FINAL REPORT

WILKINSON MURRAY

TRINITY POINT

49, 81 & 85 TRINITY POINT DRIVE, MORISSET PARK

NOISE & VIBRATION IMPACT ASSESSMENT
RWDI # 2201228
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SUBMITTED TO

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EXECUTIVE SUMMARY

This report presents a noise and vibration impact assessment for the proposed Trinity Point mixed-use development to be located at 49, 81 & 85 Trinity Point Drive, Morisset Park. The assessment has been prepared to address the noise and vibration clauses of the Secretary's Environmental Assessment Requirements (SEARs) for the State Significant Development Application (SSD 27028161).

Existing ambient noise levels have been established at nearby sensitive receivers via long-term unattended noise monitoring as presented in section 3. The noise monitoring data has been processed in accordance with the EPA's Noise Policy for Industry (NPfI) to establish the rated background noise levels (RBLs) at the potentially most-affected sensitive receivers.

Noise impacts associated with the operation of the development (primarily patron and music noise, vehicle noise from the porte cochere and mechanical plant noise) have been assessed with reference to the NPfI and Liquor and Gaming NSW (L&GNSW) as presented in section 4. The results of the noise emission assessment indicate in-principle that noise emissions from the site are capable of complying with the relevant acoustic requirements through considered design and the implementation of appropriate acoustic treatments and noise management controls.

Noise intrusion from helicopter operations associated with the proposed helipad near the site have been assessed with reference to the internal noise recommendations of Australian Standard AS 2021:2015 – Acoustics – Aircraft Noise Intrusion – Building Siting and Construction. Helicopter noise impacts on the development have been based on helicopter noise testing presented in the Proposed Helipad Acoustic Assessment prepared by The Acoustic Group (ref: 48.4732.R7C:MSC and dated 23 April, 2018). Indicative recommendations for the building façade construction for the development have been presented in section 5.3 to achieve the internal noise requirements. These recommendations should be reviewed once the room layouts and glazing areas have progressed sufficiently.

Road noise impacts associated with the operation of the development have been assessed in accordance with the EPA's Road Noise Policy (RNP), and predicted traffic noise generation associated with the site comply with the RNP impact assessment criteria as shown in section 6.

Noise and vibration impacts from the construction of the development have been assessed in-principle in section 7 of the report in accordance with the ICNG. Construction NMLs have been established for sensitive receivers based on the established RBL. A computer noise model has been developed to predict $L_{Aeq,15min}$ construction noise levels at sensitive receivers.

Construction noise levels have been predicted for a range of construction activities. The predicted $L_{Aeq,15min}$ construction noise levels are expected to exceed the established noise affected NMLs numerous receivers in the vicinity of the site. It is therefore recommended that a CNVMP be developed for the site and that all reasonable and feasible measures be implemented to minimise construction noise and vibration impacts. No exceedances of the 75 dBA highly affected level were predicted.

1 INTRODUCTION

RWDI was engaged by the Johnson Property Group (the client) to conduct a noise and vibration assessment for the proposed Trinity Point mixed-use development to be located at 49, 81 & 85 Trinity Point Drive, Morisset Park.

The following report forms part of the State Significant Development Application (SSD 27028161) for the proposed development and addresses the Secretary's Environmental Assessment Requirements (SEARs) relevant to the development issued 24 September 2021.

This report responds to the Secretary's Environmental Assessment Requirements (SEARs) as they relate to noise and vibration. This report supports an Environmental Impact Statement (EIS) prepared in respect of the proposal and should be read in conjunction with the EIS and development plans submitted with the SSDA.

The SEARs relevant to this report have been considered and are addressed as outlined in Table 1-1.

Table 1-1 Secretary's Environmental Assessment Requirements (SEARs)

Relevant SEARs	Response
The EIS must: • ***Assess the environmental and residential amenity impacts associated with the proposal, including … acoustic impacts … A high level of environmental amenity must be demonstrated.***	Noise and vibration emissions associated with the construction and operation of the proposed development have been assessed against the relevant EPA and State guidelines, with noise and vibration mitigation recommendations provided to ensure that the acoustic amenity of sensitive receivers in the vicinity of the site is preserved. This report includes assessment of operational noise impacts associated with the development. In particular, consideration has been given of patron and music noise emissions, vehicle noise from the at-grade porte cochere and mechanical plant noise, and has been presented in section 4. In-principle noise mitigation recommendations have been presented in section have been presented in section 4.3 to facilitate compliance with the relevant EPA Noise Policy for Industry and the Liquor and Gaming NSW guidelines (refer to section 4.1). Noise impacts on the proposed development from helicopter operations at the proposed helipad have been assessed and indicative building façade constructions have been presented in section 5.3 to facilitate compliance with the internal noise recommendations of AS2021. An assessment of traffic noise generation from the development on the surrounding public road network has been provided in section 6 and demonstrates that the development is capable of complying with the requirements of the EPA Road Noise Policy. A preliminary assessment of construction noise and vibration impacts from the development has been presented in section 7, with noise and vibration mitigation strategies presented in sections 0 and 7.4 to ensure that impacts are managed in accordance with the EPA's Interim Construction Noise Guideline.
The EIS must: • ***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, including impacts from the adjacent helicopter landing site, and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented."***	

The following documents have been referenced in establishing noise and vibration criteria for the proposed development:

- Noise from the operation of the development has been assessed in accordance with the NSW *Noise Policy for Industry* (NPfI), NSW EPA, 2017, as well as the requirements of Liquor and Gaming NSW (L&GNSW) for licensed/entertainment venues;
- Noise intrusion into the development from helicopter operations associated with the proposed helipad near the site has been assessed against the requirements of Australian Standard (AS) 2021:2015 – *Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*.

- Construction noise has been assessed in accordance with the EPA's *Interim Construction Noise Guideline* (ICNG), 2009.
- Construction vibration has been assessed in accordance with Transport for NSW's (TfNSW) *Construction Noise and Vibration Strategy* (CNVS).
- Traffic noise generation associated with the site has been assessed in accordance with the NSW *Road Noise Policy* (RNP), DECCW, 2011

2 PROJECT DESCRIPTION

2.1 Site Location

The subject site is located at Trinity Point Lake Macquarie (in the suburb of Morisset Park). The site is identified as Lots 101 and 102 DP 1256630, and Lot 32 DP 1117408, with a physical address of 49, 81 and 85 Trinity Point Drive, Morisset Park as shown in Figure 2-1.

Figure 2-1 Site Location (Image Courtesy of Nearmap)

The site is located at the end of a peninsula. The site is bound to the west by Trinity Point Drive, which carries low volumes of traffic, and to the north, east and south by Lake Macquarie.

Towards the northern end of the site is the operational "8@Trinity" licenced restaurant. Located in the waters to the immediate north-east of the site is an operational 94 berth marina, with an additional 94 berth concept approved and to be subject to a separate DA. In addition, approval has been granted for a helipad to be

constructed off the marina breakwater as part of the Stage 2 marina construction (location indicated in pink in Figure 2-1).

The land to the west of the site across Trinity Point Drive has been developed by the proponent for detached housing with some medium density integrated housing. The locality otherwise consists of low-density detached housing with a substantial bushland located further west.

2.2 Existing Approvals

A concept approval for the site has previously been granted in 2009 (MP 06-0309). In addition to the 188 berth marina and helipad approvals, the previous concept approval provides for the following:

- 65 room hotel;
- 93 short stay tourist serviced apartments;
- 157 residential apartments;
- 300 seat function centre;
- 340 seat restaurant/café spaces (indoor and outdoor dining);
- At grade and basement car parking (approximately 677 spaces);

The approval included hotel and hospitality uses at the northern end of the site across two buildings of 2-4 storeys, and serviced apartment/residential uses in the centre and south of the site across eight buildings of 3-4 storeys.

The tourism and hospitality buildings and uses, and four of the eight apartment buildings also received development consents.

2.3 Proposed Development

The proposed layout for the site is presented in Figure 2-2.

The new proposal for the site significantly varied from the approved concept plan and, as a result, a new concept approval is being sought for a mixed use tourist, hospitality and residential development.

The new proposal will comprise six buildings, with five of the buildings being 8 storeys high, and one building (building F) being 6 storeys high. The development will include the following uses:

- 300 seat function centre;
- Two 300 seat restaurants (including outdoor dining);
- Serviced meeting rooms;
- Outdoor pool on the eastern façade of building B;
- 218 hotel rooms and 6 serviced apartments;
- Approximately 180 residential dwellings;
- Basement car parking.

The two northern buildings (buildings A and B) are proposed for tourism, hotel and hospitality uses, with porte cochere and embellishments including pool. The four central and southern buildings (buildings C-F) are proposed for residential uses.

The proposed hours of operation for the function centre and restaurant uses are not known at this early stage. For the purposes of this assessment, it will be assumed that the venues will operate 24 hours a day, 7 days a week to provide a conservative assessment with respect to noise emissions for the development.

Unloading of delivery vehicles to the site will take place at the loading dock located in the enclosed, basement level of the development.

Figure 2-2 Site Layout

2.4 Noise Catchment Areas

The areas with noise-sensitive receivers around the site have been divided into three Noise Catchment Areas (NCAs). The NCAs group together sensitive receivers with similar existing noise environments. The NCAs and sensitive receivers in the area around the development are detailed in Table 2-1 and are shown in Figure 2-1.

The nearest residential receivers are located to the west of the site across Trinity Point Drive.

Table 2-1 Noise Catchment Areas (Refer to Figure 2-1)

NCA	Direction from Development	Description
NCA01	West	Receivers to the west of the site across Trinity Point Drive where the noise environment is currently influenced by distant mechanical plant noise serving the existing '8@Trinity' restaurant located on site, as well as by intermittent traffic noise along Trinity Point Drive.
NCA02	West	Receivers to the west of the site across the water where the noise environment is influenced by faintly audible mechanical plant noise from the existing '8@Trinity' restaurant located on site, and intermittent traffic noise from the surrounding roadways (namely Trinity Point Drive, Edgewater Drive and Lakeview Road). The closest receivers are approximately 120m from the site.
NCA03	North-East	Receivers to the north-east of the site across Lake Macquarie where the noise environment is influenced by intermittent traffic noise from the surround roadways (primarily Buttaba Road). The closest residential receivers are approximately 700m from the site.

3 EXISTING NOISE ENVIRONMENT

To characterise the existing noise environment of the project location, RWDI personnel attended site to conduct short and long-term unattended noise measurements as described in the sub-sections below.

Figure 2-1 shows the locations of the short and long-term unattended noise measurements.

3.1 Unattended Noise Measurements

Four unattended noise monitors were installed on site as shown in yellow in Figure 2-1. Three of the noise monitors were used for measuring the background noise levels (L_{A90}) at the identified NCAs, and the fourth monitor was used to measure existing traffic noise levels (L_{Aeq}) along Trinity Point Drive. The locations of the noise monitors were as follows:

- L1: On the premises of the nearest residential complex at 64 Trinity Point Drive, Morisset Park to the west of the site across Trinity Point Drive. This noise monitor location will be representative of the noise environment for NCA01.
- L2: Along the southern boundary of the residential dwelling at 5 Edgewater Drive, Morisset Park. This noise monitor location will be representative of the noise environment for NCA02.
- L3: Near the south-western boundary of the residential dwelling at 13 Lake View Avenue, Brightwaters. This noise monitor location will be representative of the noise environment for NCA03.
- L4: Approximately 9m from the northern trafficable lane of Trinity Point Drive, near the intersection of Sundial Drive.

All noise monitors were located in free field conditions.

The unattended noise monitoring equipment used at locations L1, L2 and L3 consisted of Acoustic Research Laboratory (ARL) NGARA noise monitors, and the noise monitoring equipment used at location L4 consisted of an ARL Rion NL-42 noise monitor. All noise monitors were programmed to measure A-weighted, statistical noise levels stored at 15-minute intervals on fast response mode. The noise monitors were calibrated at the beginning and end of the monitoring period, with no significant drift being observed.

The noise monitors were on site between 27 October and 10 November 2021.

The measured noise levels at the unattended noise monitoring locations are presented in Table 3-1 and Table 3-2 below. Refer to Appendix A for graphs of the unattended noise monitoring data. In accordance with the NPfI, weather-affected data (periods where average wind speeds have exceeded 5m/s and/or have been affected by rain) have been excluded in determining the ambient and background noise levels.

The measured background noise levels at locations L1, L2 and L3 are presented in Table 3-1.

Table 3-1 Unattended Noise Measurements – Background (L_{A90}) Noise Levels

Noise Monitor Location	Time of Day [1]	Rating Background Level (RBL) $L_{A90, period}$ dBA
L1	Day	35
	Evening	35
	Night	30 [2] (28)
	Early Night	30 [2] (29)
L2	Day	36
	Evening	36
	Night	32
	Early Night	33
L3	Day	36
	Evening	33
	Night	30 [2] (29)
	Early Night	30

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am, Early Night = 10pm – 12am

Note 2: As the measured RBL was below 30 L_{A90} during the night time period, the night time RBL has been set at 30 L_{A90} in accordance with the procedures of the NPfI,

The L_{Aeq} traffic noise levels measured at noise monitoring location 4 are presented in Table 3-2.

Table 3-2 Unattended Noise Measurements – Traffic (L_{Aeq}) Noise Levels

Noise Monitor Location	Time of Day [1]	Traffic Noise Level, dBA	
		$L_{Aeq, period}$	$L_{Aeq,1hour}$
L4 – Approximately 9m from Trinity Point Drive	Day	52	54
	Night	46	52

Note 1: Day = 7am – 10pm; Night = 10pm – 7am

In addition to the RBLs presented in Table 3-1, the noise monitors recorded background noise spectrums in octave bands. The measured background noise spectrums that were representative of the day, evening and night time periods at each monitoring location are presented in Table 3-3.

Table 3-3 Measured Background Noise Spectrums

Noise Monitor Location	Time of Day	Background Noise Levels – L_{90} dB									
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-Wt
L1	Day	47	47	39	35	33	28	26	25	22	**35**
	Evening	45	43	36	32	33	28	29	24	19	**35**
	Early Night/ Night	40	40	33	30	28	23	21	22	19	**30**
L2	Day	48	48	41	34	30	31	30	27	20	**36**
	Evening	46	45	40	34	29	30	30	27	21	**36**
	Night	42	44	37	34	28	26	24	22	18	**32**
	Early Night	43	45	38	35	29	27	25	23	19	**33**
L3	Day	46	48	45	38	31	26	27	25	17	**36**
	Evening	46	48	43	36	30	22	20	20	16	**33**
	Early Night/ Night	42	43	36	29	25	22	22	20	15	**30**

4 OPERATIONAL NOISE ASSESSMENT

4.1 Operational Noise Level Criteria

4.1.1 **Liquor and Gaming NSW**

4.1.1.1 Amplified Music and Entertainment Noise

Licensed premises are controlled by Liquor & Gaming NSW (L&GNSW). The L&GNSW Standard Conditions for noise from licensed premises were developed principally for the assessment of entertainment noise emissions and are summarised below:

"The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5Hz–8kHz inclusive) by more than 5dB between 7:00 am and 12:00 midnight at the boundary of any affected residence.

The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5Hz–8kHz inclusive) between 12:00 midnight and 7:00 am at the boundary of any affected residence.

Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 7:00 am."

The assessment of tonal characteristics, in accordance with the L&GNSW, is warranted for amplified music or entertainment noise emissions that may contain high levels of low frequency energy. By contrast, patron noise is generally more broadband in nature and, as a result, is not as intrusive as music entertainment noise. As a result, it is proposed that only entertainment / music noise emissions from the licensed premises on site are assessed against the L&GNSW noise emission criteria.

Based on the unattended background noise monitoring data and the background noise spectrums presented in Table 3-2 and Table 3-3, the entertainment / music noise emission criteria for licensed premises within the development at neighbouring residential receivers prior to 12am midnight are summarised in Table 4-1 below.

Table 4-1 Licensed Premises Entertainment / Music Noise Emission Criteria Before 12am Midnight (L&GNSW)

Receiver Location	Time	Criteria	Frequency									Total A-Wt
			31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
NCA01	Day	35 BG+5	52	52	44	40	38	33	31	30	27	**40**
	Evening	35 BG+5	50	48	41	37	38	33	34	29	24	**40**
	Night	30 BG+0	40	40	33	30	28	23	21	22	19	**30**
	Early Night	30 BG+5	45	45	38	35	33	28	26	27	24	**35**
NCA02	Day	36 BG+5	53	53	46	39	35	36	35	32	25	**41**
	Evening	36 BG+5	51	50	45	39	34	35	35	32	26	**41**
	Night	32 BG+0	42	44	37	34	28	26	24	22	18	**32**
	Early Night	33 BG+5	48	50	43	40	34	32	30	28	24	**38**
NCA03	Day	36 BG+5	51	53	50	43	36	31	32	30	22	**41**
	Evening	33 BG+5	51	53	48	41	35	27	25	25	21	**38**
	Night	30 BG+0	42	43	36	29	25	22	22	20	15	**30**
	Early Night	30 BG+5	47	48	41	34	30	27	27	25	20	**35**

The L&GNSW noise criteria also states that noise from the licensed premises shall not be audible within the habitable areas of a residential premise between 12am midnight and 7am in addition to the "background + 0dB in octave bands" criteria applied to this period. In standard acoustics practice, it is generally agreed that a noise source will be inaudible if the A-weighted noise level of the noise source is at least 10dBA lower than the background noise level. Considering this, if the noise impact from the licensed premises is at least 10dBA below the external RBL at the façade of the residential receivers, then it can be reasonably concluded that the licensed premise noise will be inaudible within the habitable areas of the residence, regardless of whether the windows of the dwelling are opened or closed.

Given that the 12am to 7am period is a more noise-sensitive for residences, the inaudibility requirement for this period (under the L&GNSW) will be applied to both patron and music noise emissions.

Based on this, the L&GNSW inaudibility criteria for the licensed premises for the 12am midnight to 7am period are summarised in Table 4-2.

Table 4-2 Licensed Premises Patron and Music Noise Emission Criteria After 12am Midnight (L&GNSW)

NCA	Period	Measured RBL, $L_{A90, period}$	L&GNSW Noise Emission Criteria, $L_{Aeq, 15min}$
NCA01	12am midnight – 7am	28	**18**
NCA02		32	**22**
NCA03		29	**19**

4.1.1.2 Patron Noise

As discussed in Section 4.1.1.1 above, the octave band L&GNSW assessment criteria, whilst applicable to amplified music and operational noise emissions with high levels of low frequency energy, are not warranted for the assessment of patron noise emissions. Assessment of patron noise emissions is more appropriately based upon intrusiveness, in accordance with the procedures documented in the NSW Noise Policy for Industry (NPfI) for the periods up 12am midnight. This criteria will also be applied to noise emissions from the outdoor pool. The applicable criteria are discussed in Section 4.1.2.

As also discussed in Section 4.1.1.1, patron noise emissions during the 12am to 7am period will be assessed against the inaudibility requirement of the L&GNSW due to the more noise-sensitive nature of this period for residential uses.

4.1.2 Noise Policy for Industry

The NPfI provides a framework for assessing environmental noise impacts from industrial premises and industrial development proposals in New South Wales.

The NPfI recommends the development of project noise trigger levels, which provide a benchmark for assessing a proposal or site. The project noise trigger levels should not be interpreted as mandatory noise criteria but, rather, as noise levels that, if exceeded, would indicate a potential noise impact on the community.

The project noise trigger level is the lower value of the project intrusiveness noise level and the project amenity noise level. The project intrusiveness noise level assesses the likelihood of noise being intrusive above the ambient noise level and is applied to residential receivers only. The project amenity noise level ensures the total industrial noise from all sources in the area does not rise above a maximum acceptable level.

4.1.2.1 Project Intrusiveness Noise Levels

The intrusiveness noise level is the noise level 5 dBA above the background noise level for each time period (daytime, evening or night time) of interest at a residential receiver. The background noise level is derived from the measured L_{A90} noise levels.

The NPfI stipulates that project intrusiveness noise levels should not be set below 40 dBA during the daytime and 35 dBA in the evening and night time. Additionally, the NPfI recommends that the project intrusiveness noise level for evening is set at no greater than that for the daytime, and that the project intrusiveness level for night time is set at no greater than that for the evening and daytime.

Intrusiveness noise levels for the project are summarised in Table 4-3.

Table 4-3 Project Intrusiveness Noise Levels

Noise Monitor Location	Time of Day [1]	Rating Background Level (RBL) $L_{A90,\ period}$ dBA	Project Intrusiveness Noise Level $L_{Aeq,\ 15min}$ dBA
NCA01	Day	35	40
	Evening	35	40
	Early Night & Night	30	35
NCA02	Day	36	41
	Evening	36	41
	Early Night	33	38
	Night	32	37
NCA03	Day	36	41
	Evening	33	38
	Early Night & Night	30	35

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am, Early Night = 10pm – 12am

4.1.2.2 Project Amenity Noise Levels

Project amenity noise levels aim to set a limit on continuing increases in noise levels from all industrial noise sources affecting a variety of receiver types; that is, the ambient noise level in an area from all industrial noise sources remains below recommended amenity noise levels.

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include transportation noise (when on public transport corridors), noise from motor sport, construction noise, community noise, blasting, shooting ranges, occupational workplace noise, wind farms, amplified music/patron noise.

The amenity noise level aims to limit continuing increases in noise levels which may occur if the intrusiveness level alone is applied to successive development within an area.

The recommended amenity noise level represents the objective for total industrial noise at a receiver location. The project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To prevent increases in industrial noise due to the cumulative effect of several developments, the project amenity noise level for each new source of industrial noise is set at 5dBA below the recommended amenity noise level.

The following exceptions apply to determining the project amenity noise level:

- For high-traffic areas the amenity criterion for industrial noise becomes the $L_{Aeq,period\ (traffic)}$ minus 15dBA.
- In proposed developments in major industrial clusters.

- If the resulting project amenity noise level is 10dB or more, lower than the existing industrial noise level, the project amenity noise level can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.
- Where cumulative industrial noise is not a consideration because no other industries are present in, or likely to be introduced into the area, the relevant amenity noise level is assigned as the project amenity noise level for the development.

Amenity noise levels are not used directly as regulatory limits. They are used in combination with the project intrusiveness noise level to assess the potential impact of noise, assess mitigation options and determine achievable noise requirements.

The project amenity noise levels are calculated from the recommended amenity noise levels presented in Table 4-4.

Table 4-4 Recommended Amenity Noise Levels

Receiver	Noise Amenity Area	Time of Day [1]	Recommended Amenity Noise Level $L_{Aeq,period}$ dBA
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day.
School classroom-internal	All	Noisiest 1-hour period when in use	35
Hospital ward internal external	All	Noisiest 1-hour	35
	All	Noisiest 1-hour	50
Place of worship-internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	65
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dB(A) to recommended noise amenity area

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am

Recommended amenity noise levels presented in Table 4-4 represent the objective for total industrial noise at a receiver location. No other industries are present, or likely to be introduced in the area surrounding the proposed development. Therefore, the recommended amenity noise levels presented in Table 4-4 are assigned as the project amenity noise levels for the Project.

Due to different averaging periods for the $L_{Aeq,15min}$ and $L_{Aeq,period}$ noise descriptors, the values of project intrusiveness and amenity noise levels cannot be compared directly when identifying noise trigger levels i.e. the most stringent values of each category. In order to make a comparison between descriptors, the NPfI assumes that the $L_{Aeq,15min}$ equivalent of an $L_{Aeq,period}$ noise level is equal to the $L_{Aeq,15min}$ level plus 3dB.

The most potentially affected residential receivers near the site are classified as being in a "suburban" noise amenity area. The project amenity noise levels for the Project are presented in Table 4-5.

Table 4-5 Project Amenity Noise Levels

Receiver	Time of Day [1]	Recommended Amenity Noise Level $L_{Aeq,period}$ dBA	Project Amenity Noise Level $L_{Aeq,15min}$ dBA
All nearby residences	Day	55	58
	Evening	45	48
	Night	40	43

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am

4.1.2.1 Project Noise Trigger Level

The project noise trigger levels are defined as the lower of the project intrusiveness and the project amenity noise levels. These overall project noise trigger levels are summarised in Table 4-6 below. Since overall noise is a combination of elements which may vary significantly hour to hour (i.e., noise from the hotel, restaurants and function centre) and other aspects which are more consistent in each time period (mechanical services) separate criteria have been established in Table 4-7 for mechanical services to ensure the overall project trigger levels can be achieved.

The project noise trigger levels for mechanical services have been set at 8dBA below the overall project trigger noise level criteria so that noise contributions from mechanical plant will be generally negligible compared to other operational noise generating activities associated with the development (e.g. patron/music noise).

Table 4-6 NPfI Overall Project Trigger Noise Level Criteria

Receiver Type	Time of Day [1]	Intrusiveness Criteria $L_{Aeq,15min}$ dBA	Amenity Criteria $L_{Aeq,15min}$ dBA	Project Noise Trigger Criteria $L_{Aeq,15min}$ dBA
NCA01	Day	40	58	**40**
	Evening	40	48	**40**
	Early Night and Night	35	43	**35**
NCA02	Day	41	58	**41**
	Evening	41	48	**41**
	Early Night	38	43	**38**
	Night	37	43	**37**
NCA03	Day	41	58	**41**
	Evening	38	48	**38**
	Early Night and Night	35	43	**35**

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am, Early Night = 10pm – 12am

Table 4-7 Project Trigger Noise Level Criteria for Mechanical Services Noise

Receiver Type	Time of Day [1]	Intrusiveness Criteria $L_{Aeq,15min}$ dBA	Amenity Criteria $L_{Aeq,15min}$ dBA	Mechanical Services Noise Trigger Criteria $L_{Aeq,15min}$ dBA
NCA01	Day	40	58	**32**
	Evening	40	48	**32**
	Night	35	43	**27**
NCA02	Day	41	58	**33**
	Evening	41	48	**33**
	Night	37	43	**29**
NCA03	Day	41	58	**33**
	Evening	38	48	**30**
	Night	35	43	**27**

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am

4.1.3 Sleep Disturbance

Guidance for assessing the potential for sleep disturbance impacts on nearby residences is provided in Section 2.5 of the *NPfI*, which states:

> *Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
> - L_{Amax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,
>
> *a detailed maximum noise level event assessment should be undertaken.*

Based on the above, the night-time sleep disturbance screening noise levels for the residential areas in the vicinity of the development is presented Table 4-8.

Table 4-8 Sleep Disturbance Criteria

NCA	Period	Measured RBL, $L_{A90, period}$	Sleep Disturbance Criteria, L_{AMAX}
NCA01	Night-time (10pm-7am)	30	**52**
NCA02		32	
NCA03		30	

Note 1: Minimum RBL for 'Night-time' used for assessment.

Where the sleep disturbance screening noise level is predicted to be exceeded then a detailed maximum noise level event assessment should be undertaken. The detailed assessment should discuss the predicted level of the events, the exceedance of the screening level, existing maximum noise levels, and consider guidance from current literature regarding sleep disturbance, such as the *Road Noise Policy*.

4.2 Assessment of Operation Noise

Modelling of noise emissions from the Proposal has been undertaken using the ISO 9613 noise prediction algorithm in the CadnaA modelling software.

At relatively large distances from a source, the resultant noise levels at receivers can be influenced by meteorological conditions, particularly temperature inversions and gradient winds. Where these factors are a feature of an area, their effect on resultant noise levels should be taken into account. The NPfI recommends that noise predictions be conduct under these meteorological conditions favourable for noise propagation.

IS0 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favourable for noise propagation. These conditions are for downwind noise propagation or, equivalent to noise propagation under a well-developed moderate groundbased temperature inversion, such as commonly occurring at night.

The primary sources of noise generation from the site are as follows:

- Patron and music noise from the restaurant and function room venues and the outdoor pool;
- Vehicle noise from the use of the porte cochere (located near buildings A and B); and
- Mechanical plant noise.

We note that noise emissions from vehicles manoeuvring within the enclosed basement carpark, as well as from delivery vehicles unloading within the basement carpark will have a negligible impact on the surrounding residences and so have not been considered in this assessment.

Our noise modelling methodology and noise predictions of the various noise sources are presented in the sub-sections below.

4.2.1 Patron Noise and Music Noise

4.2.1.1 Noise Modelling Procedure

Modelling of patron noise emissions has been undertaken based on the following:

- The sound power level (SWL) of one person talking with a raised voice in the indoor and outdoor dining areas is 78L_{Aeq}.
- On average, one in three patrons will be speaking at any given time in the indoor or outdoor dining areas.
- SWL from one person using the outdoor swimming pool is 75L_{Aeq} (based on VDI 3770:2012-09 – *Characteristic Noise Emission Values of Sound Sources – Facilities for Recreational and Sporting Activities*).

The locations of the outdoor dining areas used for the noise modelling are indicated in green in Figure 4-1.

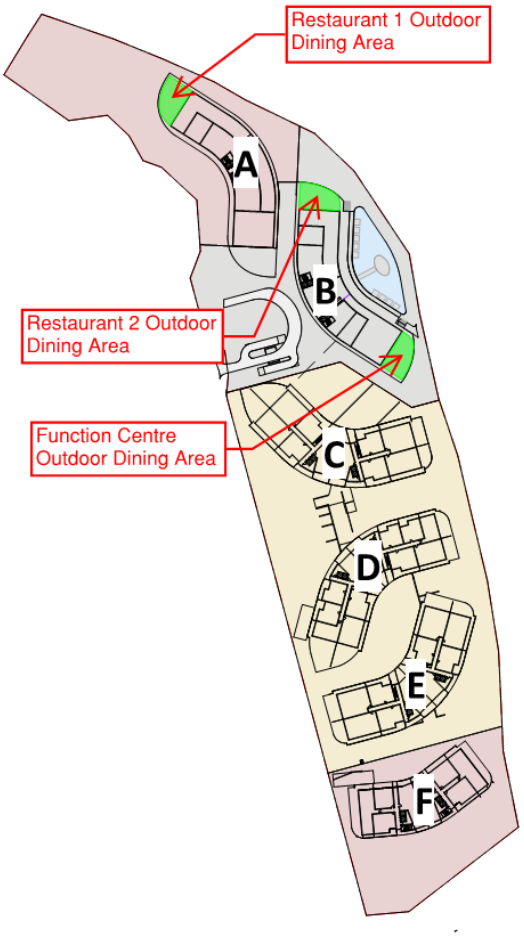


Figure 4-1 Locations of Outdoor Dining Areas

Modelling of music noise emissions from the development have been undertaken based on the following:

- The spatially averaged internal music noise level within Restaurant 1, Restaurant 2 and the Function Centre will be limited to the noise levels presented in Table 4-9.
- Furthermore, there will be no amplified music in any of the outdoor dining areas.

Table 4-9 Music Noise Level within Restaurant 1, Restaurant 2 and Function Centre – dB

Time of Day	Descriptor	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	Total dBA
Day & Evening (7am-10pm)	$L_{Aeq, 15min}$	100	100	98	96	100	93	90	88	83	**100**
	$L_{A10, 15min}$	103	103	101	99	103	96	93	91	86	**103**
Early Night (10pm-12am)	$L_{Aeq, 15min}$	97	97	95	93	97	90	87	85	80	**97**
	$L_{A10, 15min}$	100	100	98	96	100	93	90	88	83	**100**
After Midnight	$L_{Aeq, 15min}$	83	83	81	79	83	76	73	71	66	**83**
	$L_{A10, 15min}$	86	86	84	82	86	79	76	74	69	**86**

The noise emission predictions presented in section 4.2.1.2 assume that the noise mitigation recommendations presented in section 4.3 have been implemented, namely:

- 2.4m high acoustic screens are installed along the western perimeter of all three outdoor dining areas;
- Sound insulation performance of the glazing and frames to the restaurants and the function centre to achieve a minimum weighted sound reduction index (R_w) rating of 36;
- Number of patrons in the outdoor dining areas and pool areas are limited to the following:
  - Day and Evening (7am-10pm):
    - 150 patrons in each outdoor dining area (Restaurant 1, 2 and Function Centre. Total 450 patrons in outdoor dining areas), which would correspond to 150 patrons in each of the internal dining areas of Restaurant 1, 2 and the Function Centre.
    - 53 people using the pool based on an average utilisation density of 10m^2 per person.
  - Early Night (10pm-12am):
    - 75 patrons in each outdoor dining area (Restaurant 1, 2 and Function Centre. Total 225 patrons in outdoor dining areas), which would correspond to 225 patrons in each of the internal dining areas of Restaurant 1, 2 and the Function Centre.
    - 53 people using the pool based on an average utilisation density of 10m^2 per person.
  - After 12am midnight:
    - No patrons in any of the outdoor dining areas, which would correspond to 300 patrons in each of the internal dining areas of Restaurant 1, 2 and the Function Centre.
    - No use of the pool.
- No amplified music in the outdoor dining areas or the outdoor pool.
- That the entrances to both restaurants and the function centre will consist of a vestibule door system (i.e. two sets of doors) with adequate spacing between the two sets of doors such that at least one of the doors is typically closed at any given time during patron or staff ingress/egress.

Music noise emissions from the site for the period up until 12am midnight will be assessed against the octave band noise criteria of the L&GNSW as discussed in section 4.1.1.

For the period after 12am midnight, both patron and music noise emissions from the site will be assessed against the inaudibility requirement of the L&GNSW, the criteria for which is summarised in Table 4-2.

4.2.1.2 Predicted Noise Levels

Patron Noise Emissions – Before 12am Midnight (NPfI Criteria)

As discussed in section 4.1.1.2, patron noise emissions from the site will be assessed against the intrusiveness noise criterion ($L_{Aeq,\ 15min}$) of the NPfI for the period up until 12am midnight (refer to section 4.1.2.1).

To assess overall noise intrusiveness from the licensed premises, the cumulative noise from patrons (in both the indoor and outdoor dining areas) as well as music noise within the internal areas of the venues have been presented in Table 4-10.

Table 4-10 Predicted Noise Levels from Patron and Music Noise Emissions Before Midnight – (NPfI Criteria)

NCA	Predicted Noise Level from Patron and Music Noise [1] $L_{Aeq, 15min}$	NPfI Noise Criteria [1] $L_{Aeq, 15min}$	Complies
NCA01	Day & Evening – 38 Early Night – 33	Day & Evening – 40 Early Night – 35	Yes
NCA02	Day & Evening – 34 Early Night – 31	Day & Evening – 41 Early Night – 38	Yes
NCA03	Day & Evening – 34 Early Night – 32	Day & Evening – 38 Early Night – 35	Yes

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Early Night = 10pm – 12am

Cumulative $L_{Aeq, 15min}$ patron and music noise emissions from the development's licensed premises and outdoor pool comply with the nominated intrusiveness criteria of the NPfI for all periods prior to 12am midnight.

Music Noise Emissions – Before 12am Midnight (L&GNSW Criteria)

Music noise emissions from the site for the period up until 12am midnight will be assessed against the L&GNSW "background noise + 5dBA in octave bands" criteria. The predicted music noise emissions are presented in Table 4-11.

Table 4-11 Predicted Music Noise Emissions Before Midnight – (L&GNSW Criteria)

NCA	Time Period [1]		Octave Band Levels dBA										Complies
			31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	Total dBA	
NCA01	Day & Evening	Predicted Noise Level – dBL_{10}	48	48	40	32	35	25	23	15	0	**34**	**Yes**
		Criteria – dBL_{10}	50	48	41	37	38	33	34	29	24	**40**	
	Early Night	Predicted Noise Level – dBL_{10}	45	45	37	29	32	22	20	12	0	**31**	**Yes**
		Criteria – dBL_{10}	45	45	38	35	33	28	26	27	24	**35**	
NCA02	Day & Evening	Predicted Noise Level – dBL_{10}	42	42	32	24	26	16	13	2	0	**26**	**Yes**
		Criteria – dBL_{10}	51	50	45	39	34	35	35	32	26	**41**	
	Early Night	Predicted Noise Level – dBL_{10}	39	39	29	21	23	13	10	0	0	**23**	**Yes**
		Criteria – dBL_{10}	48	50	43	40	34	32	30	28	24	**38**	
NCA03	Day & Evening	Predicted Noise Level – dBL_{10}	41	41	30	21	22	14	8	0	0	**23**	**Yes**
		Criteria – dBL_{10}	51	53	48	41	35	27	25	25	21	**38**	
	Early Night	Predicted Noise Level – dBL_{10}	38	38	27	18	19	11	5	0	0	**20**	**Yes**
		Criteria – dBL_{10}	47	48	41	34	30	27	27	25	20	**35**	

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Early Night = 10pm – 12am

Table 4-12 Predicted Patron and Music Noise Emissions After Midnight – (L&GNSW Octave Band Criteria)

NCA	Time Period [1]		Octave Band Levels dBA										Complies
			31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	Total dBA	
NCA01	12am – 7am	Predicted Noise Level – dBL_{10}	32	32	23	18	21	13	8	0	0	**20**	**Yes**
		Criteria – dBL_{10}	40	40	33	30	28	23	21	22	19	**30**	
NCA02	12am – 7am	Predicted Noise Level – dBL_{10}	25	25	16	10	12	4	0	0	0	**12**	**Yes**
		Criteria – dBL_{10}	42	44	37	34	28	26	24	22	18	**32**	
NCA03	12am – 7am	Predicted Noise Level – dBL_{10}	41	41	30	21	22	14	8	0	0	**23**	**Yes**
		Criteria – dBL_{10}	42	43	36	29	25	22	22	20	15	**30**	

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Early Night = 10pm – 12am

Music noise emissions from the site during the period before 12am midnight comply with the requirements of L&GNSW.

Patron and Music Noise Emissions – After 12am Midnight (L&GNSW Criteria)

Patron and music noise emissions from the site for the period after 12am midnight will be assessed against the "background noise + 0dBA in octave bands" criteria (see Table 4-1) and the inaudibility criteria (see Table 4-2) of L&GNSW. The predicted cumulative patron and music noise emissions have been assessed against the "background noise + 0dBA in octave bands" and the inaudibility criteria.

Table 4-13 Licensed Premises Patron and Music Noise Emission Criteria After 12am Midnight (L&GNSW Inaudibility Criteria)

NCA	Period	Predicted Noise Level $L_{Aeq, 15min}$	L&GNSW Noise Emission Criteria, $L_{Aeq, 15min}$	Complies
NCA01	12am midnight – 7am	18	**18**	**Yes**
NCA02	12am midnight – 7am	11	**22**	**Yes**
NCA03	12am midnight – 7am	< 10	**19**	**Yes**

Patron and music noise emissions from the site will comply with the L&GNSW criteria during the 12am to 7am through the implementation of suitable noise mitigation measures (indicative recommendations presented in section 4.3).

4.2.2 Vehicle Noise in Porte Cochere

4.2.2.1 Noise Modelling Procedure

Modelling of noise emissions from vehicle movements along the porte cochere within the site have been based on the following:

- The SWL noise emissions from a car are as presented in Table 4-14 (based on measurements conducted by RWDI):

Table 4-14 SWL from Cars

Noise Source	Sound Power Level, L_{Aeq}, dBA [1]
SWL Car Manoeuvring at 10km/hr	85
SWL Car Idling	80

- Based on the expected traffic predictions provided by The Transport Planning Partnership, traffic flow through the porte cochere will be as follows:
    - Approximately 30 vehicle movements into and out of the porte cochere in one hour during the day and evening periods (7am-10pm); and
    - Approximately 20 vehicle movements into and out of the porte cochere in one hour during the night time period (10pm-7am).
- It is assumed that each vehicle accessing the port cochere will idle for 15 seconds upon arrival and then switch off its engine.

We note that noise emissions from cars manoeuvring within the basement level carpark will be negligible and will have no appreciable contribution to noise impacts on surrounding receivers.

4.2.2.2 Predicted Noise Levels

The predicted noise levels at the surrounding receivers from vehicle movements within the porte cochere are presented in Table 4-15. Noise emissions will be assessed against the requirements of the project noise trigger levels of the NPfI (refer to section 4.1.2.1).

Table 4-15 Predicted Noise Levels from Vehicle Movements Through Porte Cochere

NCA	Predicted Noise Level [1] $L_{Aeq, 15min}$	NPfI Noise Criteria [1] $L_{Aeq, 15min}$	Complies
NCA01	Day & Evening – 37 Night – 35	Day & Evening – 40 Night – 35	Yes
NCA02	Day & Evening – 23 Night – 22	Day & Evening – 41 Night – 37	Yes
NCA03	Day & Evening – < 20 Night – < 20	Day & Evening – 38 Night – 35	Yes

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am, Early Night = 10pm – 12am

Our analysis indicates that noise emissions from vehicle movements along the porte cochere will comply with the NPfI project noise trigger criteria.

4.2.3 Discussion of Cumulative Noise Impacts (Patron/Music Noise and Porte Cochere)

Cumulative noise impacts from patron/music noise emissions and vehicle noise from the porte cochere have been considered and is discussed below.

Noise predictions indicate that cumulative noise from these noise sources (patron/music noise and vehicle noise from the porte cochere) will comply with the nominated emission criteria at NCA02 and NCA03 during all periods (day, evening and night), and at NCA01 during the day and evening periods, and after midnight.

The cumulative impact from these noise sources at the potentially most-affected receivers in NCA01 is predicted to be 37$L_{Aeq, 15min}$ during the early night period (10pm-12am midnight), which is a marginal 2dBA exceedance of the nominated acoustic criteria of 35$L_{Aeq, 15min}$. We note that this predicted noise level represents a typical worst-case scenario for noise generation from these uses. Considering that patron/music noise and vehicle noise in the porte cochere are intermittent and non-constant in nature (i.e. there will be periods where the uses will generate levels lower than what have been predicted in this assessment), and that it is unlikely that these two uses will be generating their typical worst-case noise emissions simultaneously, the cumulative noise impacts will typically be lower than the predicted 37$L_{Aeq, 15min}$, and likely be compliant with the 35$L_{Aeq, 15min}$ criteria at various (potentially the majority of) periods throughout the early night period.

Furthermore, section 4.2 of the NPfI classifies the significance of a 2dBA exceedance of the project noise trigger level as negligible, with Table 4.2 of the NPfI stating that an exceedance of this magnitude *"would not be discernible by the average listener"* when compared to a compliant noise level.

In summary, while cumulative impacts from patron/music noise and vehicle noise in the porte cochere are predicted to exceed the project noise trigger levels during the early night period, these exceedances are unlikely to occur as it is unlikely that these two sources of noise will be generating their typical worst-case noise emissions simultaneously (due to the intermittent and non-constant nature of the noise sources), and even if the exceedance does occur it would generally not be discernibly louder than a compliant level. Based on this, it can be reasonably concluded that cumulative noise impacts from patron/music noise and vehicle noise in the porte cochere will not result in adverse noise impacts on the surrounding sensitive receivers.

Noise from mechanical plant has not been included in this discussion as separate acoustic criteria has been developed for mechanical plant (as discussed in section 4.1.2.1) to ensure that noise contributions from the development's plant will be generally negligible.

4.2.4 Sleep Disturbance

Operational noise emissions associated with the site that occur during the night time period (10pm-7am) should be assessed for potential sleep disturbance at the nearest noise sensitive receivers. The primary external transient noise sources that may potentially cause sleep disturbance include the following:

- Vehicles manoeuvring on the at grade porte cochere;
- Patron noise in the outdoor dining areas and outdoor pool.

A summary of the L_{Amax} sound power levels of typical activities that may occur on site with the potential to cause sleep disturbance is presented in Table 4-16.

Table 4-16 Sleep Disturbance – L_{Amax} Sound Power Levels

Noise Source	L_{Amax} SWL (dBA)
SWL Car Manoeuvring at 10km/hr in Porte Cochere	85
SWL Car Door Closing	92
SWL of Patron Shouting	97

The predicted night-time L_{Amax} noise levels at the nearest receivers to the development are presented in Table 4-17, and are assessed against the NPfI's sleep disturbance criteria (see section 4.1.3).

The noise emission predictions presented in section 4.2.1.2 assume that the noise mitigation recommendations presented in section 4.3 have been implemented, namely that 2.4m high acoustic screens are installed along the western perimeter of all three outdoor dining areas.

Table 4-17 Summary of Predicted Sleep Disturbance Noise Levels

NCA	Noise Source	L_{AFmax} Noise Level (dBA)		Complies
		Predicted	Criteria	
NCA01	Car Manoeuvring	46	52	Yes
	Car Door Slam	48	52	Yes
	Patron Shouting	38	52	Yes
NCA02	Car Manoeuvring	40	52	Yes
	Car Door Slam	35	52	Yes
	Patron Shouting	36	52	Yes
NCA03	Car Manoeuvring	35	52	Yes
	Car Door Slam	< 20	52	Yes
	Patron Shouting	35	52	Yes

The above assessment indicates that predicted night-time L_{AFmax} noise levels from the site complies with the night-time sleep disturbance criteria at all receivers. As such, sleep disturbance impacts are unlikely and no further analysis is required.

4.2.5 Mechanical Plant

At this stage, selections of specific mechanical equipment and the location of the equipment have not been finalised. The major plant and their indicative locations that have been proposed in concept are list below. In addition, sound power levels (SWLs) for the plant that have been assumed for the purposes of this assessment have also been presented:

Table 4-18 Major Mechanical Plant Items With Indicative Locations and SWLs

Plant Item	Indicative Location	Assumed Individual SWL, dBA
Carpark Exhaust Fans	Basement level plant rooms discharging at ground level (discharges assumed to be on the eastern façade of development)	95
Carpark Supply Fans	Basement level plant rooms with intakes on ground level, eastern façade of development)	95
Air Cooled Chillers	Rooftop plant rooms. Assumed that one will be located on the roof of building A and one on the roof of building B	100
Cooling Towers	Rooftop plant rooms. Assumed that two will be located on the roof of building A and two on the roof of building B	90

Plant Item	Indicative Location	Assumed Individual SWL, dBA
Kitchen Exhaust Fans (KEFs)	Rooftop plant rooms with discharges through the roof. Assumed that one will be located on the roof of building A and two on the roof of building B	90
Kitchen Make Up Fans	Within the commercial kitchens of restaurant 1, 2 and the function centre with intakes on ground level, eastern façade of the development. Assumed that one will be located in building A and two in building B	85
Air Handling Units (AHUs)	Rooftop plant rooms. Assumed that there will be one AHU on the roof of each building (6 in total)	90
Diesel Generator	Rooftop plant room. Assumed that one will be located on the roof of building A.	75 dBA at 7m (assumed to be located within an acoustic enclosure)

The following has been assumed as part of the preliminary noise emission modelling for the mechanical plant:

- The rooftop plant rooms generally do not have any openings or discharge/intakes on the façades with line of sight to the NCA01 receivers.
- Any rooftop plant not located in the rooftop plant rooms are located towards the eastern side of the buildings such that the plant rooms maximise shielding between the plant and the NCA01 receivers.
- Chillers are housed in an area of the plant rooms that is partitioned off from the remainder of the plant room (housing the other mechanical plant such as KEFs) to prevent excessive noise breaking out from the plant room. The section of the plant room housing the chillers has a solid, imperforate external wall construction with the room either being mechanically ventilated, or naturally ventilated with acoustic louvres installed in the ventilation openings. The acoustic louvres will achieve a noise reduction of at least 10dBA.
- Intakes and discharges for the carpark ventilation fans, and the intakes for the kitchen make up fans are located on the eastern façade of the buildings.
- The following plant will be acoustically treated (e.g. silencers and/or internally lined ductwork) such that noise emissions from the plant to external areas is reduced by at least 10dBA:
    - Carpark supply and exhaust fans;
    - All KEFs (recommended that these are axial fans);
    - All AHUs.
- Cooling towers and carpark ventilation fans are fitted with variable speed drives which will facilitate these plant items typically operating at no more than 50% capacity during the night time period due to decreased load/ventilation requirements.
- Acoustic treatment has been applied to the AHUs and KEFs (e.g. in-duct treatment such as silencers, acoustic louvres) to reduce noise emissions from the plant by at least 10dBA.
- The generator will also operate during emergencies, however will need to undergo testing on a regular basis. It is anticipated that the generator would only be tested during the daytime period (7am to

6pm). For the purposes of this assessment, it is has been assumed that the air inlet and discharge, and exhaust gas discharge for the generator are shielded from the NCA01 receivers and have been acoustically treated to achieve a noise level of no more than 70dBA at a distance of 3m from the inlet/discharge grilles.

4.2.5.1 Predicted Noise Levels

Based on the assumption presented above the predicted noise levels at the surrounding receivers from mechanical plant are presented in Table 4-19. Noise emissions will be assessed against the requirements of the nominated project noise trigger levels of the NPfI for mechanical services (refer to Table 4-7).

Table 4-19 Predicted Noise Levels from Mechanical Plant

NCA	Predicted Noise Level [1] $L_{Aeq, 15min}$	NPfI Noise Criteria [1] $L_{Aeq, 15min}$	Complies
NCA01	Day & Evening – 29 Night – 27	Day & Evening – 32 Night – 27	Yes
NCA02	Day & Evening – 31 Night – 26	Day & Evening – 33 Night – 29	Yes
NCA03	Day & Evening – 29 Night – 26	Day & Evening – 30 Night – 27	Yes

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am

Our preliminary review indicates that with considered design, noise from the development's mechanical plant is capable of being adequately attenuated to comply with the nominated NPfI project noise trigger criteria for mechanical services.

4.3 Operational Noise Recommendations

Based on the preliminary review of noise emissions from the development, indicative recommendations are provided in the following sub-sections in order for the development to comply with the nominated noise emission requirements. A review should be conducted at development application stage to ensure that noise emissions from the development are adequately mitigated.

4.3.1 Patron and Music Noise

The following noise control measures are recommended to adequately control patron and music noise from the restaurant and function centre spaces impacting residential receivers external to the site.

- 2.4m high acoustic screens are likely to be required along the western perimeter of all three outdoor dining areas as shown in blue in Figure 4-2. The screens should be constructed of a solid, unperforated material with a minimum surface density of 12.5kg/m^2.

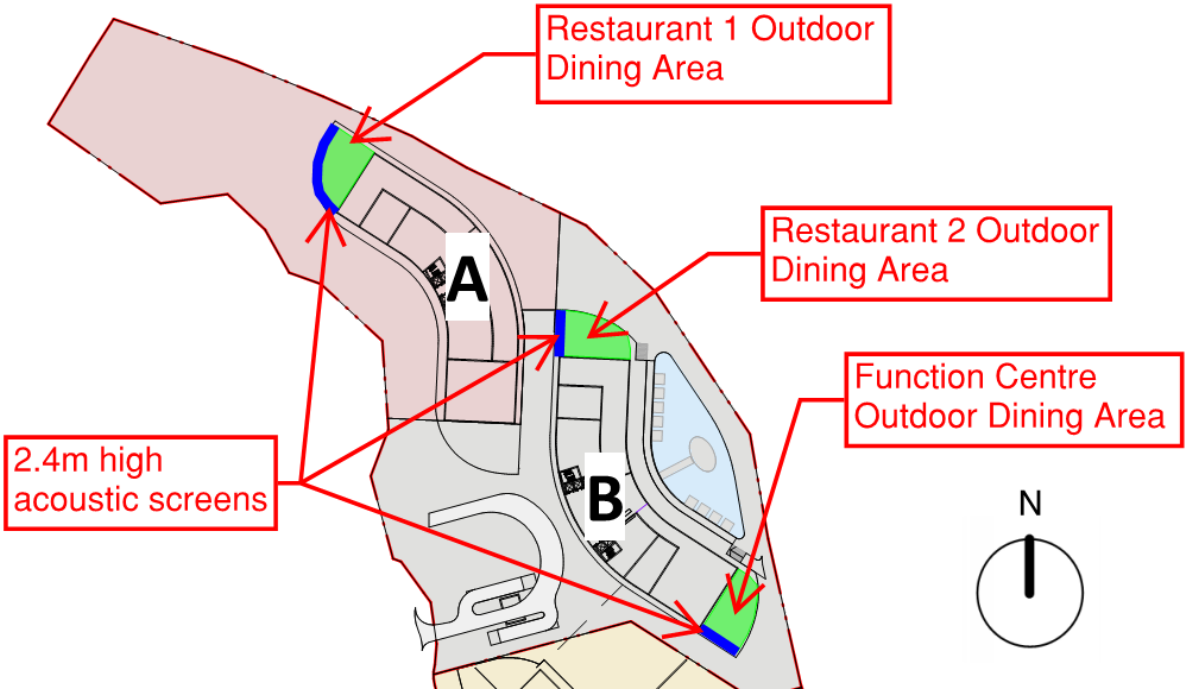


Figure 4-2 Indicative Screen Requirements for Outdoor Dining Areas

- Sound insulation performance of the glazing and frames to the restaurants and the function centre should achieve a minimum weighted sound reduction index (R_w) rating of 36 (indicatively 12.38mm laminated glass);
- Number of patrons in the outdoor dining areas should be limited to the following:
  - Day and Evening (7am-10pm):
    - 150 patrons in each outdoor dining area (Restaurant 1, 2 and Function Centre. Total 450 patrons in outdoor dining areas).
  - Early Night (10pm-12am):
    - 75 patrons in each outdoor dining area (Restaurant 1, 2 and Function Centre. Total 225 patrons in outdoor dining areas).
  - After 12am midnight:
    - No patrons in any of the outdoor dining areas.
- The entrances to both restaurants and the function centre should consist of a vestibule door system (i.e. two sets of doors) with adequate spacing between the two sets of doors such that at least one of the doors is typically closed at any given time during patron or staff ingress/egress.
- Signs should be displayed in the restaurant and function centre spaces reminding patrons to minimise noise when departing the premises, especially after 10pm.
- The spatially averaged internal music noise level within the restaurant and function centre spaces should be limited to the noise levels presented in Table 4-20.
- Amplified music should not be played in in any of the outdoor dining areas or the outdoor pool area.

Table 4-20 Music Noise Level within Restaurant 1, Restaurant 2 and Function Centre – dB

Time of Day	Descriptor	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	Total dBA
Day & Evening (7am-10pm)	$L_{Aeq, 15min}$	100	100	98	96	100	93	90	88	83	**100**
	$L_{A10, 15min}$	103	103	101	99	103	96	93	91	86	**103**
Early Night (10pm-12am)	$L_{Aeq, 15min}$	97	97	95	93	97	90	87	85	80	**97**
	$L_{A10, 15min}$	100	100	98	96	100	93	90	88	83	**100**
After Midnight	$L_{Aeq, 15min}$	83	83	81	79	83	76	73	71	66	**83**
	$L_{A10, 15min}$	86	86	84	82	86	79	76	74	69	**86**

Noise management controls for the restaurant and function centre tenancies should be reviewed once tenants have been confirmed and specific operational details are provided.

4.3.2 Porte Cochere (Vehicle Noise)

- Signs should be displayed at the porte cochere reminding drivers to switch off their engines during idling.
- Any speed bumps, drainage grates or expansion joint covering plates should be firmly down such that they to not generate any rattling noises when driven over by vehicles.

4.3.3 Mechanical Plant

- An acoustic review of mechanical plant should be undertaken at detailed design stage once plant selections and locations have been finalised. Noise from the mechanical plant should be designed to comply with the project noise trigger levels of the NPfI presented in Table 4-7.

4.4 Noise Impacts on Sensitive Spaces Within Development

Consideration should also be given to the impacts of noise-generating uses in the development on noise-sensitive uses within the site (primarily residential as well as hotel guest rooms). As the noise-generating uses are in relatively close proximity to residential facades/residential outdoor living spaces, the design should account for adequate acoustic separation and sound isolation to mitigate excess noise impact at all noise-sensitive receptors.

In this section, the potential noise impact of noise-generating uses to on-site noise-sensitive uses are discussed at a high-level, since noise mitigation could be applied at the source and receptor to ensure the applicable criteria are met. Details of noise mitigation will need to be developed during the project detailed design.

The primary sources of noise generation identified for the proposed development are as follows:

- Restaurants, function centre and outdoor dining areas (patron activity and music); and
- Rooftop mechanical plant, including noise from any outdoor/uncovered units and ventilation openings.

4.4.1 Restaurants, Function Centre, Outdoor Dining Areas and Outdoor Pool

The outdoor dining areas are anticipated to potentially have considerable effects on the residential and hotel room facades overlooking these venues. This is intended to be managed through establishing a Noise Management Plan for the precinct to consider cumulative noise impacts and determine reasonable operating hours, managing patron numbers and strict limits on any music. It is expected with these controls in place, noise emissions will meet the nominated acoustic criteria at off-site receptors (see section 4.1).

Whilst restaurant and function centre tenancies are proposed for the development, the exact operating details for these tenancies are not known at this early stage. Once operators for tenancies have been confirmed, it is recommended that the details of the noise control requirements are coordinated to ensure that noise emissions from the operation of the tenancies will not result in any adverse noise impacts on nearby sensitive receivers (either within or outside the development) noting different expectations about vibrancy in a residential development overlooking outdoor venues/dining areas.

4.4.2 Mechanical Plant

As discussed in section 4.2.5, selections of specific mechanical equipment and the location of the equipment have not been finalised. Given this, it is not possible to carry out an assessment of noise emissions of mechanical plant at this early stage.

It is recommended that a detailed acoustic assessment of the mechanical equipment is undertaken at construction certification stage.

Mitigation measures that are commonly employed to control noise emissions from mechanical equipment include:

- Locating mechanical equipment as far as practicable from noise sensitive receivers;
- Using in-duct treatments such as internally lined ductwork or silencers;
- Building barriers or enclosures around equipment;
- Using acoustic louvers.

5 EXTERNAL NOISE INTRUSION ASSESSMENT

The most significant source of external noise intrusion on the development will be from helicopter operations to and from the helipad located approximately 180m east of the site.

5.1 External Noise Intrusion Criteria

5.1.1 Australian Standard AS 2021:2015 – Acoustics – Aircraft Noise Intrusion – Building Siting and Construction

AS 2021:2015 provides guidance for assessing aircraft noise impacts on developments located in the vicinity of airports and aerodromes, however is also suitable for assessing noise from helicopter operations.

Table 3.3 of the AS2021 provides internal sound level recommendations for various space types depending on their use. The relevant internal noise criteria from the Standard are summarised in Table 5-1 below.

Table 5-1 AS 2021:2015 Internal Sound Level Recommendations

Building Type and Activity	Indoor Design Sound Level $L_{AMax(slow)}$, dBA
Houses, Home Units, Flats, Caravan Parks	
Sleeping Areas, Dedicated Lounges	50
Other Habitable Spaces	55
Bathrooms, Toilets, Laundries	60
Hotels, Motels, Hostels	
Relaxing, Sleeping	55
Social Activities	70
Service Activities	75

5.2 Assessment External Aircraft Noise Level – AS 2021:2015

The helicopter noise impacts on the proposed development have been based on noise measurements conducted of helicopter movements to and from the proposed helipad location as part of the Acoustic Assessment prepared by The Acoustic Group (ref: 48.4732.R7C:MSC and dated 23 April, 2018).

During the helicopter operations, noise measurements were undertaken at a location that would be representative of the impacts that are likely to be experienced by the future occupants of the subject development when the helipad is in operation (location 1 in the Appendix A7 figure from The Acoustic Group report – see Figure 5-1).

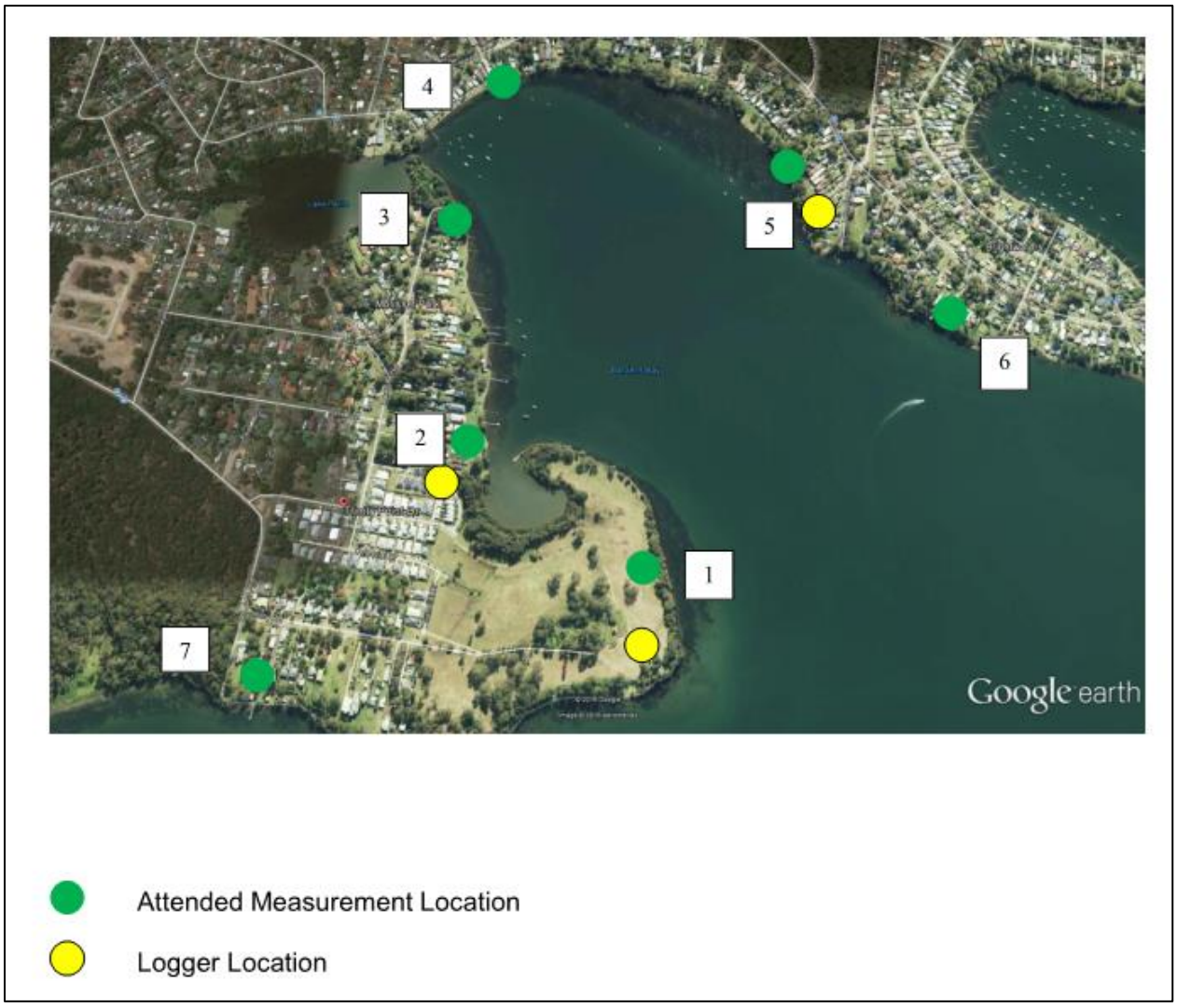


Figure 5-1 Measurement Locations from Appendix A7 of The Acoustic Group Acoustic Assessment for the Proposed Helipad

The results of the noise testing are summarised in Appendix E of The Acoustic Group report, and indicate that the loudest typical helicopter noise level at the subject site location will be 77dB(A)$L_{max(slow)}$ as a result of a helicopter taking off in a south-south easterly direction. This noise level will be used for the purposes assessing external noise intrusion into the development.

We note that helicopter model used during The Acoustic Group noise testing was an Airbus H125 (formerly Eurocopter or Aerospatiale AS 350F) helicopter and represents the common class of helicopters used in the area for charter work.

5.3 Recommendations

Using the expected external helicopter noise level presented in 5.2, noise modelling was performed to determine the internal noise levels within the development as a result of noise transmission through the building façade elements (glazing, external walls and roof/ceiling). This modelling considered the transmission

loss performance of the façade elements, the estimated surface area of each façade element exposed to external noise and the absorption characteristics of the internal spaces due to room finishes.

Based on our analysis, the indicative weighted sound reduction index (R_w) performance for the building façade elements have been presented in the sub-sections below. These recommendations should be reviewed at DA and detailed design stage once room layouts and glazing areas have progressed sufficiently to ensure that the internal noise criteria of AS2021 are achieved (refer to section 5.1).

5.3.1 Glazing and Glazed Doors

The indicative minimum glazing performance for the development are presented in Table 5-2 below.

Glazing suppliers are to provide acoustic laboratory test reports confirming that the acoustic performance of their window systems (combined performance of the glass and window frame) meet the R_w requirements.

Table 5-2 Recommended Minimum Acoustic Performance for Glazing

Room Type	Façade	Minimum Glazing Performance
Apartment Bedrooms	North, East and South	R_w 34
	West	R_w 30
Apartment Living Rooms	North, East and South	R_w 30
	West	R_w 28
Apartment Bathrooms/Laundries	All	R_w 22
Hotel Guest Rooms	North, East and South	R_w 30
	West	R_w 28
Restaurants and Function Centre	All	R_w 22 [1]

Note 1: R_w 22 glazing would be sufficient for the purposes of achieving the internal noise criteria from helicopter operations, however upgraded glazing would be required to control patron and music noise emissions from these entertainment venues (indicatively Rw 36 glazing as discussed in section 4.3.1).

Sample glazing assemblies for each of the R_w ratings are noted below.

R_w 22 Glazing

- Standard glazing (no acoustic seals required)

R_w 28 Glazing

- 6mm float glazing with continuous rubber acoustic seals (similar to Schlegel Q-lon seals)

R_w 30 Glazing

- 6.38mm laminated glazing with continuous rubber acoustic seals (similar to Schlegel Q-lon seals)

R_w 34 Glazing

- 10.38mm laminated glazing with continuous rubber acoustic seals (similar to Schlegel Q-lon seals)

5.3.2 External Walls

Any proposed concrete or masonry external walls will provide adequate acoustic isolation to meet the internal noise requirements. No additional acoustic treatment is expected to be required for these external walls.

Any lightweight external walls should be reviewed at detailed design stage to determine the appropriate construction to meet in the internal noise requirements.

Any penetrations in the external walls (e.g. for services) should be adequately seals so as not to reduce the acoustic performance of the external walls.

5.3.3 Roof/Ceiling

Any concrete roof will provide adequate acoustic isolation to meet the internal noise requirements. No additional acoustic treatment is expected to be required for the roof/ceiling to mitigate external noise intrusion.

Any lightweight roof constructions should be reviewed at detailed design stage to determine the appropriate construction to meet in the internal noise requirements.

5.3.4 Ventilation

In order to meet the internal noise recommendations of AS 2021:2015, the windows and doors on the north, south and eastern façades of the development will need to remain closed. This does not mean that the windows and doors cannot be opened for natural ventilation, however there should an alternative means of ventilation be provided for the space (e.g. mechanical ventilation), this should not compromise the sound isolation performance of the external façade.

6 ROAD TRAFFIC NOISE GENERATION

This section of the report considers the potential impacts from additional traffic generated on the surrounding local road network as a result of the proposed development.

The site will be accessed primarily via the following roadways:

- Trinity Point Drive, primarily for vehicles travelling to/from the tourism/accommodation buildings A and B towards the northern end of the site; and
- Charles Avenue/Henry Road, primarily for vehicles travelling to/from the residential buildings C-F towards the middle and southern end of the site.
- Both of these roadways (Trinity Point Drive and Charles Avenue/Henry Road) connect to Morisset Park Road via a roundabout further to the west of the site.

Figure 6-1 shows an aerial photo of the site and highlights these public roadways.

Figure 6-1 Aerial Photo of Site and Surrounding Road Network (Image Courtesy of Nearmap)

6.1 Traffic Noise Criteria - NSW Road Noise Policy (2011)

Additional guidance for the assessment of traffic noise generated on public roads by new developments is set out in the EPA's Road Noise Policy 2011 (RNP).

Table 3 of the RNP is reproduced in Table 6-1 and presents the relevant baseline criteria for traffic noise impacts from various road categories on residential uses.

Table 6-1 Road Traffic Noise Assessment Baseline Criteria for Residential Land Uses

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from **new** freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15\ hour)}$ 55 (external)	$L_{Aeq, (9\ hour)}$ 50 (external)
	2. Existing residences affected by noise from **redevelopment** of existing freeway/arterial/sub-arterial roads	$L_{Aeq, (15\ hour)}$ 60 (external)	$L_{Aeq, (9\ hour)}$ 55 (external)
	3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local roads	4. Existing residences affected by noise from **new** local road corridors	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (external)
	5. Existing residences affected by noise from **redevelopment** of existing local roads		
	6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments		

For the purposes of this assessment, Trinity Point Drive, Henry Road, Charles Avenue and Morisset Park Road will be classified as sub-arterial roads. This is based on the functional role definition for sub-arterial roads provided in Table 2 of the RNP where it states that sub-arterial roads "*may have been designed as local streets but can serve major traffic-generating developments or support non-local traffic*".

Given that the abovementioned roadways are used by non-local traffic to access the existing 8@Trinity restaurant on site as well as the Trinity Point Marina wharf, it can be reasonably concluded that the identified roadways (Trinity Point Drive, Henry Road, Charles Avenue and Morisset Park Road) can be categorised as sub-arterial roads under the RNP.

As such the baseline noise criteria applicable to the development in Table 3 of the RNP (reproduced in Table 6-1 above) is in line 3, and has been highlighted in red in Table 6-1.

Where noise from additional road traffic noise exceed the relevant base line criteria stipulated in Table 6-1, additional analysis should be conducted to evaluate whether traffic noise levels at residences would increase by more than 2dBA. If the increase in overall traffic noise levels is less than 2dBA, this would typically be considered as a barely perceptible increase in noise level and is unlikely to result in any adverse impacts on residential receivers.

6.2 Traffic Noise Generation Assessment

Estimates of projected traffic volumes on the surrounding roadways with (Build scenario) and without (No Build scenario) the development for the year 2034 have been provided by The Transport Planning Partnership (TTPP). For the No Build scenario, the projected traffic volumes have assumed the following background traffic growth rates for the surrounding roadways (based on discussions with TTPP):

- 2021-2026: 1.06% increase per annum
- 2026-2034: 0.58% increase per annum

The traffic projections used for the purpose of this assessment are presented in Table 6-2.

Table 6-2 Traffic Volume Projections for Surrounding Roadways – Year 2034

Road Label	"No Build" Scenario Year 2034				"Build" Scenario Year 2034			
	Day [1]		Night [1]		Day [1]		Night [1]	
	Volume	HV%	Volume	HV%	Volume	HV%	Volume	HV%
Trinity Point Drive	825	2	124	2	1648	2	248	2
Charles Avenue / Henry Road	444	2	31	2	1214	2	85	2
Morisset Park Road	1269	2	155	2	2862	2	333	2

Note 1: Day = 7am – 10pm; Night = 10pm – 7am

6.2.1 Predicted Noise Levels

Traffic noise impacts at the nearby neighbouring residences have been modelled using the Calculation of Road Traffic (CoRTN) algorithms. Predicted traffic noise impacts at the potentially most-affected residential receivers based on the 2034 Build scenario traffic volumes (see Table 6-2) have been presented in Table 6-3. Traffic noise impacts will be assessed against the RNP's baseline criteria as highlighted in Table 6-1.

Table 6-3 Predicted Noise Levels – Increased Traffic Noise on Public Roads

Receiver Location	Time Period [1]	Predicted Traffic Noise Level from Additional Traffic $L_{Aeq, period}$ dBA	Noise Criteria $L_{Aeq, period}$ dBA	Complies
Residences along Trinity Point Drive	Day	59	60	Yes
	Night	53	55	Yes
Residences along Charles Avenue / Henry Road	Day	57	60	Yes
	Night	48	55	Yes
Residences along Morisset Park Road	Day	59	60	Yes
	Night	52	55	Yes

Note 1: Day = 7am – 10pm; Night = 10pm – 7am

Predicted traffic noise impacts on the surrounding residences are expected to comply with the baseline criteria of the RNP, and so no further analysis is required.

7 CONSTRUCTION NOISE & VIBRATION IMPACT ASSESSMENT

7.1 Acoustic Criteria / Management Levels

7.1.1 **Noise – Interim Construction Noise Guideline (EPA, 2009)**

The NSW EPA *Interim Construction Noise Guideline (ICNG)* requires project-specific Noise Management Levels (NMLs) to be established for noise affected receivers. In the event construction noise levels are predicted to be above the NMLs, all feasible and reasonable work practices are investigated to minimise noise emissions.

Having investigated all feasible and reasonable work practices, if construction noise levels are still predicted to exceed the NMLs then the potential noise impacts would be managed via site specific construction noise management plans, to be prepared in the detailed design phase.

Table 7-1 details the *ICNG* noise management levels.

Table 7-1 Interim Construction Noise Guideline Criteria

Time of Day	NML	How to Apply
Recommended Standard Hours **Monday to Friday 7am to 6pm** **Saturday 8am to 1pm** **No work on Sundays or Public Holidays**	Noise Affected RBL+10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences; 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise Affected RBL+5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the *ICNG*.

Based on the above, presents the applicable noise management levels for construction activities at surrounding receivers that have been adopted for all applications.

Table 7-2 Site-Specific Construction Noise Management Levels

Location	Construction Noise Management Level (NMLs) - $L_{Aeq,15min}$				Highly Noise Affected Noise Level – $L_{Aeq,15min}$
	Day Standard Hours[1]	Day OOH	Evening OOH[2]	Night OOH[3]	
NCA01	45	40	40	35	75
NCA02	46	41	41	37	
NCA03	46	41	38	35	

Note 1: Standard Hours (7am – 6pm Monday to Friday, 8am – 1am Saturday with no work on Sundays or Public Holidays)
Note 2: Evening OOH (6pm – 10pm)
Note 3: Night OOH (10pm – 7am)

7.1.2 Vibration – Construction Noise & Vibration Strategy (TfNSW, 2018)

Minimum working distances for typical vibration intensive construction equipment are provided in the Transport for NSW's (TfNSW) *Construction Noise and Vibration Strategy* (CNVS).

The minimum working distances presented in Appendix D of the CNVS are for both cosmetic damage (from BS 7358) and human comfort (from the NSW EPA Vibration Guideline) and are based on empirical data which suggests that where vibration intensive works are conducted outside the minimum distances, adverse vibration impacts are unlikely.

The recommended minimum working distances for vibration intensive activities from the CNVS are presented in Table 7-3.

Table 7-3 Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Approx. Size / Weight / Model	Minimum Distance	
		Cosmetic Damage (BS 7385)	Human Response (NSW EPA Guideline)
Vibratory Roller	1-2 tonne	5 m	15 m to 20 m
	2-4 tonne	6 m	20 m
	4-6 tonne	12 m	40 m
	7-13 tonne	15 m	100 m
	13-18 tonne	20 m	100 m
	> 18 tonne	25 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18t excavator)	7 m	23 m
Large Hydraulic Hammer	1600 kg (18 to 34t excavator)	22 m	73 m
Pile Driver – Vibratory	Sheet Piles	2 m to 20 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	4 m
Piling Rig – Hammer	12 t down force	15 m	50 m
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

7.2 Proposed Construction Activities

7.2.1 Construction Hours

Where possible, works should be completed during the standard daytime construction hours of Monday to Friday 7.00am to 6.00pm and Saturday 8.00am to 1.00pm. Where Out-of-Hours Works (OOHWs) are required (for emergency works/delivery, etc) it is likely that they would require separate approval.

7.3 Construction Noise Assessment

Noise modelling of the construction noise emissions was undertaken using the ISO9612 noise prediction algorithm in the Cadna/A modelling software.

The noise model was constructed from a combination of aerial photography, existing ground topography, design ground topography and proposed design. The local terrain, receiver buildings and structures have been digitised in the noise model to develop a three-dimensional representation of the construction works and surrounding environment.

7.3.1 Proposed Works

This report provides a preliminary assessment of the potential construction noise and vibration impacts associated with the proposed development. The construction noise and vibration assessment has considered the following construction stages in-principle:

- Demolition and clearing works
- Excavation and piling
- Building construction

Sound power levels (SWLs) for the typical operation of construction equipment applied in the modelling are listed in Table 7-4 and have been based on measurements conducted by RWDI and Appendix C of the CNVS. To assess construction noise levels against the NMLs, the noise levels have been converted to equivalent $L_{Aeq,15min}$ noise emissions based on the expected period of operation of the individual pieces of construction plant.

Table 7-4 Construction Noise Sources

Stage	Equipment	Operating minutes in 15-min period	Quantity	Sound Power Level (dB)		
				Individual Item (SWL)	L_{Aeq} Activity	L_{Amax} Activity
Demolition and Clearing	Excavator (30 t)	15	2	110	**113**	114
	Truck & Dog (30 t)	15	1	108	**108**	
Excavation and Piling	Dozer (D10)	10	2	116	**117**	122
	Truck & Dog (30 t)	15	2	108	**111**	
	Excavator (40 t)	15	2	115	**118**	
	Piling Rig	5	1	116	**111**	
	Concrete Truck	15	1	109	**109**	
Construction	Concrete Truck / Agitator	15	2	106	**109**	117
	Concrete Pump	15	1	109	**109**	
	Truck (20 t)	15	1	103	**103**	
	Mobile Crane	10	1	113	**113**	
	Hand Tools	7.5	5	105	**109**	
	Elevated Work Platform	10	2	97	**98**	

Consistent with the requirements of the *ICNG*, and to inform the scheduling of construction activity and management of noise during the detailed design phase, the construction noise impacts are based on an expected typical worst-case scenario. The *ICNG* recommends that the realistic worst-case or conservative noise levels from the source should be predicted for assessment locations representing the most noise exposed residences or other sensitive land uses. For each receiver area the noise levels are predicted at the most noise-exposed location, which would usually be the closest receiver.

For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted at the most-exposed receiver as the noise levels presented in this report are based on a realistic worst-case assessment.

7.3.2 Predicted Construction Noise Impacts

Preliminary noise impacts have been quantitatively assessed of construction activities for the NCAs surrounding the site. The activities considered are described in Table 7-4.

The typical $L_{Aeq,15min}$ noise levels at the surrounding NCAs are provided in Table 7-5. Each of the construction activities are representative of the 'noisiest' construction periods where there may be simultaneous operation of noise intensive construction plant on site.

Table 7-5 Predicted Construction Noise Impacts

Stage	NCA	Noise Level – $L_{Aeq,15min}$ dBA					
		Predicted Noise Level	Noise Affected Noise Management Levels (NMLs)				Highly Noise Affected NML
			Day [1] Standard	Day OOH	Eve OOH [2]	Night OOH [3]	
Demolition and Clearing	NCA01	60 – 66	45	40	40	35	75
	NCA02	54 – 56	46	41	41	37	
	NCA03	44	46	41	38	35	
Excavation and Piling	NCA01	57 – 73	45	40	40	35	
	NCA02	54 – 62	46	41	41	37	
	NCA03	51 – 53	46	41	38	35	
Construction	NCA01	52 – 68	45	40	40	35	
	NCA02	49 – 57	46	41	41	37	
	NCA03	46 – 48	46	41	38	35	

Note 1: Standard Hours (7am – 6pm Monday to Friday, 8am – 1am Saturday with no work on Sundays or Public Holidays)
Note 2: Evening OOH (6pm – 10pm)
Note 3: Night OOH (10pm – 7am)

During standard construction hours (as defined in the ICNG) noise from demolition and clearing works are expected to comply with the noise affected NML at the NCA03 receivers, while construction works are expected to result in a marginal 2dBA exceedance of the noise affected NML. This exceedance would typically be perceived as just noticeably louder than a compliant noise level.

Exceedances of the noise affected NMLs are generally expected at NCA01 and NCA02 during all stages of construction primarily due to the low background noise levels at these receiver locations, also the close proximity of NCA01 receivers to the site. Exceedances of the noise-affected NML are also expected at the NCA03 receivers during excavation and piling works.

Exceedances of up to 28dBA of the standard hours noise-affected NML are expected at NCA01 during excavation and piling works when works are taking place towards the western boundary of the site.

There are no expected exceedances of the highly-noise affected NML at any of the NCAs. In light of the findings from this preliminary construction noise assessment, all reasonable and feasible noise mitigation measures should be implemented to minimise construction noise impacts on the surrounding sensitive receivers.

Measures to manage construction noise emissions are discussed in section 7.3.3.

7.3.3 Construction Noise Mitigation

As discussed in section 7.3.2, noise levels from construction activities during standard hours are predicted to exceed the NMLs of the ICNG at several receivers surrounding the site. Therefore, in accordance with the ICNG, all reasonable and feasible measures should be applied to manage construction noise emissions from the site. In particular, the following is recommended:

A detailed Construction Noise and Vibration Management Plan (CNVMP) should be prepared and should include, but not be limited to the following:

- Identification of nearby residences and other sensitive land uses;
- Description of approved hours of work;
- Description and identification of construction activities, including work areas, equipment and duration;
- Description of what work practices (generic and specific) will be applied to minimise noise;
- Consider the selection of plant and processes with reduced noise emissions;
- A complaints handling process;
- Noise monitoring procedures;
- Overview of community consultation required for identified high impact works;
- Overview of community consultation process and assessment required for identified additional works outside of standard construction hours; and
- Induction and training will be provided to relevant staff and sub- contractors outlining their responsibilities with regard to noise.

Examples of typical construction noise mitigation measures are provided in Table 7-6, along with the likely reduction in noise levels. Where reasonable and feasible, these measures should be employed during the construction of the development.

Table 7-6 Indicative Construction Noise Mitigation Measures

Mitigation Measure	Anticipated Noise Reduction, dBA
Administrative Controls	
Operate during approved hours	N/A
Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers	N/A
Appropriate training of onsite staff	N/A
Undertake community consultation and respond to complaints in accordance with established project procedures	N/A
Turning off machinery when not in use	0-5
Respite periods for pile drivers and rock breakers (if applicable)	N/A
Conducting regular maintenance of plant to ensure that they are operating as efficiently and quietly as practicable	N/A
Engineering Controls	
Portable temporary screens	5-10
Screen or enclosure for stationary equipment	10-15
Maximising the offset distance between noisy plant items and sensitive receivers	3-6

Mitigation Measure	Anticipated Noise Reduction, dBA
Avoiding using noisy plant simultaneously and / or close together, adjacent to sensitive receivers	2-3
Orienting equipment away from sensitive receivers	3-5
Carrying out loading and unloading away from sensitive receivers	3-5
Using dampened tips on rock breakers	3-6
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Selecting site access points and roads as far as reasonably practicable away from sensitive receivers	3-6
Using spotters, closed circuit television monitors, "smart" reversing alarms, or "squawker" type reversing alarms in place of traditional reversing alarms	2-5
Employ non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers	5-10

7.4 Predicted Construction Vibration Impacts

The nearest neighbouring residential building to the site is approximately 23m west of the site, across Trinity Point Drive.

Based on the CNVS's recommended minimum working distances for vibration sensitive equipment (refer to Table 7-3), the vibration intensive activities that could potentially occur at distances less than the recommended minimum working distances from the sensitive receivers with respect to cosmetic building damage and human comfort are listed in Table 7-7.

Table 7-7 Vibration Intensive Equipment that Could Operate within the Minimum Recommended Distances of Sensitive Receivers

Equipment Potentially Operating Within Recommended Minimum Distances to Sensitive Receivers	
Cosmetic Damage (BS 7385)	**Human Response (NSW EPA Guideline)**
Vibratory Roller > 18 tonne	Vibratory Roller > 4 tonne
	Large Hydraulic Hammer – 1600 kg
	Piling Rig – Hammer

Should these pieces of plant be operated within the minimum recommended distances of the CNVS of a sensitive receiver, or if there are any other vibration intensive plant items that the Contractor has concerns for causing disruption at neighbouring development, it is recommended that a preliminary vibration survey (typically attended vibration measurements) be undertaken of each vibration generating piece of plant.

This vibration survey will determine whether there will be any exceedances of the relevant construction vibration criteria. If exceedances are observed, vibration mitigation and management strategies can be

developed to minimise vibration impacts as far as practicable, and ideally to be compliant with the vibration criteria.

The vibration management strategy may also include the installation of unattended vibration monitors at sensitive receivers to notify the contractor of any exceedances of the vibration criteria. Any such vibration management strategy should be developed as part of a CNVMP.

8 CONCLUSION

This report has presented a noise and vibration impact assessment for the proposed Trinity Point mixed-use development to be located at 49, 81 & 85 Trinity Point Drive, Morisset Park. This assessment has been prepared to address the noise and vibration clauses of the SEARs for the State Significant Development Application (SSD 27028161).

Existing ambient noise levels have been established at nearby sensitive receivers via long-term unattended noise monitoring as presented in section 3. The noise monitoring data has been processed in accordance with the NPfI to establish the RBLs at sensitive receivers.

Noise impacts associated with the operation of the development (primarily patron and music noise, vehicle noise from the porte cochere and mechanical plant noise) have been assessed with reference to the NPfI and L&GNSW as presented in section 4. The results of the assessment indicate in-principle that noise emissions from the site are capable of complying with the relevant acoustic requirements through considered design and the implementation of appropriate acoustic treatments and noise management controls.

Noise intrusion from helicopter operations associated with the proposed helipad near the site have been assessed with reference to the internal noise recommendations of AS2021. Helicopter noise impacts on the development have been based on helicopter noise testing presented in the Proposed Helipad Acoustic Assessment prepared by The Acoustic Group (ref: 48.4732.R7C:MSC and dated 23 April, 2018). Indicative recommendations for the building façade construction have been presented in section 5.3 to achieve the internal noise requirements. These recommendations should be reviewed once the room layouts and glazing areas have progressed sufficiently.

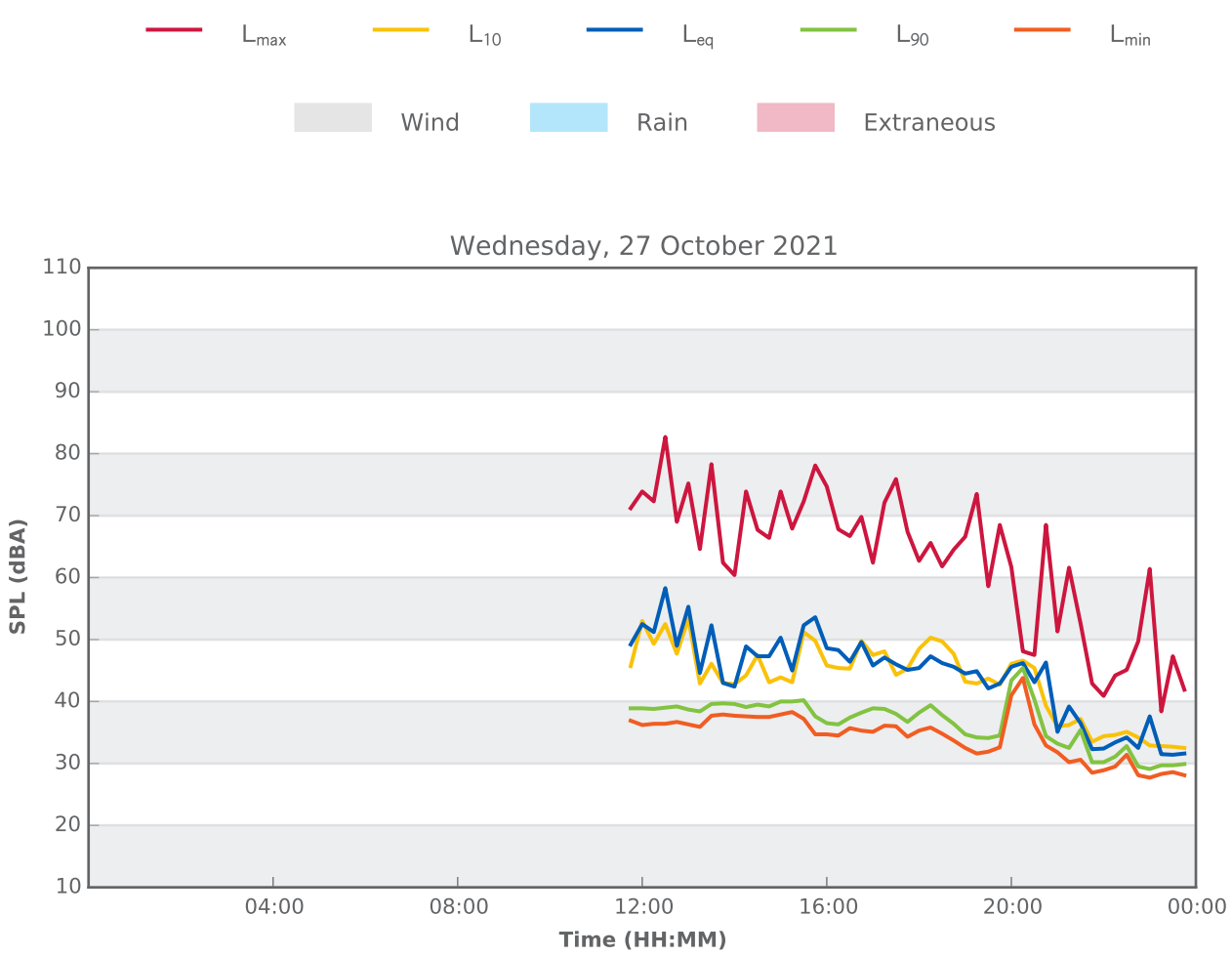
Road noise impacts associated with the operation of the development have been assessed in accordance with the RNP, and predicted traffic noise generation associated with the site comply with the RNP impact assessment criteria as shown in section 6.

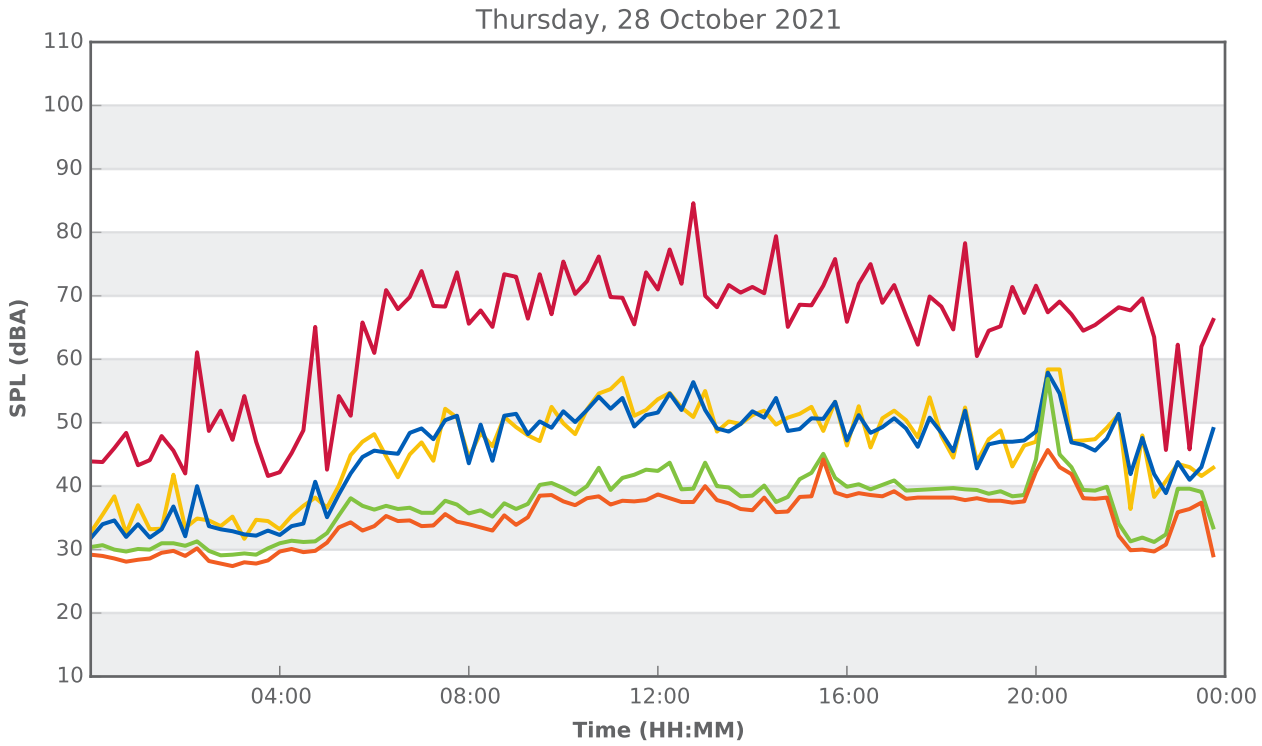
Noise and vibration impacts from the construction of the development have been assessed in-principle in section 7 of the report in accordance with the ICNG. Construction NMLs have been established for sensitive receivers based on the established RBL. A computer noise model has been developed to predict $L_{Aeq,15min}$ construction noise levels at sensitive receivers.

Construction noise levels have been predicted for a range of construction activities. The predicted $L_{Aeq,15min}$ construction noise levels are expected to exceed the established noise affected NMLs numerous receivers in the vicinity of the site. It is therefore recommended that a CNVMP be developed for the site and that all reasonable and feasible measures be implemented to minimise construction noise and vibration impacts. No exceedances of the 75 dBA highly affected level were predicted.

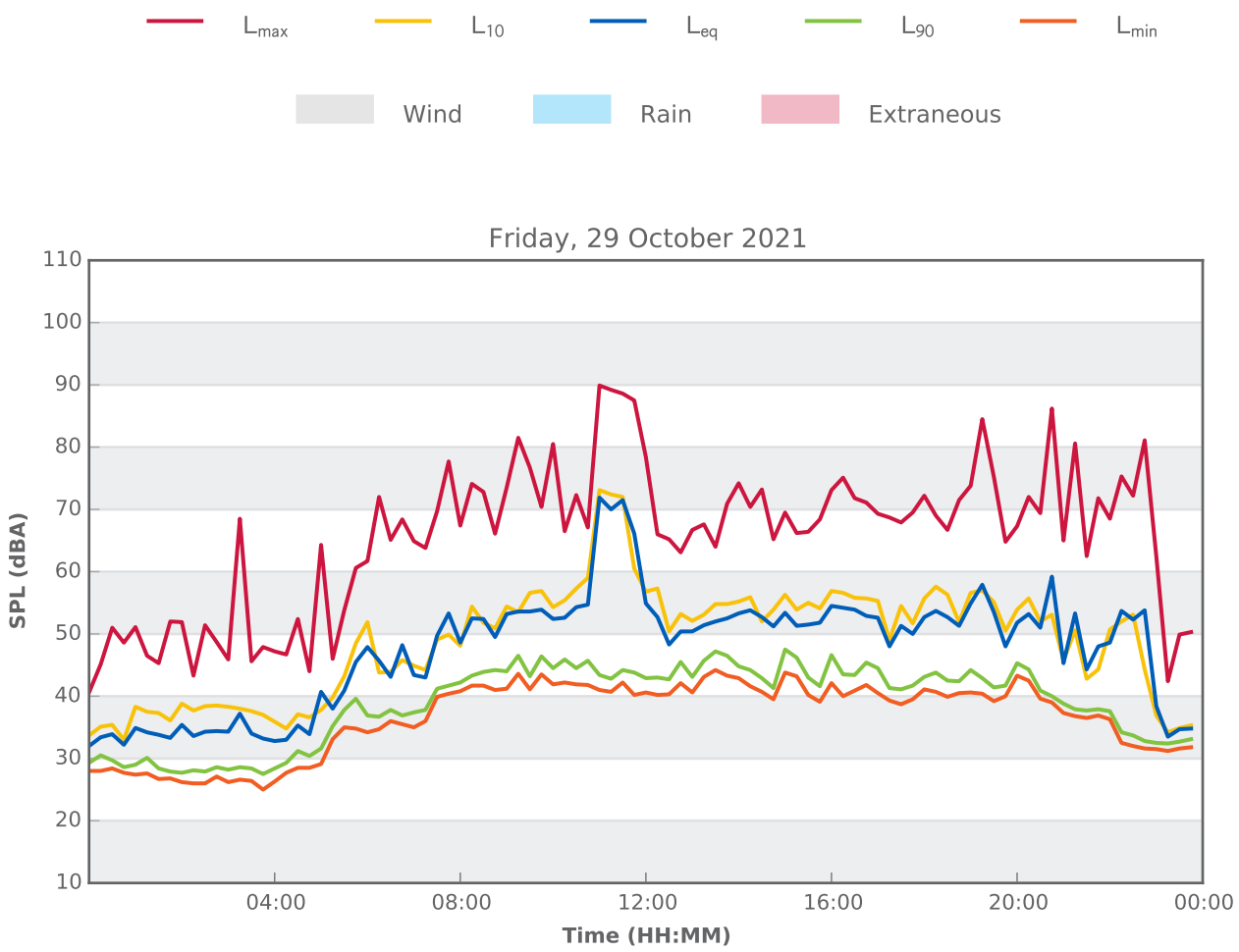
APPENDIX A

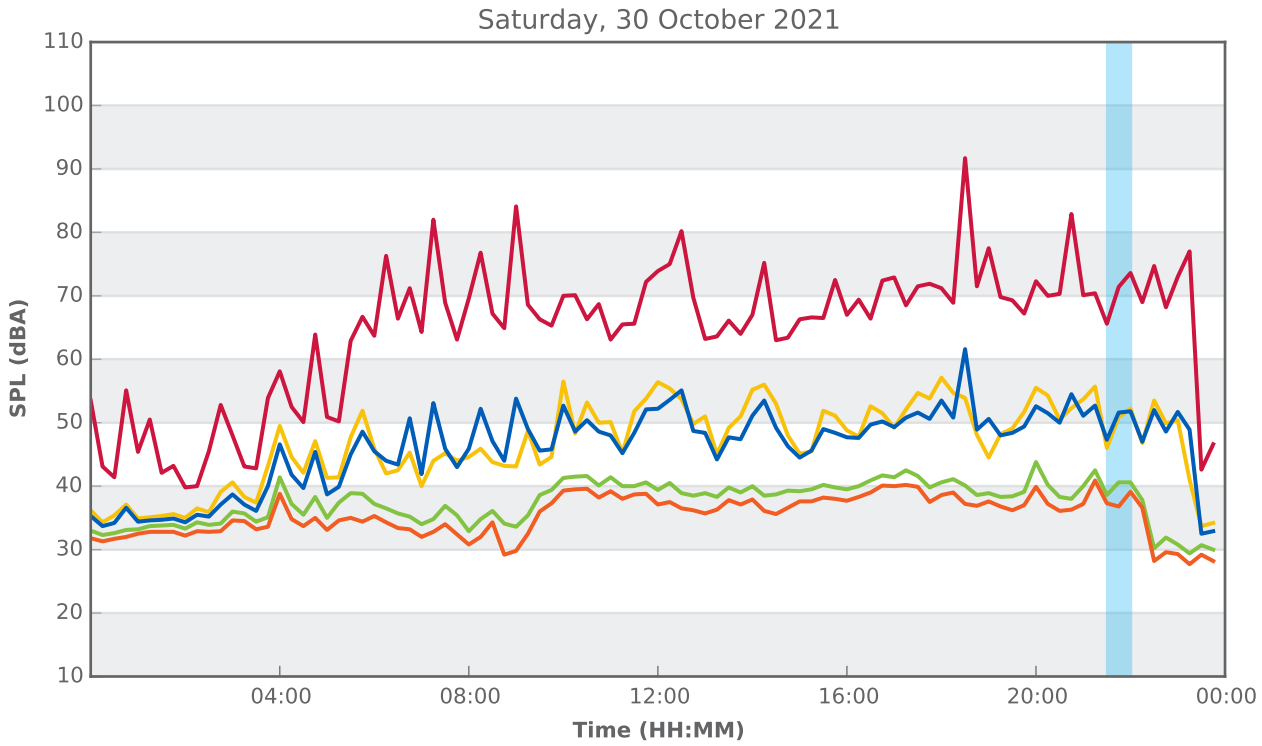
Logger Location 1 - Nearest Residential to West



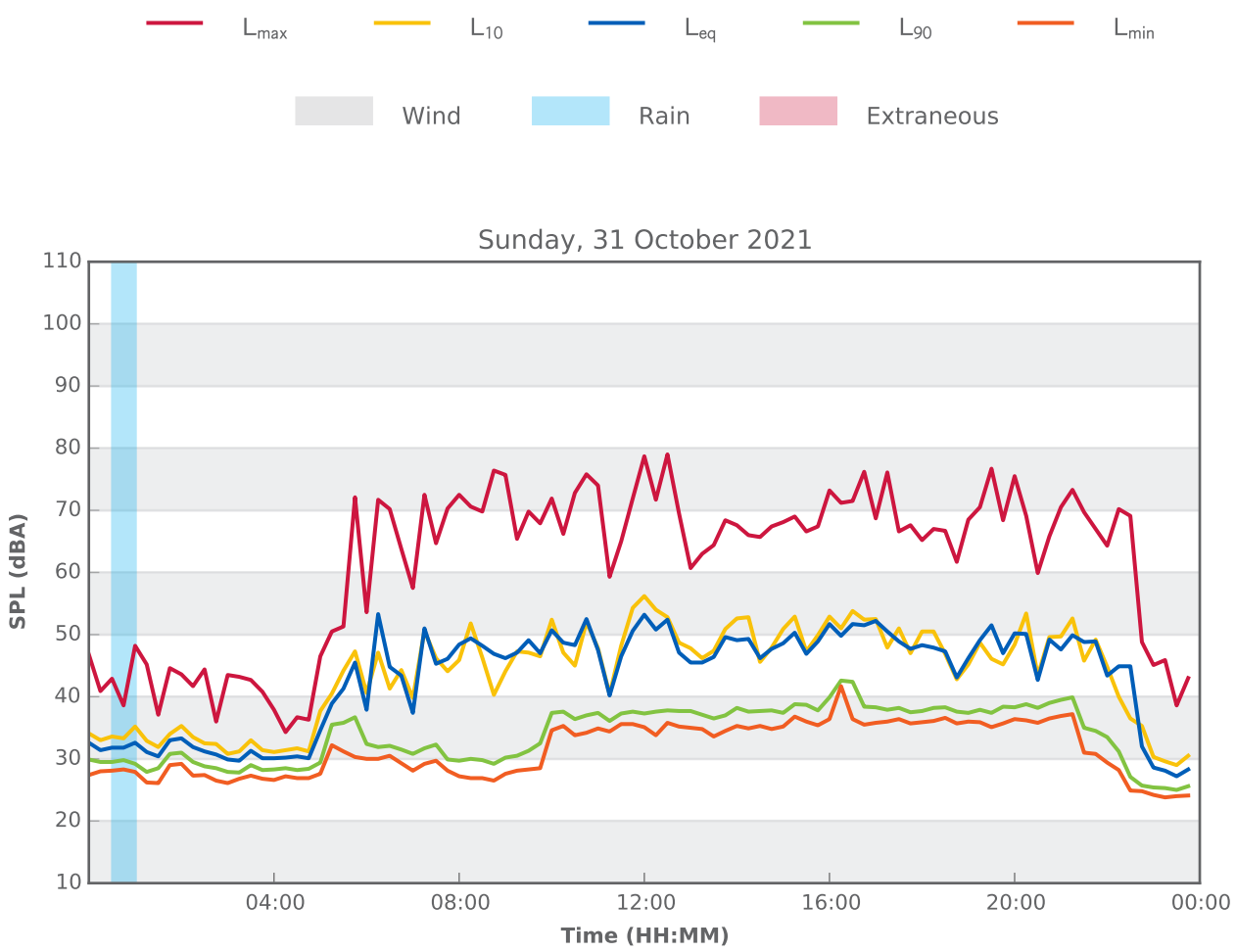


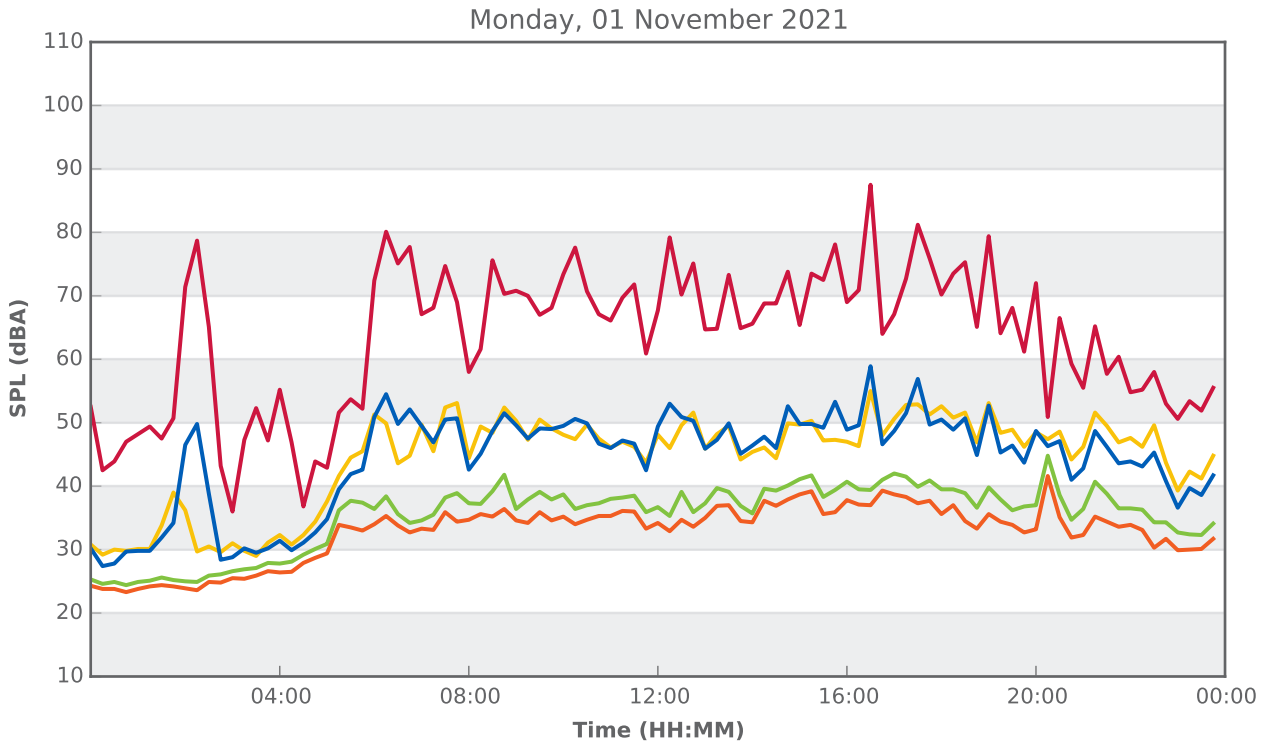
Logger Location 1 - Nearest Residential to West





Logger Location 1 - Nearest Residential to West





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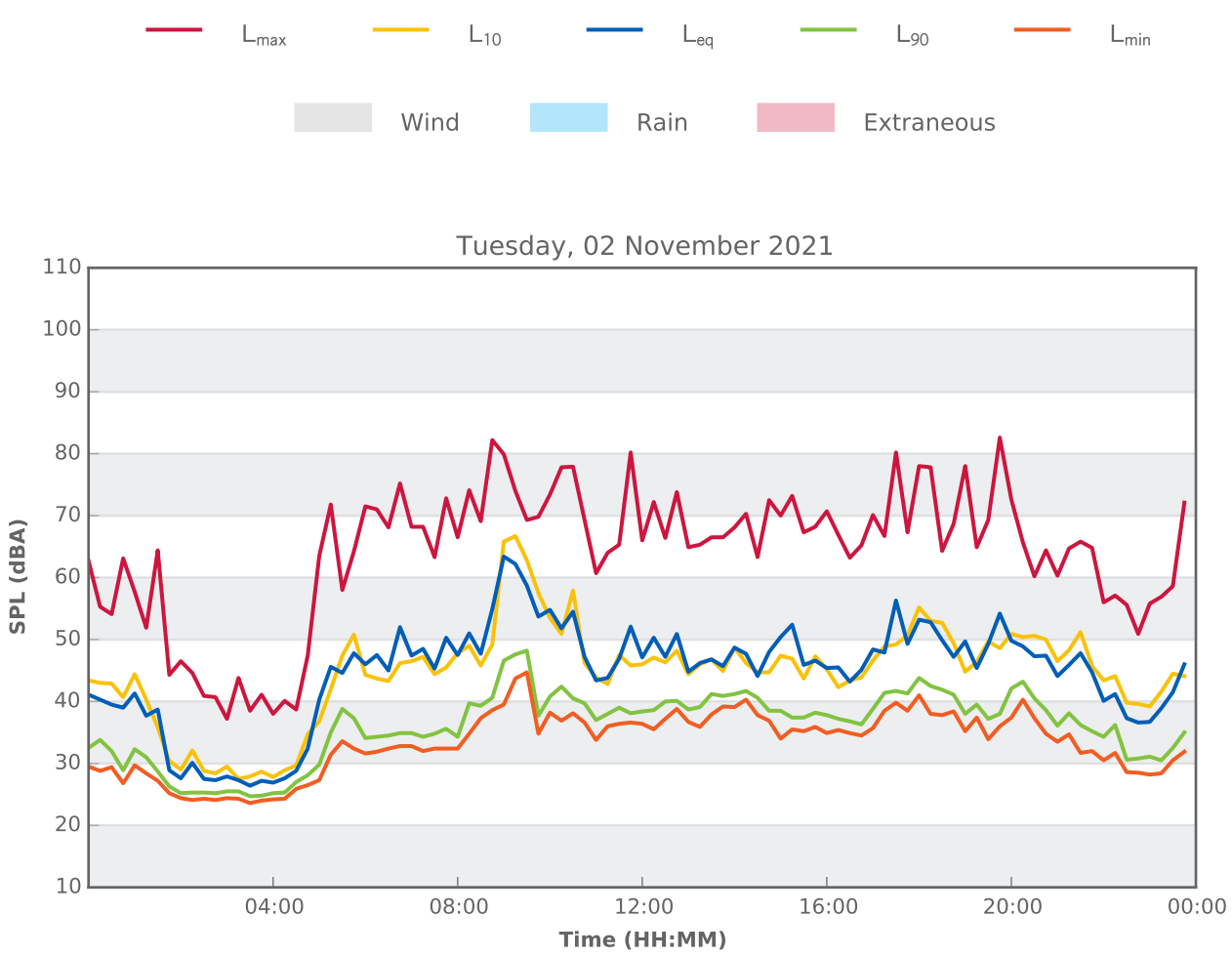

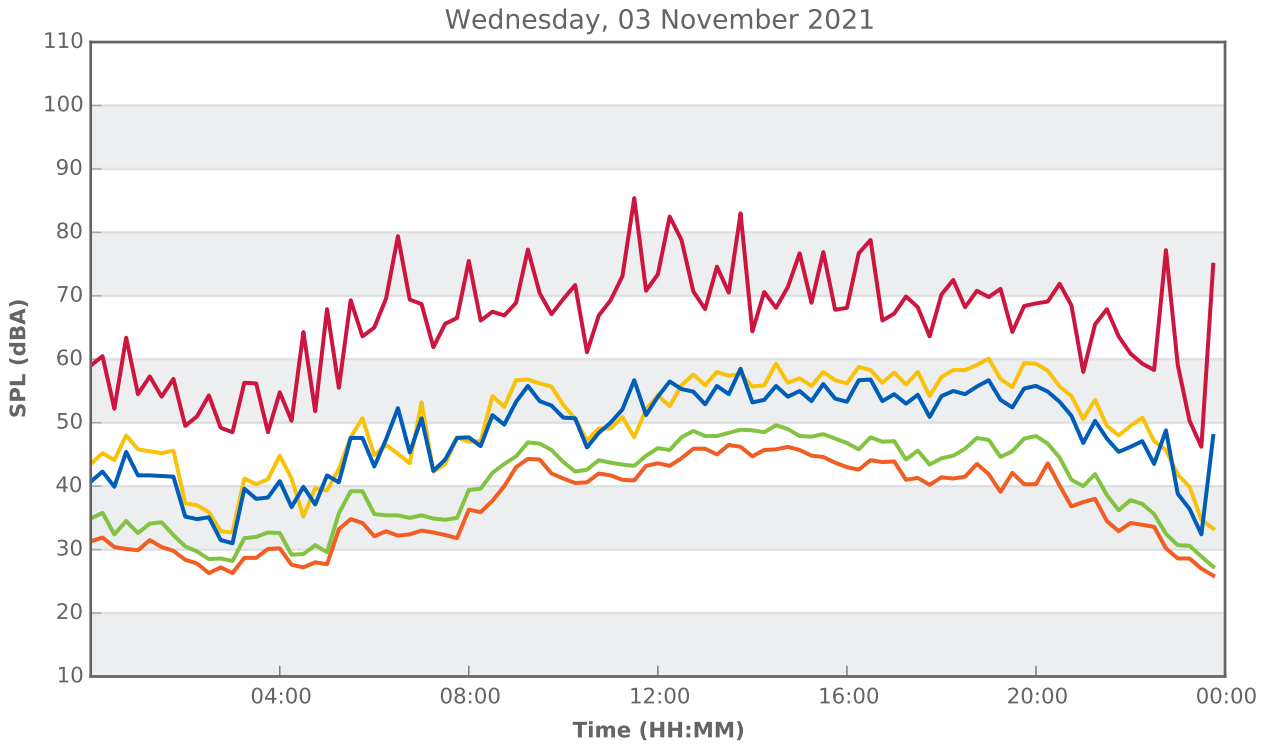

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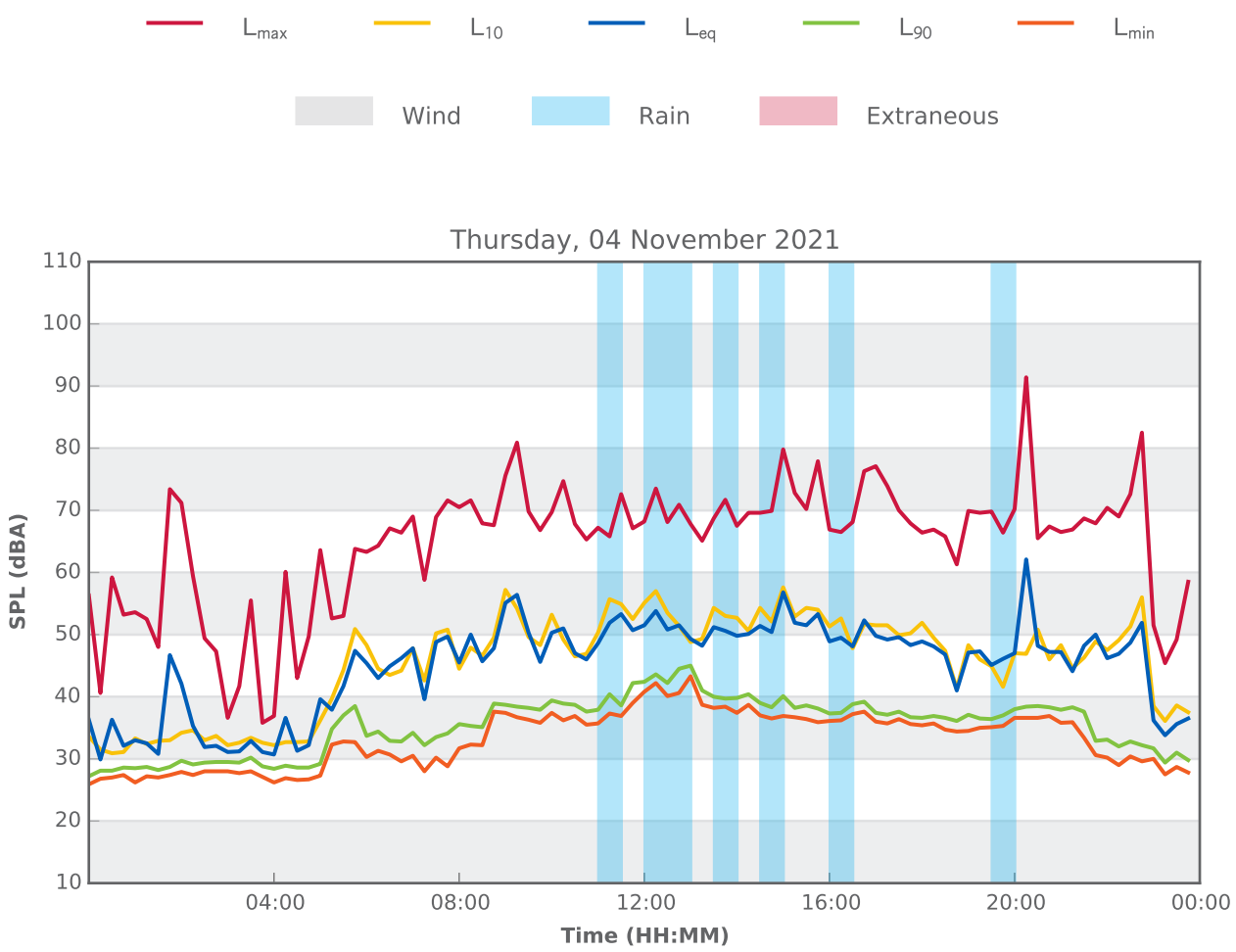

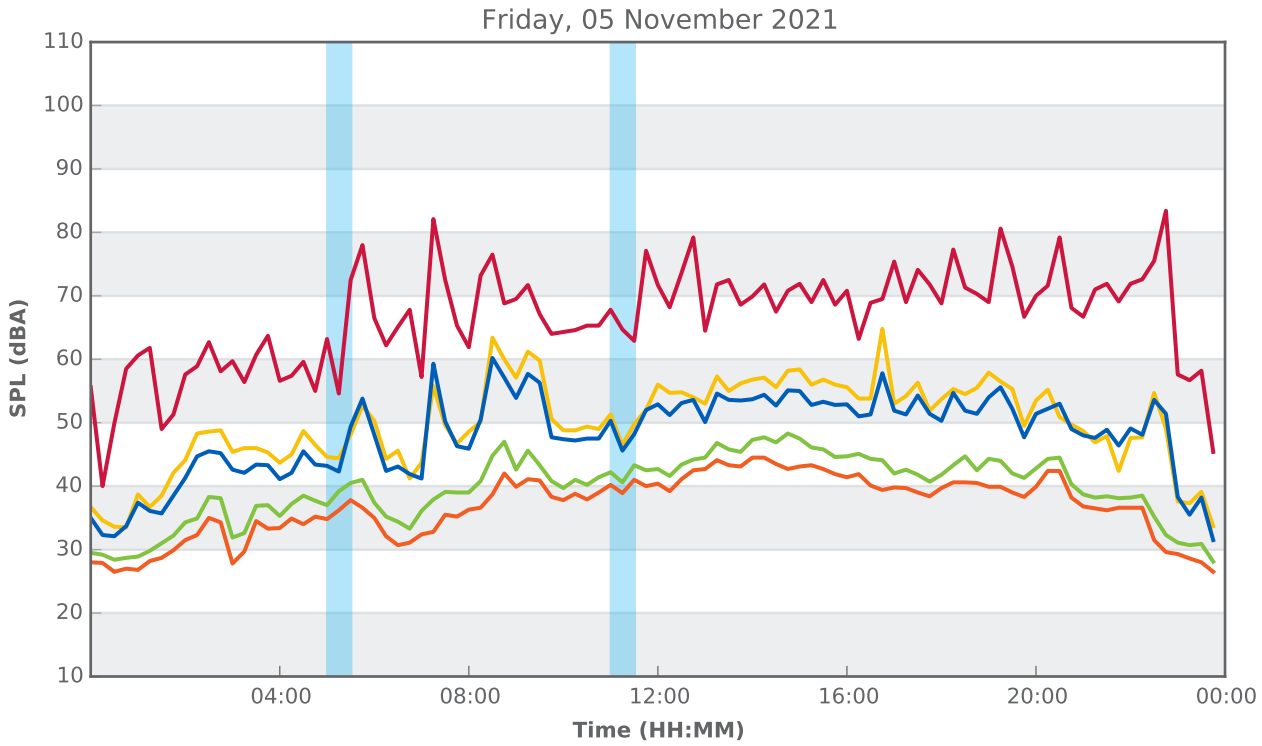

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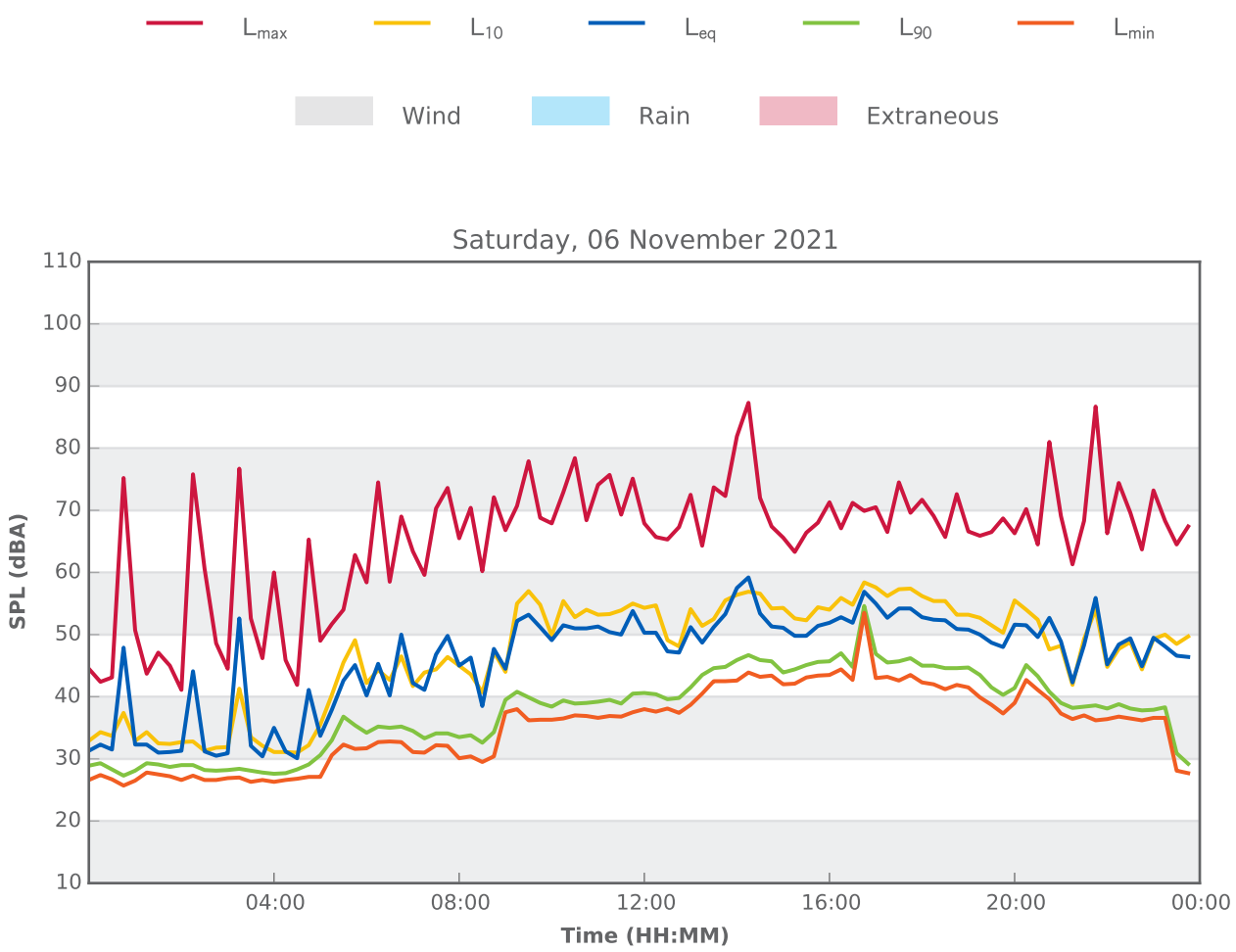

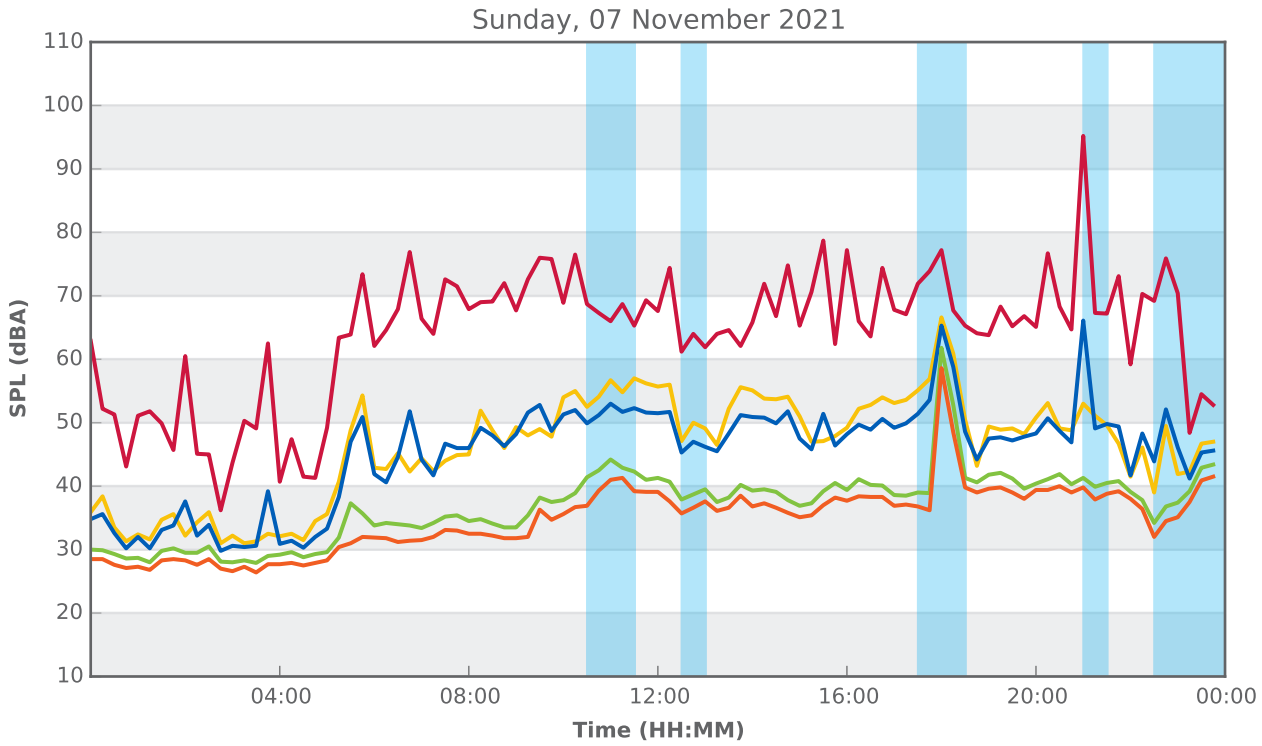

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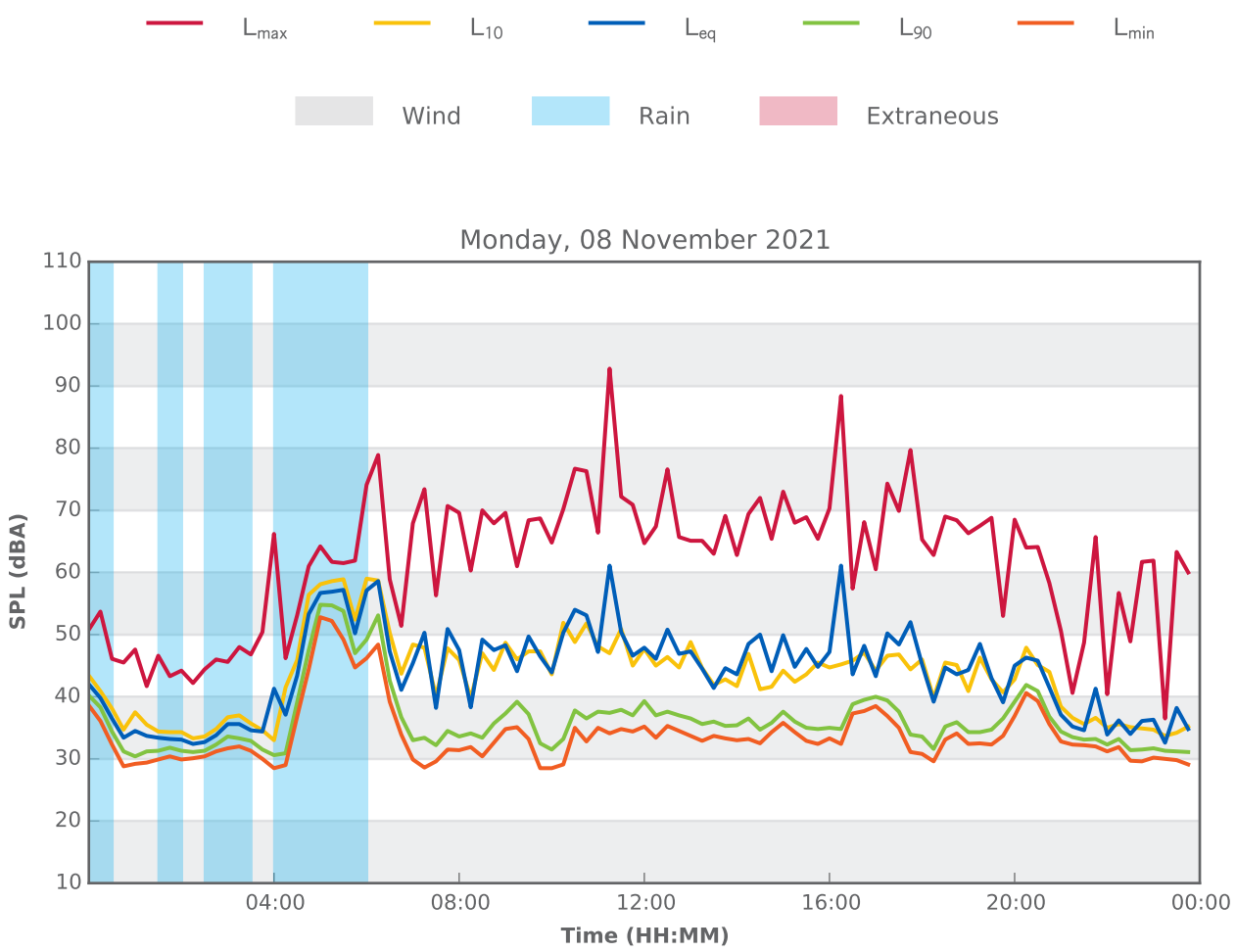

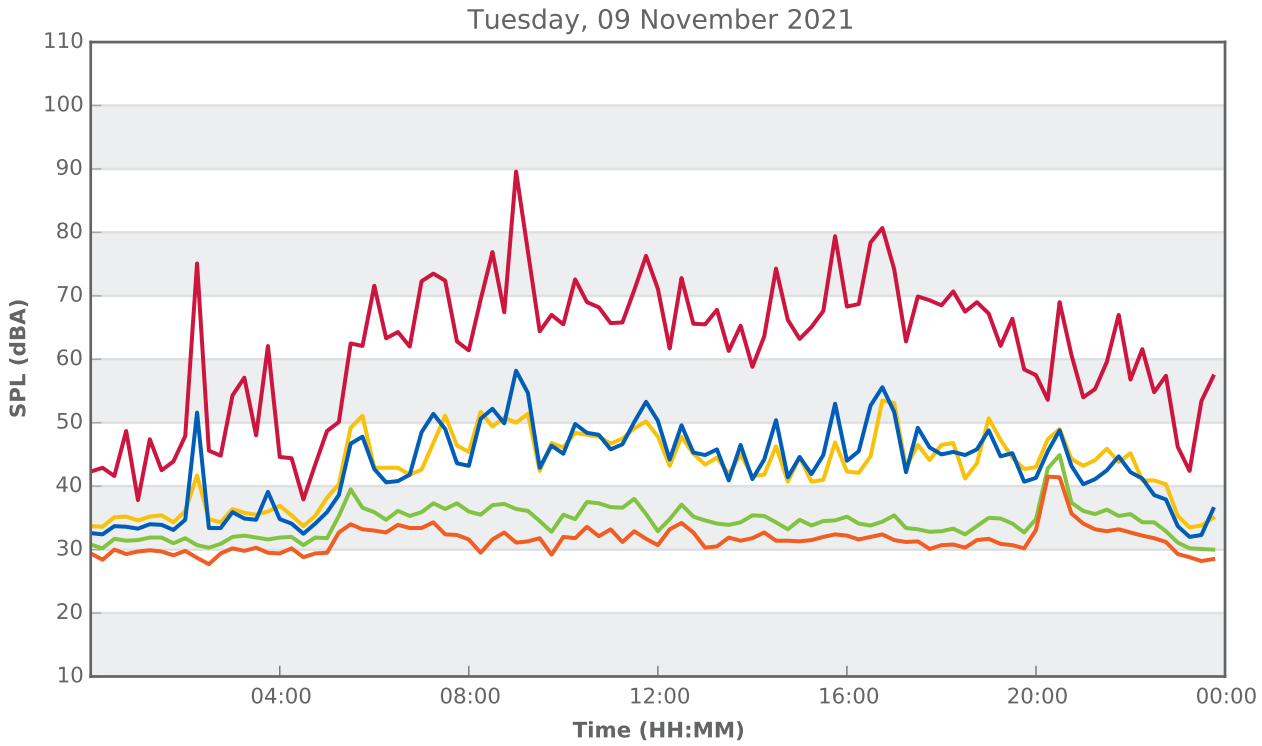

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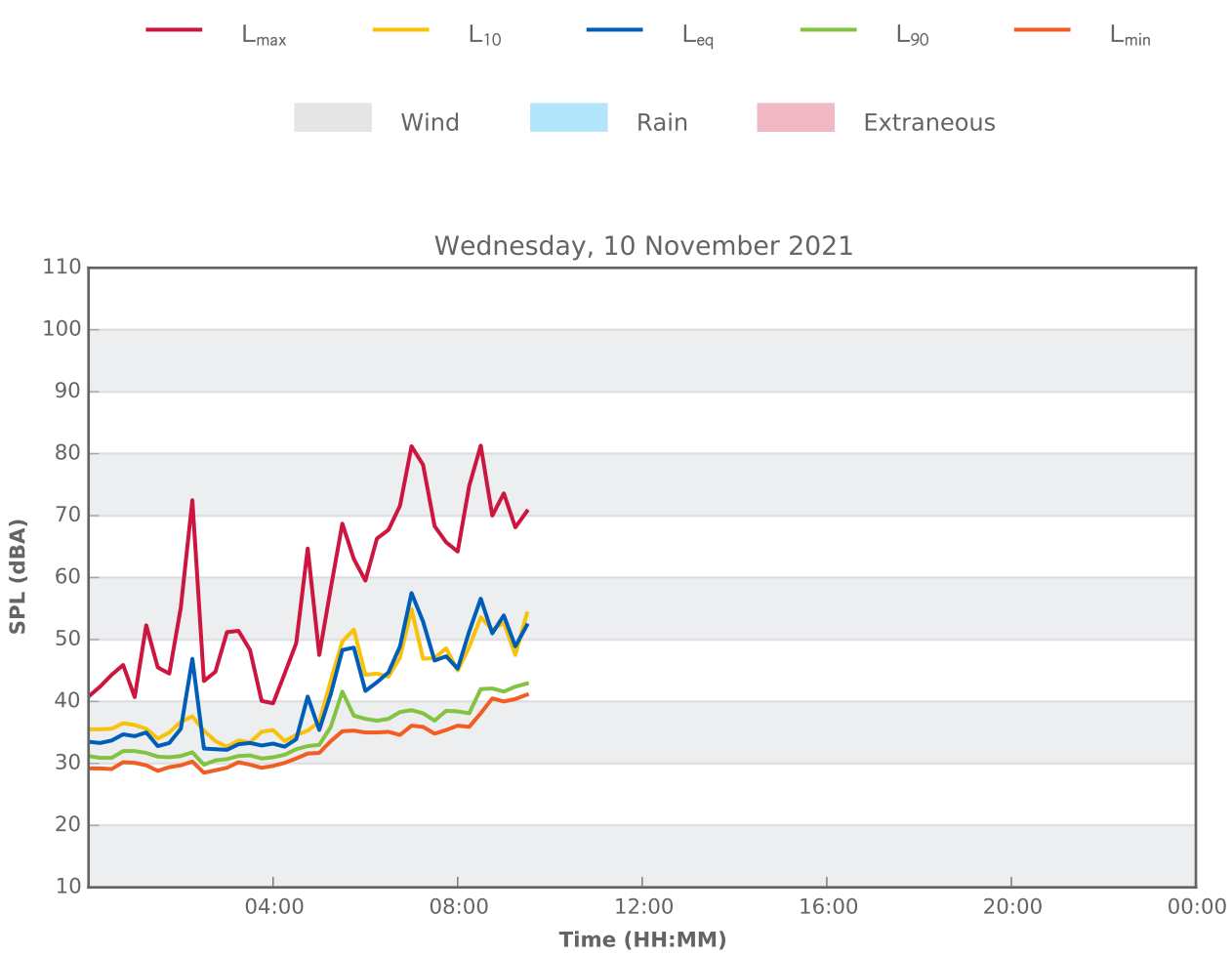
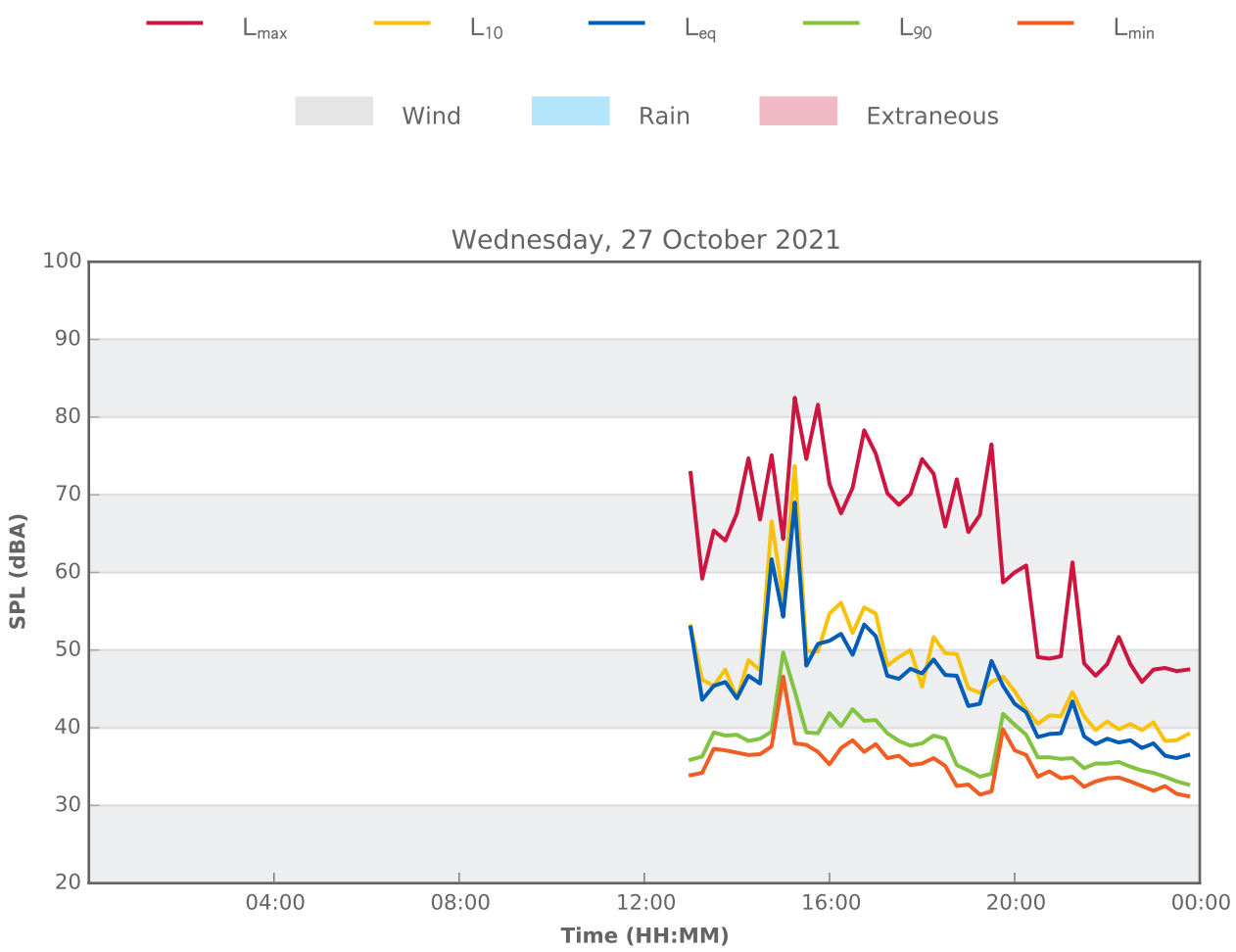
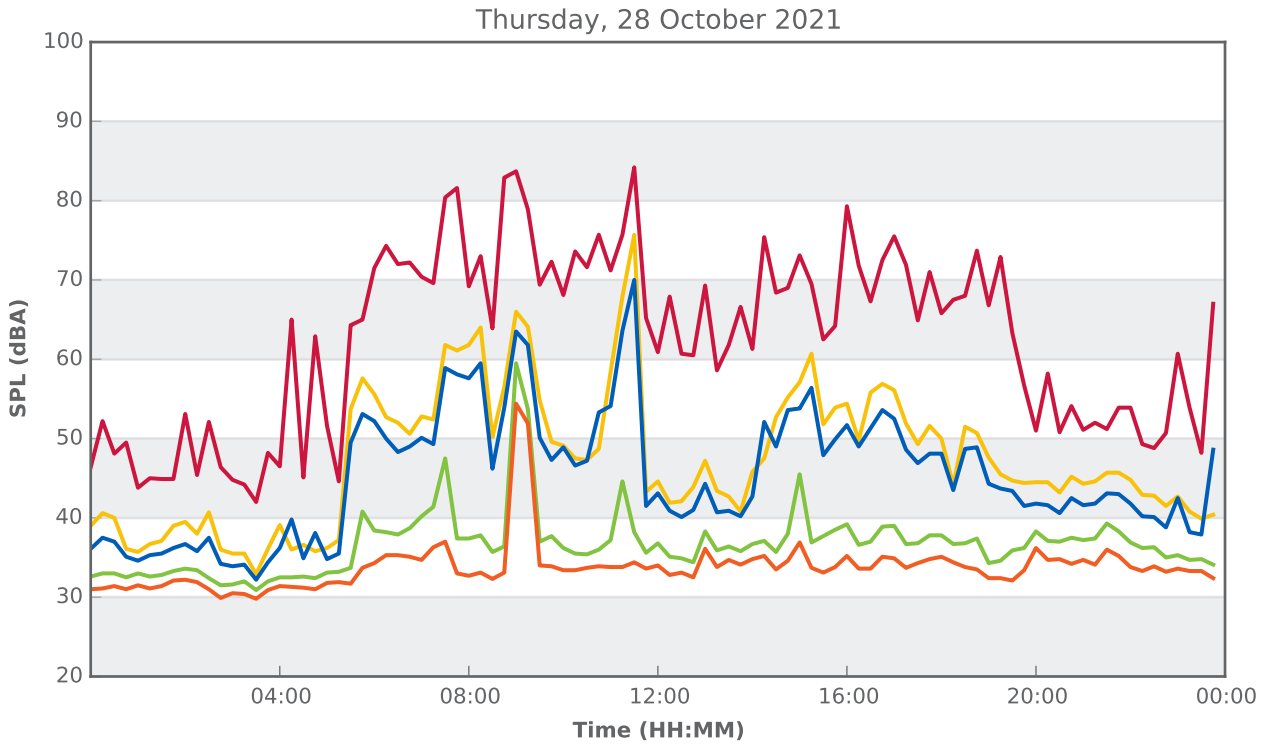


Logger Location 2 - Residences to West Across Water





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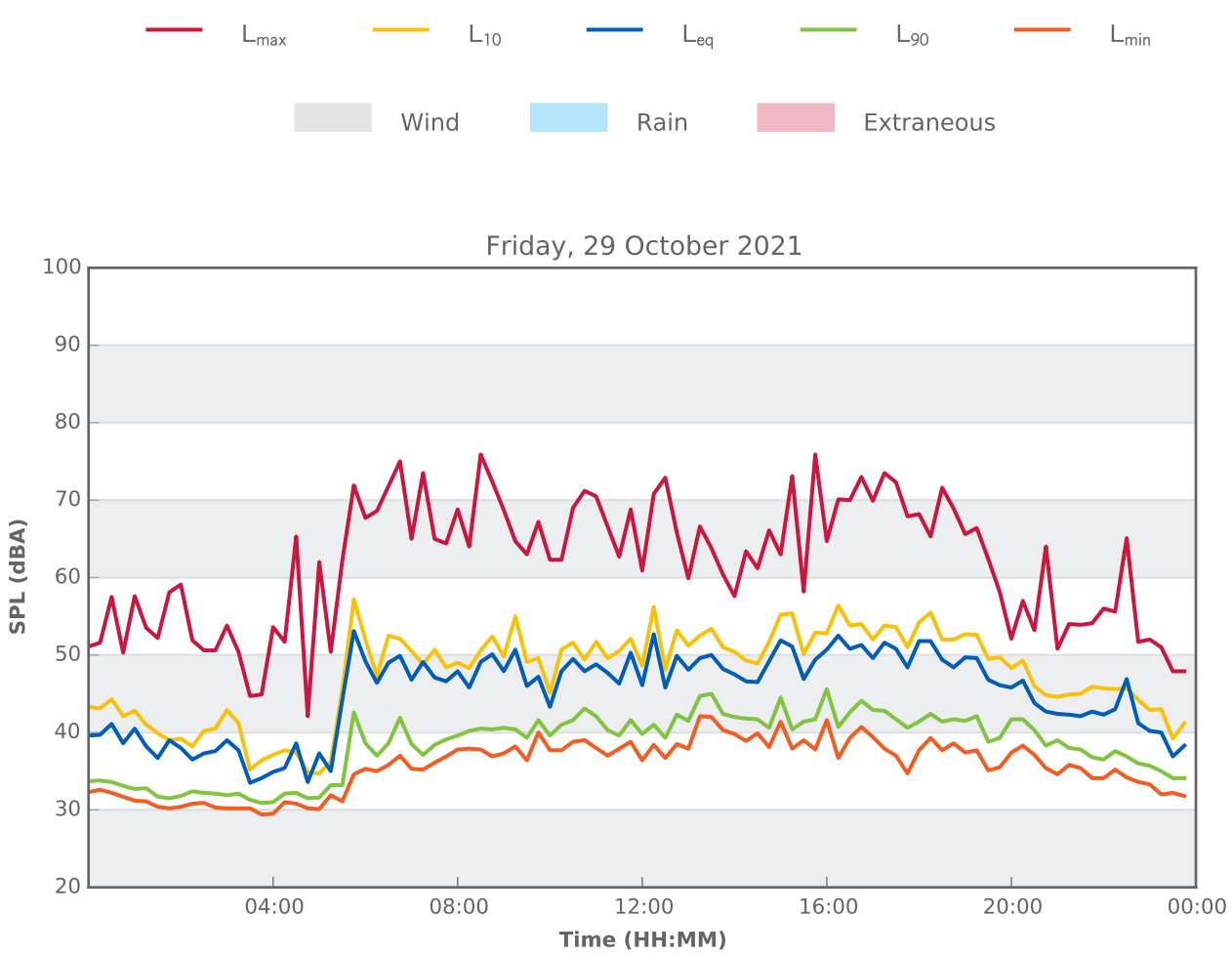

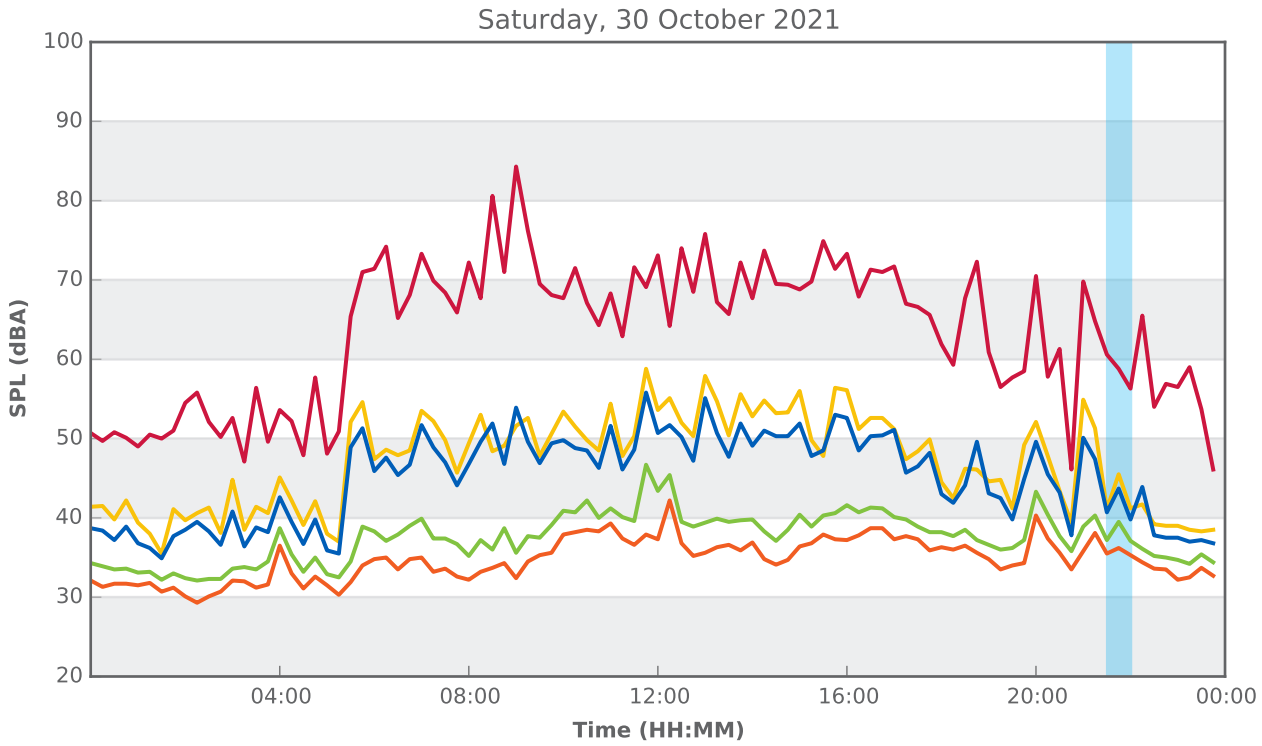

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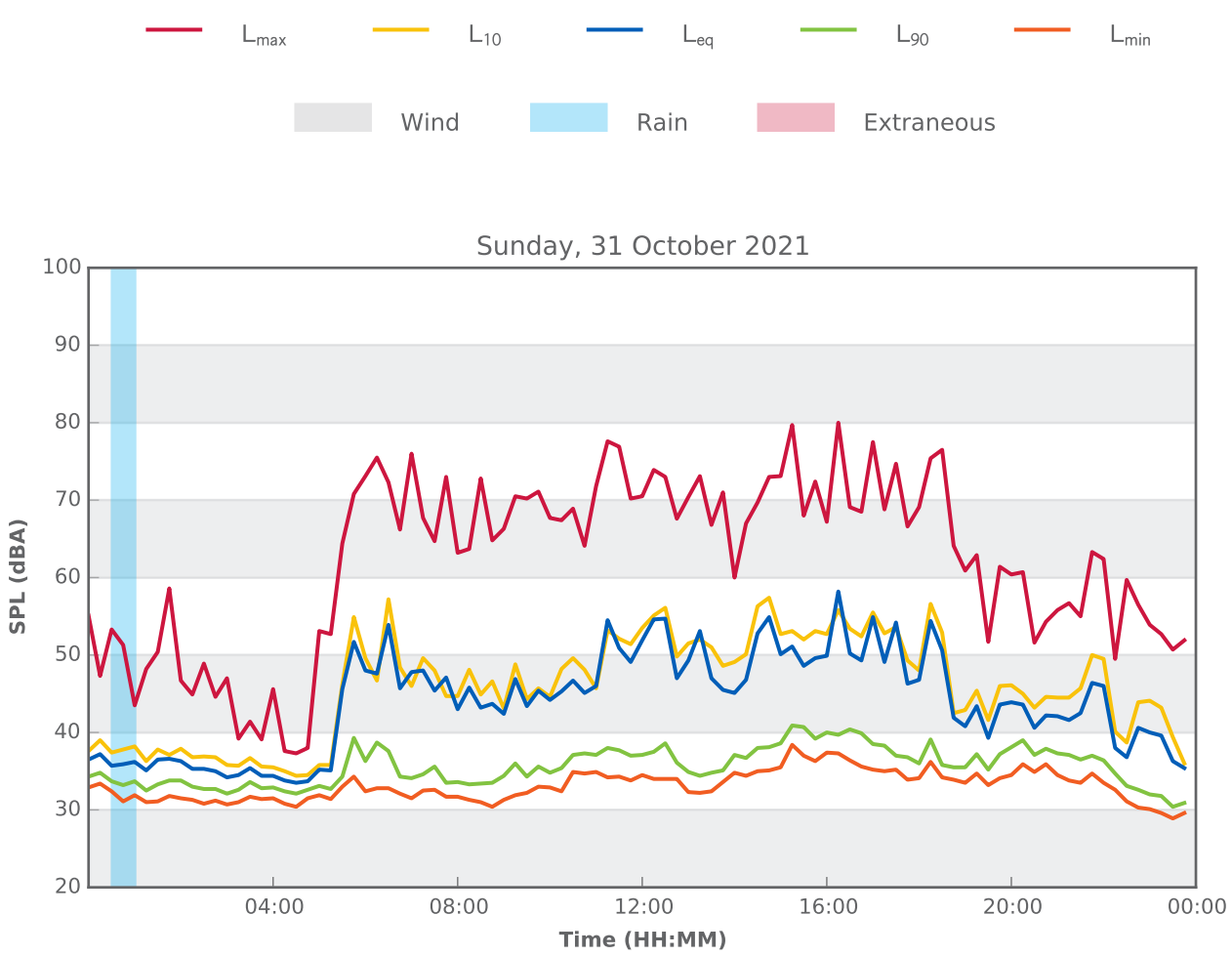

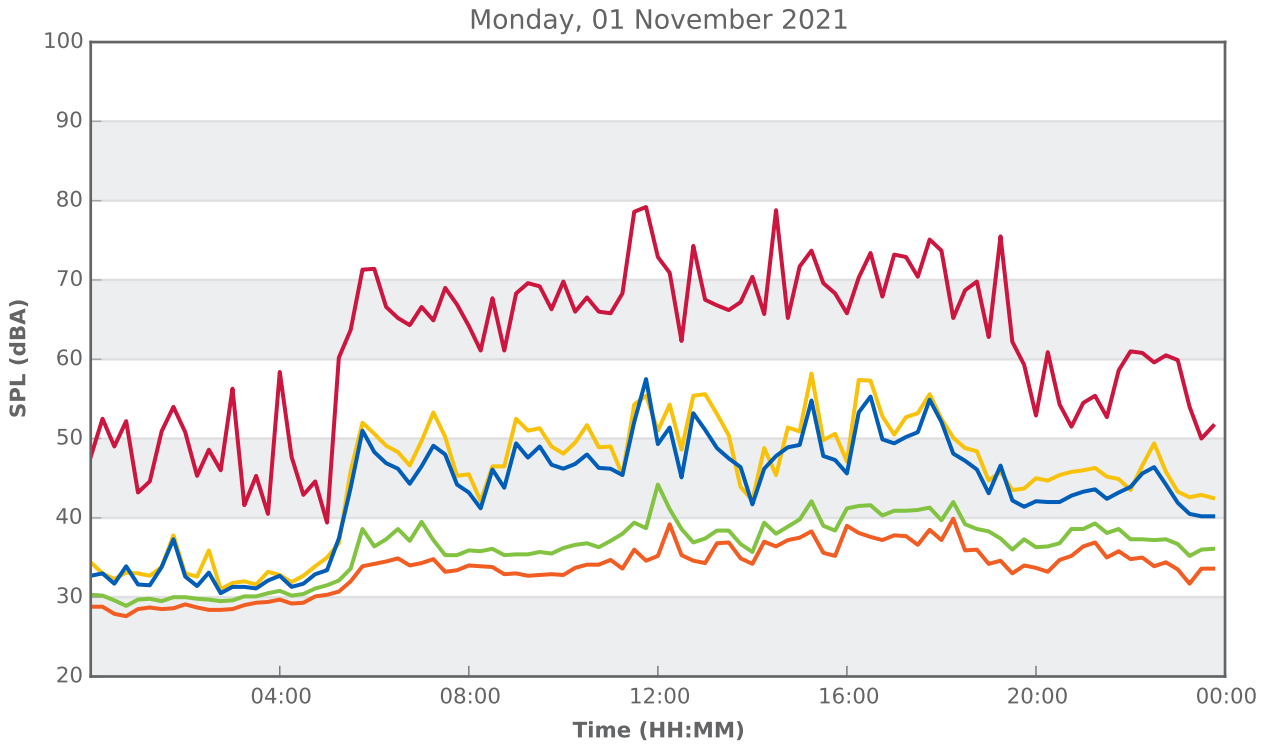

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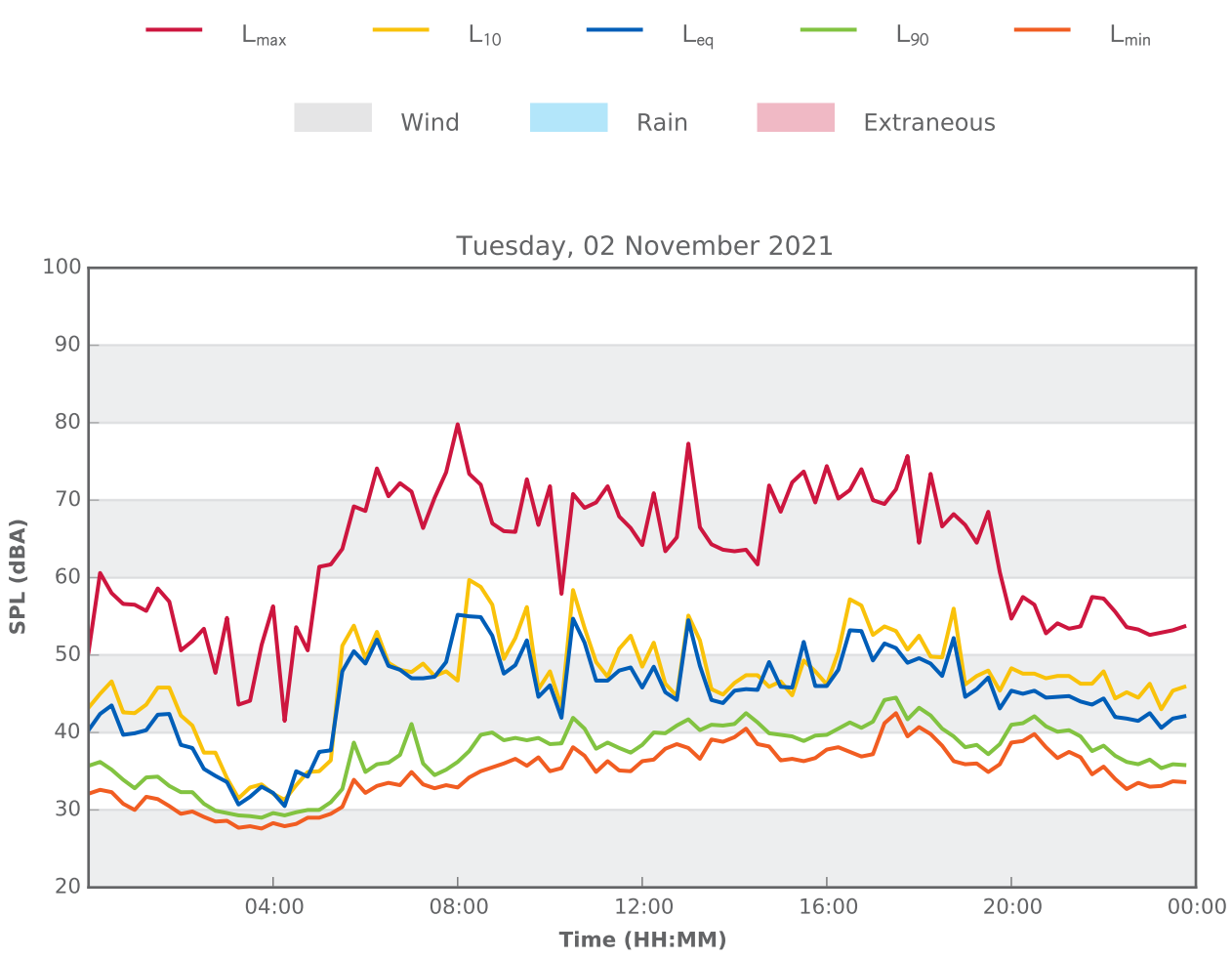

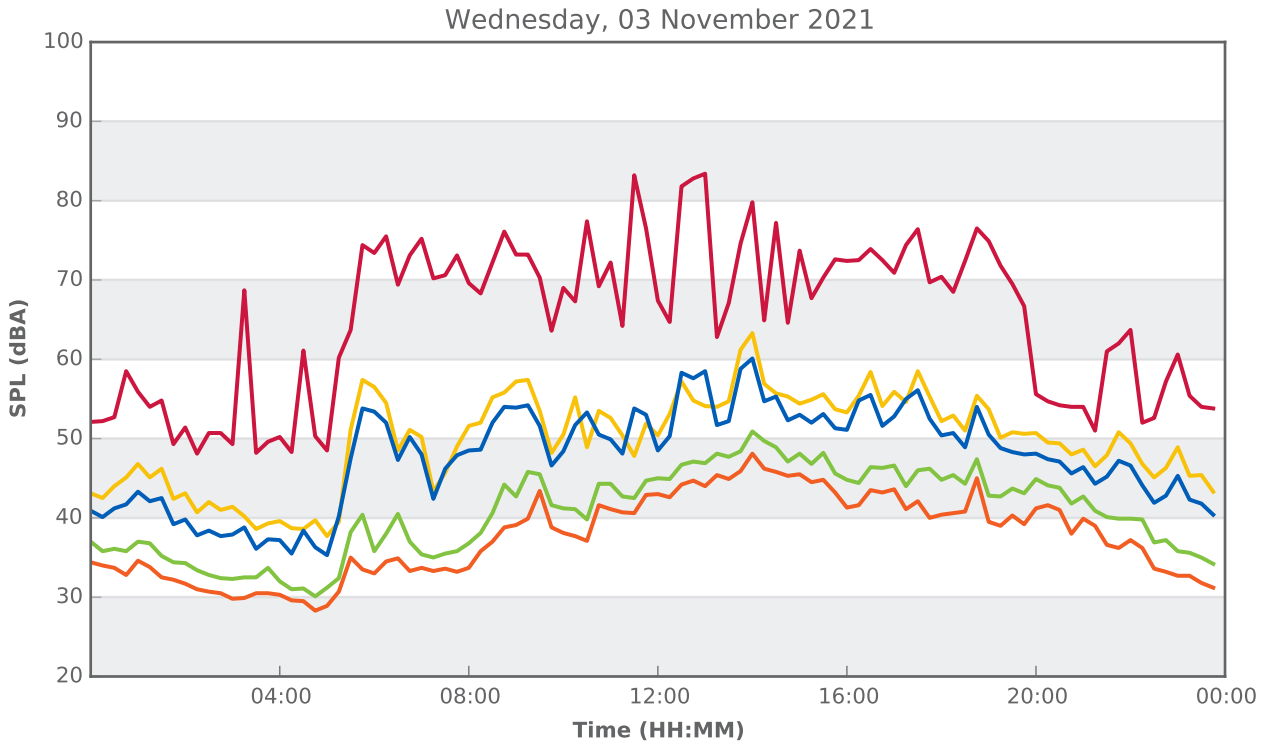

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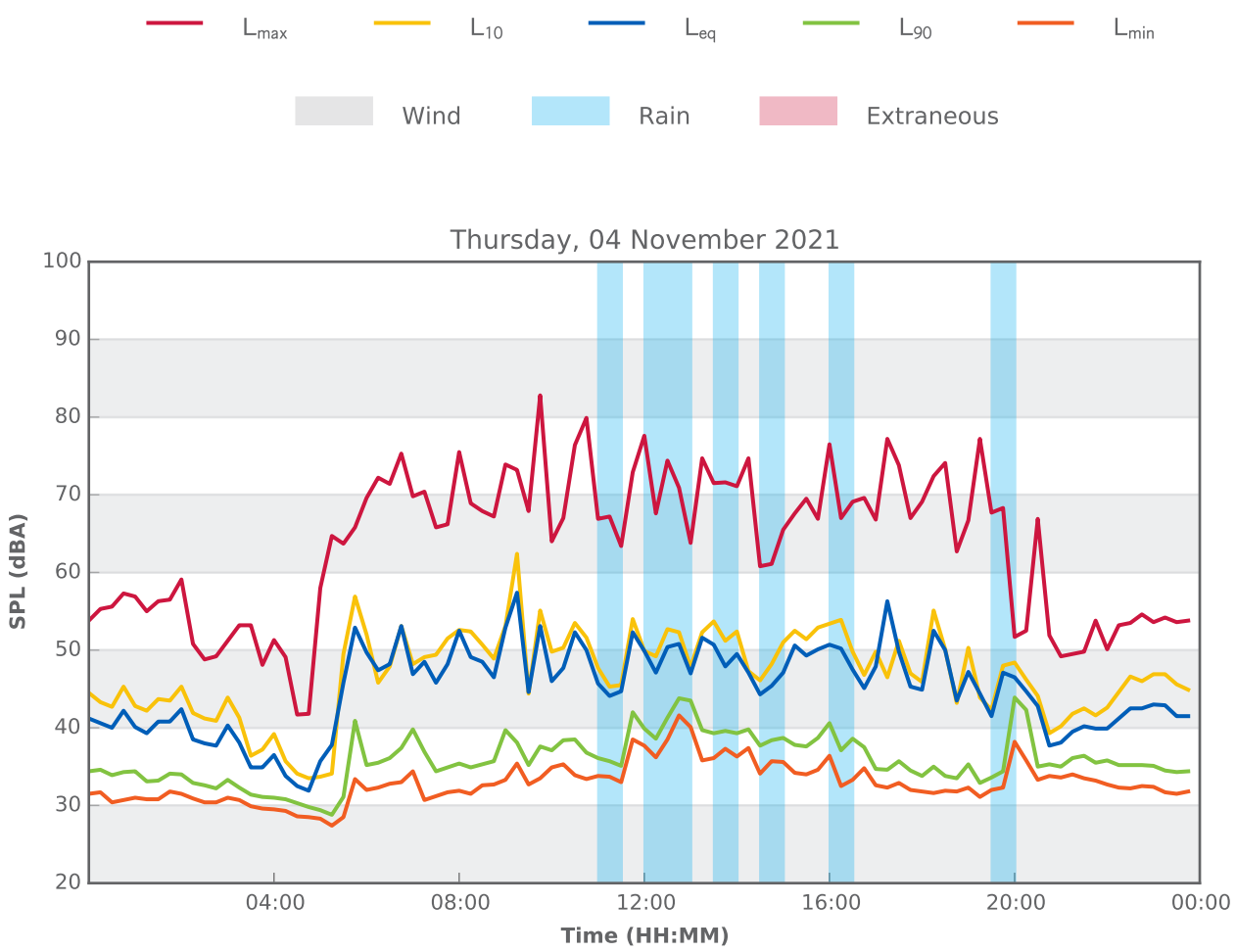

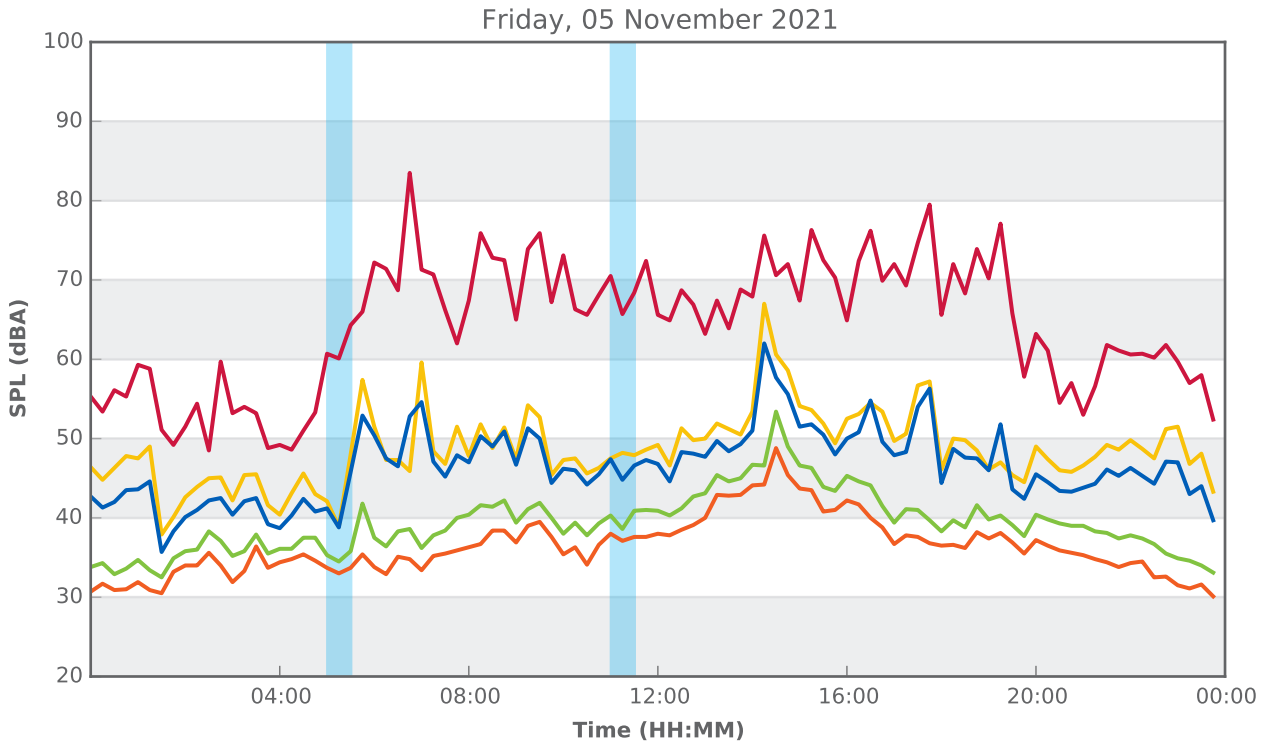

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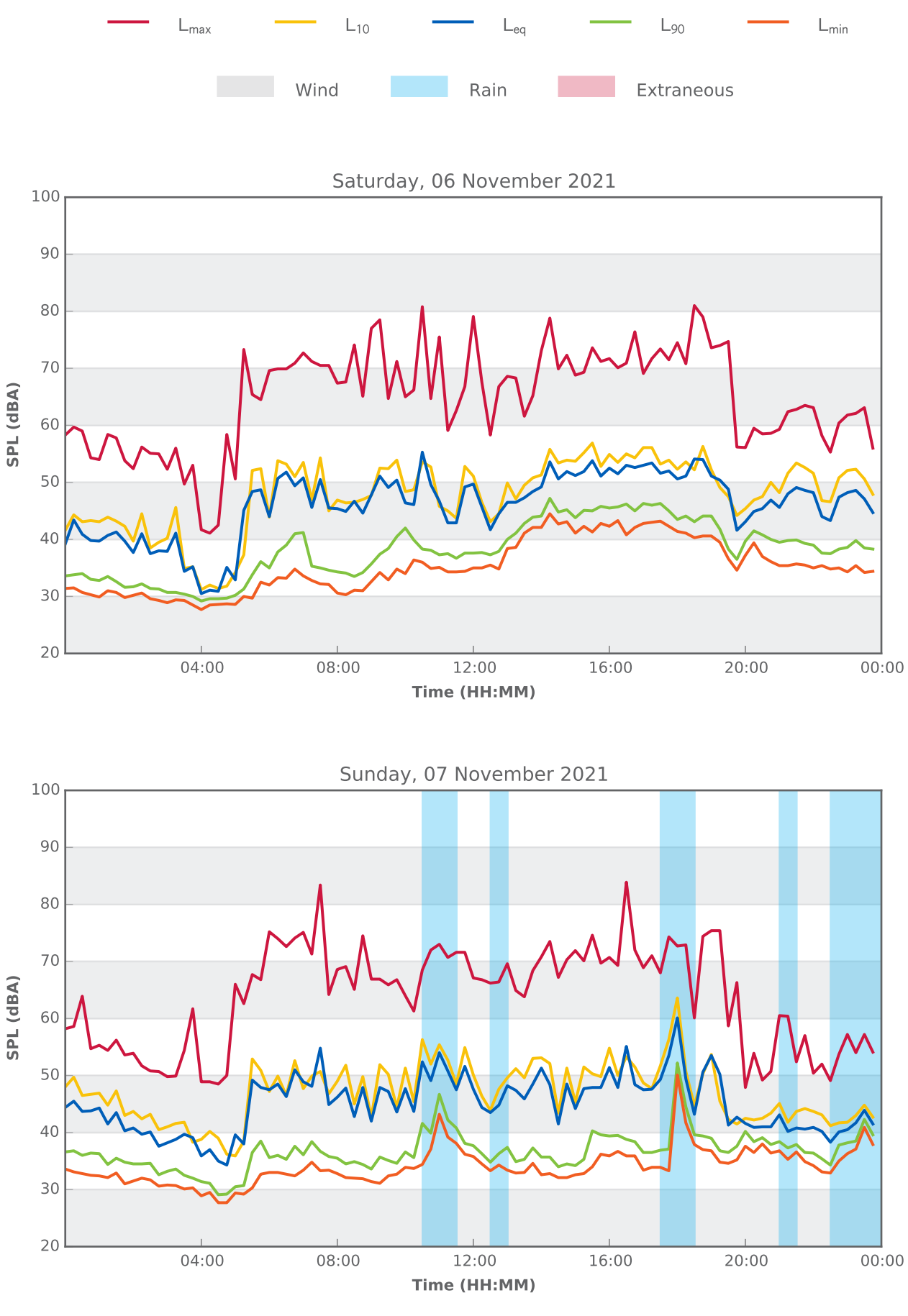

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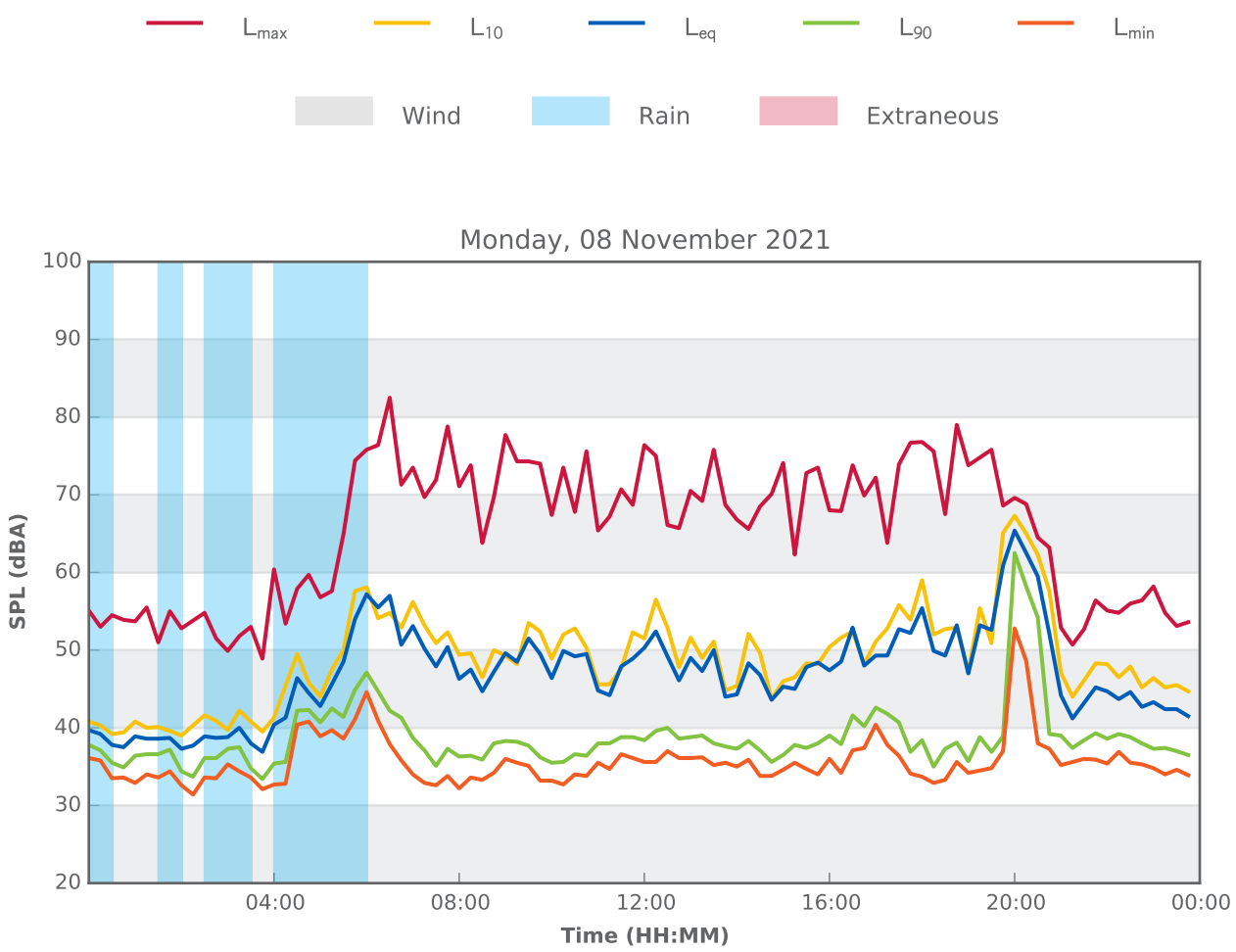

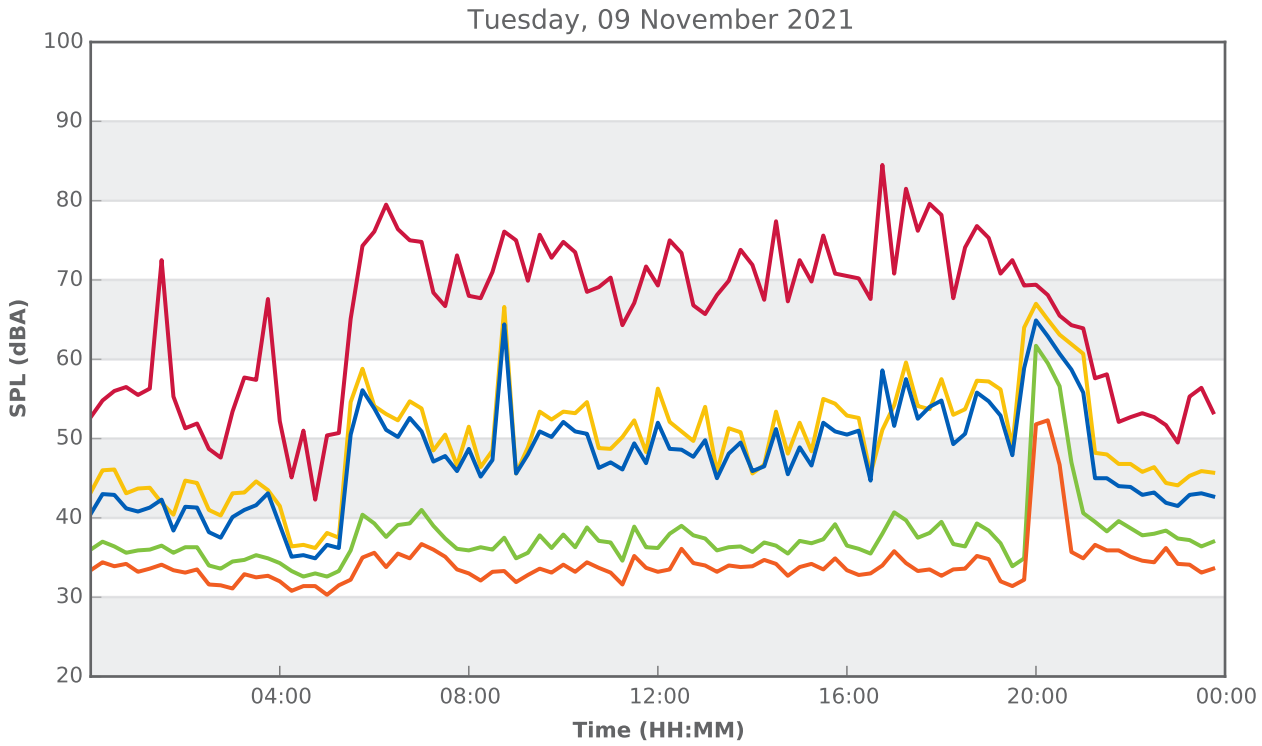

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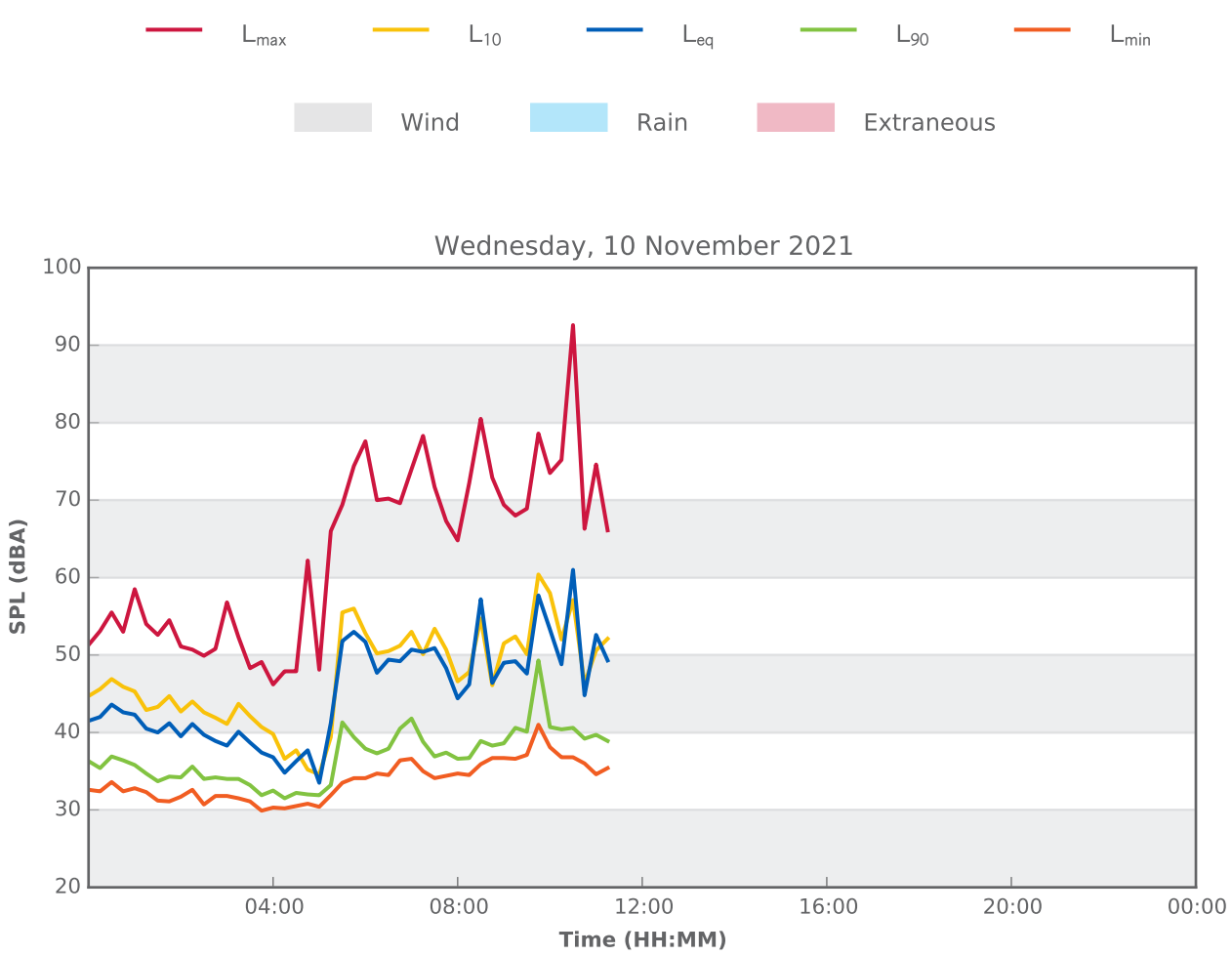

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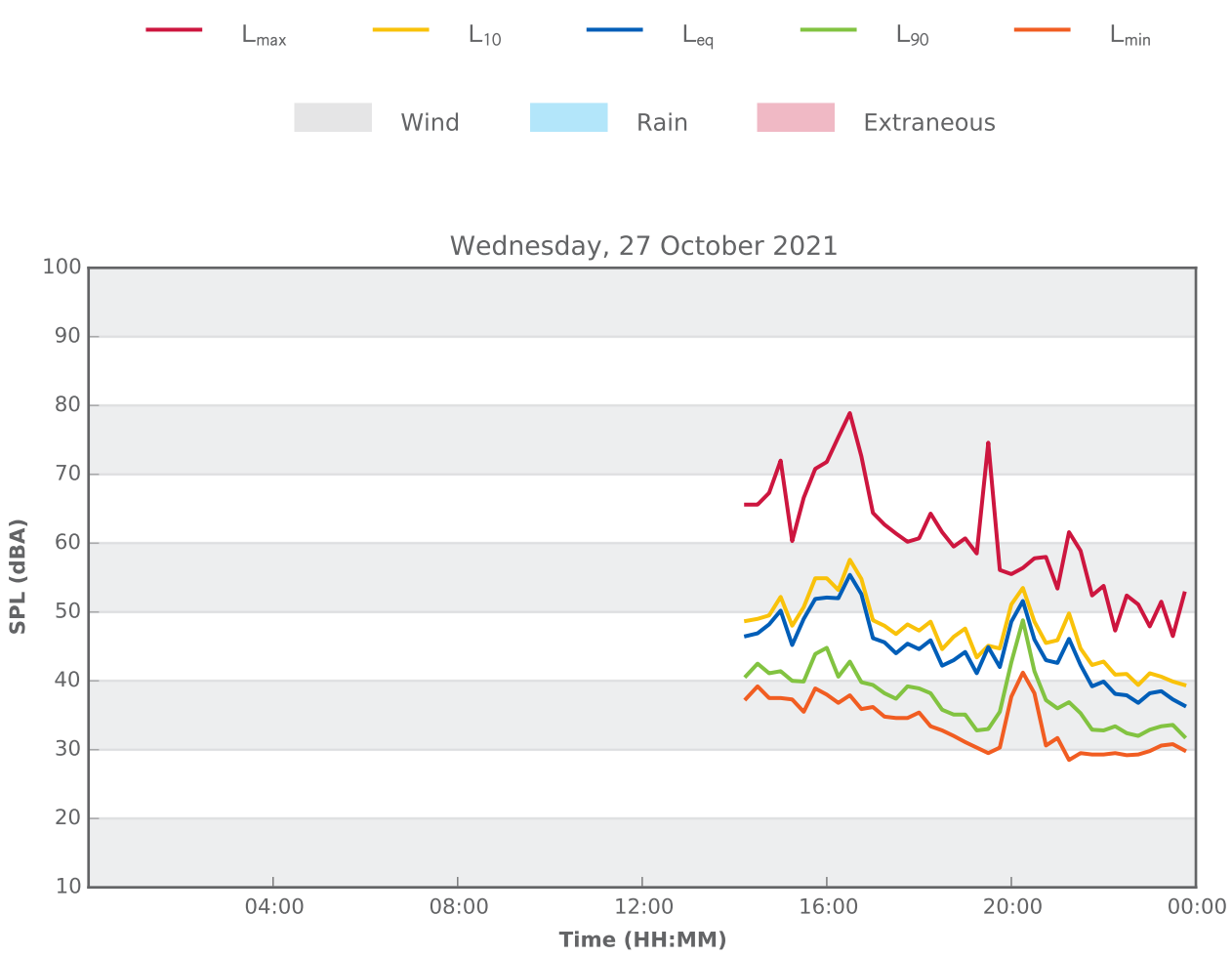

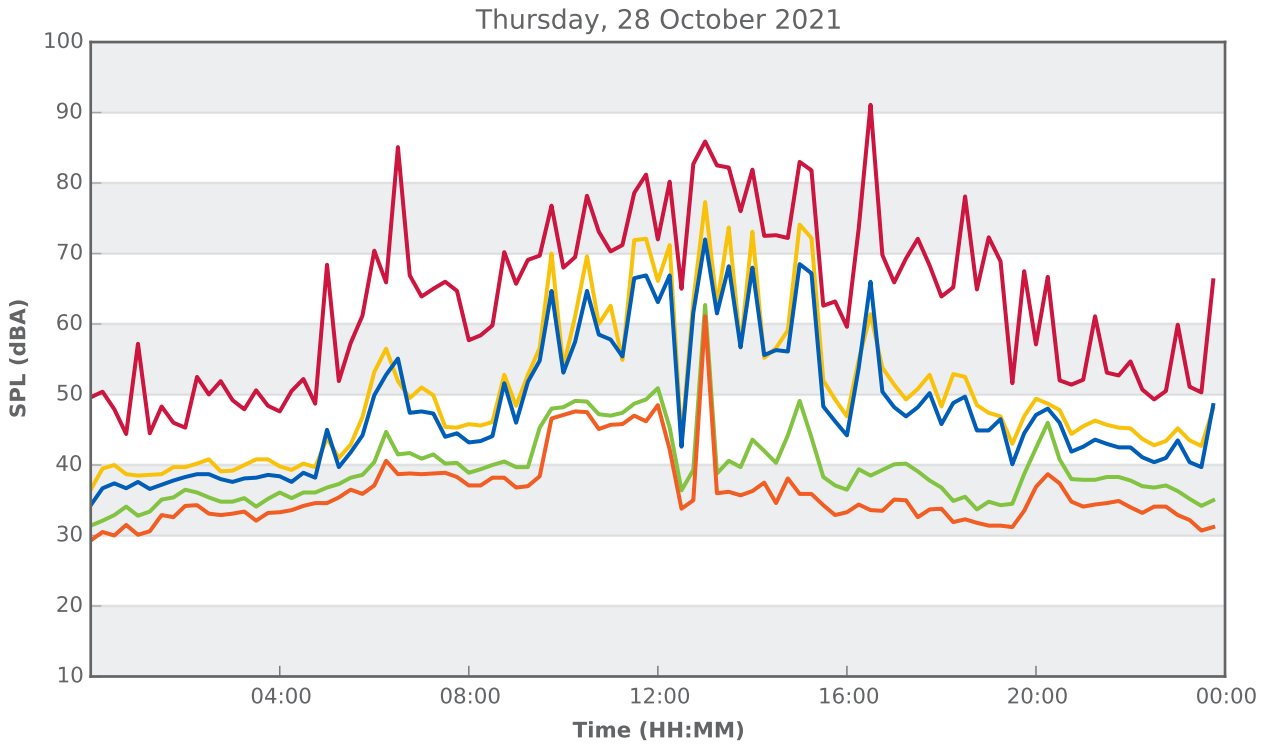

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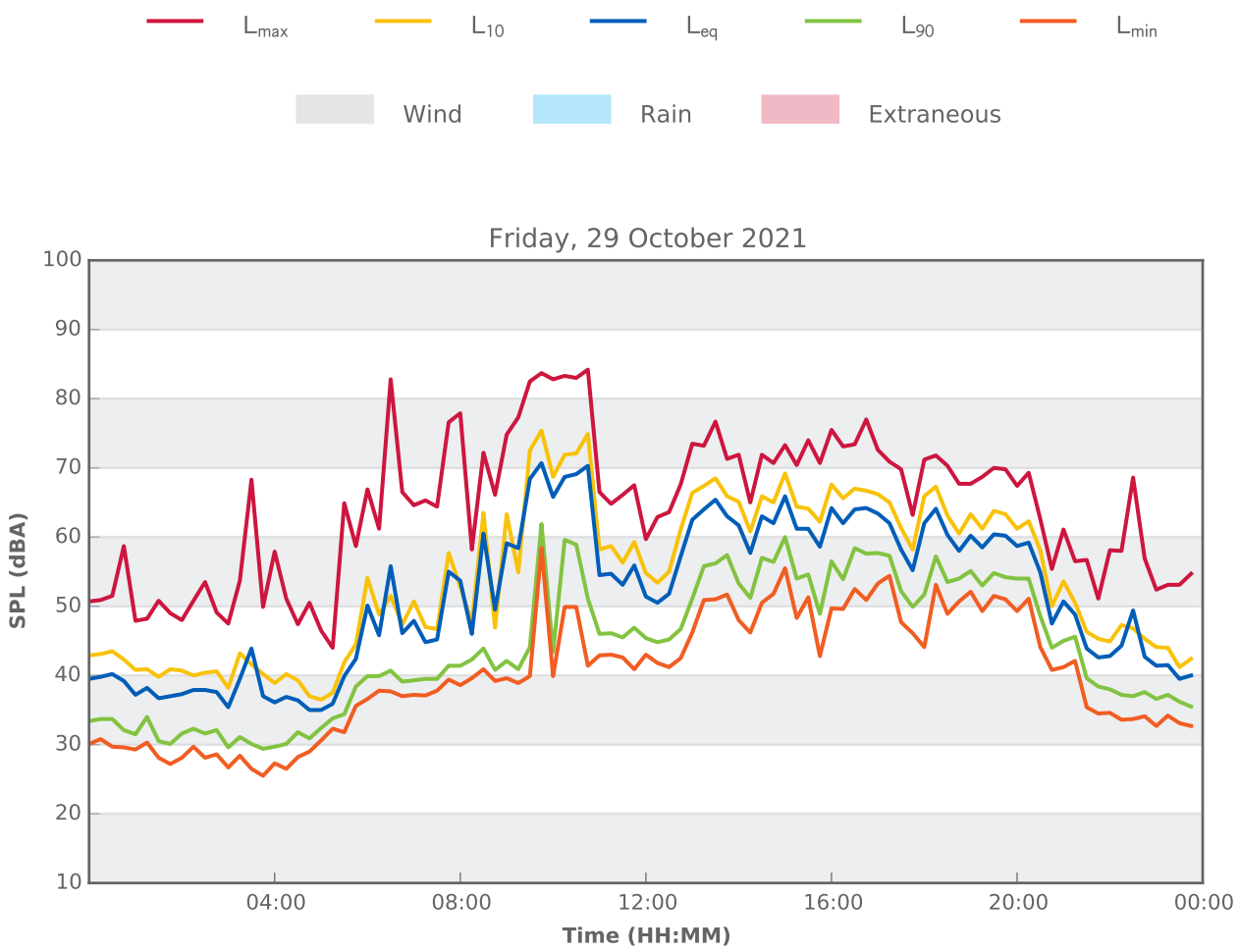

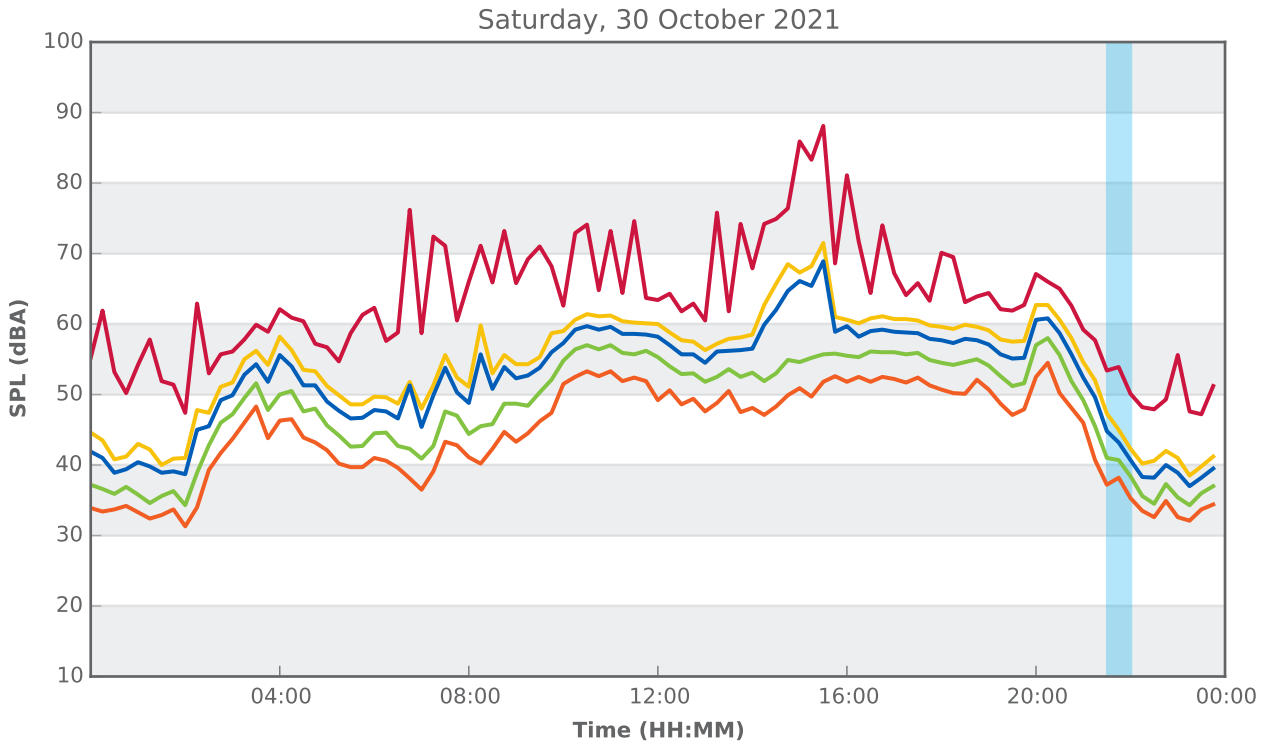

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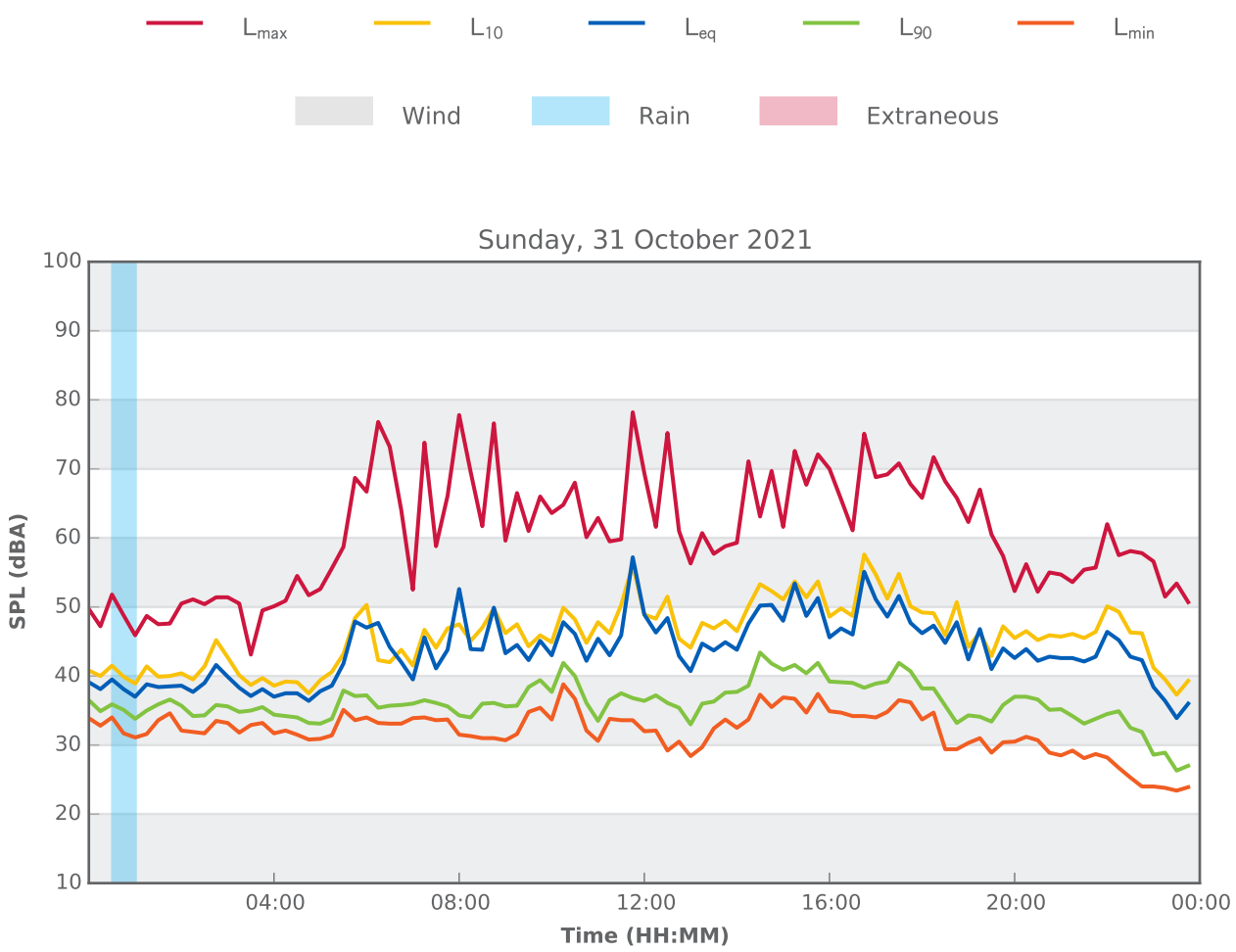

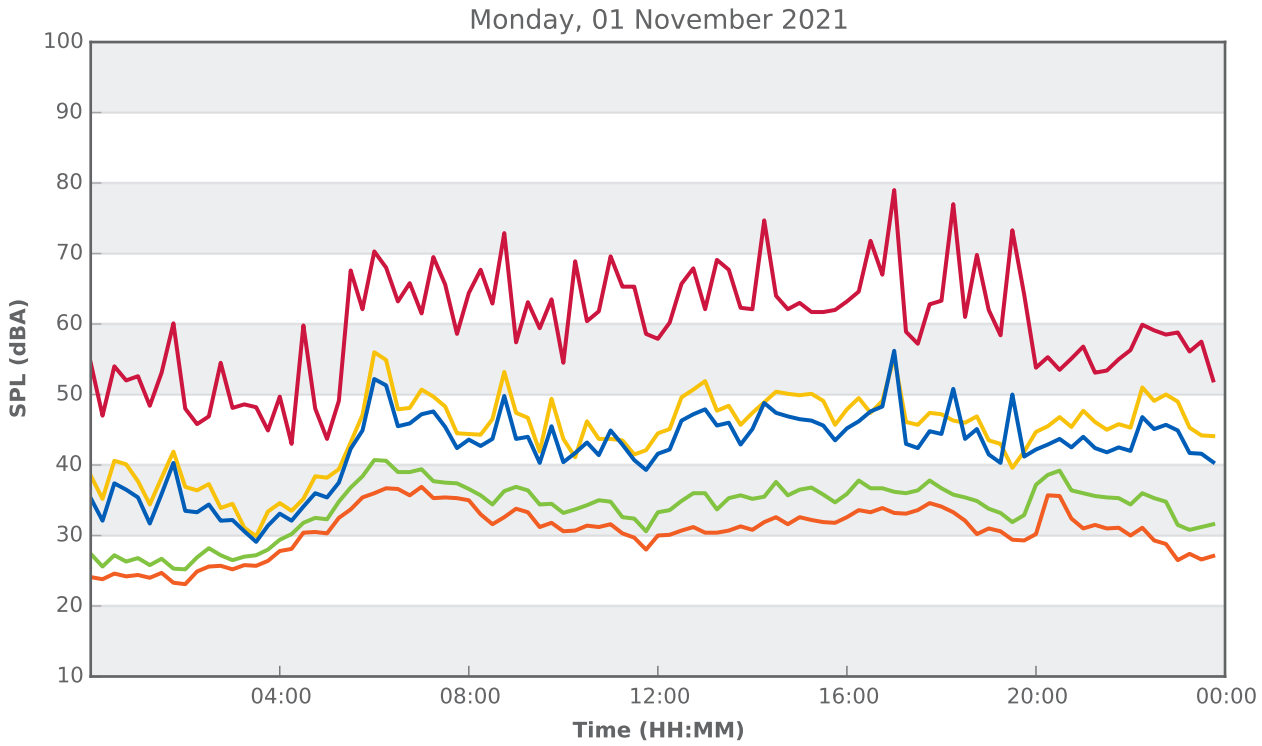

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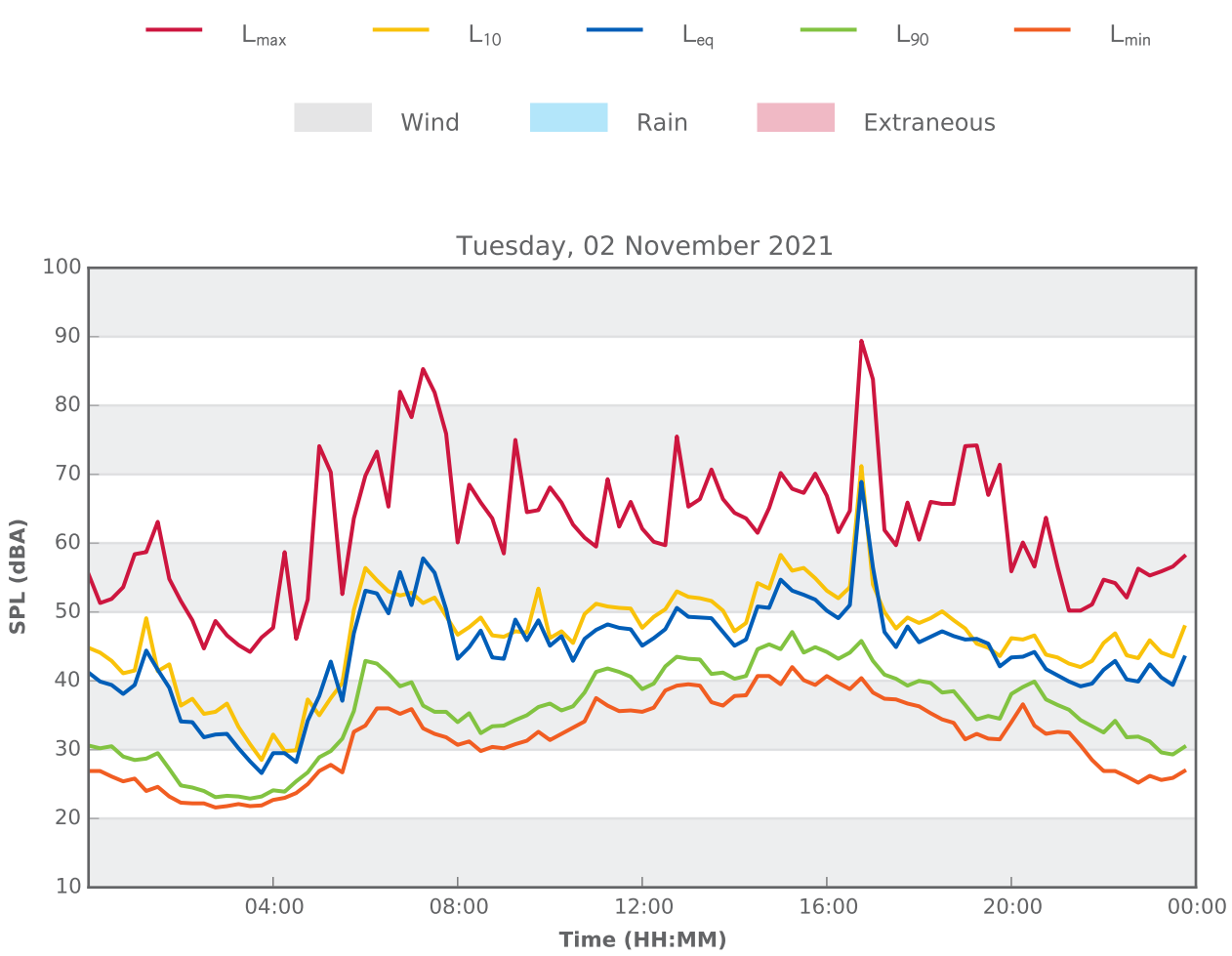

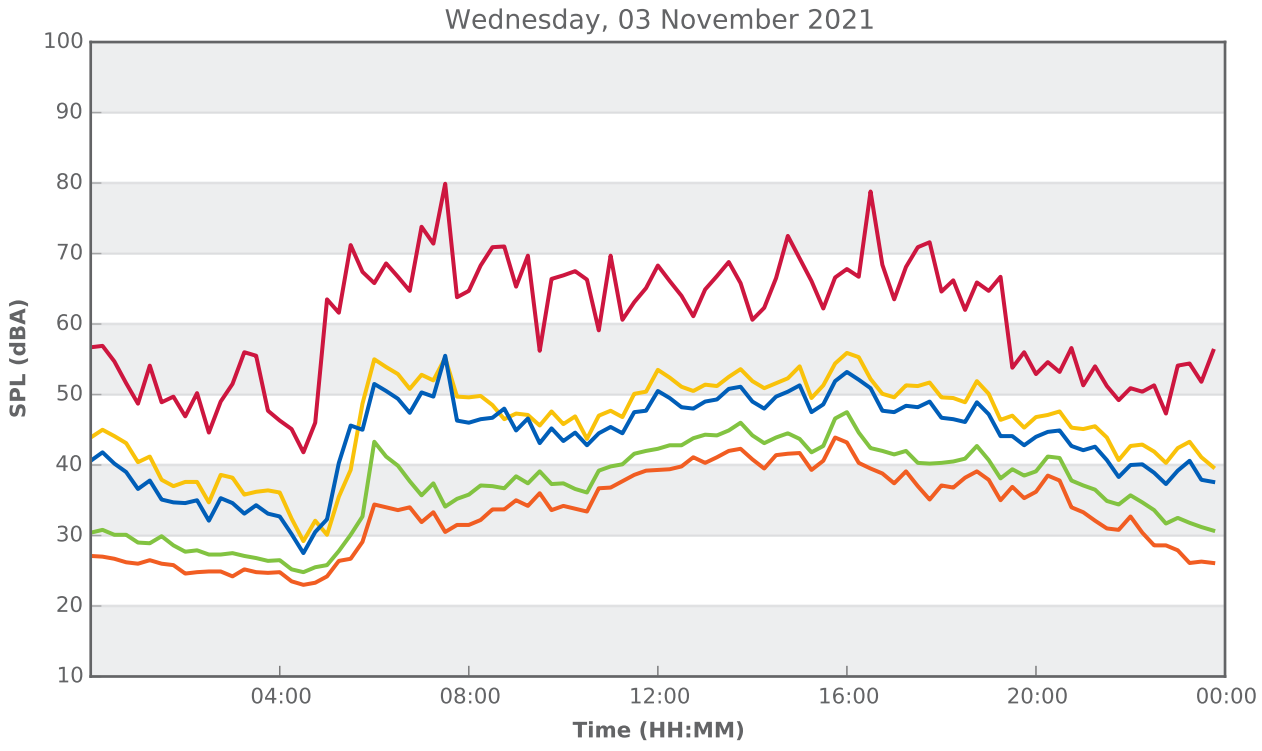

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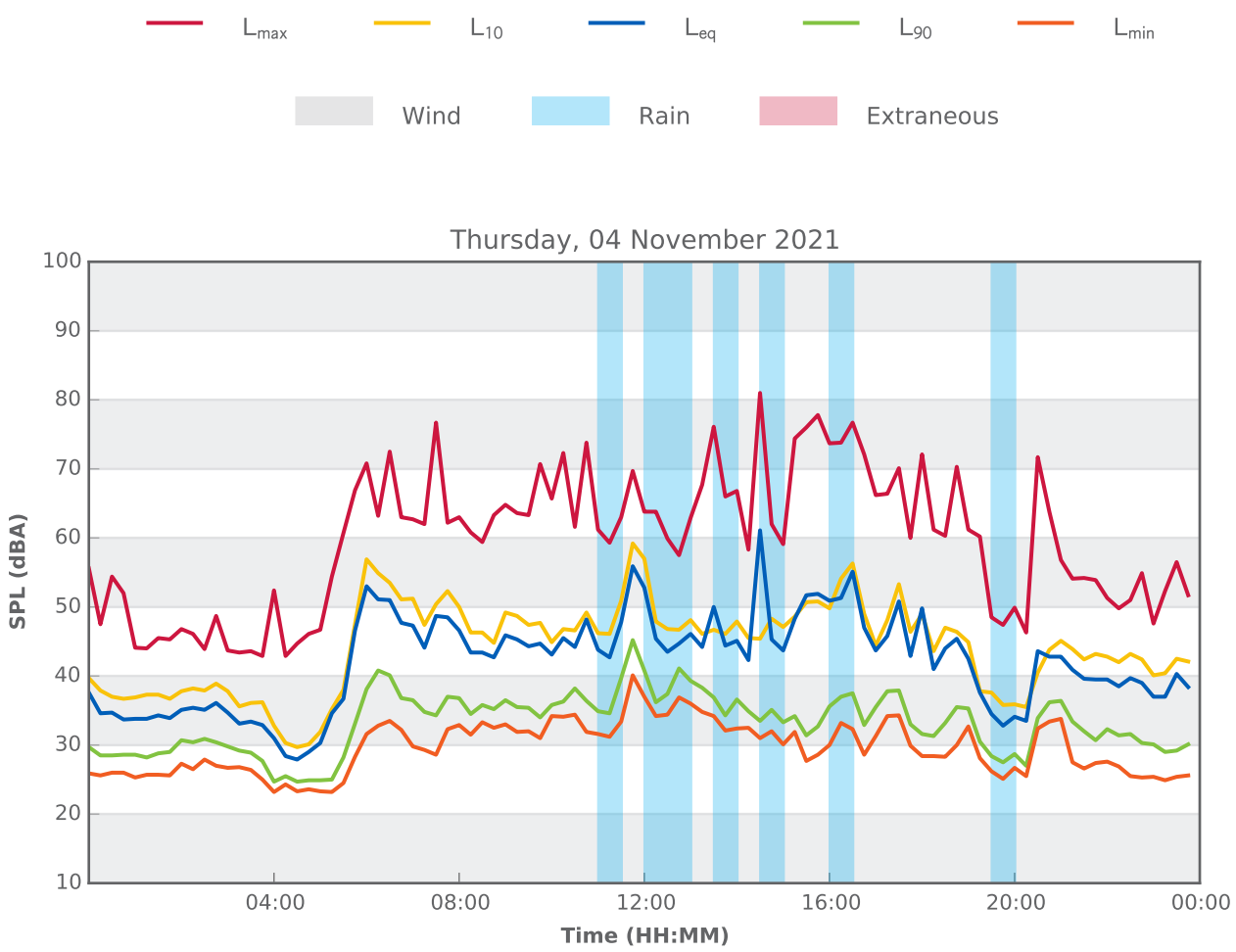

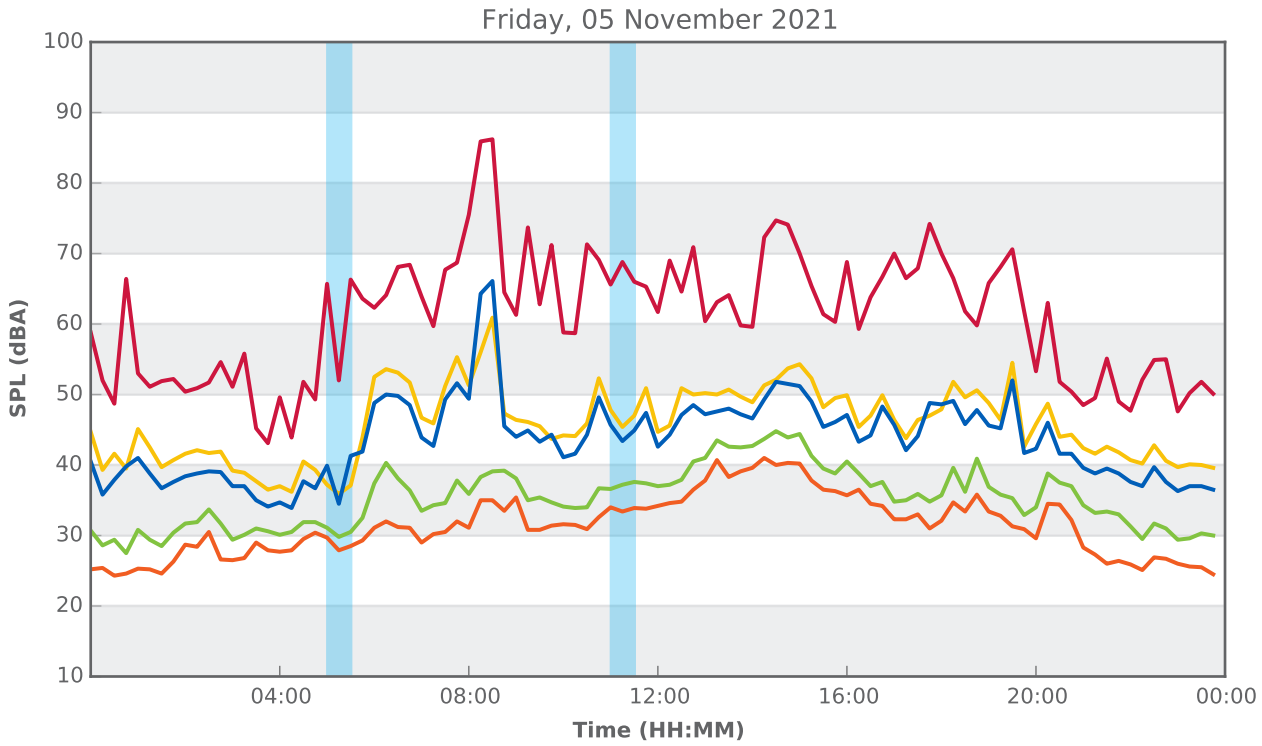

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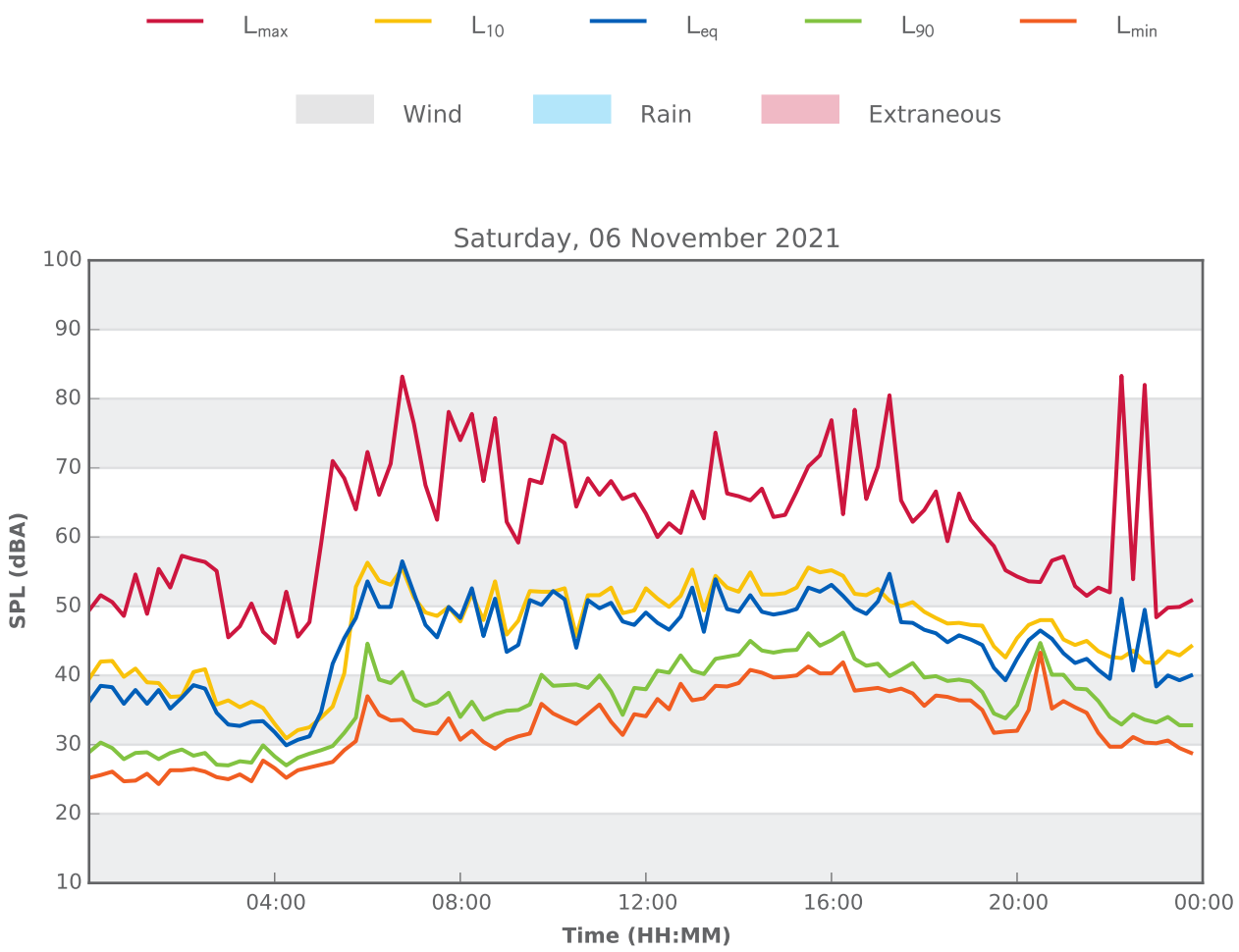

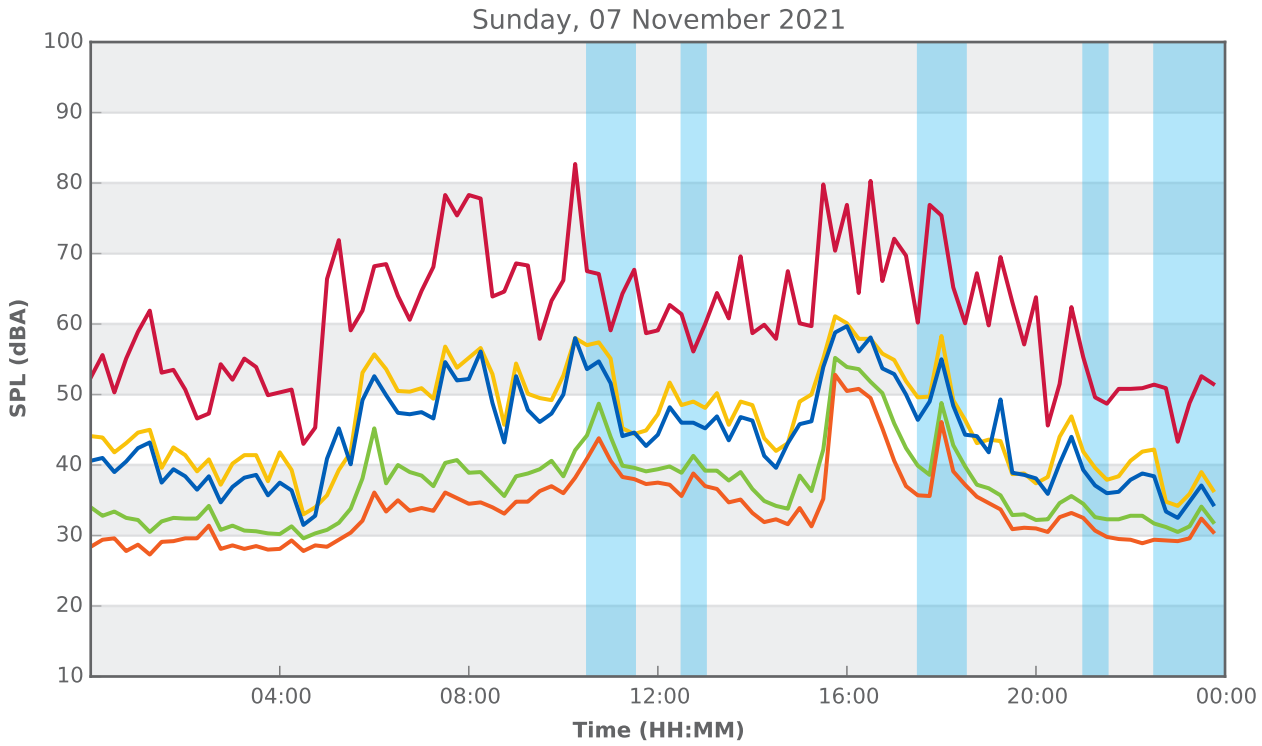

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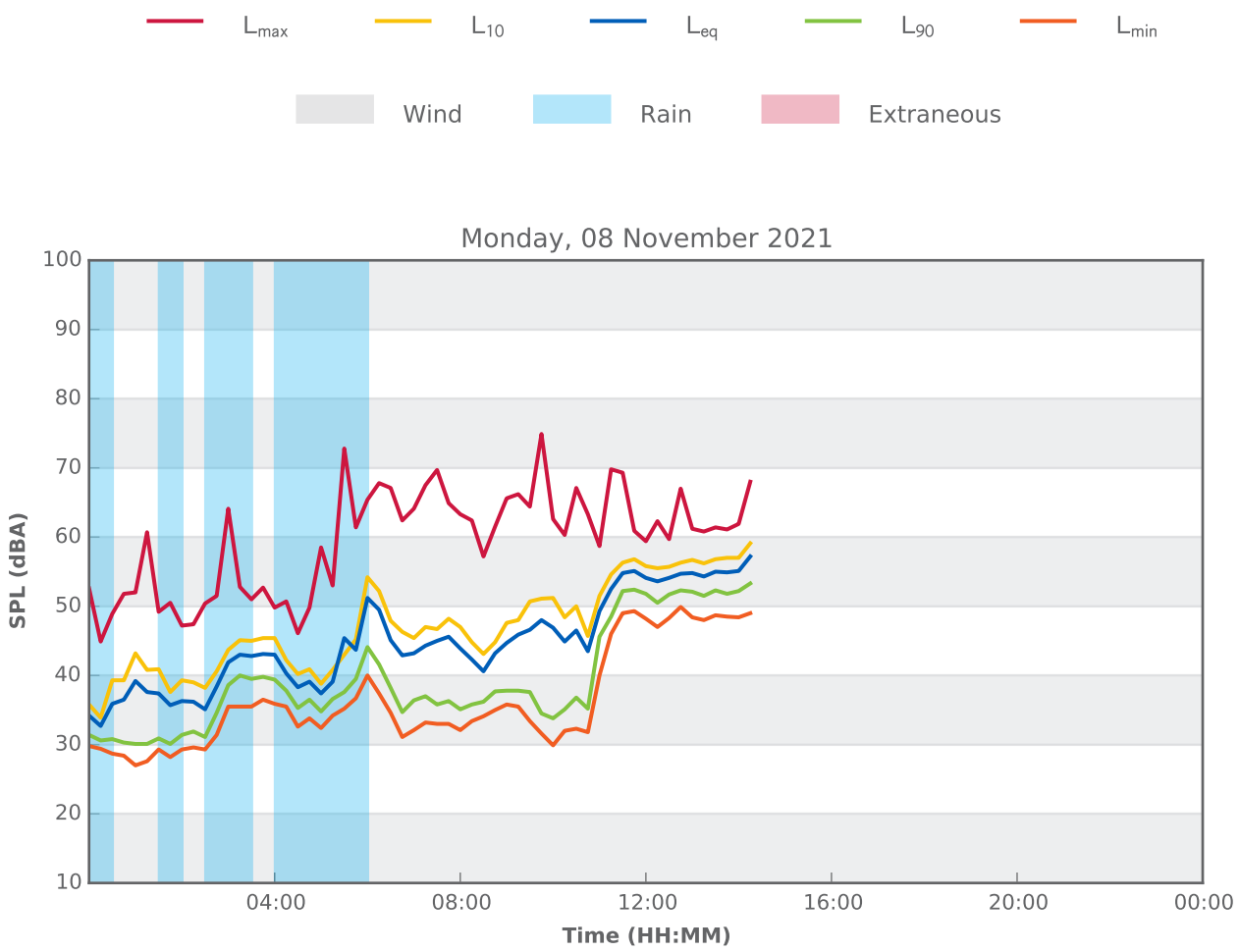
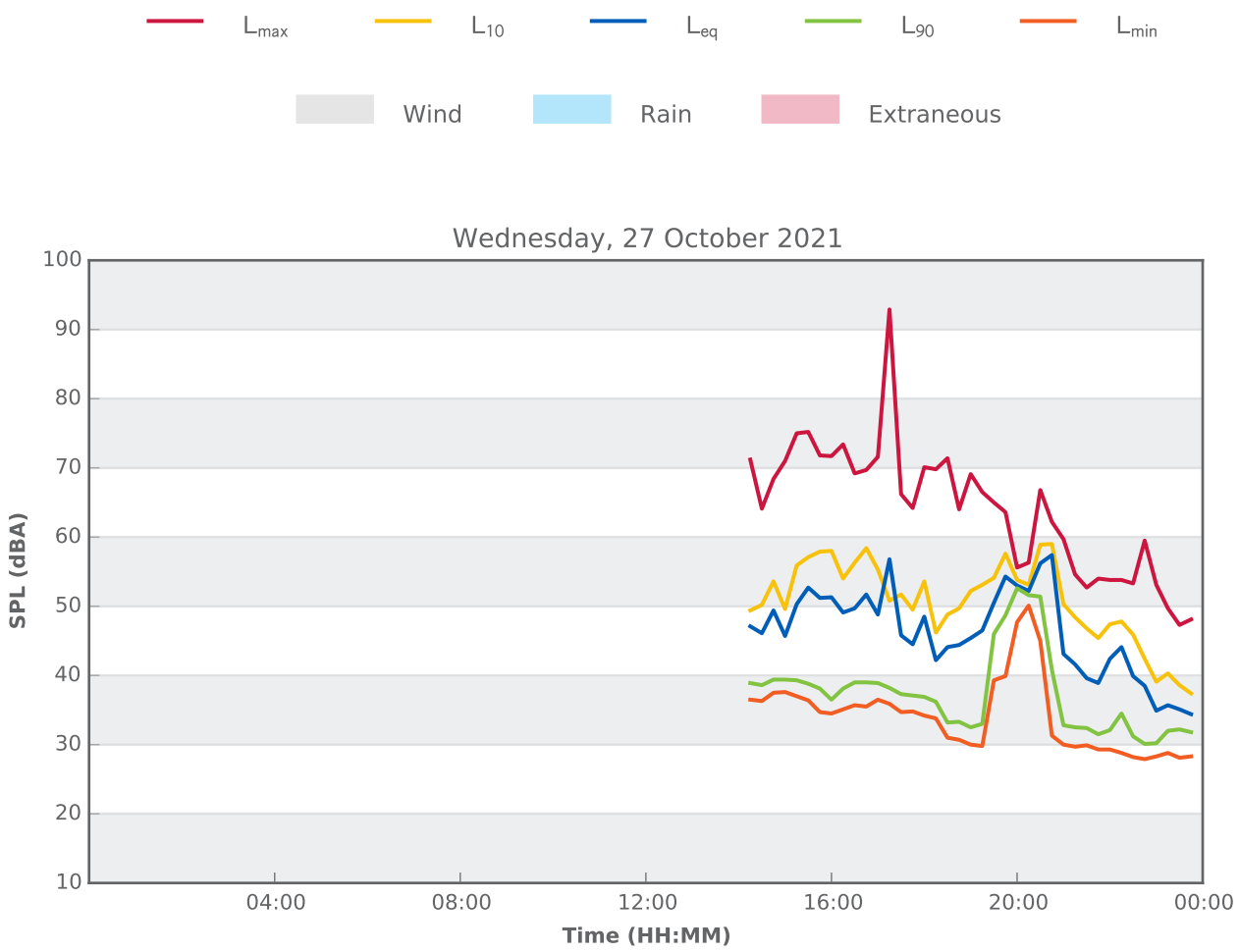
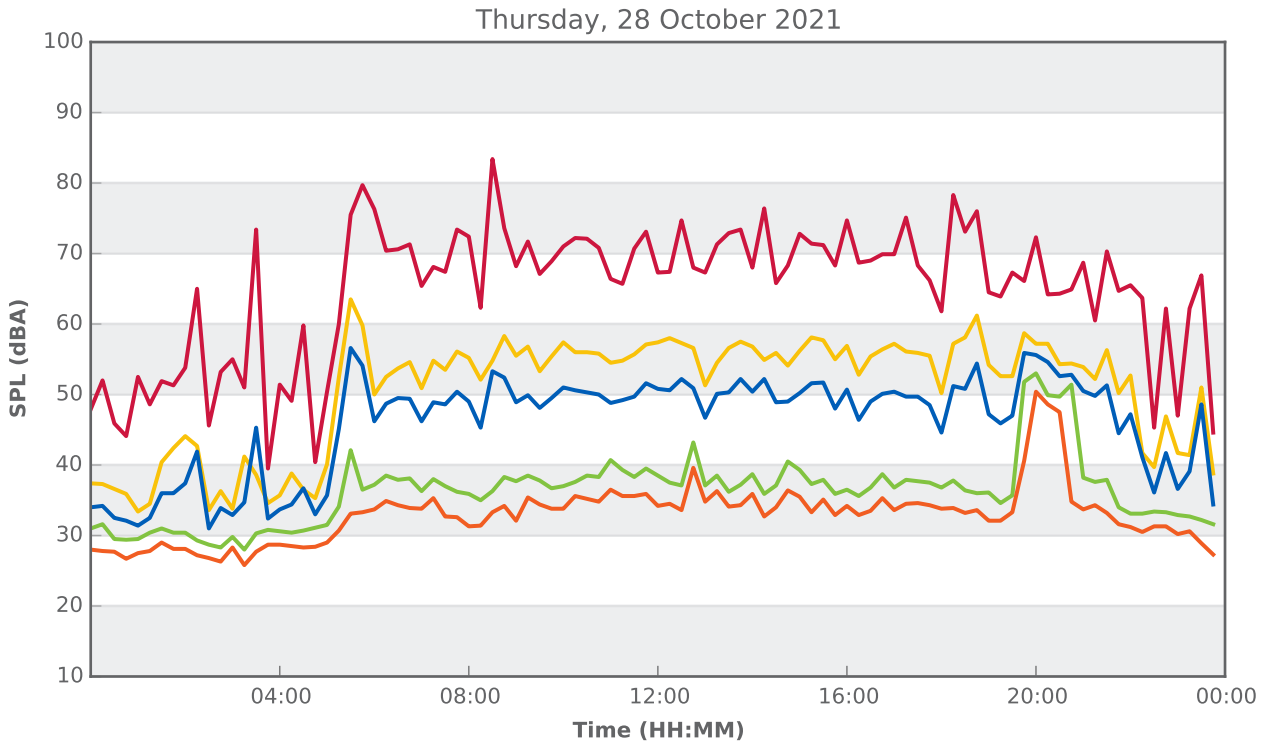


Logger Location 4 - Along Trinity Point Drive (Traffic Noise)





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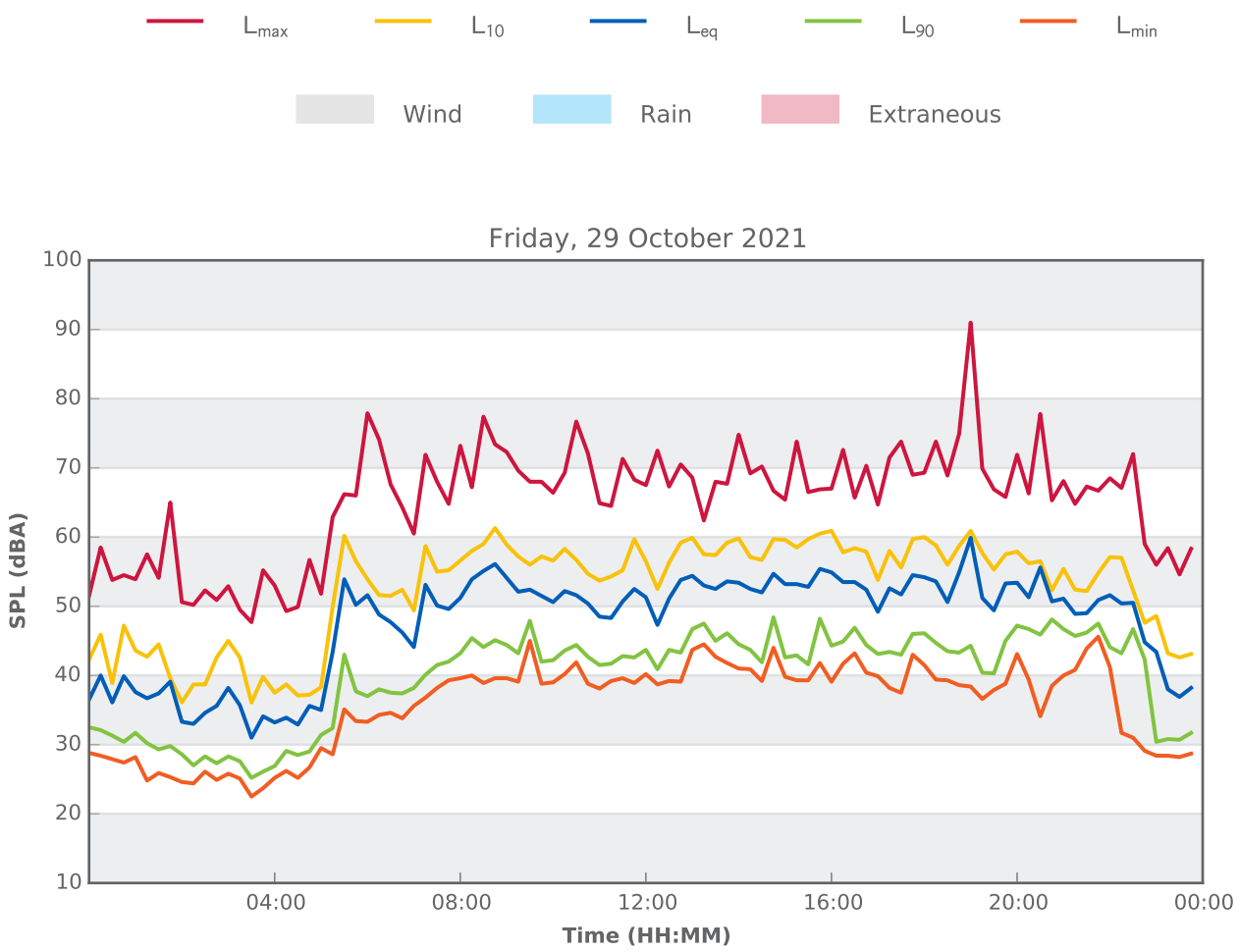

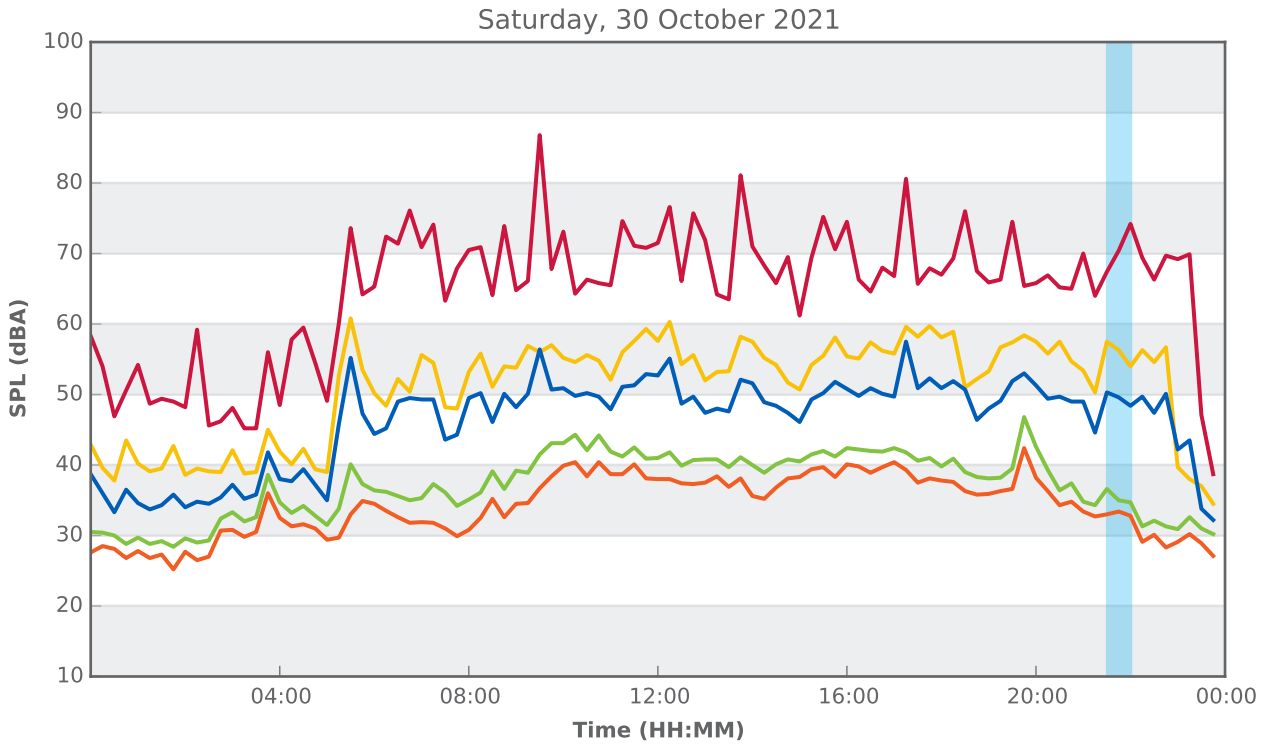

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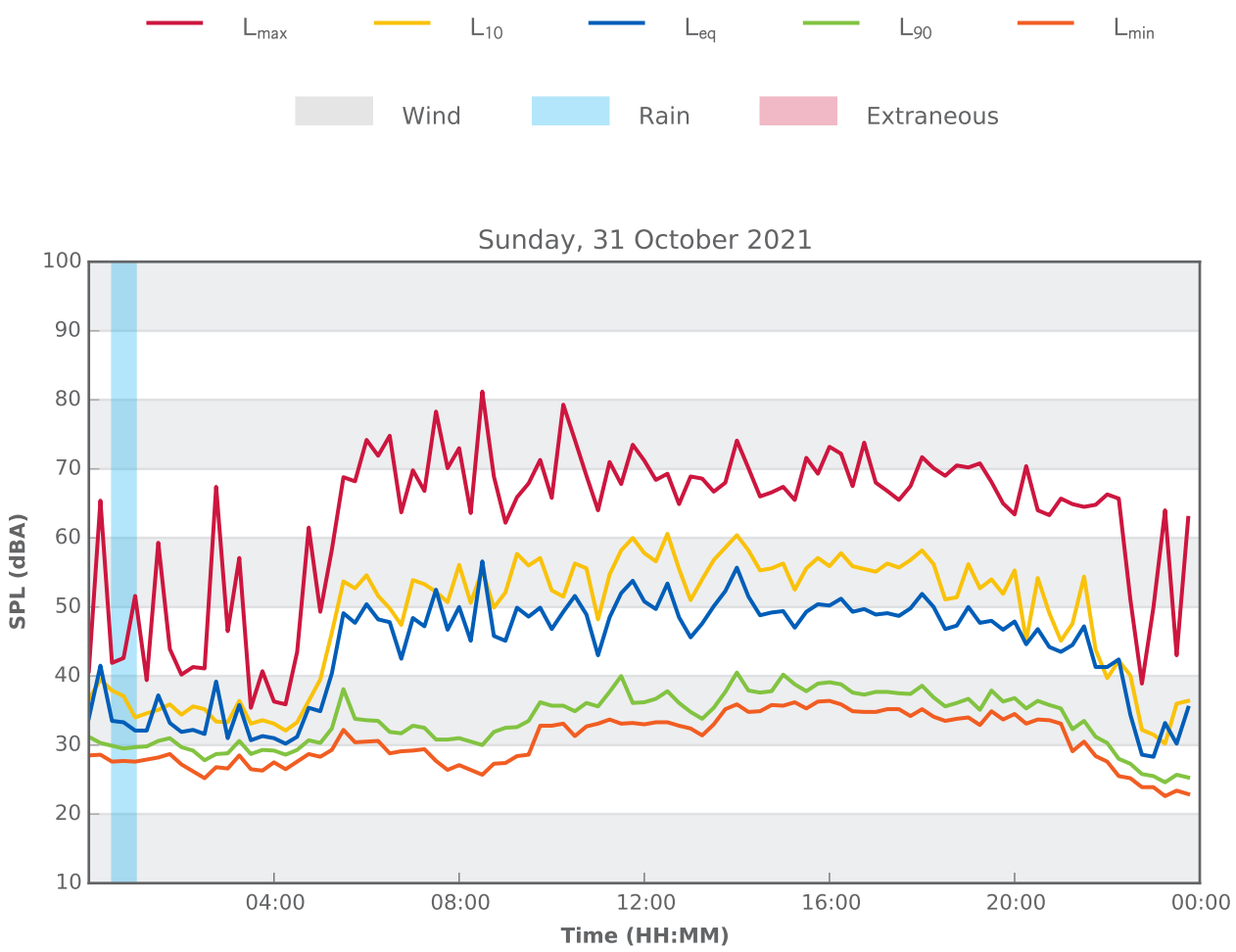
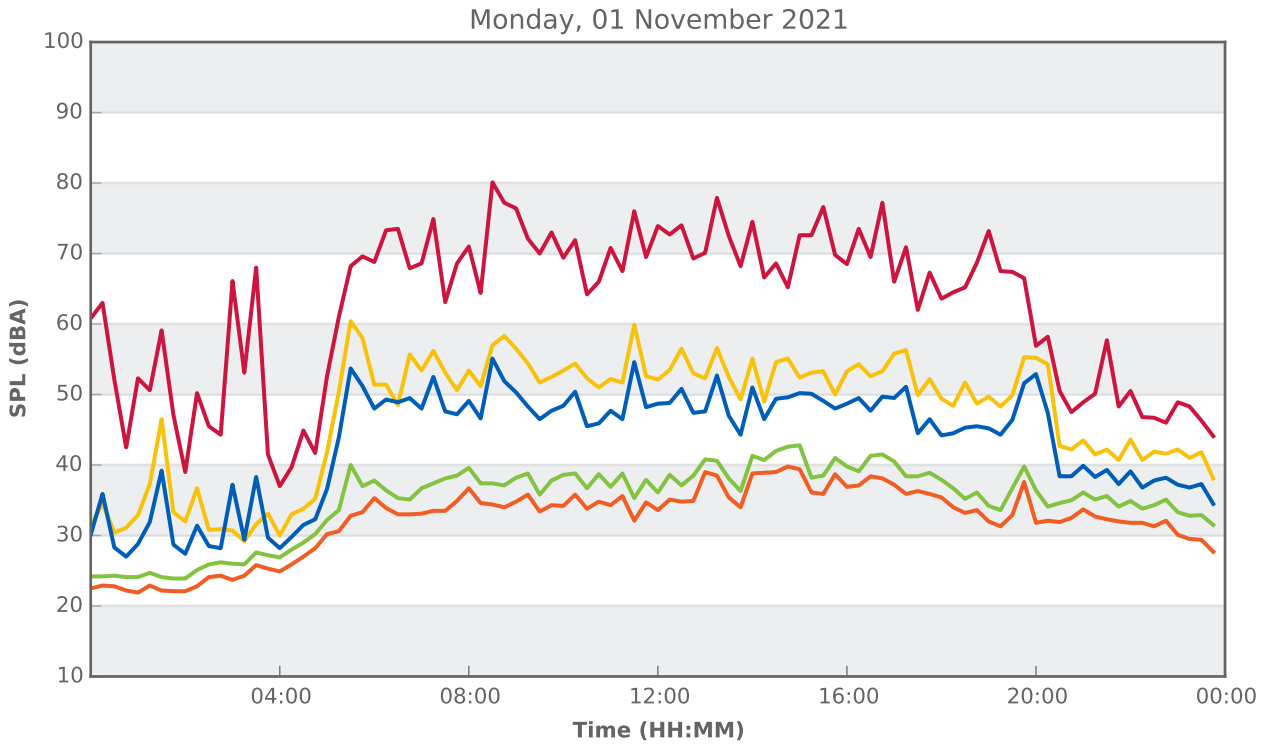
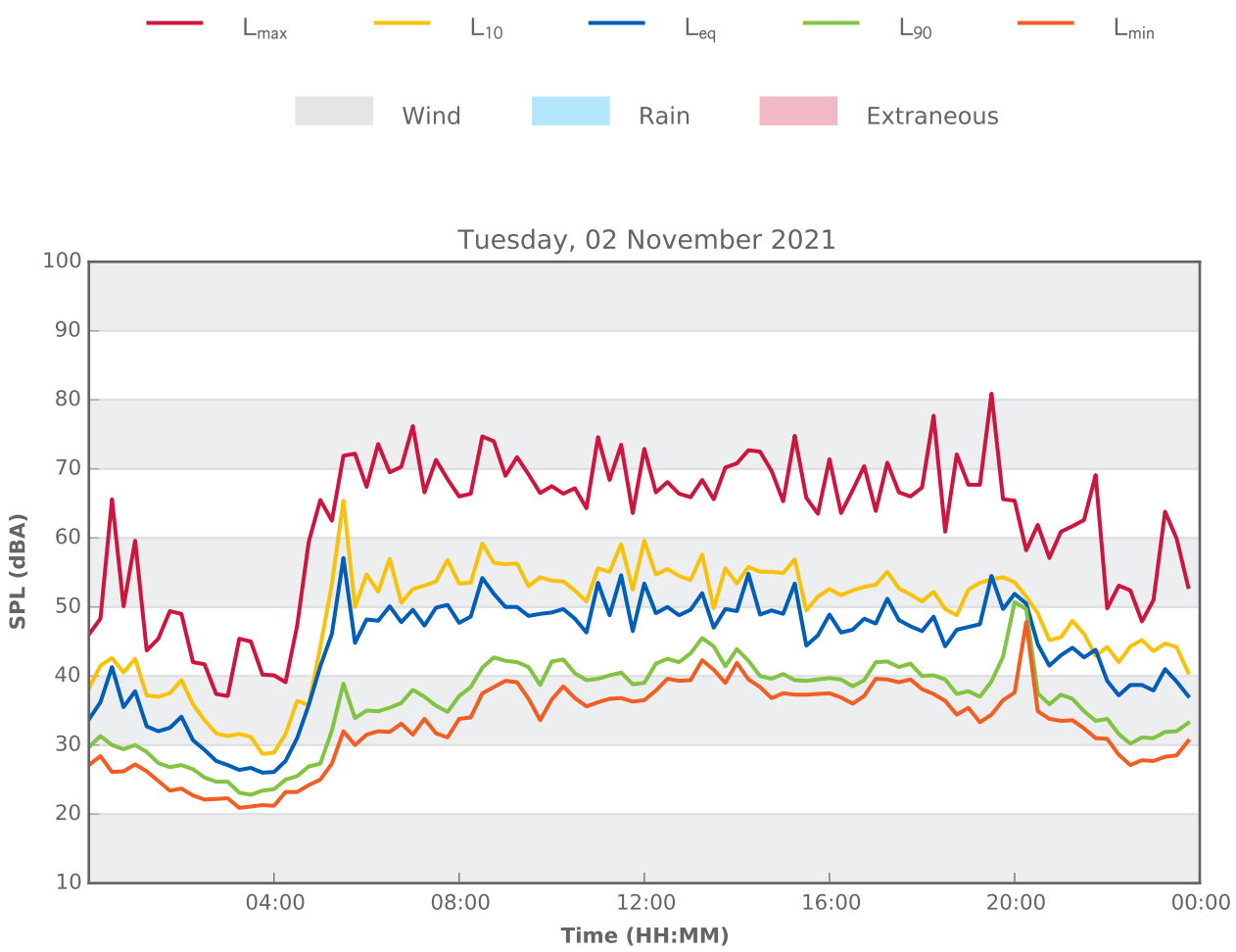
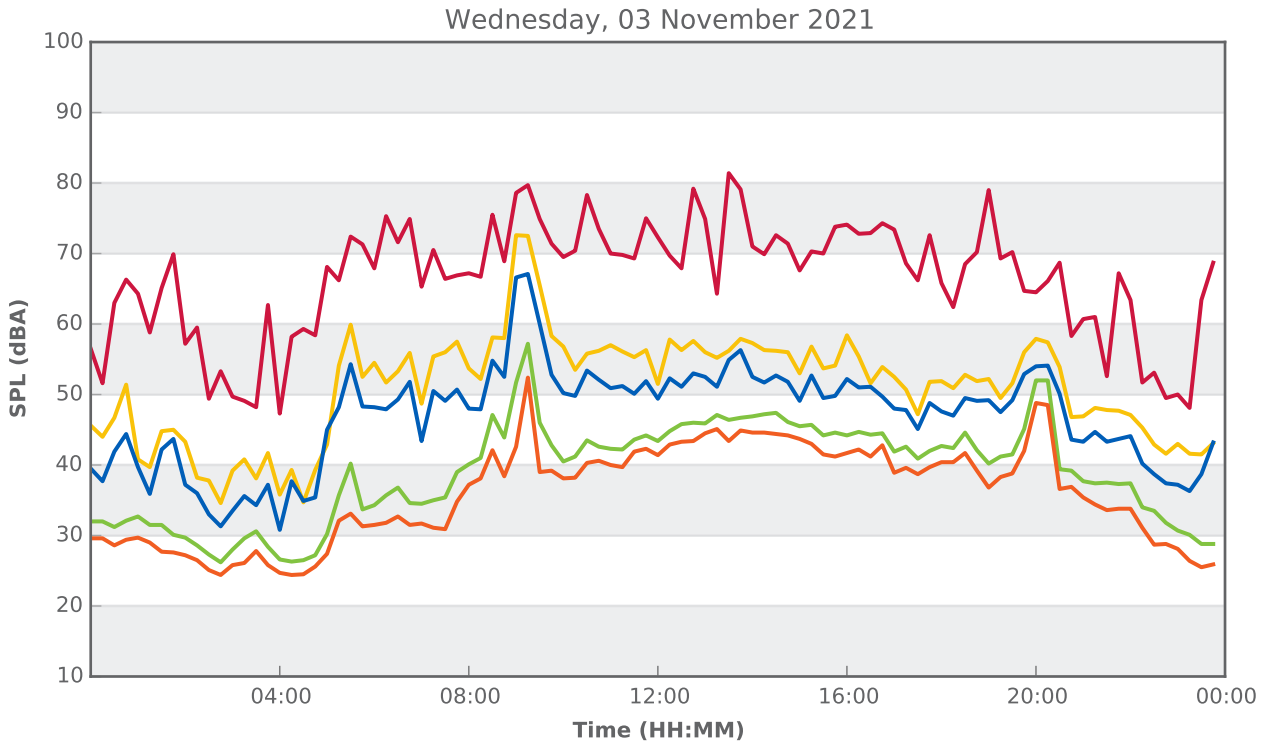




Logger Location 4 - Along Trinity Point Drive (Traffic Noise)





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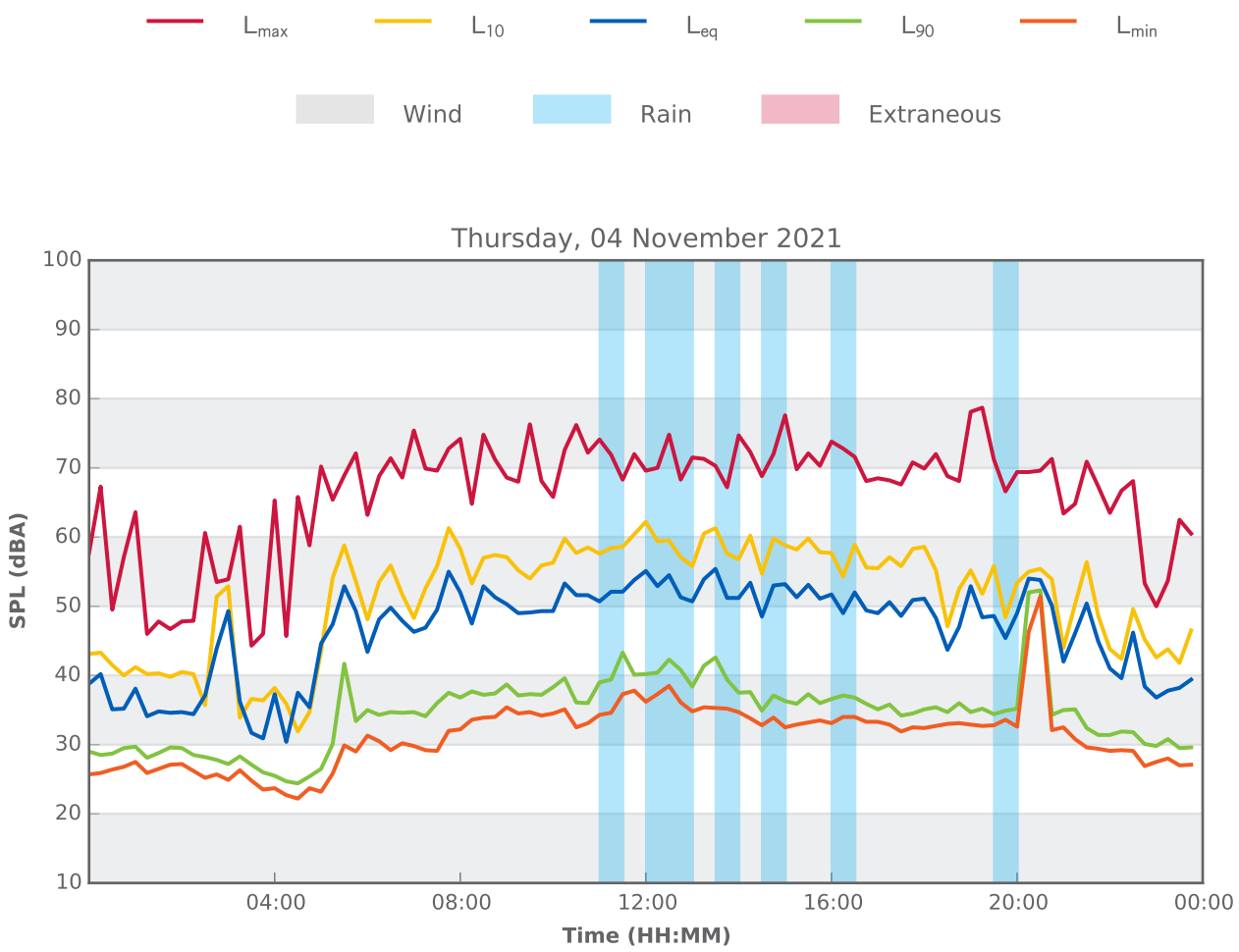
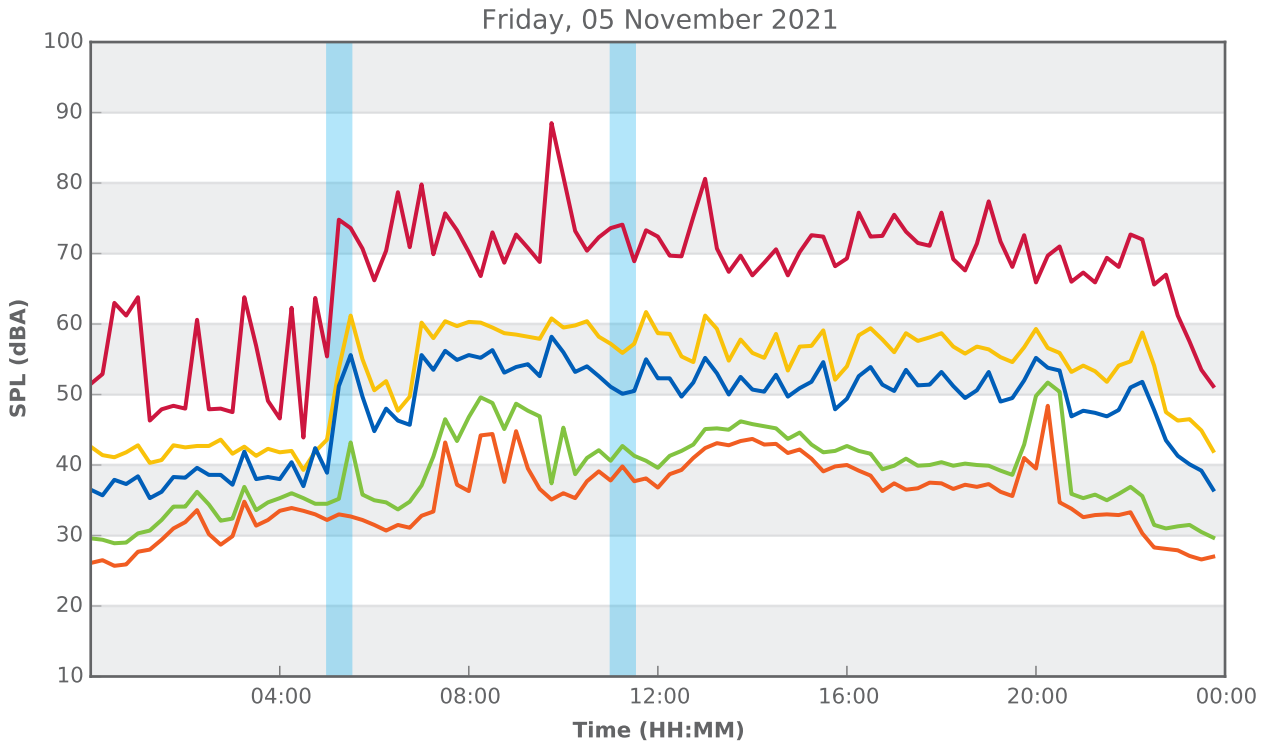
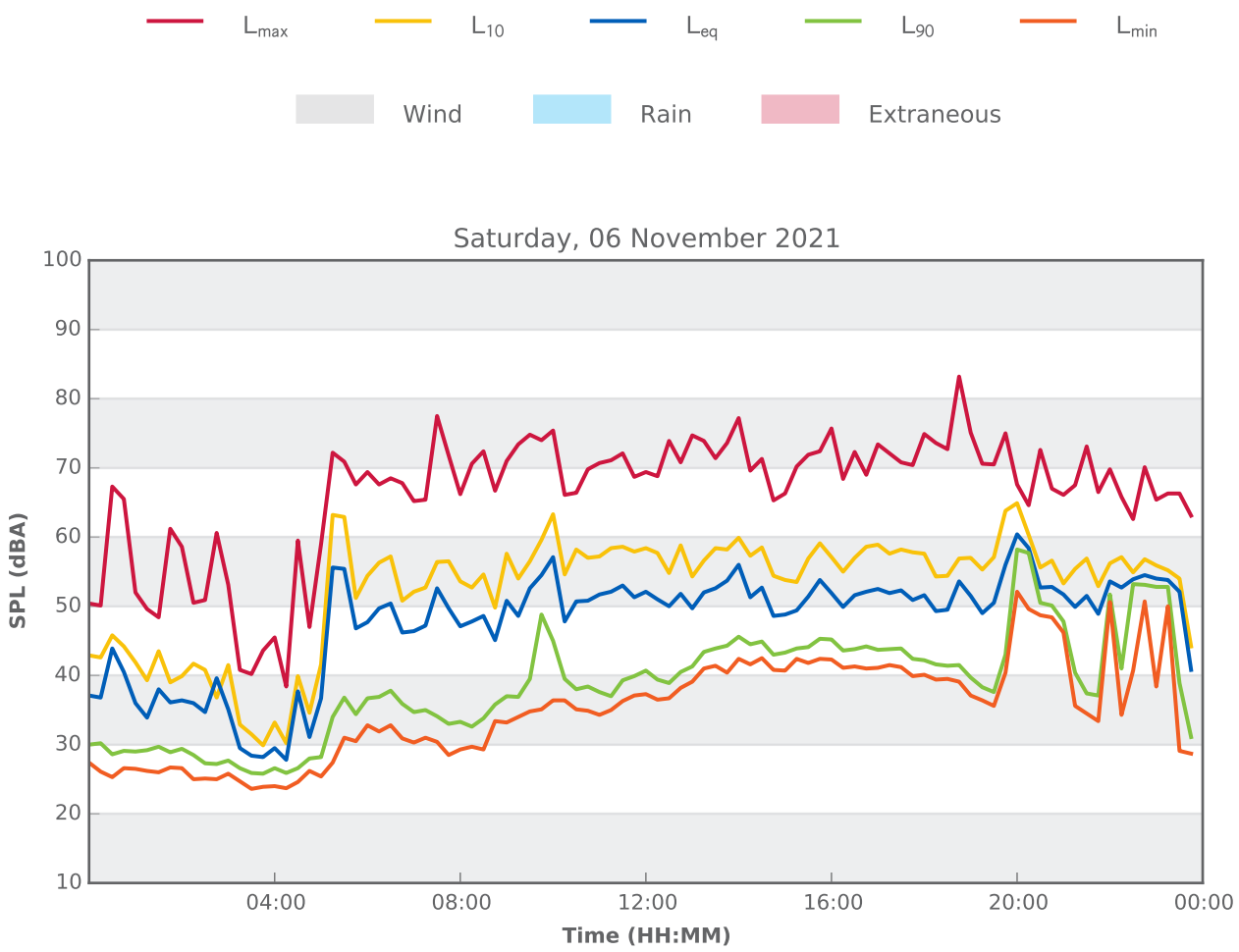
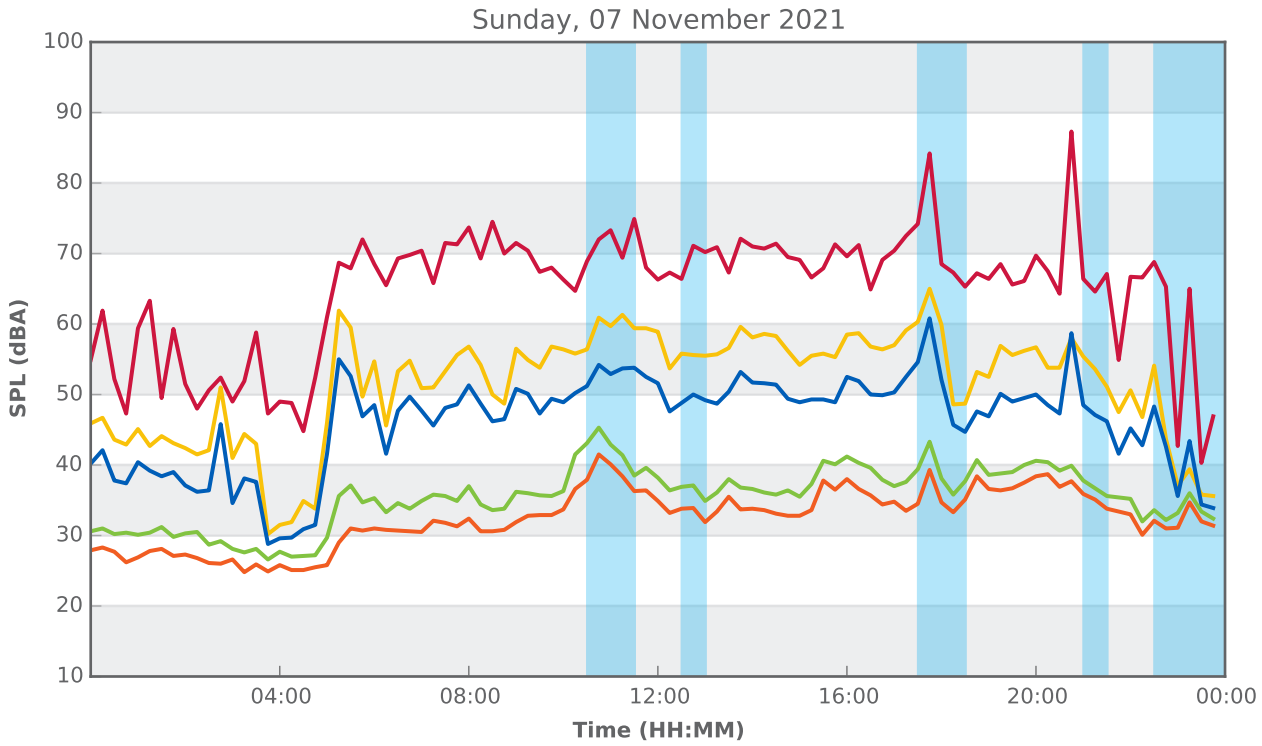




Logger Location 4 - Along Trinity Point Drive (Traffic Noise)





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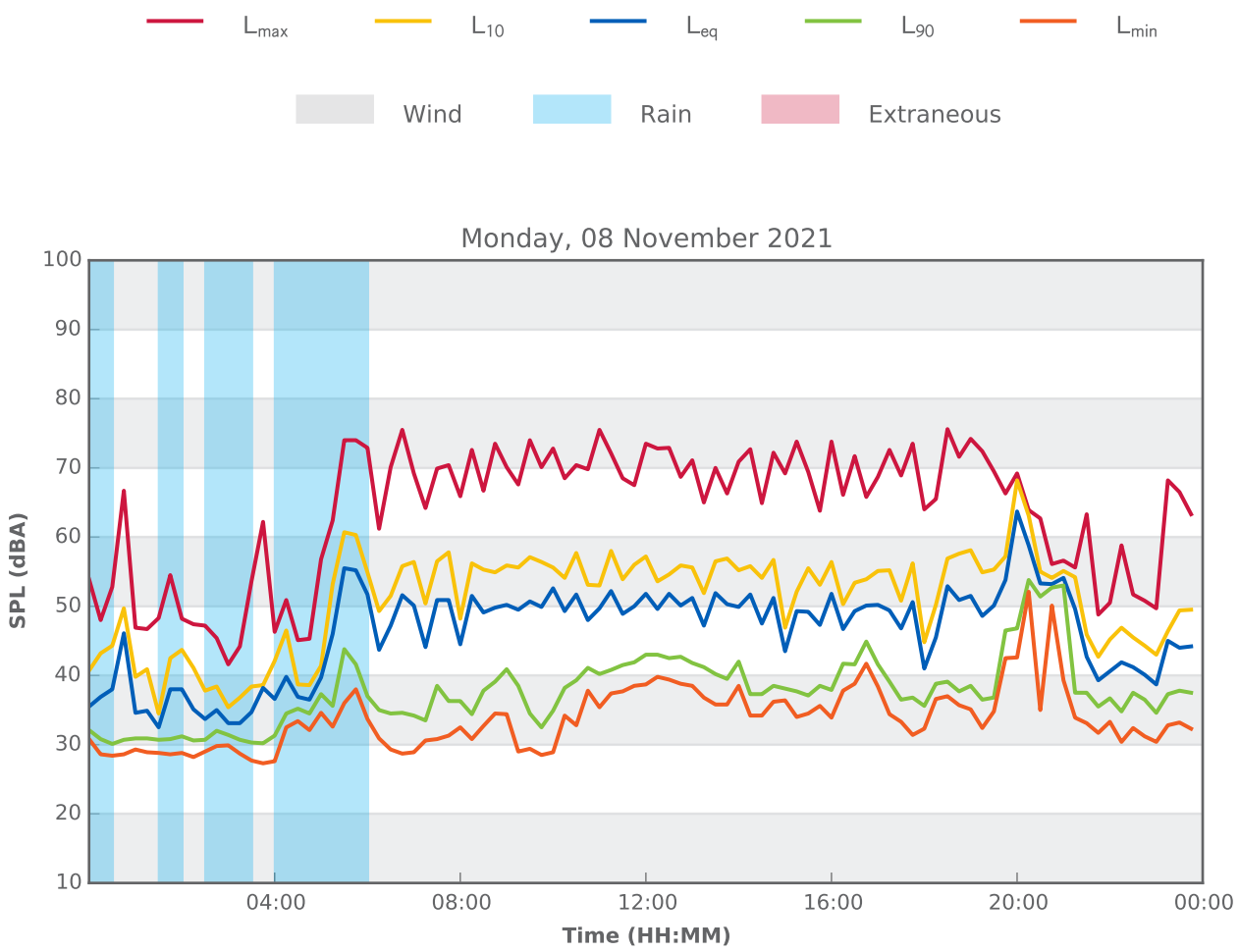

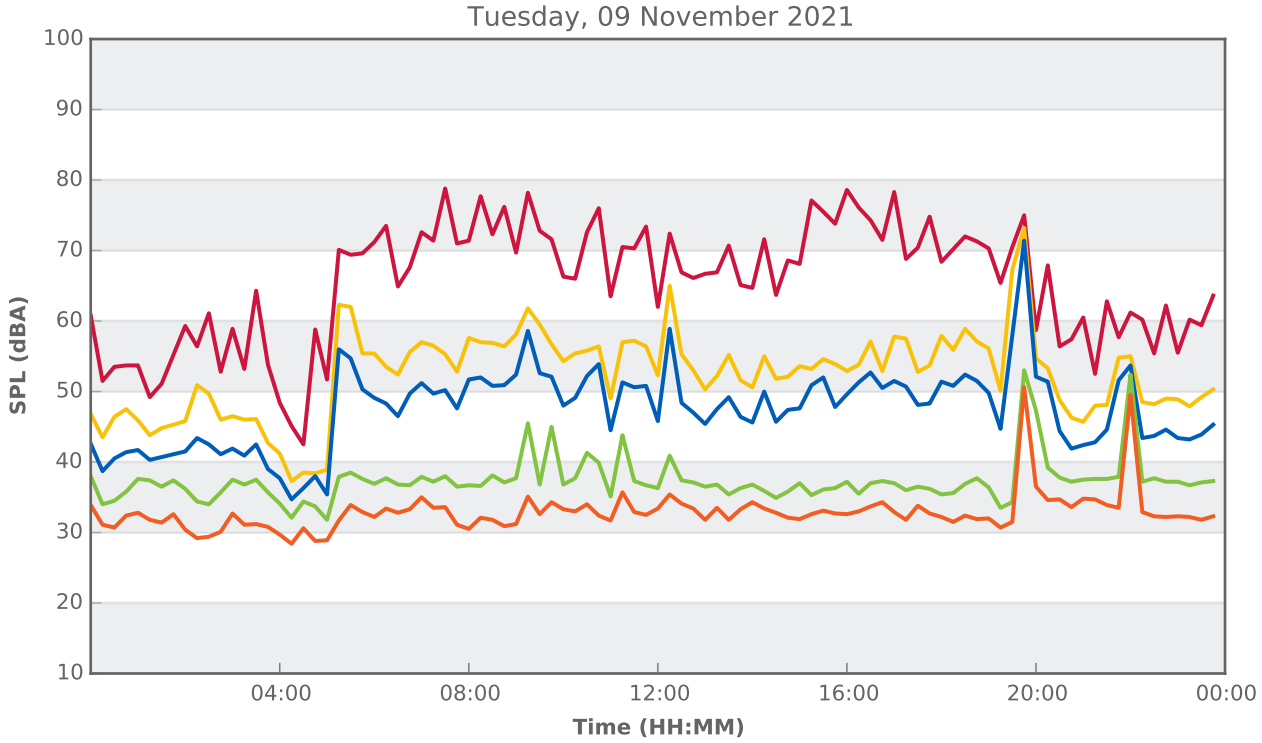

Logger Location 4 - Along Trinity Point Drive (Traffic Noise)