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DA Acoustic Assessment

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TABLE OF CONTENTS

1 INTRODUCTION

Acoustic Logic (AL) has been engaged to conduct an acoustic assessment of potential noise impacts associated with the proposed co-living development at 175-177 Cleveland St & 1-5, 6-8 Woodburn St, Redfern NSW.

This document addresses noise impacts associated with the following:

- Traffic noise intrusion from adjacent roads.
- Rail noise intrusion and vibration impacts from railway at the east of the site.
- Noise emissions from mechanical plant to service the project site (in principle).

AL have utilised the following documents and regulations in the noise assessment of the development:

- NSW Department of Planning *State Environmental Planning Policy Transport and Infrastructure* (SEPPT&I) 2021
- NSW Department of Planning *Developments near Rail Corridors or Busy Roads – Interim Guideline*
- Australian Standard AS2107:2016 *Recommended Design Sound Levels and Reverberation Times for Building Interiors*, and
- NSW Environmental Protection Authority (EPA) *Noise Policy for Industry* (NPI) 2017.

This assessment has been conducted using architectural drawings by Mark Shapiro Architects (*Project Number: 21022*, Issue P11, dated 7th September 2022).

2 SITE DESCRIPTION

This SSDA seeks development consent for the development of a privately-operated co-living development. The proposal has been designed to offer and support co-working activities for residents as well as the wider community to promote employment and social interaction throughout the development. Specifically, the proposal involves:

- Construction of a mixed use co-living housing development ranging in height from five (5) to seven (7) storeys, comprising:
    - 7,006.4m^2 of GFA (FSR of 3.47:1) comprising 927.7m^2 of retail/commercial and 6,078.7m^2 of residential GFA;
    - Basement containing 19 car parking spaces; 25 motorcycle spaces and 116 bicycle spaces;
    - 216 co-living rooms (67 single and 149 double rooms) for lodgers and a building manager;
    - Ground and first floor co-working and commercial/retail uses fronting Cleveland, Woodburn and Eveleigh Streets;
    - Communal open space areas (1,458.8m2) including an open to the sky internal courtyard and rooftop garden;
    - Communal living areas (549.4m2) comprising resident amenities; and
- Associated landscape works (697.5m2 landscaped area) and provision of a through-site link.

Investigation has been carried out by this office around the proposed development, which is detailed below:

- Attended noise measurements besides Cleveland Street and Eveleigh Street.
- Attended vibration measurements besides Woodburn Street and inside the existing building.
- Unattended noise measurements at the roof terrace (third floor) of the existing building facing the railway.

The noise receivers around the site include:

- **R1:** Residential receiver to the west at 165-173 Cleveland Street.
- **R2:** Residential receiver to the south at 9-11 Woodburn Street.
- **H1:** Hotel receiver to the north at 47-49 Chippen Street.
- **H2:** Hotel receiver to the east at 179 Cleveland Street.
- **C1:** Commercial receiver to the west at 16 Eveleigh Street.
- **C2:** Commercial receiver to the south at 13 Woodburn Street and 13 Eveleigh Street.
- **C3:** Commercial receiver to the north at 232-236 Cleveland Street.

A site map, measurement description and surrounding receivers are presented in Figure 1 below.

Figure 1 – Project Site
Source: NSW Six Maps

3 NOISE DESCRIPTORS

Ambient noise constantly varies in level from moment to moment, so it is not possible to accurately determine prevailing noise conditions by measuring a single, instantaneous noise level.

To quantify ambient noise, a 15-minute measurement interval is typically utilised. Noise levels are monitored continuously during this period, and then statistical and integrating techniques are used to characterise the noise being measured.

The principal measurement parameters obtained from the data are:

L_{eq} - represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of noise impact as it closely corresponds with how humans perceive the loudness of time-varying noise sources (such as traffic noise).

L_{90} – This is commonly used as a measure of the background noise level as it represents the noise level heard in the typical, quiet periods during the measurement interval. The L_{90} parameter is used to set noise emission criteria for potentially intrusive noise sources since the disturbance caused by a noise source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

L_{10} is used in some guidelines to measure noise produced by an intrusive noise source since it represents the average of the loudest noise levels produced at the source. Typically, this is used to assess noise from licenced venues.

L_{max} is the highest noise level produced during a noise event, and is typically used to assess sleep arousal impacts from short term noise events during the night. It is also used to assess internal noise levels resulting from aircraft and railway ground vibration induced noise.

L_1 is sometimes used in place of L_{max} to represent a typical noise level from a number of high level, short term noise events.

4 ENVIRONMENTAL NOISE SURVEY

NSW EPA's Rating Background Noise Level (RBL) assessment procedure requires determination of background noise level for each day (the ABL) then the median of the individual days as set out for the entire monitoring period.

Appendices in this report present results of unattended noise monitoring conducted at the project site. Weather affected data was excluded from the assessment. The processed RBL (lowest 10th percentile noise levels during operation time period) are presented in Table 4-2.

Attended short term measurements of traffic noise were undertaken by this office to supplement the unattended noise monitoring.

4.1 ATTENDED NOISE MEASUREMENTS

4.1.1 Measurement Positions and Period

Attended noise measurements were taken around the project site on Monday 11th October 2021 between 10:00 am to 11:00 am, and on Friday 22nd July 2022 between 09:00 am to 10:00 am. The measurements were conducted 2.5 meters away from the Cleveland Street and 1.5 meters away from the Eveleigh Street and Woodburn Street. Refer to Figure 1 for detailed locations.

4.1.2 Measurement Equipment

Attended noise measurements were conducted using a Norsonic 140 Sound Analyser. The analyser was set to fast response and calibrated before and after the measurements using a Norsonic Sound Calibrator type 1251. No significant drift was noted.

4.1.3 Measurement Results

The results of the attended noise measurements around the project site are presented below.

Table 4-1 – Noise Levels at the Attended Measurement Positions

Location	Time	Noise Level – L_{Aeq}
177 Cleveland Street, Redfern (Facing Cleveland Street)	Friday 22nd July 2022 10:00 am	73 dB(A)
6 Woodburn Street, Redfern (Facing Woodburn Street)	Friday 22nd July 2022 09:50 am	64 dB(A)
8 Woodburn Street, Redfern (Facing Eveleigh Street)	Monday 11th October 2021 10:35 am	58 dB(A)

The measured traffic noise levels above are based on measurements conducted at 1.5m above ground level. All measurements were conducted within 3m of local façades on Cleveland, Woodburn and Eveleigh Street with façade reflections on all façades.

4.2 UNATTENDED NOISE MEASUREMENTS

4.2.1 Measurement Positions and Period

One unattended noise monitor was located at the third-floor roof terrace of 6-8 Woodburn Street facing the railway from Thursday 30th September to Monday 11th October. Refer to Figure 1 for detailed location.

4.2.2 Measurement Equipment

Equipment used consisted of an Acoustic Research Laboratories Pty Ltd noise logger. The logger was set to A-weighted fast response and was programmed to store 15-minute statistical noise levels throughout the monitoring period. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted. Noise logger data is provided in Appendix One – Unattended Noise Monitoring.

4.2.3 Summarised Rating Background Noise Levels

Summarised rating background noise levels for the project site and immediate surroundings are presented below.

Table 4-2 – Background Noise Levels at the Monitoring Positions

Monitor	Time of day	Rating Background Noise Level dB(A)$_{L90(Period)}$*
Third floor balcony of 6-8 Woodburn Street, Redfern (Eastern façade facing the railway)	Day (7am – 6pm)	54
	Evening (6pm – 10pm)	50
	Night (10pm – 7am)	41

*Corrected for façade reflections based on the logger placement close to a glazed partition.

On review of the monitoring data, the measured L_{90} noise levels during high wind speed days do not increase background noise levels significantly as periods with little to no wind. This demonstrates that even though wind speeds measured at Sydney Observatory Hill (the closest weather station) exceed EPA guidelines, either:

- The wind speed on site at this time was significantly lower than at Observatory Hill (which is likely given Observatory Hill is located in a very exposed area) and/or
- The wind on site was not sufficiently consistent to increase background noise levels compared to calm periods.

Therefore, only periods of adverse weather that were determined to have affected the noise data have been eliminated when determining the rating background noise level at the site, which is presented above.

4.2.4 Summarised Traffic and Rail Noise Levels

The following noise levels for the site have been established based on short-term attended measurements and long-term noise monitoring. Measured noise levels include façade reflections from local façades.

Table 4-3 – Measured Noise Levels

Location	Time of Day	Traffic/Train Noise Level – $L_{eq(period)}$*
Third floor balcony of 6-8 Woodburn Street, Redfern (Eastern façade facing the railway)	Daytime 7 am – 10 pm	71 dB(A) $L_{eq\ (15hr)}$
	Night time 10 pm – 7 am	68 dB(A) $L_{eq\ (9hr)}$

The measured traffic/train noise levels above are based on measurements conducted at 1.5 m above ground level corrected to a façade noise level (presented noise level are without façade reflections, i.e., the noise level incident on the facade). All measurements were conducted at least 3m away from any façades.

Based on the attended noise measurements and the installed unattended noise monitoring conducted for the site, the below noise levels are predicted at the façades of the proposed development. Façade reflections have been taken out to present noise levels incident to the façade.

Table 4-4 – Predicted Façade Noise Levels

Location	Time of Day	Noise Level – L_{eq}
Future northern façade facing Cleveland Street	Daytime (7am – 10pm)	69 dB(A) $L_{eq\ (15hr)}$
	Night time (10pm – 7am)	67 dB(A) $L_{eq\ (9hr)}$
Future eastern façade facing Woodburn Street	Daytime (7am – 10pm)	68 dB(A) $L_{eq\ (15hr)}$
	Night time (10pm – 7am)	65 dB(A) $L_{eq\ (9hr)}$
Future western façade facing Eveleigh Street	Daytime (7am – 10pm)	55 dB(A) $L_{eq\ (15hr)}$
	Night time (10pm – 7am)	53 dB(A) $L_{eq\ (9hr)}$

5 EXTERNAL NOISE INTRUSION ASSESSMENT

Site investigation indicates that the major external noise sources around project site are from traffic movements along Cleveland Street north of the site and rail noise east of the site.

5.1 NOISE INTRUSION CRITERIA

A noise intrusion assessment has been conducted based on the requirements of the following acoustic noise criteria and standards:

- NSW Department of Planning and Environment *State Environmental Planning Policy Transport and Infrastructure* (SEPPT&I) 2021.
- NSW Department of Planning and Environment *Developments near Rail Corridors or Busy Roads – Interim Guideline*, and
- Australian Standard AS2107:2016 *Recommended Design Sound Levels and Reverberation Times for Building Interiors*.

5.1.1 NSW Department of Planning SEPPT&I 2021

RMS Map No. 16 of the traffic volume maps referenced by the SEPPT&I 2021 on the RMS website (see below), classifies the section of Cleveland Street where the development is located adjacent to as a road where a noise intrusion assessment is mandatory under clause 2.119 of SEPPT&I 2021. See RMS average annual daily road traffic volume map number 16 and the approximate location of the site below.

Figure 2 – RMS Map No. 16 and Approximate Location of Proposed Development

Clause 2.119 Impact of road noise or vibration on non-road development

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

a) in any bedroom in the building--35 dB(A) at any time between 10 pm and 7 am,

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

5.1.2 NSW Department of Planning *Development near Rail Corridors or Busy Roads – Interim Guideline*

Section 3.5 of the NSW Department of Planning's 'Development near Rail Corridors and Busy Roads (Interim Guideline)' states:

"The following provides an overall summary of the assessment procedure to meet the requirements of clauses 87 and 102 of the Infrastructure SEPP. The procedure covers noise at developments for both Road and Rail.

- *If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
    - *in any bedroom in the building: 35dB(A) at any time 10pm-7am*
    - *anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40dB(A) at any time."*

Additionally, NSW Department of Planning's *Development near Busy Roads and Rail Corridors - Interim Guideline* dictates that:

If internal noise levels with windows or doors open exceed the criteria by more than 10dB(A), 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.

With windows open, the allowable internal noise goal is permitted to be 10dB(A) higher than when the windows are closed (i.e. – allowable level in bedrooms becomes 45dB(A), and 50dB(A) in living rooms).

5.1.3 Australian and New Zealand AS/NZS 2107:2016 *Recommended design sound levels and reverberation times for building interiors*

AS2107:2016: Recommended design sound levels and reverberation times for building interiors specifies allowable internal noise levels for internal spaces within residential and commercial buildings. Table 1, in Section 5 of AS2107:2016, gives the following maximum internal noise levels for commercial buildings and residential buildings near major roads.

Table 5-1 – Recommended Design Sound Levels

Space /Activity Type	Recommended Design Sound Levels
Sleeping Areas	35-40 dB(A) $L_{eq\ (10pm-7am)}$
Living Areas	35-45 dB(A) $L_{eq\ (anytime)}$
General Office Areas	40-45 dB(A) $L_{eq\ (anytime)}$
Small Retail Stores	50 dB(A) $L_{eq\ (anytime)}$

5.1.4 Sleep Disturbance

Sleep disturbance is discussed by the NSW EPA *Noise Policy for Industry* 2017 and *Road Noise Policy* 2011. A discussion of criteria has been made in Section 7.1.3. An internal L_{max} criteria of 55 dB(A) has been adopted for instantaneous noise events within units from environmental factors such as the rail corridor parallel with Woodburn Street,

5.1.5 Summarised External Noise Intrusion Criteria

The internal noise criteria adopted for each internal space is therefore summarised below based on the relevant State, Council and Australian Standard requirements.

Table 5-2 – Summarised Internal Noise Criteria

Space / Activity Type	Required Internal Noise Level
Sleeping Areas	35 dB(A) $L_{eq\ (9\ hour)}$
Living Areas	40 dB(A) $L_{eq\ (anytime)}$
General Office Areas	45 dB(A) $L_{eq\ (anytime)}$
Small Retail Stores	50 dB(A) $L_{eq\ (anytime)}$
Sleeping Areas	55 dB(A) $L_{max\ (9\ hour)}$

5.2 COMPLYING CONSTRUCTIONS

Assessment of façade requirements to achieve required indoor noise levels has been undertaken. Dimensions of rooms, setbacks from roadways, window openings and floor areas have been used. To assess the construction materials of the proposed development, the façade noise levels predicted in Table 4-4 and the internal noise criteria summarised in Table 5-2 were adopted.

5.2.1 Glazed Windows and Doors

The following constructions will comply with the project noise objectives for any new glazed elements that may be introduced to the development. Aluminium framed/sliding glass doors and windows will be satisfactory provided they meet the following criteria. All external windows and doors listed are required to be fitted with Q-lon type acoustic seals. (**Mohair Seals are unacceptable**). It is recommended that the existing glazing upgrade to include acoustic seals if feasible.

Thicker glazing may be required for structural, safety or other purposes. Where it is required to use thicker glazing than scheduled, this will also be acoustically acceptable. The complying constructions are detailed in Table 5-3.

Table 5-3 – Minimum Complying Glazing Construction

Room	Glazing Thickness	Acoustic Seals
Units facing Cleveland Street, Woodburn Street and Two Units Facing Eveleigh Street Nearest to Cleveland Street*	12.5 mm VLam Hush	Yes
Other Units Facing Eveleigh Street	6.38 mm Laminated	Yes
Units with Glazing Facing Internal Courtyard	6.38 mm Laminated	Yes
Commercial/Retail Areas Facing Cleveland/ Woodburn Street	6.38 mm Laminated	Yes
Café Facing Eveleigh Street	6.38 mm Laminated	Yes
Level 6 Areas Facing Woodburn Street	6.38 mm Laminated	Yes
All other areas	6 mm Float	Yes

*A minimum glazing thickness mark up can be found in Appendix Two – Acoustic Mark Up.

It is recommended that only window systems having test results indicating compliance with the required ratings obtained in a certified laboratory be used where windows with acoustic seals have been recommended.

In addition to complying with the minimum scheduled glazing thickness, the Rw rating of the glazing fitted into open-able frames and fixed into the building opening should not be lower than the values listed in Table 5-4 for all areas. Where nominated, this will require the use of acoustic seals around the full perimeter of open-able frames and the frame will need to be sealed into the building opening using a flexible sealant.

Table 5-4 – Minimum R_w of Glazing Assembly (with Acoustic Seals)

Glazing Assembly	Minimum R_w of Installed Window
12.5 mm VLam Hush	40
6.38mm Laminated	31
6mm Float	29

Note: Façade constructions to be reviewed at CC stage based on construction drawings. The glazing types listed above are indicative and for authority approvals purposes only. IGU's will need to be further reviewed for acoustic performance.

5.2.2 External Wall Construction

External wall construction will be constructed from concrete elements therefore no acoustic upgrading is required. In the event that any penetrations are required thru the external skin, an acoustic sealant should be used to minimise all gaps.

5.2.3 External Roof/Ceiling Construction

External roof construction will be constructed from concrete elements therefore no acoustic upgrading is required. In the event that any penetrations are required thru the external skin, an acoustic sealant should be used to minimise all gaps. Penetrations in ceilings (such as for light fittings etc.) must be sealed gap free with a flexible sealant. Any ventilation openings in the ceilings would need to be acoustically treated to maintain the acoustic performance of the ceiling construction.

5.2.4 Mechanical Ventilation

NSW Department of Planning's *Development near Busy Roads and Rail Corridors - Interim Guideline* dictates that:

> *"If internal noise levels with windows or doors open exceed the criteria by more than 10dB(A), 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."*

With windows open, the allowable internal noise goal is permitted to be 10dB(A) higher than when the windows are closed (i.e. – allowable level in bedrooms becomes 45dB(A) $L_{eq(9\ hr)}$and 50dB(A) $L_{eq(anytime)}$ in living rooms.

- All façades facing Eveleigh Street will be able to achieve required internal noise levels with windows or doors open.
- All façades facing Cleveland Street and Woodburn Street will require alternative ventilation strategies.

The current design of the proposed development includes mechanical ventilation for all rooms. Indicative treatments to the duct opening include 1m of 25mm internally lined rigid ducting from the façade penetration. The design is to be iterated during CC Stage.

Any supplementary ventilation system proposed to be installed should be acoustically designed to ensure that the acoustic performance of the acoustic treatments outlined above is not reduced and does not exceed Council criteria for noise emission to nearby properties. A mechanical engineer is to confirm if supplementary ventilation (to meet Australian Standard AS1668.2 requirements) will be required to these rooms.

6 RAILWAY VIBRATION

A rail vibration assessment has been conducted based off the requirements of the following acoustic noise criteria/standards:

- British Standard BS 7385:1990 Part 2 *Evaluation and measurement for vibration in buildings – part 2*.
- Australian Standard AS2670:1990 *Vibration and Shock – Guide to the evaluation of human exposure to whole body vibration*.
- NSW Department of Environment and Conservation's *Assessing Vibration: A Technical Guideline*.
- NSW Department of Planning and Environment's *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects*.

6.1 TACTILE VIBRATION

Human comfort is normally assessed with reference to the British Standard BS 7385 Part 2 1993 or Australian Standard AS 2670.2 1990.

The Interim Guideline references the DECCW *Assessing Vibration- A technical guideline* which recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)".

British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" is recommended by the RIC's and SRA's Interim Guidelines for Councils "Consideration of rail noise and vibration in the planning process" as this standard includes guidance for the assessment of human response to building vibration including intermittent vibrations such as that caused by trains.

Human response to vibration has been shown to be biased at particular frequencies, which are related to the orientation of the person. This standard provides curves of equal annoyance for various orientations. These curves are applied as correction filters such that an overall weighted acceleration level is obtained. As the orientation of the resident is unknown or varying the weighting filter used is based on the combined base curve as given in ISO 2631 & Australian Standard 2670 "Evaluation of Human Exposure to Vibration and Shock in Buildings (1 to 80Hz)" which represents the worst case of the X, Y and Z axes. Filtered measurements are made in all three co-ordinate axes and the highest value axis used.

This standard assesses the annoyance of intermittent vibration by using the Vibration Dose Value (VDV). Alternatively, the VDV may be estimated by the eVDV which is derived by a simpler calculation using an empirical factor. The VDV or eVDV is calculated for the two periods of the day being the "Daytime" (7am-10pm) and "Night time" (10pm-7am). The overall value is then compared to the levels in table 2.4 of the guideline. For this project, the aim will be for a low probability of adverse comment.

Table 6-1 – Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime (7am – 10pm)		Night Time (10pm – 7am)	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20	0.40	0.13	0.26

6.2 STRUCTURE BORNE NOISE

NSW Department of Planning and Environment's *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* stipulates the following structure borne noise trigger levels for residential developments with regard to structure borne noise for the 95th percentile of train pass-bys. This criteria only applies to habitable areas that are shielded from airborne noise from the railway.

Table 6-2 – Structure Borne Noise Trigger Levels

Location	Daytime (7am – 10pm)	Night Time (10pm – 7am)
Residences	40 dB(A)$L_{max(slow)}$	35 dB(A)$L_{max(slow)}$

6.3 RAIL VIBRATION MEASUREMENTS

6.3.1 Measurement Position and Period

Rail vibration measurements were conducted in line with the future proposed eastern façade (facing Woodburn Street) which is the closest façade to the rail corridor. Measurements were conducted on Thursday 30th September 2021 from 14:00 to 15:00.

6.3.2 Measurement Equipment

A Svantek 958 Vibration Analyser was used for the vibration measurements. The analyser was fitted with three Svantek SV80 accelerometers.

6.3.3 Measurement Results

6.3.3.1 Tactile Vibration

The measured VDV of a typical rail pass-by is presented in the table below.

Table 6-3 – Measured Vibration

Location	Measured VDV m/s$^{1.75}$*
6-8 Woodburn Street The eastern (closest) façade to the rail corridor	0.011*

*Highest VDV of 15 rail pass-bys.

The measured vibration levels, duration of train pass-by and the number of rail movements per hour were used to determine the overall vibration dose (VDV) at the proposed development for both daytime and night time periods. This is calculated based on the measured VDV of a typical train pass-by and taking into account the number of rail movements in a typical daytime/night time period (based on rail timetables). The results are presented in the table below.

Table 6-4 – Calculated Vibration Dose Values

Time Period	Calculated VDV $m/s^{1.75}$	Criteria VDV $m/s^{1.75}$	Complies (Yes/No)
Day (7am – 10pm)	<0.1	0.20 to 0.40	Yes
Night (10pm -7am)	<0.1	0.13 to 0.26	Yes

6.3.3.2 Structure Borne Noise Generated by Train Movements

Vibration measurements were also carried out at locations of the proposed habitable space near the rail corridor which are not directly affected by airborne noise from the rail corridor. The structure borne noise generated by the train vibration has been predicted based on the measured vibration level from 1Hz to 10KHz. The predicted structure borne noise below has been made for ground floor area.

Table 6-5 – Predicted Structure Borne Noise dB(A) L_{max}

Location	Predicted Structure Borne Noise Level	Criteria	Compliance
14.6 meters from the eastern boundary (Facing away from the rail corridor)	< 35 dB(A) L_{max}	35 dB(A) L_{max}	Yes

6.3.4 Discussion

It is noted that the façade of proposed development facing the rail corridor is with glazing, which would result in the structure borne noise being masked by airborne noise levels when trains pass.

The 'Rail Infrastructure Noise Guideline' also states the following regarding structure borne noise:

Ground-borne noise or regenerated noise in buildings is typically noted at receiver locations where the level of ground-borne noise is likely to be greater than airborne noise (e.g., in buildings above rail tunnels where the airborne noise is masked by the tunnel).

Although structure borne noise can vary for several reasons, including the condition of wheels, train size, and weight, etc., it is expected that airborne noise will have a masking effect over the structure borne noise for this development (when looking at an instantaneous maximum sound pressure level, dB(A)$L_{max(slow)}$) as:

- The rail corridor is on-ground with the development; and
- All living units facing the rail corridor contain glazing.

Nonetheless, based on the measured train vibration levels, the predicted structure borne noise inside living units not facing the rail corridor (Woodburn Street) have been found to achieve satisfactory internal noise levels and in our opinion, building isolation is not required.

Furthermore, measurements above indicate that the overall vibration dose (VDV) at the proposed development for both daytime and night time period satisfy the requirements of British Standard BS 7385 Part 2 1993 or Australian Standard AS 2670.2 1990.

7 NOISE EMISSION CRITERIA

The noise emission from the project site shall comply with the requirements of the NSW Environmental Protection Authority (EPA) *Noise Policy for Industry* (NPI) 2017.

7.1 NSW EPA NOISE POLICY FOR INDUSTRY (NPI) 2017

The EPA NPI has two criteria which both are required to be satisfied, namely Intrusiveness and amenity. The NPI sets out acceptable noise levels for various localities. The policy indicates four categories to assess the appropriate noise level at a site. They are rural, suburban, urban and urban/industrial interface. Under the policy the nearest residential receivers would be assessed against the urban criteria.

Noise levels are to be assessed at the property boundary or nearby dwelling, or at the balcony or façade of an apartment.

7.1.1 Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

Background noise levels adopted are presented in Table 4-2. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

7.1.2 Project Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment.

The EPA's NPI sets out acceptable noise levels for various localities. The recommended noise amenity area is based upon the measured background noise levels at the sensitive receiver. Based on the measured background noise levels detailed in Table 4-2, the Noise Policy for Industry suggests the adoption of the 'urban' categorisation.

The NPI requires project amenity noise levels to be calculated in the following manner:

$$L_{Aeq,15min} = \textit{Recommended Amenity Noise Level} - 5\ dB(A) + 3\ dB(A)$$

The amenity levels appropriate for the receivers surrounding the site are presented in Table 7-1.

Table 7-1 – EPA Amenity Noise Levels

Type of Receiver	Time of day	Recommended Noise Level dB(A)$L_{eq(period)}$	Project Amenity Noise Level dB(A)$L_{eq(15\ minute)}$
Residential – Urban	Day	60	58
	Evening	50	48
	Night	45	43
Hotel	Day	65	63
	Evening	55	53
	Night	50	48
Commercial	When in use	65	63

The NSW EPA Noise Policy for Industry (2017) defines:

- Day as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays.
- Evening as the period from 6pm to 10pm.
- Night as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.

7.1.3 Sleep Arousal Criteria

The Noise Policy for Industry recommends the following noise limits to mitigate sleeping disturbance:

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

- *$L_{eq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever i72s the greater, and/or*
- *L_{Fmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*

a detailed maximum noise level even assessment should be undertaken.

Table 7-2 – Sleep Arousal Criteria for Residential Receivers

Receiver	Rating Background Noise Level (Night) dB(A)L_{90}	Emergence Level
Nearby residential receivers Night (10pm – 7am)	41 dB(A) L_{90}	46 dB(A)$L_{eq,\ 15min}$ 56 dB(A)L_{Fmax}

If there are noise events that could exceed the emergence levels detailed in the table above, then an assessment of sleep arousal impact is required to be carried out, taking into account the level and frequency of noise events during the night, existing noise sources, etc. This more detailed sleep arousal test is conducted using the guidelines in the EPA Road Noise Policy. Most relevantly, the Road Noise Policy states:

> *From the research on sleep disturbance to date it can be concluded that:*
>
> - *Maximum internal noise levels below 50-55 dB(A) are unlikely to awaken people from sleep*
> - *One or two noise events per night, with maximum internal noise levels of 67-70 dB(A), are not likely to affect health and wellbeing significantly.*

Typically, a 10 dB(A) noise reduction can be taken for noise through a naturally ventilated open window of a residential façade, noting that modern façades can reduce noise levels by more than 20-30 dB(A).

7.2 COMMUNAL AREAS

The NPI applies only to activities detailed in Schedule 1 of the Protection of the Environment Operations Act, of which housing communal areas are not listed. As such, noise impacts from outdoor communal areas shall be assessed against the requirements of City of Sydney *Development Control Plan* (DCP) 2012. Though no specific controls are provided for co-living/ residential units, a boarding house control can be applied for conservative assessment.

Section 4.4.1.7 (Boarding Houses) of the DCP states the following:

> *(d) measures to minimise unreasonable impact to the habitable areas of adjoining properties, including the management of communal open spaces. For boarding houses located within residential areas or where adjoining sites contain residential activities this use of open space should be restricted to before 10pm.*

7.3 SUMMARISED NOISE EMISSION CRITERIA

Table 7-3 – EPA NPI Noise Emission Criteria (Residents Surrounding Project Site)

Receiver	Time Period	Assessment Background Noise Level dB(A)L_{90}	Project Amenity Criteria dB(A) L_{eq}	Intrusiveness Criteria $L_{eq(15min)}$	NPI/RNP Criteria for Sleep Disturbance
Residential	Day	54	**58**	59	N/A
	Evening	50	**48**	55	N/A
	Night	41	**43**	46	**NPI: 46 dB(A)$L_{eq,\ 15min}$;** NPI: 56 dB(A)$L_{Fmax\ (external)}$ **RNP: 55 dB(A)$L_{Fmax\ (internal)}$**
Hotel	Day	-	**63**	-	N/A
	Evening	-	**53**	-	N/A
	Night	-	**48**	-	N/A
Commercial	When in use	-	**63**	-	N/A

The project noise trigger levels are indicated by the bolded values in the table above.

8 NOISE EMISSION ASSESSMENT

8.1 NOISE FROM MECHANICAL PLANT WITHIN PROPOSED SITE GENERALLY

Detailed plant selection and location has not been undertaken at this stage. Satisfactory levels will be achievable through appropriate plant selection, location and if necessary, standard acoustic treatments such as duct lining, acoustic silencers, and enclosures.

Noise emissions from all mechanical services to the closest residential receiver should comply with the requirements of Section 7.3.

Detailed acoustic review should be undertaken at CC stage to determine acoustic treatments to control noise emissions to satisfactory levels.

8.2 COMMUNAL AREAS

The communal outdoor areas are to be operated as per the recommendations of City of Sydney DCP 2012 for communal areas in a boarding house to only be useable between 7am to 10pm.

8.3 COMPLYING CONTROLS

8.3.1 Communal Areas

- Outdoor areas are not used during the night time period (10pm to 7am).
- Music played indoors are to be restricted within the hours of 7am to 10pm.
- All windows and doors openable to the outside are to be closed while communal indoor area is in use.
- All windows and doors openable to the outside are to have acoustic seals across the full perimeter.
- Prominent notice shall be placed within and around all outdoor communal areas to remind residents to minimise noise at all times.

9 CONCLUSION

This report presents an acoustic assessment of noise impacts associated with the development to be located at 175-177 Cleveland St & 1-5, 6-8 Woodburn St, Redfern NSW.

Provided that the complying constructions presented in Section 5.2 are adopted, internal noise levels for the development will comply with the acoustic requirements of the following documents:

- NSW Department of Planning *State Environmental Planning Policy Transport and Infrastructure* (SEPPT&I) 2021
- NSW Department of Planning *Developments near Rail Corridors or Busy Roads – Interim Guideline*, and
- Australian Standard AS2107:2016 *Recommended Design Sound Levels and Reverberation Times for Building Interiors*.

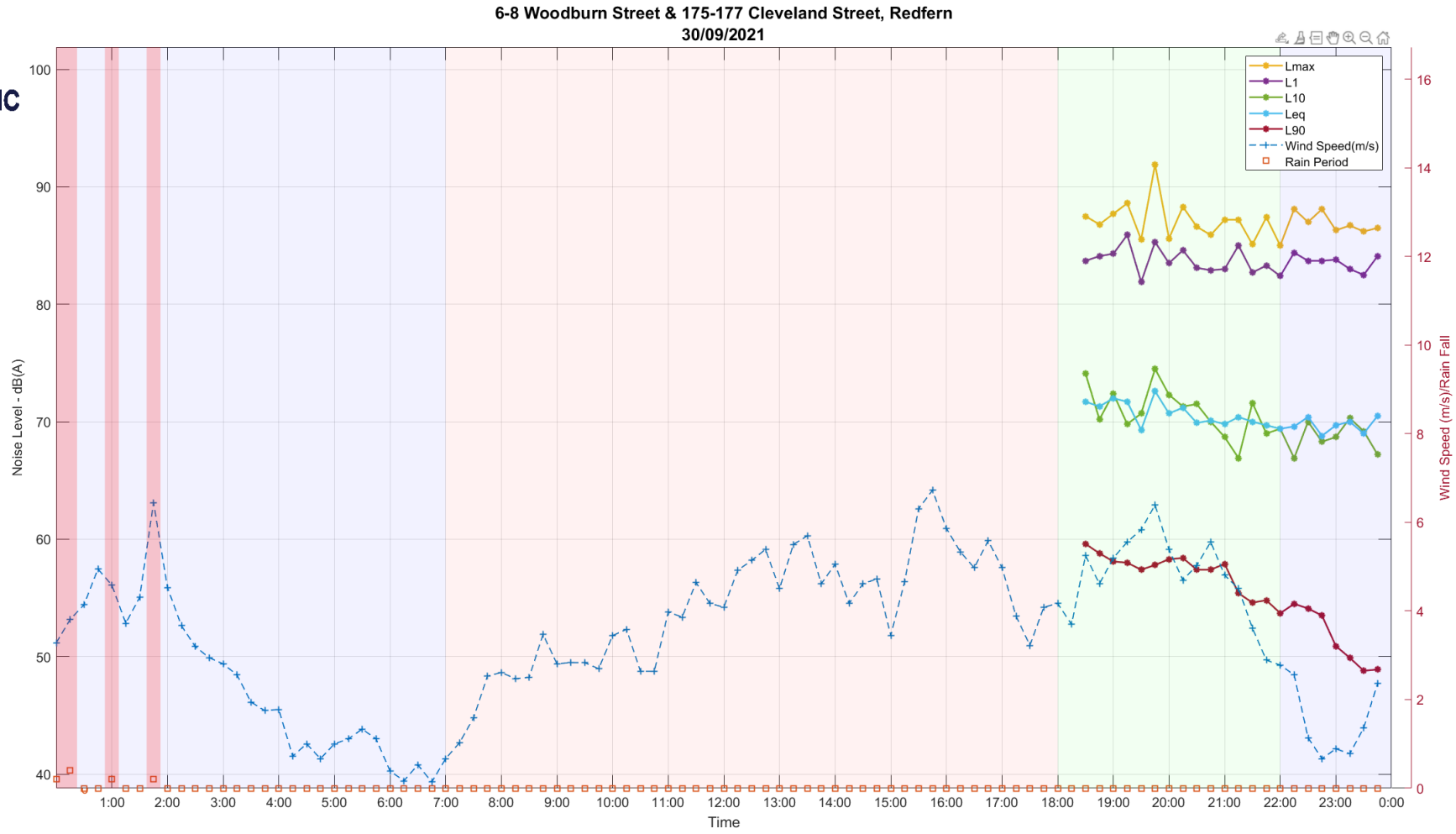
External noise emissions criteria have been established in this report to satisfy the requirements of the NSW Environmental Protection Authority (EPA) *Noise Policy for Industry* (NPI) 2017.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Pty Ltd
Weber Yeh

APPENDIX ONE – UNATTENDED NOISE MONITORING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Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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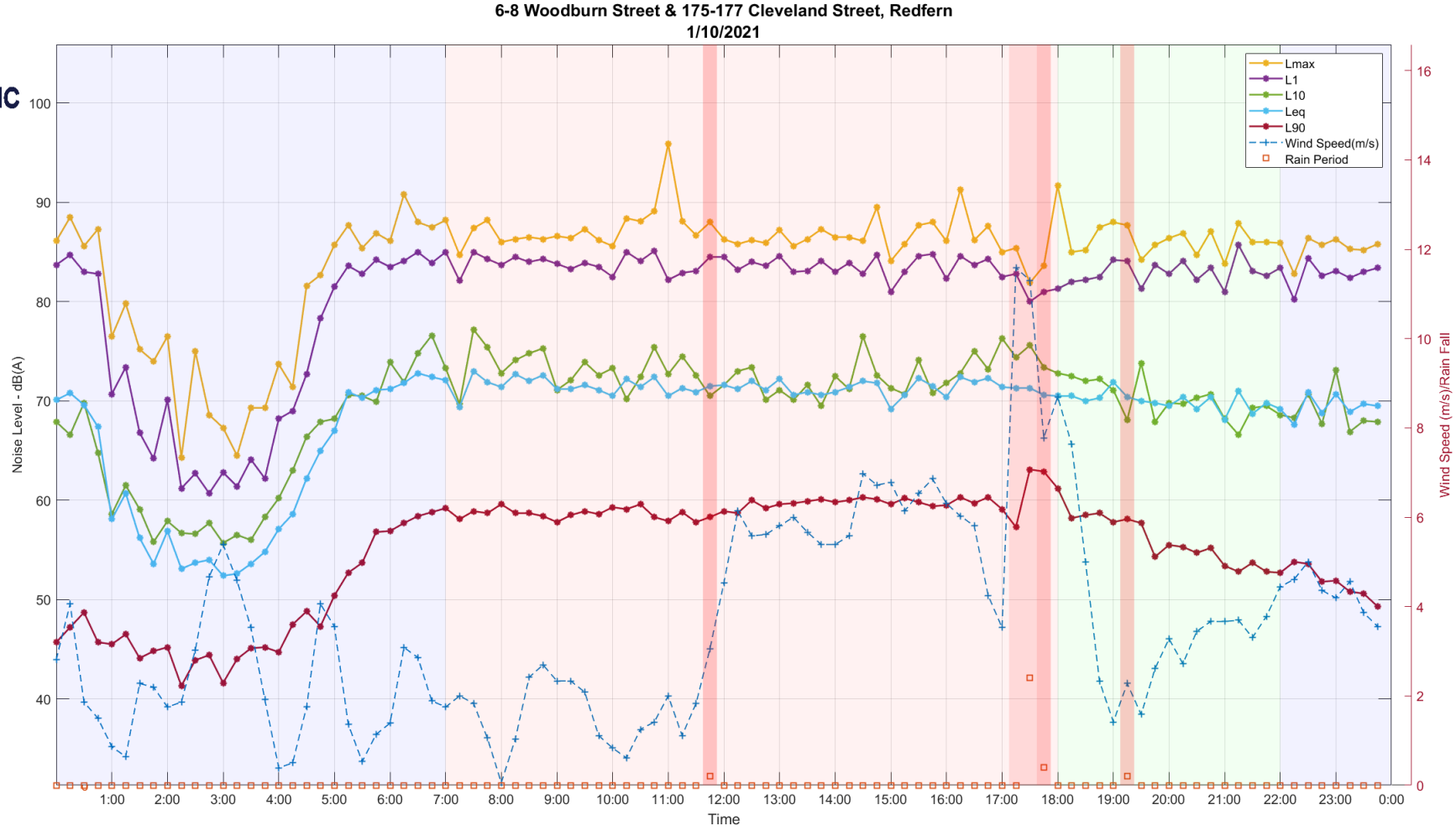
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Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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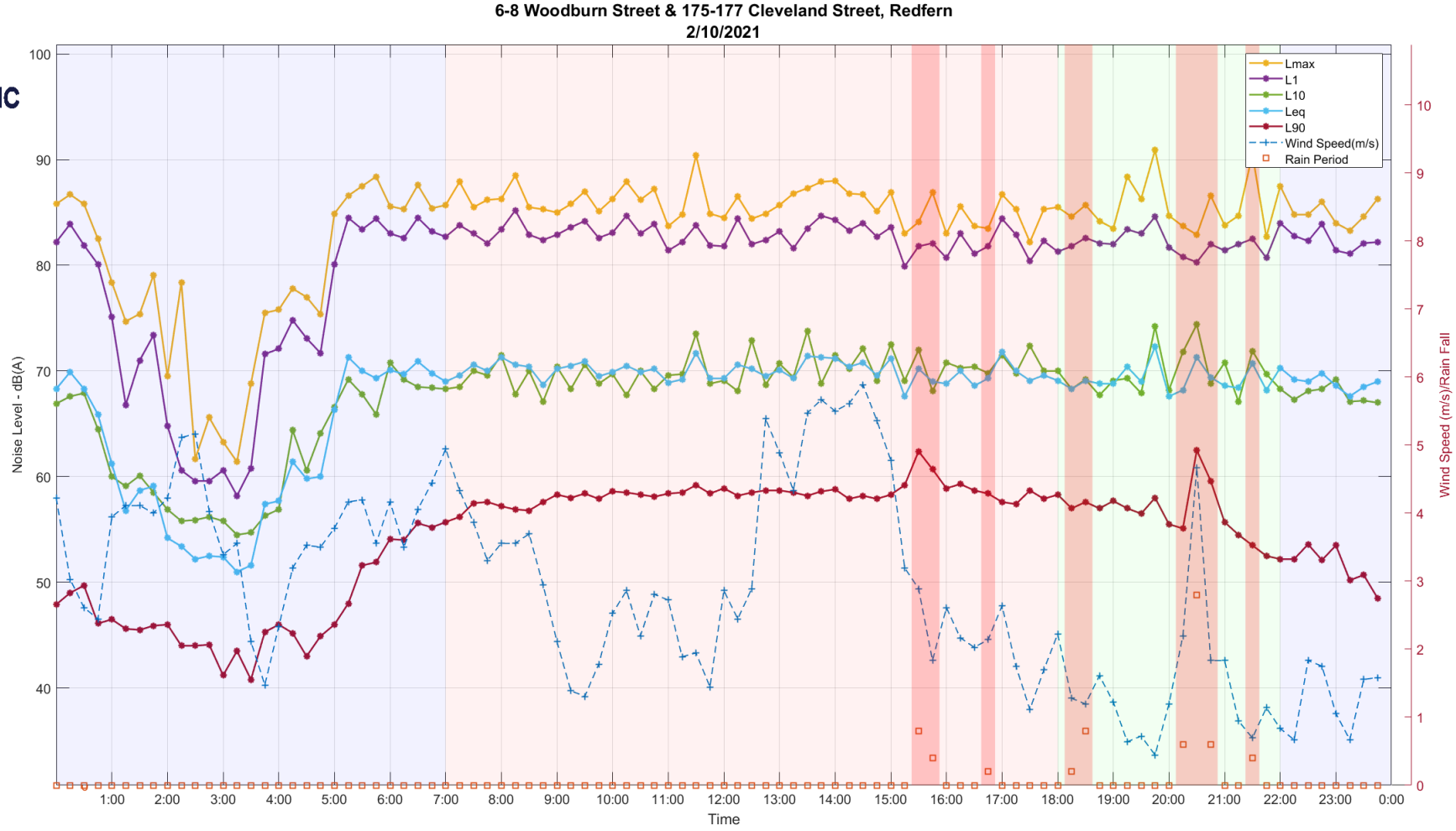
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Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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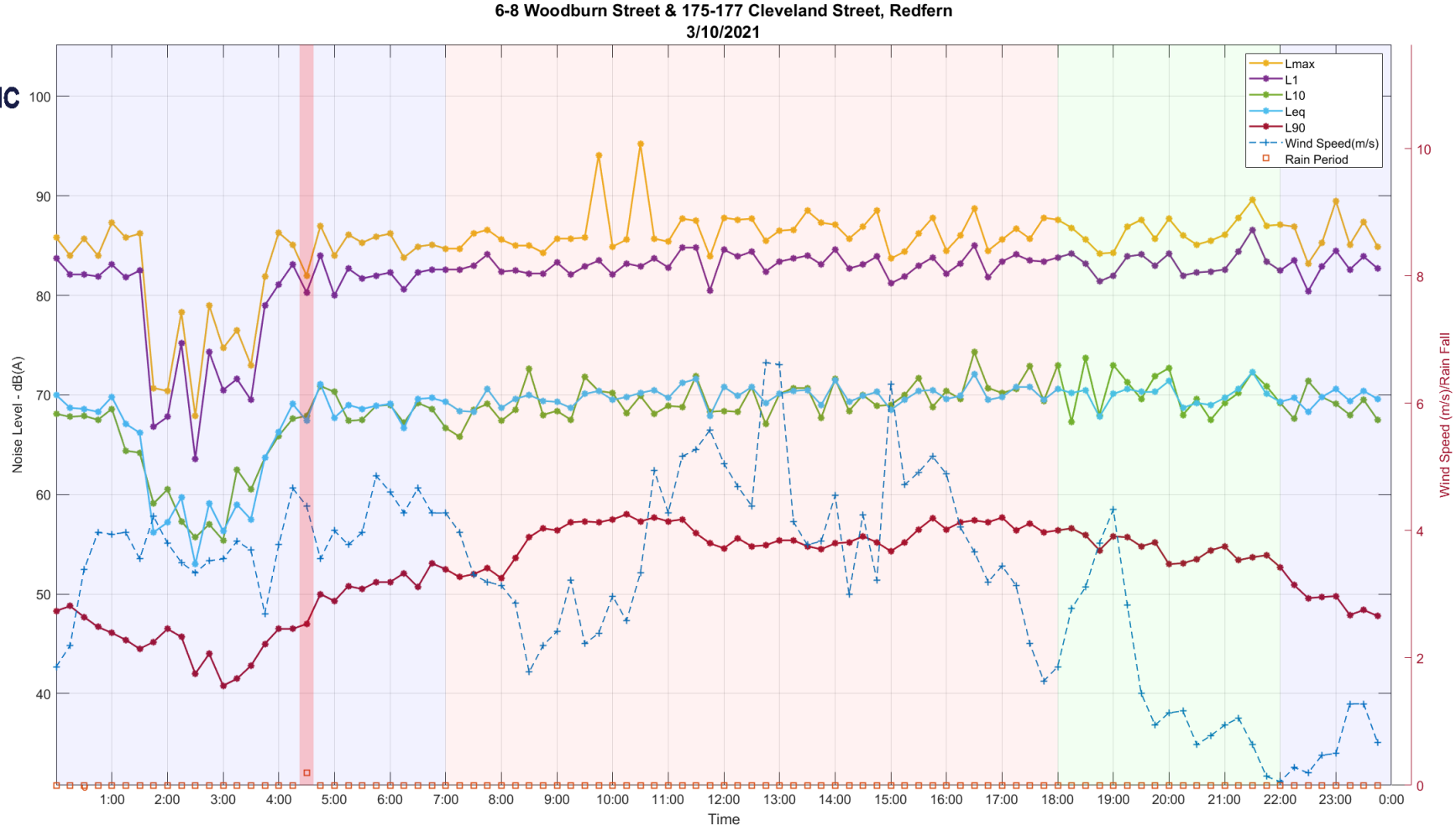
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Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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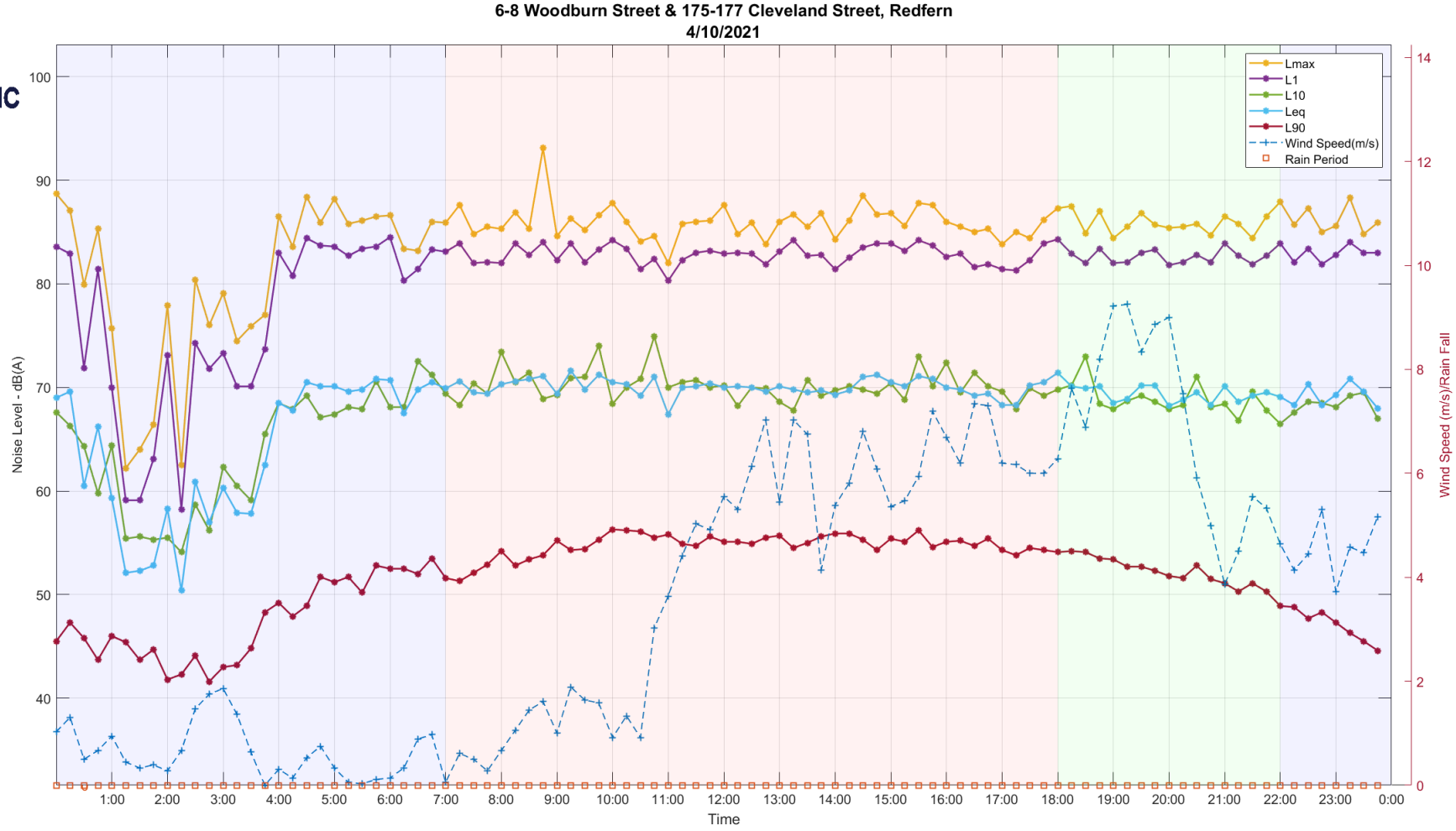
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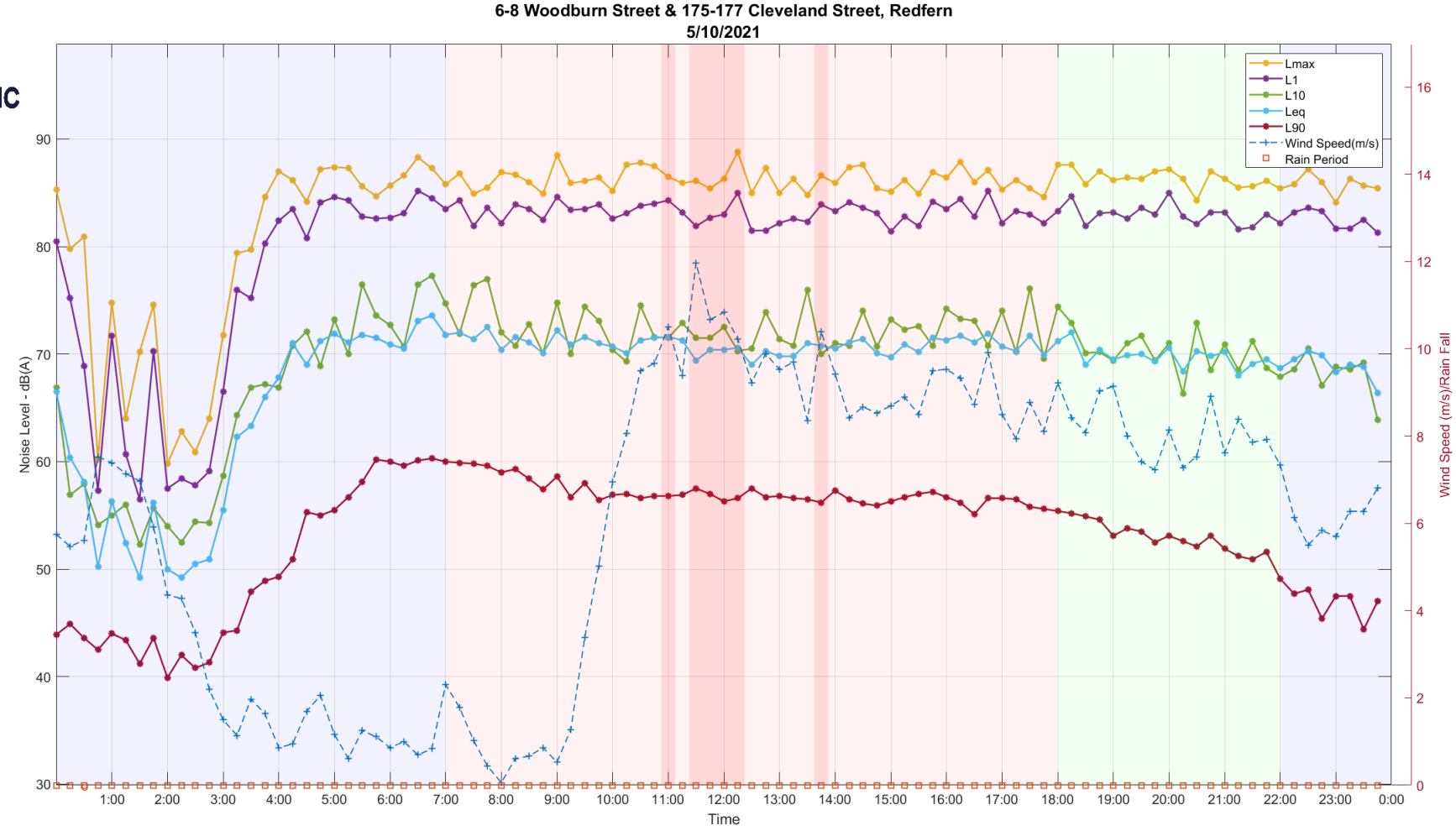
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Wind Speed (m/s)/Rain Fall
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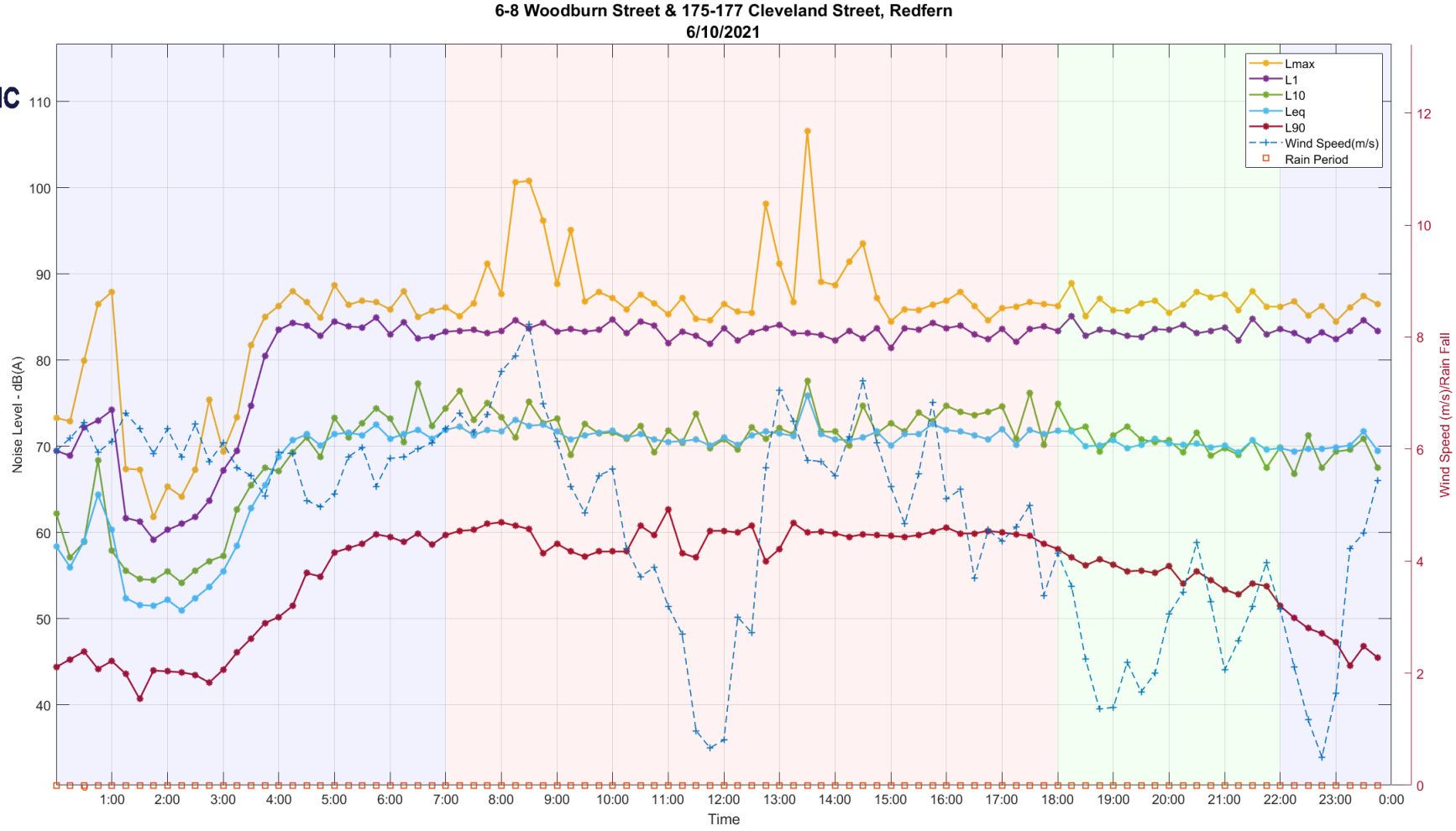
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Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
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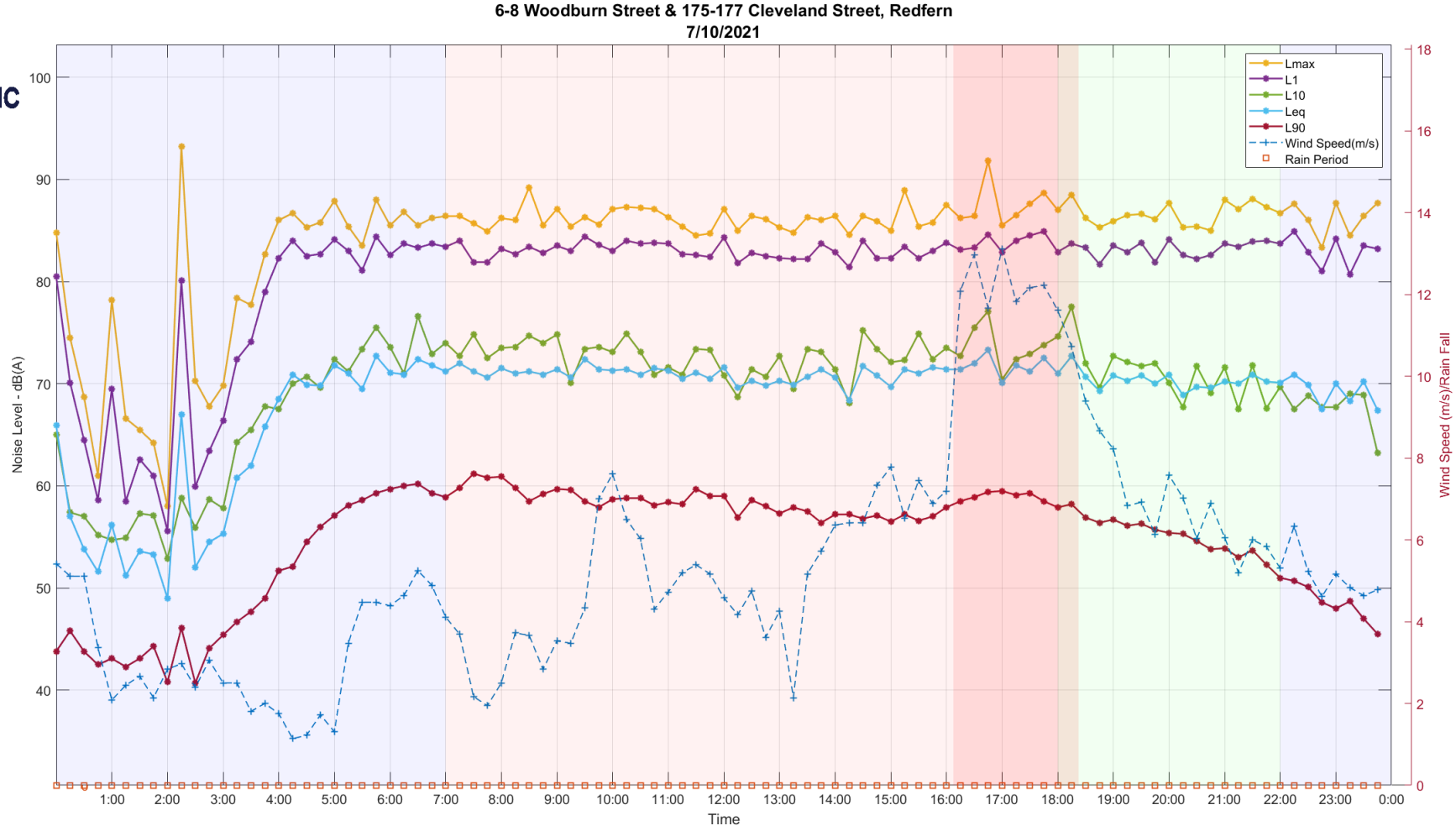
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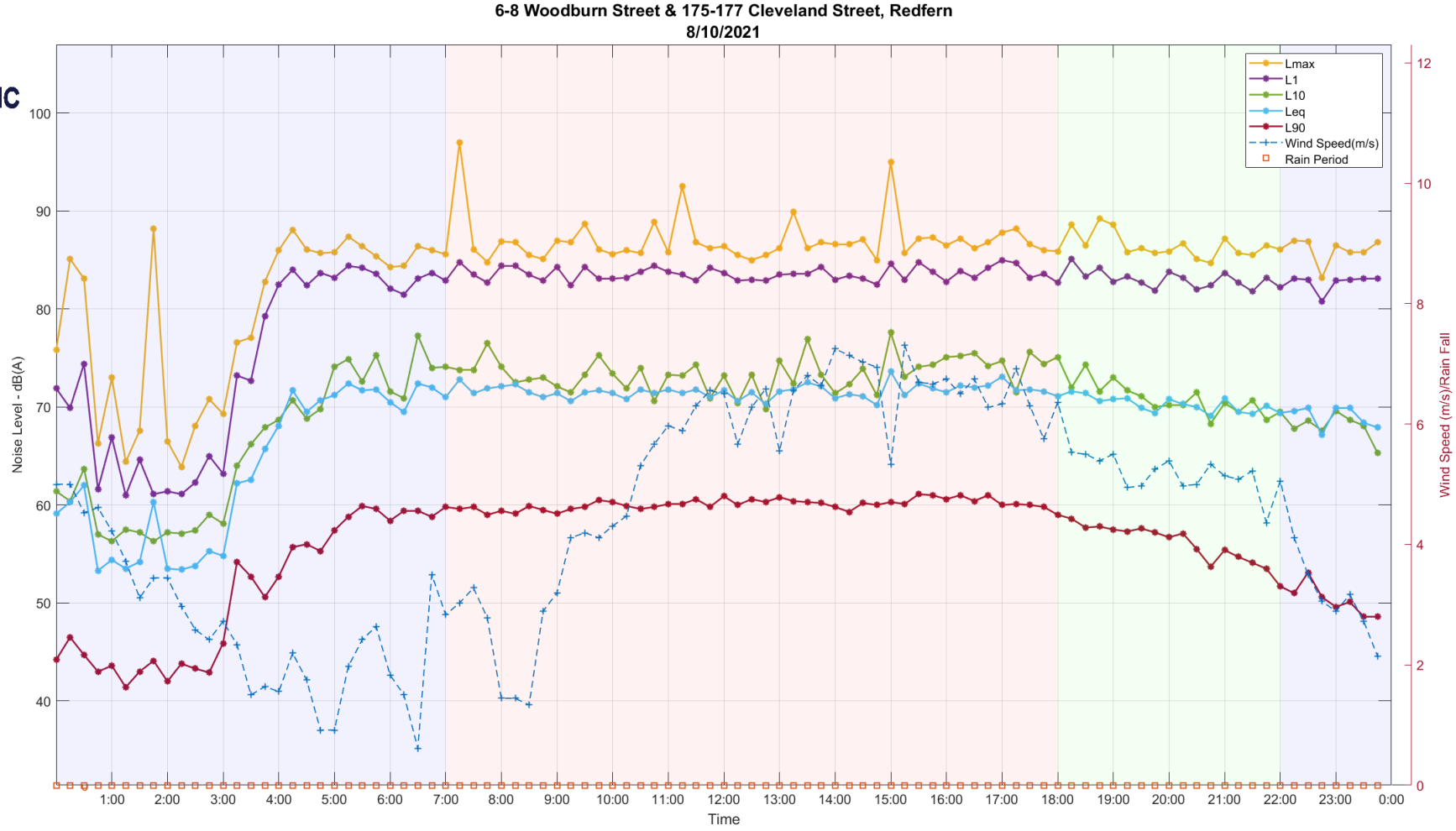
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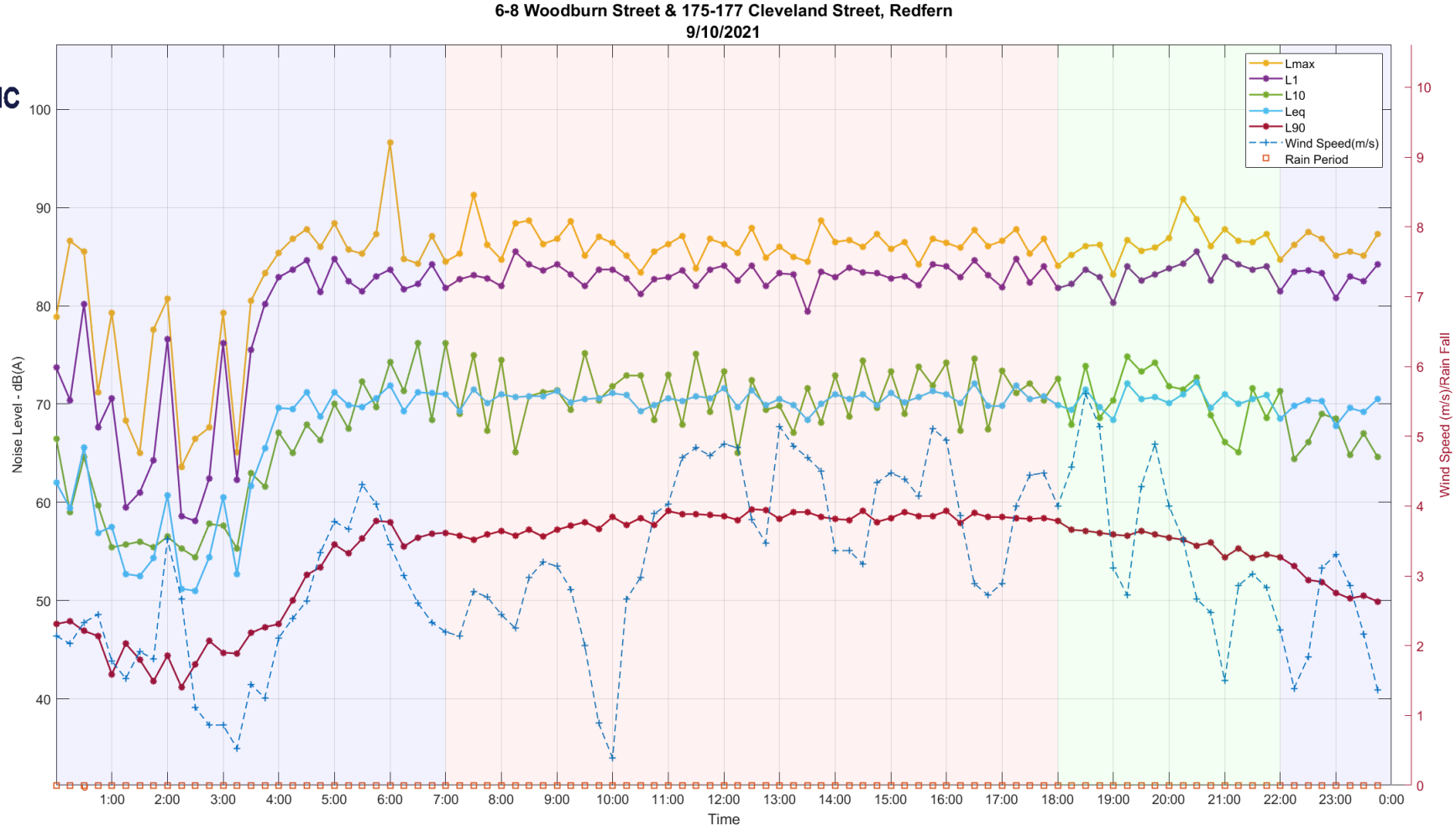
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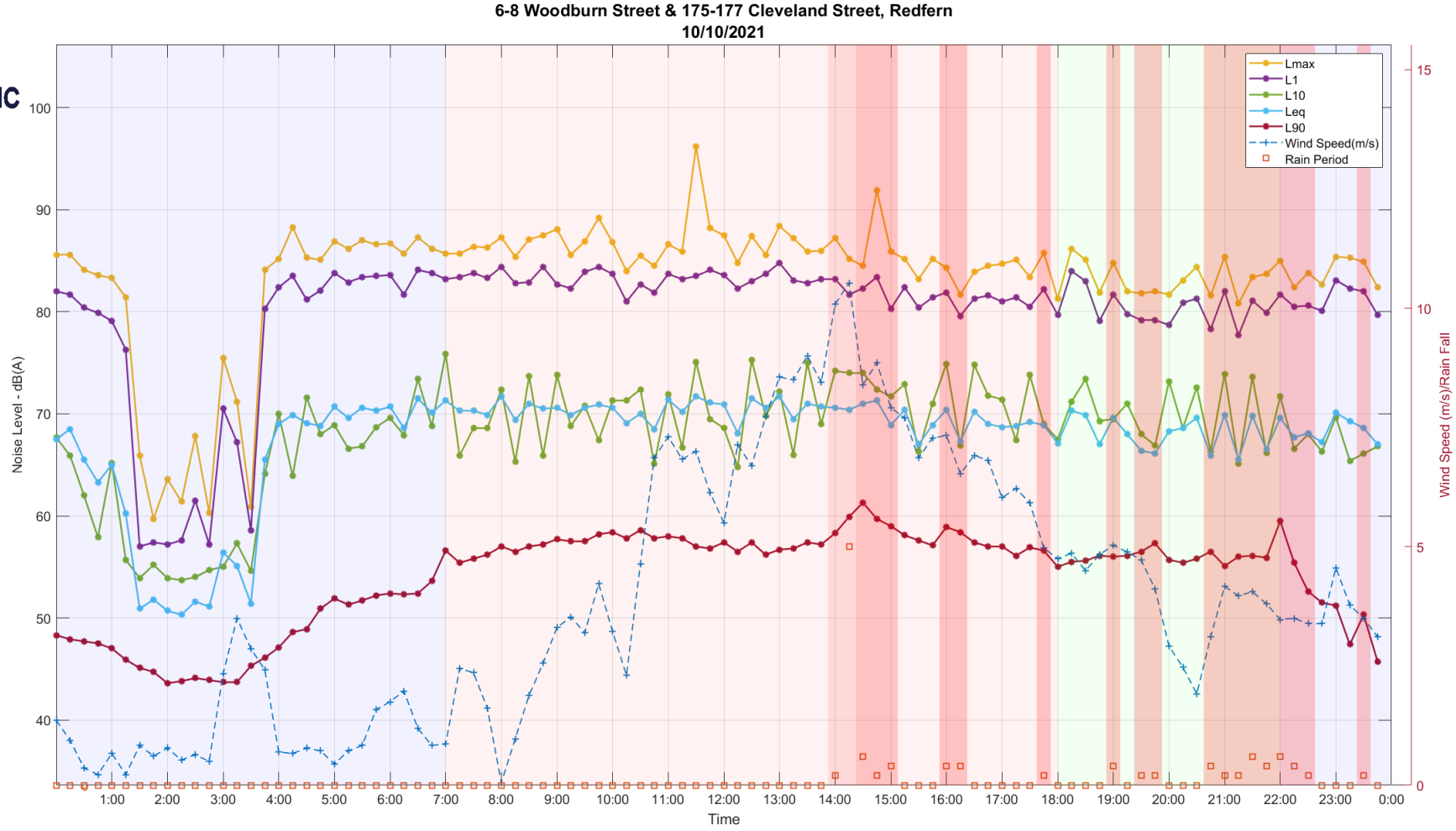
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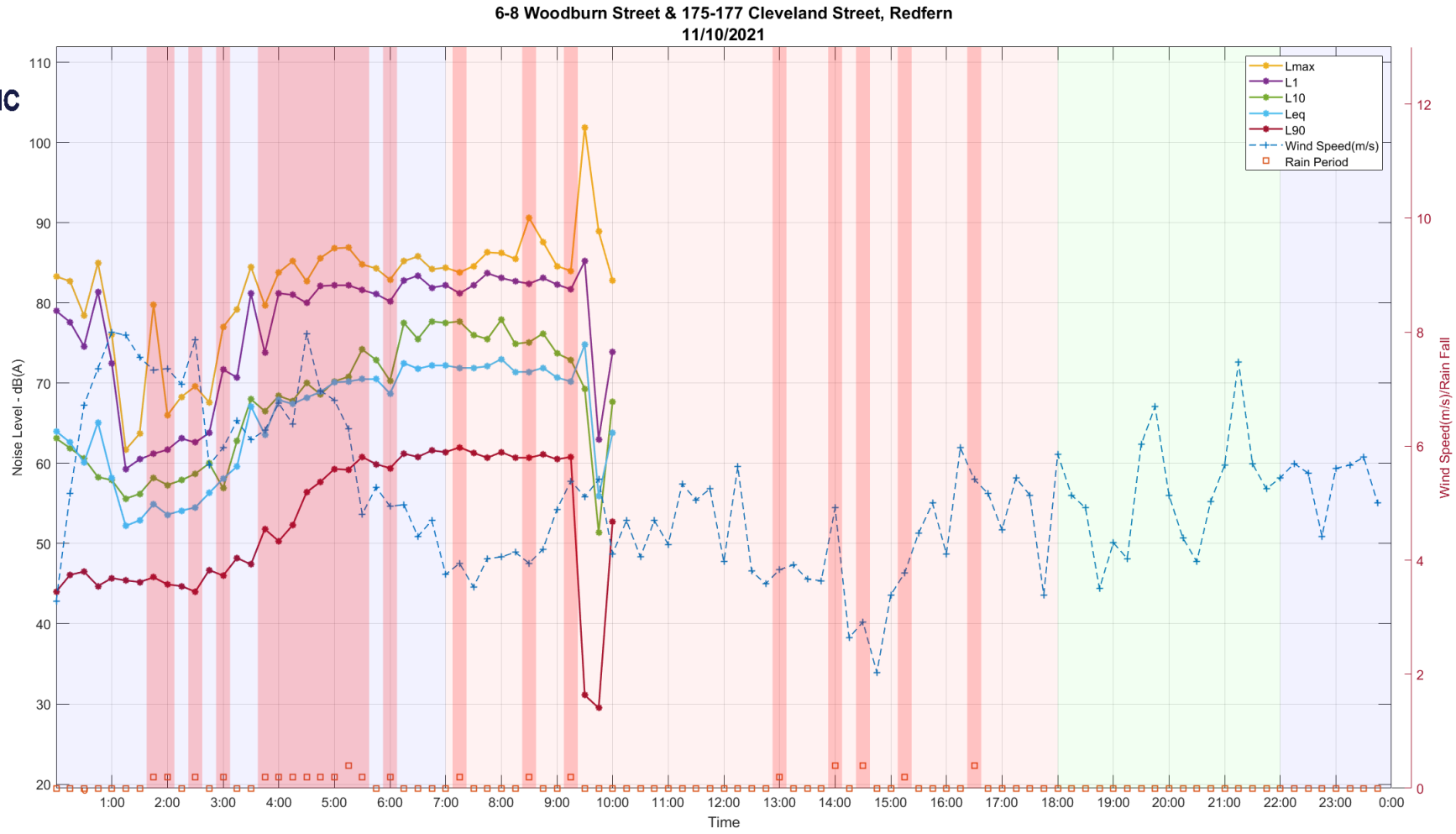
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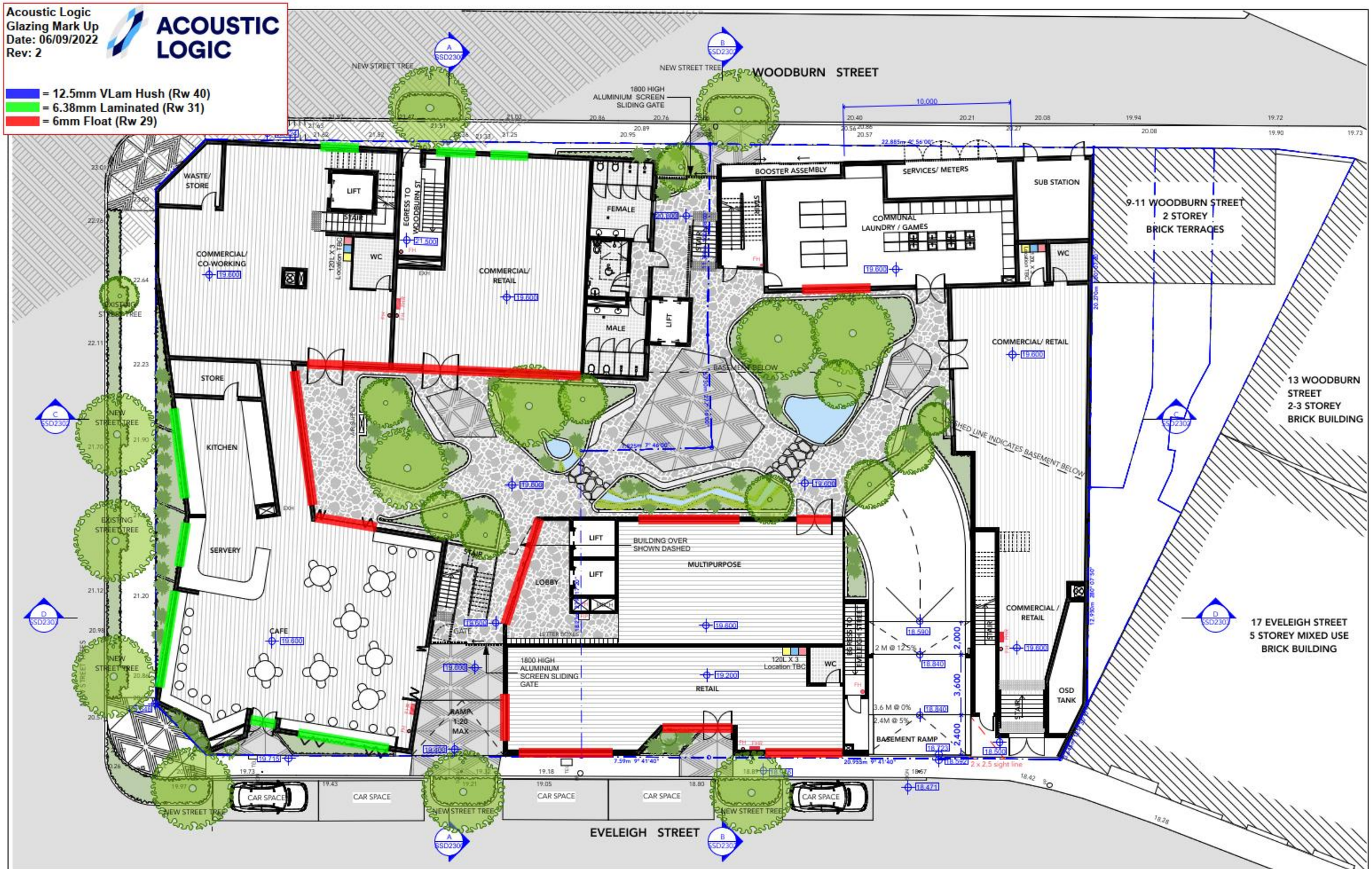
APPENDIX TWO – ACOUSTIC MARK UP

Acoustic Logic
Glazing Mark Up
Date: 06/09/2022
Rev: 2

ACOUSTIC LOGIC

= 12.5mm VLam Hush (Rw 40)
= 6.38mm Laminated (Rw 31)
= 6mm Float (Rw 29)



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NSW REG. 9789
ABN 646 2000 7678

ISSUE	DATE	REVISION
P06	21/7/22	FOR COUNCIL CONSULTATION
P05	20/7/22	FOR CONSULTANT CO-ORDINATION
P04	10/7/22	FOR CONSULTANT CO-ORDINATION

PRELIMINARY 21/7/22

DRAWING NOT TO SCALE IF REPRODUCED 0 2 4 6m 1:200

PROJECT:
PROPOSED AFFORDABLE HOUSING DEVELOPMENT
175-177 Cleveland St & 6-8 Woodburn St
DRAWING:
GROUND FLOOR PLAN

PROJECT NO:
21022
SCALE: 1:200 @A3
PLOTTED: 21/7/22
DRAWING NO: **SSD2002** REV: **P06**

FILE: 220118 Redfern 1+2 220720_MAIN_AC22_MOWA.pln

Acoustic Logic
Glazing Mark Up
Date: 06/09/2022
Rev: 2

ACOUSTIC LOGIC

= 12.5mm VLam Hush (Rw 40)
= 6.38mm Laminated (Rw 31)
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P04	10/7/22	FOR CONSULTANT CO-ORDINATION

PRELIMINARY 21/7/22

DRAWING NOT TO SCALE IF REPRODUCED 0 2 4 6m 1:200

PROJECT:
PROPOSED AFFORDABLE HOUSING DEVELOPMENT
175-177 Cleveland St & 6-8 Woodburn St
DRAWING:
LEVEL 1 PLAN

PROJECT NO:
21022
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PLOTTED: 21/7/22
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Acoustic Logic
Glazing Mark Up
Date: 06/09/2022
Rev: 2

ACOUSTIC LOGIC

= 12.5mm VLam Hush (Rw 40)
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P04	10/7/22	FOR CONSULTANT CO-ORDINATION

PRELIMINARY 21/7/22

DRAWING NOT TO SCALE IF REPRODUCED 0 2 4 6m 1:200

PROJECT:
PROPOSED AFFORDABLE HOUSING DEVELOPMENT
175-177 Cleveland St & 6-8 Woodburn St
DRAWING:
LEVEL 2 PLAN

PROJECT NO:
21022
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PLOTTED: 21/7/22
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Acoustic Logic
Glazing Mark Up
Date: 06/09/2022
Rev: 2

ACOUSTIC LOGIC

= 12.5mm VLam Hush (Rw 40)
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P05	20/7/22	FOR CONSULTANT CO-ORDINATION
P04	10/7/22	FOR CONSULTANT CO-ORDINATION

PRELIMINARY 21/7/22

DRAWING NOT TO SCALE IF REPRODUCED 0 2 4 6m 1:200

PROJECT:
PROPOSED AFFORDABLE HOUSING DEVELOPMENT
175-177 Cleveland St & 6-8 Woodburn St
DRAWING:
LEVEL 3 PLAN

PROJECT NO:
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PLOTTED: 21/7/22
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Acoustic Logic
Glazing Mark Up
Date: 06/09/2022
Rev: 2

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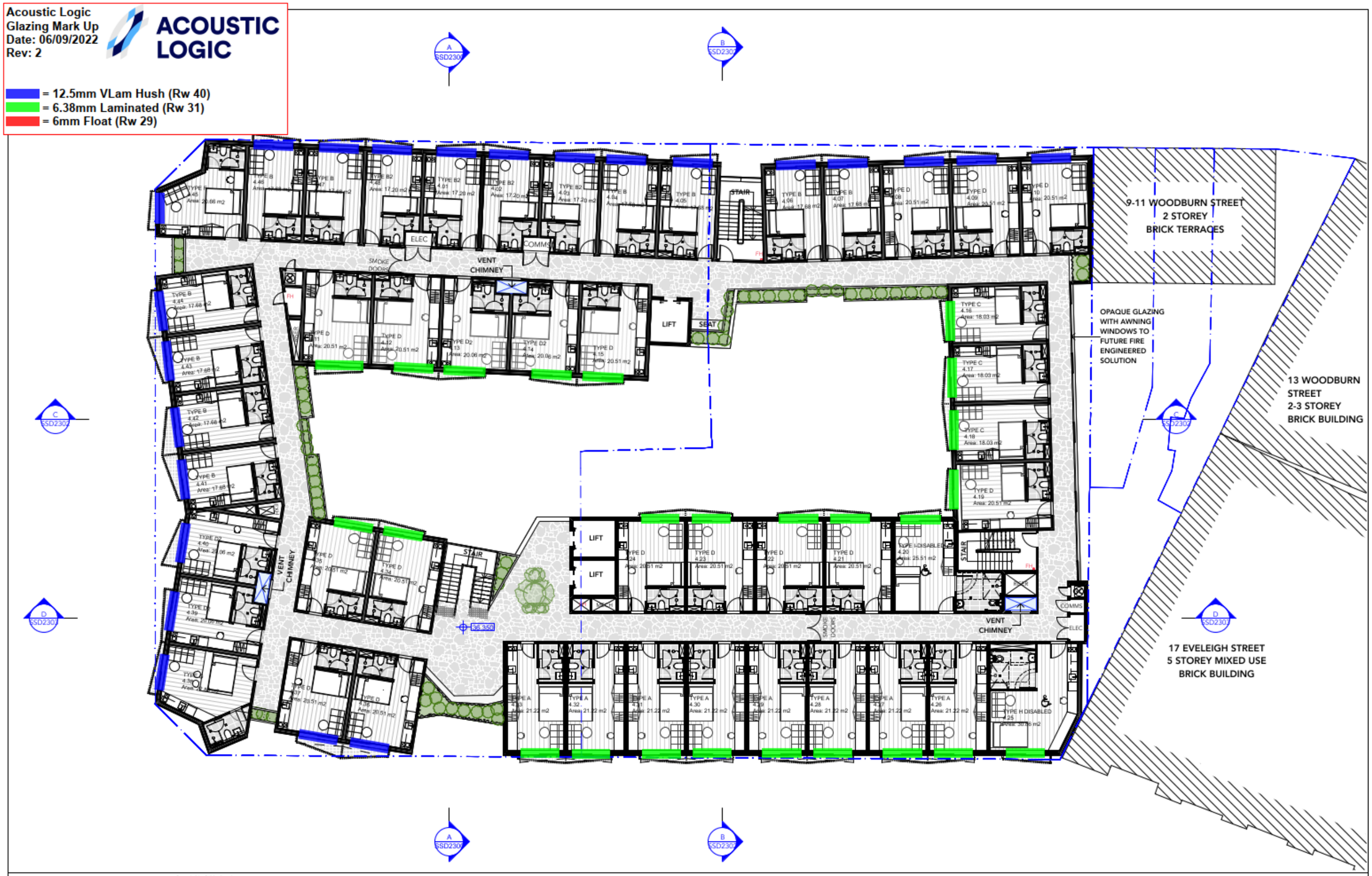

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P04	10/7/22	FOR CONSULTANT CO-ORDINATION

PRELIMINARY 21/7/22

DRAWING NOT TO SCALE IF REPRODUCED 0 2 4 6m 1:200

PROJECT:
PROPOSED AFFORDABLE HOUSING DEVELOPMENT
175-177 Cleveland St & 6-8 Woodburn St
DRAWING:
LEVEL 4 PLAN

PROJECT NO:
21022
SCALE: 1:200 @A3
PLOTTED: 21/7/22
DRAWING NO: REV:
SSD2006 P06

FILE: 220118 Redfern 1+2 220720_MAIN_AC22_MOWA.pln

Acoustic Logic
Glazing Mark Up
Date: 06/09/2022
Rev: 2

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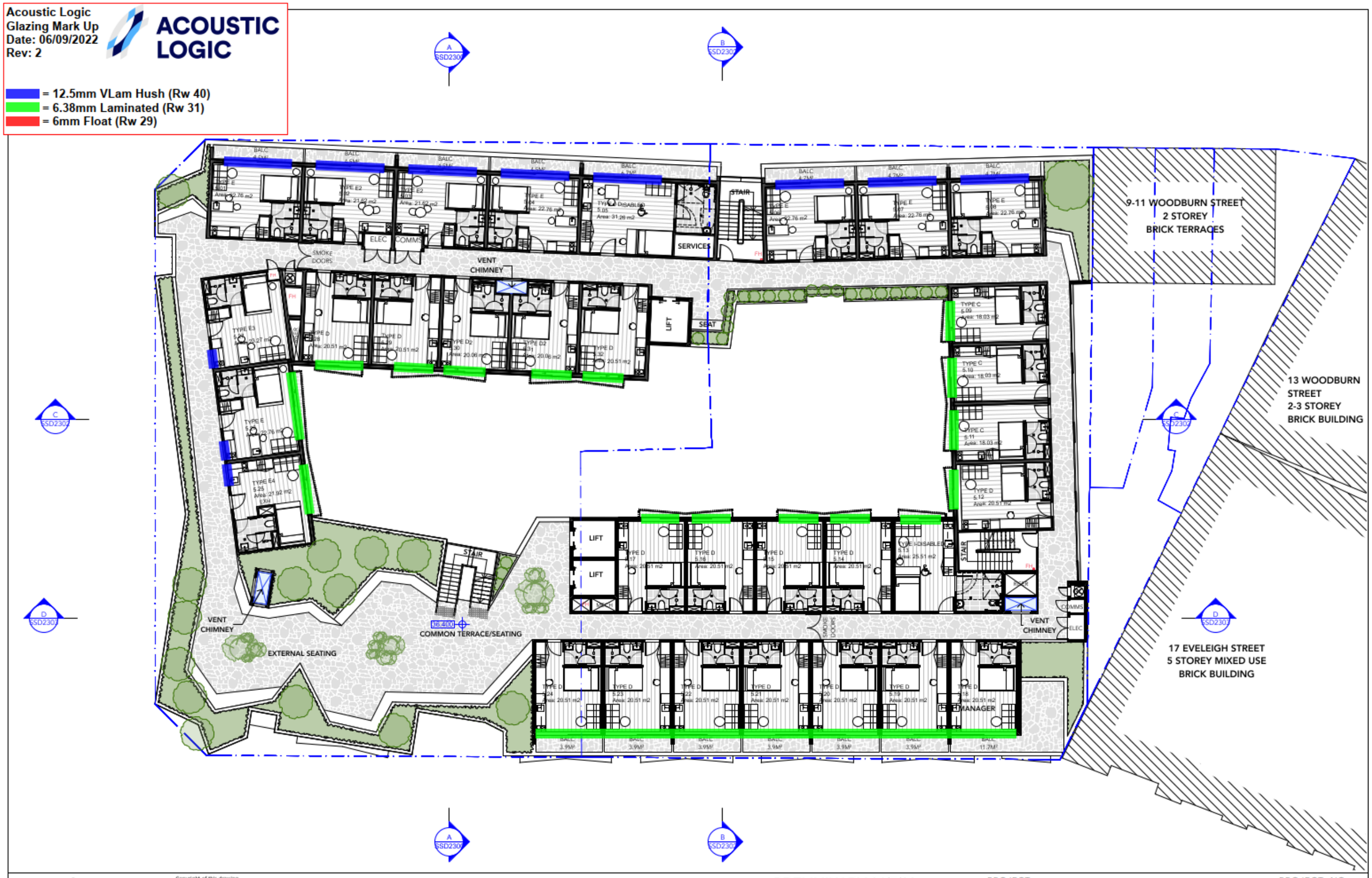

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PRELIMINARY 21/7/22

DRAWING NOT TO SCALE IF REPRODUCED 0 2 4 6m 1:200

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PROPOSED AFFORDABLE HOUSING DEVELOPMENT
175-177 Cleveland St & 6-8 Woodburn St
DRAWING:
LEVEL 5 PLAN

PROJECT NO:
21022
SCALE: 1:200 @A3
PLOTTED: 21/7/22
DRAWING NO: REV:
SSD2007 P06

FILE: 220118 Redfern 1+2 220720_MAIN_AC22_MOWA.pln

Acoustic Logic
Glazing Mark Up
Date: 06/09/2022
Rev: 2

ACOUSTIC LOGIC

= 12.5mm VLam Hush (Rw 40)
= 6.38mm Laminated (Rw 31)
= 6mm Float (Rw 29)

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ISSUE	DATE	REVISION
P06	21/7/22	FOR COUNCIL CONSULTATION
P05	20/7/22	FOR CONSULTANT CO-ORDINATION
P04	10/7/22	FOR CONSULTANT CO-ORDINATION

PRELIMINARY 21/7/22

DRAWING NOT TO SCALE IF REPRODUCED 0 2 4 6m 1:200

PROJECT:
PROPOSED AFFORDABLE HOUSING DEVELOPMENT
175-177 Cleveland St & 6-8 Woodburn St
DRAWING:
LEVEL 6 PLAN

PROJECT NO:
21022
SCALE: 1:200 @A3
PLOTTED: 21/7/22
DRAWING NO: **SSD2008** REV: **P06**

FILE: 220118 Redfern 1+2 220720_MAIN_AC22_MOWA.pln