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Pacific Brook Christian School, 72-74 Maitland Street, Muswellbrook - Stage 1

DA Noise Impact Assessment

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1 INTRODUCTION

This environmental noise and vibration assessment has been prepared by Acoustic Logic (AL) on behalf of the applicant. It accompanies an Statement of Environmental Effects in support of a development application for the new Pacific Brook Christian School at 72-74 Maitland Street, Muswellbrook. The site is legally described as Lot 100 in Deposited Plan (DP) 1261496.

The proposed development is for the establishment of a new K-12 school (Pacific Brook Christian School)on the subject site. The proposed development will comprise site preparation and remediation, tree removal, construction of new school buildings, covered outdoor learning area, covered walkways, car parking, landscaping and associated works. The school will accommodate 140 students and 16 staff.

Stage 1 will involve site preparation work (including remediation), the removal of trees, civil works, landscaping, and construction works.

Stage 1 is proposed to consist of:

- Site remediation;
- Removal of 7 trees;
- Facilities for a maximum of 140 students and 16 staff, including:
    - One (1) staff and student amenities block; and
    - Six (6) General Learning Areas (GLAs);
- Landscaping;
- Internal infrastructure works; and
- Vehicular access via Maitland Street.

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

The assessment:

- Identifies nearby noise sensitive receivers and operational noise sources with the potential to adversely impact nearby development.
- Identifies relevant Council, Transport and Infrastructure SEPP and EPA noise emission criteria applicable to the development.
- Assesses compliance with Transport and Infrastructure SEPP requirements.
- Predicts operational noise emissions and assess them against acoustic criteria.
- If necessary, determine building and/or management controls necessary to mitigate potential noise impacts.

2 SITE DESCRIPTION AND SITE OPERATION

The site is triangular in shape, with a northwest/southeast alignment and has an area of 2.432 ha. The site is bound by Muswellbrook Golf Course along the north eastern boundary, Maitland Street along the south western boundary and residential properties to the south eastern boundary. There are also residential properties north of the golf course (along Victoria Street) and across Maitland Street to the west (see Figure 1). The site address is 72-74 Maitland Street and is legally described as Lot 100 in Deposited Plan (DP) 1261496.

72-74 Maitland Street was previously used for forestry plantation purposes and is mapped as Muswellbrook State Forest. The site is no longer used for this purpose and currently sits as an empty and underutilised site.

The main vehicular access to the site is from Maitland Street, as well as pedestrian access. Existing vehicular parking on site includes open air at grade parking spaces facing Maitland Street.

Figure 1 - Aerial Image of Site

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

Table 1- School Uses and Operating Times

Item	Use	Times
GENERAL	It is proposed that the site be used for an educational establishment.	Operating hours for the school will generally be: • Monday – Friday: 7:30am and 6:30pm School bell times are to be 8:50am to 3:10pm. The School has bells ringing every 50 minute period. There is a 10:30am recess for 20 minutes followed by lunch at 12:30pm for 40 minutes. Before school care will commence at 7:30am, and after school care running until 6:30pm.
COLA	Intended to only be used by school during general school operating hours – refer "general"" above.	
OOSH	Out of school hours (OOSH) use of the school facilities, typically for before and after school care.	Weekdays at Mornings 7.30am – 9am and Afternoons 3pm – 6.30pm.

The assessment is based on the attached NBRS Architecture drawings and previous ambient noise measurements conducted at the site. Figure 2 shows the Stage 1 site plan and Figure 3 shows the ambient noise measurements locations.

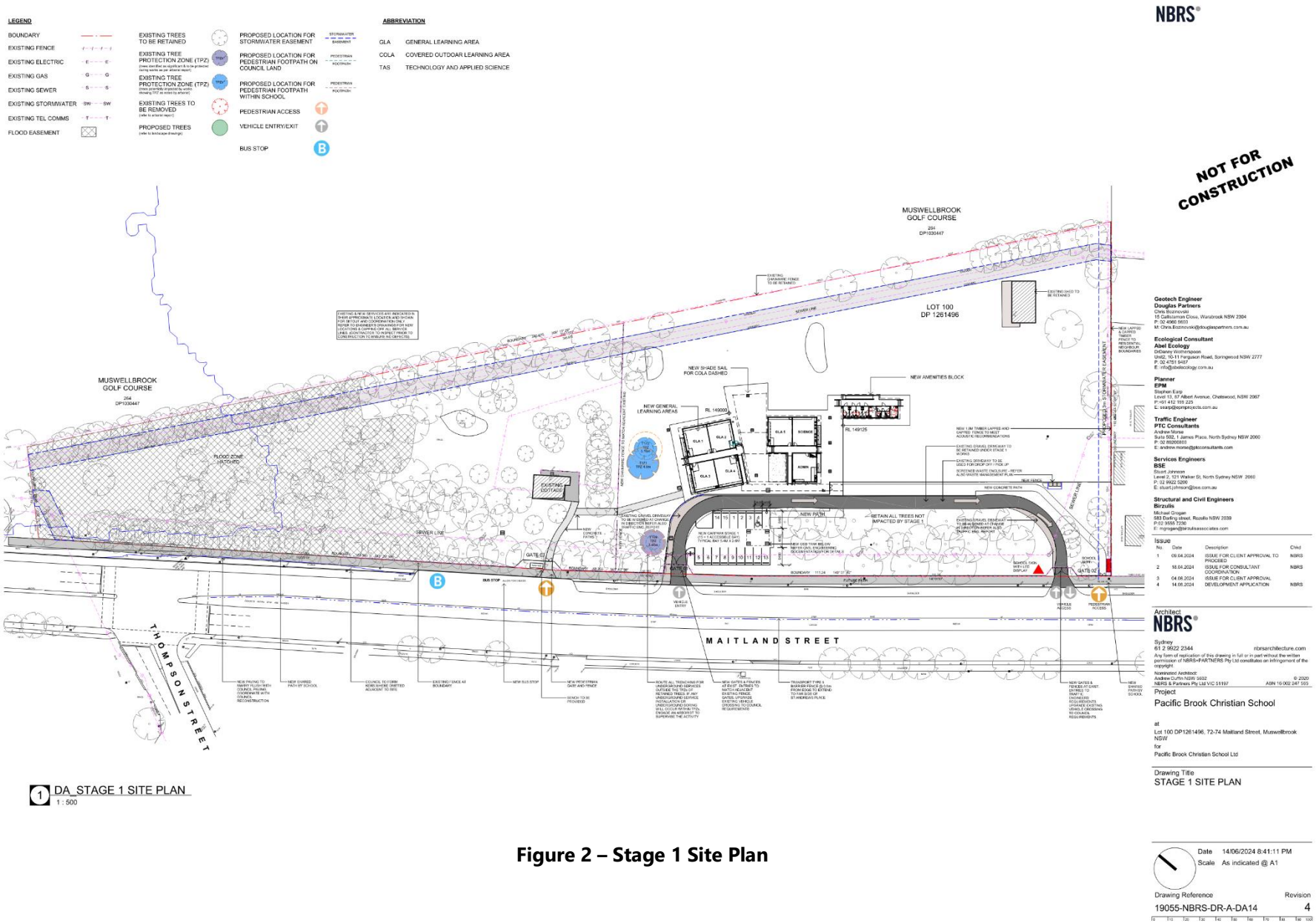


Figure 2 – Stage 1 Site Plan

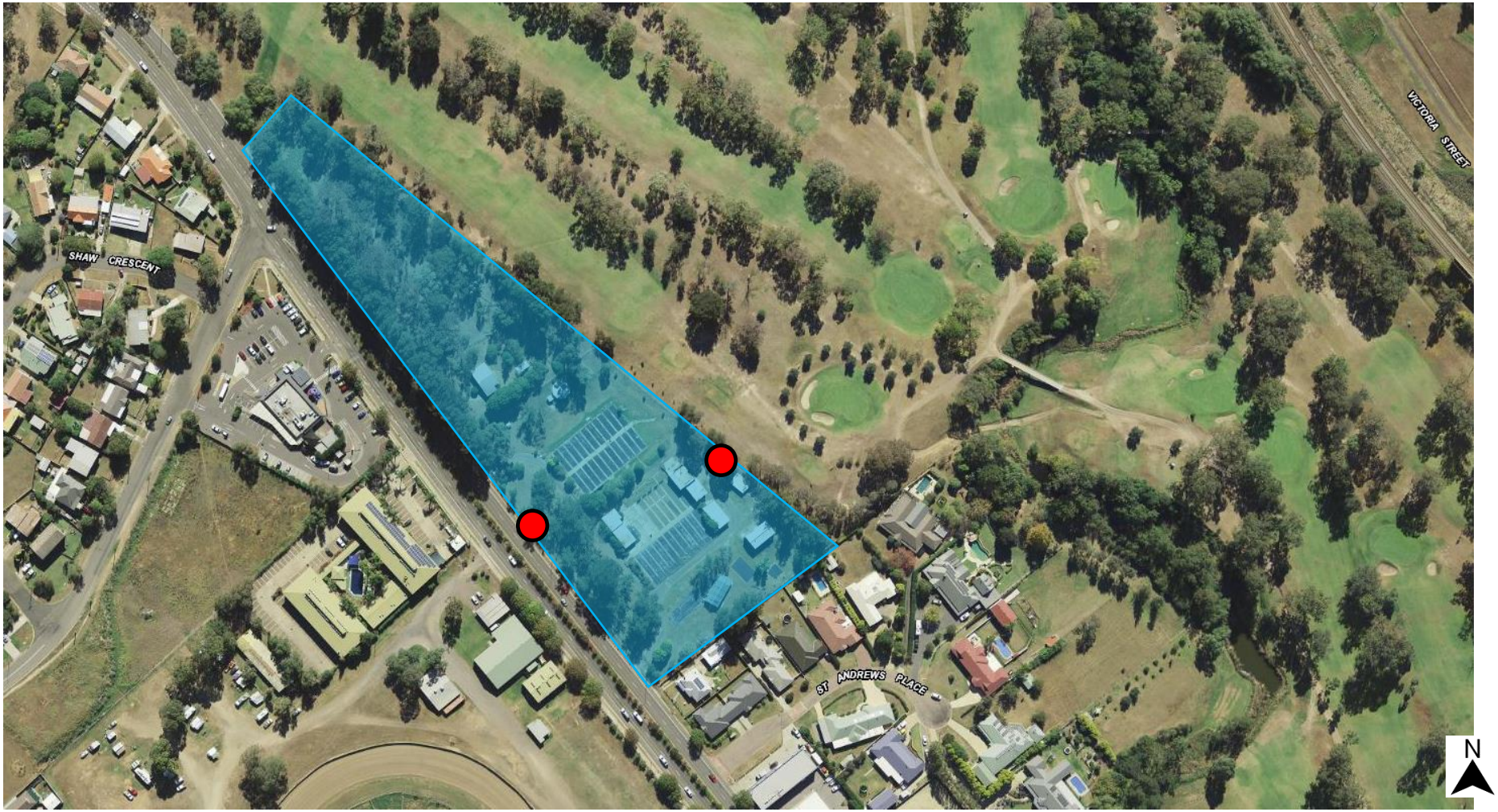


Figure 3 – Site Location and Noise Measurement Location
(Map Sourced from SixMaps)

3 ABBREVIATIONS AND DEFINITIONS

The following Abbreviations and definitions are used in this noise impact assessment.

dB	Decibels - unit for the measurement of sound
dB(A)	A-weighted decibels. Unit of measurement for broadband sound with the A-frequency weighting applied to approximate human loudness perception to sounds of different pitch.
L_{eq}	Energy, time averaged sound level
L_{max}	Maximum sound pressure level, fast response
L_{90}	Sound level exceeded for 90% of the measurement period
R_w	Frequency weighted sound reduction index.
NRC	Average absorption co-efficient for the octave bands with centre frequencies of 250Hz to 2 kHz inclusive.
Day*	For noise emissions assessment - the period from 7 am to 6 pm (Monday to Saturday) and 8 am to 6 pm(Sundays and public holidays). For transportation noise - the period from 7 am to 10 pm
Evening*	Refers to the period from 6 pm to 10 pm.
Night*	The period from 10 pm to 7 am (Monday to Saturday), and 10 pm to 8 am(Sundays and public holidays). For transportation noise - the period from 10 pm to 7am
Project Trigger Level	Target receiver noise levels for a particular noise-generating facility.
Assessment Background Level (ABL)	A-weighted background noise level representative of a single period. (Calculated in accordance with NPfI unless noted otherwise)
Rating Background Level (RBL)	The overall, single-figure A-weighted background level representing each assessment period (day/evening/night) over the whole monitoring period. (Calculated in accordance with NPfI unless noted otherwise)
RNP	Road Noise Policy, NSW DECCW (March 2011)
NPfI	Noise Policy for Industry, NSW EPA October 2017
NGLG	Noise Guide for Local Government, NSW EPA Jan 2023
TISEPP	NSW Transport and Infrastructure SEPP (as at report date)

* Unless nominated otherwise.

4 NOISE DESCRIPTORS

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

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

The principal measurement parameters obtained from the data are:

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

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

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

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

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

L_{max} is the loudest event recorded during the measurement period.

5 SURVEY OF AMBIENT NOISE

Long term unattended noise logging was conducted to quantify the existing acoustic environmental at the site. All monitoring and measurement locations are shown in Figure 3.

5.1 UNATTENDED, LONG TERM NOISE LOGGING

Unattended noise monitoring was conducted between 28th July and 6th August 2020 using Acoustic Research Laboratories monitors set on A-weighted fast response mode. The monitors were field calibrated before and after the measurements using a Rion Type NC-73 calibrator. No significant drift was recorded. As no significant changes in acoustic environment have occurred since the 2020 monitoring, the background noise levels currently experienced as are not expected to be lower than measured in 2020.

One noise monitor was placed to the rear of site near the golf course, this location was selected to represent the background noise level at the potentially most impacted receivers located away from Maitland Street, and to determine whether noise from the rail corridor was impacting the site.

Another noise monitor was placed on the project site near Maitland Street to capture the traffic noise levels impacting the site and the background noise levels for receivers located near Maitland Street.

5.2 RESULTS

Measurement results are presented below. The Rating Background Noise Level has been determined using NPfI guidelines with periods affected by excessive wind or rain (as noted on the attached graphs) excluded from the calculation. The day by day and median background noise levels are presented in the following tables. Where no level is indicated these periods were either incomplete or the period was weather affected and invalid. It is noted that the Scone AP weather station was used to obtain weather information.

The wind data obtained during the daytime period of the 4th and 5th of August exceeded 5 m/s however it is only the noise data obtained at the logger location set back from the road on the 4th shows any appreciable effect on background noise increase due to wind, and therefore only this data has been excluded. As a conservative measure, for the day period for the 4th and 5th the lowest recorded L_{90} during the day was used rather than the 90th percentile of the weather unaffected levels. It is noted that the 7 day median includes Sunday when the school would not generally operate, and background noise levels are generally lower.

Table 2 – Noise Monitoring Results (Near Golf Course)

Date	Day L_{90}	Evening L_{90}	Night L_{90}
Tuesday 28 July 2020	-	40	34
Wednesday 29 July 2020	43	40	34
Thursday 30 July 2020	42	42	34
Friday 31 July 2020	43	43	35
Saturday 01 August 2020	41	41	36
Sunday 02 August 2020	41	43	36
Monday 03 August 2020	44	39	35
Tuesday 04 August 2020	-	44	32
Wednesday 05 August 2020	45	39	35

Table 3 – Noise Monitoring Results (Near Maitland Street)

Date	Day L_{90}	Evening L_{90}	Night L_{90}
Tuesday 28 July 2020	-	43	38
Wednesday 29 July 2020	53	43	36
Thursday 30 July 2020	53	47	36
Friday 31 July 2020	54	46	38
Saturday 01 August 2020	50	45	38
Sunday 02 August 2020	47	46	38
Monday 03 August 2020	53	42	37
Tuesday 04 August 2020	53	46	36
Wednesday 05 August 2020	52	42	38

Table 4 - Summary Long Term Noise Logging (Near Golf Course)

Location	Time of Day	Rating Background Noise Level – dB(A)L_{90}
North Eastern Side of Site - Logger Location in Figure 3	Day (7am-6pm)	43
	Evening (6pm-10pm)	41
	Night (10pm to 7am)	35

Table 5 - Summary Long Term Noise Logging (Near Maitland Street)

Location	Time of Day	Rating Background Noise Level – dB(A)L_{90}
Southern Western Side of Site - Logger Location in Figure 3.	Day (7am-6pm)	53
	Evening (6pm-10pm)	45
	Night (10pm to 7am)	38

For the residences on the southern side of Maitland Street, the rating background noise level at the first of residences can be represented by the noise logger located close to the road. The RBL at the residences at 5-7 Shaw Place can be represented by the logger that was set back from Maitland Street.

For the Victoria Street and other residences the EPA default minimum background noise levels of 35 dB(A) (day) and 30 dB(A) (evening) will be adopted, leading to day and evening noise goals of 40 dB(A) and 35 dB(A) respectively.

6 OPERATIONAL NOISE EMISSION ASSESSMENT

The assessment of operational noise emission requires a consideration of noise emissions including any public address system, school bell, mechanical services (e.g., air conditioning plant). Where required, measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land have been identified.

There are no specific EPA criteria applicable to the acoustic assessment of schools. Noise assessment goals for the various noise sources can be inferred from other guidelines.

6.1 NORMAL SCHOOL ACTIVITIES

6.1.1 Relevant Guidelines

The NGLG indicates that:

- Schools are required to comply with the Protection of the Environment Operations Act, and subject to Clause 139 (operation of plant).
- *Meriden v Pedavoli [2009 NSWLEC 183]* in the NSW Land and Environment Court is cited in the NGLG as being relevant to noise emissions from schools. The decision notes that "*All noise that emanates from the normal activities at a school is not offensive*".

Part 3.4 and Schedule 8 of the TISEPP stipulate requirements for school development. There are no specific requirements relating to noise emissions, other than when seeking "complying development" consent, which are:

- compliance with any existing conditions of development consent.
- "Schedule 6 Schools – complying development" Clause 6 "Noise" of the TISEPP includes the following complying development condition:

  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 L_{Aeq} of 5 dB(A) above background noise when measured at any property boundary.

6.1.2 Assessment

6.1.2.1 Discussion

In respect of typical school external activities:

- Schools are typically sited in locations that enable community integration and access, and this generally results in schools being located close to residential properties. Therefore, playgrounds and sport fields are commonly located near residential properties.
- Planning of the school layout can minimise emissions to sensitive receivers. More intensive uses (such as basketball courts) may be located so that distance separation to receivers is maximised, or they are screening by school buildings or landscaping. However, the extent to which this can be practically achieved is typically limited due to site constraints and the need to meet other desirable planning outcomes for the school.
- External activity noise impact at surrounding receivers can be reduced by erecting noise barriers/mounding around the school. These barriers have other negative impacts, including security, overshadowing and visual impacts, and Schedule 8 of the TISEPP requires that these

aspects be addressed in the design of schools. Because the moderate level of noise impact from normal school activities, and for these reasons sated, barriers are typically not used in schools.

A 1.8m high lapped and capped fence at the eastern boundary of the school is proposed.

For typical activities within school buildings, while the LEC decision indicates that normal school activities are not considered to be offensive, "background noise level plus 5 dB(A)" for emissions to adjacent residential properties has been adopted as a design goal for building noise emissions, which is consistent with the complying development condition for school buildings.

6.1.2.2 Internal Activities Noise Impact Review

A review of noise from typical internal activities has been undertaken to determine whether noise emissions are likely to exceed the background noise level by more than 5 dB(A). Where exceedances of this noise level are predicted, the measures available to reasonably minimise noise emissions are discussed.

Noise goals for the nearest residential properties have been established using "Golf Course" noise monitor rating background noise levels. The applicable goals are summarised in the following table.

Table 6 – Day Noise Goal for Emissions from Buildings

Location	RBL (dB(A)	Background + 5 dB(A)
Eastern Residences and 5-7 Shaw Place	43	48
Victoria Street	35	40

Taking into account the typical noise generation within buildings, that windows in the learning spaces being open to 5% of the floor area and the significant distance separation to the sensitive receivers, the predicted noise levels from the learning spaces are in all cases well below these assessment criteria.

6.2 BEFORE AND AFTER SCHOOL CARE

Noise emissions from these activities have been assessed.

The proposed activities in the buildings (as indicated in Table 1) typically occur between 7am and 6pm, with some overlap to 6:30pm for after school care and to 7pm for pack down activities. Given that:

- The background noise level between 6pm and 7pm is not significantly different to the day RBL.
- Noise generating activities during these periods will likely be "winding down".

The 6pm to 7pm period will be treated as a "shoulder period". That is it will be assessed as being part of the "day" period.

External play during before/after school care is assumed to occur within the proposed COLA area. Emissions have been predicted using the Association of Australasian Acoustic Consultants recommended sound power level of 87 dB(A) per 10 students (3-5 year olds, which are assumed to be similar to older pupils).

The predicted worst case noise levels (assuming all are located outside and unscreened) are:

- 43 dB(A) at the most impacted residences to the east.
- <37 dB(A) at the Victoria Street Residences
- <35 dB(A) at the residences opposite Maitland Street.

The predicted noise levels are below the established noise goals indicating the proposed before/after school care will not adversely impact the nearest residences.

6.3 EQUIPMENT, PUBLIC ADDRESS SYSTEMS, AIR CONDITIONING AND VENTILATION PLANT

Detailed acoustic design of mechanical plant and public address systems cannot be undertaken at approval stage as plant selections and locations are not finalised. A 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. Noise emissions should comply with criteria established using the EPA NPfI guidelines.

It is our assessment that, given the relatively minor nature of the proposed plant, it is 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.

In regard to the school bell/PA system, the system should minimise noise spill to adjacent properties by adopting the following system design principles:

- Speaker location and direction can be used to reduce noise spill to neighbouring properties while still maintaining suitable noise levels within the school grounds (typically 70-75dB(A)).
- Broadly speaking, more speakers, closer to the noise receiver is a more effective way to provide coverage of the external areas while reducing noise spill to neighbouring properties.
- Similarly, highly directional speakers (angled downwards) will also reduce noise spill. Speakers with a drop of at least 5dB(A) for mid-frequencies noise for each 10 degrees in the horizontal plane outside of the coverage area should be considered.
- Where possible speakers should be placed in locations that are screened from surrounding nearest receivers

6.3.1 EPA Noise Policy for Industry (2017)

Criteria to assess noise emissions from these noise sources have been developed using the NPfI guideline.

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 (not required in this case).

6.3.1.1 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.

6.3.1.2 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 applicable recommended project amenity levels for residential receivers are Day -53 dB(A), Evening 43 dB(A) and Night – 38 dB(A) $L_{eq,15\ min}$. Given the residential receivers are not currently impacted by other "industrial" noise sources, nor are likely to in the future, the recommended levels can be adopted as trigger levels.

The Noise Policy for Industry provides dispensation for locations already impacted by elevated transportation noise levels. Where transportation L_{eq} noise levels exceed the amenity level by more than 15 dB(A) the amenity noise level can be set to 15 dB(A) lower than the traffic noise level. For the subject site, this will mean that residential receivers facing Maitland Street will have a higher evening and night amenity trigger level. However, a bypass is proposed that would significantly reduce traffic volumes on Maitland Street and for this reason we have assumed that no dispensation will apply for the purposes of the assessment.

6.3.1.3 Sleep Arousal Assessment

In addition to the above, the NSW EPA *NPfI* provides an assessment procedure for assessing any potential sleep arousal impacts for when any noise is generated between 10:00pm and 7:00am (i.e., night period). 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:

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

  a detailed maximum noise level event assessment should be undertaken.

- 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 *NPfI*, 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.*

6.3.2 Summary of NPfI Trigger Levels

Table 7 summarises the trigger levels determined using NPfI guidelines and the measured rating background noise levels. A general night time criterion is not required as there are no noise emissions during this period. It is noted that the early morning background noise level is higher than the "day" background noise level, as the background noise level is set by distant traffic noise, which is highest during the morning and afternoon peak periods and lowest (during the EPA "day" period) around lunch time.

The Noise Policy for Industry "minimum background noise levels" have been assumed at the Victoria Street residences for the purposes of this assessment.

The "active recreation" amenity noise level has been adopted for the golf course. Given there are no other likely future "industrial noise sources" impacting this location the uncorrected amenity level will be adopted.

Table 7 – Summary of NPfI Trigger Levels

Receiver	Time	Intrusiveness $L_{Aeq,15min}$	Project Amenity $L_{Aeq,15min}$	Sleep $L_{Aeq,15min}$ / L_{AFmax}
Away from Maitland Street (adjacent golf course) and 5-7 Shaw Place	Day (7am-6pm)	**48**	53	-
	Evening (6pm-10pm)	46	**43**	-
	Night (10pm-7am)	40	**38**	40/**52**
Residences On Maitland Street	Day (7am-6pm)	58	**53**	-
	Evening (6pm-10pm)	50	**43**	-
	Night (10pm-7am)	43	**38**	43/**53**
Victoria Street	Day (7am-6pm)	**40**	53	-
	Evening (6pm-10pm)	**35**	43	-
	Night (10pm-7am)	**35**	38	40/**52**
Golf Course	Day	-	58	-

**The adopted Project Noise Trigger Levels for "industrial" noise sources are presented in bold.*

6.4 TRAFFIC GENERATION

6.4.1 Carpark

The school will use a carpark located adjacent Maitland Street, as indicated in Figure 2 . 15 car spaces will be provided for the school. The school carpark will typically fill and empty once per day, and it is assumed it takes ½ hour to fill or empty.

From the assumptions above it would be expected that the noise level generated at the boundary of the nearest residential receiver to the south east of the site would be less than 25dB(A)$L_{eq(1hr)}$. This is significantly lower than the background noise level and will therefore not adversely impact any of the nearby receivers.

6.4.2 Kiss and Drop

A school parent/pupil drop off bay is proposed along the southern side of the primary school buildings.

Peak periods of activity for both AM (8:15am-9:15am) and PM (3:00pm-4:00pm) peak hours as it is anticipated that students will utilise the same travel mode to and from school.

The noise generated by kiss and drop vehicles will be significantly less than general traffic on Maitland Street, which will mask any noise generated by the kiss and drop zone.

It is concluded that kiss and drop noise emissions will not adversely impact any of the surrounding properties.

6.5 WASTE REMOVAL

Waste removal should occur between 7am and 6pm. The proposed time restrictions adequately address noise impact from waste removal operations. The proposed boundary fence will also assist in managing noise impacts to the eastern residences.

6.6 ADDITIONAL TRAFFIC NOISE GENERATION ON LOCAL ROADS

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

According to the policy, Maitland Street would be defined as an arterial road. The applicable assessment criteria for residential receivers 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 arterial roads.
- Noise impacts from increases in noise levels of 2 dB(A) or less are minor, and by implication do not require mitigation.

The additional traffic generation would produce a noise level increase significantly less than 2 dB(A). Therefore, the proposed development would not produce adverse impact due to increased traffic generation.

7 OPERATIONAL VIBRATION EMISSION ASSESSMENT

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

8 NOISE INTRUSION ASSESSMENT

8.1 DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS –INTERIM GUIDELINE (DEPARTMENT OF PLANNING 2008)

The guideline is used to assess the impact of adjacent road and rail corridors on noise sensitive development. The guideline recommends a maximum noise level within classrooms of 40 dB(A) $L_{eq,1hr}$.

8.2 RAIL NOISE

The school has a rail corridor to the north east past the adjacent golf course approximately 350m away. We note that in accordance with the document Development Near Rail Corridors and Busy Roads - Interim Guideline (Department of Planning, 2008, Section 3.5.1) if a development is within 40m of an operational track and Passenger and Freight services are ≥80km/h a full noise assessment should be undertaken. It also states for rail corridors further away than 80m acoustic advice should be sought.

As the rail corridor to this development is much further in distance it is our opinion that with the noise attenuation from the distance loss and the use of typical building elements for a school the internal noise level requirement of 40dB(A) $L_{eq,1hr}$ within classrooms will be achievable.

The noise monitor located at the golf course boundary would include noise emissions from the railway and confirms that no specific treatment is needed to comply with DNRCBR.

8.3 TRAFFIC NOISE

The school will be impacted by traffic noise from Maitland Street which is classified as a state road and located at the south western boundary. The most impacted school buildings would be the classrooms within the school buildings nearest to the road and having a façade facing Maitland Street.

We note that the Traffic Impact Assessment by PTC states (Section 3.3 of their report) a New England Highway bypass is proposed to run east of Muswellbrook area, connecting the New England Highway southwest and north of the town, thus diverting through traffic away from the Muswellbrook Town Centre and the proposed school development. This along with the introduction of a school speed limit in front of the development (changing the speed limit from 50km/h to 40km/h) would mean that traffic noise in the future from Maitland Street will be reduced and therefore traffic noise levels captured and used for this assessment will be conservative.

Existing noise levels at the facades of the proposed buildings were predicted using the noise logger data obtained. The noise monitor measured a traffic noise level of 67 dB(A) $L_{eq,1hr}$. The predicted noise level at a point corresponding to the closest classroom façade to Maitland Street is 65 dB(A)$L_{eq,1hr}$.

With standard windows and constructions, the noise level in the classrooms would be expected to be reduced by approximately 20dB(A), meaning the 40dB(A) criterion would be exceeded, with the predicted external noise level of 65 dB(A) $L_{eq,\ worst\ 1hr}$. This indicates that, if the buildings are constructed prior to the road bypass being built, an acoustically upgraded façade would be needed that provides a traffic noise reduction of 25 dB(A) with windows closed.

9 CONSTRUCTION NOISE ASSESSMENT

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

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

9.1 SITE DESCRIPTION

Construction works for the proposed school will consist primarily of three construction phases, namely site works, general construction activities and completion landscaping/external works. The proposal consists of a number of buildings including a multipurpose centre containing a basketball court, general teaching areas and administrative offices.

There are no below ground/basement levels proposed, meaning that significant excavation and piling will not be required. Construction works (and typical loudest plant/equipment) expected for the project are as follows:

- Clearing of the site and earthworks to level the site as required and excavate for footings and services (excavators, pneumatic hammers)
- Erection of buildings (powered hand tools for formwork, concrete pump, vibrators);
- Internal fit out.
- Landscaping (front end loaders etc);

Work hours for the site are proposed as follows:

Monday to Friday:	7am – 6pm
Saturday:	7:30am – 3:30pm
Sundays or Public Holidays:	No work.

9.2 RECEIVER LOCATIONS

Sensitive receiver locations are identified in Section 2 above.

9.3 NOISE AND VIBRATION GUIDELINES

9.3.1 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;
- If necessary, recommendation of noise controls strategies in the event that 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.

A summary of the above noise management levels from the ICNG is presented below in Table 11.

Table 11 – Noise Management Levels - Residential

Location	"Noise Affected" Level - dB(A)$L_{eq(15min)}$	"Highly Noise Affected" Level - dB(A)$L_{eq(15min)}$
Residential Receivers at the south east boundary	53	75
Residential receivers to the north east along Victoria Street (across the golf course)	50	75
Residential receivers to the north west (across Maitland Street)	63	75
Golf Course	58	-

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

9.3.2 Vibration

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

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

9.3.2.1 Structure Borne Vibrations (Building Damage Levels)

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

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

Table 12 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

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

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

9.3.2.2 Assessing Amenity

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 13 – 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

9.4 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. The following table presents assessment noise levels for typical construction equipment expected to be used during the construction of the proposal.

Table 14 - Sound Power Levels of the Typical Equipment

Equipment / Process	**Sound Power Level dB(A)***
Dozer/Excavator	112
Concrete Pump	110
Trucks	100
Bobcat	105
Crane (electric)	85
Powered Hand Tools	95-100

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

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

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

9.5 ASSESSMENT

9.5.1 Noise Predictions

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

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

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

Table 8 – Predicted Noise Generation to Residential Receivers to the South East Boundary

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	62	Will generally exceed NML
Concrete Pump	60	Will generally exceed NML
Trucks	50	Will generally not exceed NML
Bobcat	55	Will marginally exceed NML
Crane/Hoist (electric)	35	Generally below NML
Powered Hand Tools (Externally)	50	Will generally not exceed NML

Table 9 – Predicted Noise Generation to Residential Receivers to the North East (Across the Golf Course Along Victoria Street)

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	50	Will generally not exceed NML
Concrete Pump	48	Generally below NML
Trucks	38	Generally below NML
Bobcat	43	Generally below NML
Crane/Hoist (electric)	23	Generally below NML
Powered Hand Tools (Externally)	38	Generally below NML

Table 10 – Predicted Noise Generation to Residential Receivers to the North West (Across Maitland Street)

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	59	Generally below NML
Concrete Pump	57	Generally below NML
Trucks	47	Generally below NML
Bobcat	52	Generally below NML
Crane/Hoist (electric)	32	Generally below NML
Powered Hand Tools (Externally)	47	Generally below NML

Table 11 – Predicted Noise Generation to Residential Receivers to the Golf Course

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	62-68	Will generally exceed NML
Concrete Pump	60-66	Will generally exceed NML
Trucks	50-56	Will generally not exceed NML.
Bobcat	55-61	Will generally exceed NML when closer to golf course boundary
Crane/Hoist (electric)	35-41	Generally below NML
Powered Hand Tools (Externally)	50-56	Will generally not exceed NML.

9.5.2 Discussion – Noise

The greatest noise impact will be at the residences immediately to the south east of the site and to the golf course at the north east boundary. Noise levels from some activities will exceed the NML but all will be less than the HNAL. Therefore, "reasonable and feasible" mitigation should be applied in accordance with the "Control of Construction Noise and Vibration – Procedural Steps" outlined in Section 9.7.

9.5.3 Discussion - Vibration

There are no significant sources of vibration envisaged. Given the distance from nearby receivers, vibration impacts on all receivers is expected to be within the recommended levels detailed in Section 9.3.2.

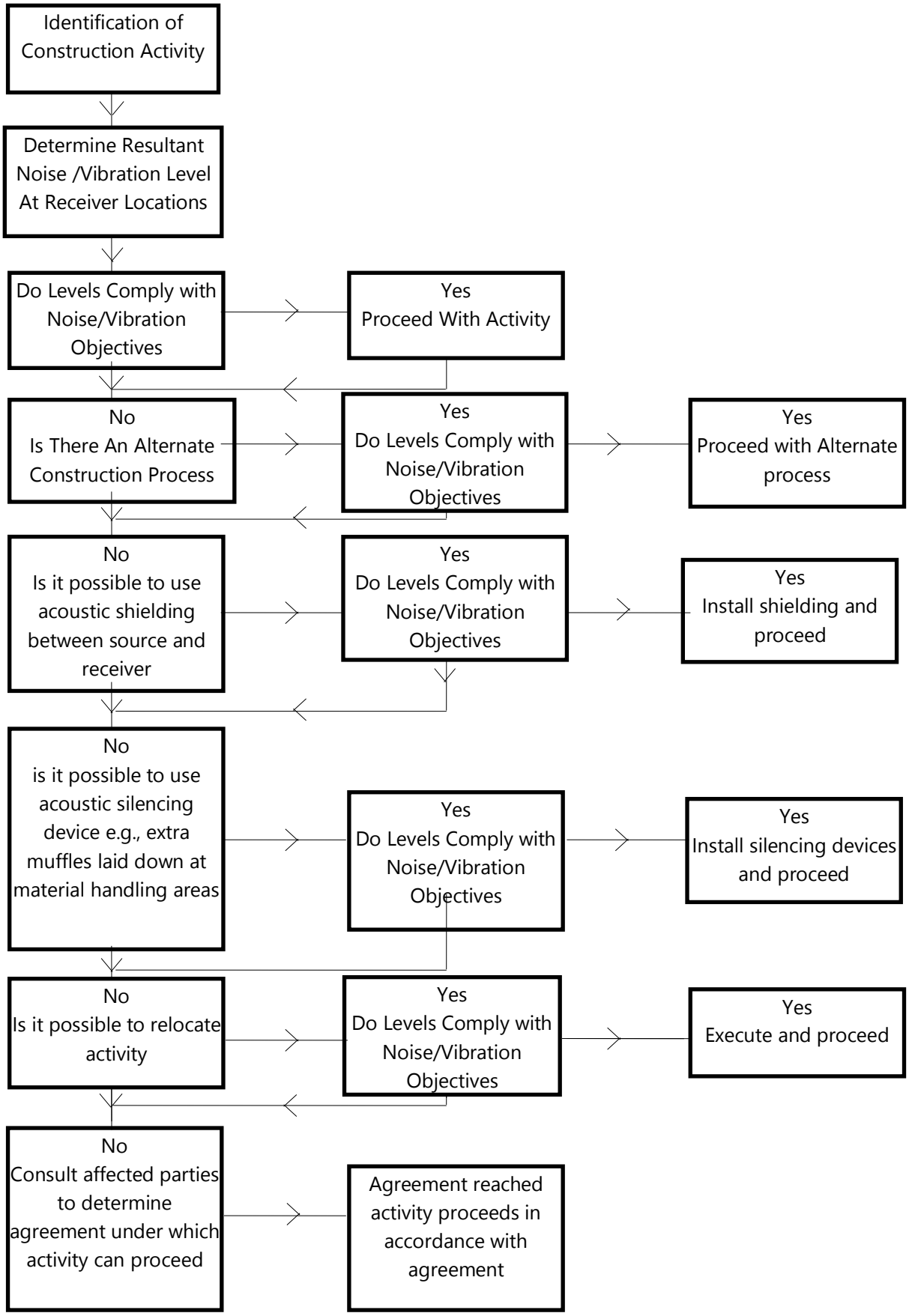
9.6 RECOMMENDATIONS

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

- Quiet work methods/technologies:
    - The primary noise generating activity at the site will be the ground work period. As much as practicable, use of quieter methods is adopted.
    - Concrete pump trucks should be located within the bounds of the site (rather than on nearby roads at the perimeter of the site) where possible.
    - 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).
- In respect of pneumatic/hydraulic hammering (if required) noise impacts should be addressed via the imposition of respite periods, typically limiting operation to:
    - 8am – 6pm, Monday to Friday
    - 8am to 1pm, Saturday
    - In any case maximum 3 hours operation with 1 hour uninterrupted respite.
- Noisy activities (exceeding the RBL by more than 5 dB(A)) should not be carried out after 1pm Saturdays. This would generally limit the activities to "quiet" trades such as internal fitout and maintenance activities.
- Complaint's handling - In the event of a complaint, the procedures outlined in Sections 9.7, 9.8 and 9.9 should be adopted.
- A detailed noise management plan should be developed 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 noise complaint.

9.7 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS

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



9.8 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.

9.8.1 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.

9.8.2 Acoustic Barriers

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

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

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

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

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

9.8.3 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).

9.8.4 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.

9.8.5 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 with the construction methodology outlining work procedures and methods for minimising noise.

9.8.6 Combination of Methods

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

9.9 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.

10 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 1 of this report, subject to additional mitigation of noise for certain activities and operating times as indicated below.

- 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) Trigger Levels, with detailed design to be done at CC stage.

- External speakers for PA and bells should designed to minimise noise spill, be directional facing away from residential receivers to comply with EPA Noise Policy for Industry (2017) guidelines (refer to Sections 0)

- Waste removal times should be scheduled between 7am and 6pm, Monday to Friday.

- Ground maintenance should only occur between 7am and 6pm, Monday to Friday.

- A 1.8m high imperforate boundary fence extending from the waste area to near the road boundary. The fence could be constructed from Sheet metal, FC sheet panels or plywood panels, 100% lapped timber or other imperforate material having a surface density exceeding 3.5 kg/m^2.

- Current levels of traffic noise exposure would require, for the buildings closer to Maitland Street, an acoustically attenuated building envelope and the provision of an alternative ventilation system to permit the windows to be closed. Prior to CC a detailed assessment should be undertaken to recommend the performance of the building envelope needed to comply with the internal noise level recommendations of "Development Near Rail Corridors and Busy Roads" Interim Guideline.

- 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 9 Construction noise assessment.

11 CONCLUSION

Noise impacts associated with the proposed Pacific Brook Christian School have been assessed with reference to relevant EPA and other acoustic guidelines presented in the report.

Operational noise emissions have been assessed in Section 6 of the report along with recommendations where required for the following:

- Noise from internal areas
- Noise from traffic generation (Carpark and Kiss and Drop)
- Waste Removal
- External activities
- Before and after hours school activities
- Noise from mechanical plant, PA system and school bells.

Comments have been made regarding operational vibration emissions (Section 7), noise intrusion into the development (Section 8) and noise increase from traffic generation on local road (Section **Error! Reference source not found.**).

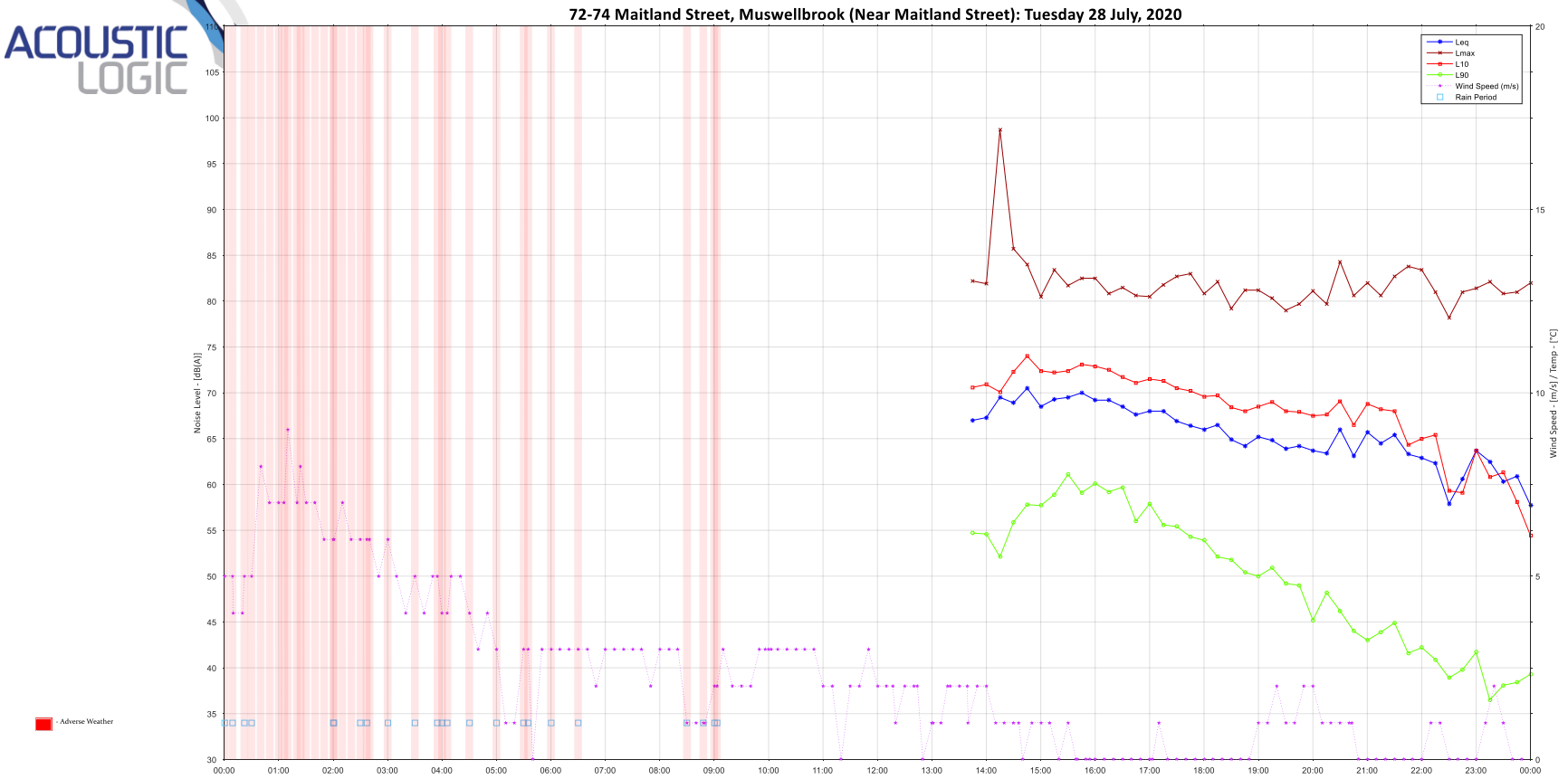
Finally, an assessment on construction activities has been undertaken in Section 9 of the report.

A summary of the recommendations to mitigate acoustic impacts associated with the proposed development has been presented in Section 10. Recommendations have been made so that noise emissions from the school do not adversely impact the surrounding properties. Provided the recommendations within this report are adopted the proposed school will not adversely impact the acoustic amenity of surrounding receivers.

Yours faithfully,

Acoustic Logic Pty Ltd
Victor Fattoretto
MAAS

APPENDIX A – NOISE LOGGING DATA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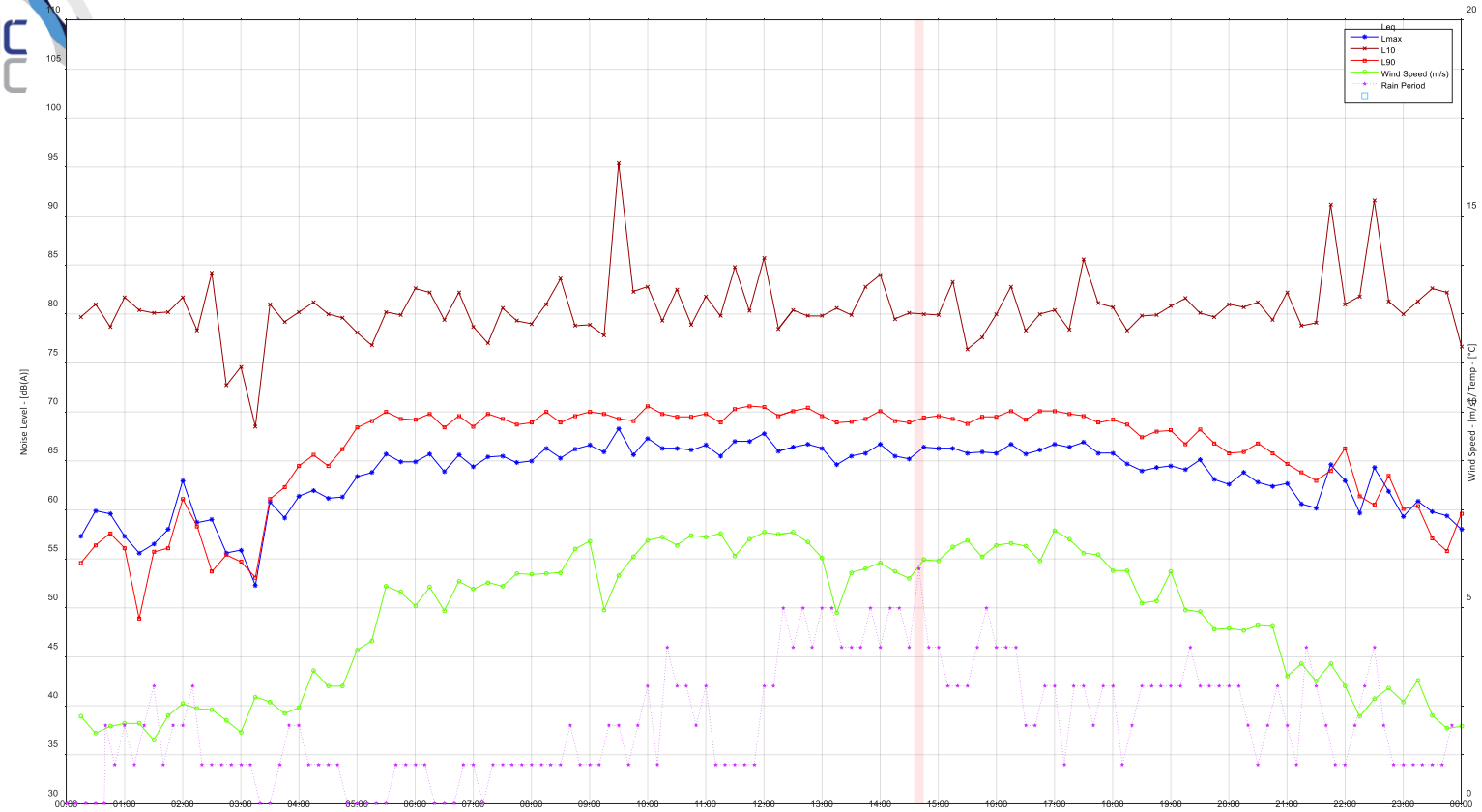

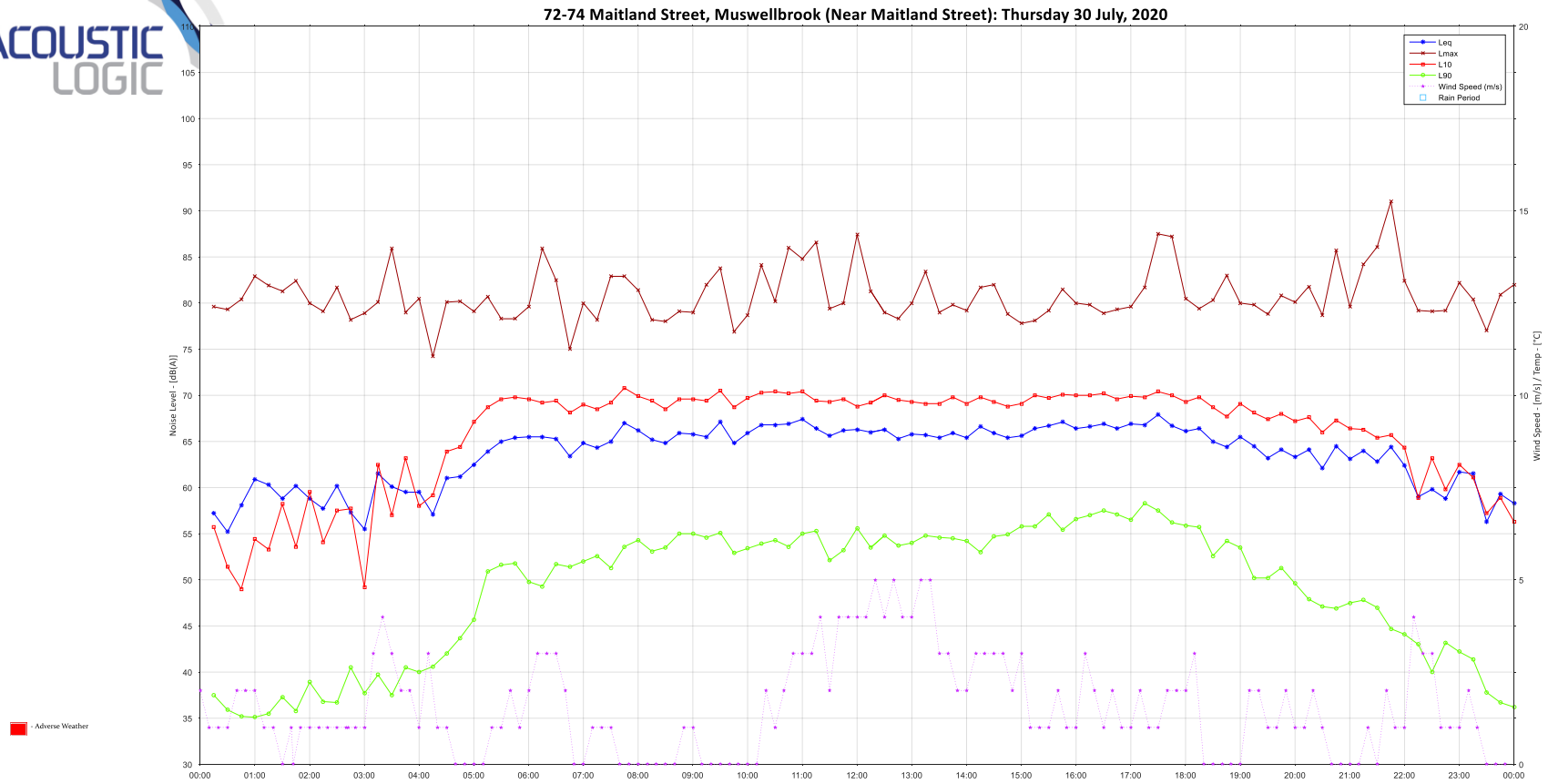
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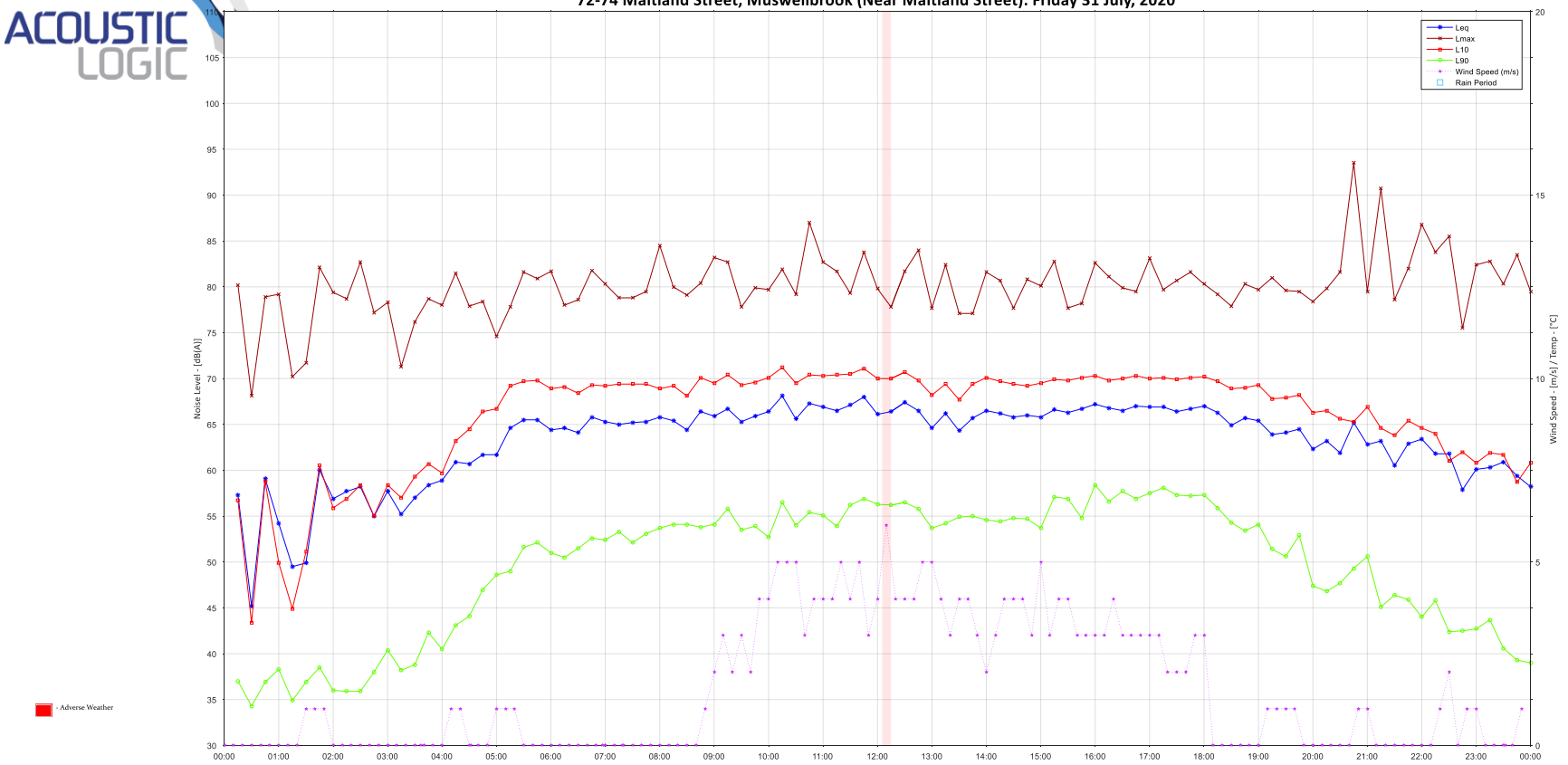
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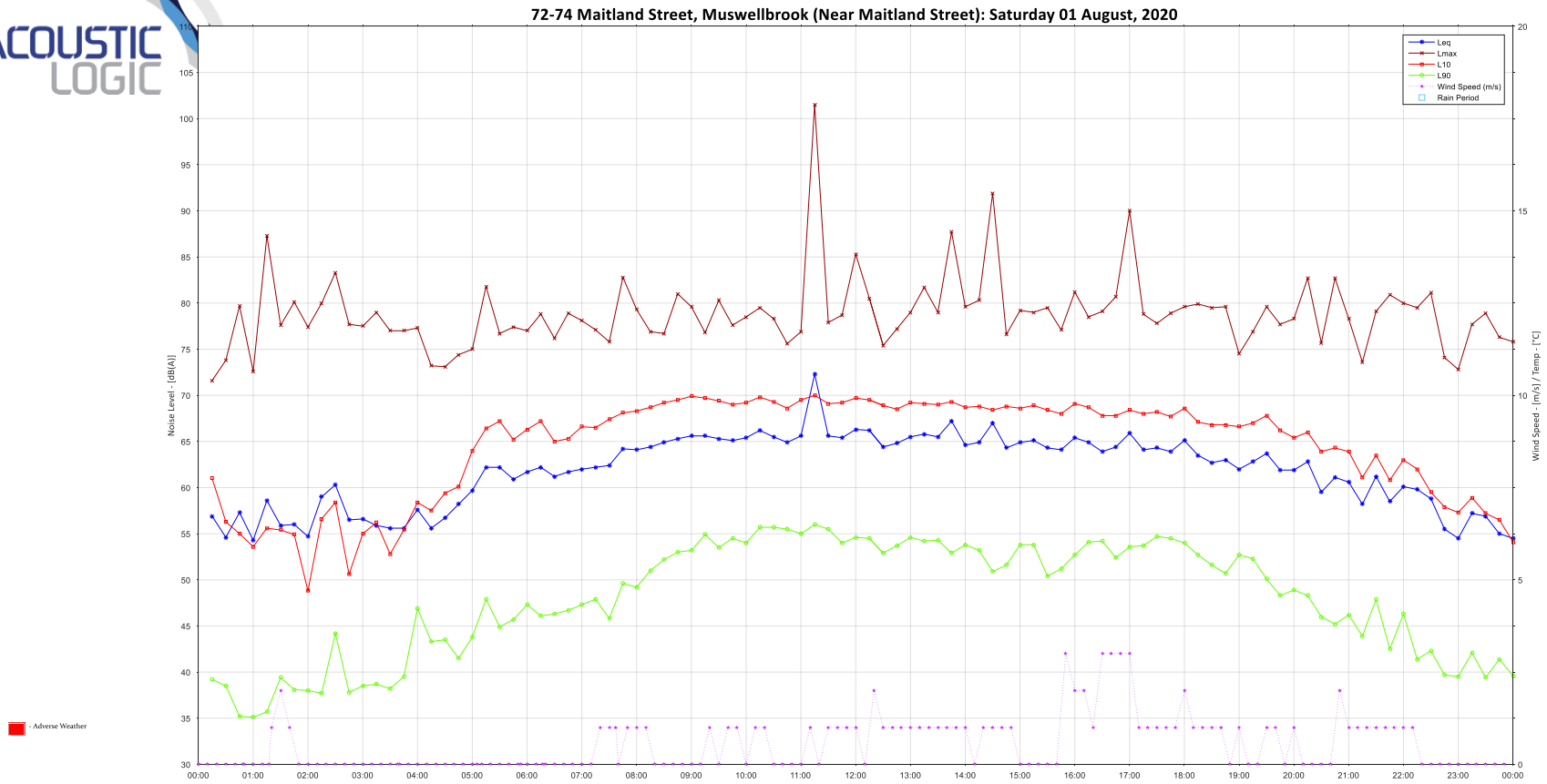
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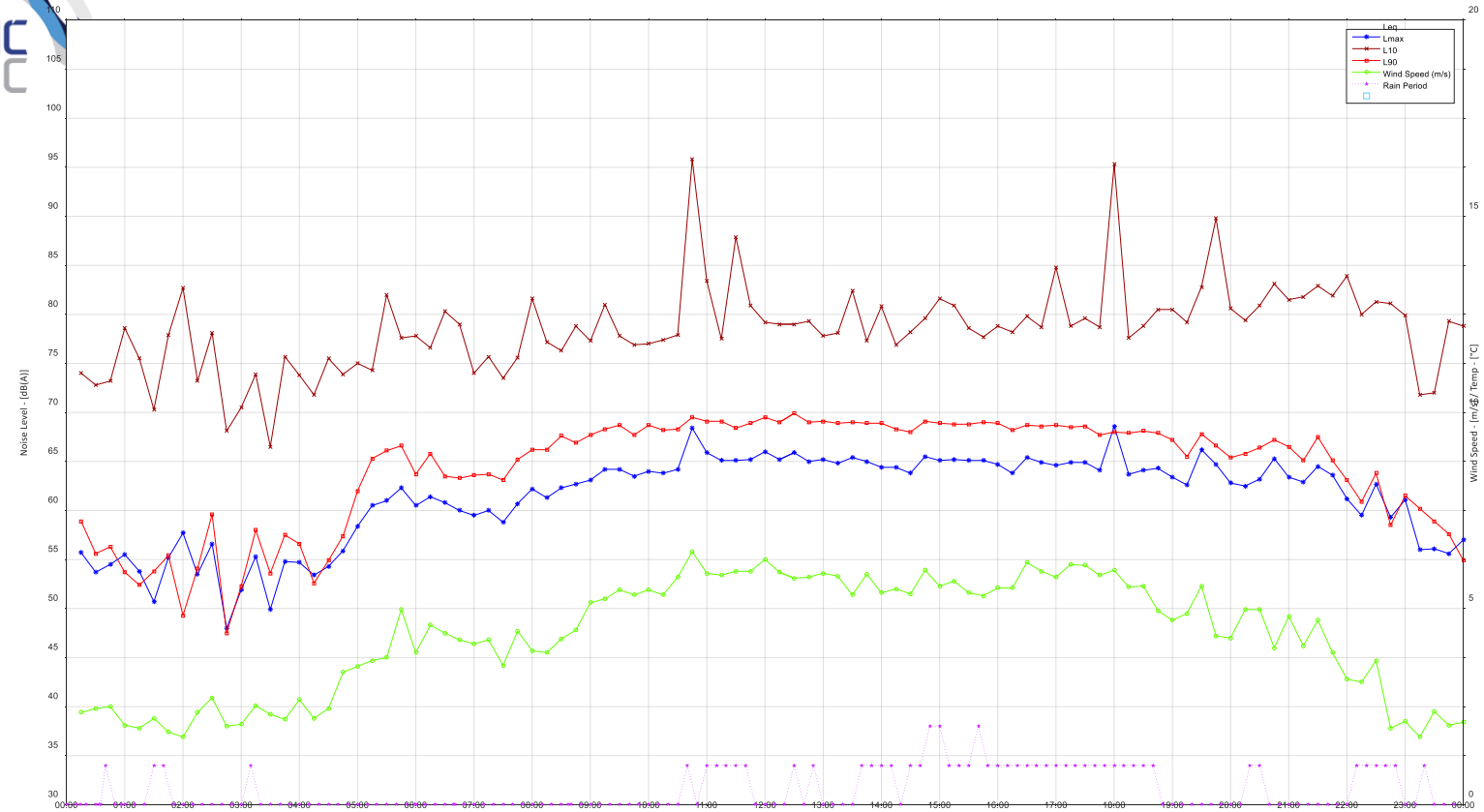

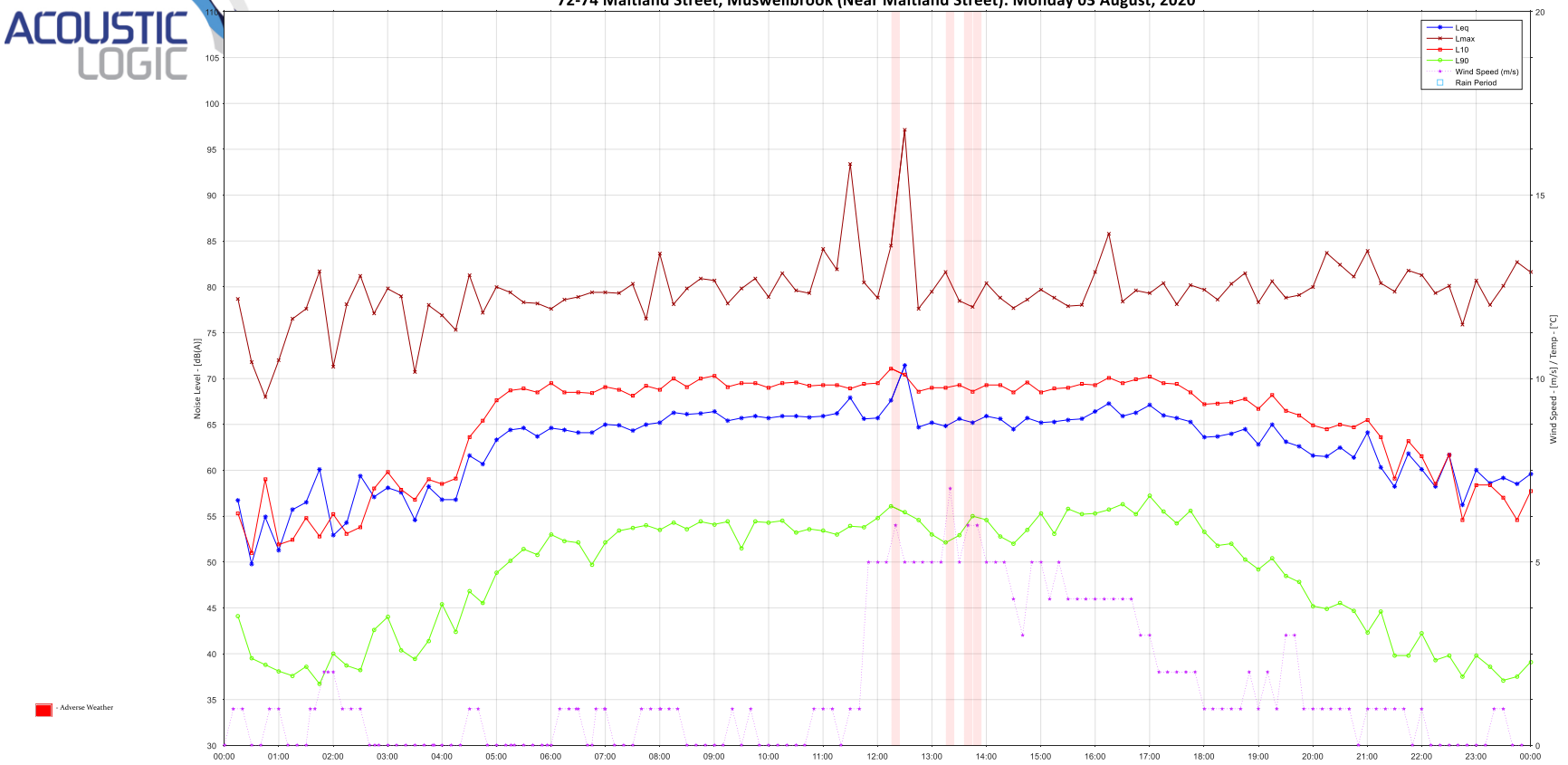
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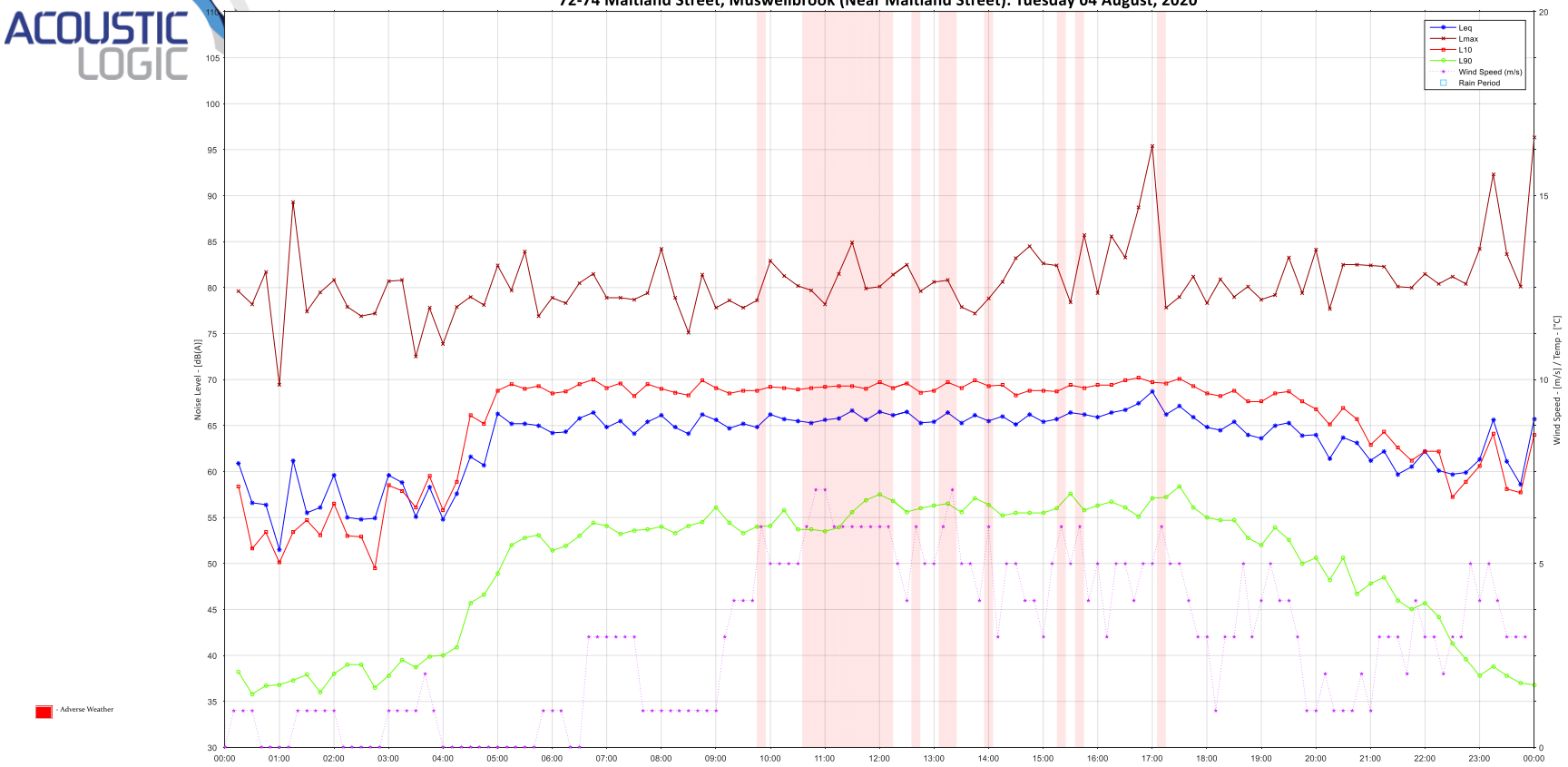
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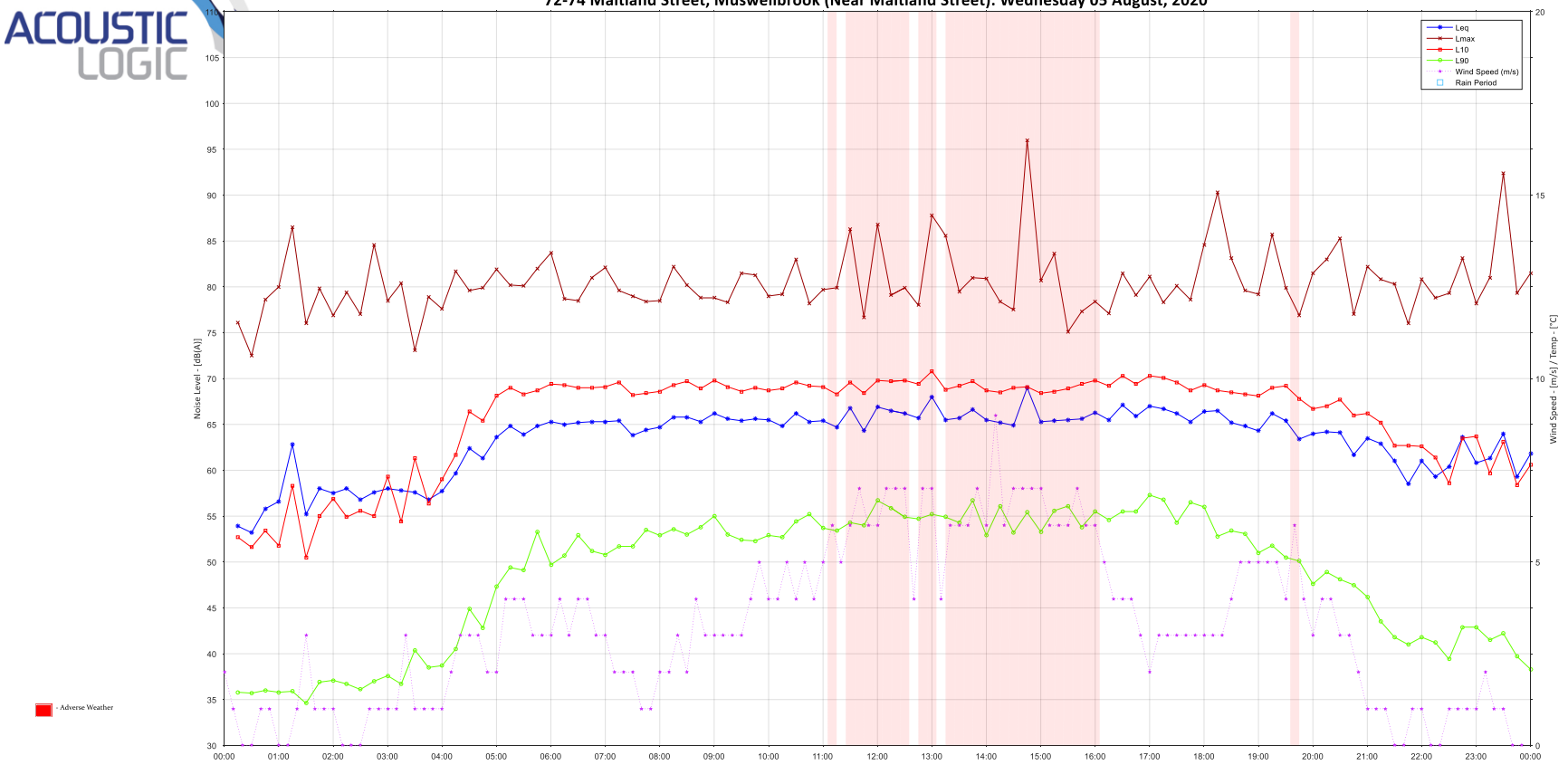
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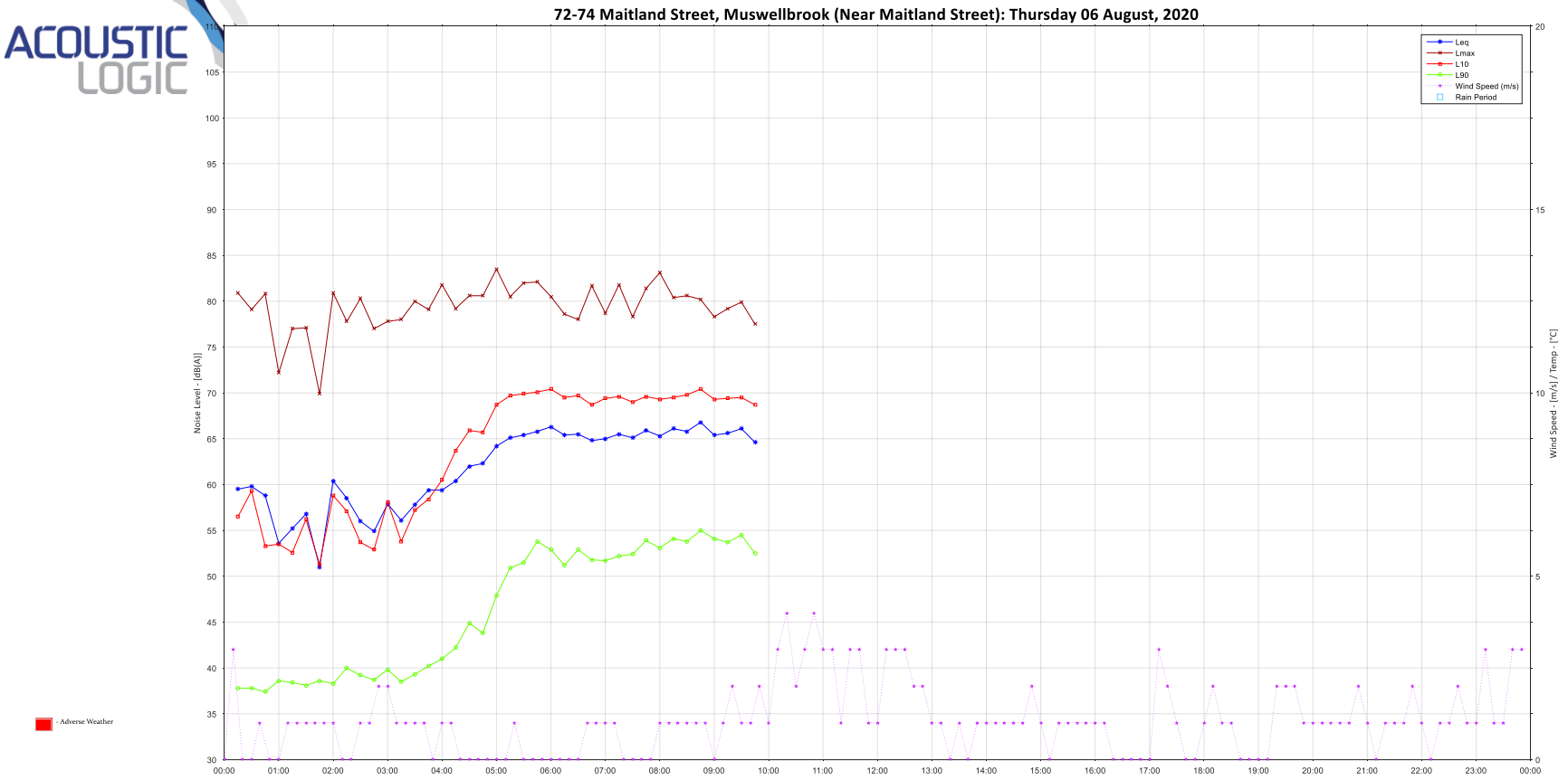
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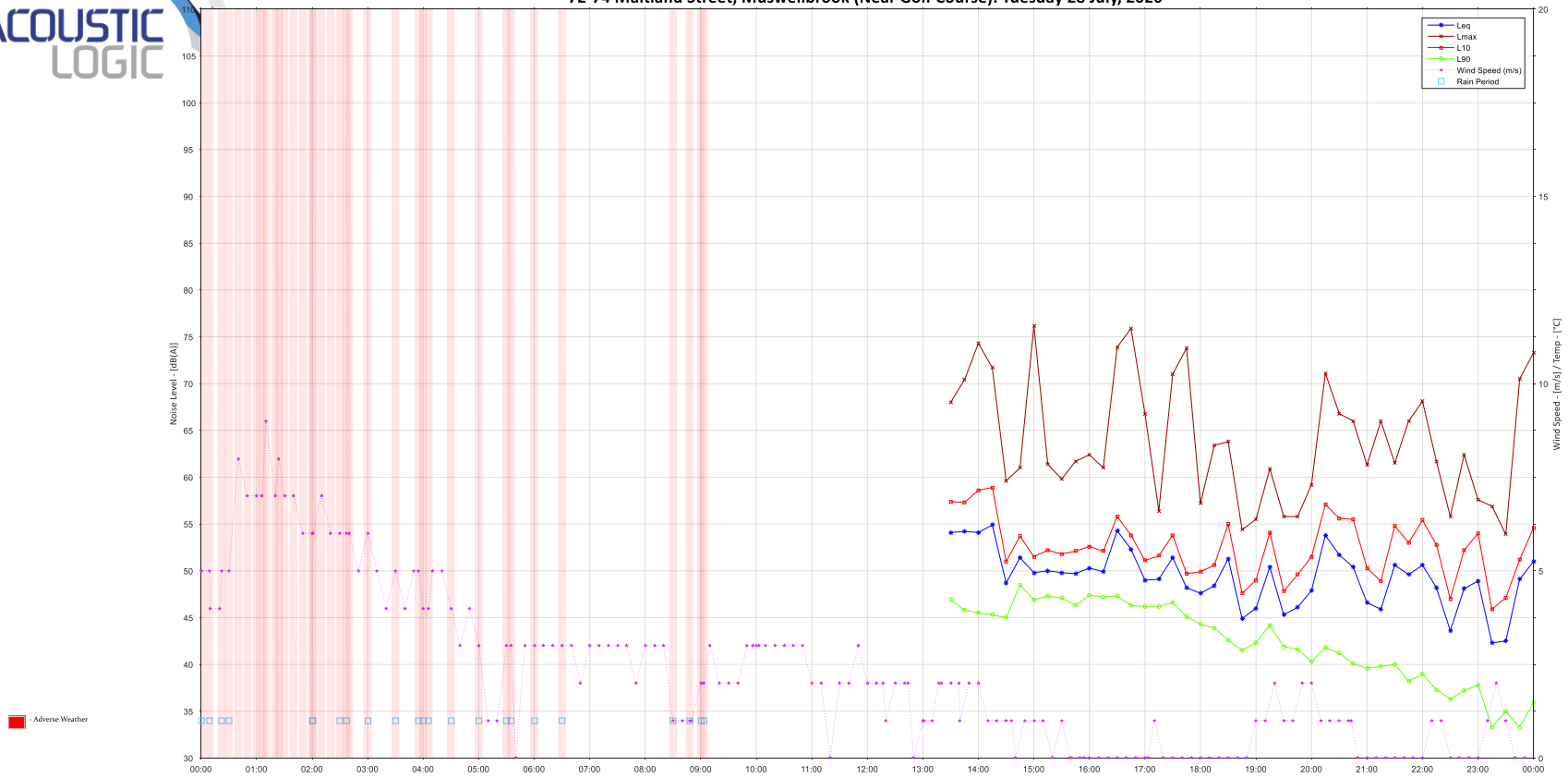

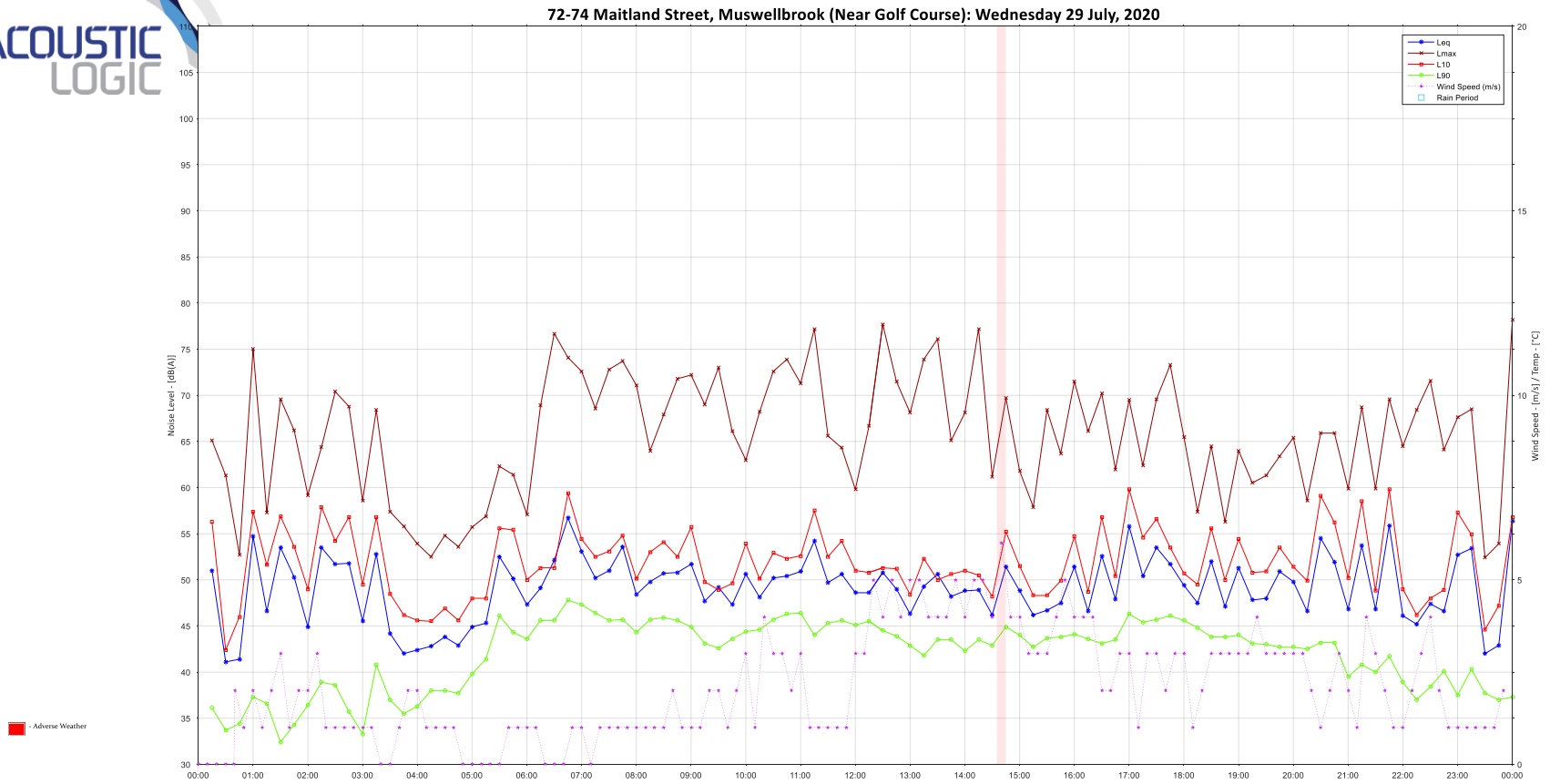
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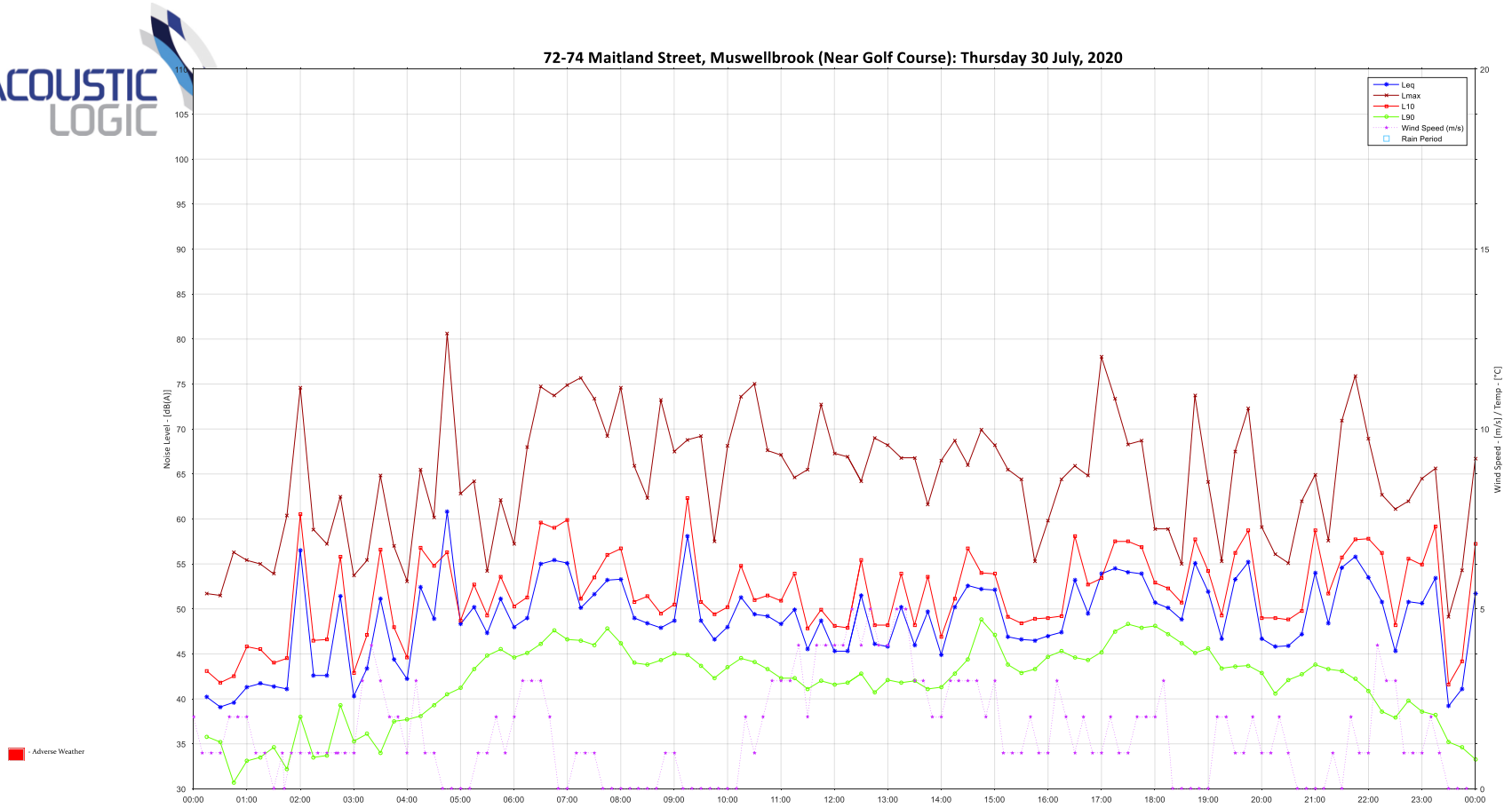
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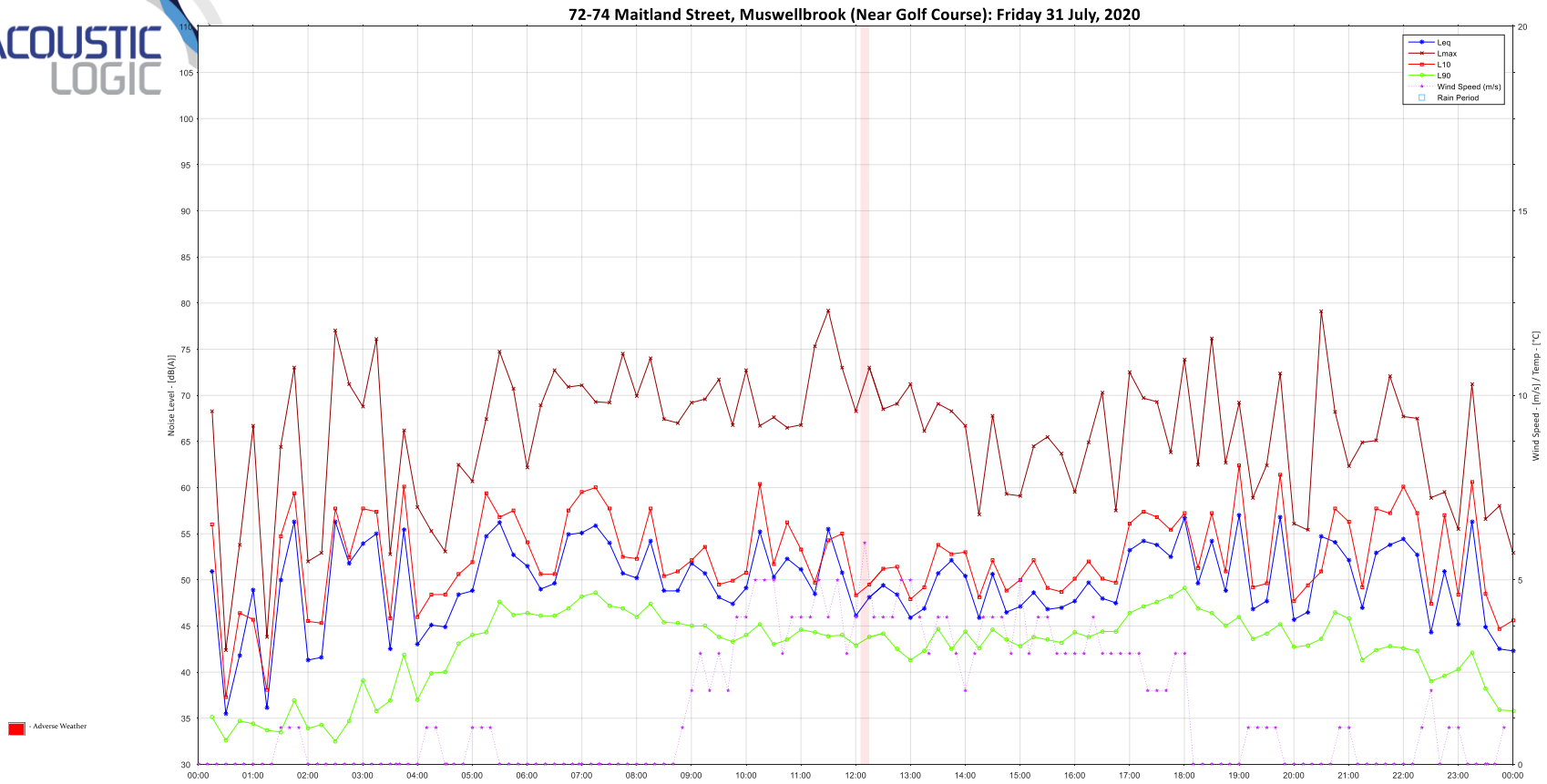
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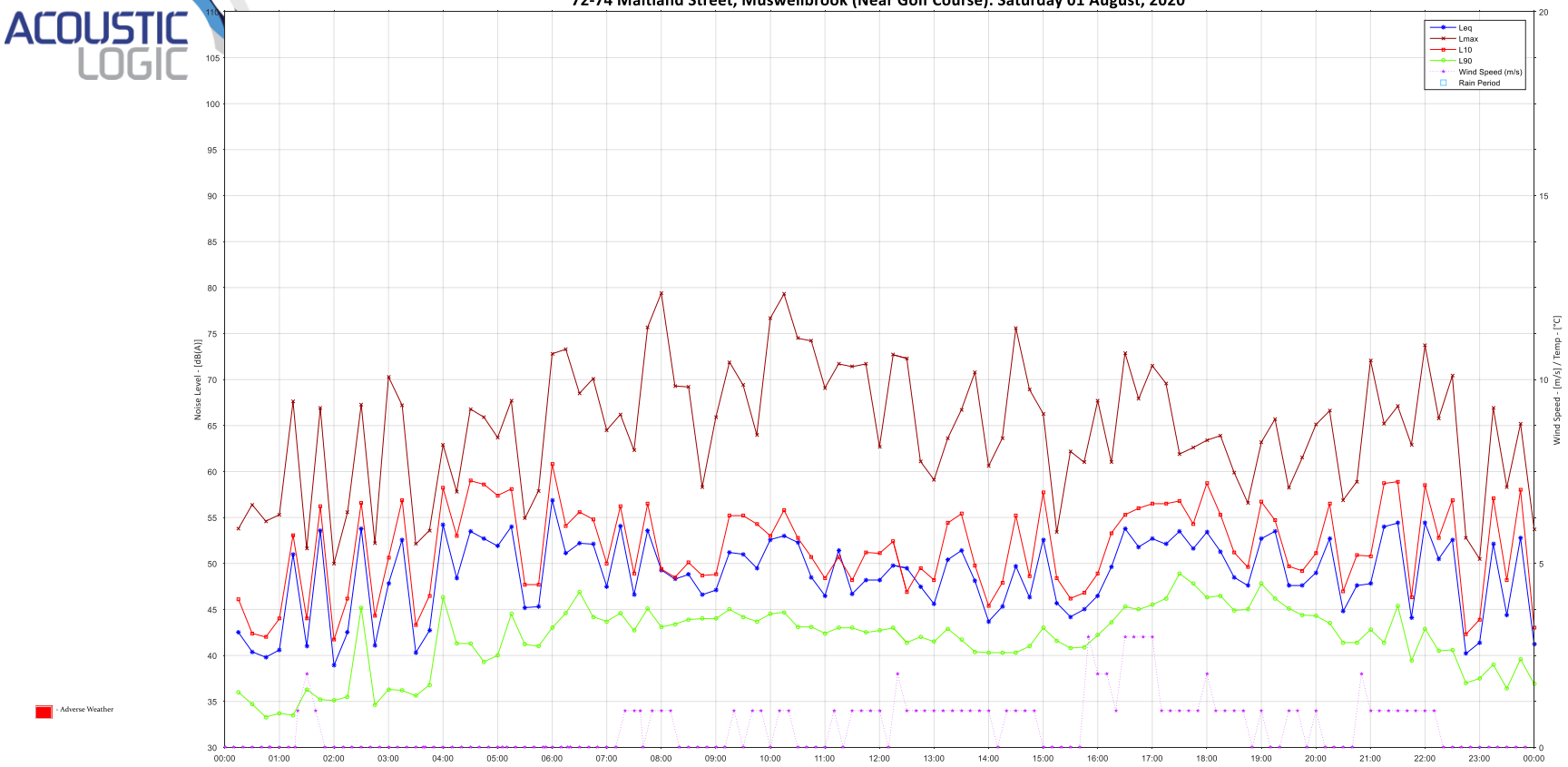
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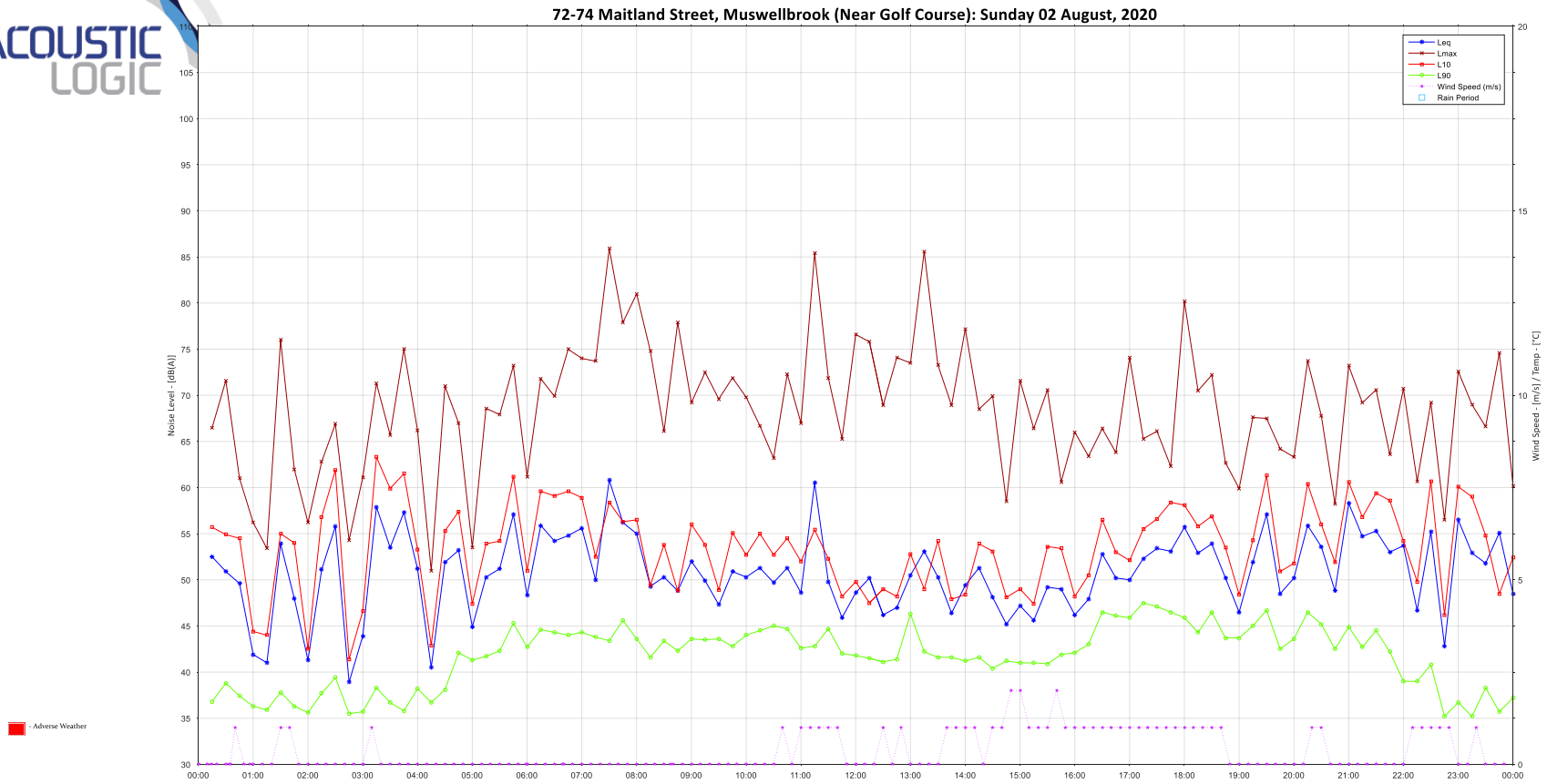
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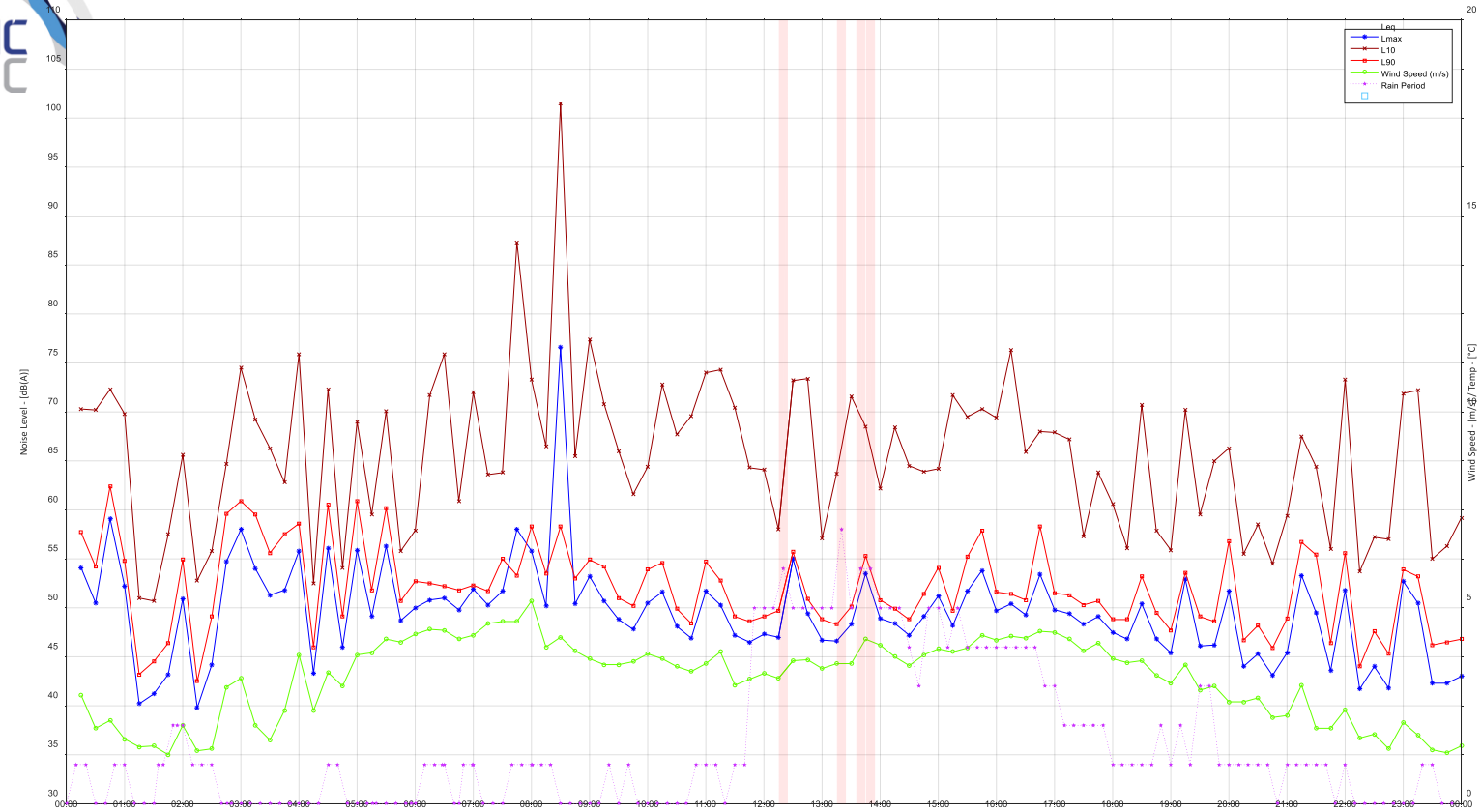

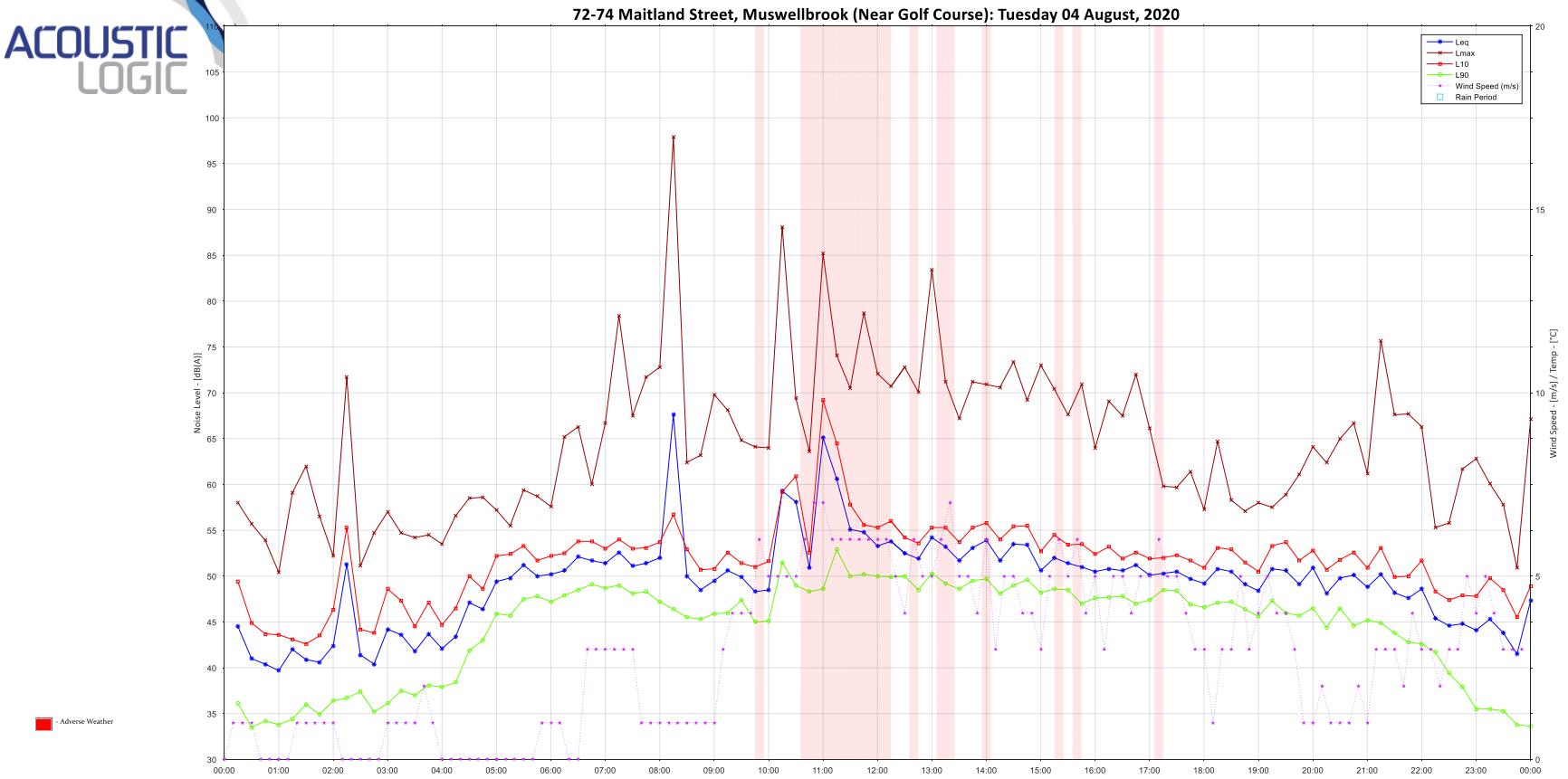
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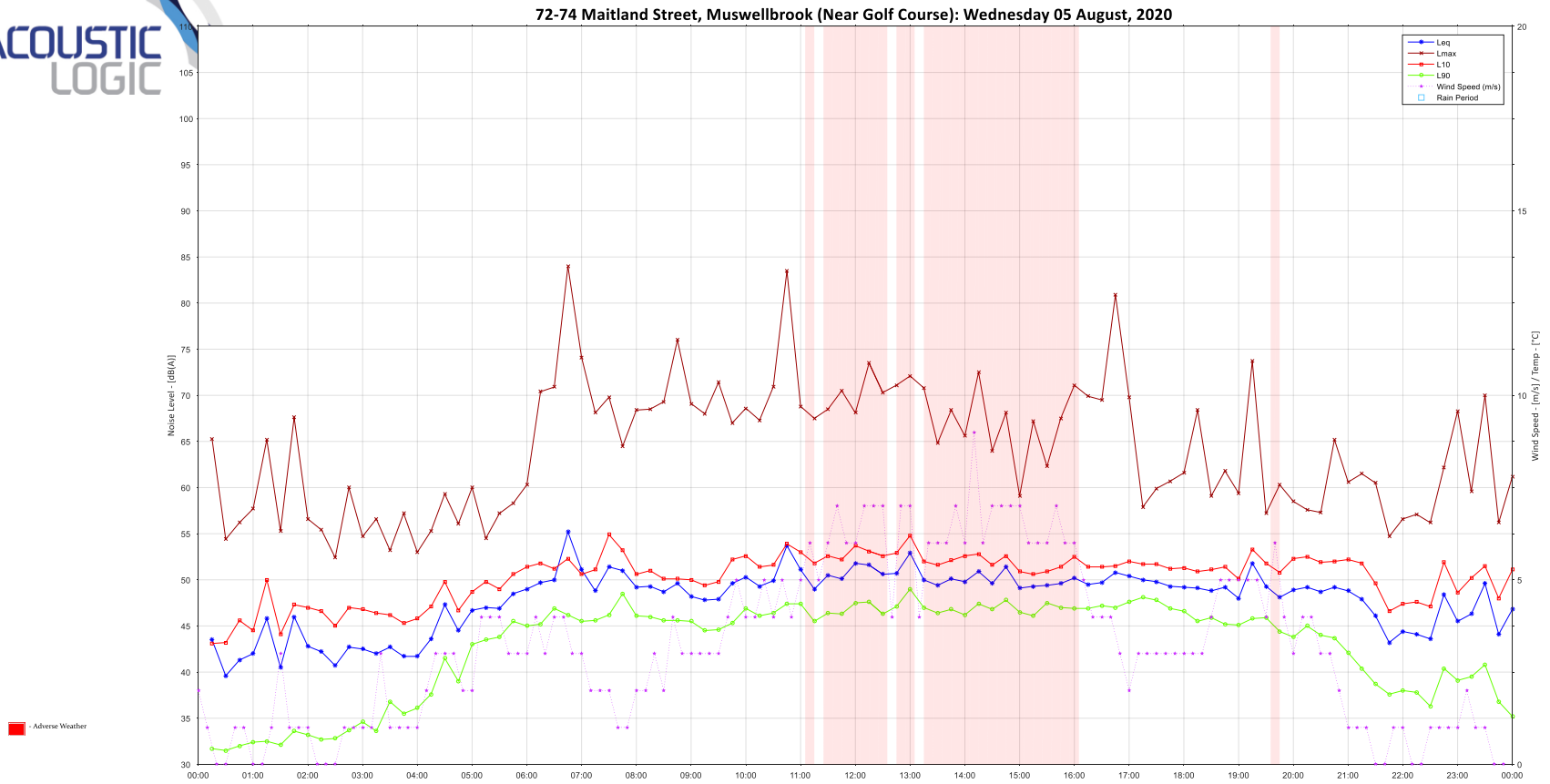
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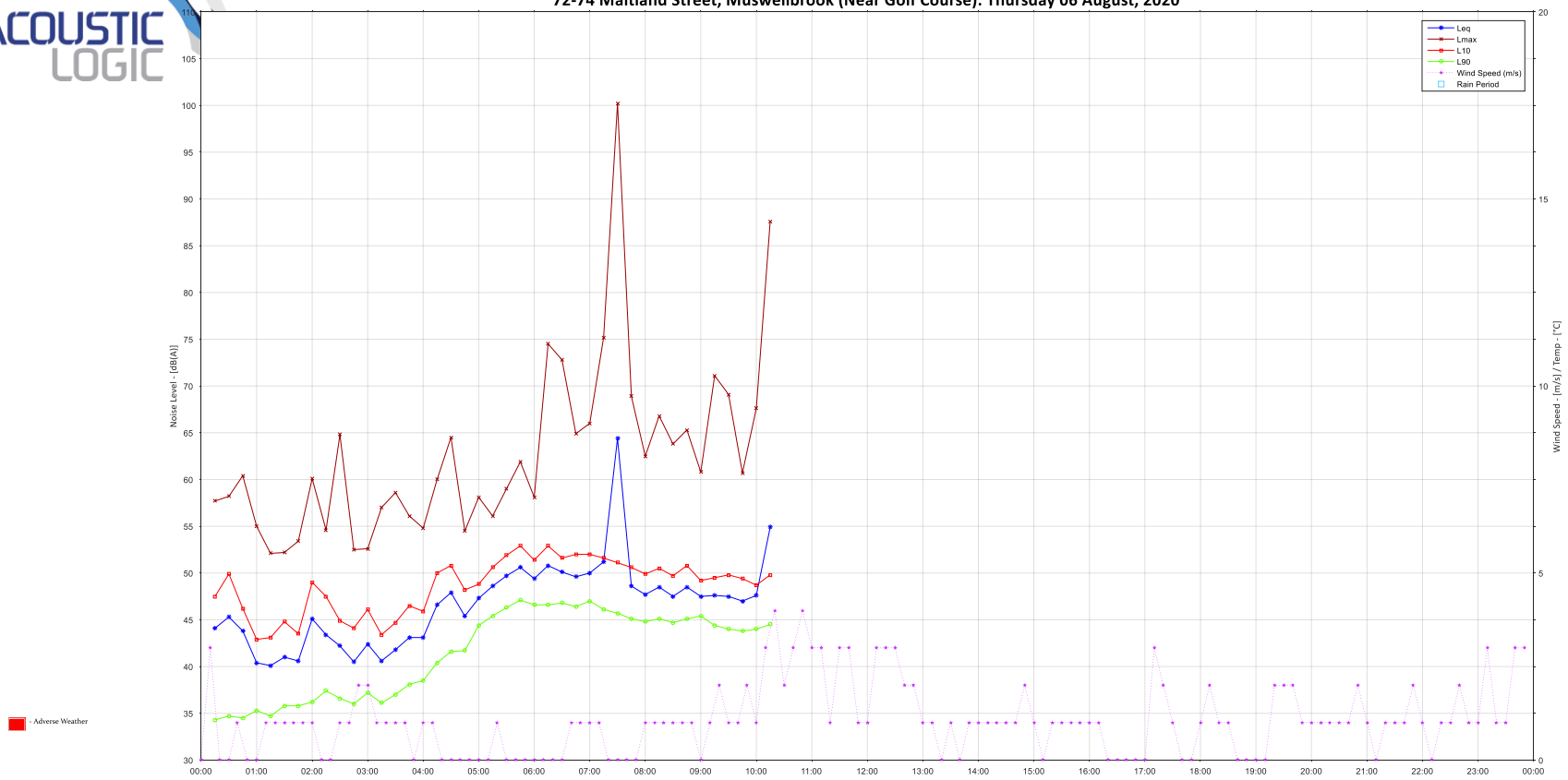
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather


72-74 Maitland Street, Muswellbrook (Near Golf Course): Thursday 06 August, 2020
Leq
Lmax
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather