MATTHEW PALAVIDIS
VICTOR FATTORETTO
MATTHEW SHIELDS

International Chinese School, 211 Pacific Highway, St Leonards

Noise & Vibration Impact Assessment

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

ABN 11 068 954 343
www.acousticlogic.com.au

The information in this document is the property of Acoustic Logic Consultancy Pty Ltd ABN 11 068 954 343 and shall be returned on demand. It is issued on the condition that, except with our written permission, it must not be reproduced, copied or communicated to any other party nor be used for any purpose other than that stated in particular enquiry, order or contract with which it is issued.

Project ID	20190534.1
Document Title	Noise & Vibration Impact Assessment
Attention To	International Chinese School Ltd

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	4/06/2019	20190534.1/0406A/R0/AR	AR		VF
1	26/06/2019	20190534.1/2606A/R1/AR	AR		VF

TABLE OF CONTENTS

1 INTRODUCTION 5
2 RESPONSE TO SEARS 6
3 SITE DESCRIPTION AND SITE OPERATION 7
3.1 SITE DESCRIPTION 7
3.2 SITE OPERATION 9
4 SURVEY OF AMBIENT NOISE 11
4.1 ENVIRONMENTAL NOISE DESCRIPTORS 11
4.2 BACKGROUND NOISE LEVELS 11
4.2.1 Measurement Equipment 11
4.2.2 Measurement Location 11
4.2.3 Measurement Period 11
4.2.4 Measured Background Noise Levels 12
5 EXTERNAL NOISE INTRUSION ASSESSMENT 14
5.1 NOISE INTRUSION CRITERIA 14
5.1.1 NSW Department of Planning document – '*Development near Rail Corridors and Busy Roads – Interim Guideline*' 14
5.1.2 Australian and New Zealand Standard AS/NZS 2107:2016 – '*Recommended design sound levels and reverberation times for building interiors*' 14
5.1.3 Summarised Internal Noise Criteria 15
5.2 TRAFFIC NOISE MEASUREMENTS 15
5.2.1 Measurement Equipment. 15
5.2.2 Measurement Location 15
5.2.3 Measurement Period 15
5.2.4 Measured Traffic Noise Measurements 15
5.3 PREDICTED HELICOPTER NOISE LEVELS 17
5.4 RECOMMENDED TREATMENT 17
5.4.1 Glazed Windows and Doors 17
5.4.2 External Wall Construction 18
5.4.3 Roof Construction 18
6 NOISE EMISSION ASSESSMENT 19
6.1 POTENTIALLY IMPACTED RECEIVERS 19
6.2 OPERATIONAL NOISE EMISSION CRITERIA 19
6.2.1 State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 19
6.2.2 EPA Noise Policy for Industry 20
6.2.3 Road Noise Policy (RNP) 21
6.3 OPERATIONAL NOISE EMISSION ASSESSMENT 22
6.3.1 Noise from Internal Spaces 22
6.3.2 External Activities 22
6.3.3 Out of School Hours Activities 23
6.3.4 Traffic Generation and Carpark 24
6.3.5 Waste Removal 24
6.3.6 Non-School/Community Uses 24
7 OPERATIONAL VIBRATION EMISSION ASSESSMENT 24
8 CONSTRUCTION NOISE 25
8.1 SITE DESCRIPTION 25

8.2 RECEIVER LOCATIONS 25
8.3 CONSTRUCTION NOISE AND VIBRATION CRITERIA/GUIDELINES 25
8.3.1 EPA Interim Construction Noise Guideline 25
8.3.2 German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures* 26
8.3.3 British Standard BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)* 27
8.4 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES 28
8.5 NOISE PREDICTIONS 28
8.6 DISCUSSION 30
8.7 DISCUSSION – VIBRATION 30
8.8 RECOMMENDATIONS 31
8.9 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS 32
8.10 ADDITIONAL NOISE AND VIBRATION CONTROL METHODS 33
8.10.1 Selection of Alternate Appliance or Process 33
8.10.2 Acoustic Barriers 33
8.10.3 Material Handling 33
8.10.4 Treatment of Specific Equipment 33
8.10.5 Establishment of Site Practices 33
8.10.6 Combination of Methods 34
8.11 ADDRESSING COMPLAINTS 34
9 SUMMARY OF RECOMMENDATIONS 35
10 CONCLUSION 36
APPENDIX A – UNATTENDED NOISE MONITORING RESULTS (RATING BACKGROUND NOISE LEVELS) 37
LOGGER LOCATION 1 – 7 PORTVIEW ROAD, GREENWICH, BACKYARD 37
APPENDIX B – UNATTENDED NOISE MONITORING RESULTS (TRAFFIC NOISE MEASUREMENTS) 48
LOGGER LOCATION 2 – 211 PACIFIC HIGHWAY, ST LEONARDS, SOUTHERN BOUNDARY 5M FROM KERB 48

1 INTRODUCTION

This environmental noise and vibration assessment has been prepared by Acoustic Logic Consultancy (ALC) on behalf of The Trustee for Anglo Australian Christian & Charitable Trust (the Applicant). It accompanies an Environmental Impact Statement (EIS) in support of Stage Significant Development Application (SSD -10260) for the new International Chinese School to be located at 211 Pacific Highway, St Leonards.

The new school will cater for approximately 210 students and 12 full time staff upon complete. The proposal seeks consent for:

- Change of use of the existing office site to an educational establishment. The existing 2-storey building and one basement level will comprise of the following:
    - School administrative spaces including reception and foyer;
    - A staff meeting room and staff office;
    - Amenities (wash closets, kitchenette);
    - Four ground level general learning areas (GLA's);
    - Four first floor GLA's;
    - Ground floor shared resource area/library;
    - Basement level parking containing 10 spaces for visitors and staff, accessible from The Avenue.
- Minor associated site landscaping and open space including associated security fencing and play area;
- New vehicular access point (pick-up and drop-off zone):
    - Entrance via the existing local council carpark situated north-east of the site across The Avenue;
    - Four designated drop-off zones along The Avenue and one slow speed vehicle passing lane; and
    - Exit via the existing local council carpark.
- Signage associated with the school.

The purpose of this assessment is to address the SEARs related to noise and vibration impacts including an assessment of noise emissions during operational phases of the project and potential impacts from surrounding environmental noise sources.

2 RESPONSE TO SEARS

The environmental noise and vibration assessment is required by the Secretary's Environmental Assessment Requirements (SEARs) for SSD-10260. The table below identifies the SEARS that have been issued to the development located at 211 Pacific Highway, St Leonards, or formally known as The International Chinese School as of 18th April 2019. The relevant reference within this report has also been provided.

Table 1 -SEARs and Relevant Reference

SEARs Item	Report Reference
5. Environmental Amenity • Assess amenity impacts on the surrounding locality, including visual privacy, and acoustic impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated. • Identify any proposed use of the school outside of school hours (including weekends) and assess any resultant amenity impacts on the immediate locality and proposed mitigation measures.	Sections 4-9 Sections 2 & 4-6
11. Noise and Vibration Identify and assess operational noise, including consideration of any public-address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land. **Relevant Policies and Guidelines** NSW Noise Policy for Industry 2017 (EPA) Interim Construction Noise Guideline (DECC) Assessing Vibration: A Technical Guideline 2006 Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008) Australian Standard 2363:1999 Acoustics – Measurement of noise from helicopter operations.	Section 4-9

In this assessment we will:

- Identify nearby noise sensitive receivers and operational noise sources with the potential to adversely impact nearby development;
- Identify relevant noise emission criteria and guidelines applicable to the development;
- Predict operational noise emissions and assess them against acoustic criteria; and
- If necessary, determine building and/or management controls required to mitigate potential noise impacts.

3 SITE DESCRIPTION AND SITE OPERATION

3.1 SITE DESCRIPTION

The project site for the proposed school is located at 211 Pacific Highway, St Leonards. Onsite investigations have been carried out by this office regarding the surrounding acoustic environment around the project site, which has been detailed below:

- Pacific Highway located along the southern boundary of the project site, beyond the Pacific Highway are existing commercial buildings.
- The Avenue located along the north eastern boundary of the project site (laneway serving Gore Hill Cemetery), beyond The Avenue is the existing local council carpark;
- Gore Hill Cemetery adjacent to the site along the north western common boundary of the project site; and
- Gore Hill Oval and Gore Hill Park situated approximately 55m north-east of the project site.

The nearest noise sensitive receivers around the project site include:

- Receiver 1 – Existing commercial building located at 120 Pacific Highway, Greenwich situated approximately 35m south of the project site across Pacific Highway. Commercial receiver is multi-storey;
- Receiver 2 – Existing commercial building located at 124 Pacific Highway, Greenwich situated approximately 35m south of the project site across Pacific Highway. Commercial receiver is multi-storey;
- Receiver 3 – Residential dwelling located at 2 Anglo Road, Greenwich situated approximately 75m south west of the project site across Pacific Highway. Residential receiver is multi-storey;
- Receiver 4 – Residential dwelling located at 4 Portview Road, Greenwich situated approximately 75m south east of the project site across Pacific Highway. Residential receiver is multi-storey; and
- Receiver 5 – Residential dwelling located at 5 Portview Road, Greenwich situated approximately 100m south of the project site across Pacific Highway. Residential receiver is multi-storey.

A site map, measurement description and surrounding receivers are presented in Figure 3-1 below.

Figure 3-1: Site Survey and Monitor Positions

3.2 SITE OPERATION

The following table describes how the school is proposed to be used.

Table 2 – School Uses and Operating Times

Item	Use	Times
General	The proposed International Chinese School will cater for students K – Year 6. The school will have the following capacity upon completion of the development: • 12 full time staff • 210 students	General school operating hours will be: Monday – Friday 7:00am – 6:00pm.
Outdoor Play Area	Intended to be used only during school operating hours by school personnel.	Monday – Friday 7:00am – 6:00pm.
Out of School Hours	Out of School Hours (OOSH) use of the school facilities by school personnel only. This will include small before and after school care of a maximum 25 students.	Weekdays in the mornings (7:00am – 9:00am) and afternoons (3:00pm – 6:00pm).
Library	Intended use by school personnel only during school operating hours and OOSH above. No community use.	Monday – Friday 7:00am – 6:00pm. Occasional weeknight uses for presentations, parent/teacher nights.

This assessment has been conducted using the Stanton Dahl Architects architectural drawings, see details below.

Table 3 – Architectural Drawing List

Drawing Author	Drawing Number	Drawing Title	Date	Revision
Stanton Dahl Architects	SK01	SITE PLAN	23/05/19	4
	SK02	BASEMENT FLOOR PLAN	29/05/19	2
	SK03	GROUND FLOOR PLAN		
	SK04	FIRST FLOOR PLAN		

The site plan is shown below.

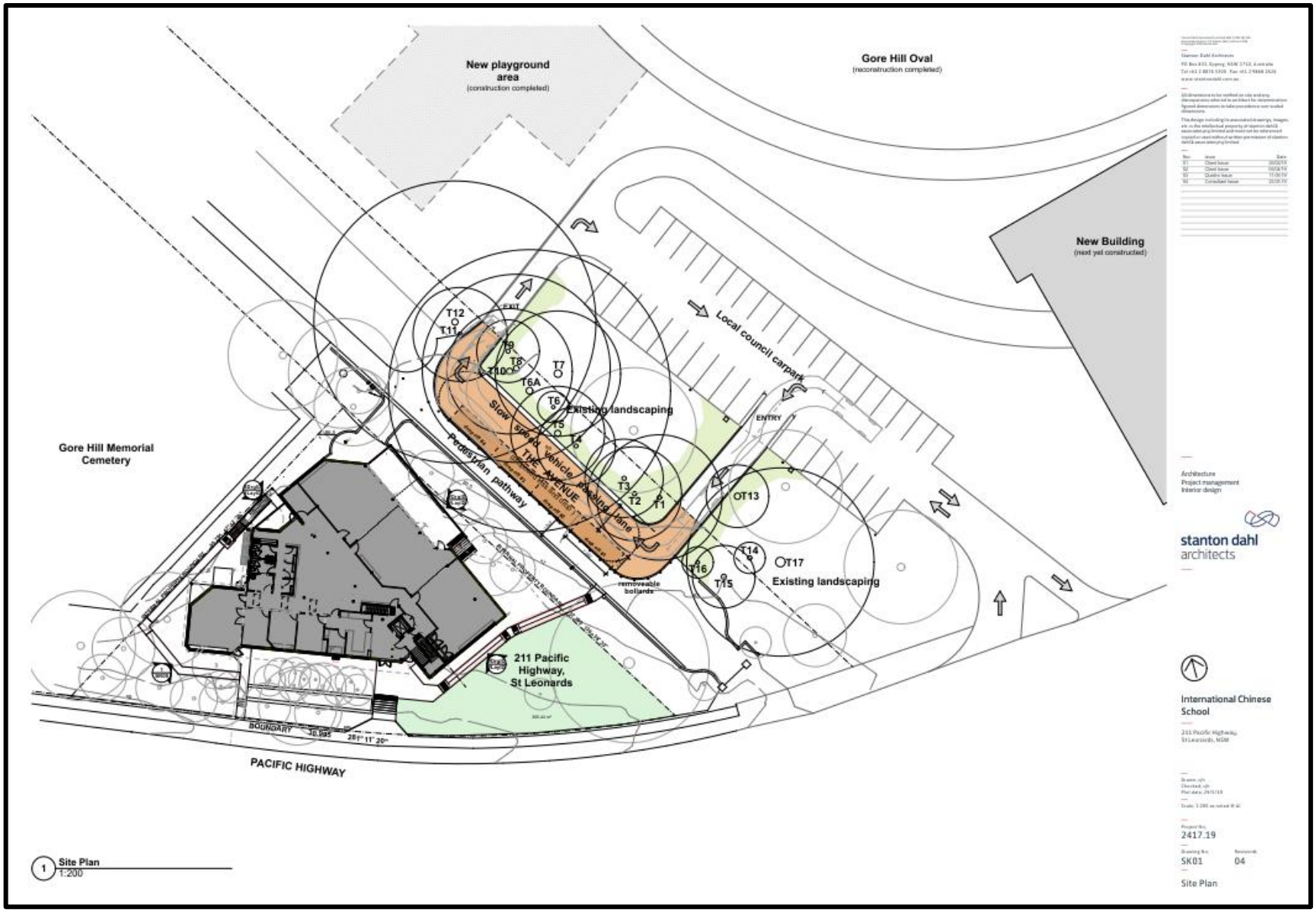


Figure 3-2: Proposed School Site Plan

4 SURVEY OF AMBIENT NOISE

Acoustic monitoring was conducted establish the background noise levels of the existing acoustic environment which will be used as basis for this assessment.

4.1 ENVIRONMENTAL 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_{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 environmental noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

4.2 BACKGROUND NOISE LEVELS

Background noise levels which will be used as a basis for this assessment are detailed in the following sections.

4.2.1 Measurement Equipment

Unattended noise monitoring was conducting using an Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of each measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

4.2.2 Measurement Location

An unattended noise monitor was installed at the residential dwelling located at 7 Portview Road, Greenwich in the centre of the backyard. Refer to Figure 3-1 above for a detailed location (Logger location L1).

4.2.3 Measurement Period

Unattended noise monitoring was conducted from Thursday 16th May 2019 to Saturday 25th May 2019.

4.2.4 Measured Background Noise Levels

The background noise levels established from the unattended noise monitoring are detailed in the table below.

4.2.4.1 Unattended Noise Measurements

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

Appendix A provides detailed graphed results of the unattended noise monitoring for background noise levels. Weather data has been obtained from the Observatory Hill weather station. Weather affected data (rainfall and wind speeds above 5m/s) has been excluded from the assessment. The processed Rating Background Noise Levels (lowest 10th percentile noise levels during operation time period) are presented in the tables below.

Table 4 – Unattended Noise Monitor – Location 1 – Rating Background Noise Level

Date	Measured Assessment Background Noise Level dB(A)$L_{90(Period)}$		
	Day (7:00am-6:00pm)	Evening (6:00pm-10:00pm)	Night (10:00pm-7:00am Next Day)
Thursday, 16 May 2019	-	38	31
Friday, 17 May 2019	40	38	31
Saturday, 18 May 2019	39	38	33
Sunday, 19 May 2019	38	38	30
Monday, 20 May 2019	39	39	32
Tuesday, 21 May 2019	40	38	32
Wednesday, 22 May 2019	40	37	31
Thursday, 23 May 2019	40	37	30
Friday, 24 May 2019	40	39	32
Saturday, 25 May 2019	-	-	-
Median	**40**	**38**	**31**

4.2.4.2 Summarised Rating Background Noise Levels

Site investigations, attended and unattended noise measurements indicate that the acoustic environment for the project site are as below.

Table 5 -Summarised Rating Background Noise Level

Location	Time of day	Rating Background Noise Level dB(A)$L_{90(Period)}$
7 Portview Road, Greenwich (See Figure 3-1)	Day (7:00am-6:00pm)	40
	Evening (6:00pm-10:00pm)	38
	Night (10:00pm-7:00am)	31

5 EXTERNAL NOISE INTRUSION ASSESSMENT

Site investigations indicate that the major external noise sources around the project site is traffic noise from Pacific Highway situated along the southern boundary of the project site, and potentially helicopter movements from the nearby Royal North Shore Hospital situated approximately 400m north-east of the project site. Noise intrusion from these sources will be assessed in accordance with the nominated criteria below.

5.1 NOISE INTRUSION CRITERIA

A noise intrusion assessment has been conducted to address the requirements of the following noise criteria/standards:

- NSW Department of Planning document – '*Development near Rail Corridors and Busy Roads – Interim Guideline'; and*
- Australian and New Zealand Standard AS/NZS 2107:2017 – '*Recommended design sound levels and reverberation times for building interiors*'.

5.1.1 NSW Department of Planning document – '*Development near Rail Corridors and Busy Roads – Interim Guideline*'

Table 3.1 on Page 19 of the guideline provides noise criteria for maximum noise levels within educational institutions. The guideline recommends a maximum noise level of 40dB(A)$L_{eq(15hr)}$.

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

The standard provides recommended internal noise levels for internal spaces within educational buildings. The following table gives the range of internal noise levels for educational buildings, as detailed in Table 1 in Section 5 of AS2107-2016.

Table 6 – AS/NZS 2017:2016 Recommended Design Sound Levels

Space/Activity Type	Recommended Design Sound Level[(1)]
Libraries – Reading areas	40-45dB(A)$L_{eq(when\ in\ use)}$
Medical Rooms (First Aid)	40-45dB(A)$L_{eq(when\ in\ use)}$
Office Areas and Staff Common Rooms	40-45dB(A)$L_{eq(when\ in\ use)}$
Professional and Administrative Offices	35-40dB(A)$L_{eq(when\ in\ use)}$
Teaching Spaces/Single Classroom – Primary Schools	35-45dB(A)$L_{eq(when\ in\ use)}$

Table Notes:

1. Compliance with AS/NZS 2107:2016 is achieved if internal noise levels do not exceed the above ranges, therefore at a minimum, for compliance with AS/NZS 2107:2016 we will adopt the highest number of the range as a compliant level.

5.1.3 Summarised Internal Noise Criteria

Summarised internal noise criteria for each room/space is given below. The most stringent noise levels from the criteria outlined above has been adopted for our assessment.

Table 7 – Summarised Internal Noise Level Requirements

Room	Internal Noise Level Requirement
Libraries – Reading areas	40dB(A)$L_{eq(when\ in\ use)}$
Medical Rooms (First Aid)	
Office Areas and Staff Common Rooms	
Professional and Administrative Offices	
Teaching Spaces/Single Classroom – Primary Schools	

5.2 TRAFFIC NOISE MEASUREMENTS

Noise measurements have been conducted at the site to establish traffic noise levels impacting the development. The results of these measurements are presented below.

5.2.1 Measurement Equipment.

Unattended noise monitoring was conducting using an Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of each measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weight fast response mode.

Attended short term measurements of traffic noise were undertaken by this office. Measurements were conducted using a Norsonic 140 Sound Analyser. The analyser was set to fast response and calibrated before and after the measurements using a Norsonic Sound Calibrator type 1251. No significant drift was noted.

5.2.2 Measurement Location

An unattended noise monitor was installed at the adjacent to the fence on the southern boundary of the project site. Refer to Figure 3-1 (Logger location L2). Unattended noise monitor had a direct, 180° view of Pacific Highway and was setback 5m from the kerb. Attended measurements were also conducted at the noise monitor location L2.

5.2.3 Measurement Period

Unattended noise monitoring was conducted from Monday 3rd June 2019 to Monday 10th June 2019.

Attended noise measurements were undertaken between the hours of 12:30pm and 2:30pm on Thursday 16th May 2019.

5.2.4 Measured Traffic Noise Measurements

Attended and unattended traffic noise measurements have been summarised below for all locations.

5.2.4.1 Unattended Noise Monitoring

Results of the unattended noise monitoring conducted around the site has been summarised in the table below. Further detailed results can be found in Appendix B of this report. Weather affected data indicated by the red shading on the figures in Appendix B have been removed from the calculation of the average noise levels below. Additionally, monitoring data for the weekend has not been included as the school will not be operating on these days.

Table 8 – Unattended Noise Monitor – Location 2 – Traffic Noise Measurements

Date	Measured Traffic Noise Level dB(A)$L_{eq(Period)}$	
	Day (7:00am-10:00pm)	**Night (10:00pm-7:00am)**
Thursday, 06 June 2019	71	66
Friday, 07 June 2019	73	65
Monday, 10 June 2019	68	64
Logarithmic Average	**71**	**65**

5.2.4.2 Attended Traffic Noise Measurements

Results of the attended noise measurement conducted around the project site has been summarised below.

Table 9 – Attended Noise Measurements

Location	Time of Measurement	Measured Noise Level dB(A)$L_{eq(15\text{-}minutes)}$
Pacific Highway (See Figure 3-1) 5m from kerb 180° view of the road	12:30pm – 2:30pm Thursday 16th May 2019	71

5.2.4.3 Summarised Measured External Noise Levels

The existing traffic and environmental noise levels listed in the table below were determined based on the unattended noise monitoring and attended noise measurements presented above.

Table 10 – Measured Existing Traffic and Environmental Noise Levels

Location	Summary of Measured Existing Traffic and Environmental Noise Level	
	Daytime (7:00am-10:00pm) dB(A)$L_{eq(15hour)}$	**Night time (10pm-7am) dB(A)$L_{eq(9hour)}$***
Pacific Highway (See Figure 3-1)) 5m from kerb	71	65

5.3 PREDICTED HELICOPTER NOISE LEVELS

It is a long establish principle that noise from emergency helicopters is treated in a similar manner to noise from other emergency vehicles including ambulance and fire appliance sirens, that is it is not generally taken into account when assessing site suitability. Emergency helicopter noise is not covered by AS 2021 for example .

Notwithstanding, worst case noise levels at the site from helicopter movements to and from the Royal North Shore Hospital situated approximately 400m north-east of the project site have been predicted based on the following information/assumptions:

- Helicopters on approach to the Royal North Shore Hospital Helicopter Landing Site (HLS) are permitted to fly directly over the project site.
- A sound power level (SWL) of 135dB(A) based on measurements by this office has been adopted for the helicopters servicing the hospital (Agusta AW-139).
- Based on the approach plan for the Acute Hospital HLS, helicopters on approach to the HLS flying directly over the project site will be at an approximate altitude of 93m above ground level.

An external noise level of 84dB(A)L_{max} is predicated at the façade of the development. With regard to the above information, we note the following:

- Taking into account the operation hours of the school and the number of flights per day, noise impacts from helicopters on approach and departing the Royal North Shore Hospital HLS will have minimal noise impacts on the development.
- Heavy vehicles on the highway will generate similar noise levels at the façade of the development.

5.4 RECOMMENDED TREATMENT

The following treatment is recommended to meet the internal noise level requirements.

5.4.1 Glazed Windows and Doors

Recommended glazing and door constructions are summarised below:

- All spaces are to have minimum 6.38mm glazing fitted to openable frames, with the overall glazed system achieving a minimum acoustic rating of R_w 31.
- Any doors in the south façade (facing Pacific Highway) or north east façade (facing The Avenue) should have a minimum rating of R_w 31.

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.

5.4.2 External Wall Construction

The external walls for the proposed development are to be constructed from a combination of masonry double brick, brick veneer and light weight wall systems.

External walls constructed from double brick and brick veneer (110mm Brick + Cavity + 92mm Steel Stud with 75mm thick 11kg/m^3 glasswool insulation in stud cavity + 13mm Standard Plasterboard) will not require further acoustic treatment.

External walls to be constructed from light weight elements will require further acoustic treatment. Minimum recommended constructions are detailed in the table below.

Table 11 – Recommended Minimum External Wall Constructions

Facade	Internal Lining	Stud System	External Lining
South (Facing Pacific Highway)	2 x 13mm Standard Plasterboard	Min. 92mm Steel Stud with 75mm thick 11kg/m^3 glasswool insulation in stud cavity	As Per Architects Detail (Min. 12.5kg/m^2)
Remaining	1 x 13mm Standard Plasterboard		

If any penetrations are required through any of the external linings in the systems above for other building services, all gaps should be filled with acoustic sealant.

5.4.3 Roof Construction

The roof for the proposed development is to be constructed from a lightweight sheet metal roof system which will require further acoustic treatment. Minimum recommended constructions are detailed in the table below.

Table 12 – Recommended Minimum Roof Constructions

Roof	Internal Lining	Truss System	External Lining
Ground Level Roof (Over GLA4, Office, Staff Meeting Room, Withdrawal, Reception/Admin, Foyer and Library)	2 x 13mm Standard Plasterboard	Min. 250mm Timber truss with 75mm thick 11kg/m^3 glasswool insulation in truss cavity	Min. 0.5mm Sheet Metal (Colorbond or similar)
First Floor Roof (Over GLA5-7 and Shared Resource Area)	1 x 13mm Standard Plasterboard		

If any penetrations are required through any of the external linings in the systems above for other building services, all gaps should be filled with acoustic sealant.

6 NOISE EMISSION ASSESSMENT

6.1 POTENTIALLY IMPACTED RECEIVERS

The potentially most impacted receivers are:

- Receiver 1 – Existing commercial building located at 120 Pacific Highway, Greenwich situated approximately 35m south of the project site across Pacific Highway. Commercial receiver is multi-storey;
- Receiver 2 – Existing commercial building located at 124 Pacific Highway, Greenwich situated approximately 35m south of the project site across Pacific Highway. Commercial receiver is multi-storey;
- Receiver 3 – Residential dwelling located at 2 Anglo Road, Greenwich situated approximately 75m south west of the project site across Pacific Highway. Residential receiver is multi-storey;
- Receiver 4 – Residential dwelling located at 4 Portview Road, Greenwich situated approximately 75m south east of the project site across Pacific Highway. Residential receiver is multi-storey; and
- Receiver 5 – Residential dwelling located at 5 Portview Road, Greenwich situated approximately 100m south of the project site across Pacific Highway. Residential receiver is multi-storey.

The remainder of the properties around the site will be impacted to a lesser extent than those identified above. Therefore, if the properties listed above are not adversely impacted, all other properties around the site will not be adversely impacted.

6.2 OPERATIONAL NOISE EMISSION CRITERIA

The SEARS requires a consideration of noise emissions including any public address system, school bell, mechanical services (E.g. air conditioning pant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of the land.

Guidelines referenced in the SEARs, as well as other applicable guidelines are provided below:

- NSW Department of Planning State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017
- EPA Noise Policy for Industry (NPfI) 2017 (applicable for plant/equipment noise)
- EPA Road Noise Policy (applicable for the assessment of noise from traffic generation by the site)
- EPA Assessing Vibration: A Technical Guidelines 2006

6.2.1 State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017

Schedule 2 "Schools - Complying Development" of the Educational SEPP provides the following complying development requirements relating to noise emissions:

6. Noise

> *A new building or (if the development is an alteration or addition to an existing building for the purpose of changing its use) an existing building that is to be used for the purpose of a school or school-based child care must be designed so as not to emit noise exceeding an LAeq of 5 dB(A) above background noise when measured at any lot boundary.*

6.2.2 EPA Noise Policy for Industry

Noise sources generally covered by this code are mechanical services and plant noise. Both the intrusiveness and the amenity criteria (as set out below) must be complied with. Emissions from activities carried out prior to 7am and after 10pm should also be assessed for potential impacts on sleep for residential receivers.

6.2.2.1 Intrusiveness Assessment

Intrusiveness criteria aim to limit noise generation to no more than 5dB(A) above existing background noise levels. The intent is to limit the audibility of noise emissions above the prevailing background noise level.

6.2.2.2 Amenity Assessment

The amenity criteria set additional criteria based on the land use of the noise sensitive receivers and time of day. The intent is to limit the absolute noise level to that is consistent with the prevailing land use.

The EPA's *NPfI* sets out acceptable noise levels for various localities based on land zoning. The recommended noise amenity area for the residential receivers identified in Section 6.1 is 'Suburban'.

The NPfI 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 applicable to the receivers surrounding the project site are presented in Table 13.

Table 13 – EPA NPfI Project Amenity Noise Levels

Receiver	Time of Day	Recommended Amenity Noise Level dB(A)$L_{eq(period)}$	Project Amenity Noise Level dB(A)$L_{eq(15min)}$
R1, R2 (Commercial)	When in use	65	63
R3, R4, R5 (Residential, Suburban)	Day (7:00am-6:00pm)	55	53
	Evening (6:00pm-10:00pm)	45	43
	Night (10:00pm-7:00am Next day)	40	38

6.2.2.3 Summary of NPfI Trigger Levels

Table 14 summarises the trigger levels determined using NPfI guidelines and the measured rating background noise levels.

Table 14 – Summary of NPfI Trigger Levels

Receiver	Time	Intrusiveness $L_{Aeq,15min}$	Amenity $L_{Aeq,period}$
R1, R2 (Commercial)	When in use	-	63 (External)
R3, R4, R5 (Residential)	Day (7:00am-6:00pm)	45	53
	Evening (6:00pm-10:00pm)	43	43
	Night (10:00pm-7:00am Next day)	36	38

6.2.3 Road Noise Policy (RNP)

The RNP provides guidelines for assessing noise emissions from public roads, including the impact of traffic generated by developments.

The policy applies different assessment objectives to various road classifications. Pacific Highway would be classified as an arterial road.

The applicable assessment criteria for residential receivers affected by traffic generated by land use developments are (measured at the façade of dwellings) :

- Arterial – 60 dB(A) $L_{eq,15hr}$ (7am to 10pm) and 55 dB(A) $L_{eq,9hr}$ (10pm to 7am)

The policy also states that:

- Consideration of the noise increase should be made for sub-arterial and arterial roads.
- Noise impacts from increases in noise levels of 2 dB(A) or less are minor, and by implication do not require mitigation.

6.3 OPERATIONAL NOISE EMISSION ASSESSMENT

An assessment of operational noise emissions is presented below. The following noise sources are assessed:

- Noise from internal areas
- Noise from mechanical plant, PA system and school bells.
- Traffic generation
- Waste Removal
- External activities

6.3.1 Noise from Internal Spaces

6.3.1.1 Administration, Library and General Learnings Spaces

These spaces would operate only during normal school hours, except occasional uses during the evening for presentations and parent/teacher nights.

The library, administration and teaching spaces generate low to medium levels of noise. The teaching spaces are typically at least 70m from any residential receiver and emissions from these spaces would clearly not exceed the Educational SEPP criteria. Residential receivers are also significantly shielded.

6.3.1.2 Noise from Mechanical Plant, PA System and School Bell

Detailed acoustic design of mechanical plant cannot be undertaken at approval stage, as plant selections and locations are not finalised. However, detailed acoustic assessment of all ventilation or other plant items should be undertaken at CC stage, once equipment items are selected and locations are finalised.

Given the proposed buildings are mostly remote from existing and future residential buildings, it is both possible and practical to treat noise from the operation of the proposed mechanical equipment to comply with the EPA NPfI criteria using appropriate siting and selection, standard acoustic treatments such as lined ductwork, silencers, screens and the like.

This office has been advised that the proposed school development will not use a PA system or school bells. As such, assessment of this items is not required.

6.3.2 External Activities

The expected external school activities include:

- Use of all external spaces immediately before school commencing, during recess/lunch periods and immediately after school finishing.

There are no criteria to be met regarding normal activities conducted by the school. Notwithstanding, noise levels from these facilities during operation will be predicated at the surrounding properties. Noise emissions from the use of the outdoor play area is predicated based on the following assumptions/information:

- At given time, a maximum of 75 students are allowed in the outdoor play area.
- Based on measurements conducted by this office at Anzac Park Public School, a sound power level (SWL) of 83dB(A) per student with one in two students speaking at any given time.

Predicted noise emissions to the surrounding properties have been predicted and are presented in Table 15.

Table 15 – Predicted Noise Levels from Outdoor Play Area Use

Receiver	Predicted Noise Level dB(A)$L_{eq(15min)}$	Noise Objective dB(A)$L_{eq(15min)}$	Comments
Commercial Receiver R1	56	65	Complies
Commercial Receiver R2	59	65	Complies
Residential Receiver R3	37	45	Complies
Residential Receiver R4	36	45	Complies
Residential Receiver R5	48	45	Minor Exceedance of Noise Objective. See Discussion below.

The predicted noise level at noise receiver R5 exceeds the noise objective by 3 dB(A). The level of impact from the outdoor play area at all other residences will be significantly lower due to the screening effects provided by the commercial buildings at 120 and 124 Pacific Highway, St Leonards.

With respect to the above for playground use it is typical to apply a less stringent indicator of noise impact than "background + 5 dB(A)" given that it is present for short periods through the day and it is regarded as "community" noise. Additionally, noise emissions to the other residences are compliant with a "background + 10dB(A)" noise emission indicator.

However, in our opinion, the higher exceedances for the most exposed residences are not unreasonable for the following reasons:

- It is common (and almost unavoidable) in school development that a playground is located in close proximity to residential development. In this regard we note that in *Meriden v Pedavoli [2009 NSWLEC 183]* the NSW Land and Environment Court noted "*All noise that emanates from the normal activities at a school is not offensive*". The Court had regard to the fact that there was other school development in the local government area in which playgrounds adjoin residential development and the fact the proposed use was permissible in the zone. This is consistent with the proposed development.

- As noted above, a playground located near a residential boundary is a common scenario in school developments. At the subject site, the main play areas are located well away from residential receivers.

- Given that there is already significant distance separation between the play areas and residences, the only way of minimising noise impact is to erect noise barriers around the school, However, these barriers have other negative impacts which, while technically feasible, may not be a reasonable response to a level of impact that typically occurs with schools placed within residential zonings and appears to be a generally accepted level of impact.

6.3.3 Out of School Hours Activities

Activities out of school hours would largely relate to the use of the school library, classrooms and outdoor play area. There could also be other "quiet" activities that may occur externally or within the buildings that would not result in significant noise emissions above those already discussed above. This would include parent/teacher nights or presentations.

6.3.4 Traffic Generation and Carpark

A basement staff carpark (10 vehicle capacity) is proposed to be accessed from The Avenue and a designated "kiss and drop" area with 5 allocated spaces is proposed to be located on The Avenue. A traffic assessment has been prepared by *Stanbury Traffic Planning* (reference: 19-050) to address parking and traffic impacts from the proposed development.

The expected flow of traffic is as follows:

- Vehicles turns left into the Council carpark from the Pacific Highway eastbound carriageway;
- Vehicles turn left into a single lane access road connecting the Council carpark and The Avenue;
- Vehicles turn right on to The Avenue and arrive at the "kiss and drop" area;
- Vehicles turn right into a single lane access road connecting The Avenue and the Council carpark;
- Vehicles turn left from the Council carpark on to the Pacific Highway eastbound carriage way.

As per the traffic assessment, additional traffic generated by the development is not projected to have noticeable impacts on the operation of the surrounding public roads. Access to and egress from the "kiss and drop" area on The Avenue is only via the Council carpark, and it is not desired that parents park within the Council carpark prior to and following the school day. The noise levels generated by traffic movements associated with the school would not cause a significant increase in traffic noise on these roads and would therefore not adversely impact receivers along nearby traffic routes.

Section 6.1 of the *Parking and Traffic Impact Assessment* indicates the projected peak hour traffic generated by the site based on student numbers will be 130 vehicle movements in a peak one-hour period.

At 130 vehicle movements per hour, the noise level at the building line of the nearest residences will be less than 60dB(A)$L_{eq(1hr)}$. This is therefore compliant with the Road Noise Policy allowable noise level as detailed in Section 6.2.3 which permits 60dB(A) as an average noise level over a 15-hour period.

6.3.5 Waste Removal

Waste collection should be scheduled to occur during the day time period only (7:00am – 6:00pm) to avoid disturbance to nearby residents outside of these hours. In particular, there should be no collection of waste during the night time period (10:00pm – 7:00am).

6.3.6 Non-School/Community Uses

Use of the school facilities for non-school/community use are not proposed at this stage. If uses are proposed in the future, they should be assessed for noise impact and appropriate mitigation and management implemented to prevent adverse impacts on surrounding properties. Appropriate assessment criteria should be development depending on the frequency of the use, time of day, type of activity, etc.

7 OPERATIONAL VIBRATION EMISSION ASSESSMENT

There would be no vibration impact from the proposal as there are no vibration sources that would produce perceptible vibration on any surrounding property.

8 CONSTRUCTION NOISE

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; and
- Formulation of a strategy to address the guidelines identified and mitigation treatments.

8.1 SITE DESCRIPTION

Construction works for the proposed school will consist primarily of the following construction activities:

- Landscaping and minor earthworks for construction of pedestrian pathway and loop road (accommodating the kiss and ride zone).

Work hours for the site are proposed as follows:

- Monday to Friday: 7:00am – 6:00pm
- Saturday: 7:00am – 12:00pm
- Sundays and Public Holidays: No work

8.2 RECEIVER LOCATIONS

Sensitive receiver locations have been identified in Section 6.1.

8.3 CONSTRUCTION NOISE AND VIBRATION CRITERIA/GUIDELINES

Noise and vibration emissions from construction activities at the project site will be assessed against the following guidelines:

- Noise
  - EPA Interim Construction Noise Guideline
- Vibration
  - German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures*
  - British Standard BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)*

8.3.1 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.

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 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.

Section 4.1.3 of the guideline also specifies management levels for land used for commercial purposes. The guidelines recommend that external noise levels be assessed at the most affected occupied point of the premises.

A summary of the above noise management levels from the ICNG is presented below in Table 16.

Table 16 – Noise Management Levels

Location	"Noise Affected" Level - dB(A)$L_{eq(15min)}$	"Highly Noise Affected" Level - dB(A)$L_{eq(15min)}$
Commercial Receiver R1	70	-
Commercial Receiver R2	70	-
Residential Receiver R3	50	75
Residential Receiver R4	50	75
Residential Receiver R5	50	75

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

8.3.2 German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures*

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 17 – 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 buildings would be considered a Type 1 structures, whilst nearby residences would be classified as type 2 structures.

8.3.3 British Standard BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)*

The NSW EPA document "*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 18 – 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

8.4 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

Typically, the most significant sources of noise or vibration generated during a construction project will be demolition, ground works and building structure works. Specifically, for this project, the main sources of noise will be generated during the demolition/ground works associated with the construction of the loop road to facilitates the kiss and ride zone. The following table presents assessment noise levels for typical construction equipment expected to be used:

Table 19 – Sound Power Levels of Typical Equipment

Equipment/Process	Sound Power Level dB(A)
Dozer/Excavator	112
Concrete Pump	110
Concrete Vibrators	100
Trucks	100
Powered Hand Tools	95-100
Bobcat	105

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

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

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

8.5 NOISE PREDICTIONS

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

- The activity undertaken; and
- The distance between the worksite 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 and shielding effects of existing structures.

Table 20 – Predicted Noise Generation to Commercial Receiver R1

Activity	Predicted Level (External) dB(A) $L_{eq(15min)}$	Comment
Dozer/Excavator	64-67	Complies with NML
Concrete Pump	64-65	Complies with NML
Concrete Vibrator	54-57	Complies with NML
Trucks	56	Complies with NML
Powered Hand Tools	56-61	Complies with NML
Bobcat	58	Complies with NML

Table 21 – Predicted Noise Generation to Commercial Receiver R2

Activity	Predicted Level (External) dB(A) $L_{eq(15min)}$	Comment
Dozer/Excavator	66-69	Complies with NML
Concrete Pump	64-68	Complies with NML
Concrete Vibrator	54-60	Complies with NML
Trucks	56-59	Complies with NML
Powered Hand Tools	55-61	Complies with NML
Bobcat	58-61	Complies with NML

Table 22 – Predicted Noise Generation to Residential Receiver R3

Activity	Predicted Level (External) dB(A) $L_{eq(15min)}$	Comment
Dozer/Excavator	47-49	Complies with NML
Concrete Pump	45-47	Complies with NML
Concrete Vibrator	35-38	Complies with NML
Trucks	37-38	Complies with NML
Powered Hand Tools	36-39	Complies with NML
Bobcat	39-40	Complies with NML

Table 23 – Predicted Noise Generation to Residential Receiver R4

Activity	Predicted Level (External) dB(A) $L_{eq(15min)}$	Comment
Dozer/Excavator	46-47	Complies with NML
Concrete Pump	44-46	Complies with NML
Concrete Vibrator	34-37	Complies with NML
Trucks	35-37	Complies with NML
Powered Hand Tools	35-37	Complies with NML
Bobcat	37-39	Complies with NML

Table 24 – Predicted Noise Generation to Residential Receiver R5

Activity	Predicted Level (External) dB(A) $L_{eq(15min)}$	Comment
Dozer/Excavator	59-60	Will exceed NML
Concrete Pump	55-59	Will exceed NML
Concrete Vibrator	45-48	Complies with NML
Trucks	47-50	Complies with NML
Powered Hand Tools	45-48	Complies with NML
Bobcat	49-52	Minor exceedance of NML

8.6 DISCUSSION

Without mitigation, noise at the most affected receivers around the site will generally comply with the NML. The greatest noise impact to residences will be those to the south west of the site at 4 Portview Road, Greenwich where there is less shielding from the existing commercial buildings along Pacific Highway.

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

8.7 DISCUSSION – VIBRATION

There are no significant sources of vibration envisaged. Given the distance of the project site from nearby receivers, vibration impacts are expected to be within the recommended levels detailed in Section 12.3.

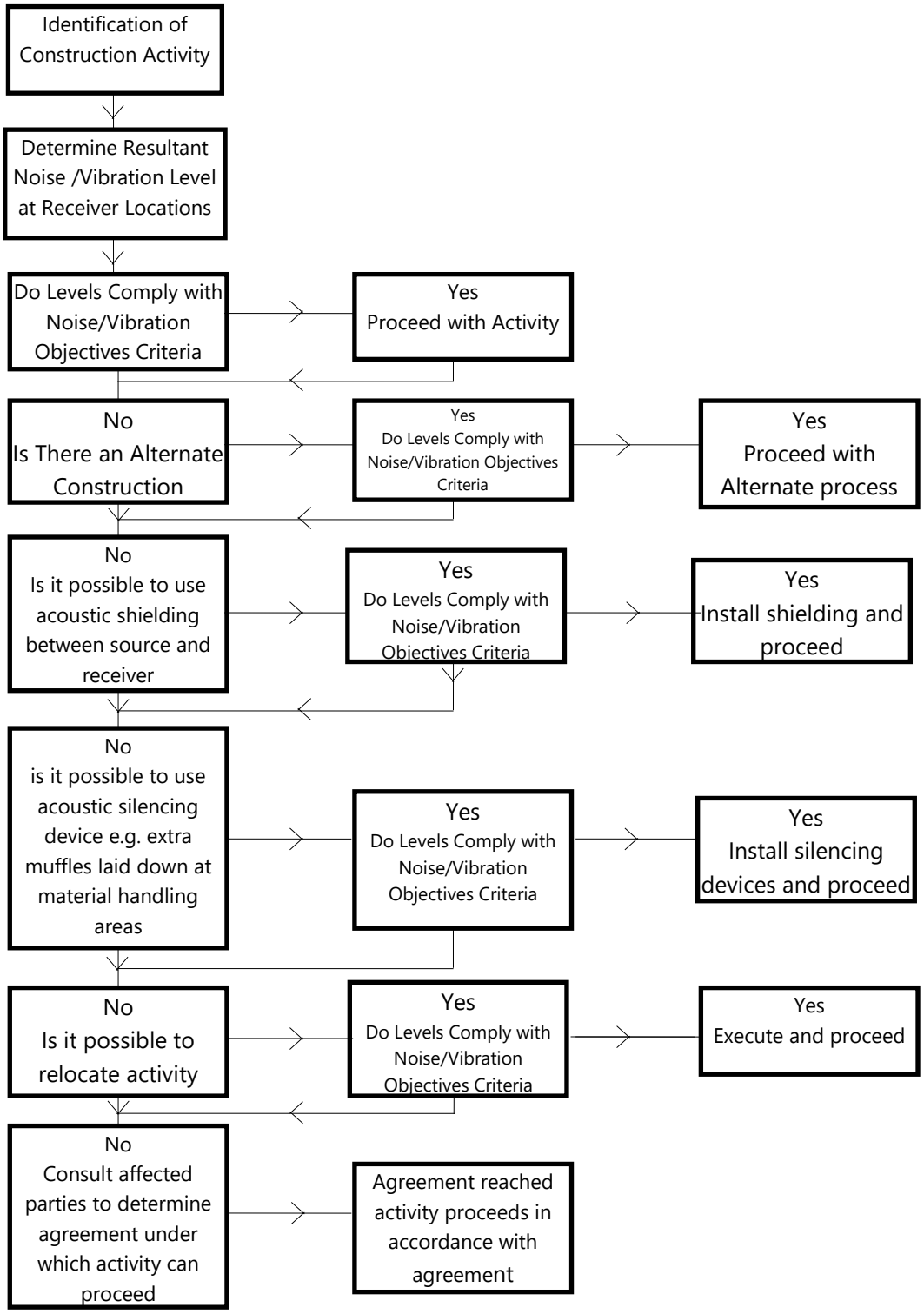
8.8 RECOMMENDATIONS

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

- Operation of large earthmoving equipment (bulldozers and excavators) between 7am and 8am should be avoided.
- Quiet work methods/technologies:
    - Concrete pump trucks should be located within the bounds of the site or as close as possible (rather than on nearby roads at the perimeter of the site) where feasible.
    - 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 8.9, 8.10 and 8.11 should be adopted.
- A detailed noise management plan should be adopted by the main contractor that describes in detail the construction phases, programme, processes and equipment used, noise impact assessment and proposed mitigation and management.
- 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 any noise complaint.

8.9 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS

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



8.10 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.

8.10.1 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.

8.10.2 Acoustic Barriers

Given the position of adjacent development, it is unlikely that noise screens will provide significant acoustic benefit for commercial receivers which overlook the project site. Residential receivers are also mostly shielded by existing buildings along Pacific Highway.

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 affected. 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.

8.10.3 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).

8.10.4 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.

8.10.5 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.

8.10.6 Combination of Methods

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

8.11 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 SUMMARY OF RECOMMENDATIONS

We recommend the following acoustic treatments/management controls are implemented to mitigate acoustic impact as much as practicable:

- Operation of the school should be limited to the activities and times of operation indicated in Table 2 of this report, subject to additional mitigation of noise for certain activities and operating times as indicated below.
- Use of school facilities by non-school/community use is not proposed at this stage. If uses are proposed in future, they should be assessed for noise impact and appropriate mitigation and management controls implement to prevent adverse impact on surrounding properties. As part of the assessment appropriate assessment criteria should be development depending on the frequency of use, time of day, type of activity, etc.
- Detailed acoustic review of all external plant items should be undertaken following equipment selection and duct layout design. All plant items will be capable of meeting noise emission requirements of Council and the EPA Noise Policy for Industry (2017), with detailed design to be done at CC stage.
- External speakers for PA and bells are not proposed at this stage. Should these be required, they should be assessed for noise impact and appropriate mitigation implemented to ensure compliance with EPA Noise Policy for Industry (2017) requirements stated in Section 6.2.2.
- Waste removal times should be scheduled between 7am and 6pm and co-ordinated with the child care centre to avoid child rest periods.
- Minimum glazing, external wall and roof constructions should be installed as per the recommendations specified in Section 5.4 to ensure internal noise levels meet the requirements stated in Section 5.1.3.
- The proposal would not produce adverse vibration impacts on nearby structures or impact the amenity of the surrounding properties.
- Construction noise impacts should be managed as outlined in Section 8.8-8.11.

10 CONCLUSION

Noise emissions associated with the proposed International Chinese School to be located at 211 Pacific Highway, St Leonards have been assessed with reference to the following acoustic guidelines/criteria:

- NSW Department of Planning *State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017*
- EPA *Noise Policy for Industry (NPfI) 2017*
- EPA *Road Noise Policy*
- EPA *Assessing Vibration: A Technical Guidelines 2006*
- NSW Department of Planning *Development Near Rail Corridors and Busy Roads – Interim Guideline*
- EPA *Interim Construction Noise Guideline*

Recommendations have been made to ensure that noise emissions from the school do not adversely impact the surrounding properties. Provided the recommendations are adopted the proposed school will not adversely impact the acoustic amenity of surrounding receivers.

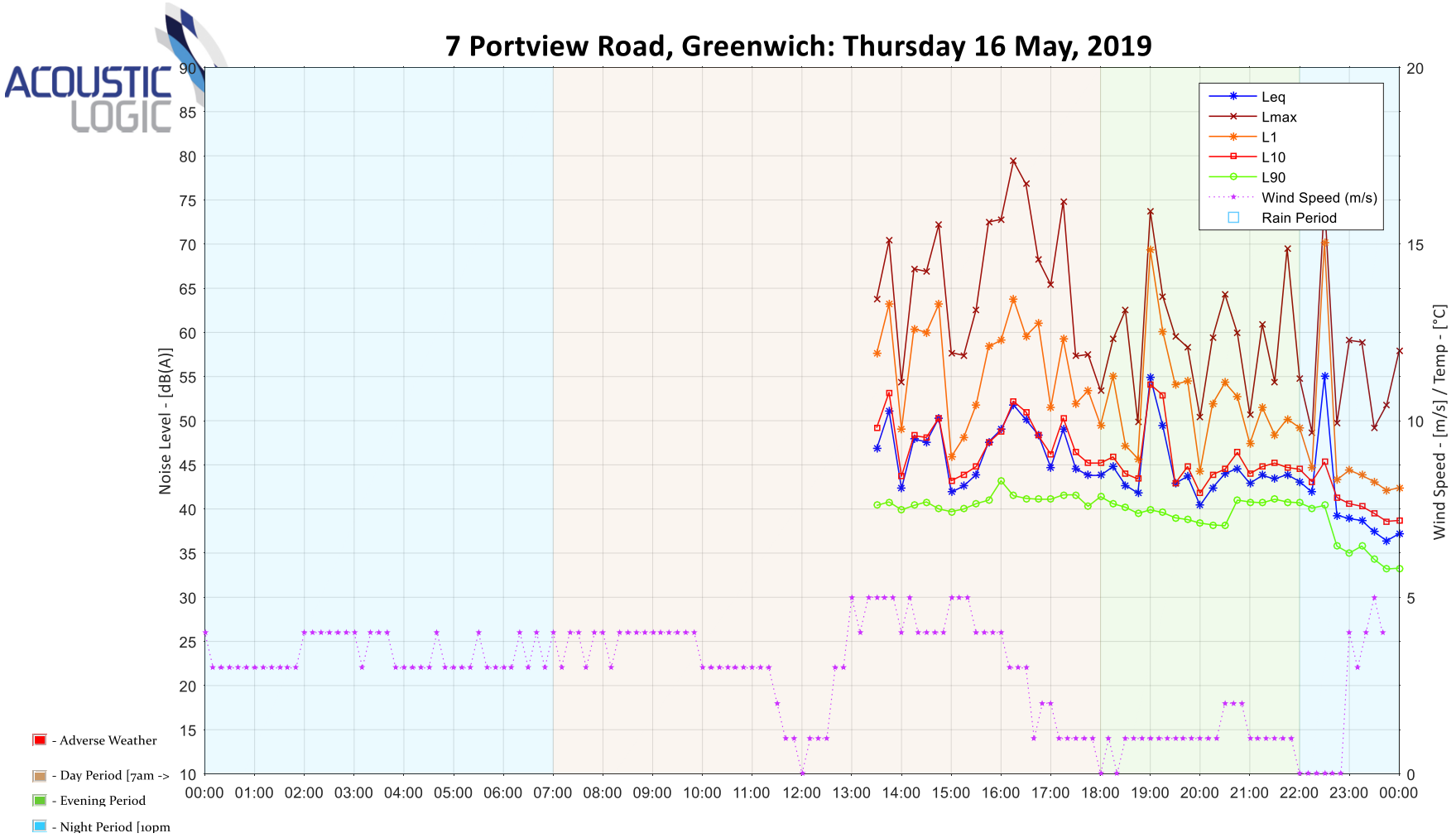
We trust this information is satisfactory. Please contact us should you have any further queries.

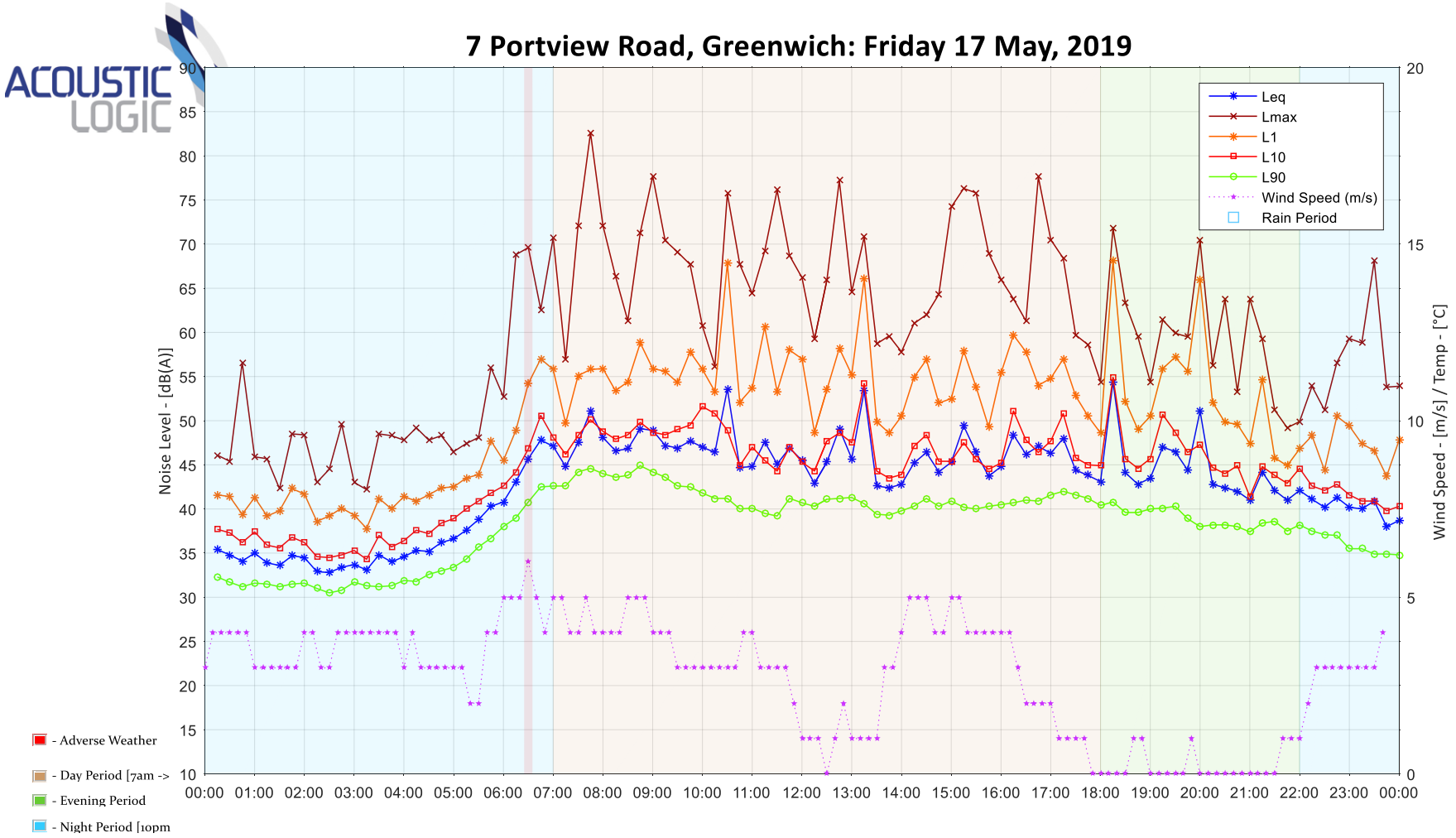
Yours faithfully,

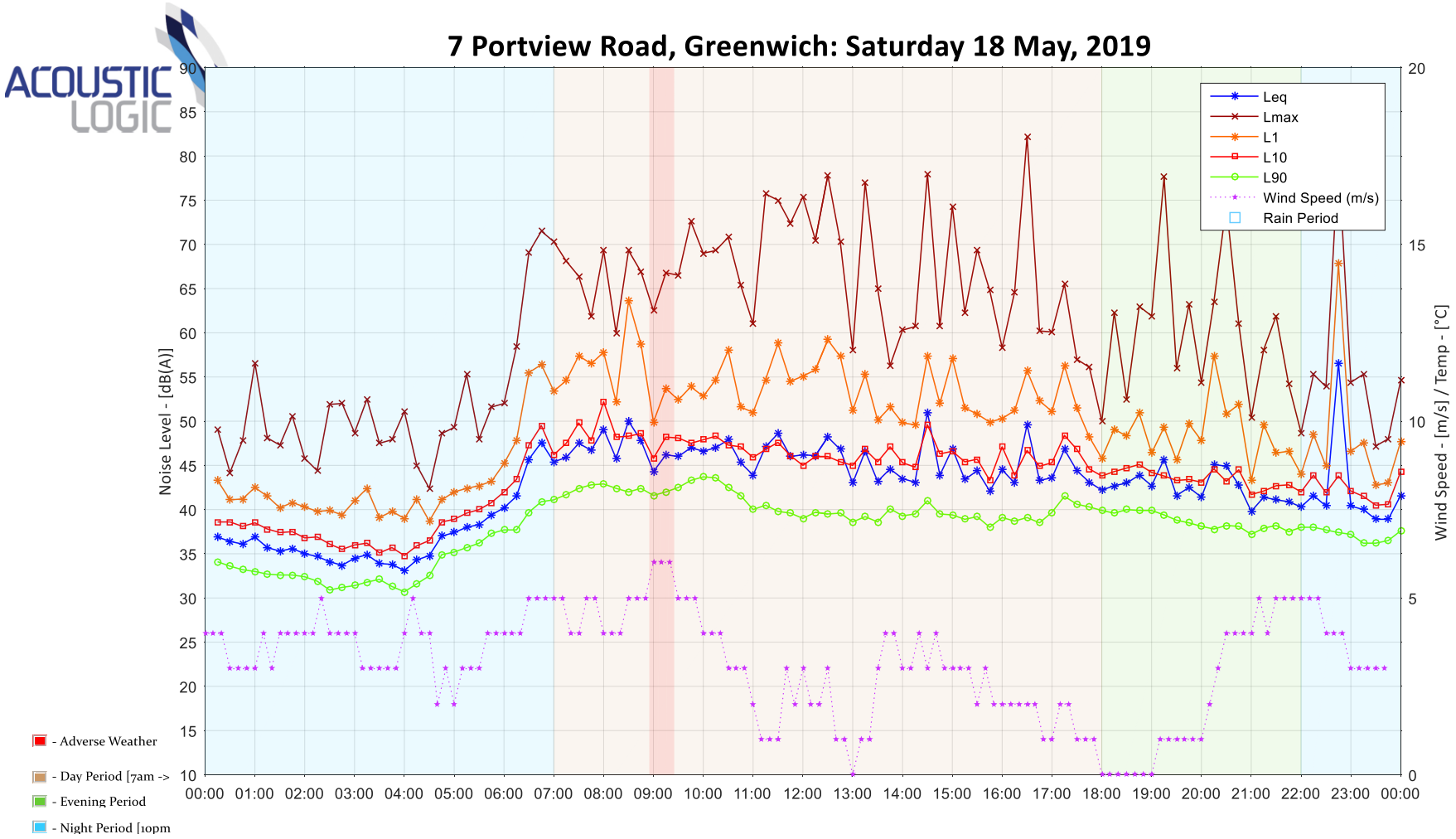
Acoustic Logic Consultancy Pty Ltd
Artie Rattananikom

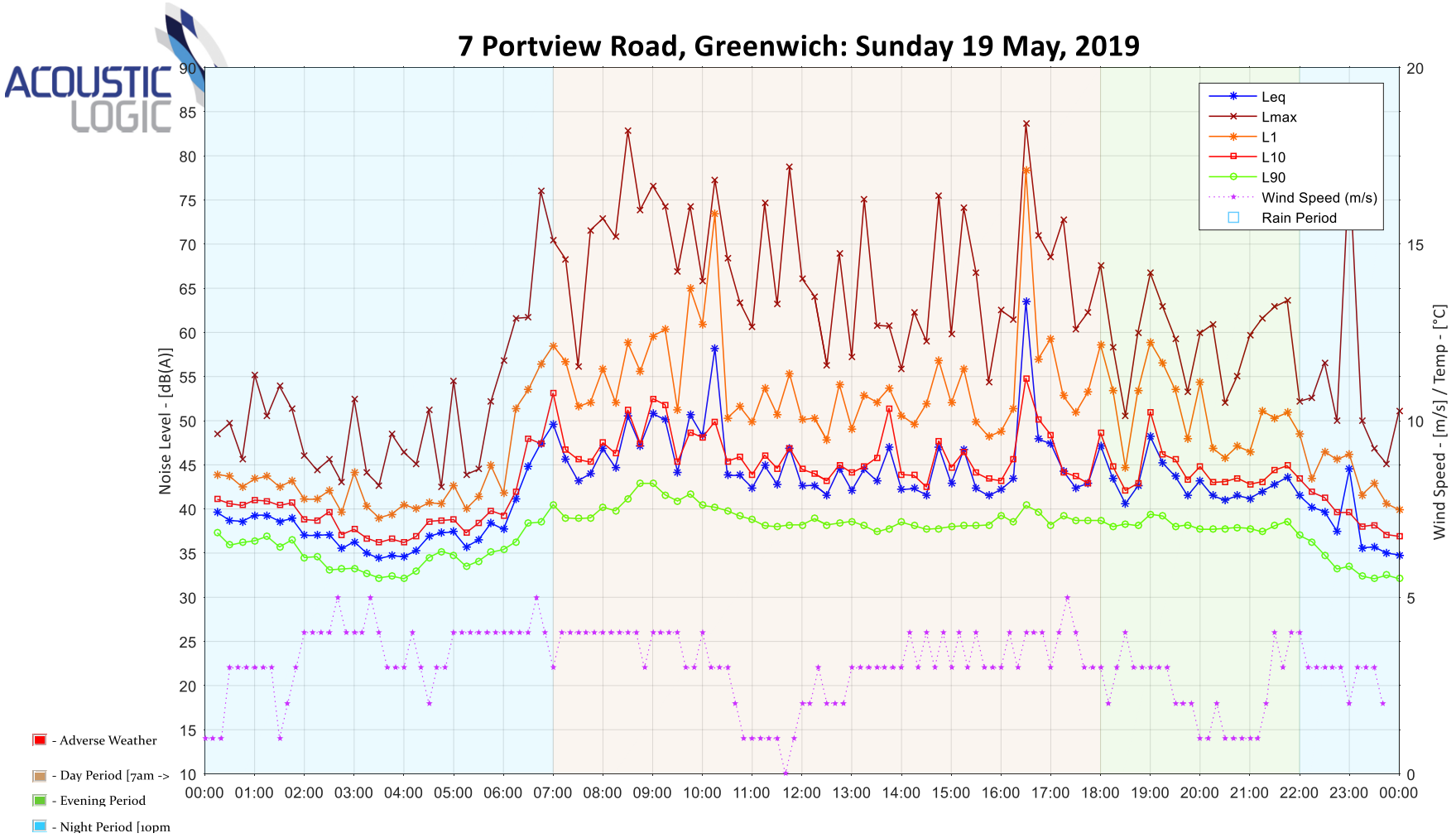
APPENDIX A – UNATTENDED NOISE MONITORING RESULTS (RATING BACKGROUND NOISE LEVELS)

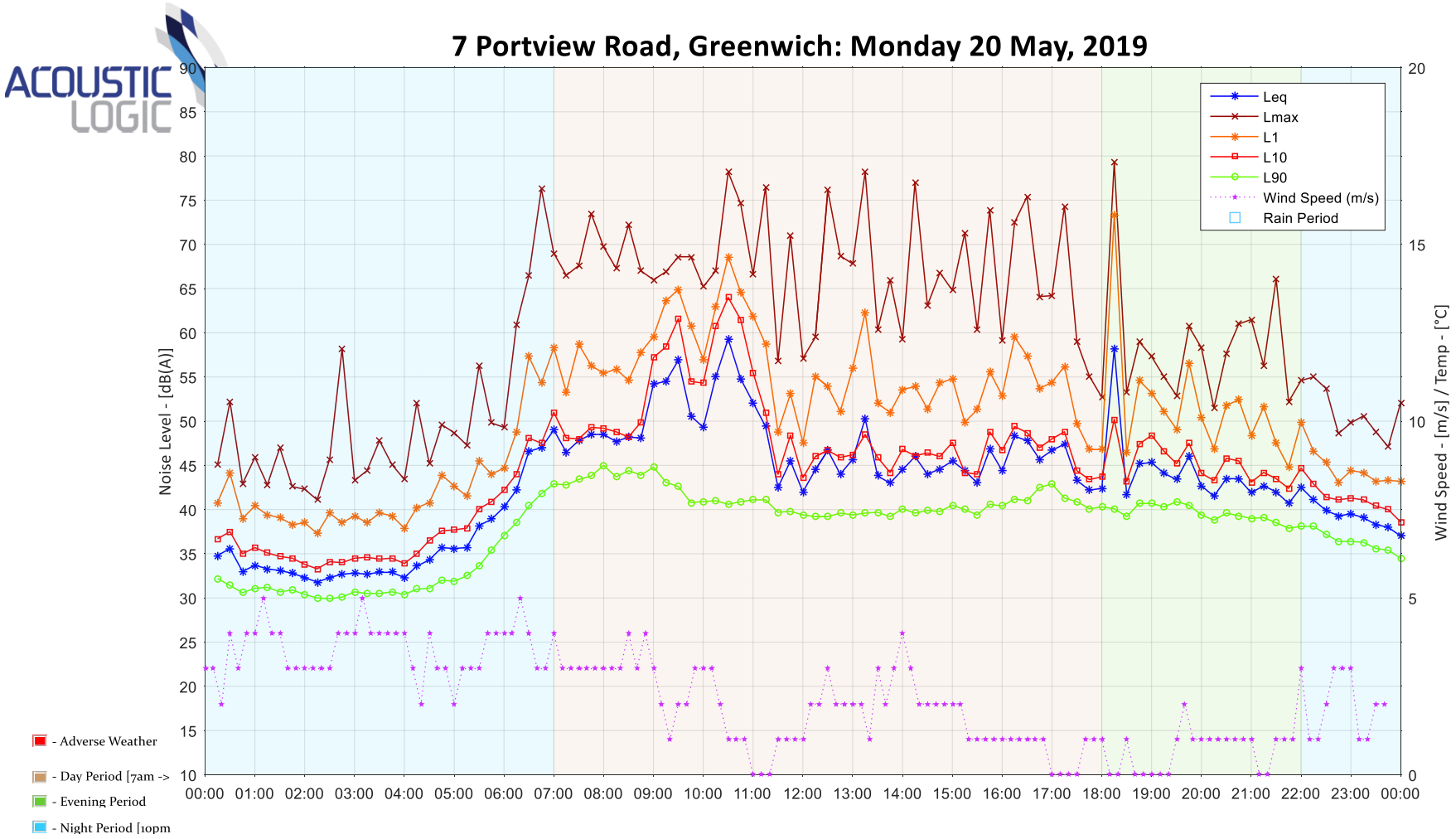
LOGGER LOCATION 1 – 7 PORTVIEW ROAD, GREENWICH, BACKYARD

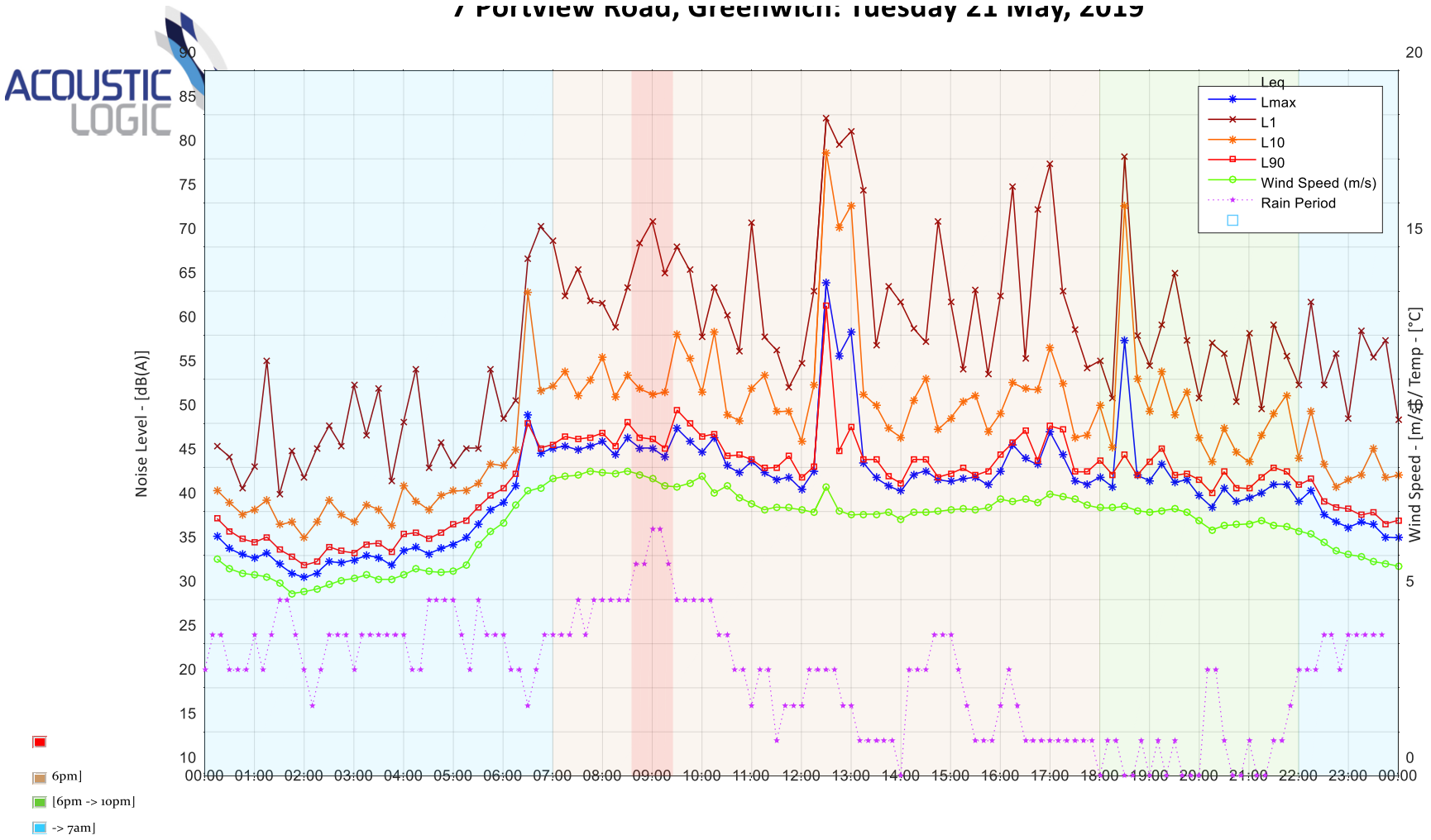

7 Portview Road, Greenwich: Thursday 16 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

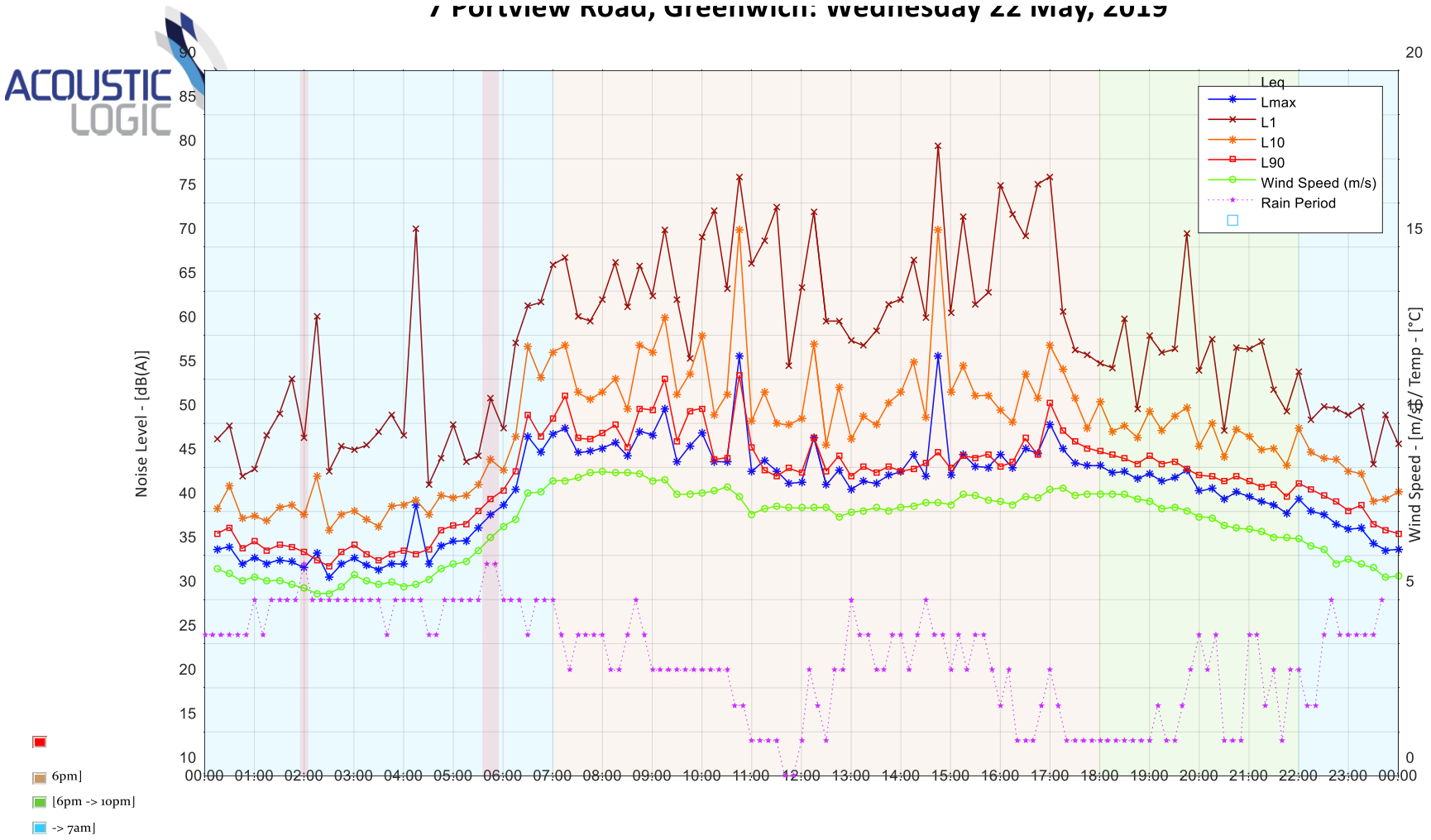

7 Portview Road, Greenwich: Friday 17 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

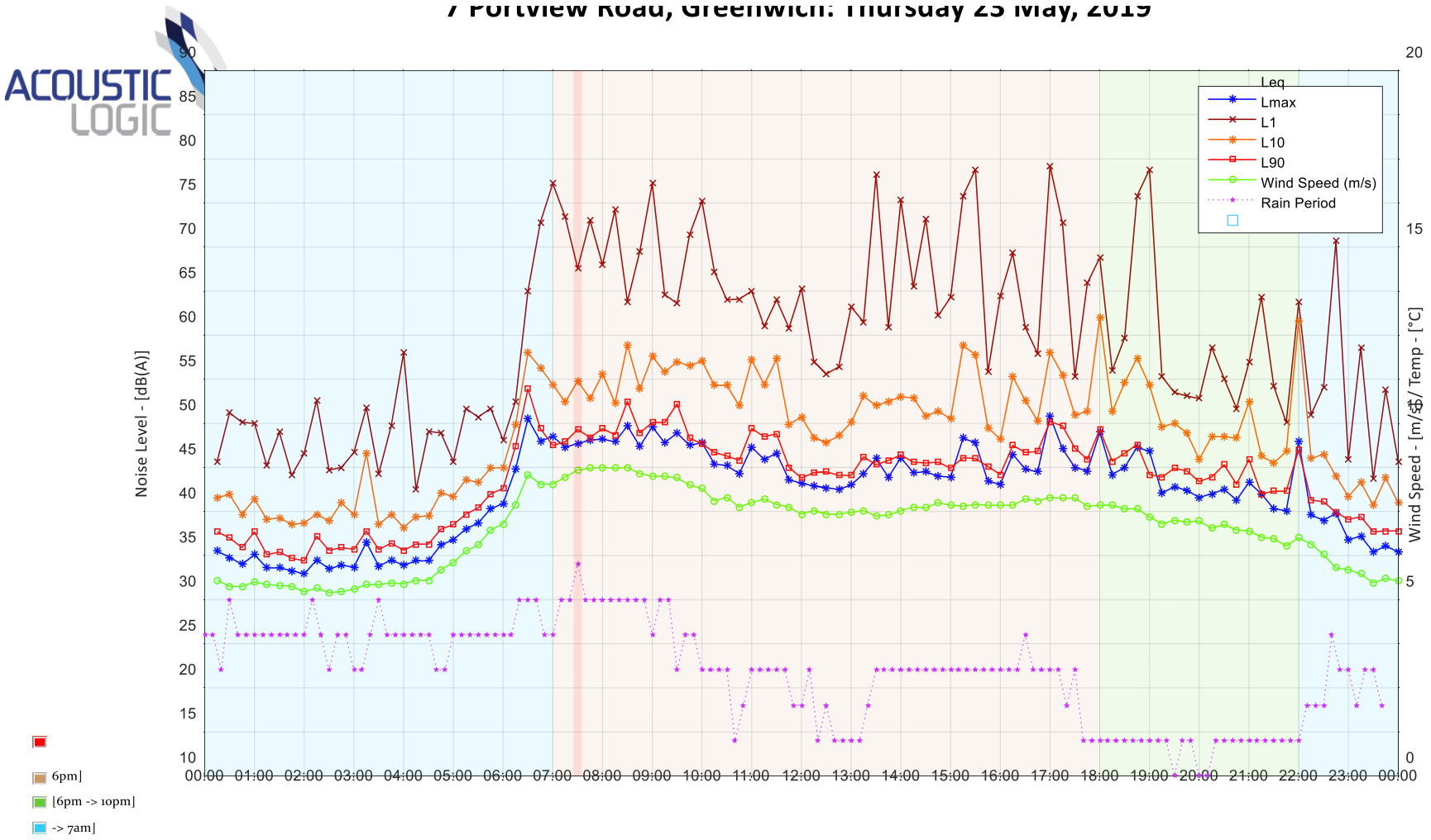

7 Portview Road, Greenwich: Saturday 18 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

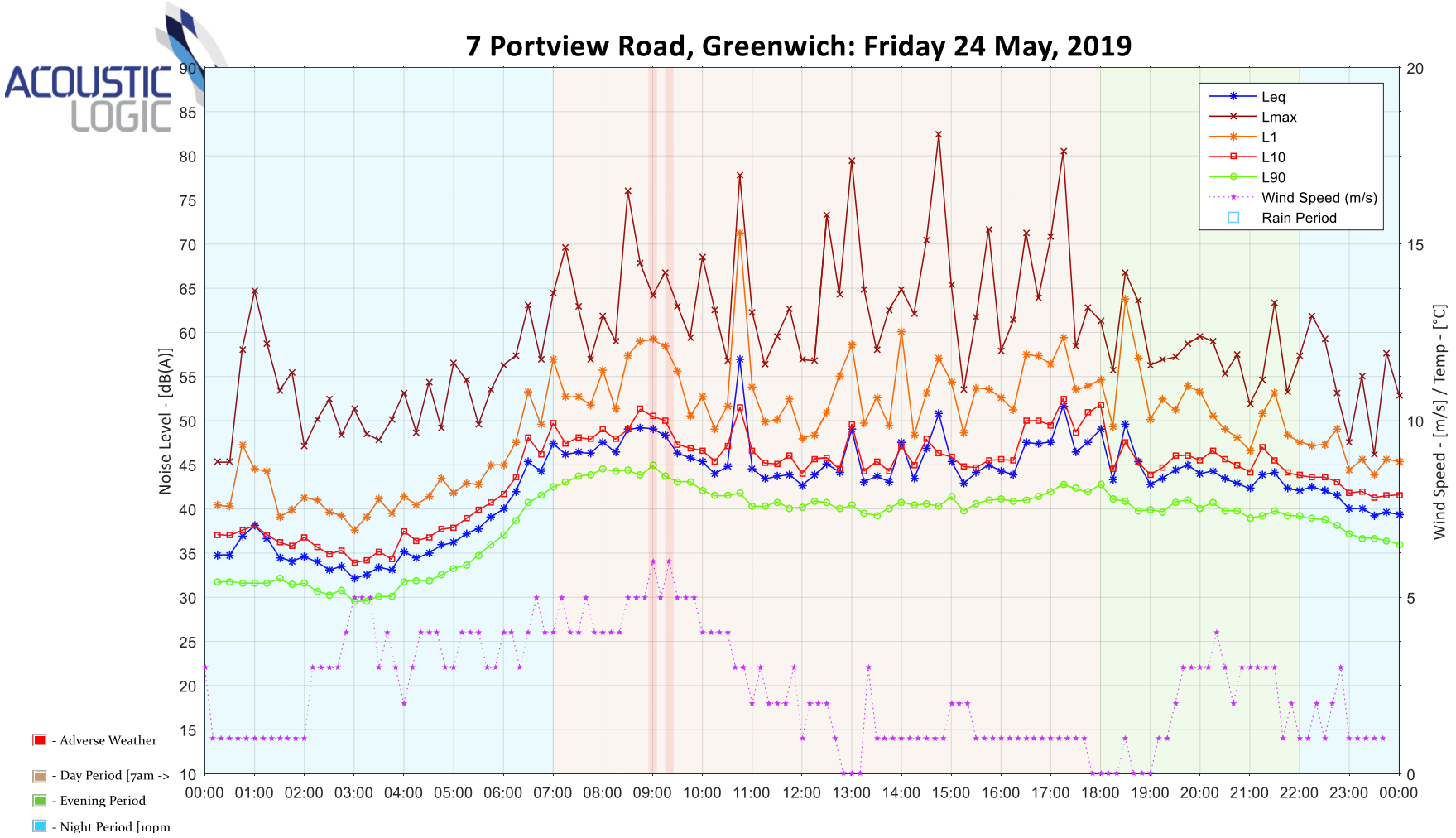

7 Portview Road, Greenwich: Sunday 19 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

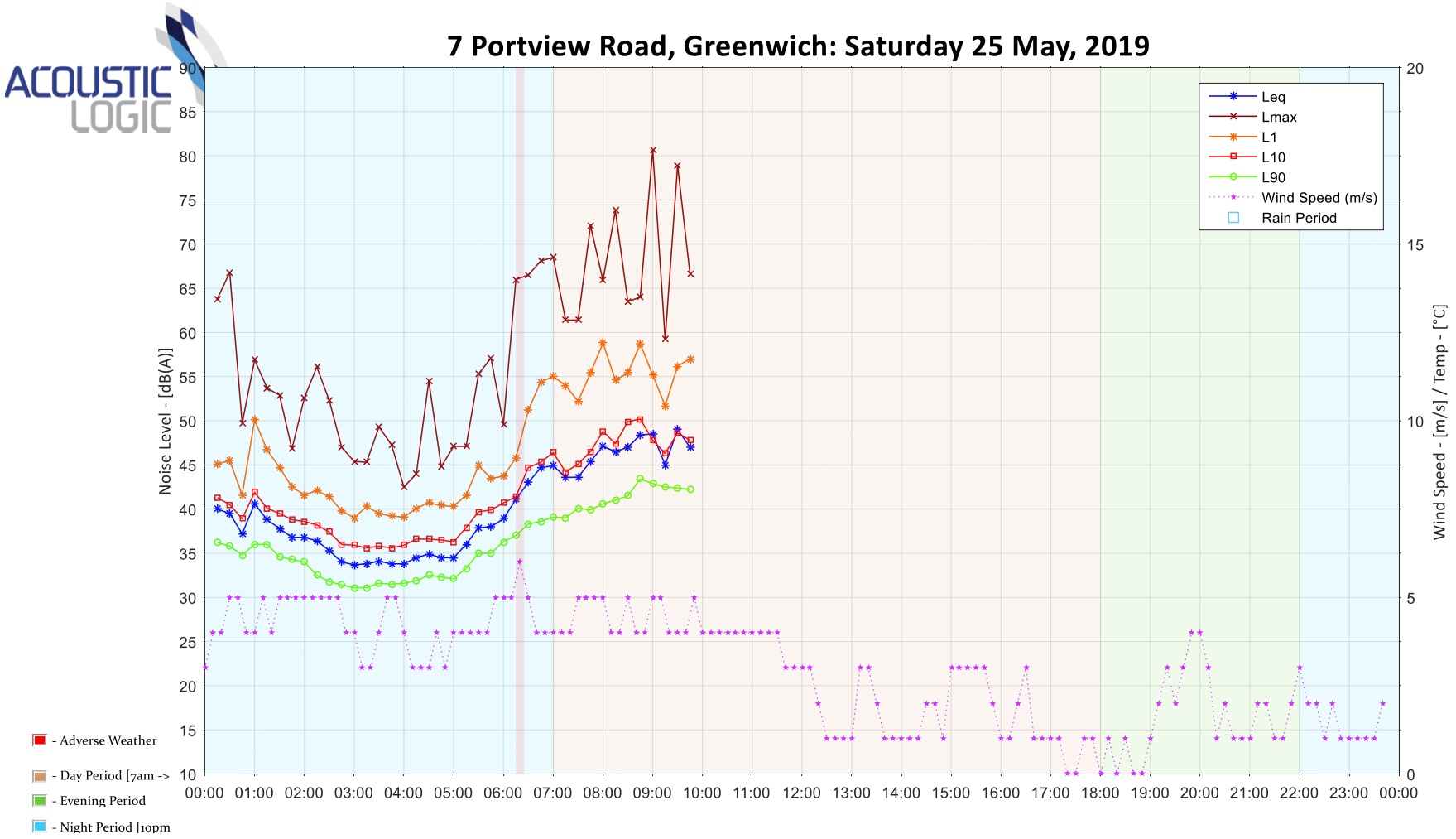

7 Portview Road, Greenwich: Monday 20 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00


7 Portview Road, Greenwich: Tuesday 21 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
6pm]
[6pm -> 10pm]
-> 7am]


7 Portview Road, Greenwich: Wednesday 22 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
6pm]
[6pm -> 10pm]
-> 7am]

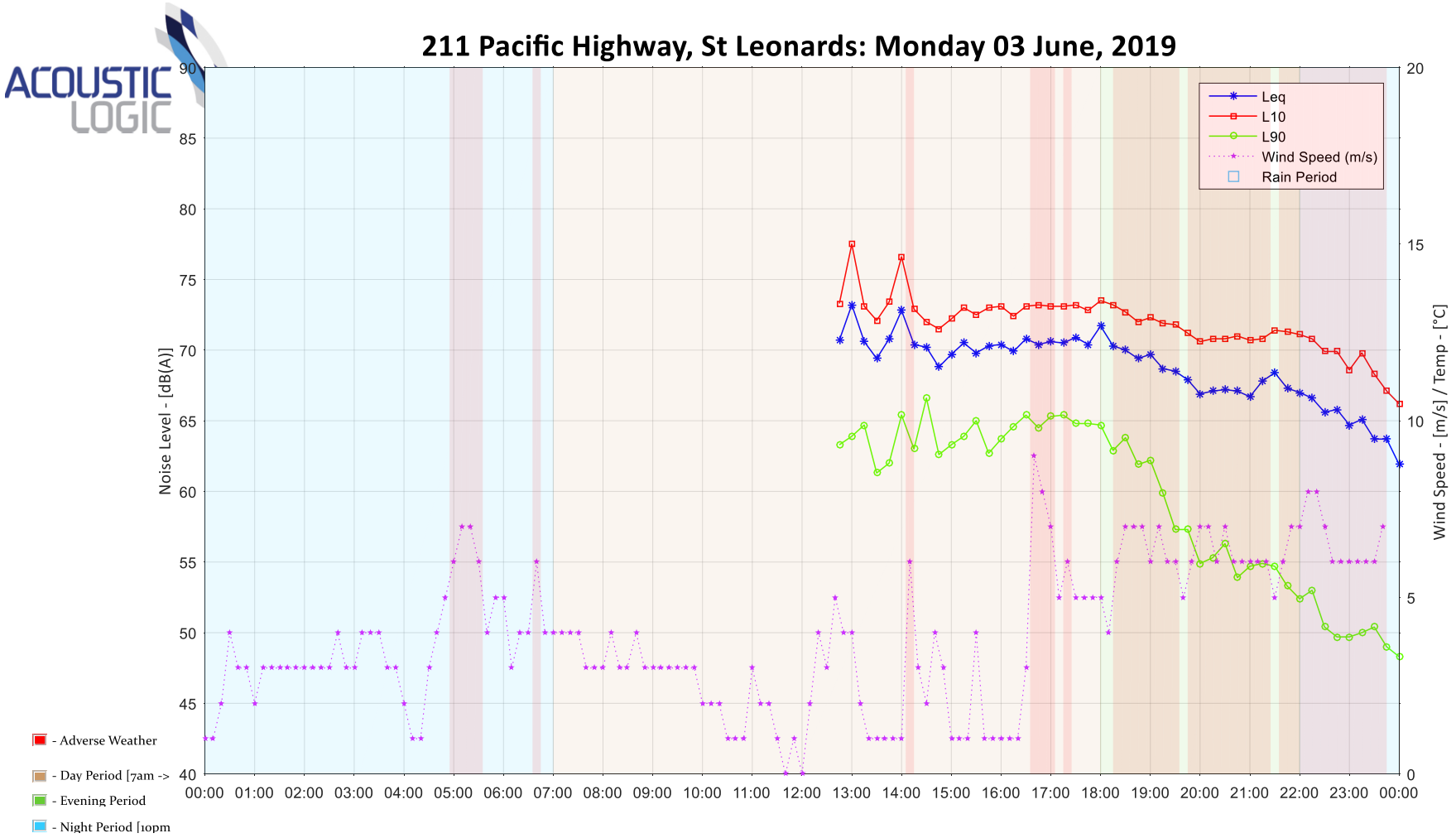

7 Portview Road, Greenwich: Thursday 23 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
6pm]
[6pm -> 10pm]
-> 7am]
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

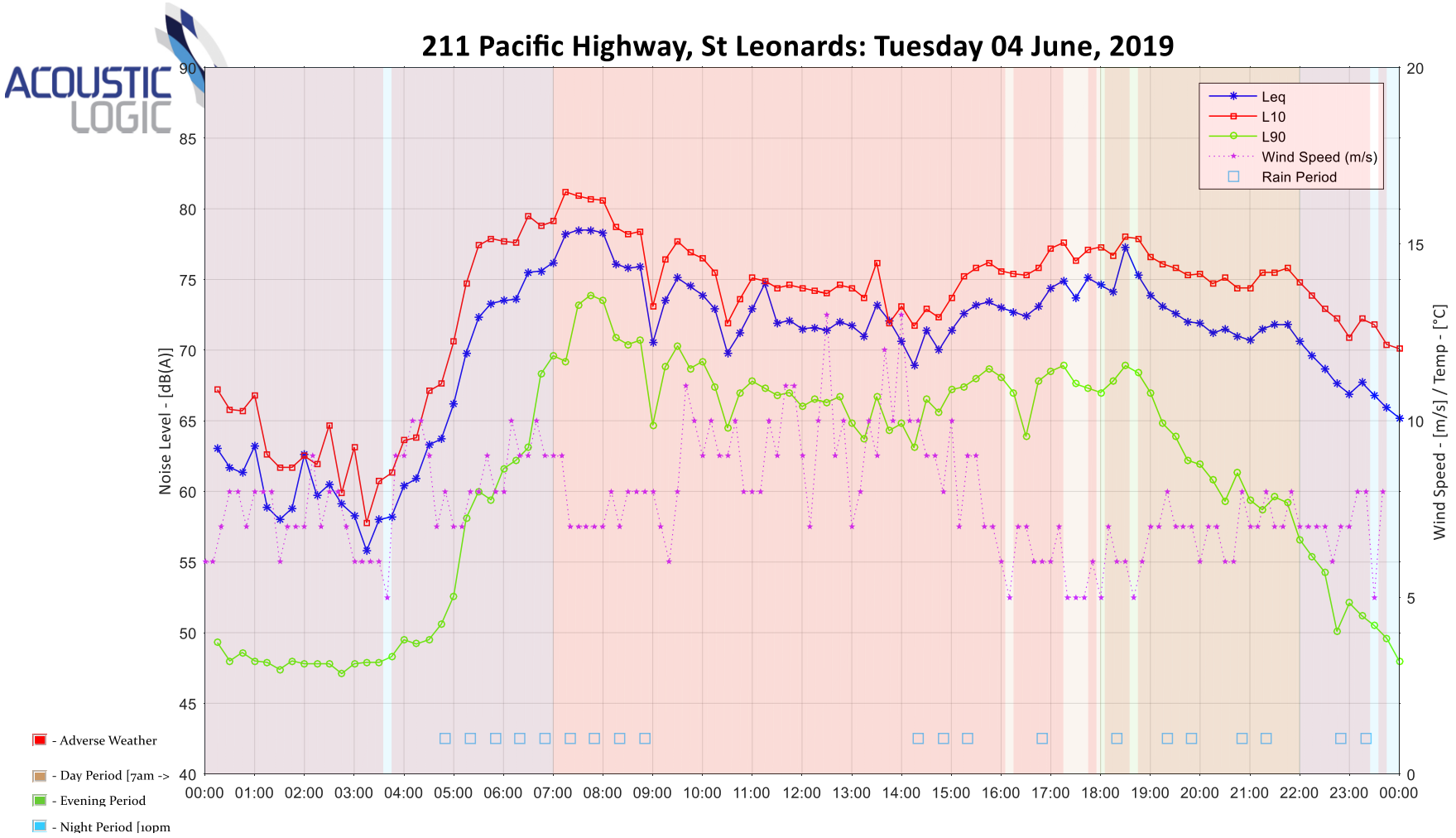

7 Portview Road, Greenwich: Friday 24 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

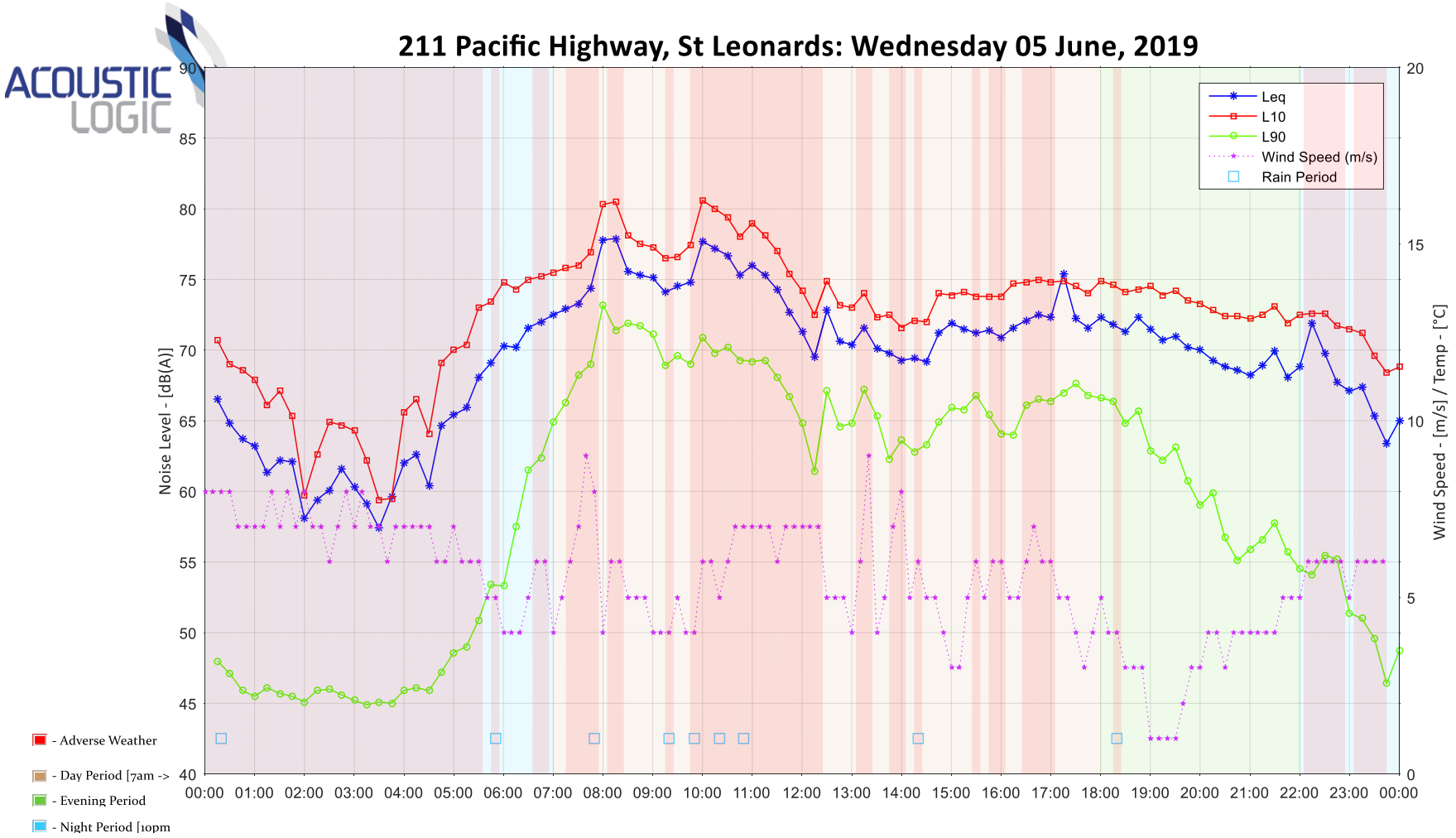

7 Portview Road, Greenwich: Saturday 25 May, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

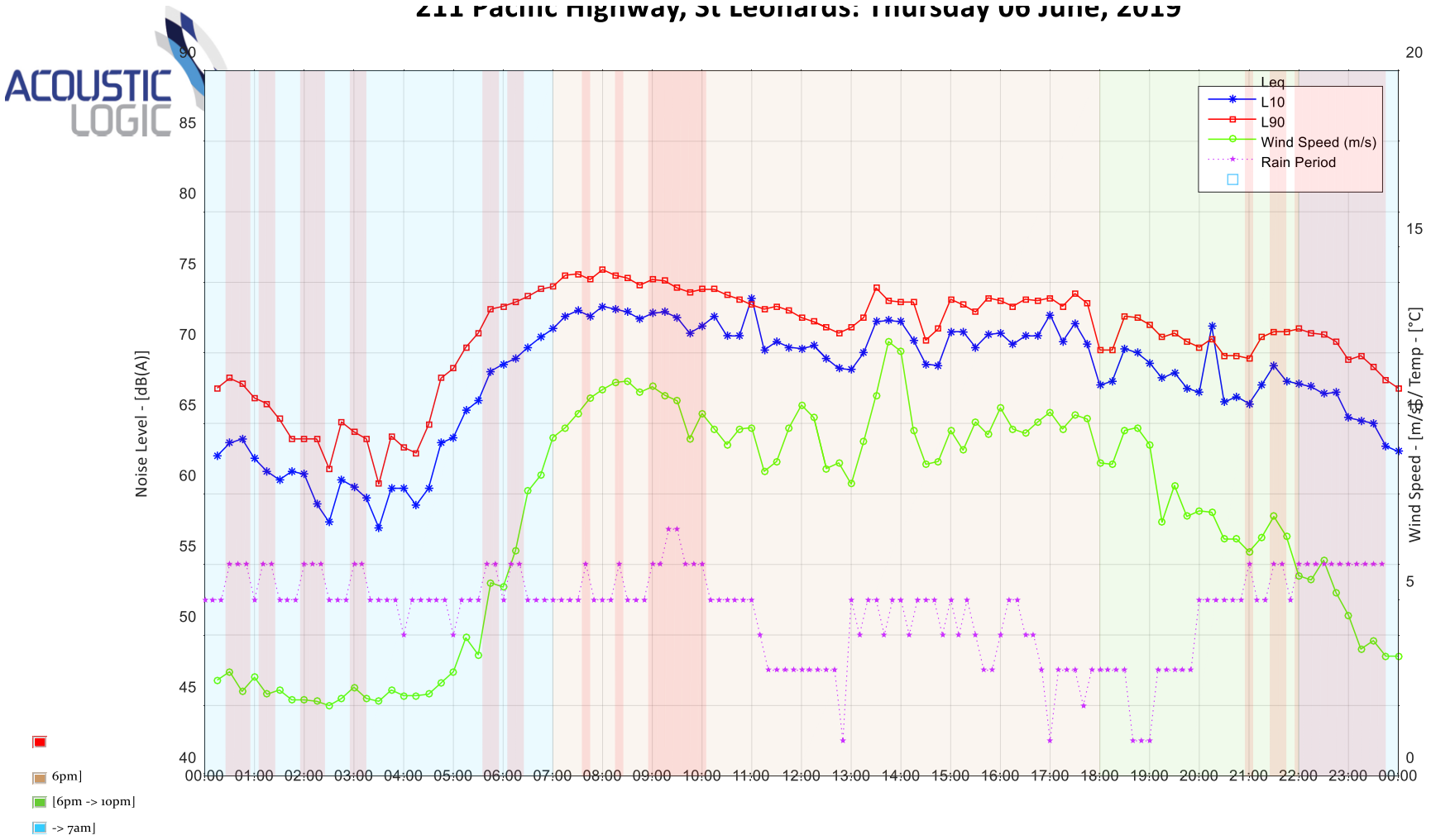
APPENDIX B – UNATTENDED NOISE MONITORING RESULTS (TRAFFIC NOISE MEASUREMENTS)

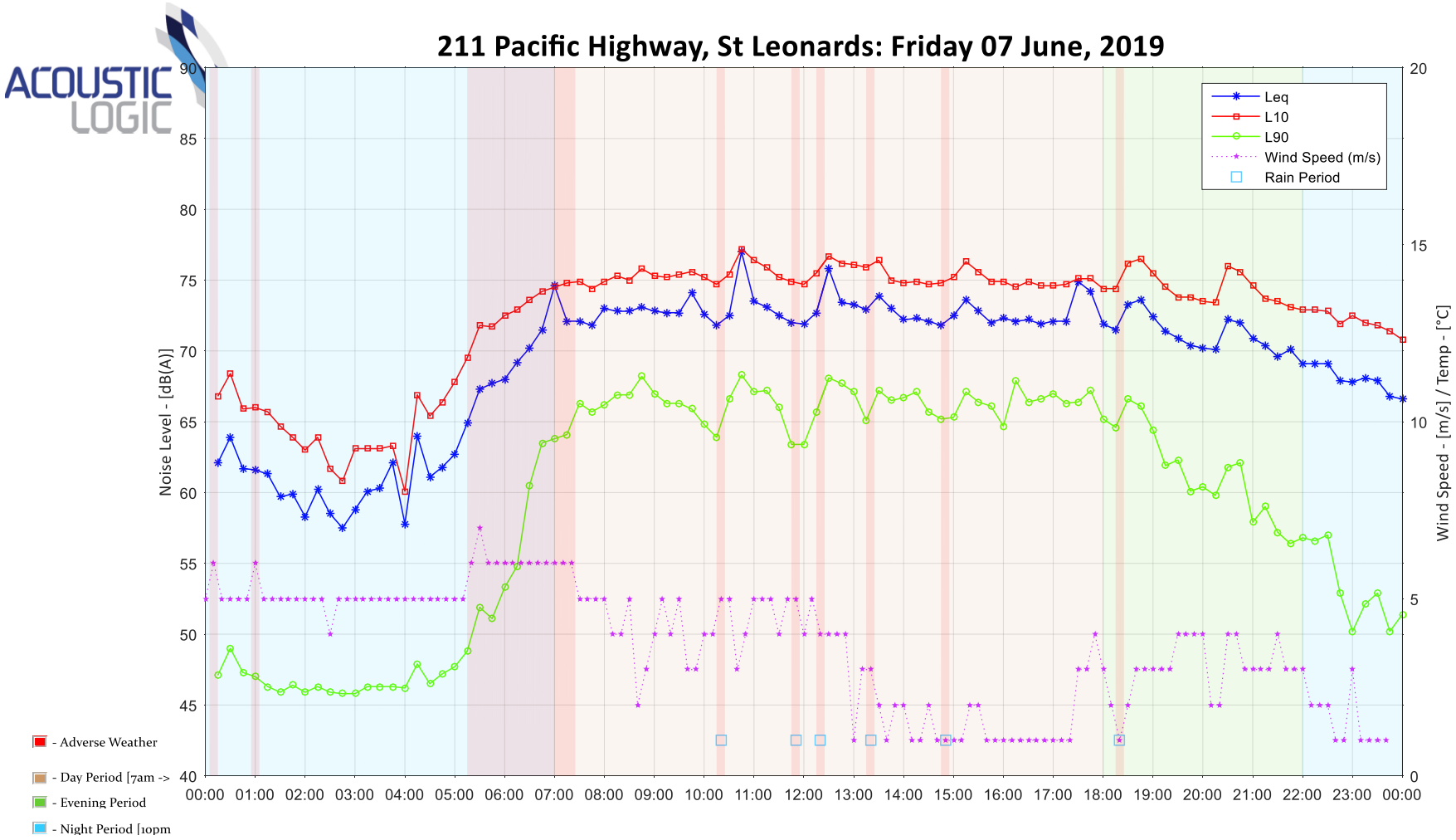
LOGGER LOCATION 2 – 211 PACIFIC HIGHWAY, ST LEONARDS, SOUTHERN BOUNDARY 5M FROM KERB

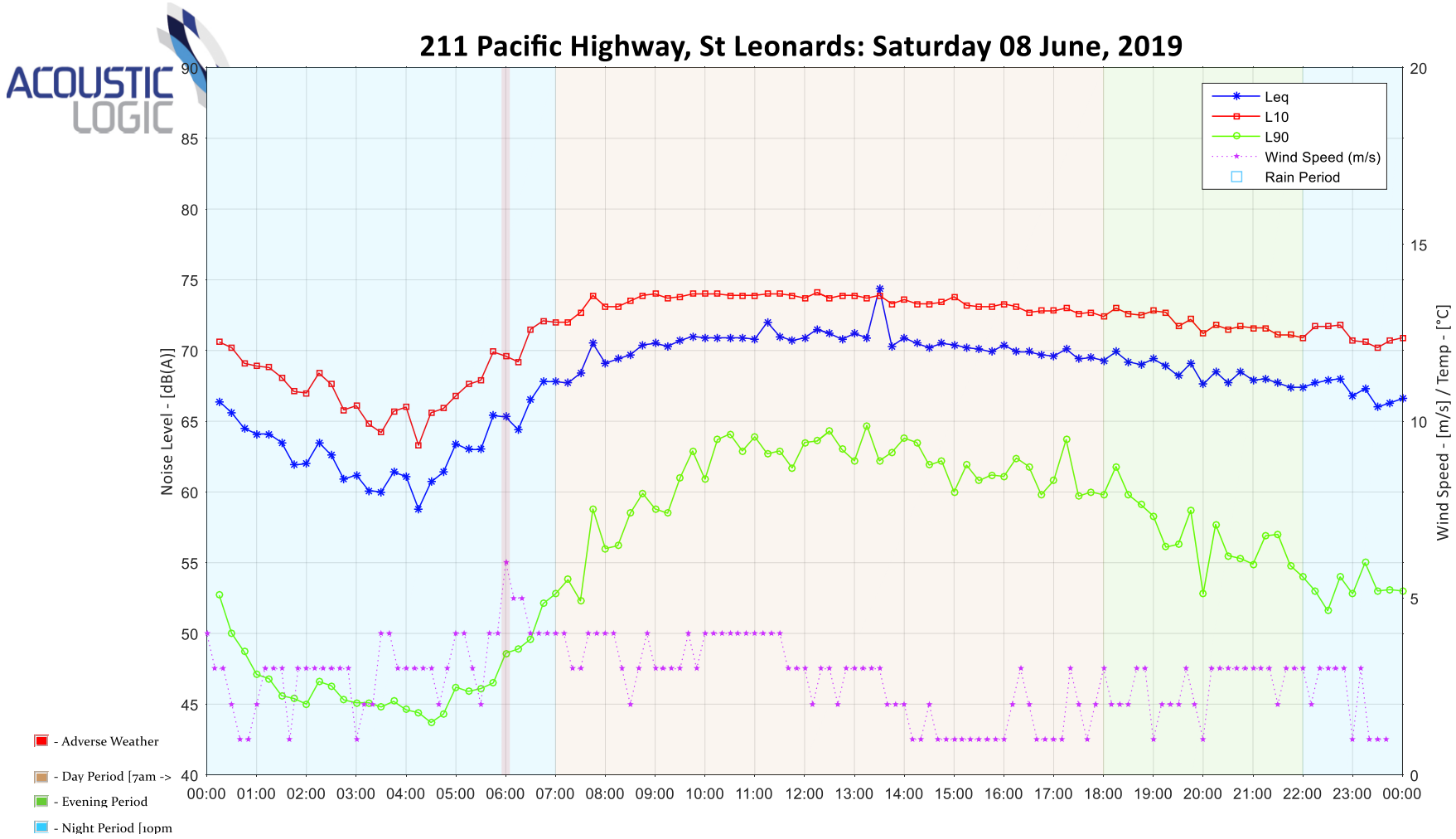

211 Pacific Highway, St Leonards: Monday 03 June, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
90
85
80
75
70
65
60
55
50
45
40
20
15
10
5
0
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

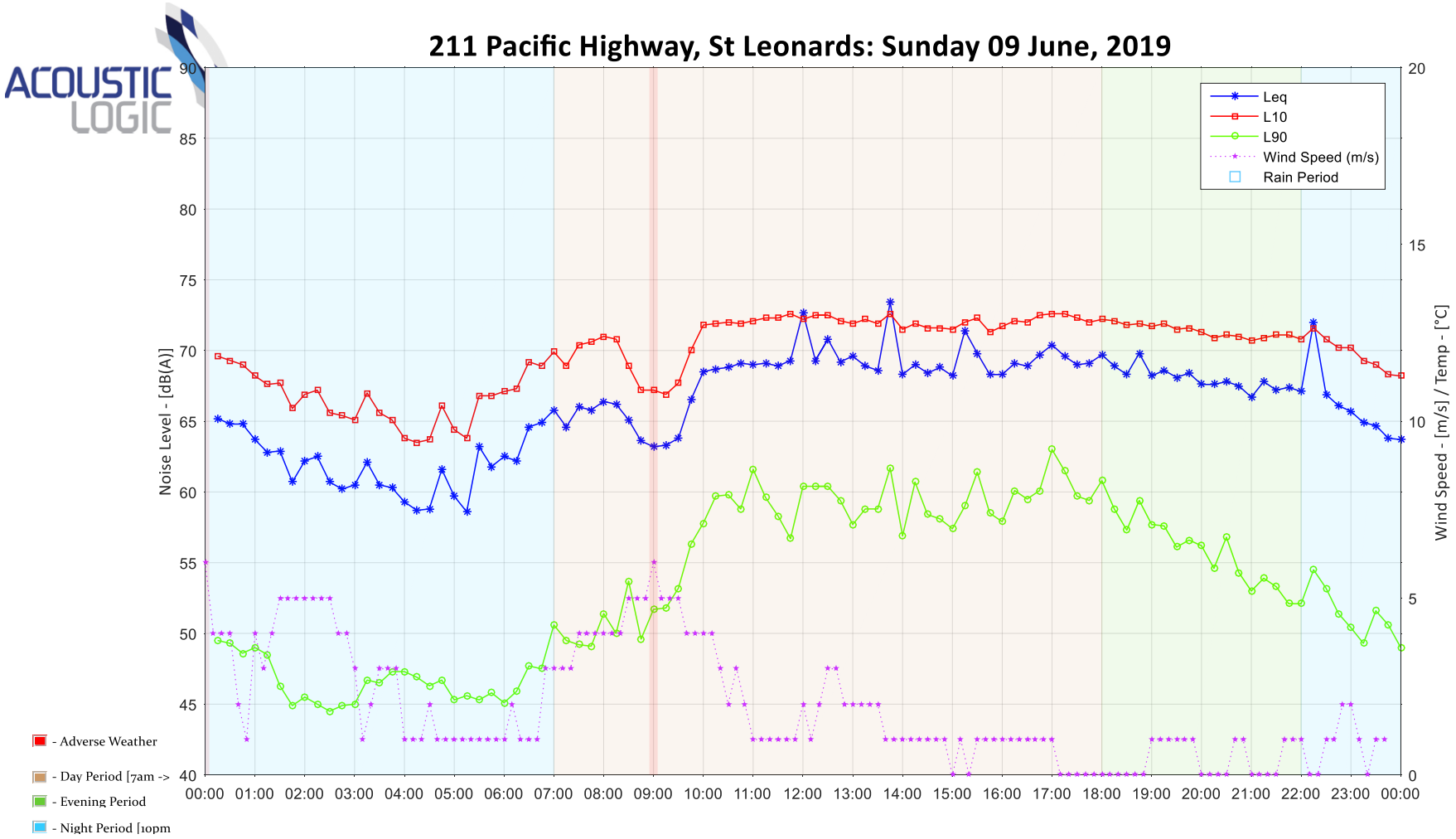

211 Pacific Highway, St Leonards: Tuesday 04 June, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

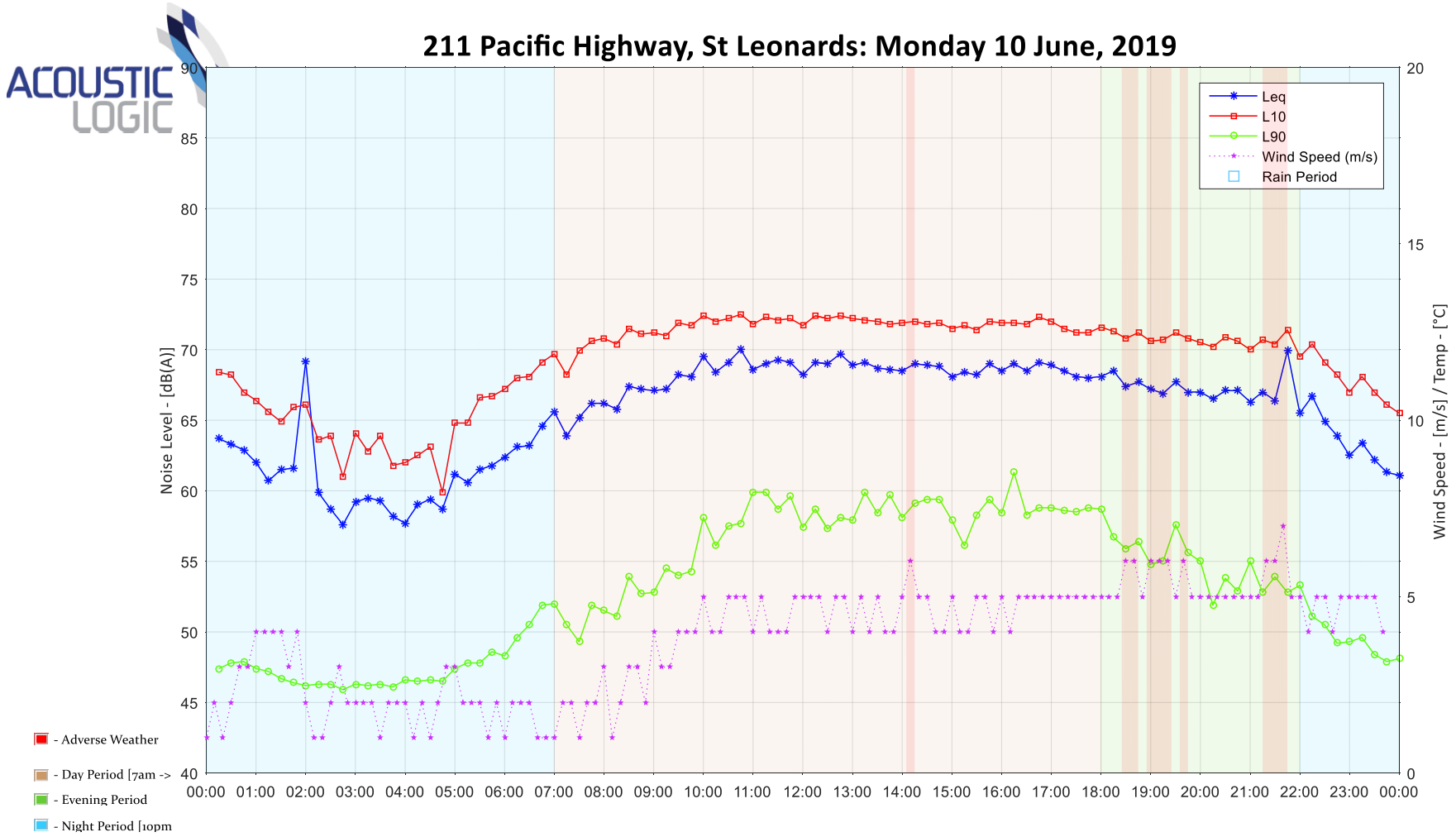

211 Pacific Highway, St Leonards: Wednesday 05 June, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00

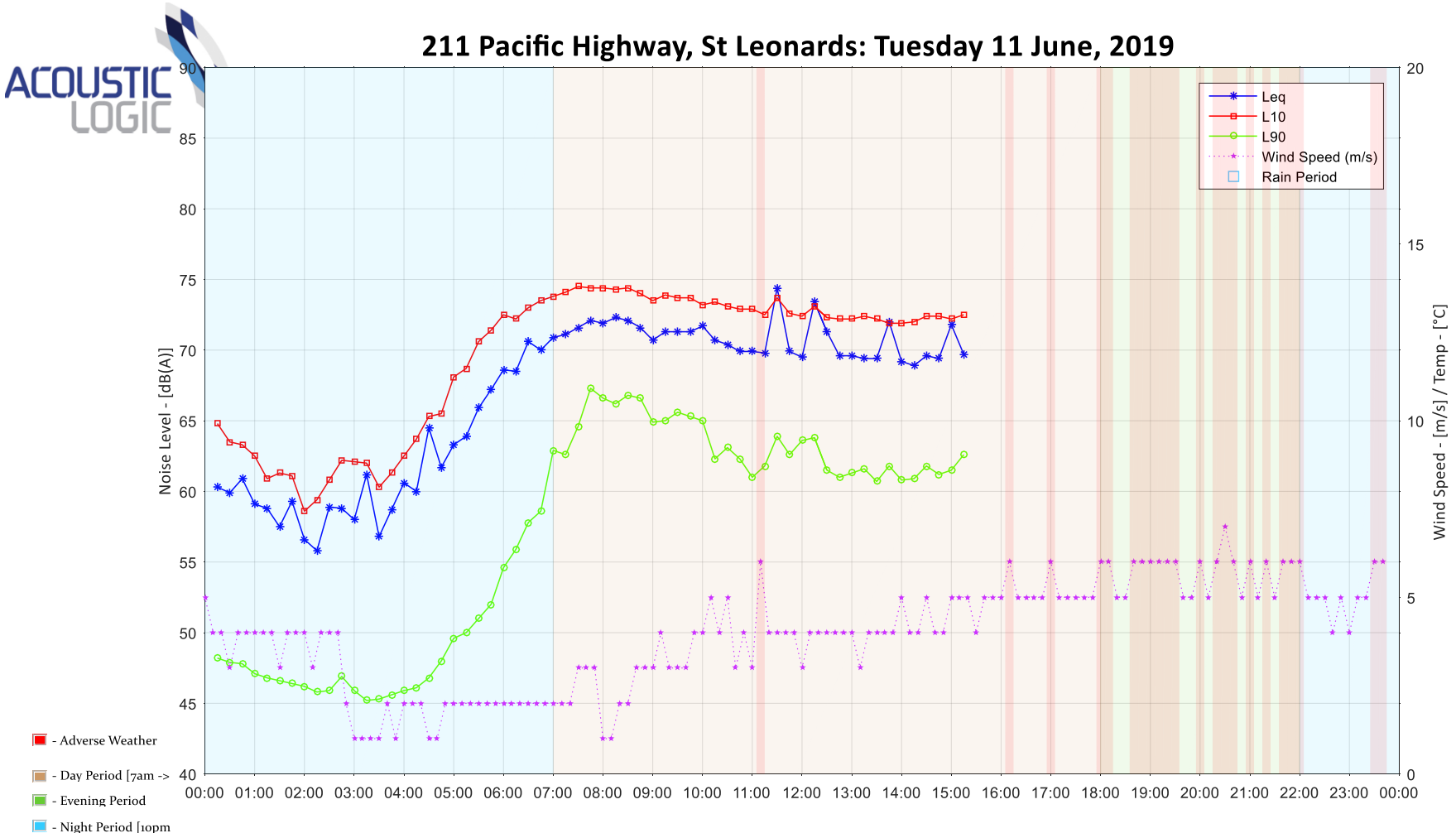

211 Pacific Highway, St Leonards: Thursday 06 June, 2019
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
90
85
80
75
70
65
60
55
50
45
40
20
15
5
0
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00
6pm]
[6pm -> 10pm]
-> 7am]


211 Pacific Highway, St Leonards: Friday 07 June, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00


211 Pacific Highway, St Leonards: Saturday 08 June, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
90
85
80
75
70
65
60
55
50
45
40
20
15
10
5
0
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00


211 Pacific Highway, St Leonards: Sunday 09 June, 2019
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
90
85
80
75
70
65
60
55
50
45
40
20
15
10
5
0
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm


211 Pacific Highway, St Leonards: Monday 10 June, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
90
85
80
75
70
65
60
55
50
45
40
20
15
10
5
0
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00


211 Pacific Highway, St Leonards: Tuesday 11 June, 2019
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am ->
- Evening Period
- Night Period [10pm
90
85
80
75
70
65
60
55
50
45
40
20
15
10
5
0
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00