



**Parramatta Eels National Rugby League Club:  
Centre of Excellence & Community Facilities  
CNVMP**

**Construction Noise and Vibration Management Plan**

S230621RP1 Revision A

Monday, 11 September 2023



## Document Information

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## Revision Table

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## Glossary

A-weighting	A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies.
Daytime	Between 7 am and 6 pm as defined in the NPI.
dB	Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy. We typically perceive a 10 dB increase in sound as a doubling of that sound level.
dB(A)	‘A’ Weighted sound level in dB.
Evening	Between 6 pm and 10 pm as defined in the NPI.
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second. The human ear responds to sound in the frequency range of 20 to 20,000 Hz.
NPI	New South Wales <i>Noise Policy for Industry</i> , 2017.
Intrusive Noise	Noise emission that when assessed at a noise-sensitive receiver (principally a residential premises’ boundary) is greater than 5 dB(A) above the background noise level.
L <sub>10</sub>	Noise level exceeded for 10% of the measurement time. The L <sub>10</sub> level is commonly referred to as the average maximum noise level.
L <sub>90</sub>	Noise level exceeded for 90% of the measurement time. The L <sub>90</sub> level is commonly referred to as the background noise level.
L <sub>eq</sub>	Equivalent Noise Level—Energy averaged noise level over the measurement time.
L <sub>max</sub>	Maximum measured sound pressure level in the time period.
mm/s	Millimetres per second—units of vibration velocity.
Night-time	Between 10 pm on one day and 7 am on the following day as defined in the NPI.
Rating Background Level (RBL)	Overall single-figure A-weighted background level representing an assessment period (Day/Evening/Night). For the short-term method, the RBL is simply the measured L <sub>A90,15min</sub> noise level. For the long-term method, it is the median value of all measured background levels during the relevant assessment period.

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## 1 Introduction

Resonate Consultants has been commissioned by Kane Constructions to provide an acoustic assessment and Construction Noise and Vibration Management Plan (CNVMP) for the development of the Parramatta Eels Centre of Excellence, which includes the construction of a high-performance community facility, including a grandstand with approximately 1500 seats.

The construction consists of 7 stages:

- Site establishment and enabling works
- Demolition
- Retaining piles and excavation
- Substructure construction
- Frame construction
- Facade works
- Internal works and fitout.

### 1.1 Objectives

The CNVMP has been prepared to *ensure noise generating activities are appropriately managed and nearby sensitive receivers protected*. The Development Application (DA) conditions, reference DA173/18, issued by The Hills Shire Council for the Project, specifically Condition C12, are presented below in Table 1.

**Table 1 Development Application conditions**

Reference	Condition	Addressed in this report
C12	Prior to the commencement of any earthwork or construction, the Applicant must submit to the satisfaction of the Certifier a Construction Noise and Vibration Management Plan (CNVMP) for the development	Context
C12 (a)	identification of the specific activities that will be carried out and associated noise sources at the site.	Section 5.1.1
C12 (b)	identification of all potentially affected sensitive residential receiver locations	Section 2.2
C12 (c)	quantification of the rating background noise level (RBL) for sensitive receivers, as part of the Plan, or as undertaken in the EIS.	Section 4.1.3
C12 (d)	the construction noise, ground-borne noise and vibration objectives derived from an application of the EPA Interim Construction Noise Guideline (ICNG), as reflected in conditions of approval.	Section 5.1
C12 (e)	prediction and assessment of potential noise, ground-borne noise (as relevant) and vibration levels from the proposed construction methods expected at sensitive receiver premises against the objectives identified in the ICNG and conditions of approval.	Section 5.1.1
C12 (f)	where objectives are predicted to be exceeded, an analysis of feasible and reasonable noise mitigation measures that can be implemented to reduce construction noise and vibration impacts.	Section 6

Reference	Condition	Addressed in this report
C12 (g)	description of management methods and procedures, and specific noise mitigation treatments/measures that can be implemented to control noise and vibration during construction.	Section 6
C12 (h)	where objectives cannot be met, additional measures including, but not necessarily limited to, the following must be considered and implemented where practicable; reduce hours of construction, the provision of respite from noise/vibration intensive activities, acoustic barriers/enclosures, alternative excavation methods or other negotiated outcomes with the affected community.	Section 7.3
C12 (i)	where night-time noise management levels cannot be satisfied, a report must be submitted to the Planning Secretary outlining the mitigation measures applied, the noise levels achieved and justification that the outcome is consistent with best practice.	Section 7.1
C12 (j)	measures to identify non-conformances with the requirements of the Plan, and procedures to implement corrective and preventative action.	Section 7.3
C12 (k)	suitable contractual arrangements to ensure that all site personnel, including sub-contractors, are required to adhere to the noise management provisions in the Plan.	Section 7.3
C12 (l)	procedures for notifying residents of construction activities that are likely to affect their noise and vibration amenity.	Section 5.3.2
C12 (m)	measures to monitor noise performance and respond to complaints.	Section 6.2
C12 (n)	measures to reduce noise related impacts associated with offsite vehicle movements on nearby access and egress routes from the site.	Section 5.3.4
C12 (o)	procedures to allow for regular professional acoustic input to construction activities and planning.	Section 7.3
C12 (p)	effective site induction, and ongoing training and awareness measures for personnel (e.g., toolbox talks, meetings etc).	Section 7.3
C12 (q)	be consistent with and incorporate all relevant recommendations and mitigation measures detailed in the Noise and Vibration Assessment, prepared by Resonate, dated 19 March 2022.	Section 6
D3 (a)	Construction, including the delivery of materials or machinery to and from the site, may only be carried out between the following hours of 7am and 6pm, Mondays to Fridays.	Section 4.1.1
D3 (b)	Construction, including the delivery of materials or machinery to and from the site, may only be carried out between the following hours of 8 am and 1 pm, Saturdays.	Section 4.1.1
D4	No work may be carried out on Sundays or public holidays.	Section 4.1.1
D5 (a)	Activities may be undertaken outside of these hours if required by the Police or a public authority for the delivery of vehicles, plant or materials.	Section 5.3.3
D5 (b)	Activities may be undertaken outside of these hours if required in an emergency to avoid the loss of life, damage to property or to prevent environmental harm.	Section 5.3.3

Reference	Condition	Addressed in this report
D6	Notification of activities undertaken in the circumstances in Condition D5 must be given to affected residents before undertaking the activities or as soon as is practical afterwards.	Section 4.1.3
D7 (a)	Rock breaking, rock hammering, sheet piling, pile driving, and similar activities may only be carried out between the following hours of 9 am to 12 pm, Monday to Friday.	Section 5.3.3
D7 (b)	Rock breaking, rock hammering, sheet piling, pile driving, and similar activities may only be carried out between the following hours of 2 pm to 5 pm Monday to Friday.	Section 5.3.3
D7 (c)	Rock breaking, rock hammering, sheet piling, pile driving, and similar activities may only be carried out between the following hours of 9 am to 12 pm, Saturday.	Section 5.3.3
D15	The development must be constructed to achieve the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the management and mitigation measures identified in the CNVMP (Condition C12).	Section 0
D16	The Applicant must ensure construction vehicles (including concrete agitator trucks) do not arrive at the subject site or surrounding residential precincts outside of the construction hours of work outlined under this consent.	Section 5.3.4
D17	The Applicant must implement, where practicable and without compromising the safety of construction staff or members of the public, audible movement alarms of a type that would minimise noise impacts on surrounding noise sensitive receivers.	Section 5.3.5
D18	The Applicant must ensure that any work generating high noise impact (i.e. work exceeding a NML of LAeq 75 dBA) as measured at any sensitive receiver is only undertaken in continuous blocks of no more than 3 hours, with at least a 1 hour respite between each block of work generating high noise impact, where the location of the work is likely to impact the same receivers. For the purposes of this condition 'continuous' includes any period during which there is less than 1 hour respite between ceasing and recommencing any of the work the subject of this condition.	Section 0
D19	Any noise generated during construction of the development must not be offensive noise within the meaning of the Protection of the Environment Operations Act 1997 or exceed approved noise limits for the site.	Section 4.1
D20	Vibration caused by construction at any residence or structure outside the site must be limited.	Section 4.2
D20 (a)	for structural damage, the latest version of DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures (German Institute for Standardisation, 1999).	Section 4.2

Reference	Condition	Addressed in this report
D20 (b)	for human exposure to vibration, the evaluation criteria set out in the Environmental Noise Management Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006) (as may be updated or replaced from time to time).	Section 4.2.2
D21	Vibratory compactors must not be used within 30 metres of residential or heritage buildings unless vibration monitoring confirms compliance with the vibration criteria specified above. These limits apply unless otherwise outlined in the project specific CNVMP required by this consent.	Section 4.2.1

The key objective of the CNVMP is to ensure that project impacts on noise and vibration sensitive receivers are minimised and within the scope permitted by the planning approval. This includes a target to minimise complaints from the community and stakeholders relating to noise and vibration.

To achieve this objective, Kane Construction will undertake the following:

- Ensure appropriate controls and procedures are implemented during construction activities to avoid or minimise noise and vibration impacts and potential adverse impacts to neighbouring sensitive receivers.
- Ensure appropriate measures are implemented to address Condition C12 and other guidance for construction noise and vibration management relevant to building works in NSW.

## 2 Project and Site Description

### 2.1 Project Description

The proposed development will provide state of the art facilities which enable physical recreation opportunities in conjunction with improved facilities for staff, players and existing users of the site. The proposed development will be integrated with the existing recreational landscape of the site and complement the upgrades to the existing playing fields being undertaken by Council. The proposed development is defined as a Recreation facility (major), and includes the following components:

- Construction of high-performance Centre of Excellence in the north-east of the site adjacent to Training Field 2:
  - Elite level gymnasium.
  - Medical and rehabilitation facilities.
  - Aquatic recovery and rehabilitation pools.
  - Lecture theatre and meeting rooms.
  - Player education and study areas.
  - Administration offices for the Parramatta Eels.
  - New female facilities including a dedicated female change room, cubicle toilets and showers.
  - Balcony and terrace area.
  - End of Trip Facilities and bicycle parking.
  - Refuse Area.
- Construction of a Community Facility, including a grandstand with approximately 1,500 seats in the centre of the site adjacent to the Main Playing Field 3:
  - Unisex changerooms and amenities.
  - Referee changeroom and amenities.
  - First Aid/Medical room.
  - Community gymnasium.
  - Café/kiosk.
  - Concourse terrace.
  - Multipurpose community function room with kitchen and amenities.
  - Refuse Area.
  - Bicycle parking.
- Solar arrays will be included on the roof of both the Centre of Excellence and Community Facility.
- Additional 40 car parking spaces for the proposed facility to operate in conjunction with existing at grade car parking already constructed by Council.
- Additional landscaping throughout the development footprint.
- Removal of a small number of trees internal to the site, however noting perimeter trees will be retained where not affected by the proposed building footprints.
- Hours of operation for the Centre of Excellence and Community Facility are 5:00am to 12:00am, however the following key times are likely:
  - Centre of Excellence: 7.00am - 7.00pm
  - Community Facility: 7.00am - 10.00pm

The site is bounded by Memorial Avenue to the north and Stone Mason Drive to the east. Playing fields are located to the west of the buildings and council reserves are to the south. Figure 1 shows the proposed site location.

Several noise and vibration sensitive land uses are located in the immediate vicinity of the site as shown in Figure 1, including residential receivers located on Gormon Avenue, Stone Mason Drive and McKellar Court.



## 2.2 Location

The site is located at Kellyville Memorial Park, 8 Memorial Avenue, Kellyville. It is bound by Memorial Avenue to the North and Stone Mason Drive to the East. The site is primarily surrounded by residential receivers, with other receivers including medical, commercial buildings, and a childcare centre. The most affected Noise Sensitive Receivers (NSR) are summarised alongside a description of the land use, as shown in Figure 1.

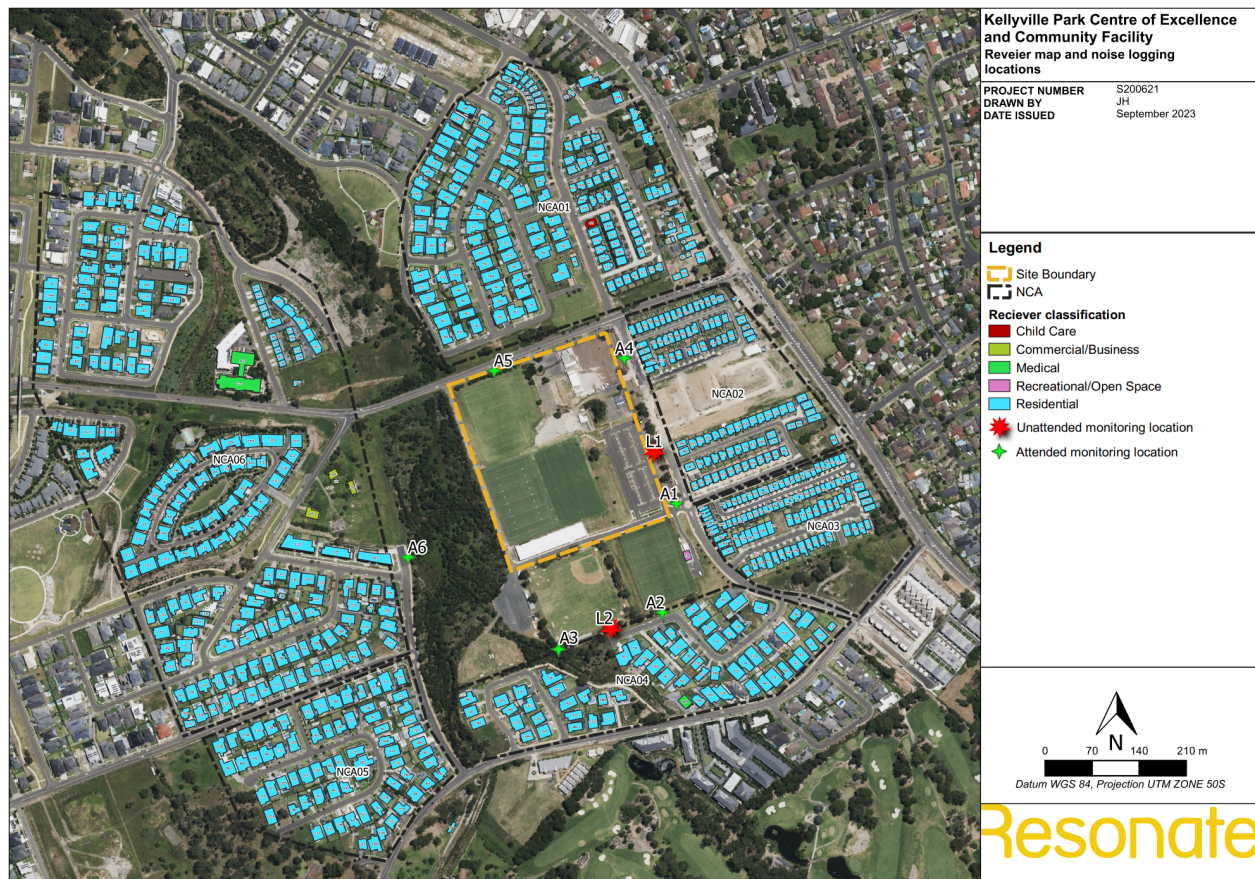


Figure 1 Site location in context

## 3 Existing Acoustic Environment

### 3.1 Noise monitoring

Unattended and attended noise measurements were undertaken to determine the existing background and ambient noise levels at representative sensitive receivers surrounding the project site, as shown in Figure 1 above.

#### 3.1.1 Instrumentation

Noise logging was conducted using two Rion noise loggers bearing the serial numbers 00841630 and 772983. Field calibration was conducted at the commencement and conclusion of the logging period and no significant calibration drift was observed.

The noise loggers were configured to record all relevant noise indices, including background noise level ( $L_{A90}$ ) and equivalent continuous noise levels ( $L_{Aeq}$ ). Samples were accumulated at 15-minute intervals. The time response of the logger was set to 'fast'.

Attended measurements were conducted using a Rion NL-52 sound level meter bearing the serial number 820944. Field calibration was conducted before and after the measurements and no significant calibration drift was observed. Each measurement was for a period of 15 minutes with the meter response set to 'fast'.

The noise logger at Stone Mason Drive was vandalised on 16 September 2021 and so data from that that point forward has been excluded.

Noise measurements were taken in general accordance with AS1055.1.

#### 3.1.2 Weather conditions

It is a requirement that noise data is captured during periods of favourable weather conditions avoiding adverse impacts of wind and rain on background noise levels. In order to assess weather conditions for the measurement period, half-hourly weather data was obtained from the Bureau of Meteorology (BOM) weather observation station ID 60800 at Richmond.

Noise data has been excluded from the analysis if:

- Rain was observed during a measurement period, and/or
- Wind speed exceeded 5 m/s (18 km/h) at the measurement height of 1.5 m above ground. Wind data obtained from the BOM is presented as the value at 10 m above ground.

The BOM wind speed data obtained for this report was measured at a height of 10 m above ground level. It is therefore necessary to apply a correction factor in order to estimate the wind speed at the height of the logger (1.5 m).

The methodology to formulate a correction factor has been derived<sup>1</sup>. The correction multiplier for the measured wind speed at 10 m is derived by the following formula:

$$W_{1.5} = W_{10} \times \left( \frac{M_{1.5,cat}}{M_{10,cat}} \right)$$

where:

$W_{1.5}$  = Wind speed at height of 1.5 m

<sup>1</sup> Gowen, T., Karantonis, P. & Rofail, T. (2004), *Converting Bureau of Meteorology wind speed data to local wind speeds at 1.5m above ground level*, Proceedings of ACOUSTICS 2004

$W_{10}$  = Wind speed at height of 10 m  
 $M_{1.5,cat}$  = AS 1170 multiplier for receiver height of 1.5 m and terrain category  
 $W_{10,cat}$  = AS 1170 multiplier for receiver height of 10 m and terrain category

Noise logging data that has been excluded due to adverse weather conditions is identified in the overall summary and daily noise logging graphs presented in Appendix A.

## 3.2 Unattended noise monitoring

Unattended noise monitoring conducted in accordance with the NSW EPA's Noise Policy for Industry (NPI) has been used to establish existing conditions at the following locations around the site:

- L1 – Off Stonemason Drive on the Kellyville Park side near Towell Way
- L2 – At the end of McKellar Court at the southwest end of Kellyville Park

The unattended measured noise levels are presented in Table 2. Detailed charts presenting measured noise levels versus time overlaid with weather data for the monitoring period are presented in Appendix A.

**Table 2 Unattended monitoring results**

Location <sup>1</sup>	Rating Background Level, dB(A) $L_{90}$ <sup>2</sup>			Ambient noise level, dB(A) $L_{eq}$		
	Day 7 am–6 pm	Evening 6 pm–10 pm	Night 10 pm–7 am	Day 7 am–6 pm	Evening 6 pm–10 pm	Night 10 pm–7 am
L1 – Stone Mason Drive	44	39	31	55	55	44
L2 – McKellar Court	42	39	31	53	51	47

(1) Refer to Figure 1 for the location of the monitoring.

(2) The Rating Background Level is a measure of the typical minimum steady background noise level for each time of day.

## 3.3 Attended noise monitoring

Attended monitoring was conducted at locations around the site on Wednesday, 6 October 2021. The monitoring was conducted between 3:00 pm and 6:00 pm.

The measured noise levels at each location are shown in Table 3, with the measurement locations shown on Figure 1.

**Table 3 Attended noise level measurement results**

Location	Measured noise level, dB(A)			
	$L_{max}$	$L_{10}$	$L_{eq}$	$L_{90}$
A1 – The corner of Stonemason Drive and Kennedy Avenue	71	53	51	43
A2 – McKellar Court across from number 26	71	50	47	40
A3 – At the southwestern corner of the baseball field	60	46	44	39

Location	Measured noise level, dB(A)			
	L <sub>max</sub>	L <sub>10</sub>	L <sub>eq</sub>	L <sub>90</sub>
A4 – On Stonemason drive midway between Memorial Avenue and Abbottsford Road	68	58	55	45
A5 – On Memorial Avenue near the midpoint of the two northern playing fields	89	76	73	58
A6 – At the northern extent of Severn Vale Drive	69	53	47	46

## 4 Construction noise and vibration criteria

### 4.1 Construction noise

Construction noise in New South Wales is assessed using the Department of Environment & Climate Change (now Environment Protection Authority) *Interim Construction Noise Guideline* (ICNG).

The ICNG aims to manage noise from construction works regulated by the EPA. It is also intended to provide guidance to other interested parties in the management of construction noise, and has therefore been adopted for this construction noise assessment. The ICNG prescribes  $L_{eq,15min}$  Noise Management Levels (NML) for sensitive receivers as part of a quantitative construction noise assessment. Where the predicted or measured construction noise level exceeds these management levels, then all feasible and reasonable work practices should be implemented to reduce construction noise, and community consultation regarding construction noise is required to be undertaken.

Any noise generated during construction of the development must not be offensive noise within the meaning of the Protection of the Environment Operations Act 1997 or exceed approved noise limits for the site. Noise limits for the site are the NML set out in Section 4.1.4 below.

#### 4.1.1 Standard Working Hours

The ICNG recommends standard working hours for construction as follows:

- Monday to Friday, 7 am to 6 pm
- Saturday, 8 am to 1 pm
- No work on Sundays or Public Holidays

To encourage work during the Standard Working Hours, and to reflect the lower impact of work at these times, the ICNG prescribes less stringent Standard Working Hours NMLs.

It should be noted that the Standard Working Hours are only applicable to residential (or similar) land uses. At educational or commercial land uses, where evening amenity and sleeping is not a concern, the impact of construction noise is assessed based on the times that the land use operates.

#### 4.1.2 Residential land uses

The NMLs prescribed for residential land uses by the ICNG are presented in Table 4. The levels apply at the most exposed property boundary of the noise sensitive receiver at a height of 1.5 metres above ground level.

#### 4.1.3 Other sensitive land uses

The ICNG also prescribes NMLs for other sensitive land uses, including educational buildings and offices. The NMLs for relevant land uses are summarised in Table 5 and apply only when those land uses are in use.

For those receivers where an internal NML applies, it is common to assume an outdoor-to-indoor noise reduction of 10 dB(A). This is based on a standard residential building facade with windows kept open.

**Table 4 Noise management levels for residential land uses**

Time of day	NML, $L_{Aeq,15min}$	Application notes
Recommended Standard Working Hours	Noise affected: RBL + 10 dB(A)	<p>May be some community reaction to noise.</p> <ul style="list-style-type: none"> <li>Where the predicted or measured construction noise level exceeds the noise affected level, all feasible and reasonable work practices should be applied to meet the noise affected level.</li> <li>All residents potentially impacted by the works should be informed of the nature of the works, the expected noise levels and duration, and provided with site contact details.</li> </ul>
	Highly noise affected: 75 dB(A)	<p>May be strong community reaction to noise.</p> <ul style="list-style-type: none"> <li>Where construction noise is predicted or measured to be above this level, the relevant authority may require respite periods that restrict the hours that the very noisy activities can occur.</li> <li>Respite activities would be determined considering times identified by the community when they are less sensitive to noise, and if the community is prepared to accept a longer period of construction to accommodate respite periods.</li> </ul>
Outside recommended Standard Working Hours	Noise affected: RBL + 5 dB(A)	<ul style="list-style-type: none"> <li>A strong justification would typically be required for works outside the recommended standard hours.</li> <li>The proponent should apply all feasible and reasonable work practices to meet the affected noise level.</li> <li>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the affected noise level, the proponent should negotiate with the affected community.</li> </ul>

**Table 5 ICNG noise management levels for other sensitive land uses**

Land use	NML $L_{Aeq,15min}$ (applies when property in use)
Classrooms at schools and other educational institutions	Internal noise level of 45 dB
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation).	External noise level of 60 dB
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion).	External noise level of 65 dB
Offices, retail outlets	External noise level of 70 dB



#### 4.1.4 Project specific noise management levels

Table 6 summarises the NMLs applicable to sensitive land uses around the site during the construction phase. The NMLs are based on the background noise levels from unattended monitoring.

**Table 6 Noise Management Levels**

Land use	NML for time period, dB(A)			
	Standard Working Hours	Out of Hours Day <sup>1</sup> (Saturday afternoon & Sundays)	Out of Hours Evening <sup>2</sup>	Out of Hours Night <sup>3</sup>
NCA 01, 02 and 03	54	49	44	36
NCA 04, 05 and 06	52	47	44	36
Commercial	70	70	70	70
Industrial	75	75	75	75
Classrooms at schools and other educational institutions	45 <sup>2</sup>	45 <sup>2</sup>	45 <sup>2</sup>	45 <sup>2</sup>
Hospital wards and operating theatres	45 <sup>2</sup>	45 <sup>2</sup>	45 <sup>2</sup>	45 <sup>2</sup>
Places of worship	45 <sup>2</sup>	45 <sup>2</sup>	45 <sup>2</sup>	45 <sup>2</sup>
Active recreation areas	65	65	65	65
Passive recreation Areas	60	60	60	60

- (1) Any out of hours work occurring between 7 am and 6 pm.
- (2) Any out of hours work occurring between 6 pm and 10 pm.
- (3) Any out of hours work occurring between 10 pm and 7 am.

## 4.2 Construction vibration

Ground vibration generated by construction can have a range of effects on buildings and building occupants. The main effects are generally classified as:

- human disturbance – disturbance to building occupants: vibration which inconveniences or interferes with the activities of the occupants or users of the building.
- effects on building structures – vibration which may compromise the condition of the building structure itself.

In general, vibration criteria for human disturbance are more stringent than vibration criteria for effects on buildings. Building occupants will normally feel vibration readily at levels well below those which may cause a risk of cosmetic or structural damage to a structure. However, it may not always be practical to achieve the human comfort criteria. Furthermore, unnecessary restriction of construction activities can prolong construction works longer than necessary, potentially resulting in other undesirable effects for the local community.

Construction vibration criteria have been adopted from the following sources:

- Cosmetic and structural damage to buildings: German Standard DIN 4150-3<sup>2</sup>
- Human comfort: *Assessing Vibration – A Technical Guideline: DEC 2006* (the Vibration Guideline)

### 4.2.1 Cosmetic and structural damage

DIN 4150-3 summarises structural and cosmetic damage assessment criteria for different types of buildings, which are presented in Table 7, which are widely used for the assessment of construction vibration effects on buildings in Australia. The criteria are specified as Peak Particle Velocity (PPV) levels measured in any direction at or adjacent to the building foundation.

**Table 7 DIN 4150-3 vibration cosmetic and structural damage criteria**

Structure type	Peak Particle Velocity (PPV), mm/s			
	Foundation of structure			Vibration at horizontal plane of highest floor at all frequencies
	<10 Hz	10-50 Hz	50-100 Hz	
Buildings used for commercial, industrial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwelling and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in rows 1 and 2, and are of great intrinsic value (e.g. heritage-listed buildings)	3	3 to 8	8 to 10	8

DIN 4150-3 states that exposing buildings to vibration levels higher than that recommended would not necessarily result in damage. Rather, it recommends these values as maximum levels of short-term construction vibration at which experience has shown damage reducing the serviceability of structures will not occur due to vibration effects.

<sup>2</sup> German Standard DIN 4150-3, 1999, *Structural Vibration – Part 3: Effects of vibration on structures*.



DIN 4150-3 is considered to be suitable for the assessment of both structural and cosmetic damage as it considers a reduction in serviceability of the structure is deemed to have occurred if cracks form in plastered surfaces of walls, existing cracks in the building are enlarged or partitions become detached from loadbearing walls or floors.

## 4.2.2 Human comfort

The ICNG recommends that vibration from construction works be assessed under *Assessing Vibration – a technical guideline* (the Vibration Guideline), consistent with the SEARs issued by DPIE. The vibration assessment criteria defined in the Vibration Guideline are for human comfort and represent goals that, where exceeded, require the application of all feasible and reasonable mitigation measures. Where the maximum value cannot be feasibly and reasonably achieved, the operator would need to negotiate directly with the affected community.

The Vibration Guideline defines vibration assessment criteria for continuous, impulsive and intermittent vibration. Vibration can be classified according to the following definitions:

- Continuous vibration: continues uninterrupted for a defined period. Applies to continuous construction activity such as tunnel boring machinery.
- Impulsive vibration: rapid build-up to a vibration peak followed by damped decay or the sudden application of several cycles of vibration at approximately the same magnitude providing that the duration is short. Applies to very occasional construction activities that create distinct events such as dropping of heavy equipment.
- Intermittent vibration: interrupted periods of continuous vibration (such as a drill) or repeated periods of impulsive vibration (such as a pile driver).

The majority of construction activities as part of the proposed works would be expected to be continuous or intermittent in nature.

Table 8 presents the management levels for continuous and impulsive vibration at different land uses. The management levels specified are as overall unweighted RMS vibration velocity levels. The Vibration Guideline specifies the management levels as suitable for vibration sources predominantly in the frequency range 8-80 Hz as would be expected for construction vibration.

**Table 8 RMS velocity management levels for continuous and impulsive vibration**

Land use	Continuous vibration – RMS vibration velocity, mm/s		Impulsive vibration – RMS vibration velocity, mm/s	
	Preferred	Maximum	Preferred	Maximum
Critical areas <sup>1</sup>	0.1	0.2	0.1	0.2
Residences and hospital wards – daytime <sup>2</sup>	0.2	0.4	6.0	12.0
Residences and hospital wards – night time <sup>3</sup>	0.14	0.28	2.0	4.0
Offices, schools	0.4	0.8	13.0	26.0
Workshops	0.8	1.6	13.0	26.0

(1) Critical operating areas include hospital operating theatres and precision laboratories where sensitive operations are occurring.

(2) Daytime is defined by the Vibration Guideline to be 7 am to 10 pm.

(3) Night time is defined by the Vibration Guideline to be 10 pm to 7 am.

For intermittent vibration, the Vibration Dose Value (VDV) is used as the metric for assessment as it accounts for the duration of the source, which will occur intermittently over the assessment period. The VDV management levels at different land uses for intermittent vibration sources are presented in Table 9.

**Table 9 VDV management levels for intermittent vibration**

Land use	VDV – intermittent vibration, m/s <sup>1.75</sup>	
	Preferred	Maximum
Critical areas <sup>1</sup>	0.1	0.2
Residences and hospital wards – daytime <sup>2</sup>	0.2	0.4
Residences and hospital wards – night time <sup>3</sup>	0.13	0.26
Offices, schools	0.4	0.8
Workshops	0.8	1.6

(1) Critical operating areas include precision laboratories where sensitive operations are occurring.

(2) Daytime is defined by the Vibration Guideline to be 7 am to 10 pm.

(3) Night time is defined by the Vibration Guideline to be 10 pm to 7 am.

## 4.2.3 Minimum working distances

The *Construction Noise and Vibration Guideline (CNVG)* (NSW Government, 2006) provides guidelines for minimum working distances for vibration-intensive activities with respect to the stated standards and guidelines. The minimum working distances for building damage should be complied with at all times. The distances are noted as being indicative and are likely to vary depending on the particular item of plant and local geotechnical conditions. The minimum working distances apply to addressing the risk of cosmetic (minor – easily repairable) damage of typical buildings under typical geotechnical conditions.

Where vibration intensive works are required to be undertaken within the specified minimum working distances, vibration monitoring should be undertaken to ensure acceptable levels of vibration are satisfied.

In relation to human comfort, the minimum working distances relate to continuous vibration. For most construction activities, vibration emissions would be intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods may be allowed.

Table 10 presents the recommended minimum working distances for vibration intensive plant.

**Table 10 Recommended safe working distances for vibration intensive plant**

Plant Item	Rating/Description	Minimum Working Distance – Cosmetic Damage (BS7385)	Minimum Working Distance – Human Response (OH&E Guideline)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	Five metres	15 metres to 20 metres
	< 100 kN (Typically 2-4 tonnes)	Six metres	20 metres
	< 200 kN (Typically 4-6 tonnes)	12 metres	40 metres
	< 300 kN (Typically 7-13 tonnes)	15 metres	100 metres
	> 300 kN (Typically 13-18 tonnes)	20 metres	100 metres
	> 300 kN (> 18 tonnes)	25 metres	100 metres

Plant Item	Rating/Description	Minimum Working Distance – Cosmetic Damage (BS7385)	Minimum Working Distance – Human Response (OH&E Guideline)
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	Two metres	Seven metres
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	Seven metres	23 metres
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 metres	73 metres
Vibratory Pile Driver	Sheet piles	2 metres to 20 metres	20 metres
Pile Boring	≤ 800 mm	2 metres (nominal)	Four metres
Jackhammer	Hand held	1 metres (nominal)	Two metres

### 4.3 Construction road noise criteria

The NSW Road Noise Policy (RNP) provides guidance, criteria and procedures for assessing noise impacts from existing, new and redeveloped roads and traffic generating developments. The assessment of road traffic noise impacts on public roads is assessed under the RNP.

Road traffic generated by the operation of the Project will not increase from the existing operational traffic volumes, and as such, there will be no increase to the existing road traffic. Hence, road traffic noise impact due to operational noise will not be assessed in this study.

The construction of the Project will generate additional traffic on surrounding public roads, such as construction worker car movements and delivery and construction vehicle movements. Once construction is complete, project traffic is expected to return to levels similar to the current situation.

The RNP details a number of noise assessment criteria for various road categories and land uses.

The Application Notes for the RNP state that;

*‘for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.’*

If road traffic noise during the Project construction is within 2 dB(A) of current levels then the objectives of the RNP are met and no specific mitigation measures are required. Where the Project road traffic noise levels exceed 2 dB(A) of current levels then the consideration should be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the RNP criteria as presented in Table 11.

**Table 11 RNP Residential Road Traffic Noise Criteria**

Road Category	Type of Project/Land Use	Assessment Criteria – dB(A)	
		Day 7am to 10pm	Night 10pm to 7am
Local roads	Existing residences affected by additional traffic on existing local roads by land use developments.	$L_{Aeq,15hr}$ 55(external) <sup>1</sup>	$L_{Aeq,9hr}$ 50 (external) <sup>1</sup>

(1) The assessment criteria for external noise levels apply at 1 metre from the facade of any affected residential receiver

An estimation of the anticipated noise level contribution of construction traffic on local roads has been conducted using the TfNSW Construction Noise Estimator Tool. The following indicative construction road traffic volumes have been assumed for Stone Mason Drive:

- 30 two-way light vehicle movements per hour.
- 2 two-way heavy vehicle movements per hour.

The following has been determined:

- A typical  $L_{Aeq}(1 \text{ hour})$  noise level contribution of 52 dB(A) has been predicted for construction scenarios.
- A total combined noise level of 57 dB(A) is predicted with a noise level increase of 2 dB or less, noting that the existing daytime  $L_{Aeq}$  noise level is approximately 55 dB(A) outside of peak times.

Therefore, per the NSW RNP, no further assessment of construction road traffic is required.

## 5 Construction Noise and Vibration Assessment

### 5.1 Construction noise

#### 5.1.1 Construction noise sources

Table 12 summarises the assumed sound power levels ( $L_W$ ) for the major construction noise sources which we expect would be on site during each phase. The sound power levels have been based on data obtained from previous measurements conducted by Resonate and those within the UK Department for Environment, Food and Rural Affairs (DEFRA) *Update of noise database for prediction of noise on construction and open sites*. An overall sound power level for each phase has also been assumed based on the loudest typical source(s) operating for each works phase.

**Table 12 Construction noise source sound power levels**

Stage	Typical plant items	Assumed sound power level, dB(A)
Site establishment and enabling works	Large excavator	111
	Vibratory roller <sup>1</sup>	107
	Concrete truck	109
	Concrete pump	107
	Large truck	108
	Chainsaw	114
	<b>Typical overall sound power level</b>	<b>112</b>
Demolition	Large excavator	111
	Rockbreaker <sup>1</sup>	121
	Crane	106
	Pneumatic jackhammer <sup>1</sup>	109
	Large truck	108
	<b>Typical overall sound power level</b>	<b>118</b>
Retaining piles and excavation	Bored piling rig	111
	Large excavator	111
	Crane	106
	Large truck	108
	<b>Typical overall sound power level</b>	<b>112</b>
Substructure	Crane	106
	Large excavator	111
	Pneumatic jackhammer <sup>1</sup>	109
	Concrete truck	109

Stage	Typical plant items	Assumed sound power level, dB(A)
	Concrete pump	107
	Large truck	108
	<b>Typical overall sound power level</b>	<b>114</b>
Frame	Concrete truck	109
	Concrete pump	107
	Crane	106
	General hand tools	98
	Large truck	108
	<b>Typical overall sound power level</b>	<b>111</b>
Facade works	Crane	106
	General hand tools	98
	Large truck	108
	<b>Typical overall sound power level</b>	<b>107</b>
Internal works and fitout	General hand tools	98
	Compressor	94
	Portable generator	95
	<b>Typical overall sound power level</b>	<b>84<sup>2</sup></b>

(1) Results include a 5 dB penalty to account for 'annoying' characteristics.

(2) Includes a 15 dB(A) indoor-to-outdoor reduction in noise levels for internal works.

## 5.1.2 Typical construction noise levels during Standard Works Hours

Typical worst-case construction noise levels are to be predicted using a three-dimensional environmental noise model of the site and surrounds, developed in SoundPLAN version 8.2 environmental noise modelling software, including:

- topography
- building structures
- ground absorption (ground assumed to be 50% absorptive and 50% reflective)
- air absorption
- attenuation with distance.

Predictions have been carried out based on the environmental noise prediction algorithms documented in ISO 9613-2:1996 *Acoustics - Attenuation of sound during propagation outdoors -- Part 2: General method of calculation*. This provides predictions typical of conditions where the receiver is downwind of the source or where there is a moderate ground-based temperature inversion.

It is important to note that these predictions are typical worst-case predictions as they assume that:

- The construction works are occurring at the nearest point to each receiver and that the receiver is located at the most exposed position.
- The noisiest construction sources are operating continuously for the entire 15-minute period. This will not occur at all times as equipment will regularly be stood down or idled while other activities are undertaken.

Typical worst-case predicted noise levels are shown in Table 13 for each sensitive-receiver location and each phase of works. Noise levels are predicted to exceed the relevant Standard Work Hours NMLs for all activities with the exception of those occurring inside the new buildings (such as fitout works).

As seen in Table 13 properties are predicted to be in the highly noise affected category (predicted sound pressure level > 75 dB(A)) in NCA01 and NCA02 during demolition.

**Table 13 Typical worst-case external construction noise levels for Standard Working Hours**

NCA	Typical worst-case external construction noise level for phase during Standard Working Hours, dB(A) $L_{eq}$						
	Site establishment	Demolition	Retaining piles and excavation	Substructure	Frame	Facade works	Internal works and fitout
1	69	<b>76</b>	65	72	65	66	38
2	74	<b>80</b>	69	<b>76</b>	68	67	39
3	67	73	63	70	61	64	36
4	67	74	63	70	61	62	34
5	64	70	59	66	58	57	29
6	66	72	61	69	60	59	31

A description of predicted noise levels per NCA are discussed below with reference to subjective effects of changes to sound levels as shown in Table 14. Noise contours of predicted construction noise levels are also presented in Appendix B. Exceedances of standard working hours criteria are expected across all noise catchment areas, during site establishment, demolition, retaining piles and excavation, substructure, frame, and façade works as seen in Table 15.

**Table 14 Subjective effect of changes to sound levels**

Change in sound level, dB	Subjective change in apparent loudness
1	Not perceptible
2 – 3	Just perceptible
5	Clearly noticeable
10	Half or twice as loud
20	Much quieter or louder

**Table 15 Predicted number of exceedances and average exceedance in dB(A) for Standard Working Hours**

NCA	Site Establishment		Demolition		Retaining piles and excavation		Substructure		Frame		Façade works	
	No.	Average NML exceedance dB(A)	No.	Average NML exceedance dB(A)	No.	Average NML exceedance dB(A)	No.	Average NML exceedance dB(A)	No.	Average NML exceedance dB(A)	No.	Average NML exceedance dB(A)
1	156	5	241	9	56	4	201	6	50	4	61	4
2	160	7	183	12	96	5	177	9	92	5	106	5
3	90	6	98	12	44	4	93	8	35	3	54	4
4	58	8	64	13	42	5	63	9	40	4	24	5
5	56	4	71	9	17	3	66	6	13	2	11	2
6	131	4	205	8	30	3	175	5	21	3	20	3

Recommendations for construction noise management are provided in Section 0.

## NCA01

NCA01 is expected to be the most impacted by Demolition works. Demolition noise levels are predicted to range from *Clearly Noticeable* to *Twice as Loud* as existing background noise levels. 2 Bugle Circuit and Receiver 1537 are predicted to be highly noise affected with a predicted sound pressure level of 80 dB(A). Predicted noise levels during site establishment, retaining piles and excavation, substructure works, frame works and façade works are expected to be *Clearly Noticeable* at most receivers in NCA01, with some receivers on the north western and north eastern flank of the NCA experiencing just perceptible noise levels.

## NCA02

NCA02 is expected to be most impacted by noise from demolition and substructure works. The noise levels from demolition works are predicted to result in noise levels approximately *Twice as Loud* as the background noise levels across the entire noise catchment area.

The following ten receivers, located in closest proximity to the works along Bugle Circuit and Stone Mason Drive are predicted to be highly noise effected during demolition works;

- 1 Bugle Circuit
- 2 Bugle Circuit
- 3 Bugle Circuit
- 3/4 Bugle Circuit
- 6 Bugle Circuit
- Receivers located on Stone Mason Drive, QGIS ID's as shown in Appendix B:
  - 356, 936, 1016, 1537, 1890,

Noise levels during site establishment, retaining piles and excavation, frame works, and façade works are expected to exceed daytime NMLs and are likely to be *clearly noticeable* throughout the NCA. During substructure works 2 Bugle Circuit is expected to be highly affected.

## NCA03

NCA03 is expected to be most impacted by noise from demolition and substructure works. The noise levels from demolition works are predicted to result in noise levels approximately *Twice as Loud* as the background noise levels across the NCA. Noise levels during site establishment, retaining piles and excavation, frame works and façade works are predicted to exceed the daytime NMLs and are likely to be *Clearly Noticeable* throughout the NCA.



## NCA04

NCA04 is expected to have an average NML exceedance of approximately 15 dB (more than *Twice as Loud*) during demolition. No receivers are predicted to be highly noise affected. Substructure works are also predicted to result in noise levels in the *Clearly Noticeable* range. Noise levels from site establishment, retaining piles and excavation frame works and façade works would be considered as *Clearly Noticeable*.

## NCA05

NCA05 is expected to be most impacted by noise from demolition and substructure works. The noise levels from demolition works are predicted to result in noise perceptibly *Twice as Loud* as the background noise level across the NCA. Noise levels during site establishment, retaining piles and excavation, frame works and façade works are expected to exceed daytime NMLs and will be clearly noticeable throughout the catchment area.

## NCA06

NCA06 is expected to be most impacted by noise from demolition works, which is predicted to be perceptibly *Twice as Loud* as the background noise level across the NCA. Noise levels from site establishment and substructure works are expected to be *Clearly Noticeable*. Retaining piles and excavation and façade works noise levels are predicted to be *Barely Perceptible*.

## 5.2 Construction vibration

Table 16 summarises recommended safe working distances for key vibration-generating activities that would be expected during the construction phase, based on prior measurements conducted by Resonate. The closest receivers to the works are approximately 35 metres northeast of the site boundary of the construction site. Works to be undertaken within the typical safe working distance for occupant comfort and building damage should be subject to a vibration management plan.

**Table 16 Recommended safe working distances for key vibration generating activities**

Plant	Rating	Typical safe working distance for occupant comfort, m		Typical safe working distance for building damage, m	
		Preferred vibration target	Maximum vibration target	Heritage structure	Commercial building
Vibratory roller	< 7t	≥ 35	≥ 20	≥ 10	≥ 2
	7t – 12t	≥ 50	≥ 30	≥ 15	≥ 5
	≥ 13t	≥ 75	≥ 40	≥ 20	≥ 10
Small hydraulic hammer	300 kg – 5 to 12T excavator	≥ 12	≥ 7	≥ 5	≥ 2
Medium hydraulic hammer	900 kg – 12 to 18T excavator	≥ 35	≥ 23	≥ 15	≥ 7
Large hydraulic hammer	1600 kg – 18 to 34T excavator	≥ 65	≥ 45	≥ 35	≥ 22
Excavator	Large excavator digging	≥ 25	≥ 15	≥ 5	≥ 1

Plant	Rating	Typical safe working distance for occupant comfort, m		Typical safe working distance for building damage, m	
		Preferred vibration target	Maximum vibration target	Heritage structure	Commercial building
Bored piling	≤ 800mm	≥ 20	≥ 10	≥ 2	≥ 1
Jackhammer	Handheld	— <sup>(1)</sup>	— <sup>(1)</sup>	≥ 3	≥ 1

## 5.3 Construction noise and vibration management measures

To manage the potential impact of noise and vibration during construction, reasonable and feasible management measures and work practices should be implemented as detailed below.

### 5.3.1 Construction Noise and Vibration Management Plan

Prior to the commencement of major construction works, the contractor should develop a Construction Noise and Vibration Management Plan (CNVMP). The CNVMP should:

- identify relevant construction noise and vibration criteria as detailed in this report
- identify neighbouring sensitive land uses for noise and vibration
- summarise key noise- and vibration-generating construction activities and the associated predicted levels at neighbouring land uses
- identify reasonable and feasible work practices to be implemented during the works
- summarise stakeholder consultation and complaints handling procedures for noise and vibration.

### 5.3.2 Stakeholder consultation

Nearby stakeholders should be consulted prior to the works and kept regularly informed of potential noise and vibration impacts from the works. Specifically, this would involve:

- Residential receivers on Bugle Circuit
- Residential receivers on Stone Mason Drive

A noise and vibration complaints handling procedure and register should be developed and implemented during construction.

### 5.3.3 Work programming

Work should be programmed such that particularly noisy works occur during Standard Working Hours wherever feasible, namely:

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm
- No work on Sundays or public holidays.

If high noise works are to occur outside of the Standard Working Hours and later than 1 pm on a Saturday, then the CNVMP should define an approval process for undertaking out of hours works and for identifying reasonable and feasible mitigation measures to be implemented.

Consideration of a respite regime where particularly highly intensive activities are programmed to occur at times identified by the community when they are less sensitive to noise.

## 5.3.4 Truck movements and site access

Truck movements during long term construction projects have the potential to cause annoyance for sensitive receivers, even where trucks may be travelling on sealed roads. The design and selection of site access routes shall consider the potential disturbance to residents. In particular:

- site access and delivery points shall be located as far away from residences as possible
- truck movements shall use arterial roads and be diverted away from residential streets where feasible
- deliveries to/from site shall not occur during the night time period where possible.

## 5.3.5 Site management

Site management procedures should include the following:

- processes that generate lower noise levels should be selected where feasible.
- noisy plant should be located as far away from residences as is practical to allow efficient and safe completion of the task.
- the potential shielding provided by site topography and intervening buildings should be considered in locating equipment.
- site compounds should be located as far away as possible from residences.
- equipment that is used intermittently should be shut down or throttled down to a minimum during periods where it is not in use.
- works should be planned to minimise the reduce the noise from reversing signals.
- warning horns should not be used as signalling devices.
- two-way radios should be set to the minimum effective volume.
- noise associated with packing up plant and equipment at the end of works should be minimised.
- audible movement alarms of a type that would minimise noise impacts on surrounding noise sensitive receivers.

## 5.3.6 Equipment management

Equipment management should include the following:

- selection of low-noise plant and equipment where possible.
- equipment should be well maintained.
- equipment should have quality mufflers and silencers installed where relevant.
- equipment not in use on site should be shut down.
- tasks should be completed using the minimum feasible power and equipment.

## 6 Noise and Vibration Management Measures

This section outlines noise management measures that will be implemented as part of the construction works, including consultation and complaint handling procedures.

It may not be feasible to adopt all management measures at all times during construction, and identification of all reasonable and feasible mitigation methods will be conducted by the site supervisor and/or environmental representative on a regular basis during noisy works near sensitive land uses.

In relation to the implementation of mitigation measures, feasibility addresses engineering consideration regarding what is practical to build. Reasonableness relates to the application of judgment in arriving at a decision, taking into account the following factors:

- noise reduction achieved
- number of people or other uses benefited
- cost of the measure
- delay to schedule and whether the measure will prolong exposure to noise
- community views
- pre-construction noise levels at receivers.

While the management measures presented will not necessarily result in mitigating all noise impacts at all times, they are expected to reduce impacts to levels most stakeholders should find acceptable considering the anticipated benefits of the completed project as a whole.

### 6.1 Noise and vibration management measures

Noise and vibration management measures that will be implemented throughout works where reasonable and feasible are presented in Table 17:

**Table 17 Noise and vibration management measures**

Reference	Details of management measures	Implementation		Responsibility
<b><i>Implemented throughout external works</i></b>		<b>PC<sup>1</sup></b>	<b>C<sup>2</sup></b>	
NVMM01	Works to be undertaken during Standard Working Hours where possible.	✓	✓	Construction Manager
NVMM02	The induction of site staff will include a reference to potential noise impacts and the identification of noise-sensitive land uses.	✓		Construction Manager
NVMM03	'Toolbox talks' will include a reference to any noise management measures being implemented on site at the time.		✓	Site Supervisor
NVMM04	Where possible, schedule work breaks at same time as sensitive times for receivers. For example, break for lunch between 12 and 2 pm when catering usage is busy.		✓	Site Supervisor
NVMM05	Implement complaint response procedures as detailed in Section 6.2.	✓	✓	Community Relations Manager

Reference	Details of management measures	Implementation		Responsibility
<b>Implemented throughout external works</b>		<b>PC<sup>1</sup></b>	<b>C<sup>2</sup></b>	
NVMM06	Vehicle warning devices, such as horns, are not to be used as signalling devices.		✓	Site Supervisor Operators
NVMM07	No swearing or unnecessary shouting or loud stereos/radios on site.		✓	Site Supervisor
NVMM08	No unnecessary dropping of materials from height, throwing of metal items and slamming of doors.		✓	Site Supervisor
NVMM09	Site access and delivery points will be located as far away from the sensitive receivers as possible.	✓	✓	Construction Manager
NVMM10	Truck movements will use arterial roads and be diverted away from residential streets where feasible.	✓	✓	Construction Manager
NVMM11	Loading and unloading operations will be undertaken away from the northern boundary of the site to reduce impacts on the childcare centre.		✓	Site Supervisor Operators
NVMM12	Traffic flow, parking and loading/unloading areas will be planned to avoid the need for reversing near sensitive receivers.	✓	✓	Construction Manager Site Supervisor
NVMM13	Two-way radios will be used at the minimum effective volume.		✓	Site Supervisor Operators
NVMM14	Quieter construction methods will be used where feasible and reasonable.	✓	✓	Construction Manager
NVMM15	Noise levels of plant and equipment will be considered in rental decisions and all plant and equipment will be selected and operated to be compliant with the sound power levels by referral to Section 5.1 wherever possible.	✓	✓	Construction Manager
NVMM16	Simultaneous operation of noisy plant close together and near the sensitive receivers will be avoided.		✓	Site Supervisor
NVMM17	The offset distance between plant and sensitive uses will be maximised.		✓	Site Supervisor
NVMM18	Plant used intermittently will be shut down or throttled down to a minimum in between use.		✓	Site Supervisor
NVMM19	Plant emitting noise in a particular direction will be directed away from sensitive receivers.		✓	Site Supervisor
NVMM20	Delivery vehicles will be fitted with straps rather than chains for unloading near sensitive areas, wherever possible.		✓	Site Supervisor Operators
NVMM21	Ensure that truck tailgates are cleared and locked at the point of unloading.		✓	Site Supervisor Operators

Reference	Details of management measures	Implementation		Responsibility
<b>Implemented throughout external works</b>		<b>PC<sup>1</sup></b>	<b>C<sup>2</sup></b>	
NVMM22	Locate plant and equipment to take advantage of barriers provided by existing site features and structures.		✓	Site Supervisor Operators
NVMM23	Implement mufflers/silencers on plant and equipment. Undertake regular maintenance of plant and equipment, including silencers, to ensure that noise emissions do not increase over time. Servicing, refuelling and warm-up to be undertaken during standard construction hours.		✓	Site Supervisor Operators
NVMM24	Noise associated with packing up plant and equipment at the end of works will be minimised.		✓	Site Supervisor Operators

(1) Pre-construction – note that this may refer to prior to commencement of specific activities rather than prior to the commencement of all construction works.

(2) Construction

## 6.2 Complaint handling

The person receiving complaints will have the ability to implement reasonable and feasible measures to action the complaint. These measures may include modification of the work site or work practices, or a review of night activities. The following complaint management procedure will be implemented during all works:

- 1) Assess whether the issue can be resolved easily and take immediate action if possible.
- 2) If not, assess the construction site and activities and determine whether there is any reason to believe noise levels are higher than anticipated.
- 3) Undertake monitoring of noise (where this is an appropriate response).
- 4) Ensure all planned management measures have been appropriately implemented.
- 5) If steps 3 and 4 are correct, no further site actions are required (proceed to step 8).
- 6) If steps 3 and 4 are incorrect, implement all reasonable and practicable mitigation measures where possible and implement correct engagement procedures.
- 7) Ensure person receiving complaints is well briefed on the existing mitigation measures in place during the activity and the justification for the activity and understands the details of any night works approvals (if applicable).
- 8) Advise complainant of actions undertaken.

Records of any noise and vibration complaint received during the works, and the action taken in response to the complaint, will be maintained throughout the works. The Kane Construction's Health Safety and Environment Site Management Plan should be updated to adopt these recommendations.

## 7 Compliance management

### 7.1 Roles and responsibilities

Kane Construction's Project Team's organisational structure and overall roles and responsibilities are outlined in the Environmental Site Management Plan. Specific responsibilities for the implementation of noise and vibration management measures are detailed in Section 6.

### 7.2 Training

All employees, sub-contractors and utility staff working on site will undergo site induction training relating to noise and vibration management issues, including:

- Existence and requirements of this CNVMP.
- Standard Working Hours.
- Location of noise sensitive areas and receivers.
- General noise and vibration management measures, including monitoring procedures.
- Complaints reporting.

Kane Construction's Health Safety and Environment Site Induction documentation should be updated to adopt all noise and vibration related requirements.

### 7.3 Monitoring and inspections

Weekly inspections by the Site Manager or a suitably qualified representative will occur throughout construction.

Noise and vibration monitoring will also occur routinely during the works as detailed in Table 18.

Table 18 Noise and vibration monitoring plan

Situation	Monitoring requirements	Frequency, reporting and responsibility
<b>Noise monitoring</b>		
<p>Attended monitoring to assess typical construction noise levels at noise sensitive receivers.</p>	<p>If monitoring cannot be undertaken at the nearest relevant sensitive receiver, a suitable representative location will be selected. The testing method includes:</p> <ul style="list-style-type: none"> <li>• Sound level meter configured for “Fast” time weighting and “A” frequency weighting.</li> <li>• Test environment free from reflecting objects where possible. Where noise monitoring is conducted within 3.5 metres of large walls or a building facade, then a reflection correction of up to -2.5 dB(A) will be applied to remove of increased noise due to sound reflections.</li> <li>• Tests will not be carried out during rain or when wind speed exceeds 5m/s.</li> <li>• Conditions such as wind velocity and direction, temperature, relative humidity and cloud cover will be recorded from the nearest Bureau of Meteorology station or on-site weather station/observations.</li> <li>• The monitoring period should be sufficient such that measured noise levels are representative of noise over a 15-minute period.</li> <li>• At a minimum <math>L_{Aeq}</math>, <math>L_{AF,max}</math>, <math>L_{A10}</math> and <math>L_{A90}</math> levels will be measured and reported.</li> </ul> <p>The observations of the person undertaking the measurements will be reported including audibility of construction noise, other noise in the environment and any discernible construction activities contributing to the noise at the receiver.</p>	<p><u>Frequency</u></p> <p>On a minimum bi-monthly basis for attended monitoring or</p> <p>As required for complaints.</p> <p><u>Reporting</u></p> <p>Written reports of all noise monitoring will be maintained by Kane Construction staff and submitted to key stakeholders on request.</p> <p><u>Responsibility</u></p> <p>Monitoring to be undertaken by Kane Construction staff suitably experienced in carrying out noise monitoring. If deemed necessary, a suitably qualified acoustic consultant will undertake monitoring to resolve complaints.</p>
<p>Where complaint is received and monitoring is considered an appropriate response to determine if noise levels exceed predicted construction noise levels documented in this CNVMP.</p>		



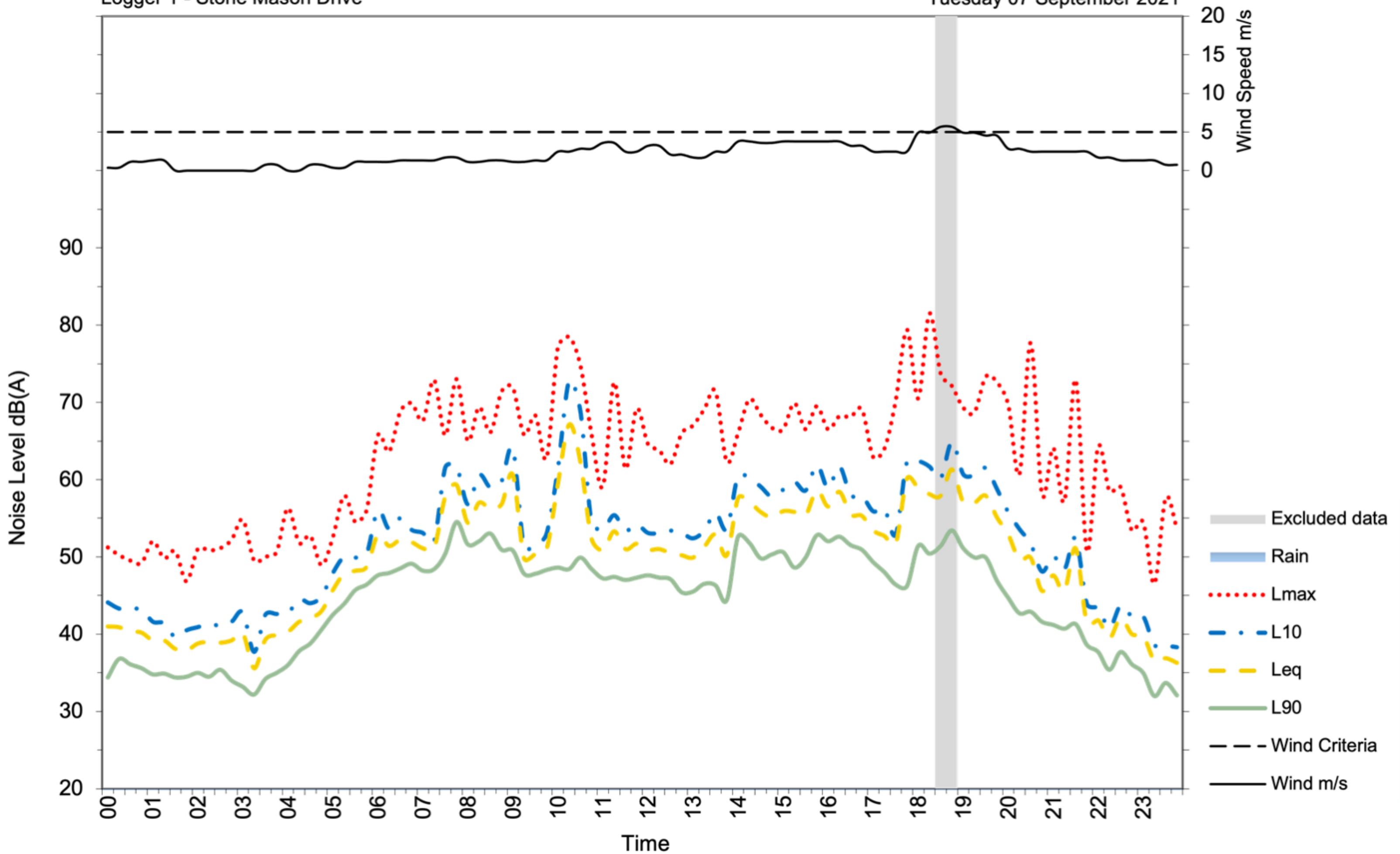
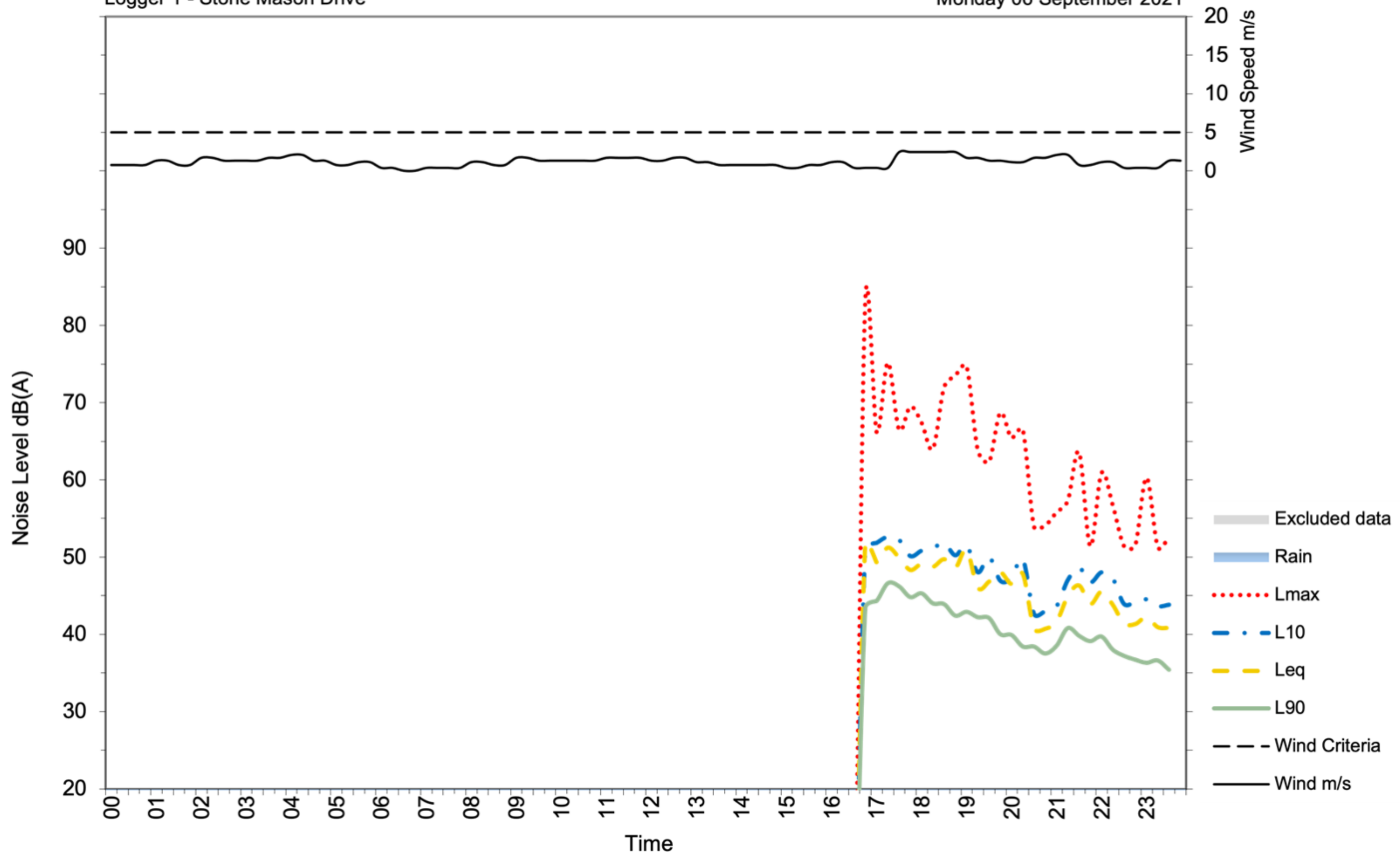
Situation	Monitoring requirements	Frequency, reporting and responsibility
<p>Spot checks of noisy plant to determine noise emission levels for:</p> <ul style="list-style-type: none"> <li>assessing compliance against manufacturer specifications</li> <li>assisting to assess accuracy of predictions</li> <li>assessing quieter construction techniques where required.</li> </ul>	<p>Stationary test procedures according to AS 2012.1:1990 <i>Acoustics – Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors – Stationary test condition</i>. The testing method includes:</p> <ul style="list-style-type: none"> <li>Sound level meter configured for “Fast” time weighting and “A” frequency weighting.</li> <li>The test environment will be free from reflecting objects.</li> <li>Tests will not be carried out during rain or when wind speed exceeds 5 m/s.</li> <li>In accordance with AS 2012.1, a minimum of three measurement points will be defined at locations on the hemispherical surface around the plant with the radius determined by the basic length of the machine.</li> <li>The <math>L_{A90}</math> background noise level at the measurement locations will be at least 6 dB and preferably 10 dB below the level with plant operating.</li> <li><math>L_{Aeq}</math> and <math>L_{A10}</math> levels will be measured and reported.</li> </ul>	<p><u>Frequency</u></p> <p>On an as required basis during main works.</p> <p><u>Reporting</u></p> <p>Records of spot checks of noisy plant will be maintained by Kane Construction.</p> <p><u>Responsibility</u></p> <p>Monitoring to be undertaken by Kane Construction staff suitably experienced in carrying out noise monitoring.</p>
<b>Vibration monitoring</b>		
<p>If any works occur within safe working distances for damage to buildings, detailed in Section .4.2.</p>	<p>Continuous vibration monitoring conducted throughout works as follows:</p> <ul style="list-style-type: none"> <li>Geophone installed at ground adjacent to building foundations or equivalent (or nearer) location if access not provided to the outside of the building.</li> <li>Monitor to continuously record PPV vibration level in 15-minute (or shorter) intervals.</li> <li>If PPV level exceeds 75% of the minimum DIN 4150-3 building damage limit, an alert will be sent to nominated site staff via email/SMS. This will include a Site Supervisor with suitable authority to stop work.</li> <li>Upon receipt of an alert, work will STOP.</li> <li>Necessary modifications will be made to work practices to reduce the vibration level and the works will continue as long as further alerts are not received.</li> <li>Note that if the frequency of the vibration event is such that 75% of the DIN 4150-3 limit was not exceeded, then works will proceed with caution, and the alert level adjusted as appropriate.</li> </ul>	<p><u>Frequency</u></p> <p>If required if works change such that works may occur in safe working distances for buildings.</p> <p><u>Reporting</u></p> <p>Records of logged vibration levels will be maintained by Kane Construction.</p> <p><u>Responsibility</u></p> <p>Monitoring to be undertaken by a suitably qualified acoustic consultant.</p>

Situation	Monitoring requirements	Frequency, reporting and responsibility
Vibration monitoring in response to a complaint, where this is considered an appropriate response.	<p>Attended vibration monitoring will be conducted of the relevant activities as follows:</p> <ul style="list-style-type: none"> <li>• Geophone installed at ground adjacent to building foundations or equivalent (or nearer) location if access not provided to the outside of the building.</li> <li>• Monitor to continuously record PPV and/or VDV vibration levels generated by the activity.</li> <li>• Measured levels to be compared to human disturbance vibration goals and/or building damage limits as appropriate.</li> </ul> <p>If necessary following the vibration measurements:</p> <ul style="list-style-type: none"> <li>• Appropriate vibration management measures will be implemented.</li> </ul> <p>Continuous vibration monitoring will be considered if this is considered of benefit to address the complaint.</p>	<p><u>Frequency</u> As required for complaints.</p> <p><u>Reporting</u> Report detailing measurement results and any corrective actions to be provided to the complainant and relevant stakeholders.</p> <p><u>Responsibility</u> A suitably qualified acoustic consultant will undertake monitoring to resolve complaints.</p>

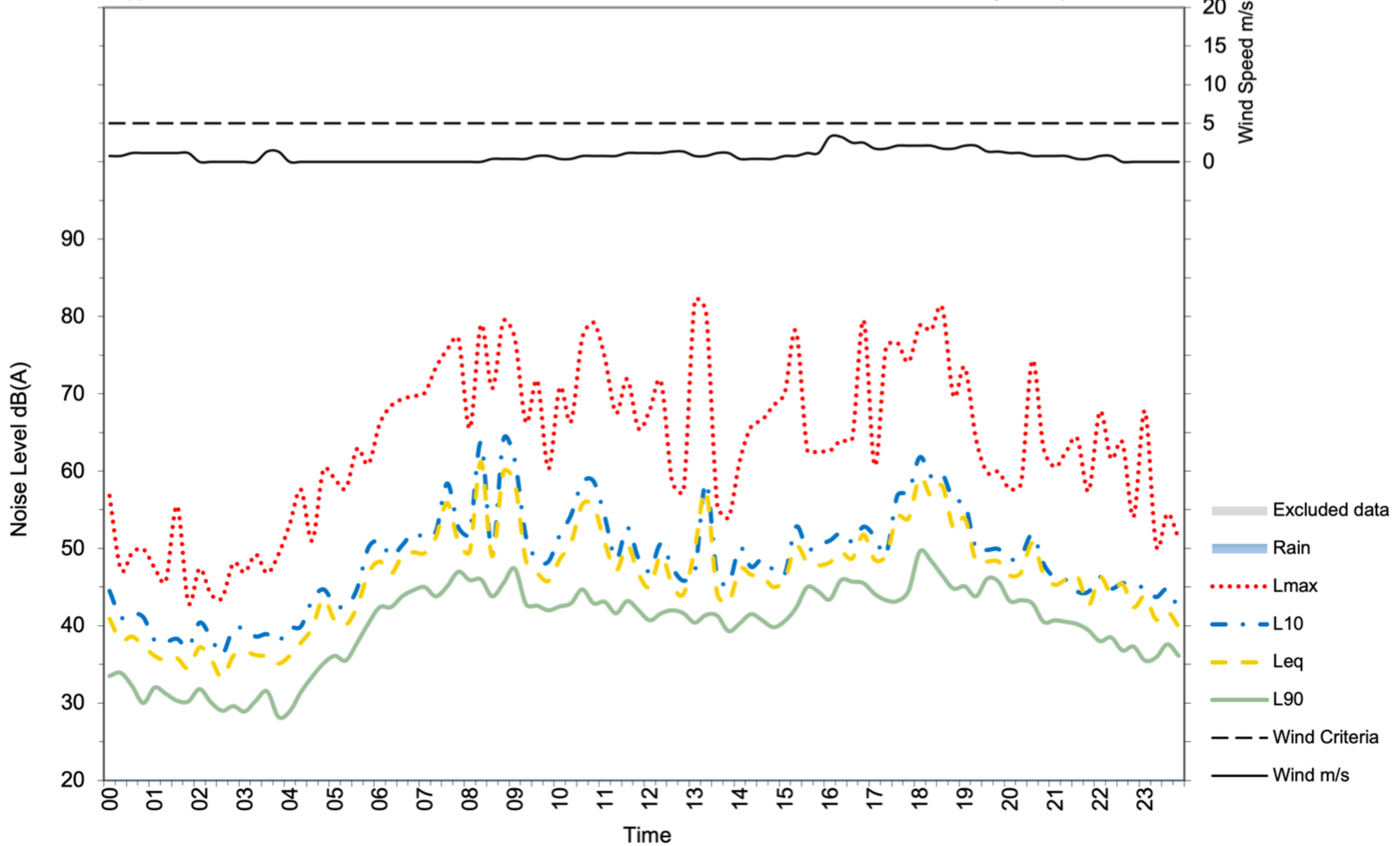
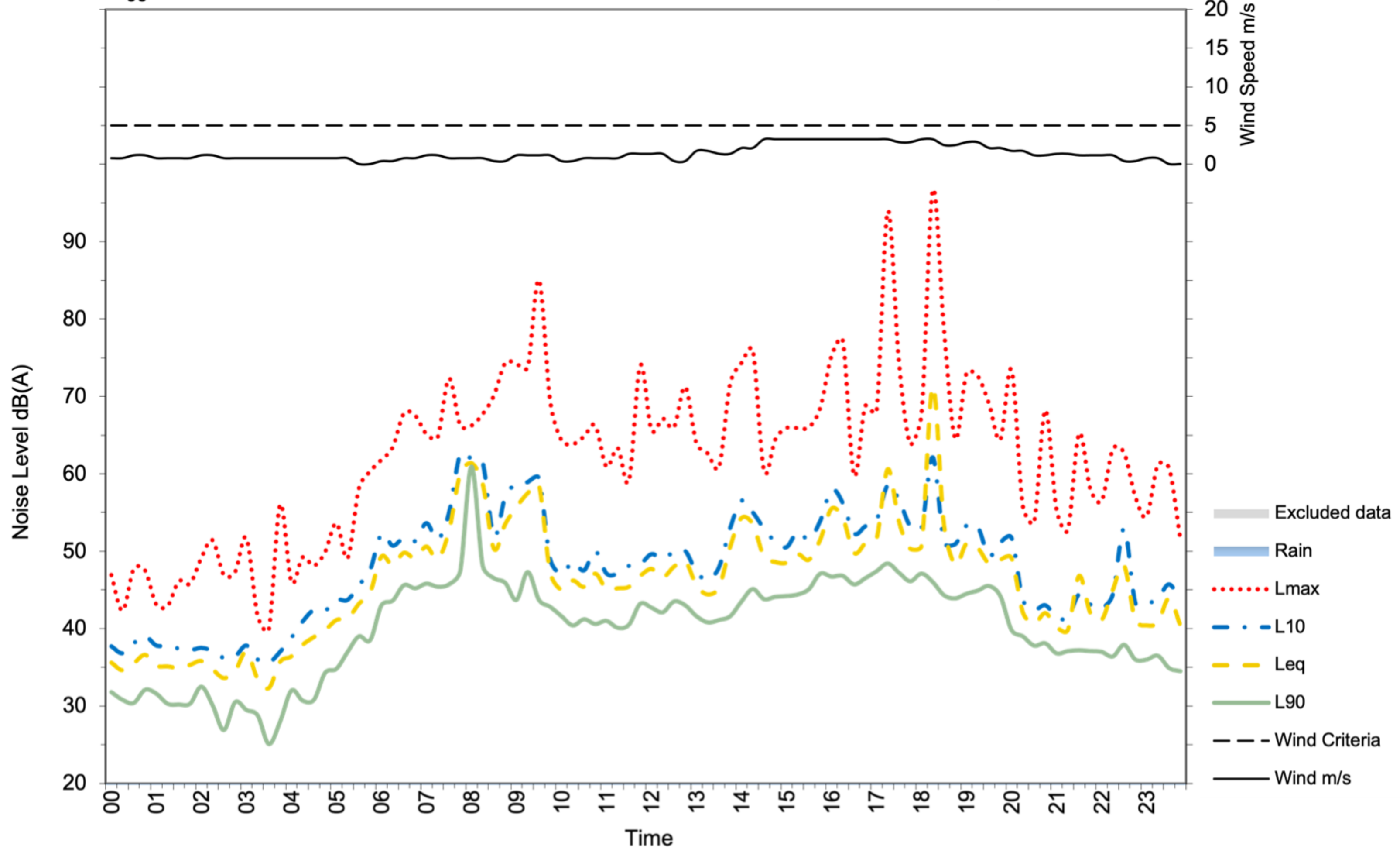
## Appendix A — Unattended noise monitoring

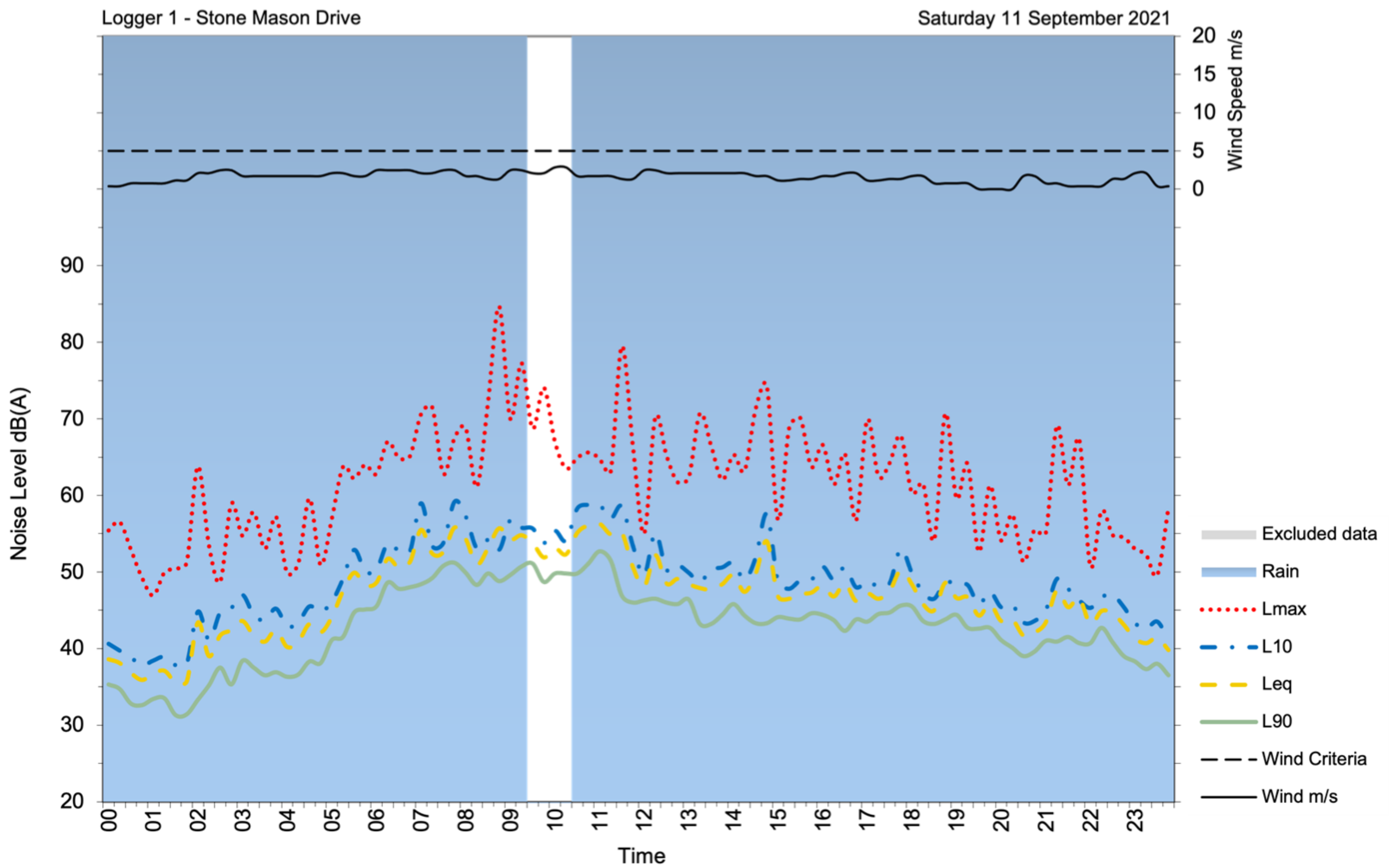
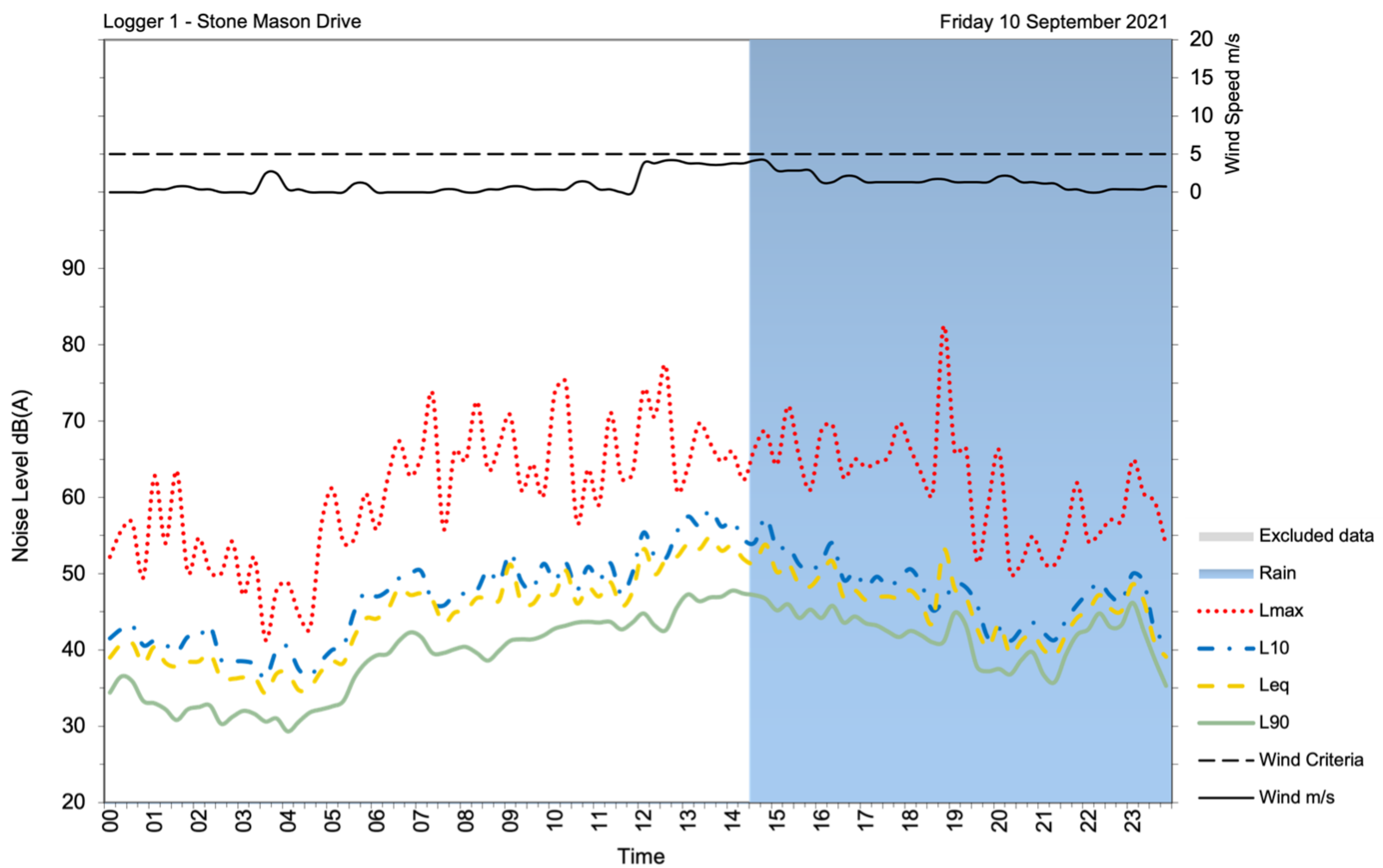
An initial unattended environmental noise survey was conducted during the period 6 September to 19 September 2021. The noise logging was conducted at two locations, with positions shown on Figure 1. The noise logger at Stone Mason Drive was vandalised on 16 September 2021 and was rendered non-operational from that point onward.

For reference, a weekly chart showing the graphed noise logging results is shown in the tables below for each noise logging location.

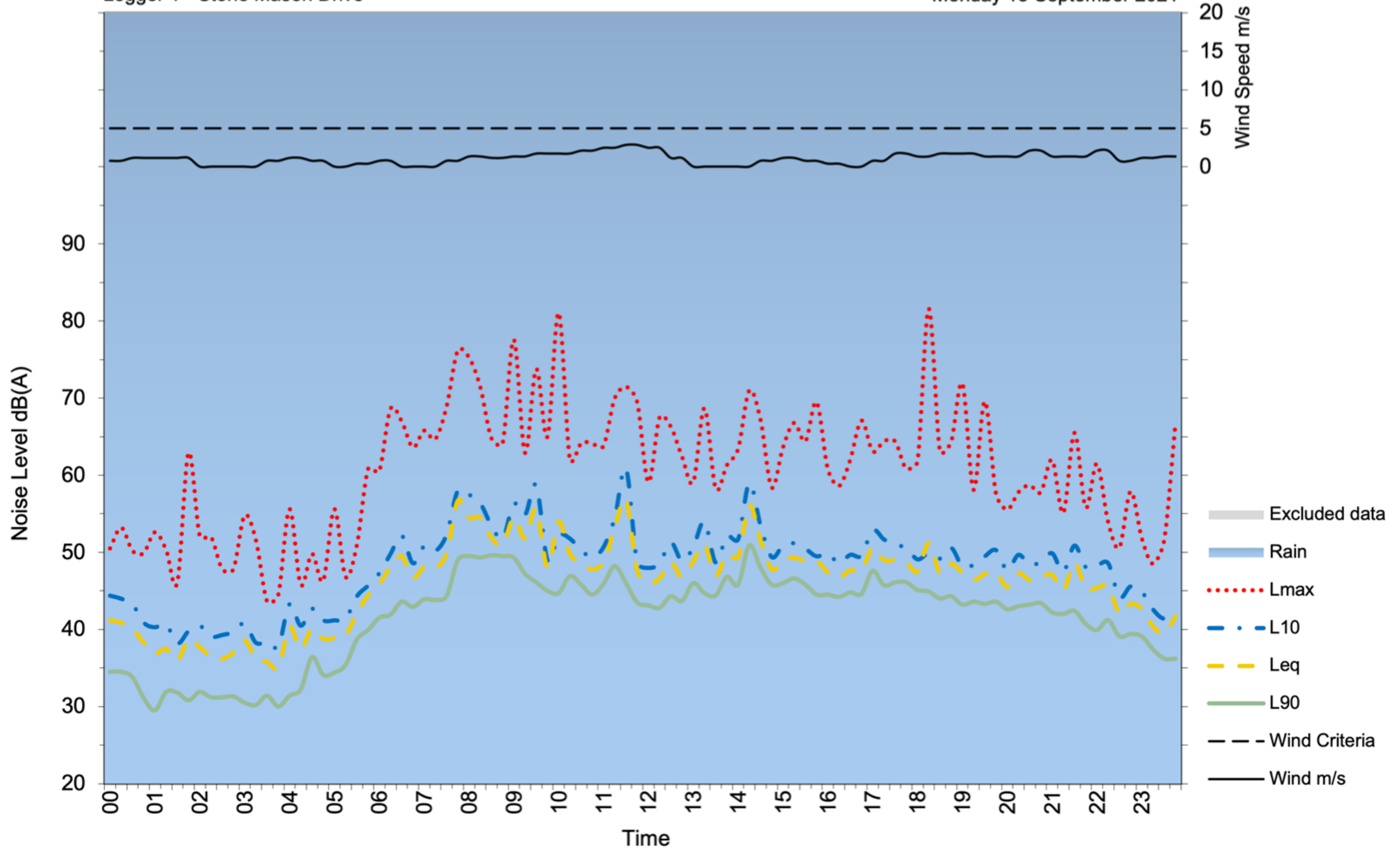
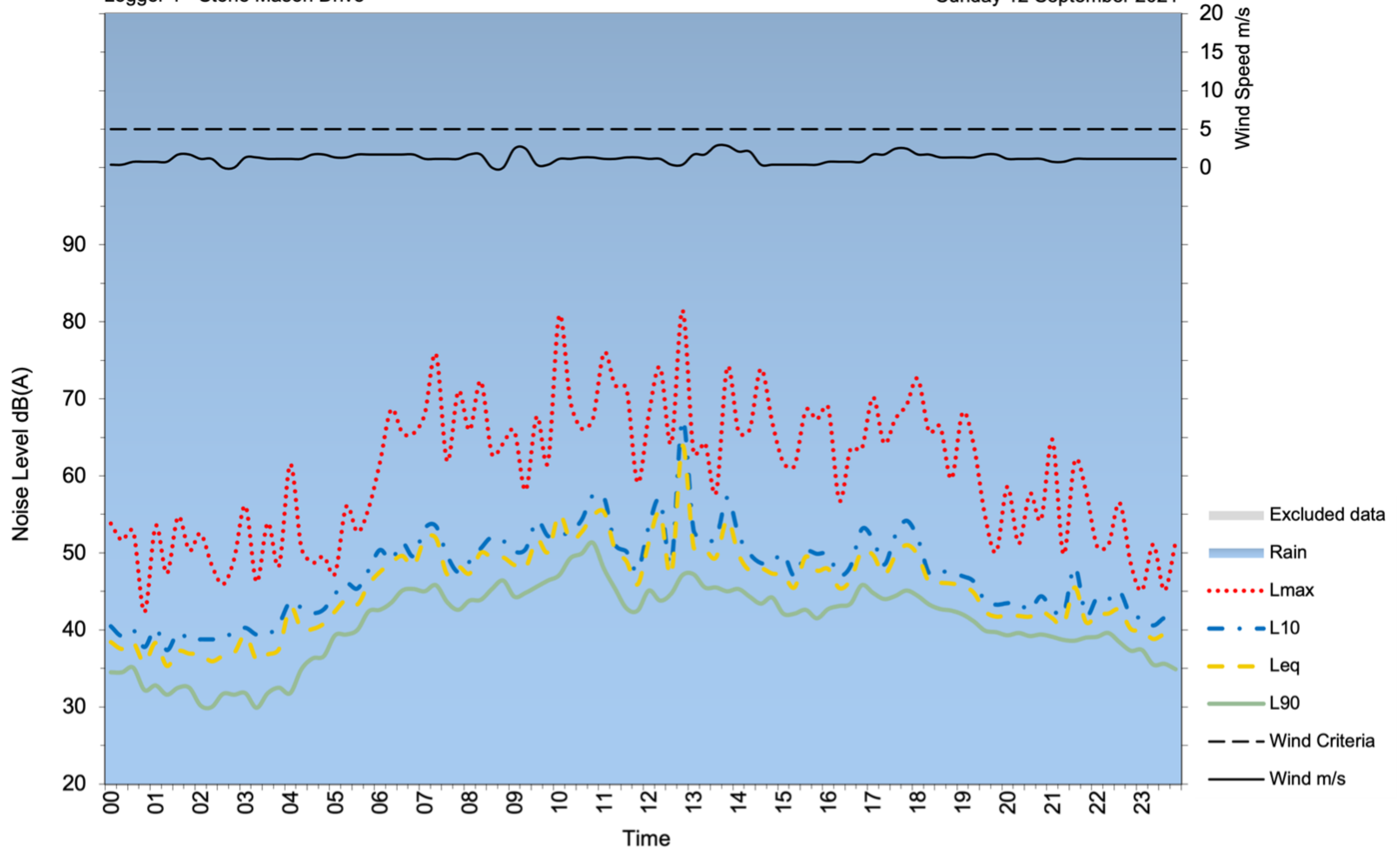


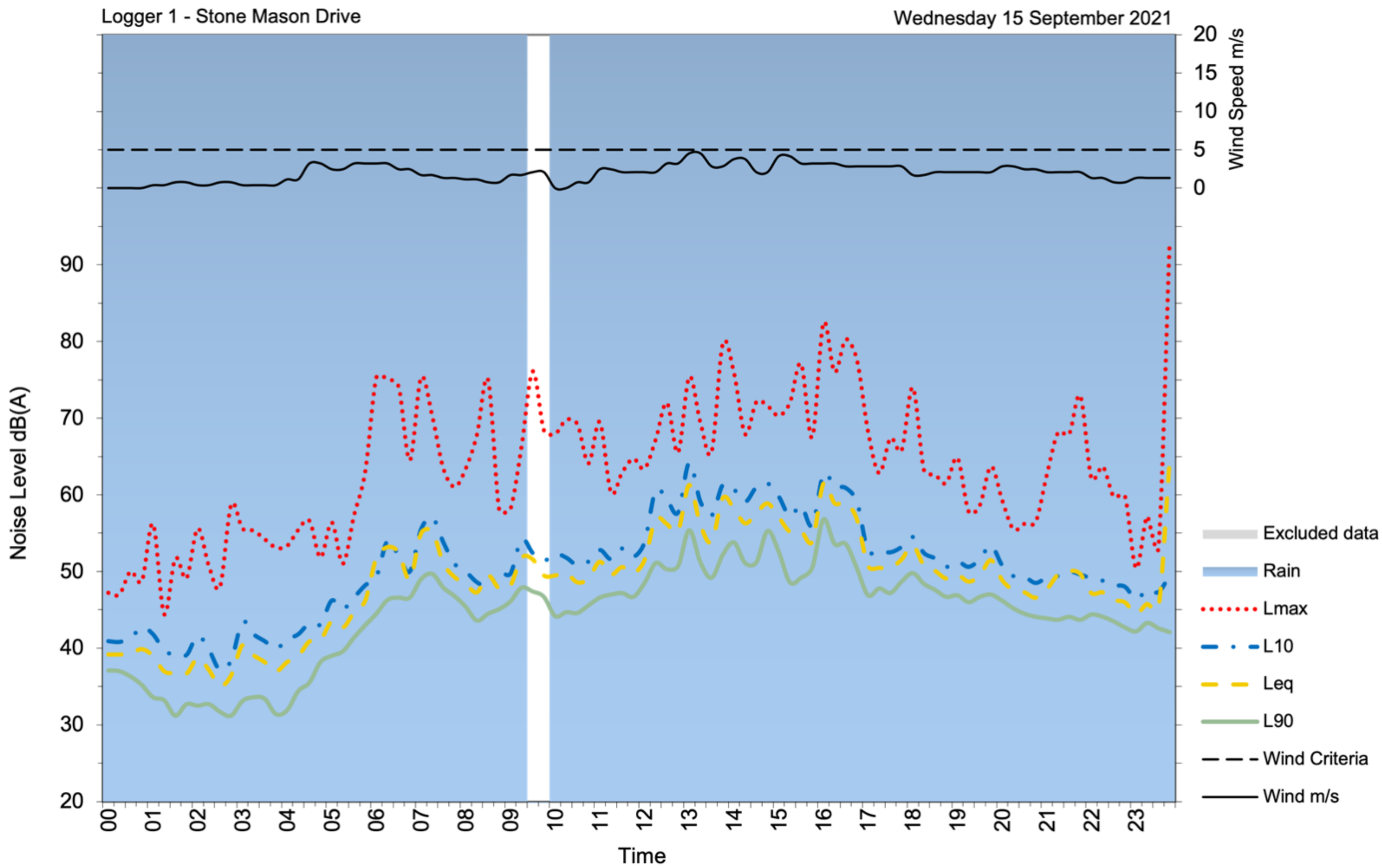
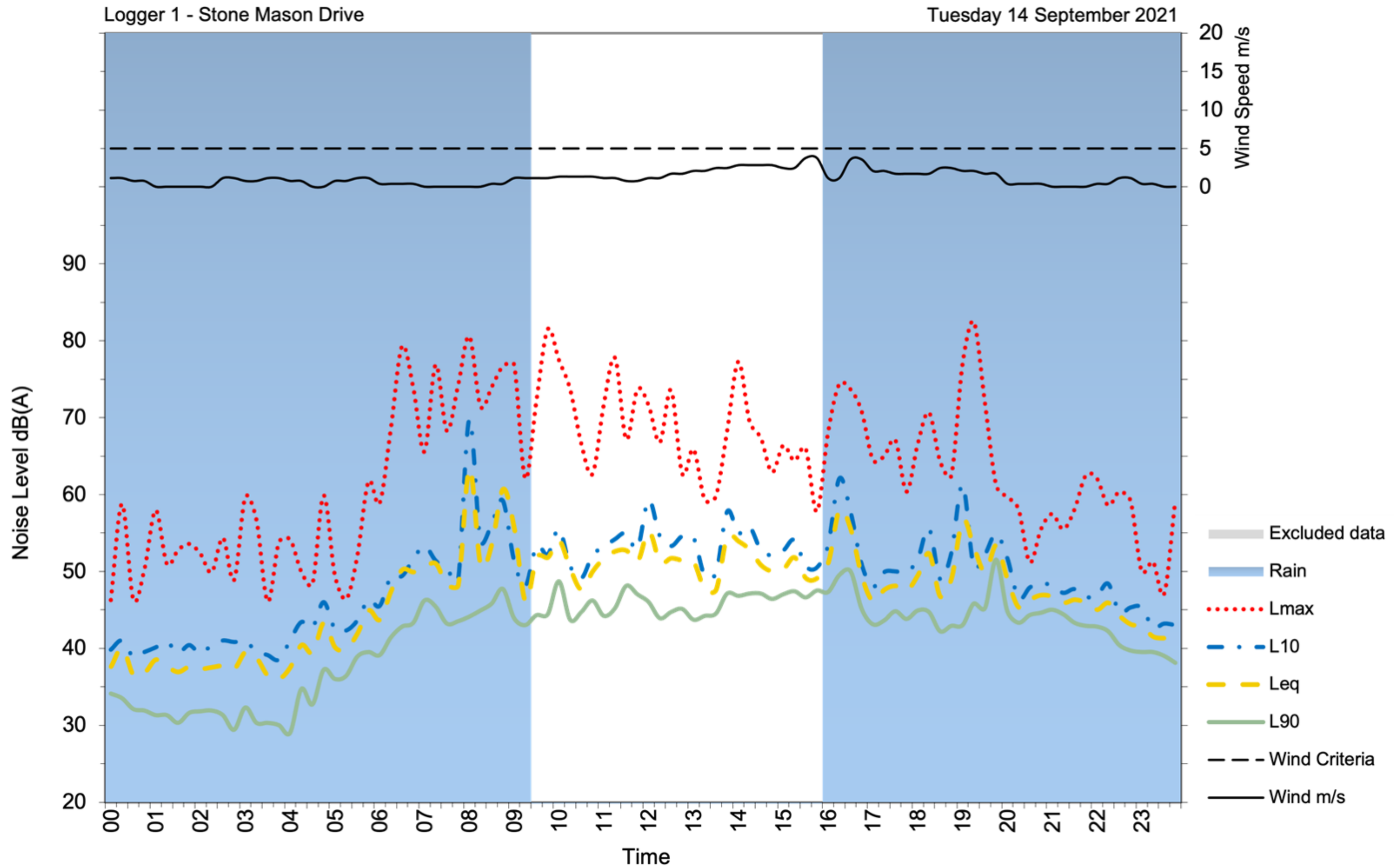




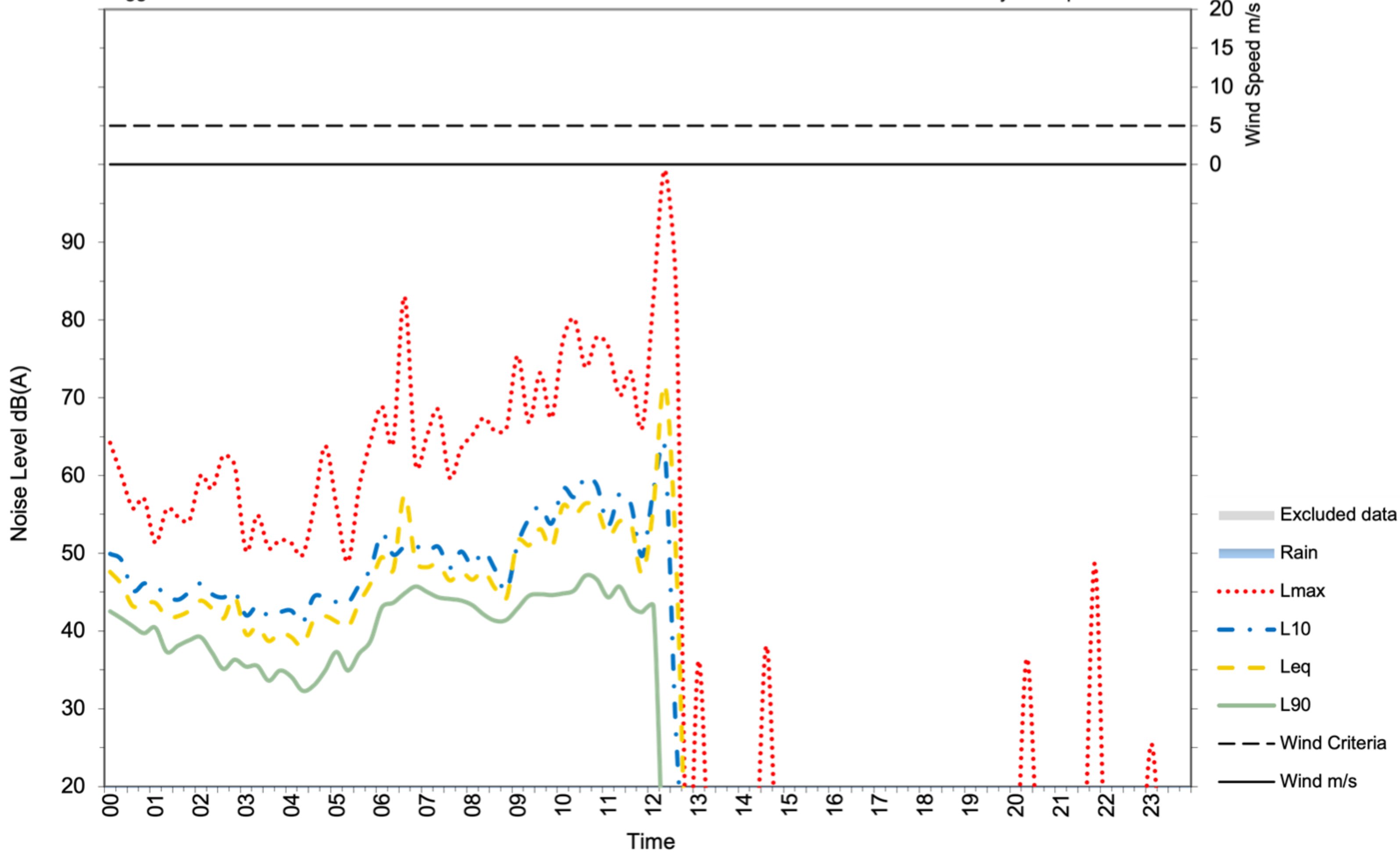
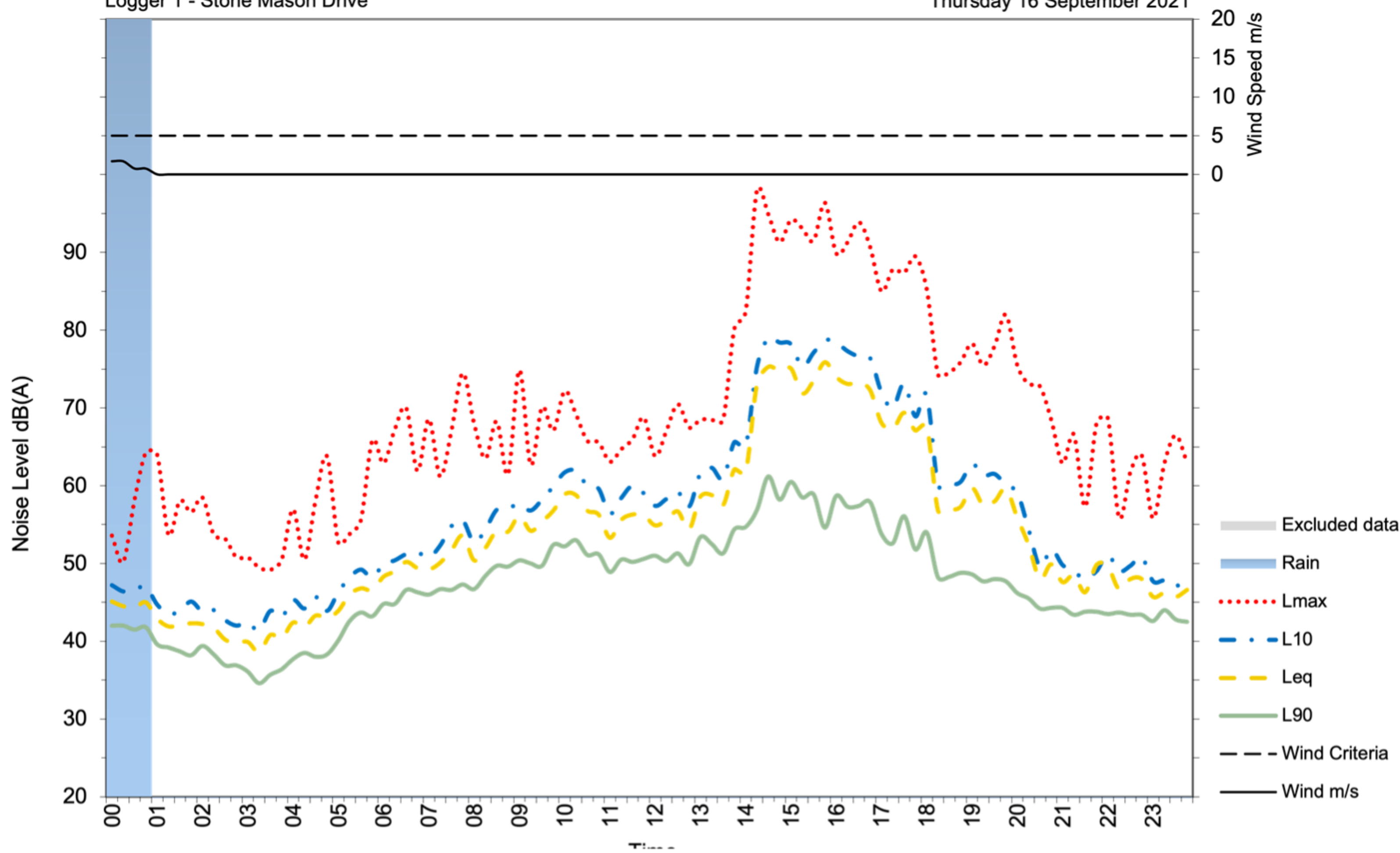


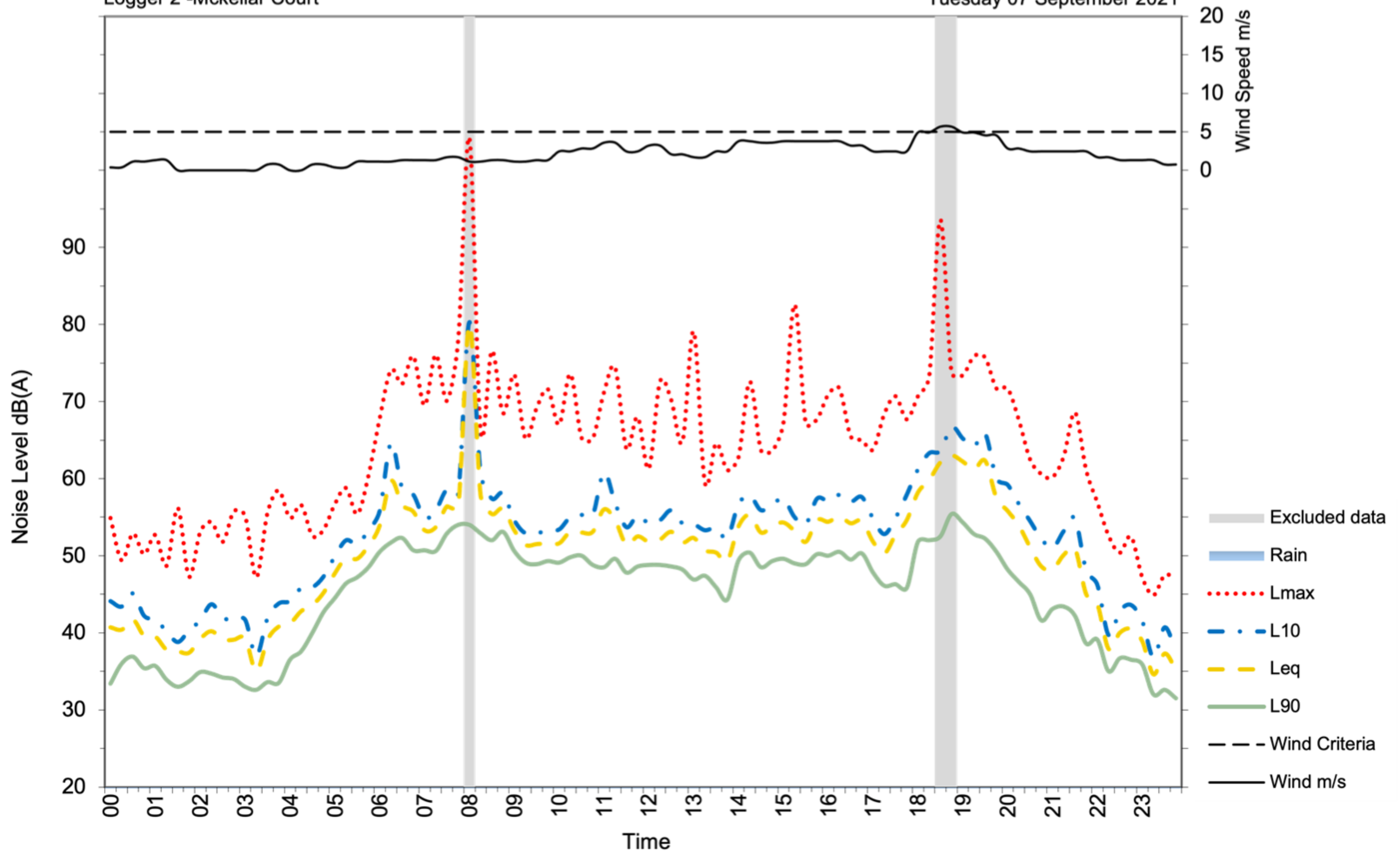
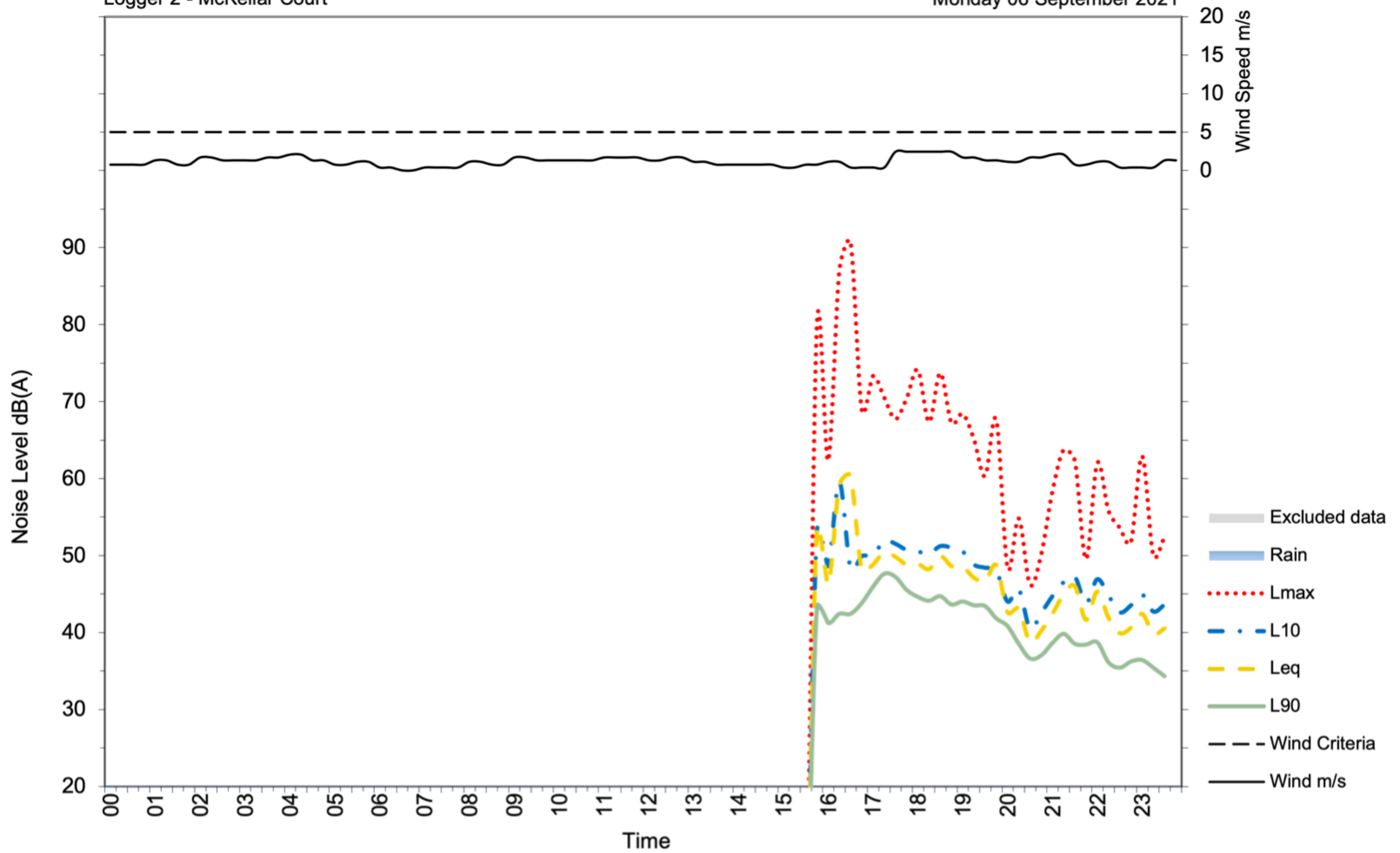




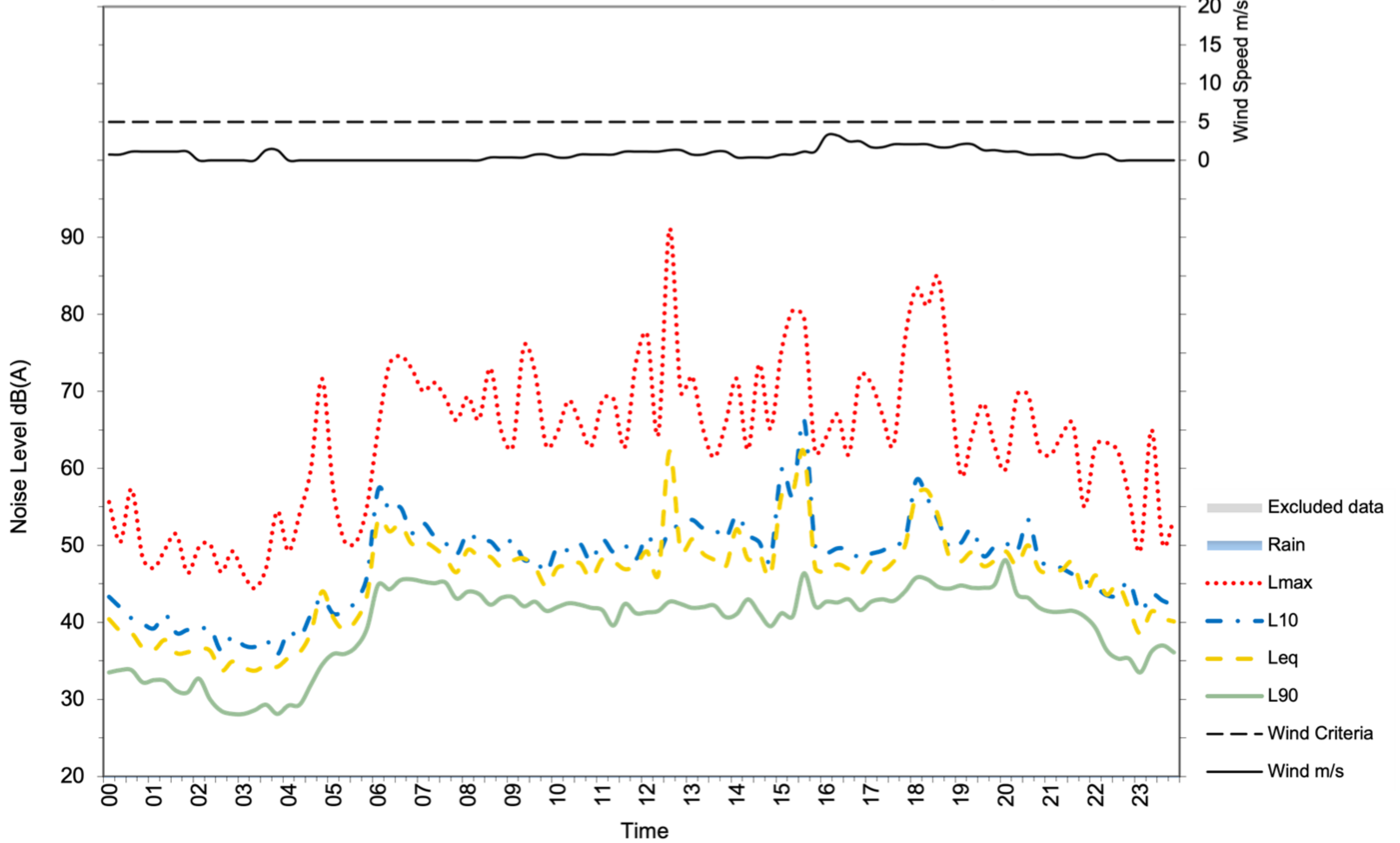
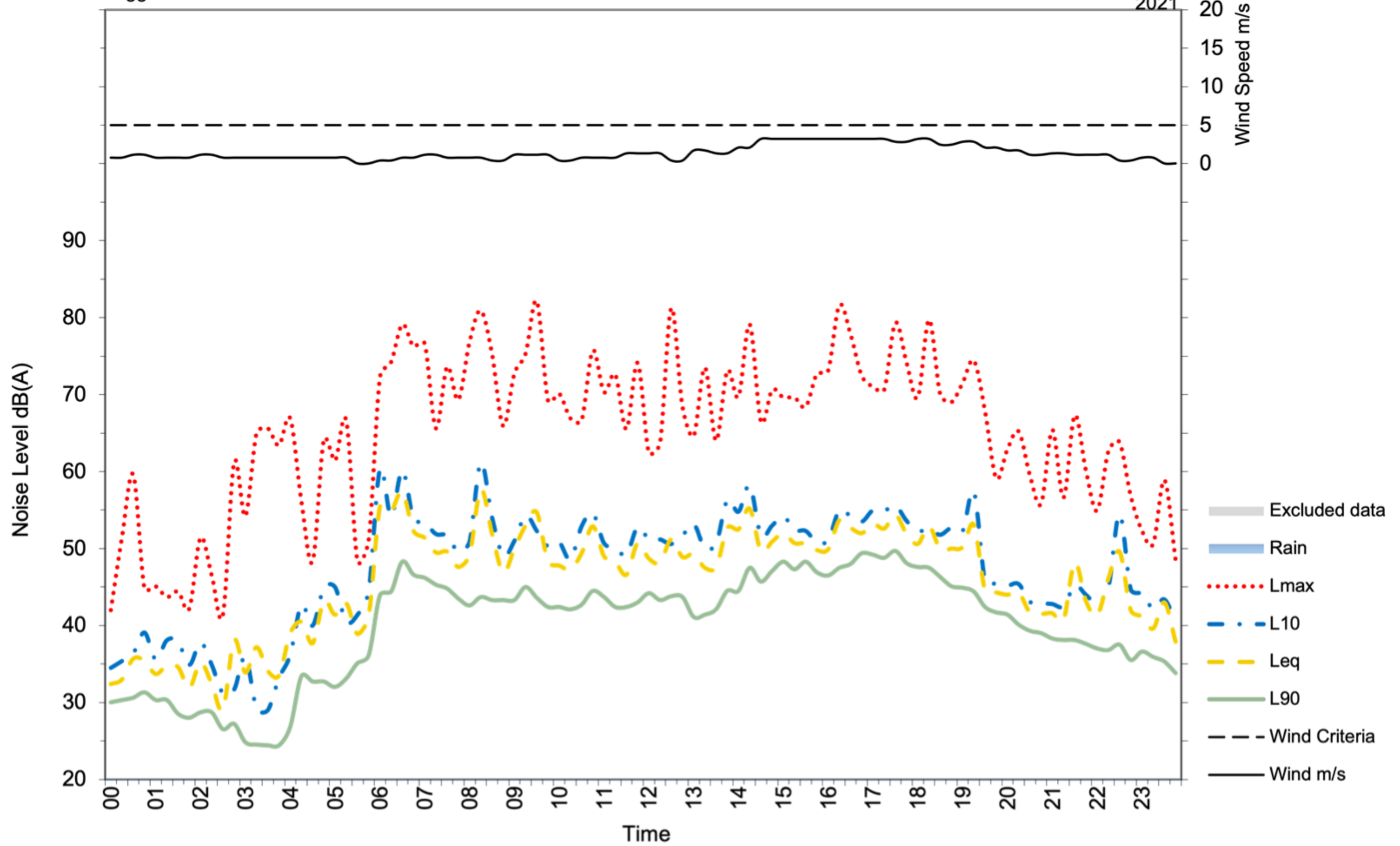






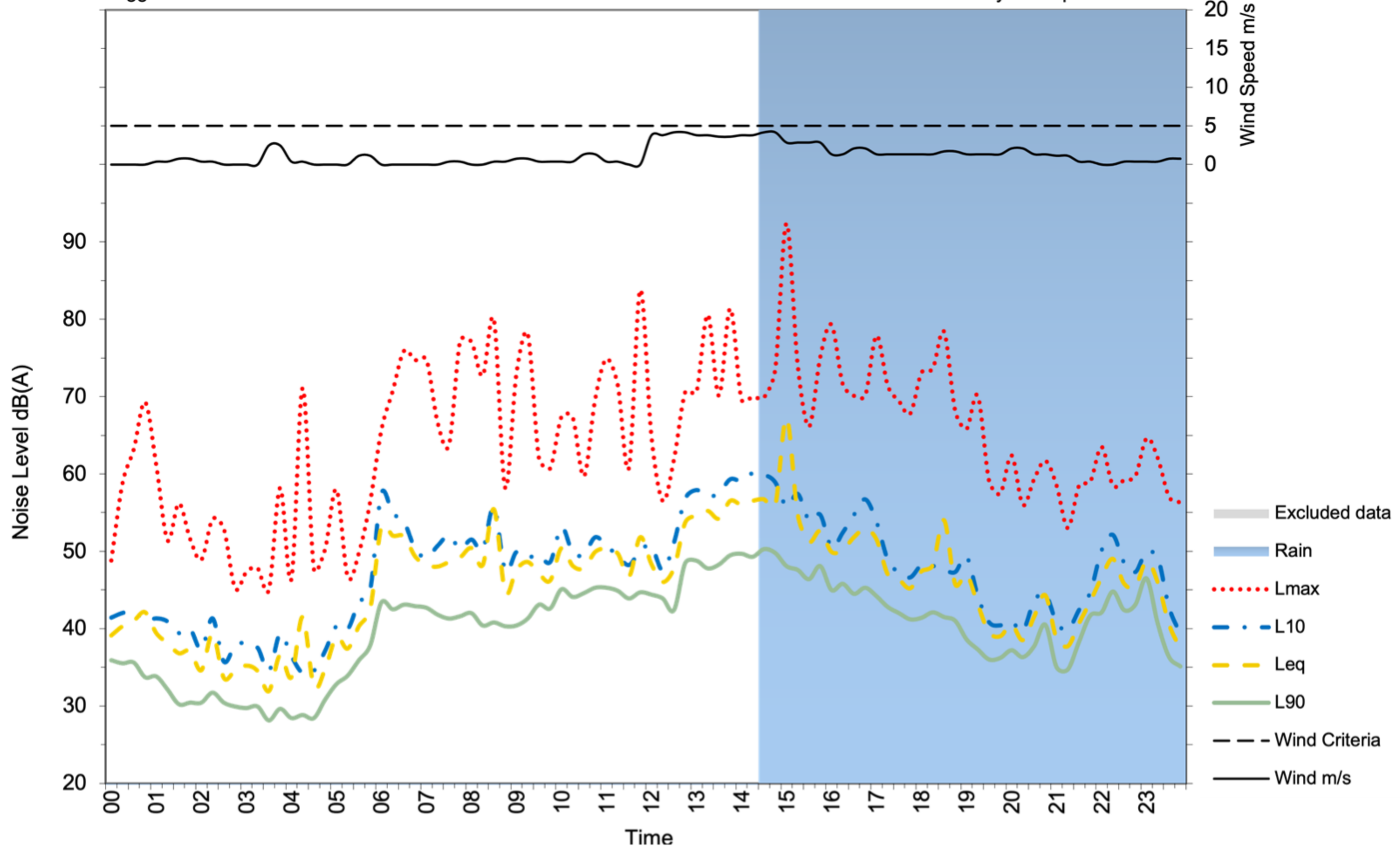






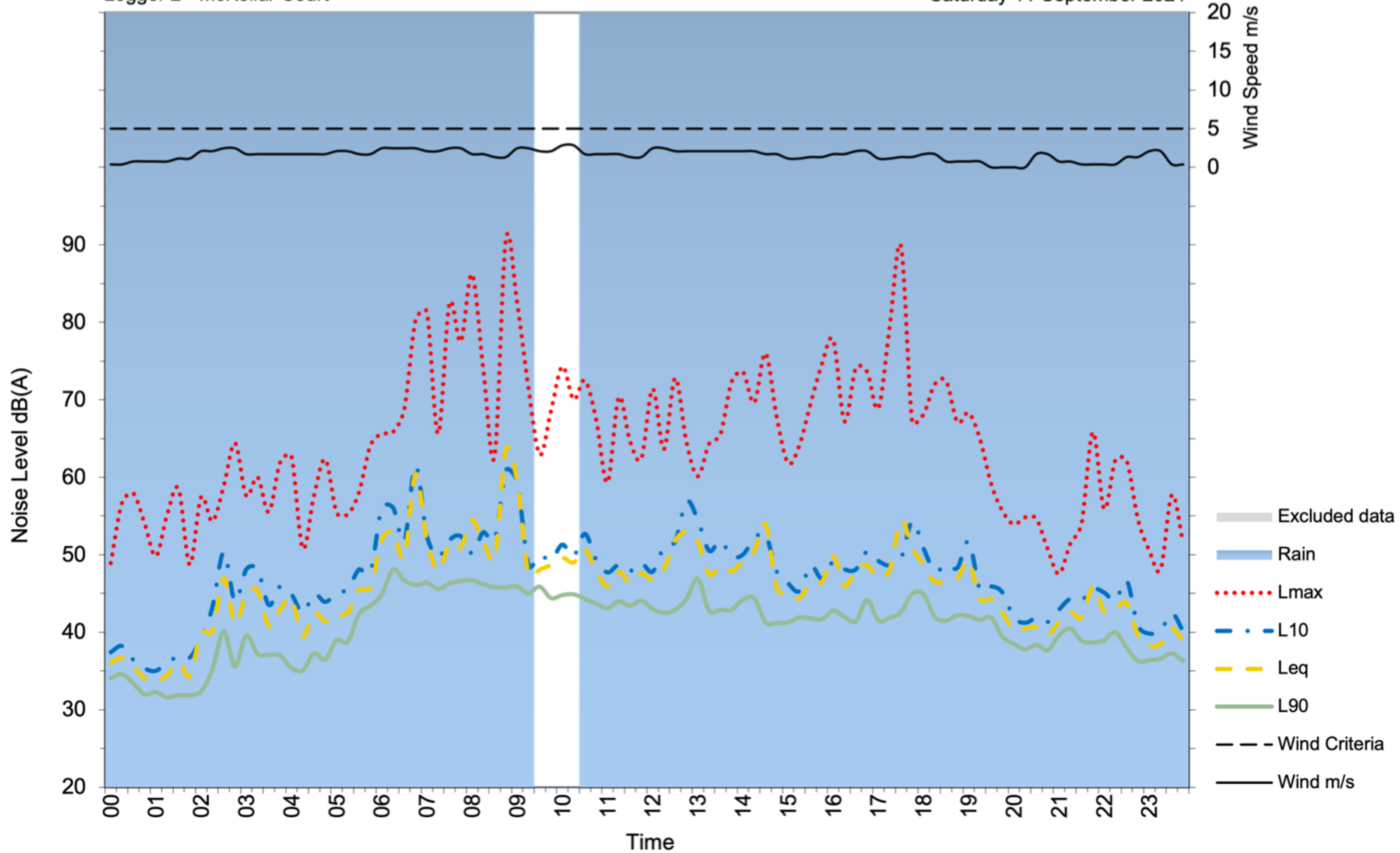
Logger 1 - Stone Mason Drive

Friday 10 September 2021

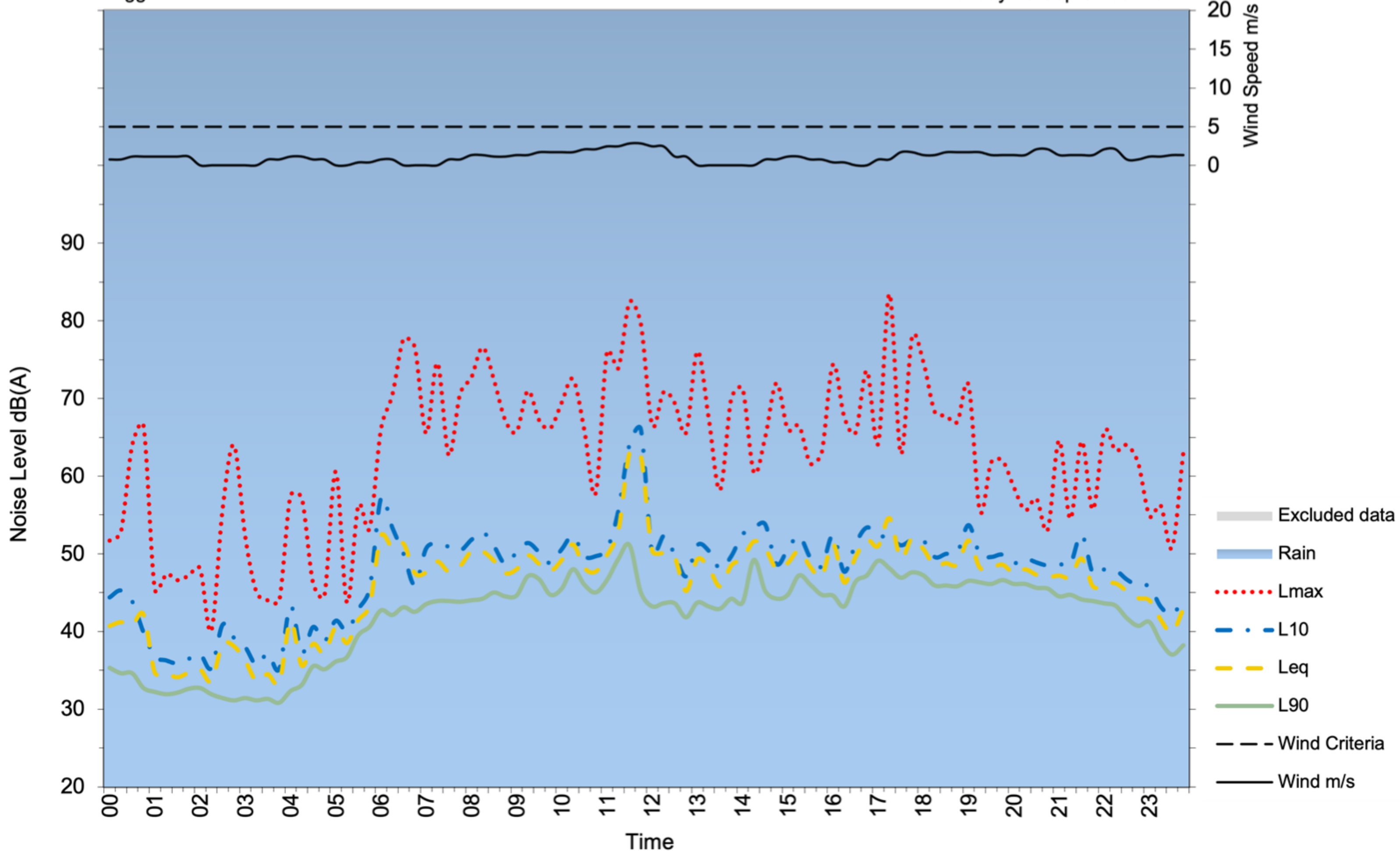
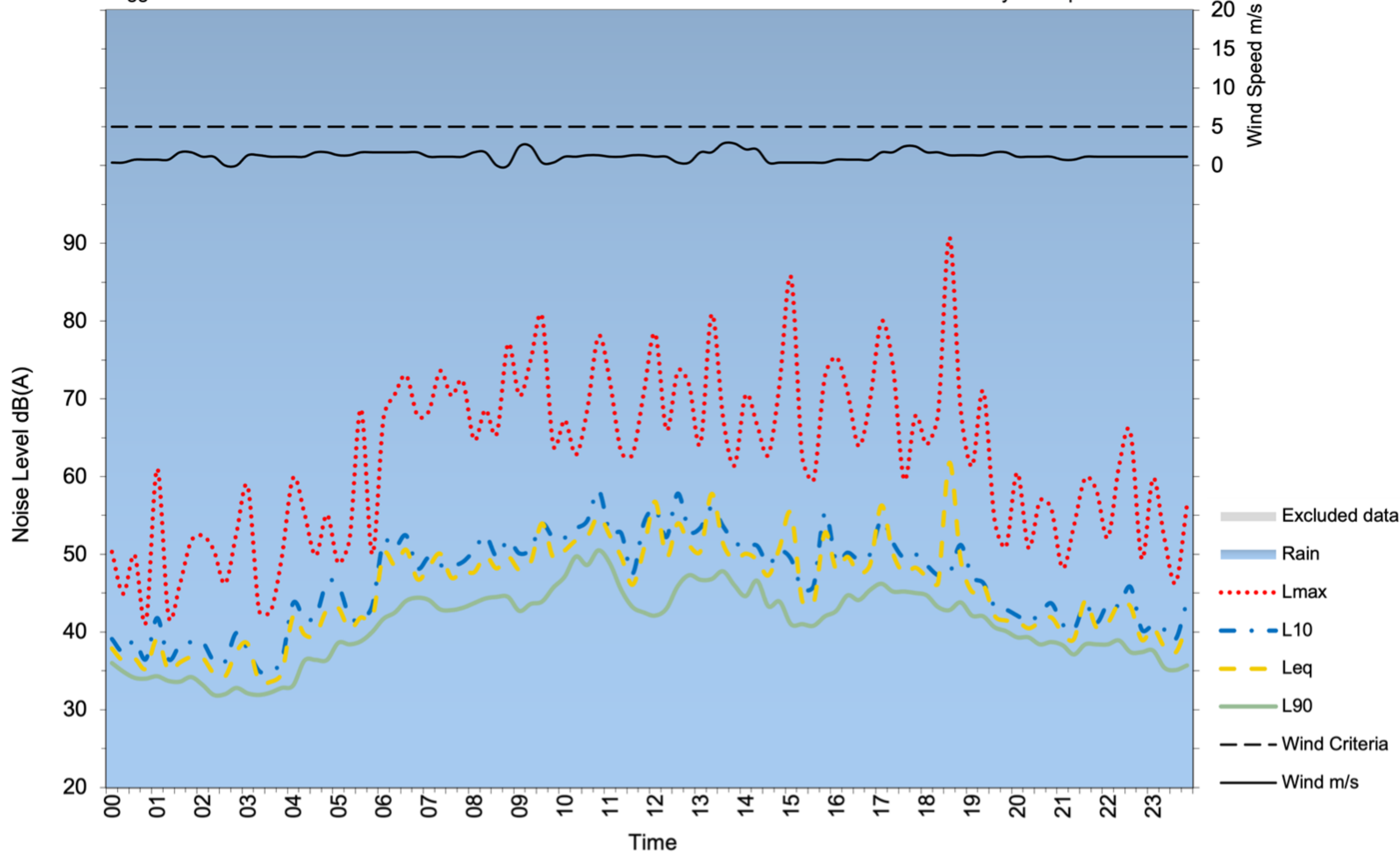


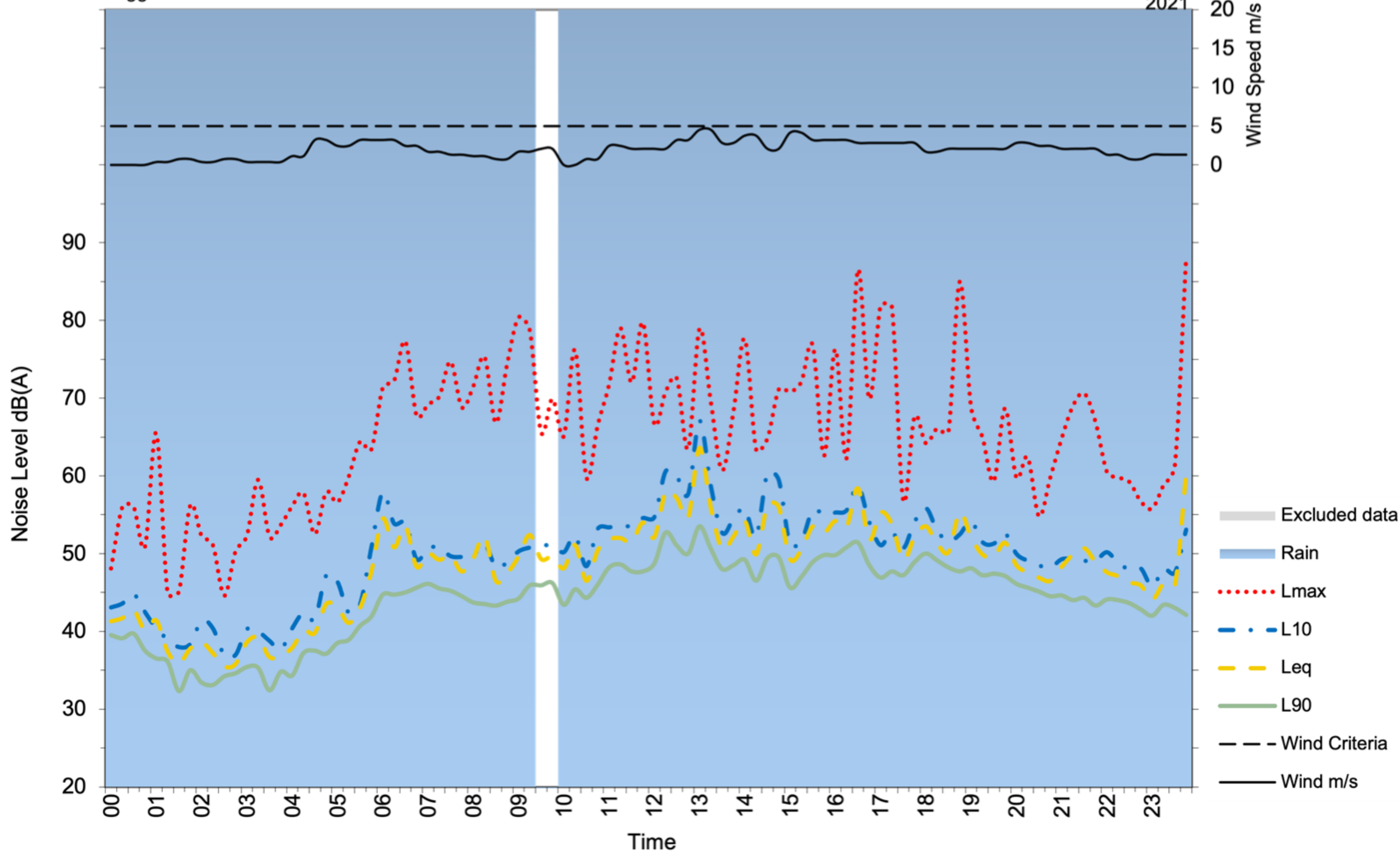
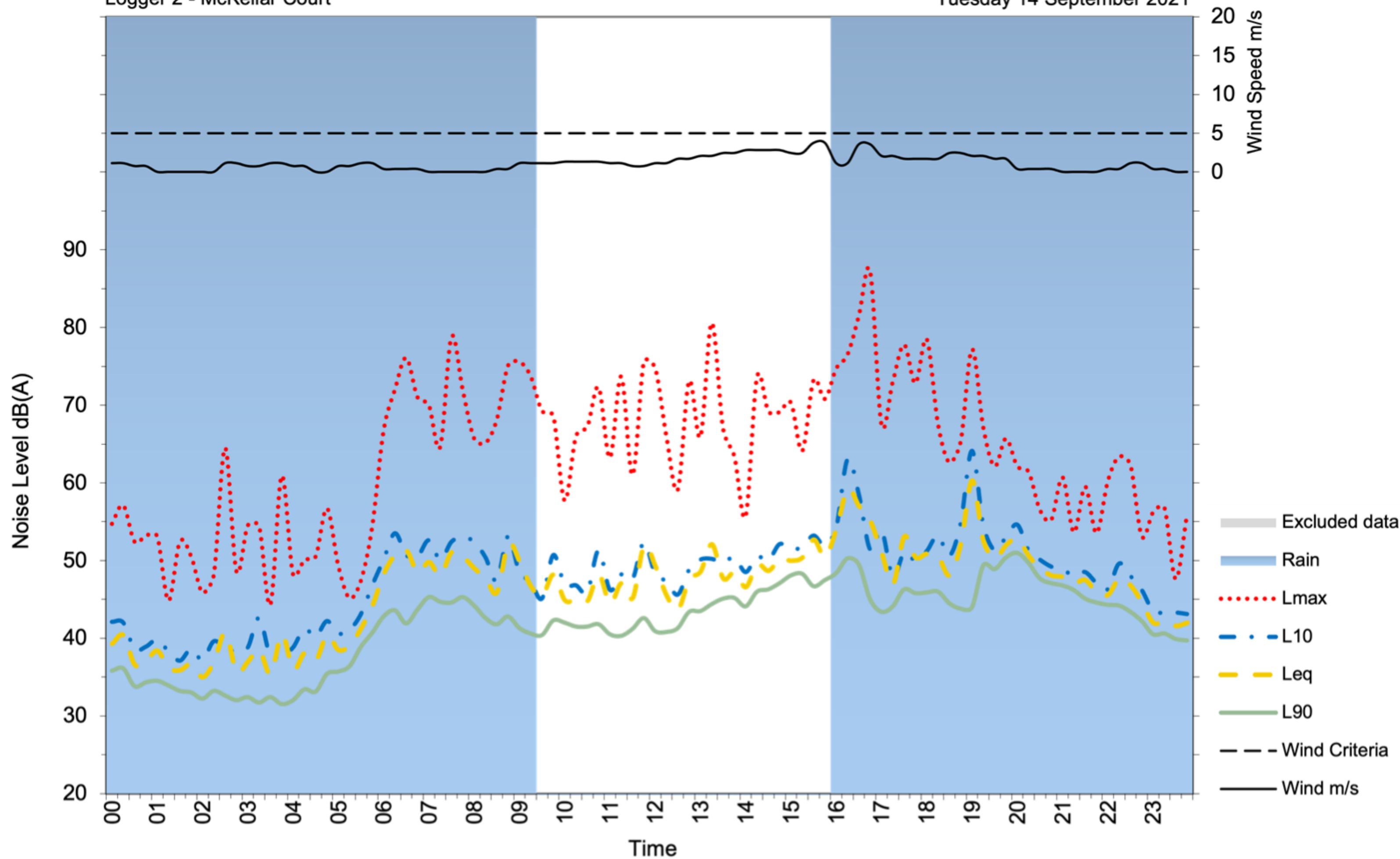
Logger 2 - McKellar Court

Saturday 11 September 2021

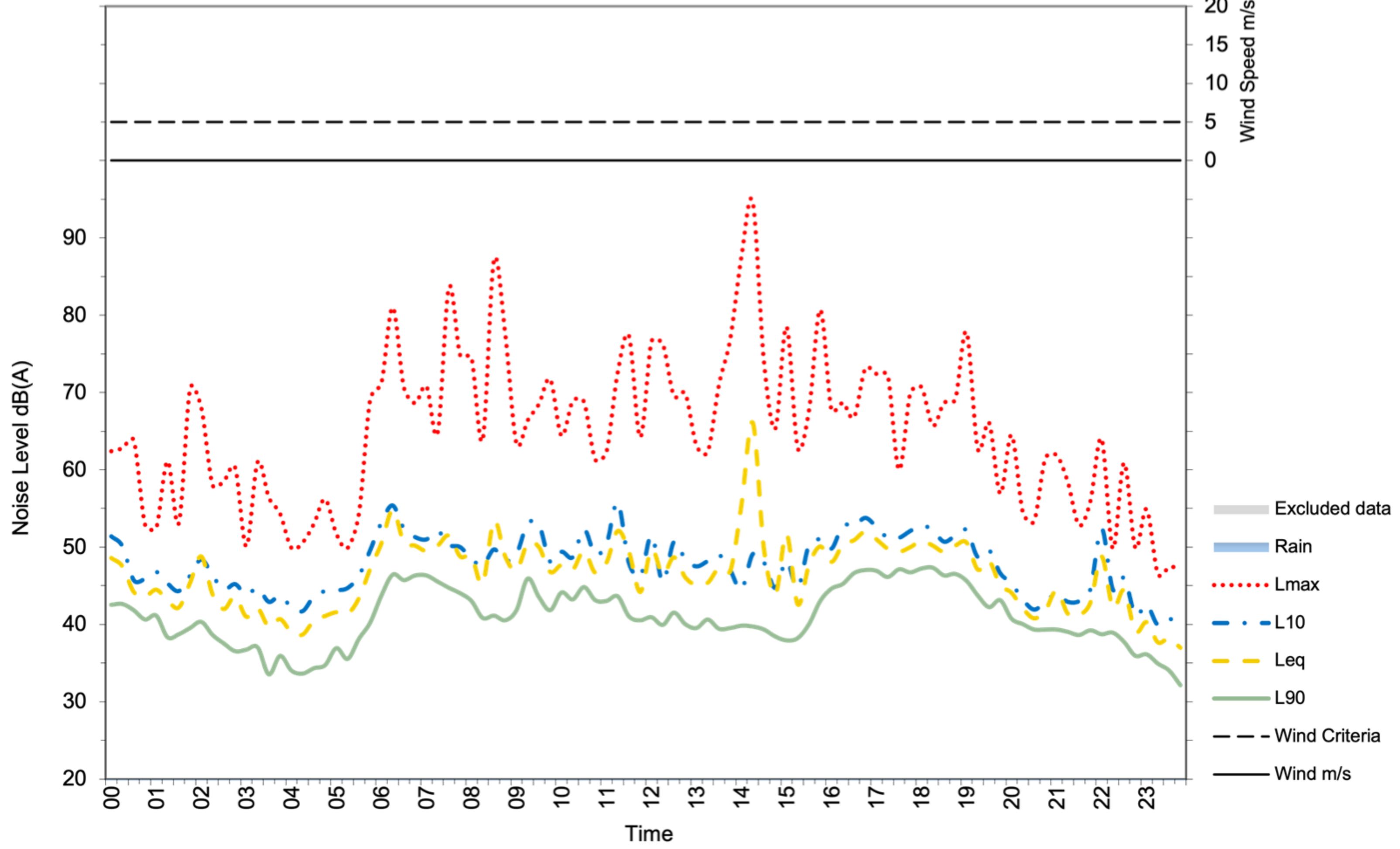
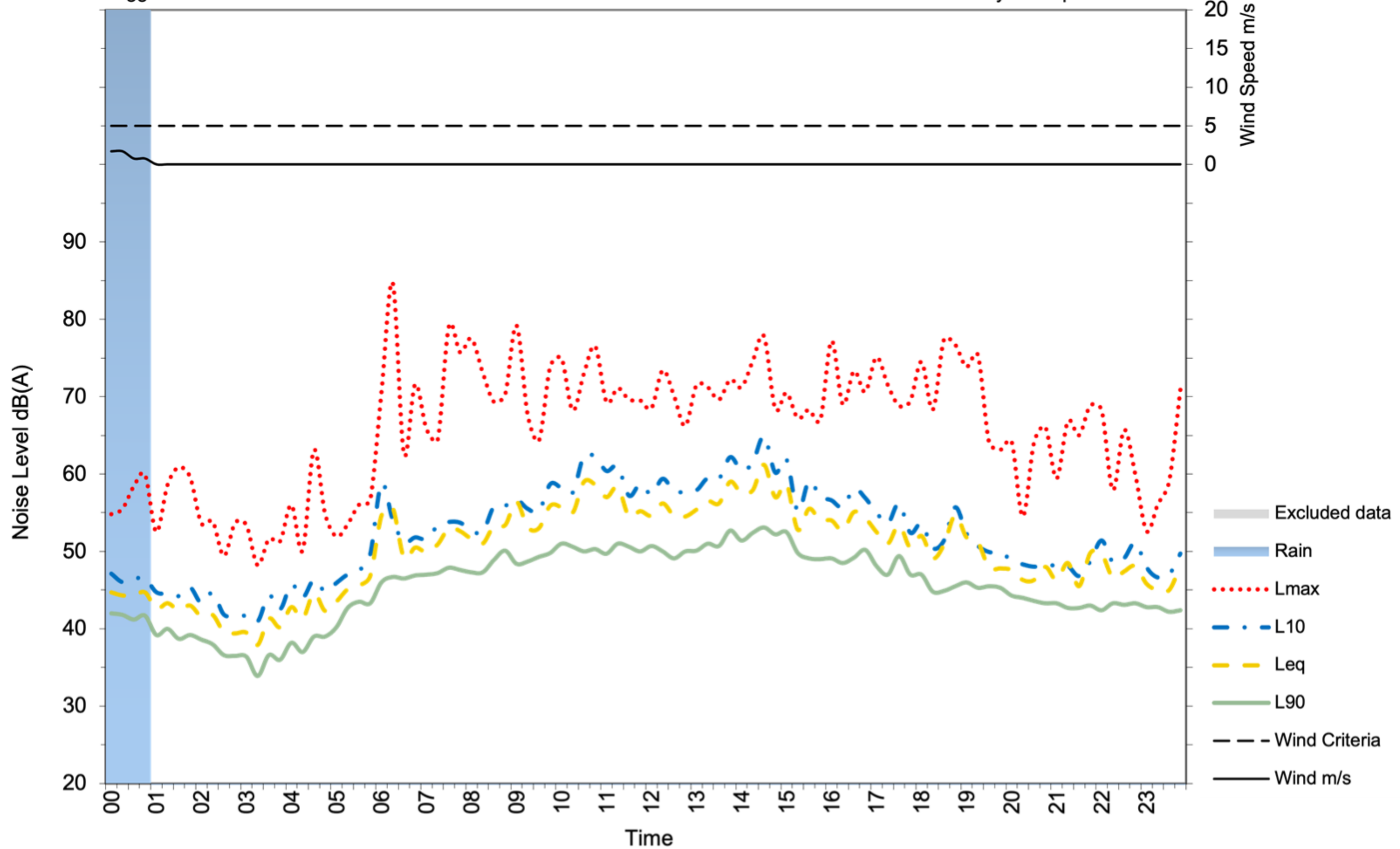


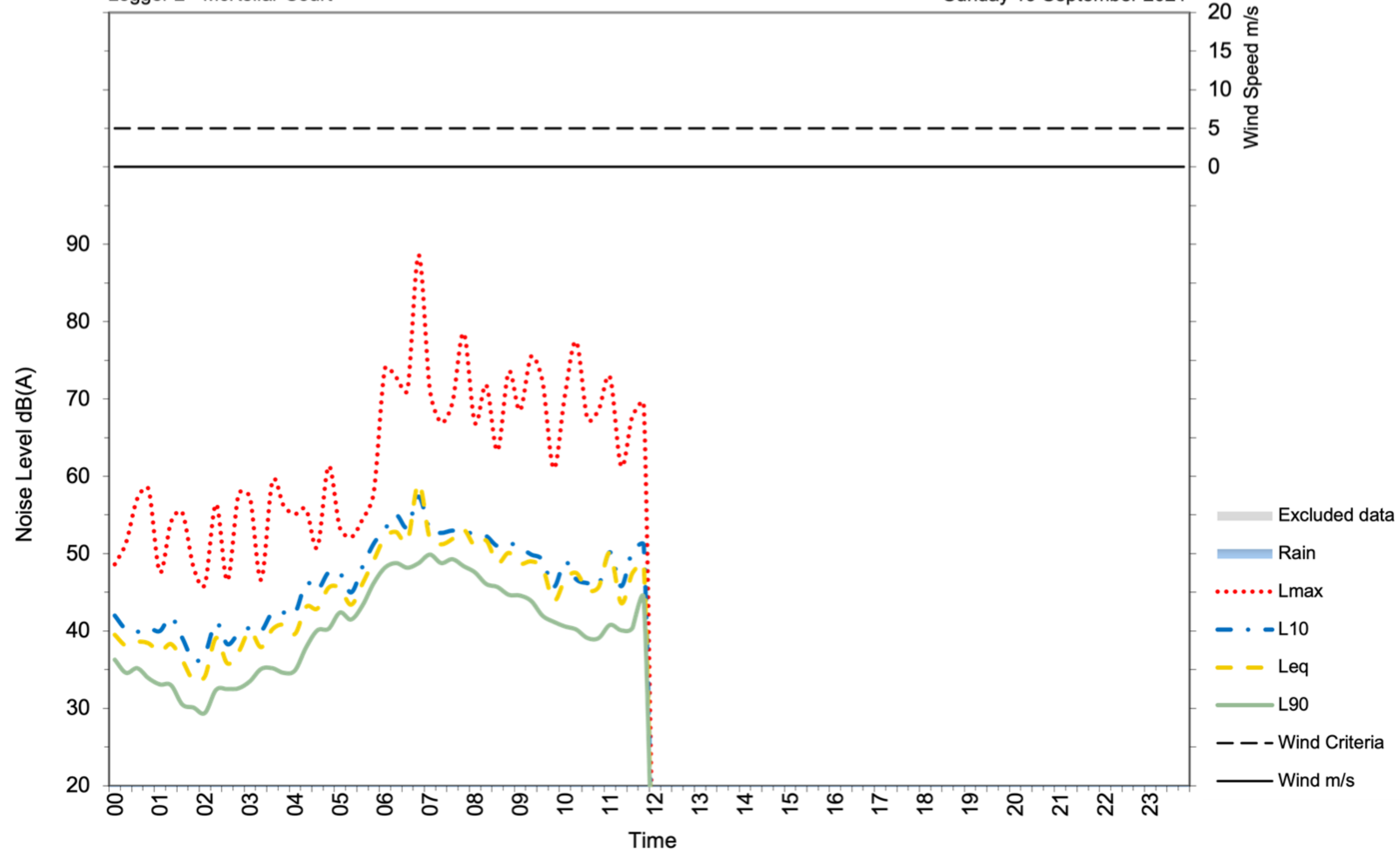
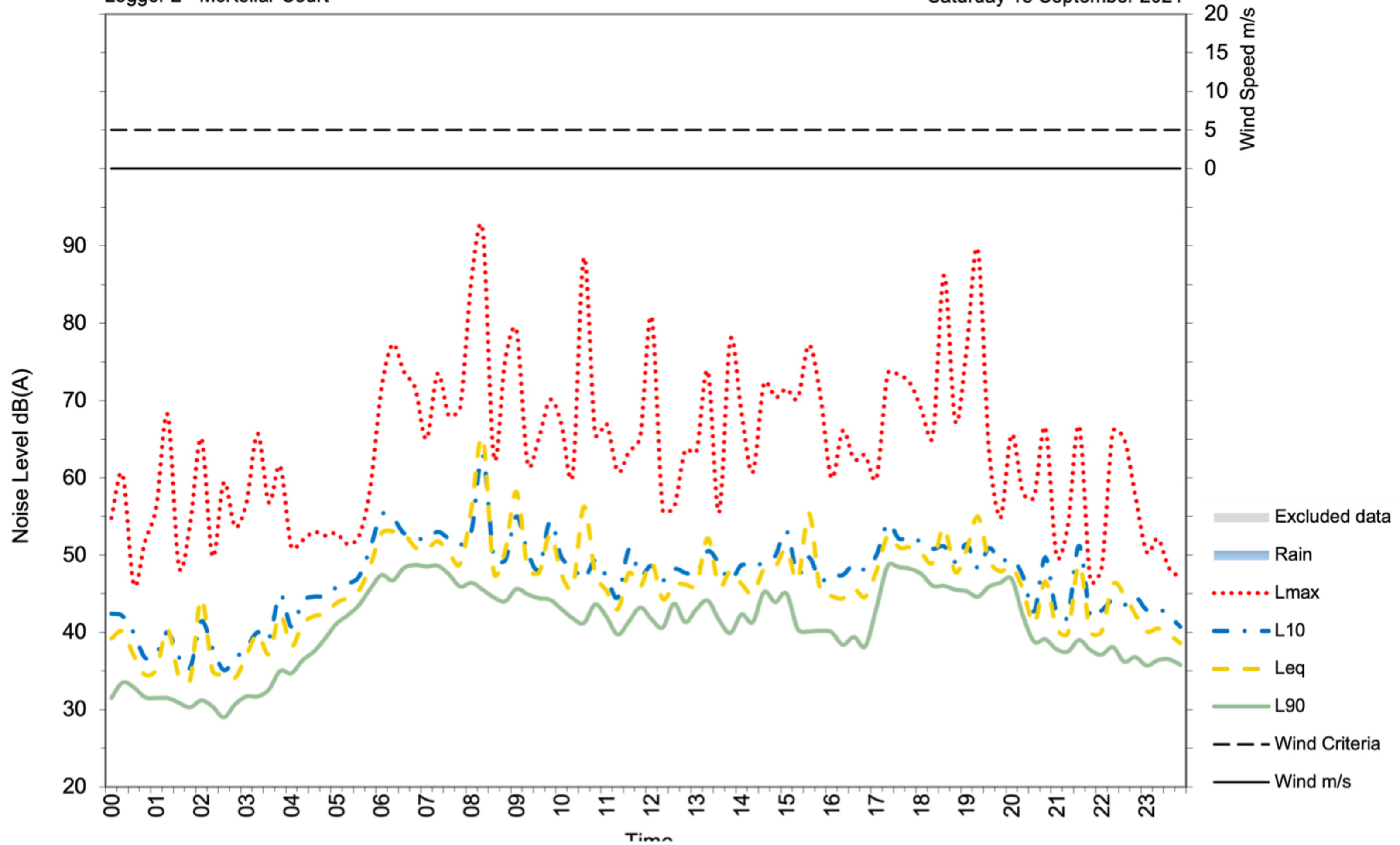














## Appendix B — Noise contours



Kellyville Park Centre of Excellence  
and Community Facility

Noise contours  
Site establishment

PROJECT NUMBER	S200621
DRAWN BY	JH
DATE ISSUED	September 2023
CLIENT	Kane Constructions
PREDICTION METHOD	Concawe
GROUND ABSORPTION	G=0.4
RECEIVER HEIGHT	1.5 m AGL
TEMP	24°C
RH	70%

Legend

- Site Boundary
- NCA

Reciever classifications

- Child Care
- Commercial/Business
- Medical
- Recreational/Open Space
- Residential

Noise contours dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- > 75



0 70 140 210 m

Datum WGS 84, Projection UTM ZONE 50S

Resonate





Kellyville Park Centre of Excellence  
and Community Facility






Noise contours  
Demolition works

PROJECT NUMBER	S200621
DRAWN BY	JH
DATE ISSUED	September 2023
CLIENT	Kane Constructions
PREDICTION METHOD	Concawe
GROUND ABSORPTION	G=0.4
RECEIVER HEIGHT	1.5 m AGL
TEMP	24°C
RH	70%










Legend

-  Site Boundary  
 NCA

Reciever classifications

-  Child Care  
 Commercial/Business  
 Medical  
 Recreational/Open Space  
 Residential

Noise contours dB(A)

-  35 - 40  
 40 - 45  
 45 - 50  
 50 - 55  
 55 - 60  
 60 - 65  
 65 - 70  
 70 - 75  
 > 75



0 70 140 210 m



Datum WGS 84, Projection UTM ZONE 50S

Resonate



Kellyville Park Centre of Excellence and Community Facility

Noise contours  
Retaining piles

PROJECT NUMBER	S200621
DRAWN BY	JH
DATE ISSUED	September 2023
CLIENT	Kane Constructions
PREDICTION METHOD	Concawe
GROUND ABSORPTION	G=0.4
RECEIVER HEIGHT	1.5 m AGL
TEMP	24°C
RH	70%

Legend

- Site Boundary
- NCA

Reciever classifications

- Child Care
- Commercial/Business
- Medical
- Recreational/Open Space
- Residential

Noise contours dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- > 75



0 70 140 210 m



Datum WGS 84, Projection UTM ZONE 50S

Resonate





Kellyville Park Centre of Excellence  
and Community Facility






Noise contours  
Structure construction

PROJECT NUMBER	S200621
DRAWN BY	JH
DATE ISSUED	September 2023
CLIENT	Kane Constructions
PREDICTION METHOD	Concawe
GROUND ABSORPTION	G=0.4
RECEIVER HEIGHT	1.5 m AGL
TEMP	24°C
RH	70%










Legend

-  Site Boundary  
 NCA

Reciever classifications

-  Child Care  
 Commercial/Business  
 Medical  
 Recreational/Open Space  
 Residential

Noise contours dB(A)

-  35 - 40  
 40 - 45  
 45 - 50  
 50 - 55  
 55 - 60  
 60 - 65  
 65 - 70  
 70 - 75  
 > 75



0 70 140 210 m

Datum WGS 84, Projection UTM ZONE 50S

Resonate



Kellyville Park Centre of Excellence  
and Community Facility

Noise contours  
Frame

PROJECT NUMBER	S200621
DRAWN BY	JH
DATE ISSUED	September 2023
CLIENT	Kane Constructions
PREDICTION METHOD	Concawe
GROUND ABSORPTION	G=0.4
RECEIVER HEIGHT	1.5 m AGL
TEMP	24°C
RH	70%

Legend

- Site Boundary
- NCA

Reciever classifications

- Child Care
- Commercial/Business
- Medical
- Recreational/Open Space
- Residential

Noise contours dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- > 75



0 70 140 210 m



Datum WGS 84, Projection UTM ZONE 50S

Resonate





Kellyville Park Centre of Excellence  
and Community Facility






Noise contours  
Facade works

PROJECT NUMBER	S200621
DRAWN BY	JH
DATE ISSUED	September 2023
CLIENT	Kane Constructions
PREDICTION METHOD	Concawe
GROUND ABSORPTION	G=0.4
RECEIVER HEIGHT	1.5 m AGL
TEMP	24°C
RH	70%










Legend

-  Site Boundary  
 NCA

Reciever classifications

-  Child Care  
 Commercial/Business  
 Medical  
 Recreational/Open Space  
 Residential

Noise contours dB(A)

-  35 - 40  
 40 - 45  
 45 - 50  
 50 - 55  
 55 - 60  
 60 - 65  
 65 - 70  
 70 - 75  
 > 75



0 70 140 210 m

Datum WGS 84, Projection UTM ZONE 50S

Resonate



Kellyville Park Centre of Excellence  
and Community Facility

Noise contours  
Internal works

PROJECT NUMBER	S200621
DRAWN BY	JH
DATE ISSUED	September 2023
CLIENT	Kane Constructions
PREDICTION METHOD	Concawe
GROUND ABSORPTION	G=0.4
RECEIVER HEIGHT	1.5 m AGL
TEMP	24°C
RH	70%

Legend

- Site Boundary
- NCA

Reciever classifications

- Child Care
- Commercial/Business
- Medical
- Recreational/Open Space
- Residential

Noise contours dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- > 75



0 70 140 210 m

Datum WGS 84, Projection UTM ZONE 50S

Resonate