MATTHEW PALAVIDIS
VICTOR FATTORETTO
MATTHEW SHIELDS

Riverwood Estate State Significant Precinct

Preliminary Noise Impact Assessment

SYDNEY
9 Sarah St
MASCOT NSW 2020
(02) 8339 8000

ABN 98 145 324 714
www.acousticlogic.com.au

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1 INTRODUCTION

Acoustic Logic (AL) have been engaged to undertake an assessment of noise impacts associated with the planning proposal of the Riverwood Estate State Significant Precinct.

This report has been prepared to assess the potential acoustic impacts of the development. In this report, we will:

- Identify nearby noise and vibration sensitive receivers and operational noise sources with the potential to adversely impact the nearby development.
- Identify relevant noise and vibration emission criteria applicable to the development.
- If necessary, determine building and/or management controls necessary to mitigate potential noise and vibration impacts.

This assessment has been based on master plan drawings provided by Architectus dated 12.2.2021.

1.1 RESPONSE TO NSW DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT STUDY REQUIREMENTS

This report addresses the requirements of the NSW Department of Planning, Industry and Environment (DPIE) Study Requirements for the Riverwood Estate State Significant Project.

Table 1 presents the relevant NSW DPIE requirements and associated reference within this report.

Table 1 - DPIE and Report Reference

DPIE Item	Requirement	Report Reference
2. Public Domain, Place and Urban Design	Given the proximity of the M5 Motorway and nearby industrial land uses, outline the acoustic and air quality impacts of the proposal and the mitigations measures to ensure a high standard of amenity for future residents. The *State Environmental Planning Policy (Infrastructure) 2007* and the *Development Near Rail Corridors and Busy Roads – Interim Guideline* must be addressed. These assessments should also consider other current and future local air and noise issues in the area, including potential cumulative impacts from other activities;	
	<u>Relevant Policies and Guidelines:</u>	
	• State Environmental Planning Policy (Infrastructure) 2007 and the Development Near Corridors and Busy Roads – interim Guideline.	Section 5.1.1 & Section 5.1.2
	• Noise Policy for Industry (EPA 2017) which provides guidance in relation to land use planning regarding industrial noise issues; and	Section 7.1.1

	• The NSW Road Noise Policy (DECCW 2011) which provides a method to manage noise from new and redeveloped road projects, or land use developments generating additional road traffic.	Section 7.1.2
8. Environmental Sustainability, Climate Change and Waste Management	Prepare a noise and vibration report for the proposal that:	
	• Assesses the likely noise and vibration impacts on future development including but not limited to any potential impacts particularly in relation to road traffic, night time economy, any sensitive land uses (including proposed and adjoining) and open space to ensure a high level of amenity is achieved;	Section 6.2 & 7.2
	• Identifies principles for efficiency of the likely future noise, and vibration measures to minimise negative impacts on comfort and to minimise harm to people or property (to be addressed in Development Control Plan or Design Guideline);	Section 6.1 & 7.1
	• Recommends appropriate noise, vibration and pollution development standards to be applied to subsequent planning and development stages; and	Section 5.1.3, 7.1 & 6.1
	• Measures to ensure appropriate validation is undertaken to demonstrate that noise criteria in the SEPP have been achieved prior to occupation.	Section 5.2.5
	<u>Relevant Policies and Guidelines:</u>	
	• State Environmental Planning Policy (Infrastructure) 2007 and the Development Near Corridors and Busy Roads – interim Guideline;	Section 5.1.1 & 5.1.2
	• Noise Policy for Industry (EPA 2017) which provides guidance in relation to land use planning regarding industrial noise issues; and	Section 7.1.1
	• The NSW Road Noise Policy (DECCW 2011) which provides a method to manage noise from new and redeveloped road projects, or land use developments generating additional road traffic.	Section 7.1.2

2 BACKGROUND

The Riverwood renewal project provides an opportunity to revitalise the Riverwood social housing estate into an integrated mixed-use precinct that will deliver a mix of social and private dwellings. The revitalisation of the Riverwood estate offers the government the opportunity to renew ageing social housing whilst significantly improving this area, and the quality of life for residents. A key objective of the project is to establish a new planning framework to facilitate renewal of the Riverwood Estate.

AL and a consultant team have worked with the LAHC to prepare a master plan for the redevelopment of the site that will renew the existing dwellings, provide for additional private dwellings, new streets and parks and community uses. The proposed master plan consists of approximately 3,900 social and private dwellings, buildings ranging between 3 and 12 storeys and local open spaces – Roosevelt Park and neighbourhood parks.

2.1 STUDY AREA

The Riverwood Estate State Significant Precinct (the Study Area) is an area of 30ha and is located within the Canterbury-Bankstown LGA. The Study Area contains a large area of government-owned land (16.7 ha owned by LAHC) and is of state importance in achieving key government policy objectives, particularly renewing social housing and increasing housing supply.

The study area is bound by Belmore Road to the east, the M5 Motorway to the north, Salt Pan Reserve to the west and Killara Avenue to the south. The majority of the site is located within walking distance, approximately 5-15 minutes, from Riverwood Station.

The Study Area comprises 1,019 social housing dwellings, private dwellings and land owned by Canterbury Bankstown Council. A diverse range of dwelling types, including three-storey walk-up apartments, free standing cottages and nine storey apartment buildings is located within the study area.

Figure 1 below illustrates the site, surrounding noise sensitive receivers, noise monitoring locations and the busy roads adjacent to the development.

2.2 NEARBY SENSITIVE RECEIVERS

Noise sensitive receivers in the vicinity of the site are as follows:

- **R1** – Residential Receiver 1: Receivers along Kentucky Road, Washington Avenue, New Hampshire Street. Residential flat buildings up to 10 storeys bounding the site to the north east.
- **R2** – Residential and Commercial Receiver 2: 152 to 264 Belmore Road on eastern side of Belmore Road. One and two storey residential commercial premises to the east.
- **R3** – Residential Receiver 3: Receivers along Truman Avenue, Florida Crescent, Hunter Street, Union Street, Coleridge Street, Mary Street. One and two storey residential flats and houses bounding the site to the south.
- **R4** – Receiver 4: Riverwood Public School bounding the site to the south west.
- **R5** – Passive Recreation Receiver 5: Salt Pan Reserve bounding the site to the west.
- **R6** – Residential and Industrial Receiver 6: Receivers along Iris Avenue, Bell Street, Lily Avenue, Belguin Street, Averstone Street, Sofala Street and Belmore Road. One and two storey residential flats, houses and industrial warehouses bounding the site to the north. These receivers are north or the M5 Motorway.

Refer to Figure 1 for detailed location of surrounding receivers.

Figure 1 - Site Survey and Monitoring Locations
Source Six Maps

- Attended noise measurements locations
- Unattended noise monitoring locations
- Attended vibration monitoring locations

Project Site
Residential receivers
Passive Recreation Area
Mixed Residential/ Commercial Receivers
School

3 NOISE DESCRIPTORS

Environmental noise constantly varies. Accordingly, it is not possible to accurately determine prevailing environmental noise conditions by measuring a single, instantaneous noise level.

To accurately determine the environmental noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In analysing environmental noise, three principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new 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.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the 15 minute period. L_{eq} is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

The L_{max} level represents the loudest noise event during a measurement period.

4 SURVEY OF EXISTING NOISE CONDITIONS

4.1 SURVEY OF AMBIENT NOISE

Both long term unattended noise logging and attended noise measurements were conducted to quantify the existing acoustic environment at the site.

Unattended noise monitoring was conducted between Wednesday 2nd of December to Wednesday 14th of December 2020.

All unattended noise measurements were made using Acoustic Research Laboratories monitors set on A-weighted fast response mode. The monitors were calibrated before and after the measurements using a Rion Type NC-73 calibrator. No significant drift was recorded. Periods of adverse weather have been omitted when determining the rating background noise level (RBL). Logging data is presented in Appendix One.

Details of logger locations are provided in Figure 1 and Table 4-1 below .

Table 4-1 – Noise Monitoring Details

Logger	Receiver	Location	Noise Environment
1 (north east)	R1	14 Roosevelt Avenue	The noise logger was located away from any major noise sources
2 (south east)	R2	2 Truman Avenue	The noise logger was placed in proximity to Belmore Road
3 (south west)	R3	28 Union Street	The noise logger was located across from the existing Riverwood Public School, with traffic and operational noise being the predominant acoustic environment.
4 (north)	R6	54 Kentucky Road	The noise logger was in rear yard of apartment block facing the M5 Motorway Corridor

These monitoring locations were selected as they would provide background noise data representative of the nearest noise sensitive receivers.

With regard to logger position number 1 (along Roosevelt Avenue), the installed noise monitor was tampered during the initial installation (microphone was removed) and so only four days of valid data was obtained. A second noise monitor was installed at 45 Arizona Place to provide additional noise monitoring data for the location, however it was subject to theft. The available four days of noise data from the initial monitoring period has been used to establish relevant background noise levels for this location.

4.1.1 Measured Noise Levels

Measured Noise Levels are presented in Table 4-2 below:

Table 4-2 –Measured Environmental Noise Levels

Logger	Location	Time of Day		
		Day	Evening	Night
1 (north east)	14 Roosevelt Avenue	L_{90} 45 dB(A) L_{eq} 60 dB(A)	L_{90} 43 dB(A) L_{eq} 55 dB(A)	L_{90} 37 dB(A) L_{eq} 50 dB(A)
2 (south east)	2 Truman Avenue	L_{90} 56 dB(A) L_{eq} 66 dB(A)	L_{90} 51 dB(A) L_{eq} 65 dB(A)	L_{90} 36 dB(A) L_{eq} 56 dB(A)
3 (south west)	28 Union Street	L_{90} 42 dB(A) L_{eq} 58 dB(A)	L_{90} 38 dB(A) L_{eq} 56 dB(A)	L_{90} 35 dB(A) L_{eq} 49 dB(A)
4 (north)	54 Kentucky Road	L_{90} 56 dB(A) L_{eq} 60 dB(A)	L_{90} 52 dB(A) L_{eq} 56 dB(A)	L_{90} 46 dB(A) L_{eq} 49 dB(A)

4.2 SURVEY OF ROAD TRAFFIC NOISE FROM ADJACENT ROADWAYS

In addition, noise monitoring and supplementary attended measurements were used to determine the existing traffic noise levels at the site. This is relevant to the assessment of noise due to the potential for road noise impacts on future occupants of the proposed development.

Attended measurements were conducted in the following locations:

- Location One (Corner of Truman Avenue and Belmore Road) – Measurement was conducted at monitoring location 3, approximately 3m from the kerb of Belmore Road. Measurement position and had full line of sight to traffic movements along the roadway.
- Location Two (M5 Motorway overpass) – Measurement was conducted at the intersection of Belmore Road and the M5 Motorway. Measurement position had full line of sight to traffic movement along the M5 Motorway and Belmore Road The dominant source of noise for the duration of measurements at this location was road traffic along the M5 Motorway.

Table 4-3 – Measured Traffic Noise Levels

The traffic noise levels presented below have been determined utilising short term and long term measurement data.

	Location	Time of Day	Measured Noise Level
Existing Traffic Noise Levels	Corner Truman Avenue & Belmore Road, @3m from kerb	Day (7am – 10pm)	66 dB(A) $L_{eq(15\ hour)}$
		Night (10pm – 7am)	63 dB(A) $L_{eq(9\ hour)}$
	6m from M5 Motorway, 6m above motorway	Day (7am – 10pm)	77 dB(A) $L_{eq(15min)}$
		Night (10pm – 7am)	73* dB(A) $L_{eq(9\ hour)}$
	54 Kentucky Road (45m from M5, screened with acoustic barrier)	Day (7am – 10pm)	60 dB(A) $L_{eq(15\ hour)}$
		Night (10pm – 7am)	56 dB(A) $L_{eq(9\ hour)}$

*Note: Night-time reduction based on noise monitoring at the north of site, which is screened from the M5 roadway. Traffic noise from the roadway is the dominant source of noise at this location.

5 EXTERNAL NOISE INTRUSION ASSESSMENT

The predominant external noise source impacting the development is traffic noise from surrounding roadways – namely the M5 Motorway & Belmore Road.

5.1 NOISE INTRUSION CRITERIA

Guidelines referenced in the DPIE study, as well as other guidelines are provided below:

- NSW Department of Planning – *State Environment Planning Policy (SEPP) 2007;*
- Development Near Rail Corridors and Busy Roads –Interim Guideline (Department of Planning 2008) (to assess noise from traffic on the subject development);

5.1.1 NSW Department of Planning – *State Environmental Planning Policy (SEPP) (Infrastructure) 2007*

Clause 102 of the NSW SEPP for road traffic noise stipulates

"This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transit way or any other road with an annual average daily traffic volume of more than 20,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:

(a) a building for residential use,

(b) an education establishment or child care centre.

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

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

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

The M5 Motorway to the north of the site carries high traffic volumes, more than 40,000 daily vehicles according to RMS Traffic Volumes Maps published in November 2008. Belmore Road is a regional road and carries medium traffic volumes. All other roads within the estate (Washington Ave, Kentucky Rd, Roosevelt Ave, Truman Ave, Pennsylvania Rd, Union St and Michigan Rd) are local roads carrying low volumes of traffic. Refer to Figure 2 for map and site location.

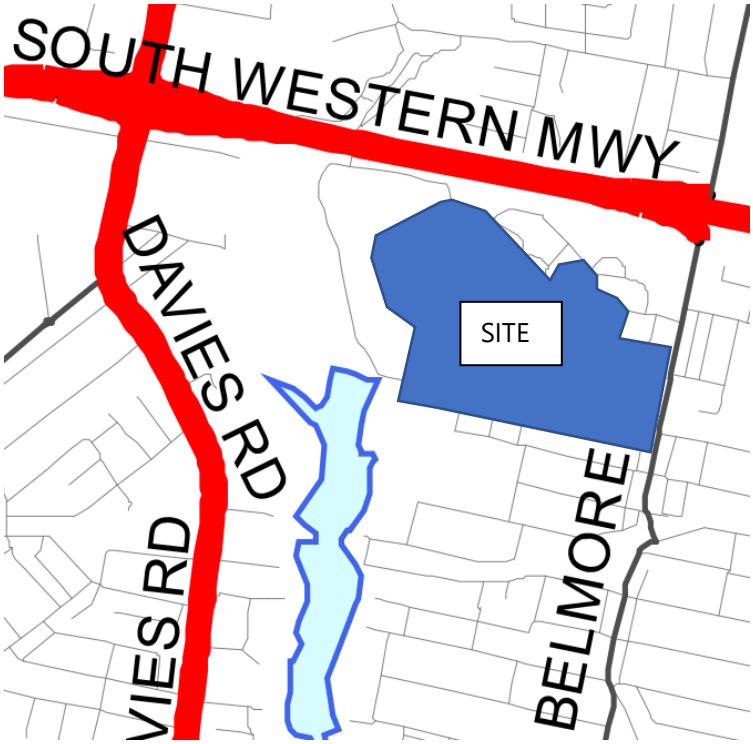


Figure 2 – Extract from traffic volume maps for noise assessment for building on land adjacent to busy roads, Map n.15

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."*

Section 3.6 of the NSW Department of Planning's 'Development near Rail Corridors and Busy Roads (Interim Guideline) specifies the following noise descriptors for the assessment of traffic noise:

- Day - $L_{eq\ (15\ hour)}$
- Night - $L_{eq\ (9\ hour)}$

The guideline also provides guidance on the assessment of natural ventilation. The allowable internal noise goal is permitted to be 10 dB(A) higher than when the windows are closed (i.e. – allowable level in bedrooms becomes 45 dB(A), and 50 dB(A) in living rooms). Where noise levels would exceed this, the NSW Planning guideline recommends that a ventilation system be provided to achieve the ventilation requirements of the BCA with windows closed. We note that where the 'open window/door' scenario cannot be achieved, this does not necessarily mean than there cannot be operable elements on these façades, only that internal noise level requirements will only be met when they are closed.

5.1.3 Summarised External Noise Intrusion Criteria

Summarised internal noise criteria adopted for each internal space is summarised below.

Table 5-1 – Adopted Internal Noise Levels

Space / Activity Type	Design Internal Noise Level
Residential Living Areas	40 dB(A) $L_{eq\ (15hr)}$ ***SEPP (Infrastructure) 2007***
Residential Bedrooms	35 dB(A) $L_{eq\ (9hr)}$ ***SEPP (Infrastructure) 2007***
Educational Institutions including child care centres	40 dB(A) $L_{eq\ (1\ hour)}$ **Development Near Rail Corridors and Busy Roads –Interim Guideline**
Places of worship	40 dB(A) $L_{eq\ (1\ hour)}$ **Development Near Rail Corridors and Busy Roads –Interim Guideline**

5.2 INDICATIVE FAÇADE CONSTRUCTIONS

Indicative treatments to meet the criteria detailed in Section 5.1.3 have been determined based on the master plan prepared by Architectus dated 12th February 2021. The major sources of noise impacting the site are from the M5 Motorway and Belmore Road. As such it is anticipated that facades facing these roadways will require acoustic treatment. It is anticipated that facades facing Roosevelt Avenue, the main collector road of the precinct, will also require acoustic treatment.

Given all other internal roadways are generally local roads, rather than collector roads or connections to other major roadways, traffic noise from within the site is expected to be relatively low and as such no specific acoustic treatment will be required to meet internal noise goals. It is recommended that acoustic treatments for internal facades of the development be reviewed once road layouts and expected peak traffic volumes have been finalised.

A full assessment of all treatments recommended within this report is to be conducted during detailed design to ensure that the criteria determined within this report is met.

5.2.1 Roof / Ceiling

Masonry or concrete roof structures will be acceptable without any further acoustic treatment required. In the event that light weight constructions are proposed as part of the detailed design of the project, these are to be reviewed by the project acoustic consultant to ensure that the internal noise criteria is achieved.

Any penetrations through the ceiling are to be acoustically sealed to maintain the required acoustic rating of the façade structure.

5.2.2 Glazed Windows and Doors

The following constructions are recommended to comply with the project noise objectives. 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**).

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 recommended constructions are detailed in Table 5-3.

Mullions, perimeter seals and the installation of the windows/doors in the building openings shall not reduce the R_w rating of the glazing assembly below the values nominated in the table above. All external windows and doors listed are required to be fitted with Q-lon type acoustic seals. **Note that mohair or fin type seals will not be acceptable for the windows requiring acoustic seals.**

Table 5-3 – Recommended Glazing Constructions

Façade	Area	Recommended Construction	Acoustic Seals Required
Facing Belmore Road	Bedrooms	10.38mm Laminated	Yes
	Living Areas		
Facing M5 Motorway	Bedrooms	10.38mm Laminated	Yes
	Living Areas		
Facing Major Internal Roadways (Roosevelt Avenue)	Bedrooms	6.38mm Laminated	Yes
	Living Areas		

Facades not listed in Table 5-3 may have standard glazing.

The window/door suppliers should provide evidence that the systems proposed have been tested in a registered laboratory with the recommended glass thicknesses and comply with the minimum listed R_w requirements. Also, the glazing installer should certify that the window/doors have been constructed and installed in a manner equivalent to the tested samples.

Table 5-2 - Minimum R_w of Glazing (with Acoustic Seals)

Glazing Assembly	Minimum R_W of Installed Window (with acoustic seals)	Acoustic Seals Required
Standard Glazing	24	No
10.38mm Laminated	35	Yes

5.2.3 External Walls

Masonry or concrete wall structures will be acceptable without any further acoustic treatment required. In the event that light weight constructions are proposed as part of the detailed design of the project, these are to be reviewed by the project acoustic consultant to ensure that the internal noise criteria is achieved.

Any penetrations through the ceiling are to be acoustically sealed to maintain the required acoustic rating of the façade structure.

5.2.4 Ventilation and Air Conditioning

As referenced in Section 5.1.2, the NSW Department of Planning's 'Development near Rail Corridors and Busy Roads (Interim Guideline)' specifies the following controls regarding natural ventilation:

- With respect to natural ventilation of a dwelling the allowable internal noise goal is permitted to be 10 dB(A) higher than when the windows are closed (i.e. – allowable level in bedrooms becomes 45 dB(A), and 50 dB(A) in living rooms). Where noise levels would exceed this, the NSW Planning guideline recommends that a ventilation system be provided to achieve the ventilation requirements of the BCA with windows closed. We note the following:

  - Facades facing Belmore Road and the M5 Motorway require windows/doors to be closed in order to achieve required noise levels.

  - All facades facing local internal roadways will be able to achieve required internal noise levels with windows/doors open to 5% of the floor area.

Where the recommended internal noise levels cannot be achieved with windows open within the development, confirmation on the ventilation requirements for apartments will be required.

Any supplementary ventilation system or façade opening proposed to be installed to provide ventilation to apartments should be acoustically designed to ensure that the internal noise level requirements are achieved. In the event mechanically assisted ventilation is utilised, it should be acoustically designed so that internal noise levels within apartments are appropriate, and any external noise emissions to surrounding noise sensitive receivers is within the requirements detailed in Section 7.1.1.4 of this report.

5.2.5 Verification Requirements Prior to Occupation

Prior to occupation, appropriate measures must be taken to demonstrate that the internal noise level criteria in SEPP (Refer Section 5.1.3) have been achieved. Compliance with the SEPP criteria may be demonstrated through compliance measurements carried out in accordance with Appendix D of the NSW DPIE document 'Development Near Rail Corridors and Busy Roads – Interim Guideline'.

6 VIBRATION ASSESSMENT

6.1 VIBRATION CRITERIA

6.1.1 Broadband Vibration Levels

The NSW EPA document "*Assessing Vibration: A Technical Guideline*" provides procedures for assessing tactile vibration within potentially affected buildings and is used in the assessment of vibration impact on amenity. Vibration is typically characterised by its magnitude and duration, summarised below:

- **Criteria Set 1:**
    - **Continuous**: vibration continues uninterrupted for a defined period (usually throughout daytime and/or night time).
    - **Intermittent:** Vibration can be defined as interrupted periods of continuous (eg a drill) or repeated periods of impulsive vibration (eg a pile driver), or continuous vibration that varies significantly in magnitude. It may originate from impulse sources or repetitive sources, or sources which operate intermittently, but which would produce continuous vibration if operated continuously.
- **Criteria Set 2 - Impulsive**:
    - Vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds. Impulsive vibration typically has no more than three occurrences in an assessment period
    - These criteria are typically only adopted for events occurring 3-4 times per day.

The EPA guideline cites steady road traffic as an example of 'continuous' vibration. Given that the primary source of potential vibration impacting the project site is steady traffic along the M5 Motorway and Belmore Road, the continuous vibration criteria will be applied in this assessment.

Table 6-1 – EPA Recommended Vibration Criteria

		RMS acceleration (m/s^2)		**RMS velocity (mm/s)**		**Peak velocity (mm/s)**	
Place	Time	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Residences	Daytime	0.010	0.020	0.20	0.40	0.28	0.56
	Night-time	0.007	0.014	0.14	0.28	0.20	0.40

6.2 VIBRATION MEASUREMENTS

Vibration measurements were conducted in proximity to possible sources of vibration: the M5 Motorway and Belmore Road, as well as at Missouri Place, located at the centre of the site away from possible vibration sources. See Figure 1 in Section 2 for map detailing specific locations. Measured vibration levels are presented in the Table 6-2 below.

Table 6-2 – Measured Traffic Vibration Levels

Location	Measured Vibration Level (RMS Acceleration)	Recommended Vibration Level for Night-time Residents (RMS Acceleration)	Comments
1 (Adjacent to the M5 Motorway)	0.001	≤0.007 m/s^2*	Existing vibration levels from road traffic significantly below recommended vibration levels.
2 (Missouri Place)	<0.001		
3 (Belmore Road)	<0.001		

Based on the measured vibration levels, it is anticipated that there will be no vibration impacts from adjacent roadways to the development.

7 OPERATIONAL NOISE EMISSION ASSESSMENT

7.1 NOISE EMISSION CRITERIA

Consideration of noise emissions from mechanical services (e.g. air conditioning plant), and measures to minimise and mitigate the potential noise impacts on surrounding occupiers is assessed in accordance with the following documents:

- NSW EPA Noise Policy for Industry (NPI) 2017
- NSW EPA Road Noise Policy

7.1.1 Mechanical Plant Noise (EPA Noise Policy for Industry)

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.

7.1.1.1 Intrusiveness Criterion

The NPI 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 Section 4. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

7.1.1.2 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 NPI sets out acceptable noise levels for various localities. Table 2.3 of the NPI provides guidance on assigning residential receiver noise categories. Table 7-1 below summarises this guidance for residential receiver types relevant to the development.

Table 7-1 – Summarised Guidance for Assigning Residential Receiver Categories

Receiver Category	Typical Planning Zoning	Typical Existing Background Noise Levels	Description
Suburban Residential	R2 – low density residential R3 – medium density residential	Daytime RBL<45 dB(A) Evening RBL<40 dB(A) Night RBL <35dB(A)	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	R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing)	Daytime RBL> 45 dB(A) Evening RBL> 40 dB(A) Night RBL >35 dB(A)	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.

Based on the guidance provided in the INP and summarised in Table 7-1 above, residential receiver categories have been applied as follows:

Table 7-2 – Residential Receiver Categories

Receiver	Category	Comment
R1	Urban Residential	• R4 planning zoning • RBLs consistent with typical 'urban' background noise levels • Noise environment consistent with 'urban' description
R2	Urban Residential	• B1 planning zoning • RBLs consistent with typical 'urban' background noise levels • Noise environment consistent with 'urban' description
R3	Suburban Residential	• R2/R3 planning zoning • RBLs consistent with typical 'urban' background noise levels for residences set back from Belmore Road • Noise environment consistent with 'suburban' description levels for residences set back from Belmore Road
R6	Urban Residential	• R3 planning zoning, however RBLs consistent with typical 'urban' background noise levels and noise environment consistent with 'urban' description

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

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

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

Table 7-3 – EPA NPI Project Amenity Noise Levels

Type of Receiver	Time of day	Recommended Noise Level dB(A)$L_{eq(period)}$	Project Amenity Noise Level dB(A)$L_{eq(15min)}$
Residential – Urban (R1/R2/R6)	Day	60	58
	Evening	50	48
	Night	45	43
Residential – Suburban (R3)	Day	55	53
	Evening	45	43
	Night	40	38
School classroom – external*	Noisiest 1 hour when in use	45	43
Place of worship – external*	When in Use	50	48
Passive recreation area	When in Use	50	48
Active recreation area (school playground)	When in Use	55	53
Commercial Premises	When in Use	65	63
Industrial Premises	When in Use	70	68

*External noise levels account for the 10dB façade reduction described in the EPA Noise Policy for Industry.

The NSW EPA NPI (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

7.1.1.3 Sleep Arousal Criteria

The NPI recommends the following noise limits to mitigate sleeping disturbance:

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

- *$L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is 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
Receiver 1 Night (10pm – 7am)	37	42 dB(A)$L_{eq,\ 15min}$; 52 dB(A)L_{Fmax}
Receiver 2 Night (10pm – 7am)	46	51 dB(A)$L_{eq,\ 15min}$; 61 dB(A)L_{Fmax}
Receiver 3 Night (10pm – 7am)	36	41 dB(A)$L_{eq,\ 15min}$; 52 dB(A)L_{Fmax}
Receiver 4 Night (10pm – 7am)	35	40 dB(A)$L_{eq,\ 15min}$; 52 dB(A)L_{Fmax}

In addition, NSW EPA Road Noise Policy states:

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

7.1.1.4 Summarised Noise Policy for Industry Requirements

Table 7-3 – EPA NPI Project Noise Trigger Level (Residential)

Receiver	Time Period	Assessment Background Noise Level dB(A)L_{90}	Project Amenity Criteria dB(A) L_{eq}	Intrusiveness Criteria $L_{eq(15min)}$	NPI Criteria for Sleep Disturbance
R1	Day	45	58	**50**	-
	Evening	43	48	**48**	-
	Night	37	43	**42**	42 dB(A)$L_{eq,\ 15min}$; 52 dB(A)L_{Fmax}
R2	Day	56	**58**	61	-
	Evening	51	**48**	56	-
	Night	36	43	**41**	41 dB(A)$L_{eq,\ 15min}$; 52 dB(A)L_{Fmax}
R3	Day	42	53	**47**	-
	Evening	38	**43**	53	-
	Night	35	**38**	41	40 dB(A)$L_{eq,\ 15min}$; 52 dB(A)L_{Fmax}
R6	Day	56	**58**	61	-
	Evening	52	**48**	57	-
	Night	46	43	**41**	51 dB(A)$L_{eq,\ 15min}$; 61 dB(A)L_{Fmax}

Note: Project Noise Trigger Levels (PNTL) for each receiver/time period are indicated in bold.

Table 7-4 – EPA NPI Project Noise Trigger Level (Non-Residential)

Receiver	Time of Day	Amenity Criteria dB(A) $L_{eq,\ 15min}$
School classroom – external	Noisiest 1 hour when in use	43
Place of worship – external	When in use	48
Passive recreation area	When in use	48
Active recreation area (school playground)	When in use	53
Commercial	When in use	63
Industrial	When in use	68

7.1.2 NSW Road Noise Policy (DECCW 2011)

Traffic noise impacts as a result of new roadways or additional traffic on existing roadways are assessed with reference to the NSW Road Noise Policy.

For land use developments with the potential to create additional traffic on public streets the development should comply with the NSW Road Noise Policy.

Noise levels generated by traffic should not exceed the noise levels set out in the table below when measured at a nearby property.

Table 7-5 – Criteria for Traffic Noise Generated by New Development

Road Type	Time of day	Permissible Noise Generation
Arterial	Day (7am to 10pm)	60 dB(A)$L_{eq(15hr)}$
	Night (10pm to 7am)	55 dB(A)$L_{eq(9hr)}$
Local Road	Day (7am to 10pm)	55 dB(A)$L_{eq(1hr)}$
	Night (10pm to 7am)	50 dB(A)$L_{eq(1hr)}$

However, if existing noise levels exceed those in the table above, section 3.4 of the Road Noise Policy is applicable, which requires noise impacts to be reduced through feasible and reasonable measures. However, in determining what is feasible/reasonable, the Policy notes that an increase of less than 2dB(A) is a minor impact and would be barely perceptible.

As existing noise levels at Belmore Road, the major arterial road servicing the site, exceed those listed in Table 7-5 for an arterial road, the criteria of an increase of less than 2dB(A) will be applied. As the precinct's internal road network will be substantially redeveloped, the NSW Road Noise Policy criteria for local roads will be adopted to assess the noise impact from traffic generated by the redevelopment.

Table 7-6 – Summarised Criteria for Traffic Noise Generated from Site

Road	Time of day	Existing Traffic Noise Levels	Permissible Noise Generation
Belmore Road	Day (7am to 10pm)	66 dB(A) $L_{eq(15\ hour)}$	**68 dB(A)$L_{eq(15hr)}$**
	Night (10pm to 7am)	63 dB(A) $L_{eq(9\ hour)}$	**65 dB(A)$L_{eq(9hr)}$**
Internal Roadways	Day (7am to 10pm)	N/A	**55 dB(A)$L_{eq(1hr)}$**
	Night (10pm to 7am)	N/A	**50 dB(A)$L_{eq(1hr)}$**

7.2 NOISE EMISSION ASSESSMENT

Noise impacts from the site are generally expected to be limited to mechanical plant noise associated with the new residential development (and any retail/commercial tenancies) as well as the potential for increased traffic noise externally from the site.

7.2.1 Mechanical Plant Noise

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 7.1.1.

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

7.2.2 Road Traffic Noise to External Receivers

Noise impacts due to increased site traffic generation to surrounding receivers is assessed in accordance with the NSW Road Noise Policy (DECCW 2011).

Sections 6.2 and 6.9 of the Traffic Report for the Riverwood Estate SSP prepared by TTPP (document ref: 18055_r02v12_220419_Traffic Report.docx; dated 19/04/2022) details the current and future predicted traffic levels for the proposed site. Based on these levels, a summary of the current and future predicted traffic volumes on major internal and surrounding roadways is presented in table 7-7 below.

Table 7-7 – Existing and Predicted Traffic Volumes

Time of Day	Existing Belmore Road Peak Hour Traffic Volumes	Existing Site Traffic Generation	Predicted Site Traffic Generation (2041)	Predicted Increase of Belmore Road peak Hour Traffic Volumes from Development (2041)	Resulting Predicted Increase in Noise Level
AM Peak Hour	1500	333	1104	2097	$\leq$2 dB(A)
PM Peak Hour	1300	383	1277	1950	$\leq$2 dB(A)

Based on the future predicted traffic volumes, traffic generation from the site would not increase noise levels on surrounding major roadways (Belmore Road) by more than 2dB(A), and as such is acceptable under the NSW Road Noise Policy (DECCW 2011). Noise impacts on other roadways surrounding the site are also expected to be acceptable.

7.2.3 Road Traffic Noise to Receivers Within the Development

CoRTN road traffic model is used to calculate traffic noise levels resultant on the façades of the future development, based on the traffic volumes provided by TTPP (document ref: 18055_r02v12_220419_Traffic Report.docx; dated 19/04/2022). Noise level predictions are based on the following:

- The highest volume of traffic being 218 vehicles per hour travelling from Roosevelt Avenue south approach.
- AM peak hour site traffic generation of 1104 vehicles.
- PM peak hour site traffic generation of 1277 vehicles.
- 75% of site traffic travelling along Roosevelt Avenue and Truman Avenue.
- 25% of site traffic travelling along Washington Avenue.

It has been assumed that traffic during regular daytime hours (i.e. outside of AM/PM peaks) is approximately 80% of peak volumes as well as a day/night traffic split of 85/15 percent of total daily volumes.

Predicted traffic noise levels at the various buildings along Roosevelt Avenue and Washington Avenue are detailed in table 7-8 below:

Table 7-8 – Predicted Noise Levels at Traffic Exposed Façades – CoRTN Model

Façade	Predicted Noise Level dB(A)L_{eq}	
	Daytime (7am-10pm)	Night-time (10pm-7pm)
Facing Roosevelt Avenue	59 dB(A) $L_{eq(1hr)}$	51 dB(A)$L_{eq(1hr)}$
Facing Washington Avenue	54 dB(A) $L_{eq(1hr)}$	46 dB(A)$L_{eq(1hr)}$

It is noted that traffic generated within the development will exceed the permissible noise generation given by the NSW Road Noise Policy for buildings with facades facing Roosevelt Avenue. However, given that it is a new development, there is an opportunity to acoustically treat glazing, building facades and roofs in order to achieve the internal noise levels required by the Department of Planning 'Development Near Rail Corridors and Busy Roads – Interim Guideline'. This is detailed in Section 5.2 of this assessment.

8 CONSTRUCTION NOISE ASSESSMENT

An assessment of likely construction noise impacts has been undertaken. The assessment includes:

- Identification of the noise and vibration guidelines which will be applicable to this project.
- Identification of potentially impacted nearby sensitive receivers.
- Identify likely sources of noise and vibration generation and predicted noise levels at nearby development.
- Formulation of a strategy to address the guidelines identified and including mitigation treatments.

8.1 RECEIVER LOCATIONS

Sensitive receiver locations for the construction phase of the development are detailed in Section 2.2.

8.2 NOISE AND VIBRATION GUIDELINES

8.2.1 EPA Interim Construction Noise Guideline

The EPA Interim Construction Noise Guideline (ICNG) assessment requires:

- Determination of noise management levels (based on ambient noise monitoring);
- Review of generated noise levels at nearby development;
- Recommendation of noise controls strategies when noise management levels are exceeded.

The ICNG guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:

- *"Noise affected" level*. Where construction noise is predicted to exceed the "noise affected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise affected level". For residential properties, the "noise effected" level occurs when construction noise exceeds ambient levels by more than 10dB(A)$L_{eq(15min)}$.

- "*Highly noise affected level*". Where noise emissions are such that nearby properties are "highly noise affected", noise controls such as respite periods should be considered. For residential properties, the "highly noise affected" level occurs when construction noise exceeds 75dB(A)$L_{eq(15min)}$ at nearby residences.

A summary of the above noise management levels from the ICNG is presented below in Table 8-1. In order to present a conservative assessment, the lowest daytime rating background noise level determined from monitoring has been used as a basis for calculation of the 'Noise Affected Level'.

Table 8-1 – Noise Management Levels - Residential

Location	"Noise Affected" Level - dB(A)$L_{eq(15min)}$	"Highly Noise Affected" Level - dB(A)$L_{eq(15min)}$
R1	55	75
R2	66	75
R3/R4	52	75
R6	66	75

If noise levels exceed the management levels identified above, reasonable and feasible noise management techniques will be reviewed.

8.2.2 Vibration

Vibration caused by construction at any residence or structure outside the subject site must be limited to:

- For structural damage vibration, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures; and*
- For human exposure to vibration, the evaluation levels presented in the British Standard BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)* for low probability of adverse comment.

8.2.2.1 Structure Borne Vibrations (Building Damage Levels)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The vibration levels presented in DIN 4150-3 (1999-02) are detailed in Table 4.

It is noted that the peak velocity is the value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 8-2 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			**Plane of Floor of Uppermost Storey**
		< 10Hz	**10Hz to 50Hz**	**50Hz to 100Hz**	**All Frequencies**
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

The surrounding commercial/industrial buildings would be considered a Type 1 structure, whilst nearby residences would be classified as a type 2 structure.

8.2.2.2 Assessing Amenity

The NSW EPA "*Assessing Vibration: A Technical Guideline*" provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings and is used in the assessment of vibration impact on amenity. Relevant vibration levels are presented below.

Table 8-3 – EPA Recommended Vibration Levels

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	Time	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Offices		0.02	0.04	0.4	0.8	0.56	1.1
Workshops		0.04	0.08	0.8	1.6	1.1	2.2
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0
Offices		0.64	1.28	13.0	26.0	18.0	36.0
Workshops		0.64	1.28	13.0	26.0	18.0	36.0

8.3 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

For this project, the most significant sources of noise or vibration generated during construction will be building structure works. The following table presents assessment noise levels for typical construction equipment expected to be used during the construction of the proposal.

Table 8-4 - Sound Power Levels of the Typical Equipment

Equipment / Process	Sound Power Level dB(A)*
Excavator Mounted Hammer	120
Concrete Pump	110
Trucks	100
Bobcat	105
Crane (electric)	85
Powered Hand Tools	95-100

The noise levels presented in the above table are derived from the following sources, namely:

- Table A1 of Australian Standard 2436-2010.
- Data held by this office from other similar studies.

Noise levels take into account correction factors (for tonality, intermittency where necessary).

8.4 NOISE PREDICTIONS

The predicted noise levels during excavation and construction will depend on:

- The activity undertaken.
- The distance between the work site and the receiver. The distance between the noise source and the receiver will vary depending on which end of the site the work is undertaken. For this reason, the predicted noise levels will be presented as a range.

Predicted noise levels are presented in the following tables. Predictions take into account the expected noise reduction as a result of distance only.

Table 8-5 – Predicted Noise Generation to R1

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Excavator Mounted Hammer	60-92	Exceeds Highly Noise Affected Level when operating near north eastern boundary.
Concrete Pump	50-82	Exceeds Highly Noise Affected Level when operating near north eastern boundary.
Trucks	40-72	Exceeds NAML, below HNAML at all times
Bobcat	45-77	Exceeds Highly Noise Affected Level when operating near north eastern boundary
Crane (electric)	< 40	Within NAML
Powered Hand Tools (Externally)	40-72	Exceeds NAML, below HNAML at all times

Table 8-6 – Predicted Noise Generation to R2

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Excavator Mounted Hammer	54-88	Exceeds Highly Noise Affected Level when operating near eastern boundary
Concrete Pump	44-78	Exceeds Highly Noise Affected Level when operating near eastern boundary
Trucks	34-68	Exceeds NAML, below HNAML at all times
Bobcat	39-73	Exceeds Highly Noise Affected Level when operating near eastern boundary
Crane (electric)	< 40	Within NAML
Powered Hand Tools (Externally)	34-68	Exceeds NAML, below HNAML at all times

Table 8-7 – Predicted Noise Generation to R3 and R4

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Excavator Mounted Hammer	56-92	Exceeds Highly Noise Affected Level when operating near south and south eastern boundary
Concrete Pump	46-82	Exceeds Highly Noise Affected Level when operating near south and south eastern boundary
Trucks	36-72	Exceeds NAML, below HNAML at all times
Bobcat	41-77	Exceeds Highly Noise Affected Level when operating near south and south eastern boundary
Crane (electric)	< 40	Within NAML
Powered Hand Tools (Externally)	36-72	Exceeds NAML, below HNAML at all times

Table 8-8 – Predicted Noise Generation to R6

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Excavator Mounted Hammer	52-72	Exceeds NAML, below HNAML at all times
Concrete Pump	42-62	Within NAML
Trucks	32-52	Within NAML
Bobcat	47 – 51	Within NAML
Crane (electric)	37-57	Within NAML
Powered Hand Tools (Externally)	32-52	Within NAML

8.5 DISCUSSION – CONSTRUCTION NOISE

The greatest noise impact from construction activities will be at the residences immediately to the north east (R1) and south (R3) of the site. The residences to the east will be lightly impacted. The residences to the north are unlikely to be significantly impacted as predicted noise levels are below the 'noise affected' level at all times.

The "highly noise affected levels" will be exceeded for R1 and R3 when high noise generating sources operate close to the boundaries.

"Reasonable and feasible" mitigation should be applied in accordance with the "Control of Construction Noise and Vibration – Procedural Steps" outlined below.

8.6 DISCUSSION – VIBRATION FROM CONSTRUCTION ACTIVITIES

There are no significant sources of vibration envisaged. Given the distance from nearby receivers, vibration impacts on all receivers is expected to be within the recommended levels detailed in Section 8.2.2. Construction activities which have the potential to generate high levels of vibration (sheet piling, for example) are to be reviewed as part of the construction management procedure.

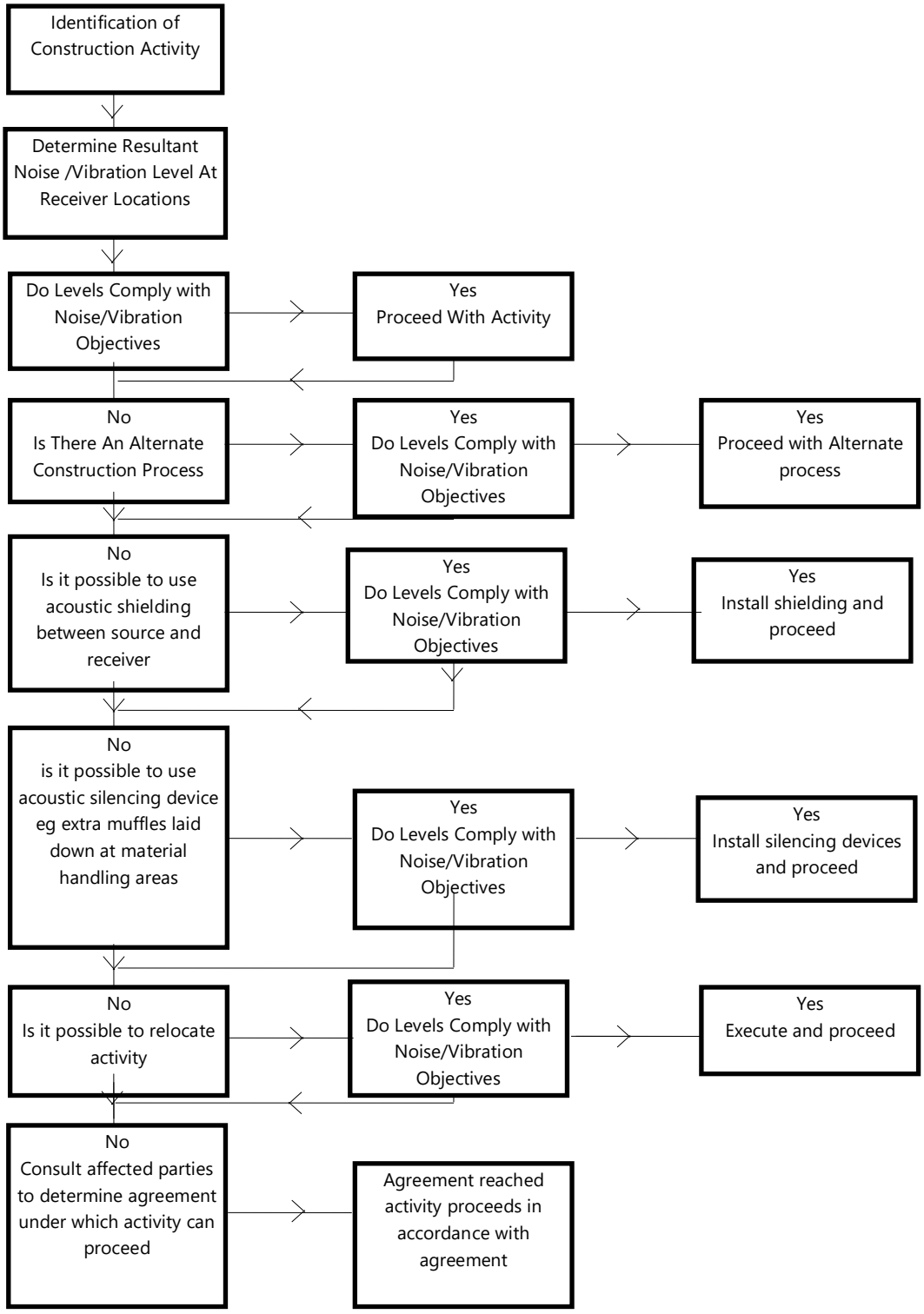
8.7 RECOMMENDATIONS

In light of the above, the following recommendations are made:

- A detailed noise management plan should be developed by the construction contractor that describes in detail the construction phases, programme, processes and equipment used, noise impact assessment and proposed mitigation and management.
- Where the highly noise affected management level is expected to be exceeded for a prolonged duration (for example demolition of buildings close to external residents), respite periods may need to be considered to mitigate noise impacts.
- Quiet work methods/technologies:
    - Materials handling/vehicles:
        - Trucks and bobcats to use a non-tonal reversing beacon (subject to OH&S requirements) to minimise potential disturbance of neighbours.
        - Avoid careless dropping of construction materials into empty trucks.
        - Trucks, trailers and concrete trucks (if feasible) should turn off their engines during idling to reduce noise impacts (unless truck ignition needs to remain on during concrete pumping).
- Complaints handling - In the event of complaint, the procedures outlined in Sections 8.8, 8.9 and 8.10 should be adopted.
- Site Induction:
    - A copy of the Noise Management Plan is to be available to contractors. The location of the Noise Management Plan should be advised in any site induction.
    - Site induction should also detail the site contact is to be notified in the event of noise complaint.

8.8 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS

The flow chart presented below illustrates the process that will be followed in assessing construction activities.



8.9 ADDITIONAL NOISE AND VIBRATION CONTROL METHODS

In the event of complaints, there are a number of noise mitigation strategies available which can be considered.

The determination of appropriate noise control measures will be dependent on the particular activities and construction appliances. This section provides an outline of available methods.

8.9.1 Selection of Alternate Appliance or Process

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. Undertaking this activity using bulldozers, ripping and/or milling machines will result in lower noise levels. This measure has the potential to reduce noise emissions by 10 dB(A) or more.

8.9.2 Acoustic Barriers

Given the position of adjacent development, it is unlikely that noise screens will provide significant acoustic benefit for commercial or residential receivers but will provide noticeable improvement for those on ground level.

The placement of barriers at the source is generally only effective for static plant. Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance that is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10mm or 15mm thick plywood (radiata plywood) would be acceptable for the barriers.

8.9.3 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

8.9.4 Treatment of Specific Equipment

In certain cases it may be possible to specially treat a piece of equipment to dramatically reduce the sound levels emitted.

8.9.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. A more detailed management plan will be developed for this project in accordance to the construction methodology outlining work procedures and methods for minimising noise.

8.9.6 Combination of Methods

In some cases, it may be necessary that two or more control measures be implemented to minimise noise.

8.10 ADDRESSING COMPLAINTS

Should ongoing complaints of excessive noise or vibration levels occur immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices.

If a noise complaint is received the complaint should be recorded. Any complaint form should list:

- The name and address of the complainant (if provided);
- The time and date the complaint was received;
- The nature of the complaint and the time and date the noise was heard;
- The name of the employee who received the complaint;
- Actions taken to investigate the complaint, and a summary of the results of the investigation;
- Required remedial action, if required;
- Validation of the remedial action; and
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

9 CONCLUSION

Acoustic Logic (AL) have been engaged to undertake an assessment of noise and vibration impacts associated with the proposed renewal of the Riverwood Estate State Significant Precinct.

This report addresses the requirements detailed by the NSW Department of Planning, Industry and Environment Study Requirements (detailed in requirements 2 & 8).

An assessment of noise impacts from the surrounding roadways and rail facilities indicates that additional acoustic treatment will be required to control road traffic noise for buildings adjoining the M5 motorway and Belmore Road. Indicative façade constructions have been presented - it has been recommended that the specific measures to control noise impacts be considered during further design of the precinct, and to be considered as part of any planning application for specific buildings of the development.

Vibration impacts to the development from adjacent roadways has been assessed in accordance with the NSW EPA document "*Assessing Vibration: A Technical Guideline*". Based on the assessment, it is anticipated that there will be no vibration impacts from adjacent roadways to the development.

All development on the site is capable of complying with the noise intrusion requirements of State Environment Planning Policy (Infrastructure) and the Development Near Rail Corridors and Busy Roads.

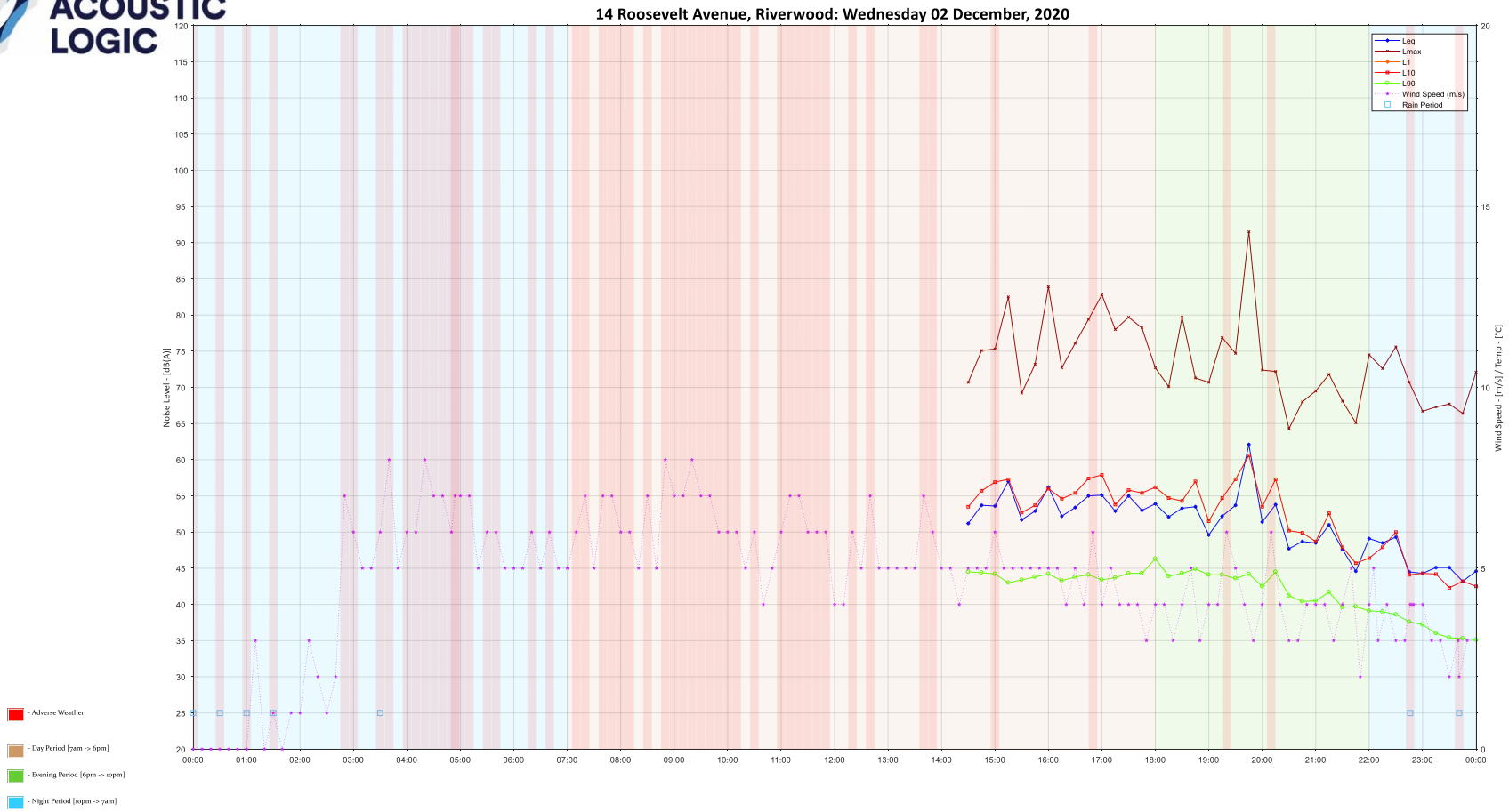
Noise impacts from mechanical plant to service the development is to be assessed with reference to the requirements of the NSW EPA Noise Policy for Industry (2017), as detailed in Section 7.1.1. The assessment of specific plant items should be undertaken as part of the development application process for individual lots within the precinct, however consideration must be given to the cumulative noise impacts from each site to ensure that the overall level of noise emitted from mechanical plant achieves above requirements.

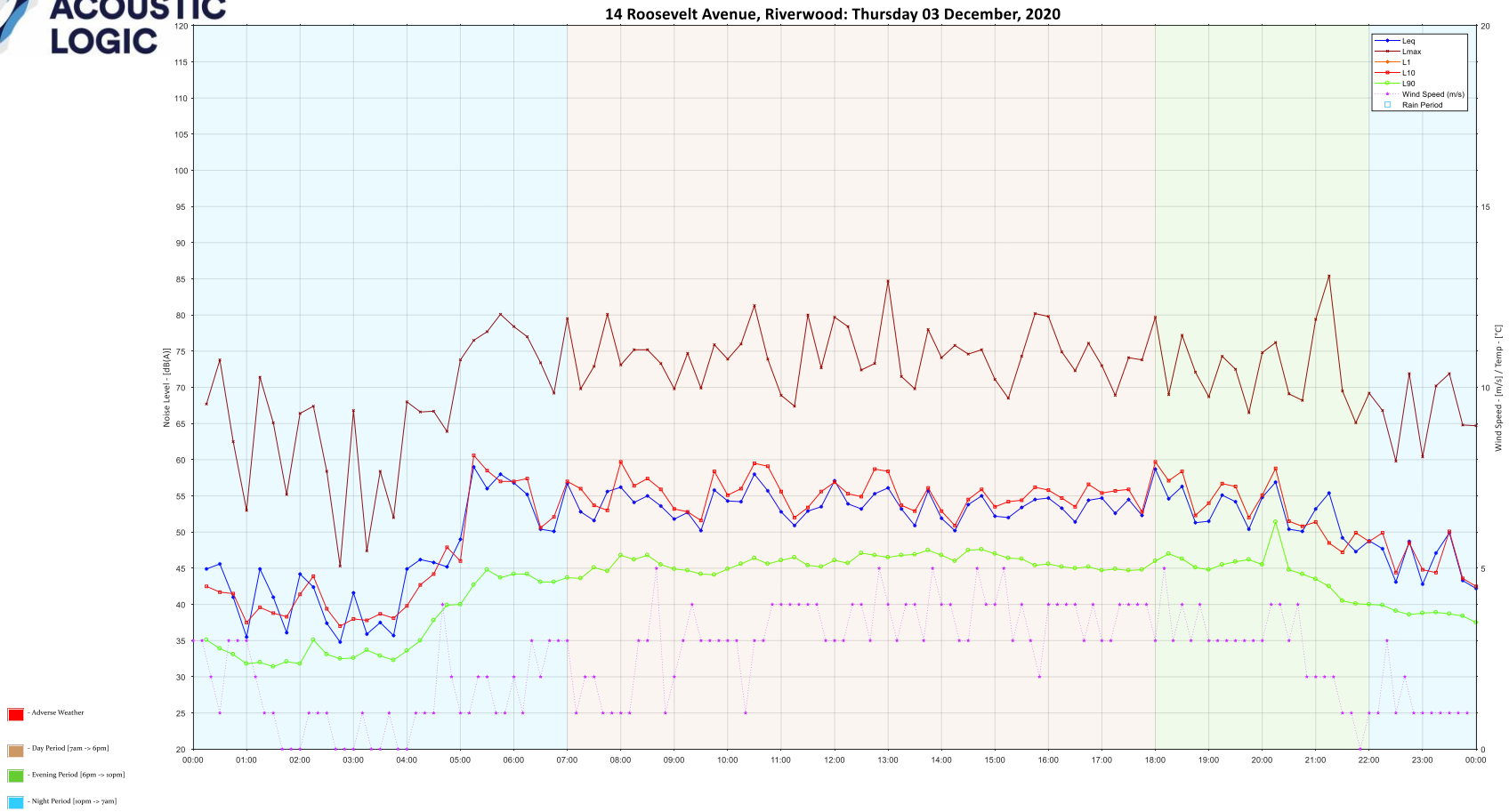
We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Pty Ltd
Ross Ferraro

APPENDIX A – UNNATENDED NOISE MONITORING DATA – 14 ROOSEVELT AVENUE


14 Roosevelt Avenue, Riverwood: Wednesday 02 December, 2020
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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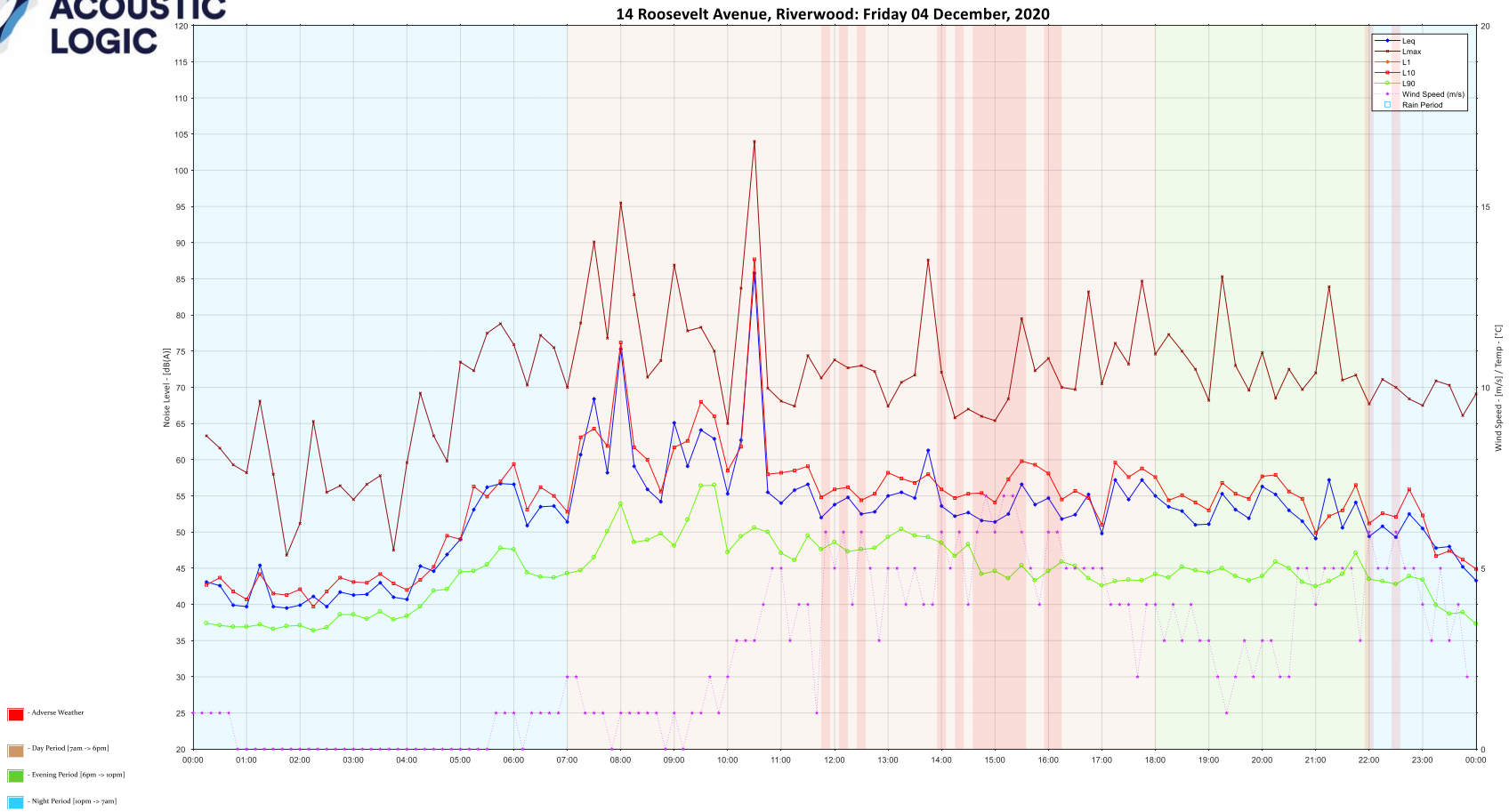
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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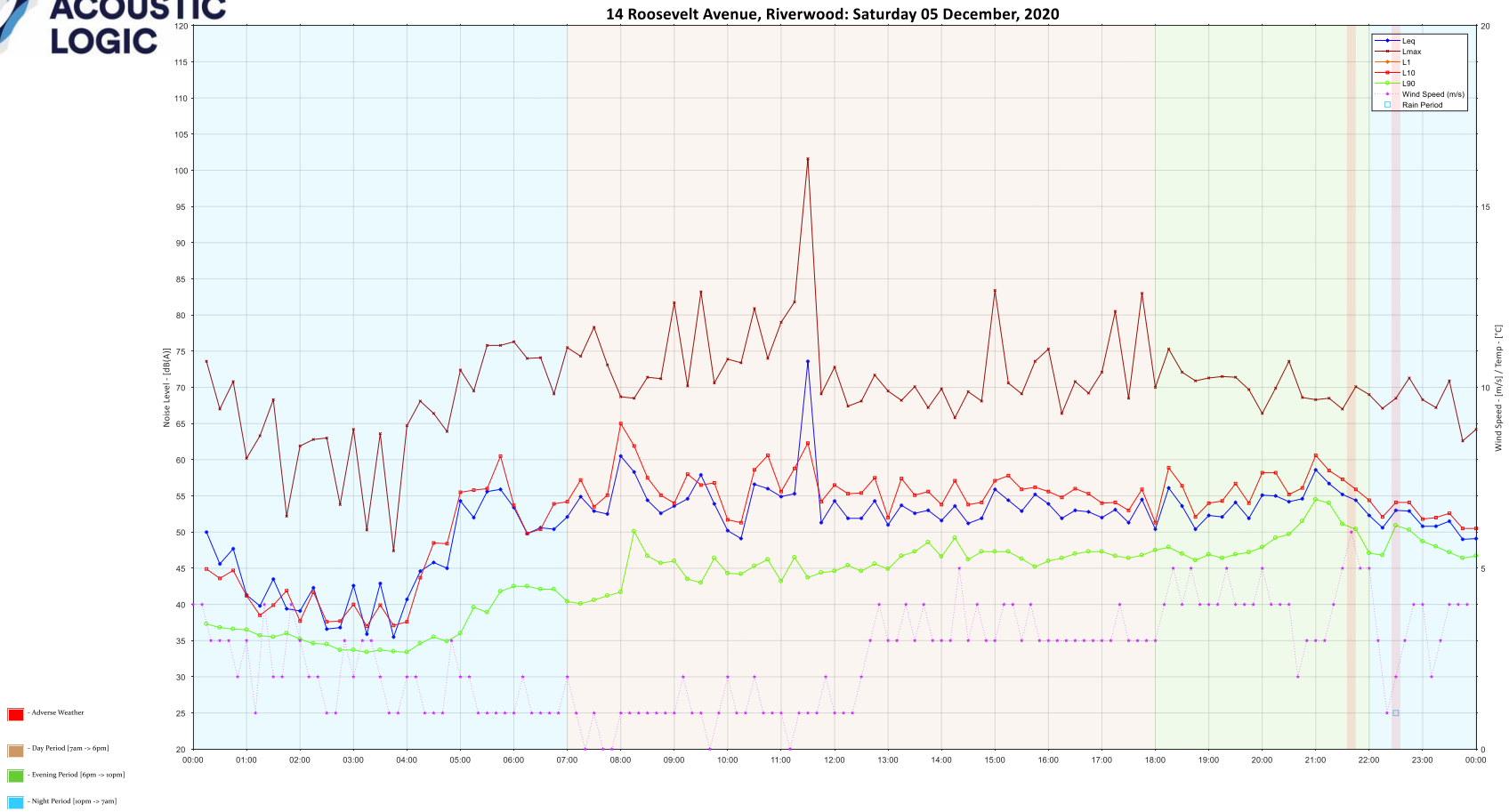
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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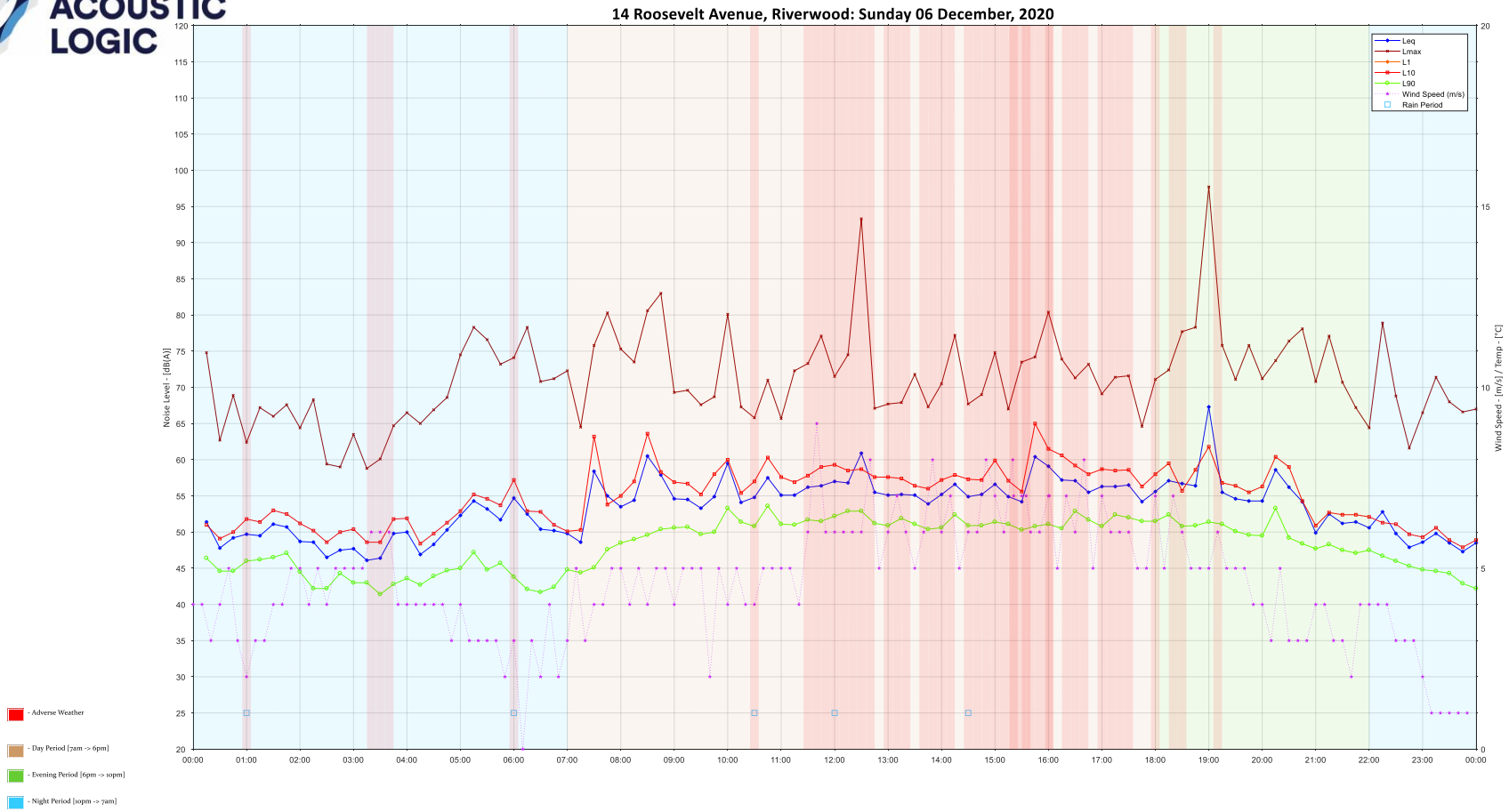
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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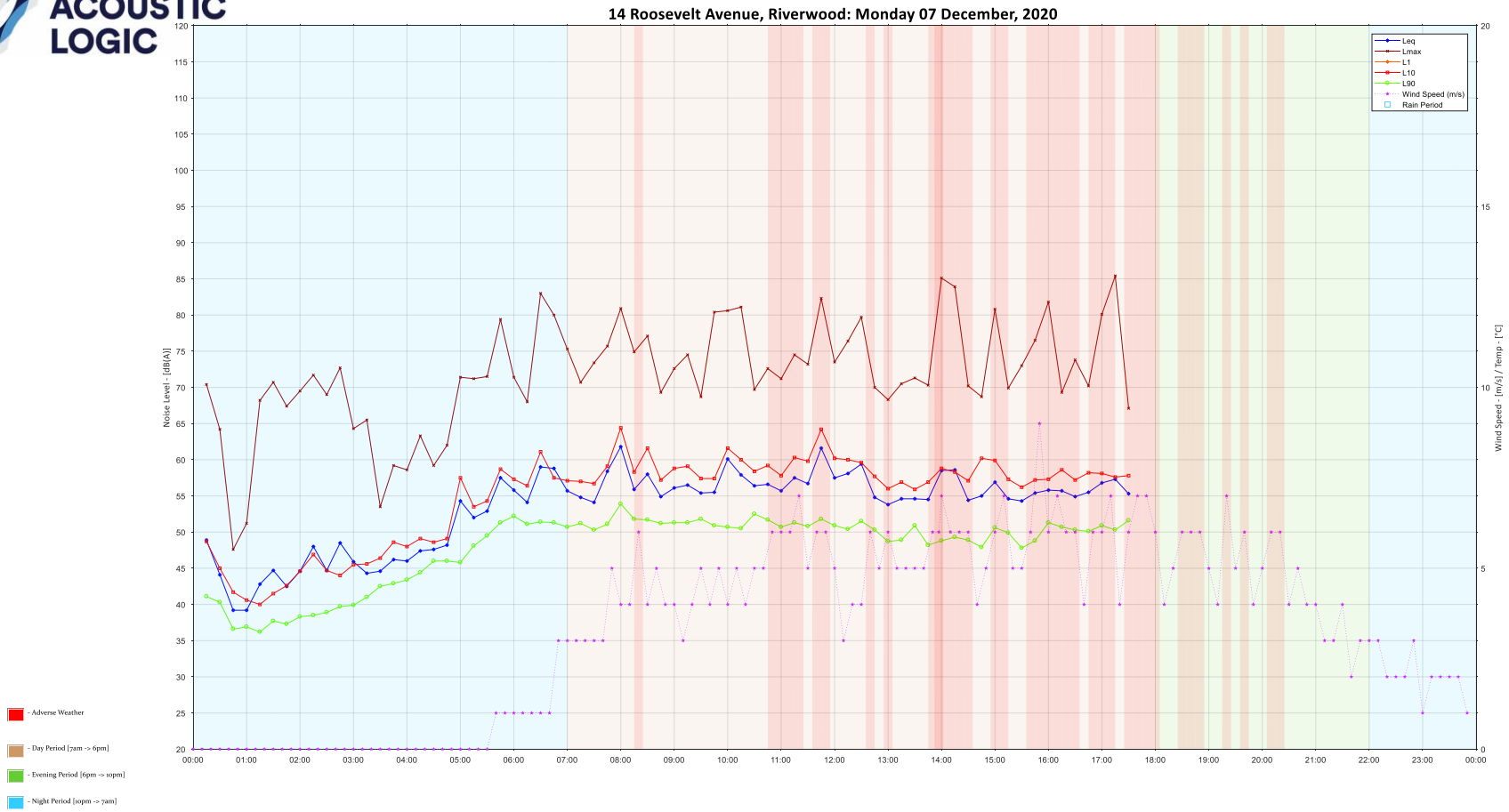
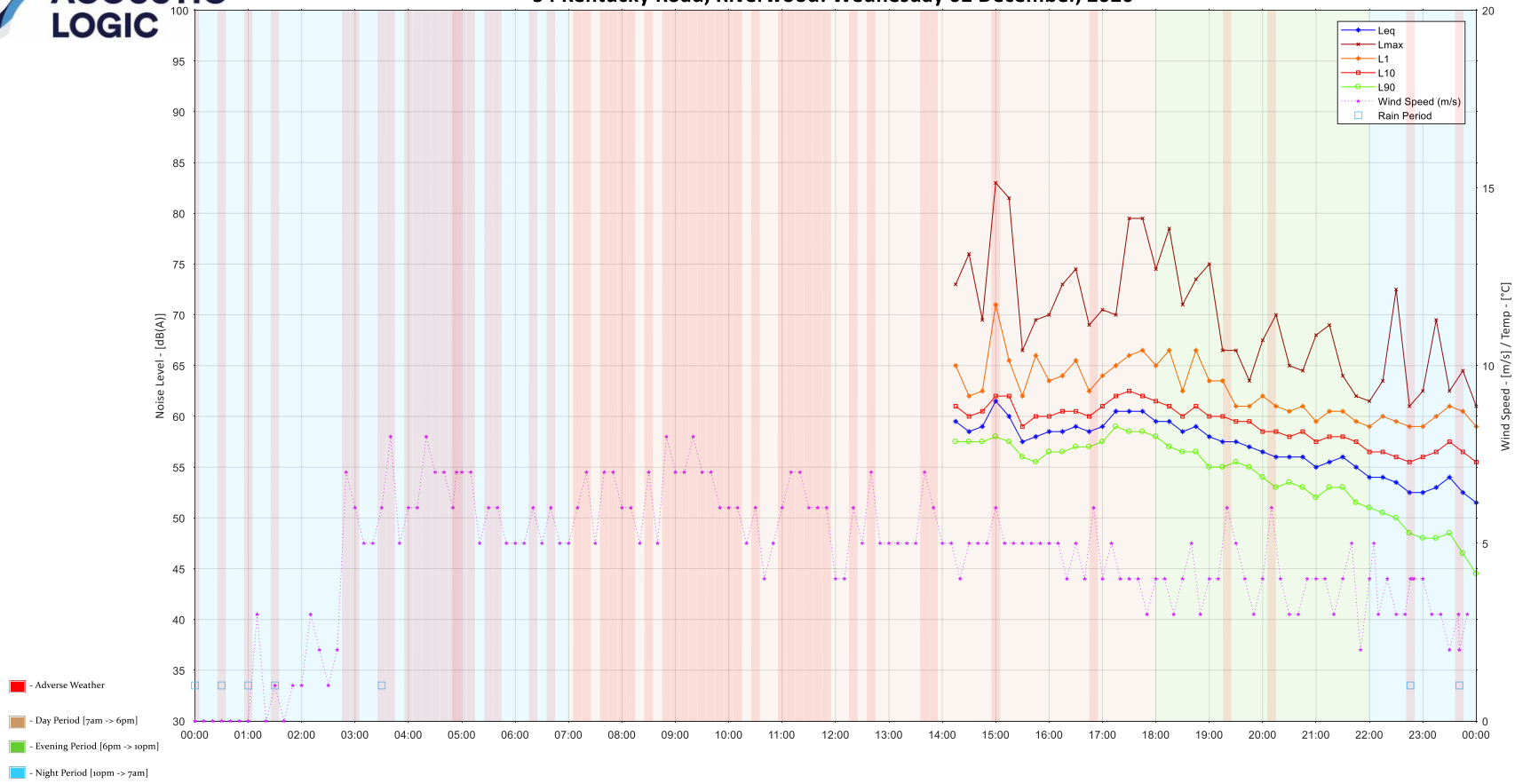
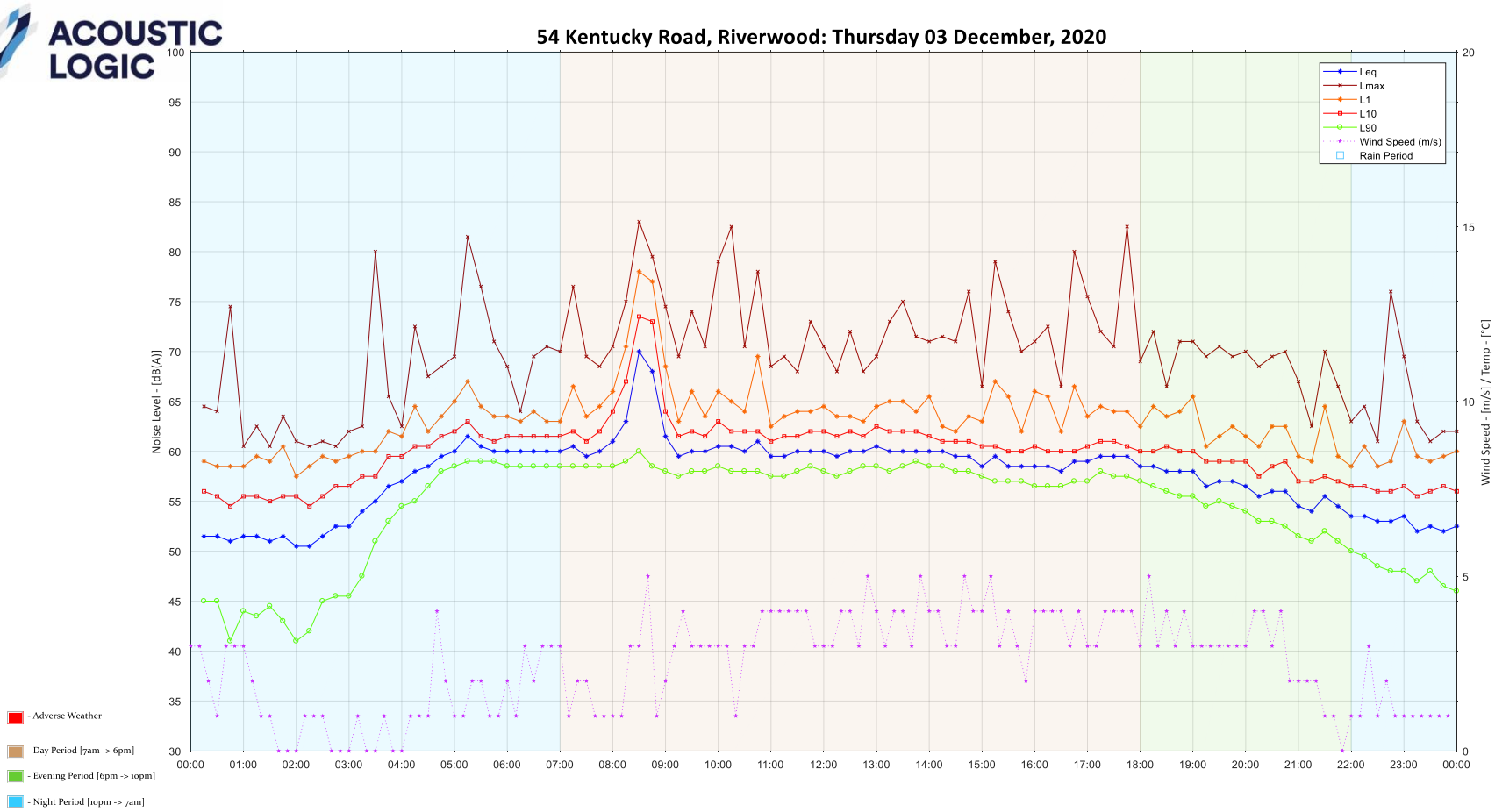
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


14 Roosevelt Avenue, Riverwood: Monday 07 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

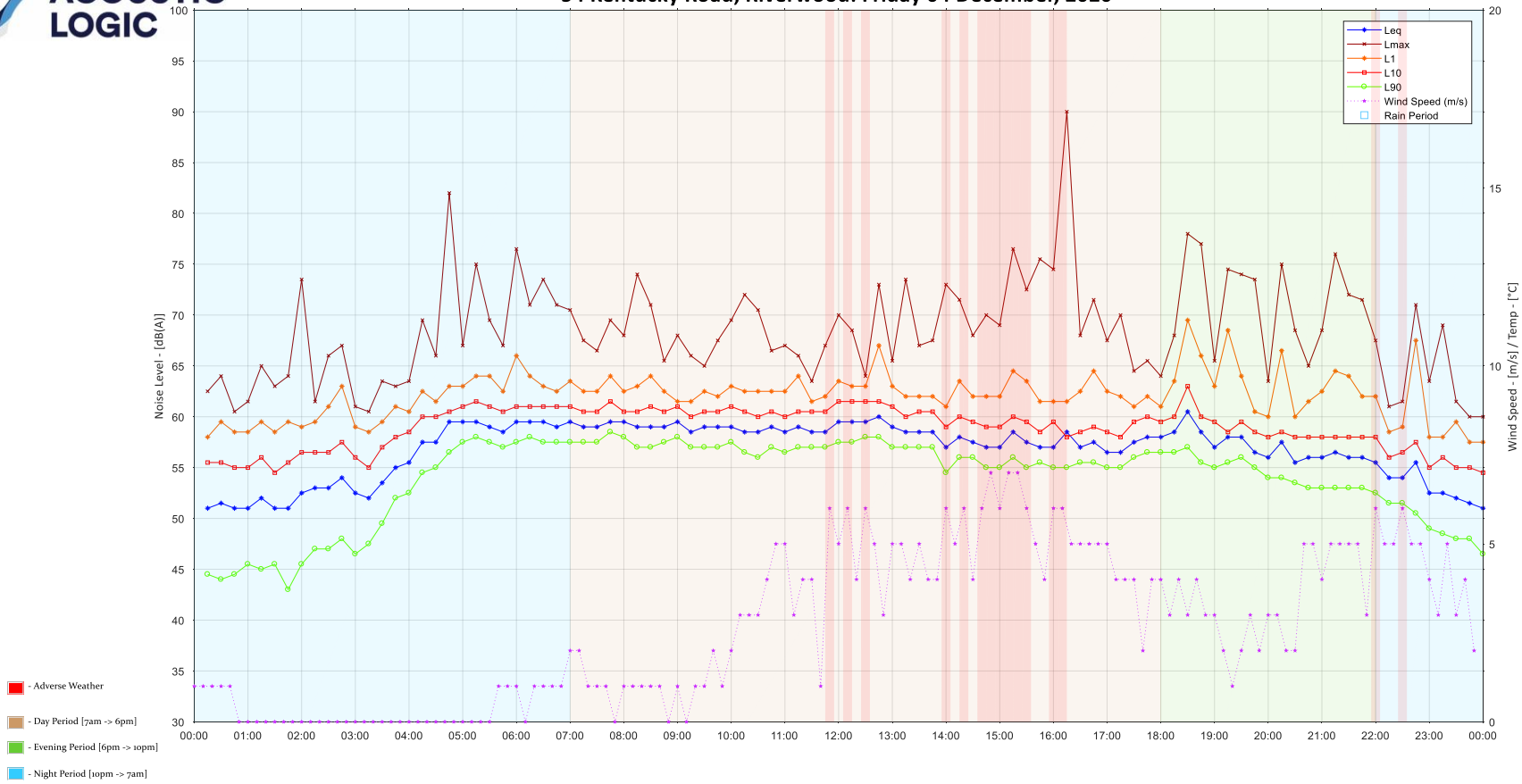
APPENDIX B – UNNATENDED NOISE MONITORING DATA – 54 KENTUCKY ROAD

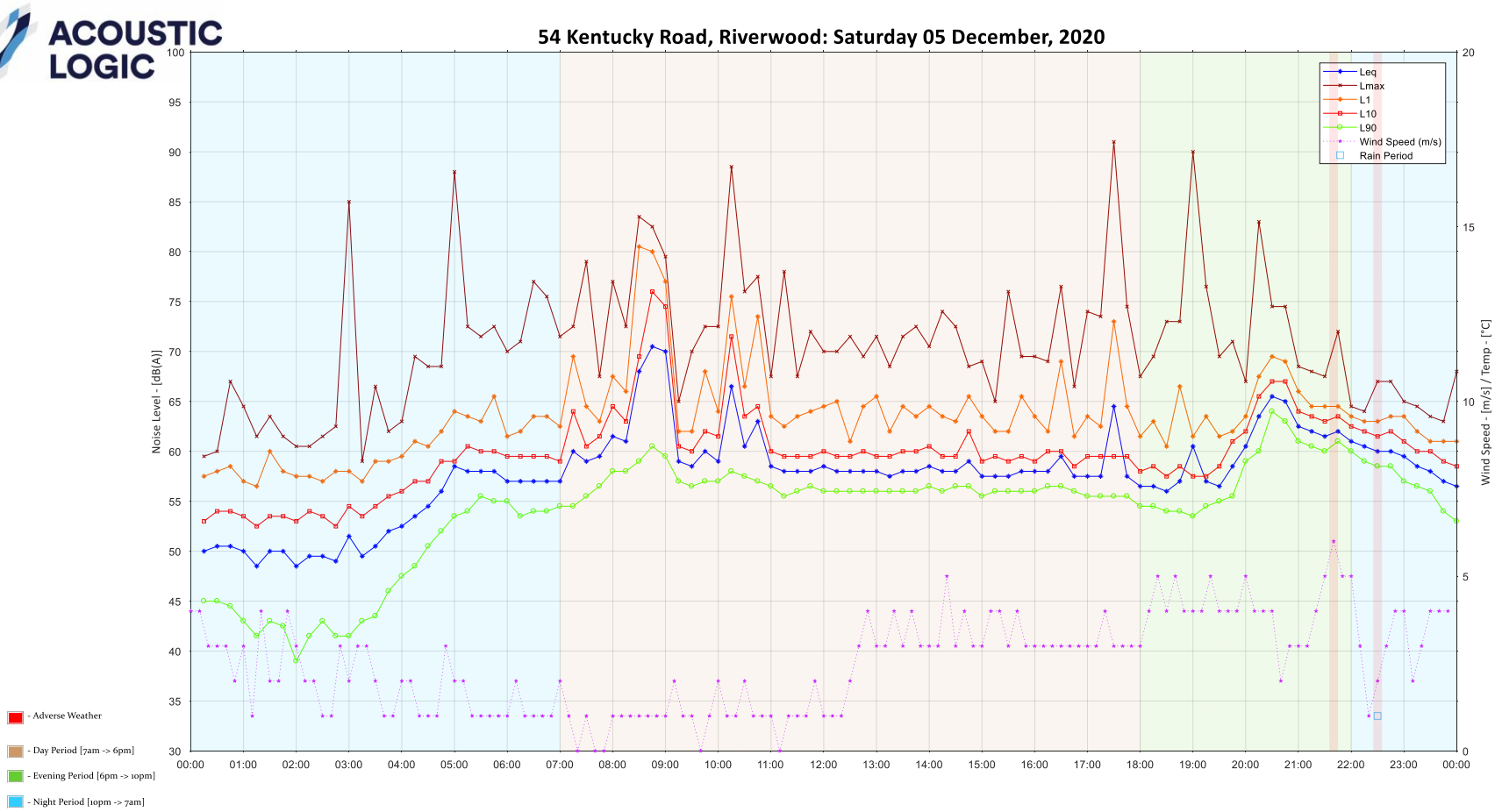
54 Kentucky Road, Riverwood: Wednesday 02 December, 2020

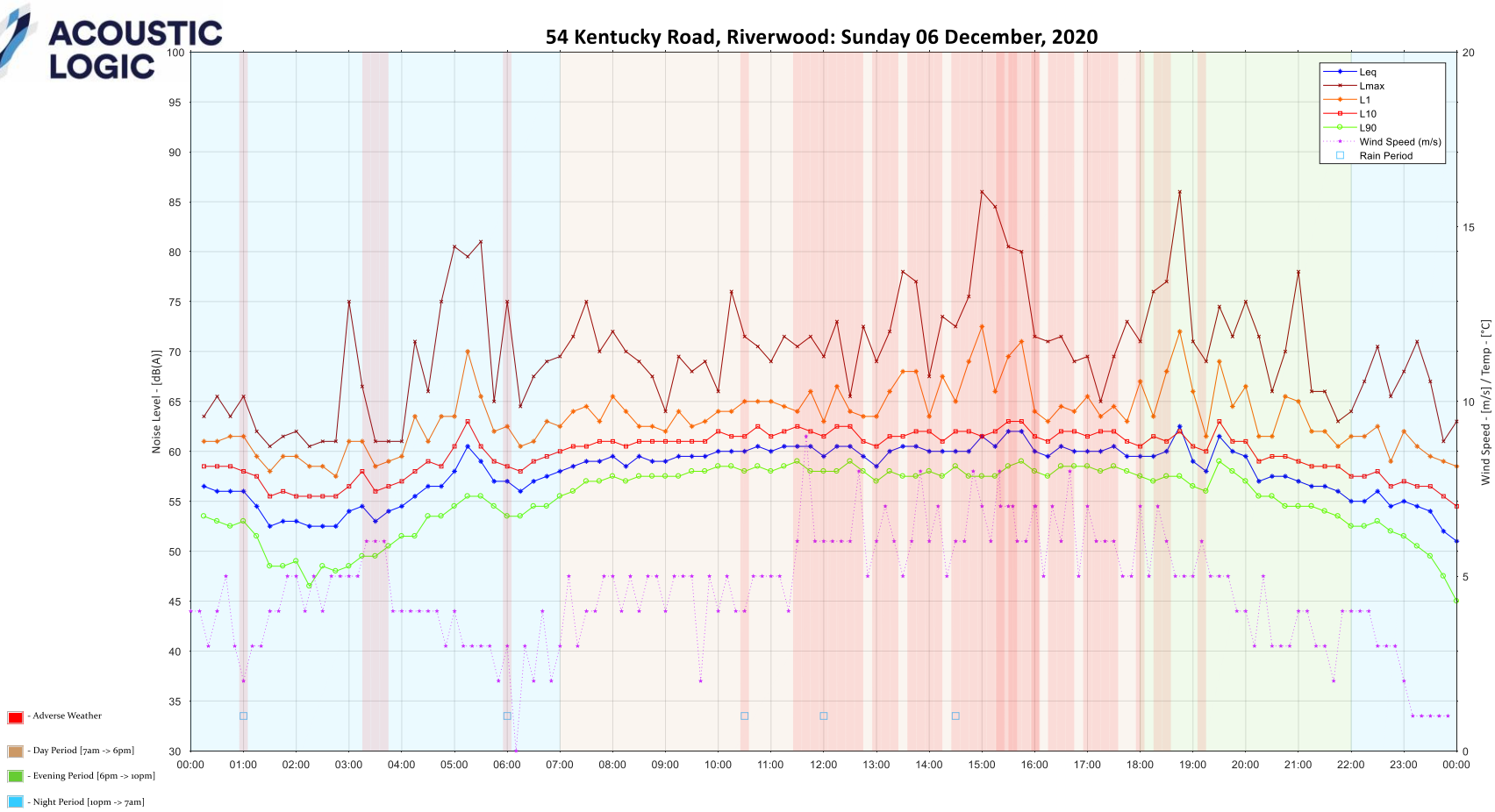


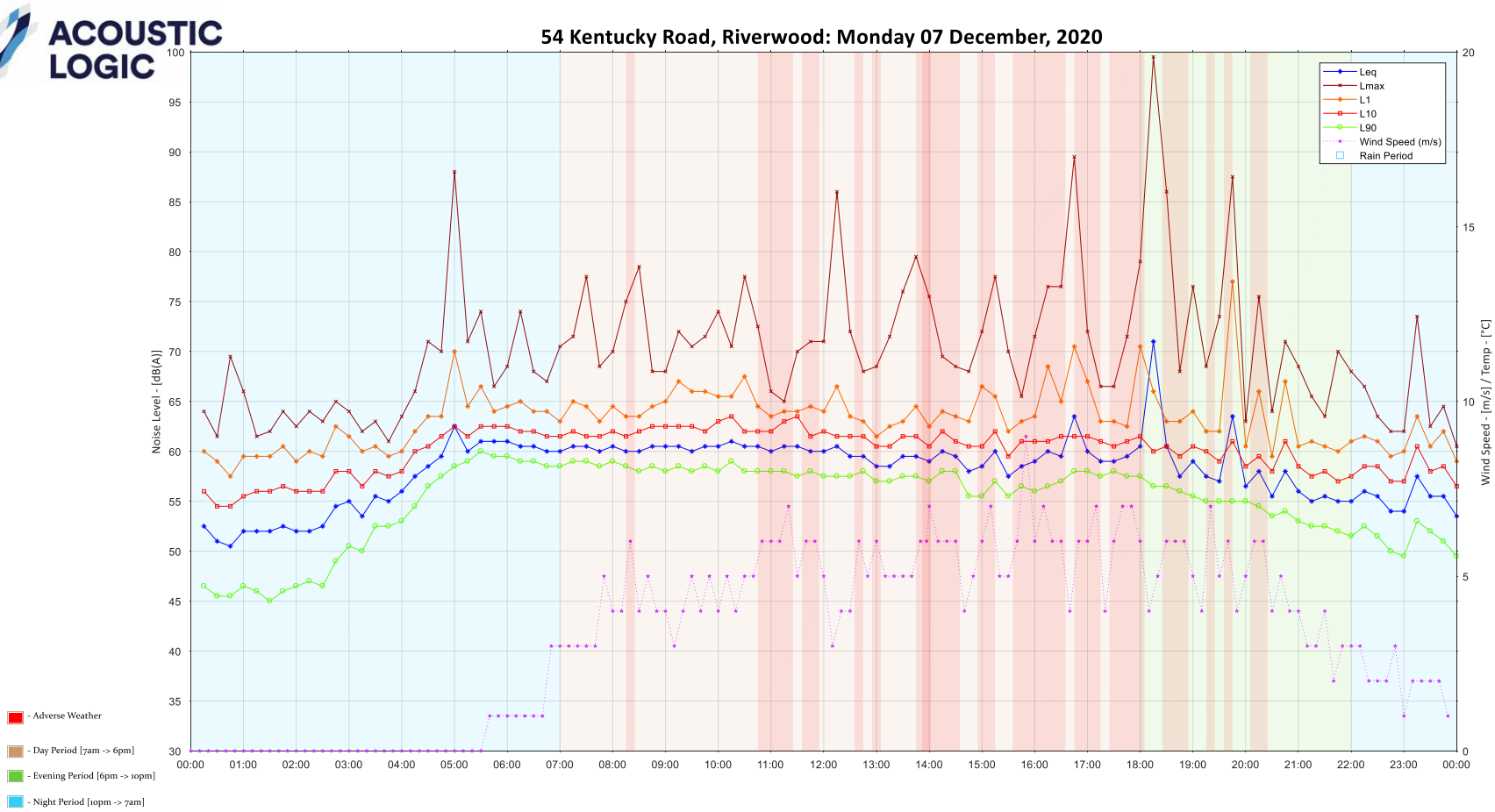

54 Kentucky Road, Riverwood: Thursday 03 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

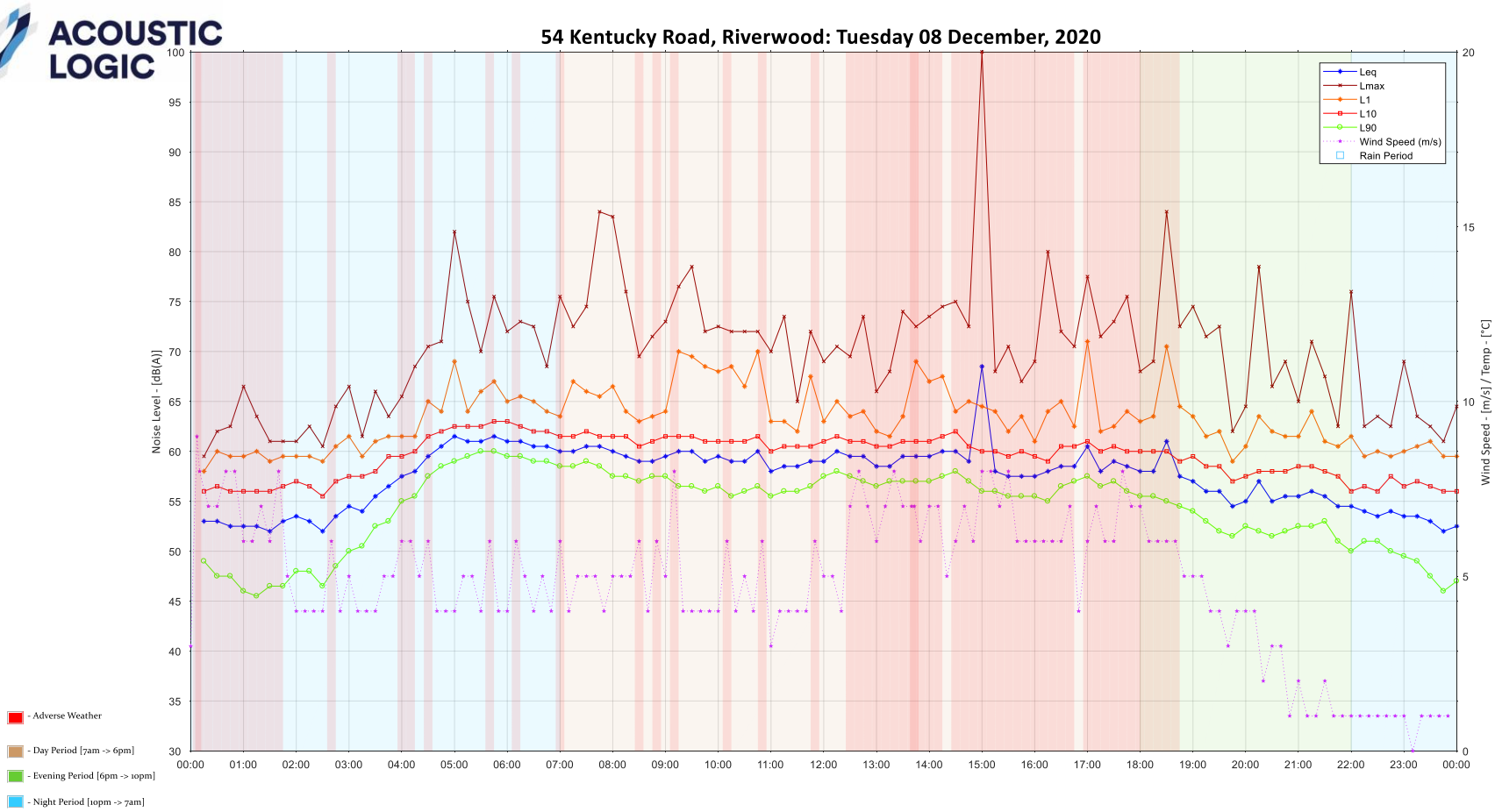
54 Kentucky Road, Riverwood: Friday 04 December, 2020



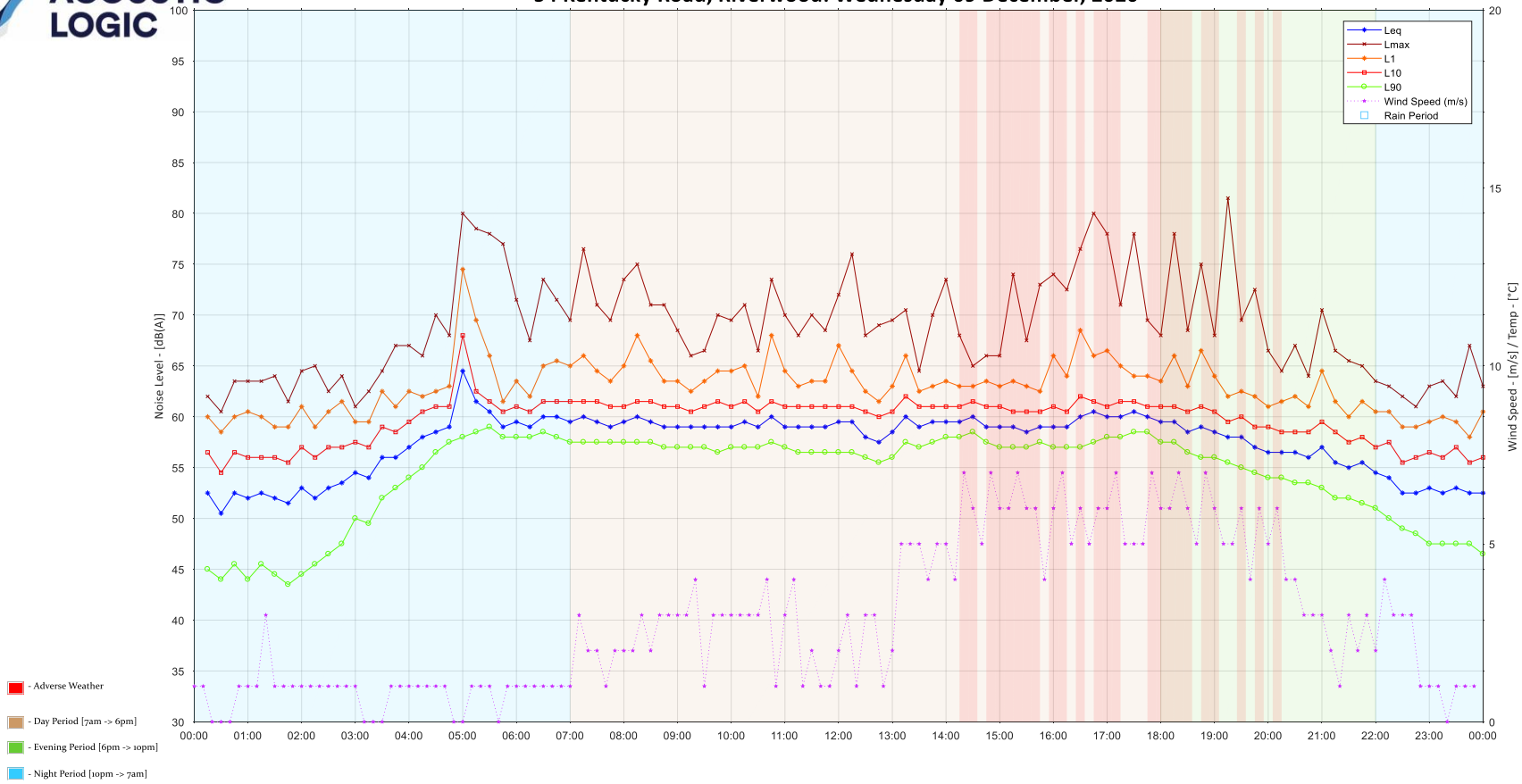

54 Kentucky Road, Riverwood: Saturday 05 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

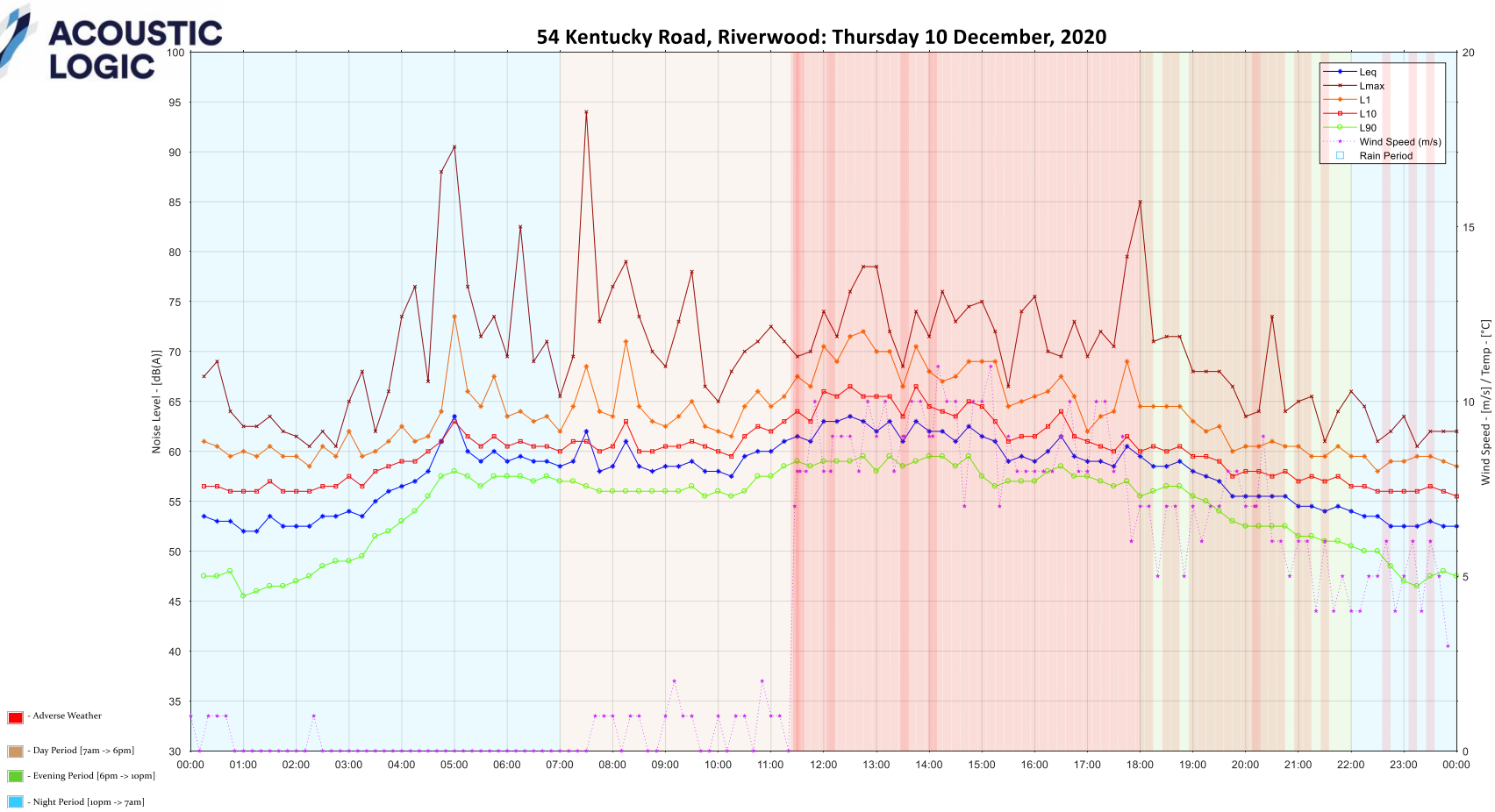

54 Kentucky Road, Riverwood: Sunday 06 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

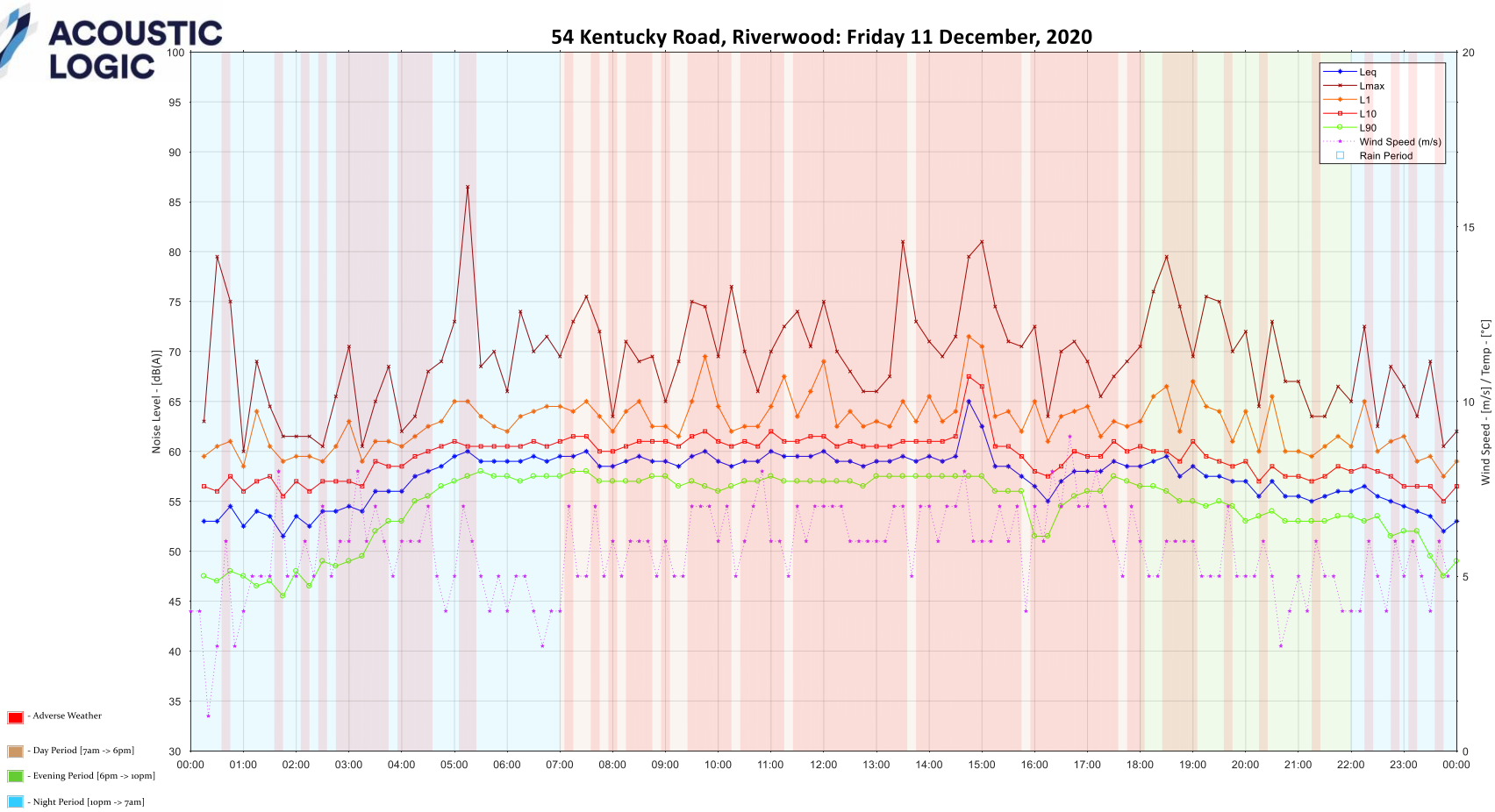

54 Kentucky Road, Riverwood: Monday 07 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


54 Kentucky Road, Riverwood: Tuesday 08 December, 2020
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

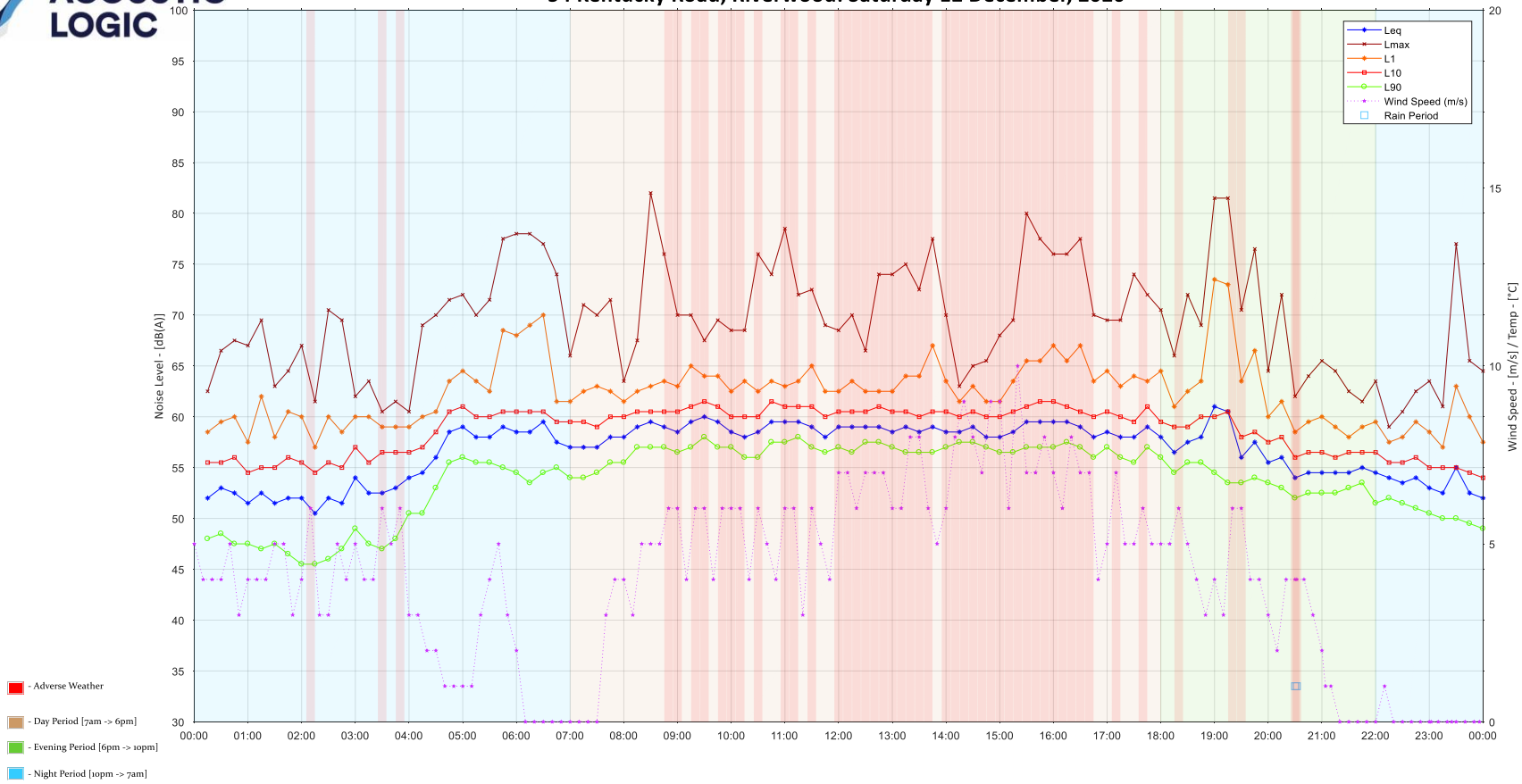
54 Kentucky Road, Riverwood: Wednesday 09 December, 2020



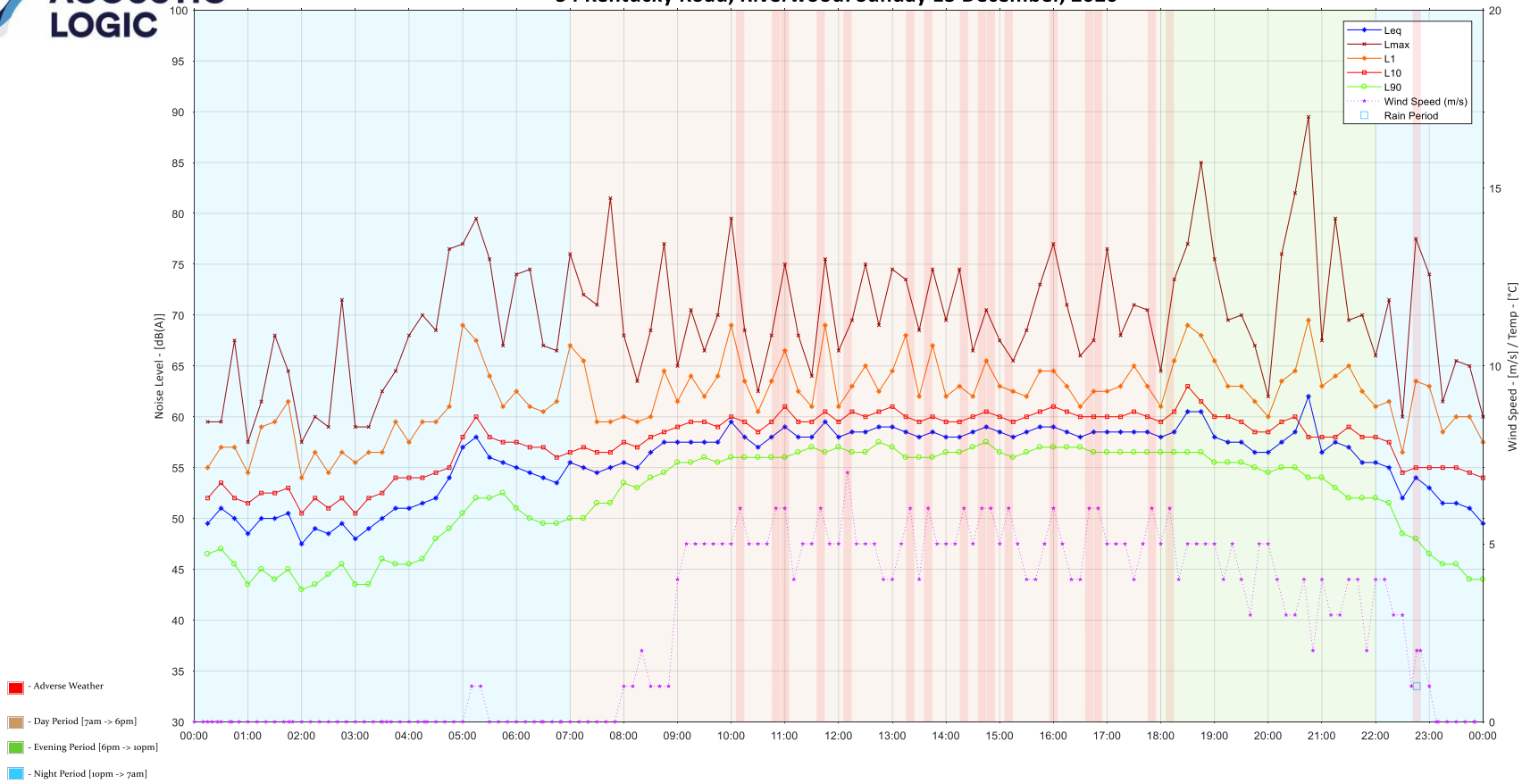

54 Kentucky Road, Riverwood: Thursday 10 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


54 Kentucky Road, Riverwood: Friday 11 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

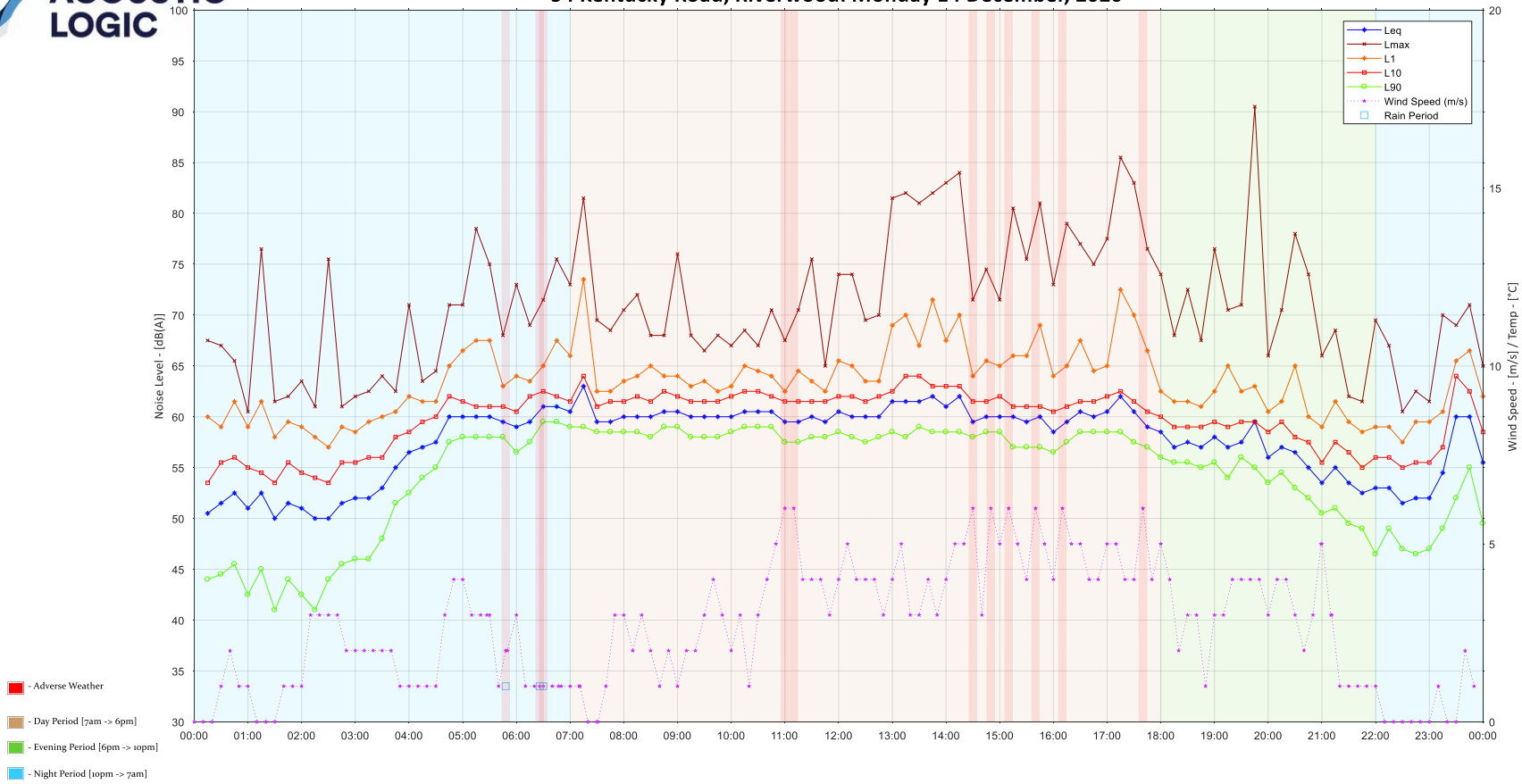
54 Kentucky Road, Riverwood: Saturday 12 December, 2020



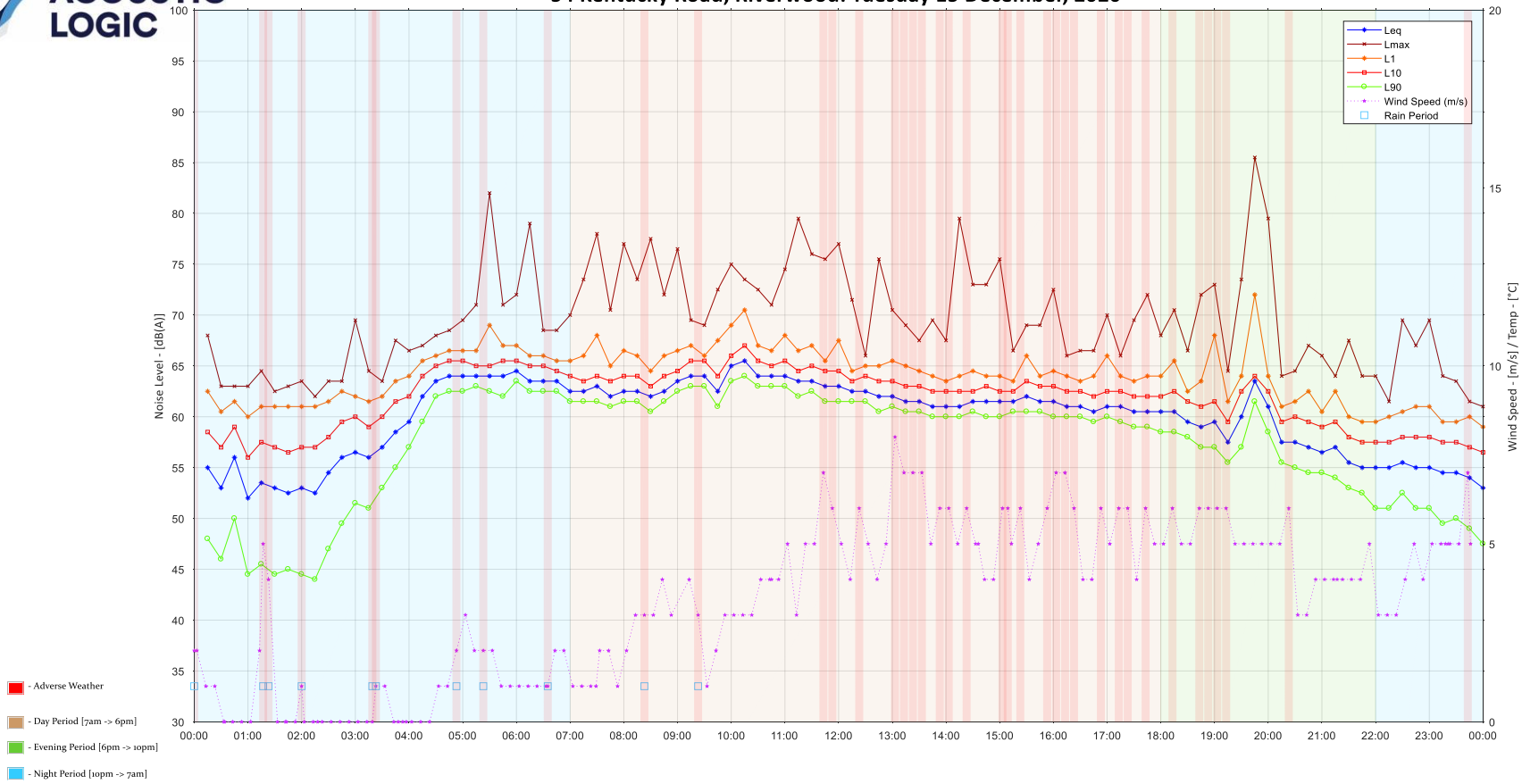
54 Kentucky Road, Riverwood: Sunday 13 December, 2020



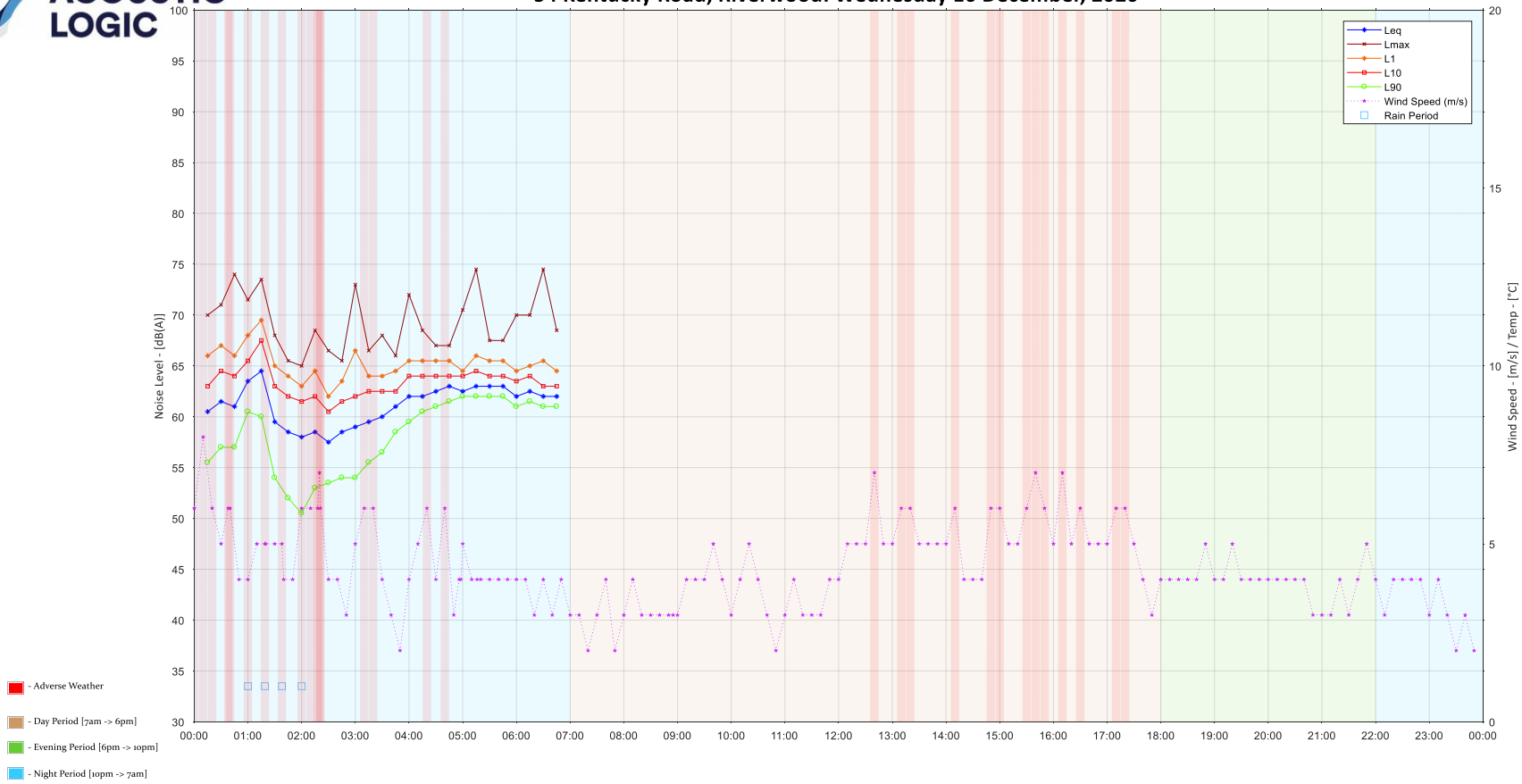
54 Kentucky Road, Riverwood: Monday 14 December, 2020



54 Kentucky Road, Riverwood: Tuesday 15 December, 2020

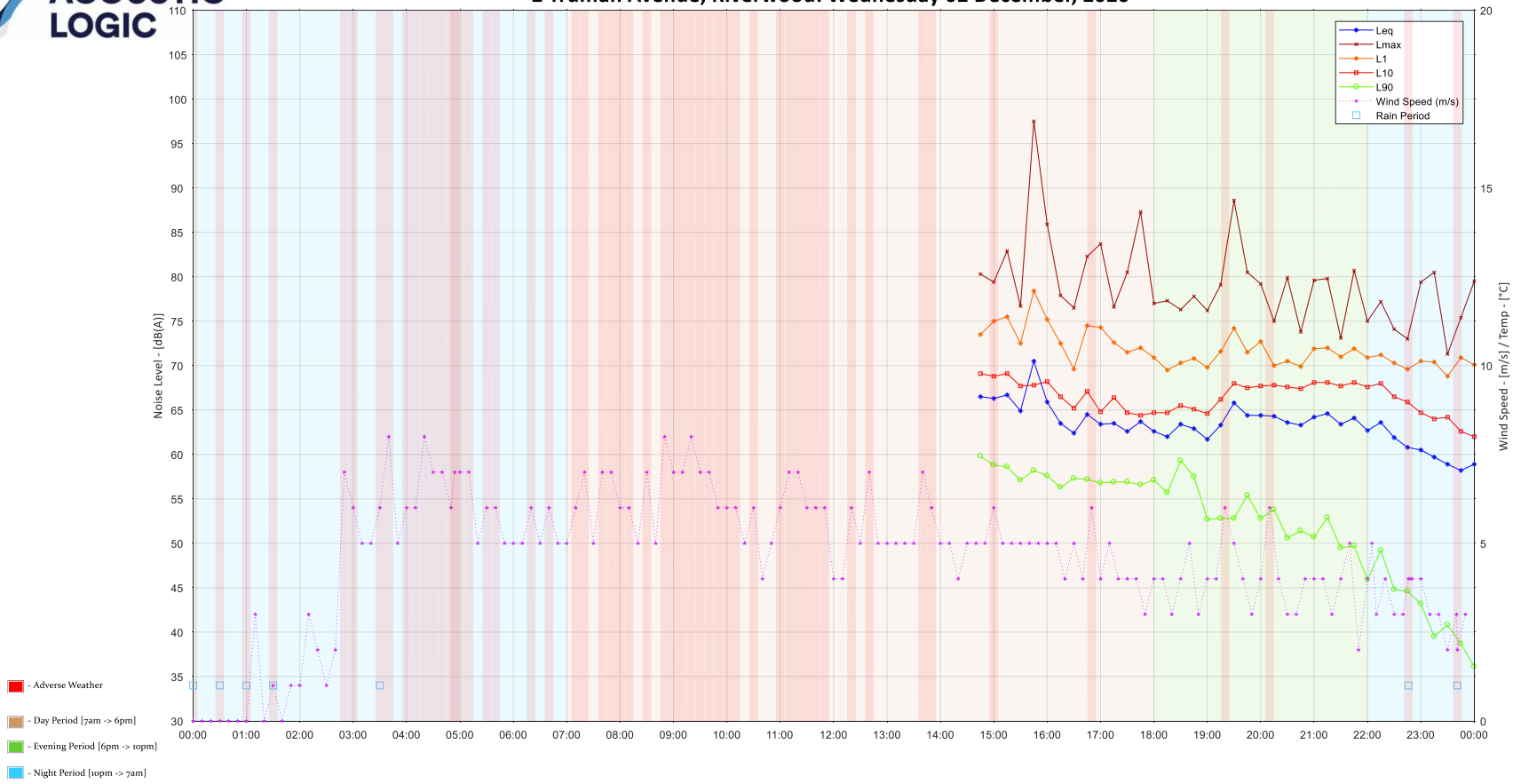


54 Kentucky Road, Riverwood: Wednesday 16 December, 2020

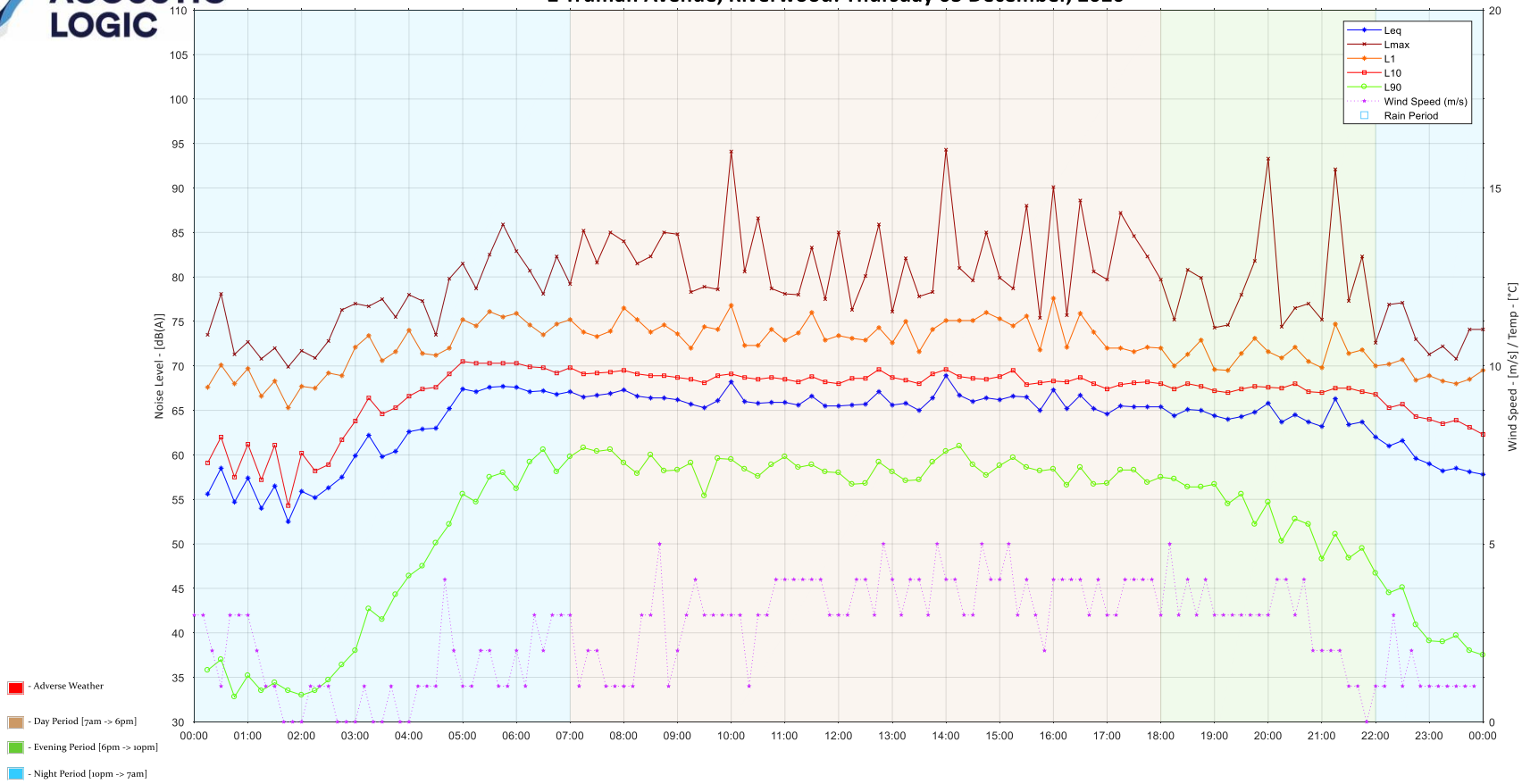


APPENDIX C – UNNATENDED NOISE MONITORING DATA – 2 TRUMAN AVENUE

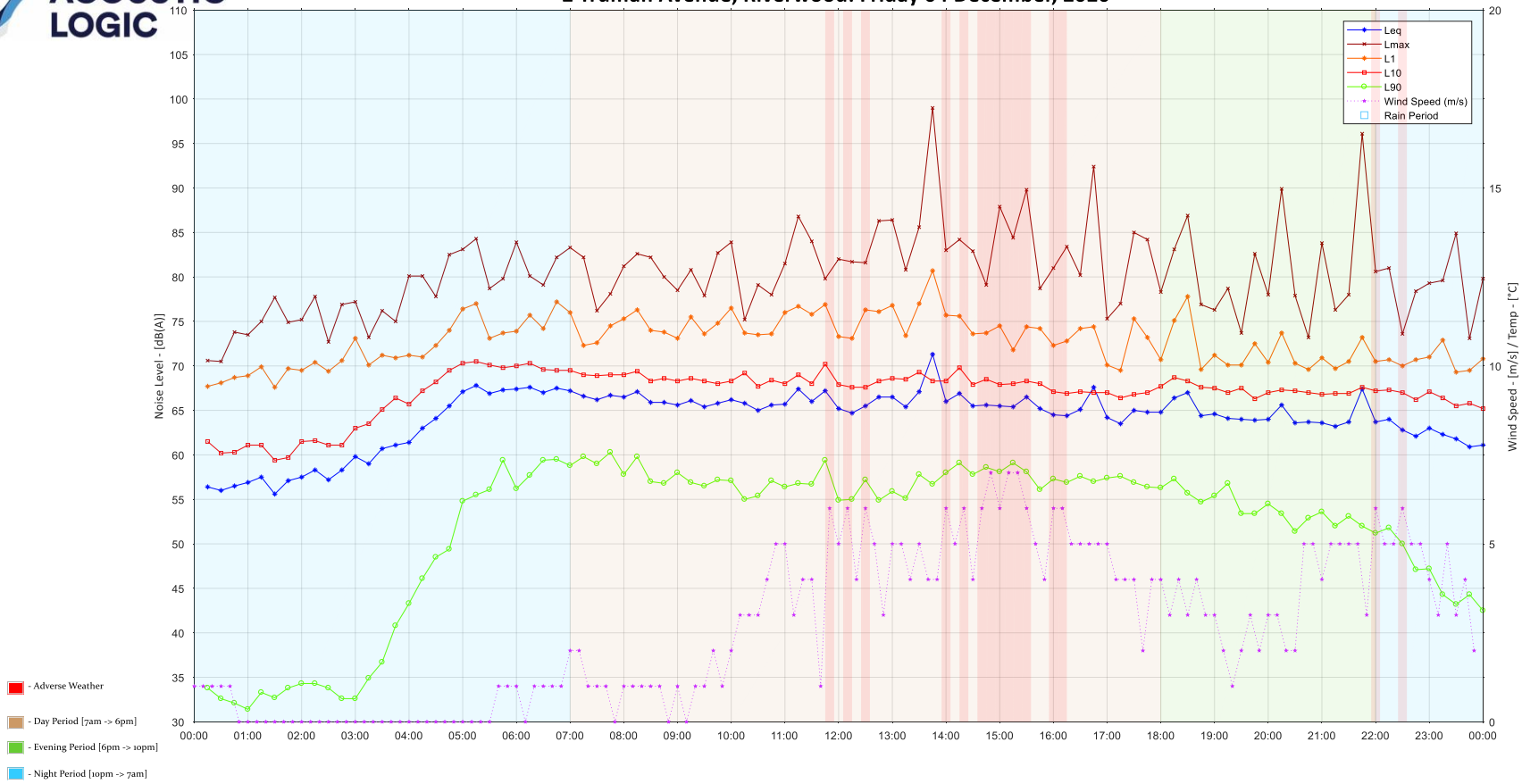
2 Truman Avenue, Riverwood: Wednesday 02 December, 2020

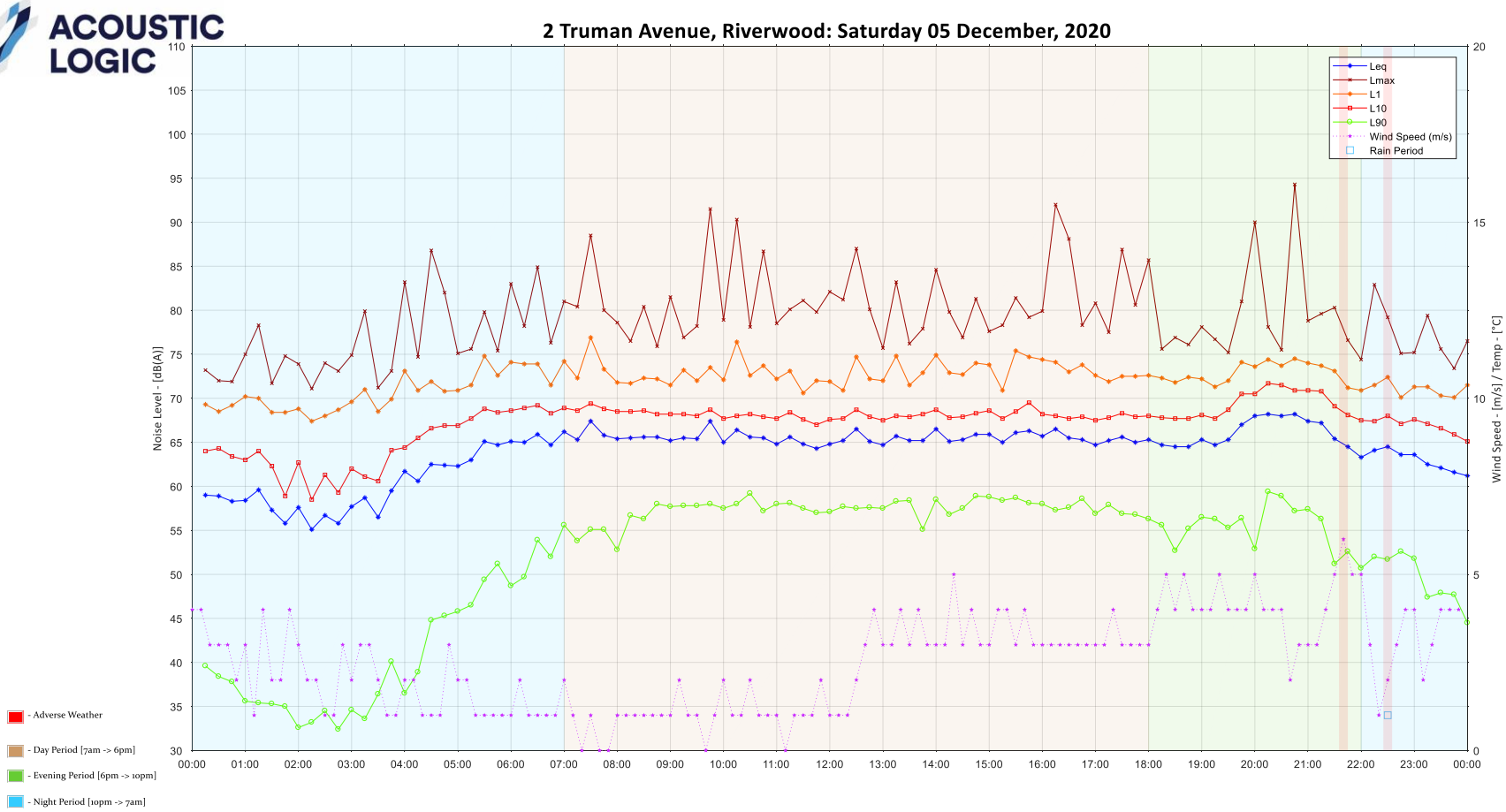


2 Truman Avenue, Riverwood: Thursday 03 December, 2020

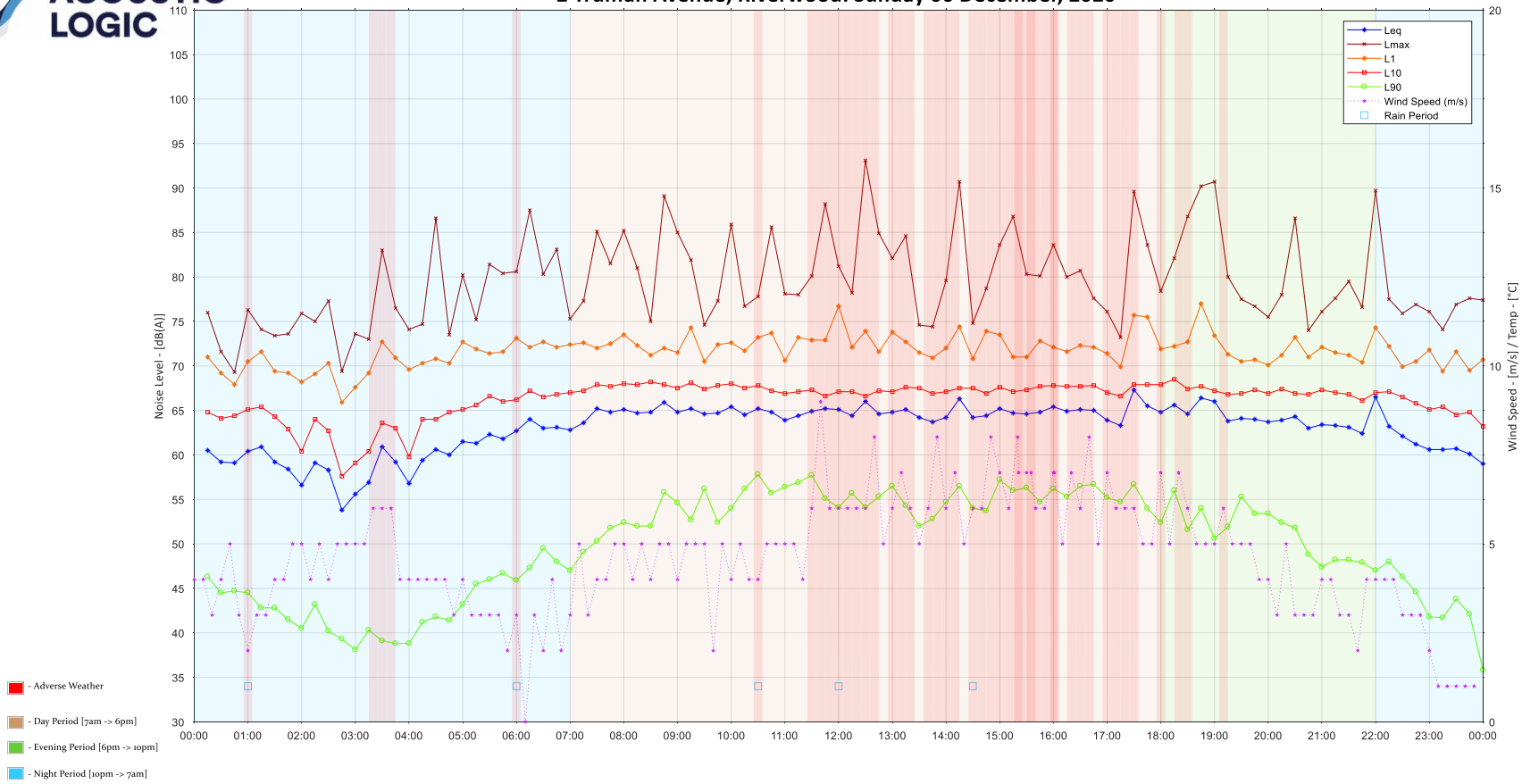


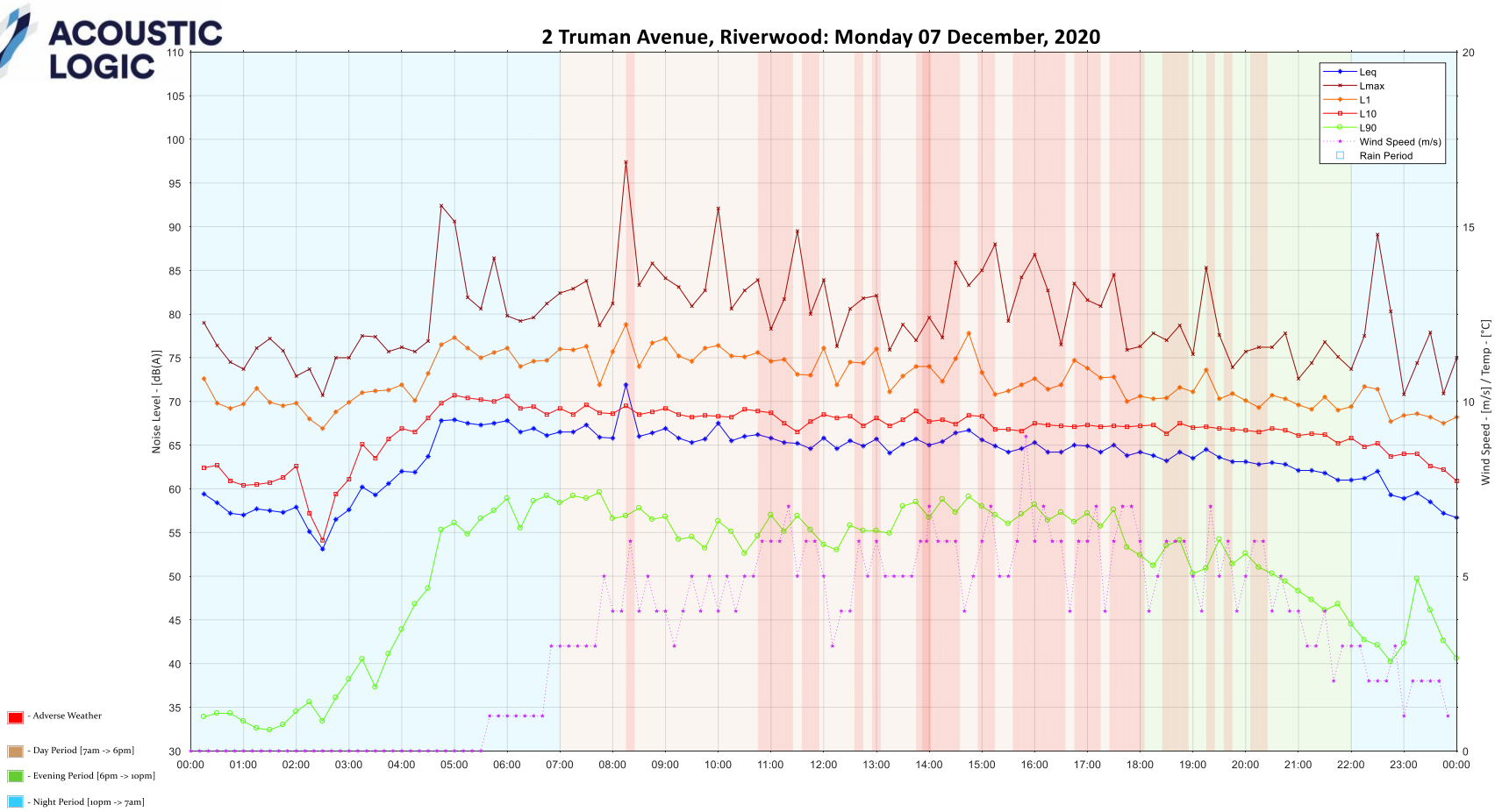
2 Truman Avenue, Riverwood: Friday 04 December, 2020

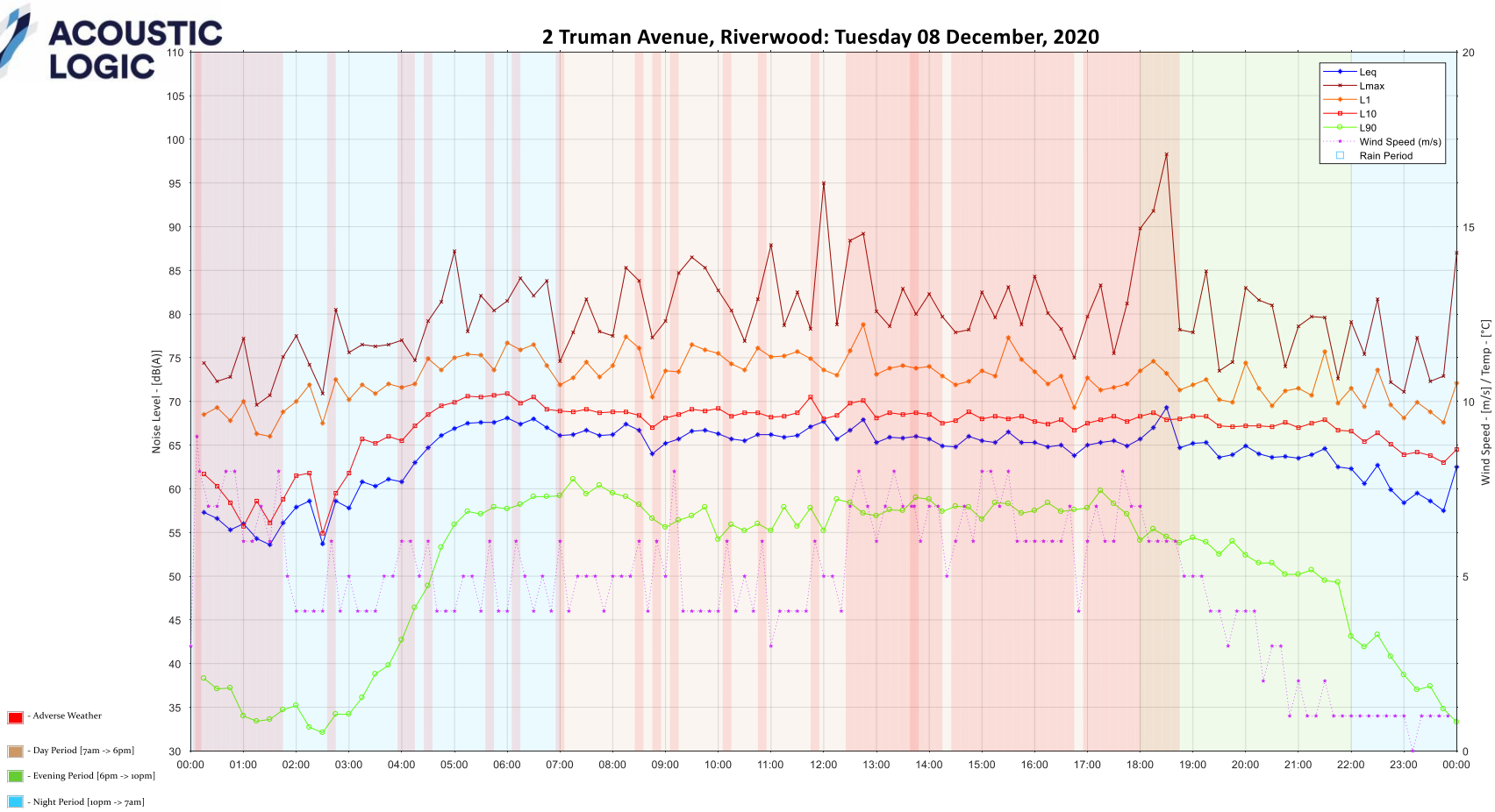


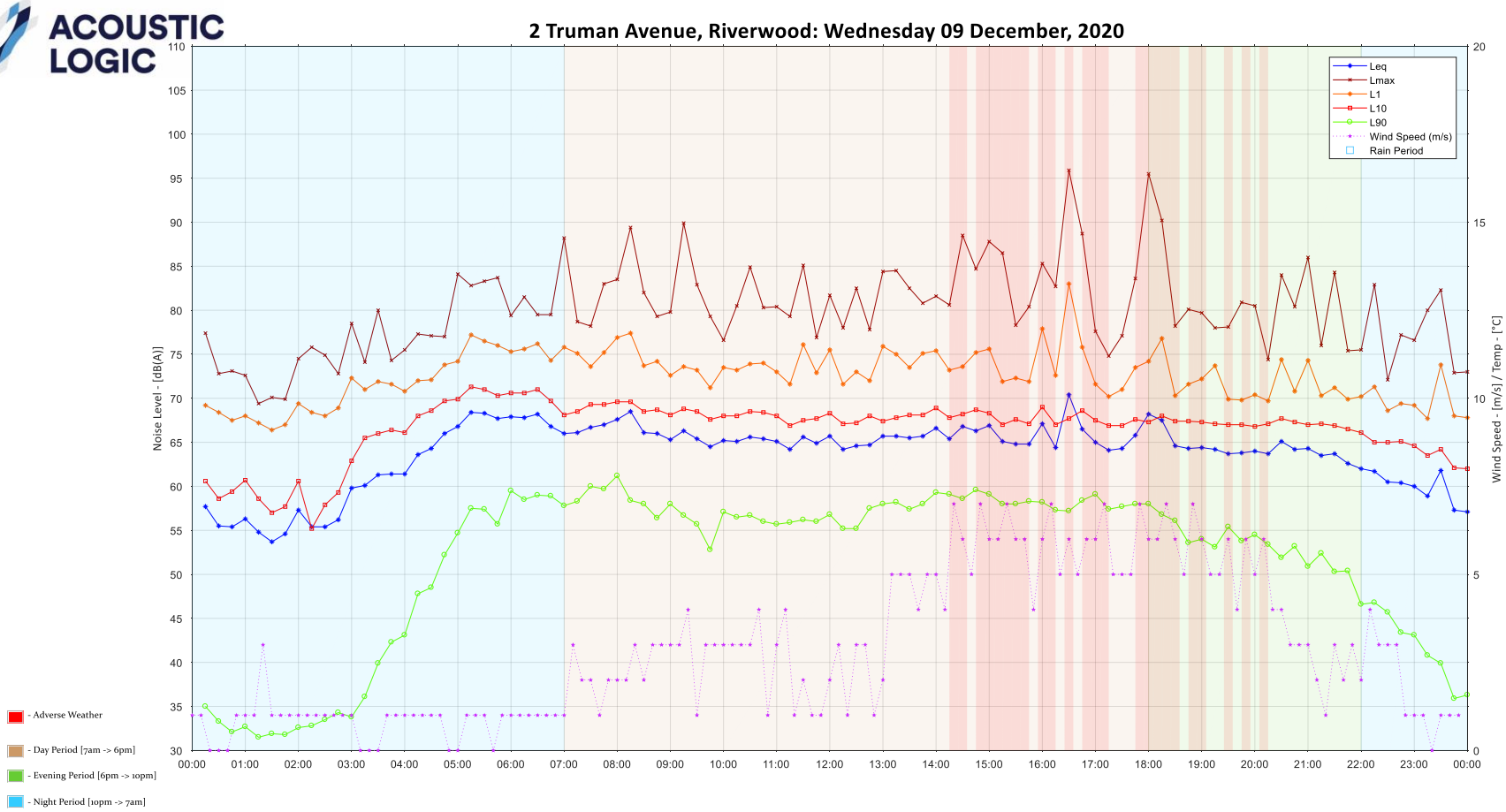

2 Truman Avenue, Riverwood: Saturday 05 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

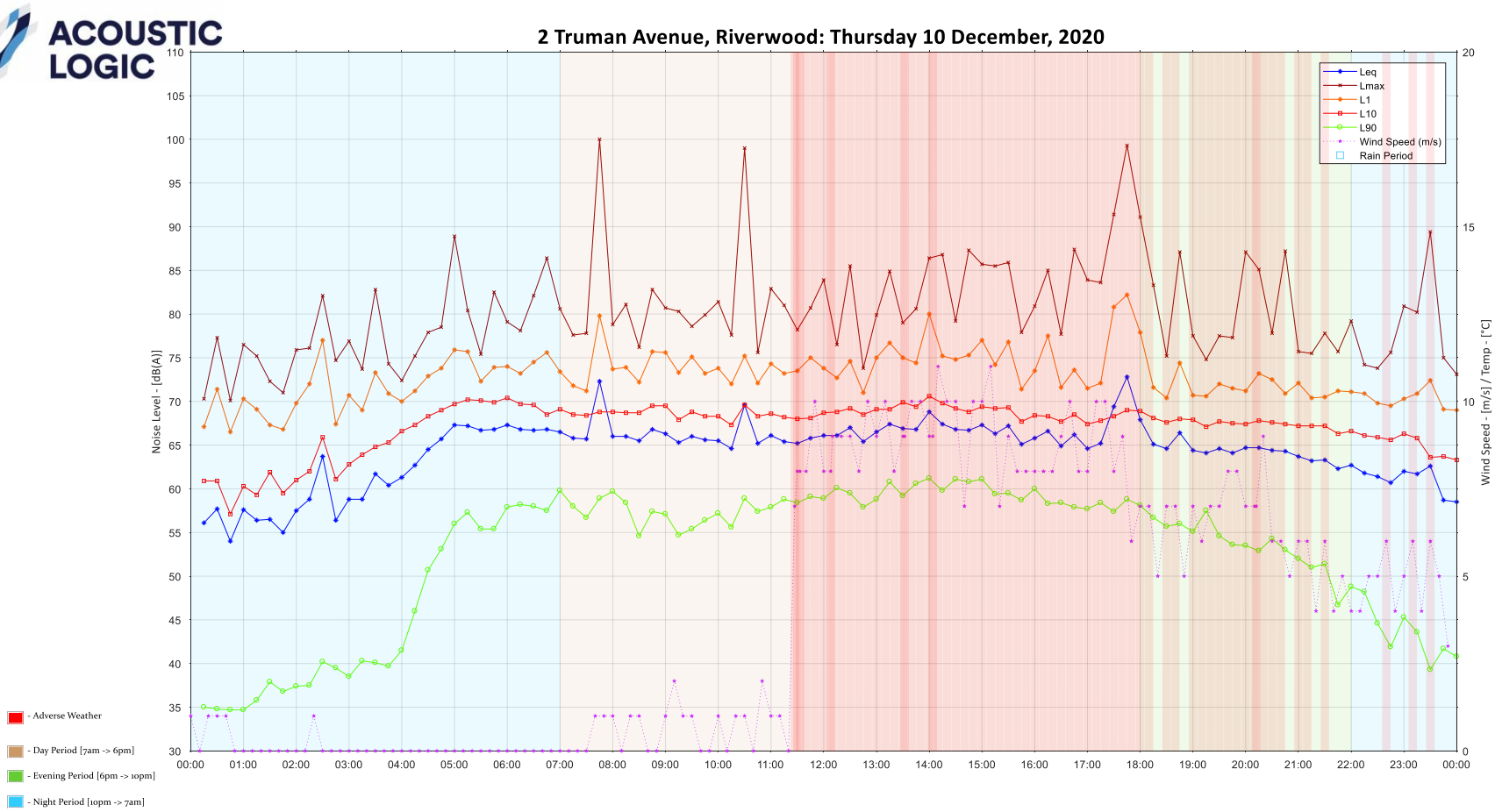
2 Truman Avenue, Riverwood: Sunday 06 December, 2020



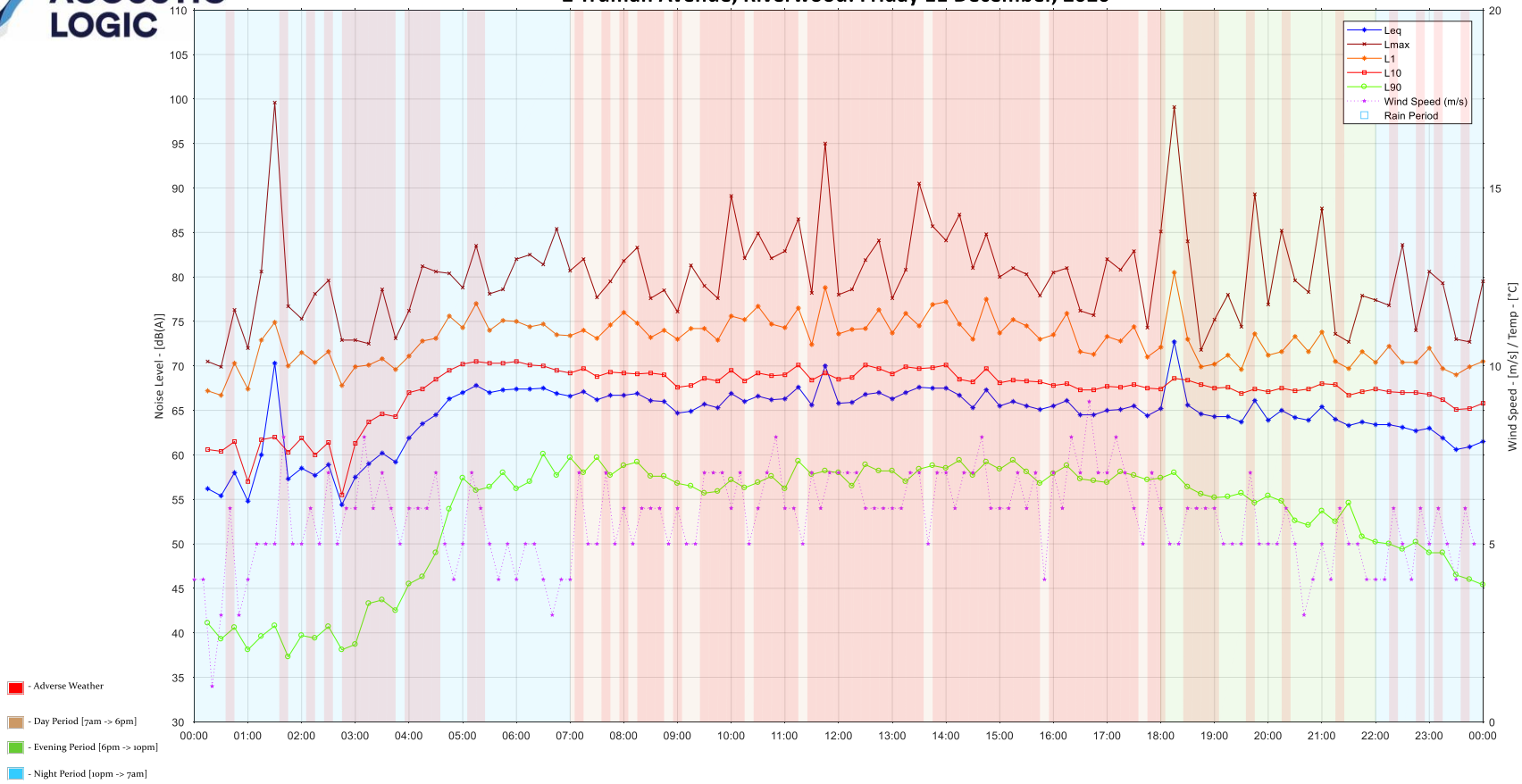

2 Truman Avenue, Riverwood: Monday 07 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


2 Truman Avenue, Riverwood: Tuesday 08 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

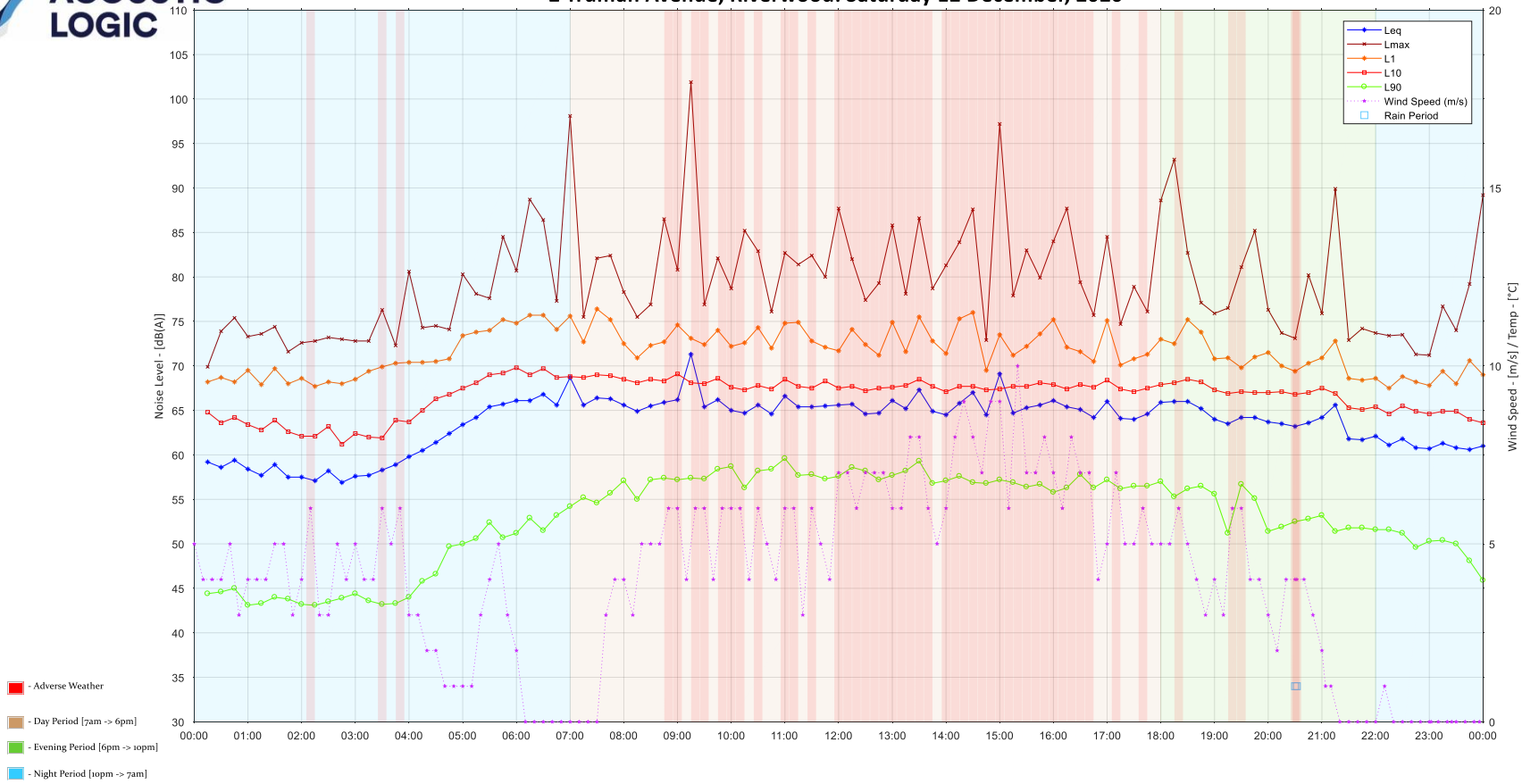

2 Truman Avenue, Riverwood: Wednesday 09 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


2 Truman Avenue, Riverwood: Thursday 10 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

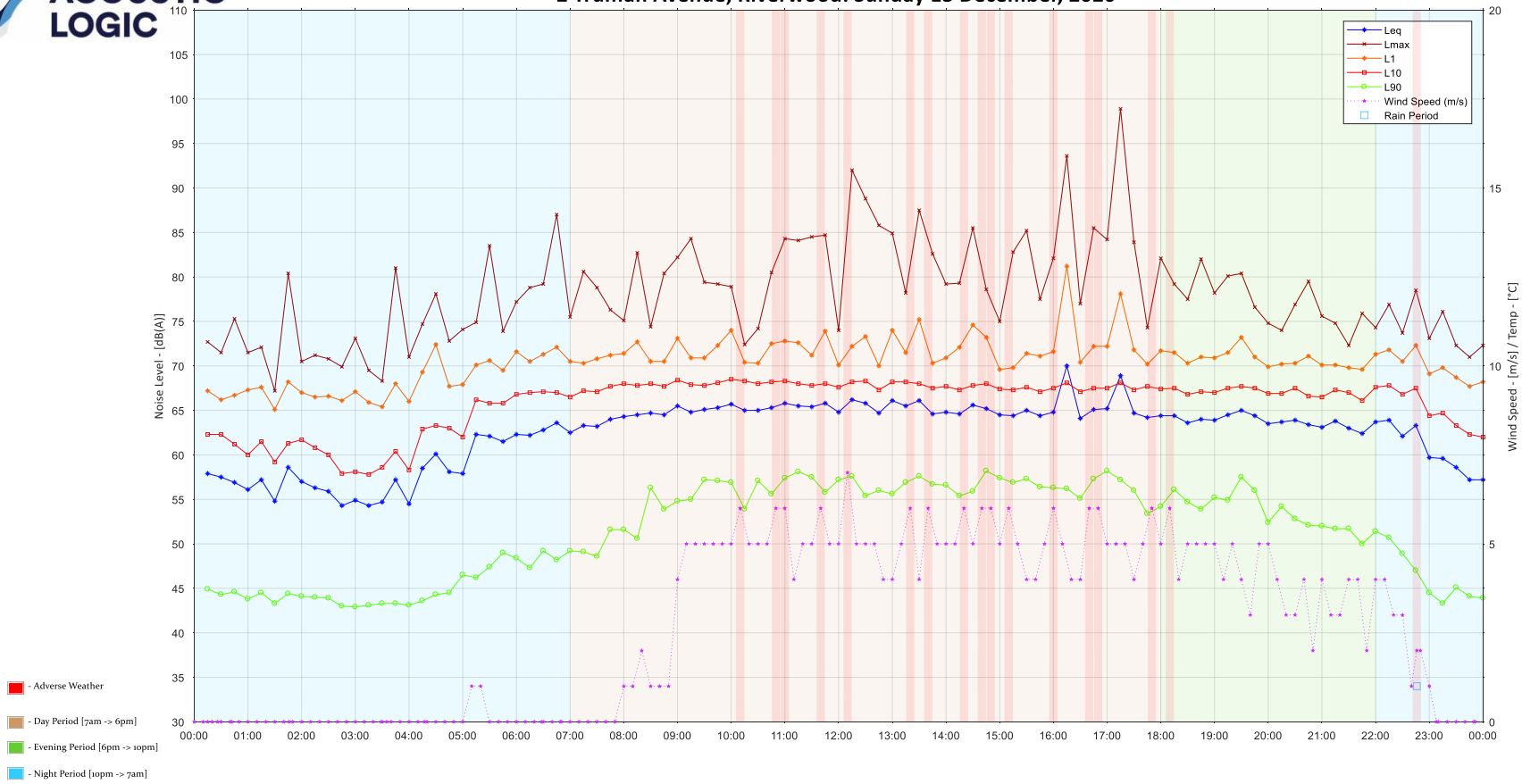
2 Truman Avenue, Riverwood: Friday 11 December, 2020

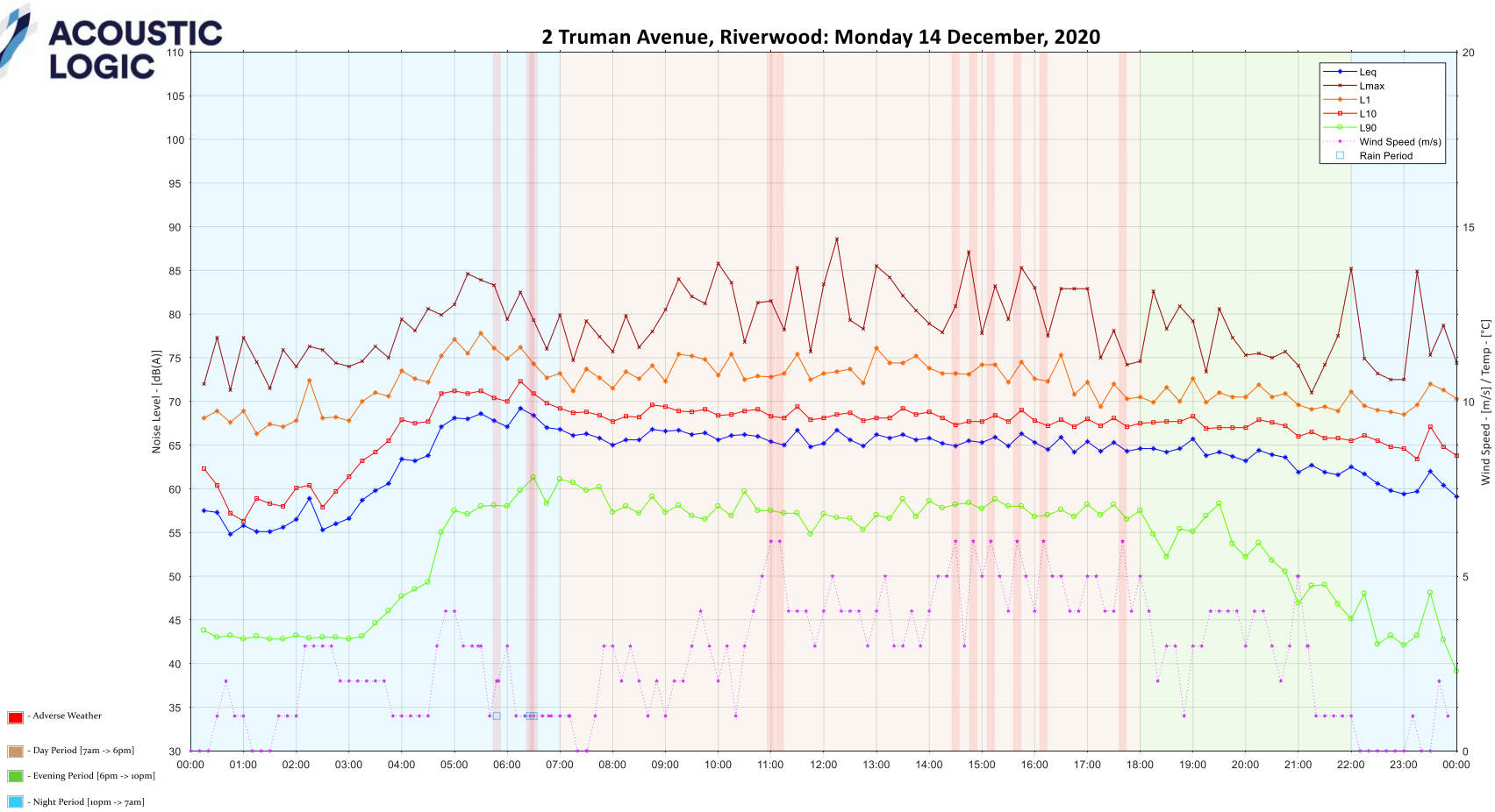


2 Truman Avenue, Riverwood: Saturday 12 December, 2020

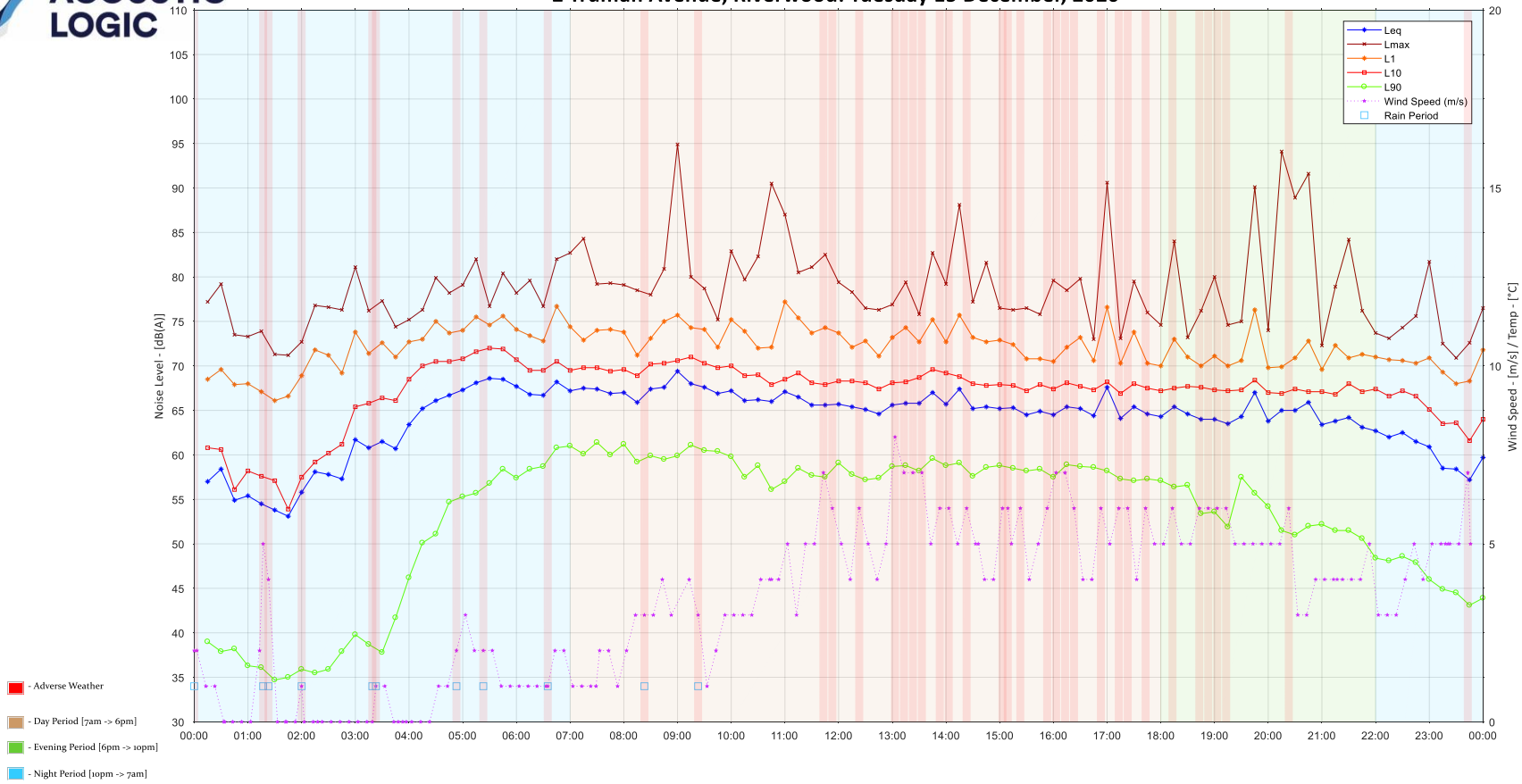


2 Truman Avenue, Riverwood: Sunday 13 December, 2020

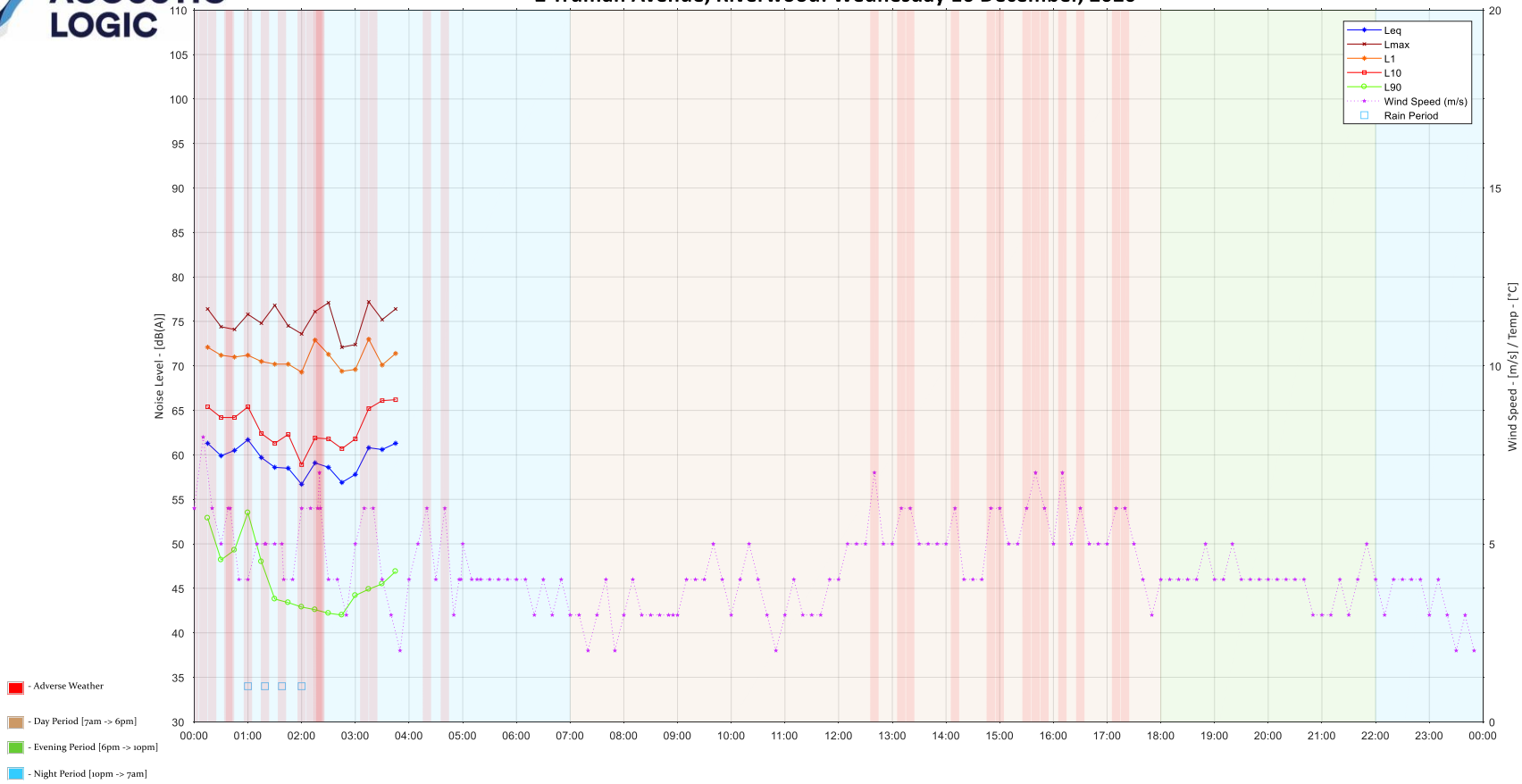



2 Truman Avenue, Riverwood: Monday 14 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

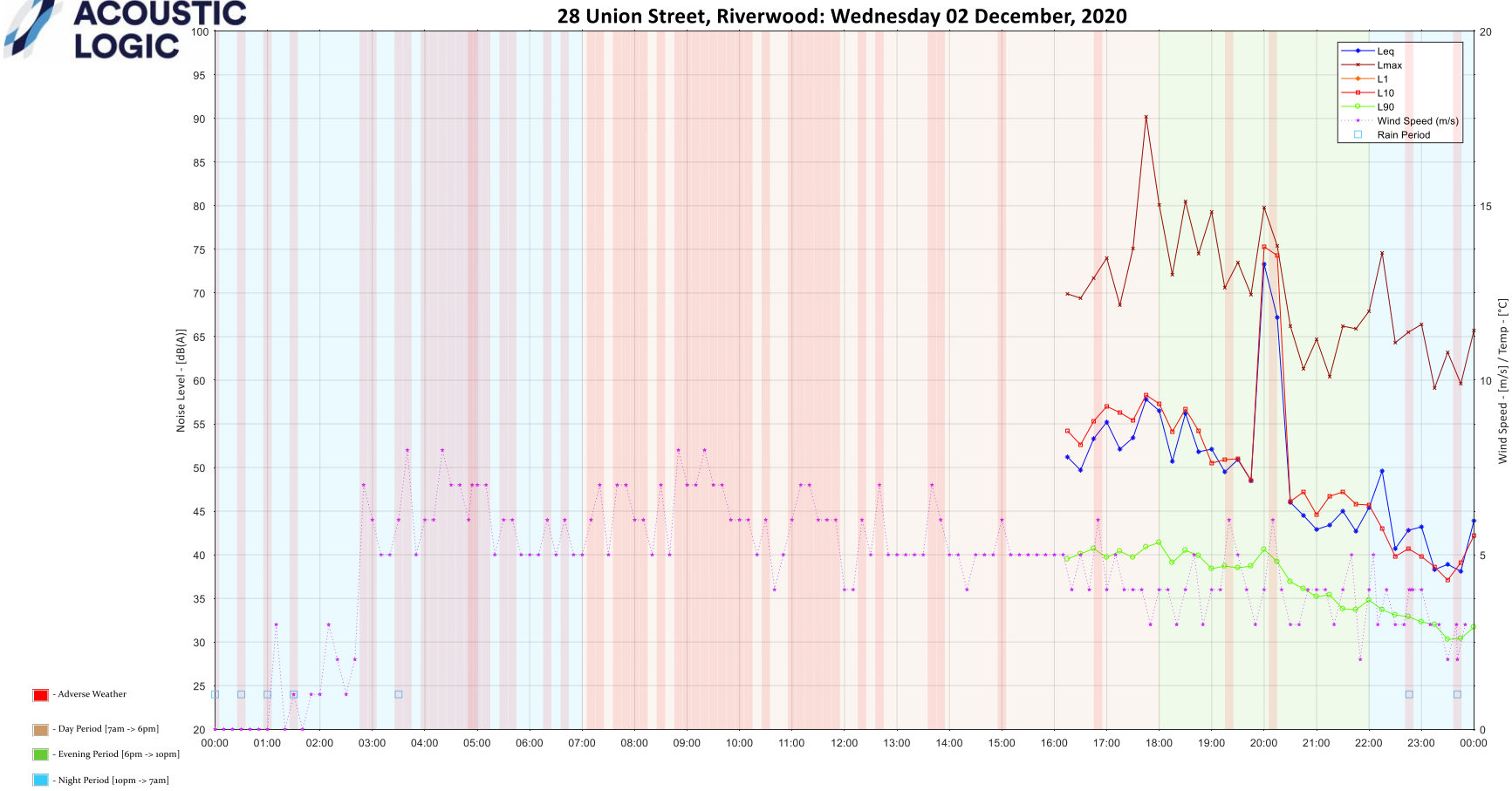
2 Truman Avenue, Riverwood: Tuesday 15 December, 2020

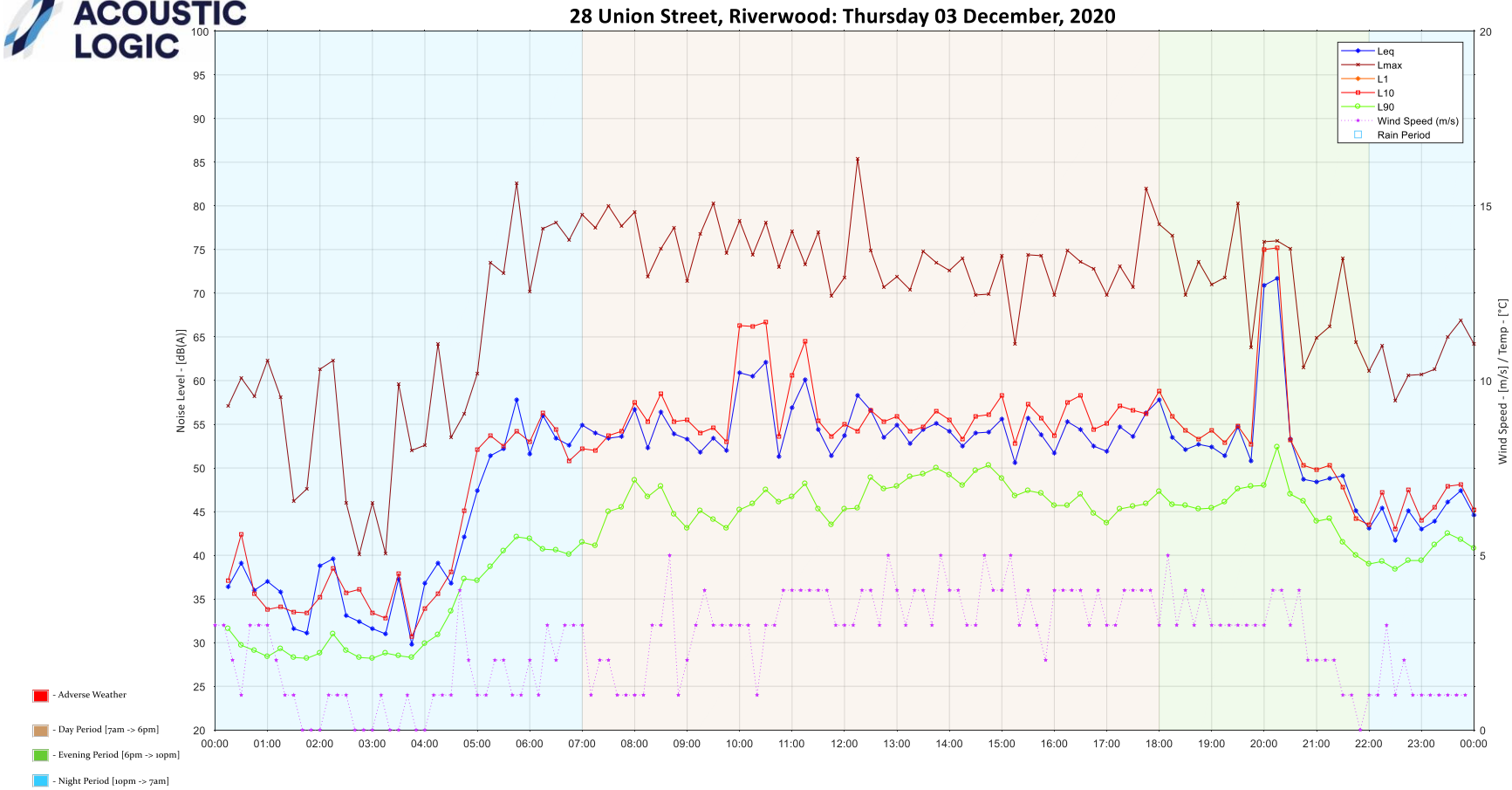


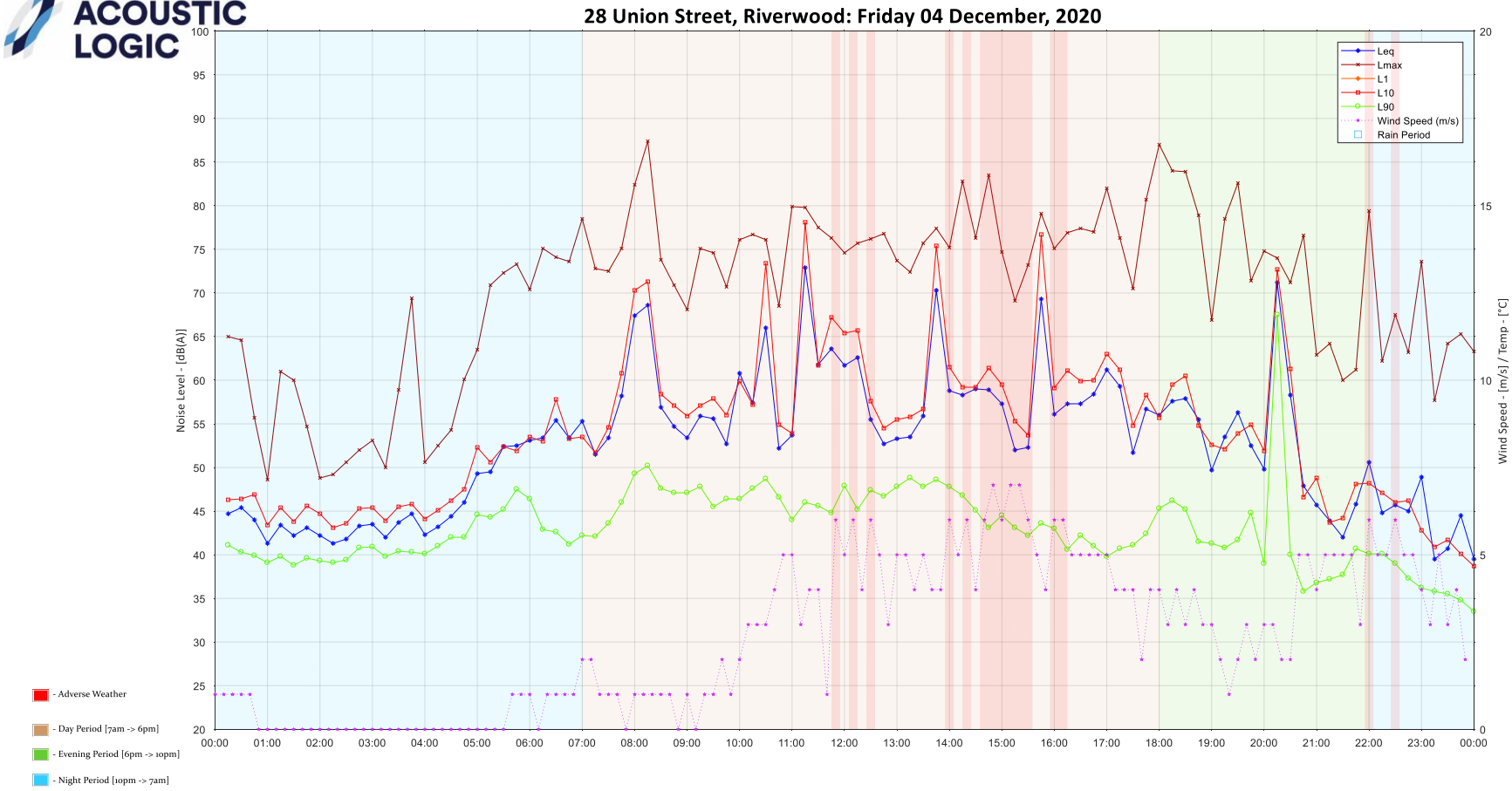
2 Truman Avenue, Riverwood: Wednesday 16 December, 2020

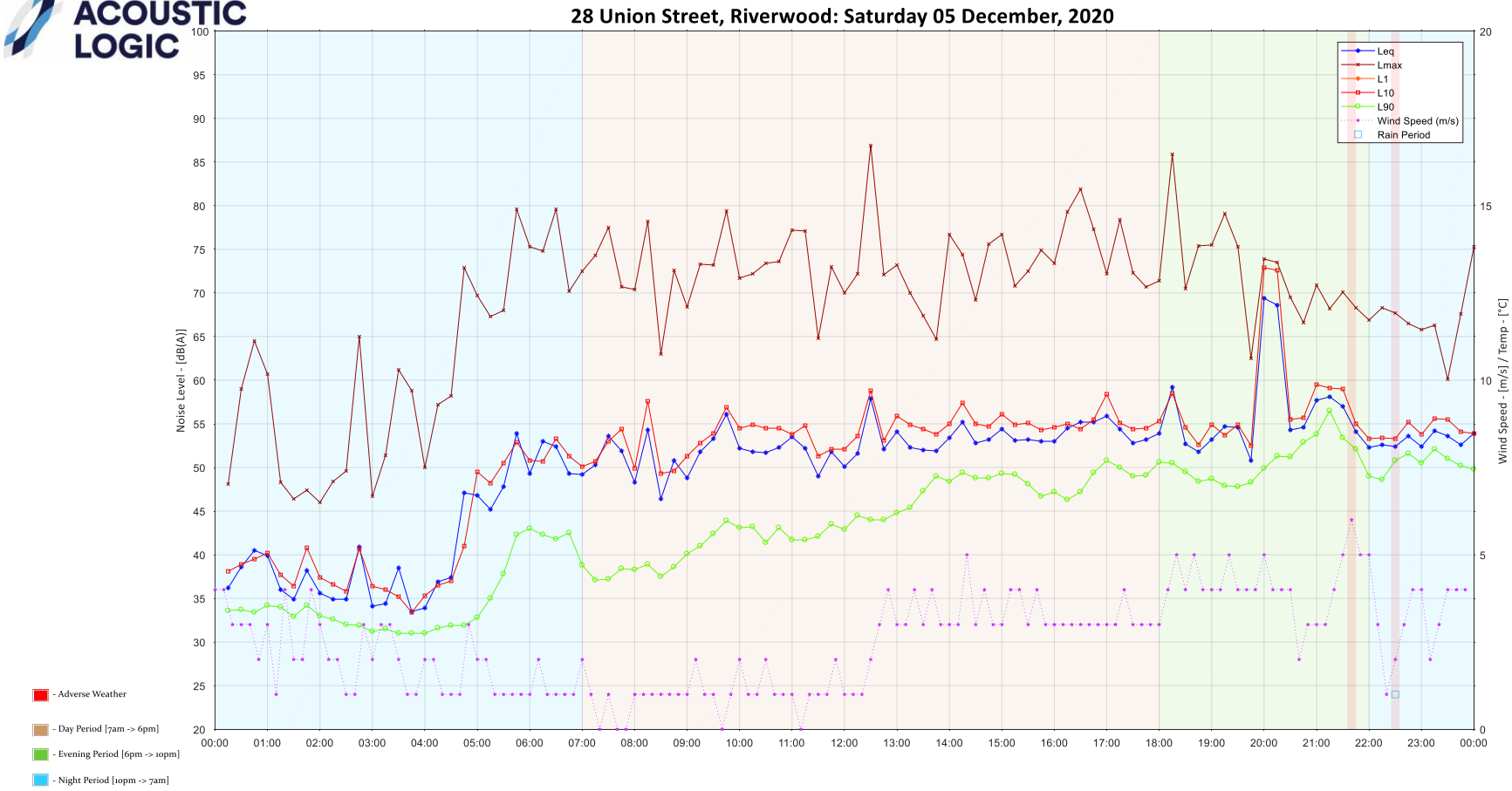


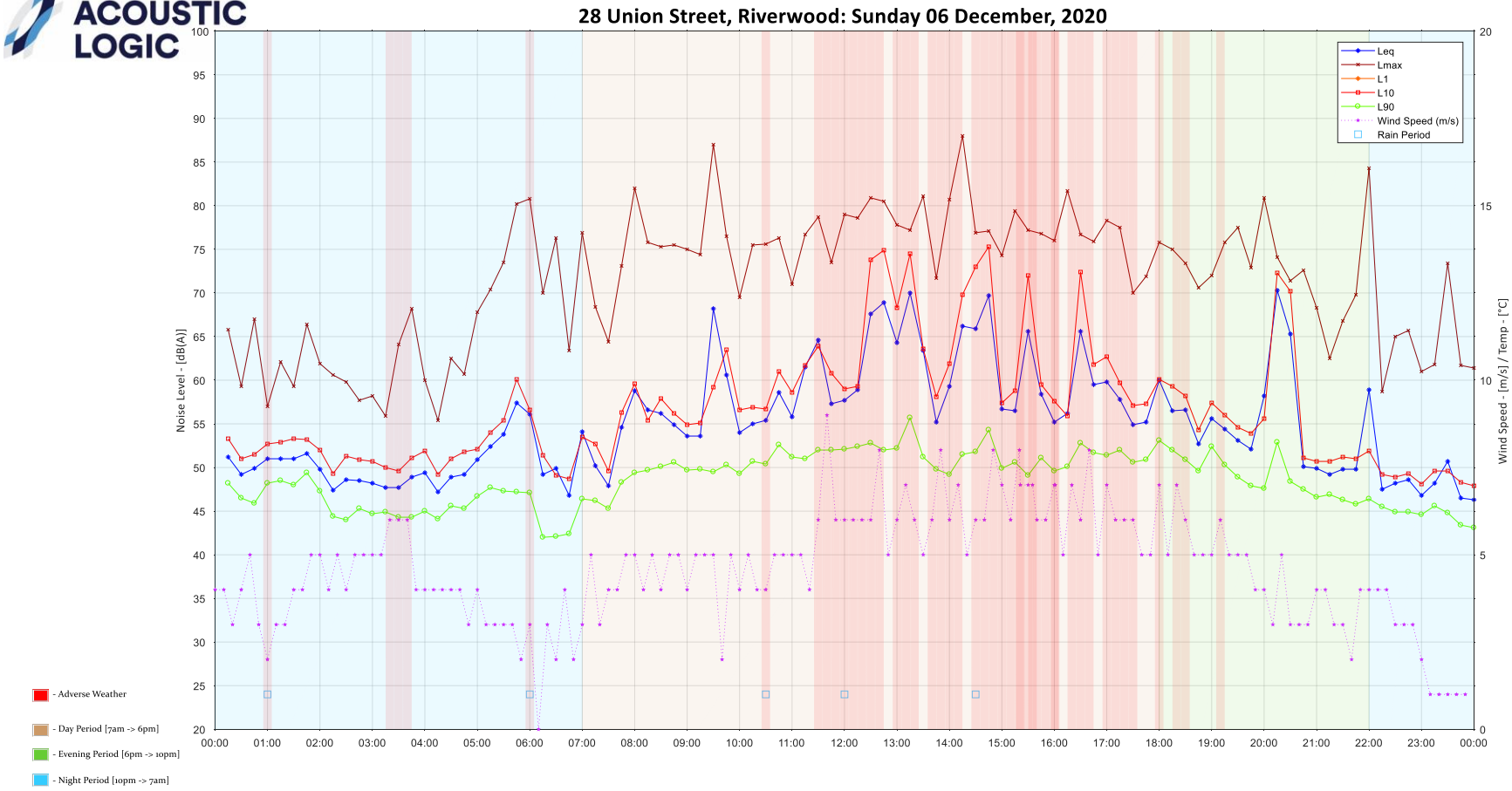
APPENDIX D – UNNATENDED NOISE MONITORING DATA – 28 UNION STREET

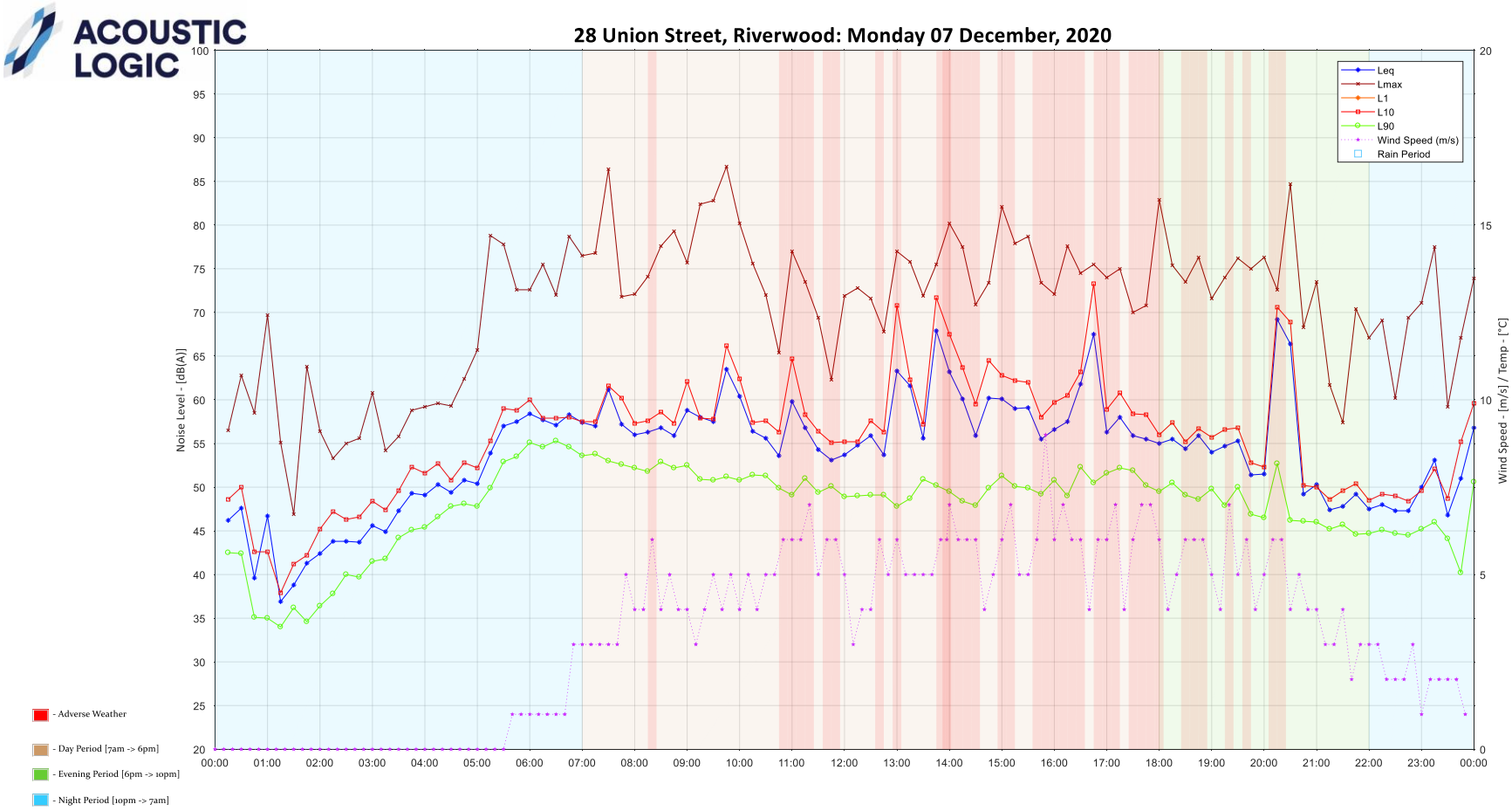

28 Union Street, Riverwood: Wednesday 02 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

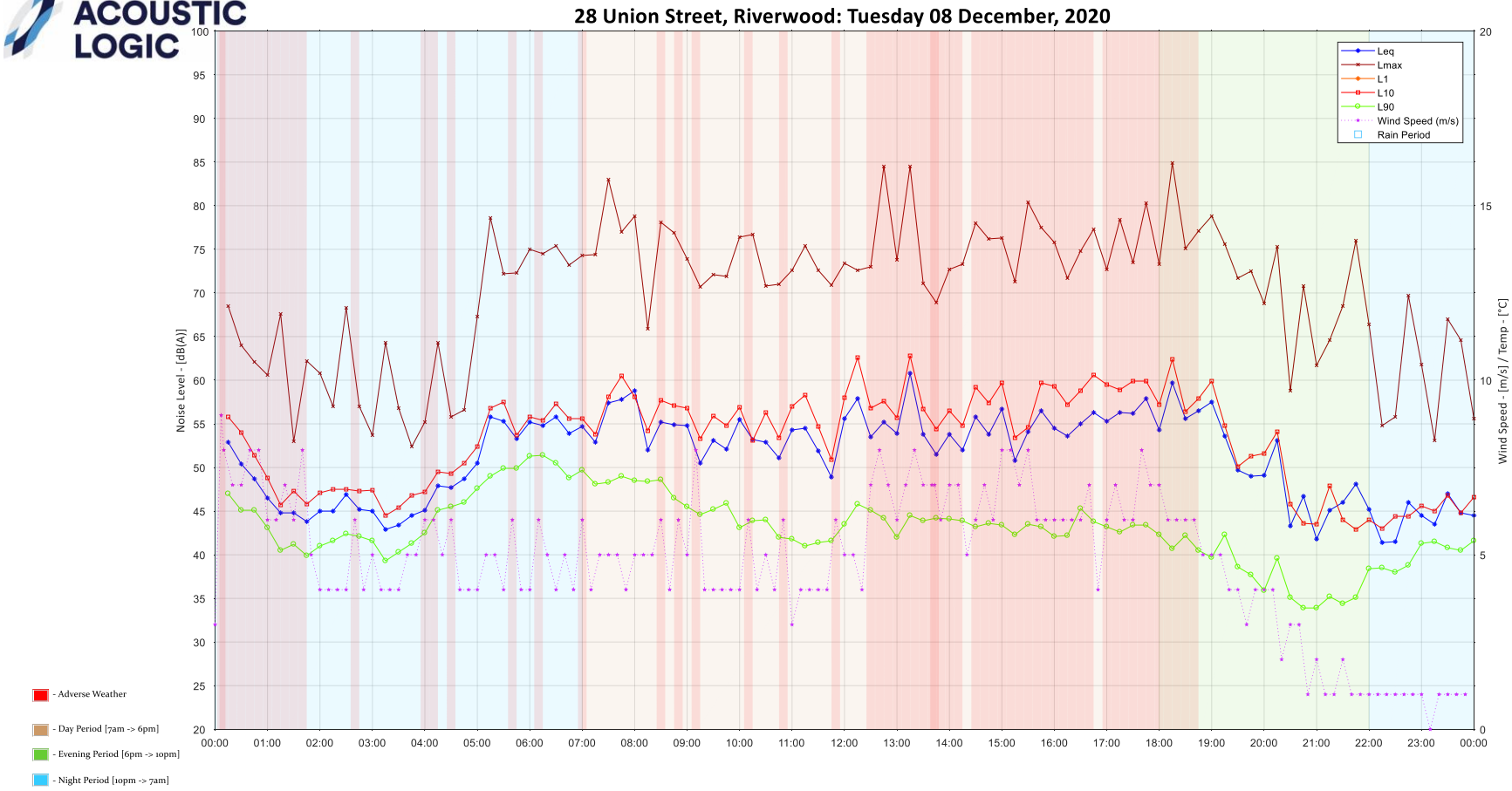

28 Union Street, Riverwood: Thursday 03 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

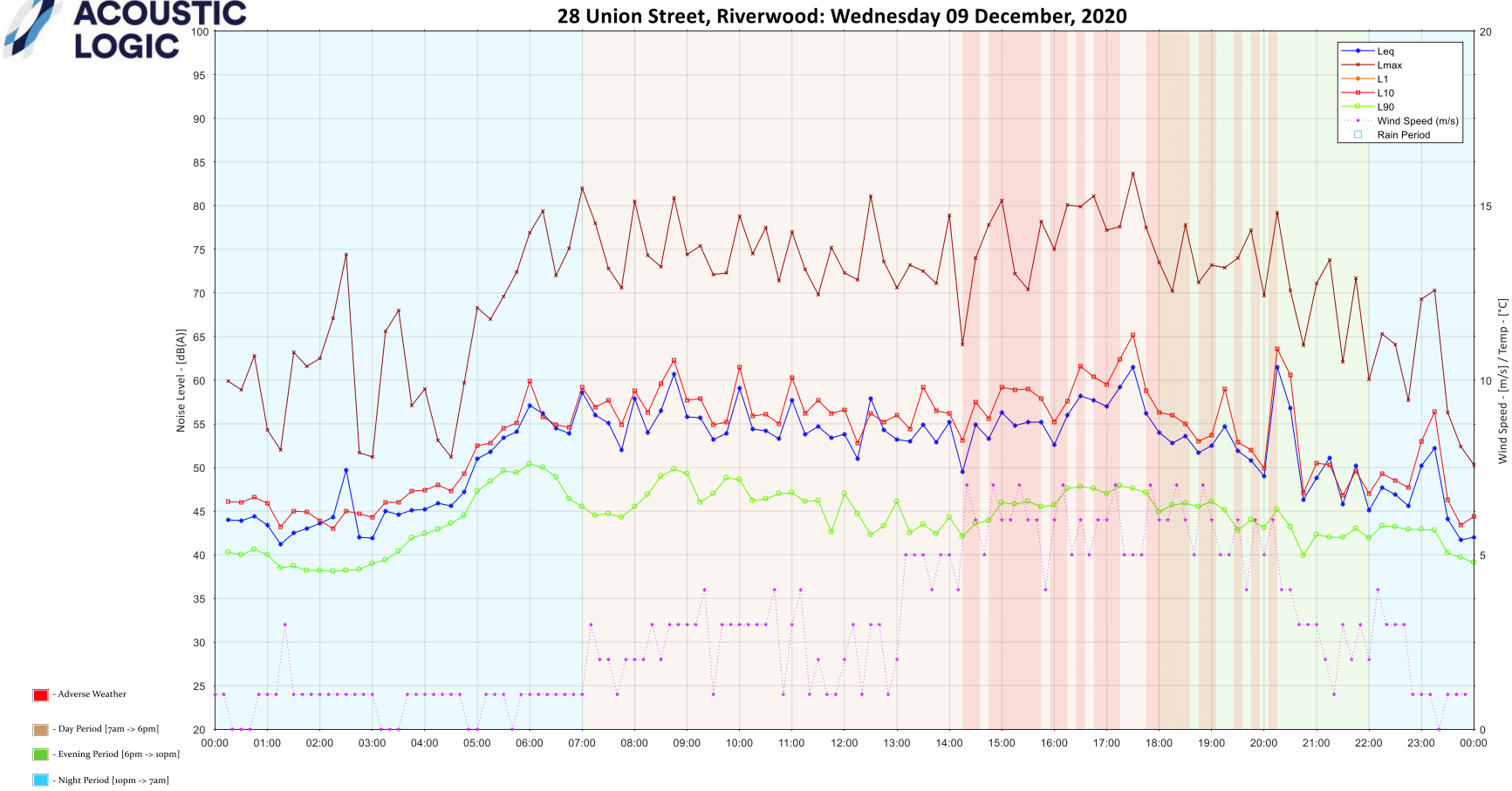

28 Union Street, Riverwood: Friday 04 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

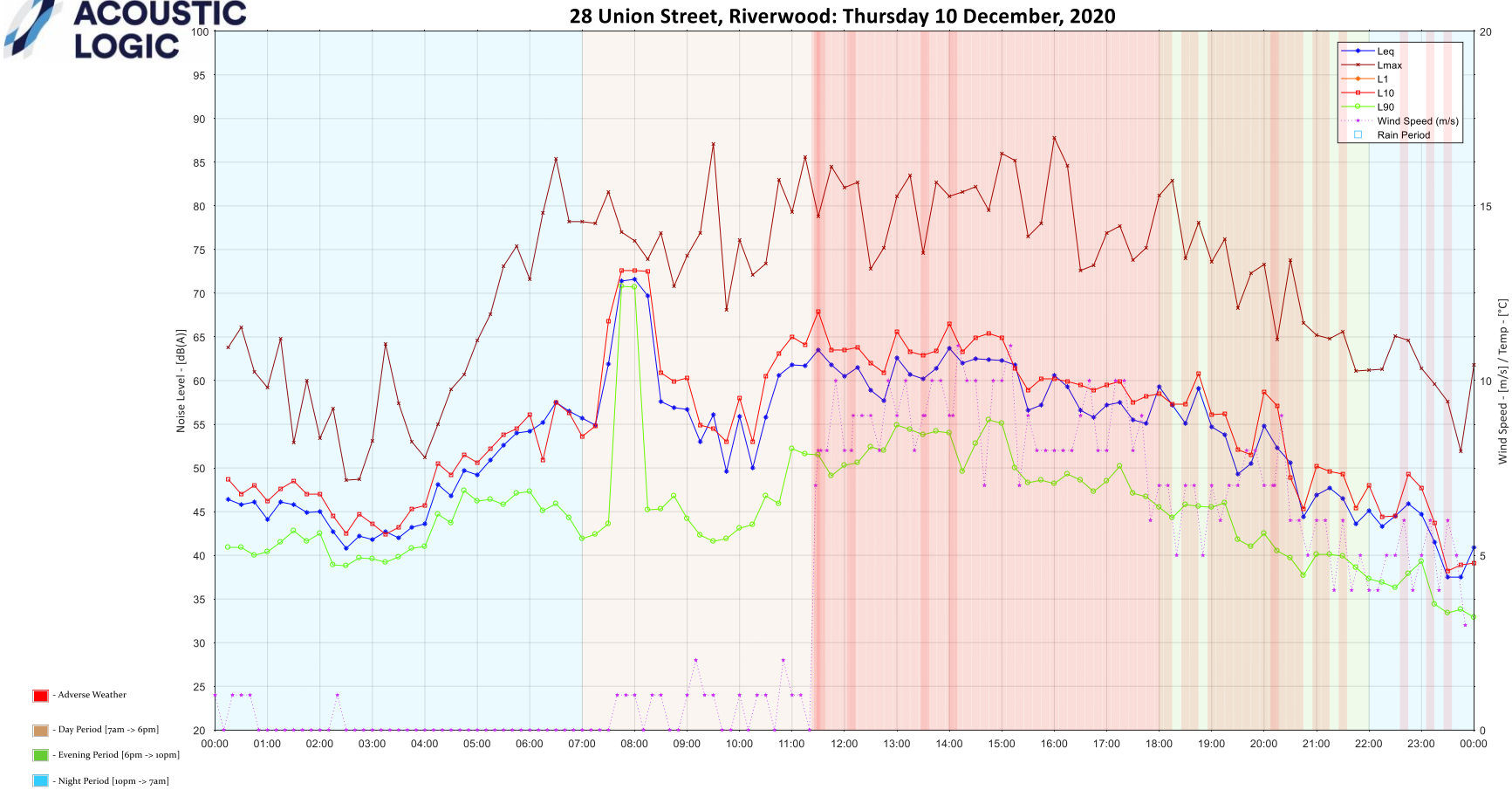

28 Union Street, Riverwood: Saturday 05 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

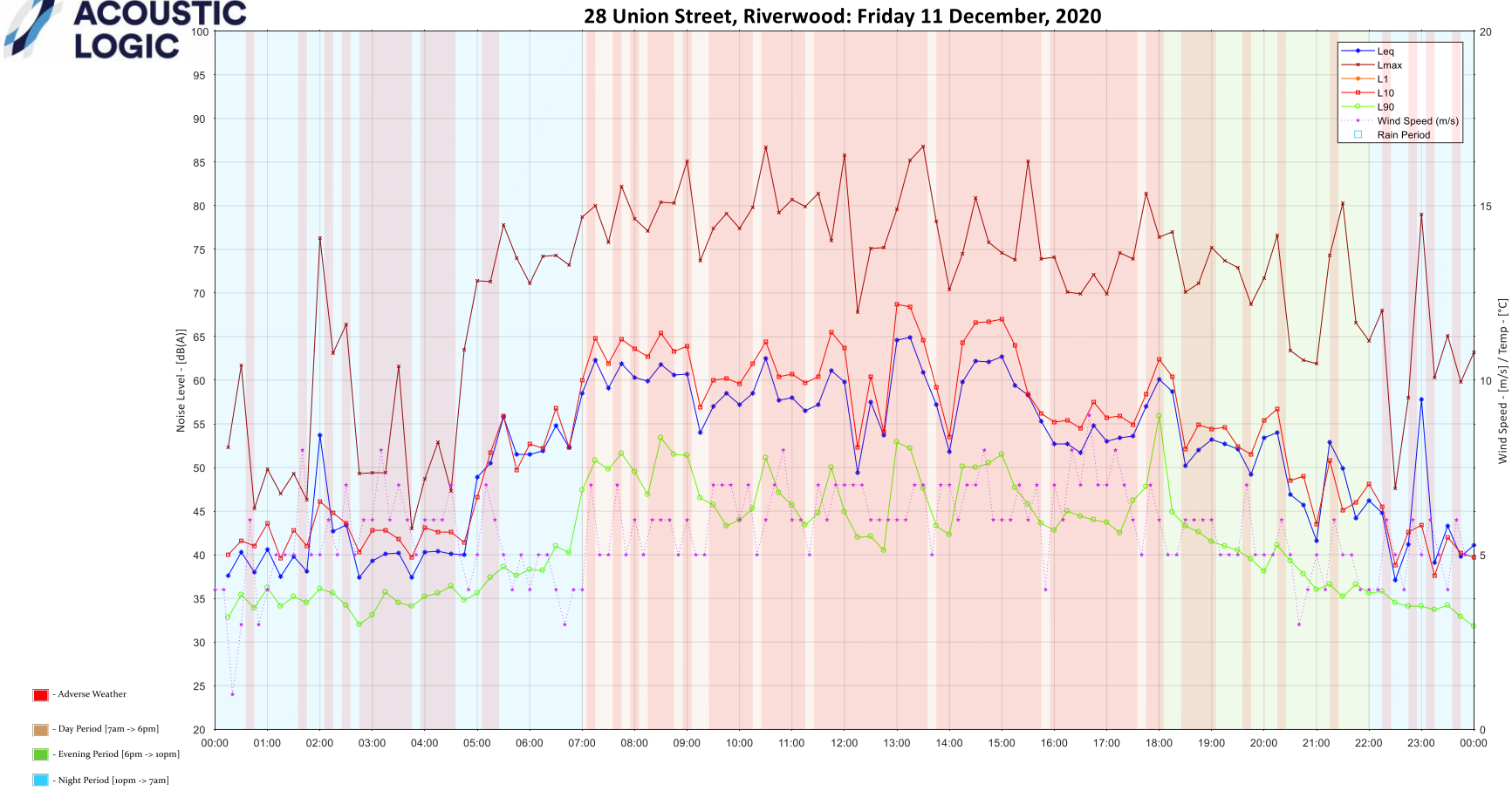

28 Union Street, Riverwood: Sunday 06 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

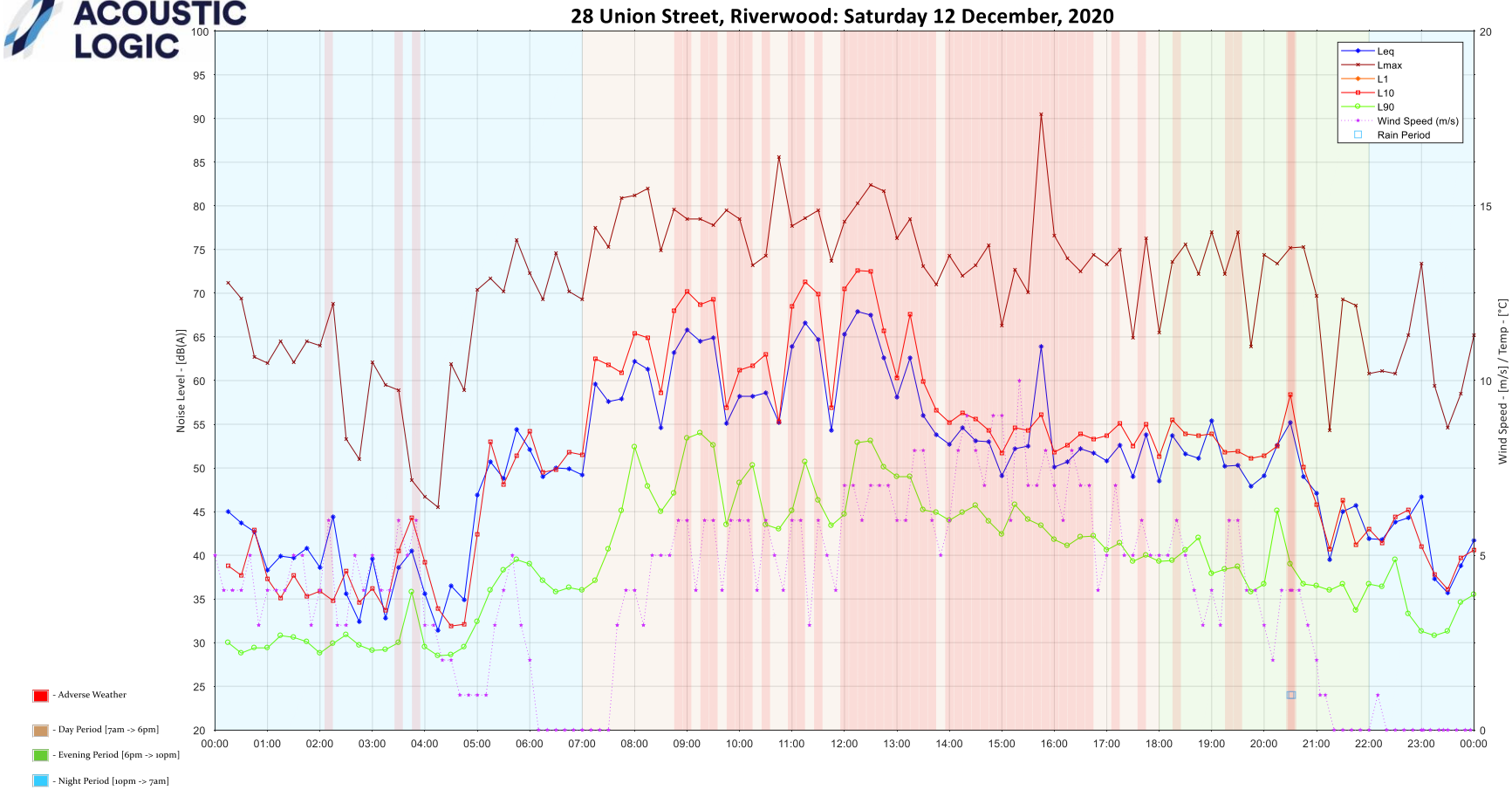

28 Union Street, Riverwood: Monday 07 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

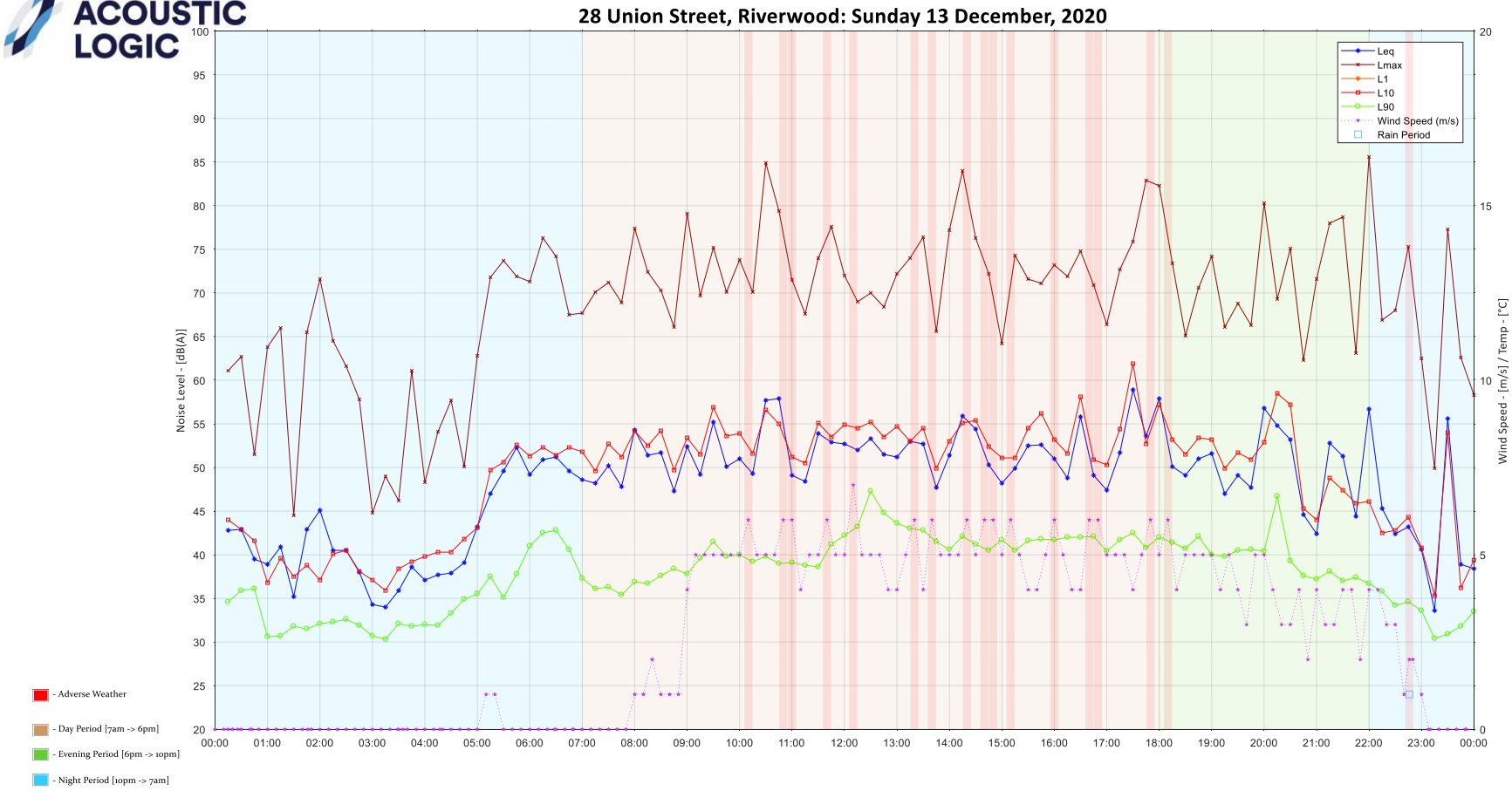

28 Union Street, Riverwood: Tuesday 08 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

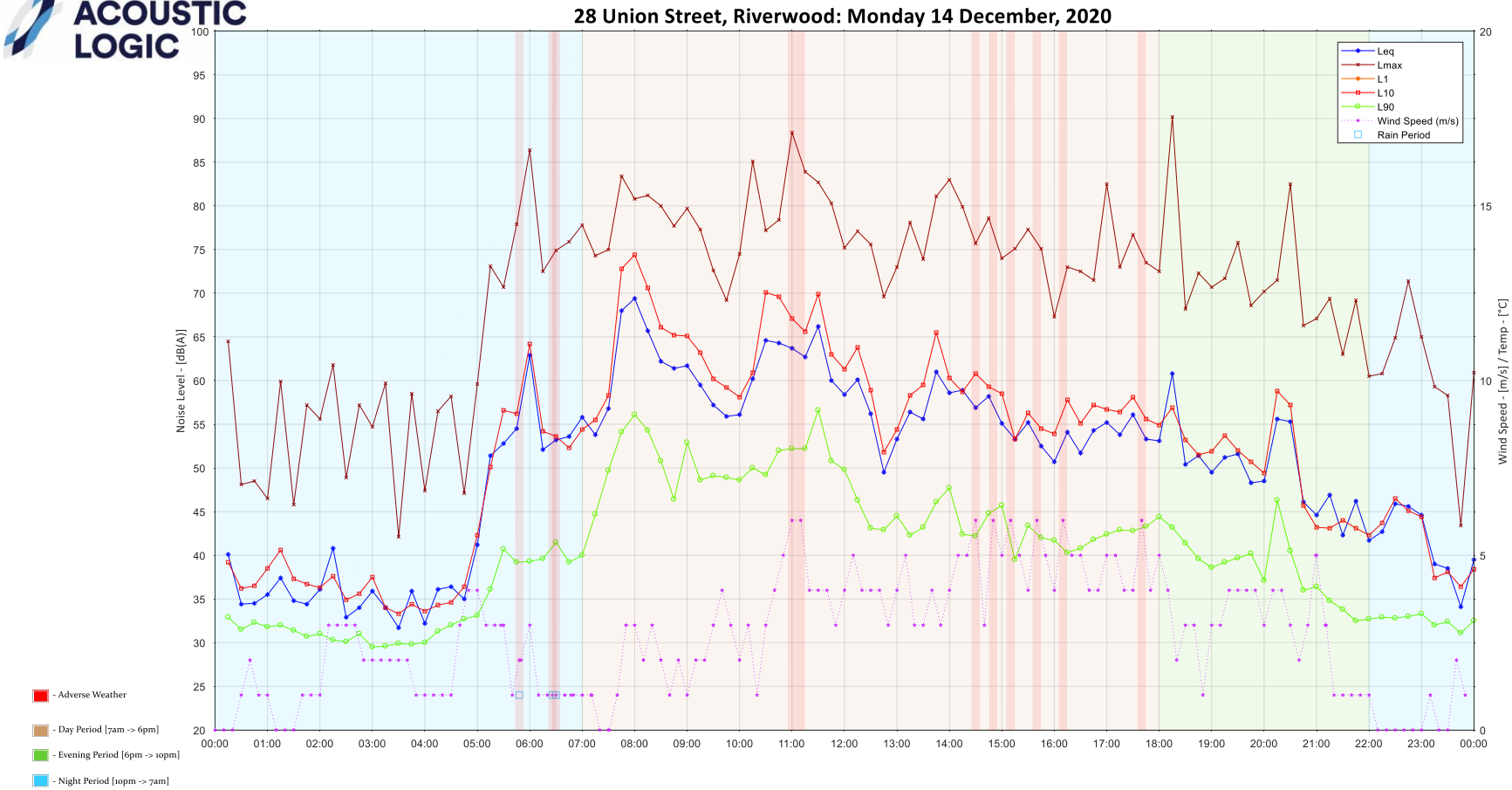

28 Union Street, Riverwood: Wednesday 09 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

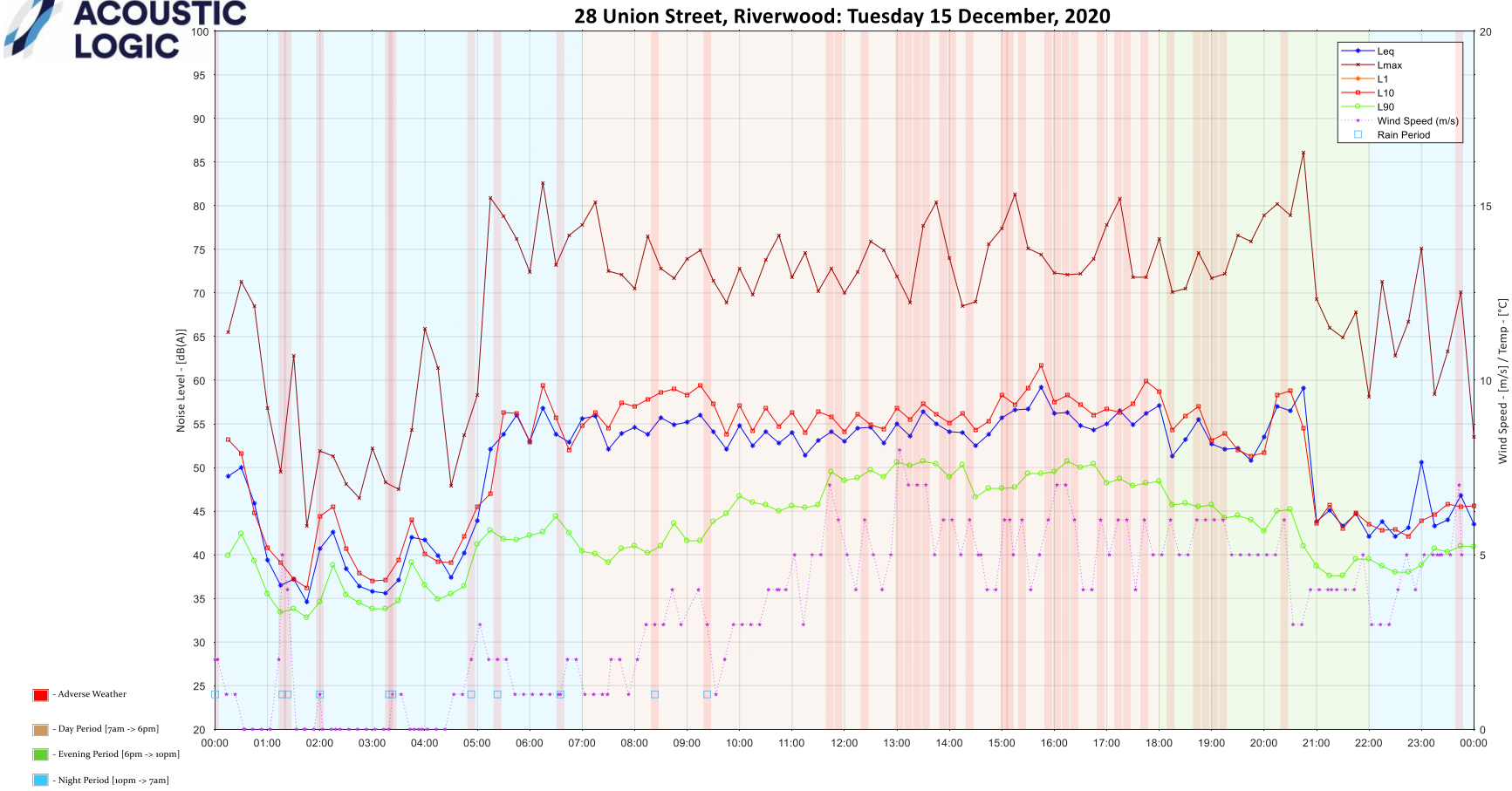

28 Union Street, Riverwood: Thursday 10 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

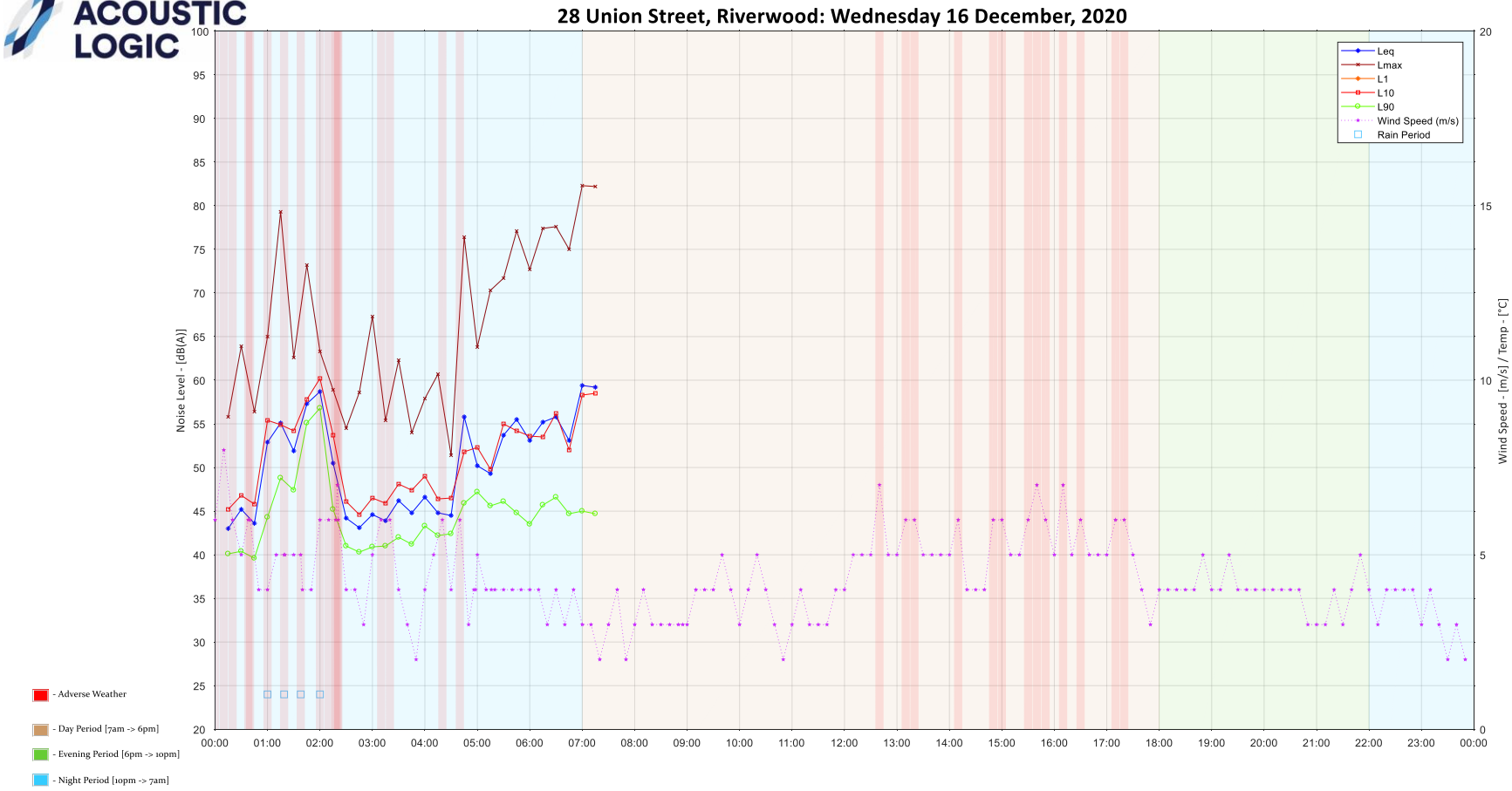

28 Union Street, Riverwood: Friday 11 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


28 Union Street, Riverwood: Saturday 12 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


28 Union Street, Riverwood: Sunday 13 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


28 Union Street, Riverwood: Monday 14 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


28 Union Street, Riverwood: Tuesday 15 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


28 Union Street, Riverwood: Wednesday 16 December, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]