

Bankstown North public school

Noise Impact Assessment

JDH Architects




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1.0

Introduction

1.0 Introduction

Cundall has been commissioned by JDH Architects to carry out a noise impact assessment of the proposed development within existing Bankstown North public school, Bankstown NSW. The assessment will consider noise ingress and egress of Stage 1 of the proposed development.

Masterplan Stage 1:

- Demolition of Block B, C, D, M and K
- New three storey building (separated into Block 2 to the north and Block 4 to the south) to facilitate 24 permanent homebases and associated learning areas, library, student facilities & administration;
- New games court;
- Assembly court and other outdoors works.

This report is based on the architect's concept design plans provided to Cundall dated 16 April 2020.

1.1 Design criteria

In this report, acoustic design targets are established for:

- noise impact of the surrounding community on the development, including internal noise levels;
- noise impact of the development on the surrounding community.

The proposed development location is found in the local government area of City of Canterbury Bankstown Council and so the development within this area will utilise the Canterbury Bankstown council management and control plans. A review of the Canterbury Banks found it has a development control plan (DCP) for educational establishments¹ with respect to the acoustic design. In addition to the city council DCP, the design targets and guidance derivative of relevant Australian codes, standards, and guidance, also include the following:

- NSW Educational Facilities Standards and Guidelines [EFSG], DG11 – Acoustics;
- EPA 'NSW Noise Policy for Industry' [NPfI] (October 2017);
- State Environmental Planning Policy – Infrastructure 2007 [SEPP infrastructure];
- State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 [SEPP Education]
- Australian Standard AS2107 'Acoustics – Recommended design sound levels and reverberation times for building interiors' (2016);
- Association of Australia Acoustical Consultants [AAAC] 'Guideline for educational facilities acoustics' (September 2010).
- Interim construction noise guideline (NSW Environment Protection Authority, 2009);
- Australian Standard AS 2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*

A glossary of acoustic terminology used in this report is included in Appendix A.

1.2 DCP criteria

The following items are relevant to the project:

1.2.1 Acoustic privacy

6.1 Air conditioning, mechanical ventilation or any other continuous noise source must not exceed the ambient level at any specified boundary by more than 5dB(A)

6.2 Acoustic Report prepared by a suitably qualified acoustic consultant to determine:

¹ Bankstown DCP 2015 Part B7 Educational Establishments:
http://online.bankstown.nsw.gov.au/Docs/Temp/frvHPhVOhLeLqEucpPHt.docx_140354.pdf

- (a) existing noise levels at the identified sensitive receiver locations;
- (b) likely noise levels to emanate from the school at the identified sensitive receiver locations;
- (c) whether the development must apply measures to ensure the noise of students does not exceed 10dB(A) above the background noise level;
- (d) whether the location and setbacks of the development are sufficient to protect the acoustic privacy of adjacent dwellings; Bankstown City Council Bankstown Development Control Plan 2015–Part B7 22 March 2015 (Amended May 2015)
- (e) whether the location of the outdoor areas and free play areas should avoid living areas and bedrooms of adjacent dwellings; and
- (f) whether the development must install certain noise attenuation measures to protect the acoustic privacy of adjacent dwellings. The Acoustic Report must measure the noise readings over a 15 minute period and must provide details of all modelling assumptions including source noise data, noise monitoring positions, receiver heights and locations, prevailing meteorological conditions during the monitoring, confirmation of the methodology adopted along with a copy of the model input and output data.

6.3 The maximum height for noise attenuation walls and fences along the boundary of an allotment is 2 metres.

1.3 SEARS requirements

1.3.1 Demolition and construction noise

As part of the Secretary's Environmental Assessment Requirements (SEARs), an acoustic consultant is required to prepare an Acoustic and Vibration Impact Assessment which is to:

Identify and provide a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation, construction and construction-related work. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.

Cundall has prepared a report for the early works component of the proposal². Measures to minimise noise during demolition and construction are discussed in Section 6.0 of this report.

1.3.2 Operational noise

The acoustic consultant is also required to:

Identify and assess operational noise, including consideration of any public-address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, time restrictions on grounds maintenance and waste collection and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.

In accordance with the relevant policies.

As this project consists of homebases and administration elements, and is part of an existing school, the only relevant part of the above is new mechanical services equipment, which is discussed within this report.

² Cundall REF report 1019593-RPT-AS-02 Rev A dated 2 April 2020

2.0

Site description

2.0 Site description

2.1 Existing site and general observation

The existing Bankstown North Public school is surrounded by Stacy street to the north, Beresford Avenue to the east with residential receivers directly to the west of the school and south, past the Hume Highway.

Roads with significant contribution to the proposal within the school has been identified as Stacey Street and Hume Highway. Rookwood Road is approximately 112m away from the nearest façade of the project site without direct line of sight but may provide some contribution to the ambient noise levels.

The closest residential receiver to the nearest façade of the school is approximately 30m.

Figure 1 indicates the site and the immediate surrounds of the school, an indicative location of the proposed new building and noise monitoring locations

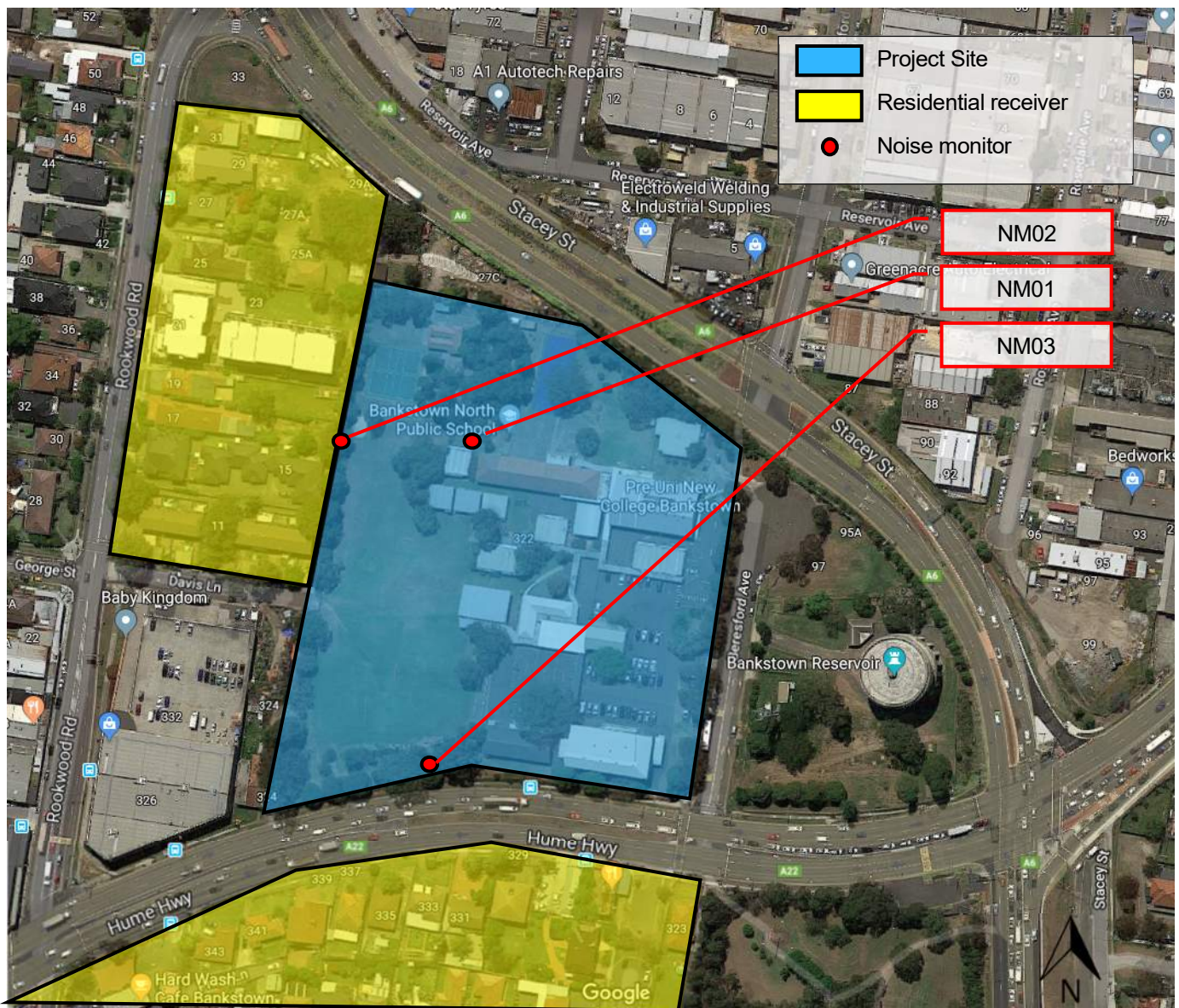


Figure 1 Existing site location and surroundings (Google Maps)

2.2 Proposed development

Stage 1 of the proposed development includes:

- New three storey building (separated into Block 2 to the north and Block 4 to the south) to facilitate 24 permanent homebases and associated learning areas, library, student facilities & administration;
- New games court;
- Assembly court.

Figure 2 outlines demolition footprints of existing structures. Figure 3 presents the proposed site plan.

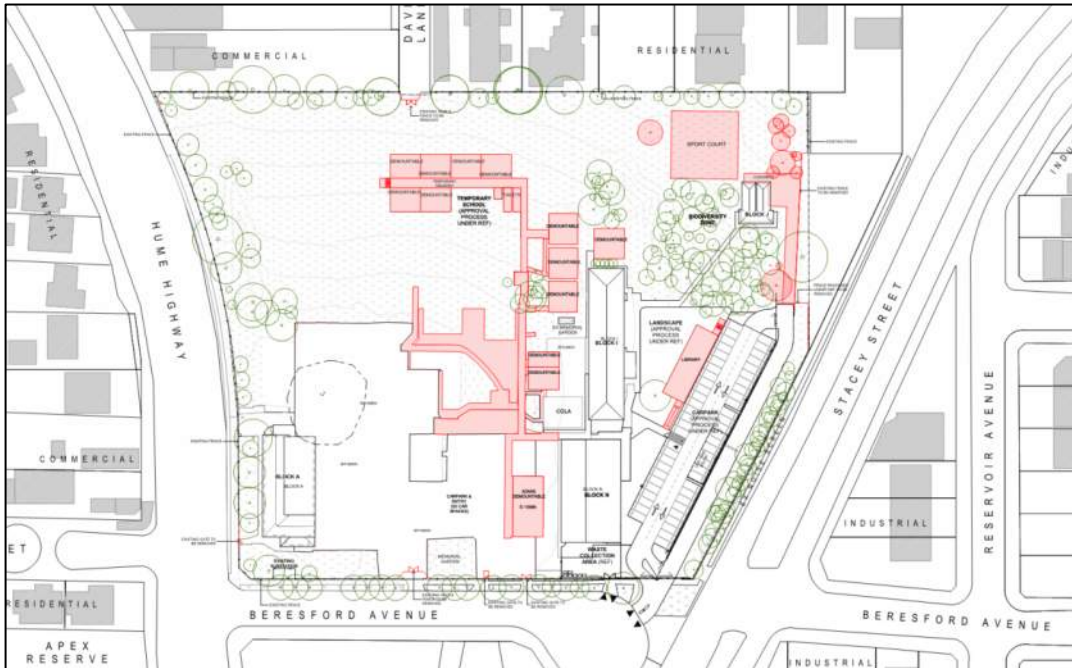


Figure 2 Proposed demolition plan (Drawing number SD-003 Rev 06, dated 24/03/2020, JDH Architects)



Figure 3 Proposed site plan – (Drawing number SD-011 Rev 14, dated 27-03-2020, JDH Architects)

3.0

Noise survey

3.0 Noise survey

The purpose of the noise survey was primarily to:

- identify sources of noise that are likely to affect the development and their expected levels;
- quantify existing ambient noise levels, to assist in setting appropriate noise criteria to assess the impact of the proposed development on the surroundings;
- identify potential noise sensitive receivers in the vicinity.

3.1 Methodology

The environmental noise survey was based on a long-term unattended monitoring positions, located north, west and south of the school grounds. The logger microphones were positioned at approximately 1.5 m above the ground with vision of Stacey Street, Hume Highway and westside residential receivers. These locations are considered representative of noise levels on the most exposed façades of the development (subject to distance attenuation corrections where necessary) and characteristic of the background noise levels at the nearest affected adjacent residential properties on Rookwood Avenue and the Hume Highway.

The logger recorded at variety of noise parameters at 15-minute intervals, including the prevailing noise level (L_{Aeq}) and background noise level (L_{A90}). Measurements were made between 1st and 12th November 2018.

Short-term attended measurements were also taken on 1st November 2018.

3.2 Weather conditions

Weather conditions at the nearest weather station (Bankstown Airport Automatic Weather Station³) have been monitored throughout the logging period. Overall weather conditions were observed to be acceptable over the unattended logging period. Any weather affected periods have been excluded as per guidance within the NPfI.

3.3 Monitoring results and observations

3.3.1 Unattended monitoring results

Appendix B presents the recorded noise levels over the long-term monitoring period, based on the 15-minute survey data.

The Table 1 presents the summary of measured ambient noise level dB, L_{Aeq} and dB, L_{A90} across the whole survey period.

Table 1 Summary of measured ambient noise levels

Measurement location	Measured Ambient Noise Level (dB, L_{Aeq})			Measured Background Noise Level (dB, L_{A90})		
	Daytime	Evening	Night-time	Daytime	Evening	Night-time
NM01	57	53	51	47	46	42
NM02	56	50	49	45	43	39
NM03	66	64	63	51	50	45

³ Ref: <http://www.bom.gov.au/products/IDN60801/IDN60801.94765.shtml>

3.3.2 Operator attended monitoring results

From our site visits, the predominant noise source affecting the site was considered to be local road traffic and general school activity. Operator attended noise survey was carried out on 1 November 2018 at each of the 3 noise monitoring location shown in Figure 1 to determine spectral content of the road traffic noise.

Table 2 presents the summary of measured road traffic noise at the proposed façade locations.

Table 2 Summary of measured road traffic noise levels

Descriptor	Ref Noise monitoring location	Measured Noise Level									
		Total dBA	Octave band Frequency, Hz (Linear, dB)								
			31.5	63	125	250	500	1k	2k	4k	8k
Daytime peak ^{1,2} (6:00 am - 8:00 am) <i>L_{Aeq}</i> (1hr)	NM01	57	63	64	57	49	48	49	48	53	45
	NM03	66	72	76	71	64	61	61	59	55	51
Daytime peak ³ (11:00 am - 12:00 pm) <i>L_{Aeq}</i> (1hr)	NM02	58	63	64	63	54	50	49	48	50	46

1) Free-field noise level

2) Excluding likely school related high noise activities (e.g. recess and lunch break)

3) School activity noise

Based on the noise survey, the following noise levels are used for the design of the building façade:

Table 3 Summary of measured road traffic noise levels

Building Identification	Façade	Main noise source	Indicative maximum façade incidental noise levels dB <i>L_{Aeq}</i> 1hr
Block 2	N	School activity	58
	E	Combination of roads	66
	W	School activity	58
Block 4	E	Combination of roads	57
	W	School activity	58
	S	Hume Highway	66

4.0

Environmental noise

4.0 Environmental noise

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

The State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 [Education SEPP] provide controls of noise from a new building and alteration of existing building which are in line with the intrusive criteria of the NSW Environment Protection Authority's Noise Policy for Industry [NPfI] dated October 2017 (detailed in the following sections). It should be noted that this design criteria are applicable to the design of the school building and not noise from children.

An extract of the development control provided by Education SEPP, Part 7, Schedule 2 Schools—complying development are presented below:

6 Noise

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

4.1 Noise egress design criteria

It is understood that the development proposals include mechanical ventilation/cooling systems to the proposed homebases, offices and demountable buildings. As such there is potential for some localised items of plant (e.g. toilet extract fans, comms room services) to be installed as part of the proposal.

Any environmental emissions from the proposed development should be designed to comply with the requirements of the NSW Environment Protection Authority's Noise Policy for Industry [NPfI] dated October 2017.

The objective of the NPfI is to ensure noise impacts from the proposed developments are assessed and managed in a consistent and transparent manner. If it is predicted that the development is likely to cause the project noise trigger level to be exceeded at noise-sensitive receivers, management measures need to be considered to seek to reduce the potential noise level.

The project noise trigger level provides an objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures. The project noise trigger level, feasible and reasonable mitigation measures, and consideration of residual noise impacts are used together to assess noise impact and manage the potential noise from a proposal or site.

The project noise trigger level is the lower (that is, the more stringent) value of the project intrusiveness noise level and project amenity noise level. The project intrusiveness noise level aims to protect against significant changes in noise levels, whilst the project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Applying the most stringent requirement as the project noise trigger level ensures that both intrusive noise is limited and amenity is protected, and that no single development can unacceptably change the noise level of an area.

The NPfI separates the day into three different time periods – daytime, evening and night-time. These time periods are detailed below.

Table 4 NPfI time periods

Period	Day of week	Time period
Day	Monday-Saturday	07:00 – 18:00 hours
	Sunday, Public Holiday	08:00 – 18:00 hours
Evening	Monday-Sunday	18:00 – 22:00 hours
Night	Monday-Saturday	22:00 – 07:00 hours
	Sunday, Public Holiday	22:00 – 08:00 hours

It is noted that the dB, L_{Aeq} noise level is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the project amenity noise level. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods.

It should be noted that the assessment is based on industrial noise sources, which in this case would relate to mechanical services plant etc. Activity noise from children falls outside of this assessment.

4.1.1 Selection of noise sensitive receivers

The most affected sensitive receivers to potential noise from the proposed development are the residential properties between Rookwood Road and directly west of the school grounds, which are separated with trees. Should mechanical plant noise emissions meet the requirements at this location then other, more distant, properties will be appropriately protected.

4.1.2 Project intrusiveness level

A shorter sampling period over 15-minute is typically used when measuring the level of intrusive noise. This is taken to be a reasonable estimate of the period over which annoyance may occur.

The applicable intrusiveness criteria for the development based on site measurement data⁴ are provided in Table 5.

Table 5 NPfI - Intrusive criteria

Location	Reference monitoring location	Time period	RBL (Measured)	Intrusive criteria RBL + 5 dB
			dBA	dB, $L_{Aeq,15min}$
Nearest residential properties	NM02	Daytime	45	50
		Evening	43	48
		Night-time	39	44

4.1.3 Project amenity level

The protection of noise amenity applies to noise from all industrial noise sources including noise emitted from the proposed development. Criteria considers the type of receiver, the area classification and the time of day the noise is proposed to occur. The amenity criterion is set so that the L_{Aeq} noise level from the industrial noise source does not increase the total industrial noise levels at the receiver above the recommended amenity noise level [ANL] for that receiver.

⁴ Because of the variable nature of background noise levels, the NPfI specifies single number background noise levels for use in setting the intrusiveness noise criterion. The Assessment Background Level [ABL] for each time period is the level exceeded by 90% of the $L_{A90,15min}$ measurements. The Rating Background Level [RBL] for a particular time period is the median of the ABL values for that time period for each day of the measurement period.

In cases where no other industries are present in the area, the project amenity noise level is set to the ANL for the proposed development.

A summary of the amenity criteria using data from the noise loggers is presented in Table 6.

Table 6 NPfI – Amenity criteria

Location	Classification	Time period	Measured noise level dB L _{Aeq,15min}	ANL ^{1,2} dB L _{Aeq, period}	Amenity criteria dB L _{Aeq,15min}
Nearest residential properties	Suburban	Daytime	56	55	53 (55-5+3)
		Evening	50	45	43 (45-5+3)
		Night-time	49	40	38 (40-5+3)

1) Acceptable Noise Level for suburban residences, according to Table 2.2 of NSW NPfI, 2017.

2) To standardise the assessment period for the intrusiveness and amenity noise levels, the policy assumes $L_{Aeq,15min} = L_{Aeq, period} + 3$ dB.

4.1.4 Applicable project-specific trigger levels

The most stringent of the intrusiveness and the amenity criteria should be set as the project-specific trigger level to be met by the development. Table 7 compares the intrusiveness and the amenity criteria and identifies the limiting criterion for each time period.

Table 7 NPfI – Project-specific noise trigger levels

Location	Classification	Time period	Intrusive criteria dB L _{Aeq,15min}	Amenity criteria dB L _{Aeq,15min}	Project -specific trigger level dB L _{Aeq,15min}
Nearest residential properties	Suburban	Daytime	50	53	50
		Evening	48	43	43
		Night-time	44	38	38

4.1.5 Compliance with State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017

Compliance with the established project-specific trigger levels (Table 7) will also comply with the requirements of the SEPP Education.

4.2 Noise egress design recommendations

As specific plant items have not been selected at this stage, the project-specific noise trigger levels have been established for consideration during the subsequent design stage. Noise from any mechanical plant associated with the proposed development should be controlled to meet the criteria given in Table 7 when assessed at the nearest affected noise-sensitive location.

Typical noise mitigation strategies include selection of low noise outdoor equipment, locating plant to take advantage of shielding from building elements, and the use of plant enclosures or screens if necessary.

4.2.1 Management of other operational activities

Noise generated by waste collection, services or delivery vehicles should be controlled by management of the collection/delivery times to minimise disturbance to nearby residents. Out of hours (evening and night-time period) activities are not anticipated for the proposed development. Incorporation of Best Management Practice will ensure that impacts to the adjacent receivers, if any, will be reduced during operation.

5.0

Consideration of school activity noise

5.0 Consideration of school activity noise

Student activity noise from schools is typically one of the most understandable, and tangible, causes of concern from the occupants of neighbouring premises. Currently there are no specific State criteria for children activity noise from schools.

The Project site is an existing and established school, covering a large area, and therefore adjacent noise-sensitive dwellings will already be acclimatised to the sounds of general school activity.

The proposals do not include new spaces with a high level of activity noise (such as music rooms). The proposed sports field is currently used as an active grass covered play spaces and new outdoor areas on the side of the school facing residences on the Hume Highway are landscaped, as opposed to the existing bitumen play areas. The new games court is to be on the same side of the school as the existing court.

The proposed upgrades will provide for 277 additional students (an approximate 75% increase from 367 to 644 students). An increase in noise of approximately 2 dB could be expected from this. An increase 1-2 dB above the existing noise level is considered negligible and not discernible by the average listener⁵.

In addition to the above, the school activity noise will be limited to the daytime period and would be unusual at weekends or public holidays.

As such, a detailed assessment of noise from the activity of children is not considered necessary.

⁵ NSW Noise Policy for Industry (October 2017) Table 4.2

6.0

Consideration of construction noise

6.0 Consideration for construction noise

Cundall has prepared a report for the early works component of the proposal (report 1019593-RPT-AS-02 Rev A dated 2nd April 2020).

As the detailed plan of construction has not been established at this stage of the project, an assessment of construction noise is to be assessed once the information becomes available. It should be noted that all construction works, including demolition, excavation, and building work should comply with the following guideline as a minimum:

- Interim construction noise guideline (NSW Environment Protection Authority, 2009)
- Australian Standard AS 2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*
- Local council policies (Canterbury Bankstown city council⁶)

6.1 Proposed construction traffic

Additional road traffic generated on existing roads due to construction phase of the proposal may have the potential to cause adverse road noise impacts at receivers. The additional road traffic generated by vehicles accessing the construction site locations are to be assessed in accordance with the NSW EPA Road Noise Policy (RNP).

At this time, no information regarding the increase in traffic has been made available for review. We understand however, that the majority of demolition traffic will access the site via Beresford Avenue, which is unlikely to result in adverse impact upon residential receivers on the opposite side of the site.

6.2 Recommendation for construction noise management and mitigation

In the absence of local council's guidance on control of noise on construction activities, to minimise the impact of construction noise to the neighbouring sensitive receivers, guidance NSW Interim Construction Noise Guideline (EPA, 2009) should be considered. This include the recommended standard construction hours and derivation of construction noise criteria.

6.2.1 Construction hours

The demolition and construction hours are as follows:

- 07:00 to 18:00 Monday to Friday
- 07:00 to 13:00 Saturday
- No work Sundays or public holidays

All work on the face of the building:

- 07:30 to 17:30

Works outside of the recommended standard hours (out of hours works) are possible with appropriate permit for works requiring special condition. The following work categories might be undertaken outside the recommended standard hours:

- The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours

⁶ Bankstown demolition and construction guidelines:

http://online.bankstown.nsw.gov.au/Docs/Temp/xqWhxZHxJYHahWaVWrYt.docx_142720.pdf

For the following items, the Project should provide the relevant authority with clear justification for reasons requiring the works to occur outside of standard hours other than convenience, such as to sustain operational integrity of road, rail and utility networks:

- Public infrastructure works that shorten the length of the project and are supported by the affected community
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Application for out of hours works permit requires approval by Council. Surrounding residents nearby the project site are to be notified in advance of the out of hours works.

6.2.1.1 Respite periods

Provision of respite break should be considered for noisy activity (e.g. no piling and demolishing between 9:00 am to 12:00 pm Monday to Saturday and 2:00 pm to 5:00 pm Monday to Friday).

6.2.2 Construction Noise Management Levels (NMLs)

The noise construction management levels are established based on the measured background noise levels and the sensitive receivers are identified as per the NSW Interim Construction Noise Guideline (EPA, 2009). Table 8 provides a summary of construction noise management levels for the project.

Table 8 Construction Noise Management Levels

Receiver type	Time Period ¹	NMLs ² (dB, L _{Aeq} (15minute))
Residential	Daytime	55
	Daytime (OOH)	50
	Evening (OOH)	48
	Night-time (OOH)	44
	Highly affected noise level	75
Classrooms at schools and other educational institutions	When in use	45 (internal)
Active recreation areas	When in use	65

Note 1: OOH = Out of Hours

Note 2: Internal noise levels are to be assessed at the centre of the occupied room. External noise levels are to be assessed at the most affected point within 50 m of the area boundary. Where internal noise levels cannot be measured, external noise levels may be used (L_{Aeq}(15minute) internal noise level +10 dB).

6.3 General measures

Standard good-practice procedures should be adopted on site, including the following:

- Prior to construction, a site-specific Construction Noise and Vibration Management Plan (CNVMP) should be prepared as part of the environmental management plan. The CNVMP should include but not limited to:
 - Identification of nearby residences and other sensitive land uses.
 - Description of approved hours of work and what work will be undertaken
 - Description of what work practices will be applied to minimise noise
 - Description of complains handling process.
- Where possible, noise generating equipment should be strategically positioned to take advantage of natural screening from structures to reduce the transmission of noise to sensitive receptors;
- Where practical, undertake the noisiest works during the recommended standard hours;
- Turn off plant that is not being used;

- Fixed plant should be appropriately selected and sited and, where necessary, fitted with appropriate silencers or acoustic enclosures;
- Noisy plant operating simultaneously close together should be avoided to the greatest extent practicable, adjacent to noise affected sensitive receptors;
- All plant and equipment should be maintained in a proper and efficient manner to minimise noise emissions, including the replacement of engine covers, repair of defective silencing equipment, tightening of rattling components and the repair of leakages in air lines;
- All plant and equipment should be operated in the correct manner to minimise noise emissions;
- Noise generating equipment should be orientated away from nearby receivers where feasible to minimise noise impacts;
- Minimise plant and vehicles idling when not in use;
- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling – turn off when not in use);
- No queuing / marshalling of construction vehicles is to occur in any public road, especially along Memorial Avenue and local roads;
- Minimise the reversing movement of vehicles on site;
- Employ broadband reversing alarm for mobile equipment where practicable.

7.0

Conclusion

7.0 Conclusion

This document reports the environmental acoustics of the existing site conditions at Bankstown North Public School.

This report presents environmental acoustic input to the Complying Development submission for the proposed development at Bankstown North public School, Bankstown.

Final mechanical services system has not been selected at this stage. Noise trigger levels compliance with the Noise Policy for Industry (NPfI) and the SEARs requirements have been established for the surrounding residential receivers.

Construction Noise Management Levels and good practice guidance for controlling noise from construction sites has also been outlined within this report, as required for SEARs.

Appendices

Appendix A Acoustic terminology

ASSESSMENT BACKGROUND LEVEL (ABL)

A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening or night time period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background L_{A90} noise levels – i.e. the measured background noise is above the ABL 90% of the time.

'A'-WEIGHTED SOUND LEVEL dBA

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dBA. An A-weighting network can be built into a sound level measuring instrument such that sound levels in dBA can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. An increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise. A change of 2 to 3 dB is subjectively barely perceptible.

DECIBEL

The ratio of sound pressures which we can hear is a ratio of one million to one. For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound level' (L) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

EQUIVALENT CONTINUOUS SOUND LEVEL (L_{Aeq})

Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{Aeq} . This is a notional steady level, which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

FREQUENCY

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kilohertz (kHz), eg 2 kHz = 2000 Hz. Human hearing ranges from approximately 20 Hz to 20 kHz. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used.

For more detailed analysis, each octave band may be split into three one-third octave bands or, in some cases, narrower frequency bands.

RATING BACKGROUND LEVEL (RBL)

A single-number figure used to characterise the background noise levels from a complete noise survey.

The RBL for a day, evening or night time period for the overall survey is calculated from the individual Assessment Background Levels (ABL) for each day of the measurement period, and is numerically equal to the median (middle value) of the ABL values for the days in the noise survey.

SOUND POWER AND SOUND PRESSURE

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source.

The sound pressure level (L_p) varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its mass), which is not affected by the environment within which the source is located.

STATISTICAL NOISE LEVELS

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index that allows for this variation. 'A'-weighted statistical noise levels are denoted L_{A10} , dB L_{A90} etc. The reference time period (T) is normally included, e.g. dB $L_{A10, 5min}$ or dB $L_{A90, 8hr}$.

 $L_{A90}(T)$

Refers to the sound pressure level measured in dBA, exceeded for 90% of the time interval (T) – i.e. measured noise levels were greater than this value for 90% of the time interval. This is also often referred to the background noise level.

 $L_{A10}(T)$

Refers to the sound pressure level measured in dBA, exceeded for 10% of the time interval (T). This is often referred to as the average maximum noise level and is frequently used to describe traffic noise.

 $L_{A1}(T)$

Refers to the sound pressure level measured in dBA, exceeded for 1% of the time interval (T). This is often used to represent the maximum noise level from a period of measurement.

WEIGHTED STANDARDISED SOUND PRESSURE LEVEL ($L_{nT,w}$)

The in-situ impact sound insulation performance of a floor/ceiling when impacted by a standardised, calibrated tapping-machine. Lower values indicate higher performance.

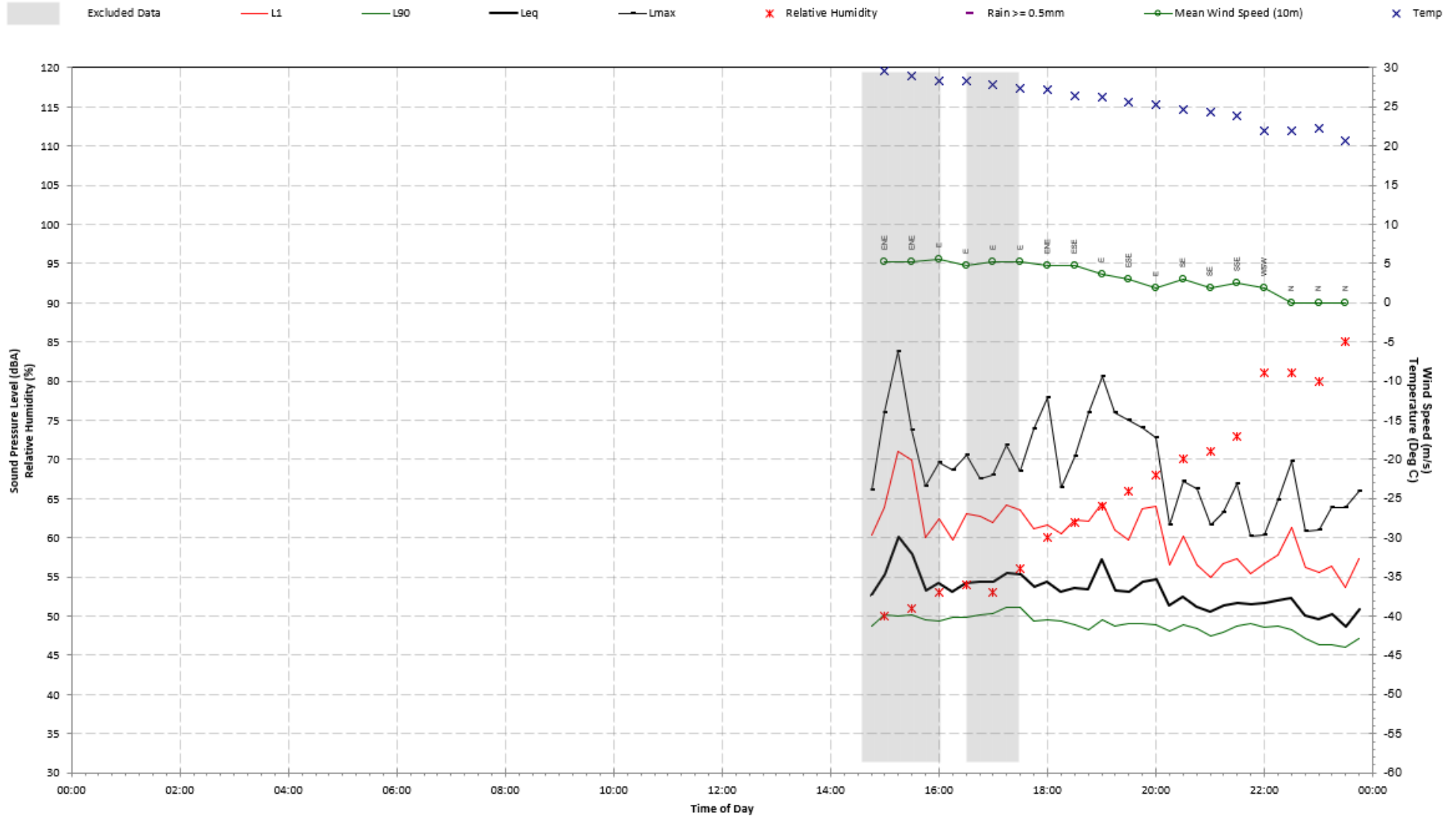
WEIGHTED SOUND REDUCTION INDEX (R_w)

The laboratory sound insulation performance usually provided by manufacturers and suppliers is the **weighted sound reduction index**, R_w . The higher the rating, the better the sound reduction between spaces.

Appendix B Long term noise monitoring results

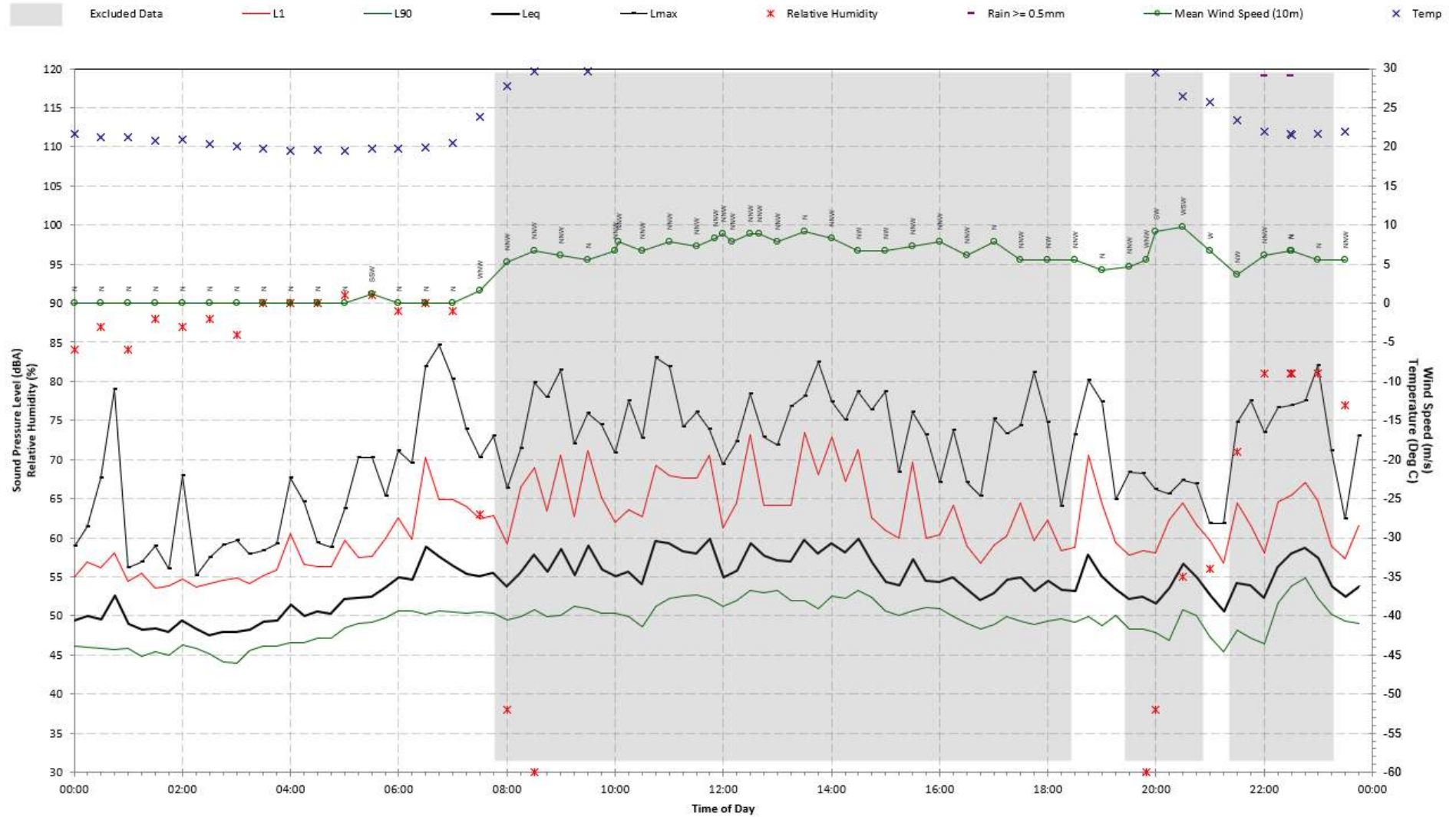
Statistical Ambient Noise Levels

Location One - Thursday, 1 November, 2018



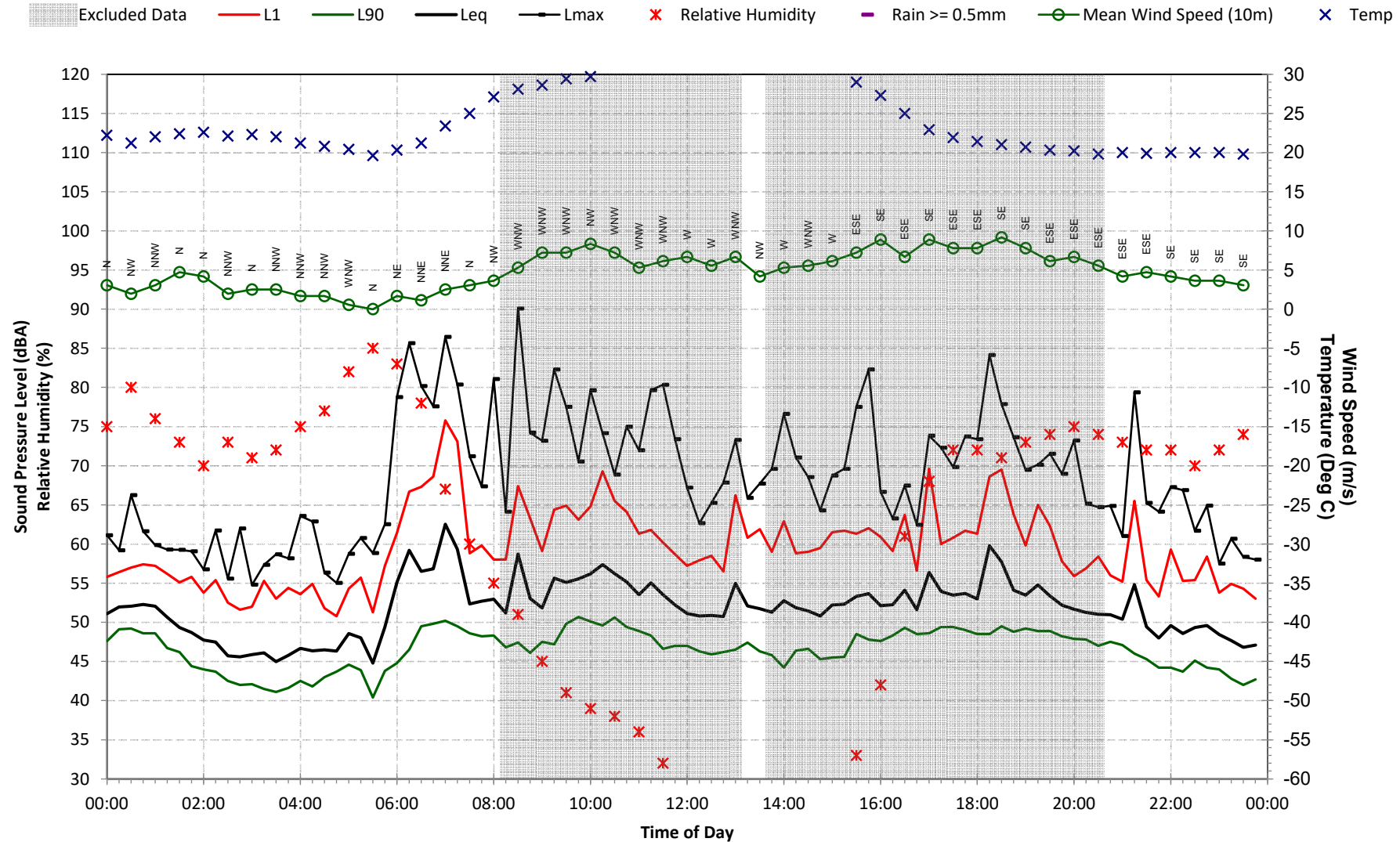
Statistical Ambient Noise Levels

Location One - Friday, 2 November, 2018



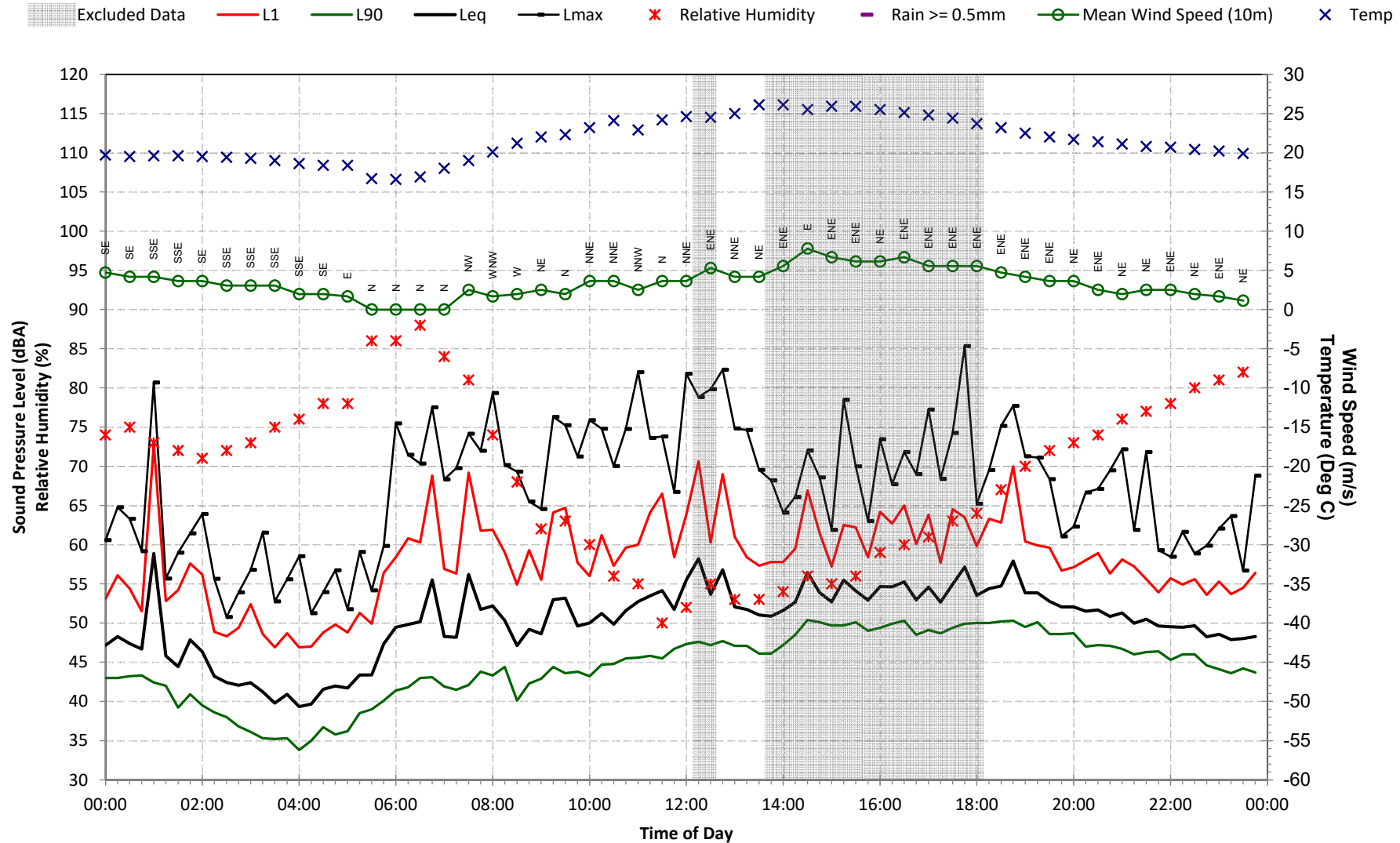
Statistical Ambient Noise Levels

Location One - Saturday, 3 November, 2018

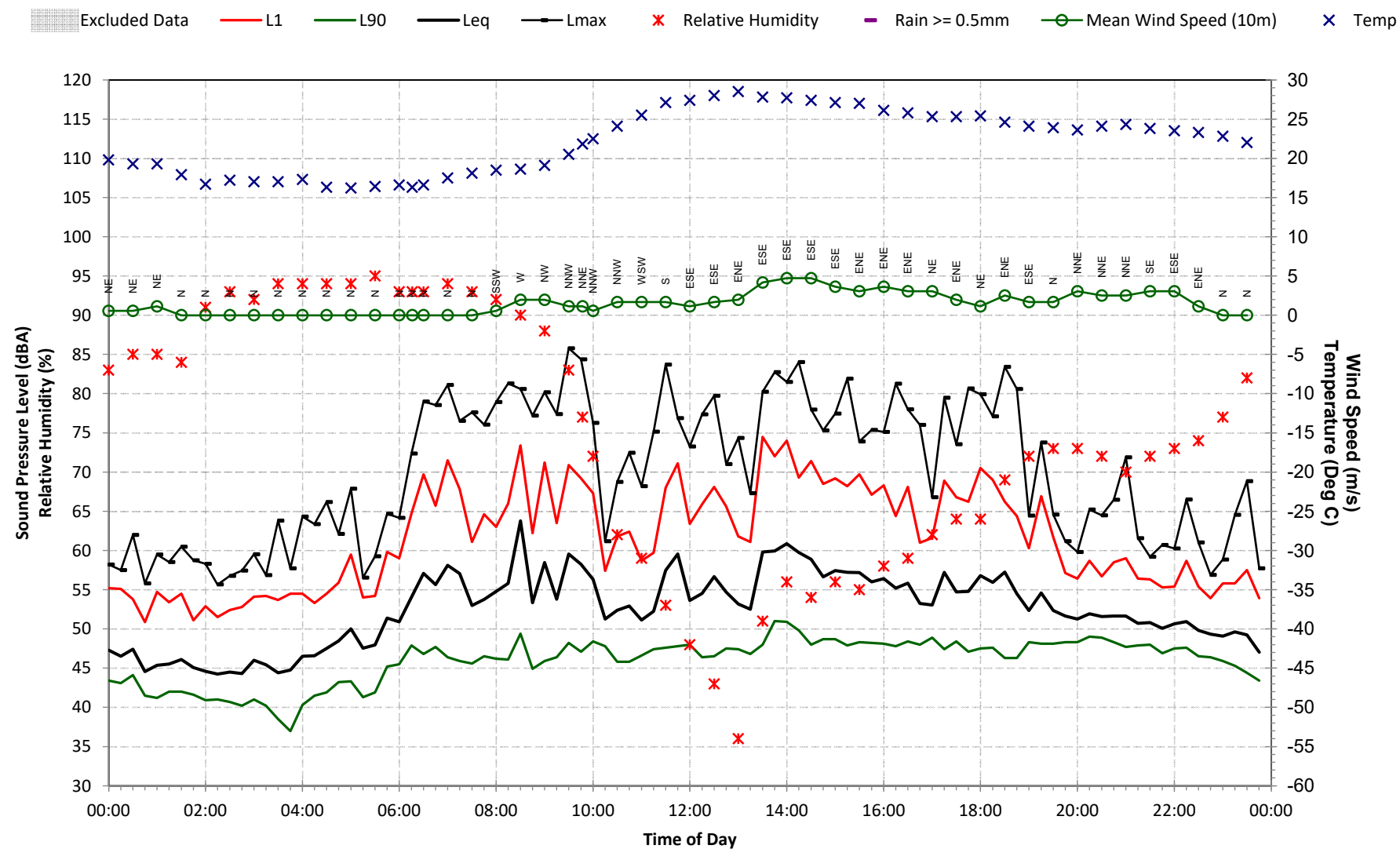


Statistical Ambient Noise Levels

Location One - Sunday, 4 November, 2018

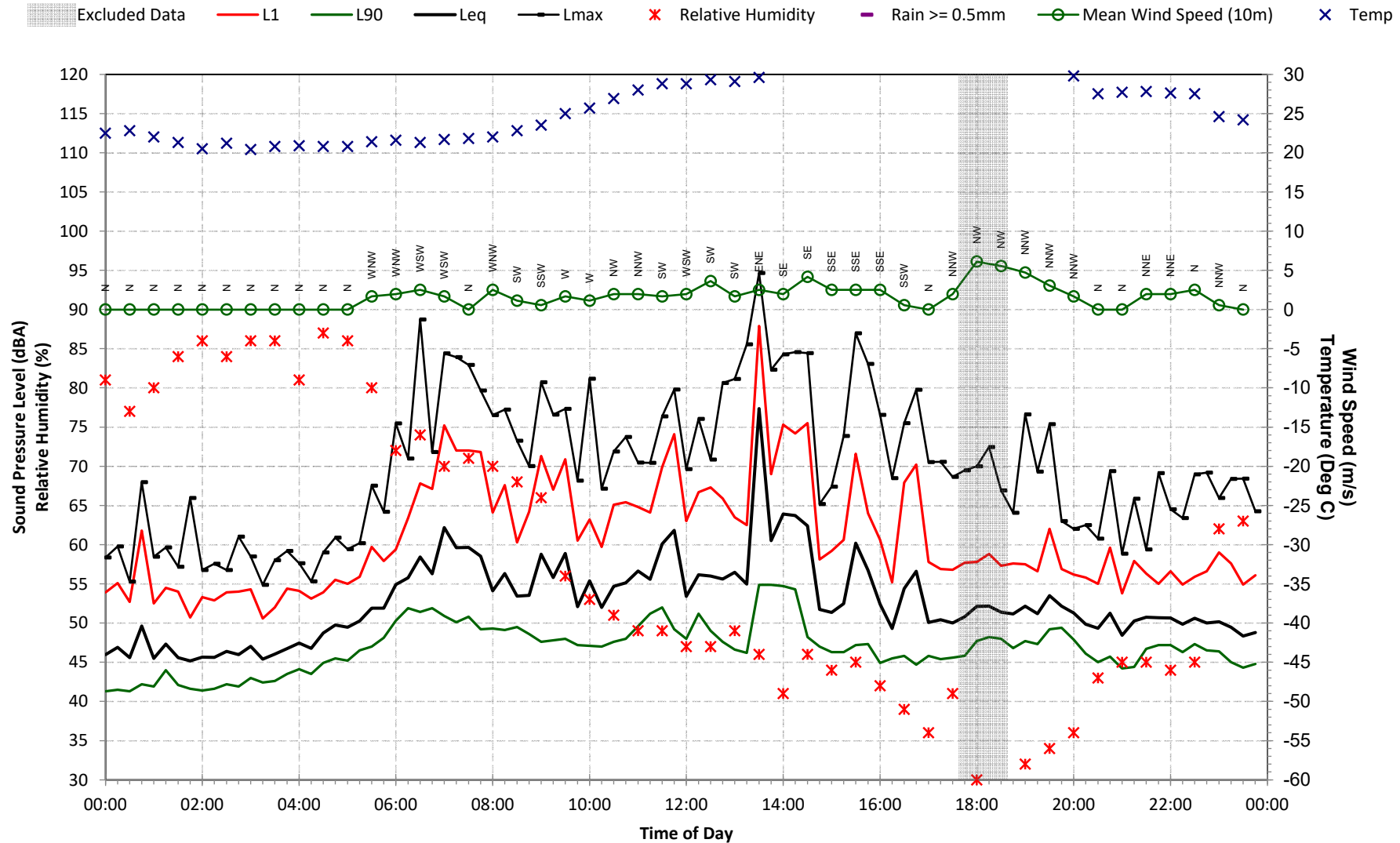


Location One - Monday, 5 November, 2018



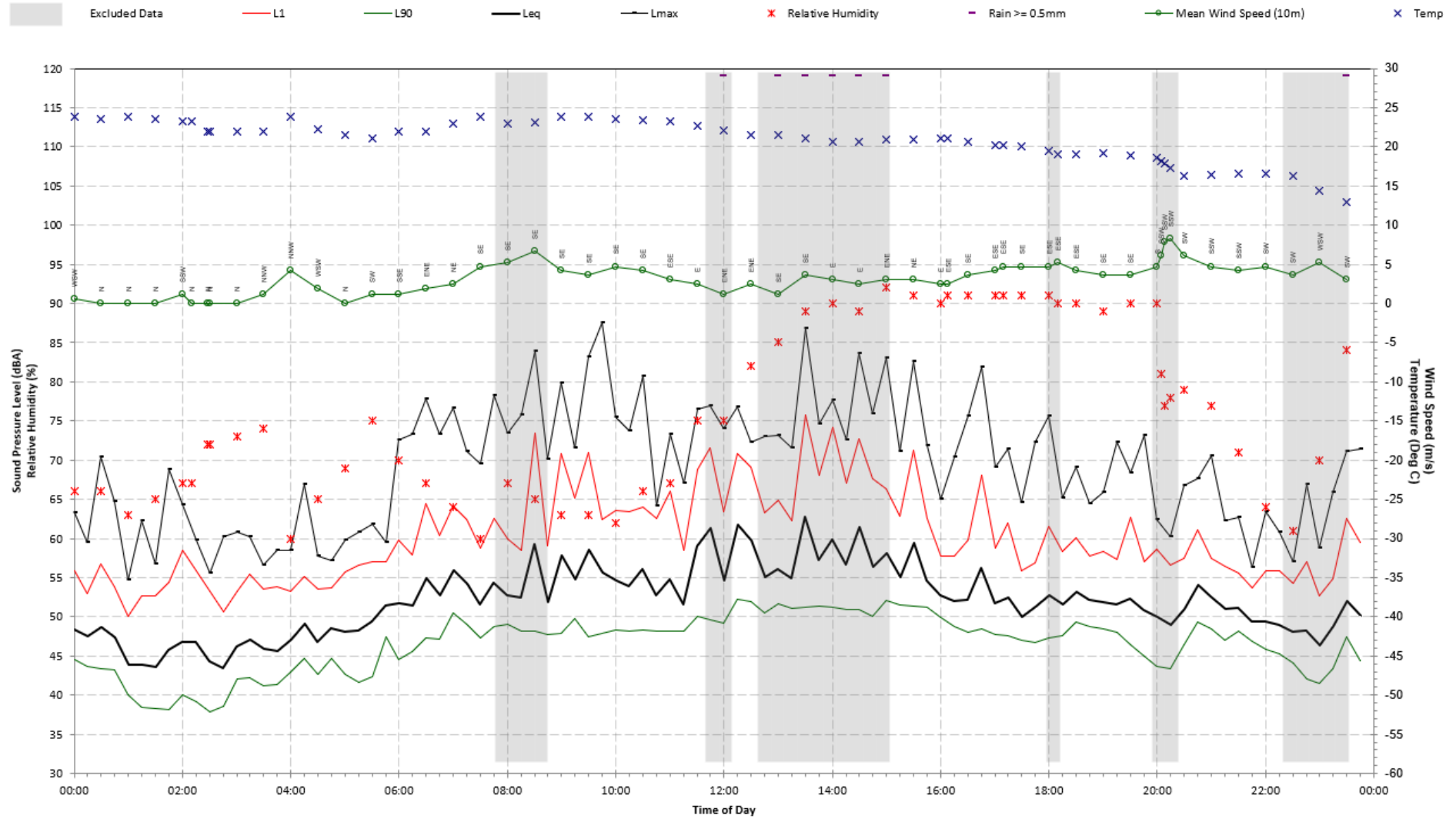
Statistical Ambient Noise Levels

Location One - Tuesday, 6 November, 2018



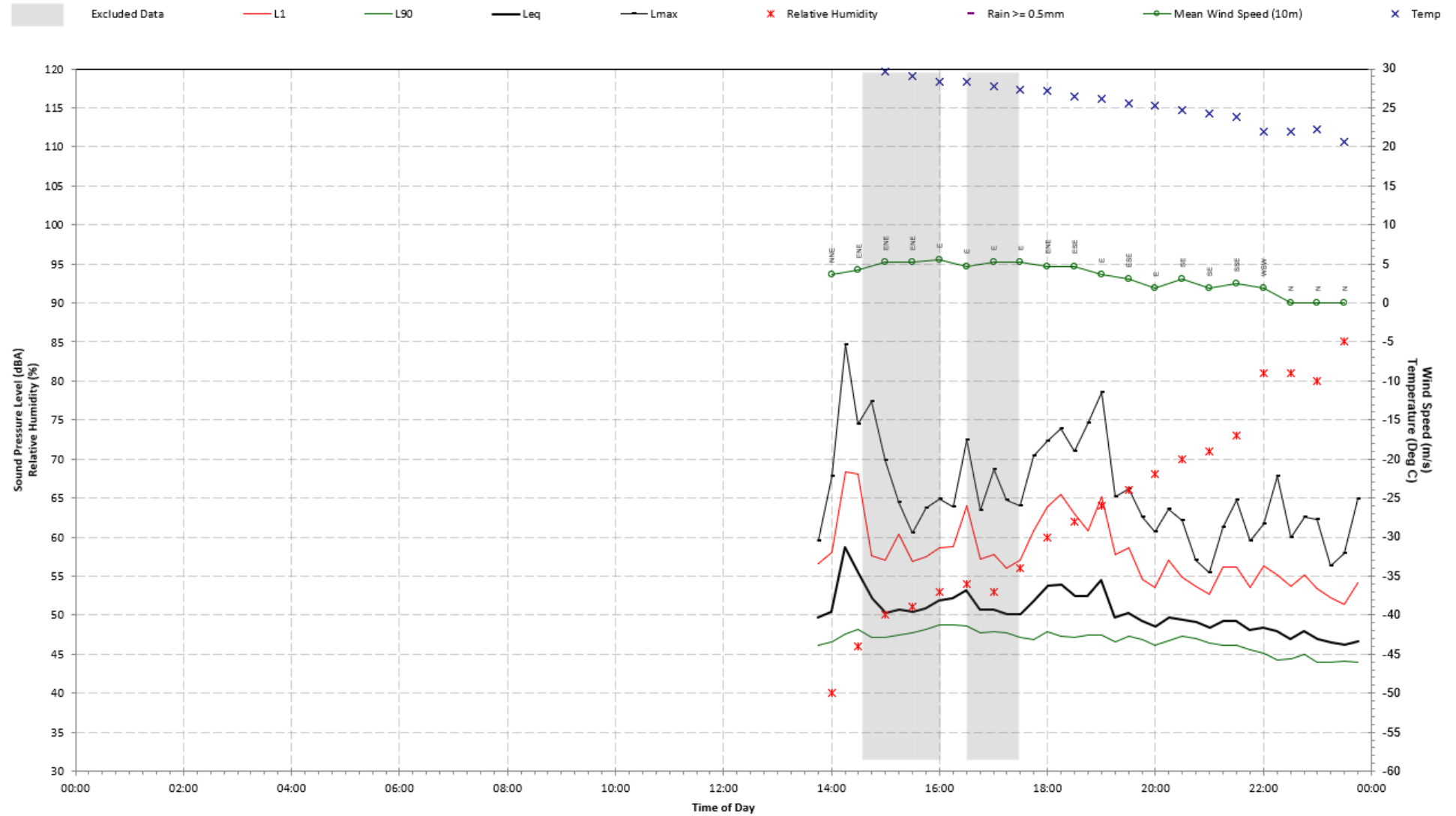
Statistical Ambient Noise Levels

Location One - Wednesday, 7 November, 2018



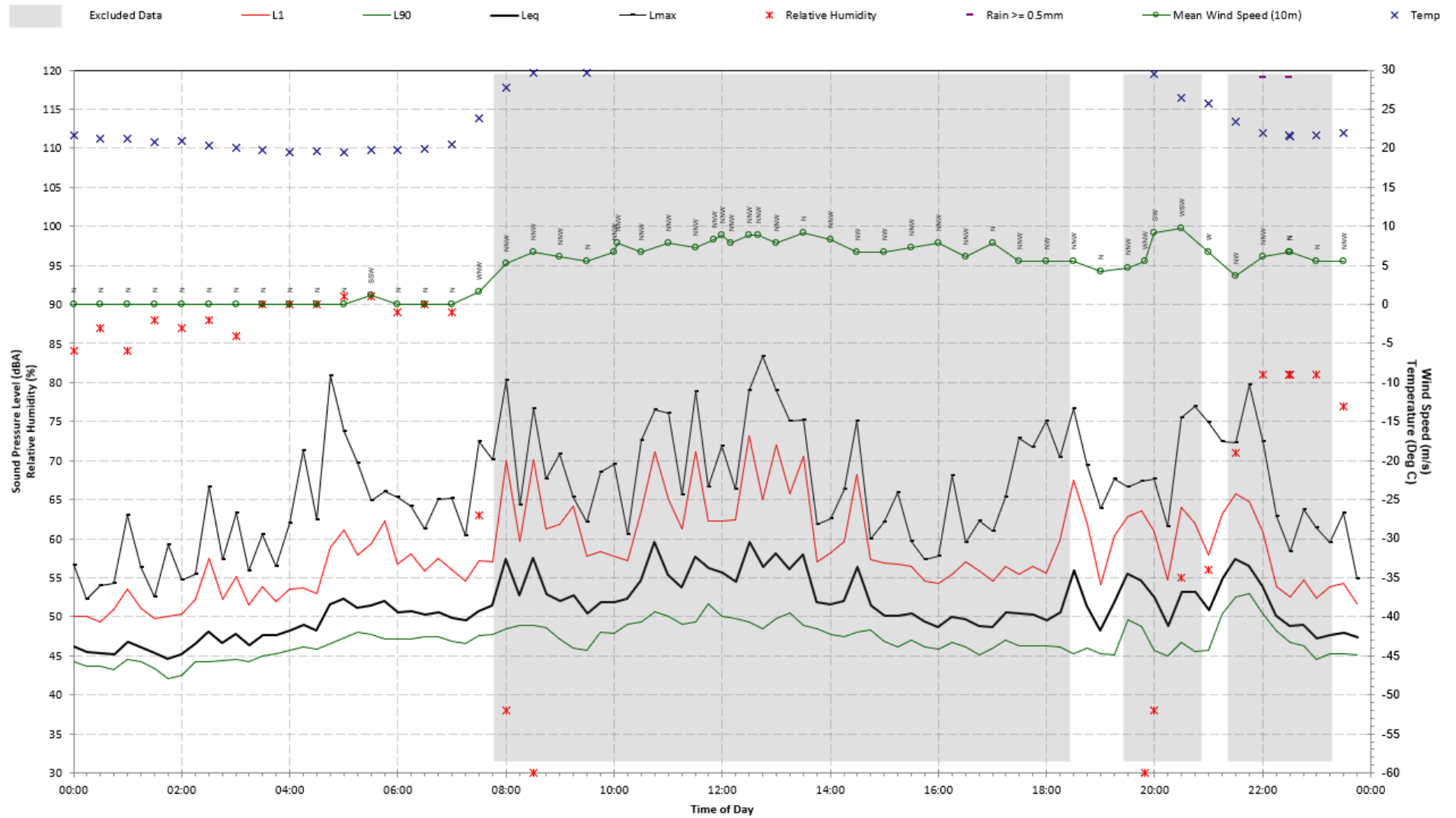
Statistical Ambient Noise Levels

Location Two - Thursday, 1 November, 2018



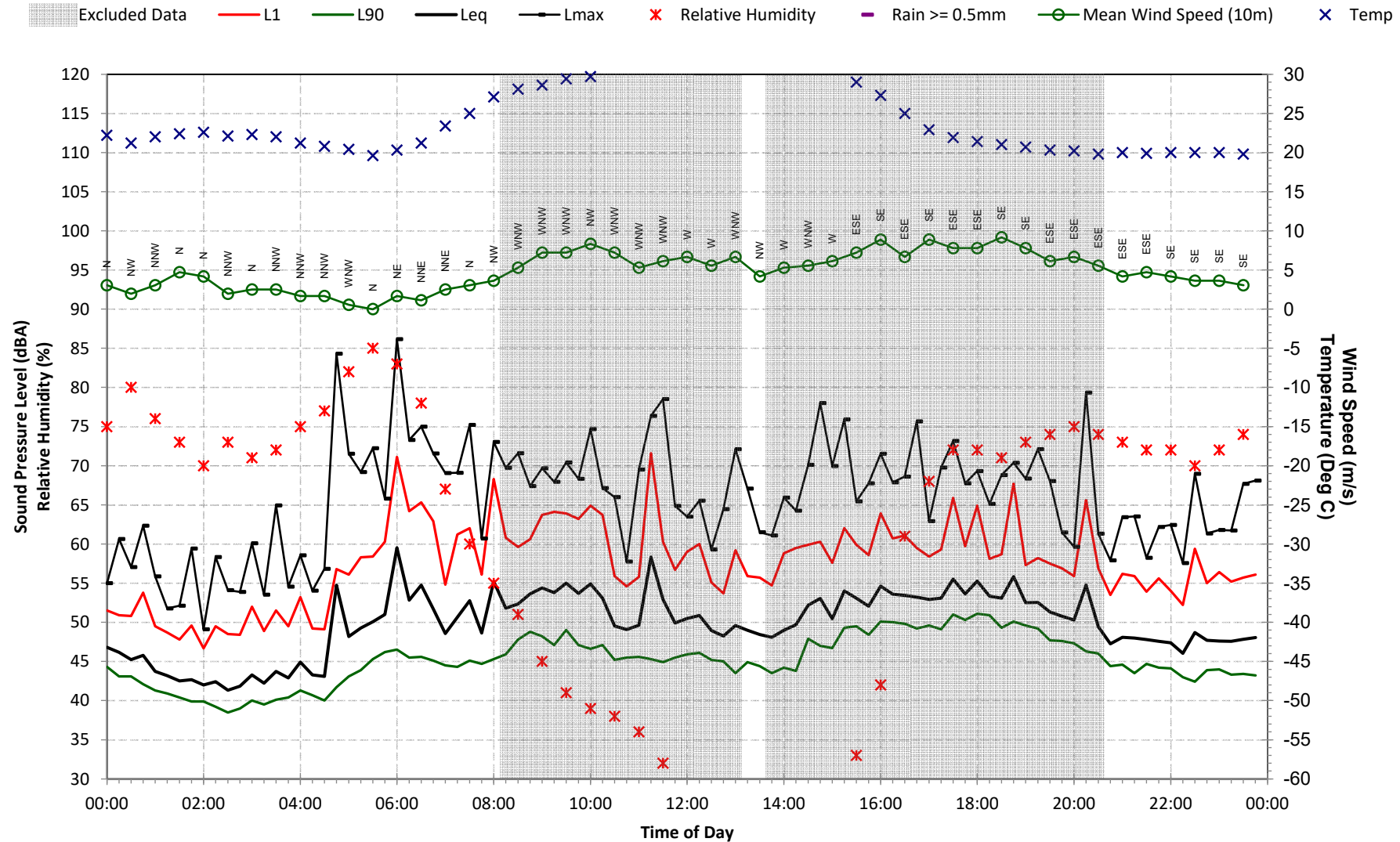
Statistical Ambient Noise Levels

Location Two - Friday, 2 November, 2018



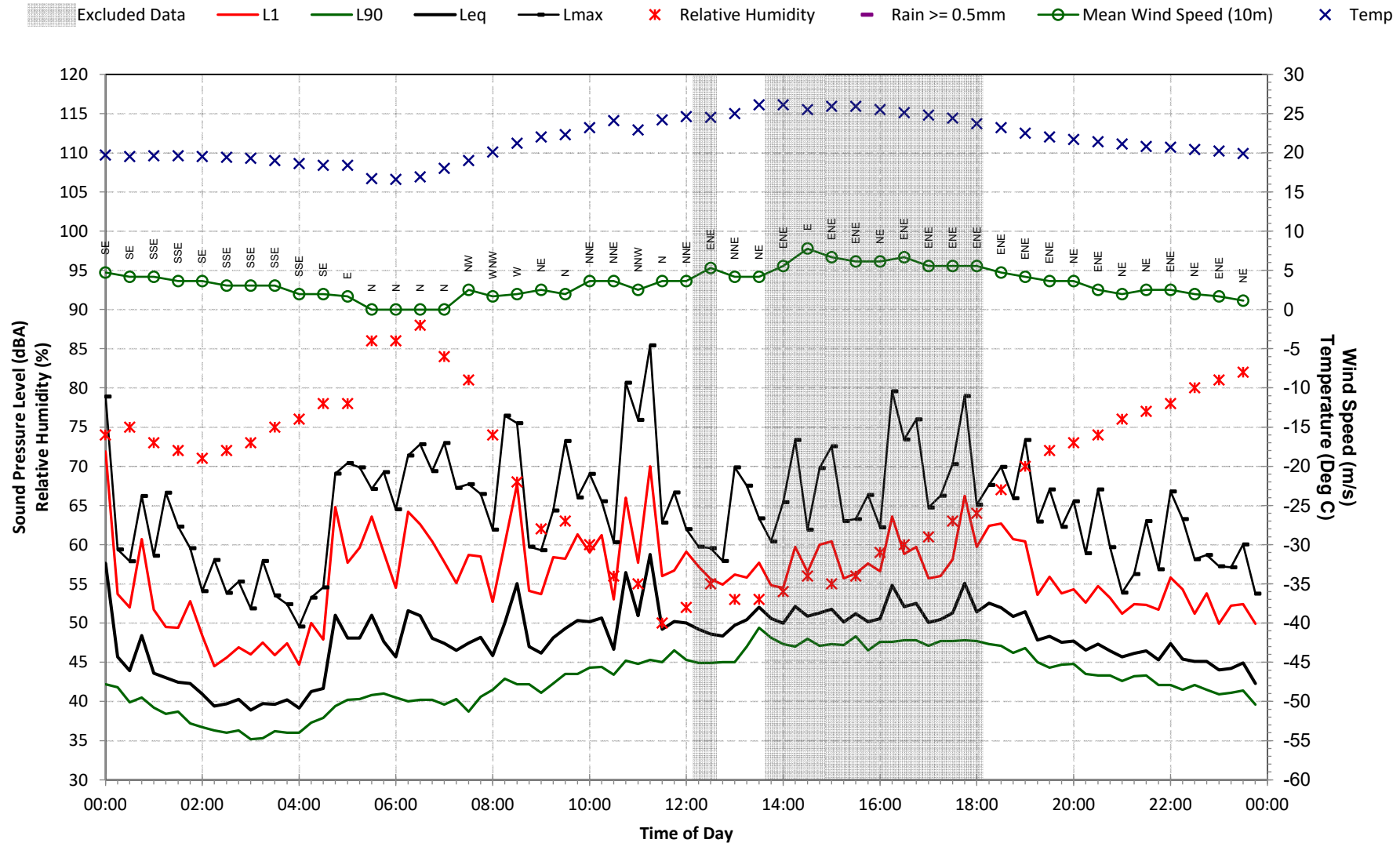
Statistical Ambient Noise Levels

Location Two - Saturday, 3 November, 2018



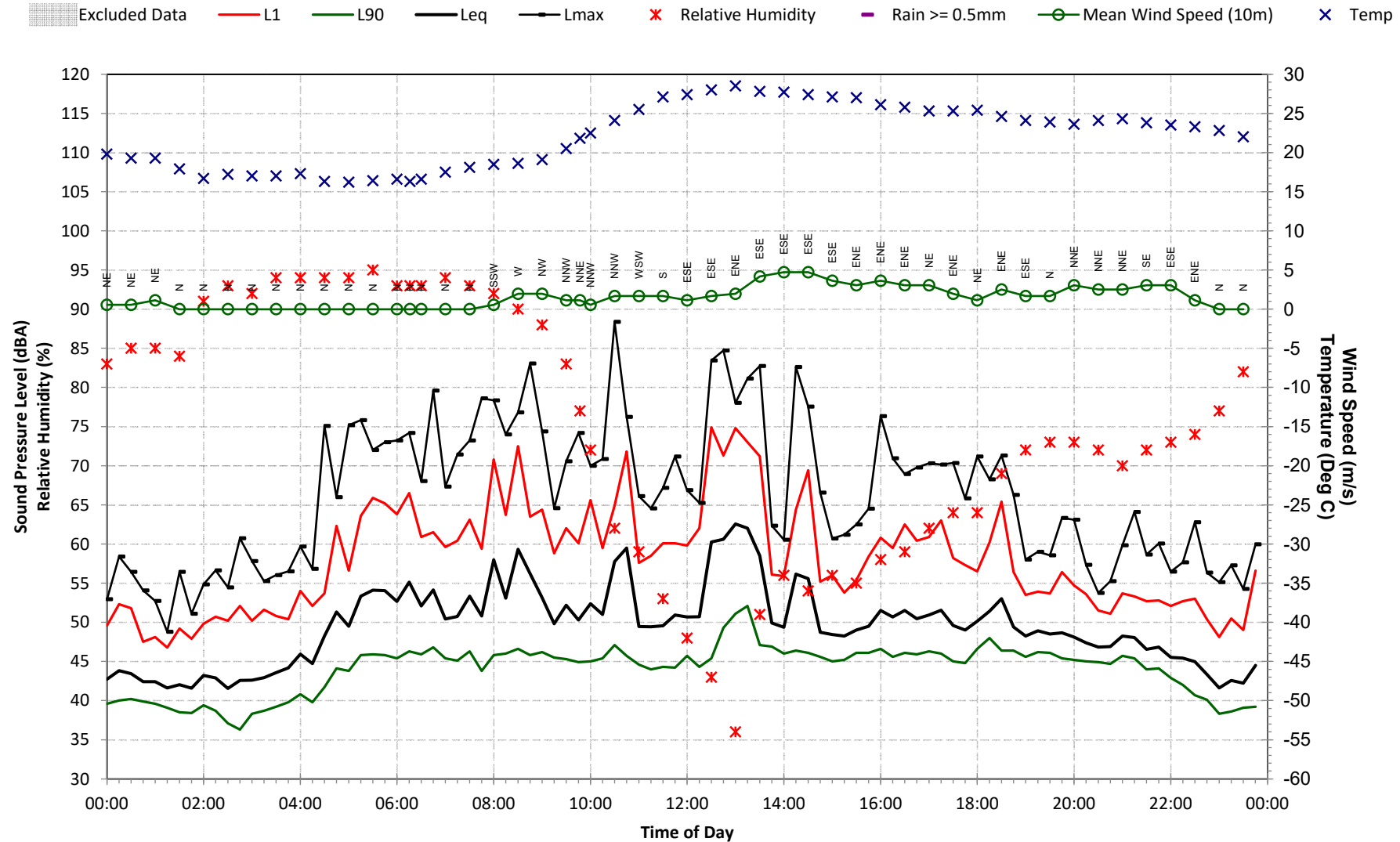
Statistical Ambient Noise Levels

Location Two - Sunday, 4 November, 2018



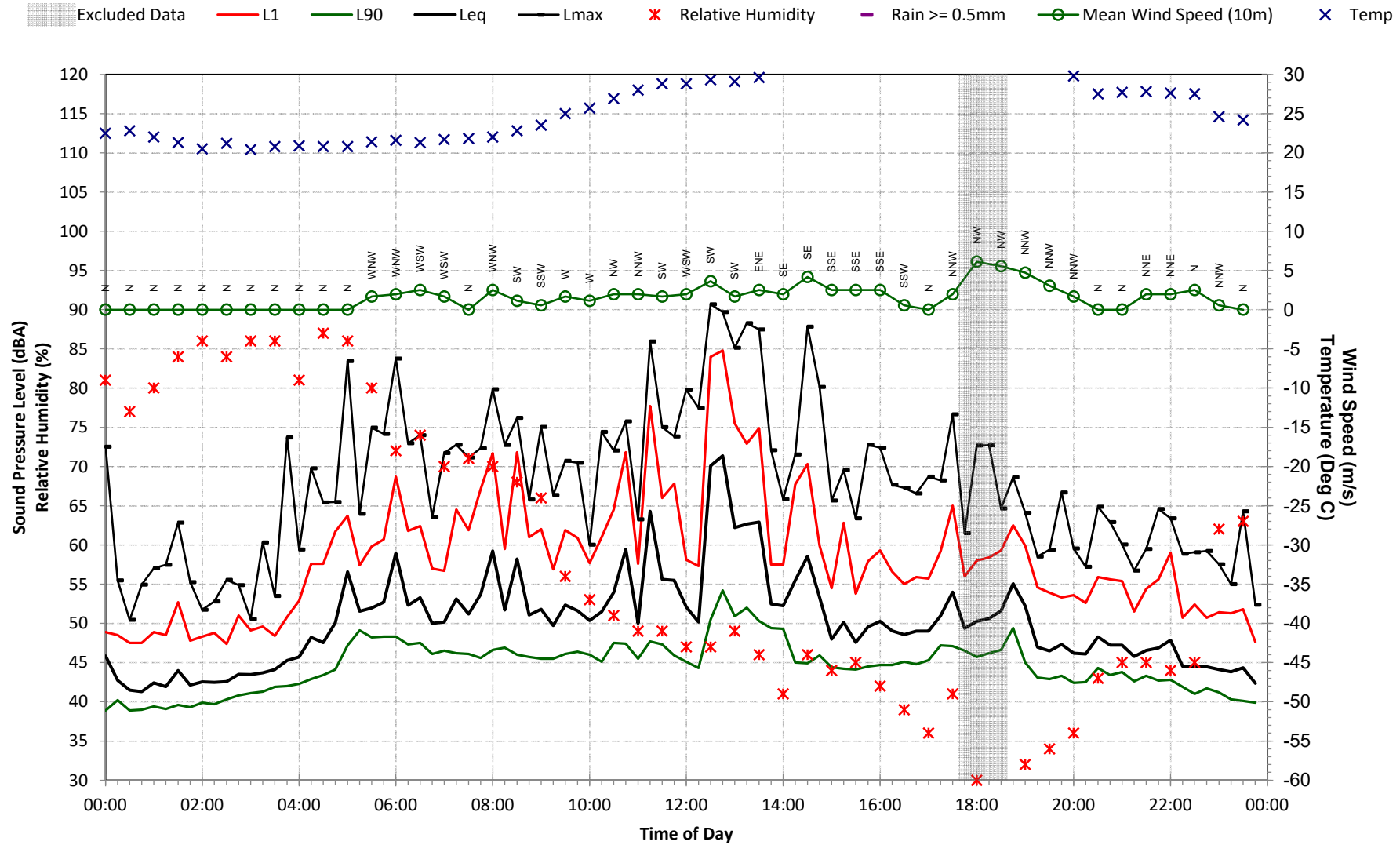
Statistical Ambient Noise Levels

Location Two - Monday, 5 November, 2018



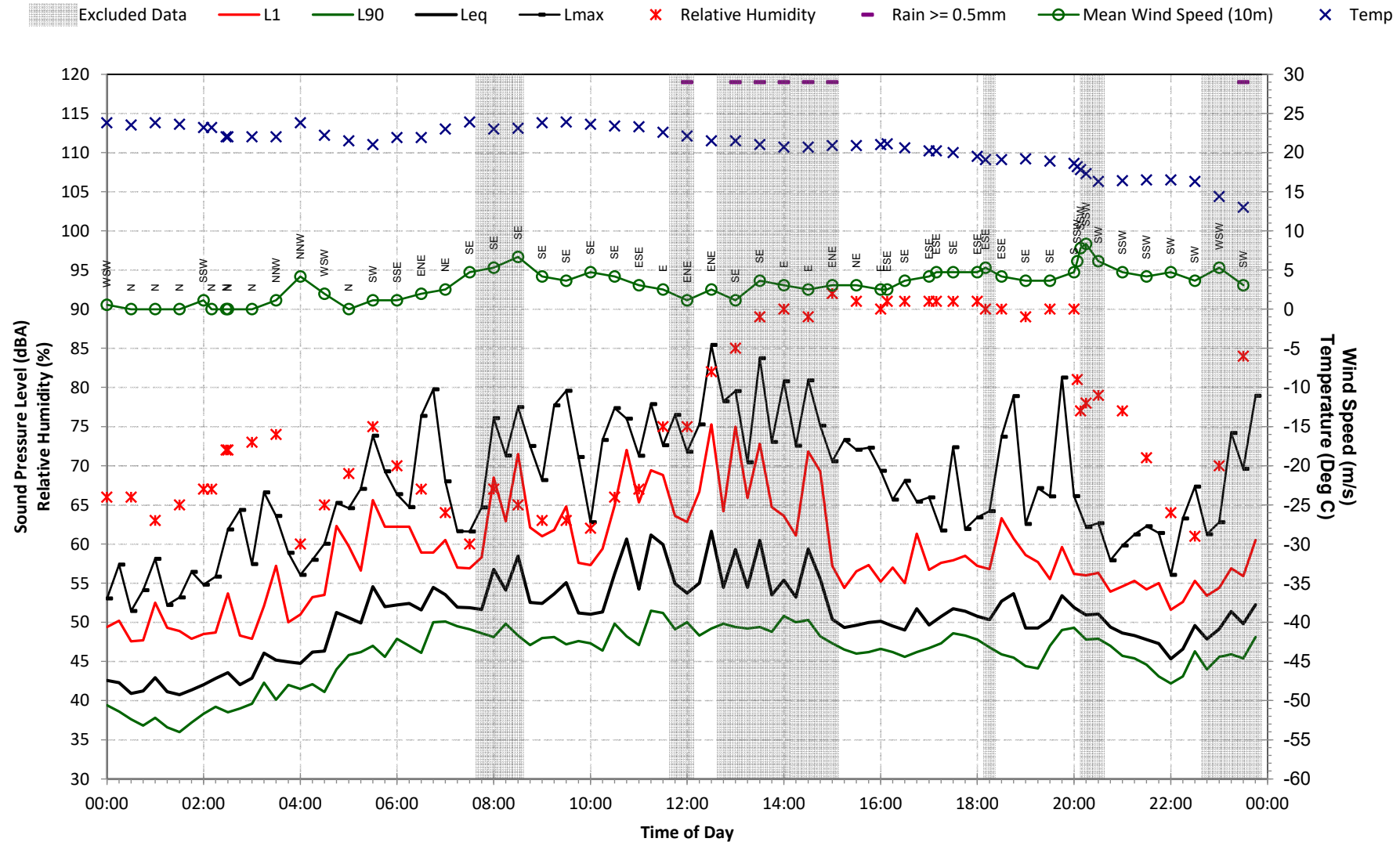
Statistical Ambient Noise Levels

Location Two - Tuesday, 6 November, 2018

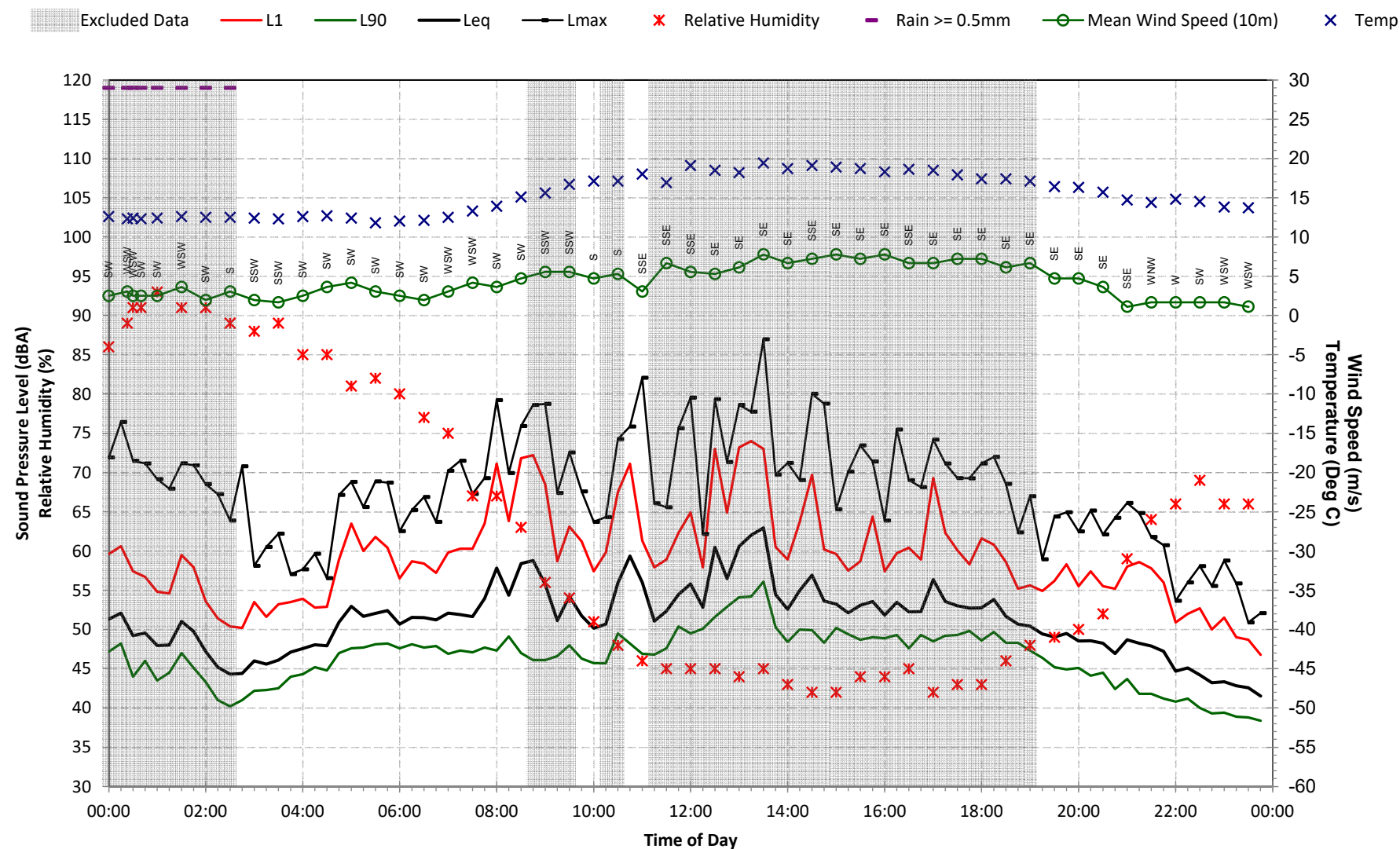


Statistical Ambient Noise Levels

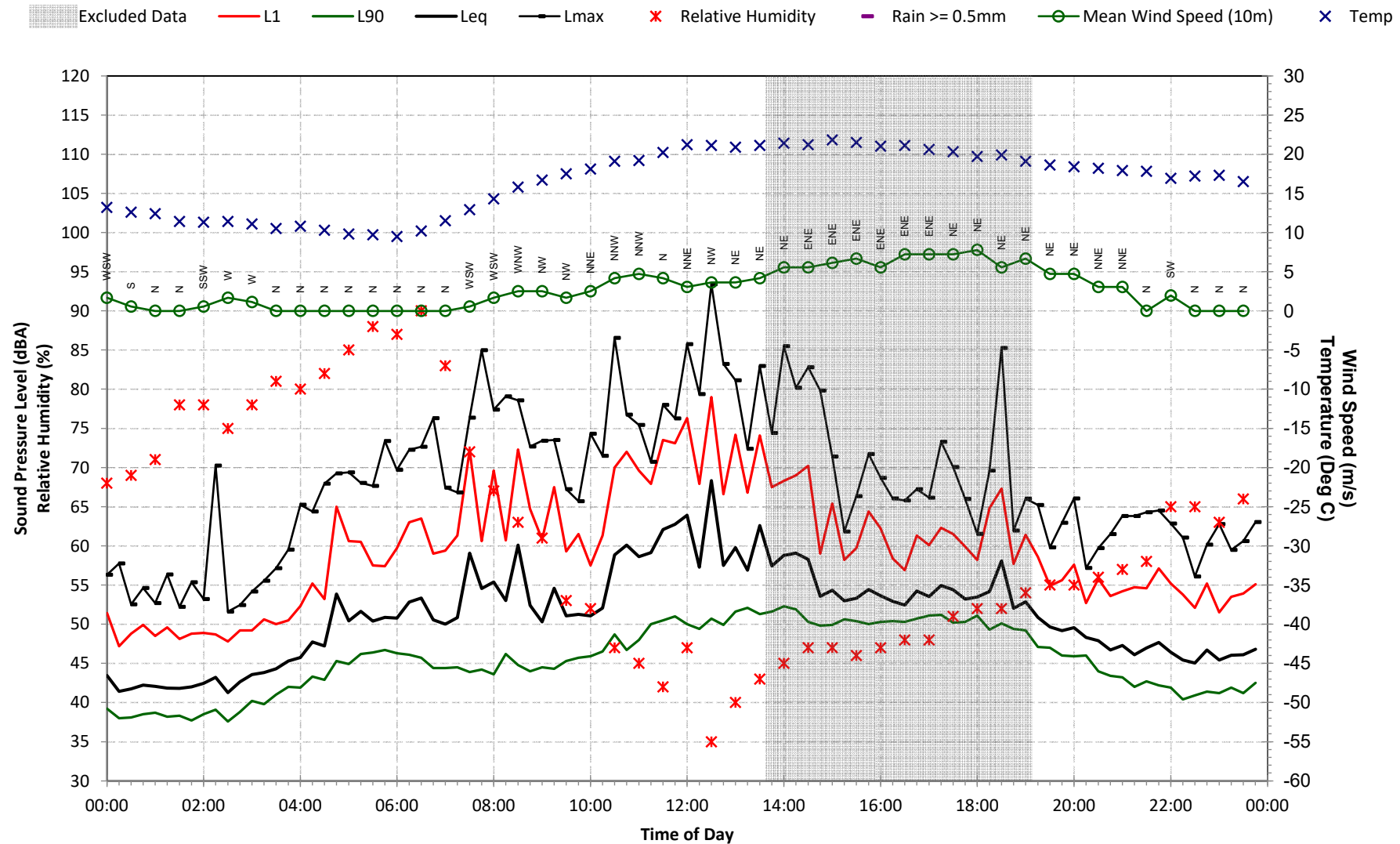
Location Two - Wednesday, 7 November, 2018



Location Two - Thursday, 8 November, 2018

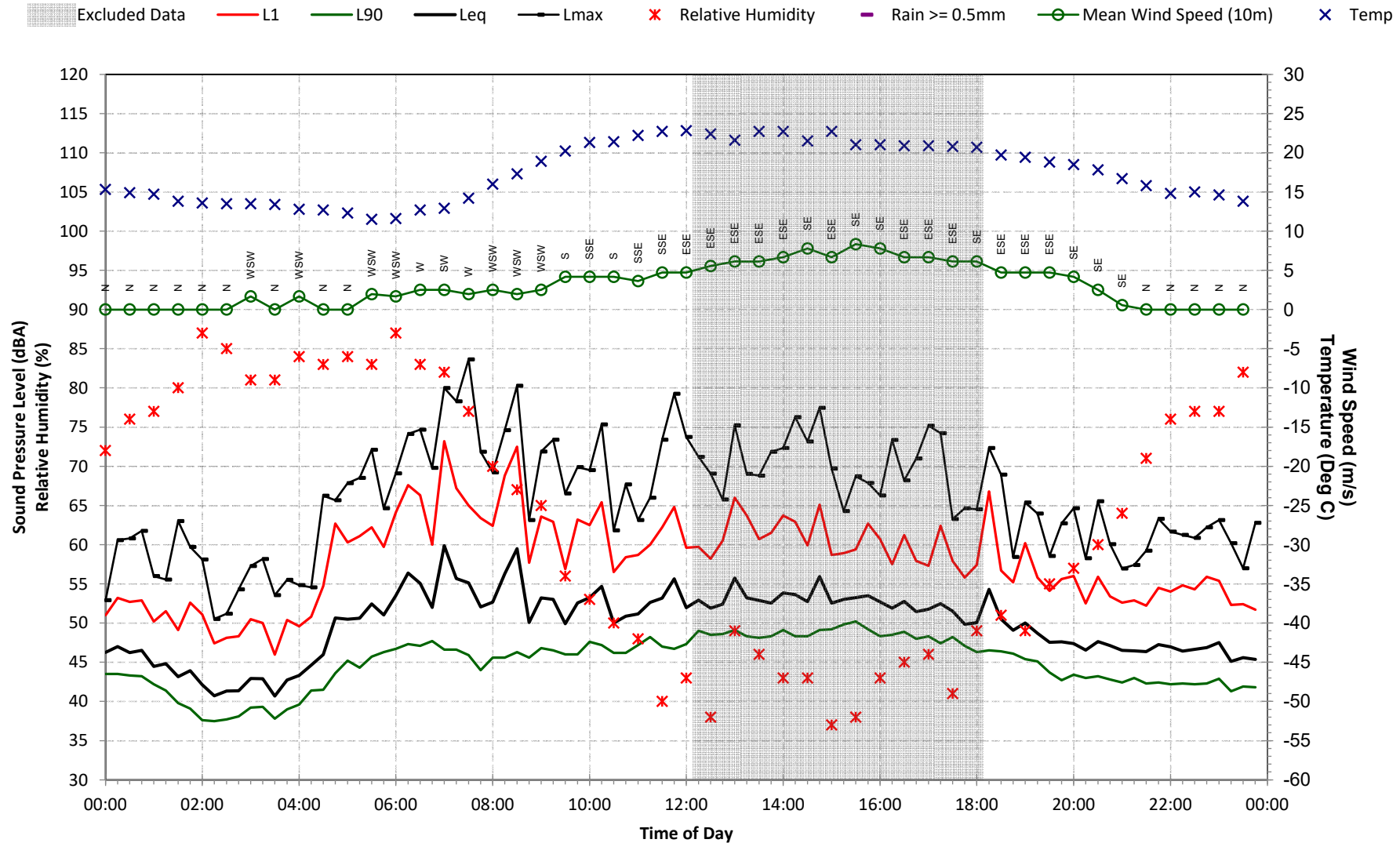


Location Two - Friday, 9 November, 2018



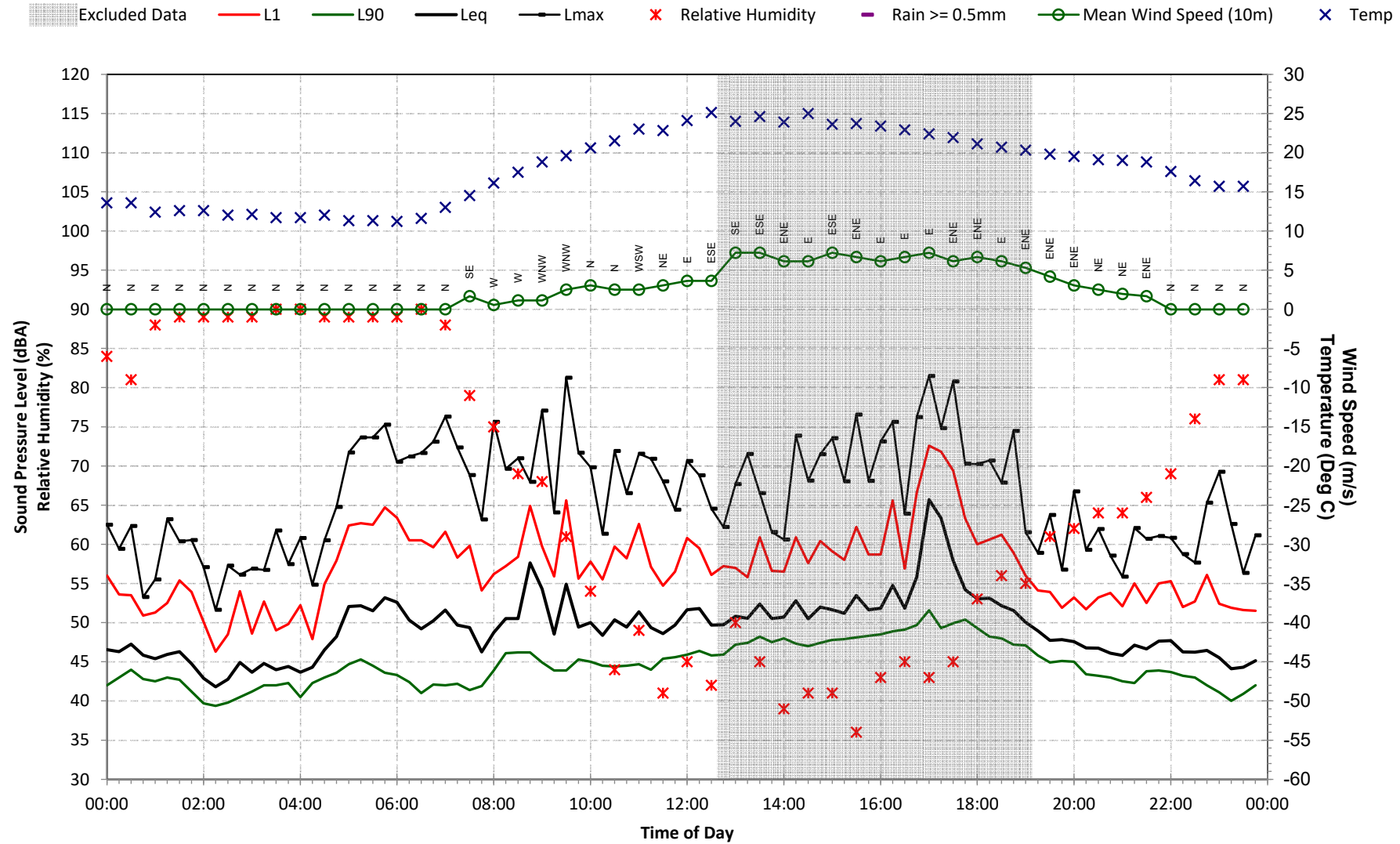
Statistical Ambient Noise Levels

Location Two - Saturday, 10 November, 2018



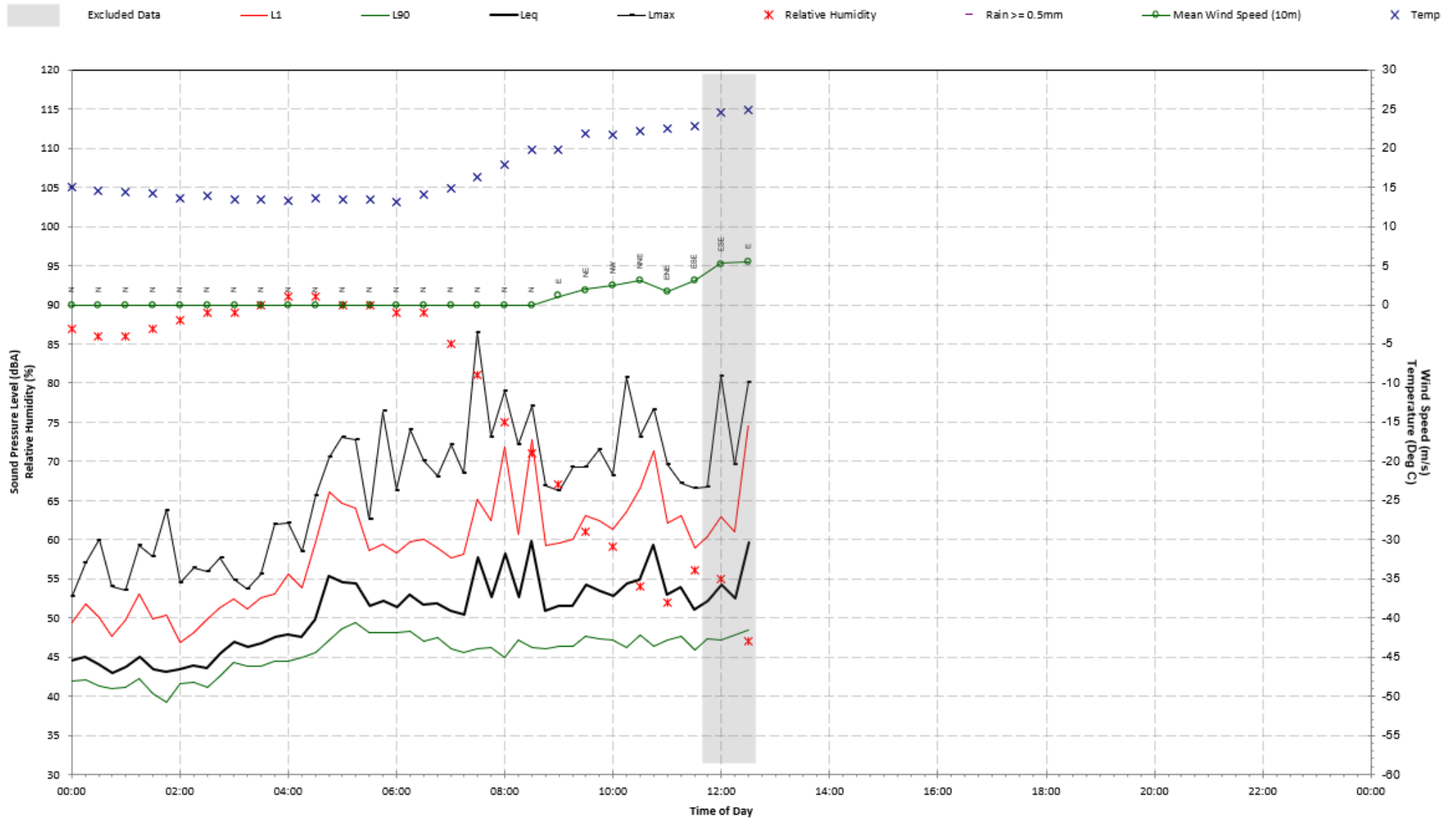
Statistical Ambient Noise Levels

Location Two - Sunday, 11 November, 2018



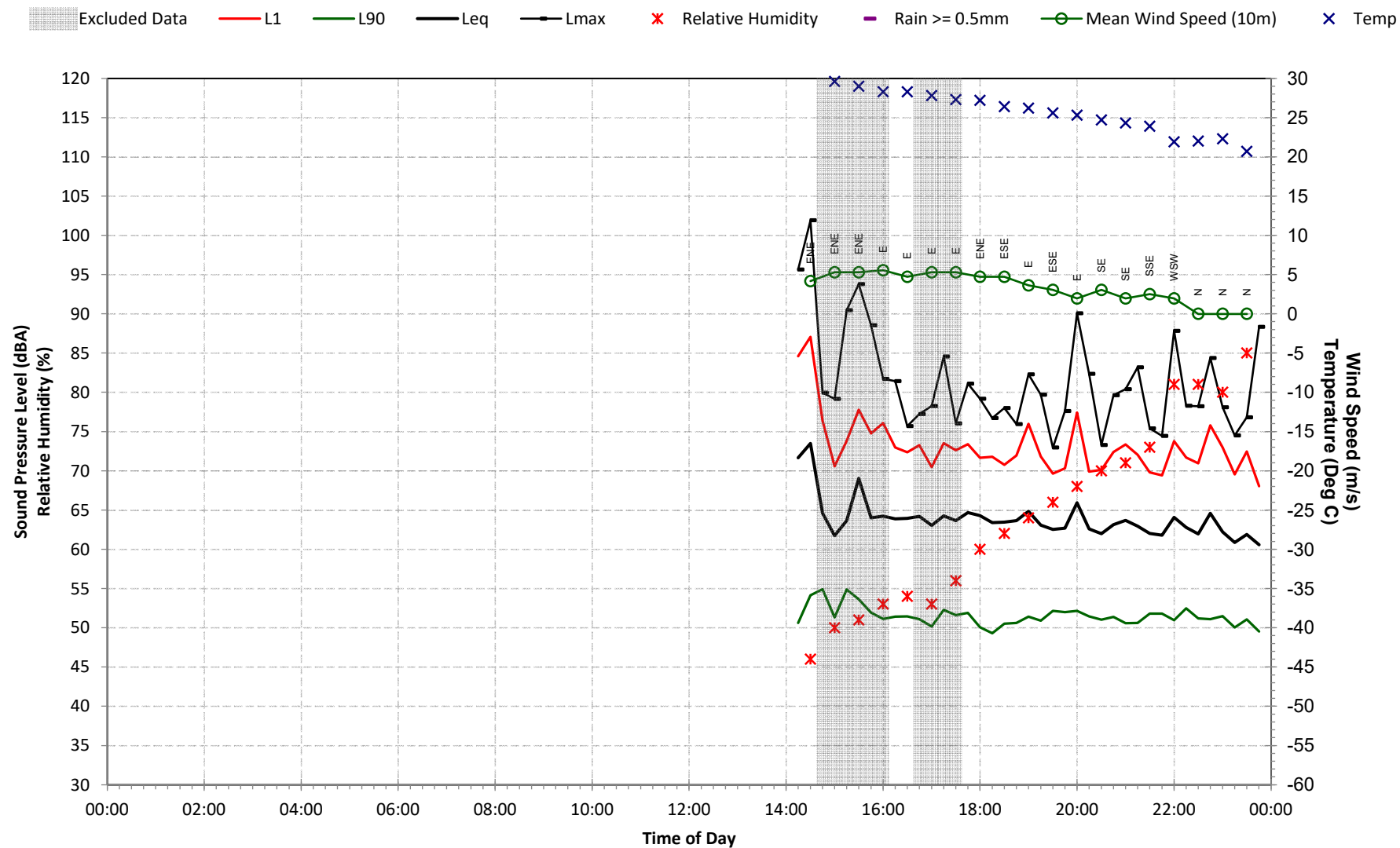
Statistical Ambient Noise Levels

Location Two - Monday, 12 November, 2018



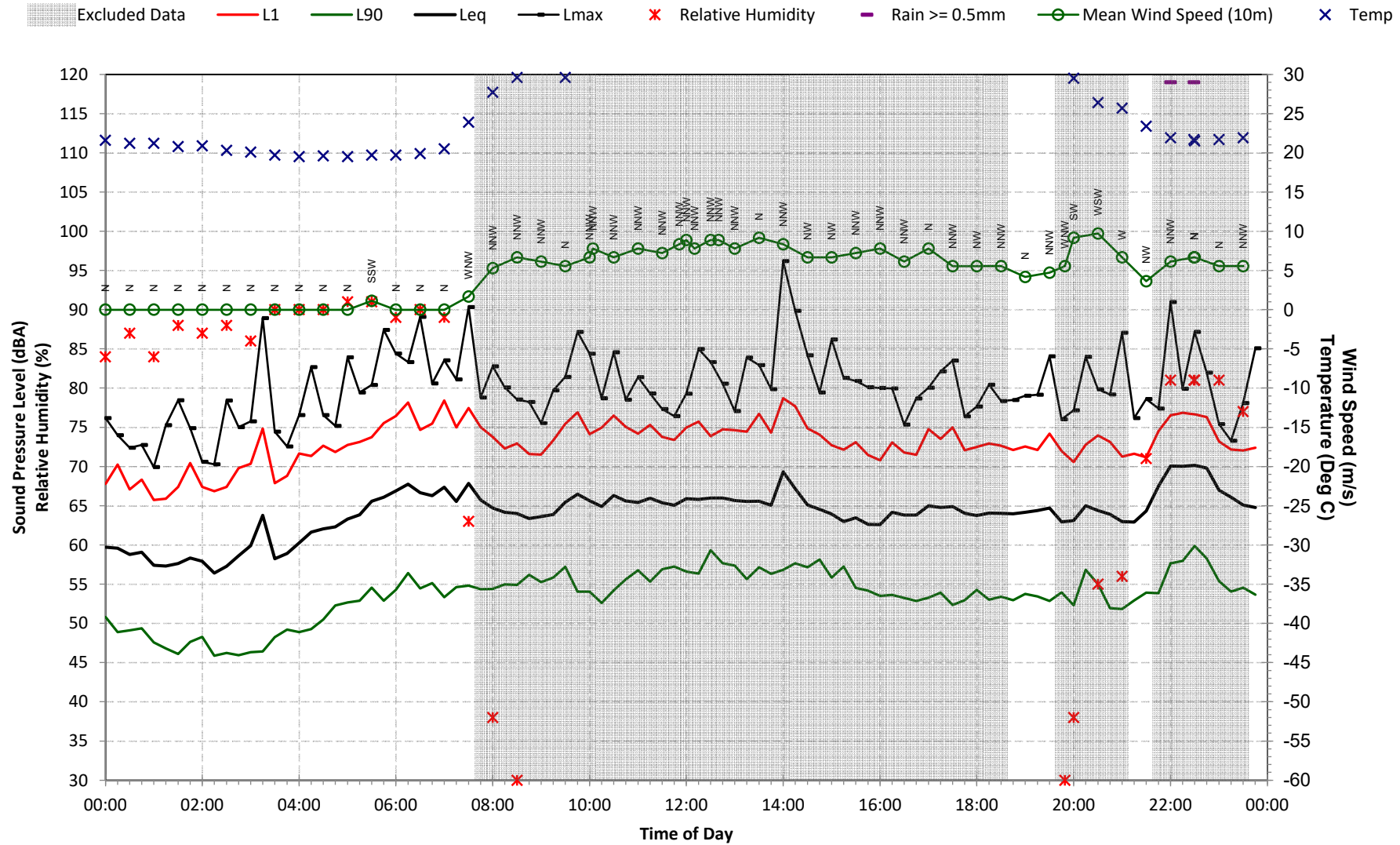
Statistical Ambient Noise Levels

Location Three - Thursday, 1 November, 2018

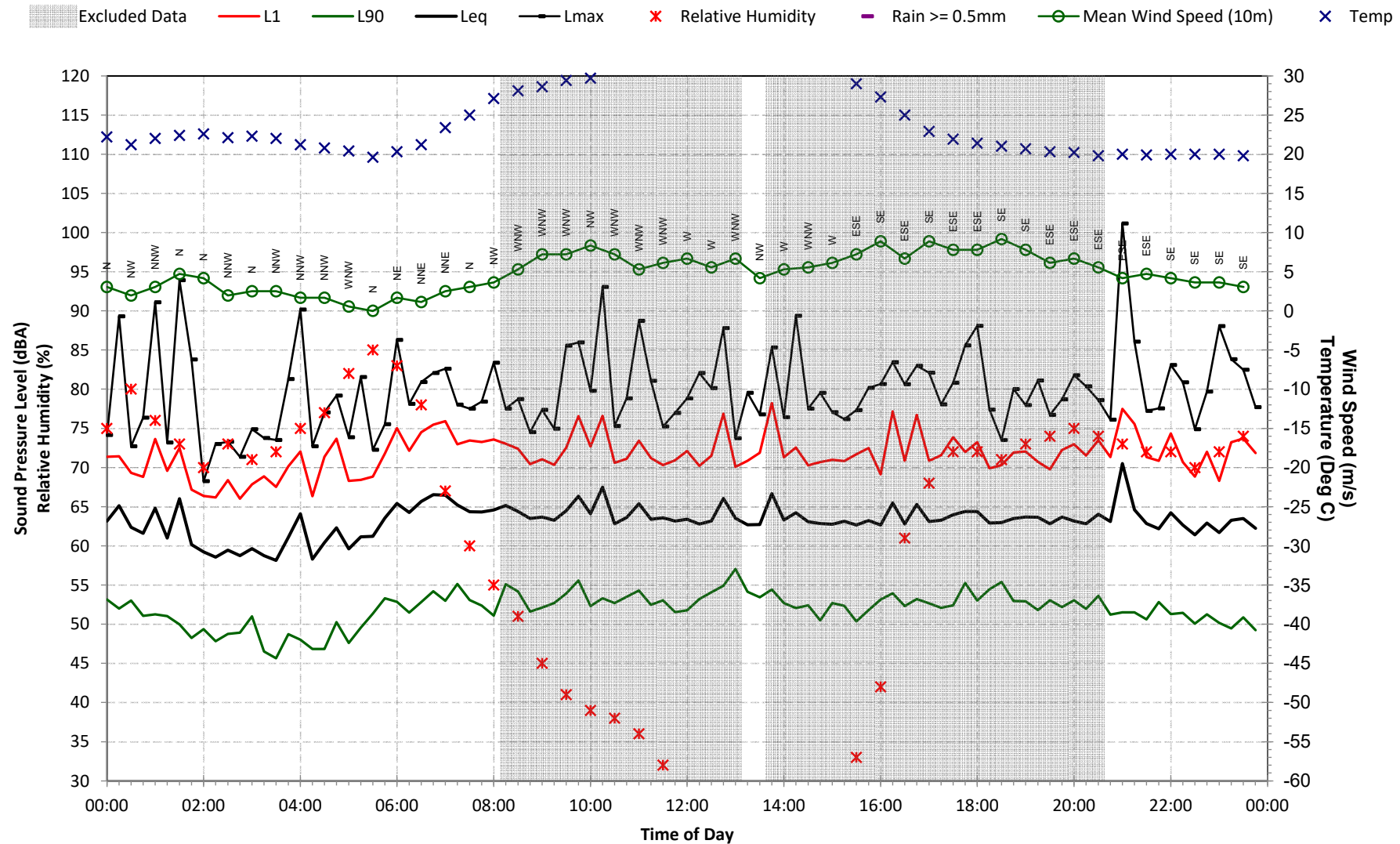


Statistical Ambient Noise Levels

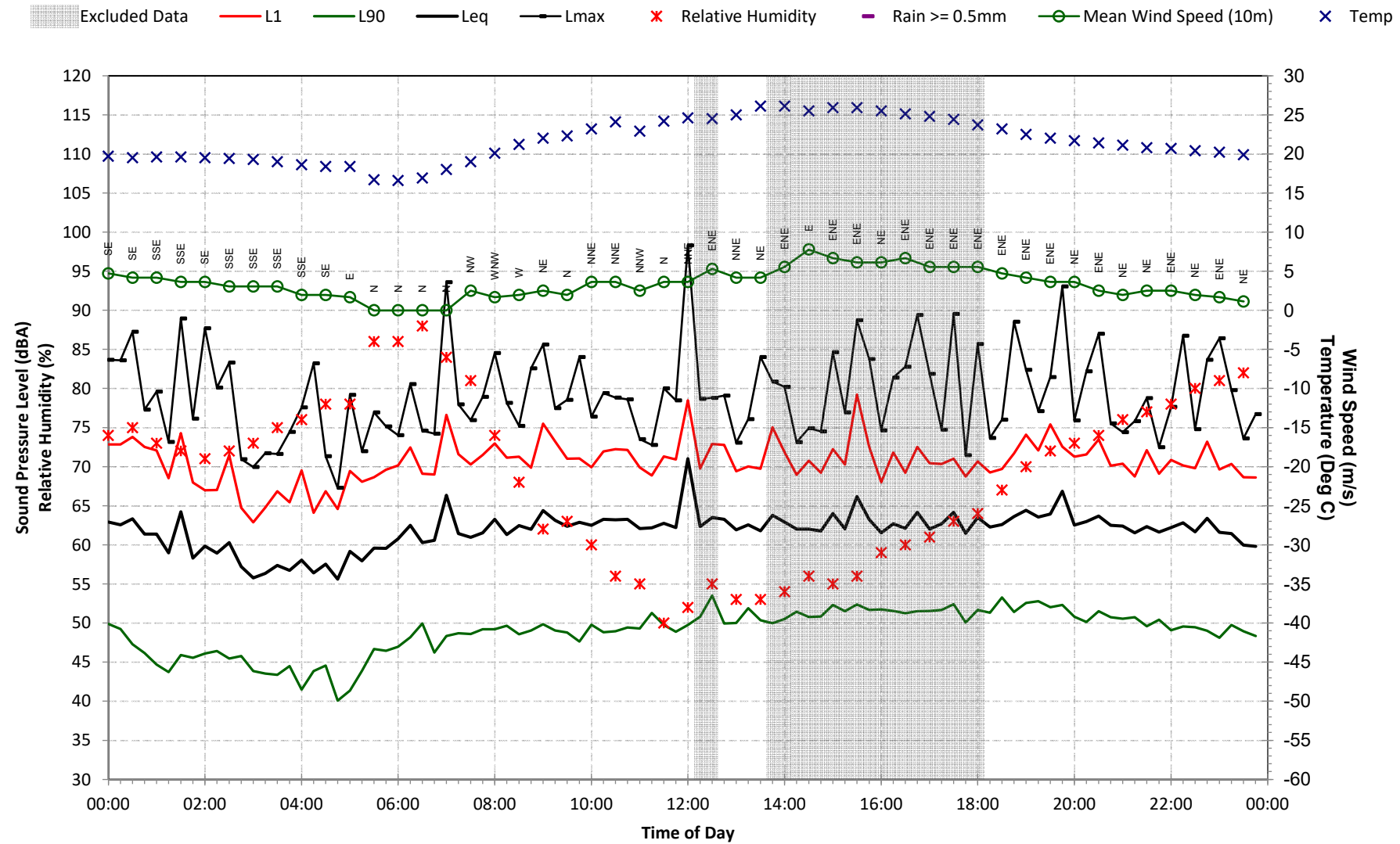
Location Three - Friday, 2 November, 2018



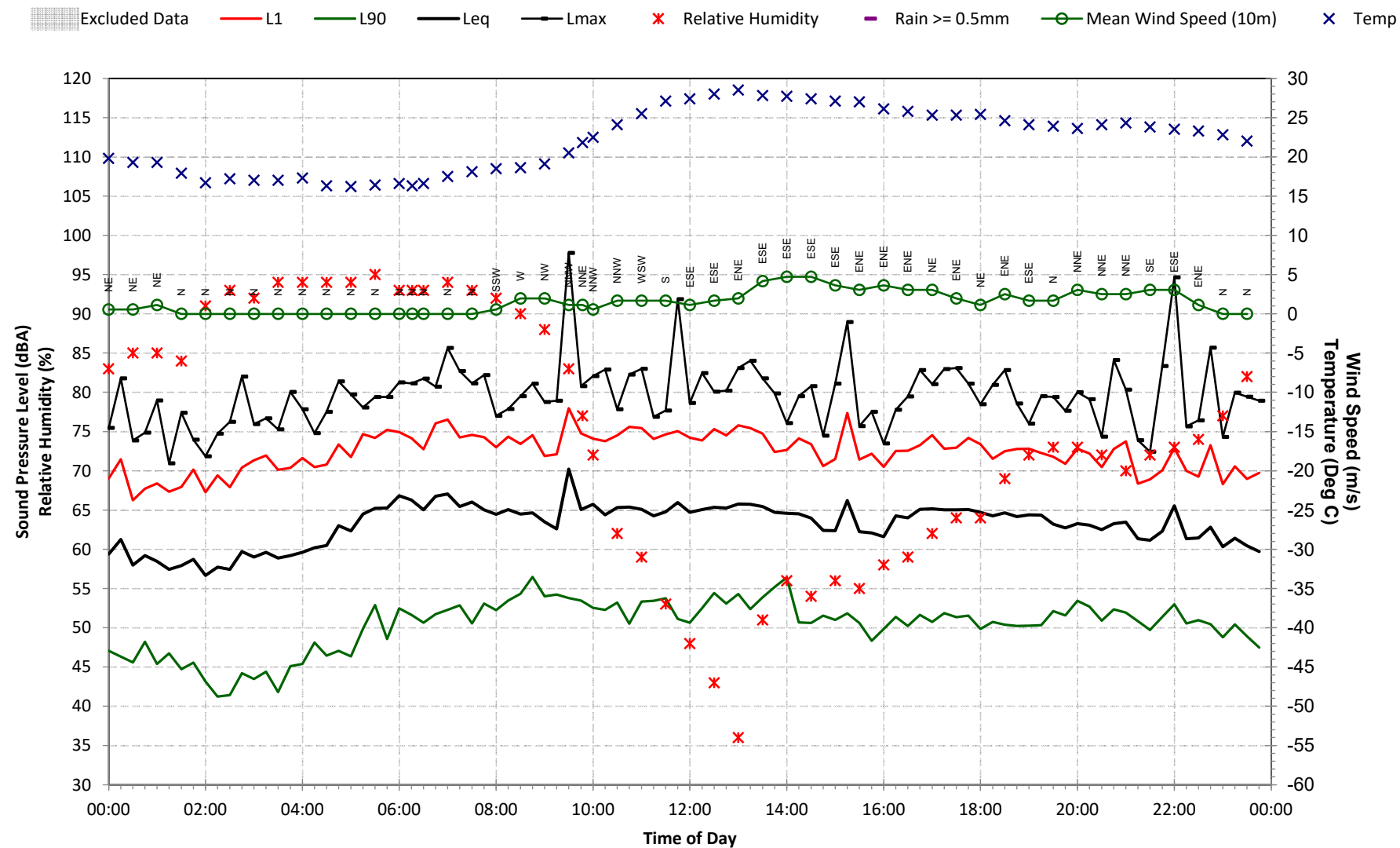
Location Three - Saturday, 3 November, 2018



Location Three - Sunday, 4 November, 2018

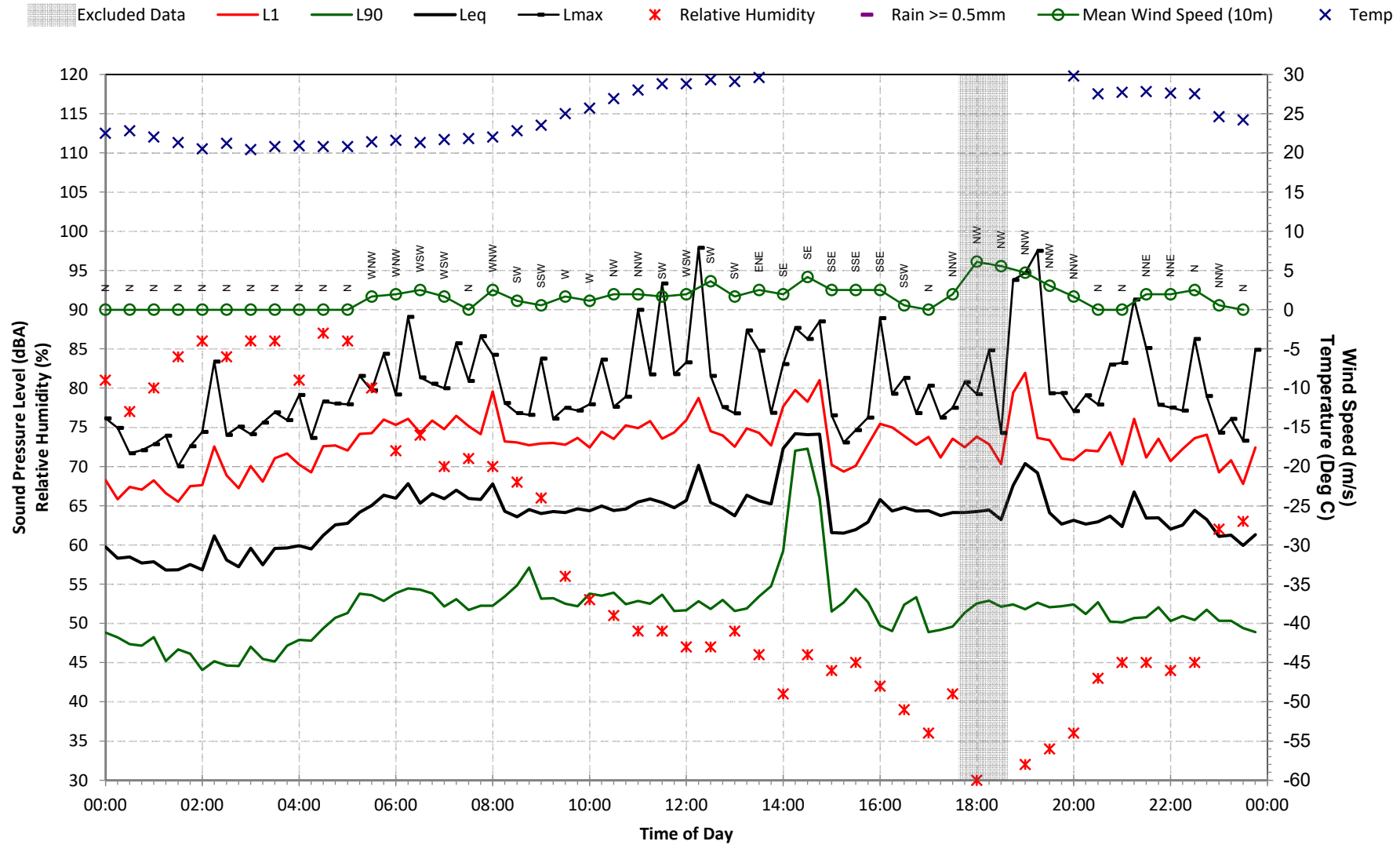


Location Three - Monday, 5 November, 2018

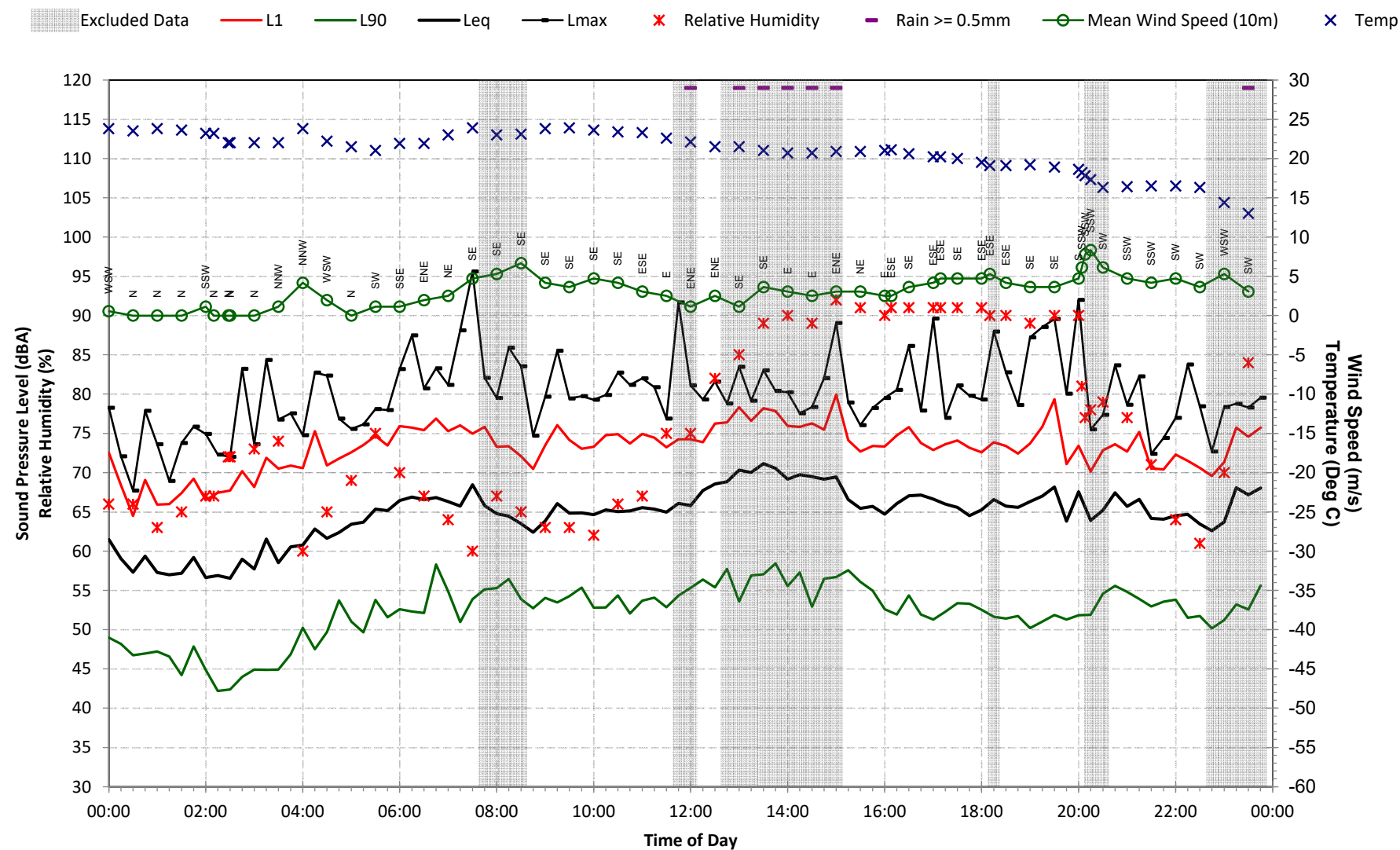


Statistical Ambient Noise Levels

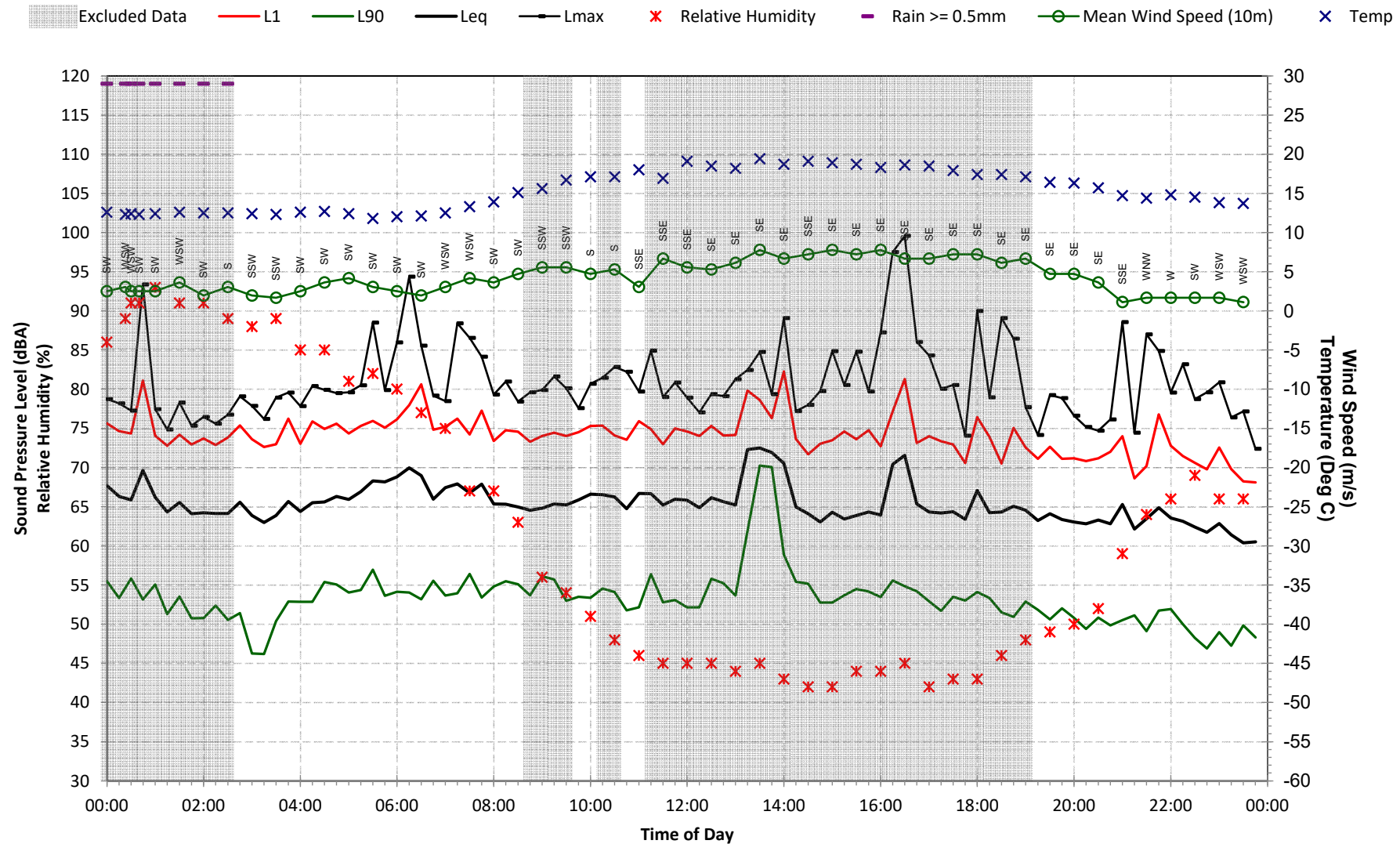
Location Three - Tuesday, 6 November, 2018



Location Three - Wednesday, 7 November, 2018

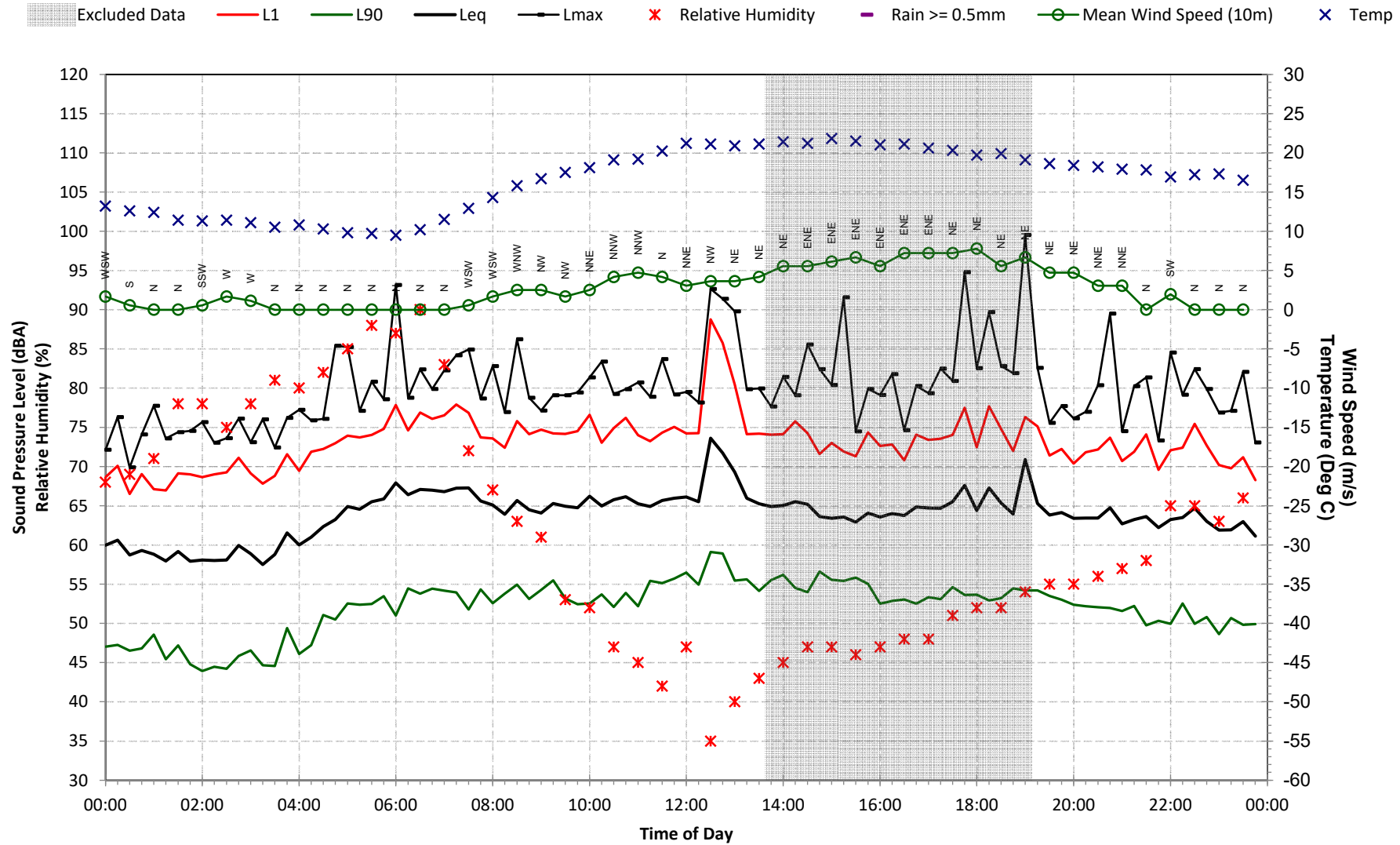


Location Three - Thursday, 8 November, 2018

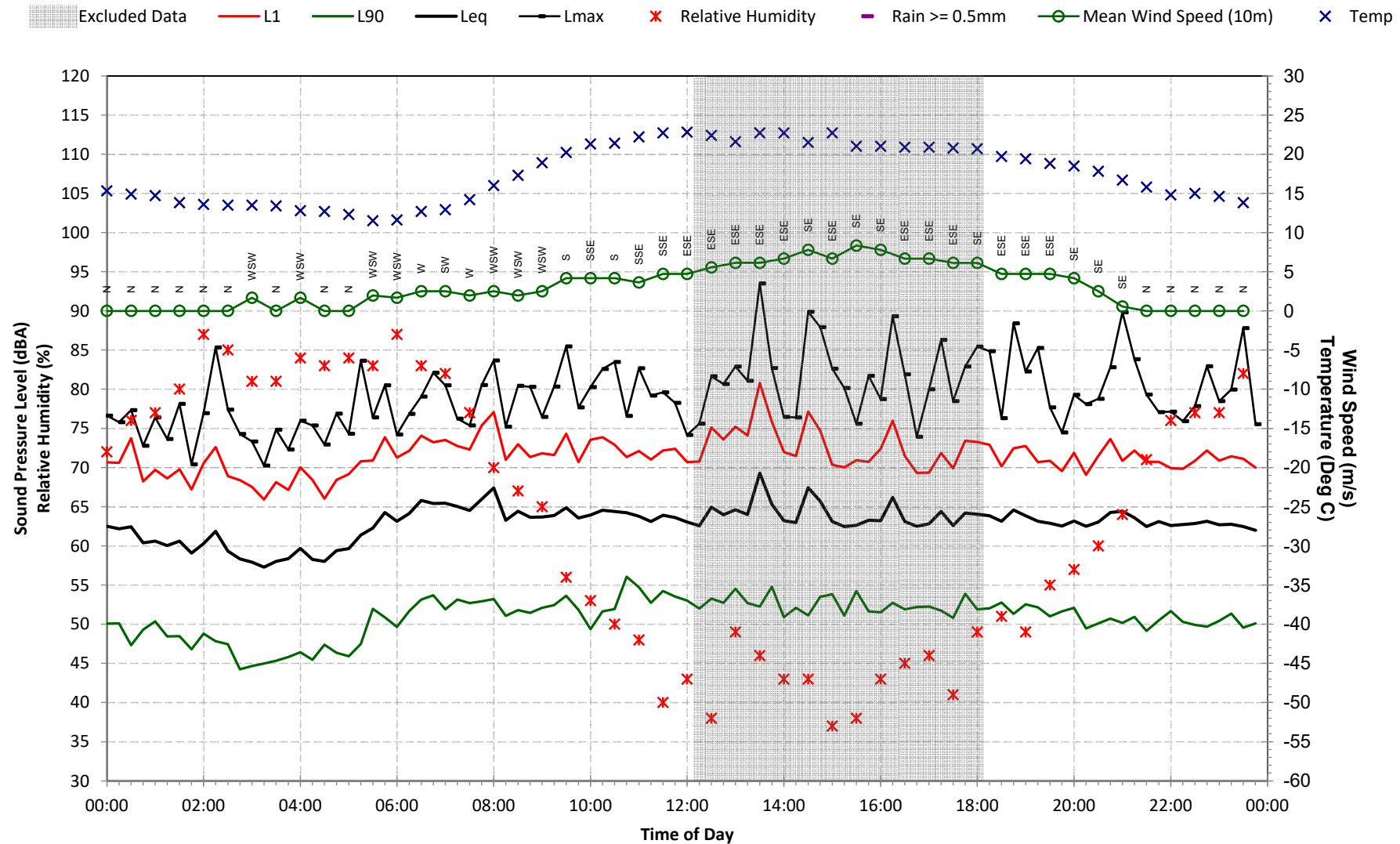


Statistical Ambient Noise Levels

Location Three - Friday, 9 November, 2018

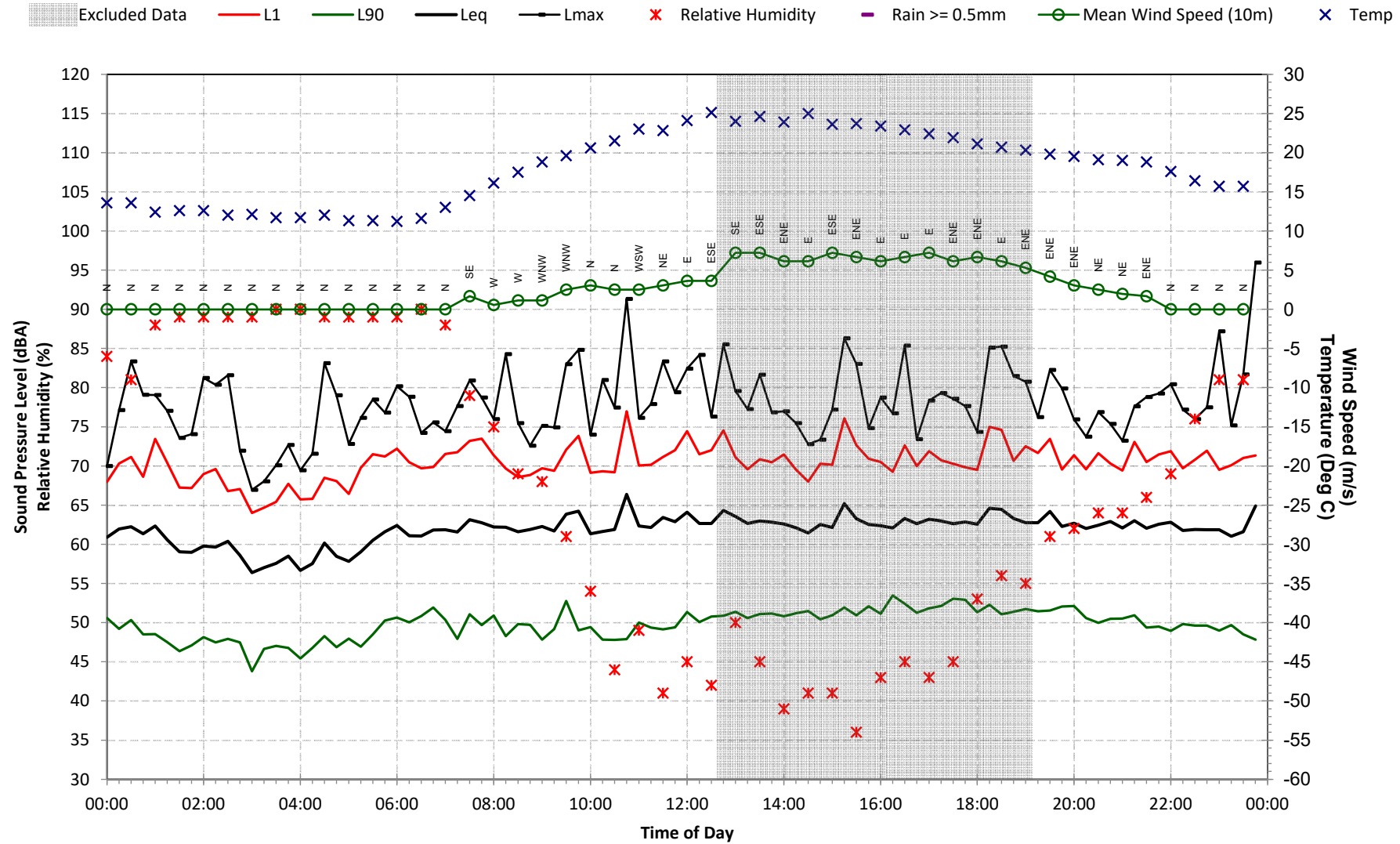


Location Three - Saturday, 10 November, 2018



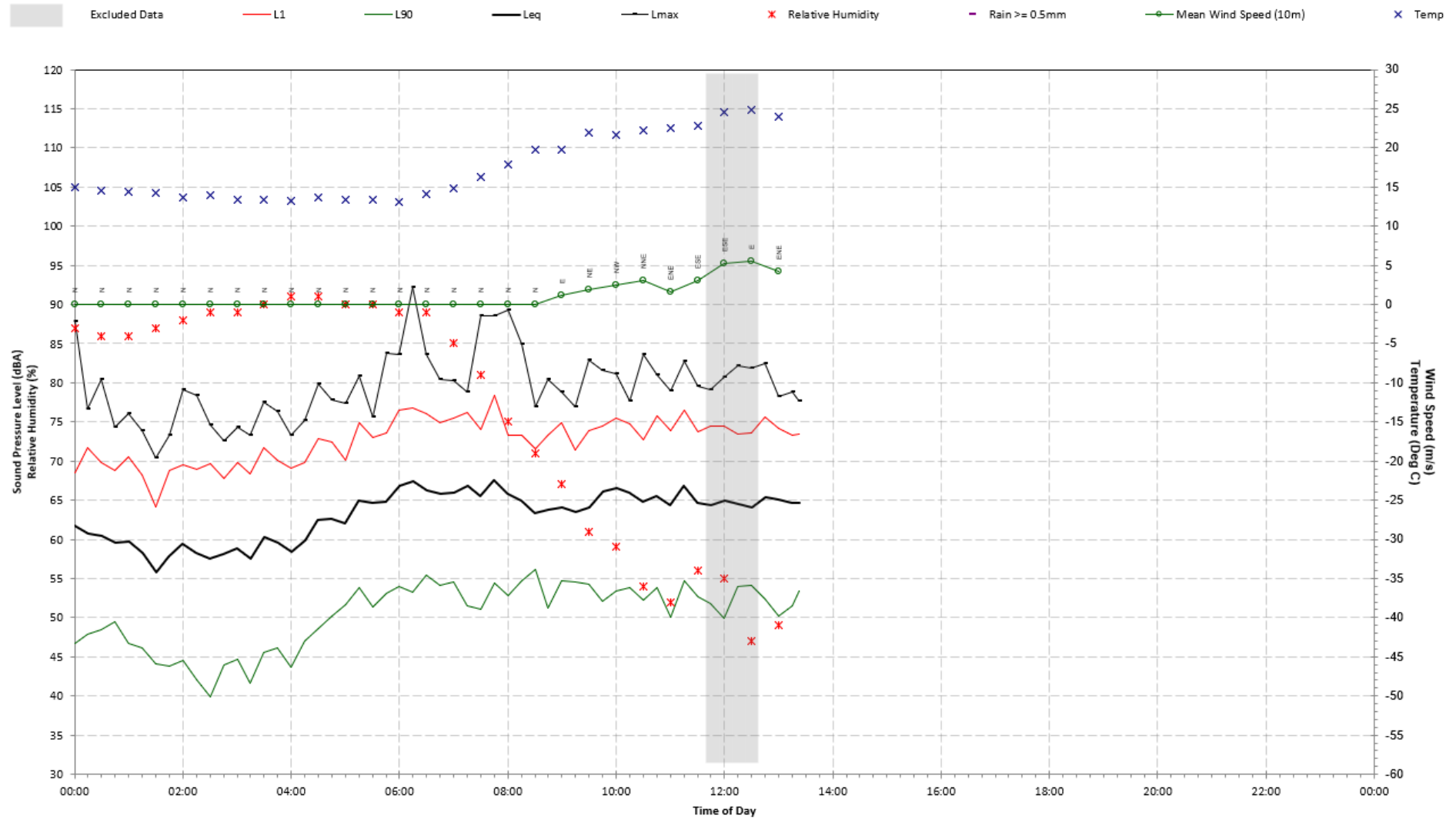
Statistical Ambient Noise Levels

Location Three - Sunday, 11 November, 2018



Statistical Ambient Noise Levels

Location Three - Monday, 12 November, 2018



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