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Greenwich Hospital Redevelopment

Concept Development Application- Acoustic Assessment

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TABLE OF CONTENTS

1 INTRODUCTION

Acoustic Logic Consultancy (ALC) has been engaged by HammondCare to undertake an assessment of potential noise and vibration impacts associated with the proposed Greenwich Hospital Redevelopment at 97-115 River Rd, Greenwich.

This report will:

- Address relevant local council, State and Australian Standard noise and vibration criteria, applicable to the subject proposal.
- Conduct an external noise (traffic) impact assessment and recommend acoustic treatments to ensure that a reasonable level of amenity is achieved for future tenants.
- Identify potential noise generating sources associated with the subject proposal and determine relevant noise emission goals, ensuring that nearby developments are not adversely impacted by the subject proposal. Conduct a preliminary assessment of operational noise emissions.
- Identify nearby noise and vibration sensitive receivers and conduct a preliminary assessment of potential noise and vibration impacts resulting from the proposed construction methodology.

Noise impacts will be addressed in accordance with the following standards and guidelines;

- Lance Cove Council Development Control Plan (DCP) 2010.
- Australian and New Zealand Standard AS/NZS 2107:2016 *"Acoustics - Recommended design sound levels and reverberation times for building interiors"*.
- NSW Environmental Protection Authority (EPA) *Noise Policy for Industry (NPfI) 2017.*
- NSW EPA *Road Noise Policy*.
- NSW EPA *Interim Construction Noise Guideline (ICNG)*.
- Australian Standard 2436-1981 *"Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites".*

This report is based on the following architectural drawings provided by Bickerton Masters Architecture;

Table 1 – Architectural Drawings (Project 1213)

Drawing Number	Revision	Date
S.01	A	March 2018
S.02	A	
S.03	A	
S.04	A	
S.H01	A	
S.H02	A	
S.H03	A	
S.H04	A	
S.H05	A	
S.H06	A	
SL.01	A	
SL.02	A	
SL.03	A	

2 SITE DESCRIPTION AND PROPOSED WORKS

It is proposed to demolish part of the Greenwich Hospital. The upgrade works will include:

- 150 place Hospital Health Care Facility with a mix of inpatient hospital beds, palliative care beds and aged care beds ;
- Inpatient and outpatient support services and areas necessary to provide a modern, attractive health facility consistent with Hammond Care's high standard of care;
- 80 new seniors housing (apartments) addressing River Road;
- 9 new seniors housing (villas) addressing St Vincents Road;
- Pallister House will be retained and continue to fulfil its present functions; and
- Car parking generally in accordance with code requirements.

Access to the site will be via two driveways on River Road and one driveway on St Vincents Road.

The site is surrounded by residential properties. The surrounding nearest affected receivers are as follows;

- Residential properties along the western boundary of the site – 117, 117A & 117B River Road, Greenwich.
- Residential properties to the north of the site, across River Road – 102 to 120 River Road, Greenwich.
- Residential properties to the east of the site, across St Vincents Road – 10 to 20 St Vincents Road, Greenwich.
- Residential properties along the southern boundary of the site – 24 to 55 Gore Street, Greenwich.

Figures 1 and 2 below illustrates locations of unattended noise monitors, attended noise measurements, development site and surrounding sensitive land uses.

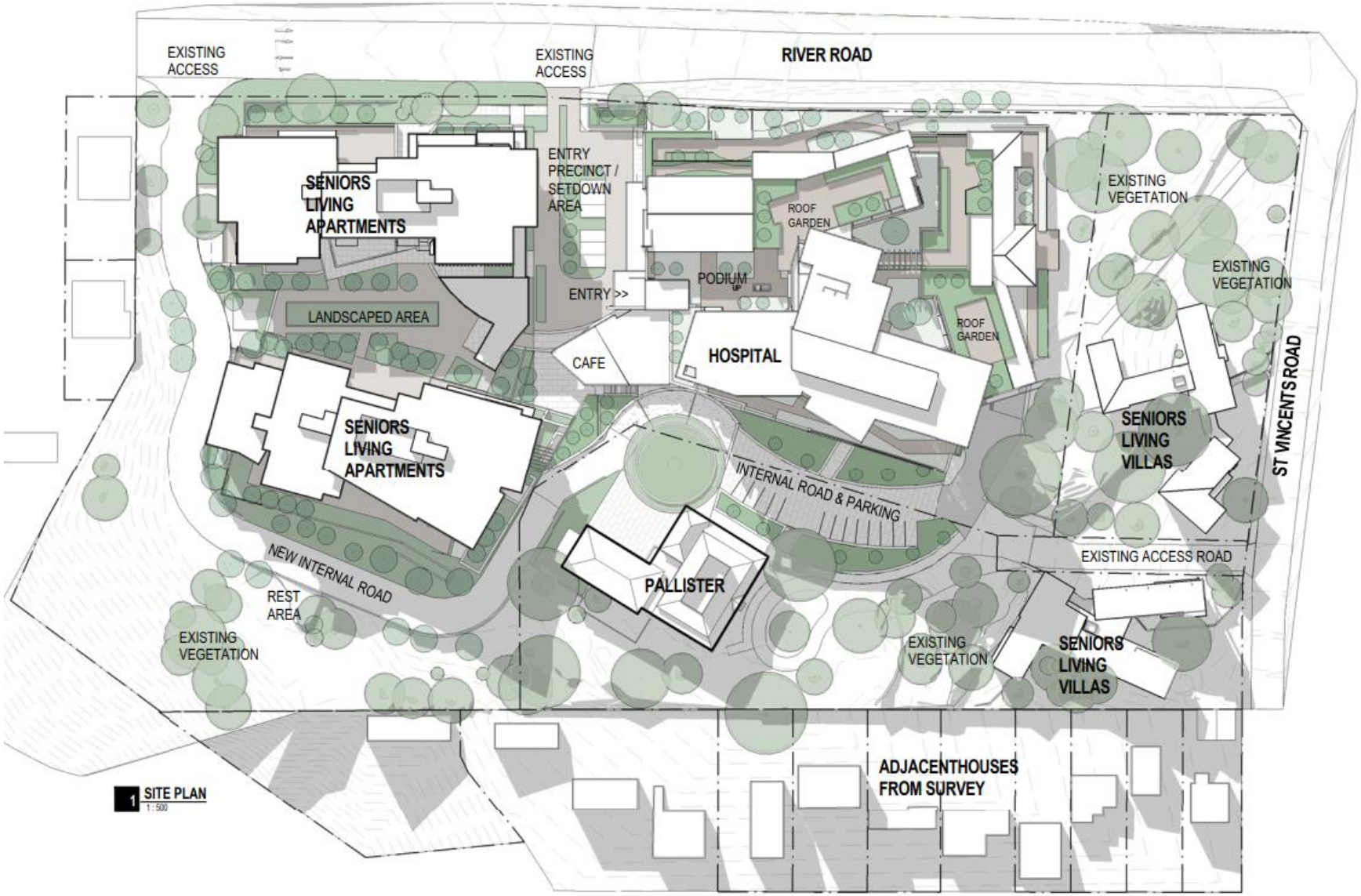


Figure 1 – Proposed Site Plan

Figure 2 – Site Description (source: Google Maps)

Subject Site
Pallister House
Unattended noise measurement location
Attended noise measurement locations

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 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_{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.

L_{Max} levels represent is the loudest noise event during a measurement period.

4 EXISTING ACOUSTIC ENVIRONMENT

Unattended long-term monitoring and attended short term measurements were conducted within and around the hospital precinct, to quantify the existing acoustic environment.

ALC confirm that all monitoring/measurement procedures, measured noise levels and calculated rating background (RBL)/project amenity (ANL)/project intrusiveness levels, were conducted in accordance with the requirements of the NSW EPA Noise Policy for Industry and Australian Standard 1055.2 "*Acoustics – Description and measurement of environmental noise".*

4.1 UNATTENDED NOISE MONITORING

Unattended noise monitoring was conducted between 30th July to 7th August 2018, using two Acoustic Research Laboratories noise monitors. The monitors were set to an A-weighted fast response mode, recording continuously at 15-minute intervals. Both monitors were calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted. In addition, calibration certificates are provided in Appendix 3 – Calibration certificates.

Monitoring was conducted as follows;

- **Monitor 1** – Installed at the southern edge of the site, adjacent Gore Street residential property boundary. Noise levels measured by this logger are representative of ambient noise levels at the residential receivers to the south of the site, away from River Road. Refer to Appendix 1 for logging data.

- **Monitor 2** – Installed along the western boundary of the site, adjacent 117, 117A & 117B River Road, Greenwich residences. Noise levels measured by this logger are representative of ambient noise levels at the residential receivers located near the west of the site and along River Road. Refer to Appendix 2 for logging data.

4.1.1 Monitoring Results

Measured noise levels are detailed below. Daily background noise levels from the two locations are shown in Appendix 4.

Table 2 – Measured Noise Levels

Monitor	Measured Rating Background Noise Level dB(A)$L_{90(period)}$			Measured Ambient Noise Level dB(A)$L_{eq(period)}$	
	Daytime (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)	Daytime (7am-10pm)	Night (10pm-7am)
Monitor 1 – Rear of the site (southern boundary)	44	40	35	50	45
Monitor 2 – 30m from River Rd (North-western boundary)	48	43	36	58	52

4.1.2 Meteorological conditions during Monitoring Period

Section A4 of the NSW EPA NPfI outlines the following with regards to meteorological impacts on noise monitoring:

"Noise monitoring should not be conducted (or the data should be excluded) when average wind speeds (over 15-minute periods or shorter) at microphone height are greater than 5 m/s, or when rainfall occurs."

However, the same section of this policy also outlines that;

"Exceptions to this rule are allowed, provided the proponent is able to show that the wind-induced noise on the microphone, and sound levels due to rain, are at least 10 dB below the noise levels (that is, background and/or ambient) under investigation."

Weather conditions during the monitoring period have been assessed and the periods of inclement weather are highlighted in the logging data in Appendices 1.

- Rain was recorded only once during the monitoring period, on 6th August between 10:30am and 11am. Noise levels measured during this interval for the two monitors, have been excluded.

- On review of the monitoring data, the measured L_{eq} and L_{90} noise levels during periods of high wind generally do not increase when compared to the L_{eq} and L_{90} noise levels measured during periods with little to no wind. This demonstrates that even though wind speeds measured at Observatory Hill exceed EPA guidelines, either:

    - The wind speed on site was significantly lower than at Observatory Hill, as the noise monitors are shielded by surrounding existing multi-storey properties in comparison to the weather station at Observatory Hill, which is on undeveloped land (adjacent to runways). and/or

    - The wind on site was not sufficiently consistent to increase background noise levels compared to calm periods.

Nevertheless, periods where adverse weather may have affected the noise monitoring data, these have been excluded from our assessment in determining the rating background noise levels.

4.2 ATTENDED NOISE MEASUREMENTS

Additionally, attended noise measurements were also conducted by this office, to supplement the unattended monitoring data. Noise measurements were conducted at 6 representative locations around the site, as illustrated in Figure 1. These measurements were conducted on the 7th August 2018, between 11:00pm and 12:00pm.

All attended measurements were conducted using a Norsonic type 140 Precision Sound Analyser. The analyser was set to measure in a fast response mode and calibrated before and after the measurements using a Norsonic Sound Calibrator type 1251. No significant drift was noted.

Measured levels and description of the acoustic environment is detailed below;

Table 3 – Attended Noise Measurements

Measurement Location (see figure 1)	**Time of Day**	**Measured Noise Level**		**Description**
		Average/Traffic $L_{eq(1hr)}$	**Background $L_{eq(15min)}$**	
AM 1	Tuesday 07th August 2018 between 11:00am – 12:00pm	64dB(A)$L_{eq(1hr)}$	55dB(A)$L_{90(15mins)}$	Measured noise level primarily impacted by traffic noise along River Road.
AM2		56dB(A) $L_{eq(1hr)}$	50dB(A)$L_{90(15mins)}$	Measured noise level impacted by distant traffic noise and on-site vehicle movements. Mechanical noise the existing hospital audible during the measurement.
AM3		59dB(A) $L_{eq(1hr)}$	46dB(A)$L_{90(15mins)}$	Measured noise level primarily impacted by traffic noise along St Vincent's Road including cars entering / exiting hospital car park.

5 EXTERNAL NOISE IMPACT ASSESSMENT

Traffic noise from vehicle movements along River Road and St Vincents Road will be the primary environmental noise sources with the potential to impact on the amenity of future residents.

5.1 TRAFFIC NOISE IMPACTS - ASSESSMENT CRITERIA

5.1.1 Lane Cove Council DCP

Lane Cove Council DCP states the following with respect to noise intrusion:

> *h) Internal habitable rooms of dwellings affected by high levels of external noise are to be designed to achieve internal noise levels of no greater than 50dBA.*

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

AS2107-2016 *"Acoustics – Recommended design sound levels and reverberation times for building interiors"* recommends internal design criteria for occupiable spaces of difference types of development. The design noise levels are determined based on the occupancy type, function/activity of the space within the occupancy and proximity to environmental noise sources.

For residential buildings, the recommended internal design sound levels are based on the location of the proposed development to transportation. This is divided into three categories;

- Houses and apartments in inner city areas of entertainment districts or near major roads.
- Houses and apartments in suburban areas or near minor roads.
- Houses in rural areas with negligible transportation.

Internal design noise level criteria applicable for the subject development is detailed below;

Table 4 – AS2107:2016 Recommended Internal Design Noise Levels

Type of Occupancy	Space	Time	Internal Traffic Noise Criteria
Houses and apartments in suburban areas or near minor roads	Sleeping Areas (Bedroom)	Night-time (10pm – 7am)	35 dB(A)$L_{eq\ (1\ hour)}$ –
	Living or any other Habitable Areas	24 hours a day	40 dB(A)$L_{eq\ (15\ hour)}$
Hospital	Meeting rooms, interview rooms, enclosed offices	When in use	40 dB(A) $L_{eq\ (1\ hour)}$
	General offices	When in use	45
	Patient Bays	24 hours a day	40
	Toilets	24 hours a day	55
	Admin\Reception areas	24 hours a day	50
	Corridors, lobbies, and waiting areas	24 hours a day	50

5.2 RECOMMENDED TREATMENTS

Based on the measured traffic noise levels on site, ALC confirm that compliance with the recommended maximum internal noise level criteria detailed in Table 3 above can be achieved, with the following minimum treatments;

- Single glazing to all façade glazed elements. Glazing will vary from Rw / STC 27 to 35 acoustic performance, depending on size and location. All glazed elements have generally been assumed as fixed and will need to be installed with full perimeter rubber acoustic seals.
- Light-weight façade elements – Standard constructions which will include steel studs, top hats, acoustic insulation and plasterboard or Fibre Cement (FC) sheet linings.
- Proposed masonry external wall construction is acoustically acceptable and will not require any additional treatments.
- Proposed concrete slab roof is acoustically acceptable and will not require any additional treatments. All opening or penetrations in ceilings must be acoustically sealed.

5.3 VENTIALTION REQUIREMENTS

5.3.1 Seniors Independent Living Apartments

To comply with AS2107 acoustic requirements, external windows and doors for rooms of the Seniors Independent Living Apartments located to the northwest of the site facing River Road (northern façade) must be closed. An alternate outside air source may be required in accordance with AS 1668.2.

Any mechanical ventilation system that is installed should be acoustically designed such that the acoustic performance of the recommended constructions is not reduced by any duct or pipe penetrating the wall/ceiling/roof. Noise emitted to the property boundaries by any ventilation system shall comply with Council requirements.

5.3.2 Hospital

Similarly, spaces within the hospital on the River Road façade may require alternative outside air sources. Ventilation requirements for the hospital components will require to be investigated when architectural design is finalised.

6 NOISE EMISSION ASSESSMENT

The following have been identified as the primary operational noise emission sources associated with the proposed development;

- Noise impacts from any external mechanical plant and equipment associated with the subject proposal.
- Noise impacts from additional traffic generated by the proposed redevelopment.

6.1 ASSESSMENT CRITERIA

6.1.1 NSW EPA Noise Policy for Industry (2017)

Noise sources covered by this code will include vehicle noise (generated on the site) and mechanical services noise. Both the Intrusiveness and the Project Amenity criteria (as set out below) must be complied with.

6.1.1.1 NSW EPA NPfI - Intrusiveness Noise Goals

Intrusiveness criteria permit noise generation to be no more than 5dB(A) above existing background noise levels. The criteria are as follows:

Table 5 – EPA Intrusiveness Criteria

Location	Time of Day	Measured Rating Background Noise Levels dB(A)$L_{90(period)}$	Intrusiveness Noise Objective dB(A)$L_{eq(15min)}$ (Background + 5dB)
Residential Receivers to the north and northwest (River Rd)	Day Time (7am - 6pm)	48	53
	Evening (6pm - 10pm)	43	48
	Night (10pm - 7am)	36	41
Residential Receivers to the east (across St Vincents Rd)	Day Time (7am - 6pm)	44	49
	Evening (6pm - 10pm)	40	45
	Night (10pm - 7am)	35	40
Residential Receivers to the south	Day Time (7am - 6pm)	44	49
	Evening (6pm - 10pm)	40	45
	Night (10pm - 7am)	35	40

6.1.1.2 NSW EPA NPfI - Project Amenity Goals

Project amenity criteria are determined based on the land use in the area (residential/commercial/industrial). The residential land use is then further categorised into rural, sub-urban and urban areas. For the purpose of this assessment the existing residential dwellings will be considered suburban.

Table 6 – EPA Project Amenity Criteria

Noise Receiver	Project Amenity Noise Level – dB(A)$L_{Aeq(15min)}$		
	Daytime	Evening	Night
Existing Residential (Suburban)	53	43	38

6.1.2 NSW EPA Road Noise Policy

For land use developments with the potential to create additional traffic on public streets the development should comply with the requirements of the 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 – Criteria for Traffic Noise Generated by New Developments

Road Type	Time of day	Permissible Noise Generation
Local Roads (including St Vincents Road)	Day (7am to 10pm)	55 dB(A)$L_{eq(1hr)}$
	Night (10pm to 7am)	50 dB(A)$L_{eq(1hr)}$
Sub-arterial Roads (including River Road)	Day (7am to 10pm)	60 dB(A)$L_{eq(15\ hour)}$
	Night (10pm to 7am)	55 dB(A)$L_{eq(9\ hour)}$

In addition to the assessment criteria above, the RNP in section 2.4 outlines that any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development must also be considered. Any existing residences experiencing increases in total traffic noise level above the relative increase criteria detailed below, should also be considered for mitigation as described in Section 3.4 of the Policy.

Table 8 – Relevant Increase Criteria for Residential Land Uses

Road Type	Type of project/development	Permissible Noise Generation	
		Daytime (7am – 10pm)	Night (10pm – 7am)
Freeway/arterial/sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing traffic LAeq, (15 hour) + 12 dB (external)	Existing traffic LAeq, (9 hour) + 12 dB (external)

As the table above does not specify a relative increase limit for local roads, pursuant to section 3.4, if existing noise levels exceed the noise assessment criteria (Table 7), noise impacts must 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.

6.1.3 Sleep Arousal Assessment

Potential sleep arousal impacts should be considered for noise generated after 10pm. Sleep arousal is a function of both the noise level and the duration of the noise.

As recommended in the NPfI, to assess potential sleep arousal impacts, a two-stage test is carried out:

- Step 1 – Section 2.5 *Maximum noise level event assessment* from the NPfI states the following:

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

  - $L_{Aeq,15min}$ *45dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
  - L_{AFmax} *55 dB(A) or the prevailing RBL plus 15 dB, whichever is greater,*

  a detailed maximum noise level event assessment should be undertaken.

Based on the above the following noise objectives apply:

Table 9 – Sleep Arousal Trigger Levels (*Average*/L_{eq} Noise Levels)

Location	Rating Background Level dB(A)L_{90}	Rating Background Level + 5dB(A)	Governing Trigger Levels dB(A)$L_{eq(15mins)}$
Adjacent residences	41	46	46

Table 10 – Sleep Arousal Trigger Levels (*Maximum*/L_{Max} Noise Events)

Location	Rating Background Level dB(A)L_{90}	Rating Background Level + 15dB(A)	Governing Trigger Levels dB(A)$L_{(Max)}$
Adjacent residences	41	56	56

- Step 2 - If there are noise events that could exceed the average/maximum criteria detailed in the tables 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 test takes into account the noise level and number of occurrences of each event with the potential to create a noise disturbance. As is recommended in the explanatory notes of the EPA Industrial Noise Policy, this more detailed sleep arousal test is conducted using the guidelines in the EPA Road Noise Policy. Most relevantly, the Road Noise Policy states:

  For the research on sleep disturbance to date it can be concluded that:

  - *Maximum internal noise levels below 50-55dB(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.*

6.2 NOISE EMISSION ASSESSMENT

Operational noise sources with the potential to impact on the amenity of surrounding sensitive land users include;

- Traffic noise on new internal roads
- Noise created on public roads as a result of additional traffic generated by the subject proposal.
- Noise emissions from any external mechanical plant and equipment associated with the subject proposal.
- Sleep disturbance.

6.2.1 Noise from cars on internal roads (cars entering/leaving the site and circulating on the site)

Noise generated by vehicles manoeuvring on the site is assessed with reference to the EPA Noise Policy for Industry. Noise emission predictions are made based on the assumption that in any given 15-minute peak period:

- The most sensitive residential receivers will be the occupants of the 117, 117A and 117B River Road multi-storey properties facing the new internal road located along the western boundary of the site.
- We assume that, during a typical peak period, there can be up to 100 cars per hour (1 car movement for 2 proposed beds) using this internal road section (a conservatively high assumption).
- Cars have an assumed sound power of 90dB(A) per car when driving on the site (20-30km/h).

Operational noise levels are predicted at the nearest residences (117, 117A and 117B River Road):

Table 11 – Vehicle Noise Impact Assessment

Noise Source	Noise Receiver Location	Predicted Noise Level – dB(A)$L_{eq(15min)}$	Compliance
Vehicles manoeuvring, driving to/from site on western boundary internal road	117, 117A and 117B River Road	51dB(A)$L_{eq(15min)}$	Complies with daytime (7am – 10pm) project amenity and intrusiveness noise criteria detailed in Table 5 and Table 6

6.2.2 Noise Generated by Additional Traffic on Public Roads

Noise generated on public roads as a result of additional traffic associated with the subject modifications to the south site, must be assessed against the provisions of the NSW EPA Road Noise Policy.

Access/egress to the site will be via River Road and St Vincents Road. Predictions of noise generation are based on the following:

- An assumed sound power level of a car driving on a public road (approx. 60km/h) of 94dB(A).
- We assume that, during a typical peak period, there can be up to 100 cars per hour (1 car movement for 2 proposed beds) using River Road or St Vincents Road to enter or exit the site. In our opinion, this is a conservatively high assumption for a peak period.

Noise emissions are predicted at the buildings façades of the River Road and St Vincents Road residences to the east of the site and compared against the acoustic criteria set out in section 6.1.2.

Predicted noise levels are as follows:

Table 12 – Noise Generated by Additional Road Traffic – Noise Impact Assessment

Receiver Location	Predicted Noise Level – dB(A)L_{eq}	Compliance
River Road residences (buildings façades)	< 50dB(A)$L_{eq(1hr)}$ *	Complies with 60dB(A) daytime criteria and 55dB(A) night time criteria
St Vincents Road residences (buildings façades)	< 48dB(A)$L_{eq(1hr)}$	Complies with 55dB(A) daytime criteria and 50dB(A) night time criteria

*Note - This predicted noise level is conservative in that it is based on a worst one-hour peak. It traffic generation is averaged over the course of the day (as is consistent for EPA guidelines for developments on arterial roads), the predicted noise level will be approximately 2dB(A) lower than the level predicted above.

Noise as a result of additional traffic generation is compliant with the EPA Road Noise Policy.

6.2.3 Noise from External Mechanical Plant & Equipment

Detailed acoustic review of mechanical design and equipment selections cannot be undertaken at approval stage, as plant selections and locations are not finalised. However, an indicative assessment of typical noise mechanical plant items, are presented below.

Typical noisy plant items will include:

- Located in hospital building:
    - Cooling towers.
    - Fan Coil Units and fans.
    - Chillers.
    - Emergency Backup Power Diesel Generator
- Condensers (Seniors Living Apartments and Villas)

6.2.3.1 Hospital Building Plant/Centralised Plant

With respect to the above, we note:

- Cooling Towers:
    - In the event the selected cooling tower sound power level (SWL) exceeds 90dB(A) per unit, there is potential for exceedance of the NSW EPA amenity noise limits, given the proximity of the cooling towers from the surrounding residential properties.
    - To ensure compliance with EPA requirements typical treatments will include:
        - Cooling towers installed with variable speed drives, to allow for reduced fan speed during periods of low load. Typically, a fan speed of no more than 70% would be expected at night-time.
        - Acoustic attenuator behind the intake louvre or selection of acoustic louvres for enclosures/plantrooms. Alternatively, dedicated air intake and discharge attenuators may be required.
- Chillers (assumed sound power of 102dB(A)).
    - Chillers must be located in a plantroom. This plantroom must be of masonry construction and should not have any external ventilation opening/louvre.
    - If light-weight external wall and roof construction is proposed for the plantroom, these areas will potentially require lining of cladding element with FC or similar and internal multiple layer plasterboard sheeting to ensure noise breakout through wall/roof are compliant with INP requirements. The external and internal element may also be required to be separated by a large single stud (150mm) or double stud system with acoustic insulation.

- Typical vibration isolation would consist of 25mm static deflection springs sitting on a concrete plinth isolated from the structural slab using 20mm rubber acoustic underlay.

- Plant room (Fans and AHU's)
  - Case radiated noise from FCU's and fans located within the plantroom are typically quieter than other plant noise sources (compared to chillers, pumps, generators etc).
  - FCU's and fans will be acoustically reviewed when selections are confirmed to determine whether internal lining or attenuators are required to the supply/exhaust and intake/return air ductwork.
  - Major fans (typically with a sound power over 90(A) – such as carpark exhaust and supply fans, garbage room exhaust fans etc.) will require acoustic treatment if located externally. This treatment would include construction of screens for rooftop fans and internal lining to any exhaust/intake ductwork for in-line fan with openings on the roof/façade.

- Emergency Backup Power Diesel Generators
  - Depending on the generator model selected, these may or may not have proprietary acoustic enclosures.

- Diesel generators without proprietary acoustic enclosures:
  - These typically have a sound power level of approximately 125dB(A).
  - Given the proximity of surrounding sensitive receivers, the generator will need to be enclosed in plantroom, with additional treatment to any louvres for intake/discharge.
  - The plantroom will typically need to be of masonry construction with insulated walls and soffit (internally).
  - Acoustic treatment to air intake and discharge openings to the plant room typically require acoustic attenuators in the order of 2400mm long, 40% free area (Noise Control or equal).

- Diesel generators that do have proprietary acoustic enclosures:
  - Typically, these units have a noise emission level of approximately 75dB(A) at 7 metres. While this substantially reduces the need for acoustic treatment, there is still typically a small amount of additional treatment required.
    - Construction of solid acoustic screens to act as barriers.
    - Lining of plantroom with absorptive treatments.
    - Small acoustic attenuators behind louvres.

- In addition (regardless of generator/enclosure type) an appropriate exhaust gas muffler would be selected such that the resultant noise level at one metre from the exhaust gas discharge point is no more 65dB(A).

6.2.3.2 Seniors apartments/Villas Plant

- Condensers (Seniors Living Apartments and Villas):
    - If condenser units for these dwellings are centralised, the units should be located on the roof top, basement or plant room (with acoustically treated ventilation openings.
    - In the event that units have individual condensers, we recommend that these units have a sound pressure level of no more than 55dB(A) at 1m distance, and be located at least 7 metres from any residential property boundary.

ALC confirms that in all cases, mechanical plant and equipment can be sufficiently treated to ensure cumulative impacts can achieve compliance with the criteria detailed in section 6.1.

6.2.4 Transient Noise Events (Sleep Arousal)

Noise events occurring between 10pm and 7am should be assessed for potential sleep disturbance impacts on nearby residents. The primary potential noise source for transient noise events will be vehicle noise.

With respect to noise from vehicles:

- The transient noise assessment will be assessed is based on the following assumptions:
    - The most sensitive residential receivers will be the occupants of the 117, 117A and 117B River Road multi-storey properties facing the new internal road located along the western boundary of the site.
    - Noise from the car engine as it leaves the site at 20-30km/h) is 90dB(A) sound power level.

Noise emissions are assessed against EPA Sleep Disturbance guidelines, as presented below.

Table 13 – Sleep Arousal Assessment

Receiver Location	Noise Source	Predicted Noise Level	Emergence Test Level	Compliance
Step 1				
Façade of 117, 117A and 117B River Road residences	Car Engine	61dB(A)$L_{1(1min)}$ 61dB(A)$L_{max)}$	56dB(A)$L_{1(1min)}$	Exceeds Step 1 sleep arousal criteria described in section 6.1.3. Step 2 assessment needs to be carried out.
Step 2				
Inside 117, 117A and 117B River Road residences bedrooms	Car Engine	51dB(A)$L_{1(1min)}$	55dB(A)$L_{1(1min)}$	Complies with the Step 2 sleep disturbance assessment

Car movements on the western boundary internal road will result in an exceedance of the 56dB(A)L_{Max} noise goal. However:

- As noted in section 6.1.3, the sleep disturbance assessment method is a two-step approach. In the event that there is an exceedance of the trigger Level in Table 10, it is necessary to conduct a more detailed assessment. Specifically, the noise level *inside* the nearest residence (windows open) should be considered.

- There is typically a 10dB(A) reduction in noise level when an external noise source is transmitted into a building (assuming the window is open at 5% of the floor area).

- This being the case, given the predicted noise level from car movements along the boundary was 61dB(A)L_{max} at the building façade, it would be expected that the momentary noise level *inside* that dwelling (window open) would be 51dB(A)L_{max}.

- As noted in the final paragraph in section 6.1.3, EPA sleep disturbance guidelines states:

  Maximum internal noise levels below 50-55dB(A) are unlikely to awaken people from sleep.

- Given that night time car movements between 10pm and 7am would be infrequent, the noise from cars driving along the western boundary would not significantly affect health and wellbeing of nearby residents, even in the event that the windows to their dwellings are left open.

6.3 RECOMMENDATIONS

Analysis indicates that the site is capable of meeting EPA noise emission guidelines. However, we recommend the following to ensure ongoing compliance with EPA requirements:

6.3.1 Mechanical Plant

Detailed review of all external mechanical plant should be undertaken at construction certificate stage (once plant selections and locations are finalised). Acoustic treatments should be determined in order to control plant noise emissions to the levels set out in section 6.1.1 of this report.

While compliance with noise emission requirements will be achievable with appropriate acoustic treatment, it is highly likely that some plant items which may operate 24 hours per day (such as refrigeration plant) will require either enclosure in plant rooms or acoustic screens to provide a line of sight break between the equipment and any residences.

Other equipment external items (fans) would be expected to be capable of compliance through use of internal duct lining and/or in-duct attenuators.

6.3.2 Traffic Noise Impacts

Noise increase from additional traffic generated by the redevelopment is expected to comply with noise objectives set out in section 6.1 based on a predicted number of vehicles entering or leaving the site. If a traffic report is produced during the application, noise predictions detailed in sections 6.2.1 and 6.2.2 should be revised to reflect more accurate traffic predictions.

7 CONSTRUCTION NOISE AND VIBRATION IMPACTS

We note that a construction program and methodology of proposed works is not available at this early stage (this is not typically undertaken prior to project approval) and as such, a detailed noise and vibration impact assessment cannot be undertaken at this point.

It is recommended that a detailed construction noise and vibration impact assessment be carried out when construction program and methodology is finalised, to determine the level of impact on surrounding properties from the proposed activities and develop a relevant management plan. As such, only an indicative analysis is possible at this stage and as outlined below.

7.1 RECOMMENDED HOURS OF WORK

As recommended in section 2.2 of the NSW EPA Interim Construction Noise Guideline (ICNG), the following hours of operation will be enforced for all construction activities and delivery of materials to and from the site;

- Monday to Friday – 7am to 6pm.
- Saturdays – 8.00am to 1pm.
- Sundays and Public Holidays – No works.

7.2 ASSESSMENT CRITERIA

7.2.1 Construction Noise Impacts

7.2.1.1 EPA Interim Construction Noise Guideline

EPA 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 effected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise effected level". For residential properties, the "noise effected" level occurs when construction noise exceeds ambient levels by more than:
    - 10dB(A)$L_{eq(15min)}$ for work during NSW EPA recommended standard construction hours (7am-6pm Monday to Friday and 8am to 1pm on Saturdays); and
    - 5dB(A)$L_{eq(15min)}$ for work outside of standard construction hours.
- "*Highly noise affected level".* Where noise emissions are such that nearby properties are "highly noise effected", noise controls such as respite periods should be considered. For residential properties, the "highly noise effected" level occurs when construction noise exceeds 75dB(A)$L_{eq(15min)}$ at nearby residences.

A summary of noise emission goals for both standard hours of construction and outside standard hours are presented.

Table 14 – Construction Noise Emission Goals

Location	"Noise Affected" Level - dB(A)$L_{eq(15min)}$	"Highly Noise Affected" Level - dB(A)$L_{eq(15min)}$
Residential Receivers to the north and northwest (River Rd)	58	75
Residential Receivers to the east (across St Vincents Rd)	54	
Residential Receivers to the south	54	

7.2.1.2 Construction Vibration Impacts

7.2.1.2.1 Building Damage

German Standard DIN 4150-3 (1999-02) provides a guideline for acceptable levels of vibration velocity in building foundations, to assess the effects of vibration on structures. The table give guidance on the maximum accepted values of velocity at the foundation and in the plane of the highest floor of various types of buildings, to prevent any structural damage.

The table below lists the peak particle velocity, which is the maximum absolute value of the velocity signals for the three orthogonal components. This is measured as a maximum value of any of the three orthogonal component particle velocities when 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 15 – 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

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
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

7.2.1.2.2 Assessing Amenity – Human Comfort

The NSW EPA's *Assessing Vibration – a technical guideline* is based on the guidelines contained in British Standard BS 6472-1992 '*Guide to Evaluate Human Exposure to Vibration Buildings (1Hz to 80Hz*'. This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings.

The recommendations of this guideline should be adopted to assess and manage vibration from the site. Where vibration exceeds, or is likely to exceed, the recommended levels then an assessment of reasonable and feasible methods for the management of vibration should be undertaken.

Table 16 – BS 6472 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	0.01	0.02	0.2	0.4	0.28	0.56
Offices	Day or night-time	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	Day or night-time	0.64	1.28	13	26	18	36
Workshops		0.64	1.23	13	26	18	36

Note 1: Continuous vibration relates to vibration that continues uninterrupted for a defined period (usually throughout the daytime or night-time), e.g. continuous construction or maintenance activity. (DECC, 2006).

Note 2: Impulsive vibration relate to vibration that builds up rapidly to a peak followed by a damped decay and that may or may not involve several cycles of vibration (depending on frequency and damping), with up to three occurrences in an assessment period, e.g. occasional loading and unloading, or dropping of heavy equipment. (DECC, 2006)

7.3 PRELIMINARY CONSTRUCTION NOISE ASSESSMENT

With respect to general construction noise, the impacts on nearby development will be dependent on the activity in question and where on the site the activity is undertaken. Excavation and piling works tend to be the loudest typical construction activity.

Work close to the boundaries will have greatest potential impact on the residents surrounding the site. Detailed acoustic assessment of individual activities cannot be undertaken prior to knowing the activities/construction methods proposed, their duration and location.

However, based on Initial analysis:

- Demolition Stage – Excavators (with bucket) and dozers are typically the loudest activity during this phase of works, with sound power levels of approximately 110dB(A)$L_{eq(15min)}$. Noise levels of between 62-82dB(A) can be expected at the façade of the surrounding residential properties to the east. Intermittent exceedances of noise management or highly noise affected can be expected at all surrounding receivers when works are being carried out within 20m of the site boundaries. Exceedance of the highly noise affected level may occur for short periods of time for Gore Street residences and 117, 117A and 117B River Road residences.

- Excavation/soil retention phase – Intrusive noise emissions are typically expected during excavation and earth retention (piling), with equipment items typically having sound power levels of approximately 115 – 120dB(A)$L_{eq(15min)}$. Depending on the type of piling (CFA vs. Sheet piling vs. bored piles) exceedances *"Noise Affected"* target levels (Table 14) are predicted at all surrounding receivers. Exceedance of *"Highly Noise Affected"* level of 75dB(A) is also likely when works are being conducted within 20m of the site boundaries if using sheet piling.

- During erection of structure, it is the use of hand tools (concrete pump, vibrators and hand tools for form working) which are the loudest typical activity (sound power levels of approximately 105dB(A)$L_{eq(15min)}$). Intermittent exceedances of the EPA *"Noise Affected"* levels may occur at the boundary of existing residences to the north, northwest, east and south). However, it should be noted that a majority of these works are largely intermittent, and will not all occur at the same time. Noise levels exceeding the *"Highly Noise Affected"* level of 75dB(A) is unlikely to occur.

- Once construction of the buildings shells is complete, noise from hand tools will be relatively low, as new buildings façades will provide considerable noise attenuation. Once buildings shells is largely complete, use of hand tools in internal areas is unlikely to exceed EPA recommended levels. Vehicle noise and crane noise will create the greatest possibility of noise disturbance during this phase.

Noise impacts can be minimised using the following:

- Appropriate selection of equipment and process – e.g. substituting concrete/rock breaking during operations with alternative measures such as sawing and lifting the slab pieces entailing:

    - Using a muncher or pulveriser to break up the slab pieces to minimise use of percussive equipment (hydraulic hammers).

- Use of augured or CFA or bored piles in place of sheet/hammer/driven/vibratory piles.
- Practical positioning of static plant (concrete pumps, cranes) – locating them as far as practicable from the site boundaries.
- Use of an electric crane (as opposed to diesel) if feasiable.
- Use of screens or enclosures (typically only feasible for static plant).
- Careful planning/scheduling of noisy works, particularly when located near the property boundaries.
- Commencing all noisy operations (piling, rock breaking, excavation, hammering, cutting, grinding) after 8am and enforcing pre-determined respite periods.
- Letter box drops or similar consultation/notification methodology to all surrounding residents, informing them on activities with the potential to result in noise levels reaching the "Highly Noise Affected" noise level. Leaflet should advise of the proposed processes/methodology and likely duration.
- When possible, access to the site for construction vehicles should be provided on River Road.

In light of the above, we recommend:

- On completion of the construction program, an acoustic review of proposed construction activities and plant/methods/selections should be undertaken to identify the extent and duration of potential exceedances of EPA construction noise management levels;
- Community consultation to inform adjacent property owners of potential noise sensitive activities;
- For those activities, likely to generate high noise levels, the analysis should Identify where on the site these activities are likely to result in high noise levels. This will then assist in determining the likely time period for which high noise levels will occur, which will in turn help in formulating relevant respite periods or relocating these activities temporarily.
- Identify feasible acoustic controls or management techniques (for example, selection of plant, use of screens around static plant, scheduling of noisy works, notification of adjoining land users, respite periods) when exceedance of management noise levels may occur;
- For activities where acoustic controls and management techniques still cannot guarantee compliant noise levels, implement a notification process whereby nearby residences are made aware of the time and duration of noise intensive construction processes; and
- Implementation of a noise monitoring program during construction to provide feedback back to the Builder to ascertain whether construction noise goals are being exceeded and determine additional management strategies.

Through adoption of the above, noise impacts on nearby residences can be suitably managed to prevent unreasonable impact.

7.4 VIBRATION IMPACTS

Excavation (rock breaking), sheet piling and vibratory compaction operations are likely to be the primary vibration generating activities.

Given their proximity to the proposed operations, there is unlikely to be vibration impacts on the surrounding residential properties. As a precaution, we recommend:

- If use of hydraulic hammers or vibratory rollers of proposed within 20m of another building, vibration monitoring at that building is recommended.

- Any monitoring system should have SMS notification to ensure that the contractor is messaged instantaneously.

8 CONCLUSION

Potential noise and vibration impacts associated with the proposed Greenwich Hospital Redevelopment at 97-115 River Rd, Greenwich.

Noise impacts from existing environmental noise sources on future occupants of the development, have been assessed in accordance with the requirements of the Lane Cove Council DCP 2010, and AS/NZS 2107:2016. Acoustic treatments necessary to achieve compliance with the requirements contained within these guidelines have been discussed in section 5.2.

An analysis of typical operational noise (vehicles noise, additional traffic, mechanical plant/equipment and transient noise events) associated with the proposed redevelopment, indicates that compliance with relevant noise emission criteria can be achieved:

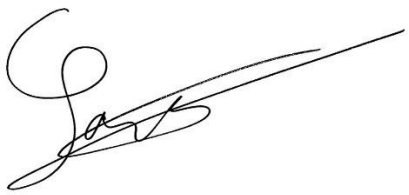
- A detailed acoustic review of mechanical plant should be undertaken once design is further progressed (plant selections and locations finalised). In-principal review indicates that acoustic treatment to any major plant items located externally is likely to be required (screens, in-duct attenuation, attenuators and enclosures). Through the appropriate selection of plant/equipment and ameliorative treatments, noise emissions are capable of complying with all existing legislation.

- No additional impacts are predicted from additional vehicle movements resulting from the subject proposal.

Detailed noise management practices should be implemented for the control of construction noise. In principal acoustic review indicates that demolition, earthworks and piling, have the potential to exceed EPA Interim Construction Noise Guideline requirements, particularly when operating within 20m of the south-eastern, and north-western site boundaries. Noise mitigation through work scheduling and equipment selection should be considered. This should be implemented via a Noise and Vibration Management Plan, which should be compiled once the construction program and methodology is finalised.

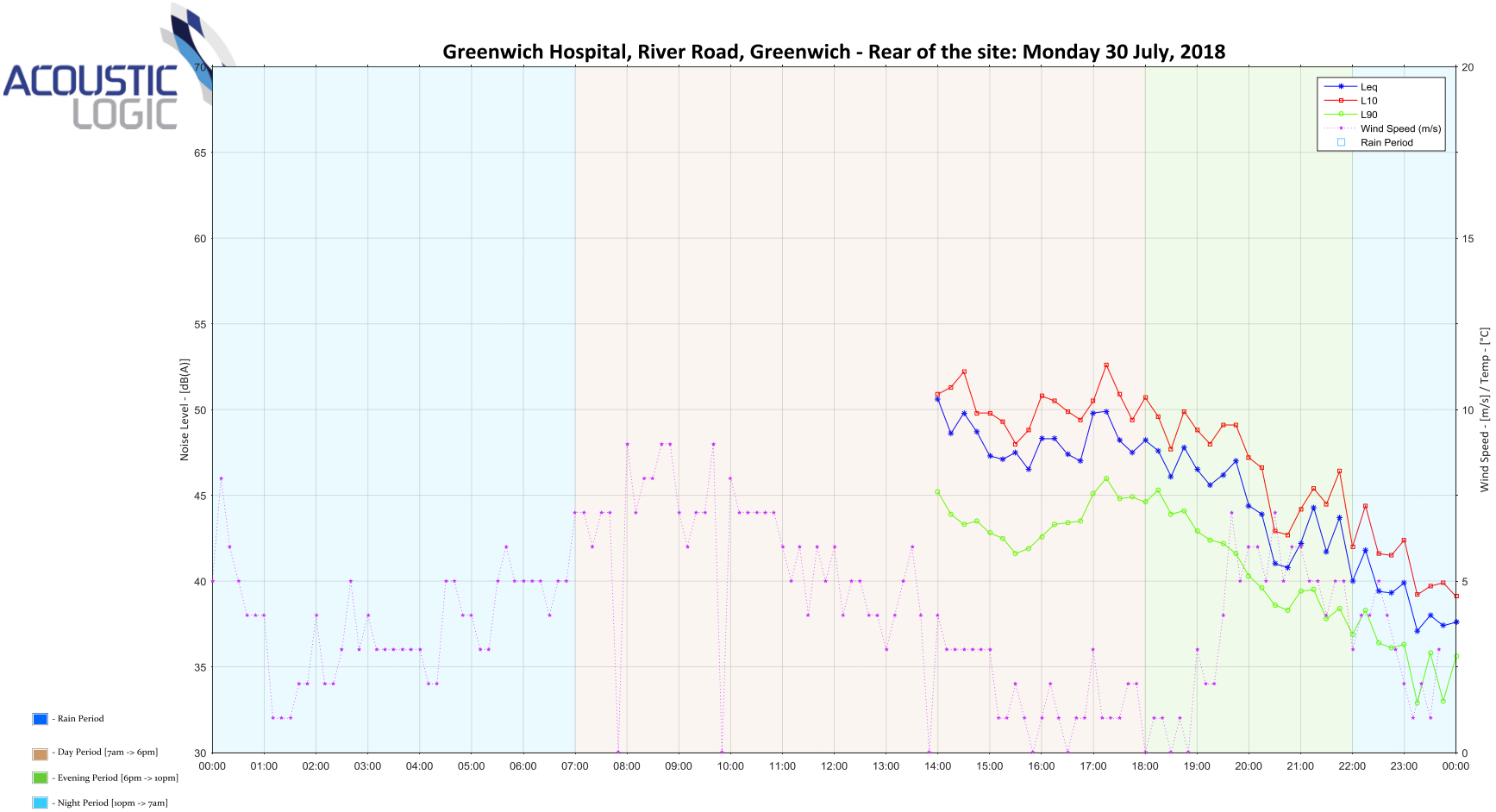
We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,



Remi Larmandieu

APPENDIX 1 – UNATTENDED NOISE MONITORING DATA- REAR OF THE SITE (SOUTH)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Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
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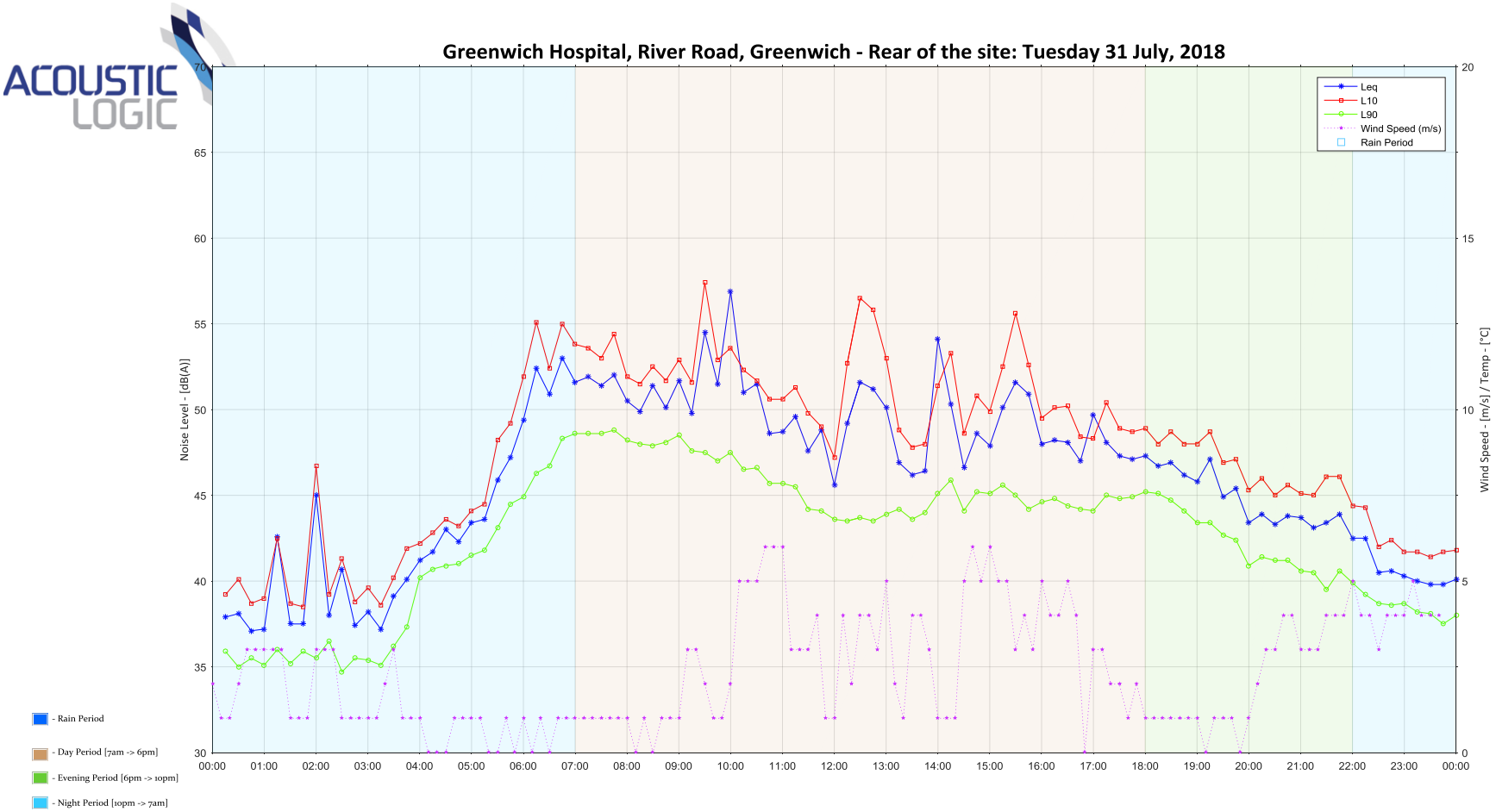
Wind Speed (m/s)
Rain Period
- Rain Period
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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Wind Speed (m/s)
Rain Period
- Rain Period
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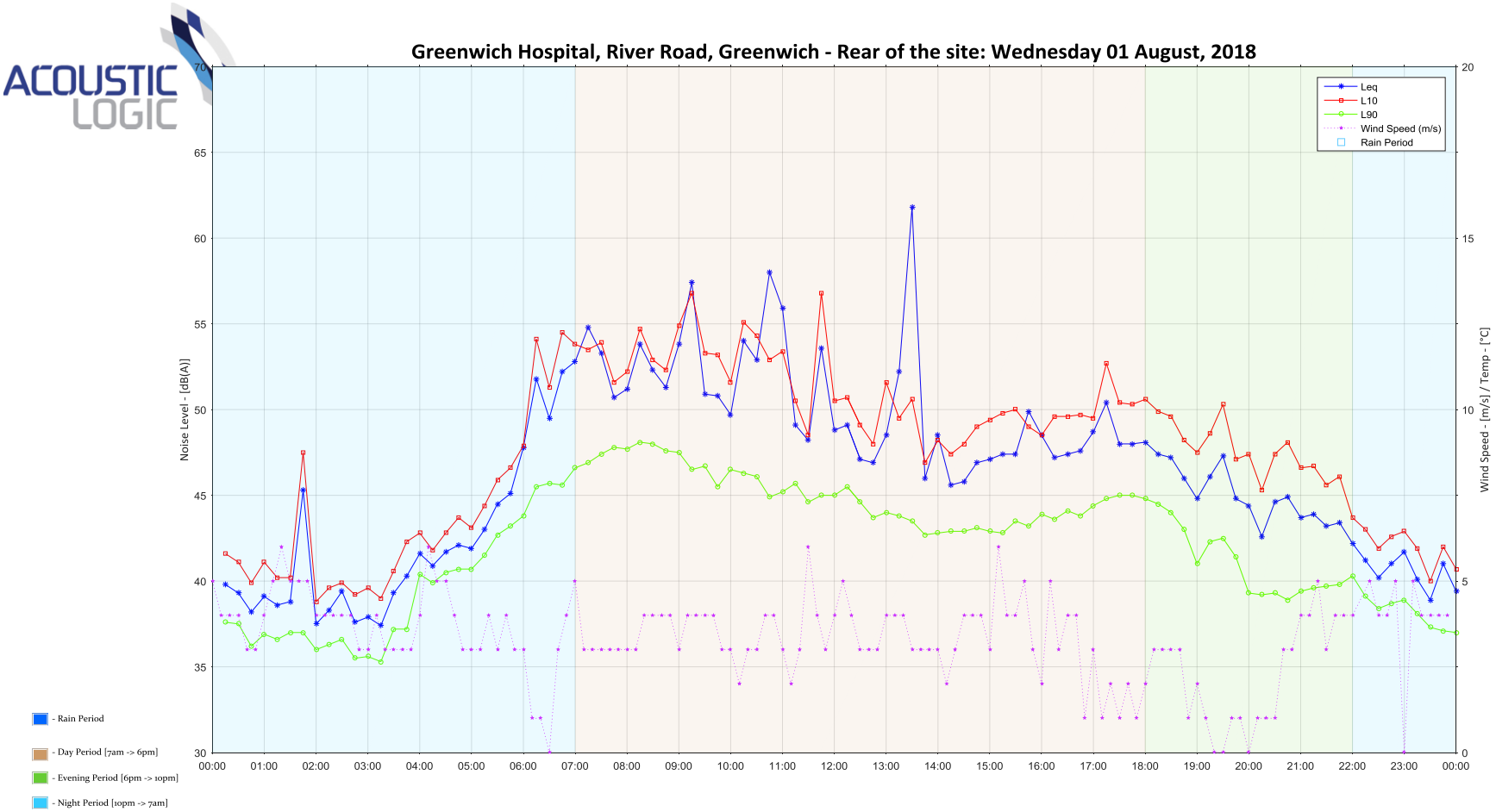
- Night Period [10pm -> 7am]


Greenwich Hospital, River Road, Greenwich - Rear of the site: Wednesday 01 August, 2018
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Wind Speed - [m/s] / Temp - [°C]
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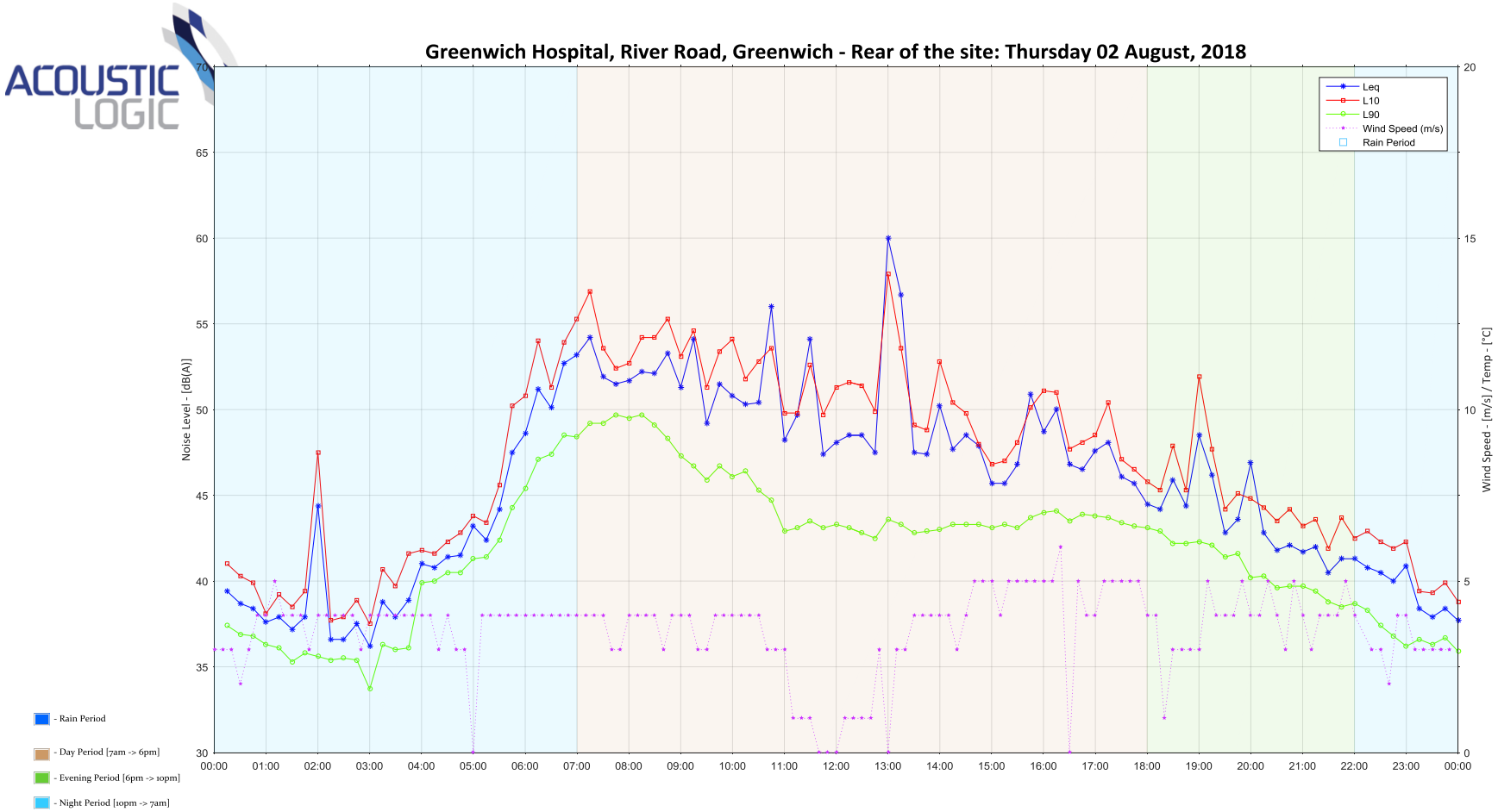
Wind Speed (m/s)
Rain Period
- Rain Period
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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Rain Period
- Rain Period
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- Evening Period [6pm -> 10pm]
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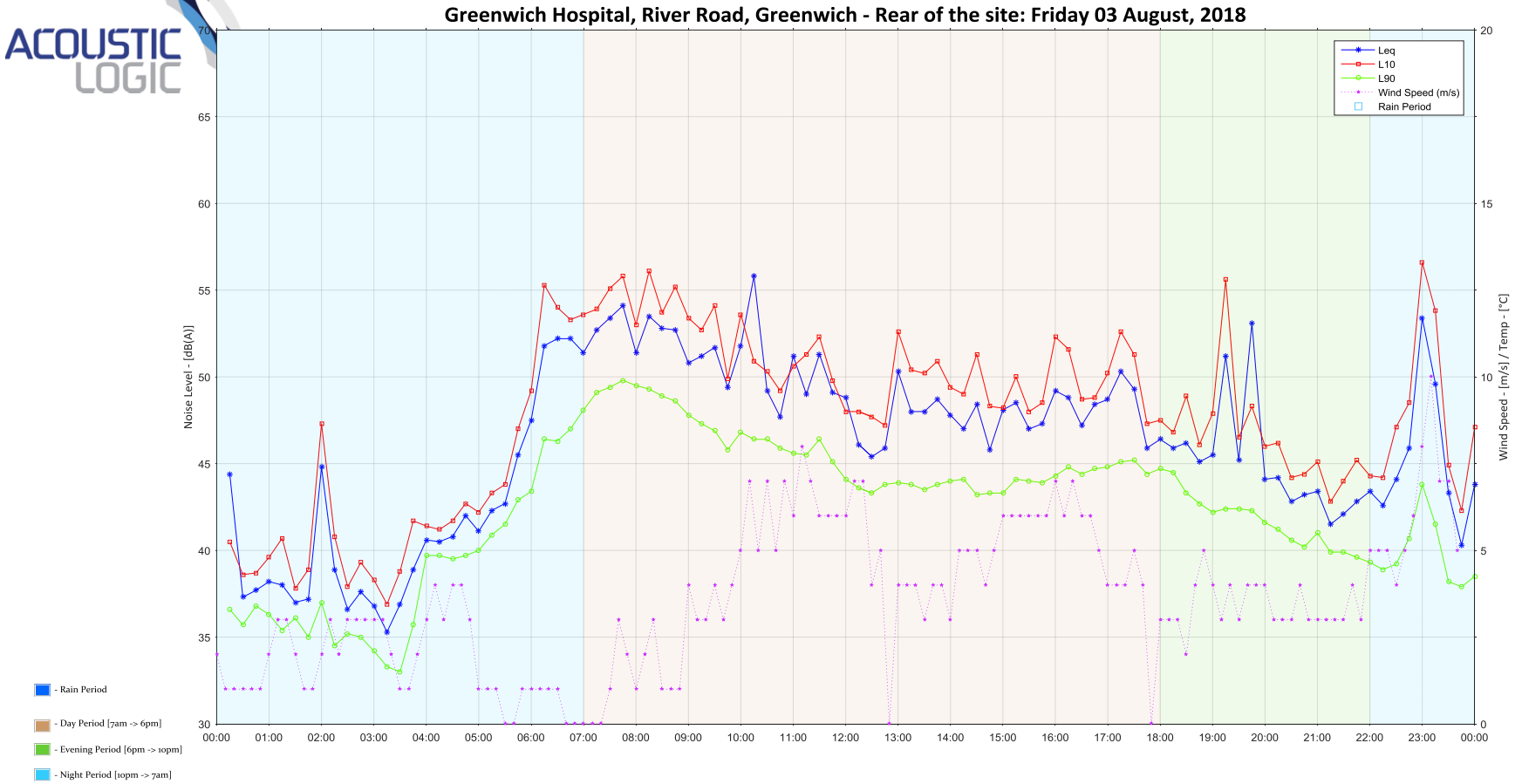
Greenwich Hospital, River Road, Greenwich - Rear of the site: Friday 03 August, 2018
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Wind Speed - [m/s] / Temp - [°C]
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Rain Period
- Rain Period
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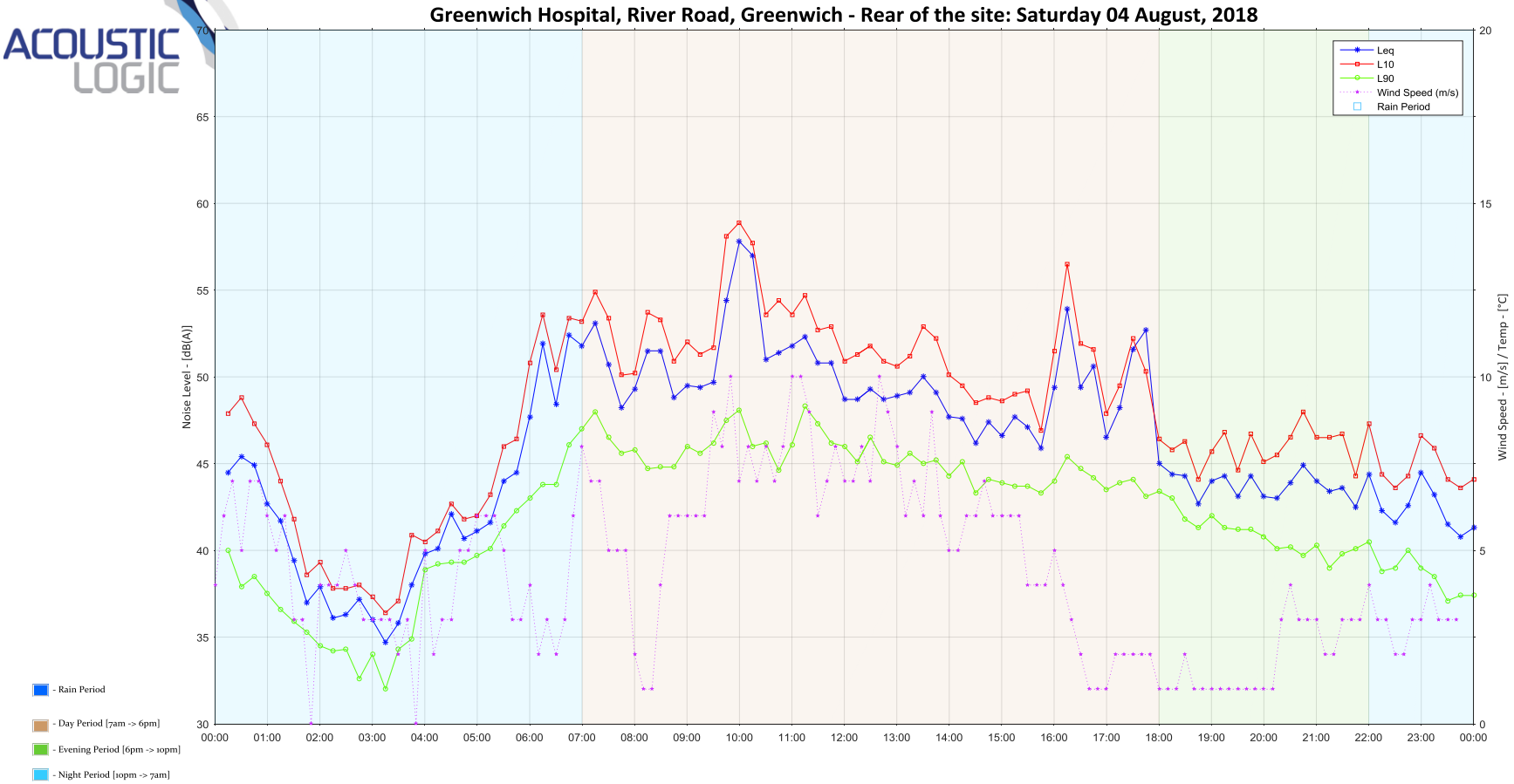
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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Rain Period
- Rain Period
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- Evening Period [6pm -> 10pm]
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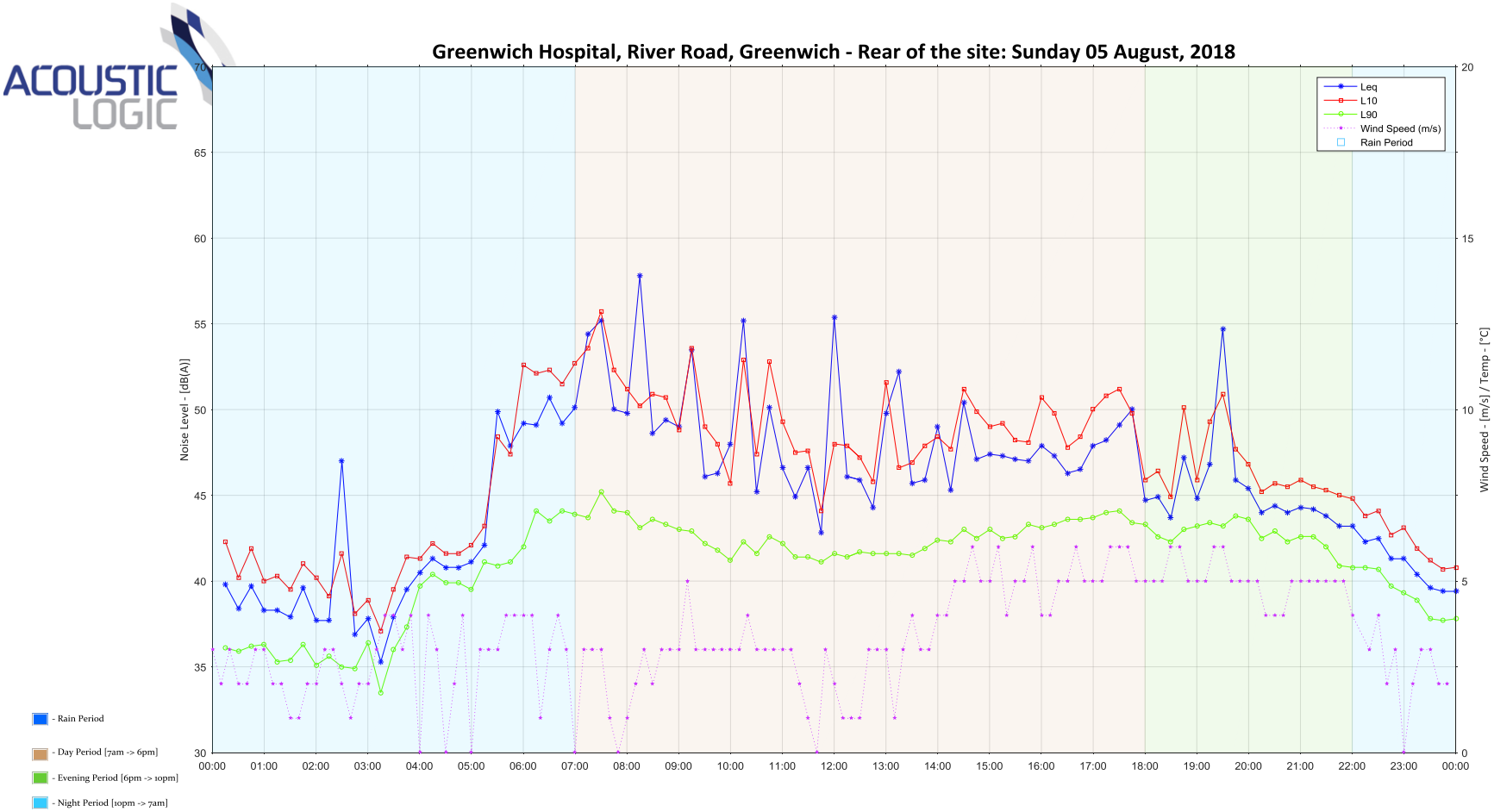
Greenwich Hospital, River Road, Greenwich - Rear of the site: Sunday 05 August, 2018
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Wind Speed (m/s)
Rain Period
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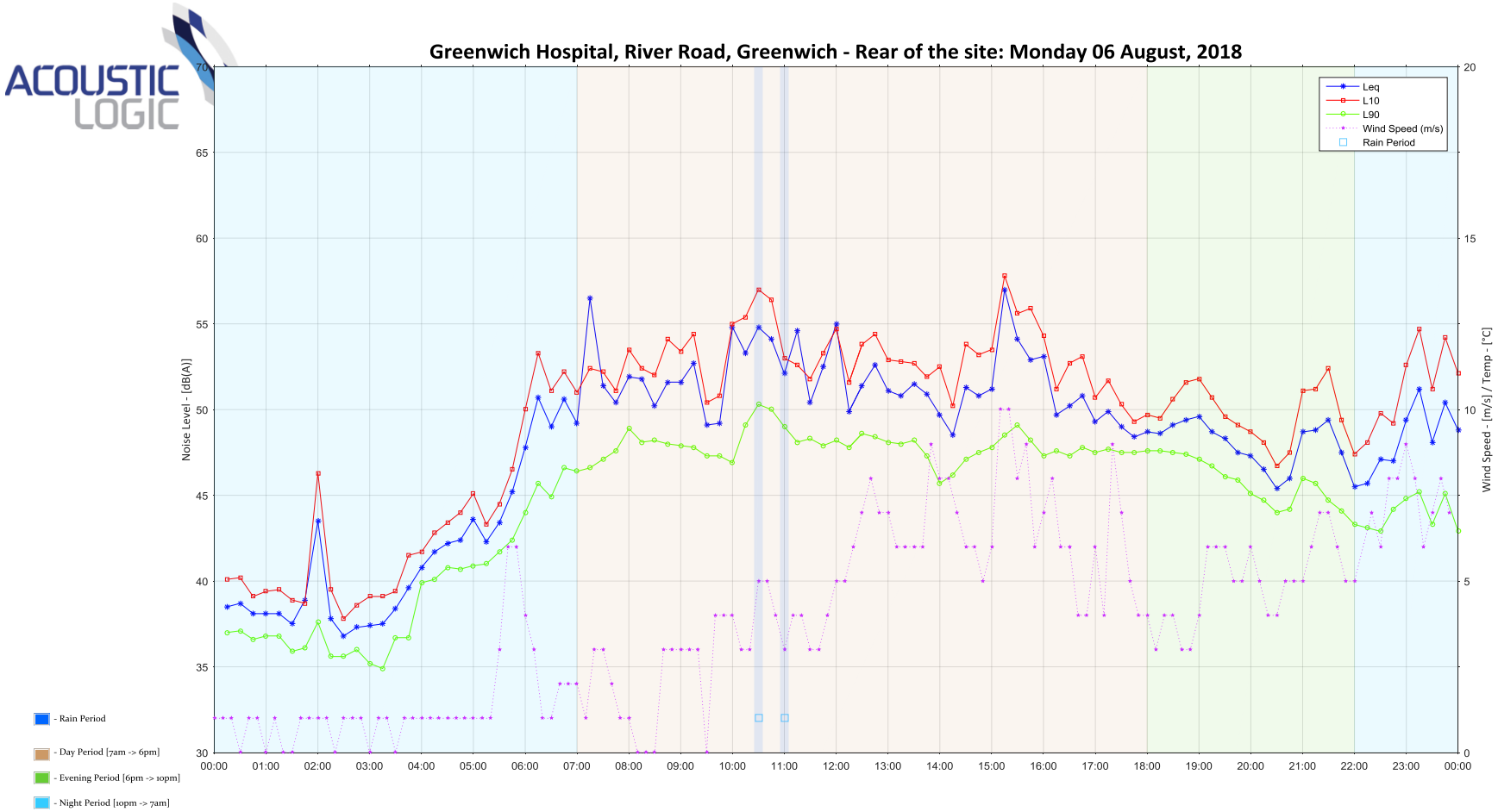
Greenwich Hospital, River Road, Greenwich - Rear of the site: Monday 06 August, 2018
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Wind Speed (m/s)
Rain Period
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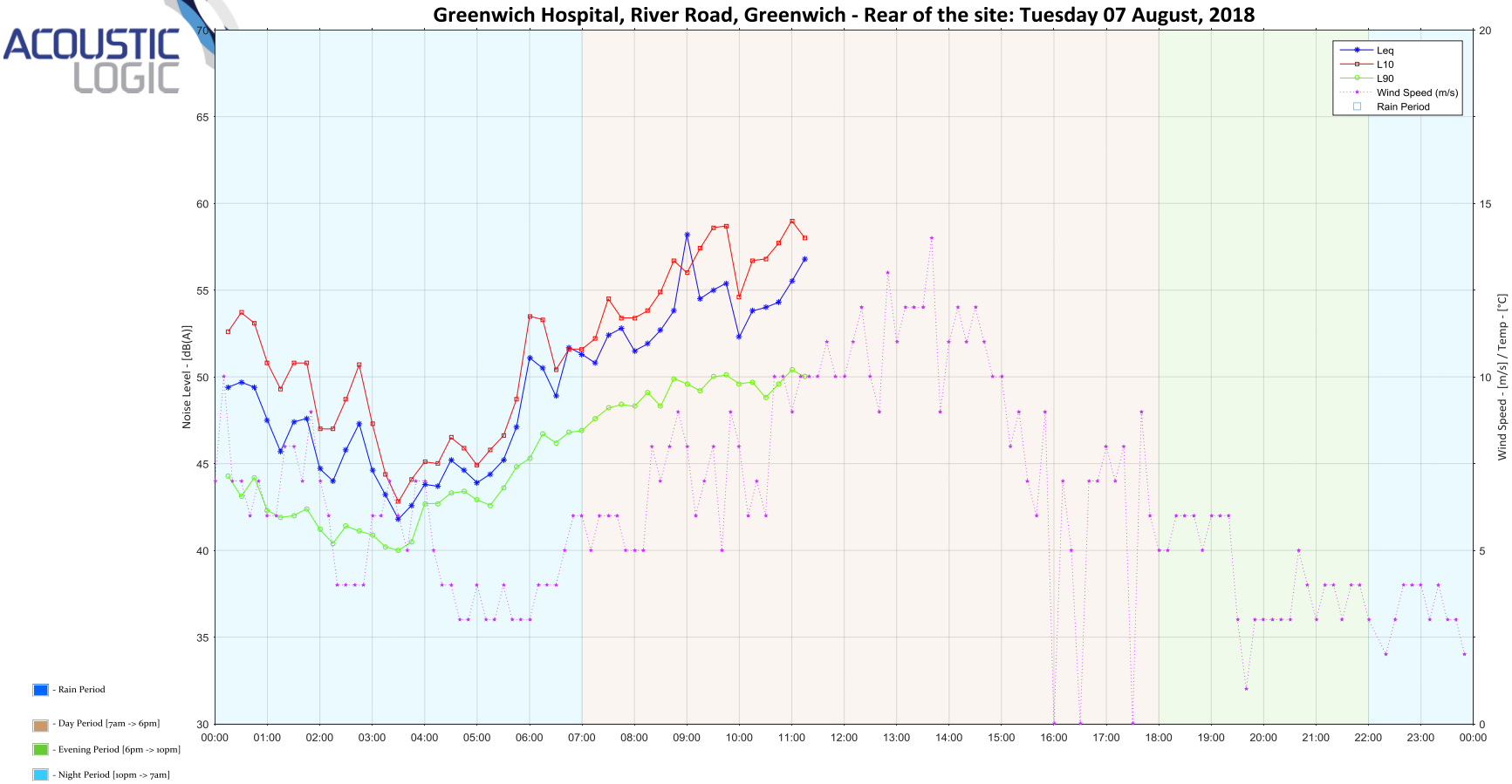
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Wind Speed (m/s)
Rain Period
- Rain Period
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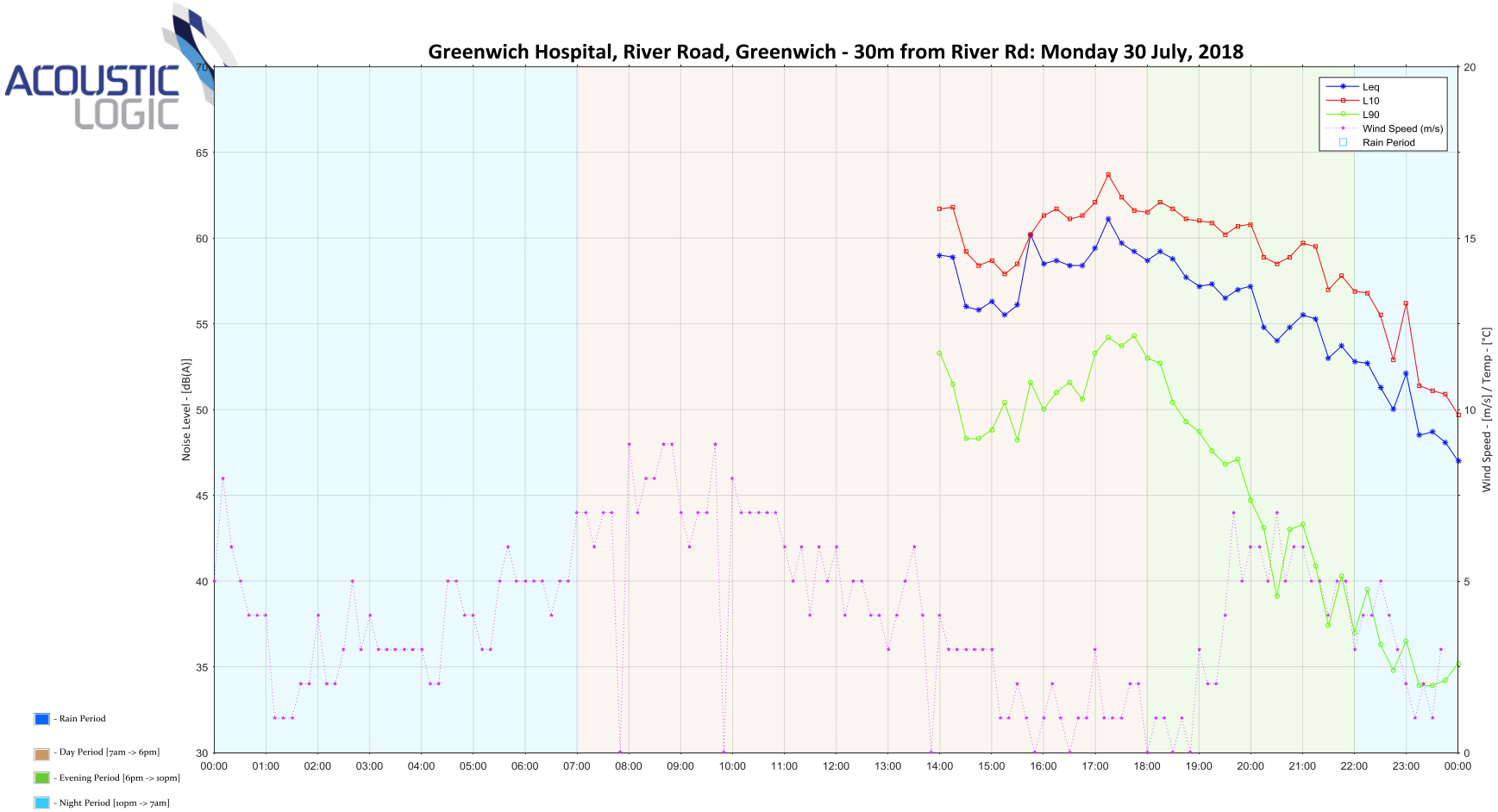
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

APPENDIX 2 – UNATTENDED NOISE MONITORING DATA - NORTHWESTERN BOUNDARY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Noise Level - [dB(A)]
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Wind Speed (m/s)
Rain Period
- Rain Period
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
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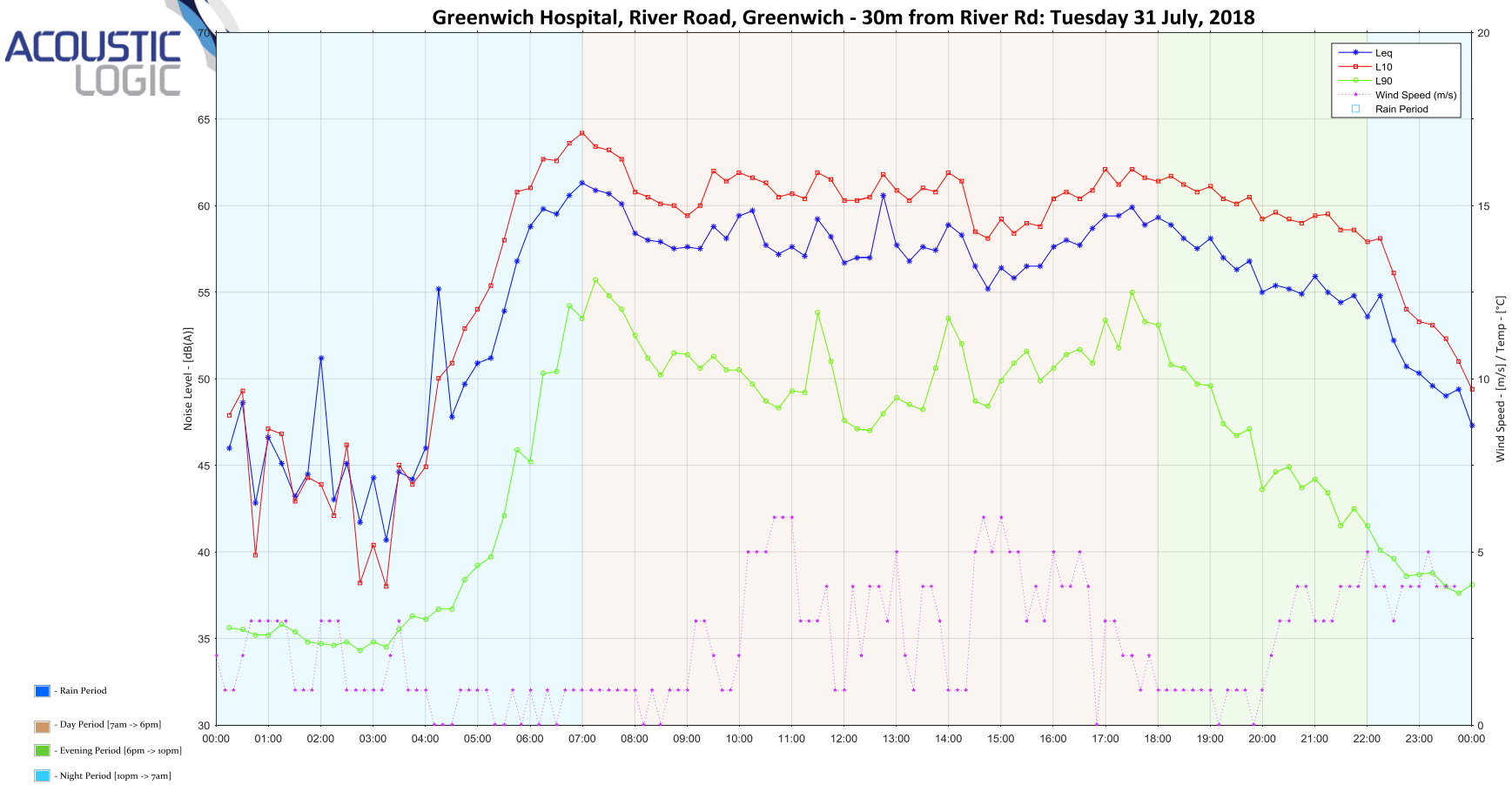
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Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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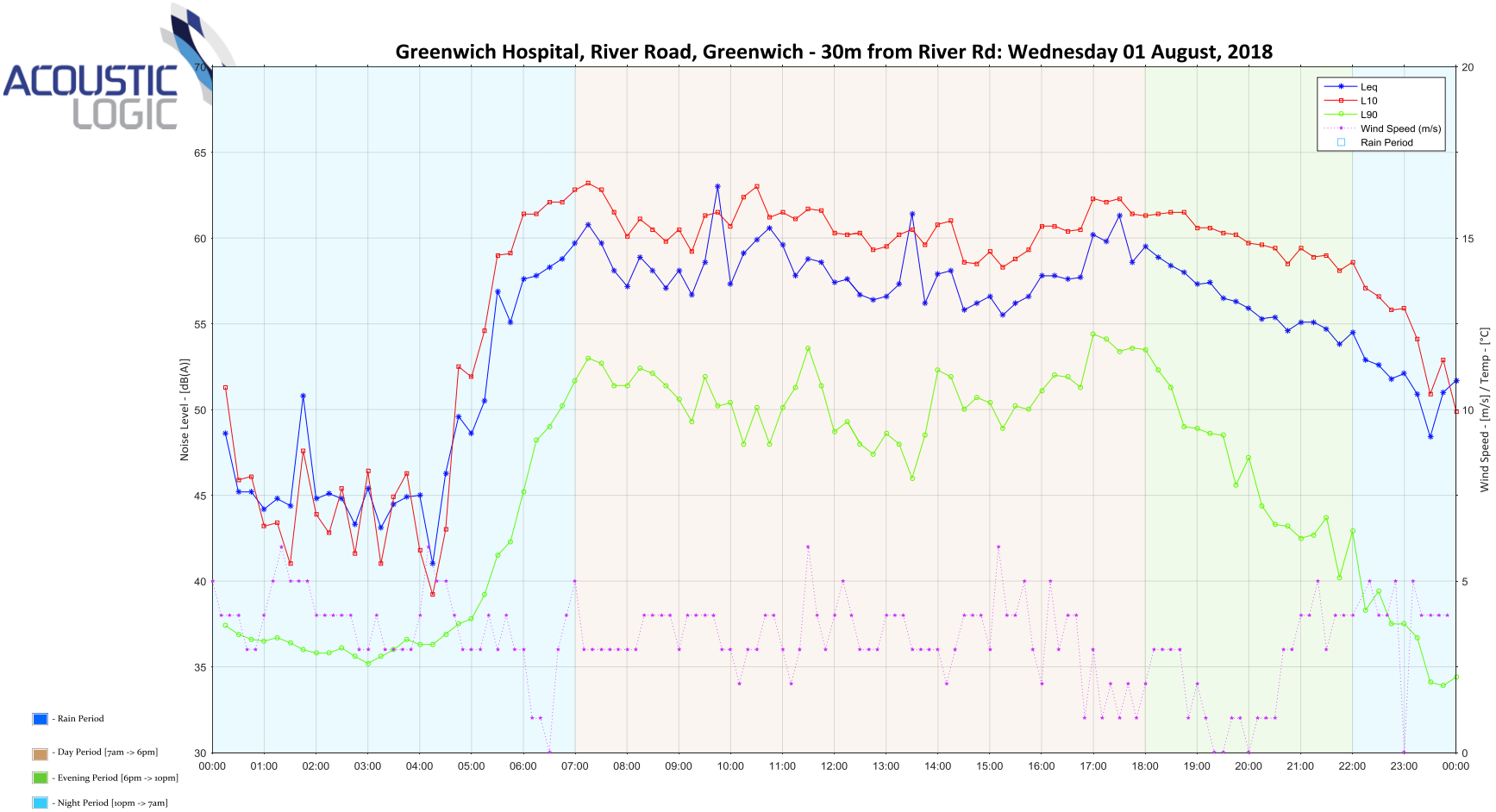
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Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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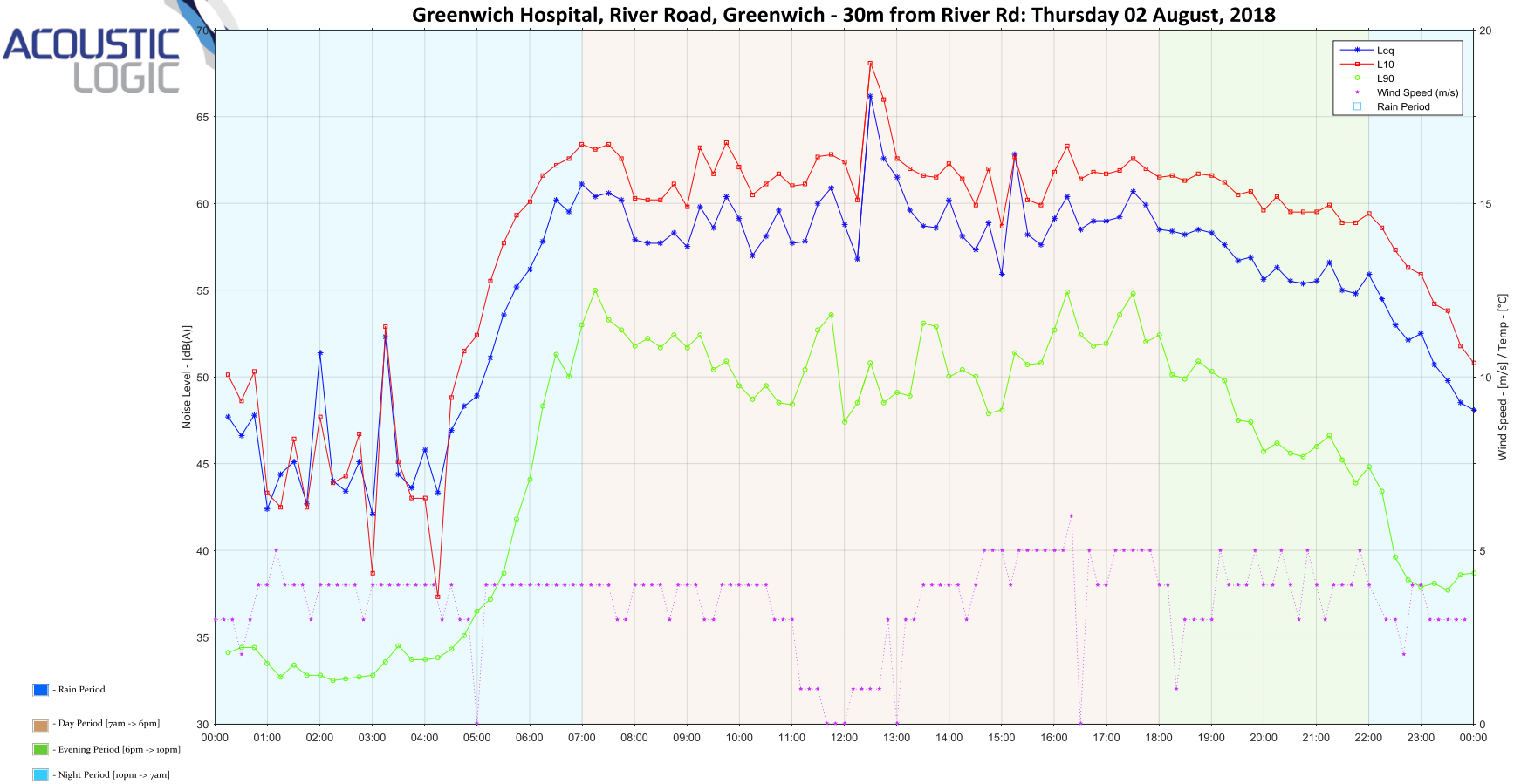
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Wind Speed (m/s)
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Noise Level - [dB(A)]
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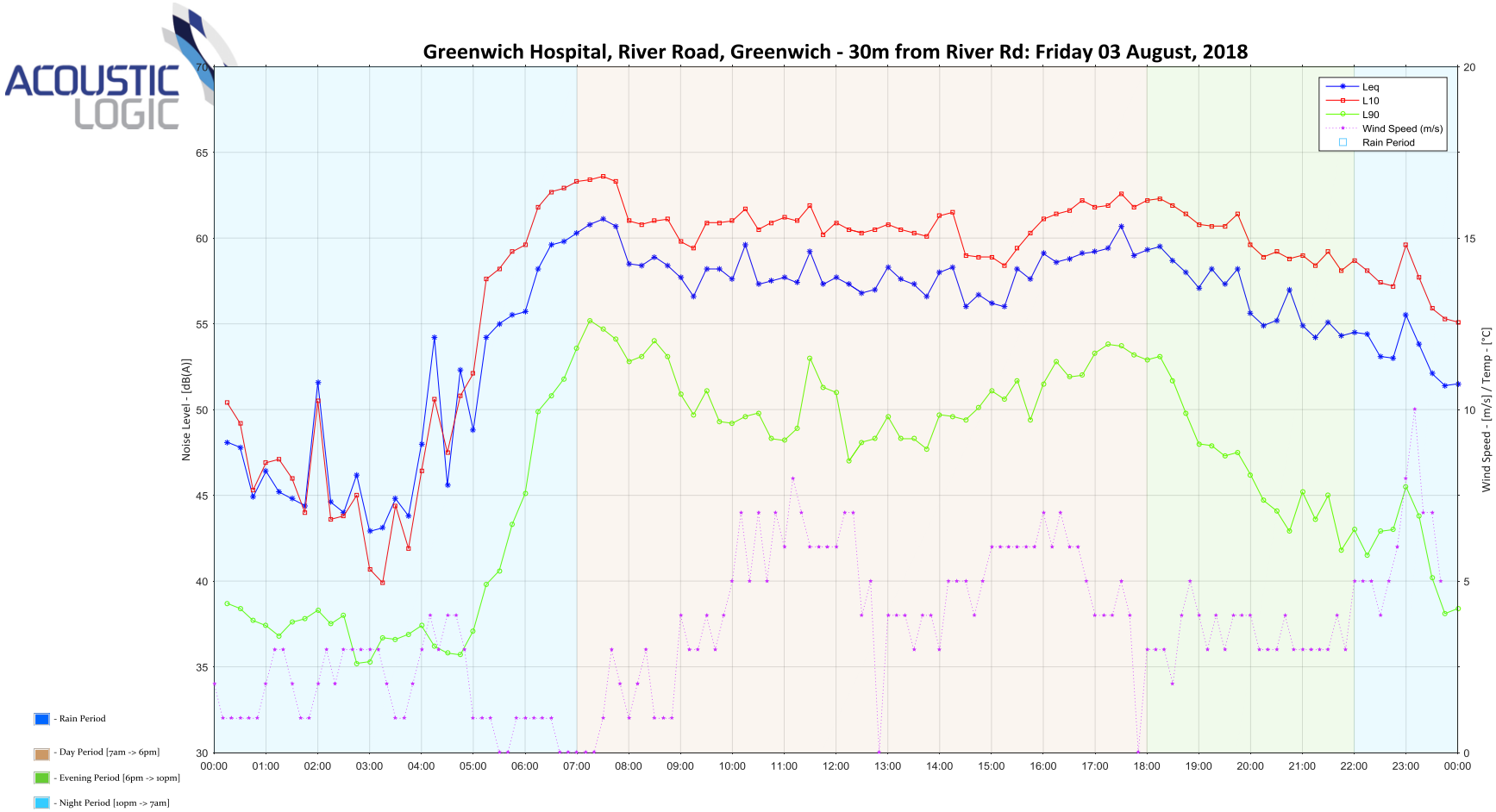
Greenwich Hospital, River Road, Greenwich - 30m from River Rd: Friday 03 August, 2018
Noise Level - [dB(A)]
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Wind Speed (m/s)
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- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
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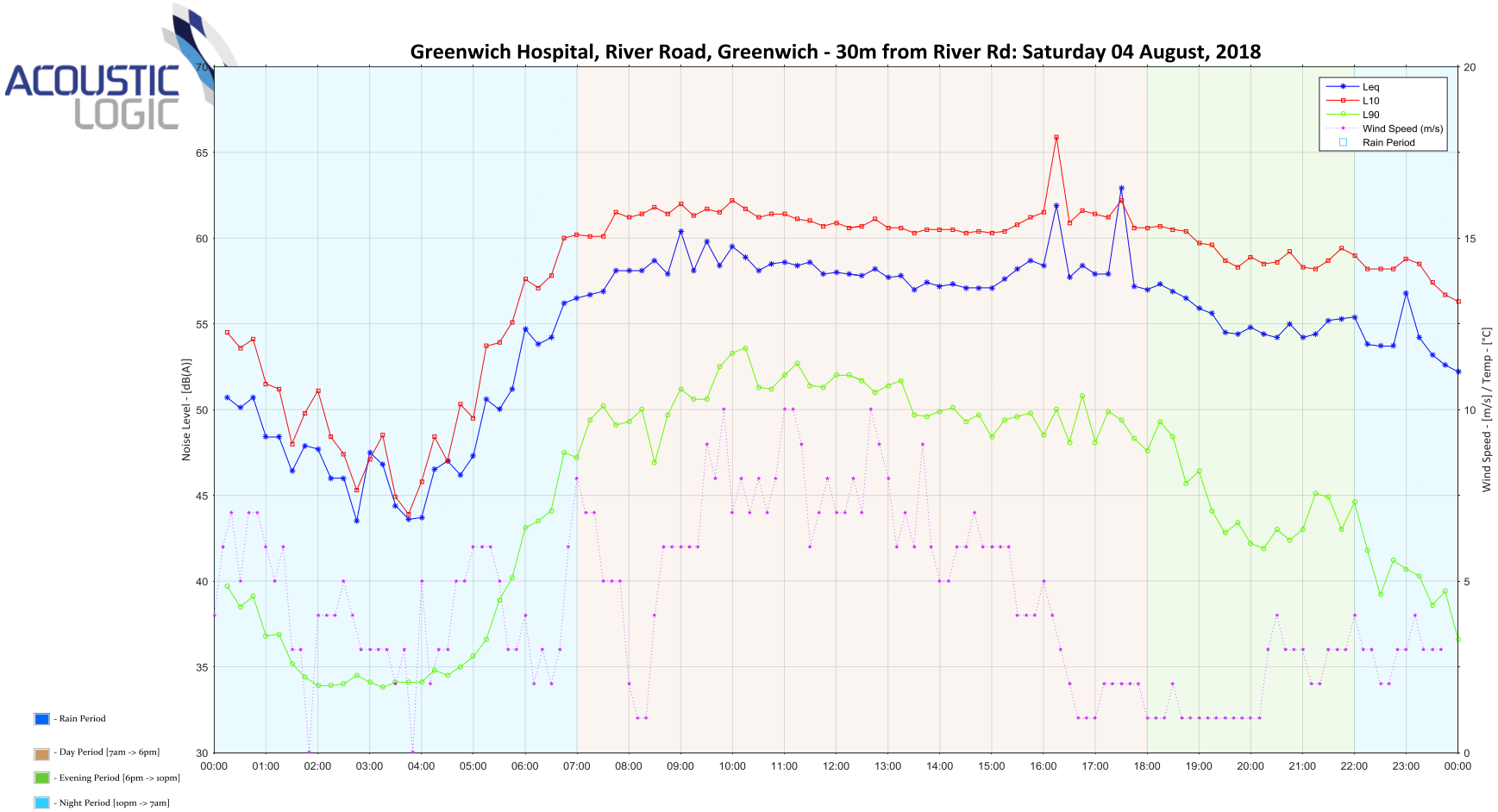
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Rain Period
Noise Level - [dB(A)]
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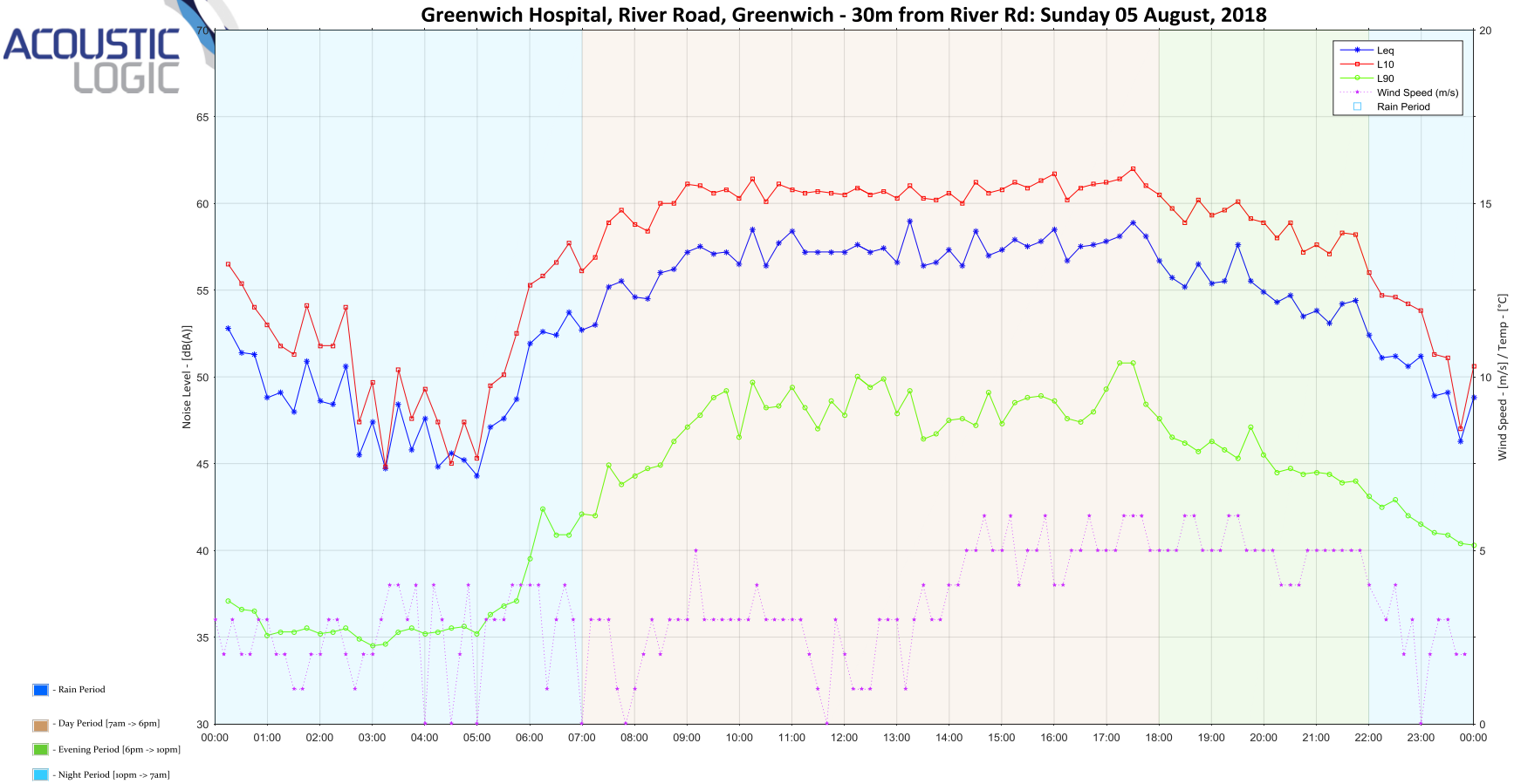
Greenwich Hospital, River Road, Greenwich - 30m from River Rd: Sunday 05 August, 2018
Noise Level - [dB(A)]
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Wind Speed (m/s)
Rain Period
- Rain Period
- Day Period [7am -> 6pm]
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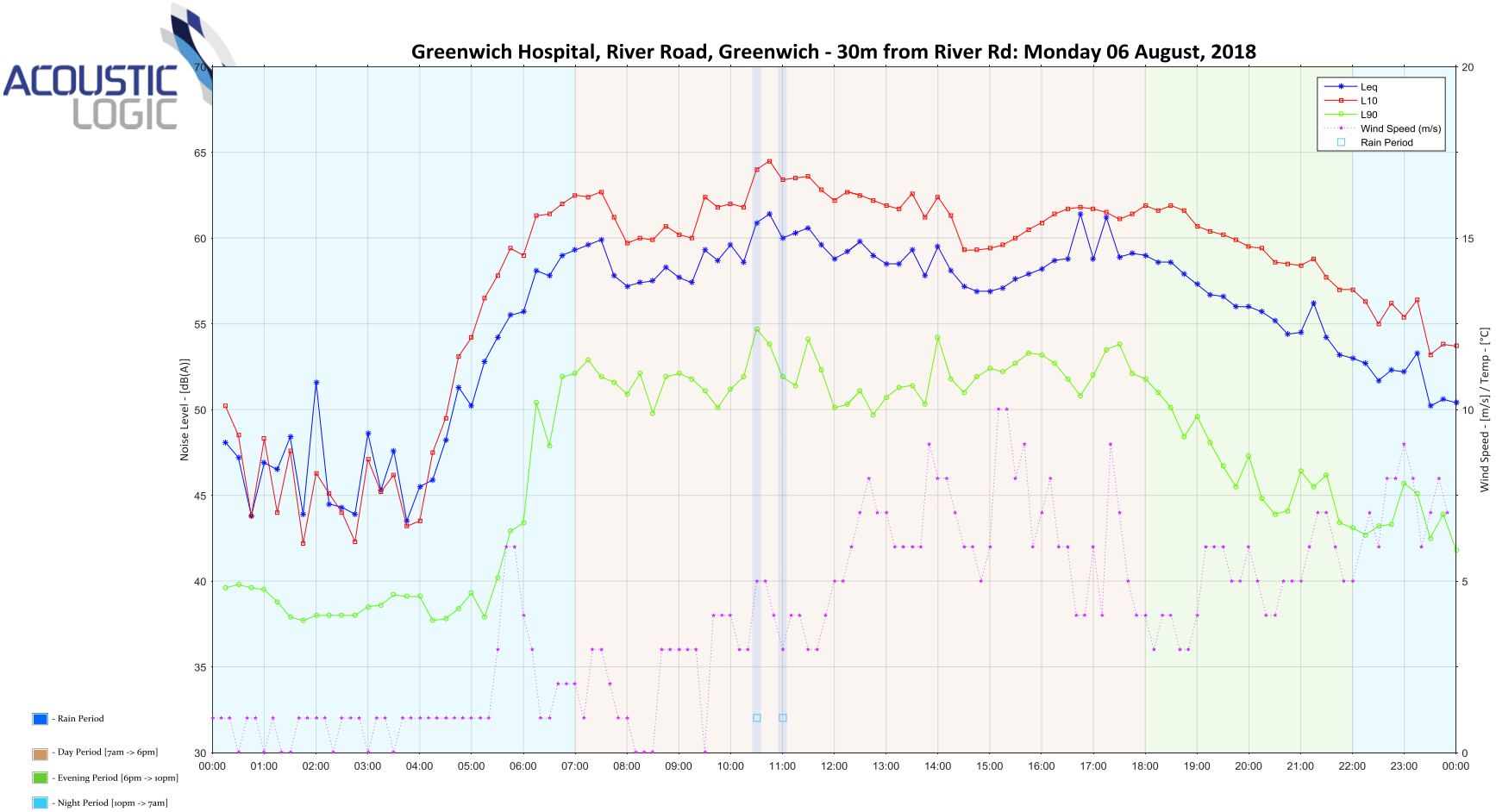
Greenwich Hospital, River Road, Greenwich - 30m from River Rd: Monday 06 August, 2018
Leq
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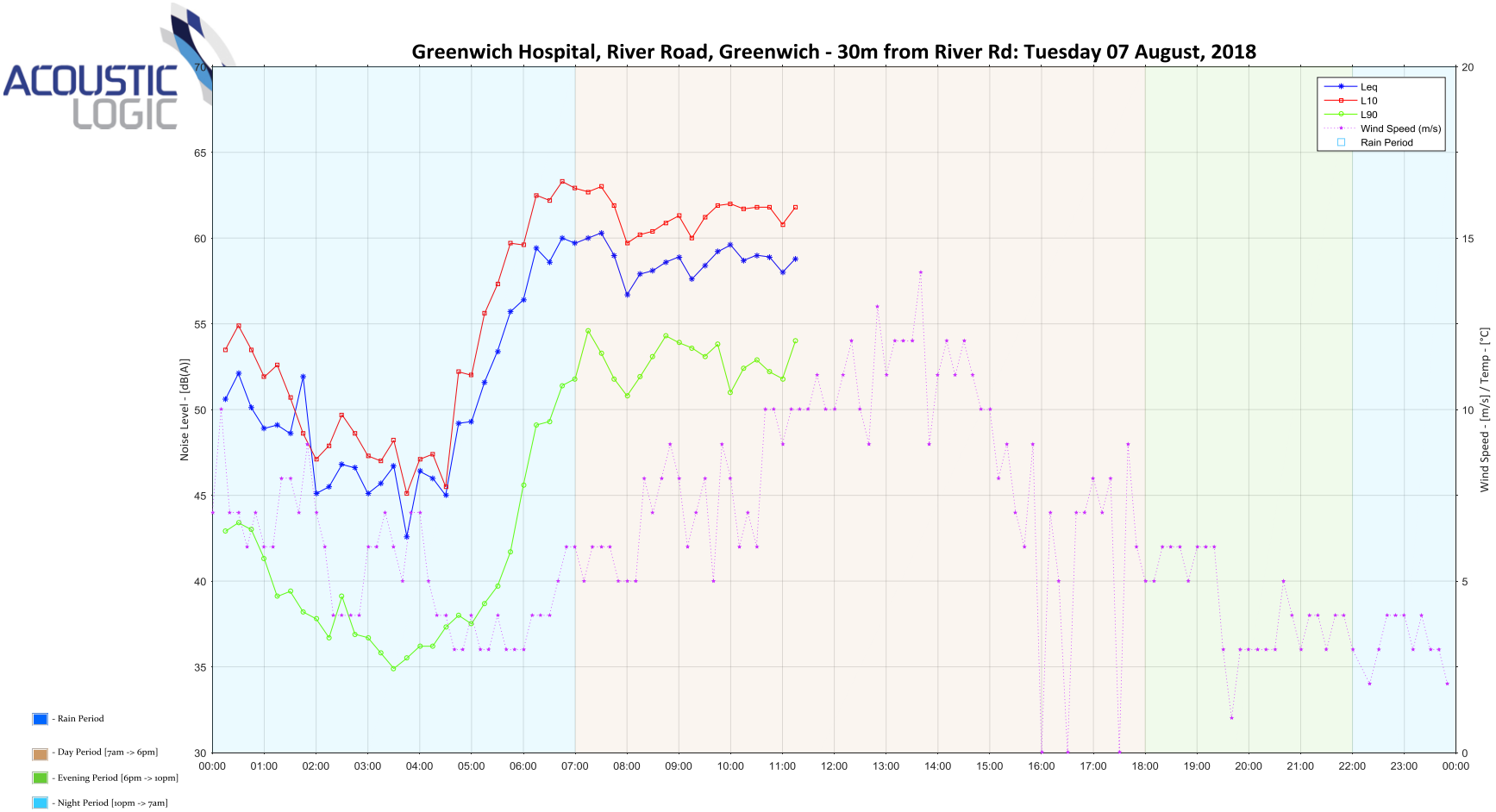
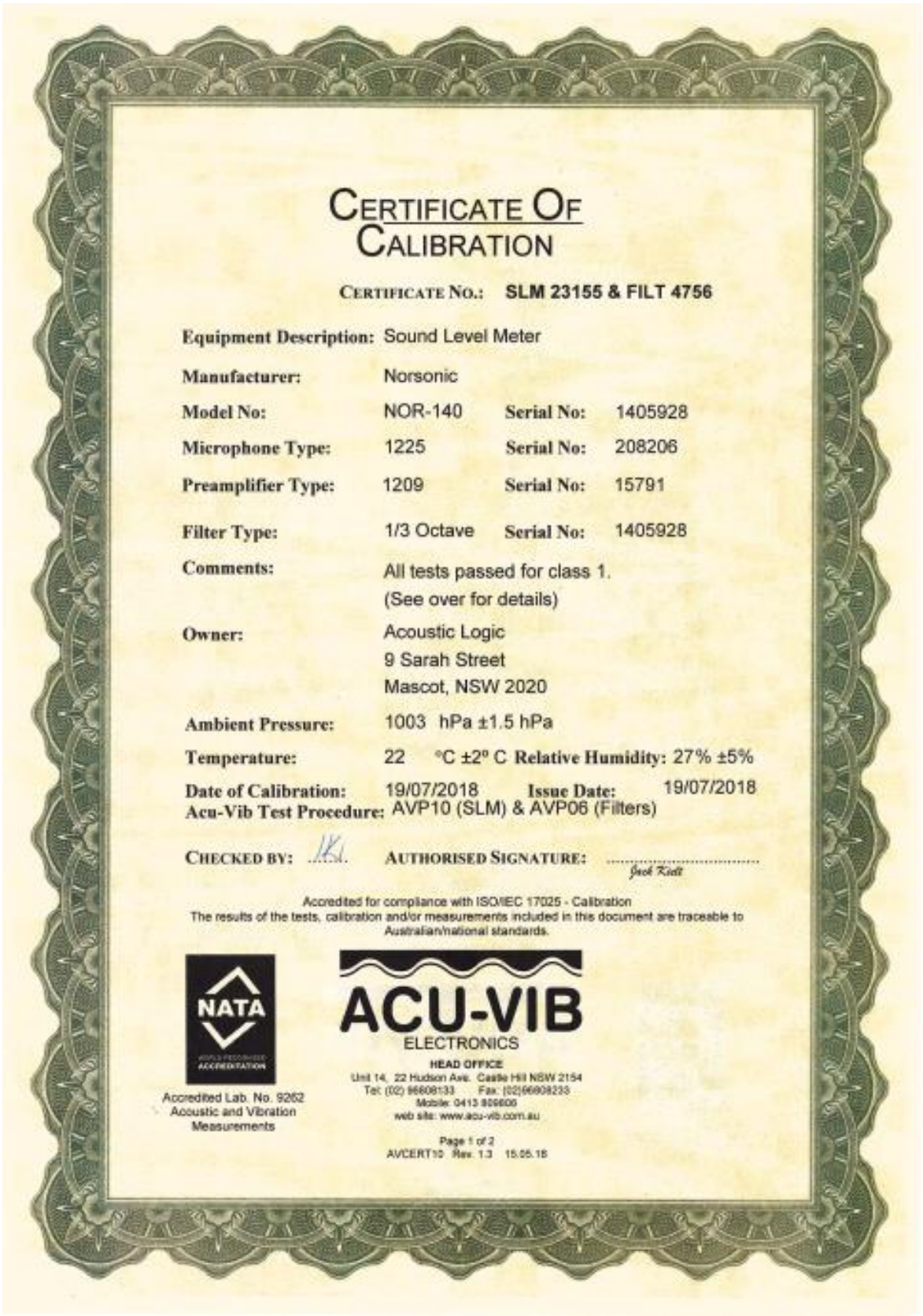
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Rain Period
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


Greenwich Hospital, River Road, Greenwich - 30m from River Rd: Tuesday 07 August, 2018
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Rain Period
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

APPENDIX 3 – CALIBRATION CERTIFICATES



CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 23155 & FILT 4756

Equipment Description:	Sound Level Meter		
Manufacturer:	Norsonic		
Model No:	NOR-140	**Serial No:**	1405928
Microphone Type:	1225	**Serial No:**	208206
Preamplifier Type:	1209	**Serial No:**	15791
Filter Type:	1/3 Octave	**Serial No:**	1405928
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Acoustic Logic 9 Sarah Street Mascot, NSW 2020		
Ambient Pressure:	1003 hPa ±1.5 hPa		
Temperature:	22 °C ±2° C	**Relative Humidity:**	27% ±5%
Date of Calibration:	19/07/2018	**Issue Date:**	19/07/2018
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

CHECKED BY: ..... **AUTHORISED SIGNATURE:** ..... Jack Kiell

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA
ACCREDITATION

Accredited Lab. No. 9262
Acoustic and Vibration Measurements

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Page 1 of 2
AVCERT10 Rev. 1.3 15.05.18

Norsonic 140 Sound Level Meter

Acoustic Research Labs Pty Ltd
Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C18142

Client Details	Acoustic Research Labs Pty Ltd Level 7, Bld 2, 423 Pennant Hills Road Pennant Hills NSW 2120
Equipment Tested/ Model Number :	Rion NL-42EX
Instrument Serial Number :	00184110
Microphone Serial Number :	173006
Pre-amplifier Serial Number :	74636

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	22°C	**Ambient Temperature :**	22.2°C
Relative Humidity :	53.6%	**Relative Humidity :**	55.8%
Barometric Pressure :	99.94kPa	**Barometric Pressure :**	99.92kPa

Calibration Technician : Vicky Jaiswal
Secondary Check: Riley Cooper
Calibration Date : 13 Mar 2018
Report Issue Date : 13 Mar 2018
Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 2 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.07°C*
12.5kHz	*±0.21dB*	*Relative Humidity*	*±0.58%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.017kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

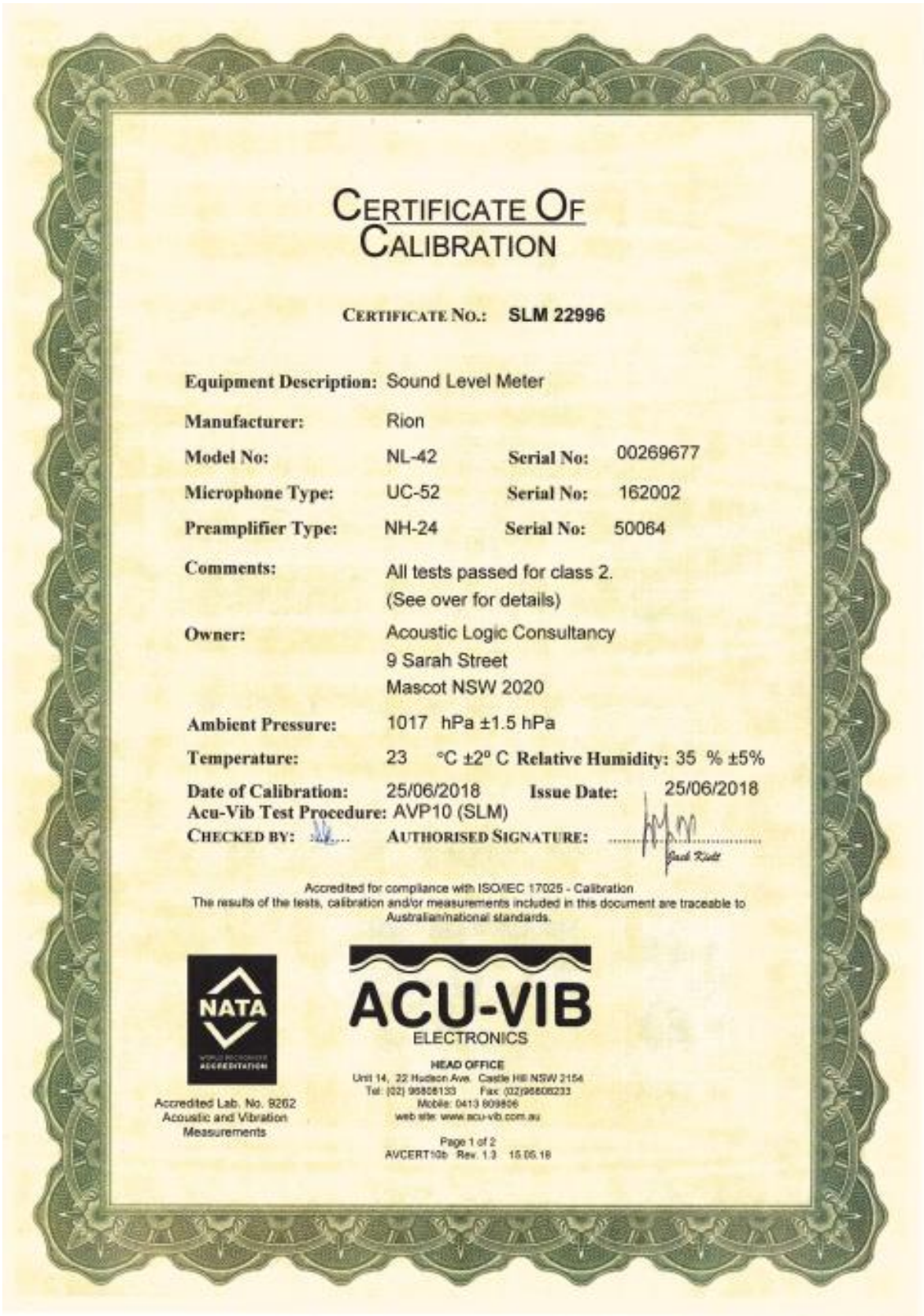
This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

Rion NL-42EX – Noise Monitor



CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 22996

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-42	**Serial No:**	00269677
Microphone Type:	UC-52	**Serial No:**	162002
Preamplifier Type:	NH-24	**Serial No:**	50064
Comments:	All tests passed for class 2. (See over for details)		
Owner:	Acoustic Logic Consultancy 9 Sarah Street Mascot NSW 2020		
Ambient Pressure:	1017 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	35 % ±5%
Date of Calibration:	25/06/2018	**Issue Date:**	25/06/2018
Acu-Vib Test Procedure:	AVP10 (SLM)		
CHECKED BY:		**AUTHORISED SIGNATURE:**	

Accredited for compliance with ISO/IEC 17025 - Calibration
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NATA
Accredited Lab. No. 9262
Acoustic and Vibration Measurements

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Page 1 of 2
AVCERT10b Rev. 1.3 15.05.18

Rion NL-42EX – Noise Monitor

APPENDIX 4 – DAILY RATING BACKGROUND NOISE LEVELS

Table 17 – Unattended Noise Monitor – Rear of the site (south)

Date	Measured Rating Background Level (RBL) dB(A)L_{90}		
	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am Next Day)
Monday 30 July 2018	-	38	35
Tuesday 31 July 2018	44	41	36
Wednesday 01 August 2018	43	39	36
Thursday 02 August 2018	43	39	35
Friday 03 August 2018	44	40	34
Saturday 04 August 2018	44	40	35
Sunday 05 August 2018	41	42	36
Monday 06 August 2018	47	44	41
Tuesday 07 August 2018	-	-	-
Median	**44**	**40**	**35**

Table 18 – Unattended Noise Monitor – Rear of the site (south)

Date	Measured Rating Background Level (RBL) dB(A)L_{90}		
	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am Next Day)
Monday 30 July 2018	-	39	35
Tuesday 31 July 2018	48	43	36
Wednesday 01 August 2018	48	43	33
Thursday 02 August 2018	49	45	36
Friday 03 August 2018	48	43	34
Saturday 04 August 2018	48	42	35
Sunday 05 August 2018	45	44	38
Monday 06 August 2018	50	44	36
Tuesday 07 August 2018	-	-	-
Median	**48**	**43**	**36**