

## Shoalhaven Hospital Redevelopment

## Main Works Noise Impact Assessment

Project ID	20211249.1
Document Title	Main Works Noise Impact Assessment
Attention To	Health Infrastructure (89 600 377 397)

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	8/02/2022	20211249.1/0802C/R0/VF	VF		VF
1	2/09/2022	20211249.1/0209A/R1/VF	TH		VF



## TABLE OF CONTENTS

<b>1</b>	<b>EXECUTIVE SUMMARY .....</b>	<b>5</b>
<b>2</b>	<b>PROPOSAL DESCRIPTION .....</b>	<b>6</b>
<b>3</b>	<b>SEARS REQUIREMENTS .....</b>	<b>7</b>
<b>4</b>	<b>CONSULTANT INTRODUCTION .....</b>	<b>8</b>
<b>5</b>	<b>SITE AND PROPOSAL DESCRIPTION.....</b>	<b>9</b>
<b>6</b>	<b>EXISTING ACOUSTIC ENVIRONMENT.....</b>	<b>12</b>
6.1	<b>NOISE DESCRIPTORS.....</b>	<b>12</b>
6.2	<b>UNATTENDED LONG TERM NOISE MONITORING.....</b>	<b>13</b>
6.2.1	Equipment Used.....	13
6.2.2	Locations Monitored.....	13
6.2.3	Measurement Period.....	13
6.2.4	Calculated Noise Levels.....	13
<b>7</b>	<b>OPERATIONAL NOISE ASSESSMENT .....</b>	<b>19</b>
7.1	<b>SHOALHAVEN DEVELOPMENT CONTROL PLAN.....</b>	<b>19</b>
7.2	<b>NSW EPA NOISE POLICY FOR INDUSTRY (NPfi) 2017 .....</b>	<b>19</b>
7.2.1	Assessing Intrusiveness.....	20
7.2.2	Assessing Amenity .....	20
7.2.3	Sleep Arousal Criteria.....	21
7.3	<b>SUMMARY OF SITE NOISE EMISSION CRITERIA .....</b>	<b>22</b>
<b>8</b>	<b>OPERATIONAL NOISE EMISSION ANALYSIS – NEW ASB .....</b>	<b>23</b>
8.1	<b>MECHANICAL PLANT NOISE EMISSION.....</b>	<b>23</b>
8.2	<b>CARPARK USAGE NOISE EMISSIONS.....</b>	<b>24</b>
8.3	<b>EMERGENCY HELICOPTER NOISE .....</b>	<b>25</b>
<b>9</b>	<b>TRAFFIC GENERATION ON LOCAL ROADS.....</b>	<b>26</b>
9.1	<b>LOADING DOCK NOISE EMISSIONS.....</b>	<b>26</b>
9.1.1	Loading Dock Noise Impact Assessment .....	27
9.1.2	Detailed Assessment of Sleep Disturbance Potential.....	27
<b>10</b>	<b>CONSTRUCTION NOISE AND VIBRATION.....</b>	<b>29</b>
10.1	<b>NOISE .....</b>	<b>29</b>
10.1.1	EPA Interim Construction Noise Guideline .....	29
10.1.2	Summary of Noise Management Levels.....	30
10.1.3	Australian Standard AS 2436:2010 “Guide to Noise Control on Construction, Maintenance and Demolition Sites” .....	30
10.2	<b>VIBRATION.....</b>	<b>31</b>
10.2.1	German Standard Din 4150-3 (2016) – <i>Structural Vibration: Effects of Vibration on Structures</i> .....	31
10.2.2	Human Comfort and Amenity .....	32
10.2.3	Recommended Vibration Limits.....	32
10.3	<b>ASSESSMENT OF CONSTRUCTION NOISE .....</b>	<b>33</b>
10.4	<b>ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE LEVELS .....</b>	<b>33</b>
10.5	<b>CONSTRUCTION NOISE EMISSION PREDICTIONS .....</b>	<b>34</b>
10.6	<b>CONSTRUCTION NOISE AND VIBRATION IMPACT ASSESSMENT .....</b>	<b>36</b>
10.7	<b>CONTROL OF CONSTRUCTION NOISE AND VIBRATION .....</b>	<b>38</b>
10.8	<b>MEASURES TO REDUCE CONSTRUCTION NOISE.....</b>	<b>39</b>
10.8.1	Acoustic Barriers.....	39
10.8.2	Treatment of Specific Equipment.....	39
10.8.3	Material Handling.....	39
10.8.4	Vehicles.....	39

10.8.5	Static Plant.....	39
10.8.6	Selection of Alternate Appliance or Process .....	39
10.8.7	Establishment of Site Practices.....	39
10.8.8	Management Training .....	40
10.8.9	Noise Monitoring .....	40
10.8.10	Vibration Monitoring.....	40
<b>11</b>	<b>COMPLYING CONTROLS – BUILDING AND MANAGEMENT .....</b>	<b>41</b>
11.1	BUILDING CONSTRUCTION.....	41
11.2	MANAGEMENT CONTROLS.....	41
11.3	CONSTRUCTION PHASE .....	41
<b>12</b>	<b>CONCLUSION.....</b>	<b>42</b>
	<b>APPENDIX A – UNATTENDED NOISE MONITORING DATA – .....</b>	<b>43</b>
	<b>APPENDIX B – ARCHITECTURAL DRAWINGS ASSESSED .....</b>	<b>71</b>

## 1 EXECUTIVE SUMMARY

The DA seeks consent for the construction and use of the redeveloped hospital which comprises:

- Construction of a 8 level acute services building (ASB) including helipad (HLS).
- External services works and landscaping of the development site;
- Earthworks and other civil engineering works; and
- Subdivision of the site from the balance of Nowra Park.

The proposal is State Significant Development (SSD) for the purposes of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and section 14(a) of Schedule 1 of the *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP) as it involves development for the purposes of a hospital with a capital investment value in excess of \$30 million.

An acoustic assessment of potential noise impacts associated with the proposed hospital redevelopment to address the SEARs has been undertaken. The following table indicates the impacts assessed and the relevant section of the report containing the assessment.

Key Acoustic Issue / Requirement	Relevant Section
<b>Policies, Guidelines and Planning Agreements</b>	
• NSW EPA's Noise Policy for Industry (NPfI) 2017	7.2
• NSW EPA's Interim Construction Noise Guideline' (ICNG)	10.1.1
• NSW EPA's Road Noise Policy	9
<b>Noise and Vibration Impact Assessment</b>	
• Construction Noise/Vibration	10
• Operational Noise/Vibration	8
• Road Traffic Noise Assessment	9

Operational noise emission trigger levels and construction noise management levels have been established for the receivers surrounding the proposed development based on measurements of ambient noise levels.

The main findings of the assessment are:

- Provided the recommendations of his assessment are adopted operational noise emissions will comply with the established trigger levels at all receivers.
- The preliminary construction noise and vibration assessment indicates that construction noise emissions will need to be managed as recommended in the assessment and the NSW Interim Construction Noise Guideline. Adverse construction vibration impact is unlikely. A detailed construction noise and vibration management plan should be produced prior to the commencement of construction based on the proposed methodologies.
- Noise from helicopter operations to surrounding properties is likely to decrease as a result of the helipad location being relocated to the roof of the proposed ASB.

- There would not be a perceptible increase in traffic noise on surrounding streets as a result of vehicle movements generated by the proposed development.

## 2 PROPOSAL DESCRIPTION

Health Infrastructure NSW (HI) is the applicant for the proposed Shoalhaven Hospital Redevelopment at Scenic Drive, Nowra in the City of Shoalhaven Local Government Area (LGA).

The proposal is State Significant Development (SSD) for the purposes of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and section 14(a) of Schedule 1 of the *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP) as it involves development for the purposes of a hospital with a capital investment value in excess of \$30 million.

The Shoalhaven Hospital Redevelopment seeks to deliver significantly enhanced acute services, as well as a new campus main entry and drop-off area.

The proposed Acute Services Building will be located south and east of the hospital's existing cluster of buildings at will address Shoalhaven Street to the hospital's east. The development is proposed to be located on the site of the existing Shoalhaven Community Pre-school (which will be separately relocated) and part of the former Nowra Park.

The proposed Shoalhaven Hospital Redevelopment under this SSD relates primarily to the development of a new hospital building and its ancillary works. The scope includes a new 7-level building of about 31,000m<sup>2</sup> GFA, with rooftop plant and helipad, generally accommodating the following:

Level 00	Back of House (BOH), Loading Dock, Kitchen, plant, Pharmacy, Staff amenities, Mortuary, and plant.
Level 01	Front of House (FOH), Emergency Department (ED), Medical Imaging, and Cafe
Level 02	Operating Suites & Endoscopy, Central Sterile Supply Department (CSSD), and linkway to Block B
Level 03	Coronary Care Unit (CCU), Close Observation Unit (COU), Intensive Care Unit (ICU), cultural centre, and plant
Level 04	In-Patient Unit (IPU), Mental Health, and plant
Level 05	In-Patient Unit (IPU)
Level 06	In-Patient Unit (IPU)
Level 07	Rooftop plant
Level 08	Helipad

This generally results in 279 new beds and treatment spaces across a range of departments, eight new operating theatres, and two new endoscopy theatres. The works include a new ambulance entry from Shoalhaven Street, new public and servicing accessway off North Street, and separate loading dock entry and mortuary parking off Shoalhaven Street.

A range of infrastructure and civil engineering works are proposed as well as demolition of existing structures within the footprint of the new building and/or on the existing hospital campus where a new linkway connection is proposed. Earthworks will be necessitated within the building's footprint and immediate environs.

Subdivision of the balance of Lot 104 (the former Nowra Park) remaining and consolidation of the existing pre-school lot into the hospital lot is also proposed.

A number of selected trees will require removal. Other significant trees will be retained and protected. Replacement planting at a minimum rate of 1:1 is proposed.

The development's SEARs were issued by the Department of Planning and Environment on 23 February 2022.

### 3 SEARS REQUIREMENTS

Item	SEARS Requirement	Documentation
12	<b>Noise and Vibration</b>	Noise and Vibration Impact Assessment
	Provide a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	

In preparing this report, the following SEARs General Requirements and Key Issues have been addressed. The table below sets out the reference or location of these matters within this report.

**Table 1 -Secretary's Environmental Assessment Requirements**

Key Acoustic Issue / Requirement	Relevant Section
<b>Policies, Guidelines and Planning Agreements</b>	
• NSW EPA's Noise Policy for Industry (NPfI) 2017	7.2
• NSW EPA's Interim Construction Noise Guideline' (ICNG)	10.1.1
• NSW EPA's Road Noise Policy	9
<b>Noise and Vibration Impact Assessment</b>	
• Construction Noise/Vibration	10
• Operational Noise/Vibration	8
• Road Traffic Noise Assessment	9

## 4 CONSULTANT INTRODUCTION

Acoustic Logic (AL) has been engaged to conduct an acoustic assessment of potential noise impacts associated with the proposed hospital redevelopment including:

- Noise emissions from plant to service the project site.
- Activity noise emissions.
- Helicopter noise impacts.
- Noise emissions from use of the carpark and traffic generated on local streets.
- The impact of local environmental noise sources on the proposed use.
- Construction noise and vibration impacts.

The applicable assessment guidelines and the results of long-term ambient noise monitoring near the potentially most impacted residential receivers have been used to develop assessment criteria for each noise source and receiver type.

Noise emissions from the proposed development will comply with the relevant guidelines provided the recommendations of this report are adopted. Principally, these are:

- Management of operational noise levels, as recommended in Section 10.8.
- Management of construction noise impacts, as recommended in Section 10.8.

With the adoption of these controls, noise and vibration emissions from the construction and operation of the proposed will not adversely impact any of the surrounding receivers.

AL have utilised the following background documents, guidelines and regulations to assess noise impacts:

- Shoalhaven City Development Control Plan 2014 (**DCP**)
- NSW Environmental Protection Authority (EPA) *Noise Policy for Industry* 2017 (**NPfi**)
- NSW EPA – ‘Interim Construction Noise Guideline’ (**IGNG**) July 2009
- NSW EPA – ‘Noise Guide for Local Government’ (**NGLG**) 2013 (as amended)
- NSW EPA – ‘Road Noise Policy’ (**RNP**) March 2011
- Conrad Gargett DA drawing set Issue 8 (refer Appendix B)
- Schematic Design Traffic Report, prepared TTW ref: 201815 dated 20 April 2022 (**TTW Report**)
- Aviation Impact Statement - SSD Report prepared by AviPro dated 5 May 2022. (**AviPro Report**)

## 5 SITE AND PROPOSAL DESCRIPTION

The DA seeks consent for the construction and use of the redeveloped hospital which comprises:

- Construction of a 8 level acute services building (ASB) including helipad (HLS).
- External services works and landscaping of the development site;
- Earthworks and other civil engineering works; and
- Subdivision of the site from the balance of Nowra Park.

The site's general context is that of a civic precinct bounded by low-rise residential land uses. The mix of existing civic-related use includes Nowra Park (now in the ownership of HAC with the Crown Land Reserve designation extinguished) to the north and east of the development site, the existing Shoalhaven Hospital campus, associated health services facilities to the west of the development site in particular the Shoalhaven Cancer Care Centre and GP Super Clinic, and professional consulting rooms in converted dwelling houses. To the east of the park along North Street is St Michael's Roman Catholic Church and St Michael's Catholic Parish Primary School. The future Shoalhaven Community Pre-School forms a further civic component of this general precinct.

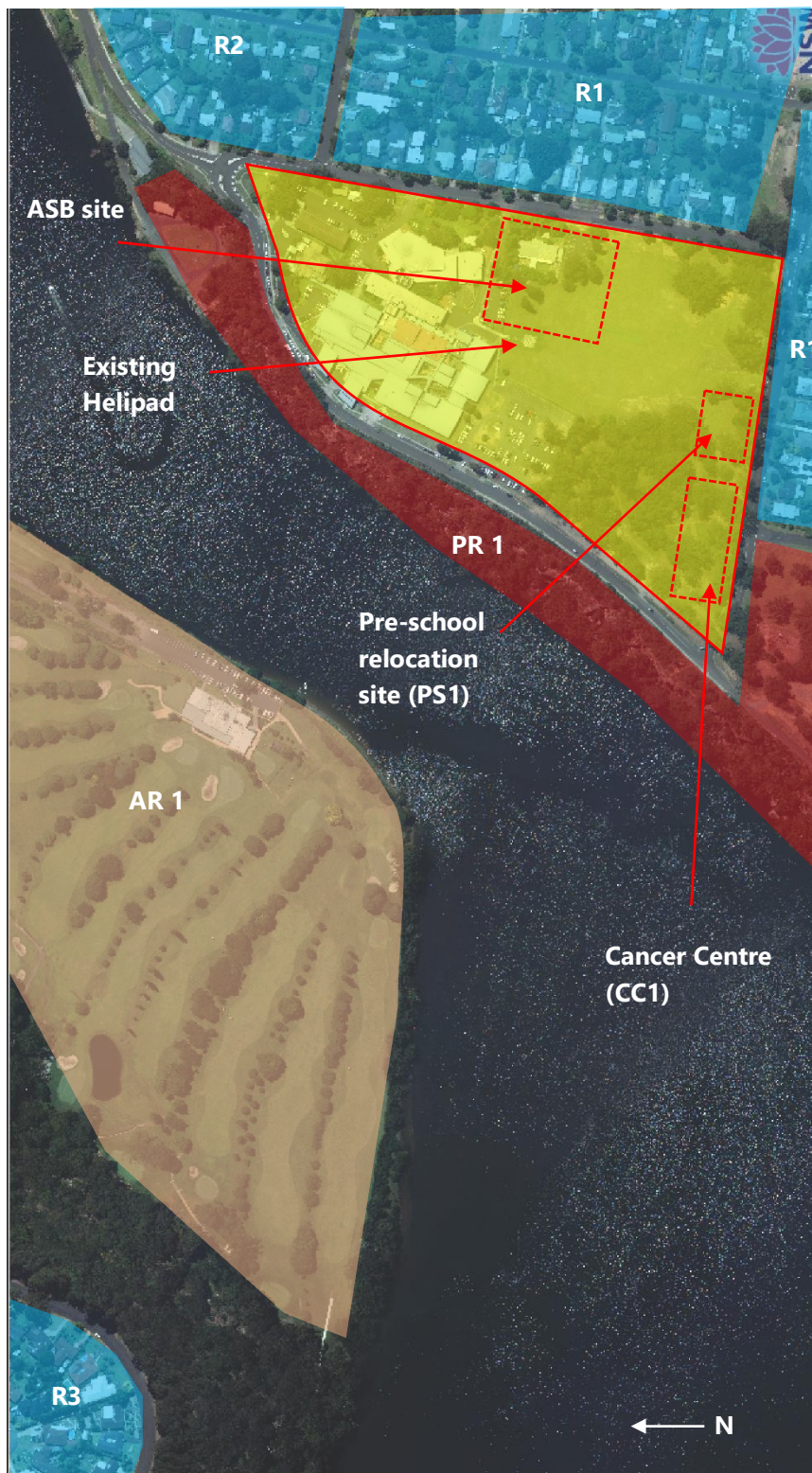
Figure 1 shows the site context, with the potentially most impacted sensitive receivers identified below:

- R1 – Residential detached dwellings to south of North Street, and residences and St Michaels Catholic Church and school to the east.
- R2 – Predominantly residential detached dwellings to north east, opposite Shoalhaven Street with some health and commercial and recreational uses.
- R3 – Residential detached dwellings to west.
- AR1 – Golf course
- PR1 – Scenic Drive Picnic Area and Bens Walk.
- PS – Shoalhaven Community Pre-School (future relocated site).
- CC – Cancer Centre overnight accommodation (part of the greater hospital site).

The remaining receivers surrounding the site will not be adversely impacted if the receivers identified above are not impacted.

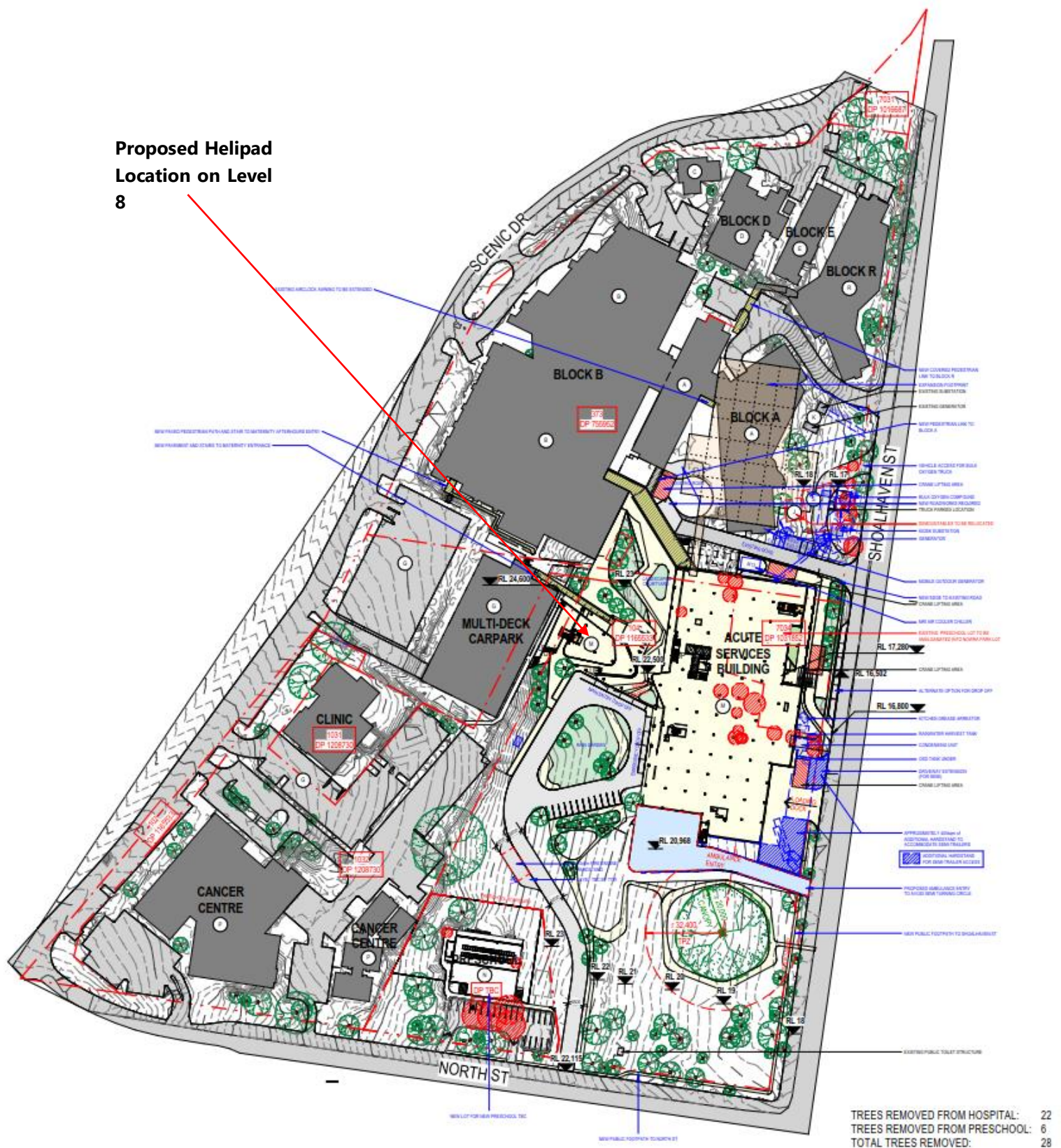
Noise emissions from the preschool have been assessed in a separate impact assessment.





**Figure 1 – Project Site and Context**





**Figure 2 –Site Plan of Proposed Development**

## 6 EXISTING ACOUSTIC ENVIRONMENT

Long term, unattended monitoring has been used to characterise the existing noise environment at the nearby residential properties.

### 6.1 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. Typically, noise is continuously sampled over a minimum of 1 week of valid data using an unattended logger.

At the end of every 15minute interval, a number of statistical parameters are calculated from the instantaneous noise levels recorded and stored in memory. The recorded 15 minute statistical levels are then downloaded for review and analysis to determine long term trends.

The principal measurement parameters obtained from the data are:

**L<sub>eq</sub>** - represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. **L<sub>eq</sub>** 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<sub>90</sub>** – 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<sub>90</sub>** 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<sub>90</sub>** level.

**L<sub>10</sub>** 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<sub>max</sub>** 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<sub>1</sub>** is sometimes used in place of **L<sub>max</sub>** to represent a typical noise level from a number of high level, short term noise events.

## **6.2 UNATTENDED LONG TERM NOISE MONITORING**

### **6.2.1 Equipment Used**

Unattended noise monitoring was conducted using the following monitors:

- Location 1 - Acoustic Research Laboratories Pty Ltd Ngara (Type 1)
- Locations 2 and 3 - Rion NL-42 (Type 2)

The monitoring was continuous, with statistical noise levels recorded at 15-minute intervals throughout the monitoring period. Measurements were taken on "A" frequency weighting and fast time response.

All monitoring equipment used retains current calibration - either manufacturers' calibration or NATA certified calibration. The monitors were field calibrated at the beginning and the end of the measurement with no significant drift in calibration noted.

### **6.2.2 Locations Monitored**

The noise monitor was placed in the following locations (see Figure 3 and Appendix 1):

- Location 1 – Bush opposite 30 Yurunga Dr, North Nowra to represent the R3 residential receivers
- Location 2 – Front yard of 19 Mandalay Ave, Nowra to represent the R2 residential receivers
- Location 3 - Front yard of 2 Westhaven Ave, Nowra to represent the R1 residential receivers

Logger locations 2 and 3 were selected as being available locations close enough to the nearest potentially most affected residences, but far enough away from the existing hospital not to be significantly impacted by noise emissions from the hospital.

As such, ambient noise levels measured at these locations are considered more conservative than if measured closer to the hospital site.

Noise emitted from the hospital was not audible at these locations during the day when the monitors were installed and removed.

### **6.2.3 Measurement Period**

Unattended noise monitoring was conducted between Friday 17<sup>th</sup> December 2021 to Sunday 9<sup>th</sup> January 2022.

### **6.2.4 Calculated Noise Levels**

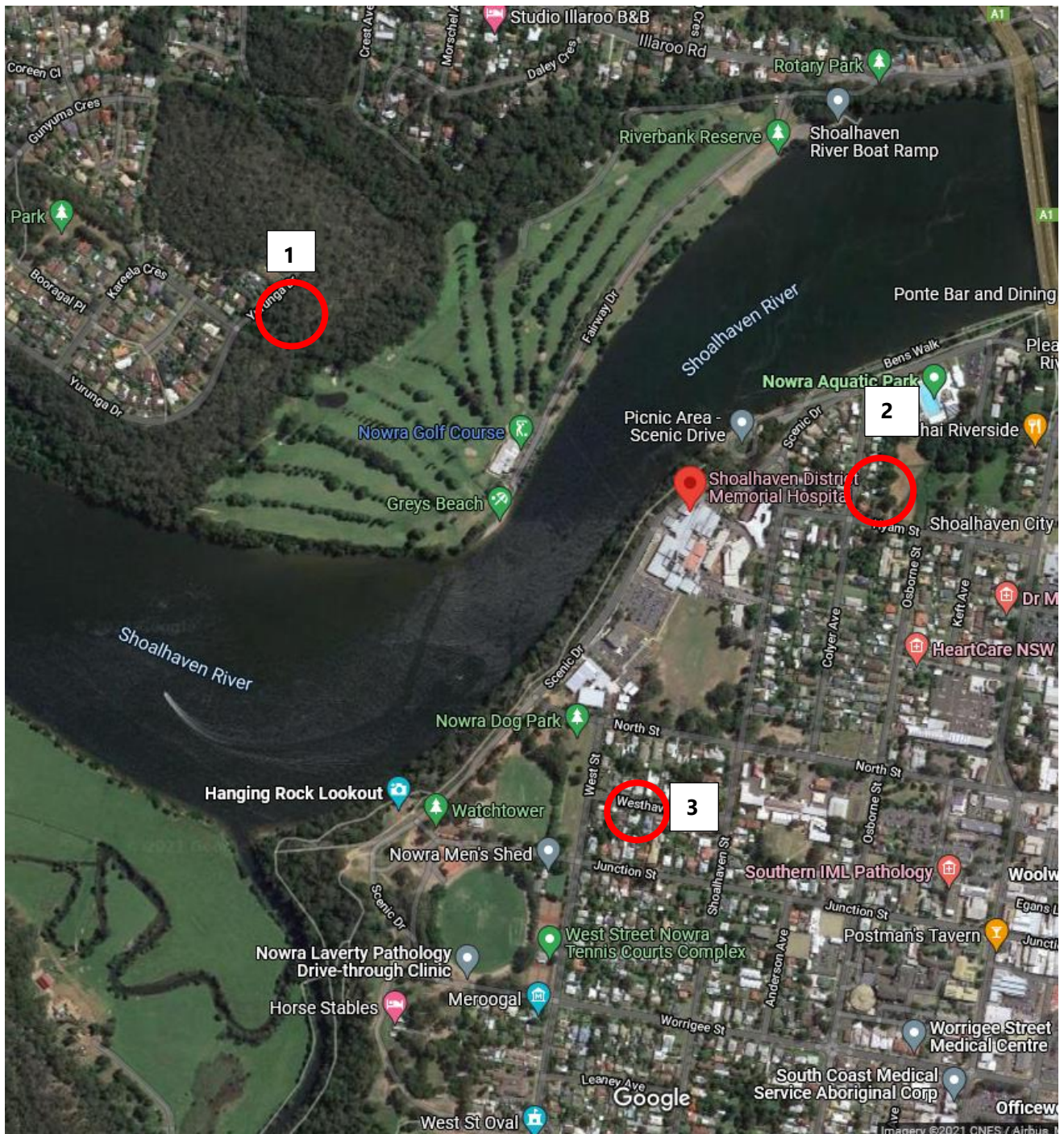
Ambient, assessment and rating background levels have been determined from the long term, unattended noise monitoring data based on the methodology in the Noise Policy for Industry Fact Sheet B. Appendix A contains the data collected, and the periods identified as being affected by adverse weather conditions or extraneous noise (as defined by NPfI Fact Sheet B).

Weather data was obtained from records provided by the Bureau of Meteorology for the weather station located at Nowra RAN Air Station. A 0.63 correction factor was used to determine the wind speed at 3m vs 10m which is used by the BOM.



The day, evening and night periods correspond to the NPfl guideline being:

- Day - period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
- Evening - the period from 6 pm to 10 pm
- Night - the remaining periods



Source: Google Maps

**Figure 3 –Unattended Noise Logging Locations  
(refer text)**

#### 6.2.4.1 Background Noise Levels

The following tables summarise the assessment background noise levels (ABL) for each location. Note that where no ABL is indicated, this is because that period was affected by adverse weather or other extraneous noise.

**Table 2 – NPfl Assessment Background Noise Levels – Monitor 1**

Location	Date	ABL		
		Day	Evening	Night
Location 1 Yurunga Dr, North Nowra	Friday 17 December 2021	-	43	31
	Saturday 18 December 2021	35	38	35
	Sunday 19 December 2021	34	38	31
	Monday 20 December 2021	38	35	35
	Tuesday 21 December 2021	34	38	29
	Wednesday 22 December 2021	36	35	34
	Thursday 23 December 2021	35	35	27
	Friday 24 December 2021	34	33	29
	Saturday 25 December 2021	34	34	31
	Sunday 26 December 2021	32	35	26
	Monday 27 December 2021	37	35	26
	Tuesday 28 December 2021	37	33	27
	Wednesday 29 December 2021	35	38	31
	Thursday 30 December 2021	37	41	31
	Friday 31 December 2021	35	42	37
	Saturday 01 January 2022	37	42	34
	Sunday 02 January 2022	36	39	30
	Monday 03 January 2022	35	39	31
	Tuesday 04 January 2022	38	38	30
	Wednesday 05 January 2022	37	42	39
	Thursday 06 January 2022	45	42	39
	Friday 07 January 2022	43	41	29
	Saturday 08 January 2022	33	37	28
	Sunday 09 January 2022	32	-	-
	<b>RBL</b>	<b>35</b>	<b>38</b>	<b>31</b>

**Table 3 – NPfl Assessment Background Noise Levels – Monitor 2**

Location	Date	ABL		
		Day	Evening	Night
Location 2 Mandalay Ave, Nowra	Friday 17 December 2021	-	42	31
	Saturday 18 December 2021	39	39	35
	Sunday 19 December 2021	37	39	31
	Monday 20 December 2021	40	36	34
	Tuesday 21 December 2021	39	37	31
	Wednesday 22 December 2021	39	37	34
	Thursday 23 December 2021	36	37	29
	Friday 24 December 2021	37	36	30
	Saturday 25 December 2021	35	39	33
	Sunday 26 December 2021	34	35	28
	Monday 27 December 2021	38	36	29
	Tuesday 28 December 2021	37	35	29
	Wednesday 29 December 2021	37	38	30
	Thursday 30 December 2021	38	40	31
	Friday 31 December 2021	37	42	35
	Saturday 01 January 2022	37	40	33
	Sunday 02 January 2022	35	38	29
	Monday 03 January 2022	36	38	31
	Tuesday 04 January 2022	39	38	31
	Wednesday 05 January 2022	37	40	36
	<b>RBL</b>	<b>37</b>	<b>38</b>	<b>31</b>

**Table 4 – NPfl Assessment Background Noise Levels – Monitor 3**

Location	Date	ABL		
		Day	Evening	Night
Location 3 Westhaven Ave, Nowra	Friday 17 December 2021	-	40	31
	Saturday 18 December 2021	34	36	32
	Sunday 19 December 2021	34	38	29
	Monday 20 December 2021	35	32	30
	Tuesday 21 December 2021	34	34	28
	Wednesday 22 December 2021	34	34	35
	Thursday 23 December 2021	32	33	28
	Friday 24 December 2021	31	31	28
	Saturday 25 December 2021	33	31	29
	Sunday 26 December 2021	30	34	28
	Monday 27 December 2021	33	35	29
	Tuesday 28 December 2021	33	33	26
	<b>RBL</b>	<b>33</b>	<b>34</b>	<b>29</b>

#### 6.2.4.2 Summarised Rating Background Noise Levels

The table below summarises the rating background noise levels determined for the day, evening and night periods as defined in the NPfl. Background levels have been calculated from the long term, unattended noise monitoring data in Appendix A.

It is noted that when determining weather affected noise data, the wind speed measured at the weather station (typically at 10m above ground level) has been corrected by a factor of 0.5 to account for the noise logger being located closer to ground level where boundary layer effects result in lower wind speeds, as well as the effect of the surrounding buildings and vegetation.

**Table 5 – NPfl Rating Background Noise Level Summary**

<b>Location</b>	<b>Time of day</b>	<b>Rating Background Noise Level dB(A)<sub>L90(Period)</sub></b>
R1 Residential Receivers (East and South)	Day (7am – 6pm)	35
	Evening (6pm – 10pm)	35* (38)
	Night (10pm – 7am)	31
R2 Residential Receivers (Nth East)	Day (7am – 6pm)	37
	Evening (6pm – 10pm)	37*(38)
	Night (10pm – 7am)	31
R3 Residential Receivers (West)	Day (7am – 6pm)	35** (33)
	Evening (6pm – 10pm)	33* (34)
	Night (10pm – 7am)	30** (29)

\* In accordance with NPfl guidelines where the evening rating background noise level is higher than the day level, the lower daytime level has been adopted. Measured background in parentheses.

\*\* In accordance with NPfl guidelines where the measured evening or night RBL is less than 30 dB(A), 30 dB(A) can be adopted, and where the daytime background is less than 35 dB(A) then 35 dB(A) can be adopted. Measured background in parentheses.

The background noise levels measured at logger location 3 has been adopted for the residential catchment R1. Catchment R1 includes the residences to the east and south of the proposed ASB. The residences immediately to the east of the proposed ASB was included in R1 as logger location 3 was marginally quieter than logger location 2, and therefore represents a more conservative approach.

The daytime background noise level is at the NPfl default daytime minimum background noise level. In any case, site investigations indicated that hospital noise emissions during the day were not audible. The night time background at logger locations 2 and 3 are only marginally higher than 3 which is remote from the existing hospital, the city centre and highway, indicating that the backgrounds are likely not related to noise from the hospital.



## 7 OPERATIONAL NOISE ASSESSMENT

The primary sources of noise generated by the proposed development will be as follows:

- Noise from the mechanical plant
- Noise associated with the operation of the driveway and carpark
- Emergency helicopter operations

The various noise sources have different characteristics, and an appropriate assessment guideline should be adopted.

The noise emission assessment has been assessed using with the following documents:

- Shoalhaven Development Control Plan (DCP) 2014
- NSW (EPA) *Noise Policy for Industry* (NPI) 2017 for plant and other noise emissions.
- Noise emissions from emergency helicopter movements are not required to be assessed. Noise impact from the proposed helipad location will be compared to the existing operations.

### 7.1 SHOALHAVEN DEVELOPMENT CONTROL PLAN

The DCP is silent on specific noise emission criteria.

### 7.2 NSW EPA NOISE POLICY FOR INDUSTRY (NPfI) 2017

This policy is generally used to assess noise from commercial and industrial operations including plant noise and the like.

The guidelines in the policy are used to formulate Project Noise Trigger Levels (PNTL). Where the predicted noise impact exceeds the trigger levels then mitigation should be assessed to minimise noise impacts.

The EPA NPfI has two primary criteria, namely Intrusiveness and amenity. Where night-time noise emissions may impact residential receivers, then night time sleep disturbance should also be assessed.

The cumulative noise emissions from the site should be assessed anywhere on a residential property within 30m of the residence, or at the balcony or façade of an apartment. For passive and active recreation uses it should be assessed where patrons are likely to use the facility.

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

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

### 7.2.1 Assessing Intrusiveness

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

Rating background noise levels adopted are presented in Table 1. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

**Table 6 – NPfl Intrusiveness Criteria**

Receiver	Time of Day	Rating Background Noise Level, dB(A) <sub>L90(15min)</sub>	Intrusiveness Criteria, dB(A) <sub>L<sub>eq</sub>(15min)</sub>
R1 Residential Receivers (East and South)	Day (7am – 6pm)	35	40
	Evening (6pm – 10pm)	35	40
	Night (10pm – 7am)	31	36
R2 Residential Receivers (North- East)	Day (7am – 6pm)	37	42
	Evening (6pm – 10pm)	37	42
	Night (10pm – 7am)	31	36
R3 Residential Receivers (West)	Day (7am – 6pm)	35	40
	Evening (6pm – 10pm)	33	38
	Night (10pm – 7am)	30	35

### 7.2.2 Assessing Amenity

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

Table 2.2 on page 11 of the NPfl sets out acceptable noise levels for various land uses. There are four categories to distinguish different residential areas - rural, suburban, urban and urban/industrial interface.

Based on the measured background noise levels detailed in Table 1 and land uses, the NPfl suggests the adoption of the 'Suburban' categorisation for residential receivers at R1, R2 and R3.

It is noted that the R1 and R2 properties also contain other uses such as commercial, health, educational and a place of worship. However, as the residential use has the most stringent requirement, the specific assessment of the other uses is not required.

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

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

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

**Table 7 – EPA Amenity Noise Levels**

Type of Receiver	Time of day	Project Amenity Noise Level, dB(A) $L_{eq}(15\text{ minute})$
R1, R2 and R3 (Residential)	Day	53
	Evening	43
	Night	38
AR1 (Active Recreation)	When in use	55
PR1 (Passive Recreation)	When in use	50
PS1 Shoalhaven Community Pre-School (School Classroom)	Noisiest 1 hour when in use (i.e. day)	35 internal
CC1 Cancer Centre Overnight Accommodation (Hospital Ward)	Noisiest 1 hour	35 internal 50 external

### 7.2.3 Sleep Arousal Criteria

The potential for sleep disturbance from maximum noise level events from premises during the night time period must be considered as the proposed operation extends into night time hours. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages. Where the subject development night-time noise levels at a residential location exceed:

- $L_{eq}(15min)$  40dB(A) or the prevailing RBL plus 5dB, whichever is greater, and/or
- $L_{AF(max)}$  52dB(A) or the prevailing RBL plus 15dB, whichever is greater, a detailed maximum noise level event assessment should be undertaken.

**Table 8 – Sleep Arousal Criteria for Residential Receivers**

Receiver	Rating Background Noise Level (Night), dB(A) $L_{90}$	Project Sleep Disturbance Level
Residences Surrounding Site Night (10pm – 7am)	30-31 dB(A) $L_{90}$	40 dB(A) $L_{eq, 15min}$ ; 52 dB(A) $L_{f,max}$

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night period.

In addition, NSW EPA Road Noise Policy states:

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

- One to two noise events per night with maximum internal noise levels of 65-70dB(A) are not likely to affect health and wellbeing significantly.

### 7.3 SUMMARY OF SITE NOISE EMISSION CRITERIA

The following table presents the noise emission objectives for the ASB.

**Table 9 –Project Noise Trigger Levels**

Source	Receiver Catchment	Period	PNTL dB(A)	
			L <sub>eq</sub>	L <sub>max</sub>
Plant and Site Activity	R1 (east and south)	Day	40	-
		Evening	40	-
		Night	36	52
	R2 (north-east)	Day	42	-
		Evening	42	-
		Night	36	52
	R3 (west)	Day	40	-
		Evening	38	-
		Night	35	52
	CC1 Cancer Centre Overnight Accommodation	Worst Hour	50*	-
	PS1 Shoalhaven Community Pre-School	Worst Hour	35 (internal)	-
	AR1	Worst Hour	55	-
	PR1	Worst Hour	50	-

\* The building is air conditioned and if the external criterion is achieved the internal noise level will comply.

## 8 OPERATIONAL NOISE EMISSION ANALYSIS – NEW ASB

### 8.1 MECHANICAL PLANT NOISE EMISSION

Detailed plant selections and location have not been undertaken at this stage. A preliminary assessment has been undertaken based on:

- Plant locations provided by Arup for main plant items.
- Indicative noise levels provided by Arup for main plant items.

Satisfactory levels will be achievable through appropriate plant selection, location and if necessary, standard acoustic treatments such as duct lining, acoustic silencers and enclosures.

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

The main plant noise source will be a plant space located on the façade end of the building. To achieve compliance with the applicable noise criteria the sound power level of the plant (including any corrections for annoying characteristics such as tonality and intermittent operation) should not exceed approximately 82 dB(A) under peak operating conditions. When corrected for distance, the noise level will be similar to the day and evening criteria of 40dB(A). It is expected that plant will operate under a reduced load between 10pm-7am and operational noise levels will be at least 5dB(A) lower during this time.

If the cumulative sound power level of this plant compound is to exceed 82dB(A), additional treatment is required. Acoustic treatment will depend on the type of plant. For example, in-line axial fans, AHUs and the like can be treated with induct lining and/or silencers whilst larger un ducted plant (i.e. heat pumps) may require solid/absorptive acoustic screens.

Based on the information available to us, the following noise levels have been calculated at surrounding residential receivers:

**Table 10 –Calculated Noise Emission Summary**

Source	Receiver Catchment	Period	Predicted Noise Level dB(A) $L_{eq}$	PNTL dB(A) $L_{eq}$
Mechanical Plant	R1 (east and south)	Day	40*	40
		Evening	40*	40
		Night	35*	36
	R2 (north-east)	Day	35	42
		Evening	35	42
		Night	30	36
	R3 (west)	Day	<30	40
		Evening	<30	38
		Night	<30	35

\*Worst case noise levels for residents directly across Shoalhaven Street (east). These will be lower elsewhere.

Acoustic treatments determined to comply at R1 residential receivers directly across Shoalhaven Street will ensure compliance at non-residential receivers in the vicinity given that these noise limits are less onerous and there is increased distance from the proposed development.

A detailed acoustic review (including all plant) is to be undertaken at CC stage to determine specific acoustic treatments to control noise emissions to satisfactory levels.

## 8.2 CARPARK USAGE NOISE EMISSIONS

With the exception of the proposed "pick up and drop off" area, carparking would be accommodated within the existing site.

For the proposed internal driveway leading to the "pick up and drop off" area noise emissions during peak usage and night-time usage have been predicted. The following have been used to make the predictions:

- A total number of 70 vehicle movements per hour during the morning peak has been assumed as a worst-case scenario for the hospital. As a conservative assumption it is assumed that 17 vehicles will use the drop off area in 15 minutes, and one vehicle at night.
- Cars entering or exiting will be driving at 10km/h.
- Each car has a sound power level of 85dB(A) (Based on FHWA, cars driving at 10km/h).
- Sound power level of a car door closing is 94 dB(A)  $L_{max}$ .

The calculated noise levels at the most impacted residential receiver (across North Street) is 39 dB(A)  $L_{eq}$  during the day and 26 dB(A)  $L_{eq}$  at night, which are both compliant with the applicable  $L_{eq}$  noise criteria.

The predicted maximum noise level at the closest residence from a car door closing is 47dB(A)  $L_{max}$ , which is less than the maximum noise level trigger level.

The noise levels predicted at all receivers will not exceed the relevant trigger levels and do not require additional treatment.

### 8.3 EMERGENCY HELICOPTER NOISE

Previous advice from AviPro regarding helicopter movements generally, is repeated below:

*Noise and vibration are not insignificant hazards. This is true for both the hospital structure (for an elevated HLS) and also the surrounding community (medical precinct and residential). The Design Helicopter is a product of modern design and rotor blade technology and has been selected for its reduced vibration characteristics. As a consequence, the impact of noise and vibration in the vicinity of the HLS and during flight is markedly reduced*

*Assessment of the surrounding obstructions, prevailing wind directions and potential “no fly” areas (e.g. mental health facility, sensitive residential areas) will help determine the approach and departure paths to and from the HLS. The contracted helicopter operator will develop specific procedures for the HLS that will take into consideration noise and vibration minimisation. Whilst all attempts are made to minimise overflight and noise impact, the safety of the helicopter (and occupants) is the prime responsibility of the pilot and therefore in certain weather conditions, overflights of noise sensitive areas may not be avoided. When considering noise mitigation strategy (glazing etc), it is important to understand what constitutes a helicopter ‘noise event’ at a hospital HLS. The following is a normal activity breakdown:*

Arrival:	1 minute approach and land
	2 minutes engine stabilise before shutdown
	Total - 3 minutes
Departure:	2 minutes start-up and hover
	1 minute backup and depart
	Total: 3 minutes

*The AW139 helicopter has been assessed by the US Federal Aviation Administration (FAA) and the International Civil Aviation Organisation (ICAO) for its noise outputs. Figures from these independent studies differ slightly however the combined worst-case noise readings for an AW139 at 6400kg (this weight will almost never be exceeded) registered the following levels of Effective Perceived Noise in Decibels (EPNDb):*

Takeoff:	90.5
Fly over:	89.8
Approach:	93.0

The proposed helipad would be used for medical emergency flights only. Emergency medical helicopter operations differ from commercial aircraft as follows:

- They can occur at any time of day or night
- They are generally much less frequent than aircraft operations near a typical airport (the total number of movements are expected less than 10 per week)
- They are directly associated with the hospital facility and are typically used when critical care is needed.

Noise emissions from emergency aircraft operations are not assessed in the same way as commercial aircraft. Similar to ambulance operations on roadways, noise limits are not typically applied to receivers around an emergency helipad.

Australian Standard AS2021-2015 "Acoustics- Aircraft noise intrusion- Building siting and construction" provides noise acceptability as below for commercial aerodromes and airports. This standard indicates it should not be used to assess emergency operations.

Notwithstanding, noise from helicopters using the proposed new helipad will be compared the existing noise levels.

The location of the existing helipad is indicated in **Figure 1**, and the proposed helipad location is shown in **Figure 2**. The proposed helipad will be at least 30m above ground level (the existing helipad) and in a similar plan location to the helipad. The elevated helipad location means that there would be additional distance separation to the ground receivers and therefore, assuming similar flight paths are used, future helicopter noise levels would be reduced.

It is mentioned within the Avipro SSD report that a temporary helipad will be required throughout the construction period. The proposed location is at ground level at the West St Oval; though this location is indicative and is not considered in detail. Noise impacts would be similar to the existing, though the relocation means that different residents would become most impacted. As stated in the report, a separate management plan is to be prepared.

## 9 TRAFFIC GENERATION ON LOCAL ROADS

The proposed development by the year 2031 is expected to increase peak hour trip generation by an additional 275 vehicles during the PM peak hour, and 281 during the AM peak hour. The increased vehicle movement generation and car parking requirements have been assessed previously and have been considered when obtaining consent for the multi-level carpark.

Access to the main hospital car park including the multi-storey car park is from Scenic Drive. The Cancer Care Centre car park has two entrances, one on Scenic Drive and the other on North Street. This Scenic Drive car park access also connects to the Grand Pacific Health Centre car park. Various smaller car parks for specialised medical services exist toward the north of Scenic Drive, including access to the staff car park.

The RNP requires assessment against the "no-build" option. Given that the multi-level carpark (and the associated vehicle movements) have been approved, for the ASB there would be no increase when assessed against the currently approved development.

Notwithstanding this, if assessed against existing traffic movements, traffic on North Street would increase as a result of the proposed development. However, given the street is already used for street parking and for other movements associated with the hospital and other uses, the increase in traffic noise is expected to be 2 dB(A) or below which represents an acceptable increase under the Road Noise Policy guideline. There is unlikely be a perceptible increase in noise for the surrounding residents.

### 9.1 LOADING DOCK NOISE EMISSIONS

Noise emissions from the operation of the proposed hospital loading dock will be assessed at nearest affected residential receivers (R1) across Shoalhaven Street. Noise level impacts at all other receivers will inherently be lower due to the increased distance from the loading dock.

Noise from the use of the dock will be predicted based on the following assumptions:

- Engine noise from trucks manoeuvring within the dock as follows:
  - Heavy-rigid trucks (travelling at 5-10km/hr) 95dB(A) $L_{eq}$



- Truck air brake sound power level: 113dB(A)<sub>L<sub>max</sub></sub>
- It is assumed there will be one truck ingress or egress movement within the loading dock in any 15 minute period during the day and evening.
- There is one truck movement during the night-time period which will occur during the early morning between 6am-7am.
- Loading/unloading operations are undertaken behind a closed sliding screen.
- Sliding screen enclosing loading dock area is imperforate and constructed of minimum 4.5kg/m<sup>2</sup> surface density material (i.e. 0.5mm sheet metal).
- After entering the driveway, trucks are required to reverse into loading bays. This necessitates the use of air brakes in external, unscreened areas.

As the loading dock will potentially be used during the early morning hour (prior to 7am), an assessment of both average and sleep disturbance criteria will be presented.

### 9.1.1 Loading Dock Noise Impact Assessment

Noise emissions are predicted below. Noise emissions are assessed to the nearest affected residence across Shoalhaven Street (R1):

**Table 11 - Loading Dock Noise Emissions – Day and Evening (7am-10pm)**

Receiver	Time of Day	Activity	Permitted Noise Level	Predicted Noise Level	Comment
R1	Day (7am – 6pm)	Vehicle Movement	40dB(A) <sub>L<sub>eq</sub>(15min)</sub>	41dB(A) <sub>L<sub>eq</sub>(15min)</sub>	Marginal
	Evening (6pm – 10pm)	Vehicle Movement	40dB(A) <sub>L<sub>eq</sub>(15min)</sub>	41dB(A) <sub>L<sub>eq</sub>(15min)</sub>	Marginal
	Night (10pm – 7am)	Vehicle Movement	36dB(A) <sub>L<sub>eq</sub>(15min)</sub>	41dB(A) <sub>L<sub>eq</sub>(15min)</sub>	Exceeds
		Brake release valve	52 dB(A) <sub>L<sub>max, F</sub></sub>	75dB(A) <sub>L<sub>max, F</sub></sub>	Detailed assessment required

With respect to the potential sleep disturbance as a result of the short duration peak noise events caused by the truck brake release valve, the assessment undertaken indicates that noise levels will be above sleep arousal criteria and that a detailed assessment is required.

### 9.1.2 Detailed Assessment of Sleep Disturbance Potential

As the loudest noise events may cause exceedances of the “Background+15” initial test (from truck valve release breaks) at the façade of the most impacted residences a more detailed impact assessment of these events is needed. This is discussed below.

- Typically, there is a 10dB(A) noise reduction between an external noise level and the noise level inside the residence (assuming that the windows are left open).
- This being the case, it would be expected that the noise level generated by a truck break valve release would be 65dB(A) inside the residences if the windows are left open.
- This is representative of a worst-case scenario given that, in most instances, windows are expected to be closed during the night.
- Assuming a conservative 25dB(A) noise reduction across a closed façade, the instantaneous internal noise level is predicted to be 50dB(A)  $L_{max}$ .
- EPA guidance in this regard states:
  - *Maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep.*
  - *One or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.*
- The monitoring indicates  $L_{max}$  noise levels of 70–80 dB(A) are common during this period. Therefore, the predicted external noise level of 75 dB(A) is within the range of existing events. The limited number of events generated by the loading dock prior to 7am would not perceptibly increase sleep arousal due to an increase in existing noise levels.
- Given that the peak noise event in question would typically be 50dB(A) or less internally (equal or below the quieter end of the range identified by the EPA).
- With respect to continuous noise levels from truck movements, we note the 36dB(A) $L_{eq(15min)}$  night period trigger level is determined by the quietest periods of monitoring period. This is typically between 2am–4am when the background level is at its lowest.
- The background noise level during the 6am–7am period (when usage of the loading dock may occur) is typically 5dB(A) higher than across the 9hr night period.
- During this hour, external noise levels from continuous truck movements would be marginal with a BG+5dB(A) noise level for the nearest receivers (within 50m) and below that at all others.
- Given the limited number of events generated by the loading dock prior to 7am, this would not perceptibly increase sleep arousal due to ambient noise at the most impacted receiver.
- For the reasons indicated above, operation between 6am–7am is not likely to adversely impact sleep and this noise generation should be considered reasonable.

## 10 CONSTRUCTION NOISE AND VIBRATION

### 10.1 NOISE

#### 10.1.1 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 operational noise levels at nearby development.
- If necessary, recommendation of additional noise controls strategies in the event that compliance with noise emission management levels is not possible.

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

- *"Noise affected" level.* Where construction noise is predicted to exceed the "noise effected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise effected level". For residential properties, the "noise effected" level occurs when construction noise exceeds ambient levels by more than:
  - 10dB(A)<sub>Leq(15-minutes)</sub> for work during standard construction hours (7:00am-6:00pm Monday to Friday and 8am to 1pm on Saturdays); and
  - 5dB(A)<sub>Leq(15-minutes)</sub> for work outside standard construction hours (6:00pm-7:00pm Monday to Friday and 1:00pm to 4:00pm on Saturdays); and
- *"Highly noise affected level".* Where noise emissions are such that nearby properties are "highly noise effected", noise controls such as respite periods should be considered. For residential properties, the "highly noise effected" level occurs when construction noise exceeds 75dB(A)<sub>Leq(15min)</sub> at nearby residences. Highly noise affected level only applies during standard construction hours.

The EPA guideline also recommends a construction noise management level of 45 dB(A) internally for hospital wards and educational facilities, and which will be used to assess noise impacts at the cancer overnight stay building and community pre-school building. Assuming an external to internal noise reduction of 20 dB(A) through a closed façade gives an external management level of 65 dB(A).

### 10.1.2 Summary of Noise Management Levels

A summary of the recommended noise levels from the ICNG is presented below. The noise monitoring has been used to determine the noise management levels for residences surrounding the project site.

**Table 12 – Noise Management Levels**

<b>Location</b>	<b>“Noise Affected” Level - dB(A)<sub>Leq(15min)</sub></b>	<b>“Highly Noise Affected” Level - dB(A)<sub>Leq(15min)</sub></b>
All Residents Surrounding the Project Site	45 (Standard Construction Hours)	75
Cancer Centre Overnight Stay	65	75
Shoalhaven Community Pre-School	65	75

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

### 10.1.3 Australian Standard AS 2436:2010 “Guide to Noise Control on Construction, Maintenance and Demolition Sites”

Australian Standard AS 2436 provides guidance on noise and vibration control in respect to construction and demolition sites, the preparation of noise and vibration management plans, work method statements and impact studies.

The Standard states that:

- “Some construction and demolition activities are by their very nature noisy. The authorities responsible for setting noise level criteria for essential works will take note of the constraints imposed by such activities, especially when they are of short duration.”
- Construction, demolition and maintenance works pose different problems of noise and vibration control when compared with most other types of industrial activity, since (a) they are mainly carried on in the open; (b) they are often temporary in nature although they may cause considerable disturbance whilst they last; (c) the noise and vibration arise from many different activities and kinds of plant, and their intensity and character may vary greatly during different phases of the work; and (d) the sites cannot be separated by planning controls, from areas that are sensitive to noise and vibration.

The standard provides advice and guidelines for the prediction of impacts and the methods available to manage impacts. The guideline promulgates feasible and reasonable mitigation strategies and controls, and stakeholder liaison, in the effort to reach a realistic compromise between site activities and impacts on neighbouring properties.

## 10.2 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 (2016) *Structural Vibration: Effects of Vibration on Structures*; and
- For human exposure to vibration, NSW Environmental Protection Authority (EPA) document – ‘Assessing Vibration: A Technical Guideline 2006’, which references the guidelines contained in British Standard BS6472 – ‘Guide to Evaluate Human Exposure to Vibration Buildings (1Hz to 80Hz).

### 10.2.1 German Standard Din 4150-3 (2016) – Structural Vibration: Effects of Vibration on Structures

German Standard DIN 4150-3 (2016) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (2016) are presented in Table 13.

It is noted that if measured vibration levels are below the guidelines listed below, damage that will reduce the serviceability of the building will not occur and if damage to the building does occur, it is assumed that the damage is related to other activities or sources. Furthermore, the DIN4150-3 guideline states the following regarding the limits presented in Table 13:

*“Exceeding the guideline values does not necessarily lead to damage. Should they be exceeded, however, further investigations may be necessary, such as determining and evaluating the stresses as detailed in 4.3 and 4.4.”.*

**Table 13 – DIN 4150-3 (2016) – Guideline values for vibration velocity,  $v_{i,max}$ , for evaluating the effects of short-term vibration on structures**

-	TYPE OF STRUCTURE	Guideline values for $v_{i,max}$ in mm/s				
		Foundation, all directions, $i = x, y, z$ , at a frequency of			Topmost floor, horizontal direction, $i = x, y$	Floor slabs, vertical direction, $i = z$
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz <sup>a</sup>	All Frequencies	All frequencies
L/C	1	2	3	4	5	6
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 <b>and</b> are of great intrinsic value (e.g., listed buildings) buildings that are under a preservation order)	3	3 to 8	8 to 10	8	20 <sup>b</sup>

Note 1: Even if guideline values as in line 1, columns 2 to 5, are complied with, minor damage cannot be excluded.

a) At frequencies above 100 Hz, the guideline values for 100 Hz can be applied as minimum values.

b) Paragraph 2 of 5.1.2 shall be observed.

### 10.2.2 Human Comfort and Amenity

The NSW EPA's *Assessing Vibration – A Technical Guideline* is based on the guidelines contained in British Standard BS6472 – 'Guide to Evaluate Human Exposure to Vibration Buildings (1Hz to 80Hz). This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings.

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

**Table 14 – BS 6472 Vibration Criteria**

		RMS Acceleration (m/s <sup>2</sup> )		RMS Velocity (mm/s)		Peak velocity (mm/s)	
Place	Time	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
<b>Continuous Vibration</b>							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
<b>Impulsive Vibration</b>							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0

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

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

### 10.2.3 Recommended Vibration Limits

The table below presents the recommended vibration limit at the nearest vibration sensitive receivers.

**Table 15 – Recommended Vibration Limit**

Receiver	Recommended Vibration Limit PPV (mm/s)
All Residents Surrounding the Project Site	≤ 5mm/s PPV
Shoalhaven Community Pre-School & Cancer Overnight Stay	≤ 20mm/s PPV

### 10.3 ASSESSMENT OF CONSTRUCTION NOISE

The purpose of this assessment of noise emissions is to highlight those activities that have the potential to exceed the noise goals, so that management of those activities can be assessed in accordance with the ICNG. The noise levels presented in the assessment are worst case noise levels without any management that may be possible (e.g., physical controls, time scheduling, selection of alternative process, etc.)

### 10.4 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE LEVELS

Typically, the most significant sources of noise generated during a construction project will be demolition, excavation, piling, and civil works. A summary of sound power levels of major construction processes/equipment is detailed in Table 16 outlines the major works to be undertaken.

With respect to construction noise, the impact on nearby development will be dependent on the activity in question, and where on the site the activity is undertaken. The primary construction equipment and sound power levels associated with the works are as follows:

**Table 16 - Sound Power Levels of the Proposed Equipment**

Stage	Equipment/Process	Sound Power Level, dB(A)
Excavation	Excavator Working	105
	Truck (general)	100
	Powered Hand Tool	100
Construction	Concrete Pump	105
	Cement Mixing Truck	105
	Crane (electric)	95
	Truck (general)	100
	Powered Hand Tool	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).

## 10.5 CONSTRUCTION NOISE EMISSION PREDICTIONS

Predictions of noise levels at the sensitive receivers identified have been made of the construction processes with the potential to produce significant noise.

Predicted noise levels take the following into account:

- Many of the noise sources are present over a small period of the day or may be present for a few days with a significant intervening period before the activity occurs again.
- The distance between the noise source and the receiver.

Noise levels from construction works have been predicted at the surrounding receivers and assessed against the construction noise management levels set out in Section 10. Refer to tables below for predicted noise levels for each receiver.

**Table 17 – Predicted Noise Emissions to R1 Residential Receivers**

Activity	Predicted Level dB(A) $L_{10(15\text{-minute})}$	Noise Management Level	Comment
<b>Excavation Stage</b>		<b>NSW EPA Interim Construction Noise Guideline</b>  <b>Residential Areas</b>  Noise Affected Level: 45 dB(A) $L_{eq(15min)}$  Highly Noise Affected Level: 75dB(A) $L_{eq(15min)}$  (Assessed at property boundary)	See discussion in Section 10.6
Excavator Working	50 to 64		
Truck (general)	45 to 59		
Powered Hand Tool	43 to 57		
<b>Construction Stage</b>			
Concrete Pump	55 to 69		
Cement Mixing Truck	55 to 69		
Crane (electric)	45 to 53		
Truck (general)	45 to 59		
Powered Hand Tool	43 to 57		



**Table 18 – Predicted Noise Emissions to R2 Residential Receivers**

Activity	Predicted Level dB(A) <sub>L<sub>10</sub>(15-minute)</sub>	Noise Management Level	Comment
<b>Excavation Stage</b>		<b>NSW EPA Interim Construction Noise Guideline</b>  <b>Residential Areas</b>  Noise Affected Level: 45 dB(A) <sub>L<sub>eq</sub>(15min)</sub> Highly Noise Affected Level: 75dB(A) <sub>L<sub>eq</sub>(15min)</sub>  (Assessed at property boundary)	See discussion in Section 10.6
Excavator Working	44 to 48		
Truck (general)	39 to 43		
Powered Hand Tool	37 to 41		
<b>Construction Stage</b>			
Concrete Pump	49 to 53		
Cement Mixing Truck	49 to 53		
Crane (electric)	39 to 43		
Truck (general)	39 to 43		
Powered Hand Tool	37 to 41		

**Table 19 – Predicted Noise Emissions to PS1 Shoalhaven Community Pre-School**

Activity	Predicted Level dB(A) <sub>L<sub>10</sub>(15-minute)</sub>	Noise Management Level	Comment
<b>Excavation Stage</b>		<b>NSW EPA <i>Interim Construction Noise Guideline</i></b>  Noise Affected Level: 65 dB(A) <sub>L<sub>eq</sub>(15min)</sub> Highly Noise Affected Level: 75dB(A) <sub>L<sub>eq</sub>(15min)</sub>	See discussion in Section 10.6
Excavator Working	49 to 55		
Truck (general)	44 to 50		
Powered Hand Tool	41 to 48		
<b>Construction Stage</b>			
Concrete Pump	53 to 59		
Cement Mixing Truck	53 to 59		
Crane (electric)	43 to 49		
Truck (general)	44 to 50		
Powered Hand Tool	41 to 48		

\*Noise levels presented assume an open window with a 10dB(A) reduction from external to internal areas.

**Table 20 – Predicted Noise Emissions to CC1 Cancer Overnight Stay**

Activity	Predicted Level dB(A) <sub>L<sub>10</sub>(15-minute)</sub>	Noise Management Level	Comment
<b>Excavation Stage</b>		<b>NSW EPA Interim Construction Noise Guideline</b>  Noise Affected Level: 65 dB(A) <sub>L<sub>eq</sub>(15min)</sub>  Highly Noise Affected Level: 75dB(A) <sub>L<sub>eq</sub>(15min)</sub>	See discussion in Section 10.6
Excavator Working	45 to 53		
Truck (general)	40 to 48		
Powered Hand Tool	38 to 46		
<b>Construction Stage</b>			
Concrete Pump	50 to 58		
Cement Mixing Truck	50 to 58		
Crane (electric)	40 to 48		
Truck (general)	40 to 48		
Powered Hand Tool	38 to 46		

## 10.6 CONSTRUCTION NOISE AND VIBRATION IMPACT ASSESSMENT

With respect to the predicted noise levels from construction activities during the excavation and construction stages, we note:

- Given the proximity of the proposed development to receivers around the site and the relatively low ambient noise levels, it is expected that the noise affected management level (NAL) will be exceeded at all nearby residential receivers (R1).
- Noise levels at Shoalhaven Street residences directly adjacent the site will be highest, though are predicted to be well below the “highly noise affected” management levels.
- Only minor exceedances of NAL are expected at residences in north of Hyam Street (R2).
- Noise levels at R3 residences are predicted to be similar to the day-time background noise level; 10dB(A) or more below the NAL level.
- External noise management levels for the pre-school and cancer centre buildings are not expected to be exceeded from construction activities.
- EPA’s ICNG noise management level is not a strict stop work noise limit. It is a noise level which, if exceeded, reasonable and feasible noise mitigation should be adopted.
- General ameliorative measures are provided in section 10.8 which will reduce noise impacts to nearby residences.
- Given that the ‘Highly Noise Affected’ level is not predicted to be exceeded and that levels can be reduced generally, construction noise impacts will typically be within reasonable and manageable limits.

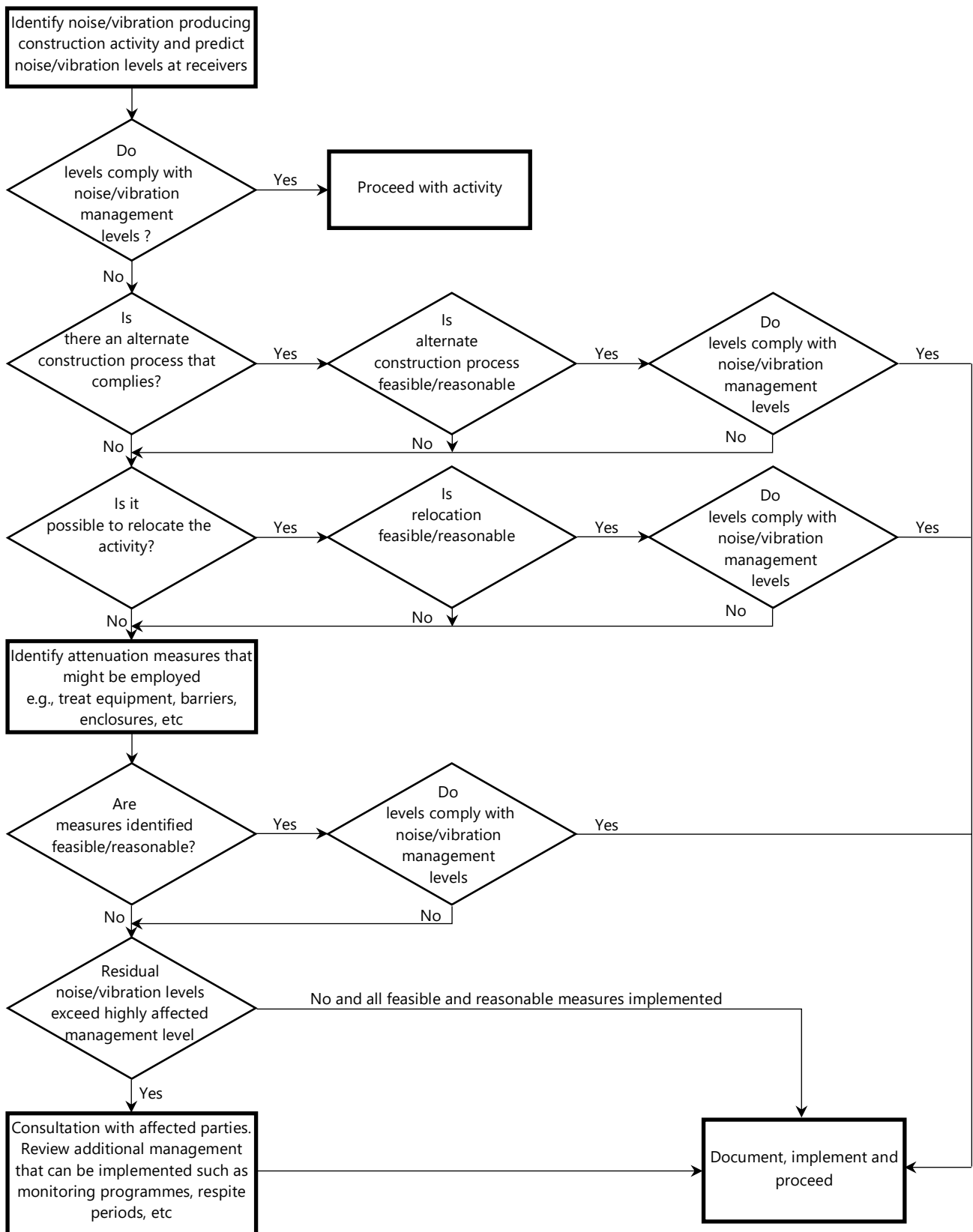
The analysis indicates that noise emissions from construction activities should be assessed for reasonable feasible work practices in accordance with the “Control of Construction Noise and Vibration” flow chart below.

Given the relatively large distance separation and the construction proposed it is unlikely that vibration levels generated will exceed the vibration objectives.

Management of noise and vibration impacts within the hospital site would also need to occur in accordance with the hospital's internal guidelines.

## 10.7 CONTROL OF CONSTRUCTION NOISE AND VIBRATION

The execution of this work will facilitate the formulation of noise control strategies for this project. The flow chart presented in Figure 2 illustrates the process that will be followed in assessing construction activities.



**Figure 4 – Process Flowchart**

## **10.8 MEASURES TO REDUCE CONSTRUCTION NOISE**

In the event of complaint, noise management techniques identified in this report should be employed to minimise the level of noise impact if management levels are found to be exceeded. This may include additional community consultation and re-scheduling of loud construction processes.

General management techniques and acoustic treatments are outlined below which may be implemented on a case-by-case basis to reduce noise emissions to surrounding receivers.

### **10.8.1 Acoustic Barriers**

The placement of barriers at the source is generally only effective for static plant (tower cranes, diesel generators). 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 15 dB(A) can be affected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

### **10.8.2 Treatment of Specific Equipment**

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

### **10.8.3 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).

Avoid careless dropping of construction materials into empty trucks. (i.e. ensure works are placing materials, not throwing them).

### **10.8.4 Vehicles**

- Trucks, trailers and concrete trucks should turn off their engines during idling to reduce noise levels emitted.
- Trucks and bobcats to use a non-tonal reversing beacon (subject to OH&S requirements) to minimise potential disturbance of residential receivers.

### **10.8.5 Static Plant**

Static plant such as concrete pumps, generators and the like to be located away from site boundaries where practicable.

### **10.8.6 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. By carrying out this activity by use of bulldozers ripping and/or milling machines lower levels of noise will result.

The use of electric cranes over diesel is to be considered where practicable.

### **10.8.7 Establishment of Site Practices**

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers. Construction vehicles accessing the site should not queue in residential streets and should only use the

designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

#### **10.8.8 Management Training**

All site managers should be aware of noise and vibration limits, applicable control measures and methods. They should ensure that all agreed noise and vibration measures are carried out by employees and sub-contractors.

A copy of the Noise Management Plan is to be available to contractors, and site inductions should detail the site contact in the event of noise complaints.

#### **10.8.9 Noise Monitoring**

Noise monitoring can be undertaken to determine the efficacy of measures which are been implemented, whilst the results of monitoring can be used to devise further control measures.

Attended noise measurements can be undertaken at key stages (i.e; demolition, bulk excavation, first major concrete pour) when particularly noise generating activities are undertaken or specific items of plant (ie. Excavator with hammer attachments) are in operation.

Attended noise measurements should be conducted in accordance with Australian Standard AS1055: 2018 '*Acoustics- Description and measurement of environmental noise*', and should include the following:

- Type 1 or 2 sound meter (calibrated)
- Use of appropriate noise descriptor (in this case,  $L_{eq(15min)}$ ).
- Detail of measurement position and proximity to reflecting surface if any (building or similar). Measurement positions will typically be a residential property boundary.

Monitoring is not to conducted under adverse weather conditions. The conditions applying at the time of the measurements should be indicated in the reporting.

#### **10.8.10 Vibration Monitoring**

It is not expected that vibration monitoring would be required for receivers external to site. Vibration impacts on other buildings within the Shoalhaven Hospital will be addressed through internal hospital management.

Where monitoring is deemed necessary, the measurement location should be near to the potentially impacted structure, or as otherwise determined to best measure representative vibration levels.

The monitor used should log the peak particle velocities and also transmit SMS warnings to the contractor and acoustic expert if a pre-determined threshold is exceeded. Regular reports should be provided (twice monthly) presenting vibration levels recorded and assessing against relevant criteria.

Attended or unattended monitoring should also be undertaken at other locations in response to complaints, as appropriate.

## 11 COMPLYING CONTROLS – BUILDING AND MANAGEMENT

The following building and management controls are indicated in order to control noise emission from the operation of the preschool.

### 11.1 BUILDING CONSTRUCTION

- An assessment of noise emissions from mechanical plant is to be carried out prior to the granting of a CC and certification provided that the proposed plant and acoustic treatment will achieve compliance with the assessment criteria established in this assessment.
- Sliding screen enclosing loading dock area to be imperforate and indicatively constructed of material with surface density  $>4.5\text{kg/m}^2$  (i.e. sheet metal). The specific make-up and construction is to be determined during design phases. Alternative proposals can be considered acceptable provided noise emission goals are satisfied.

### 11.2 MANAGEMENT CONTROLS

- Garbage collections should occur between the hours of 7am and 10pm.
- Loading dock not to be in use prior to 6am.
- Loading/unloading activities in the dock area to be undertaken by behind a closed sliding screen (loading dock entry).

### 11.3 CONSTRUCTION PHASE

All works should be carried out in accordance with the EPA Interim Construction Noise Guideline and AS 2436.

A construction noise management plan should be developed prior to construction commencing that includes:

- Identification of sensitive receivers potentially impacted and nominates noise and vibration management objectives for each.
- Identification of the proposed significant construction activities, plant and processes and times of site operation.
- Predictions and assessments of noise and vibration impacts and recommends appropriate controls.
- Nominated complaint handling procedures and responses, community liaison principles and site management practices to be adopted.



## 12 CONCLUSION

This report presents an acoustic assessment of noise impacts associated with the proposed Shoalhaven Hospital Redevelopment.

The assessment concludes that, provided the complying controls presented in Section 11 are adopted, noise and vibration impacts from the proposed development will comply with the acoustic requirements of the following documents:

- Shoalhaven City Development Control Plan (DCP) 2014
- NSW (EPA) *Noise Policy for Industry* (NPfI) 2017.
- NSW EPA – 'Interim Construction Noise Guideline' ("IGNG") July 2009
- NSW EPA – 'Road Noise Policy' ("RNP") March 2011

Yours faithfully,

A handwritten signature in black ink, appearing to read 'V Fattoretto', with a stylized flourish at the end.

Acoustic Logic Pty Ltd  
Victor Fattoretto  
MAAS MIE(Aust)

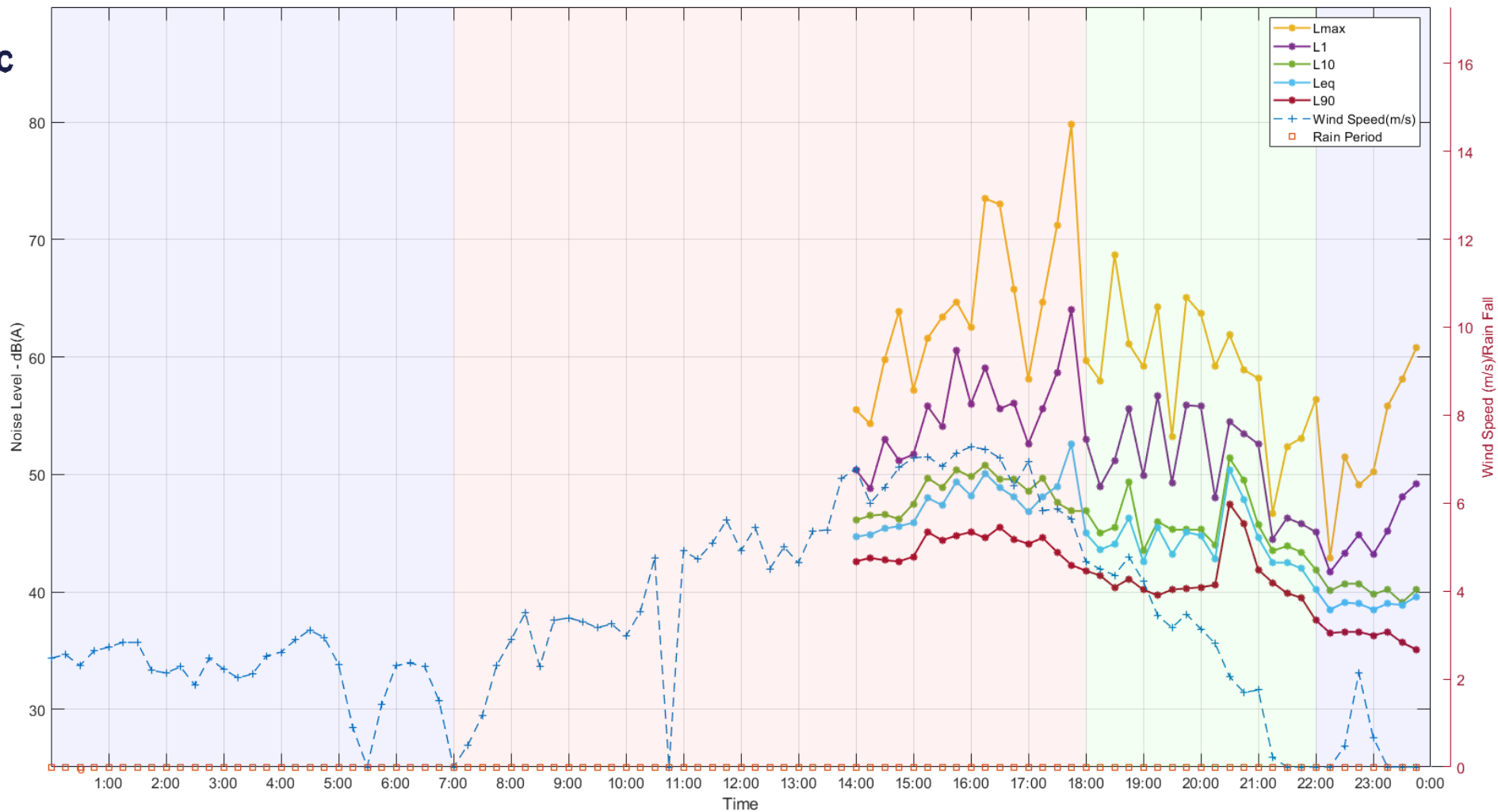
## APPENDIX A – UNATTENDED NOISE MONITORING DATA –

### Location 1 – Bush opposite 30 Yurunga Drive, North Nowra

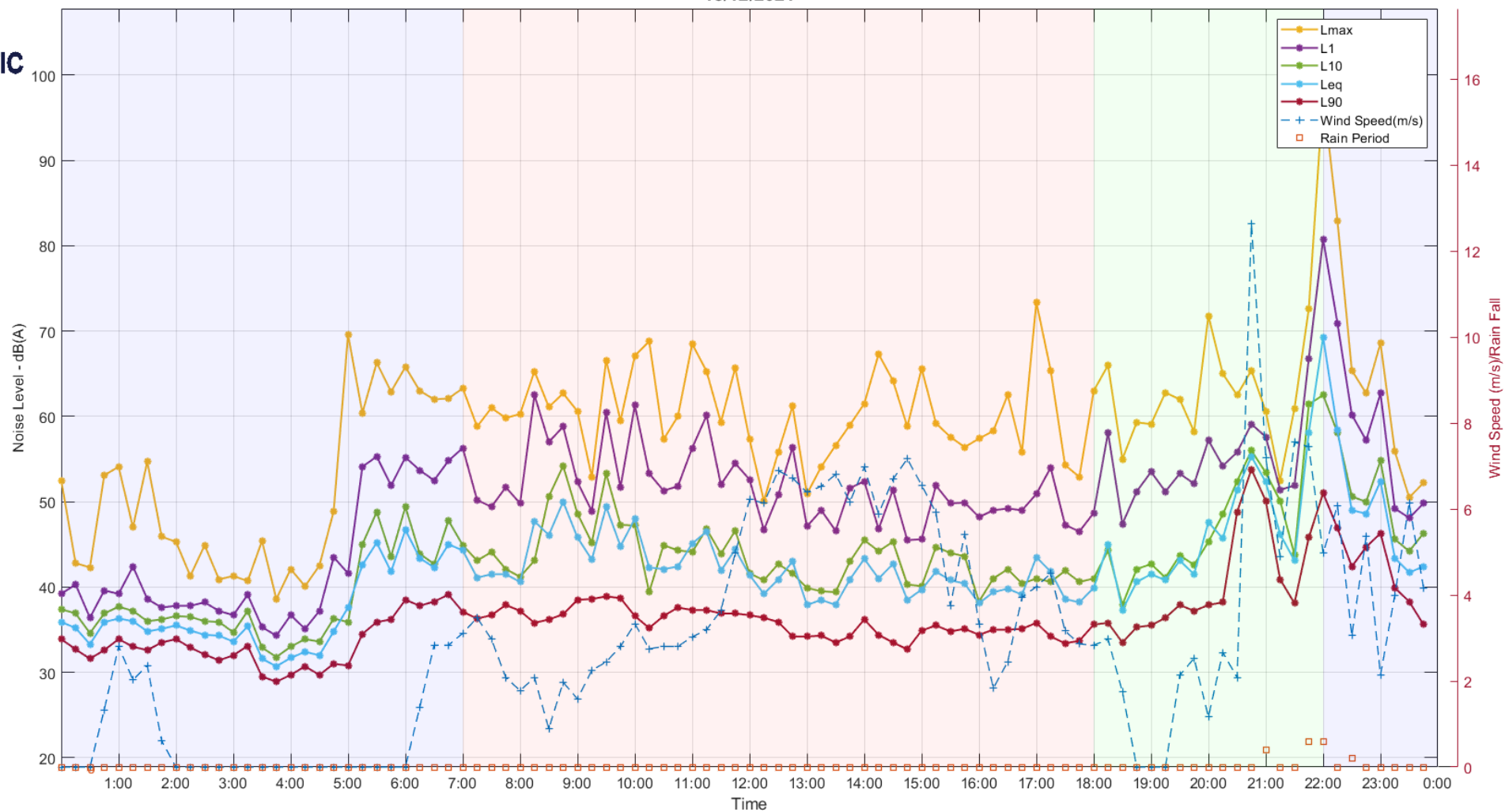
(Note : Wind speeds are raw speeds uncorrected for boundary layer reductions)



**Shoalhaven Hopsital, Location 1  
17/12/2021**

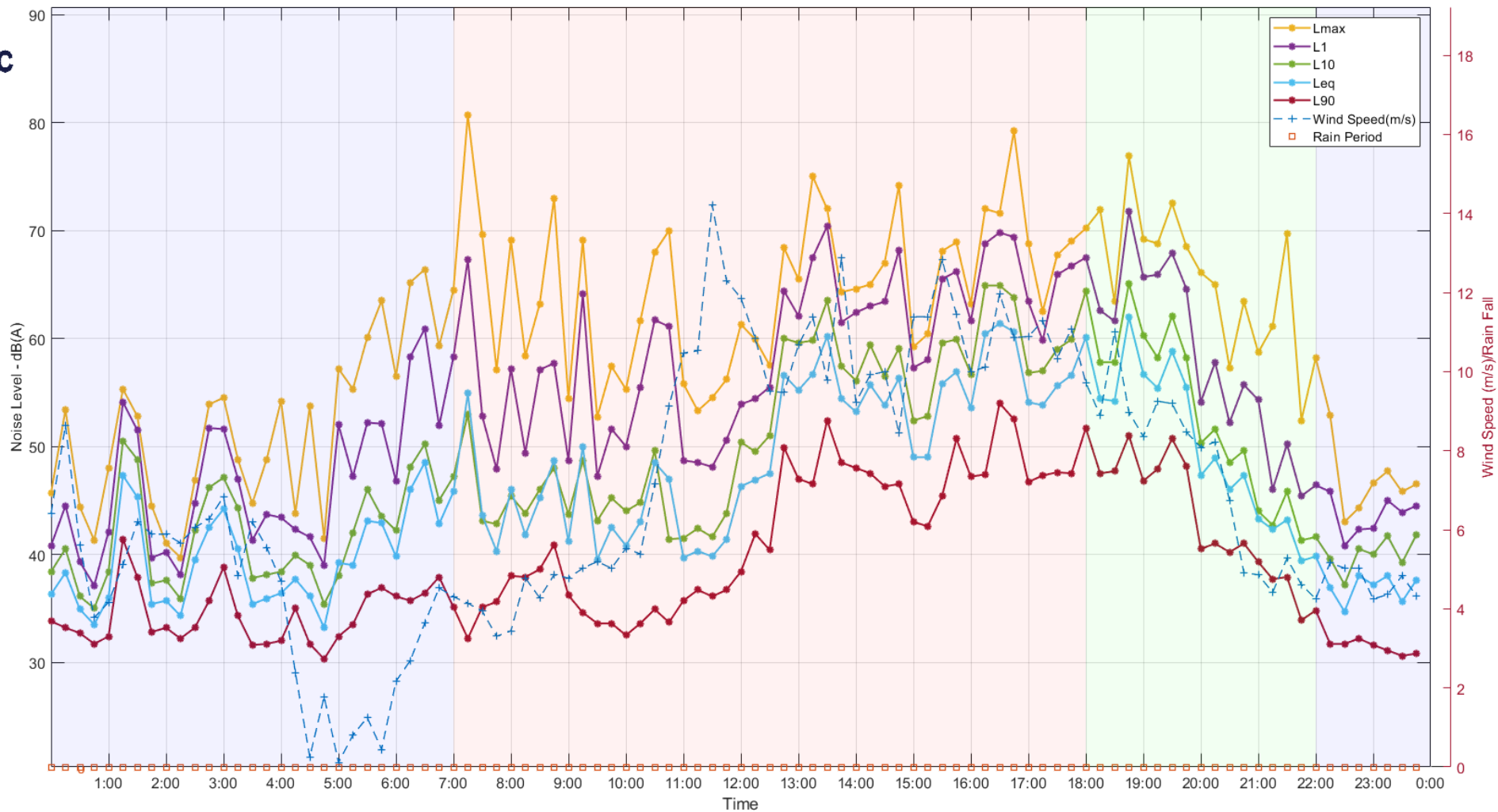


# Shoalhaven Hospital, Location 1 18/12/2021

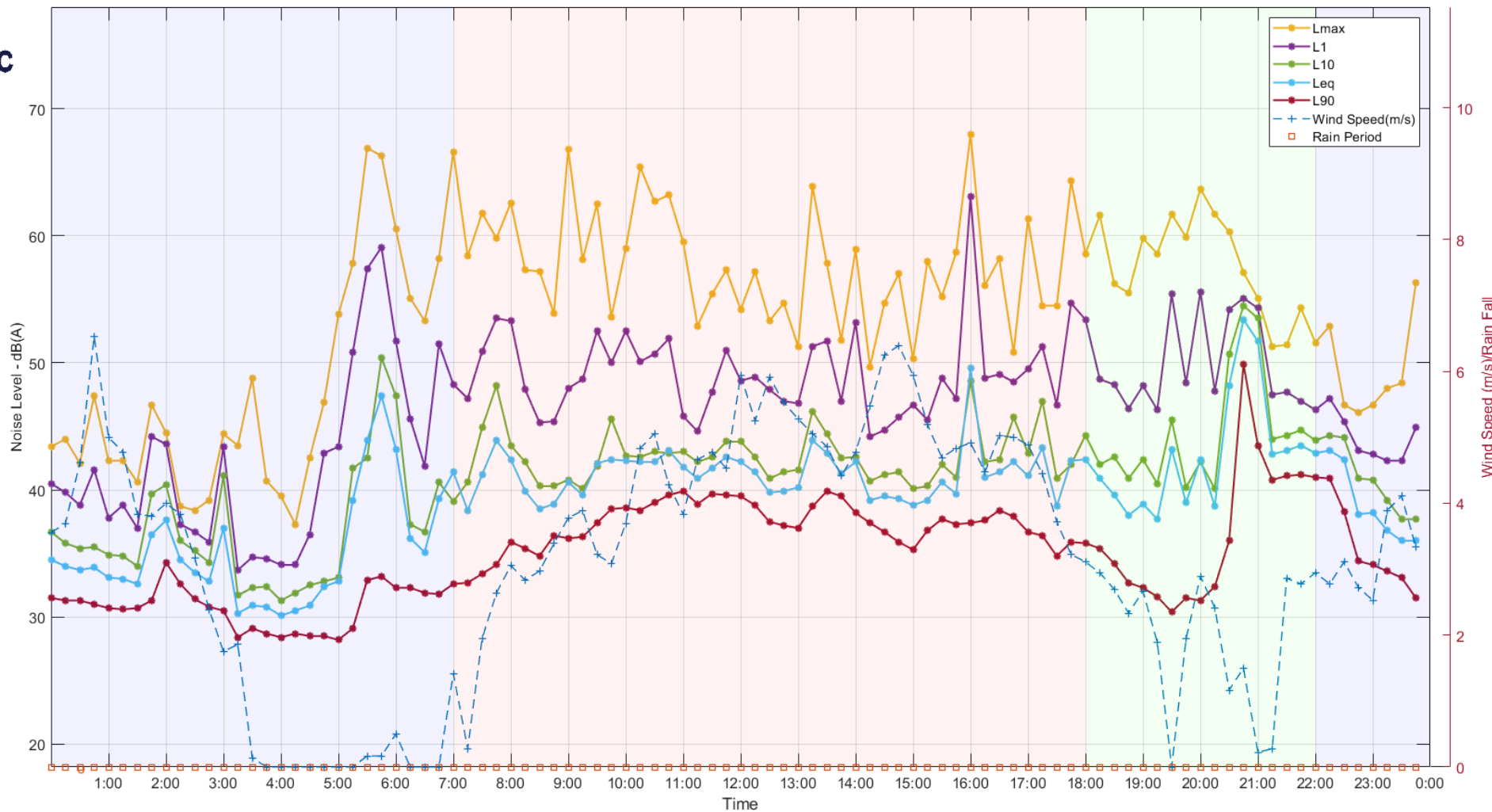




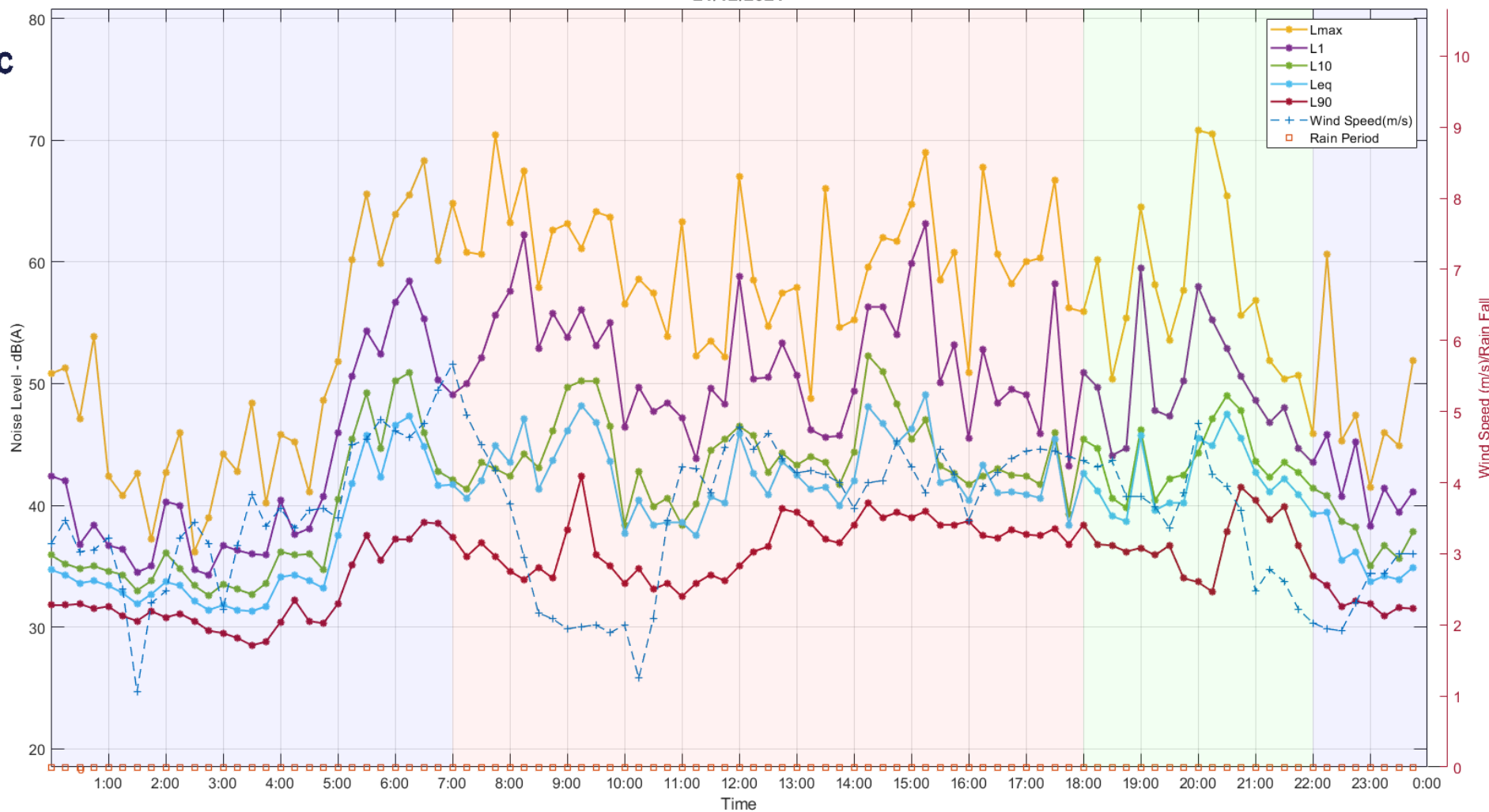
# Shoalhaven Hospital, Location 1 19/12/2021



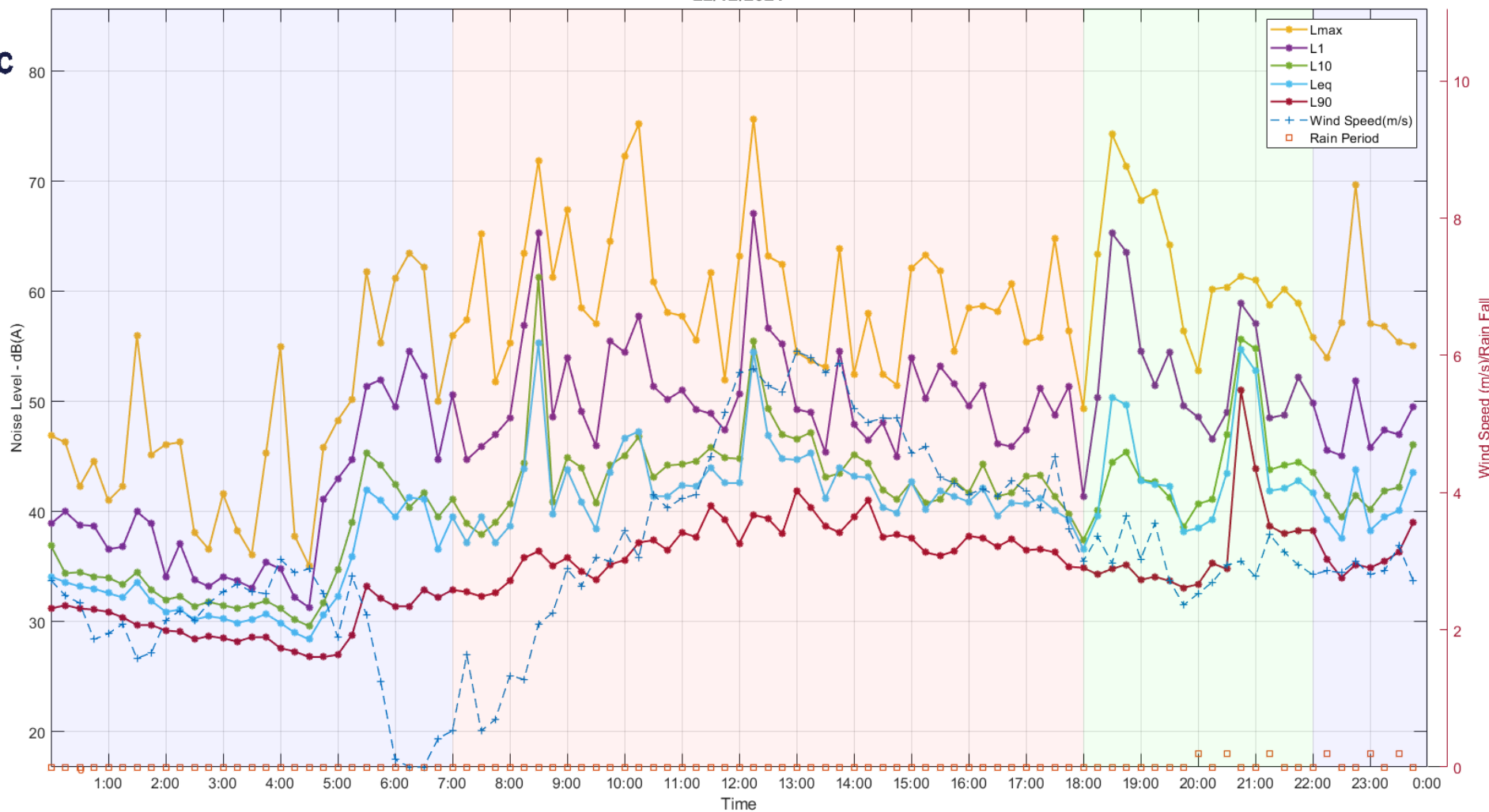
Shoalhaven Hospital, Location 1  
20/12/2021



# Shoalhaven Hopsital, Location 1 21/12/2021

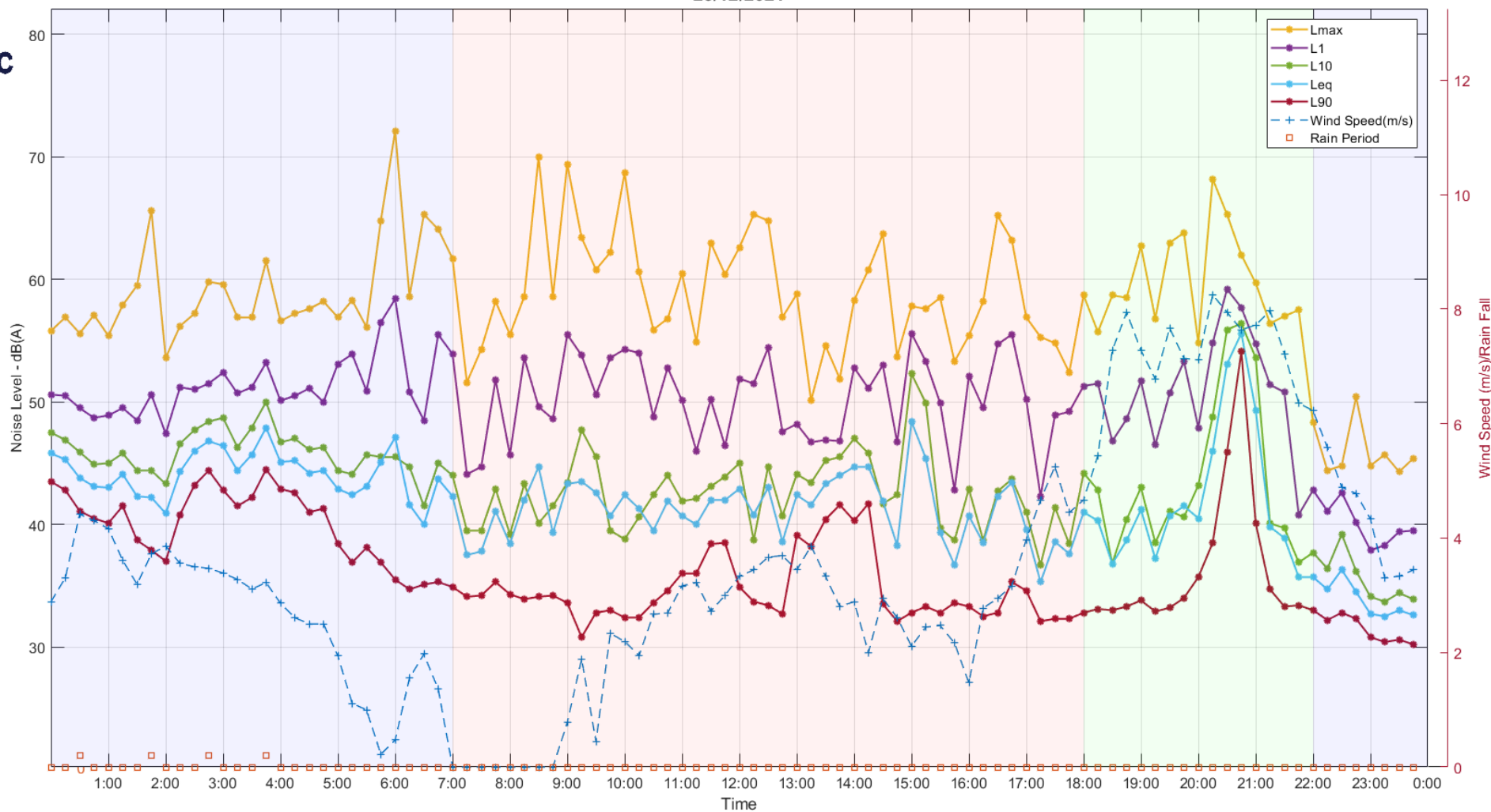


# Shoalhaven Hopsital, Location 1 22/12/2021

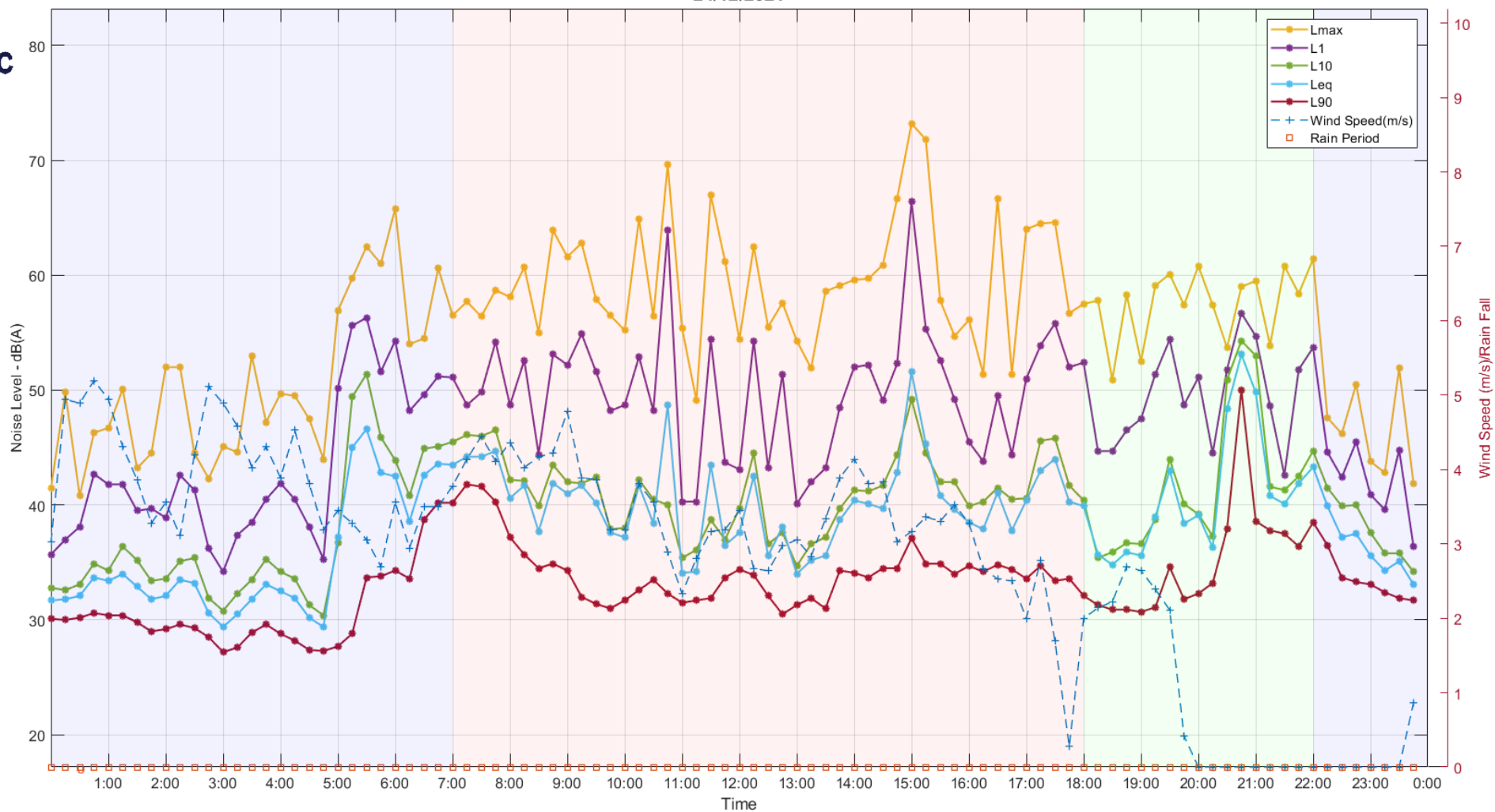




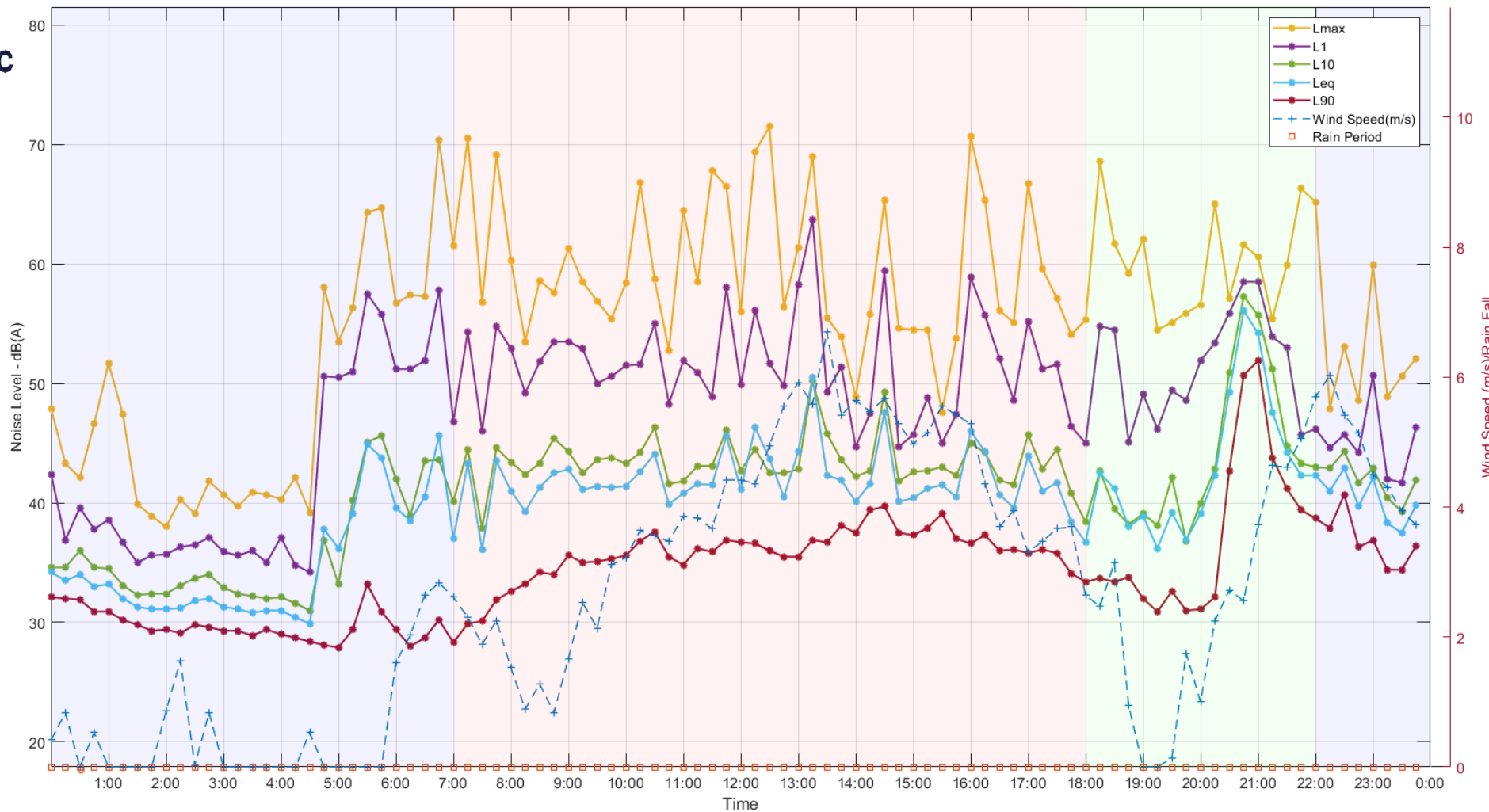
# Shoalhaven Hospital, Location 1 23/12/2021



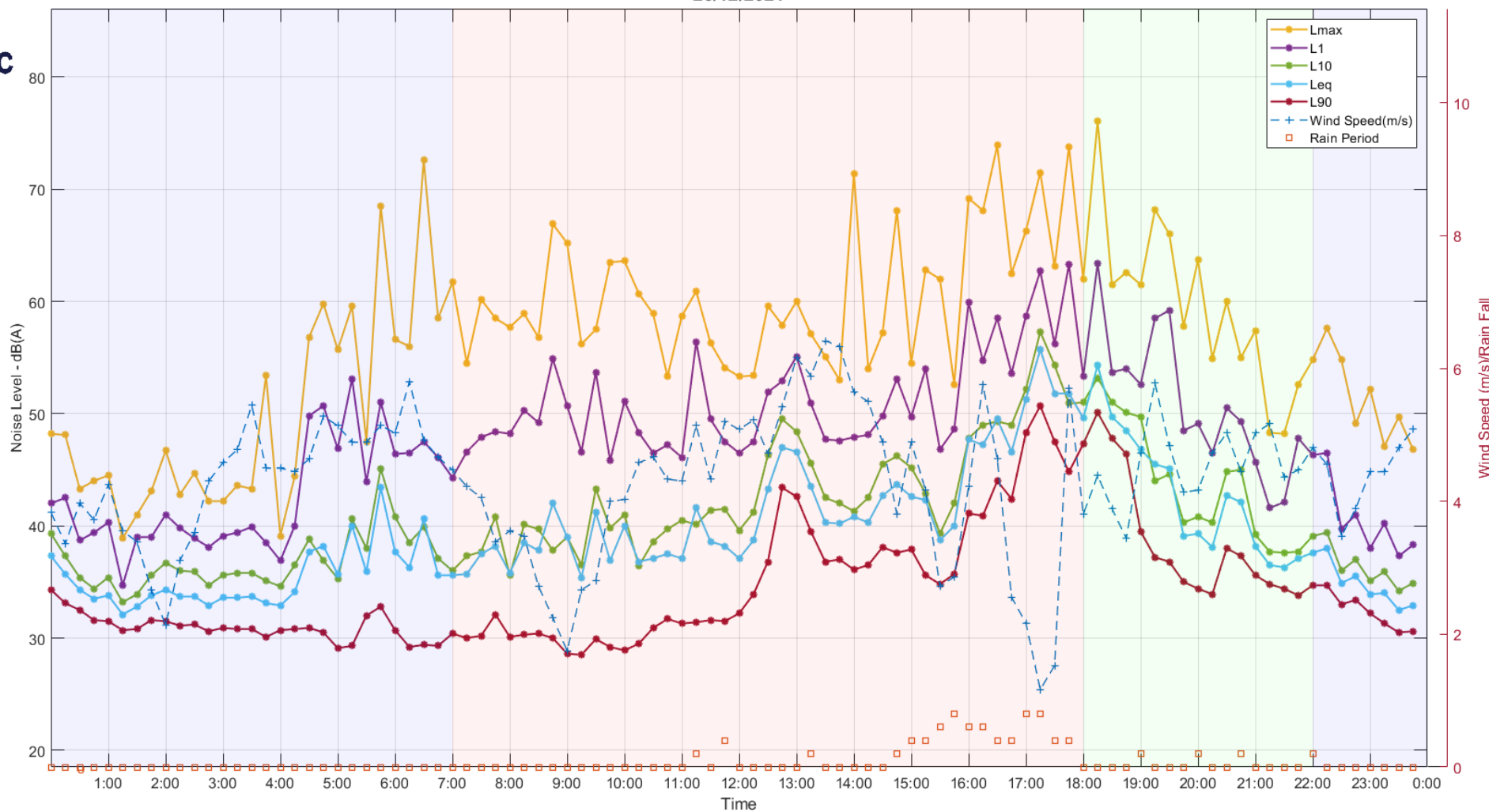
**Shoalhaven Hopsital, Location 1**  
**24/12/2021**



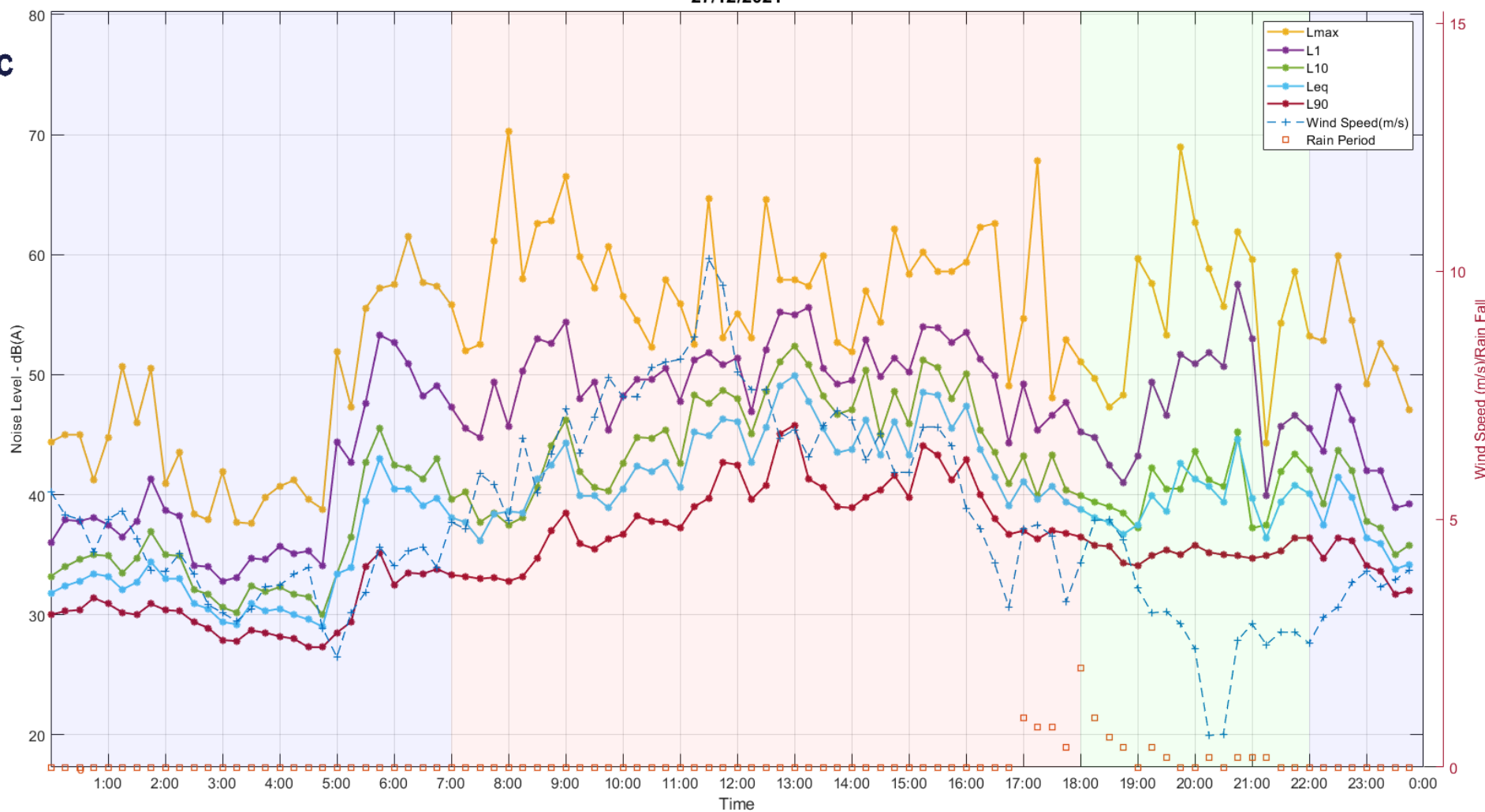
# Shoalhaven Hopsital, Location 1 25/12/2021



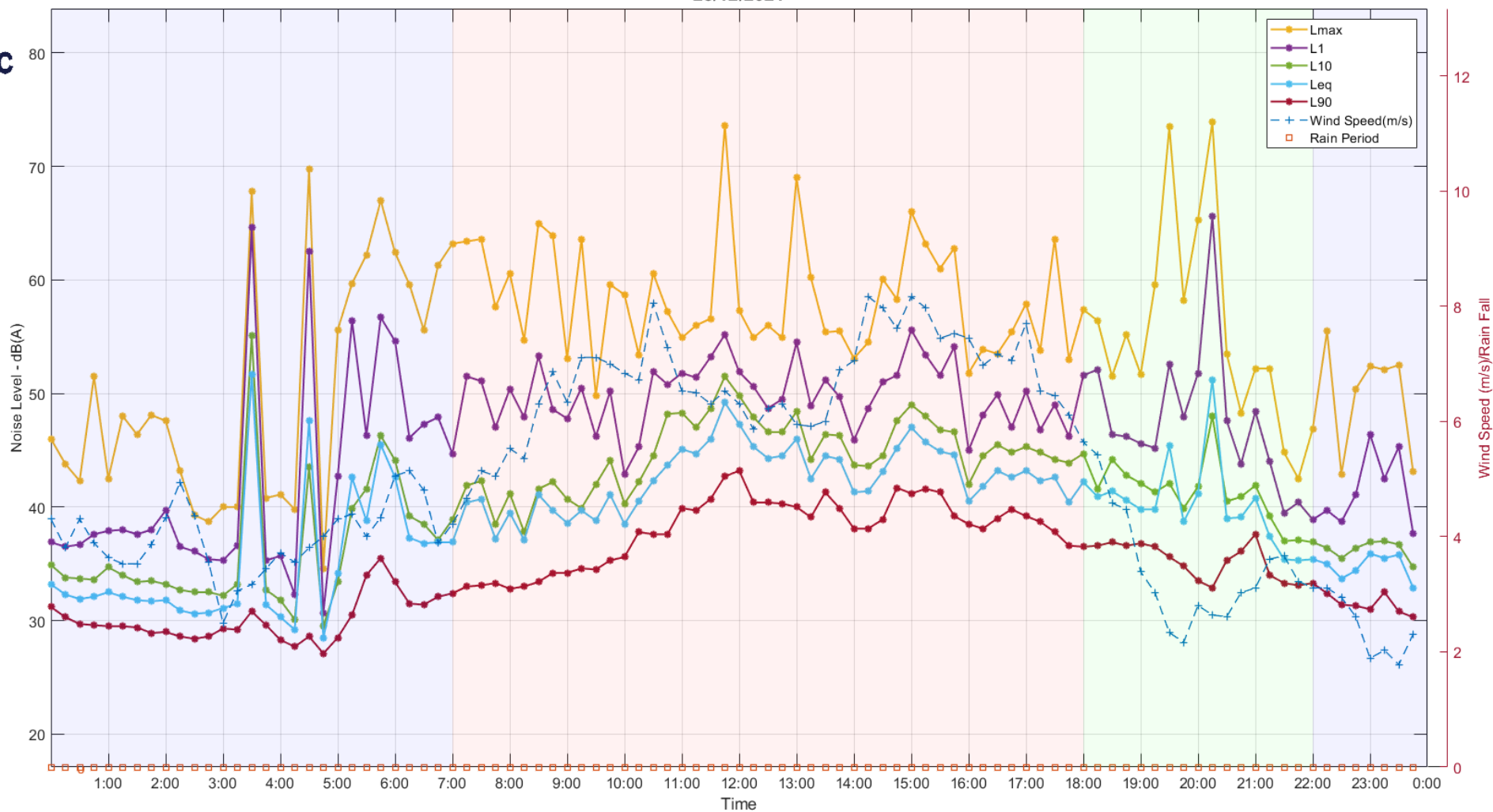
# Shoalhaven Hospital, Location 1 26/12/2021



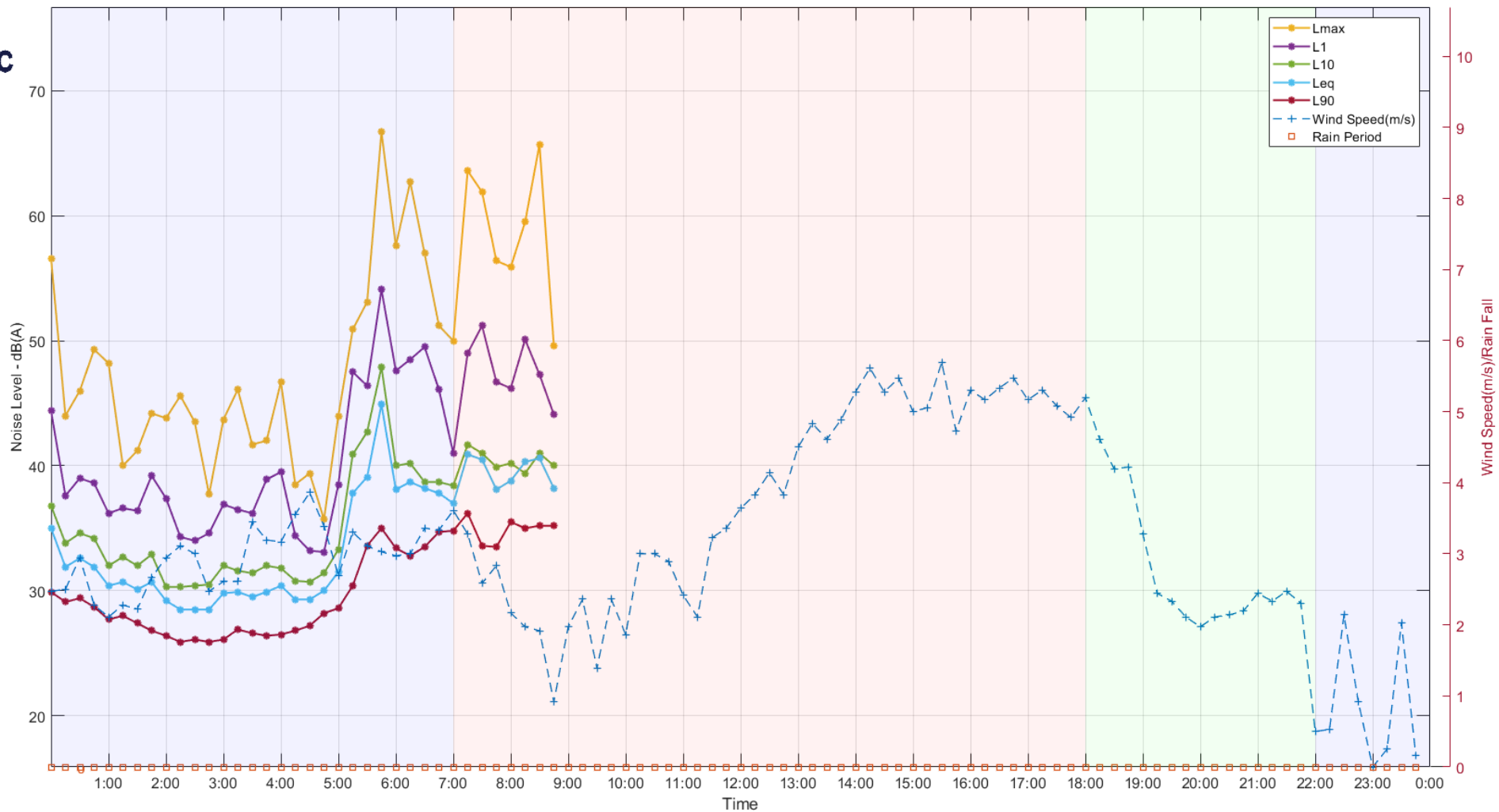
# Shoalhaven Hopsital, Location 1 27/12/2021



# Shoalhaven Hopsital, Location 1 28/12/2021



# Shoalhaven Hopsital, Location 1 29/12/2021





## Location 2 – 19 Mandalay Ave, Nowra

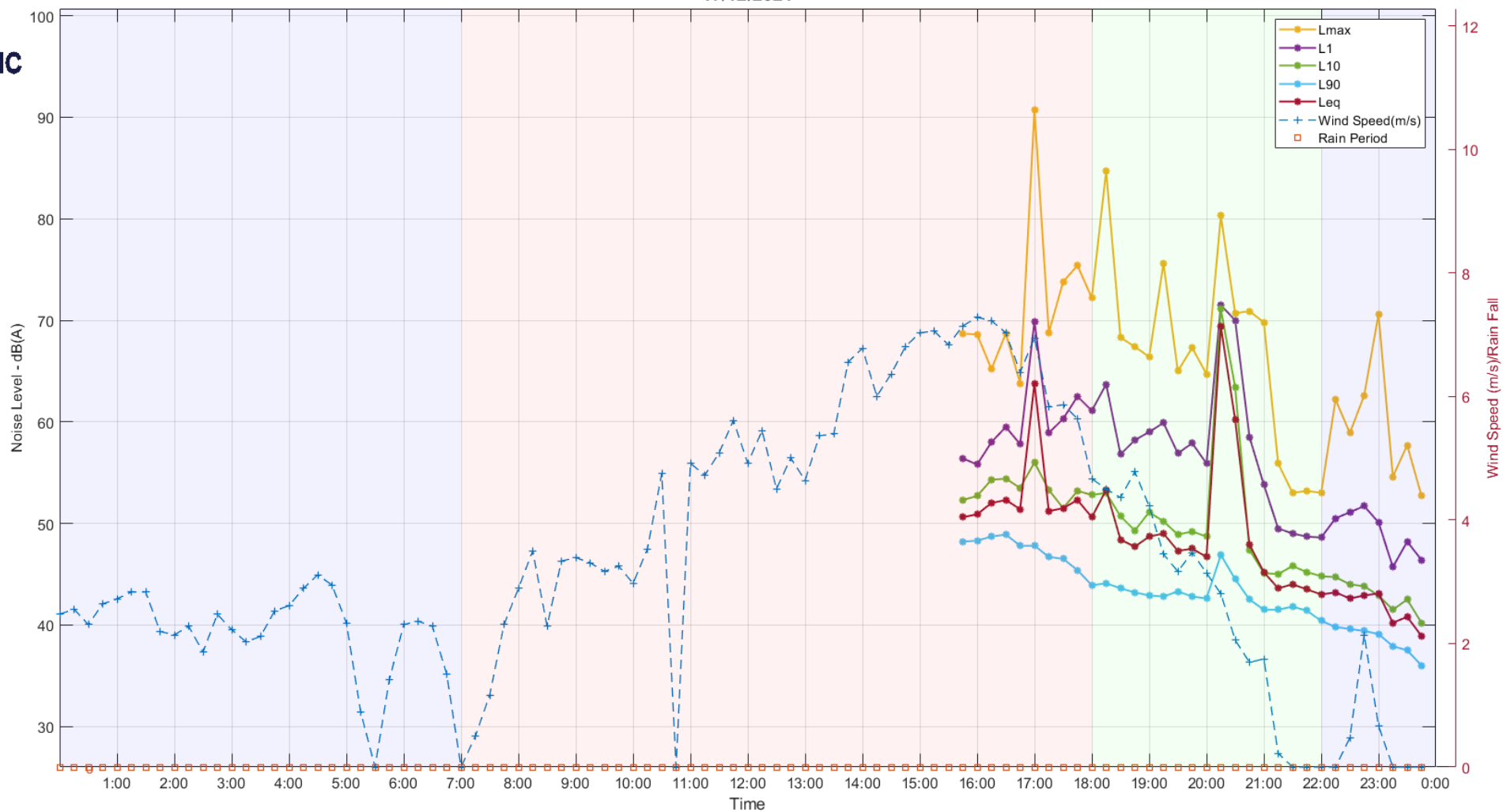
(Note : Wind speeds are raw speeds uncorrected for boundary layer reductions)



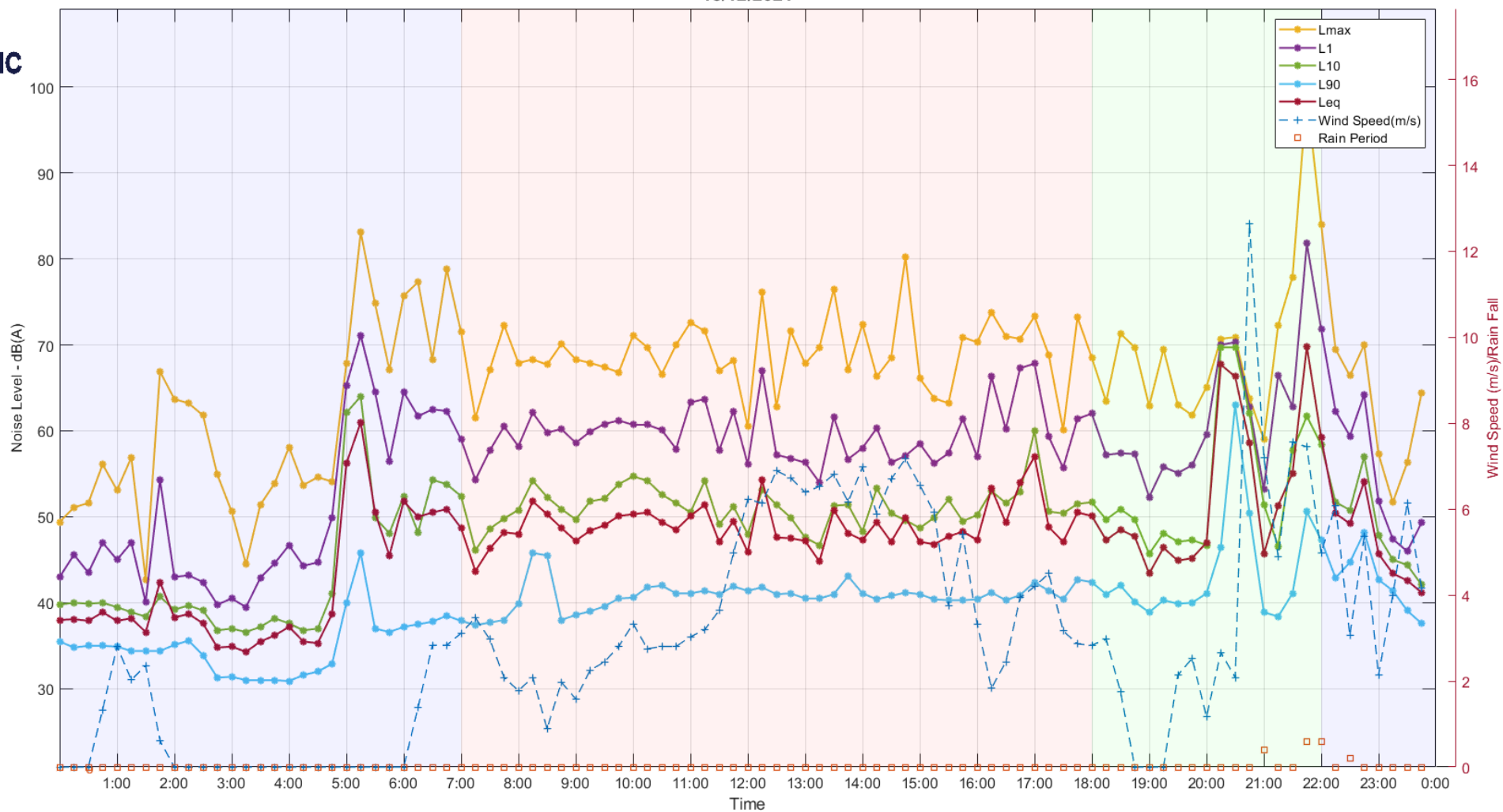
(source: google maps – actual logger photo omitted due to privacy concerns of residents)



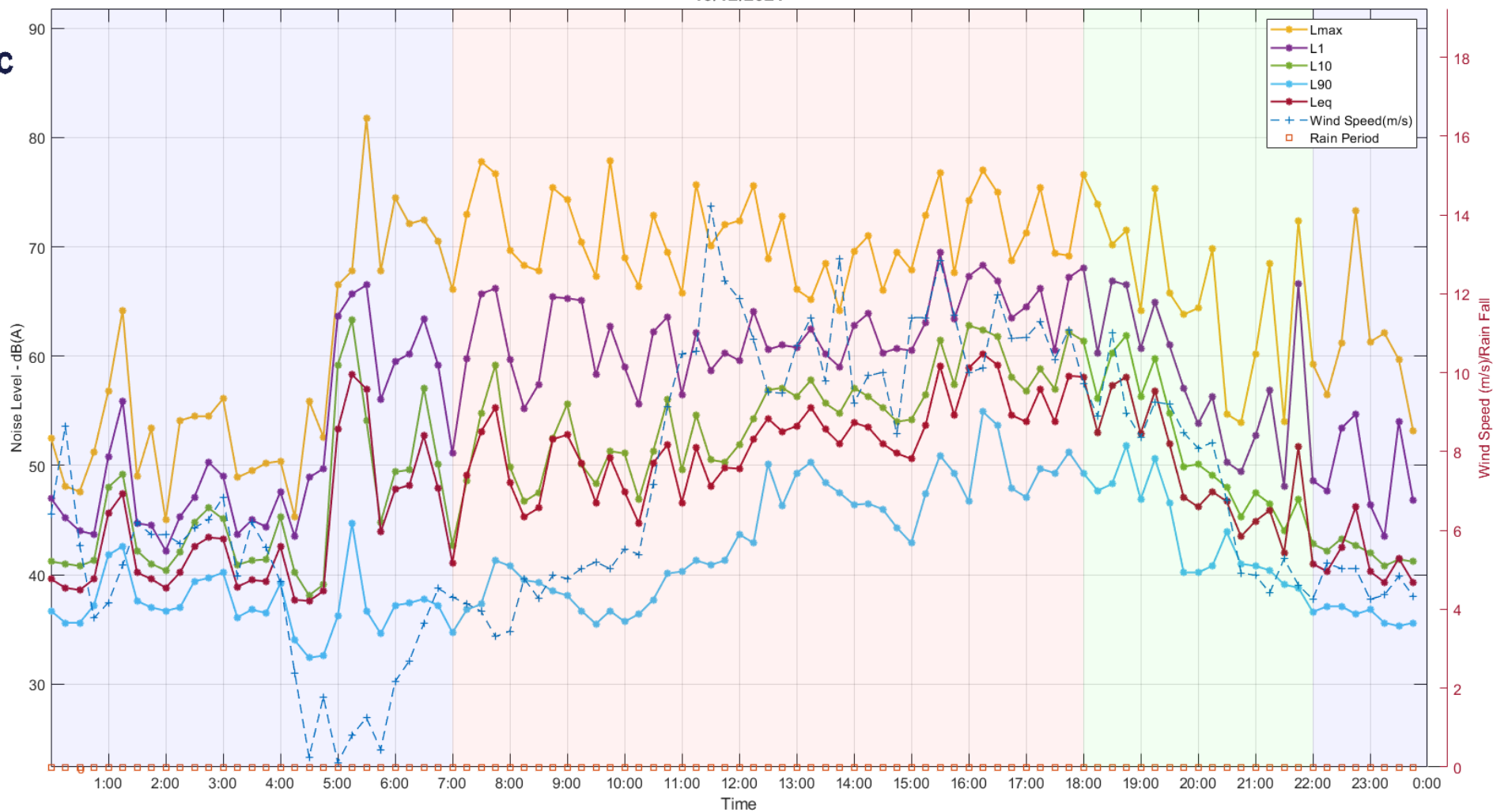
# Shoalhaven Hospital, Location 2 17/12/2021



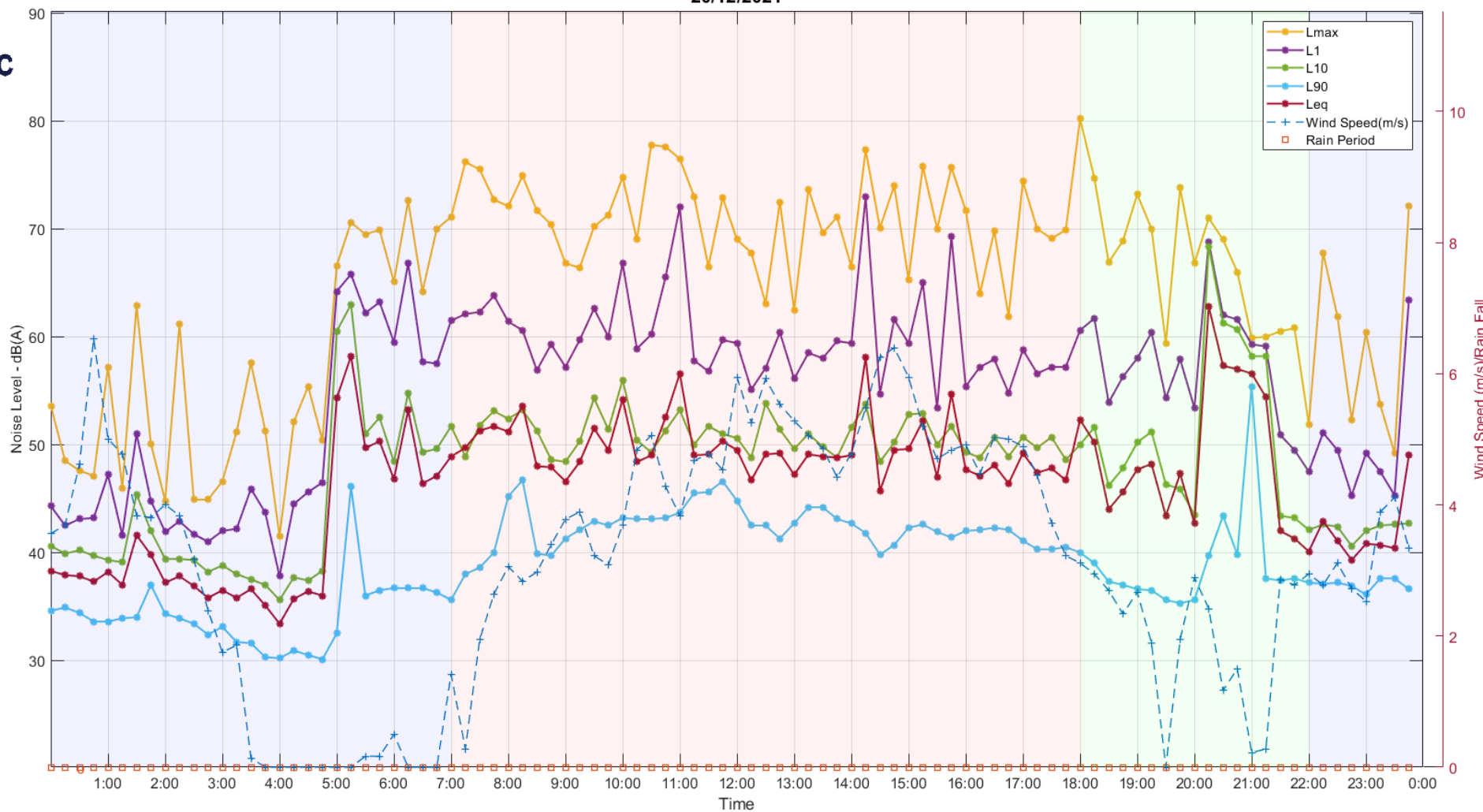
Shoalhaven Hospital, Location 2  
18/12/2021



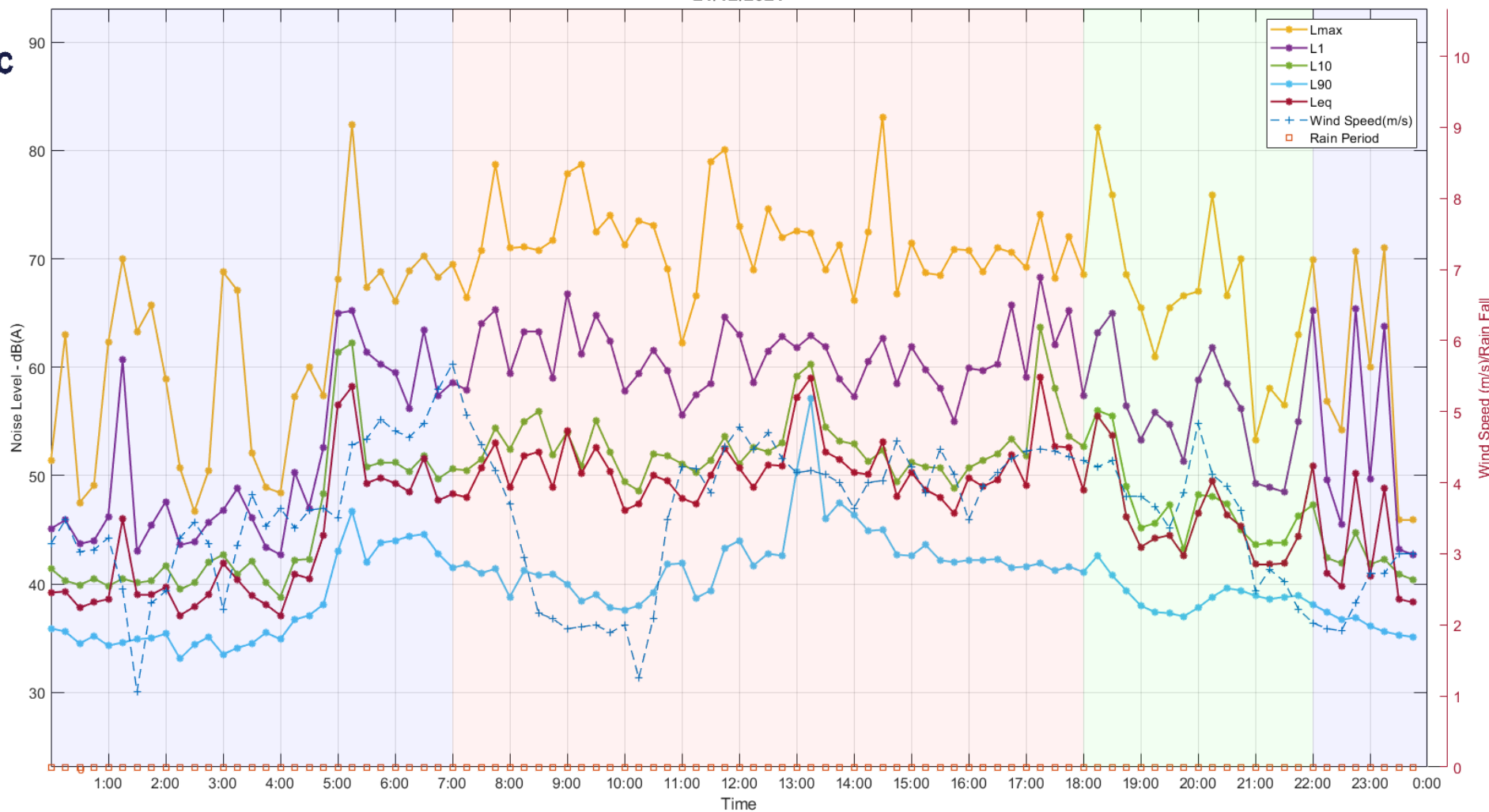
Shoalhaven Hospital, Location 2  
19/12/2021



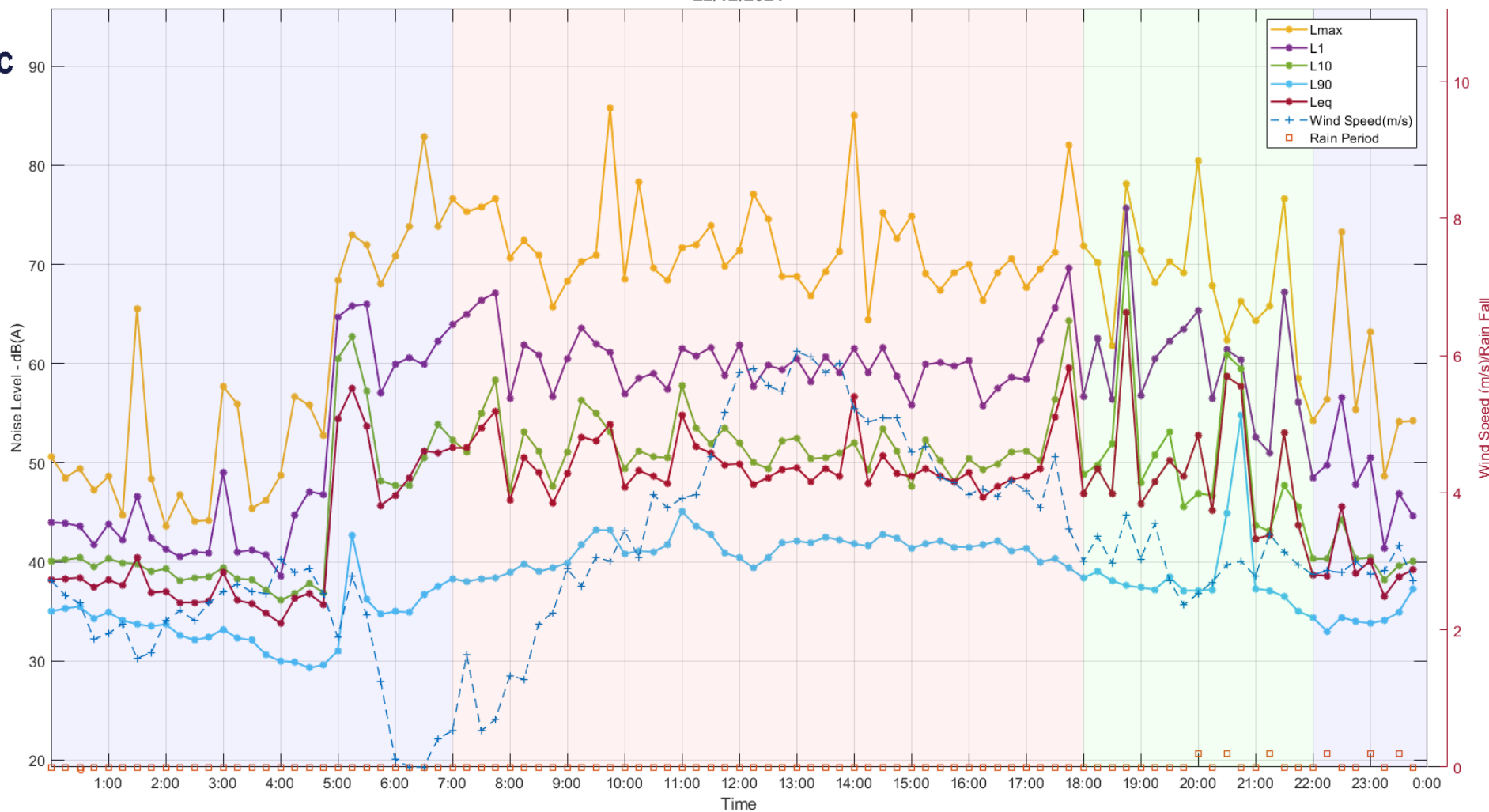
# Shoalhaven Hospital, Location 2 20/12/2021



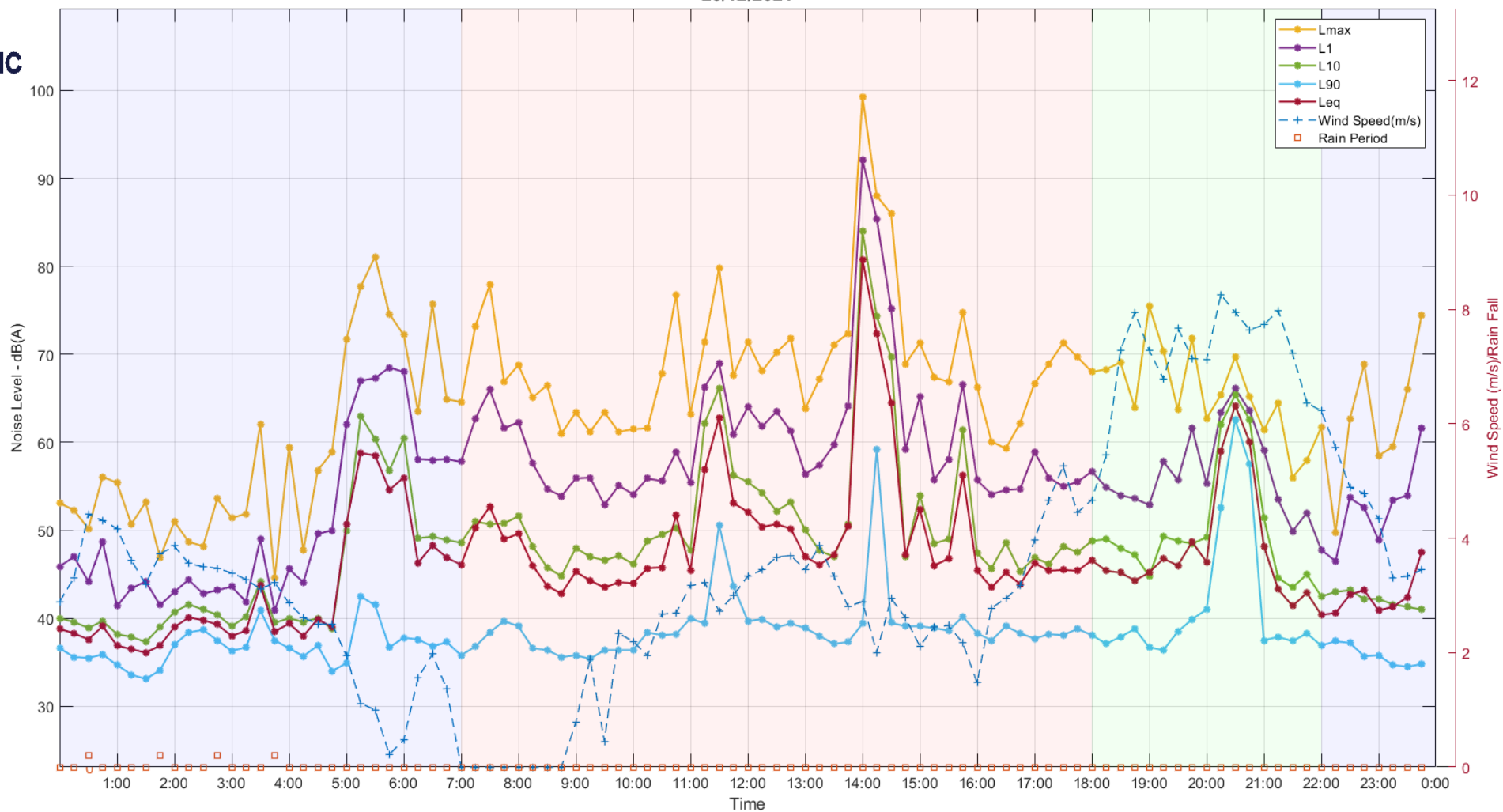
# Shoalhaven Hospital, Location 2 21/12/2021



Shoalhaven Hospital, Location 2  
22/12/2021

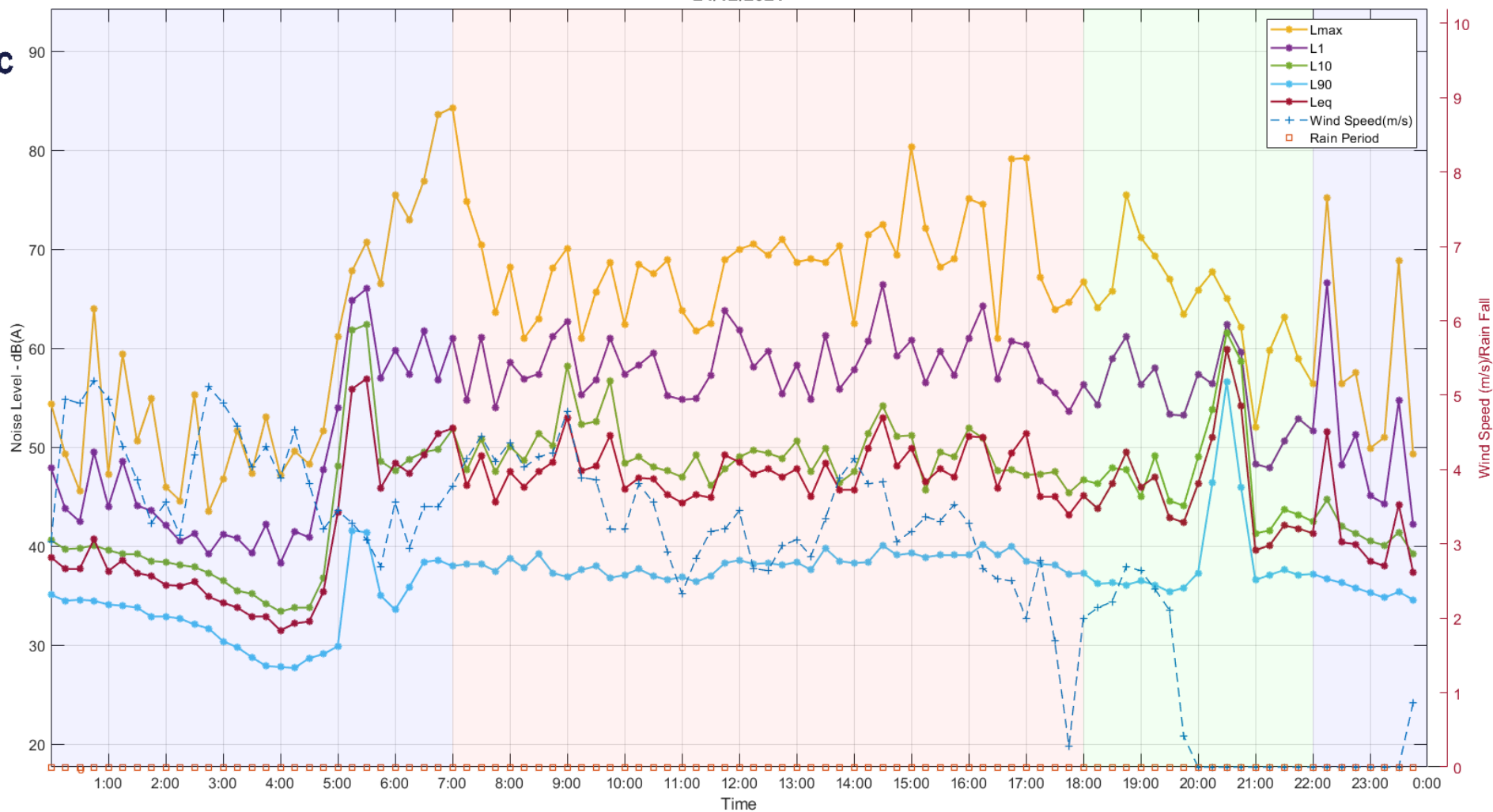


# Shoalhaven Hospital, Location 2 23/12/2021



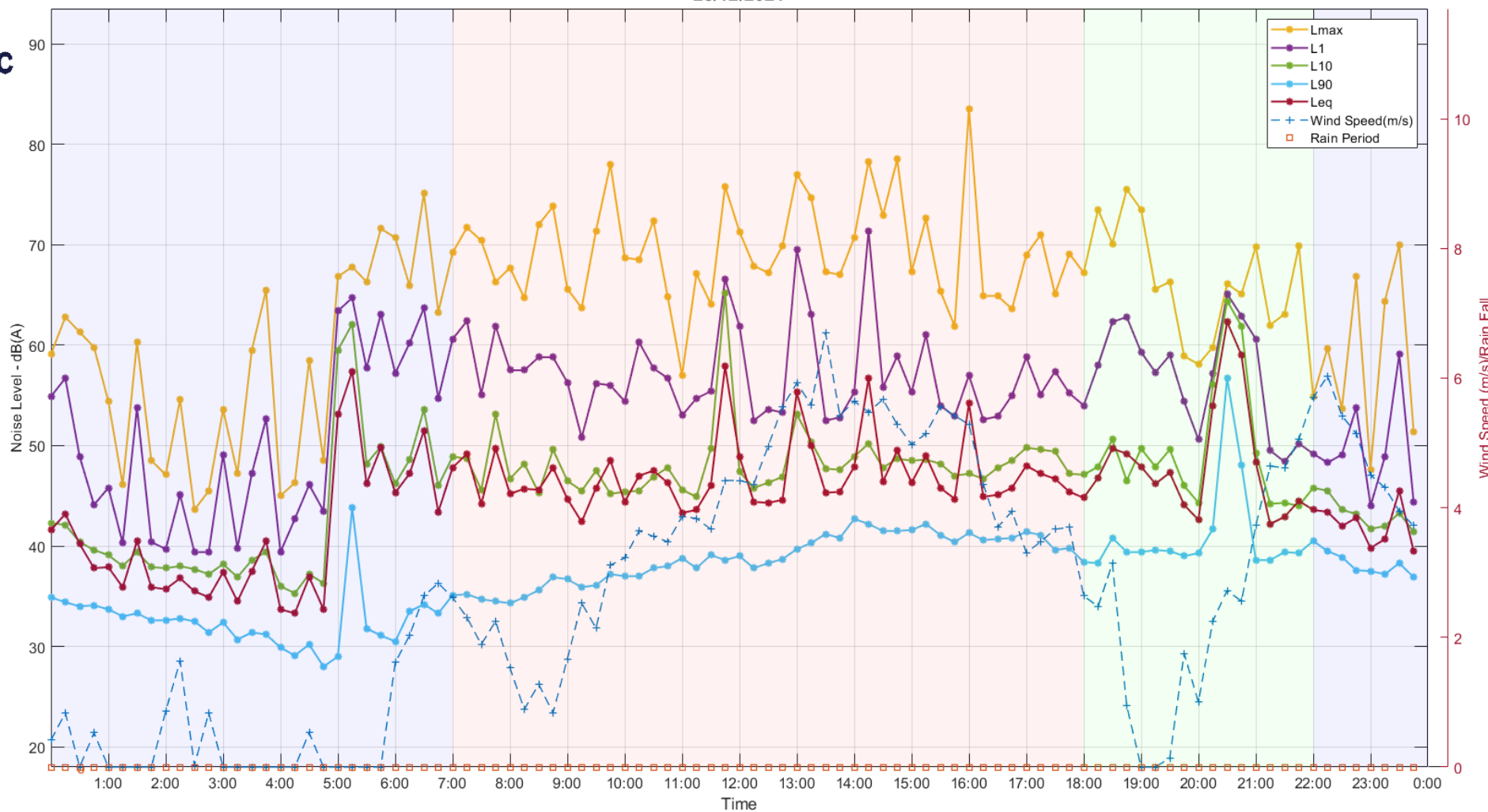


**Shoalhaven Hospital, Location 2**  
**24/12/2021**

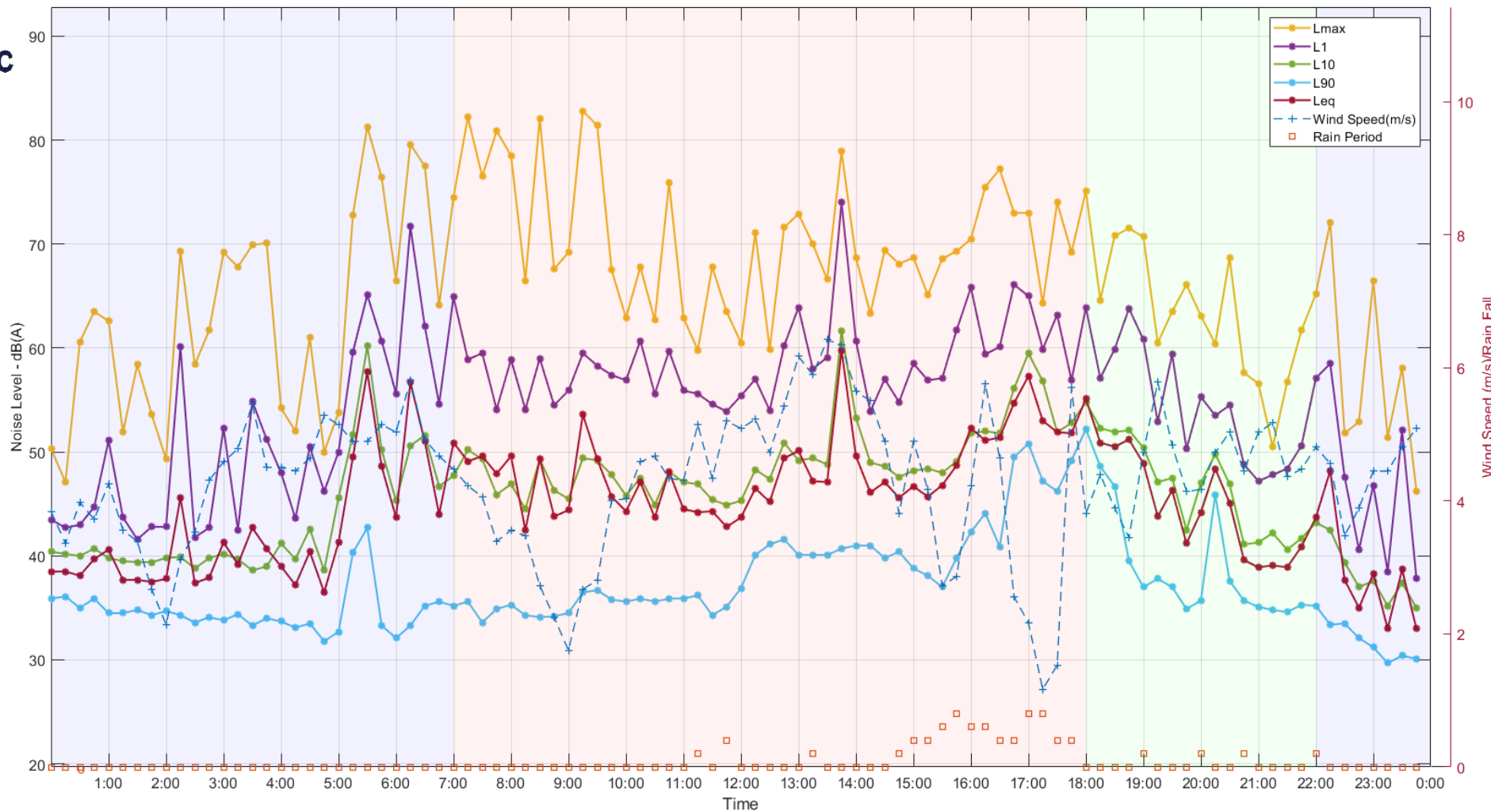




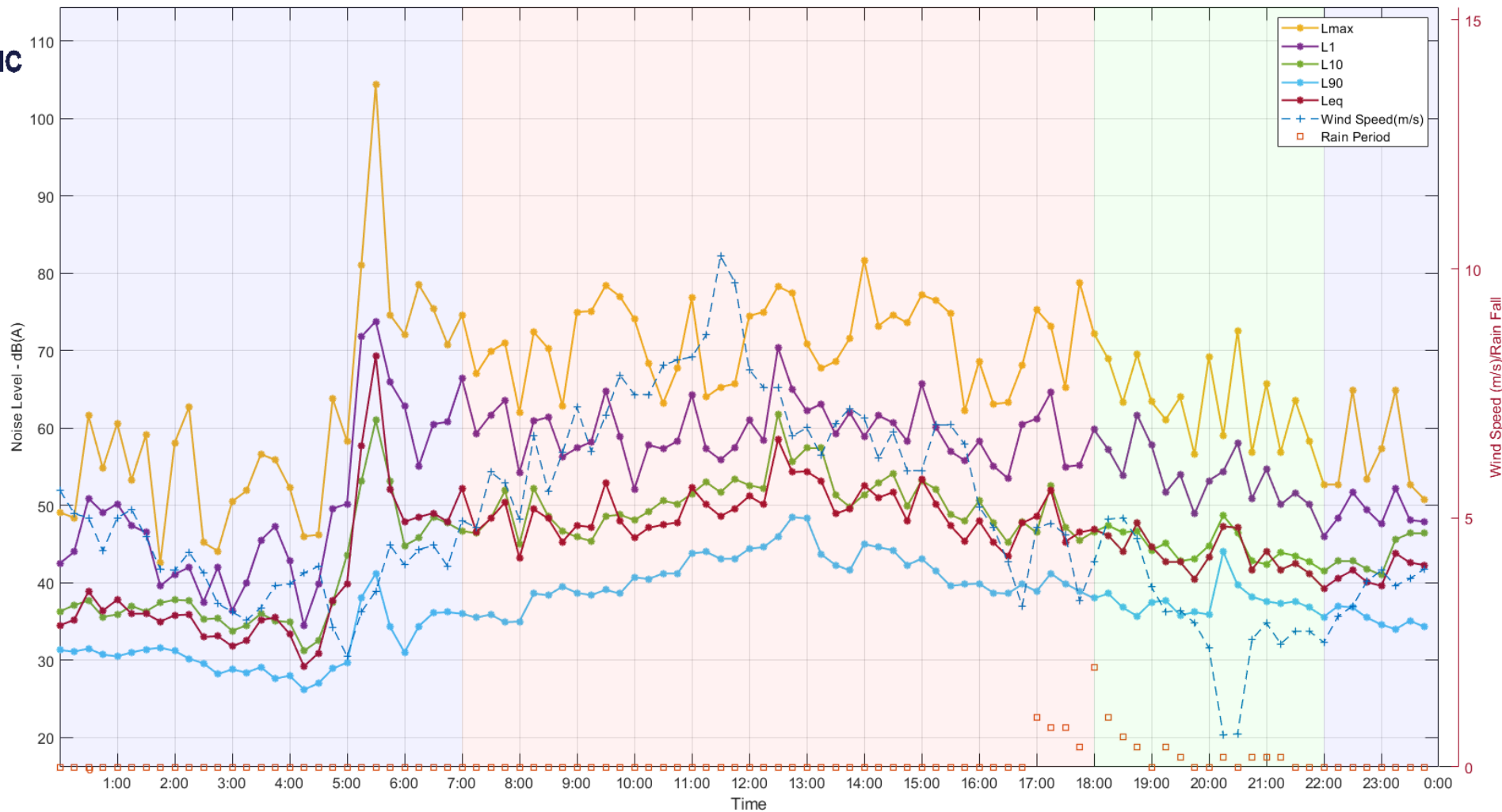
**Shoalhaven Hospital, Location 2**  
**25/12/2021**



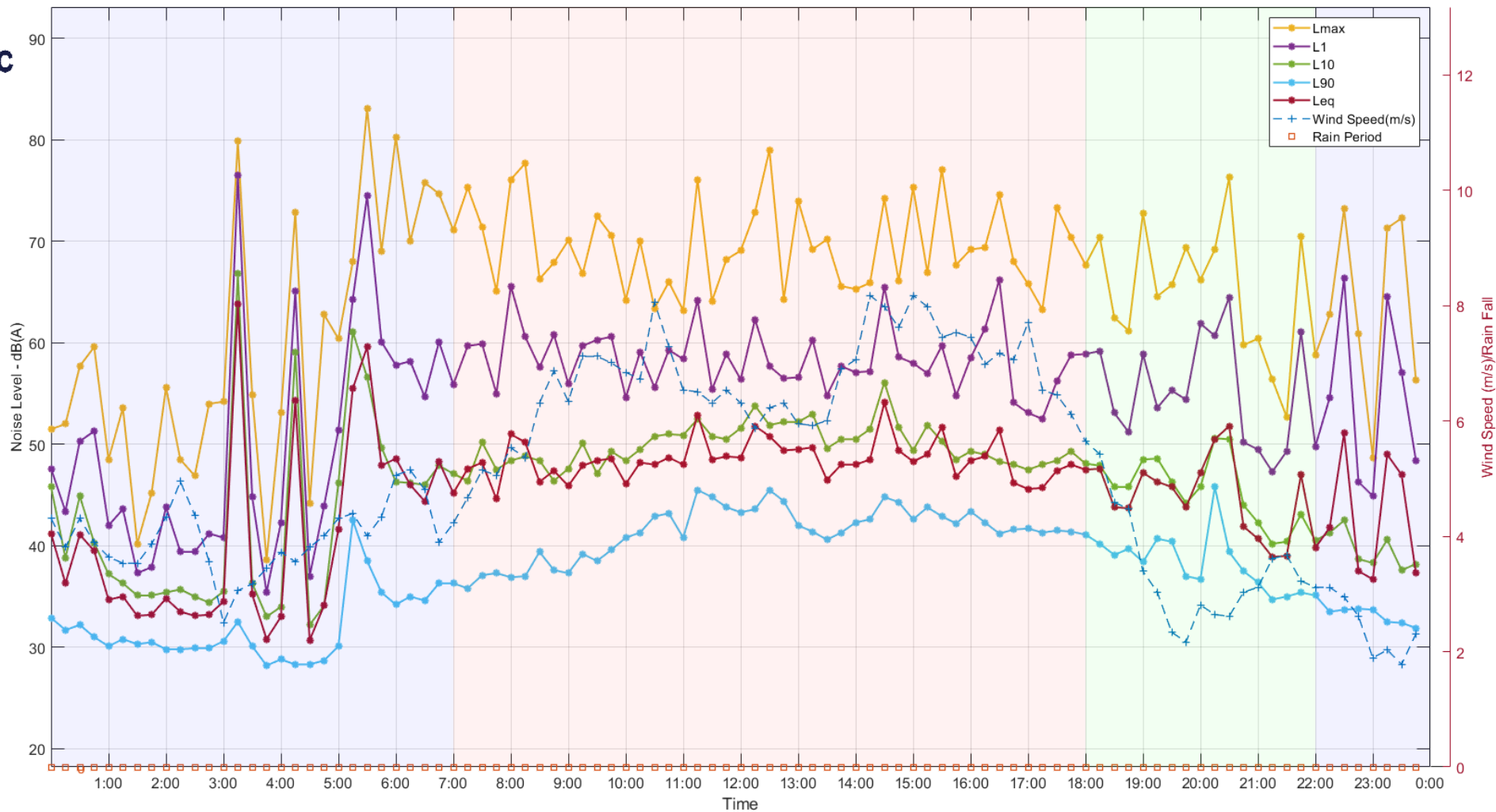
Shoalhaven Hospital, Location 2  
26/12/2021



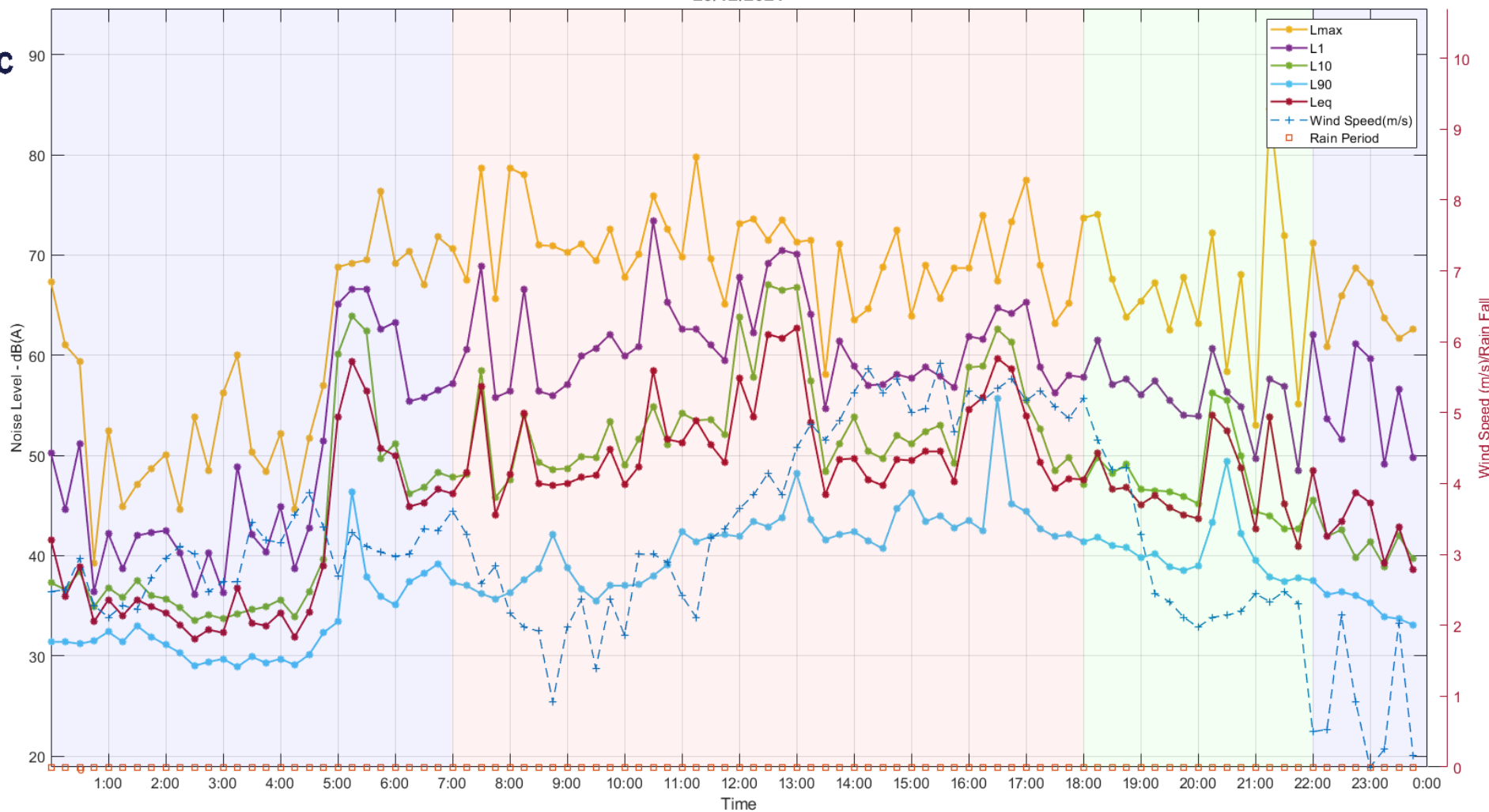
Shoalhaven Hospital, Location 2  
27/12/2021



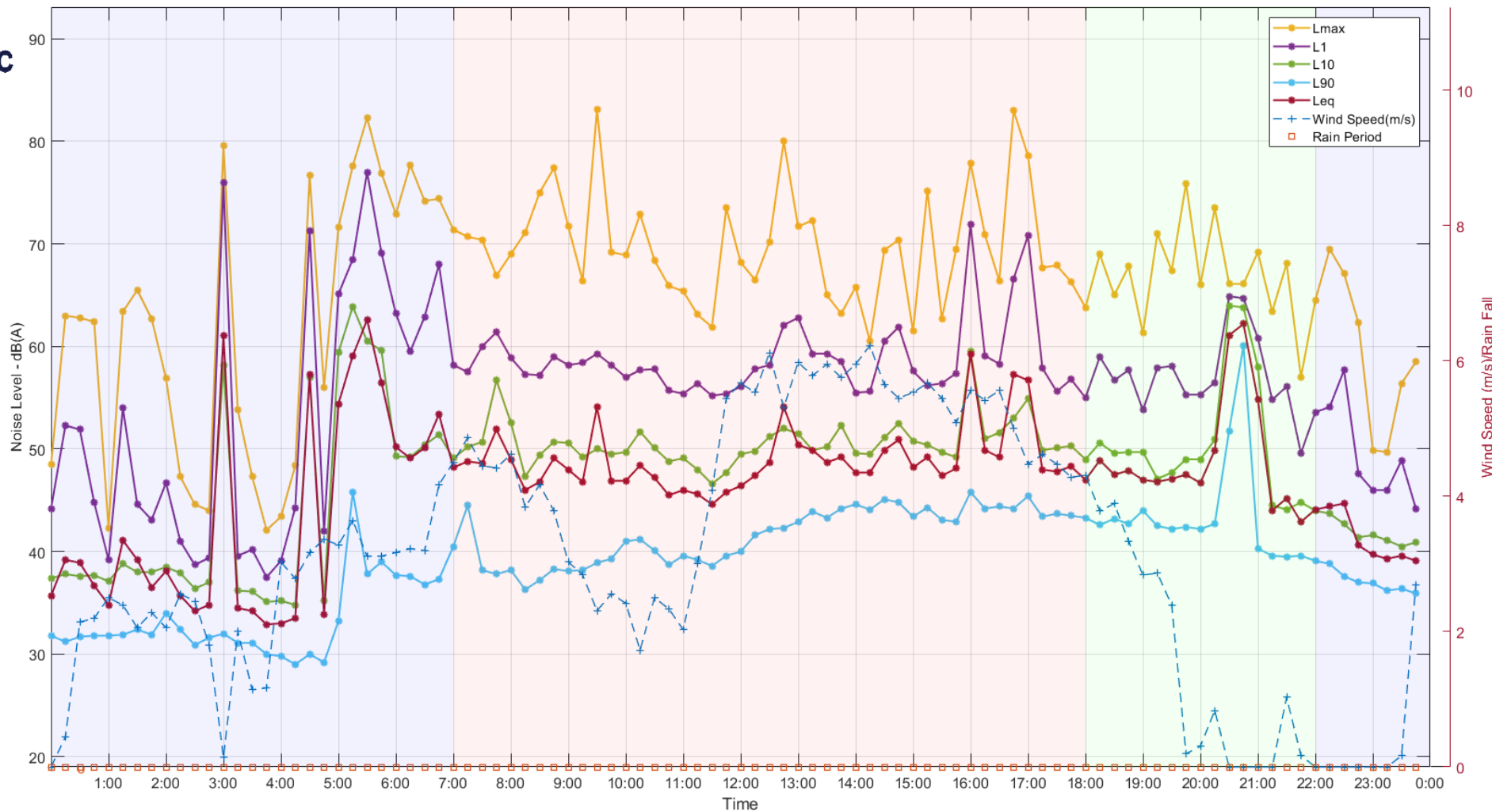
Shoalhaven Hospital, Location 2  
28/12/2021



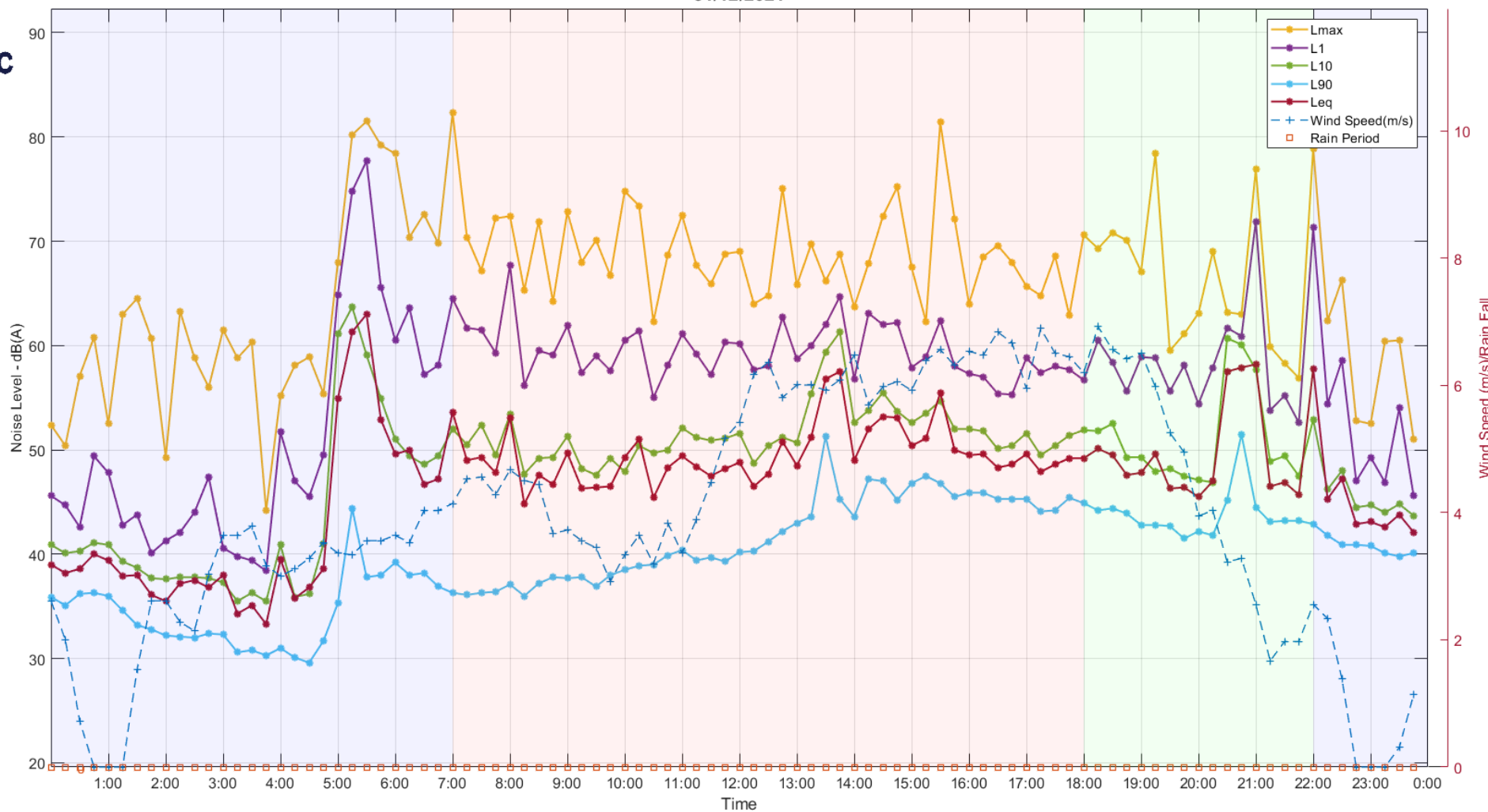
# Shoalhaven Hospital, Location 2 29/12/2021



Shoalhaven Hospital, Location 2  
30/12/2021

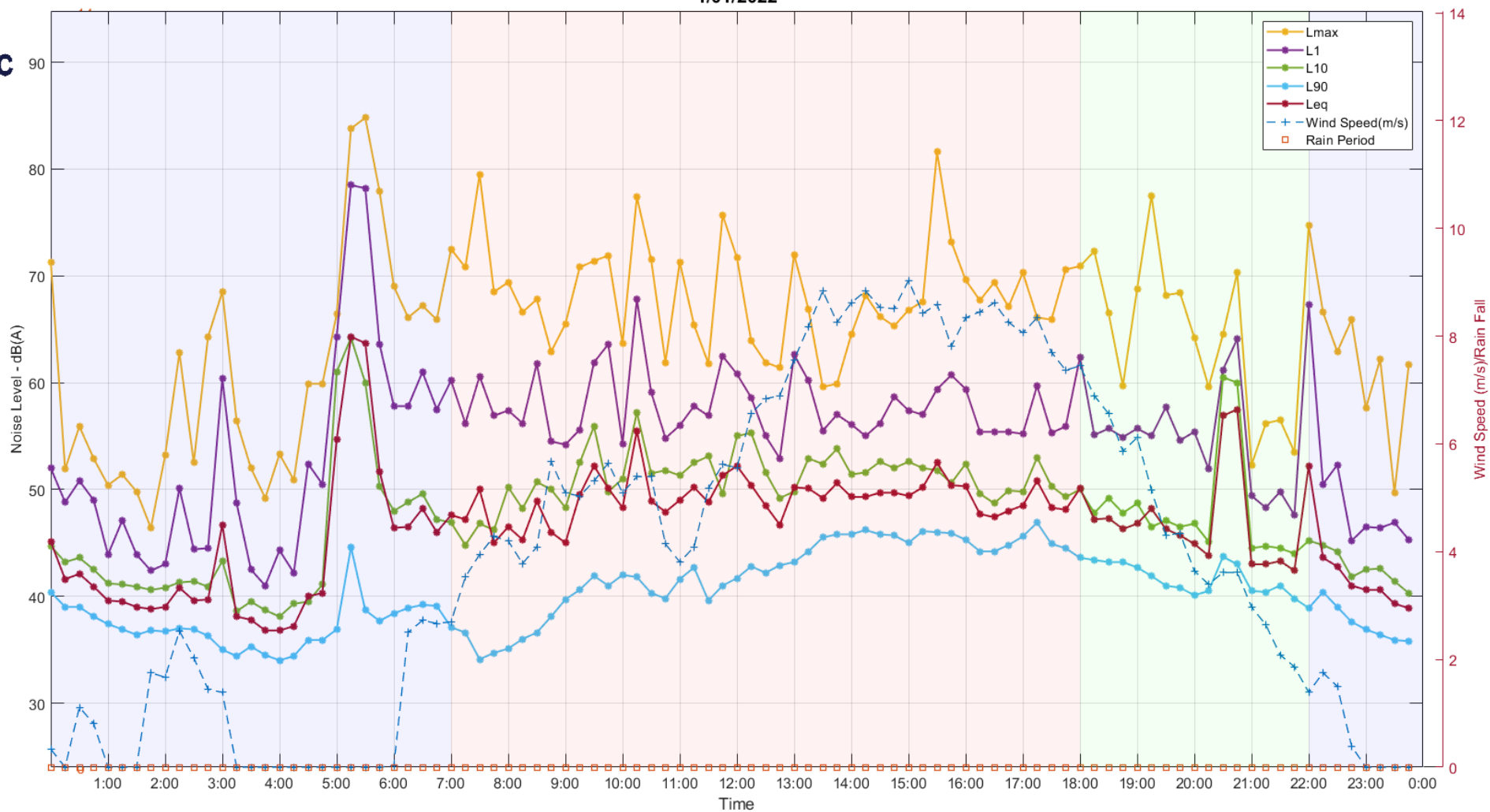


Shoalhaven Hospital, Location 2  
31/12/2021



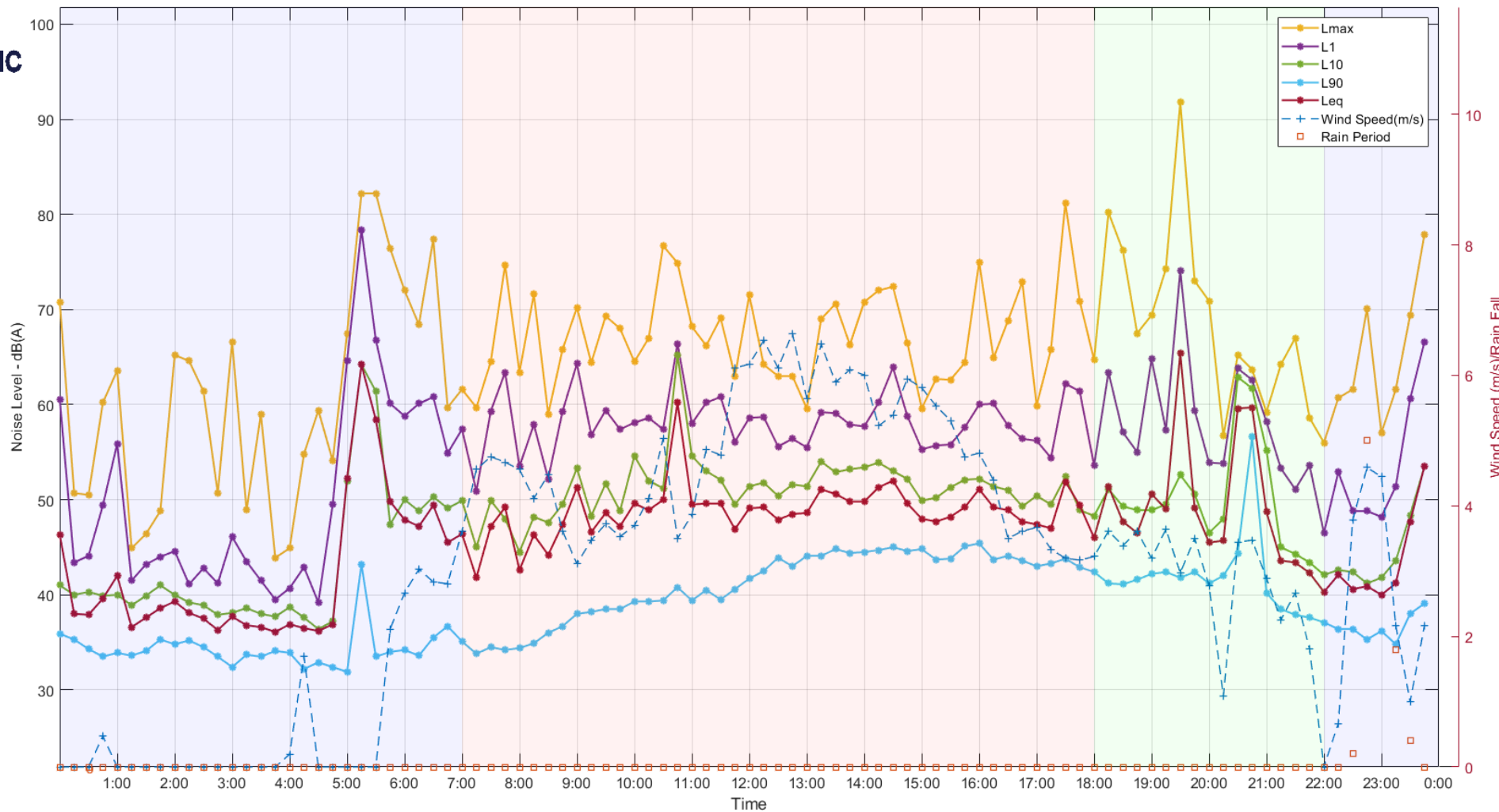


# Shoalhaven Hospital, Location 2 1/01/2022

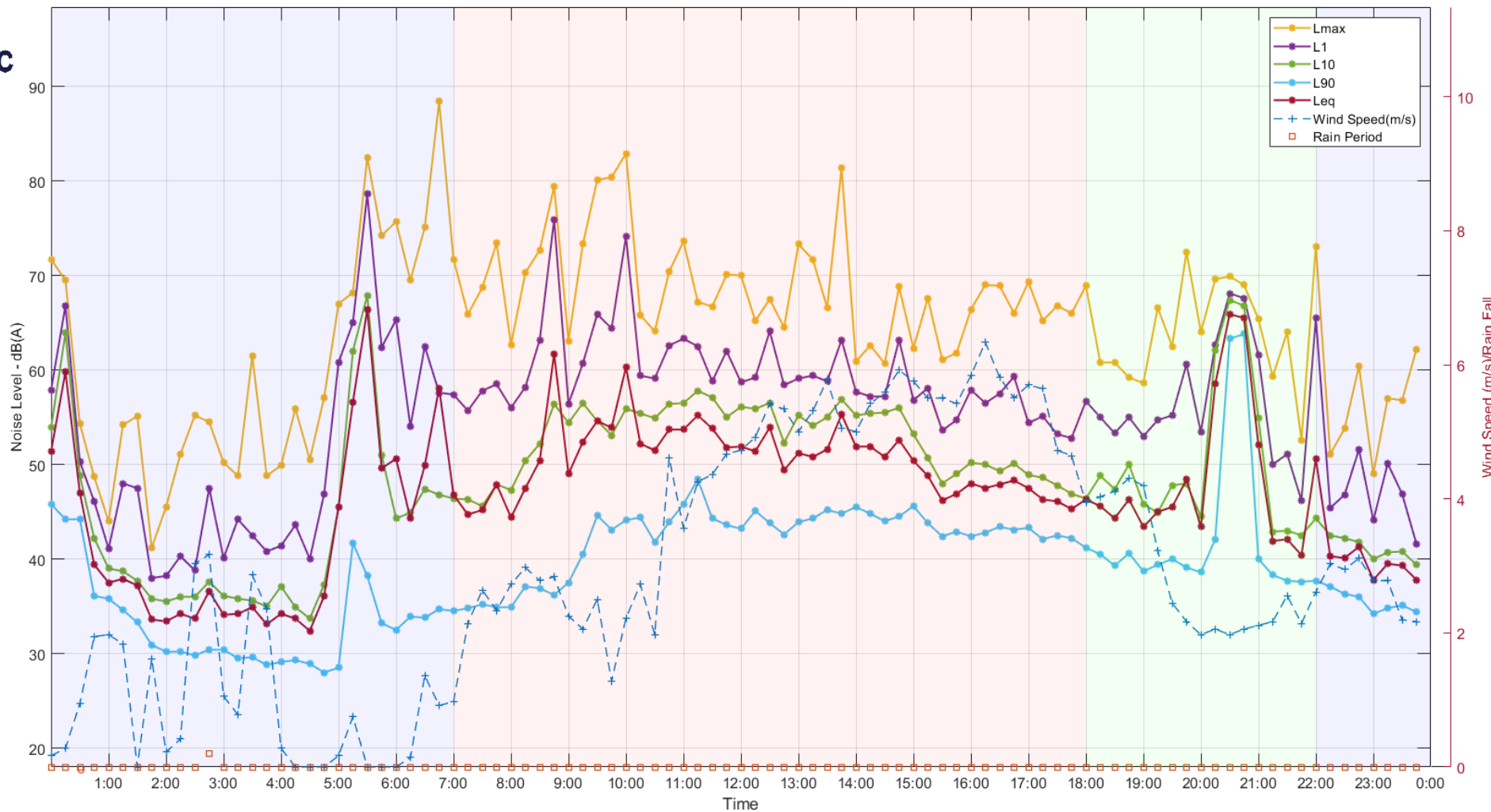




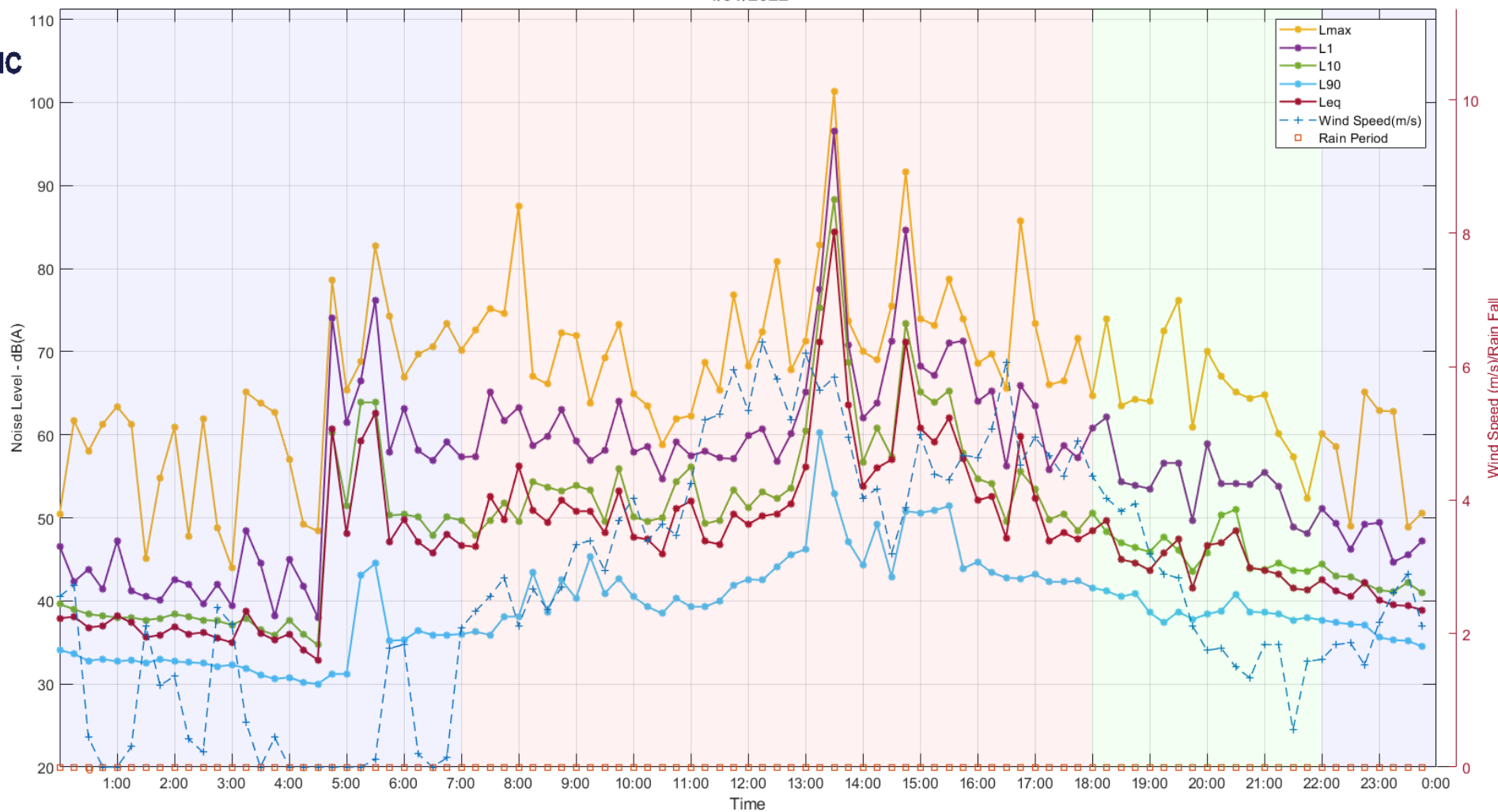
Shoalhaven Hospital, Location 2  
2/01/2022



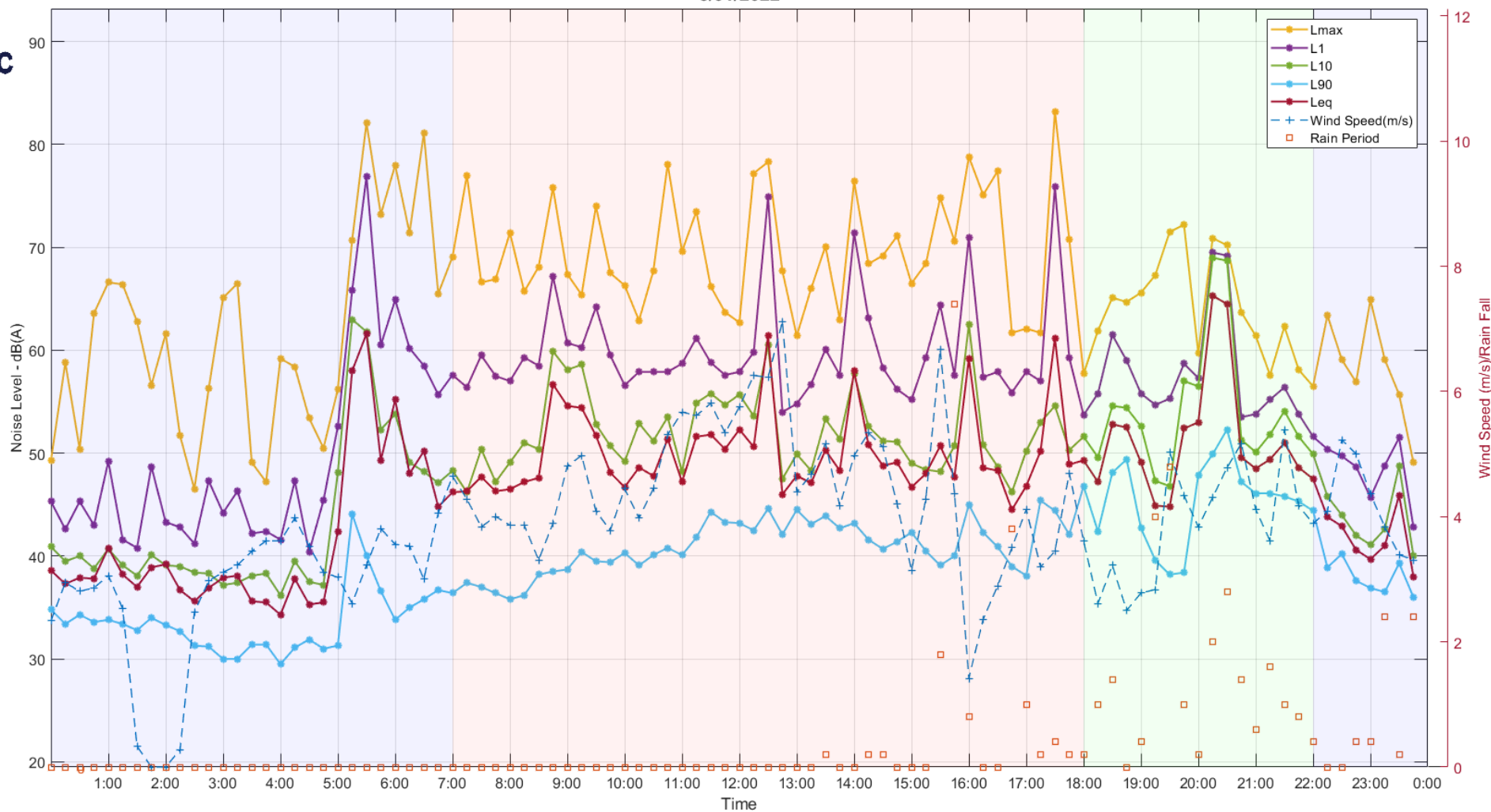
# Shoalhaven Hospital, Location 2 3/01/2022



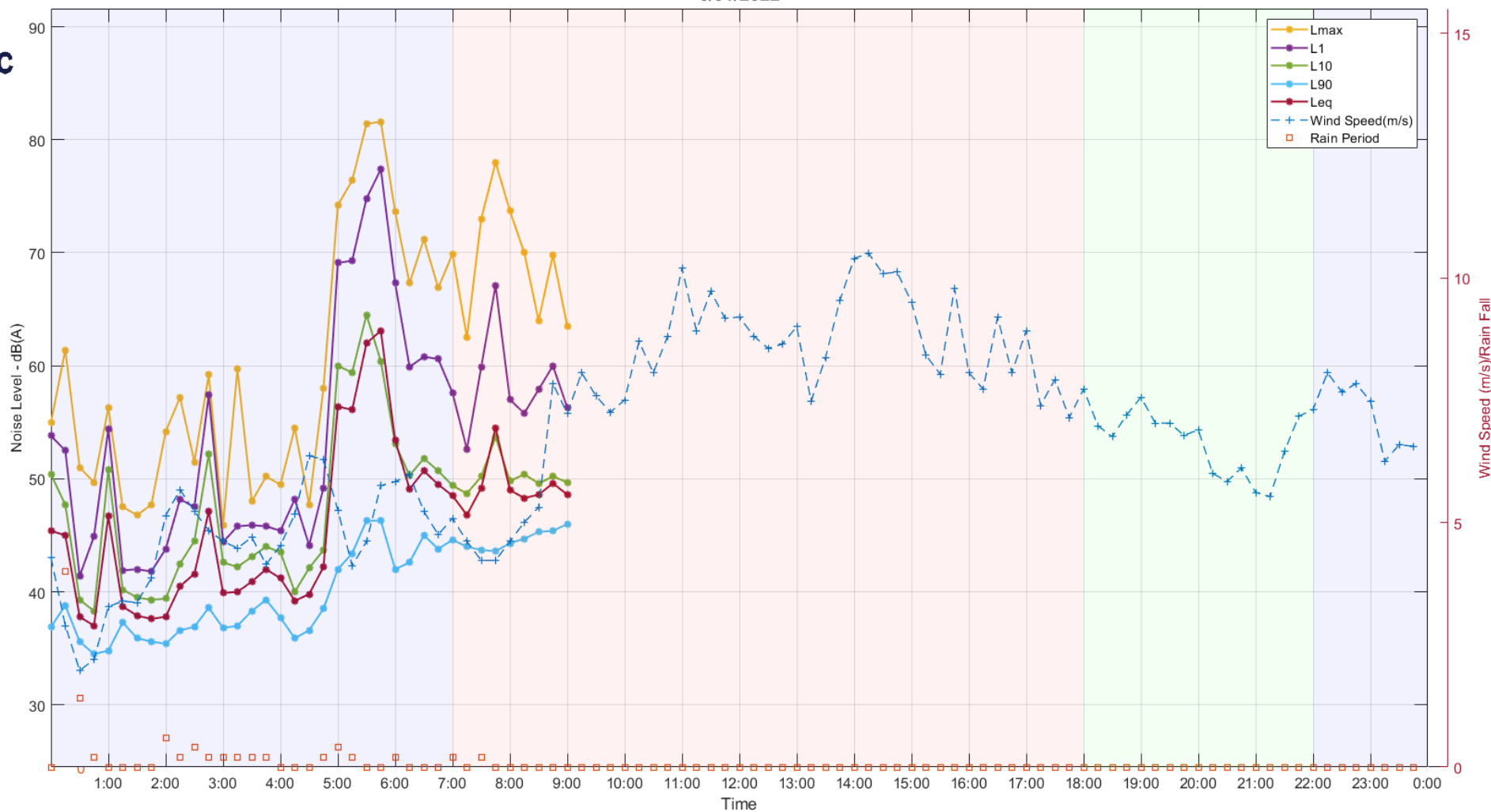
# Shoalhaven Hospital, Location 2 4/01/2022



# Shoalhaven Hospital, Location 2 5/01/2022



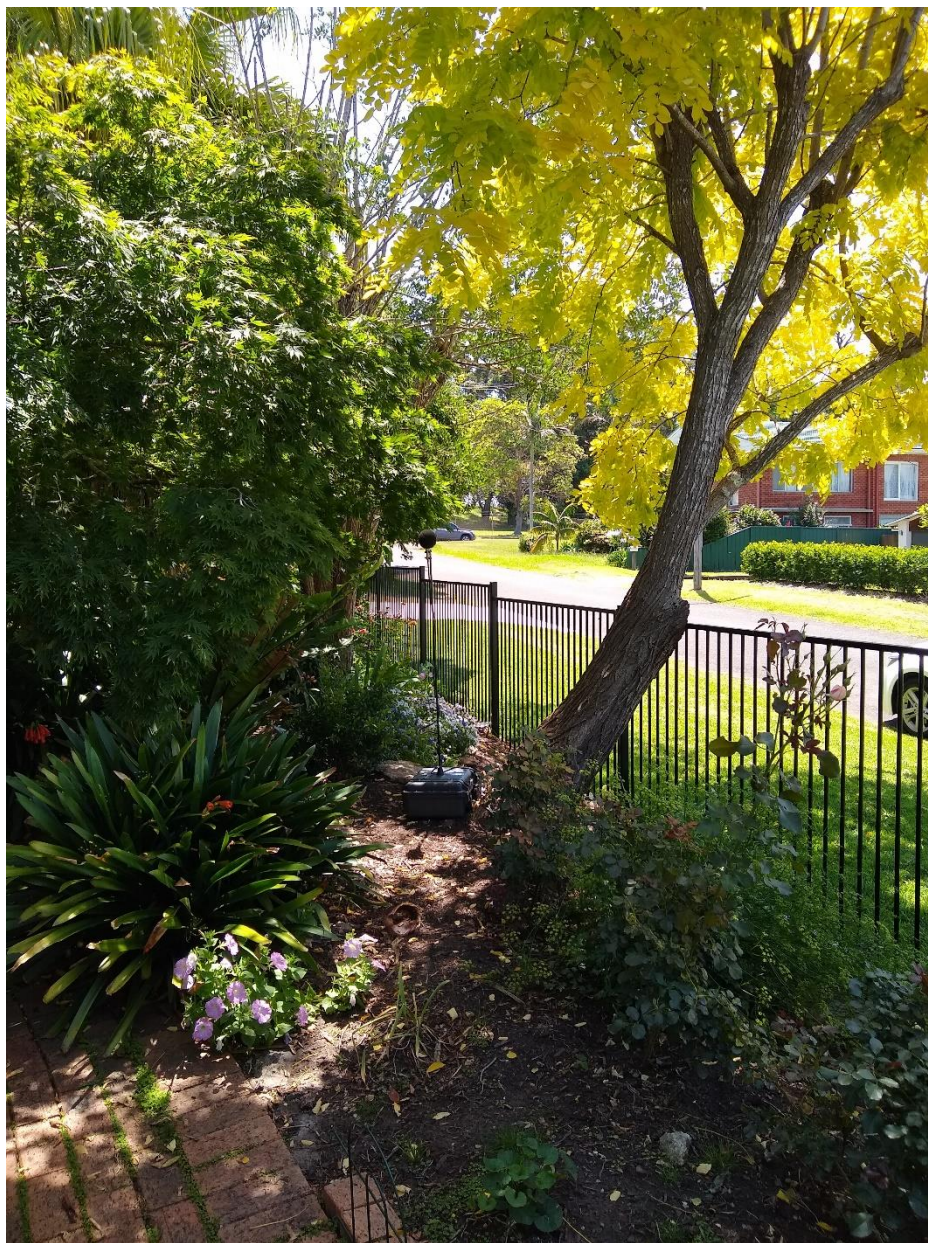
**Shoalhaven Hospital, Location 2**  
**6/01/2022**



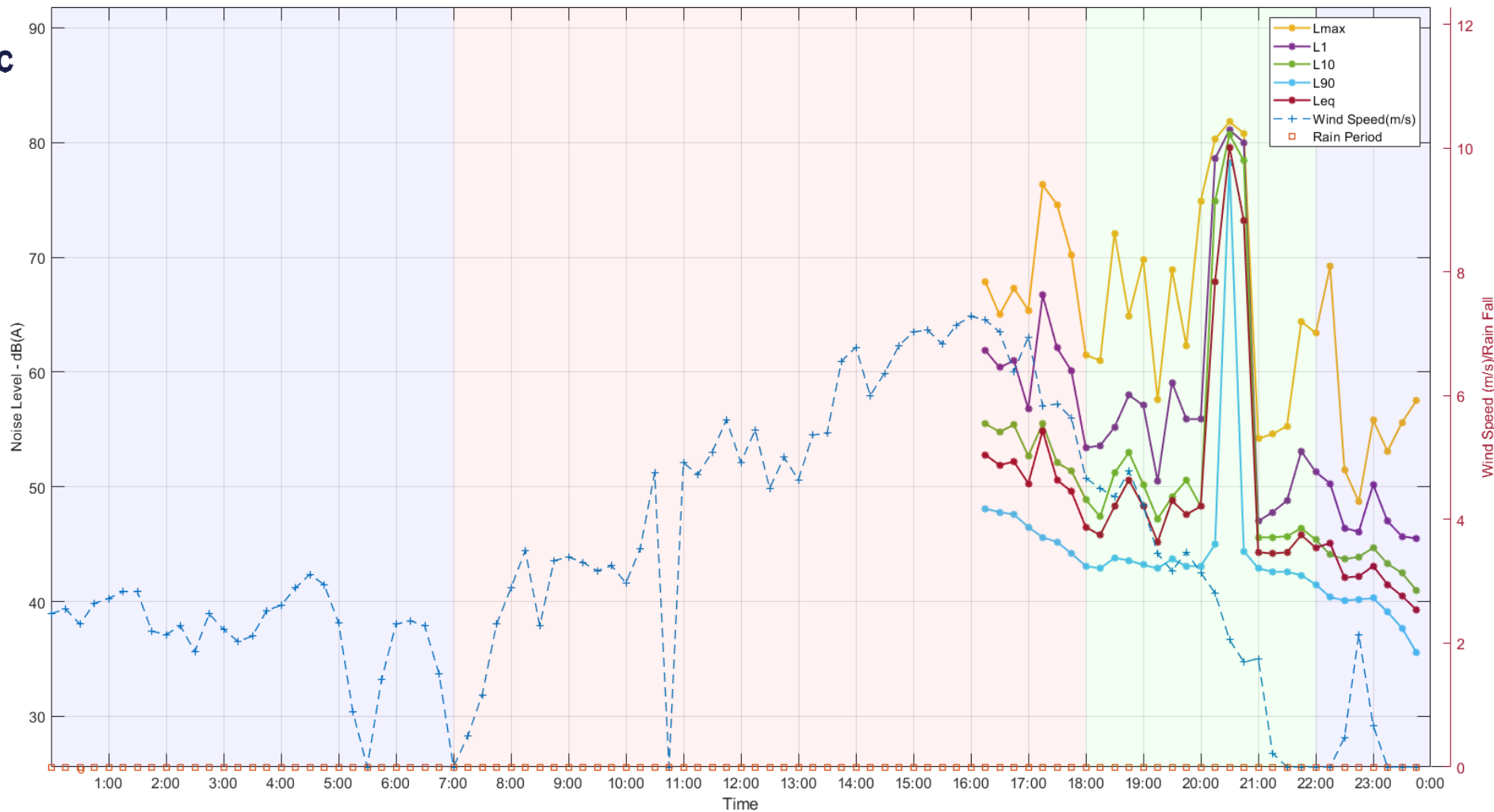


### Location 3 - 2 Westhaven Avenue, Nowra

(Note : Wind speeds are raw speeds uncorrected for boundary layer reductions)

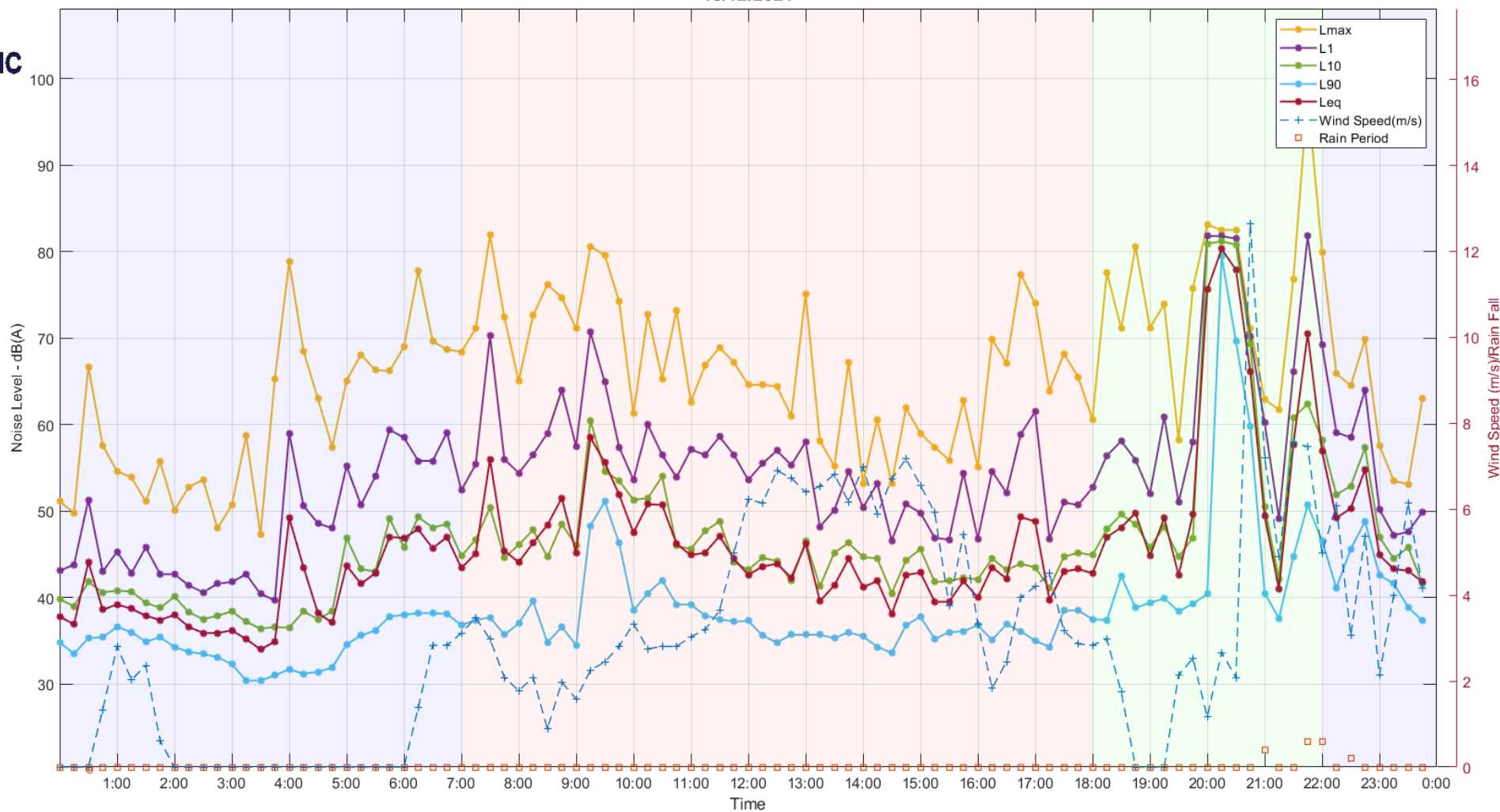


# Shoalhaven Hospital, Location 3 17/12/2021

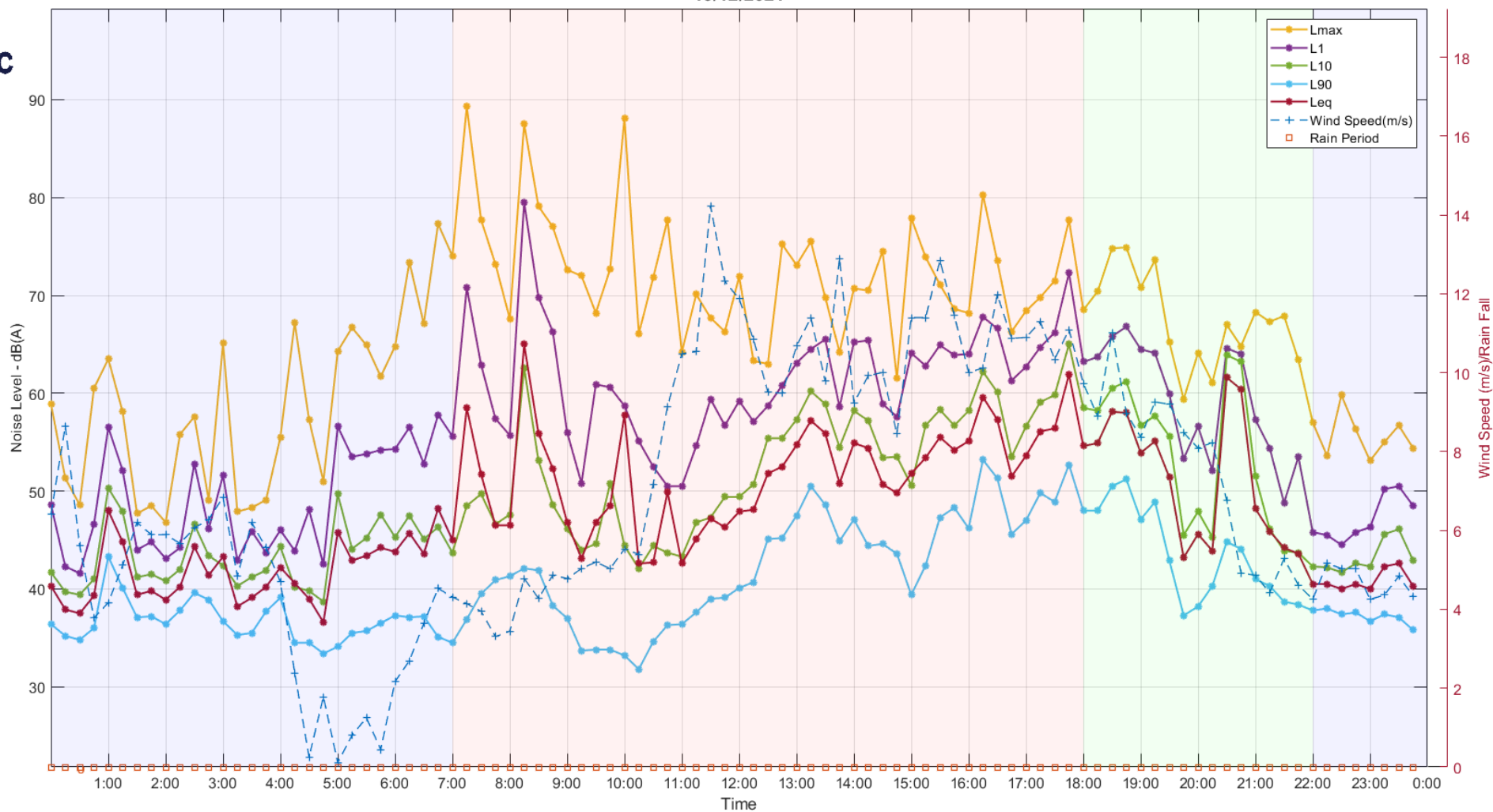




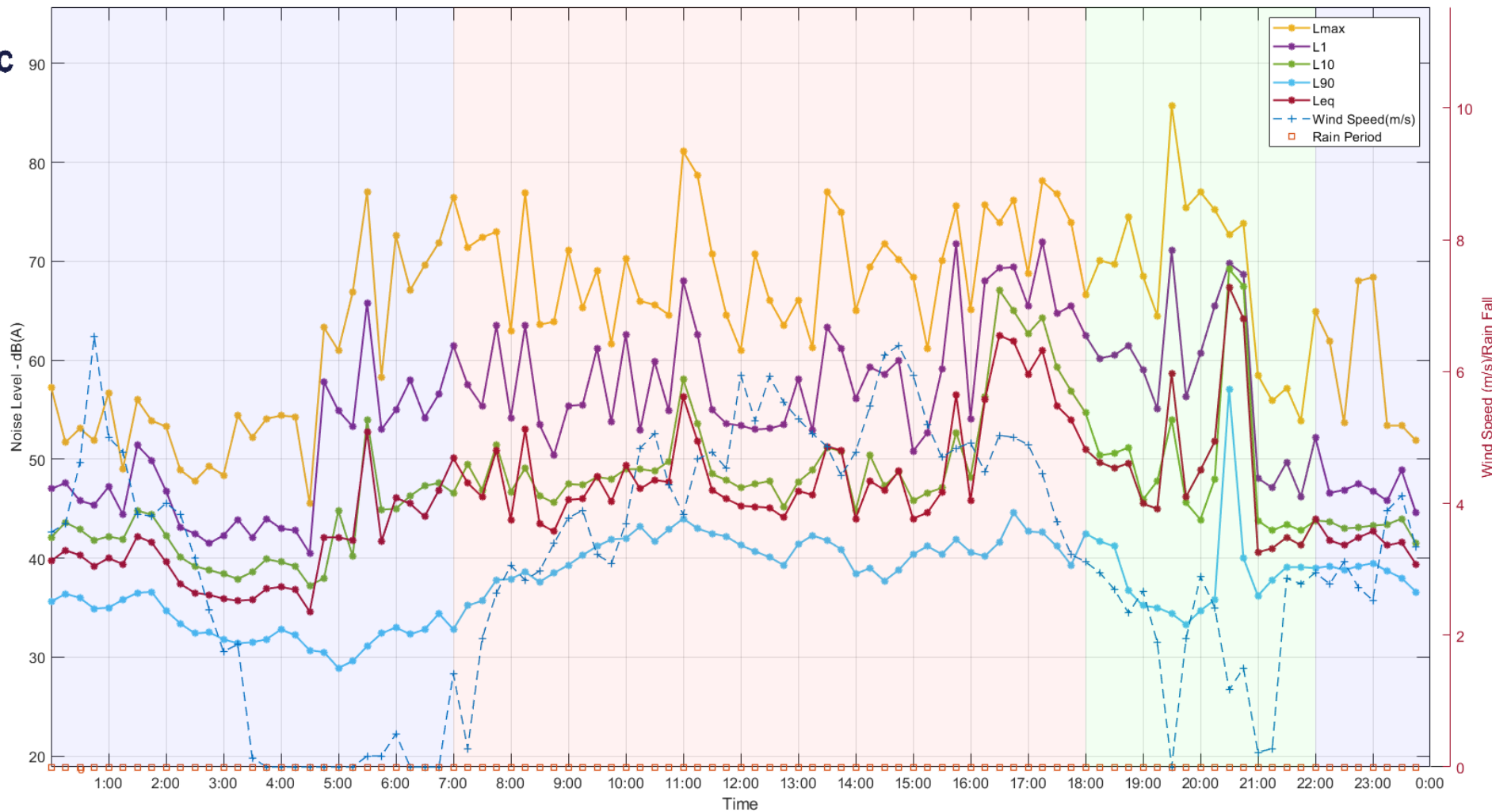
**Shoalhaven Hospital, Location 3**  
**18/12/2021**



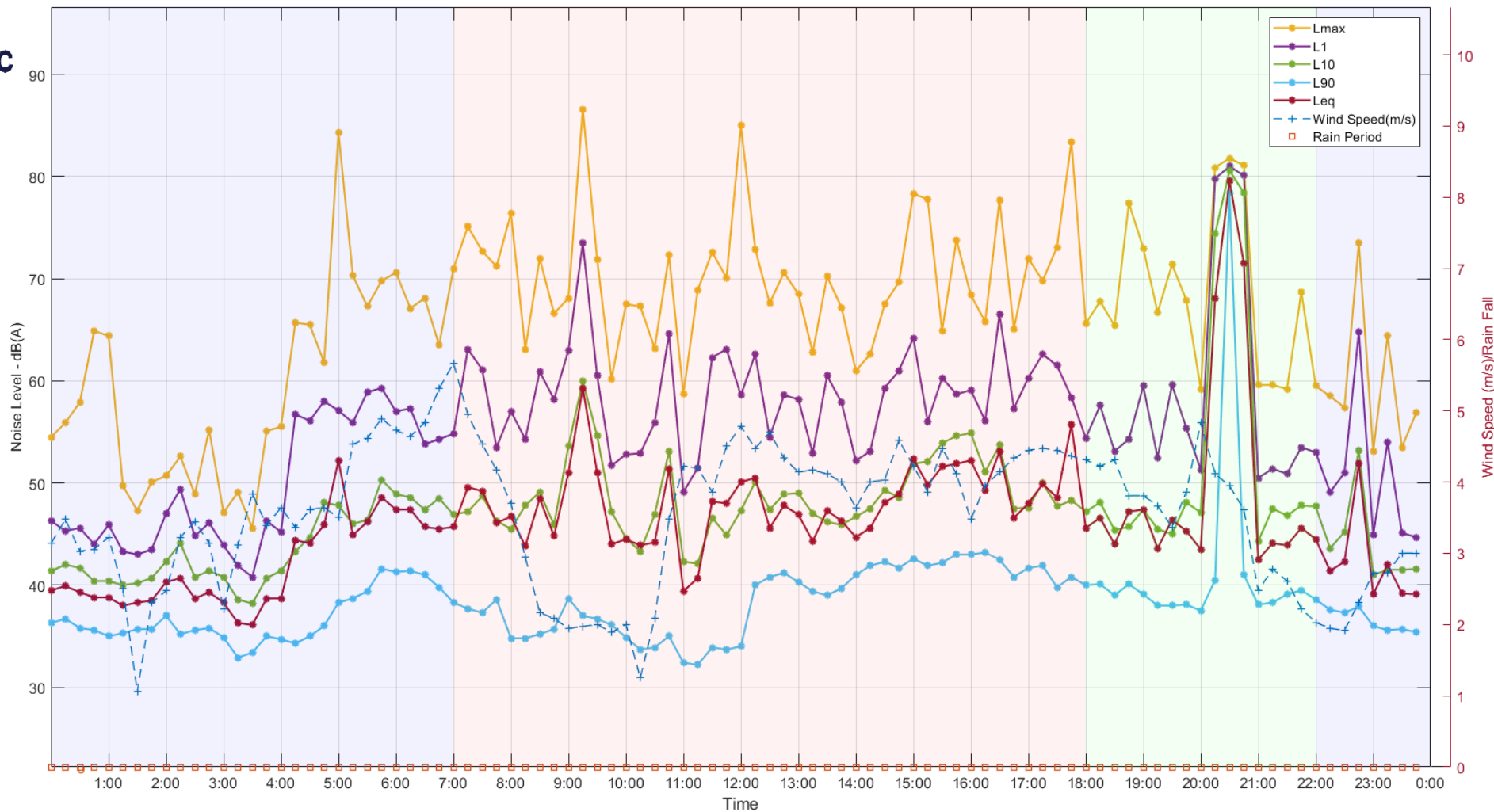
# Shoalhaven Hospital, Location 3 19/12/2021



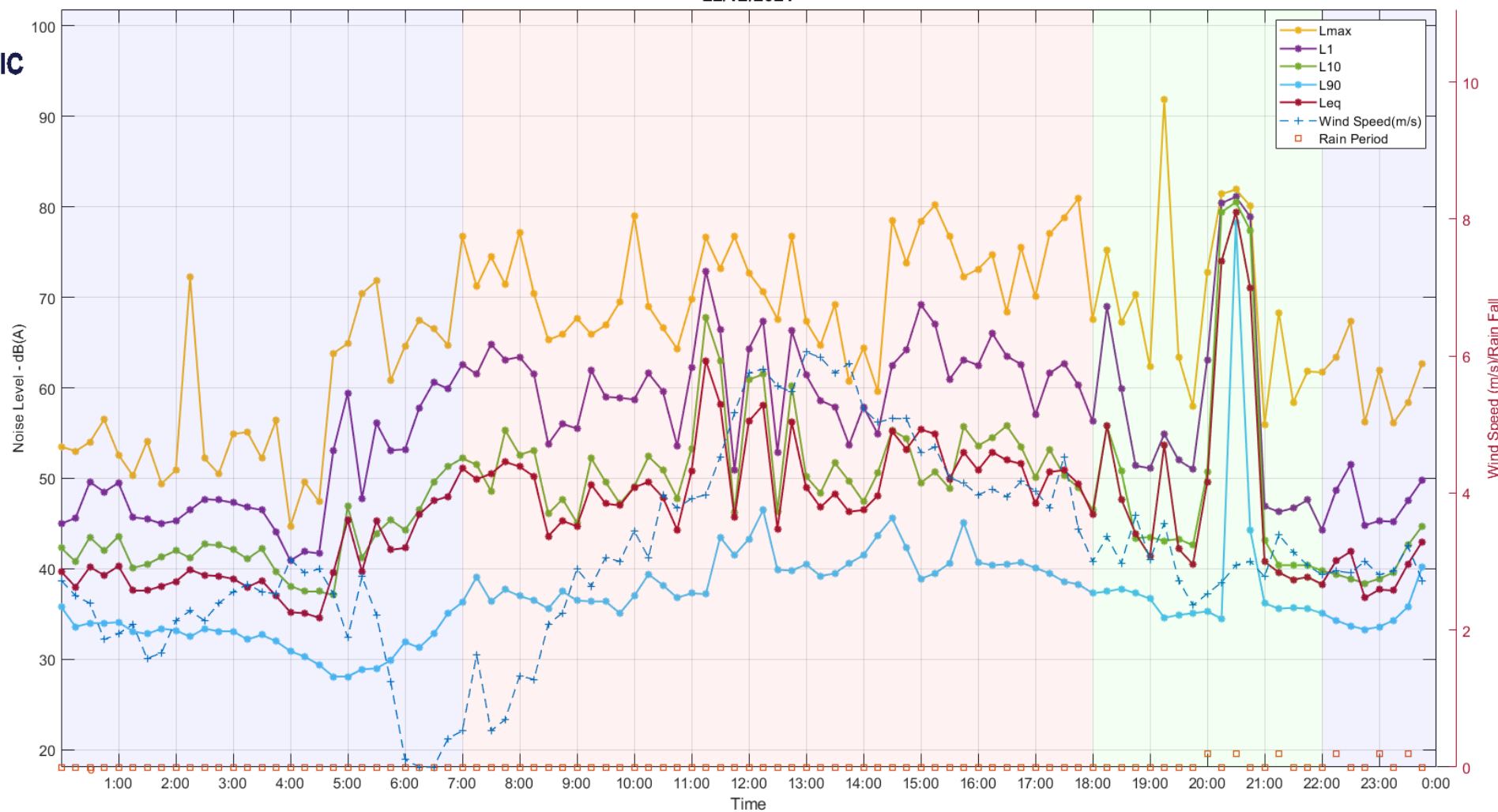
### Shoalhaven Hospital, Location 3 20/12/2021



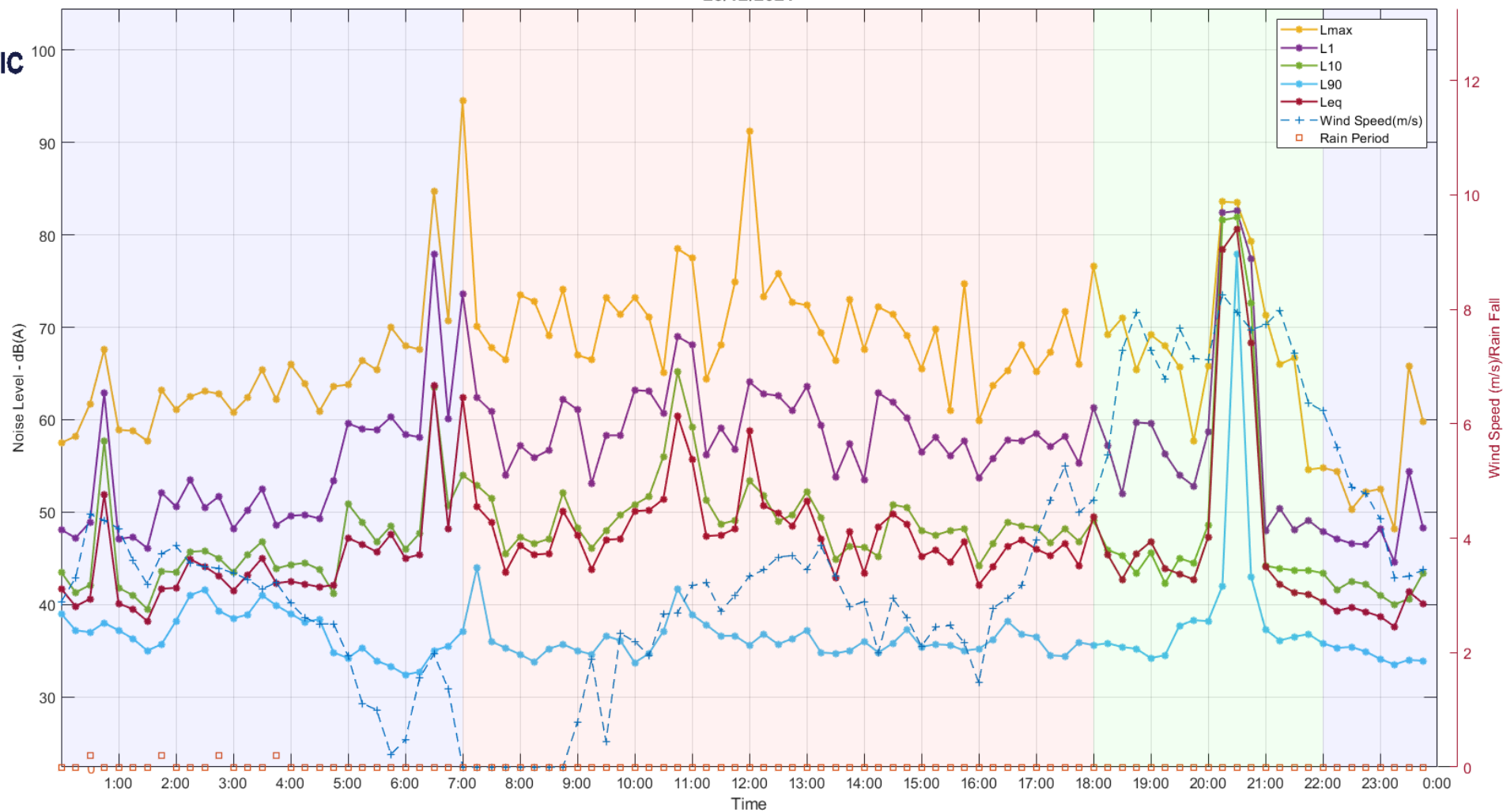
### Shoalhaven Hospital, Location 3 21/12/2021



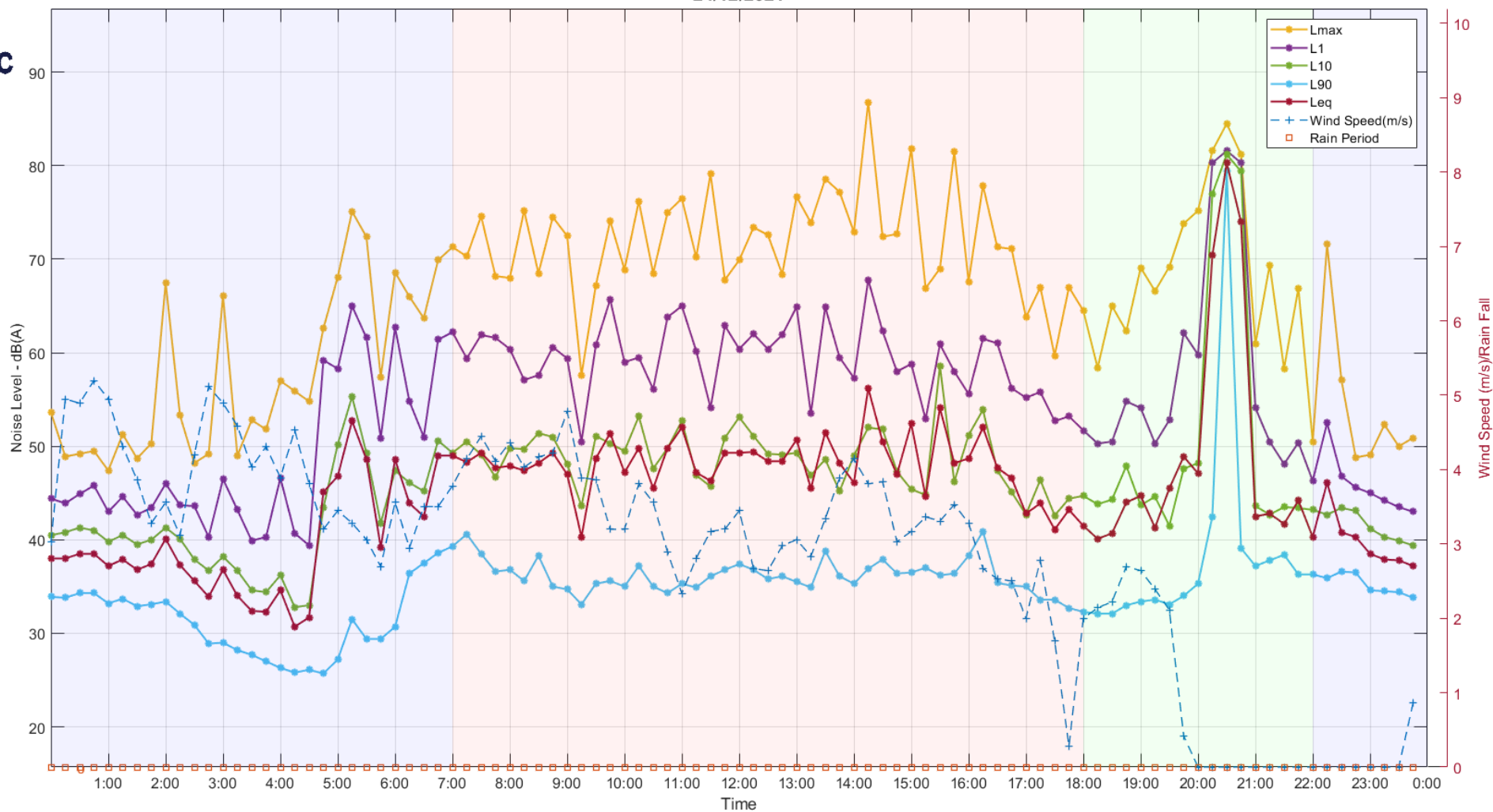
Shoalhaven Hospital, Location 3  
22/12/2021



Shoalhaven Hospital, Location 3  
23/12/2021

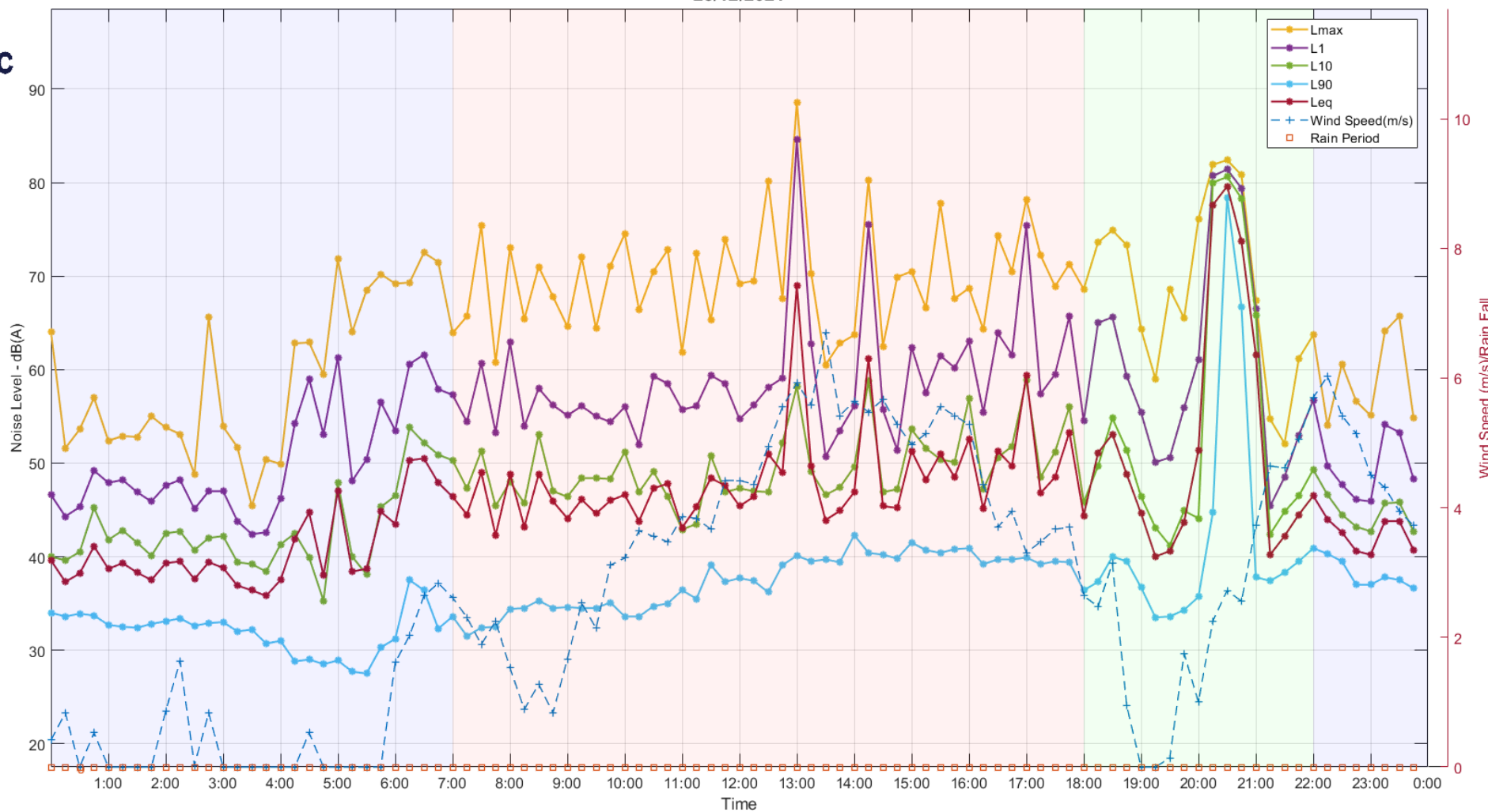


Shoalhaven Hospital, Location 3  
24/12/2021

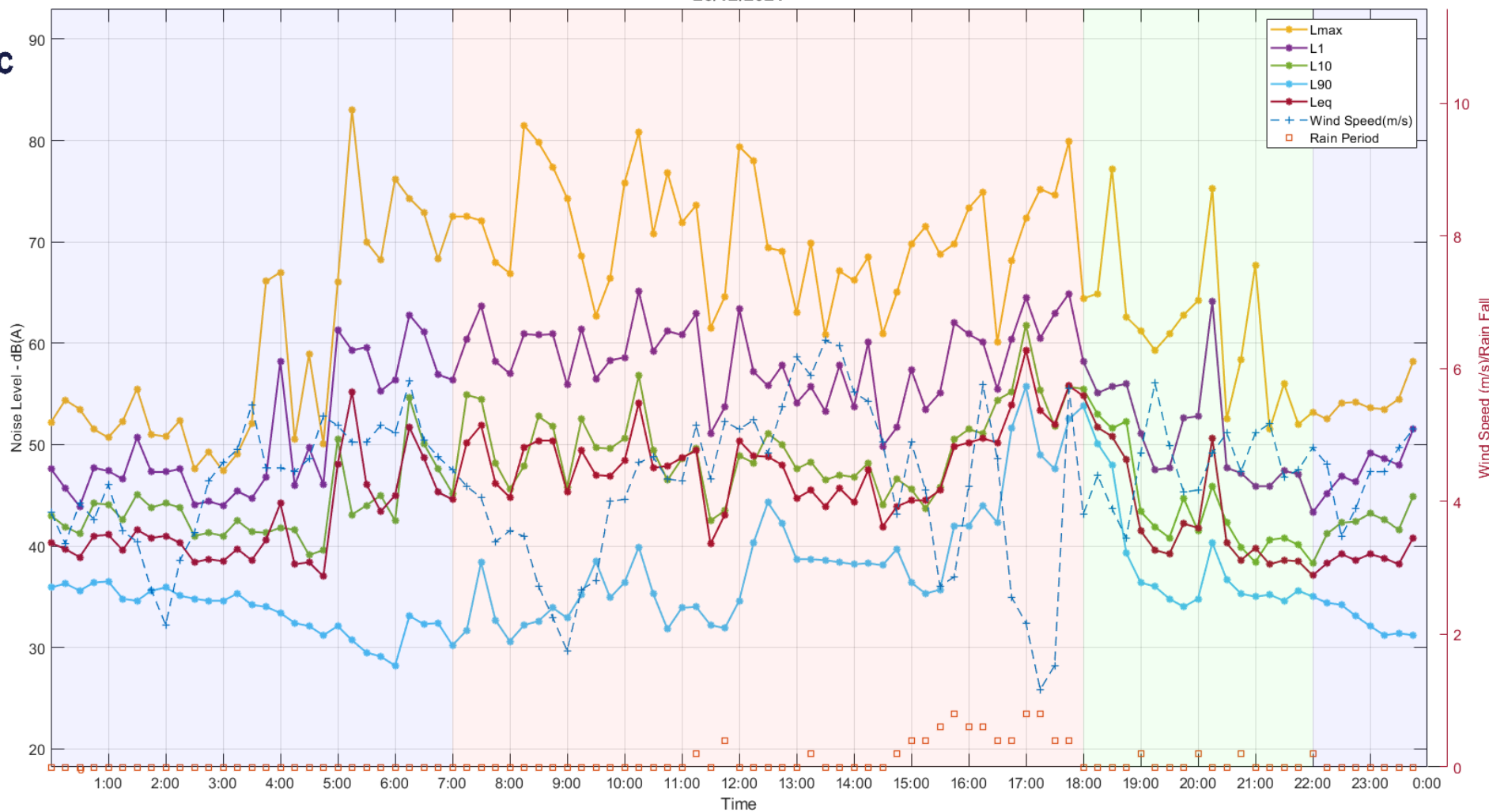




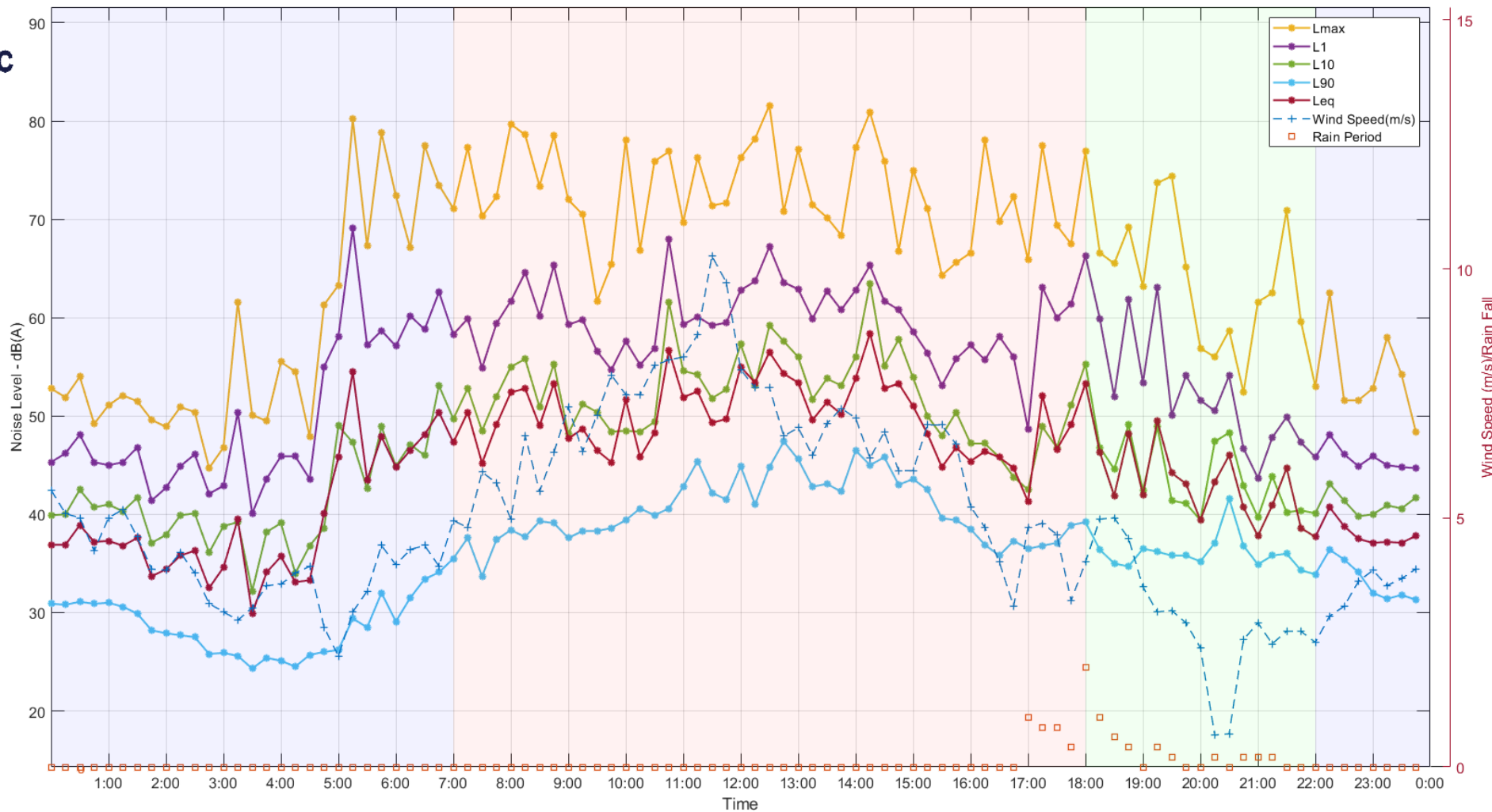
Shoalhaven Hospital, Location 3  
25/12/2021



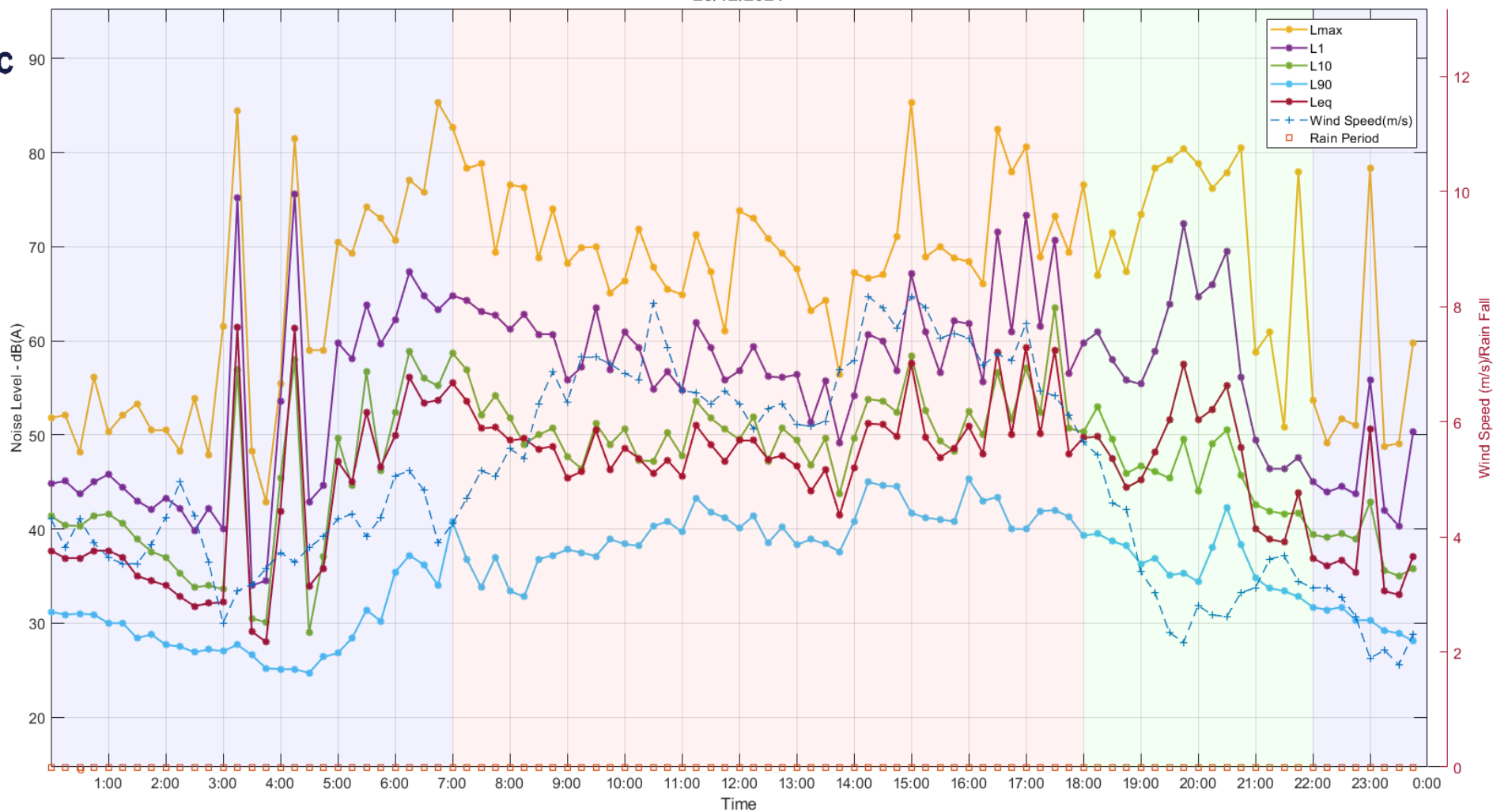
# Shoalhaven Hospital, Location 3 26/12/2021



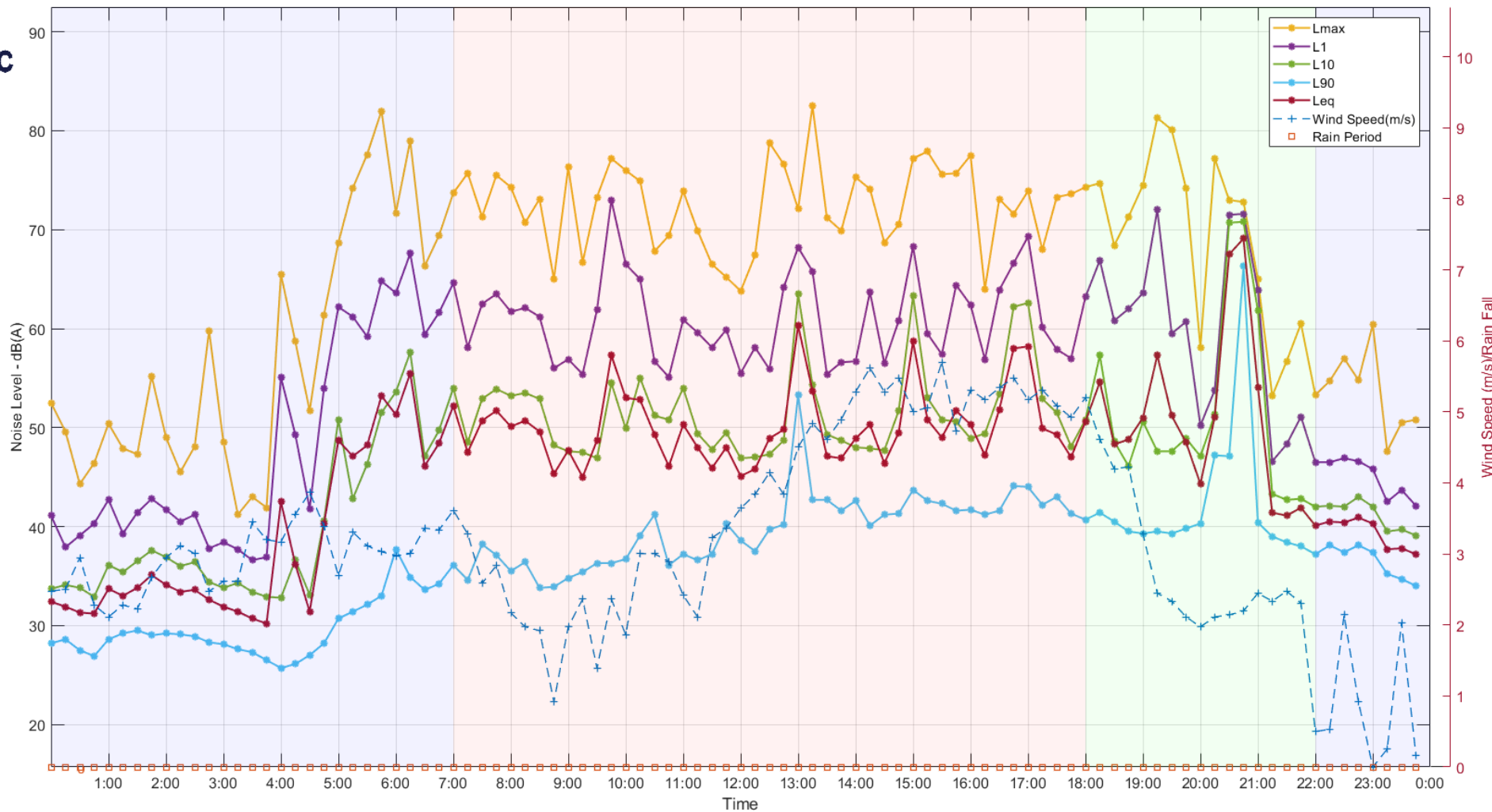
Shoalhaven Hospital, Location 3  
27/12/2021



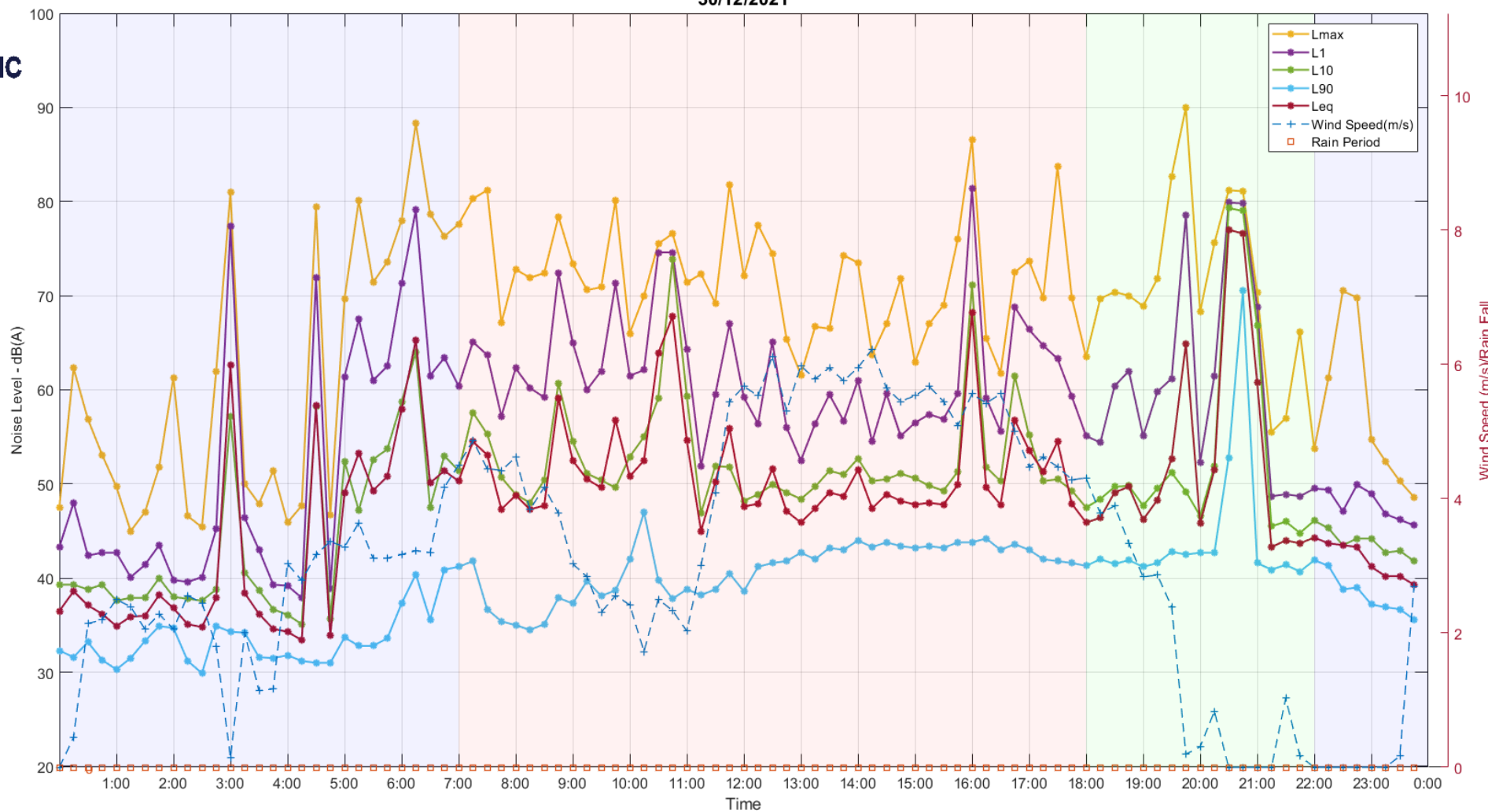
Shoalhaven Hospital, Location 3  
28/12/2021



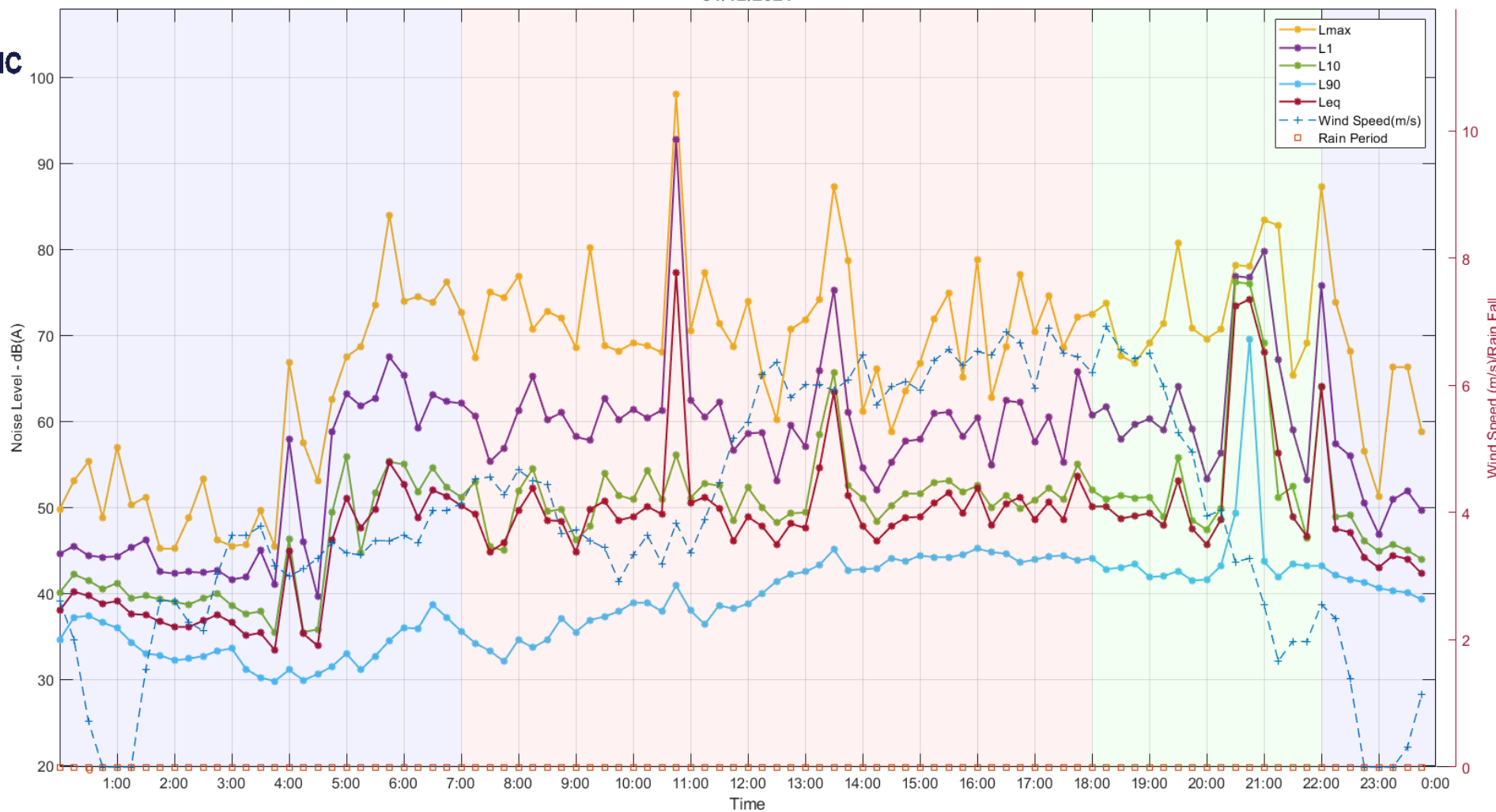
**Shoalhaven Hospital, Location 3**  
**29/12/2021**



Shoalhaven Hospital, Location 3  
30/12/2021

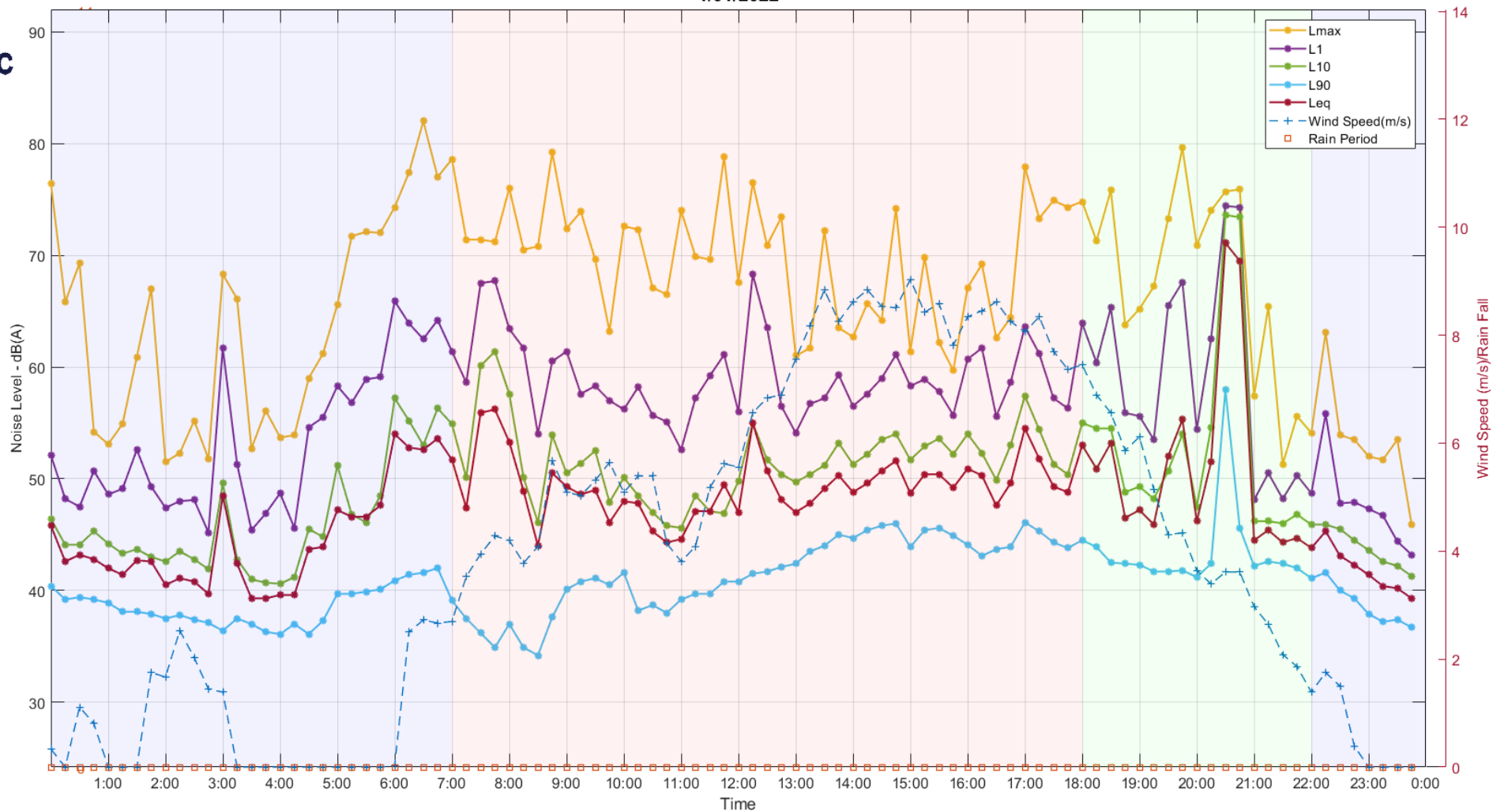


**Shoalhaven Hospital, Location 3  
31/12/2021**

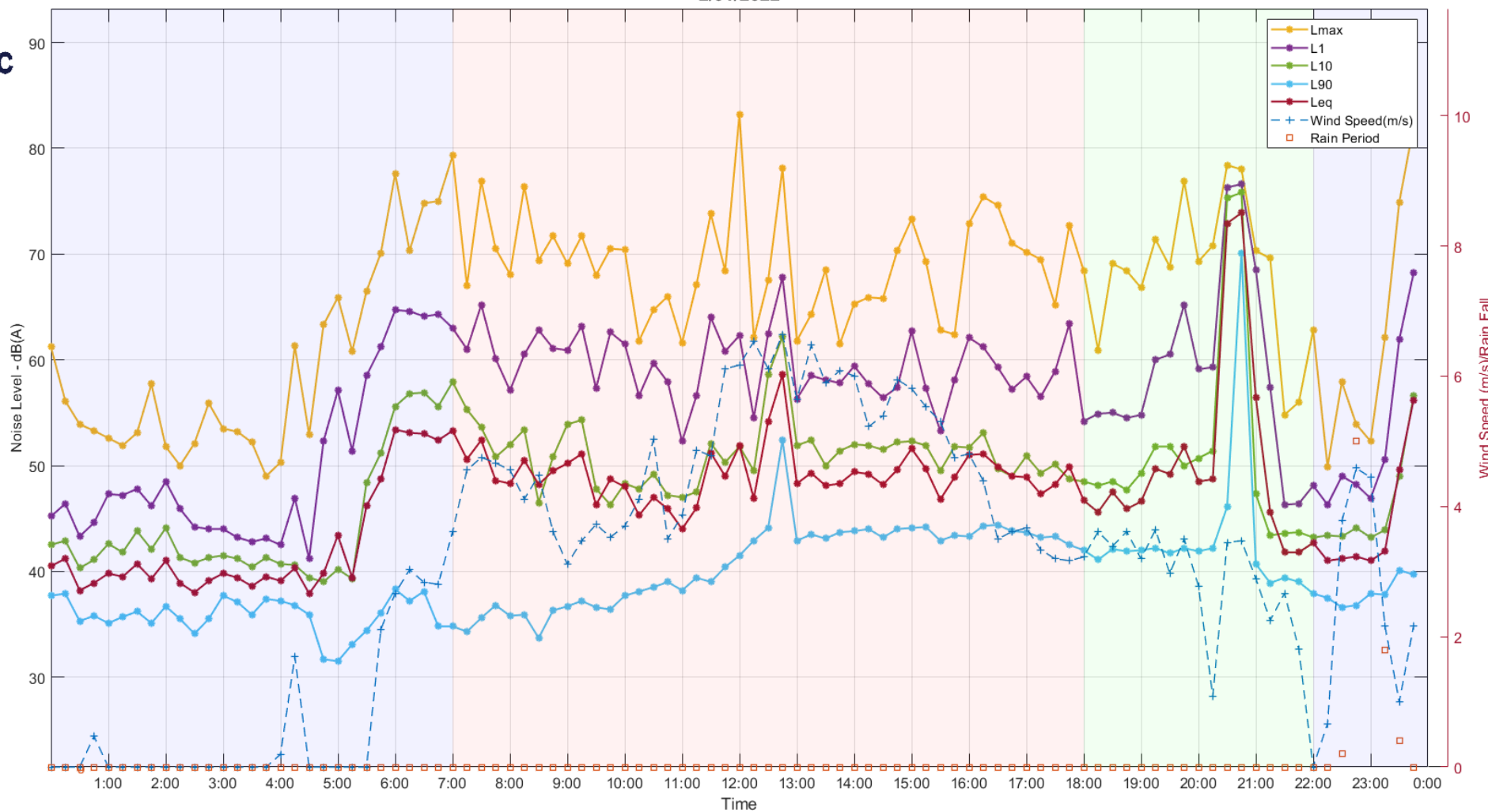




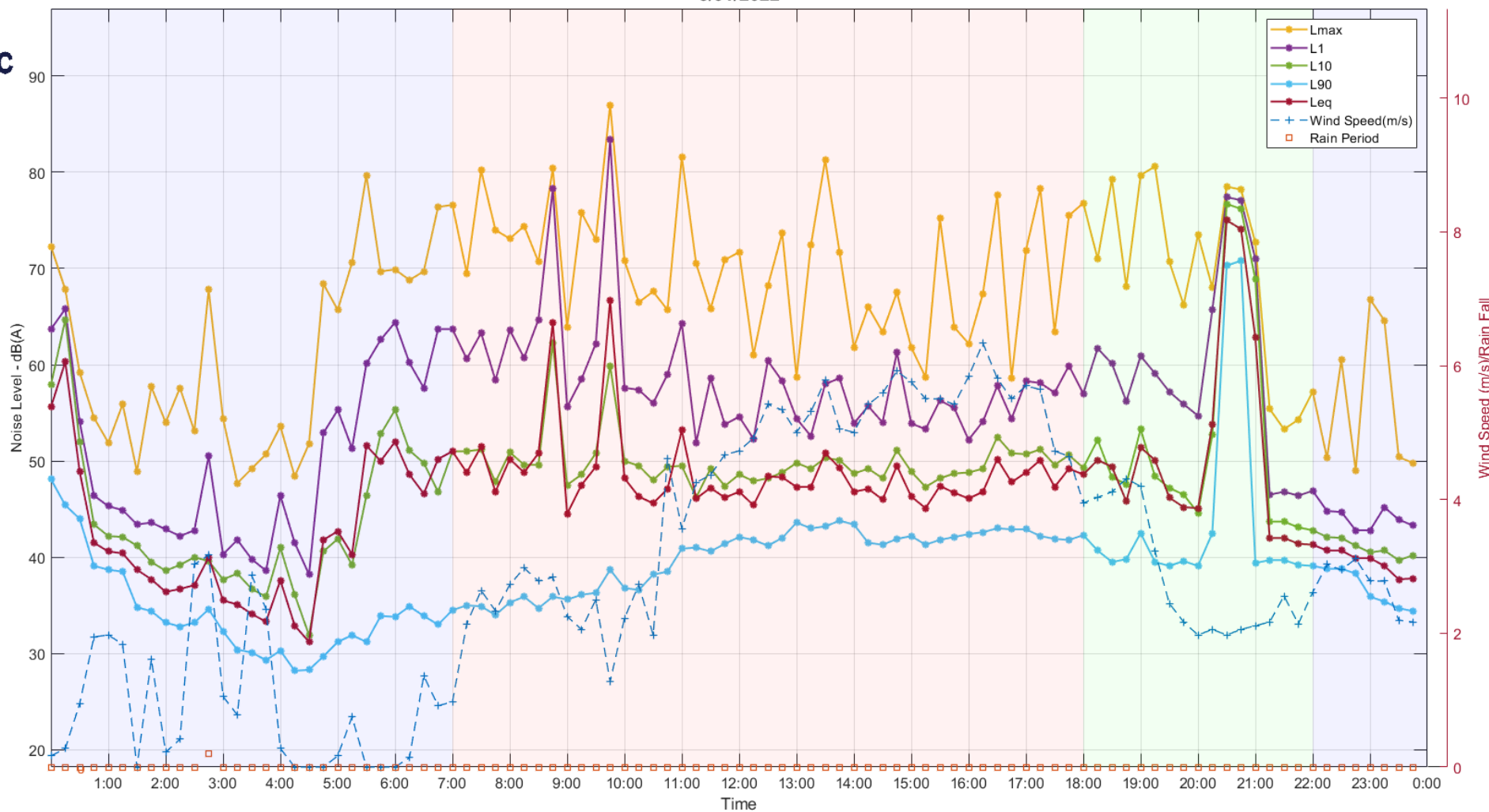
Shoalhaven Hospital, Location 3  
1/01/2022



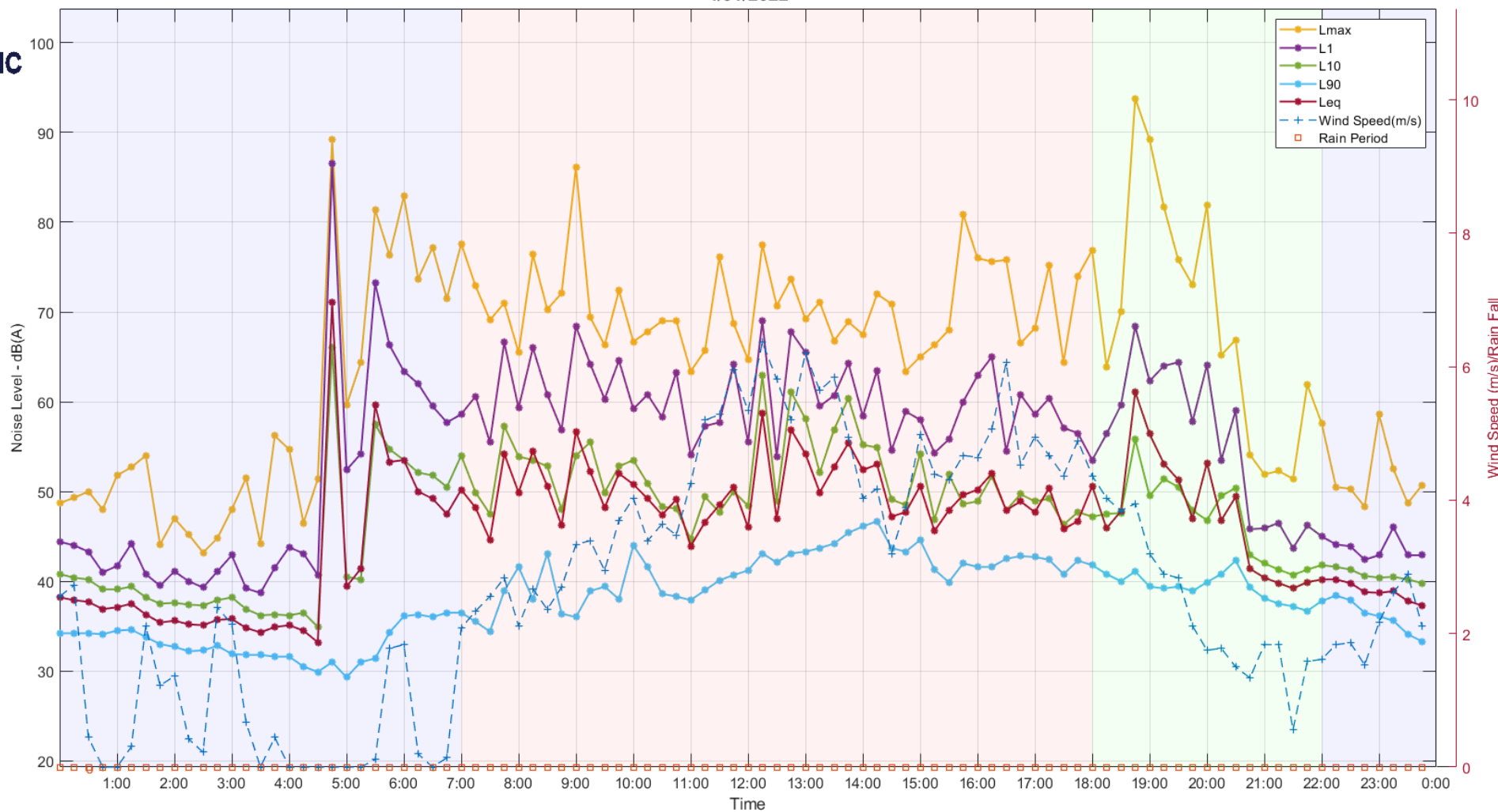
Shoalhaven Hospital, Location 3  
2/01/2022



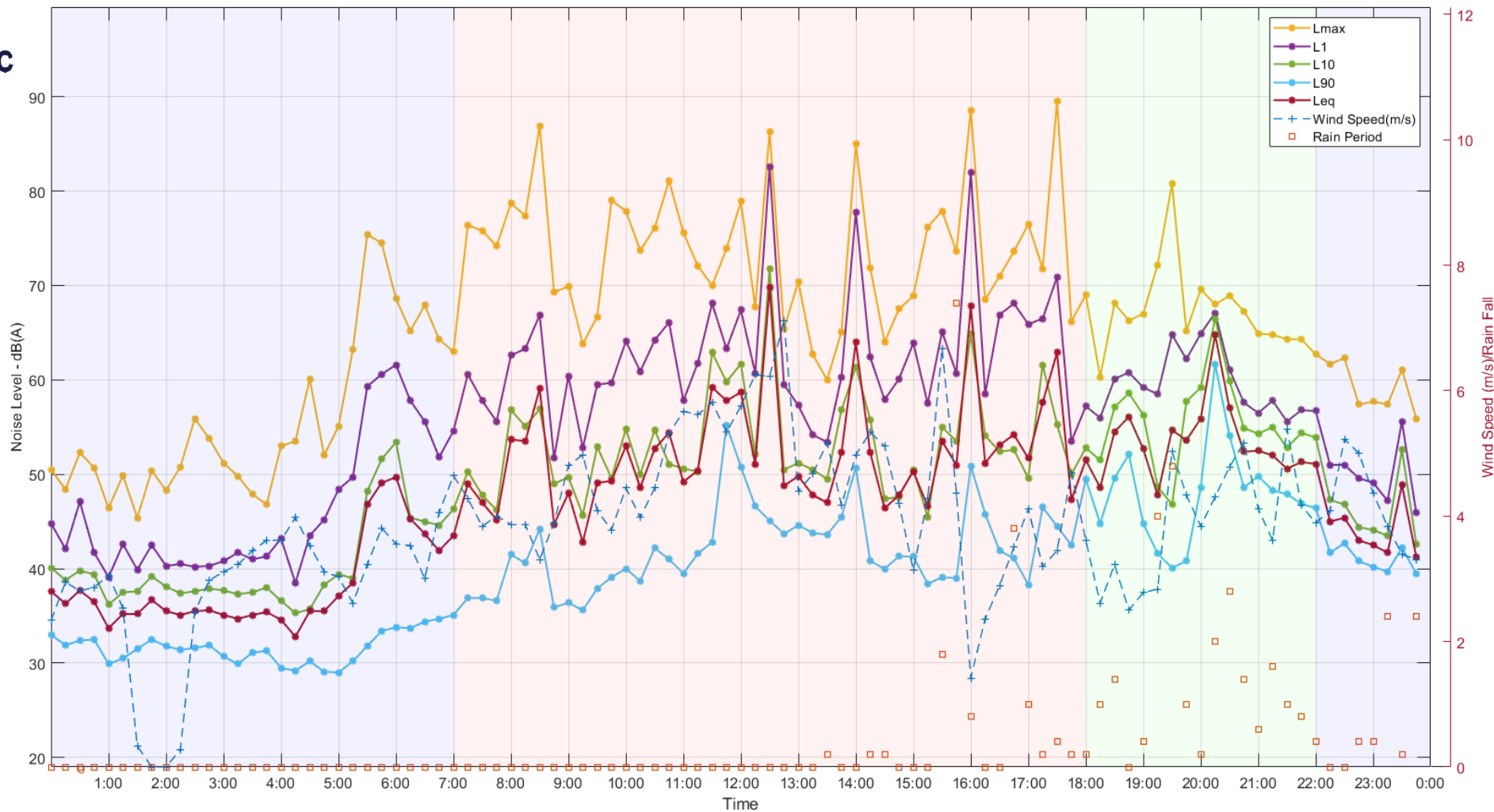
Shoalhaven Hospital, Location 3  
3/01/2022



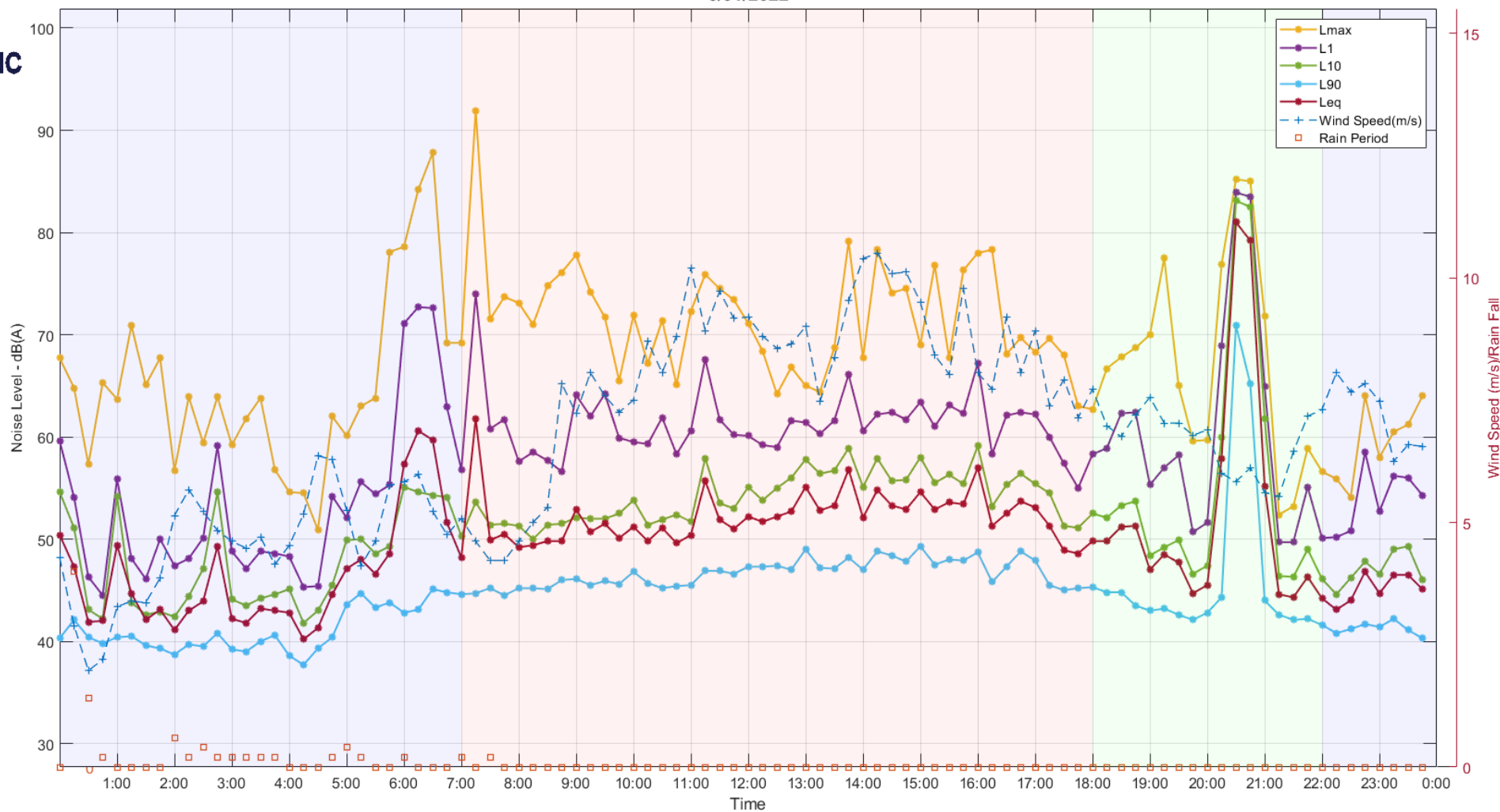
Shoalhaven Hospital, Location 3  
4/01/2022



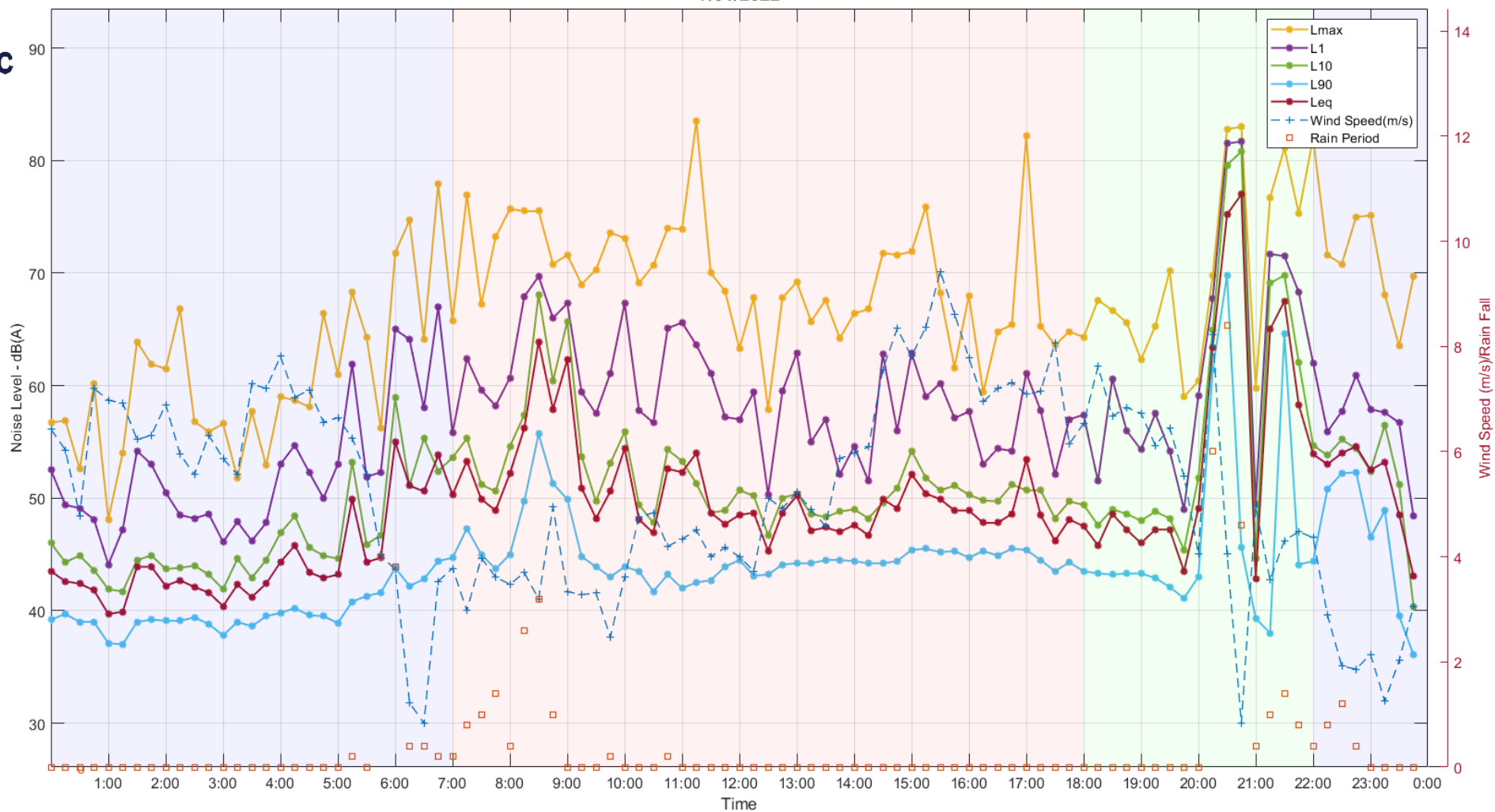
Shoalhaven Hospital, Location 3  
5/01/2022



Shoalhaven Hospital, Location 3  
6/01/2022

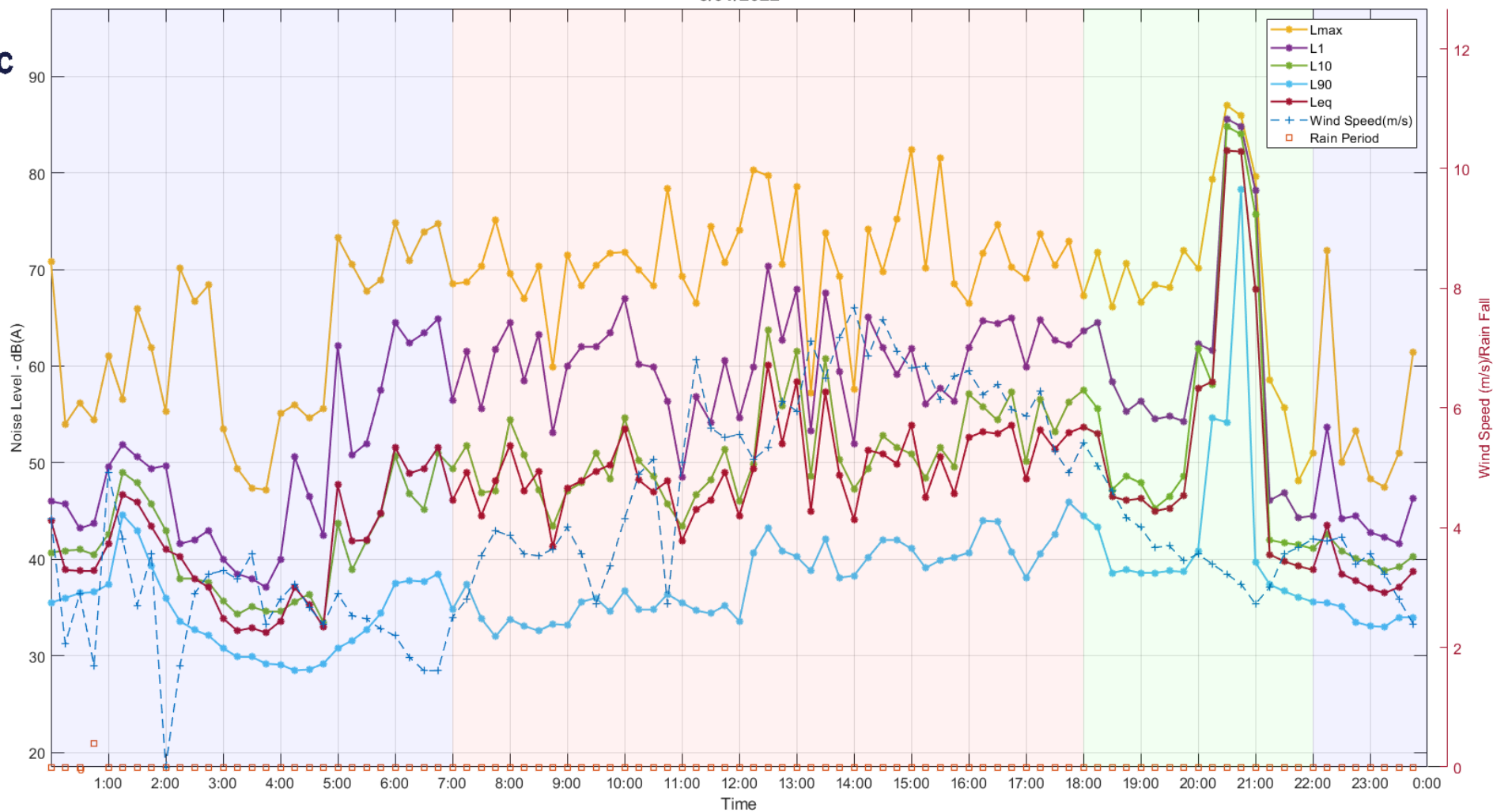


Shoalhaven Hospital, Location 3  
7/01/2022

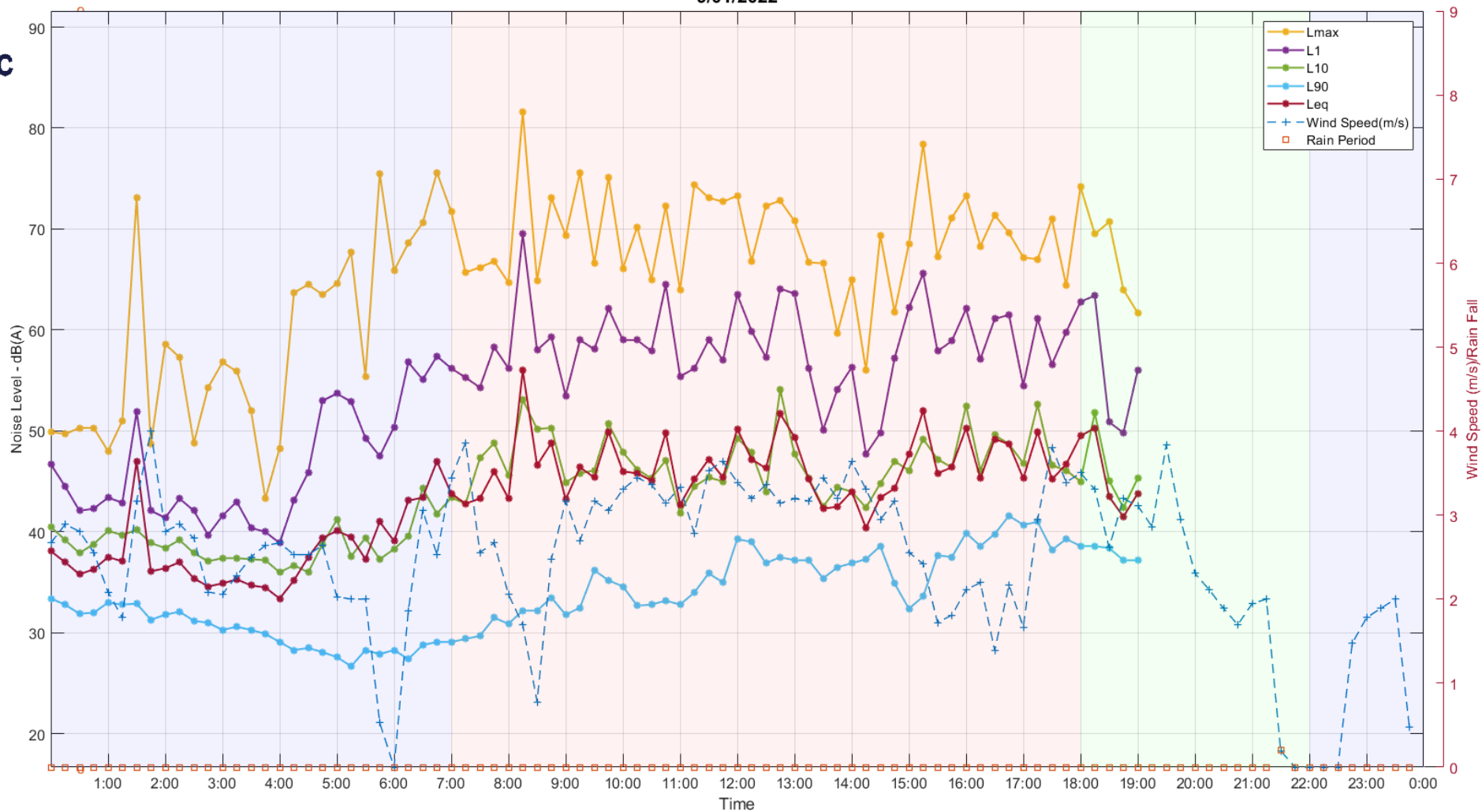




Shoalhaven Hospital, Location 3  
8/01/2022



Shoalhaven Hospital, Location 3  
9/01/2022



## **APPENDIX B – ARCHITECTURAL DRAWINGS ASSESSED**



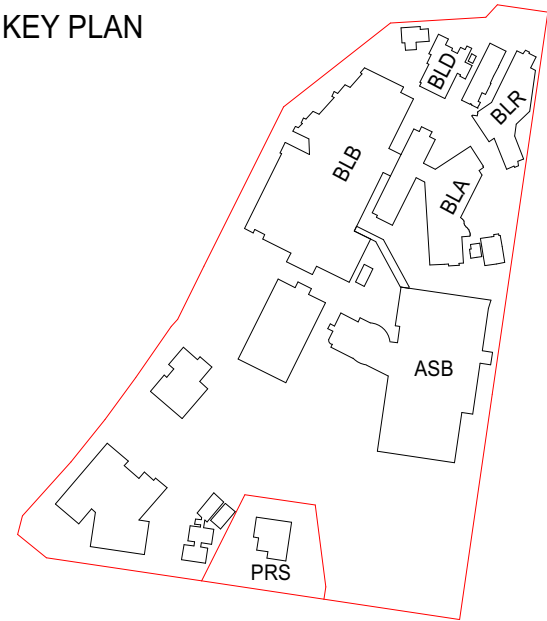
Legend

- NEW BUILD
- EXISTING BUILDINGS
- BUILDING LINKS
- LANDSCAPING
- EXISTING ROADS
- NEW ROADS
- PAVED AREAS

Revision

REV	DESCRIPTION	DATE	INT.
0	ISSUED FOR INFORMATION	11.11.21	JZ
1	ISSUED FOR INFORMATION	17.11.21	JZ
2	ISSUED FOR INFORMATION	07.12.21	JZ
3	ISSUED FOR INFORMATION	20.12.21	JZ
4	ISSUED FOR 80% SD	04.02.22	CL
5	ISSUED FOR INFORMATION	11.02.22	JZ
6	ISSUED FOR INFORMATION	18.02.22	CL
7	ISSUED FOR INFORMATION	25.02.22	CL
8	ISSUED FOR INFORMATION	04.03.22	CL
9	ISSUED FOR INFORMATION	01.04.22	JZ

KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



Managing Contractor

Building

ASB

Drawing

SITE PLAN - PROPOSED

A1 Scale 1 : 1000

Project No. 20278

Issue 9

Drawing No.

ASB-SD-DR-AR-1000

Details

Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

10 0 10 20 30 40 50 60 70

SCALE 1:1000

Scale at A1



TREES REMOVED FROM HOSPITAL: 22  
TREES REMOVED FROM PRESCHOOL: 6  
TOTAL TREES REMOVED: 28

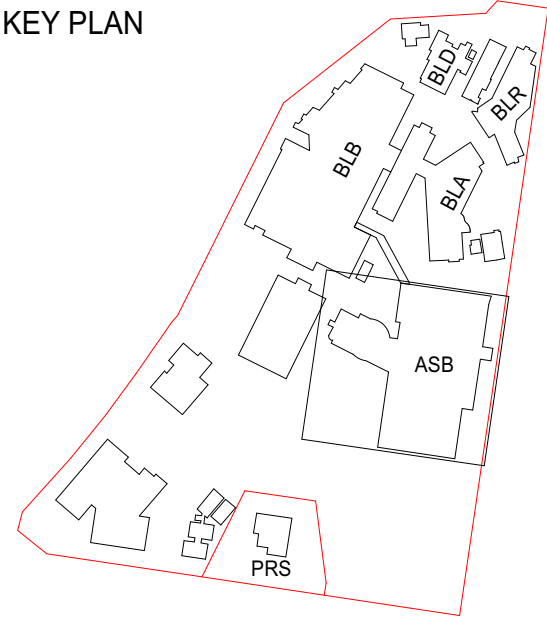




Area Schedule Level 0			
Name	Briefed Area	Designed Area	Comments
Level 00			
BOH	1,034 m²	1,143.24 m²	Excludes 30sqm Bike Racks
FOH	78 m²	89.08 m²	
KITCHEN	475 m²	512.87 m²	
LOADING DOCK	0 m²	575.73 m²	Area allocation TBC
MORTUARY	126 m²	124.76 m²	
MORTUARY COURTYARD	20 m²	19.87 m²	
MORTUARY GARAGE	0 m²	31.28 m²	Enclosed Mortuary Drop-off (not brief)
PHARMACY	575 m²	594.16 m²	
PLANT	453 m²	555.35 m²	
Project Specific FOH Area	0 m²	58.94 m²	
STF AMENITIES	236 m²	164.01 m²	
TERRACE NOT BRIEFED	0 m²	0 m²	Not Briefed
TRAVEL	0 m²	626.28 m²	
	2,997 m²	4,495.56 m²	



REV	DESCRIPTION	DATE	INT.
4	ISSUED FOR INFORMATION	26.11.21	JZ
5	ISSUED FOR INFORMATION	03.12.21	JZ
6	ISSUED FOR INFORMATION	12.12.21	JZ
7	ISSUED FOR INFORMATION	20.12.21	JZ
8	ISSUED FOR INFORMATION	21.01.22	JZ
9	ISSUED FOR 80% SD	04.02.22	JZ
10	ISSUED FOR INFORMATION	25.02.22	JZ
11	ISSUED FOR INFORMATION	04.03.22	JZ
12	ISSUED FOR INFORMATION	18.03.22	JZ
13	ISSUED FOR 100% SD	14.04.22	JZ



SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541



Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

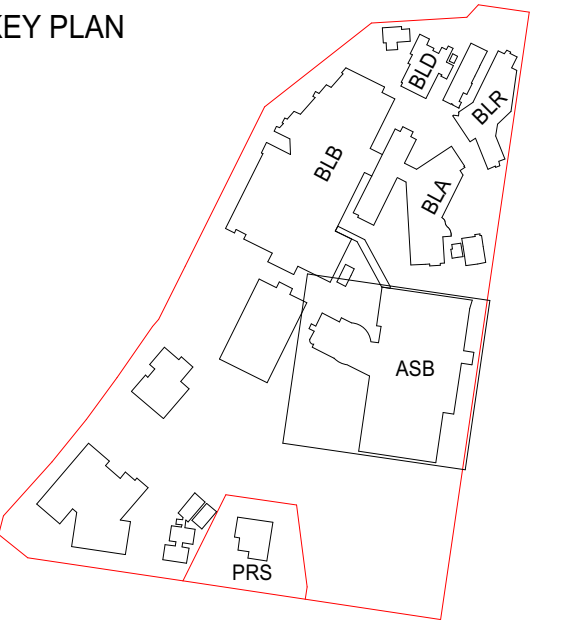
2 0 2 4 6 8 10 12 14  
SCALE 1:200  
Scale at A1





REV	DESCRIPTION	DATE	INT.
4	ISSUED FOR INFORMATION	26.11.21	JZ
5	ISSUED FOR INFORMATION	03.12.21	JZ
6	ISSUED FOR INFORMATION	12.12.21	JZ
7	ISSUED FOR INFORMATION	20.12.21	JZ
8	ISSUED FOR INFORMATION	21.01.22	JZ
9	ISSUED FOR 80% SD	04.02.22	JZ
10	ISSUED FOR INFORMATION	25.02.22	JZ
11	ISSUED FOR INFORMATION	04.03.22	JZ
12	ISSUED FOR INFORMATION	18.03.22	JZ
13	ISSUED FOR 100% SD	14.04.22	JZ

## KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



Managing Contractor

Building

ASB

### Drawing

GA PLAN - LEVEL 1 ZONE 1

A1 Scale 1 : 200

Project No. 20278

Issue 13

Drawing No.  
SB-SD-DR-AR-2211

## Details

Copyright Conrad Gargett. ABN 81 636 465 373. ACN 636 465 373.  
Do not scale this drawing and verify all dimensions and levels on site.  
Dominant Architect : Lawrence Toaldo NSW Reg. 10255.

SCALE 1:200 m

scale at A1

# PRELIMINARY

**Reviewed for Schematic Design**



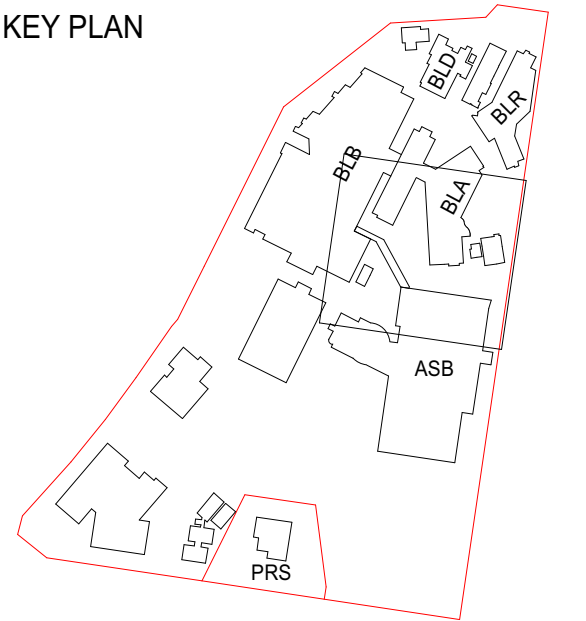


Legend

Revision

REV	DESCRIPTION	DATE	INT.
1	ISSUED FOR 80% SD	04.02.22	JZ
2	ISSUED FOR INFORMATION	11.02.22	JZ
3	ISSUED FOR INFORMATION	04.03.22	JZ
4	ISSUED FOR 100% SD	14.04.22	JZ

KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



Managing Contractor

SCHEMATIC DESIGN

Building  
ASB  
Drawing  
GA PLAN - LEVEL 1 ZONE 2

A1 Scale 1 : 200  
Project No. 20278  
Issue 4

Drawing No.  
ASB-SD-DR-AR-2212

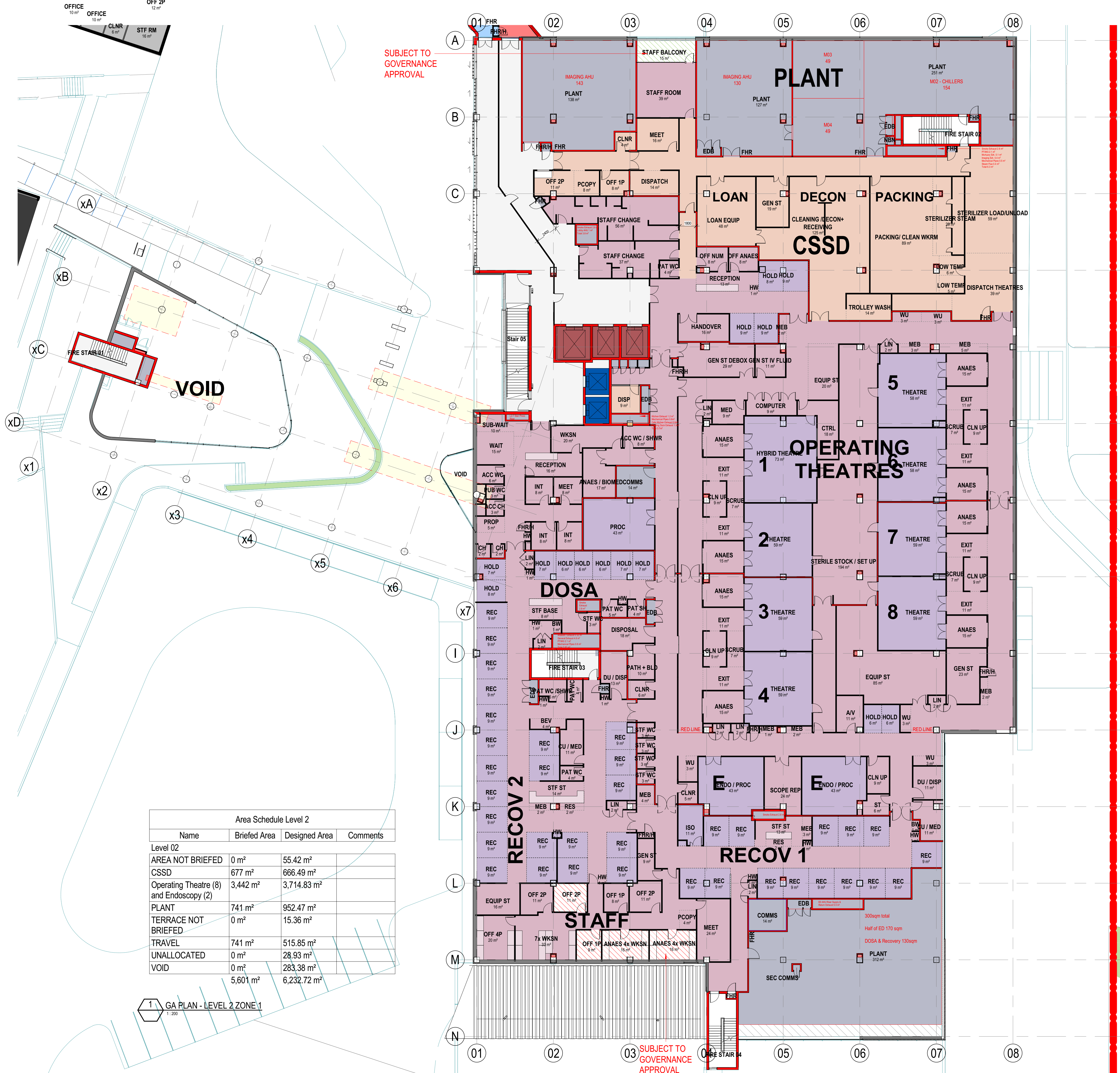
Details  
Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

2 0 2 4 6 8 10 12 14  
SCALE 1:200  
Scale at A1

Reviewed for  
Schematic Design  
per JZhang Date 04/14/2022







Area Schedule Level 2			
Name	Briefed Area	Designed Area	Comments
Level 02			
AREA NOT BRIEFED	0 m <sup>2</sup>	55.42 m <sup>2</sup>	
CSSD	677 m <sup>2</sup>	666.49 m <sup>2</sup>	
Operating Theatre (8) and Endoscopy (2)	3,442 m <sup>2</sup>	3,714.83 m <sup>2</sup>	
PLANT	741 m <sup>2</sup>	952.47 m <sup>2</sup>	
TERRACE NOT BRIEFED	0 m <sup>2</sup>	15.36 m <sup>2</sup>	
TRAVEL	741 m <sup>2</sup>	515.85 m <sup>2</sup>	
UNALLOCATED	0 m <sup>2</sup>	28.93 m <sup>2</sup>	
VOID	0 m <sup>2</sup>	283.38 m <sup>2</sup>	
	5,601 m <sup>2</sup>	6,232.72 m <sup>2</sup>	

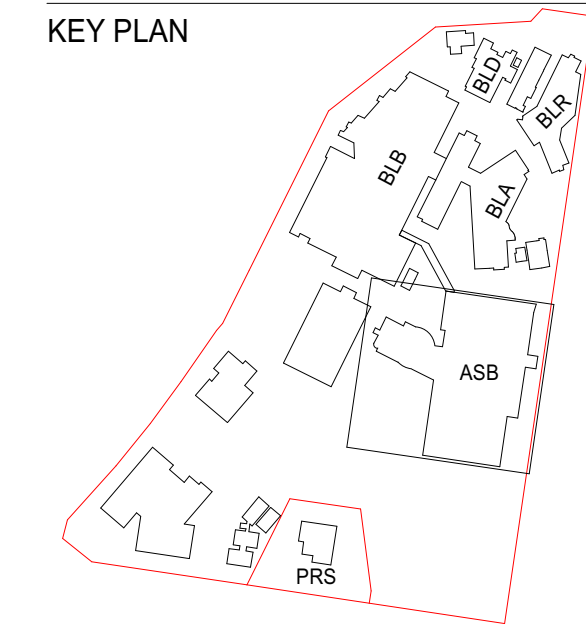
1 GA PLAN - LEVEL 2 ZONE 1  
1:200

Conrad  
Gargett

Legend

REV	DESCRIPTION	DATE	INT.
4	ISSUED FOR INFORMATION	26.11.21	JZ
5	ISSUED FOR INFORMATION	03.12.21	JZ
6	ISSUED FOR INFORMATION	12.12.21	JZ
7	ISSUED FOR INFORMATION	20.12.21	JZ
8	ISSUED FOR INFORMATION	21.01.22	JZ
9	ISSUED FOR 80% SD	04.02.22	JZ
10	ISSUED FOR INFORMATION	25.02.22	JZ
11	ISSUED FOR INFORMATION	04.03.22	JZ
12	ISSUED FOR INFORMATION	18.03.22	JZ
13	ISSUED FOR 100% SD	14.04.22	JZ

KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



Managing Contractor

SCHEMATIC DESIGN

Building  
ASB  
Drawing  
GA PLAN - LEVEL 2 ZONE 1

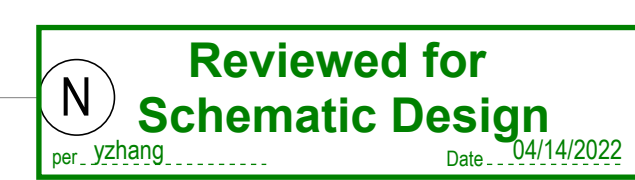
A1 Scale 1:200  
Project No. 20278  
Issue 13

Drawing No.  
ASB-SD-DR-AR-2221

Details

Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect: Lawrence Toaldo NSW Reg. 10255.

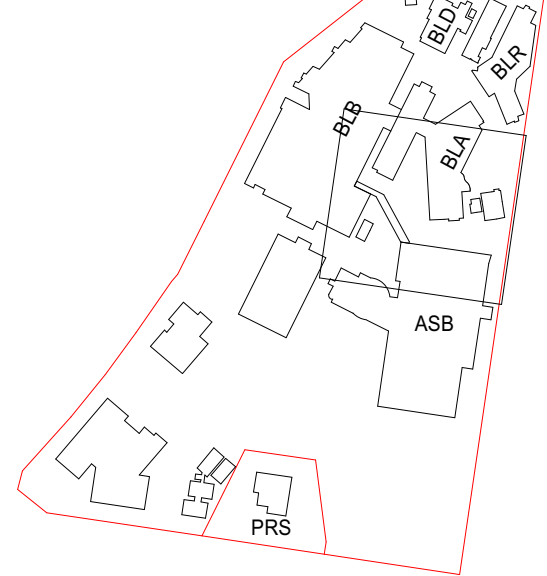
2 0 2 4 6 8 10 12 14  
SCALE 1:200  
Scale at A1





Revision			
REV	DESCRIPTION	DATE	INT.
1	ISSUED FOR INFORMATION	15.11.21	JZ
2	ISSUED FOR INFORMATION	19.11.21	JZ
3	ISSUED FOR INFORMATION	26.11.21	JZ
4	ISSUED FOR INFORMATION	12.12.21	JZ
5	ISSUED FOR INFORMATION	20.12.21	JZ
6	ISSUED FOR INFORMATION	21.01.22	JZ
7	ISSUED FOR 80% SD	04.02.22	JZ
8	ISSUED FOR INFORMATION	25.02.22	JZ
9	ISSUED FOR INFORMATION	04.03.22	JZ
10	ISSUED FOR 100% SD	14.04.22	JZ

KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



JOHNSTAFF

Managing Contractor

SCHEMATIC DESIGN

Building  
ASB  
Drawing  
GA PLAN - LEVEL 2 ZONE 2

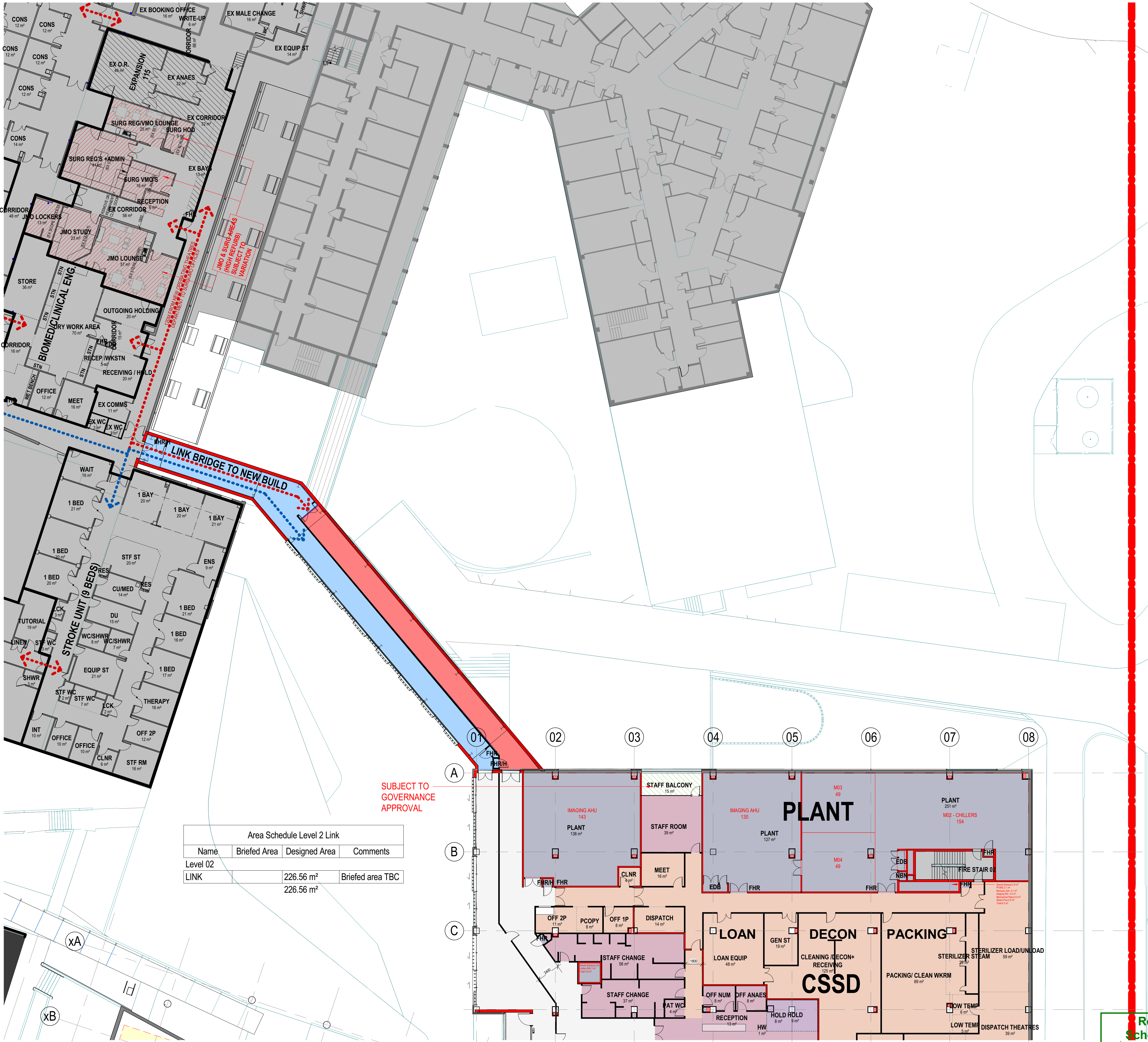
A1 Scale 1 : 200  
Project No. 20278  
Issue 10

Drawing No.  
ASB-SD-DR-AR-2222

Details  
Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

2 0 2 4 6 8 10 12 14  
SCALE 1:200  
Scale at A1

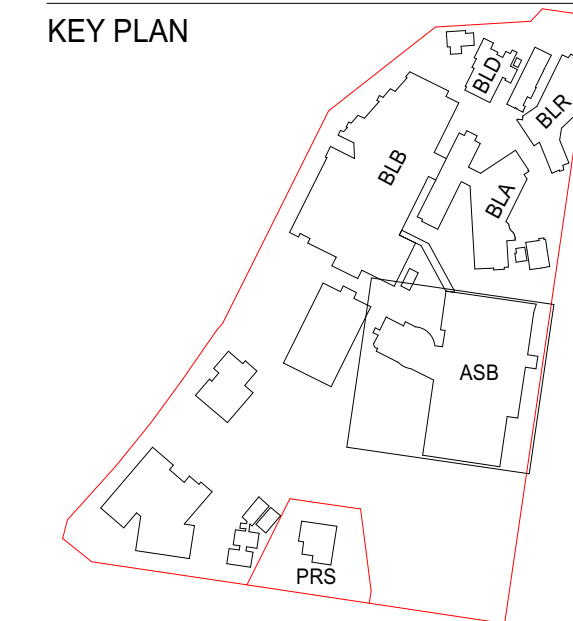
Reviewed for  
Schematic Design  
per\_jzhang Date 04/14/2022





Rev	Description	Date	Int.
5	ISSUED FOR INFORMATION	03.12.21	JZ
6	ISSUED FOR INFORMATION	12.12.21	JZ
7	ISSUED FOR INFORMATION	20.12.21	JZ
8	ISSUED FOR INFORMATION	21.01.22	JZ
9	ISSUED FOR 80% SD	04.02.22	JZ
10	ISSUED FOR INFORMATION	11.02.22	JZ
11	ISSUED FOR INFORMATION	25.02.22	JZ
12	ISSUED FOR INFORMATION	04.03.22	JZ
13	ISSUED FOR INFORMATION	18.03.22	JZ
14	ISSUED FOR 100% SD	14.04.22	JZ

KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



Managing Contractor

SCHEMATIC DESIGN

Building  
ASB  
Drawing  
GA PLAN - LEVEL 3

A1 Scale 1 : 200  
Project No. 20278  
Issue 14

Drawing No.  
ASB-SD-DR-AR-2231

Details

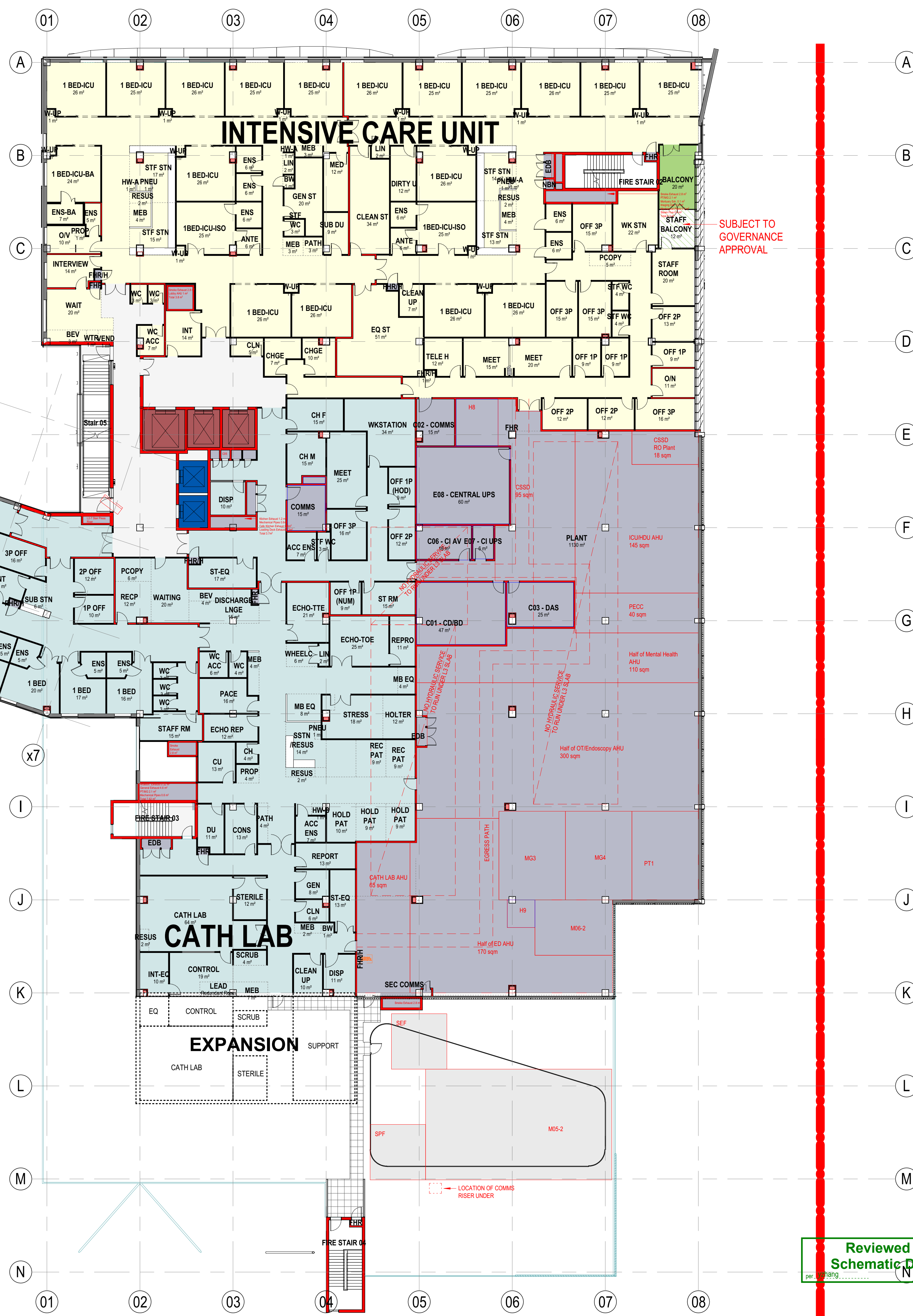
Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

2 0 2 4 6 8 10 12 14  
SCALE 1:200  
Scale at A1

Reviewed for  
Schematic Design  
per [signature] Date 04/14/2022

Area Schedule Level 3			
Name	Briefed Area	Designed Area	Comments
Level 03			
CCU (15) COU (6) CIU (1 Lab)	1,834 m <sup>2</sup>	2,079.07 m <sup>2</sup>	
ICU (20)	1,620 m <sup>2</sup>	1,614.9 m <sup>2</sup>	
ICU Balcony	20 m <sup>2</sup>	19.83 m <sup>2</sup>	
PLANT	622 m <sup>2</sup>	1,431.12 m <sup>2</sup>	
TERRACE NOT BRIEFED	0 m <sup>2</sup>	12.29 m <sup>2</sup>	
TRAVEL	622 m <sup>2</sup>	395.21 m <sup>2</sup>	
	4,718 m <sup>2</sup>	5,552.42 m <sup>2</sup>	

1 GA PLAN - LEVEL 3  
1:200

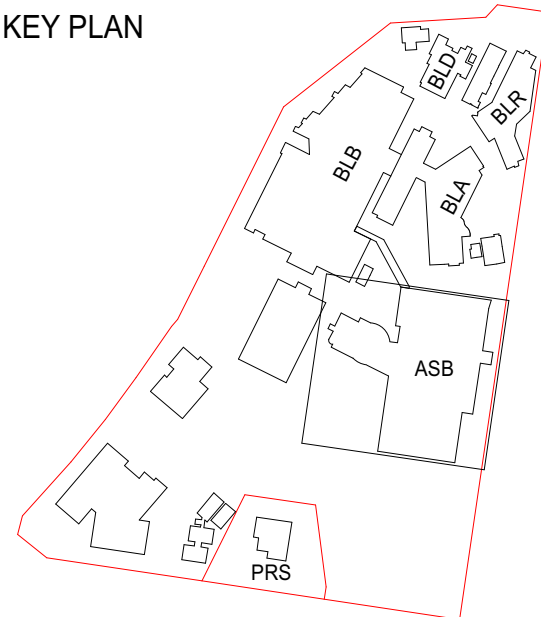




Legend

REV	DESCRIPTION	DATE	INT.
4	ISSUED FOR INFORMATION	26.11.21	JZ
5	ISSUED FOR INFORMATION	03.12.21	JZ
6	ISSUED FOR INFORMATION	12.12.21	JZ
7	ISSUED FOR INFORMATION	20.12.21	JZ
8	ISSUED FOR INFORMATION	21.01.22	JZ
9	ISSUED FOR 80% SD	04.02.22	JZ
10	ISSUED FOR INFORMATION	25.02.22	JZ
11	ISSUED FOR INFORMATION	04.03.22	JZ
12	ISSUED FOR INFORMATION	18.03.22	JZ
13	ISSUED FOR 100% SD	14.04.22	JZ

KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



Managing Contractor

SCHEMATIC DESIGN

Building  
ASB  
Drawing  
GA PLAN - LEVEL 4

A1 Scale 1 : 200  
Project No. 20278  
Issue 13

Drawing No.  
ASB-SD-DR-AR-2241

Details

Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

2 0 2 4 6 8 10 12 14  
SCALE 1:200  
Scale at A1

Reviewed for  
Schematic Design  
per\_jzhang Date: 04/14/2022



Area Schedule Level 4			
Name	Briefed Area	Designed Area	Comments
Level 04			
Geriatrics Terrace	20 m <sup>2</sup>	19.53 m <sup>2</sup>	
Medical IPU 3 (28) - Geriatrics	1,215 m <sup>2</sup>	1,320.57 m <sup>2</sup>	
Mental Health Courtyards	270 m <sup>2</sup>	270.22 m <sup>2</sup>	
Mental Health IPU (Acute + Rehab)	1,989 m <sup>2</sup>	2,202.23 m <sup>2</sup>	
PLANT	629 m <sup>2</sup>	152.8 m <sup>2</sup>	
TERRACE NOT BRIEFED	0 m <sup>2</sup>	23.66 m <sup>2</sup>	Not Briefed
TRAVEL	629 m <sup>2</sup>	376.25 m <sup>2</sup>	
	4,752 m <sup>2</sup>	4,365.27 m <sup>2</sup>	

1 GA PLAN - LEVEL 4  
1:200



Revision			
REV	DESCRIPTION	DATE	INT.
3	ISSUED FOR INFORMATION	19.11.21	<b>JZ</b>
4	ISSUED FOR INFORMATION	26.11.21	<b>JZ</b>
5	ISSUED FOR INFORMATION	03.12.21	<b>JZ</b>
6	ISSUED FOR INFORMATION	12.12.21	<b>JZ</b>
7	ISSUED FOR INFORMATION	20.12.21	<b>JZ</b>
8	ISSUED FOR INFORMATION	21.01.22	<b>JZ</b>
9	ISSUED FOR 80% SD	04.02.22	<b>JZ</b>
10	ISSUED FOR INFORMATION	04.03.22	<b>JZ</b>
11	ISSUED FOR INFORMATION	18.03.22	<b>JZ</b>
12	ISSUED FOR 100% SD	14.04.22	<b>JZ</b>

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541



**Health**

Illawarra Shoalhaven  
Local Health District



**JOHNSTAFF**   
Managing Contractor

1 GA PLAN - LEVEL 5  
1:200

## SCHEMATIC DESIGN

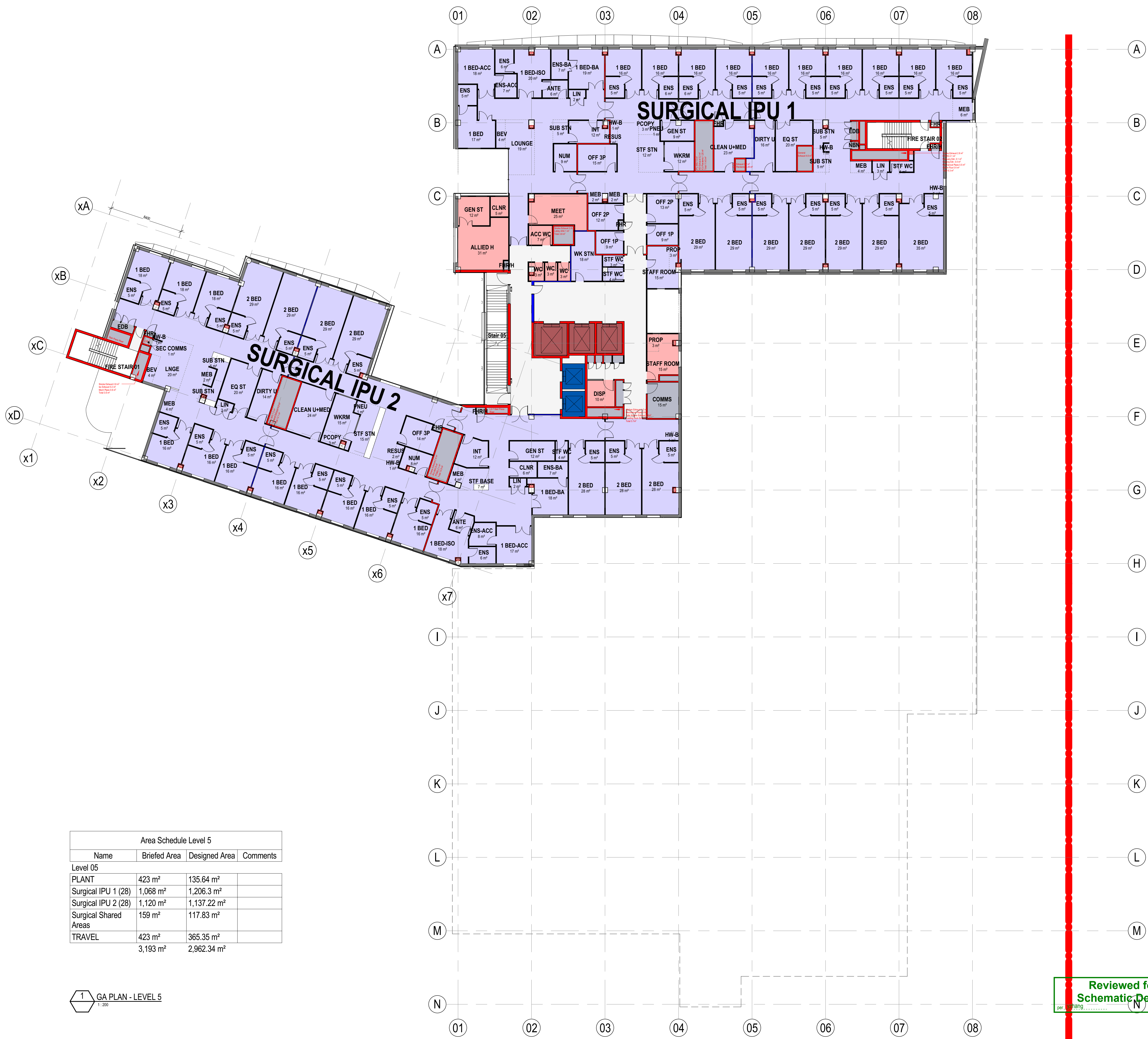
Building  
ASB  
Drawing  
GA PLAN - LEVEL 5

A1 Scale 1 : 200  
Project No. 20278  
Issue 12

Drawing No.  
ASB-SD-DR-AR-2251

Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

Reviewed for  
Schematic Design

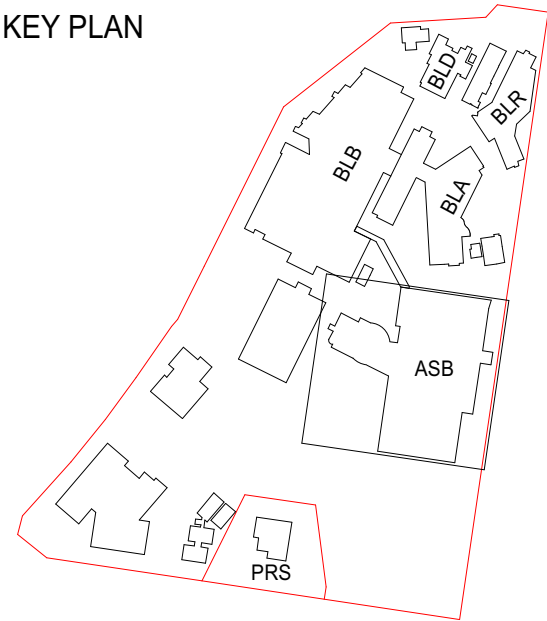




Legend

Revision			
REV	DESCRIPTION	DATE	INT.
3	ISSUED FOR INFORMATION	19.11.21	JZ
4	ISSUED FOR INFORMATION	26.11.21	JZ
5	ISSUED FOR INFORMATION	03.12.21	JZ
6	ISSUED FOR INFORMATION	12.12.21	JZ
7	ISSUED FOR INFORMATION	20.12.21	JZ
8	ISSUED FOR INFORMATION	21.01.22	JZ
9	ISSUED FOR 80% SD	04.02.22	JZ
10	ISSUED FOR INFORMATION	04.03.22	JZ
11	ISSUED FOR INFORMATION	18.03.22	JZ
12	ISSUED FOR 100% SD	14.04.22	JZ

KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



Managing Contractor

SCHEMATIC DESIGN

Building  
ASB  
Drawing  
GA PLAN - LEVEL 6

A1 Scale 1 : 200  
Project No. 20278  
Issue 12

Drawing No.  
ASB-SD-DR-AR-2261

Details  
Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

2 0 2 4 6 8 10 12 14  
SCALE 1:200  
Scale at A1

Reviewed for  
Schematic Design  
per 32/09/2022 Date 04/14/2022



Area Schedule Level 6			
Name	Briefed Area	Designed Area	Comments
Level 06			
FOH	38 m <sup>2</sup>	29.92 m <sup>2</sup>	Aboriginal Lounge
Medical IPU 1 (24)	1,050 m <sup>2</sup>	1,129.82 m <sup>2</sup>	
Medical IPU 2 (24)+4 hemodialysis bays	1,070 m <sup>2</sup>	1,156.39 m <sup>2</sup>	
Medical Shared Areas	120 m <sup>2</sup>	92.6 m <sup>2</sup>	
PLANT	410 m <sup>2</sup>	135.68 m <sup>2</sup>	
TERRACE	0 m <sup>2</sup>	19.06 m <sup>2</sup>	Not Briefed
TRAVEL	410 m <sup>2</sup>	399.94 m <sup>2</sup>	
	3,098 m <sup>2</sup>	2,963.41 m <sup>2</sup>	

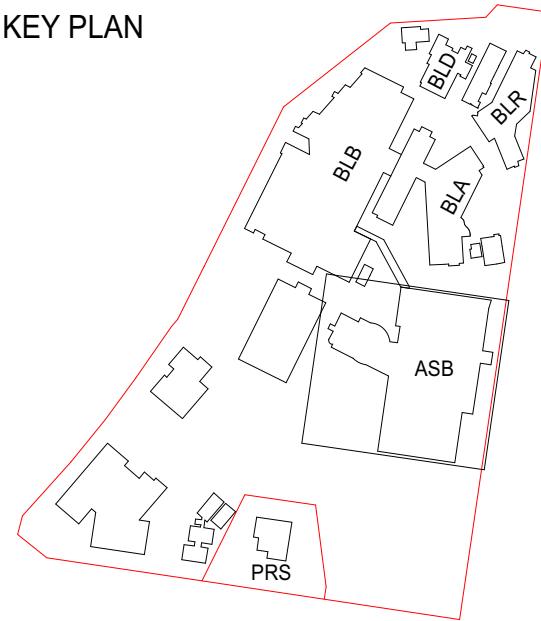
1 GA PLAN - LEVEL 6  
1:200



Legend

REV	DESCRIPTION	DATE	INT.
4	ISSUED FOR INFORMATION	26.11.21	JZ
5	ISSUED FOR INFORMATION	03.12.21	JZ
6	ISSUED FOR INFORMATION	12.12.21	JZ
7	ISSUED FOR INFORMATION	20.12.21	JZ
8	ISSUED FOR INFORMATION	21.01.22	JZ
9	ISSUED FOR 80% SD	04.02.22	JZ
10	ISSUED FOR INFORMATION	11.02.22	JZ
11	ISSUED FOR INFORMATION	04.03.22	JZ
12	ISSUED FOR INFORMATION	18.03.22	JZ
13	ISSUED FOR 100% SD	14.04.22	JZ

KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



Managing Contractor

SCHEMATIC DESIGN

Building  
ASB  
Drawing  
GA PLAN - LEVEL 7

A1 Scale 1 : 200  
Project No. 20278  
Issue 13

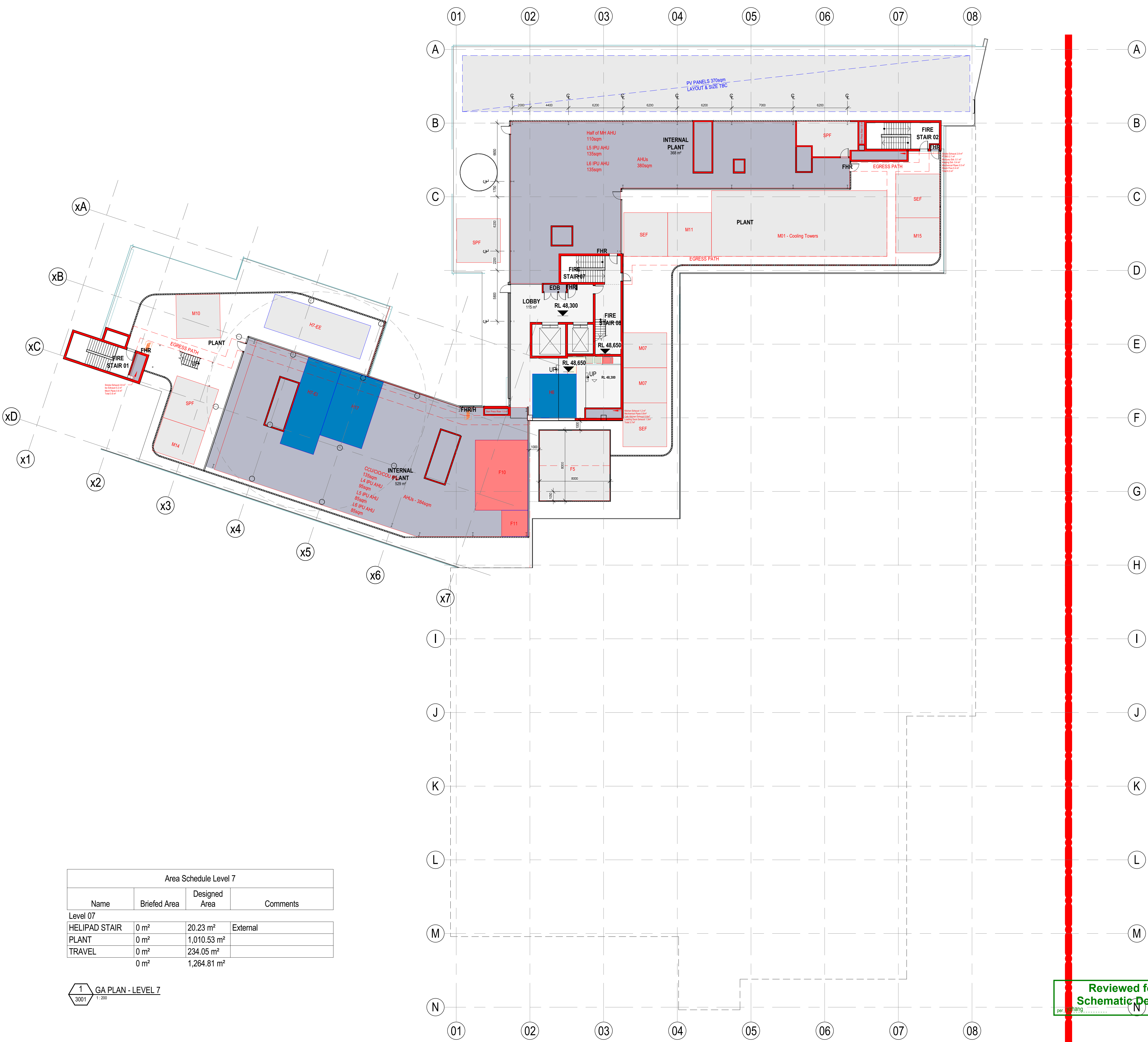
Drawing No.  
ASB-SD-DR-AR-2271

Details

Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

2 0 2 4 6 8 10 12 14  
SCALE 1:200  
Scale at A1

Reviewed for  
Schematic Design  
Date 04/14/2022



Area Schedule Level 7			
Name	Briefed Area	Designed Area	Comments
Level 07			
HELIPAD STAIR	0 m <sup>2</sup>	20.23 m <sup>2</sup>	External
PLANT	0 m <sup>2</sup>	1,010.53 m <sup>2</sup>	
TRAVEL	0 m <sup>2</sup>	234.05 m <sup>2</sup>	
	0 m <sup>2</sup>	1,264.81 m <sup>2</sup>	

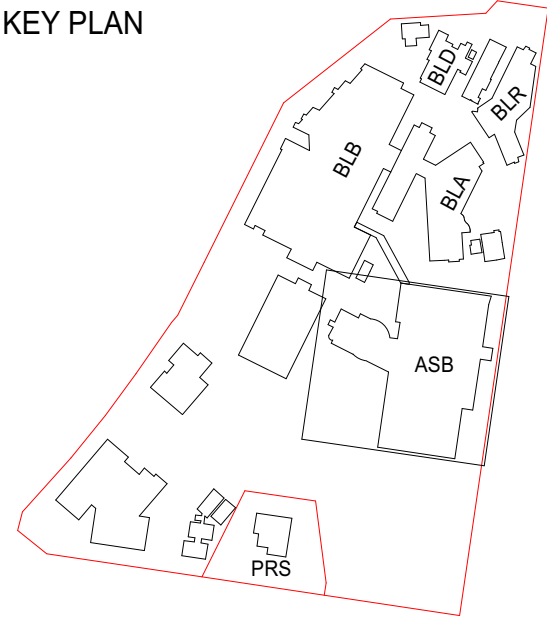
1 GA PLAN - LEVEL 7  
3001 1:200



Legend

Revision			
REV	DESCRIPTION	DATE	INT.
3	ISSUED FOR INFORMATION	19.11.21	JZ
4	ISSUED FOR INFORMATION	26.11.21	JZ
5	ISSUED FOR INFORMATION	03.12.21	JZ
6	ISSUED FOR INFORMATION	12.12.21	JZ
7	ISSUED FOR INFORMATION	20.12.21	JZ
8	ISSUED FOR INFORMATION	21.01.22	JZ
9	ISSUED FOR 80% SD	04.02.22	JZ
10	ISSUED FOR INFORMATION	04.03.22	JZ
11	ISSUED FOR INFORMATION	18.03.22	JZ
12	ISSUED FOR 100% SD	14.04.22	JZ

KEY PLAN



Project

SDMH Shoalhaven District  
Memorial Hospital  
Scenic Dr, Nowra NSW 2541

Client



Project Manager / Contract Administrator



Managing Contractor

SCHEMATIC DESIGN

Building

ASB

Drawing

GA PLAN - LEVEL 7 ROOF  
& 8 HLS

A1 Scale 1 : 200

Project No. 20278

Issue 12

Drawing No.

ASB-SD-DR-AR-2281

Details

Copyright Conrad Gargett. ABN 81 636 465 373 ACN 636 465 373  
Do not scale this drawing and verify all dimensions and levels on site.  
Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

2 0 2 4 6 8 10 12 14

SCALE 1:200

Scale at A1

Reviewed for  
Schematic Design  
per yzhang Date 04/14/2022

Area Schedule Level 8		
Name	Area	Briefed Area A
Level 08 HLS		
HELIPAD	676.06 m <sup>2</sup>	
HELIPAD STAIR	15.65 m <sup>2</sup>	
PLANT	6.72 m <sup>2</sup>	
TRAVEL	98.36 m <sup>2</sup>	
	796.78 m <sup>2</sup>	

