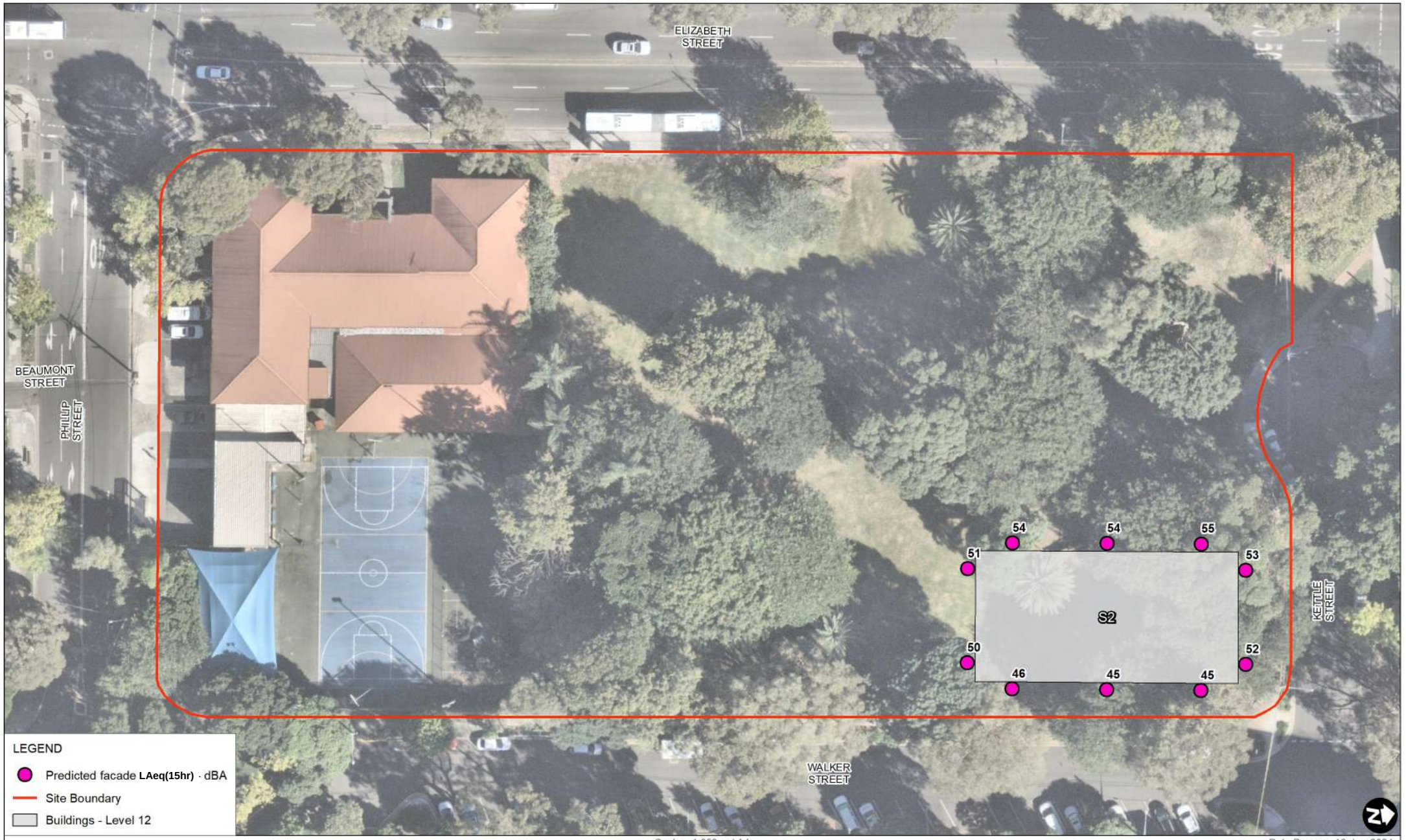

Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 12 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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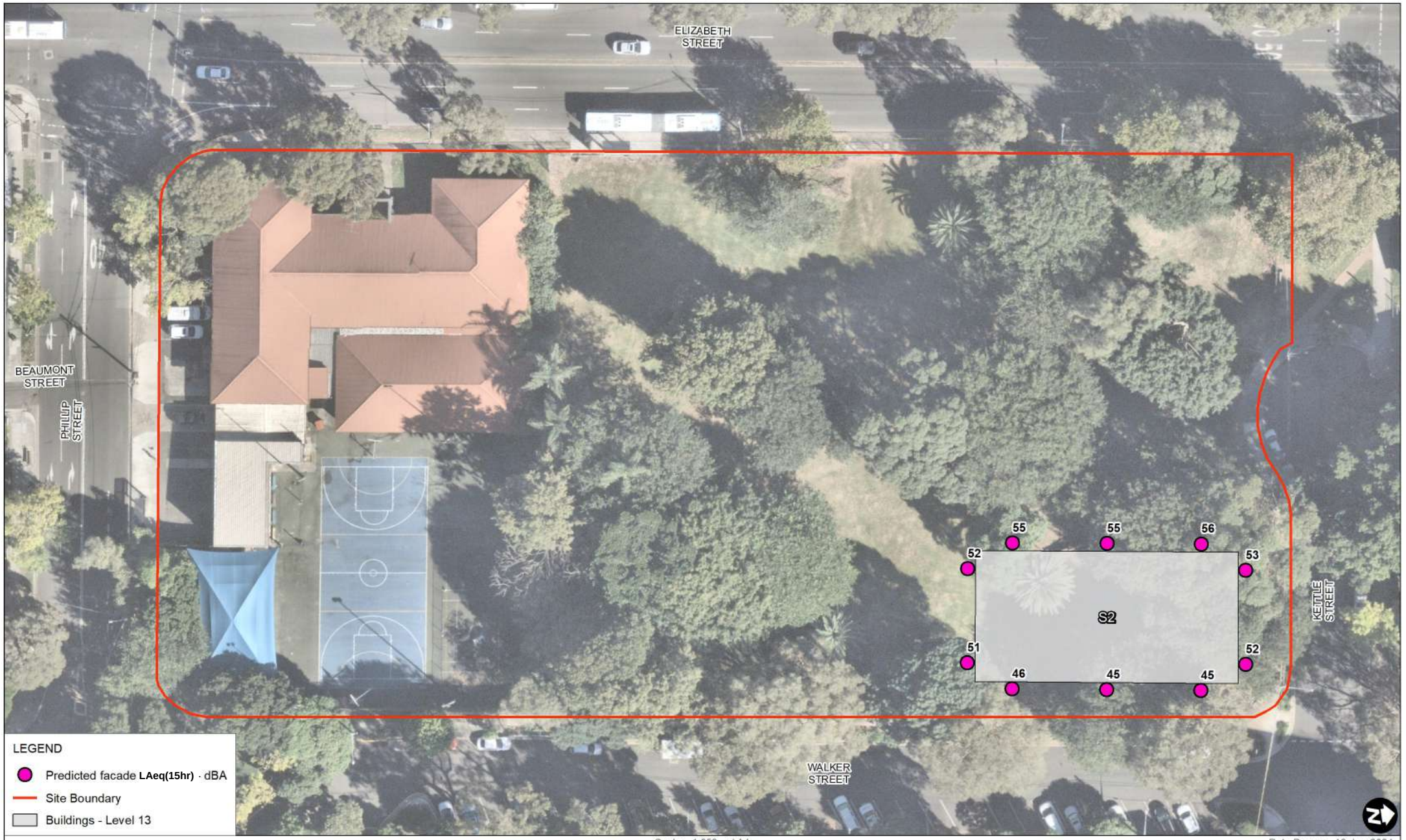

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Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 13 FACADE NOISE PREDICTIONS (DAY) 600-660 ELIZABETH ST, REDFERN

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Appendix G Predicted Facade Levels (Night)

Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024

Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 12-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

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GROUND FLOOR FACADE NOISE PREDICTIONS (NIGHT) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
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FLOOR 1 FACADE NOISE PREDICTIONS (NIGHT) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 2 FACADE NOISE PREDICTIONS (NIGHT) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

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FLOOR 3 FACADE NOISE PREDICTIONS (NIGHT) 600-660 ELIZABETH ST, REDFERN

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Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

SLR

FLOOR 4 FACADE NOISE PREDICTIONS (NIGHT) 600-660 ELIZABETH ST, REDFERN

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Scale: 1:650 at A4
Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

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FLOOR 5 FACADE NOISE PREDICTIONS (NIGHT) 600-660 ELIZABETH ST, REDFERN

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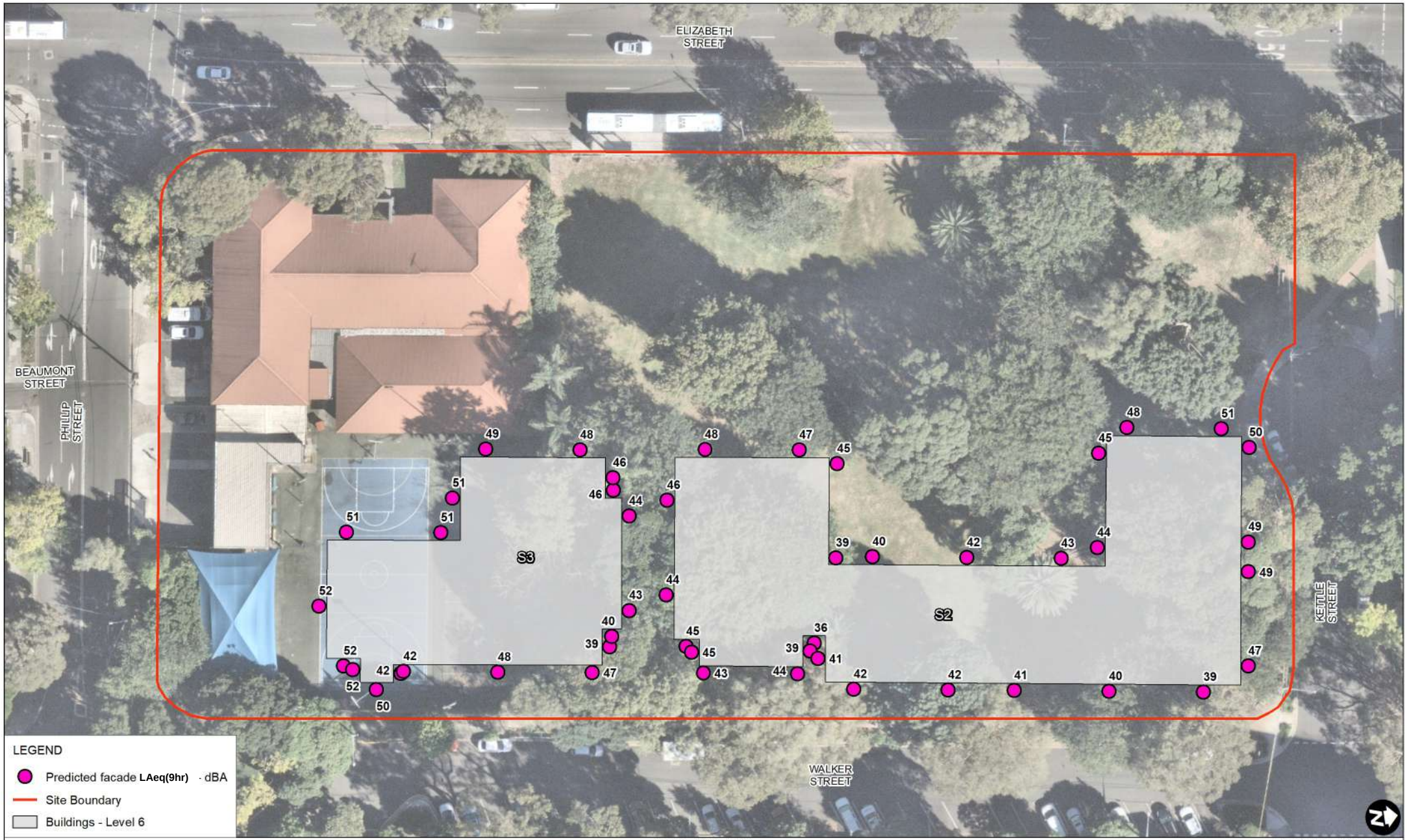

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Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
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Project Number: 610.031388

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Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
Nearmap Imagery April 2024

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Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
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Coordinate System: GDA 1994 MGA Zone 56

Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
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SLR

FLOOR 10 FACADE NOISE PREDICTIONS (NIGHT) 600-660 ELIZABETH ST, REDFERN

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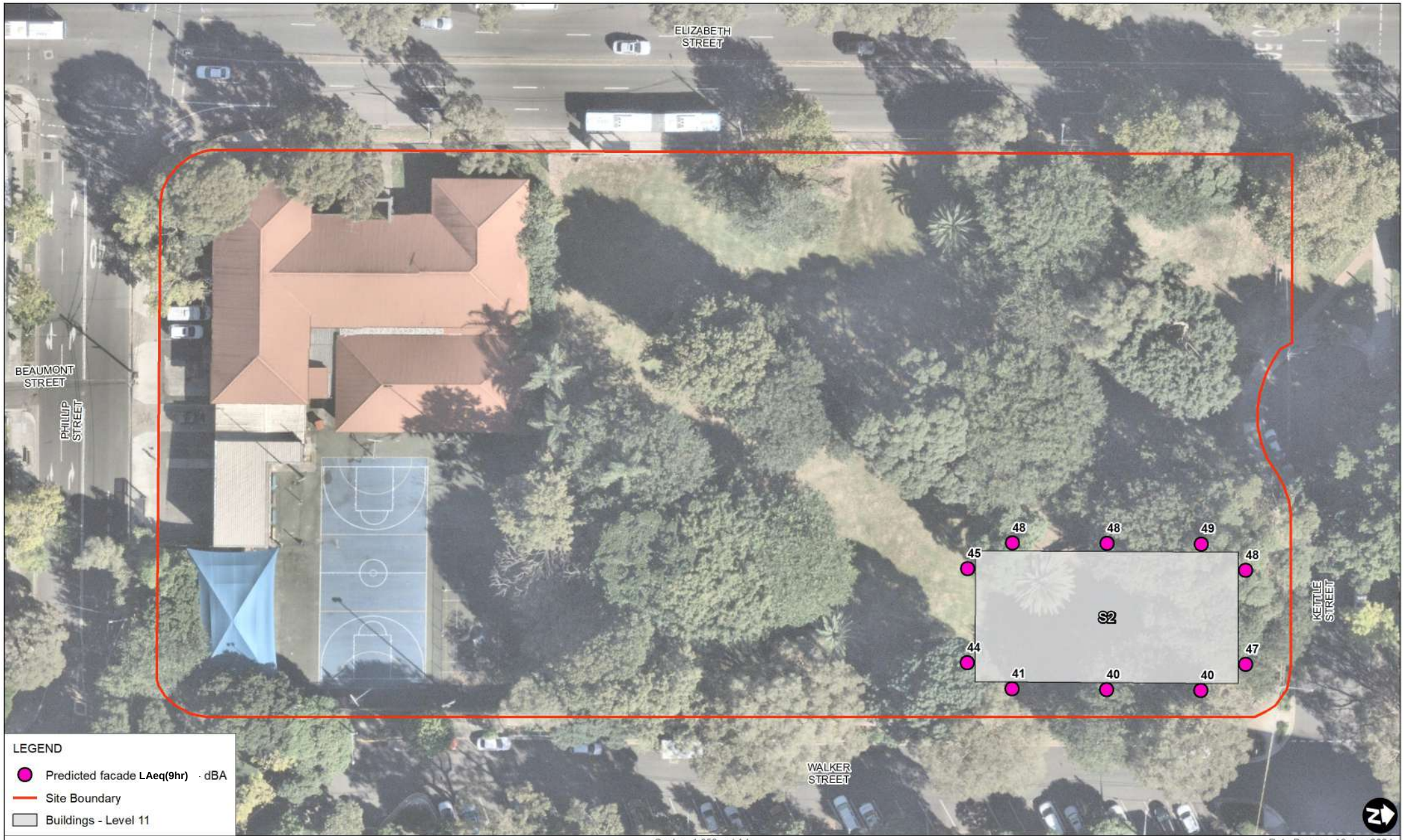

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Project Number: 610.031388

Data Source:
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FLOOR 11 FACADE NOISE PREDICTIONS (NIGHT) 600-660 ELIZABETH ST, REDFERN

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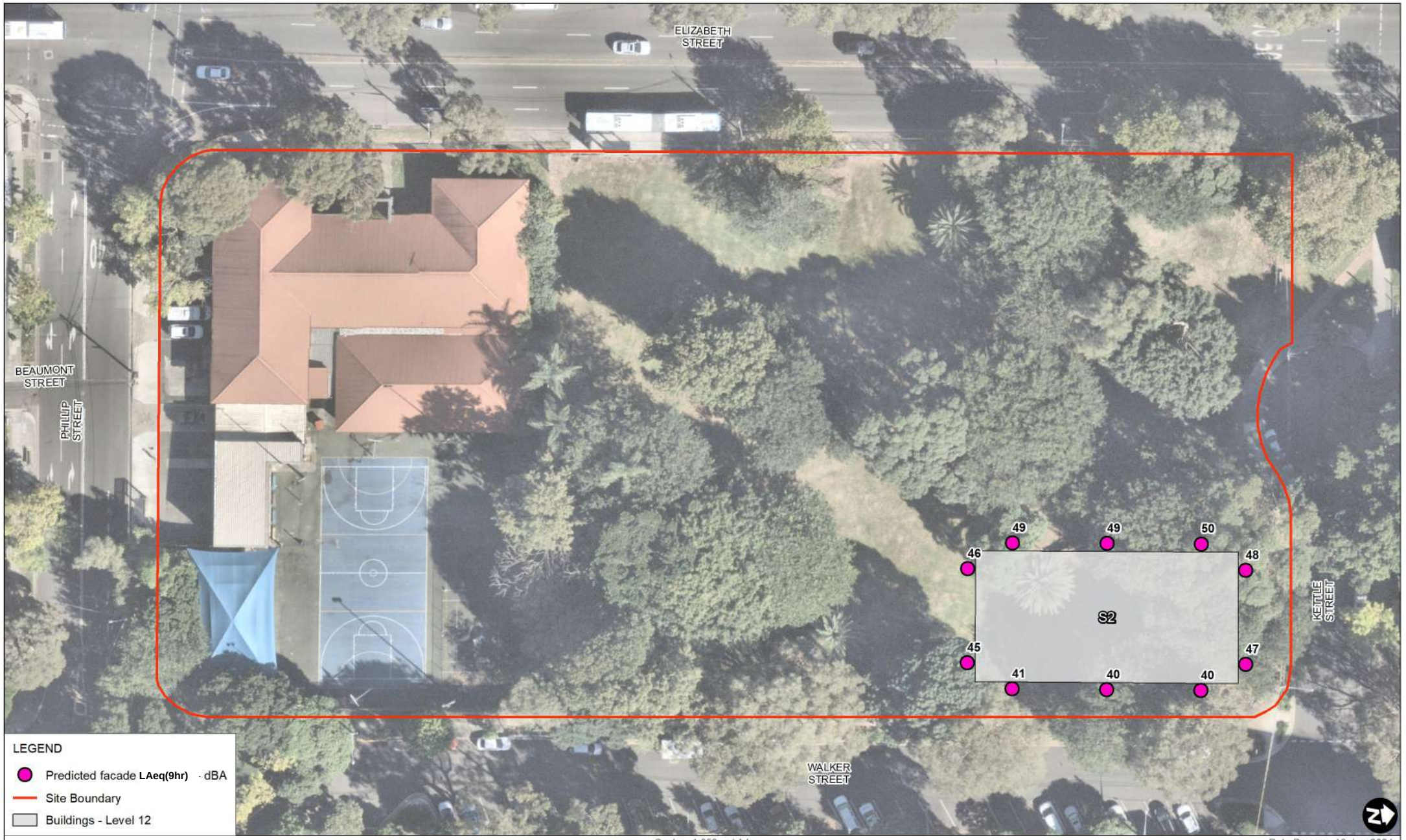

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Date Drawn: 13-Jun-2024
Project Number: 610.031388

Data Source:
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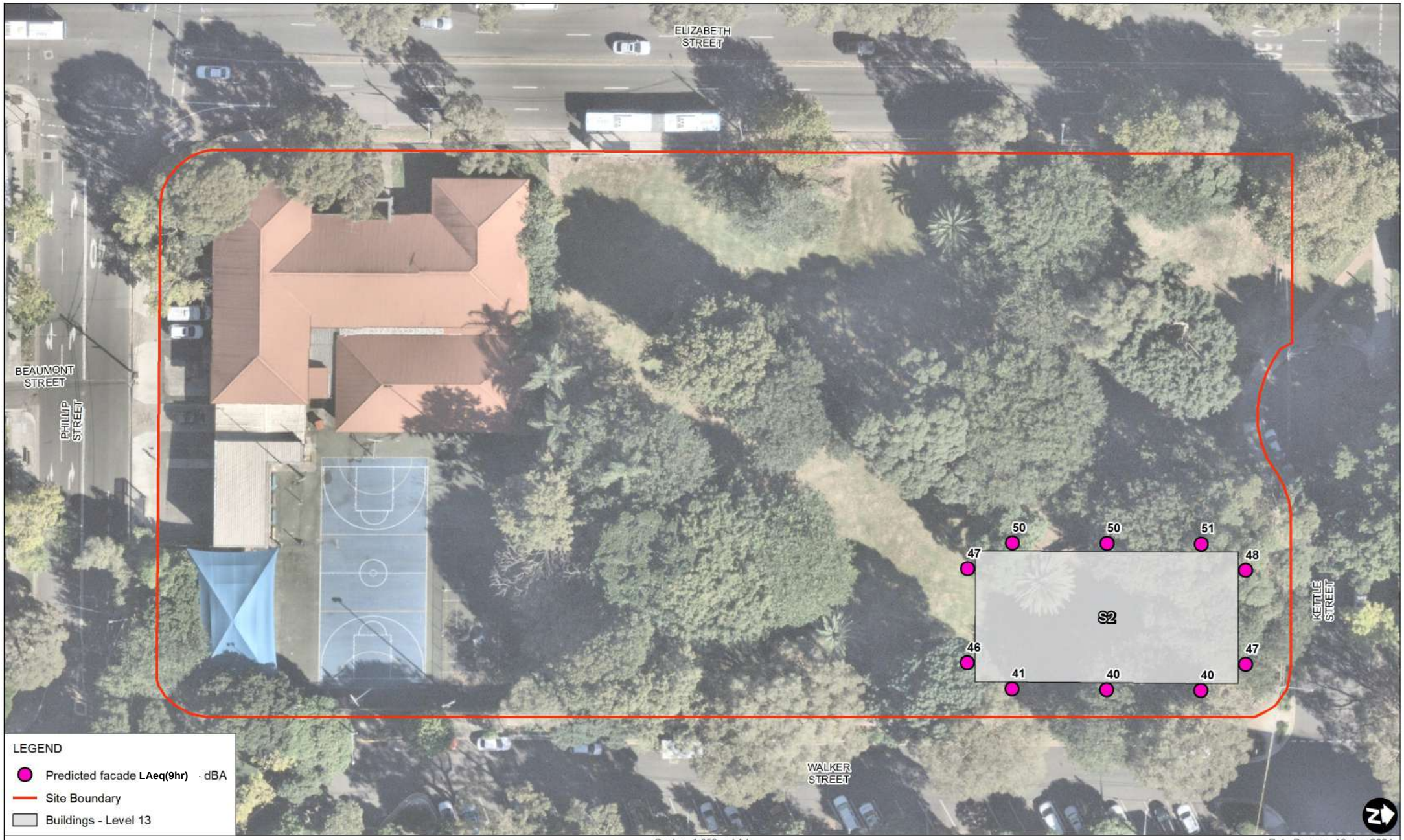

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Data Source:
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FLOOR 13 FACADE NOISE PREDICTIONS (NIGHT) 600-660 ELIZABETH ST, REDFERN

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Appendix H CNVG Mitigation Measures

Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024

CNVG Standard Mitigation and Management Measures

Action Required	Applies To	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise	Implementation of any project specific mitigation measures required.
Implement community consultation or notification measures.	Airborne noise Ground-borne noise & vibration	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance. Website (If required) Contact telephone number for community Email distribution list (if required) Community drop-in session (if required by approval conditions).
Site inductions	Airborne noise Ground-borne noise & vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • all project specific and relevant standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • environmental incident procedures.
Behavioural practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Airborne noise Ground-borne noise & vibration	Where specified under Appendix C of the CNVG a noise verification program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.

Action Required	Applies To	Details
Update Construction Environmental Management Plans	Airborne noise Ground-borne noise & vibration	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
Building condition surveys	Vibration Blasting	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage
Source controls		
Construction hours and scheduling	Airborne noise Ground-borne noise & vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period during normal hours and out-of-hours work	Ground-borne noise & vibration Airborne noise	See Appendix C of the CNVG for more details on the following respite measures: • Respite Offers (RO) • Respite Period 1 (R1) • Respite Period 2 (R2) • Duration Respite (DR)
Equipment selection.	Airborne noise Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.
Plant noise levels.	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H of the CNVG. Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturers specifications or Appendix H of the CNVG.
Rental plant and equipment.	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the CNVG.
Use and siting of plant.	Airborne-noise	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers. Only have necessary equipment on site.
Plan worksites and activities to minimise noise and vibration.	Airborne noise Ground-borne vibration	Locate compounds away from sensitive receivers and discourage access from local roads. Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.

Action Required	Applies To	Details
		Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible. Very noise activities should be scheduled for normal working hours. If the work can not be undertaken during the day, it should be completed before 11:00pm. Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters. If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again.
Reduced equipment power	Airborne noise Ground-borne vibration	Use only the necessary size and power.
Non-tonal and ambient sensitive reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise these out of hours movements where possible.
Engine compression brakes	Construction vehicles	Limit the use of engine compression brakes at night and in residential areas. Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities.	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.

Action Required	Applies To	Details
Receptor control		
Structural surveys and vibration monitoring	Ground-borne vibration	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, vibration monitoring should be conducted during the activities causing vibration.
See Appendix C of the CNVG for additional measures	Airborne noise Ground-borne vibration	In some instances, additional mitigation measures may be required.

Appendix I NPfl Mitigation Measures

Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024

I.1 Best Management Practice (BMP)

Best management practice (BMP) is the application of particular operational procedures that minimise noise while retaining productive efficiency.

Where applied, these measures and practices are often documented in a noise management plan so that operational practices and undertakings are clearly understood and applied at all levels of an industrial operation. Application of BMP can include the following types of practice:

- Using the quietest plant that can do the job
- Scheduling the use of noisy equipment at the least-sensitive time of day
- Not operating, or reducing operations at night
- Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise
- Where there are several noisy pieces of equipment, scheduling operations so they are used separately rather than concurrently
- Keeping equipment well-maintained and operating it in a proper and efficient manner
- Using ‘quiet’ practices when operating equipment, for example, positioning idling trucks in appropriate areas
- Running staff-education programs and regular tool box talks on the effects of noise and the use of quiet work practices.

For many industries there are a wide range of factors that can restrict the feasibility and reasonableness of applying BMP measures on a particular site. Work health and safety considerations must also be taken into account as well as any other regulatory and process requiremen.

Appendix J Natural Ventilation Assessment

Redfern Place, 600-660 Elizabeth Street, Redfern

SSDA Noise and Vibration Impact Assessment

Bridge Housing

SLR Project No.: 610.031388.00001

26 June 2024

Doc Ref: WE086-08F01(rev0)- NV Letter.docx

Date: June 24, 2024

To: Bridge Housing Limited

Address: Level 9, 59 Goulburn
Street Sydney NSW 2000

Attn: Ms Lindsey Gray

RE: 600-660 ELIZABETH STREET, REDFERN
- VENTILATION OF NOISE AFFECTED HABITABLE ROOMS

1 INTRODUCTION

This letter is to outline the design response to the City of Sydney's draft "*Alternative natural ventilation of apartments in noisy environments – Performance pathway guideline*" (2018).

Buildings S3 and S4 of the subject development, located at the intersection of Phillip and Elizabeth Street, Redfern, is affected by road noise. The indoor noise level criterion is expected to be exceeded by more than 15dBA when windows and doors on the first four levels are opened within apartments on the:

- Southern aspects of S3 and S4
- Western aspects, as well as the northern and eastern aspects of the north-eastern corner apartments of S4.

It is also worth noting that the Ground Level of S4 is not residential, and no exceedance of the indoor noise criterion occurs above Level 3 of S3 and S4 with windows and doors open, which is due to increased building setback from the road.

This design response was developed in conjunction with architects, Hayball, and acoustic consultants, SLR Consulting. The intent of this response is to achieve acoustic amenity and adequate natural ventilation for indoor air quality simultaneously, which in our view is over and above the guidelines and intent of the Apartment Design Guide, NSW (2015).

Based on Windtech's extensive modelling experience of the performance of similar plenums, the design presented in this report is expected to achieve the minimum performance requirements stipulated in the aforementioned City of Sydney draft guidelines as set out in Table 1 on the following page.

Table 1: Natural Ventilation Performance Criteria (SoC, 2018)

Number of bedrooms	'Threshold Apartment Area' (m^2) *	Criteria 1 (use when apartment area is less than theshold area)		Criteria 2 (use when apartment area is more than or equal to the theshold area)
		Num. occupants	Performance requirement Air Flow (l/s)	Performance requirement Air Flow (l/s)
1	67	2	20	Apartment area x 0.3
2	100	3	30	Apartment area x 0.3
3	133	4	40	Apartment area x 0.3

* the 'Threshold Apartment Area' is advisory only

2 DESIGN RESPONSE

Note that for a number of the noise affected rooms or studio apartments (highlighted blue in Figures A.1 to A.3), natural ventilation was achieved by means of opening the front doors to the ventilated corridors (which are not noise affected), or windows facing the ventilated corridors (specifically the case for a number of apartments within Building S4), both options of which are in lieu of a vertical plenum. There is an argument that vertical plenums in the case of single aspect apartments can generate some air flow by means of buoyancy-driven effects, even in the absence of a significant pressure differential. Security doors will be provided for these apartments. The front doors to these apartments will also be fitted with magnetic door closers controlled by the building fire management system. Assuming the security doors have a minimum porosity of 55%, the effective area of these "vertical plenums" will be at least 0.9m^2. This is equivalent to the minimum recommended area for 2-bedroom apartments and is more than the area recommended for a one-bedroom or studio apartments in Table 2 of Flux (2018). Vertical plenums are proposed for the noise affected bedrooms, highlighted in red for straight plenums without any bends and yellow for those with bends, in Figures A.1 to A.3.

The acoustic consultant, SLR, has calculated the plenum dimensions listed in Table 2 below to achieve the required level of noise attenuation, with 50mm thick acoustic lining (installed along the top and bottom of the plenum) and a 65mm deep cavity in the middle. A typical plan view of a horizontal plenum is shown in Figure 1 on the following page. The dimensions of the various plenums are shown in plan in Appendix A.

Table 2: Required Plenum Dimensions (as specified in by acoustic consultant)

Plenum type	External Plenum Dimensions	Attenuation Path Length
Straight	2.0m (H) by 0.165m (W) – with open area 0.4m^2	2.3m total plenum length
With 90 degree bend	2.0m (H) by 0.165m (W) – with open area 0.4m^2	1.6m minimum plenum length

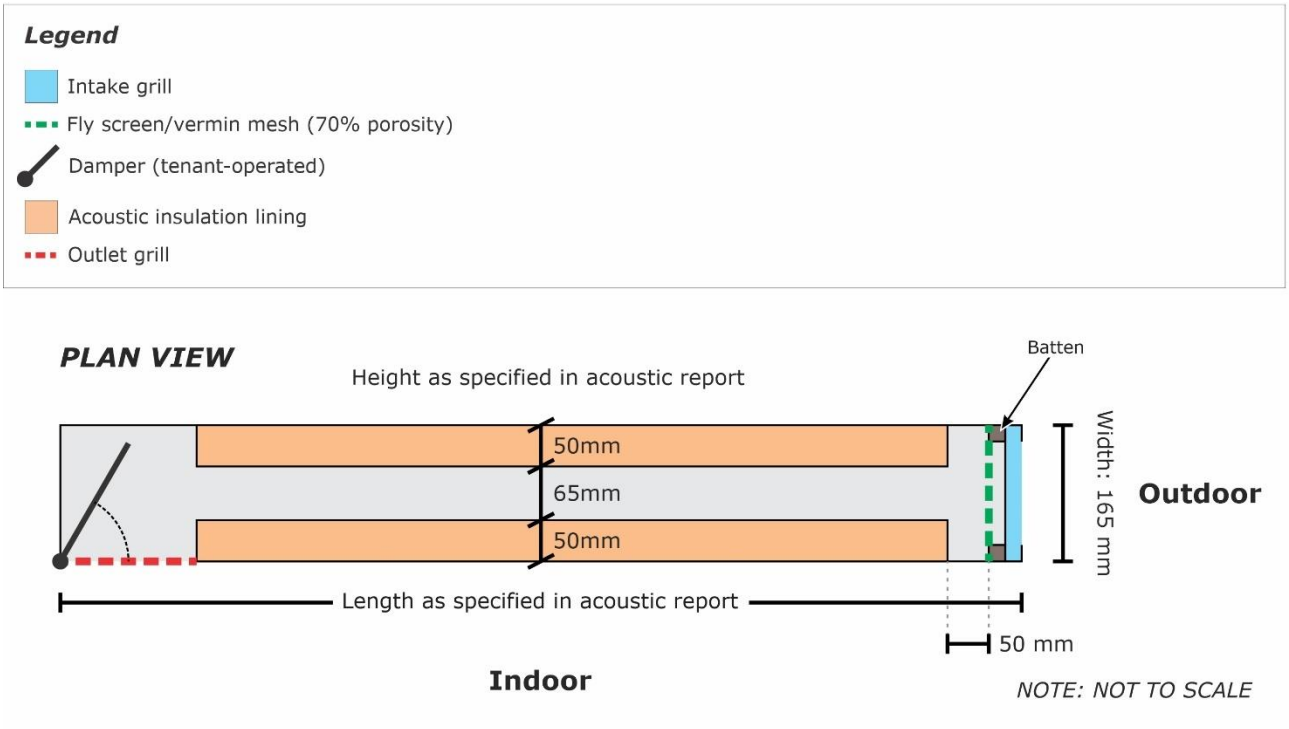


Figure 1: Vertical plenum plan view

3 CONCLUSION

In summary, the design team have developed a carefully considered response to achieve the performance requirements stipulated in the City of Sydney's draft "*Alternative natural ventilation of apartments in noisy environments – Performance Pathways Guidelines*" (2018) document.

Prepared by	Reviewed and Approved by
Avanish Shrestha	Tony Rofail
Project Engineer	*Director*

Windtech Consultants

REFERENCES

City of Sydney (2018): "*Alternative natural ventilation of apartments in noisy environments – Performance pathway guideline*"

Flux (2018): "*Example Guidelines for Natural Ventilation Device Selection for Noise Impacted Apartments*"

APPENDIX A: LAYOUT OF THE VENTILATION PLENUMS

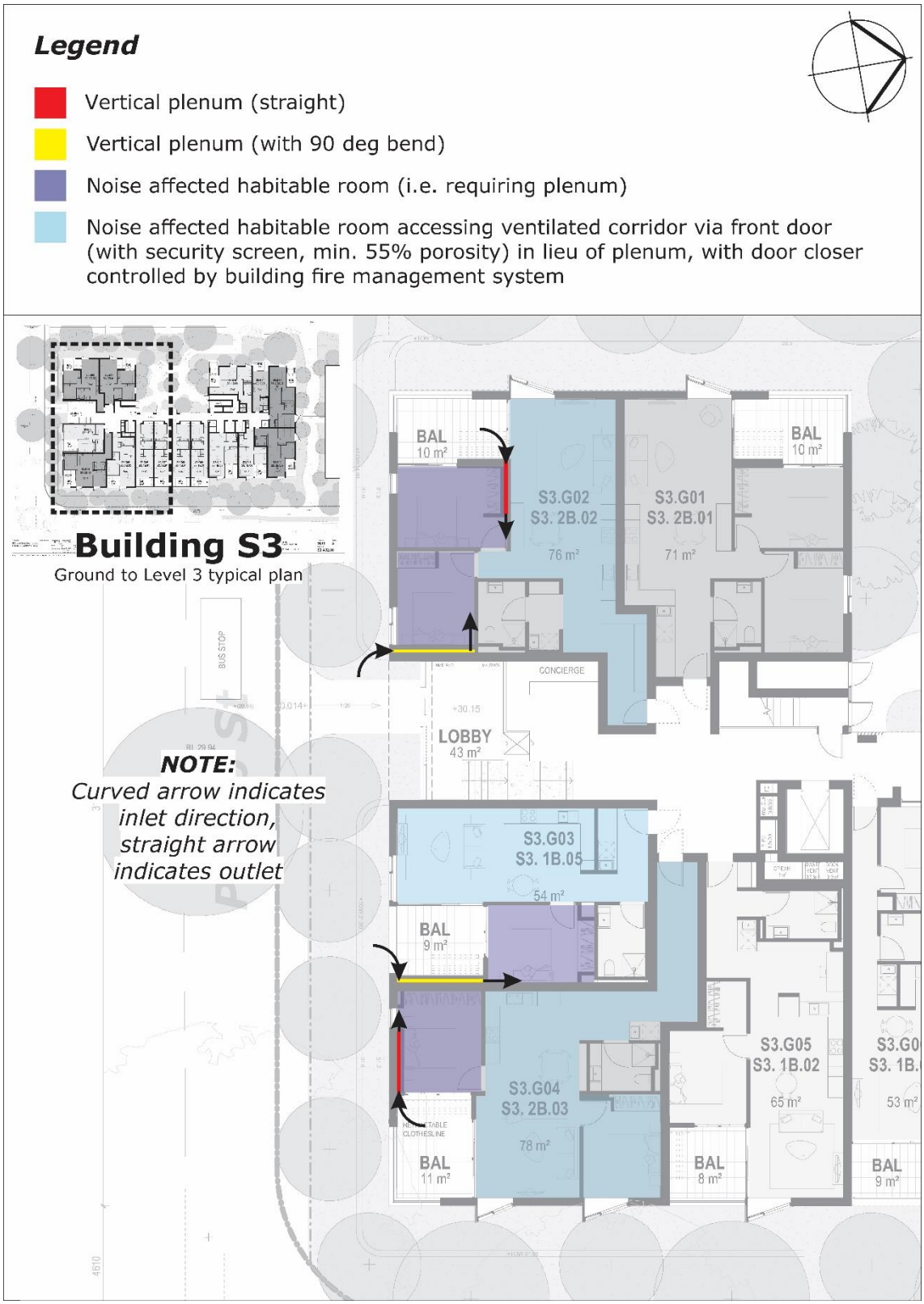


Figure A.1: Plenums for the Ground Floor to Level 3 of Building S3

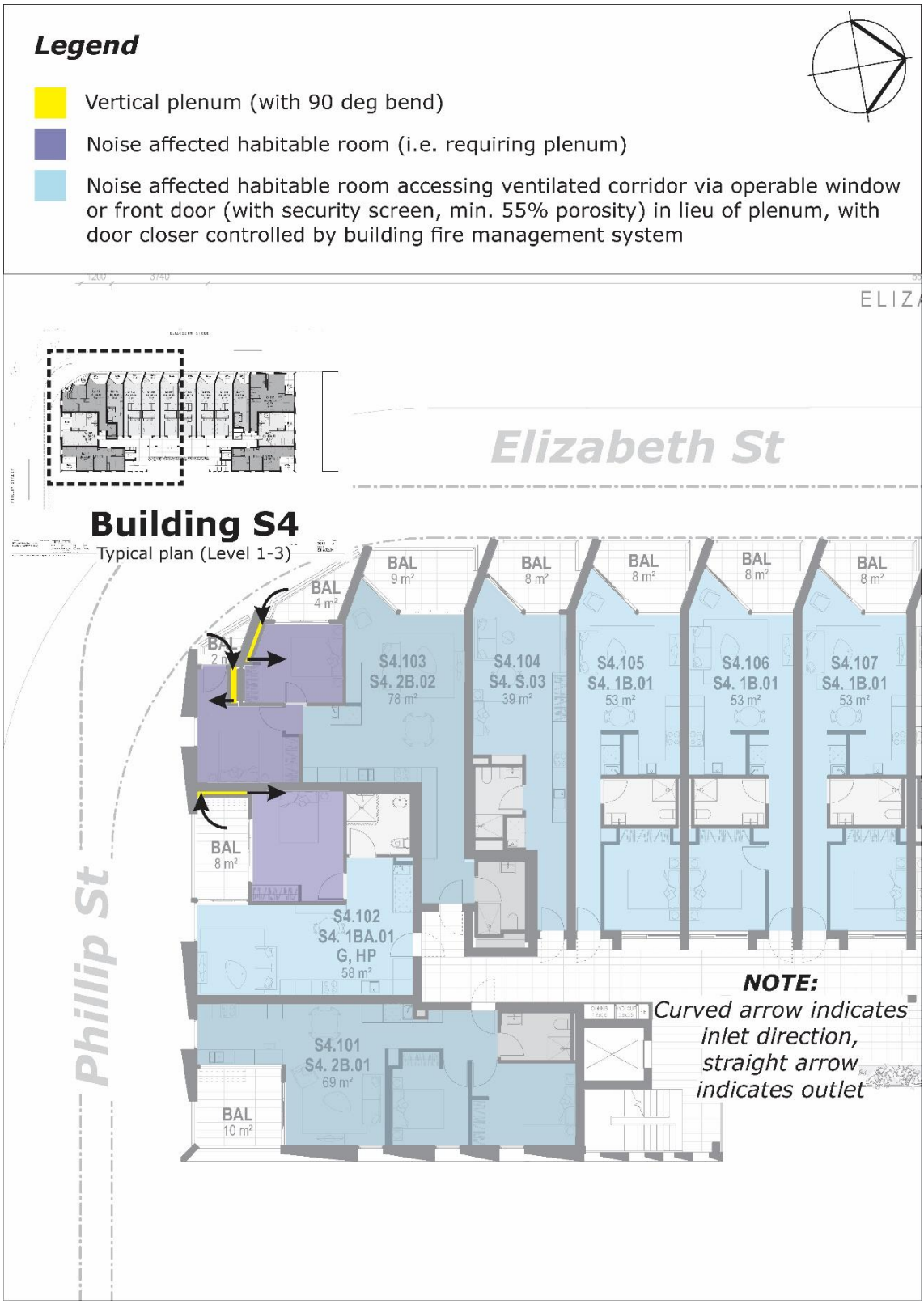


Figure A.2: Plenums for Level 1-3 of Building S4 (southern apartments)

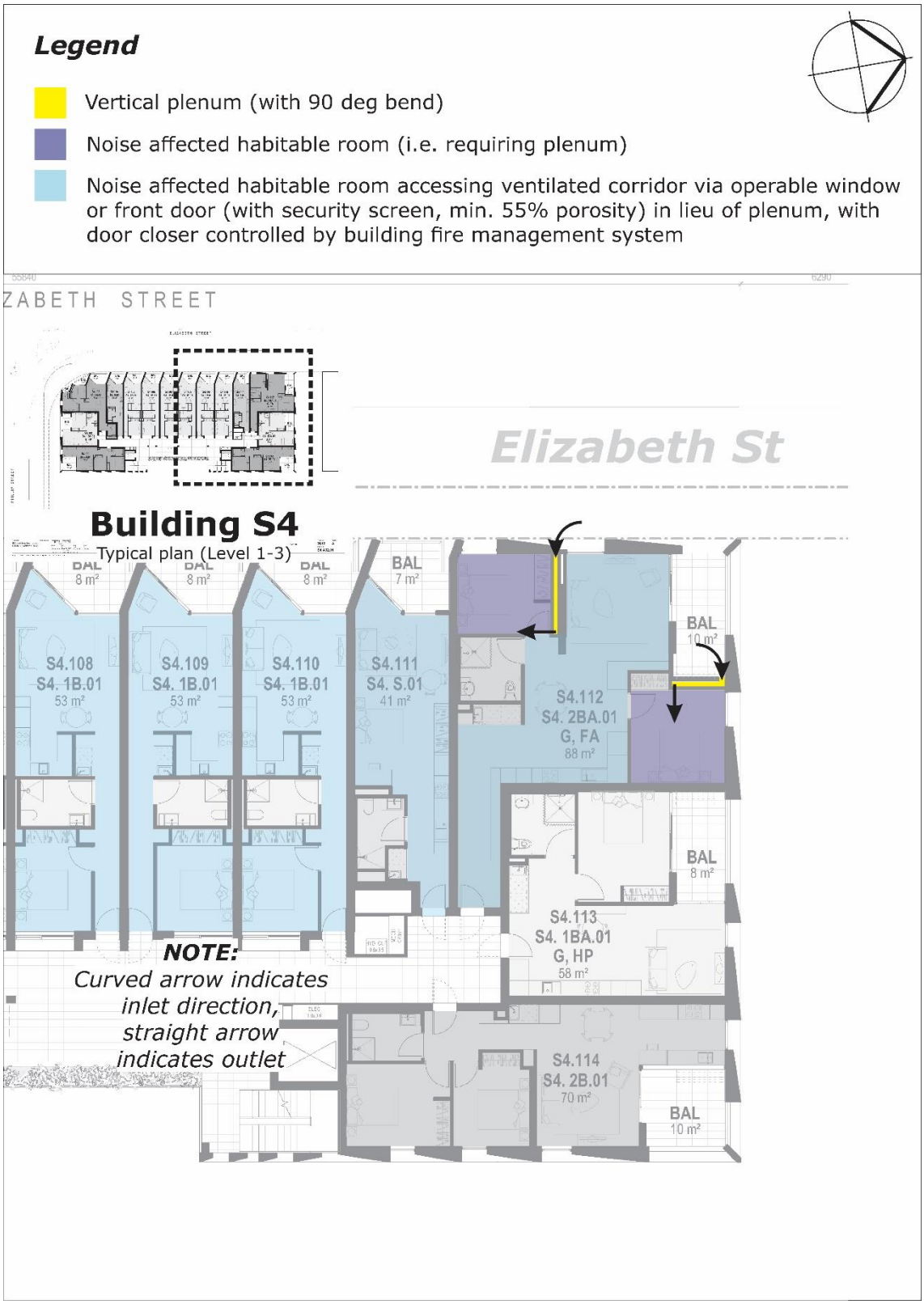
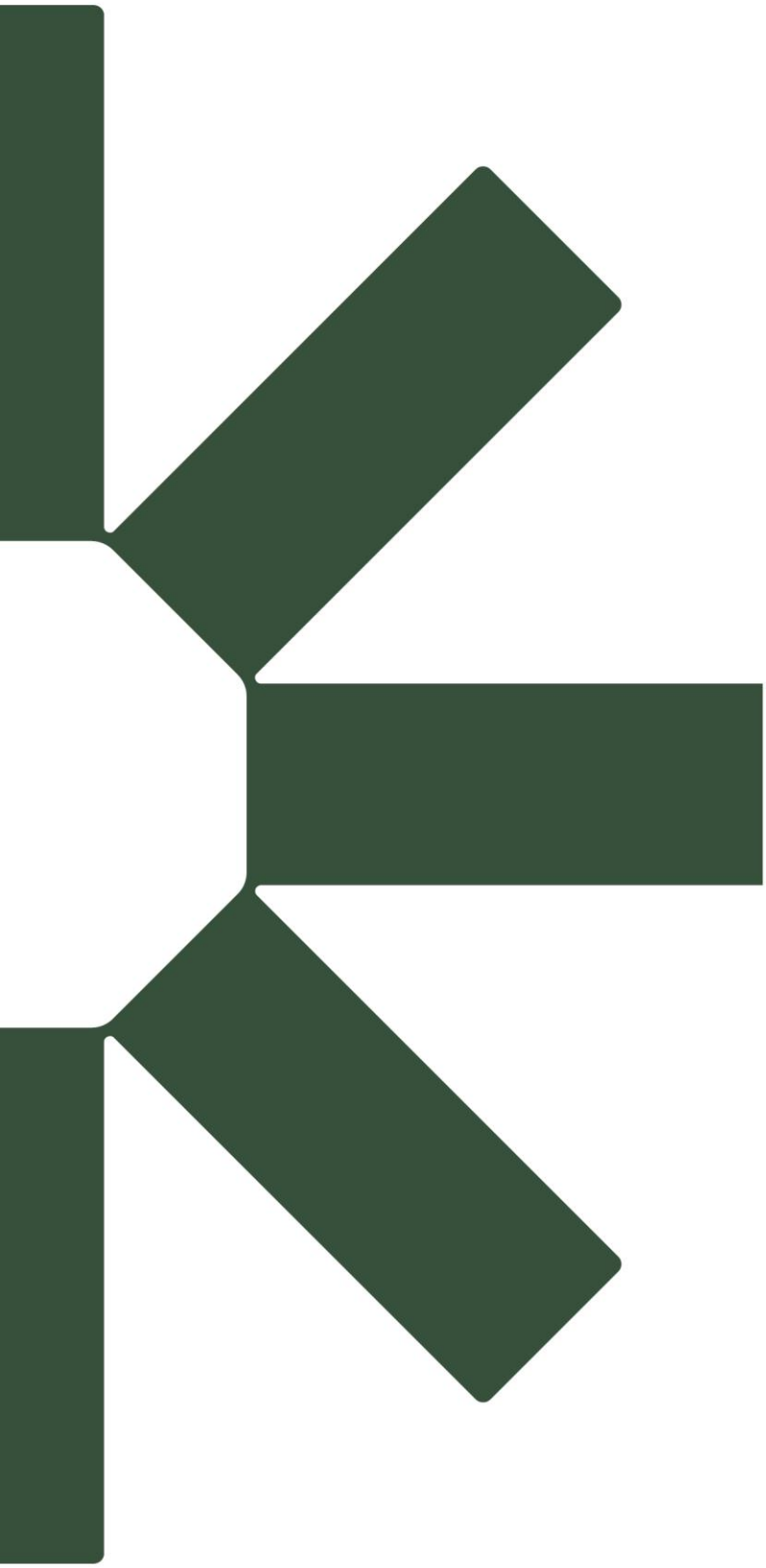


Figure A.3: Plenums for Level 1-3 of Building S4 (northern apartments)



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