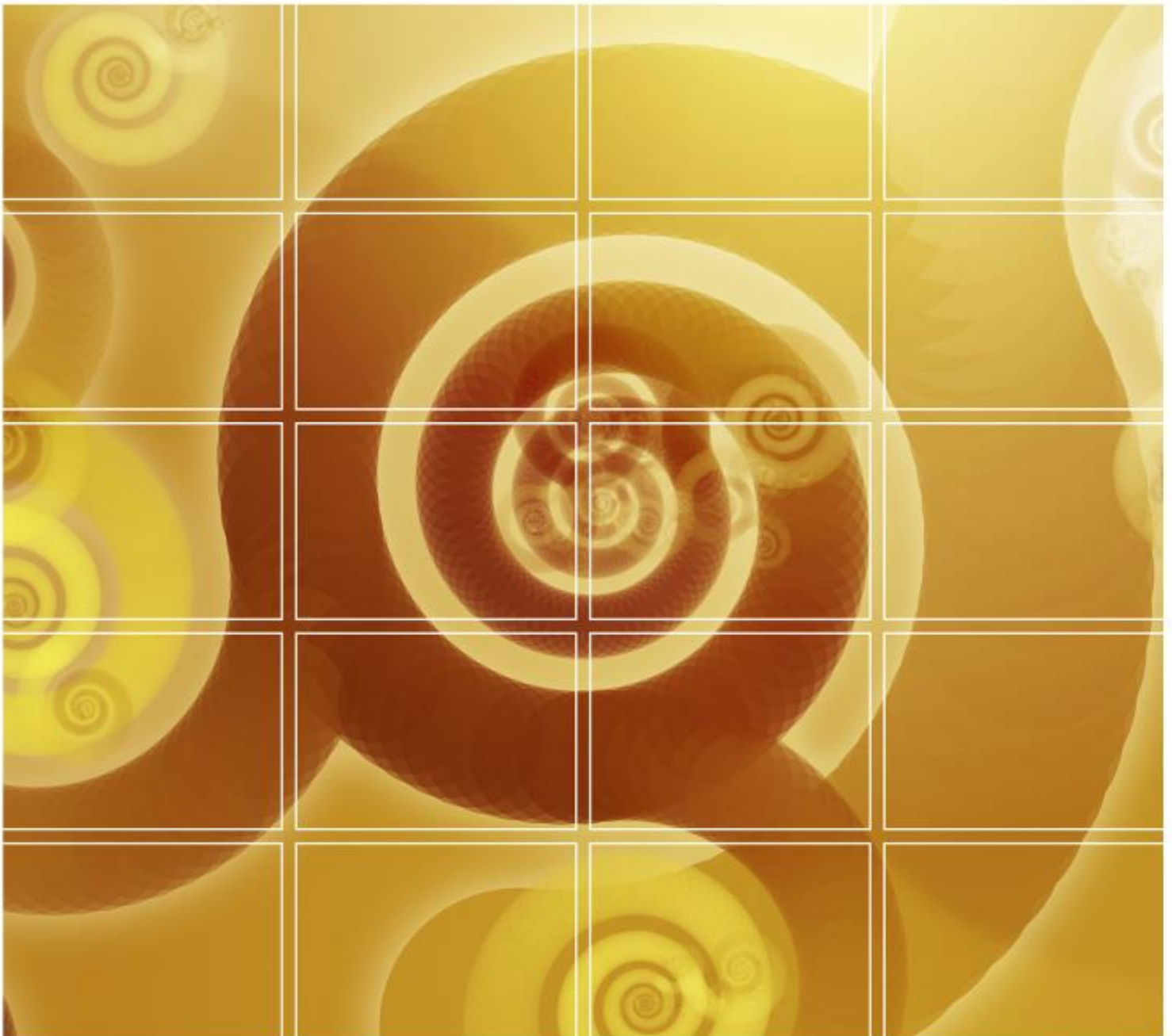


Annex G

Noise And Vibration Impact Assessment



Sancrox Quarry Expansion *Noise and Vibration Impact Assessment*

Hanson Construction Materials Pty Ltd

August 2019

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Sancrox Quarry Expansion

Noise and Vibration Impact Assessment

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August 2019

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Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Hanson Construction Materials Pty Ltd (Hanson) to conduct a Noise and Vibration Impact Assessment to inform the Environmental Impact Assessment (EIA) for the proposed Sancrox Quarry Expansion Project (the Project).

The Project is a State Significant Development (SSD #7293) and therefore the planning approvals process is regulated under Part 4.1 of the *Environmental Planning and Assessment Act 1979* (the EP&A Act), which requires Department of Planning and Environment (DP&E) approval for development consent, supported by an Environmental Impact Statement (EIS).

This report presents the methodology, results and findings of the assessment and considers the following environmental factors:

- Construction noise and vibration.
- Operational noise and vibration.
- Road traffic noise during construction and operation.
- Blasting overpressure and ground-borne vibration.

This report has been prepared to document the assessment of the environmental factors listed above and meet the requirements of the Secretary's Environmental Assessment Requirements (SEARs).

Hanson proposes to extend the life of the quarry by expanding the approved extraction boundary to facilitate the extraction and distribution of high quality construction materials for use in civil infrastructure and road construction projects. The Project will provide vital construction resources to service and accommodate further regional development in the Port Macquarie Hastings region.

The proposed expansion of the Sancrox Quarry will increase operations to 24 hours per day, seven days a week, increasing extraction from 455,000 tonnes per annum (tpa) to 750,000 tpa. The expansion of the quarry will progress westward and southward to excavate new resource.

The quarrying will be undertaken in five stages, with the first two extending the footprint of the quarry, the third stage deepening within the footprint, and the final two stages extending the footprint and extracting to the approved depth of 40 metres (m) Australian Height Datum (AHD).

In addition to the expansion of the quarry, the site will establish new ancillary facilities, including:

- a concrete batching plant (50,000 tpa);
- a concrete recycling facility (20,000 tpa); and
- an asphalt production plant (50,000 tpa).

Chapter 2 of the EIS provides further details of the Project.

1.3

PROJECT LOCALITY

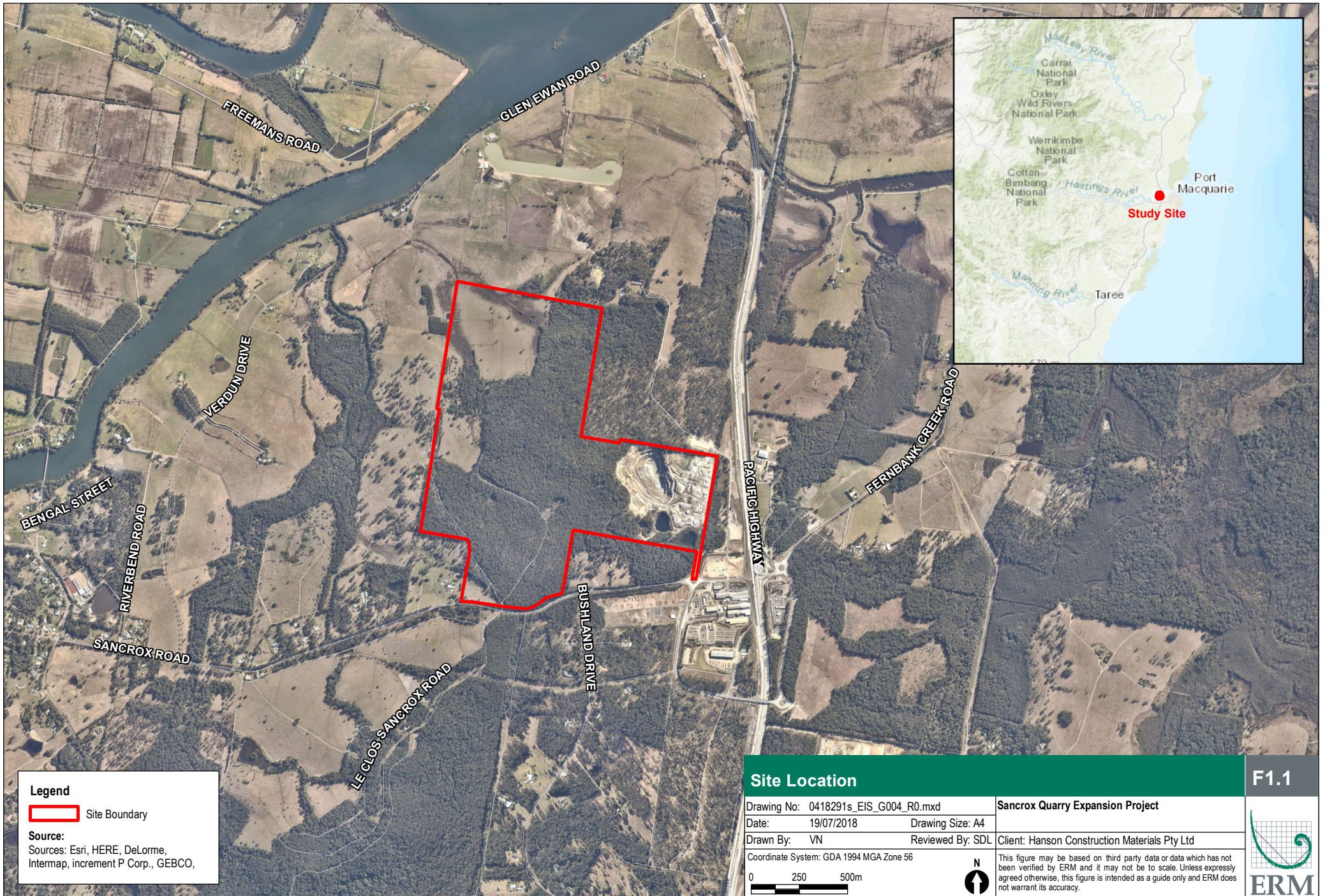
The Sancrox Quarry is located off Sancrox Road, in Sancrox NSW, approximately six kilometres (km) west of Port Macquarie. Hanson owned land includes the existing operational quarry area, as well as surrounding non-operational land.

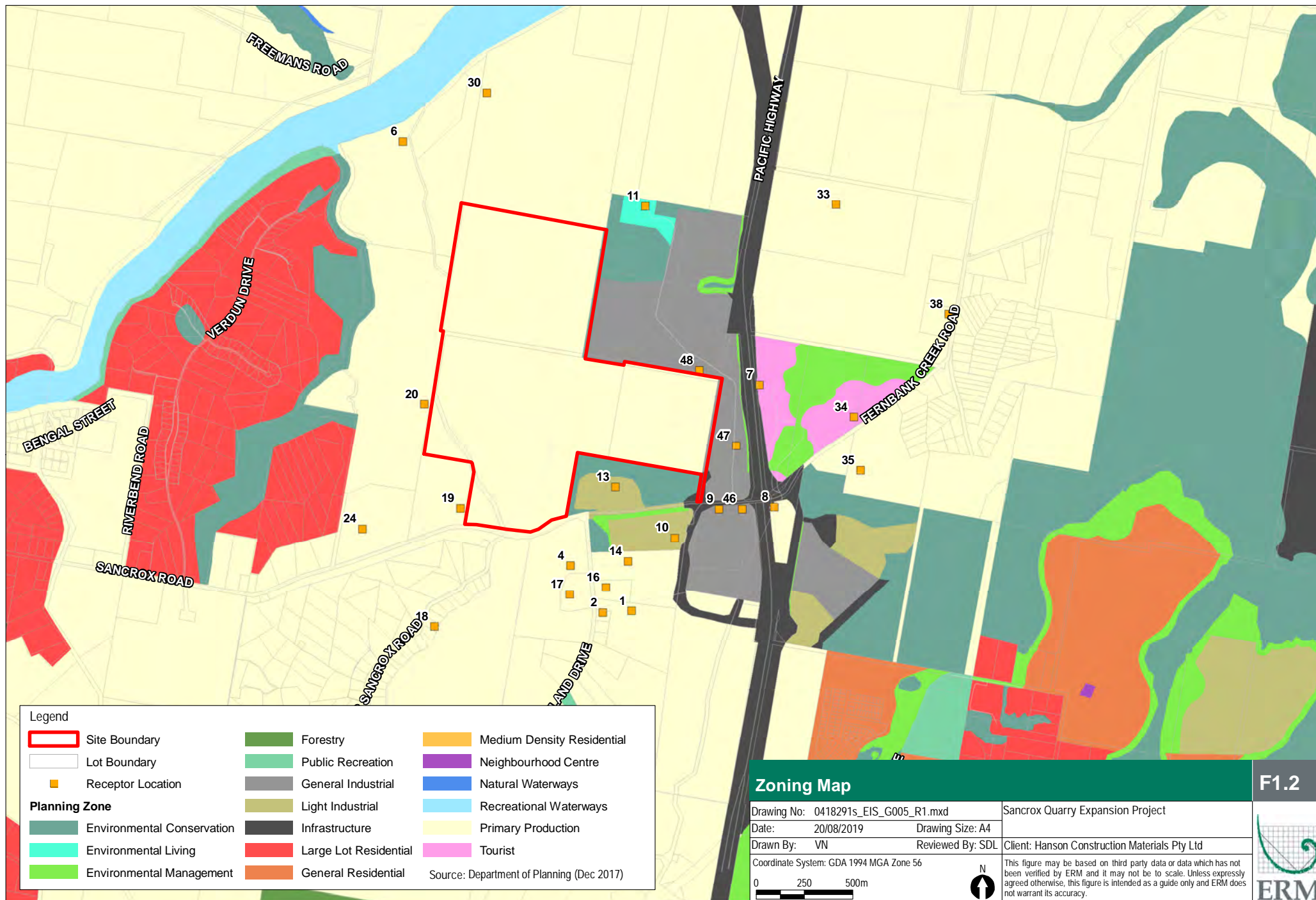
The Project site is zoned RU1 (Primary Production) within the Port Macquarie – Hastings Local Environment Plan 2011. The environment surrounding the site includes remnant woodland vegetation immediately adjacent to the north, west and south. A narrow strip of vegetation is present along the eastern boundary, with partially cleared land located 100m to the east. The Pacific Highway and Cassegrain Winery are located approximately 175 m and 210 m to the east, respectively. Sancrox Road is located approximately 230 m to the south of the site, with a suite of industrial facilities beyond.

The closest residence to the site is located approximately 150 m to the south, along Sancrox Road. A number of rural residential residences are also located along Bushland Drive to the south-west of the site, the closest being approximately 650 m to the south-west. Another rural residential residence is located approximately 1 km to the west.

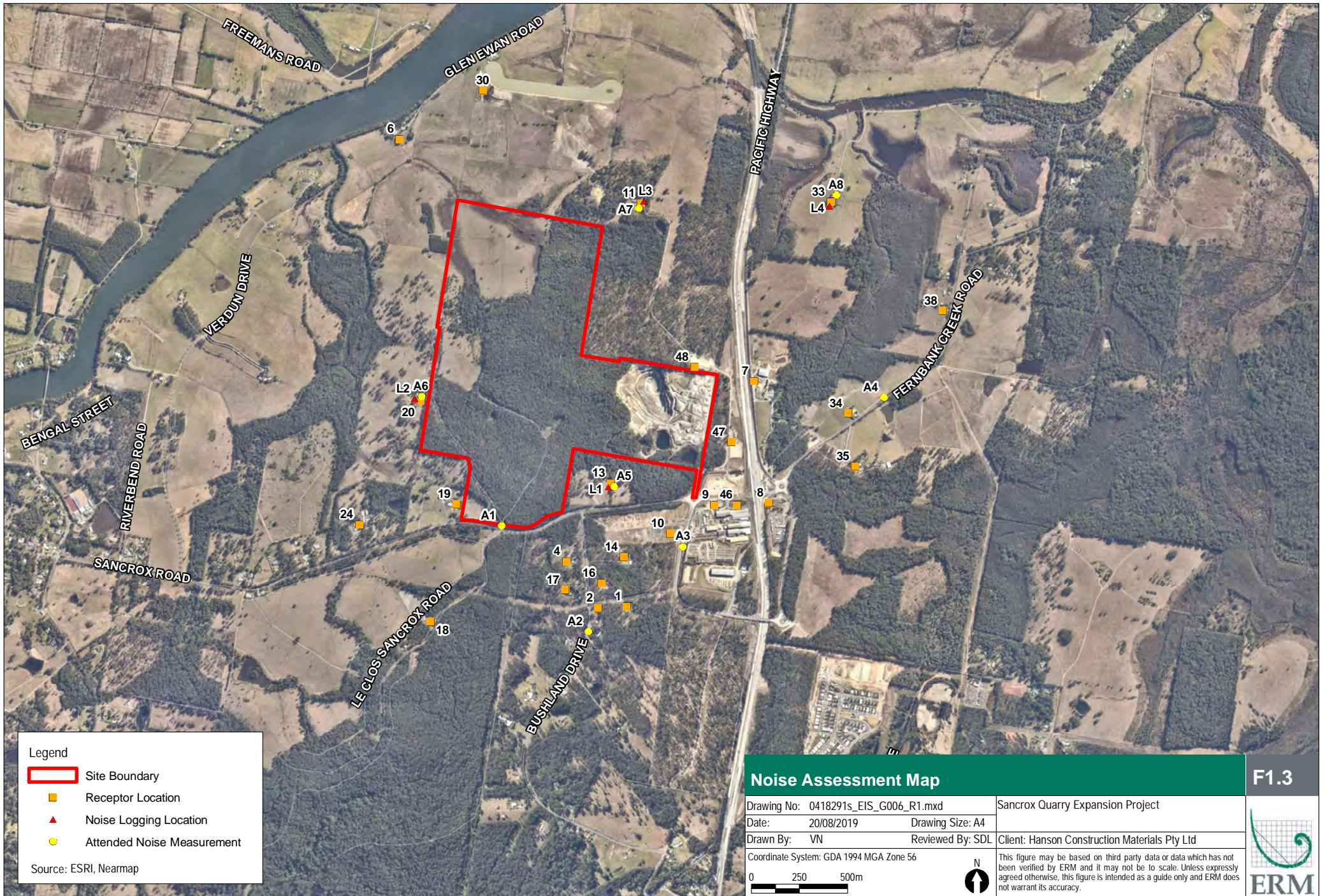
The location of the Sancrox Quarry, surrounding area and other items of importance to this assessment are identified in *Figure 1.1* to *Figure 1.3*. *Figure 1.3* includes the dwelling (receptor) locations adopted for assessing the potential noise and vibration impacts from the Project. The original proposed Project staging and layout of the ancillary facilities is presented in *Annex A*.

It should be noted that during the preparation of this report the pit layout of stage 4 and the final stage was modified in north-western corner. This was a due to the risk of flooding identified in the hydrology assessment. The updated staging layout is presented in Chapter 2 of this EIS. Based on these minor changes to the pit layout, it is not anticipated that noise impacts will alter significantly. Therefore the original noise modelling results have been retained for this report.





F1.2



This chapter describes the assessment methodology adopted for potential quarry construction and operational noise impact at nearby receptors. It also presents the methodology adopted for evaluating potential blasting overpressure and vibration impacts at nearby receptors. It should be noted that the noise modelling assessment includes conceptual mitigation (described in *Section 2.10.2*) based on reasonable and feasible mitigation measures determined through consultation with Hanson. In summary this includes boundary mitigation, plant/equipment procurement and at source mitigation.

An acoustics glossary of relevant acoustical concepts and terminology is provided in *Annex B*. All sound pressure levels presented in this report (e.g. noise levels predicted at a receptor) are in decibels referenced to 2×10^{-5} Pa. All sound power levels presented in this report (e.g. noise levels assigned to specific sources) are decibels referenced to 10^{-12} W.

A baseline noise monitoring campaign to quantify the existing noise environment (ambient and background noise levels) at the closest and/or potentially most affected residential receptors situated in the vicinity of the Project has been completed, as described in *Chapter 3*.

2.1 OBJECTIVES AND SCOPE OF WORK

The objective of this Noise and Vibration Impact Assessment is to meet the requirements of the Secretary's Environmental Assessment Requirements (SEARs). Noise and blasting related SEARs are outlined in *Table 2.1* below.

Table 2.1 Secretary's Environmental Assessment Requirements (SEARs)

SEARs	Where it's addressed
A detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the Interim Construction Noise Guideline, NSW Industrial Noise Policy and the NSW Road Noise Policy respectively, and having regard to the Voluntary Land Acquisition and Mitigation Policy.	Chapter 2 Chapter 6 Chapter 7
If a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the Interim Construction Noise Guideline.	Chapter 4 Chapter 6
Proposed blasting hours, frequency and methods.	Section 4.3.2
A detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people, animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines.	Section 7.5
Reasonable and feasible mitigation measures to minimise noise emissions.	Chapter 8
Monitoring and management measures, in particular real-time and attended noise monitoring.	Section 8.4

To assess Project construction and operational noise and vibration (including road traffic), the following scope of work has been completed:

- Review and validate the available Project and third party data and information as considered relevant to the assessment.
- Review aerial photography, zoning data, cadastre data and third party assessments conducted in the area to identify potential residential and other sensitive receptors situated within the potential area of influence of the quarry.
- Identify significant noise and vibration generating plant, equipment and machinery that may be in use or activities that will be undertaken as part of the Project and their likely/known emissions to develop applicable assessment scenarios.
- Review unattended noise measurement data to establish representative baseline noise levels for the area and then develop Project-specific noise and vibration criteria in accordance with recognised NSW policy and guidelines as applicable to Project activities.
- Complete a qualitative assessment of low risk acoustical factors (road traffic noise, vibration and ground-borne noise). Complete a quantitative assessment of key acoustical factors, including potential noise impacts associated with construction and operational aspects. The quantitative assessment was completed by predicting Project noise levels (via modelling) for the scenarios developed.
- Provide a comparison of predicted levels to the Project-specific develop noise and vibration criteria at receptors, identify any noise levels that exceed criteria and determine the magnitude and extent of any impacts.
- Recommend mitigation, management measures and/or monitoring options suitable to the predicted levels and designed to minimise impacts as far as is feasible, reasonable and practicable to implement.

2.2

POLICY SETTING

In NSW, noise pollution is regulated through the *Protection of the Environment Operations Act 1997* (POEO Act) as the key piece of environment protection legislation. Noise pollution is defined under the POEO Act as:

‘the emission of offensive noise, which means noise that by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances, is harmful (or is likely to be harmful) to or interferes unreasonably (or is likely to interfere unreasonably) with the comfort or repose of a person outside the premises from which the noise is emitted’.

Under the POEO Act, the *POEO (Noise Control) Regulation 2008* addresses common noisy activities that occur in residential situations; it limits the time of day that noisy articles (such as lawn mowers, stereos and leaf blowers) are permitted to be heard in neighbouring residences, however it does not specify noise limits and an applicable approach for the assessment of existing sites.

Various noise and vibration assessment guidelines endorsed by NSW regulators (refer to *Section 2.3*) provide a guidance framework and methodology for deriving acceptable levels and standard methods for assessing and measuring construction and operational impacts with due regard to the POEO Act. The guidelines and standards are discussed below.

2.3 RELEVANT POLICY, GUIDELINES AND STANDARDS

This assessment has been conducted with due regard to and in accordance with the following key policy, guidelines and standards:

- Australian and New Zealand Environment Council (ANZEC) – *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*, 1990.
- Department of Planning and Environment (DP&E) – *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments*, September 2018.
- International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) – *Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation*.
- German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – *Structural Vibration - Effects of Vibration on Structures*.
- NSW Environment Protection Authority (EPA) – *NSW Environmental Noise Management – Industrial Noise Policy (INP)*, January 2000 and relevant application notes.
- NSW Department of Environment and Climate Change (DECC) – *NSW Interim Construction Noise Guideline (ICNG)*, July 2009.
- NSW Department of Environment, Climate Change and Water (DECCW) – *NSW Road Noise Policy (RNP)*, March 2011.
- NSW Department of Environment and Conservation – *NSW Environmental Noise Management – Assessing Vibration: A Technical Guideline (the NSW Vibration Guideline)*, February 2006.
- NSW Government – Transport for NSW (TfNSW) *Construction Noise Strategy (7TP-ST-157/2.0)*, dated April 2013.
- Standards Australia AS1055-1997™ (AS1055) – *Description and Measurement of Environmental Noise*, Parts 1, 2 and 3.
- Standards Australia AS IEC 61672.1-2004™ (AS61672) – *Electro Acoustics - Sound Level Meters Specifications Monitoring* or Standards Australia AS1259.2-

1990TM (AS1259) – *Acoustics – Sound Level Meters – Integrating Averaging* as relevant to the device.

- Standards Australia AS/IEC 60942:2004/IEC 60942:2003 (IEC60942) – Australian StandardTM – *Electroacoustics – Sound Calibrators*.
- Standards Australia AS2187.2-2006TM (AS2187.2) – *Explosives – Storage and Use Part 2: Use of Explosives*.
- Standards Australia AS 2436-2010TM (AS2436) – *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*.
- United Kingdom (UK) – *Calculation of Road Traffic Noise* (CoRTN) calculative methods, adapted to Australia conditions.

Further information regarding the application of the key policy and guidelines is provided below.

2.4 NSW INDUSTRIAL NOISE POLICY

Responsibility for the control of noise emissions in NSW is typically vested in Local Government and the NSW Environment Protection Authority (EPA). The INP and relevant application notes provide a framework and methodology for deriving limit conditions for consent and licence conditions.

The INP is designed for large and complex industrial sources and outlines processes designed to strike a feasible and reasonable balance between the operations of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant.

In this case, the INP is considered the suitable document to establish baseline noise levels and to quantifiably assess potential noise emissions and impacts associated with the operation of the quarry.

The INP assessment methodology is outlined in more detail in *Annex C*. Baseline noise values are presented in *Chapter 3* and operational noise criteria presented in *Chapter 4*.

The INP (released in 2000) was withdrawn and replaced by the NSW Environment Protection Authority – *Noise Policy for Industry* (NPI) in October 2017. The implementation of the NPI as relevant to this Project is described below.

The INP does however remain the applicable policy and was implemented for the purposes of this assessment as per the requirements stated in the EPA document, *Implementation and Transitional Arrangements for the Noise Policy for Industry* (2017).

Item 2 of *Implementation and Transitional Arrangements for the Noise Policy for Industry* (2017) states that, “The NPI (2017) will take effect immediately upon its release and should be referenced in relevant Secretary’s Environmental Assessment

Requirements (SEARs) for new industrial development issued after the policy release date. Where SEARs were issued before the release of the new NPI policy, and have not been modified, the assessment requirements referenced in the SEARs will apply for a period of two (2) years from the date of issue of the SEARs consistent with the provisions in the Environmental Planning and Assessment Regulation 2000, Schedule 2, Part 2, 3 (7)".

Item 3 of the Implementation and Transitional Arrangements for the Noise Policy for Industry (2017) then states, "In situations where SEARs are not issued (that is, development consent that is not State Significant Development or Infrastructure), however, a proponent can demonstrate that environmental assessment substantially commenced before release of the new policy, planning and regulatory authorities may choose to determine the application based on the NSW Industrial Noise Policy (2000) for a period of up to one (1) year from the date of release of the Noise Policy for Industry (2017)".

In this circumstance the SEARs were issued first in 2015 and then re-issued in September 2017 both prior to the NPI, 2017 being released for use. Furthermore, the EIS including this NVIA where well progressed by September 2017. On this basis the NPI, 2017 does not apply to this project, which has been assessed on the basis of the INP as identified in the September 2017 SEAR's.

2.5 **NSW INTERIM CONSTRUCTION NOISE GUIDELINE**

The ICNG presents an accepted method by which construction noise and vibration impacts may be assessed for a range of receptor types for works completed in NSW.

It provides as set of recommended standard hours of construction:

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

The ICNG encourages works to occur within the recommended standard hours of construction unless justification is provided. It focuses on minimising construction noise impacts, rather than just achieving numeric noise levels, and recognises that some noise from construction sites is inevitable.

The ICNG encourages organisations involved with construction, maintenance or upgrading works (e.g. large-scale contractors or Government agencies) to develop their own best-practice techniques for managing construction noise and vibration, and implementing feasible and reasonable mitigation measures.

In this case, the ICNG is considered the suitable document to quantifiably assess potential noise emissions and impacts associated with Project construction activities.

The ICNG assessment methodology is outlined in more detail in *Annex D* of this report. Baseline noise values are presented in *Chapter 3* and construction noise management levels are presented in *Chapter 4*.

2.6

BLASTING

AS2187.2 presents methods for the preliminary estimation of air-blast overpressure and ground-borne vibration levels. These methods have been adopted here to consider potential Project emissions for a range of charge values and receptor distances.

The AS2187.2 equations offer a highly conservative method to estimate levels in the absence of measured site laws. Typically, for example at a quarry where a long-term blasting program is proposed with many blast events, the AS2187.2 equations are further refined via a series of test blasts, completed to more accurately determine site constants and exponents relevant to the equation.

2.6.1

Air-Blast Overpressure

Preliminary estimations for overpressure have been completed using the following AS2187.2 equation:

$$P = K_a \left(\frac{R}{(Q^{1/3})} \right)^a$$

Where:

- **P** = Pressure, in kilopascals;
- **Q** = Maximum Instantaneous Charge (effective charge mass per delay), in kg. Explosive loading/ detonation sequence/ effective charge mass per delay. The maximum charge, in kilograms, initiated at any instant of time.
- **R** = Distance from charge, in metres;
- **Ka** = Site constant, a value of 14.56 was adopted; and
- **a** = Site exponent, a value of -1.45 was adopted.

The conversion of the 'P' pressure unit to linear decibels (dBZ) is completed using the following formula:

$$SPL = 10 \times \log \left(\frac{P}{P_0} \right)^2$$

2.6.2

Ground-Borne Vibration

Preliminary estimations for vibration have been completed using the following AS2187.2 equation:

$$V = K_g \left(\frac{R}{(Q^{1/2})} \right)^{-B}$$

Where:

- **V** = ground vibration as vector peak particle velocity, in mm/s;
- **R** = distance between charge and point of measurement, in m;
- **Q** = Maximum Instantaneous Charge (effective charge mass per delay), in kg. Explosive loading/ detonation sequence/ effective charge mass per delay. The maximum charge, in kilograms, initiated at any instant of time.
- **Kg** = a constant related to site and rock properties for estimation purposes, a value of 1140 was adopted; and
- **B** = a constant related to site and rock properties for estimation purposes, a value of 1.6 was adopted.

2.6.3 *Estimated Charge Values*

Each of the equations presented above are reliant on a charge value being applied to predict the overpressure and ground-borne vibration levels due to blasting.

Historical blasting data provided by Hanson for November 2016 to June 2017 indicated that the average MIC (maximum instantaneous charge) value was 148 kg and the maximum MIC was 215 kg.

2.7 *NSW ROAD NOISE POLICY*

The RNP was approved to replace the Environmental Criteria for Road Traffic Noise (ECRTN) with effect from 1 July 2011. The RNP outlines the range of measures needed to minimise road traffic noise and its impacts. It is intended for use by acoustics specialists as well as:

- Road project proponents.
- Determining authorities and regulators involved in the approval and construction of road projects and land use developments that generate additional traffic on existing roads.
- City and transport planners and policymakers dealing with issues such as route corridors, heavy vehicle transport and building codes.

The RNP aims to identify the strategies that address the issue of road traffic noise from existing roads, new road projects, road redevelopment projects and new traffic-generating developments. In this case, the RNP is considered the suitable document to qualitatively assess potential noise emissions and impacts associated with construction and operational road traffic.

The RNP vary based on road type and are dependent on the development being assessed. The RNP criteria adopted for this assessment are presented in *Chapter 4* of this report.

2.8 *VIBRATION GUIDELINES AND STANDARDS*

The effects of vibration in buildings can be divided into three main categories: human comfort (annoyance), cosmetic damage and structural damage. An overview of the applicable standards and guidelines is provided below.

- **Human Comfort (annoyance):** The NSW Vibration Guideline provides guidance for assessing human exposure (comfort or annoyance issues) to vibration. The publication is based on British Standard (BS 6472-1992) – *Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*.

- **Cosmetic and Structural Damage:** There is currently no Australian policy or guideline for assessing the potential for building damage (cosmetic and structural) from vibration. It is common practice to derive safe limit values for assessment purposes from international standards, such as German Standard DIN4150 Part 3-1999 (DIN4150-3) – *Structural Vibration - Effects of Vibration on Structures*. DIN4150-3 presents a set of safe limit values that below which cosmetic or structural damage is unlikely to occur.

The NSW Vibration Guideline and DIN 4150-3 criteria vary based on vibration type and receptor type and are dependent on the component frequency of the vibration event. To avoid presenting an exhaustive list of criterion values and since vibration impacts are not expected (refer to *Chapter 5*), the criteria values from the NSW Vibration Guideline and DIN 4150-3 were considered in the assessment of potential impacts but are not reproduced here.

2.9 REQUIREMENTS FOR LAND ACQUISITION

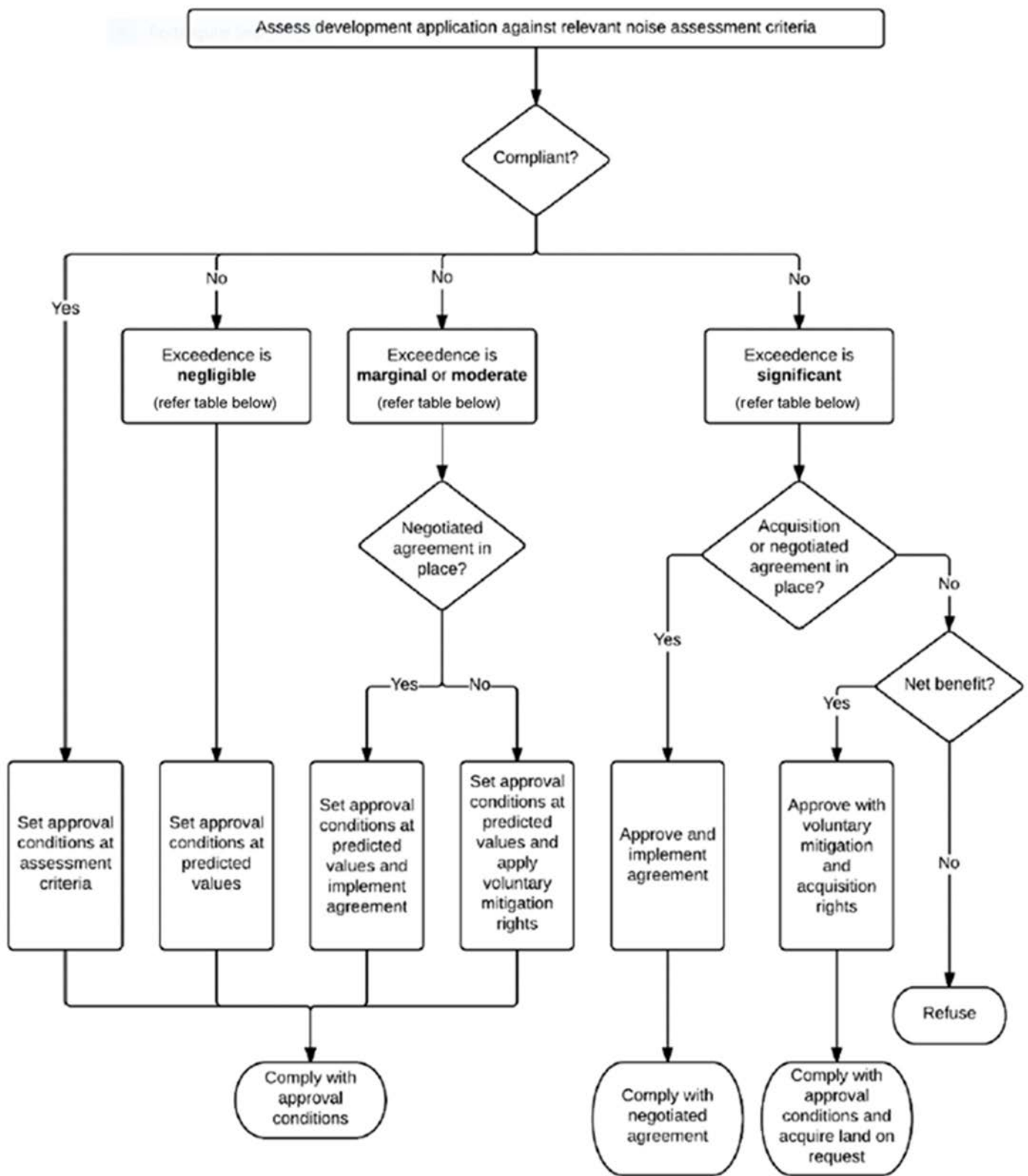
The *Voluntary Land Acquisition and Mitigation Policy For State Significant Mining, Petroleum And Extractive Industry Developments* (VLAMP) is to be applied by consent authorities when assessing and determining development applications and modification applications for mining, petroleum and extractive industry developments subject to the State significant development provisions of the Environmental Planning and Assessment Act 1979 (EP&A Act). The VLAMP (released in 2018) refers to the NPI (released in 2017) for a number of industrial noise related features. For the purposes of this assessment, these references to the NPI and its applicable noise features were applied with regard to the INP, the policy applicable to the Project for the assessment of industrial noise, as outlined in *Section 2.4*.

The policy recognises that:

- Not all exceedances of the relevant assessment criteria equate to unacceptable impacts.
- Consent authorities may decide that it is in the public interest to allow the development to proceed, even though there would be exceedances of the relevant assessment criteria, because of the broader social and economic benefits of the development.
- Some landowners may be prepared to accept higher impacts on their land, subject to entering into suitable negotiated agreements with applicants, which may include the payment of compensation.

Table 2.2 below outlines the policy's interpretation of the significance of any potential exceedances of the relevant noise assessment criteria, and identifies potential treatments for these exceedances.

The decision-making process, which should be applied by a consent authority under this policy, is summarised in *Figure 2.1* below.



Process for Decision-Making on Noise Impacts (VLAMP)

F2.1

Drawing No: 0418291s_NVIA_C001_R0.cdr

Date: 25/02/2019

Drawn by: GC

Drawing size: A4

Reviewed by: SD

Noise and Vibration Impact Assessment
Sancrox Quarry Expansion

Client: Hanson Construction Materials Pty Ltd

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.



Table 2.2 Characterisation of Noise Impacts & Potential Treatments

Predicted Noise Exceeds Project Criteria by	And the total cumulative industrial noise level is	Characterisation of Impacts	Potential Treatment
All time periods 0-2dBA above the project specific noise level (PSNL)	Not applicable	Impacts are considered to be negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls
All time periods 3-5dBA above the PSNL	<ul style="list-style-type: none"> • < recommended amenity noise levels; or • > recommended amenity noise level, but increase in total cumulative industrial noise level resulting from the development is <1 dBA 	Impacts are considered to be marginal	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
All time periods 3-5dBA above the PSNL	> recommended amenity noise level, and the increase in total cumulative industrial noise level resulting from the development is >1 dBA	Impacts are considered to be moderate	As for marginal impacts but also upgraded façade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to reduce noise levels.
Day and evening >5dBA above the PSNL	< recommended amenity noise levels	Impacts are considered to be moderate	As for marginal impacts but also upgraded façade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to reduce noise levels.
Day and evening >5dBA above the PSNL	> recommended amenity noise levels	Impacts are considered to be significant	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions below.
Night >5dBA above the PSNL	Not applicable	Impacts are considered to be significant	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions below.
<i>Source: DP&E, 2018</i>			

Voluntary Mitigation Rights

A consent authority should only apply voluntary mitigation rights where, even with the implementation of best practice management:

- The noise generated by the development would meet the requirements in Table 2.2 above, such that impacts would be characterised as marginal, moderate or significant, at any residence on privately owned land; or
- The development would increase the total industrial noise level at any residence on privately owned land by more than 1 dBA and noise levels at the residence are already above the recommended amenity criteria in Table 2.1 of the INP; or

- The development includes a private rail line and the use of that private rail line would cause exceedances of the recommended acceptable levels in Table 6 of Appendix 3 of the Rail Infrastructure Noise Guideline (RING) by greater than or equal to 3 dBA at any residence on privately owned land.

All noise levels must be calculated in accordance with the INP or RING (as applicable). The selection of mitigation measures should be guided by the potential treatments identified in *Table 2.2* above.

Voluntary Land Acquisition Rights

A consent authority should only apply voluntary land acquisition rights where, even with the implementation of best practice management:

- The noise generated by the development would be characterised as significant, according to *Table 2.2* above, at any residence on privately owned land; or
- The noise generated by the development would contribute to exceedances of the recommended maximum noise levels in Table 2.1 of the INP on more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls; or
- The development includes a private rail line and the use of that private rail line would cause exceedances of the recommended maximum criteria in Table 6 of Appendix 3 of the RING at any residence on privately owned land.

All noise levels must be calculated in accordance with the INP or RING (as applicable).

In accordance with the SEARs, this assessment has considered the characterisation of impacts and potential treatment as per the INP and with due regard to the principles presented in the Voluntary Land Acquisition and Mitigation Policy.

2.10

NOISE MODELLING

The methodology, inputs and assumptions that have informed the construction and operational noise modelling are outlined below:

- Brüel and Kjær's Predictor 7810 (Version 11.2) noise modelling software package was utilised to calculate noise levels using the International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - *Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation* noise propagation algorithms (international method for general purpose, 1/1 octaves). For sound calculated using ISO9613:2, the indicated accuracy is ± 3 dBA at source to receiver distances of up to 1000 m and unknown at distances above 1000 m.

- The ISO9613:2 calculative algorithms are widely accepted for the use of construction and operational (industrial) noise modelling regardless of the software package that simply implements these standardised calculative methods.
- The Predictor software package allows 3D elevation data to be combined with ground regions, water, foliage, significant building structures and receptor locations, to create a detailed and accurate representation of the site and surrounding area. The noise model allowed for the quantification of noise levels from multiple sources, based on sound power or pressure levels emitted from each source. The model computed the noise propagation in the assessment area of influence to specifically quantify A-weighted decibels (L_{eq} , 15 minute and L_{max} in dBA) at identified receptors.
- Sound Power Level (L_W , dBA) data incorporated into the Project-specific noise models was provided by Hanson, obtained from relevant Australian Standards or adapted from a proprietary source term database available at the time of the assessment.
 - L_W is a measure of the total power radiated by a source; it is a fundamental property of the source and is independent of the surrounding environment.
 - L_W differs from a Sound Pressure Level (L_P), which is the level of sound pressure as measured at a distance by a standard sound level meter with a microphone. L_P is the received sound (e.g. L_{eq} , 15 minute in dBA) as opposed to L_W , which is the sound 'intensity' at the source.
- 3D elevation data, zoning data and cadastre (spatial data) was obtained from the NSW Land and Property Information (LPI).
 - Buildings on and near the quarry were included in the noise model based on this spatial data or manually digitised from aerial photography.
 - Only large industrial buildings in close proximity to the site have been included into the model as buildings.
- Noise levels were calculated at 1.5m above ground level for all receptors, in accordance with the INP and ICNG. It is noted that ambient, background and project noise levels may be higher at receptor heights above 1.5 m.
- In all cases noise has been assessed at the most-affected point at or within the residential property boundary or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence.
- The model included a temperature of 12.8°C and humidity of 74%, representative of conservative noise enhancing conditions derived from annual historical data from the NSW Bureau of Meteorology (BOM). Further information is provided below regarding prevailing meteorological conditions. A ground factor of 0.8 was adopted for the modelling area (0.0 is hard, 1.0 is soft).

- Amongst other features, noise modelling software offer a range of emission source types to be used to predict levels at receptors, these include but are not limited to “area sources”, “point sources”, “line sources” and “moving point sources”. These source types were adopted as follows:
 - To accurately represent general construction emissions, capturing the size, layout and number of noise generating plant / equipment, “area sources” were utilised to predict Leq, 15 minute noise levels. A separate area source was placed in the model for each phase of works to accurately represent the distribution of noise across the site during each work phase.
 - For operational noise emissions, a combination of “point sources”, “line sources” and “moving point sources”, were used to predict Leq, 15 minute noise levels and accurately represent emissions based on the actual positions of known plant, equipment and machinery included in the current Project design.
 - For operational scenarios, “moving point sources” extended south of the site to Sancrox Road to represent emissions from Project vehicle movements leaving the quarry.
 - “Point sources” were utilised to predict all Lmax noise levels for the purpose of the sleep disturbance assessment.
- A number of other modelling features have been adopted for noise modelling and are listed below, these features are outlined in the assessment scenarios summarised in *Chapter 6* and *Chapter 7*:
 - **Quantity** is the number of equipment operating per 15 minute assessment period.
 - **Duty Factor** is the percentage of time the equipment operates per 15 minute assessment period, or represents a reduced emission for part of the period.
 - **Base LW Value** is source emission or ‘Sound Power Level’ (LW) directly allocated to the equipment, unadjusted.
 - **INP Penalty** considers any annoying characteristic such as tonality, low frequency noise or impulsiveness.
 - **Total LW Value** is the overall equipment source emission (LW) adjusted for the quality, duty factor and INP penalty. INP penalties were not included for operational stages of the noise assessment as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.
- The noise assessment scenarios and modelling data are summarised in *Chapter 6* and *Chapter 7*, however all LW, dBA values have considered and applied the relevant INP modifying factors (penalties) for offensive noise characteristics, prior to modelling.

- Construction noise level predictions have been conducted to identify results for representative worst-case scenarios, as the predicted values consider the cumulative emission (and potential impact) of all equipment sources working concurrently.
- It is not possible or warranted to reflect potential impacts, to model every plausible activity, task or usage for each noise generating source and location, hence the conservative approach adopted here has been applied to ensure that representative worst-case noise predictions were conducted. Furthermore, area sources were utilised where possible to reflect the potential distribution of noise across the site, and the potential emissions from activities undertaken at various locations within and around the site.

2.10.1 *Prevailing Meteorological Conditions*

Prevailing meteorological conditions have the potential to increase noise levels at receptors influenced by the effects of wind and temperature inversions. Winds blowing between the source and the receptor, and temperature inversions can increase noise levels by between 1 dBA and approximately 7 dBA depending on the distance of the receptor from the source and condition.

These noise level increases are normally detectable (or quantifiable via modelling) for receptor distances greater than 100 m from the source, which is the case for this Project with most receptors more than 500 m from the site.

Prevailing meteorological conditions for the area were established for this assessment based on the EPA's noise enhancing wind analysis (NEWA) method. The NEWA analysis was based on Bureau of Meteorology (BOM) meteorological data from the nearest Automated Weather Station (AWS) (i.e. Port Macquarie Airport, Station ID: 060139) for a 12 month period (2017).

The NEWA method differs to a wind rose method, that is prescribed by guidelines for use in the Air Quality Assessment. Therefore wind roses should not be applied for the assessment of noise in NSW, where the NEWA method is used.

The key difference is that NEWA calculates the percentage occurrence of wind directions during the INP daytime, evening and night time assessment periods. NEWA results will differ when compared to wind roses due to the different time periods e.g. wind roses commonly apply before 9AM, before 3PM.

The NEWA analysis identified that north-westerly and westerly winds prevailed. The north-westerly and westerly directions represent source to receiver (noise enhancing) winds. Therefore, the following conditions were included in the operational noise model for each period:

- **Daytime:** Calm wind conditions and a Class-D temperature inversion, representing a stable condition.

- **Evening:** 3 m/s wind condition for the westerly prevailing direction and a Class-F temperature inversion.
- **Night time (and morning shoulder):** 3 m/s wind condition for the two prevailing directions and a Class-G temperature inversion.

For the construction noise model a Class-D temperature inversion was adopted (representing a stable condition) for all scenarios.

Although other receptors are situated at distances further from the site that could be influenced by the effects of other wind and inversion conditions, compliance at the closest receptors and further attenuation provided by intervening topography will ensure compliance at other receptors.

2.10.2 *Conceptual Mitigation Measures*

Based on preliminary noise modelling results, it was evident that operational noise levels have the potential to exceed the PSNL during daytime, evening, night time and morning shoulder periods at residential receptors to the south of the Project site across all stages of the proposed quarry expansion.

Following preliminary noise modelling Hanson was consulted to determine suitable mitigation that could be incorporated into the project design to assist in reducing noise impacts. Based on the consultation with Hanson, reasonable and feasible mitigation measures have been discussed and conceptual mitigation was modelled to achieve compliance with the PSNL for all operational assessment scenarios.

Hanson has considered and then confirmed that all recommended measures presented in this noise assessment report are feasible and reasonable. Specifically, the noise reducing mitigation and/or required source emission values (presented in *Table 2.3* below) are achievable by using a combination of acoustic enclosures, barriers/walls/mounds and suitable equipment selection/procurement i.e. with lower source emission values.

This mitigation involves the following measures:

Boundary Mitigation:

- Earth Bunding (approximately 25 m in height, 450 m in length and 75 m in width) is required along the southern boundary of the site to provide additional shielding from the processing plant and asphalt production plant.
- Earth Bunding (approximately 20 m in height, 250 m in length and 60 m in width) is also required at the western boundary of the pit to provide shielding from in pit activities from Stage 2 of the quarry expansion when in pit activities progress closer to Receptor 20 to the west.

Plant / Equipment Procurement:

- During the operational design, choose appropriate machines for each task and adopt efficient work practices to minimise the total number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit, with consideration to offensive noise characteristics such as tonality, low frequency noise or impulsiveness.
- The key items of plant/equipment are presented in *Table 2.3*. The required LW deductions for these specific items of equipment/plant and the LW required to meet most stringent night time PSNL are presented in *Table 2.3*.
- Operational LW emissions should be at or below those presented in *Table 2.3* and *Table 7.1* of this report. Where items of procured plant generate offensive noise characteristics, INP penalties will be applied prior to meeting the LW values presented above.

At Source Mitigation:

- Where LW values for plant/equipment outlined in *Table 2.3* are not reasonable or feasible, the operational design will incorporate acoustic enclosures / barriers to assist in reducing the noise emission of identified plant/equipment. Design of acoustic enclosures / barriers will also consider offensive noise characteristics as tonality, low frequency noise or impulsiveness.

Table 2.3 below details the required LW deductions for specific items of equipment/plant and the LW required to meet most stringent night time PSNL. These LW values can be met by a combination of at source mitigation and equipment procurement.

INP penalties for offensive noise characteristics such as tonality, low frequency noise or impulsiveness were not included for conceptual mitigation noise modelling, as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.

Table 2.3 *LW mitigation required to meet most stringent PSNL*

Equipment / Plant	Reduction of LW (dBA)	Required/Mitigated LW
Cone Crusher	10	108
Jaw Crusher	10	105
Barmac Crusher	10	97
Screens	10	105
Asphalt Stack	10	102
Asphalt Plant	10	100
Pug mill	10	101
Feeder	5	108
Conveyors	10	81 (LW/m)
1. LW in dBA, rounded to nearest whole number.		

2.11

CUMULATIVE IMPACTS

Noise impact assessments are generally based on predicting project-specific levels at the closest and/or most affected receptors and then comparing these to criteria or management levels that apply to the type of emission being considered.

In the case of construction and operational emissions, the noise criteria are derived based on existing noise levels for the area, for road traffic and vibration fixed values apply. To assess potential cumulative impacts a varied approach has therefore been adopted, as described below.

2.11.1

Noise

The operational noise criteria (INP) are based on existing noise levels measured at locations surrounding the Project site, such that existing conditions and industrial noise contributions are considered as part of the assessment approach. The criteria are designed to prevent any long-term increase in cumulative industrial noise. Therefore, the INP criteria address potential cumulative impacts without further discussion required.

The construction noise criteria (ICNG) and management levels are based on existing noise levels measured at locations surrounding the Project site, but focus on the direct impacts from the site under assessment. Cumulative construction noise impacts are beyond the control of Hanson, are temporary in most circumstances and are best managed by local or state consent authorities for significant projects. Therefore, a qualitative assessment of potential cumulative impacts has been conducted but limited discussion regarding cumulative impacts is required.

Road Traffic Noise

The road traffic noise criteria (RNP) are fixed values but are derived to assess the Project's noise level contribution (i.e. project vehicles on public roads) and the effects of cumulative road traffic noise impacts. Therefore, the RNP criteria address potential cumulative impacts without further discussion required.

2.11.2

Vibration

The vibration criteria (the NSW vibration guideline and DIN4150-3) are again fixed values derived to assess the Project site vibration level contribution. Cumulative impacts are unlikely to occur in most circumstances due to the lack of existing influential sources. Therefore, a qualitative assessment of potential cumulative impacts has been conducted but limited discussion regarding cumulative impacts is required.

In light the above, the focus of any discussion regarding cumulative impacts is associated with operational noise, as presented in *Chapter 7*.

The SEARs require consultation with relevant local, State and Commonwealth Government authorities. These agencies as relevant to the noise and vibration assessment are outlined in *Table 2.4*, along with the response received.

Table 2.4 *Stakeholder Consultation*

Relevant Stakeholder	Consultation Method	Response
Environment Protection Agency	Letter advising that the EIS process is underway and the assessment will address the SEARs. Request for additional comments made.	<p>The EPA understands that the crusher plant on the premises is dated and is potentially a significant source of noise and dust impacts to sensitive receivers surrounding the premises. The influence of this plant whilst operating on noise and dust levels received at neighbouring properties must be included in any assessment of impacts from this proposal.</p> <p>If the assessment indicates that the plant is a significant noise or dust source, then consideration will be given to feasible mitigation measures and / or plant upgrade.</p>

This chapter describes the sensitive receptors in proximity to the site, the measurement approach adopted to quantify existing levels representative of their location and results; and the results of environmental noise measurements and logging.

3.1

EXISTING NOISE ENVIRONMENT

A key element in assessing environmental noise impacts is an understanding of the existing ambient and background noise levels in the vicinity of the closest and/or potentially most affected receptors situated in proximity to the site. The noise environment in the vicinity of the Project receptors is best described as 'rural' - defined by the INP as '*an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic. Such areas may include:*

- *an agricultural area, except those used for intensive agricultural activities;*
- *a rural recreational area such as resort areas;*
- *a wilderness area or national park; and*
- *an area generally characterised by low background noise levels (except in the immediate vicinity of industrial noise sources).*

This area may be located in either a rural, rural-residential, environment protection zone or scenic protection zone, as defined on a council zoning map (i.e. Local Environmental Plan (LEP) or other planning instrument).'

Despite the predominantly rural setting of the Project site, the existing noise environment of the surrounding area is under the influence of traffic noise from the nearby Pacific Highway. The existing background noise levels considered in this assessment are therefore much higher than would typically be experienced in a rural environment.

3.2

POTENTIALLY SENSITIVE RECEPTORS

The potentially sensitive receptors where compliance has been assessed are presented below in *Table 3.1* and identified in *Figure 1.3*.

Table 3.1 Potentially Sensitive Receptors

ID ¹	Description	GPS Co-ordinates (UTM, Zone 55H)		Ground Height (AHD), m	Approximate Distance from Quarry (m)	Direction from Quarry
		Easting	Northing			
13 ³	Unoccupied Residential (Dwelling) Receptor	482489	6521606	17	185	South
14	Residential (Dwelling) Receptor	482557	6521227	19	540	South
1	Residential (Dwelling) Receptor	482564	6520983	30	785	South
16	Residential (Dwelling) Receptor	482434	6521102	24	720	South
2	Residential (Dwelling) Receptor	482404	6520969	35	845	South
17	Residential (Dwelling) Receptor	482264	6521086	21	750	South
4	Residential (Dwelling) Receptor	482251	6521225	14	620	South
18	Residential (Dwelling) Receptor	481534	6520898	35	950	South West
19	Residential (Dwelling) Receptor	481673	6521507	14	300	South West
24	Residential (Dwelling) Receptor	481162	6521402	12	780	South West
20	Residential (Dwelling) Receptor	481482	6522044	23	340	West
6	Residential (Dwelling) Receptor	481371	6523402	6	1,200	North West
30	Residential (Dwelling) Receptor	481804	6523653	4	1,380	North West
11	Residential (Dwelling) Receptor	482612	6523043	19	820	North
48	Potential Future Industrial Receptor	482902	6522221	19	50	North East
33	Residential (Dwelling) Receptor	483599	6523052	10	1,100	North East
38	Residential (Dwelling) Receptor	484170	6522500	10	1,250	East
7	Cassegrain Winery – Commercial	483212	6522146	13	240	East
47	Potential Future Industrial Receptor	483092	6521830	9	150	East
34	Residential (Dwelling) Receptor	483705	6521959	16	780	East
35	Residential (Dwelling) Receptor	483732	6521688	30	790	East
8	Industrial Receptor	483289	6521515	10	490	East
46	Expressway Spares - Commercial	483124	6521504	7	400	South East
9	Industrial Receptor	482977	6521492	7	330	South East
10	Industrial Receptor	482813	6521379	12	360	South

1. Receptor ID's have been derived from the Air Quality and Greenhouse Gas Assessment (Annex G) to ensure consistency across receptors throughout the EIS.
2. Australian Height Datum (AHD) in metres.
3. This location is assessed in full despite being unoccupied.

Guidance Note

Receptor locations were established based on observations made whilst on and near the site, review of land use zoning data and the results of preliminary noise modelling, where receptor positions were optimised to predict likely worst-case noise levels.

These locations do not represent all receptors located in the vicinity of the Project site but have been selected for the purposes of this assessment; they are considered to be representative of locations that will potentially experience the highest impacts associated with the quarry's construction and subsequent ongoing operation.

During the site survey and subsequent measurements, it was observed that the dwelling at R1 appeared unoccupied and uninhabited. The land or property owner was not contacted to confirm this, so the property and occupants actual status is unknown hence noise levels have been assessed at this location regardless of the properties status.

3.3 EXISTING BACKGROUND NOISE LEVELS

This section presents the measured noise levels from short-term operator attended noise measurements and long-term unattended noise logging completed adopting the methodology described below.

3.3.1 *Monitoring Methodology*

Ambient and background noise levels were quantified via monitoring, with due regard to the requirements described in INP, applicable parts of Standards Australia AS1055-1997™ (AS1055) – *Description and Measurement of Environmental Noise* and other relevant Australian and international standards for environmental noise monitoring.

To quantify existing noise levels in the absence of the site under assessment, unattended noise logging and operator attended noise measurements were completed at select locations considered representative of existing conditions experienced by the community near the project. The unattended logging and attended measurements and were conducted by a qualified acoustician and Member of the Australian Acoustical Society (MAAS). The equipment used and key features of the monitoring methodology is described below.

Measurement and Logging Equipment

The measurement and logging equipment used to complete the assessment complied with the requirements of AS61672 or AS1259 as relevant to the device. Each device had current National Association of Testing Authorities, Australia (NATA) calibration certificates, with certification at intervals not exceeding two years at the time of use. The equipment used for this assessment was as follows:

- 4 x Ngara (Type 1) Environmental Noise Loggers.
- 1 x Brüel & Kjær 2250 (Type 1) Sound Level Meter.
- 1 x Brüel & Kjær (Type 1) Sound Level Calibrator.

Instrument calibration was checked prior to monitoring and again at the conclusion with no difference noted between the two measurements. The sound level calibrator used complied with the requirements of IEC60942.

Unattended Noise Logging

Long-term unattended noise logging was completed at four locations at residential receptors situated in proximity to the quarry, identified as L1 to L4 in *Figure 1.3*.

These locations were selected for this assessment as they allowed the measurement of existing ambient and background noise levels that are considered representative of the most affected receptors situated in close proximity to the project.

The loggers were deployed on Monday, 6 November 2017 and collected on Wednesday 22 November 2017. The logging devices were set to record acoustical and statistical parameters at 15 minute intervals for the monitoring period. As a minimum L_{max} , L_{min} , L_{eq} , L_1 , L_{10} and L_{90} values were captured.

At the conclusion of the logging period, the captured noise data was combined with meteorological data from the nearest Bureau of Meteorology (BOM) Automated Weather Station (AWS) to exclude any values that exceeded the rain and wind thresholds for noise logging analysis.

The nearest BOM AWS is situated at Port Macquarie Airport (AWS Site Number: 060139). Any extraneous or potentially spurious data was excluded during this process.

Any data recorded at the Port Macquarie Airport AWS during periods of rain or when wind speeds that exceeded 7 m/s (approximately equal to 5 m/s at microphone height, 1.5 m above ground level) has been excluded.

The residual noise data, not excluded when combined with the meteorological data noted above, was used to calculate the daily and overall ambient (L_{eq}) and background (L_{90}) noise levels as per the requirements of the INP.

Operator Attended Noise Measurements

Short-term operator attended noise measurements were conducted at eight locations around the site on Monday, 6 November; Tuesday, 7 November and Wednesday 22 November 2017, identified as R1 to R4 and A1 to A4 in *Figure 1.3*. These locations were selected whilst in the vicinity of the project site to better understand the broader acoustical environment.

Each measurement was of 15 minutes duration and time synchronised to the noise logging device to allow for comparison of measured values at a range of acoustically different locations.

The measurement device was set to show instantaneous noise levels throughout each measurement, with noise events noted by the operator. Overall 15 minute acoustical and statistical parameters were recorded by the device (in dBA) with L_{max}, L_{min}, L_{eq}, L₁, L₁₀ and L₉₀ values captured as a minimum.

3.3.2 Unattended Noise Logging Results

The measured daily and overall, ambient (L_{eq}) and background (L₉₀) noise levels, for each noise logging location (L1 to L4) are presented in *Table 3.2* to *Table 3.5*. These daily and overall summary values were established as per the requirements of the INP.

The L_{eq} acoustical parameter corresponds to the level of noise equivalent to the energy average of ambient noise levels occurring over a measurement period. L₉₀ represents the level exceeded for 90 percent of the measurement period and is referred to as the average minimum or background noise level.

In accordance with the INP the assessment periods are defined as follows:

- Daytime is the period from 7AM to 6PM, Monday to Saturday or 8AM to 6PM on Sundays and public holidays.
- Evening is the period from 6PM to 10PM, Monday to Sunday (seven days per week).
- Night time is all remaining periods.

Unattended noise logging charts which present the unattended noise logging data and weather conditions in 15 minute samples are provided in *Annex E* of this report.

Table 3.2 Unattended Environmental Noise Logging (L01)

Date	Measured Existing Noise Levels					
	ABL Day	ABL Evening	ABL Night	Leq Day	Leq Evening	Leq Night
Monday-6-Nov-17	-	37.9	36.2	38.8	52.2	44.2
Tuesday-7-Nov-17	39.8	36.5	33.5	46.8	44.0	41.6
Wednesday-8-Nov-17	37.8	36.3	33.1	47.1	44.9	44.2
Thursday-9-Nov-17	39.9	37.8	34.2	47.9	45.5	44.0
Friday-10-Nov-17	41.3	37.4	32.1	49.3	44.7	43.4
Saturday-11-Nov-17	38.9	34.2	29.0	47.3	44.3	43.3
Sunday-12-Nov-17	33.7	33.9	28.2	44.6	46.3	43.5
Monday-13-Nov-17	35.0	37.1	31.7	46.2	44.2	43.1
Tuesday-14-Nov-17	37.6	36.0	33.4	46.6	45.3	43.3
Wednesday-15-Nov-17	37.9	35.0	31.6	47.1	46.0	43.7
Thursday-16-Nov-17	38.4	35.2	32.1	46.2	53.5	42.8
Friday-17-Nov-17	38.2	35.1	30.1	47.5	48.0	42.7
Saturday-18-Nov-17	35.1	36.1	32.5	45.9	49.4	51.9
Sunday-19-Nov-17	37.6	36.8	35.2	46.6	49.8	44.2
Summary RBL Values	38	36	32	47	48	45
<ol style="list-style-type: none"> 1. All noise levels are dBA re 2 x 10⁻⁵ Pa. 2. '-' indicates periods with too few valid samples due to weather or logger operation. 3. Grey italicised text indicated that some samples were excluded from the ABL due to inclement weather experienced on the day. 4. Summary RBL parameters are rounded to the nearest whole decibel (dB). 						

Table 3.3 **Unattended Environmental Noise Logging (L02)**

Date	Measured Existing Noise Levels					
	ABL Day	ABL Evening	ABL Night	Leq Day	Leq Evening	Leq Night
Monday-6-Nov-17	-	37.6	31.7	41.5	53.9	42.2
Tuesday-7-Nov-17	33.8	37.7	31.4	43.8	51.1	41.4
Wednesday-8-Nov-17	36.4	39.3	30.1	44.6	49.5	41.5
Thursday-9-Nov-17	36.7	35.4	29.9	51.4	50.9	39.9
Friday-10-Nov-17	36.2	34.8	30.0	51.7	48.7	42.5
Saturday-11-Nov-17	34.6	33.3	30.2	53.5	49.9	42.1
Sunday-12-Nov-17	32.4	41.9	33.1	47.8	53.4	44.8
Monday-13-Nov-17	34.8	39.9	34.2	44.1	50.2	43.9
Tuesday-14-Nov-17	37.8	36.8	34.7	45.7	51.4	43.8
Wednesday-15-Nov-17	40.0	37.9	34.6	47.7	51.8	45.6
Thursday-16-Nov-17	38.5	42.0	32.5	50.0	50.6	47.0
Friday-17-Nov-17	35.4	45.9	34.8	48.9	53.3	48.1
Saturday-18-Nov-17	36.5	41.8	35.0	56.5	55.3	50.0
Sunday-19-Nov-17	37.2	35.9	38.5	45.4	54.2	52.0
Monday-20-Nov-17	-	37.6	31.7	41.5	53.9	42.2
Summary RBL Values	36	36⁵	33	50	52	46
<ol style="list-style-type: none"> 1. All noise levels are dBA re 2 x 10⁻⁵ Pa. 2. '-' indicates periods with too few valid samples due to weather or logger operation. 3. Grey italicised text indicated that some samples were excluded from the ABL due to inclement weather experienced on the day. 4. Summary RBL parameters are rounded to the nearest whole decibel (dB). 5. The evening RBL was measured to be 38 dBA, however in accordance with the INP, where the evening RBL is measured to be higher than the day-time RBL, the RBL adopted for evening time should be no greater than the day-time RBL. Therefore, the daytime RBL has been adopted for the evening period. 						

Table 3.4 **Unattended Environmental Noise Logging (L03)**

Date	Measured Existing Noise Levels					
	ABL Day	ABL Evening	ABL Night	Leq Day	Leq Evening	Leq Night
Monday-6-Nov-17	-	40.8	36.3	39.4	47.7	46.2
Tuesday-7-Nov-17	41.6	37.6	34.3	50.5	44.0	45.2
Wednesday-8-Nov-17	42.5	38.0	35.3	50.6	45.0	44.2
Thursday-9-Nov-17	42.0	39.5	36.1	49.7	45.9	45.7
Friday-10-Nov-17	41.8	38.4	33.3	50.6	48.1	45.3
Saturday-11-Nov-17	41.2	37.3	29.6	52.0	44.4	46.4
Sunday-12-Nov-17	40.4	39.6	30.2	48.3	49.2	44.9
Monday-13-Nov-17	38.6	37.9	32.8	53.1	45.1	45.7
Tuesday-14-Nov-17	40.6	38.6	35.6	51.4	49.8	46.6
Wednesday-15-Nov-17	41.2	38.3	37.0	50.0	52.3	47.2
Thursday-16-Nov-17	43.7	38.6	35.6	50.8	54.2	45.8
Friday-17-Nov-17	42.8	39.3	33.6	51.5	49.7	43.9
Saturday-18-Nov-17	37.9	36.7	32.5	50.1	53.7	43.7
Sunday-19-Nov-17	39.8	37.7	36.4	48.2	53.3	44.3
Monday-20-Nov-17	40.6	38.2	37.9	60.8	57.4	45.3
Tuesday-21-Nov-17	41.0	-	-	48.9	-	-
Summary RBL Values	41	38	35	53	51	46
<ol style="list-style-type: none"> 1. All noise levels are dBA re 2 x 10⁻⁵ Pa. 2. '-' indicates periods with too few valid samples due to weather or logger operation. 3. Grey italicised text indicated that some samples were excluded from the ABL due to inclement weather experienced on the day. 4. Summary RBL parameters are rounded to the nearest whole decibel (dB). 						

Table 3.5 Unattended Environmental Noise Logging (L04)

Date	Measured Existing Noise Levels					
	ABL Day	ABL Evening	ABL Night	Leq Day	Leq Evening	Leq Night
Monday-6-Nov-17	-	44.8	39.1	-	53.2	-
Tuesday-7-Nov-17	46.4	43.4	40.4	56.0	49.4	46.4
Wednesday-8-Nov-17	45.0	42.3	41.6	50.6	48.9	45.0
Thursday-9-Nov-17	46.4	42.4	43.9	52.1	49.3	46.4
Friday-10-Nov-17	45.7	41.7	39.3	51.7	50.2	45.7
Saturday-11-Nov-17	42.7	37.9	34.4	50.7	50.0	42.7
Sunday-12-Nov-17	39.5	37.5	35.4	48.1	52.0	39.5
Monday-13-Nov-17	39.1	43.3	40.8	48.0	49.7	39.1
Tuesday-14-Nov-17	42.1	39.6	40.8	49.3	53.1	42.1
Wednesday-15-Nov-17	41.5	39.9	41.2	49.0	50.3	41.5
Thursday-16-Nov-17	41.7	40.8	40.6	50.3	52.5	41.7
Friday-17-Nov-17	40.8	41.8	41.6	48.2	52.8	40.8
Saturday-18-Nov-17	41.7	38.3	38.5	50.6	54.7	41.7
Sunday-19-Nov-17	41.2	39.4	45.7	47.4	54.4	41.2
Monday-20-Nov-17	43.5	44.0	-	49.4	54.8	43.5
Summary RBL Values	42	42	41	51	52	50
<ol style="list-style-type: none"> 1. All noise levels are dBA re 2 x 10⁻⁵ Pa. 2. '-' indicates periods with too few valid samples due to weather or logger operation. 3. Grey italicised text indicated that some samples were excluded from the ABL due to inclement weather experienced on the day. 4. Summary RBL parameters are rounded to the nearest whole decibel (dB). 						

3.3.3

Operator Attended Noise Measurement Results

The results of short-term operator attended noise measurements are presented in *Table 3.6*. Operator attended noise measurement locations are presented in *Figure 1.3*.

Table 3.6 *Operator Attended Noise Measurements*

Location ID	Date	Start time	Measured Noise Levels, dBA					
			L _{Amax}	L _{Amin}	L _{Aeq}	L _{A1}	L _{A10}	L _{A90}
A5	6/11/2017	16:00	57	41	47	54	50	43
A6	7/11/2017	10:00	64	35	46	55	47	38
A1	7/11/2017	10:30	66	40	49	60	52	41
A2	7/11/2017	11:00	84	37	55	61	49	40
A3	7/11/2017	11:30	83	41	60	74	55	43
A4	7/11/2017	12:00	75	40	54	66	56	44
A7	7/11/2017	13:15	63	44	52	58	55	48
A8	22/11/2017	11:00	58	36	42	47	44	39
A7	22/11/2017	12:00	63	32	42	53	45	36
A6	22/11/2017	13:00	60	36	43	53	46	38
A5	22/11/2017	13:45	62	40	46	53	48	42

Discussion

The results of unattended noise logging conducted between Monday, 6 November 2017 and Wednesday 22 November 2017 were analysed and compared to the operator attended measurements conducted on Monday, 6 November; Tuesday, 7 November and Wednesday 22 November 2017.

The operator attended measurements were found to be consistent with the unattended logging results, therefore no adjustments to ambient and background noise levels were considered necessary for varying receptor locations.

The measured ambient and background noise levels presented in *Table 3.6* vary significantly, with background noise levels ranging between 36 and 48 dBA and ambient noise levels ranging between 42 and 60 dBA. However, most measurements were dominated by Pacific Highway traffic, wind-blown vegetation, some local traffic, birds and insects.

3.3.4 Rating Background Noise Levels

The Rating Background Noise Levels (RBL) for all potentially sensitive noise receptor were established based on the data presented in *Table 3.2* to *Table 3.5* and with regard to the INP as summarised above.

Unattended noise logging was conducted at four locations, hence, where background noise levels were not measured at a receptor, data from the closest or most representative noise logging location was adopted. These RBL values, for each receptor and assessment period are presented in *Table 3.7* below.

These RBL values are adopted to establish ICNG, 2009 noise management levels and INP criteria for residential receptors as identified in *Chapter 4* of this report. RBL values for commercial receptors are provided for general reference only and are not utilised to derive any criteria.

Table 3.7 Rating Background Noise Levels

Location ID	Rating Background Noise Levels (RBL)			
	Day	Evening	Night	Morning Shoulder
13	38	36	32	35
14	38	36	32	35
1	38	36	32	35
16	38	36	32	35
2	38	36	32	35
17	38	36	32	35
4	38	36	32	35
18	36	36	33	35
19	36	36	33	35
24	36	36	33	35
20	36	36	33	35
6	41	38	35	38
30	41	38	35	38
11	41	38	35	38
48	41	38	35	38
33	42	42	41	41
38	42	42	41	41
7	42	42	41	41
47	42	42	41	41
34	42	42	41	41
35	42	42	41	41
8	42	42	41	41
46	42	42	41	41
9	42	42	41	41
10	42	42	41	41

1. In accordance with the INP the assessment periods are defined as follows: Daytime is the period from 7am to 6pm - Monday to Saturday; or 8am to 6pm on Sundays and Public Holidays, Evening is the period from 6pm to 10pm and Night time is all remaining periods. The morning shoulder period is within the night time period, specifically between 5am and 7am.

Morning Shoulder Period

In accordance with the INP, the morning shoulder period is defined as part of the night time period between 5am and 7am.

This shoulder period is specifically identified in the INP for circumstances where existing ambient and background noise levels are steadily rising in these early morning hours, as is the case for areas surrounding the Project site, where transport sources (road traffic) increases noise during this period, when compared to the overall night time period.

To quantify existing overall background noise levels associated with the morning shoulder period, ERM has calculated the mid-point value between the measured daytime and night time period RBLs. The values outlined in *Table 3.4* are adopted here for the purposes of quantify existing conditions and establishing criteria by which impacts during that period may be assessed.

4.1

CONSTRUCTION NOISE MANAGEMENT LEVELS

All Project-specific “Noise Management Levels” (NML) have been established based on the representative RBL values presented in *Table 3.4* (where relevant) and in accordance with the ICNG.

During construction, the “Highly Noise Affected Management Level” (HNML) also applies to residential receptors during standard daytime hours and is a fixed value of $L_{eq, 15 \text{ minute}} \leq 75 \text{ dBA}$.

The sleep disturbance criteria of $RBL + 15 \text{ dBA}$ have been adopted for all residential receptors, consistent with the ICNG and INP.

In accordance with the ICNG, NML values for other sensitive receptors i.e. places of worship, commercial/industrial premises, schools or recreational areas are fixed levels based on usage. They do not rely on the RBL utilised for residential receptors.

The ICNG assessment periods are defined as follows:

- Daytime is the period from 7am to 6pm - Monday to Saturday; or 8am to 6pm on Sundays and Public Holidays;
- Evening is the period from 6pm to 10pm; and
- Night time is all remaining periods.

The Project-specific NMLs, for works within and outside the recommended standard hours for construction, are presented in *Table 4.1* below.

Table 4.1 Construction Noise Management Levels (NML)

ID	Type	Standard Hours ¹	Non-Standard Hours ¹				Sleep Disturbance ²	
		Daytime	Daytime	Evening	Night	Morning Shoulder	Night	Morning Shoulder
13	Residential ³	48	43	41	37	40	47	50
14	Residential ³	48	43	41	37	40	47	50
1	Residential ³	48	43	41	37	40	47	50
16	Residential ³	48	43	41	37	40	47	50
2	Residential ³	48	43	41	37	40	47	50
17	Residential ³	48	43	41	37	40	47	50
4	Residential ³	48	43	41	37	40	47	50
18	Residential ³	46	41	41	38	40	48	50
19	Residential ³	46	41	41	38	40	48	50
24	Residential ³	46	41	41	38	40	48	50
20	Residential ³	46	41	41	38	40	48	50
6	Residential ³	51	46	43	40	43	50	53
30	Residential ³	51	46	43	40	43	50	53
11	Residential ³	51	46	43	40	43	50	53
48	Potential Future Industrial	75	75	75	75	75	-	-
33	Residential ³	52	47	47	46	46	56	56
38	Residential ³	52	47	47	46	46	56	56
7	Commercial	70	70	70	70	70	-	-
47	Potential Future Industrial	75	75	75	75	75	-	-
34	Residential ³	52	47	47	46	46	56	56
35	Residential ³	52	47	47	46	46	56	56
8	Industrial	75	75	75	75	75	-	-
46	Commercial	70	70	70	70	70	-	-
9	Industrial	75	75	75	75	75	-	-
10	Industrial	75	75	75	75	75	-	-

1. Leq, 15 minute noise level in dBA.
2. Lmax noise level in dBA.
3. The HNAML (Leq, 15 minute ≤ 75 dBA) applies.

Construction and operational road traffic noise criteria were developed with due regard to the NSW Department of Environment, Climate Change and Water (DECCW) *NSW Road Noise Policy* (RNP), March 2011 and are presented in *Table 4.2*. The proposed transportation routes will mostly follow sub-arterial roads, however local roads are also considered in this assessment to ensure impacts are comprehensively assessed.

Table 4.2 *Road Traffic Noise Criteria*

Assessment Classification	Daytime (7am to 10pm) Assessment Period	Night time (10pm to 7am) Assessment Period
Road traffic noise criteria for existing residences affected by additional traffic on existing sub-arterial roads generated by land use developments.	Leq, (15 hour) 60 dB (external)	Leq, (9 hour) 55 dB (external)
Road traffic noise criteria for existing residences affected by additional traffic on existing local roads generated by land use developments.	Leq, (1 hour) 55 dB (external)	Leq, (1 hour) 50 dB (external)
1. The RNP is applied here as a guide to assess the potential impacts associated with construction and operational traffic noise from the Project.		

Guidance Note

The RNP also presents permissible increases in noise levels above the existing road traffic noise of the area. However, the relative increase criteria are primarily intended to protect existing quiet areas from excessive changes in amenity due to noise from a road project.

Where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce them through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dBA represents a minor impact that is considered barely perceptible to the average person.

4.3 OPERATIONAL NOISE CRITERIA

4.3.1 Operational (Quarry) Emissions

All Project-specific operational noise criteria ("Project-Specific Noise Levels", PSNL) have been established based on the representative RBL values presented in *Table 4.3* (where relevant) and in accordance with the INP.

The term PSNL is defined by the INP and considers the lowest of the intrusive or amenity criterion, so that the most stringent threshold is set with regard to existing industrial noise in the area. For this assessment the intrusiveness criteria have been adopted.

The sleep disturbance criteria of RBL + 15 dBA have been adopted for all residential receptors, consistent with the INP.

In accordance with the ICNG, PSNL values for other sensitive receptors i.e. places of worship, commercial/industrial premises, schools or recreational areas are fixed levels based on usage. They do not rely on the RBL utilised for residential receptors. Where the INP presents internal thresholds, a 10 dBA addition has been made to convert these to external criteria.

The INP assessment periods for Daytime, Evening and Night time are the same as those defined by the ICNG (refer to *Section 4.1*).

The PSNL are presented in *Table 4.3* below.

Table 4.3 Project-Specific Noise Levels (PSNL)

ID	Type	Project-Specific Noise Levels (Intrusiveness Criteria) ¹				Sleep Disturbance ²	
		Daytime	Evening	Night	Morning Shoulder	Night	Morning Shoulder
13	Residential	43	41	37	40	47	50
14	Residential	43	41	37	40	47	50
1	Residential	43	41	37	40	47	50
16	Residential	43	41	37	40	47	50
2	Residential	43	41	37	40	47	50
17	Residential	43	41	37	40	47	50
4	Residential	43	41	37	40	47	50
18	Residential	41	41	38	40	48	50
19	Residential	41	41	38	40	48	50
24	Residential	41	41	38	40	48	50
20	Residential	41	41	38	40	48	50
6	Residential	46	43	40	43	50	53
30	Residential	46	43	40	43	50	53
11	Residential	46	43	40	43	50	53
48	Potential Future Industrial	75	75	75	75	-	-
33	Residential	47	47	46	46	56	56
38	Residential	47	47	46	46	56	56
7	Commercial	70	70	70	70	-	-
47	Potential Future Industrial	75	75	75	75	-	-
34	Residential	47	47	46	46	56	56
35	Residential	47	47	46	46	56	56
8	Industrial	75	75	75	75	-	-
46	Commercial	70	70	70	70	-	-
9	Industrial	75	75	75	75	-	-
10	Industrial	75	75	75	75	-	-

1. Leq, 15 minute noise level in dBA.

2. Lmax noise level in dBA.

4.3.2

Quarry Blasting Emissions

Blasting limits are applicable to two main effects of blasting:

- air blast noise overpressure; and
- ground-borne vibration.

The limits for blasting described below are based on ANZEC (1990) guideline and Australian Standard AS 2187.2 – 2006 *Explosives - Storage and Use, Part 2: use of Explosives*.

Air Blast Overpressure

The air blast overpressure should not exceed 115 dBZ (L_{peak}) for more than 5% of the total number of blasts over the 12 month reporting period. However, the maximum level should not exceed 120 dBZ (L_{peak}) at any time. The dBZ (L_{peak}) unit of sound measurement considers the low frequency sounds which are not audible to the human ear but can be ‘felt’. Such limits will also ensure damage from blast noise overpressure is avoided.

Table 4.4 *Allowable Air Blast Overpressure Levels*

Air Blast Overpressure	Allowable Exceedances
115dBZ	5% of the total number of blasts over a 12 month period
120dBZ	0%

Ground-Borne Vibration

The Peak Particle Velocity (PPV, in mm/s) at any residence or noise sensitive receiver from ground vibration should not exceed 5 mm/s for more than 5% of the total number of blasts over the 12 month reporting period and the maximum level should not exceed 10 mm/s at any time.

Table 4.5 *Allowable Vibration Levels*

Peak Particle Velocity	Allowable Exceedances
5mm/s	5% of the total number of blasts over a period of 12 months
10mm/s	0%

Industrial and Commercial Receptors

The following criteria was approved by DA 1995/193, condition 25, clause (c) in 2009 by Port Macquarie Hastings Council (PMHC), although was not amended to the current Environmental Protection Licence (EPL) 5289 for the premises issued in November 2014. The criterion was developed to enable the industrial precinct to be established directly to the north of the quarry.

Ground vibration and air-blast overpressure levels from blasting undertaken at the site should not exceed the levels within *Table 4.6* at any existing or future industrial or commercial receiver on privately owned land.

Table 4.6 *Allowable Limits with Regards to Commercial and Industrial Receivers*

Parameter	Allowable Limits
Vibration (peak particle velocity)	25mm/s
Air-blast overpressure	125 dBZ

It is recommended that Hanson negotiate with the NSW EPA to have these limits included in the EPL upon development of the adjacent commercial and industrial precinct.

These criteria apply to minimise human annoyance and discomfort and were not developed to control possible structural damage. However, if ground vibration peak particle velocities comply with criteria for minimising human annoyance and discomfort, they would also be below levels that may cause structural damage to buildings.

Time and Frequency of Blasting

In accordance with the existing EPL, blasting at the premises may only be completed between the hours of 9.00 am to 3.00 pm Monday to Friday. Blasting is not permitted on Weekends or Public Holidays without the written approval of NSW EPA.

Monitoring Requirements

In accordance with the existing EPL, air-blast overpressure and ground vibration levels must be measured at any point within 1m of any affected residential boundary or other noise sensitive location, such as a school or hospital for all blasts carried out in or on the premises.

In addition, the licensee must monitor all blasts carried out in or on the premises at or near the nearest residence or noise sensitive location that is likely to be most affected by the blast.

This applies where the residence or noise sensitive location is not owned by the licensee or subject of a private agreement between the owner of the residence or noise sensitive location and the licensee relating to alternative blasting limits.

Instrumentation used to measure the air-blast overpressure and ground vibration levels must meet the requirements of Australian Standard 2187.2.

Fly-rock

Blasting practices at the quarry are to be undertaken in accordance with Australian Standard AS 2187.2 in order to:

- minimize the potential for fly-rock;
- protect the safety of people, property and livestock; and
- minimize dust and fumes emissions from blasting on the site.

Notification

According to DA 1995/193 (2009), Hanson are required to ensure the following notifications are in place prior to blasting:

- notify the landowner/occupier of any residence within 1km of the quarry pit who registers an interest in being notified about the blasting schedule on-site; and
- publicly display a number on the primary entrance to the site where information regarding blasting at the quarry can be obtained.

This section presents the qualitative assessment of lower risk acoustical factors that were considered during the preliminary stages of the data and information review process. The remainder of the assessment focuses on higher risk acoustical factors - construction and operational noise.

Construction and operational noise management plans are recommended to be prepared and implemented as detailed in *Chapter 8* of this report. These management plans act as a suitable provision and safeguard to evaluate these lower risk acoustical factors once the construction methodology and detailed design of the quarry occurs.

5.1 ROAD TRAFFIC NOISE – CONSTRUCTION

Based on the flow and mix of vehicles (mostly heavy vehicles) required to service the construction work for the Project, and the construction Road traffic noise impacts are temporary, any impacts from project traffic on public roads will be minimal, if any at all.

As stated in the Traffic assessment prepared for the EIS, the construction of the new ancillary infrastructure is assumed to take approximately 12 weeks for each plant. The delivery of all the infrastructure for site would be delivered in approximately 40 heavy vehicle movements importing items to site over these 12 weeks. During this time, personnel will be transported to site via light vehicles (approximately 10 trips per day during construction).

As such, it is expected that road traffic noise generated by the quarry will comply with the requirements of the RNP at the majority of receptors and any change in overall road traffic noise, however unlikely, would be barely perceptible to the average person such that cumulative impacts are also acceptable. It is also noted that the RNP primarily targets the assessment of operational road traffic noise impacts and is not intended for the assessment of short-term or temporary impacts associated with construction, especially where significant impacts are unlikely to occur.

Construction road traffic noise from the quarry may be audible at times but with the traffic management measures outlined in the broader environmental assessment for the quarry, will assist any adverse effects to be maintained at acceptable levels. The measures described in the broader environmental assessment are considered adequate to reduce the potential impacts (if any) associated with road traffic. Therefore, no further recommendations for construction road traffic noise mitigation and management measures are warranted or provided in this assessment.

Based on the equipment and activities identified for the construction and general operation of the quarry, potential sources of vibration are limited. This feature combined with the $\geq 100\text{m}$ distance offset (vibration dissipates rapidly with distance) to the closest sensitive receptor or buildings identifies that any vibration impacts will be minimal, if any at all.

It is expected that vibration generated by the construction works will comply with the requirements of the NSW Vibration Guideline and DIN 4150-3. During operation and maintenance, no vibration is expected to be generated and hence compliance with the requirements of the NSW Vibration Guideline and DIN 4150-3 will be achieved.

Vibration may be perceptible at times during construction but with standard construction planning and vibration management practices in place, the potential for human comfort (annoyance) impacts, or any adverse effects on buildings (cosmetic or structural damage) will be maintained at acceptable levels.

Given the limited potential for any vibration impacts to occur, no further recommendations for vibration mitigation and management measures are warranted or provided in this assessment.

Based on the equipment and activities identified for the construction and general operation of the quarry, potential sources of vibration are limited. Ground-borne construction noise is usually present on tunnelling projects when significant tunnel boring equipment is operated underground.

Ground-borne noise impacts (generated by vibration) from the quarry are therefore not anticipated, as significant vibration generating sources with the potential to generate perceptible ground-borne noise do not form part of the Project design.

It is highly unlikely that any ground-borne noise would be audible or perceptible at any times during the Project. Therefore, it is expected that ground-borne noise generated by the construction works will comply with the requirements of the ICNG, and will comply with the INP (and other relevant requirements for ground-borne noise) during operation.

Given the limited potential for any ground-borne noise impacts to occur, no further recommendations for specific mitigation and management measures are warranted or provided in this assessment.

6.1 ASSESSMENT SCENARIOS

Although other construction activities will likely be required, works with the potential to generate the most significant noise emissions are represented by the three following activities:

- Demolition of existing structures.
- Site preparation and establishment.
- General construction of infrastructure.

Assessment scenarios have been developed based on the construction activities described above. The plant, equipment, and/or machinery with the potential to generate noise impacts at the closest and/or potentially most affected sensitive receptors or structures located off-site have been considered in each case.

The construction assessment scenarios are identified in *Table 6.1* and have been adopted for the purposes of predicting noise levels and comparison to management levels. As part of the project design, the infrastructure of the existing quarry will be re-located/replaced as part of the quarry expansion. Therefore overlap between construction and operational scenarios will be minimal if any at all.

As outlined in *Section 2.10*, a number of modelling features adopted for the construction noise model are described in *Table 6.1*:

- **Quantity** is the number of equipment operating per 15 minute assessment period.
- **Duty Factor** is the percentage of time the equipment operates per 15 minute assessment period, or represents a reduced emission for part of the period.
- **Base LW Value** is source emission or 'Sound Power Level' (LW) directly allocated to the equipment, unadjusted.
- **INP Penalty** considers any annoying characteristic such as tonality, low frequency noise or impulsiveness.
- **Total LW Value** is the overall equipment source emission (LW) adjusted for the quality, duty factor and INP penalty.

Table 6.1 Construction Noise Assessment Scenarios (Works, Activities and Equipment)

Scenario	Description	Equipment	Quantity	Duty Factor	Base LW Value	Total LW Value	Source
SCN01	Demolition of Existing Structures	Excavator (approx. 20 tonne)	2	100%	105	108.0	Australian Standard AS2436
		Excavator (approx. 40 tonne) ²	1	100%	115	120.0	TfNSW CNS
		Generator	1	100%	99	99.0	Australian Standard AS2436
		Jackhammer ²	1	100%	113	118.0	TfNSW CNS
		Front end loader ²	1	100%	113	118.0	Australian Standard AS2436
		Light Vehicle (idle)	6	50%	95	99.8	Australian Standard AS2436
		Heavy Vehicle (idle)	6	50%	107	111.8	Australian Standard AS2436
		Light Vehicle (moving)	6	70%	95	101.2	Australian Standard AS2436
		Heavy Vehicle (moving)	6	70%	107	113.2	Australian Standard AS2436
SCN02 a/b	Site Preparation and Establishment	Excavator (approx. 20 tonne)	1	75%	105	103.8	Australian Standard AS2436
		Excavator (approx. 30 tonne)	1	75%	110	108.8	Australian Standard AS2436
		Concrete agitator truck	1	50%	109	106.0	Australian Standard AS2436
		Concrete pencil vibrator	1	50%	103	100.0	Australian Standard AS2436
		Concrete pump truck	1	50%	108	105.0	Australian Standard AS2436
	a) Concrete Batching Plant b) Processing Plant & Asphalt Production Plant	Scraper	1	75%	116	114.8	Australian Standard AS2436
		Roller	1	100%	108	108.0	Australian Standard AS2436
		Grader	1	75%	110	108.8	Australian Standard AS2436
		Light Vehicle (idle)	6	50%	95	99.8	Australian Standard AS2436
		Heavy Vehicle (idle)	6	50%	107	111.8	Australian Standard AS2436
		Light Vehicle (moving)	6	70%	95	101.2	Australian Standard AS2436
		Heavy Vehicle (moving)	6	70%	107	113.2	Australian Standard AS2436

Scenario	Description	Equipment	Quantity	Duty Factor	Base LW Value	Total LW Value	Source
SCN03 a/b	General Construction of Infrastructure	Cherry Picker	1	50%	105	102.0	Australian Standard AS2436
		Crane (mobile)	1	75%	104	102.8	Australian Standard AS2436
		Hand tools (electric)	6	50%	102	106.8	Australian Standard AS2436
		Hand tools (pneumatic)	1	50%	116	113.0	Australian Standard AS2436
	a) Concrete Batching Plant	Welder	2	50%	105	105.0	Australian Standard AS2436
	b) Processing Plant & Asphalt Production Plant	Light Vehicle (idle)	6	50%	95	99.8	Australian Standard AS2436
		Heavy Vehicle (idle)	6	50%	107	111.8	Australian Standard AS2436
		Light Vehicle (moving)	6	70%	95	101.2	Australian Standard AS2436
		Heavy Vehicle (moving)	6	70%	107	113.2	Australian Standard AS2436
Lmax	Maximum Noise Level Assessment	Metal on Metal Contact	2 ¹	100%	120.0	123.0	

1. Three Lmax sources were modelled, one at the Northern, Eastern, and Southern extent of the site boundary.
2. INP penalty applied for offensive noise characteristics.

Based on the construction assessment scenarios and LW values identified in *Table 6.1*, noise levels have been predicted at all receptors (via modelling), and compared to the NML identified in *Table 4.1* above.

A comparison of the predicted values is provided in *Table 6.2* for the daytime NML. L_{max} noise levels are also compared to the most stringent night time sleep disturbance criterion for works outside the recommended standard hours for construction. Any noise levels that exceed criteria are highlighted in **bold** typeset.

Guidance Note

As described in *Section 2.10*, Construction noise level predictions have been conducted to identify results for representative worst-case scenarios, as the predicted values consider the cumulative emission (and potential impact) of all equipment sources working concurrently.

It is not possible or warranted to reflect potential impacts, to model every plausible activity, task or usage for each noise generating source and location, hence the conservative approach adopted here has been applied to ensure that representative worst-case noise predictions were conducted. Furthermore, area sources were utilised where possible to reflect the potential distribution of noise across the site, and the potential emissions from activities undertaken at various locations within and around the site.

Table 6.2 Predicted Construction Noise Levels – All Scenarios (SCN01 to SCN03, Lmax)

ID	Type	Predicted Noise levels, Leq, 15 minute in dBA						Comparison to Daytime NML					Sleep Disturbance
		SCN01	SCN02a	SCN02b	SCN03a	SCN03b	Lmax ¹	SCN01	SCN02a	SCN02b	SCN03a	SCN03b	
13	Residential ²	41	37	52	36	50	38 - 57	-7	-11	4	-12	2	10
14	Residential ²	46	40	49	39	47	43 - 53	-2	-8	1	-9	-1	6
1	Residential ²	43	38	44	36	43	40 - 48	-5	-10	-4	-12	-5	1
16	Residential ²	44	39	46	37	45	41 - 51	-4	-9	-2	-11	-3	4
2	Residential ²	42	37	45	36	43	40 - 49	-6	-11	-3	-12	-5	2
17	Residential ²	43	38	46	36	44	40 - 50	-5	-10	-2	-12	-4	3
4	Residential ²	42	37	48	35	46	40 - 52	-6	-11	0	-13	-2	5
18	Residential ²	35	32	28	30	27	29 - 32	-11	-14	-18	-16	-19	-16
19	Residential ²	37	36	36	34	35	30 - 40	-9	-10	-10	-12	-11	-8
24	Residential ²	36	27	32	26	30	33 - 35	-10	-19	-14	-20	-16	-13
20	Residential ²	27	25	36	24	34	24 - 28	-19	-21	-10	-22	-12	-20
6	Residential ²	34	32	23	31	22	29 - 38	-17	-19	-28	-20	-29	-12
30	Residential ²	38	35	26	34	25	26 - 38	-13	-16	-25	-17	-26	-12
11	Residential ²	43	40	34	39	33	34 - 44	-8	-11	-17	-12	-18	-6
48	Potential Future Industrial	57	60	41	58	40	36 - 64	-18	-15	-34	-17	-35	-
33	Residential ²	45	42	34	40	33	37 - 45	-7	-10	-18	-12	-19	-11
38	Residential ²	44	40	34	39	33	36 - 43	-8	-12	-18	-13	-19	-13
7	Commercial	57	54	43	53	41	44 - 57	-13	-16	-27	-17	-29	-
47	Potential Future Industrial	56	49	46	48	45	47 - 53	-19	-26	-29	-27	-30	-
34	Residential ²	50	46	41	44	39	41 - 50	-2	-6	-11	-8	-13	-6
35	Residential ²	49	45	41	43	40	44 - 48	-3	-7	-11	-9	-12	-8
8	Industrial	52	48	48	46	46	48 - 52	-23	-27	-27	-29	-29	-
46	Commercial	56	51	50	49	48	50 - 55	-14	-19	-20	-21	-22	-
9	Industrial	52	47	46	45	44	47 - 50	-23	-28	-29	-30	-31	-
10	Industrial	46	39	49	37	48	44 - 53	-29	-36	-26	-38	-27	-

1. Lmax noise level in dBA.
2. The HNAML (Leq, 15 minute ≤ 75 dBA) applies.
3. Sleep disturbance criterion not applicable for Commercial and Industrial receptors (i.e. not a residence/dwelling).
4. “ - ” indicates that an assessment of this feature does not apply for this circumstance/receptor.

6.2.2

Summary of Results

The results presented in *Table 6.2* and *Table 6.3* identify the following:

- The predicted L_{eq} , 15 minute noise levels range between 22 and 65 dBA for noise generating construction works and activities associated with the Project.
- The L_{max} noise levels are presented as a range, these noise levels are dependent on the location of the L_{max} noise source and the receptor.
- The highest predicted L_{max} noise levels range between 28 and 57 dBA at residential receptors for maximum noise level events generated by construction works and activities associated with the Project.
- The highest L_{eq} , 15 minute and L_{max} noise levels are predicted at residential receptors 13 and 14, generally the first row of receptors south of the Project site.
- The majority of predicted L_{eq} , 15 minute noise levels are below the daytime NML applicable at residential and other sensitive receptors for works within the recommended standard hours of construction.
- Exceedance of the daytime NML at residential receptors for works within the recommended standard hours of construction are predicted at receptors 13 and 14 in SCN02b and at receptor 13 in SCN03b.
- All predicted L_{eq} , 15 minute noise levels are below the daytime HNML value of L_{eq} , 15 minute ≤ 75 dBA applicable at residential receptors for works within the recommended standard hours of construction.
- Exceedance of the evening, night time and morning shoulder NML at residential receptors for works outside the recommended standard hours of construction are predicted at receptors to the south of the Project site across all scenarios.
- Exceedance of L_{max} noise levels for the sleep disturbance criteria (night time and morning shoulder) applicable at residential receptors for works outside the recommended standard hours of construction are predicted at receptors to the south of the Project site.

6.2.3

Discussion of Findings

The predicted noise levels identified above are typical of construction works and activities undertaken in the vicinity of residential, commercial and other sensitive land use precincts.

These predicted values do not represent a constant noise emission that would be experienced by the community on a daily basis throughout the construction schedule. The predicted noise levels will only be experienced for limited periods of time when works are occurring; they will not be experienced over whole daytime, evening or night time periods. The construction schedule will involve the following key phases, demolition of existing structures (approximately 1-2 months) and construction of new infrastructure (approximately 12 months).

Construction noise may be audible at times, however impacts associated with these works will be temporary and do not represent a permanent impact on the community and surrounding environment. Some noise from construction sites is inevitable, such that the ICNG focuses on minimising construction noise impacts, rather than only on achieving numeric noise levels.

These results identify that general good-practice construction noise management and control techniques will be necessary to maintain acceptable noise levels at all receptors.

The discussion above also highlights that construction works should be limited to the recommended standard construction hours where possible, to minimise exceedances of the NMLs and reduce construction noise impacts.

6.2.4 *Sleep Disturbance*

It is important to consider potential sleep disturbance noise impacts associated with construction noise sources and with construction road traffic. Based on the results presented in *Table 6.2*, the sleep disturbance criteria is exceeded at a number of receptors to the south of the Project site. It is recommended that the majority (if not all) of construction works are limited to the recommended standard construction hours.

Construction outside of the recommended standard hours is not scheduled to occur. If construction is required outside the recommended standard hours, it is anticipated that general construction or construction road traffic will generate peak or maximum noise events with the potential to impact sleep during the night time period.

If there is a requirement for out of hours work due to an unforeseen reason, the closest and most sensitive receptors (13, 14, 1, 16, 2, 17 and 4) will be notified at least one week prior. With due regard to the requirements of the ICNG and RNP, suitable recommendations which can be practically implemented are provided in *Chapter 8*.

6.3 *POTENTIAL CUMULATIVE IMPACTS*

As noted in *Chapter 4*, the NML are based on existing noise levels measured at locations surrounding the site and focus on the direct impacts from the site under assessment. Furthermore, cumulative construction noise impacts are beyond the control of Hanson, are temporary in most circumstances and are best managed by local or state consent authorities for significant projects.

Although cumulative impacts are unlikely, as there are no other construction projects proposed for the area, due care may be required of the local or state consent authorities to manage any works occurring concurrently. Where issues arise, Hanson may be able to assist by scheduling certain works or activities to minimise cumulative impacts.

Given that the majority of predicted construction noise levels are compliant during the recommended standard hours of construction, cumulative impacts are highly unlikely to occur or to be dominated by this Project, if construction is limited to standard hours.

6.4 *ASSESSMENT OUTCOMES*

Based on the findings summarised above and in accordance with the requirements of the ICNG, suitable noise mitigation and management measures which may be feasibly and reasonably implemented are recommended in *Section 8.1*.

Construction noise levels will be reduced and impacts minimised with the successful implementation of these recommendations. Impacts may not be reduced to negligible levels for all receptors during all construction activities; however the recommendations will assist to ensure that any residual impacts are minimised as far as is practically achievable.

7.1

ASSESSMENT SCENARIOS

Unlike construction, where noise will vary with the activity undertaken, operational emissions are predicted based on the known Project design available at the time of the assessment. Indicative Project layout drawings, as well as supporting information and data provided by Hanson, have been used to establish the operational assessment scenarios.

The operational plant, equipment, and/or machinery with the potential to generate noise impacts at the closest and/or potentially most affected receptors have been considered in each scenario.

The operational assessment scenarios are identified in *Table 7.1* and have been adopted for the purposes of predicting noise levels and comparison to criteria, PSNL. As part of the project design, the infrastructure of the existing quarry will be re-located/replaced as part of the quarry expansion. Therefore overlap between construction and operational scenarios will be minimal if any at all.

As outlined in *Section 2.10*, a number of modelling features adopted for the operational noise model are described in *Table 7.1*:

- **Quantity** is the number of equipment operating per 15 minute assessment period.
- **Duty Factor** is the percentage of time the equipment operates per 15 minute assessment period, or represents a reduced emission for part of the period.
- **Base LW Value** is source emission or 'Sound Power Level' (LW) directly allocated to the equipment, unadjusted.
- **INP Penalty** considers any annoying characteristic such as tonality, low frequency noise or impulsiveness.
- **Total LW Value** is the overall equipment source emission (LW) adjusted for the quality, duty factor and INP penalty. INP penalties were not included for operational stages of the noise assessment as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.

Mitigation and management measures to avoid offensive noise characteristics are outlined in *Section 8.2*.

Table 7.1 Operational Noise Assessment Scenario (Activities and Equipment)

Scenario	Description	Equipment	Quantity	Duty Factor	Base LW Value	Total LW Value	Source
OPP01	Existing Operation of Quarry	Front End Loader (FEL) - Komatsu WA500	1	100%	110	110	Lw derived based on measured activity: stock piling and loading out.
		Front End Loader (FEL) - CAT980H	1	100%	105	105	Lw derived based on measured activity: stock piling and loading out.
		Dump truck - CAT769C	1	100%	112	112	Lw derived based on measured activity: loading out.
		Cone Crusher	1	100%	118	118	Lw measured crushing
		Jaw Crusher	1	100%	115	115	Lw measured crushing
		Barmac VSI Crusher	1	100%	107	107	Lw measured crushing
		Feeder (Dump Truck - tipping into crusher)	1	30%	113	108	Brandy Hill Quarry Report
		Excavator - Komatsu PC350LC	1	100%	107	107	Australian Standard AS2436
		Excavator - Komatsu PC400LC	1	100%	114	114	Lw derived based on measured activity: loading dump truck
		Screen	4	100%	115	121	Australian Standard AS2436
		Conveyors (LW/m)	14	100%	91	91 LW/m	ERM library of measured equipment
		Conveyor Motor	14	100%	87	87	ERM library of measured equipment
		Conveyor Transfer Point	11	100%	95	95	ERM library of measured equipment
		Water Cart	1	100%	103	103	Brandy Hill Quarry Report
OPP02 - OPP06 (Stage 1 to Final)	Quarry Processing Plant, Asphalt Production Plant, and Equipment operating in new locations.	Truck and Dog	2	75%	105	107	Brandy Hill Quarry Report
		Front End Loader (FEL) - Komatsu WA500	1	100%	110	110	Lw derived based on measured activity: stock piling and loading out.
		Front End Loader (FEL) - CAT980H	1	100%	105	105	Lw derived based on measured activity: stock piling and loading out.
		Dump truck - CAT769C	1	100%	112	112	Lw derived based on measured activity: loading out.
		Cone Crusher	1	100%	118	118	Lw measured crushing
		Jaw Crusher	1	100%	115	115	Lw measured crushing
		Barmac VSI Crusher	1	100%	107	107	Lw measured crushing
		Feeder (Dump Truck - tipping into crusher)	1	30%	113	108	Brandy Hill Quarry Report

Scenario	Description	Equipment	Quantity	Duty Factor	Base LW Value	Total LW Value	Source
		Excavator - Komatsu PC350LC	1	100%	107	107	Australian Standard AS2436
		Excavator - Komatsu PC400LC	1	100%	114	114	Lw derived based on measured activity: loading dump truck
		Screen	4	100%	115	121	Australian Standard AS2436
		Conveyors (LW/m)	21	100%	91	91 LW/m	ERM library of measured equipment
		Conveyor Motor	21	100%	87	87	ERM library of measured equipment
		Conveyor Transfer Point	14	100%	95	95	ERM library of measured equipment
		Water Cart	1	100%	103	103	Brandy Hill Quarry Report
		Truck and Dog	2	75%	105	107	Brandy Hill Quarry Report
	Concrete Batching Plant & Recycling Facility	Blending Plant	1	100%	106	106	Rooty Hill NIA
		Concrete Truck	1	75%	112	111	TfNSW CNS
		Concrete Agitator	1	100%	109	109	Australian Standard AS2436
		Concrete Pump	1	100%	108	108	Australian Standard AS2436
		Conveyors (LW/m)	2	100%	91	91 LW/m	ERM library of measured equipment
		Conveyor Motor	2	100%	87	87	ERM library of measured equipment
		Conveyor Transfer Point	1	100%	95	95	ERM library of measured equipment
		Water Supply Pump	1	100%	97	97	ERM library of measured equipment
	Asphalt Plant	Asphalt Plant	1	100%	110	110	Downer EIS - Oberon 2015
		Asphalt Stack	1	100%	112	112	Downer EIS - Oberon 2015
Lmax	Maximum Noise Level Assessment	Metal on Metal Contact	2 ¹	100%	120	123	-

- Four Lmax sources were modelled, one at the Northern, Eastern, Western and Southern extent of the site boundary.
- Location of noise sources will be based on proposed infrastructure and project design (refer Annex C).
- A combination of point, line, moving, and areas sources were utilised in the noise model to predict the likely distribution of noise sources associated with each work area.

Based on the operational assessment scenarios and L_W values identified in *Table 7.1*, noise levels have been predicted at all receptors (via modelling), and compared to the PSNL identified in *Table 4.3* above. It should be noted that noise modelling includes conceptual mitigation (described in *Section 2.10.2*) based on reasonable and feasible mitigation measures determined through consultation with Hanson. The predicted noise levels presented below are therefore contingent on the implementation of this mitigation.

A comparison of the predicted L_{eq} , 15 minute values (general operations) is provided in *Table 7.2* for the day time PSNL. A comparison to the evening PSNL and the most stringent night time PSNL are provided in *Table 7.3* to *Table 7.5*. Predicted L_{max} values are also provided in *Table 7.4* and *Table 7.5* for the sleep disturbance criteria. Compliance with the most stringent night time PSNL indicates that compliance is achieved with other PSNL (i.e. Morning Shoulder). Any noise levels that exceed criteria are highlighted in **bold** typeset.

Operational noise level predictions have been conducted to identify results for representative worst-case scenarios, as the predicted values consider the cumulative emission (and potential impact) of all equipment sources working concurrently.

Guidance Note

This noise assessment has been completed with due regard to and in accordance with the INP and other relevant acoustical standards. Noise has been assessed at receptor locations in accordance with the INP i.e. the most-affected point on or within the property boundary or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence.

The objective of the noise assessment and broader EIS is to identify that emissions from the quarry will comply (with noise reducing mitigation implemented) at the most affected location for all receptors assessed. Hence, further assessment as demonstrated in the *Figure 2.1* process chart, including assessment of noise exceedance over more than 25% of a property is not necessary.

Table 7.2 Predicted Daytime Operational Noise Levels – All Scenarios (Calm Meteorological Conditions)

ID	Type	Predicted Noise levels, Leq, 15 minute in dBA						Comparison to Daytime PSNL					
		Existing	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Existing	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage
13	Residential ³	33	33	32	33	33	34	-10	-10	-11	-10	-10	-9
14	Residential ³	43	34	35	34	34	34	0	-9	-8	-9	-9	-9
1	Residential ³	40	32	33	32	32	32	-3	-11	-10	-11	-11	-11
16	Residential ³	41	32	33	32	32	32	-2	-11	-10	-11	-11	-11
2	Residential ³	40	32	33	32	32	32	-3	-11	-10	-11	-11	-11
17	Residential ³	40	31	31	31	31	31	-3	-12	-12	-12	-12	-12
4	Residential ³	39	30	30	30	30	30	-4	-13	-13	-13	-13	-13
18	Residential ³	19	18	19	18	18	25	-22	-23	-22	-23	-23	-16
19	Residential ³	26	31	32	31	31	33	-15	-10	-9	-10	-10	-8
24	Residential ³	30	32	32	32	32	32	-11	-9	-9	-9	-9	-9
20	Residential ³	25	24	32	30	37	37	-16	-17	-9	-11	-4	-4
6	Residential ³	34	29	33	32	33	33	-12	-17	-13	-14	-13	-13
30	Residential ³	37	30	30	29	29	29	-9	-16	-16	-17	-17	-17
11	Residential ³	44	34	34	33	33	33	-2	-12	-12	-13	-13	-13
48	Potential Future Industrial	57	44	43	43	43	43	-18	-31	-32	-32	-32	-32
33	Residential ³	45	34	34	34	34	34	-2	-13	-13	-13	-13	-13
38	Residential ³	44	33	33	33	33	33	-3	-14	-14	-14	-14	-14
7	Commercial	56	44	44	44	44	44	-14	-26	-26	-26	-26	-26
47	Potential Future Industrial	54	47	47	47	47	47	-21	-28	-28	-28	-28	-28
34	Residential ³	50	39	39	39	39	39	3	-8	-8	-8	-8	-8
35	Residential ³	49	40	40	40	40	40	2	-7	-7	-7	-7	-7
8	Industrial	52	43	43	43	43	43	-23	-32	-32	-32	-32	-32
46	Commercial	54	46	46	46	46	46	-16	-24	-24	-24	-24	-24
9	Industrial	49	47	47	47	47	47	-26	-28	-28	-28	-28	-28
10	Industrial	43	42	42	42	42	42	-32	-33	-33	-33	-33	-33

1. Leq, 15 minute noise levels in dBA.

Table 7.3 Predicted Evening Operational Noise Levels – All Scenarios (Prevailing W Wind)

ID	Type	Predicted Noise levels, Leq, 15 minute in dBA					Comparison to Evening PSNL				
		Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage
13	Residential ³	34	33	34	34	35	-7	-8	-7	-7	-6
14	Residential ³	35	36	35	35	35	-6	-5	-6	-6	-6
1	Residential ³	33	34	33	33	33	-8	-7	-8	-8	-8
16	Residential ³	33	34	33	33	33	-8	-7	-8	-8	-8
2	Residential ³	33	34	33	33	34	-8	-7	-8	-8	-7
17	Residential ³	31	32	31	31	32	-10	-9	-10	-10	-9
4	Residential ³	30	31	30	30	31	-11	-10	-11	-11	-10
18	Residential ³	18	19	18	18	25	-23	-22	-23	-23	-16
19	Residential ³	31	32	31	31	33	-10	-9	-10	-10	-8
24	Residential ³	32	32	32	32	32	-9	-9	-9	-9	-9
20	Residential ³	24	32	30	37	37	-17	-9	-11	-4	-4
6	Residential ³	29	33	32	33	33	-14	-10	-11	-10	-10
30	Residential ³	30	30	29	29	29	-13	-13	-14	-14	-14
11	Residential ³	37	37	35	35	36	-6	-6	-8	-8	-7
48	Potential Future Industrial	46	44	44	44	44	-29	-31	-31	-31	-31
33	Residential ³	37	37	37	37	37	-10	-10	-10	-10	-10
38	Residential ³	36	36	35	35	36	-11	-11	-12	-12	-11
7	Commercial	47	47	46	46	47	-23	-23	-24	-24	-23
47	Potential Future Industrial	48	49	48	48	48	-27	-26	-27	-27	-27
34	Residential ³	42	42	42	42	42	-5	-5	-5	-5	-5
35	Residential ³	43	43	43	43	43	-4	-4	-4	-4	-4
8	Industrial	46	46	46	46	46	-29	-29	-29	-29	-29
46	Commercial	48	48	48	48	48	-22	-22	-22	-22	-22
9	Industrial	48	48	48	48	48	-27	-27	-27	-27	-27
10	Industrial	43	43	43	43	43	-32	-32	-32	-32	-32

1. Leq, 15 minute noise levels in dBA

Table 7.4 Predicted Night Time Operational Noise Levels – All Scenarios (Prevailing NW Wind)

ID	Type	Predicted Noise levels, Leq, 15 minute in dBA						Comparison to Night time PSNL					
		Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Lmax	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Lmax
13	Residential ³	35	34	35	35	35	35 - 43	-2	-3	-2	-2	-2	-4
14	Residential ³	37	37	37	37	37	34 - 46	0	0	0	0	0	-1
1	Residential ³	35	35	35	35	35	30 - 45	-2	-2	-2	-2	-2	-2
16	Residential ³	35	36	35	35	35	32 - 45	-2	-1	-2	-2	-2	-2
2	Residential ³	35	36	35	35	35	31 - 44	-2	-1	-2	-2	-2	-3
17	Residential ³	34	34	33	33	34	31 - 44	-3	-3	-4	-4	-3	-3
4	Residential ³	32	33	32	32	33	33 - 44	-5	-4	-5	-5	-4	-3
18	Residential ³	21	22	20	21	27	18 - 31	-17	-16	-18	-17	-11	-17
19	Residential ³	31	32	31	31	33	25 - 39	-7	-6	-7	-7	-5	-9
24	Residential ³	32	32	32	32	32	26 - 35	-6	-6	-6	-6	-6	-13
20	Residential ³	24	32	30	37	37	35 - 42	-14	-6	-8	-1	-1	-6
6	Residential ³	29	33	32	33	33	31 - 38	-11	-7	-8	-7	-7	-12
30	Residential ³	30	30	29	29	29	26 - 38	-10	-10	-11	-11	-11	-12
11	Residential ³	34	34	33	33	33	30 - 44	-6	-6	-7	-7	-7	-6
48	Potential Future Industrial	45	44	44	44	44	41 - 63	-30	-31	-31	-31	-31	-
33	Residential ³	36	36	36	36	36	26 - 48	-10	-10	-10	-10	-10	-8
38	Residential ³	36	36	35	35	36	32 - 46	-10	-10	-11	-11	-10	-10
7	Commercial	47	47	46	46	47	40 - 61	-23	-23	-24	-24	-23	-
47	Potential Future Industrial	48	49	48	48	48	33 - 63	-27	-26	-27	-27	-27	-
34	Residential ³	42	42	42	42	42	38 - 53	-4	-4	-4	-4	-4	-3
35	Residential ³	43	43	43	43	43	38 - 52	-3	-3	-3	-3	-3	-4
8	Industrial	46	46	46	46	46	33 - 56	-29	-29	-29	-29	-29	-
46	Commercial	48	48	48	48	48	32 - 59	-22	-22	-22	-22	-22	-
9	Industrial	48	48	48	48	48	34 - 58	-27	-27	-27	-27	-27	-
10	Industrial	44	44	44	44	44	37 - 51	-31	-31	-31	-31	-31	-

1. Leq, 15 minute noise levels in dBA.

2. Sleep disturbance criterion not applicable for Commercial and Industrial receptors (i.e. not a residence/dwelling).

3. " - " indicates that an assessment of this feature does not apply for this circumstance/receptor.

Table 7.5 Predicted Night Time Operational Noise Levels – All Scenarios (Prevailing W Wind)

ID	Type	Predicted Noise levels, Leq, 15 minute in dBA						Comparison to Night time PSNL					
		Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Lmax	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Lmax
13	Residential ³	34	33	34	34	35	33 - 41	-3	-4	-3	-3	-2	-6
14	Residential ³	35	36	35	35	35	34 - 44	-2	-1	-2	-2	-2	-3
1	Residential ³	33	34	33	33	34	30 - 42	-4	-3	-4	-4	-3	-5
16	Residential ³	33	34	33	33	33	32 - 42	-4	-3	-4	-4	-4	-5
2	Residential ³	33	34	33	33	34	31 - 42	-4	-3	-4	-4	-3	-5
17	Residential ³	31	32	31	31	32	29 - 41	-6	-5	-6	-6	-5	-6
4	Residential ³	30	31	30	30	31	30 - 41	-7	-6	-7	-7	-6	-6
18	Residential ³	18	19	18	18	25	15 - 28	-20	-19	-20	-20	-13	-20
19	Residential ³	31	32	31	31	33	25 - 39	-7	-6	-7	-7	-5	-9
24	Residential ³	32	32	32	32	32	25 - 35	-6	-6	-6	-6	-6	-13
20	Residential ³	24	32	30	37	37	35 - 42	-14	-6	-8	-1	-1	-6
6	Residential ³	29	33	32	33	33	31 - 38	-11	-7	-8	-7	-7	-12
30	Residential ³	30	30	29	29	29	29 - 38	-10	-10	-11	-11	-11	-12
11	Residential ³	37	37	35	35	36	30 - 44	-3	-3	-5	-5	-4	-6
48	Potential Future Industrial	46	44	44	44	44	41 - 63	-29	-31	-31	-31	-31	-
33	Residential ³	37	37	37	37	37	26 - 48	-9	-9	-9	-9	-9	-8
38	Residential ³	36	36	35	35	36	32 - 46	-10	-10	-11	-11	-10	-10
7	Commercial	47	47	46	46	47	40 - 61	-23	-23	-24	-24	-23	-
47	Potential Future Industrial	48	49	48	48	48	33 - 63	-27	-26	-27	-27	-27	-
34	Residential ³	42	42	42	42	42	38 - 53	-4	-4	-4	-4	-4	-3
35	Residential ³	43	43	43	43	43	38 - 52	-3	-3	-3	-3	-3	-4
8	Industrial	46	46	46	46	46	33 - 56	-29	-29	-29	-29	-29	-
46	Commercial	48	48	48	48	48	32 - 59	-22	-22	-22	-22	-22	-
9	Industrial	48	48	48	48	48	34 - 58	-27	-27	-27	-27	-27	-
10	Industrial	43	43	43	43	43	37 - 49	-32	-32	-32	-32	-32	-

1. Leq, 15 minute noise levels in dBA

2. Sleep disturbance criterion not applicable for Commercial and Industrial receptors (i.e. not a residence/dwelling).

3. " - " indicates that an assessment of this feature does not apply for this circumstance/receptor

7.2.2

Summary of Results

The results presented in *Table 7.2* and *Table 7.5* for general mitigated operations associated with the quarry i.e. Stage 1 to 4, and the Final Stage identifies the following

- The predicted L_{eq} , 15 minute noise levels for existing operations range between 19 and 57 dBA for general operational noise associated with the quarry.
- The predicted L_{eq} , 15 minute noise levels for future operations range between 18 and 49 dBA for general operational noise associated with the quarry.
- The L_{max} noise levels are presented as a range, these noise levels are dependent on the location of the L_{max} noise source and the receptor.
- The highest predicted L_{max} noise levels range between 28 and 53 dBA at residential receptors for maximum noise level events generated by operational activities associated with the quarry.
- The highest L_{eq} , 15 minute and L_{max} noise levels vary depending upon the location the prevailing wind conditions. In general daytime (or calm conditions) noise levels are expected to be approximately 2 dBA lower when compared to prevailing (noise enhancing) conditions. The highest levels are generally associated with the worst-case north-westerly and westerly wind conditions during night time and are experienced at receptors to the south of the site across all scenarios (stages of operation).
- Minor exceedance of the PSNL are predicted for daytime existing quarry operations at receptors 34 and 35 to the east of the Project site.
- Contingent to the conceptual mitigation modelled for all future operational scenarios, predicted noise levels are compliant with PSNL across all assessment periods and operational stages. Mitigation and management recommendations are detailed in *Chapter 8*.

7.2.3

Discussion of Findings

Preliminary results indicated that noise emissions from the expansion of quarry operations would exceed the PSNL during all modelled conditions. This is primarily due to the close proximity of residential receptors to the proposed Processing Plant and Asphalt Production Plant in the southern part of the Project site. Conceptual mitigation was therefore modelled to ensure that the Project would meet the requirements of the INP and comply with PSNLs. These results are presented in *Section 7.2* above. Recommendations for mitigation and management measures required to meet the PSNL are provided in *Section 8.2*.

It is also important to note that INP penalties were not included for conceptual mitigation noise modelling, as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.

To assess potential noise impacts associated with operational road traffic, the estimated traffic data presented in the EIS was utilised. The EIS traffic assessment presents estimated maximum overall and average heavy vehicle movements that the quarry could be expected to generate. This includes:

- an increase from the current **average** of approximately 42 heavy vehicle trips per day (42 movements in, 42 movements out for a total of 84 movements) to approximately 127 additional heavy vehicle trips per day (127 movements in, 127 movements out for a total of 254 movements); and
- an increase from the current **maximum** of 130 heavy vehicle trips per day (130 movements in, 130 movements out for a total of 260 movements) to approximately 396 additional heavy vehicle trips per day (396 movements in, 396 movements out for a total of 792 movements).

Conservative estimates were also prepared to determine the likely maximum number of truck trips (i.e. movements in + movement out) per hour, based on the most stringent night time road traffic noise criteria.

Assumed posted speed limits of 100 km/h for sub-arterial roads and 50 km/h for local roads, have been adopted to predict quarry road traffic noise levels for comparison to the RNP criteria i.e. Leq, 15 hour, Leq, 9 hour and Leq, 1 hour.

Due to the distance offsets to nearby residential receptors (>250m), road traffic noise levels were predicted at a range of distances; 150m, 200m, 250m and 300m). This precautionary approach was adopted as actual road and dwelling façade distances will vary from property to property along the length of the overall road alignments.

Although truck movements are anticipated to occur primarily in the daytime period, 1.5% of daily traffic movements were estimated to occur during the night time to provide an evaluation of site traffic occurring in this period, especially in the early morning between 6am and 7am. Daytime peak Leq, 1 hour noise levels were calculated based on 13% of daily truck movements occurring between 11am and 12pm as per the traffic assessment of the EIS. The traffic volumes based on these percentages are outlined below:

- Daytime Leq, 15 hour: 390 (maximum) and 125 (average) trips.
- Night time Leq, 9 hour: 6 (maximum) and 2 (average) trips.
- Daytime Leq, 1 hour: 51 (maximum) and 17 (average) trips.
- Night time Leq, 1 hour: 6 (maximum) and 2 (average) trips.

The predicted operational road traffic noise levels for local and sub-arterial roads are presented in *Table 7.6* below.

Based on a comparison of predicted operational road traffic noise levels to the applicable RNP criteria, the resultant noise levels from quarry heavy vehicles are below the RNP criteria values. Compliance with these RNP criteria is demonstrated for both the daytime (7am to 10pm) and night time (10pm to 7am) assessment periods. On this basis the introduction of quarry road traffic to sub-arterial and local roads is unlikely to generate significant noise impacts, if any at all.

Indicative Permissible Quarry Vehicle Flows

Further evaluation of road traffic noise levels occurred considering both assumed public traffic and maximum quarry vehicle flows. It identified that an additional flow of up to a) approximately 150 trips (300 quarry vehicle movements) could occur on sub-arterial roads during the daytime (a 15 hour assessment period) and b) approximately 12 trips (25 movements) during the night time (a nine hour assessment period) without a major risk of overall road traffic noise levels exceeding criteria.

Similarly and for local roads (a one hour assessment period for daytime and night time) this evaluation identified that an additional flow of up to approximately 12 trips (25 quarry vehicles movements) could occur during the daytime and approximately 6 trips (12 movements) during the night time without a major risk of overall road traffic noise levels exceeding criteria.

These indicative maximum vehicle flows were determined on the basis of existing road traffic contributing a noise level of 5 dBA less than the RNP road traffic noise criteria i.e.

- 55 dBA Leq, 15 hour for the daytime period / sub-arterial roads;
- 50 dBA Leq, 9 hour for the night time period / sub-arterial roads;
- 50 dBA Leq, 1 hour for the daytime period / local roads; and
- 45 dBA Leq, 1 hour for the night time period / local roads.

This evaluation is demonstrated in full in *Table 7.7* below.

These indicative flows are significantly in excess of the anticipated quarry vehicle requirements and these noise emissions will unlikely be realised, further reinforcing the finding of this report that the introduction of quarry road traffic to sub-arterial and local roads is unlikely to generate significant noise impacts, if any at all.

In summary, and with consideration of the data presented in both *Table 7.6* and *Table 7.7* below, operational road traffic noise levels are predicted to comply with the relevant RNP criteria despite the increase in proposed truck trips. Operational road traffic noise from the Project may be audible at times, but noise levels will be reduced and impacts (if any) minimised with the successful implementation of the recommendations and safeguards provided in *Section 8.2* of this report.

Table 7.6 Predicted Operational Road Traffic Noise Levels

Assessment Classification	RNP Road Traffic Noise Criteria		Predicted Noise Level (Day / Night) and Distance from Road Alignment, m				
	Daytime (7am to 10pm) assessment period	Night time (10pm to 7am) assessment period	Assessment Type	150 m	200 m	250 m	300 m
Road traffic noise criteria for existing residences affected by additional traffic on existing sub-arterial roads generated by land use developments.	Leq, (15 hour) 60 dB (external)	Leq, (9 hour) 55 dB (external)	Average	47/31	45/29	44/28	43/27
			Maximum	54/34	52/32	51/30	50/29
Road traffic noise criteria for existing residences affected by additional traffic on existing local roads generated by land use developments.	Leq, (1 hour) 55 dB (external)	Leq, (1 hour) 50 dB (external)	Average	47/38	45/36	44/35	43/34
			Maximum	52/43	50/41	49/40	48/38

1. Predicted road traffic noise levels include a +2.5 dB façade correction.

2. All noise levels are dBA re 2 x 10⁻⁵ Pa.

Table 7.7 Indicative Permissible Quarry Vehicle Flows

Assessment Classification	Estimated Existing Traffic Noise (RNP Road Traffic Noise Criteria Minus 5 dBA)		Traffic Parameter	Existing Assessment – 150 metre Scenario, refer Table 7.6					
				Predicted Noise Level		Comparison to Estimated Existing Traffic Noise (predicted – existing)		Quarry Heavy Vehicle Traffic (Trips)	
	Daytime	Night time		Daytime	Night time	Daytime	Night time	Daytime	Night time
Road traffic noise criteria for existing residences affected by additional traffic on existing sub- arterial roads generated by land use developments.	55 dBA Leq, 15 hour	50 dBA Leq, 9 hour	Ave.	47	31	-8	-19	125	2
			Max.	54	34	-1	-16	390	6
Road traffic noise criteria for existing residences affected by additional traffic on existing local roads generated by land use developments.	50 dBA Leq, 1 hour	45 dBA Leq, 1 hour	Ave.	47	38	-3	-7	17	2
			Max.	52	43	+2	-2	51	6

Assessment Classification	Predicted TOTAL Noise Level Estimated Existing + Quarry		Comparison to RNP Criteria (TOTAL predicted - criteria)		Indicative Additional Quarry Heavy Vehicles (Trips) before TOTAL road traffic noise equals criteria	
	Daytime	Night time	Daytime	Night time	Daytime	Night time
Road traffic noise criteria for existing residences affected by additional traffic on existing sub-arterial roads generated by land use developments.	56	50	-4	-5	175	4
	58	50	-2	-5	150	12
Road traffic noise criteria for existing residences affected by additional traffic on existing local roads generated by land use developments.	52	46	-3	-4	17	3
	54	47	-1	-3	12	6

1. All noise levels are dBA re 2 x 10⁻⁵ Pa.
2. Daytime is 7am to 10pm and Night time is 10pm to 7am.
3. For example, 55 dBA existing plus 47 dBA (quarry) equals 56 dBA total road traffic noise level.
4. To avoid misunderstanding the indicative flows are only presented to justify that the introduction of quarry road traffic to sub-arterial and local roads is unlikely to generate significant noise impacts.

7.4

SLEEP DISTURBANCE

It is important to consider potential sleep disturbance noise impacts associated with operational noise sources and operational road traffic. Road traffic noise impacts are not anticipated for night time / morning shoulder periods and L_{max} noise levels from general operations are not predicted to exceed sleep disturbance criteria at residential receptors surrounding the Project site.

It should be noted that predicted noise levels are contingent to the conceptual mitigation modelled for all future operational scenarios. This mitigation is detailed in *Section 8.2*.

With due regard to the requirements of the INP and RNP, suitable recommendations which can be practically implemented are provided in *Chapter 8* of this report.

7.5

BLASTING

7.5.1

Blasting Overpressure

At the closest receptor (approximately 340m from potential blasting locations), blasting overpressure is predicted to comply with the L_{peak} threshold of 120 dBZ for blasts with MIC value up to 270 kg. Blasting overpressure is predicted to comply with the 115 dBZ (L_{peak}) 5% threshold for blasts with MIC value up to 113 kg. Regarding the DA approved industrial and commercial blasting limits; blasting overpressure is predicted to comply with the L_{peak} threshold of 125 dBZ for blasts with MIC values up to 840 kg at a distance of 340 m.

Overpressure levels from blasts with MIC values greater than those outlined above are predicted to exceed the thresholds. This is contingent on the blast event location and the charge used; both of which are easily managed by good blasting practices.

As is evident in the results provided for the blasting overpressure assessment these emissions can vary significantly but are easily manageable. Any potential for impacts can be minimised such that adverse effects are fully avoided.

7.5.2

Blasting Vibration

At the closest receptor (approximately 340 m from potential blasting locations), blasting vibration is predicted to comply with the PPV threshold of 10 mm/s for blasts with MIC value up to 270 kg. Blasting vibration is predicted to comply with the 5 mm/s (PPV) 5% threshold for blasts with MIC value up to 113 kg. Regarding the DA approved industrial and commercial blasting limits; blasting overpressure is predicted to comply with the PPV threshold of 25 mm/s for blasts with MIC values up to 840 kg at a distance of 340 m.

Vibration levels from blasts with MIC values greater than those outlined above are predicted to exceed the thresholds. This is contingent on the blast event location and the charge used; both of which are easily managed by good blasting practices.

As is evident in the results provided for the blasting overpressure assessment these emissions can vary significantly but are easily manageable. Any potential for impacts can be minimised such that adverse effects are fully avoided.

7.6 *POTENTIAL CUMULATIVE IMPACTS*

As noted in *Section 4*, the operational noise criteria (PSNL) are based on existing noise levels measured at locations surrounding the Project site, such that existing conditions and industrial noise contributions are considered as part of the assessment approach.

The criteria are designed to prevent any long-term increase in cumulative industrial noise. By complying with these PSNL the quarry's noise contribution, combined with that of the existing industrial noise of the area is unlikely to generate any significant cumulative noise impacts.

Future cumulative impacts (i.e. due to other new developments approved in the future) are beyond the control of Hanson and are best managed by local or state consent authorities for significant projects.

7.7 *ASSESSMENT OUTCOMES*

Based on the findings summarised above, suitable blasting overpressure and vibration mitigation and management measures which may be feasibly and reasonably incorporated in to the blasting designs for the quarry are recommended in *Section 8.2* of this report.

This section presents the recommendations for construction and operational noise mitigation and management measures.

Qualitative assessments of potential impacts associated with construction road traffic and ground-borne noise, and impacts associated with construction and operational vibration were undertaken. No impacts are anticipated and no further recommendations are provided.

The focus of this section is construction and operational noise associated with the Project that have the potential to generate impacts at the closest and/or potentially most affected receptors. These recommendations reflect the intent of the relevant NSW noise guidelines.

8.1

CONSTRUCTION NOISE

To ensure noise emissions associated with construction works and activities are kept to acceptable levels, the following noise mitigation and management measures are recommended:

- Noise generating work and activities will be carried out during the ICNG recommended standard hours (i.e. 7am to 6pm Monday to Friday and 8am to 1pm Saturdays), with no work on Sundays or public holidays. Any work that is required outside the recommended standard hours must be suitably managed with a goal of achieving compliant noise levels at all residential receptors or undertaken with agreement from any potentially affected neighbours.
- Where unforeseen works will occur in close proximity (<100m) to a receptor and these works are anticipated to generate high levels of noise e.g. >75 dBA, potential respite periods e.g. three hours of work, followed by one hour of respite will be considered. Respite will be implemented if it is the preference of the affected receptors and if it is feasible and reasonable to achieve during the works. In some circumstances, respite may extend the duration of works and inadvertently increase noise impacts, hence due care should be taken when considering this management measure.
- During construction planning, choose appropriate machines for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit.
- During the works, avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient.

- During the works, instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.
- During any night works, any activity that has the potential to generate impulsive noise will be avoided. These types of events are particularly annoying; especially at night and have the limited potential to generate sleep disturbance or awakening impacts. Any impulsive or transient noise events expected to exceed the sleep disturbance criteria at residential receptors will be strictly avoided at night.
- During the works, ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines will be repaired or removed from the site.
- During the works, ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.
- If any validated noise complaints are received, operator attended noise measurements will be undertaken to measure and compare the site noise level contributions (L_{eq} , 15 minute and L_{max} in dBA) to:
 - the predicted values; and
 - the NMLs presented in this report.
- All site noise levels will be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the NMLs presented in this report, no further mitigation or management measures are required. If the measured site noise levels are above the predicted noise levels or NML presented in this report, further mitigation and/or management measures will be considered.
- Prior to commencement of works, a Construction Noise Management Plan (CNMP) will be prepared and implemented, and will consider all potential acoustical factors identified in this report including those addressed in *Chapter 5* and *Chapter 6*. The CNMP will detail any noise monitoring and take into consideration measures for reducing the source noise levels of construction equipment by construction planning and equipment selection where reasonable and feasible.

Contingent to the conceptual mitigation modelled for all future operational scenarios, predicted noise levels are compliant with PSNL across all assessment periods and operational stages. It is therefore recommended that the mitigation outlined in *Section 2.10.2* be implemented on site in order to comply with the PSNL. In summary, this mitigation involves the following measures:

Boundary Mitigation:

- Earth Bunding (approximately 25 m in height, 450 m in length and 75 m in width) is required along the southern boundary of the site to provide additional shielding from the processing plant and asphalt production plant.
- Earth Bunding (approximately 20 m in height, 250 m in length and 60 m in width) is also required at the western boundary of the pit to provide shielding from in pit activities from Stage 2 of the quarry expansion when in pit activities progress closer to Receptor 20 to the west.

Plant / Equipment Procurement:

- During the operational design, choose appropriate machines for each task and adopt efficient work practices to minimise the total number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit, with consideration to offensive noise characteristics such as tonality, low frequency noise or impulsiveness.
- The key items of plant/equipment are presented below in *Table 2.3*. Operational LW emissions should be at or below those presented in *Table 2.3* and *Table 7.1* of this report. Where items of procured plant generate offensive noise characteristics, INP penalties will be applied prior to meeting the LW values presented above.

At Source Mitigation:

- Where LW values for plant/equipment outlined in *Table 2.3* are not reasonable or feasible, the operational design will incorporate acoustic enclosures / barriers to assist in reducing the noise emission of identified plant/equipment. Design of acoustic enclosures / barriers will also consider offensive noise characteristics as tonality, low frequency noise or impulsiveness.

INP penalties for offensive noise characteristics such as tonality, low frequency noise or impulsiveness were not included for conceptual mitigation noise modelling, as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.

In addition to the mitigation measures outlined above, the following management measures are recommended to ensure noise emissions associated with the operation of the quarry are kept to acceptable levels:

- Avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient.
- Instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.
- During any night works, any activity that has the potential to generate impulsive noise will be avoided. These types of events are particularly annoying; especially at night and have the limited potential to generate sleep disturbance or awakening impacts. Any impulsive or transient noise events expected to exceed the sleep disturbance criteria at residential receptors will be strictly avoided at night.
- Ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines will be repaired or removed from the site.
- Ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.
- Noisy plant and equipment will be located as far as possible from noise sensitive areas.
- The location of activities, plant and equipment will optimise attenuation effects through measures such as topography, natural and purpose built barriers.
- If any validated noise complaints are received, operator attended noise measurements will be undertaken to measure and compare the site noise level contributions (L_{eq} , 15 minute and L_{max} in dBA) to:
 - the predicted values; and
 - the PSNLs presented in this report.
- All site noise levels will be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the PSNLs presented in this report, no further mitigation or management measures are required. If the measured site noise levels are above the predicted noise levels or PSNLs presented in this report, further mitigation and/or management measures will be considered.

- A Detailed Design Noise Impact Assessment will be undertaken during the final stages of the Project design to ensure that noise emissions from the Processing Plant and Asphalt Production Plant can be effectively reduced to compliant levels through plant / equipment procurement and construction of acoustic enclosures / barriers. An Operational Noise Management Plan (ONMP) will be also prepared based on the detailed design, and will consider all potential acoustical factors identified in this report including those addressed in *Chapter 5* and *Chapter 7*. The ONMP will detail any noise monitoring and take into consideration measures for reducing the source noise levels of operational equipment by equipment selection, management and mitigation where reasonable and feasible.

In accordance with the SEARs, this assessment has considered the characterisation of impacts and potential treatment as per the INP and with due regard to the principles presented in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum Production and Extractive Industry Developments (VLAMP, September 2018). As stated in *Section 7.2*, noise has been assessed at receptor locations in accordance with the INP i.e. the most-affected point on or within the property boundary or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence. The objective of the noise assessment and broader EIS is to identify that emissions from the quarry will comply (with noise reducing mitigation implemented) at the most affected location for all receptors assessed. Hence, further assessment regarding the VLAMP as demonstrated in *Figure 2.1*, including assessment of noise exceedance over more than 25% of a property is not necessary.

8.3

OPERATIONAL (BLASTING) OVERPRESSURE AND VIBRATION

Based on the results presented in *Section 7.5*, blasting overpressure and vibration are predicted to comply with the ANZEC 1990 guideline, AS 2187.2 and the approved DA 1995/193 criteria. This is contingent on the blast event location and the charge used; both of which are easily managed by good blasting practices.

As is evident in the results provided for the blasting overpressure assessment, these emissions can vary significantly but are easily manageable. Any potential for impacts can be minimised such that adverse effects are fully avoided. Blasting emissions will be reduced and impacts (if any) minimised by complying with the criteria and requirements outlined in *Section 4.3.2*.

Hanson will remain aware of the potential impacts associated with quarry blasting and continue to plan for and then manage the quarry blasting and design accordingly.

Blast Monitoring

As outlined in Section 4.3.2 monitoring is required for all blast events carried out in or on the premises. Air-blast overpressure and ground vibration levels must be measured at any point within one metre of any affected residential boundary or other noise sensitive location, such as a school or hospital for all blasts carried out in or on the premises. In addition, the licensee must monitor all blasts carried out in or on the premises at or near the nearest residence or noise sensitive location that is likely to be most affected by the blast.

Construction / Operational Noise Monitoring

Construction and operational noise monitoring will also be undertaken for the Project however, the type and frequency would be adapted according to type of work. Noise monitoring would occur in the form of attended noise measurements and/or unattended real-time noise monitoring.

As stated above the details of these monitoring measures will be outlined in the Construction Noise Management Plan and the Operation Noise Management Plan.

Key Technical Features

All noise measurement procedures adopted for the Project will be conducted in accordance with the requirements of Australian Standard (AS) 1055:1997 *Acoustics - Description and Measurement of Environmental Noise*.

Attended noise measurements would be conducted by an operator using a hand held Type 1 or Type 2 'integrating-averaging' sound level meter. All measurements will be completed with the sound level meter mounted to a tripod (if possible) and with a windscreen fitted. The preferred measurement height is 1.2 m to 1.5 m above the ground.

The device will be calibrated prior to and after all measurement rounds, with any change in calibration levels noted. Instantaneous noise levels for all noted noise emission sources (extraneous or otherwise), meteorological conditions (average and maximum wind speeds, temperature, precipitation and cloud cover etc.) would be recorded during all measurements. The location of monitoring, time of measurement and all relevant measurement parameters (i.e. Leq, Lmin, Lmax, L1, L10 and L90) would also be recorded. Noise monitoring will not be completed during periods where wind speeds exceed 5 m/s at the microphone or during any rain events.

Unattended noise measurements would be conducted using a Type 1 or Type 2 environmental noise logger. The device will be calibrated prior to and after installation, with any change in calibration levels noted. Measurements will be completed with a windscreen fitted.

Noise monitoring would not be completed within 3.5 m of any reflective structure or wall, if possible. Where it is not possible to measure more than 3.5 m from any reflective structure or wall, a reduction of up to 2.5 dB would be applied to the measured ambient and site noise contribution (Leq, 15 minute) to account for the likely increase in noise associated with reflective surfaces.

Monitoring will be conducted with due regard to AS1055; AS61672, AS1259 (or similar); IEC60942; or the NSW Vibration Guideline as relevant to the monitoring being conducted.

All noise samples would be recorded using the “fast” time response of the sound level meter or environmental noise logger. Site activity records would be maintained during any noise (or vibration) monitoring events.

Noise Monitoring Locations

Noise measurements would be undertaken at the potentially most affected receptor locations identified in this report (dependant on phase of works/scenario). Monitoring would occur at the following receptors at minimum to represent receptors surrounding the site: Receptors 13 and 14 to the south, receptor 20 to the west, receptor 11 to the north and receptor 34 to the east. Refer *Figure 3.3 in Chapter 1* of this report.

Recommendations

Within the first three months of commercial operation, noise verification and compliance monitoring is recommended to measure and compare the site noise level contributions (Leq, 15 minute in dBA) to a) the predicted values, and b) the criteria presented in this report.

The same will occur if any validated noise complaints are received. All site noise levels would be measured in the absence of any influential sources not associated with the project. If the measured site noise levels are below the predicted values and noise levels comply with the criteria presented in this report, no further mitigation or management measures would be required. If the measured site levels are above the predicted noise levels and/or criteria presented in this report, further mitigation and/or management measures will be required.

The assessment was conducted to achieve a scope of works that allowed for the successful identification of potential receptors situated in the vicinity and potential area of influence of site emission sources and identification of significant noise and vibration generating plant, equipment and/or activities associated with the quarry and their likely/known emissions. The overall assessment methodology is presented in *Chapter 2*.

The existing ambient and background noise level of the area was measured and quantified via long-term unattended noise logging and short-term operator attended noise measurements. The existing conditions at and near the Project site and the measured existing ambient and background noise levels are presented in *Chapter 3*.

Noise and vibration criteria (refer to *Chapter 4*) were developed with due regard to and in accordance with recognised NSW standards and guidelines as applicable to the quarry activities. The focus of the assessment was establishing construction noise compliance with due regard to the ICNG and INP.

The focus of the (blasting) overpressure and vibration assessment was establishing compliance with regard to Standards Australia AS2187.2-2006.

Applicable construction, operational and blasting assessment scenarios were developed based on Project information provided by Hanson and likely noise, overpressure and vibration levels were predicted, and compared to criteria to establish compliance, evaluate potential impacts and establish potential mitigation measures if necessary to reduce levels and minimise impacts.

Potential impacts associated with construction road traffic and ground-borne noise, and impacts associated with construction and operational vibration were qualitatively assessed. Due to the type of equipment in use, activities that will be undertaken in the known sensitivity/distance offset to nearby receptors no impacts are anticipated and as such no further recommendations for noise and vibration mitigation, management measures or monitoring options are warranted. Further information regarding these qualitative assessments is presented in *Chapter 5*.

A quantitative construction and operational noise impact assessment was conducted by predicting noise levels via modelling. The predictions were completed for the applicable assessment scenarios and resultant noise levels compared to Project-specific criteria and/or management levels at each receptor location, and any significant or characteristic features identified. These construction and operational noise assessments are the focus of this report and the details of each assessment presented in *Chapter 6* (for construction) and *Chapter 7* (for operation).

The assessment has identified that both construction and operational noise levels have the potential to exceed the applicable criteria, limits and thresholds of the INP and ICNG if they are not suitably mitigated. The assessment also identified the blasting overpressure and vibration levels have only a limited potential to exceed the applicable *AS2187* criteria and thresholds, as long as normal blast design planning and consideration for potential environmental impacts occurs.

Based on the findings summarised above noise mitigation, management measures and monitoring options were recommended as considered suitable to the magnitude and extent of the predicted construction and operational impacts. They are designed to reduce noise levels and minimise impacts as far as is commonly feasible and reasonable to do so and practical to implement. These measures and options are presented in *Chapter 8*.

Construction noise levels will be reduced and impacts (if any) minimised with the successful implementation of the recommendations provided in *Section 8.1*. Construction noise impacts may not be reduced to imperceptible or negligible levels for all receptors during all construction activities; however the recommendations will ensure that any residual impacts are minimised as far as possible and commonly achievable via good construction management practices.

Preliminary operational noise levels were predicted to exceed the applicable INP operational noise criteria and limits for all modelled conditions. As such, noise mitigation and management measures were established to assist achieve compliance with the INP. These measures are presented in *Section 8.2* of this report.

REFERENCES

Australian and New Zealand Environment Council (ANZEC) – 1990, **Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration**, September 1990.

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NSW Department of Environment, Climate Change and Water – **NSW Road Noise Policy (RNP)**, March 2011.

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NSW Government – Transport for NSW (TfNSW) **Construction Noise Strategy (7TP-ST-157/2.0)**, dated April 2013.

Standards Australia AS1055–1997™ (AS1055) – **Description and Measurement of Environmental Noise**: Parts 1, 2 and 3 as applicable.

Standards Australia AS IEC 61672.1-2004™ (AS61672) – **Electro Acoustics - Sound Level Meters Specifications Monitoring** or Standards Australia AS1259.2-1990™ (AS1259) – **Acoustics - Sound Level Meters - Integrating Averaging as relevant to the device**.

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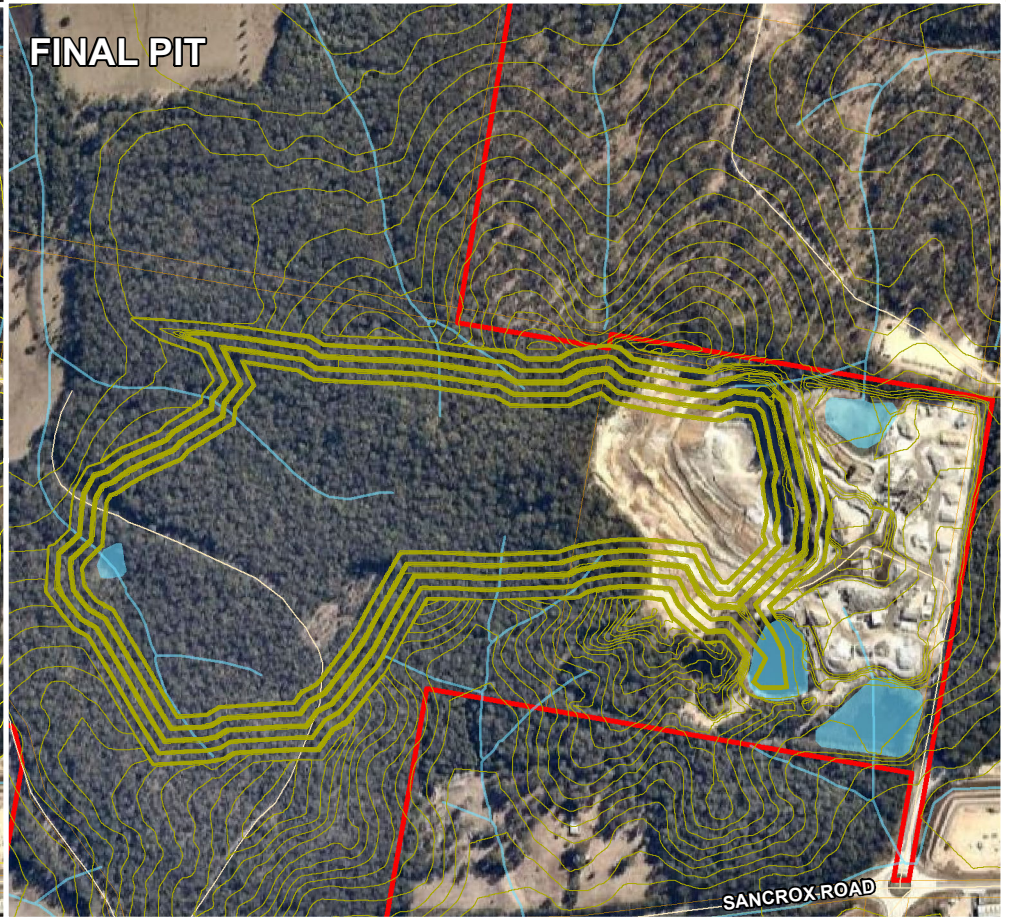
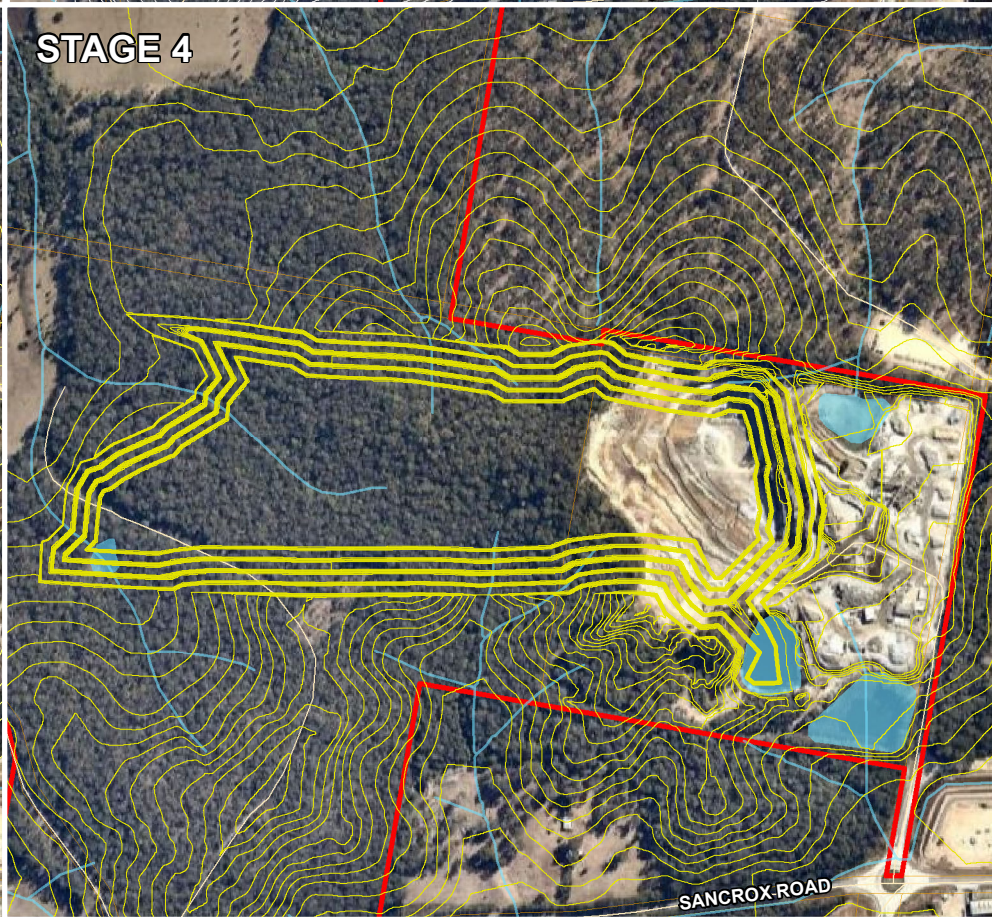
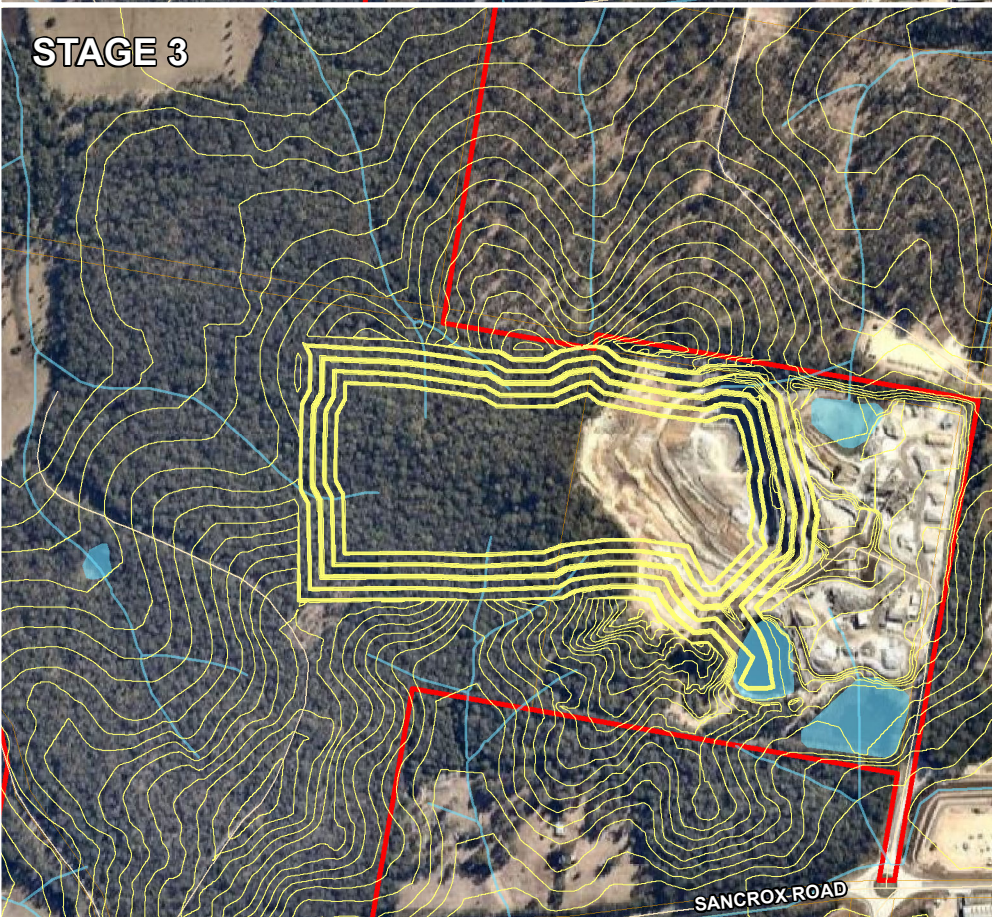
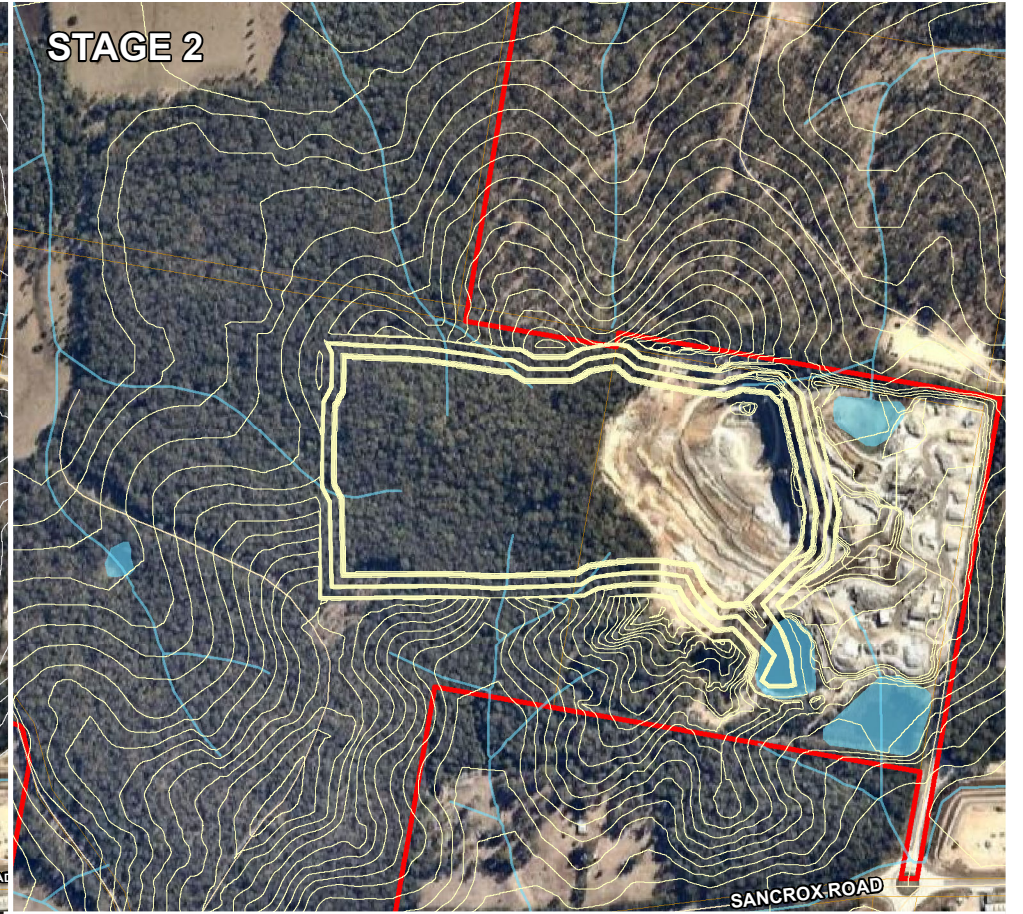
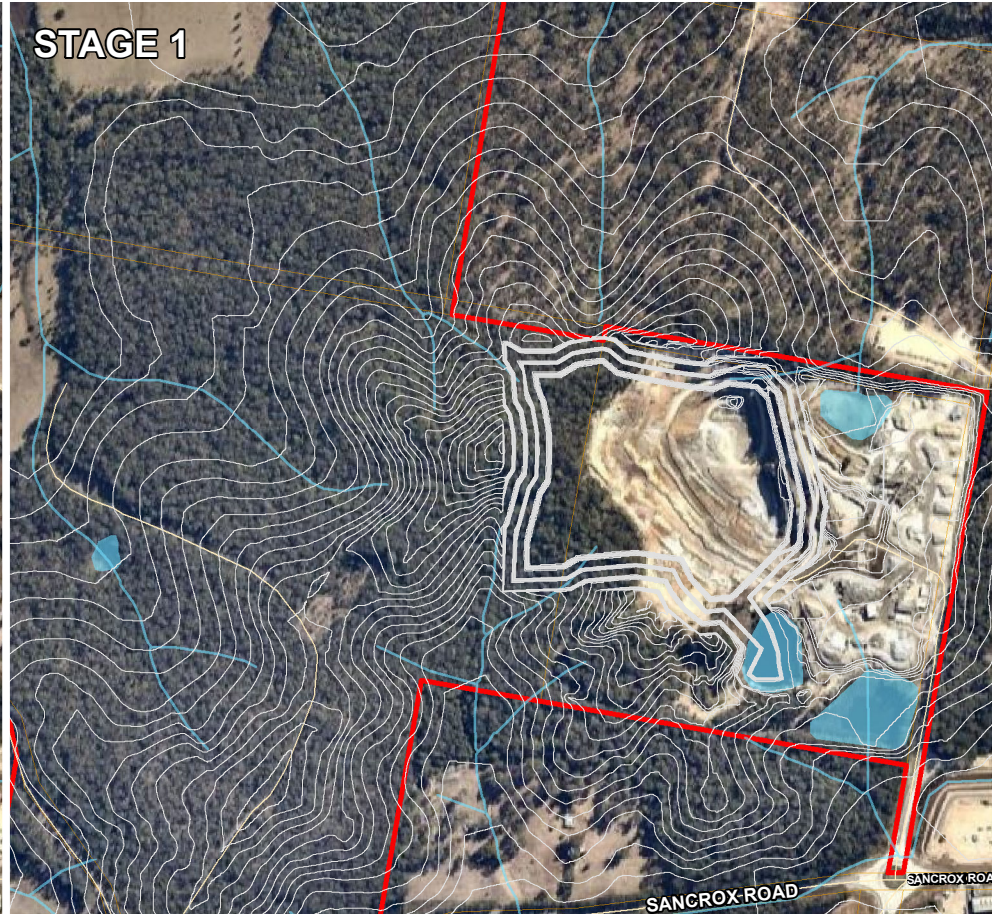
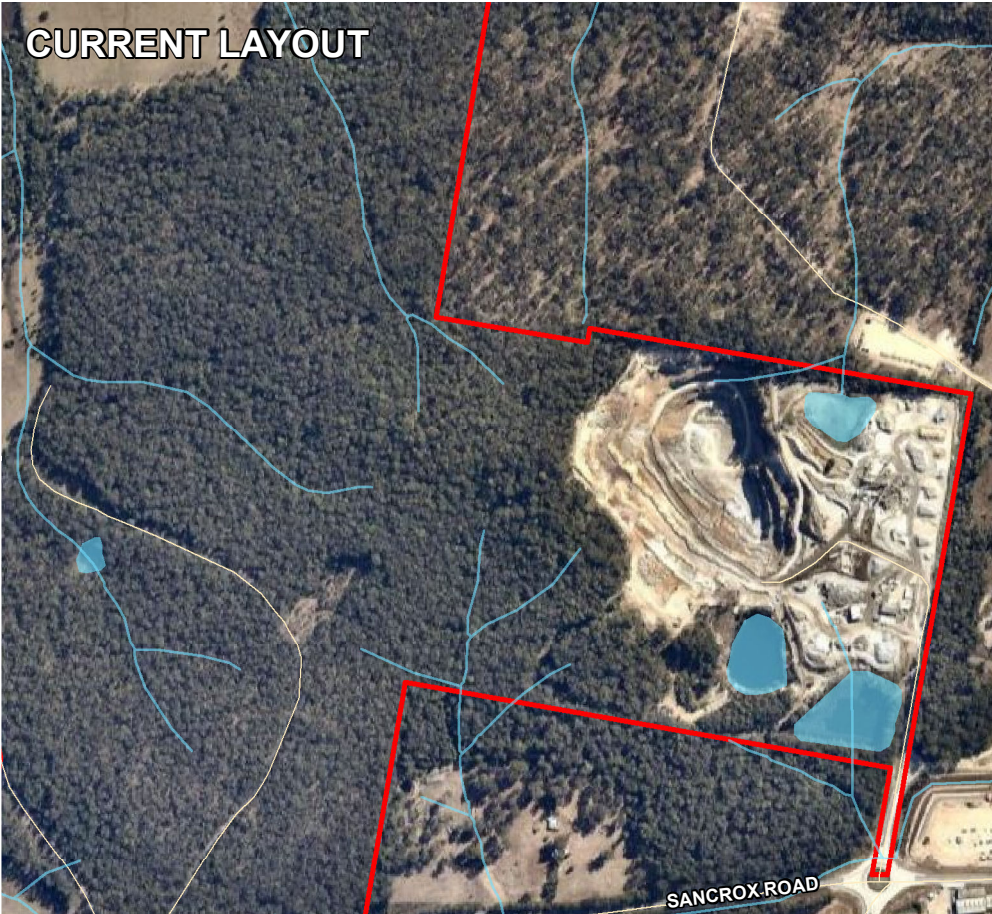
Standards Australia AS2187.2-2006™ (AS2187.2) – **Explosives—Storage and Use Part 2: Use of Explosives**.

Standards Australia AS 2436–2010™ (AS2436) – **Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites**.

United Kingdom (UK) – **Calculation of Road Traffic Noise (CoRTN)** calculative methods, adapted to Australia conditions.

Annex A

Staging and Layout



- Legend**
- Existing Property Ownership
 - Lot Boundary
 - Road Network
 - Watercourses
- Quarry Staging:**
- Stage 1 (RL-14m)
 - Stage 2 (RL-14m)
 - Stage 3 (RL-40m)
 - Stage 4 (RL-40m)
 - Final Pit (RL-40m)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap August 2017

Quarry Staging

Drawing No: 0418291s_EIS_G002_R2.mxd
Date: 27/07/2018
Drawn By: LT
Reviewed By: ME
Coordinate System: GDA 1994 MGA Zone 56
0 100 200m

Sancrox Quarry Expansion Project
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

F.A1



Annex B

Acoustics Glossary

B.1 *GLOSSARY – ACOUSTICAL CONCEPTS AND TERMINOLOGY*

B.1.1 *What Is Noise And Vibration?*

Noise

Noise is often defined as a sound, especially one that is loud or unpleasant or that causes disturbance¹ or simply as unwanted sound, but technically, noise is the perception of a series of compressions and rarefactions above and below normal atmospheric pressure.

Vibration

Vibration refers to the oscillating movement of any object. In a sense noise is the movement of air particles and is essentially vibration, though in regards to an environmental assessment vibration is typically taken to refer to the oscillation of a solid object(s). The impact of noise on objects can lead to vibration of the object, or vibration can be experienced by direct transmission through the ground, this is known as ground-borne vibration.

Essentially, noise can be described as what a person hears, and vibration as what they feel.

B.1.2 *What Factors Contribute To Environmental Noise?*

The noise from an activity received at any location can be affected by a number of factors the most significant being:

- How loud the activity is?
- How far away the activity is from the receiver.
- What type of ground is between the activity and the receiver location e.g. concrete, grass, water or sand?
- How the ground topography varies between the activity and the receiver, is it flat, hilly, mountainous? Blocking the line of sight to a noise source will generally reduce the level of noise.
- Any other obstacles that block the line of sight between the source to receiver e.g. buildings or purpose built noise walls.

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B.1.3

How to Measure and Describe Noise?

Noise is measured using a specially designed 'sound level' meter, which must meet internationally recognised performance standards. Audible sound pressure levels vary across a range of 10^7 Pascals (Pa), from the threshold of hearing at $20\mu\text{Pa}$ to the threshold of pain at 200Pa . Scientists have defined a statistically described logarithmic scale called Decibels (dB) to more manageably describe noise.

To demonstrate how this scale works, the following points give an indication of how the noise levels and differences are perceived by an average person:

- 0 dB - represents the threshold of human hearing (for a young person with ears in good condition).
- 50 dB – represents average conversation.
- 70 dB – represents average street noise, local traffic etc.
- 90 dB – represents the noise inside an industrial premises or factory.
- 140 dB - represents the threshold of pain – the point at which permanent hearing damage may occur.

B.1.4

Human Response to Changes in Noise Levels

The following concepts offer qualitative guidance in respect of the average response to changes in noise levels:

- Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice. An increase of 2 dB is hardly perceivable.
- Differences in noise levels of around 5 dBA are considered to be significant.
- Differences in noise levels of around 10 dBA are generally perceived to be a doubling (or halving) of the perceived loudness of the noise. An increase of 10 dB is perceived as twice as loud. Therefore an increase of 20 dB is four times as loud and an increase of 30 dB is eight times as loud etc.
- The addition of two identical noise levels will increase the dB level by about 3 dB. For example, if one car is idling at 40 dB and then another identical car starts idling next to it, the total dB level will be about 43 dB.
- The addition of a second noise level of similar character which is at least 8 dB lower than the existing noise level will not add significantly to the overall dB level.

- A doubling of the distance between a noise source and a receiver results approximately in a 3 dB decrease for a line source (for example, vehicles travelling on a road) and a 6 dB decrease for a point source (for example, the idling car discussed above).
- A doubling of traffic volume for a line source results approximately in a 3 dB increase in noise, halving the traffic volume for a line source results approximately in a 3 dB decrease in noise.

B.1.5

Terms to Describe the Perception of Noise

The following terms offer quantitative and qualitative guidance in respect of the audibility of a noise source:

- **Inaudible/Not Audible** - the noise source and/or event could not be heard by the operator, masked by extraneous noise sources not associated with the source. If a noise source is 'inaudible' its noise level may be quantified as being less than the measured LA90 background noise level, potentially by 10 dB or greater.
- **Barely Audible** - the noise source and/or event are difficult to define by the operator, typically masked by extraneous noise sources not associated with the source. If a source is 'barely audible' its noise level may be quantified as being 5 - 7 dB below the measured LA90 or LAeq noise level, depending on the nature of the source e.g. constant or intermittent.
- **Just Audible** - the noise source and/or event may be defined by the operator. However there are a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.
- **Audible** - the noise source and/or event may be easily defined by the operator. There may be a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.
- **Dominant** - the noise source and/or event are noted by the operator to be significantly 'louder' than all other noise sources. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.

The following terms offer qualitative guidance in respect of acoustic terms used to describe the frequency of occurrence of a noise source during an operator attended environmental noise measurements:

- **Constant** - this indicates that the operator has noted the noise source(s) and/or event to be constantly audible for the duration of the noise measurement e.g. an air-conditioner that runs constantly during the measurement.

- **Intermittent** – this indicates that the operator has noted the noise source(s) and/or event to be audible, stopping and starting intervals for the duration of the noise measurement e.g. cars passing by.
- **Infrequent** – this indicates that the operator has noted the noise source(s) and/or event to be constantly audible, however; not occurring regularly or at intervals for the duration of the noise measurement, e.g. a small number of aircraft are noted during the measurement.

B.1.6 *How to Calculate or Model Noise Levels?*

There are two recognised methods, which are commonly adopted to determine the noise at particular location from a proposed activity. The first is to undertake noise measurements whilst the activity is in progress and measure the noise, the second is to calculate the noise based on known noise emission data for the activity in question.

The second option is preferred as the first option is largely impractical in terms of cost and time constraints, notwithstanding the meteorological factors that may also influence its quantification. Furthermore, it is also generally considered unacceptable to create an environmental impact simply to measure it. In addition, the most effective mitigation measures are determined and implemented during the design phase and often cannot be readily applied during or after the implementation phase of a project.

Because a number of factors can affect how ‘loud’ a noise is at a certain location, the calculations can be very complex. The influence of other ambient sources and the contribution from a particular source in question can be difficult to ascertain. To avoid these issues, and to quantify the direct noise contribution from a source/site in question, the noise level is often calculated using noise modelling software packages. The noise emission data used in may be obtained from the manufacturer or from ERM’s database of measured noise emissions.

B.1.7 *Acoustic Terminology & Statistical Noise Descriptors*

Environmental noise levels such as noise generated by industry, construction and road traffic are commonly expressed in dBA. The A-weighting scale follows the average human hearing response and enables comparison of the intensity of noise with different frequency characteristics. Time varying noise sources are often described in terms of statistical noise descriptors. The following descriptors are commonly used when assessing noise and are referred to throughout this acoustic assessment:

- **Decibel (dB is the adopted abbreviation for the decibel)** – The unit used to describe sound levels and noise exposure. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

- **dBA** - unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
- **dB C** - unit used to measure 'C-weighted' sound pressure levels. C-weighting is an adjustment made to sound-level measurements which takes account of low-frequency components of noise within the audibility range of humans.
- **dBZ or dBL** - unit used to measure 'Z-weighted' sound pressure levels with no weighting applied, linear.
- **Hertz (Hz)** - the measure of frequency of sound wave oscillations per second. 1 oscillation per second equals 1 hertz.
- **Octave** - a division of the frequency range into bands, the upper frequency limit.
- **1/3 Octave** - single octave bands divided into three parts.
- **Leq** - this level represents the equivalent or average noise energy during a measurement period. The $Leq, 15min$ noise descriptor simply refers to the Leq noise level calculated over a 15 minute period. Indeed, any of the below noise descriptors may be defined in this way, with an accompanying time period (e.g. $L_{10, 15 \text{ minute}}$) as required.
- **Lmax** - the absolute maximum noise level in a noise sample.
- **LN** - the percentile sound pressure level exceeded for N % of the measurement period calculated by statistical analysis.
- **L10** - the noise level exceeded for 10 % of the time. It is approximately the average of the maximum noise levels.
- **L90** - the noise level exceeded for 90 % of the time. It is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used as a basis for determining noise criteria for assessment purposes.
- **Sound Power Level (Lw)** - this is a measure of the total power radiated by a source. The Sound Power of a source is a fundamental property of the source and is independent of the surrounding environment.
- **Sound Pressure Level (Lp)** - the level of sound pressure; as measured at a distance by a standard sound level meter with a microphone. This differs from L_w in that this is the received sound as opposed to the sound 'intensity' at the source.

- **Background noise** – the underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the LA90 descriptor.
- **Ambient noise** – the all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far. This is described using the LAeq descriptor.
- **Cognitive noise** – noise in which the source is recognised as being annoying.
- **Masking** – the phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.

Industrial Noise Policy (INP) Terminology

The following terminology is from the NSW Environment Protection Authority – *NSW Environmental Noise Management – Industrial Noise Policy (INP)*, January 2000 and relevant application notes:

- **Assessment Background Level (ABL)** - is defined in the INP as a single figure background level representing each assessment period (day, evening and night). Its determination is by the tenth percentile method (of the measured LA90 statistical noise levels) described in Appendix B on the INP.
- **Rating Background Level (RBL)** - is defined in the INP as the overall single figure background level representing each assessment period (day, evening and night) over the whole monitoring period (as opposed to over each 24 hour period used for the ABL). This is the level used for assessment purposes. It is defined as the median value of:
 - all the day assessment background levels over the monitoring period for the day;
 - all the evening assessment background levels over the monitoring period for the evening; or
 - all the night assessment background levels over the monitoring period for the night.
- **Extraneous noise** – noise resulting from activities that are not typical of the area. Atypical INP activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.

- **Most affected location(s)** – locations that experience (or will experience) the greatest noise impact from the noise source under consideration. In determining these locations, one needs to consider existing background levels, exact noise source location(s), distance from source (or proposed source) to receiver, and any shielding between source and receiver.
- **Noise criteria** – the general set of non-mandatory noise level targets for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (for example, noise levels for various land uses).
- **Noise limits** – enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.
- **Project Specific Noise Levels** – target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive criteria or amenity criteria. Which of the two criteria is the most stringent is determined by measuring the level and nature of existing noise in the area surrounding the actual or proposed noise-generating facility.
- **Compliance** – the process of checking that source noise levels meet with the noise limits in a statutory context.
- **Non-compliance** – development is deemed to be in non-compliance with its noise consent/ licence conditions if the monitored noise levels exceed its statutory noise limit by more than 2 dB.
- **Feasible and Reasonable measures** – feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors:
 - noise mitigation benefits (amount of noise reduction provided, number of people protected);
 - cost of mitigation (cost of mitigation versus benefit provided);
 - community views (aesthetic impacts and community wishes); and
 - noise levels for affected land uses (existing and future levels, and changes in noise levels).
- **Meteorological Conditions** – wind and temperature inversion conditions.
- **Temperature Inversion** – an atmospheric condition in which temperature increases with height above the ground.

- **Adverse Weather** – weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).

B.2 VIBRATION - GLOSSARY OF TERMS, DEFINITIONS AND METHODOLOGY

B.2.1 How to Measure and Control Vibration

Vibration refers to the oscillating movement of any object. In relation to construction projects, ground-borne vibration is the most likely outcome of works and potentially has three (3) effects on vibration sensitive receivers, these are:

- Ground-borne vibration that may cause annoyance;
- Ground-borne vibration that may have adverse effect on a structure e.g. a building; and
- Regenerated noise due to ground-borne vibration.

Each of these potential effects can be assessed in accordance with the relevant standard. Perceptible levels of vibration often create concern for the surrounding community at levels well below structural damage guideline values; this issue needs to be managed as part of the vibration-monitoring program.

Vibration is typically measured using specific devices that record the velocity or acceleration at a designated receiver location – usually being the closest premises to works. Modern vibration monitoring devices will typically capture amplitude data for the three (3) orthogonal axes being, the transverse, longitudinal and vertical and also the frequency at which the measured vibration event occurs.

Monitoring of this level of detail enables analysis of significant vibration events to determine compliance with relevant guidelines such as the NSW Department of Environment and Conservation – NSW Environmental Noise Management – *Assessing Vibration: a Technical Guideline* (the NSW vibration guideline), February 2006 and the German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – *Structural Vibration - Effects of Vibration on Structures*.

Vibration propagates in a different manner to noise and can be difficult to control depending on the frequency of the source in question, although identifying the strategy best suited to controlling vibration follows a similar approach to that of noise. This includes elimination, control at the source, control along the propagation path and control at the receiver and/or a combination of these, such as no work/respite periods.

The following terms are often used to describe measured vibration levels.

- **Parameter** – an attribute with a value - for example, weighting;
- **Particle Velocity** – the instantaneous value of the distance travelled by a particle per unit time in a medium that is displaced from its equilibrium state by the passage of a sound or vibration wave;
- **Peak Component Particle Velocity (PCPV)** – is the highest (maximum or peak) particle velocity, which is recorded during a particular vibration event over the three (3) axes. PCPV is measured in the unit, mm/s;
- **Phase** – the relative position of a sound wave to some reference point, the phase of a wave is given in radians, degrees, or fractions of a wavelength;
- **Acceleration** – the change in velocity over time. Acceleration is dependent on the velocity and the frequency of the vibration event (velocity is a vector), as such acceleration changes in two ways - magnitude and/or direction. Acceleration is measured in the unit; m/s²;
- **Perceptible** – vibration levels that a receiver of building occupant may ‘feel’. 0.2mm/s is typically considered to be the human threshold for perception of vibration;
- **Geophone or accelerometer** – the transducer/device typically used to measure vibration;
- **Damage** – is defined in DIN 4150-3 to include minor non-structural effects such as cosmetic damage or superficial cracking in paint or cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls;
- **Vibration Dose Value (VDV)** – a concept outlined in the NSW vibration guideline, which is a calculative approach to assessing the impact of intermittent vibration or extended periods of impulsive vibration. VDV require the measurement of the overall weighted RMS (Root Mean Square) acceleration levels over the frequency range 1Hz to 80Hz. To calculate VDV the following formula (refer Section 2.4.1 of the guideline) is used:

$$VDV = \left[\int_0^T a^4(t) dt \right]^{0.25}$$

Where VDV is the vibration dose value in m/s^{1.75}, $a(t)$ is the frequency-weighted RMS of acceleration in m/s² and T is the total period of the day (in seconds) during which vibration may occur;

- **MIC** - Maximum Instantaneous Charge or explosive charge mass (kg) detonated per delay (any 8ms interval); and
- **SD** (m) - The scaled distance for air-blast and ground vibration from the charge to the receiver.

Annex C

INP Methodology

Responsibility for the control of noise emissions in NSW is typically vested in Local Government and the EPA – Environment Protection Authority.

The NSW *Industrial Noise Policy* (INP) first published by the EPA in January 2000, provides a framework and methodology for deriving limit conditions for consent and licence conditions. Using this policy the EPA regulates premises that are scheduled under the *Protection of the Environment Operations Act, 1997* (POEO Act). The specific INP objectives are:

- To establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses.
- To use the criteria as the basis for deriving Project-Specific Noise Levels (PSNL).
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.
- To outline a range of mitigation measures that could be used to minimise noise impacts.
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consent or licence conditions that reconcile noise impacts with the economic, social and environmental considerations of industrial development.
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the POEO Act.

The INP is designed for large and complex industrial sources and outlines processes designed to strike a feasible and reasonable balance between the operations of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant. The application of the INP involves the following processes:

- Determining the PSNL from intrusiveness and amenity based measurement of the existing background and ambient noise levels.
- Predicting or measuring the noise levels produced by the development.
- Comparing the predicted noise levels with the PSNL and assessing impacts.

Where the PSNL are predicted to be exceeded the INP provides guidelines on the assessment of feasible and reasonable noise mitigation strategies, including:

- The process of ‘weighing up’ the benefit of the development against the social and environmental costs resulting from the noise impacts.
- Establishment of achievable and agreed noise limits for the development in consultation with the consent authority.
- Undertaking performance monitoring of environmental noise levels to determine compliance with the consent and licence conditions.

C.2 *NSW INP - ASSESSMENT METHODOLOGY*

There are two criteria to consider when establishing PSNL for the assessment of industrial noise sources. These criteria are as follows:

- The ‘Intrusive Noise’ criterion, which is based on the background noise level plus 5 dB. The background noise level, or Rating Background Level (RBL), is determined in accordance with Section 3 of the INP and is based on the use of noise monitoring data to establish the assessable background noise levels; and
- The ‘Amenity Noise’ criterion, which is based on the recommended noise levels in the INP for prescribed land use. The recommended acceptable and maximum ambient noise levels are outlined in Table 2.1 of the INP. Table 2.2 of the INP outlines the requirements for developments where the existing noise level from industrial noise sources is close to the acceptable noise level.

The relevant tables in Section 2 of the INP relating to the amenity criteria relevant to the project are presented in *Table C.1* and *Table C.2*.

Table C.1 *Amenity Criteria - Recommended LAeq Noise Levels from Industrial Sources*

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50 dBA	55 dBA
		Evening	45 dBA	50 dBA
		Night	40 dBA	45 dBA
	Suburban	Day	55 dBA	60 dBA
		Evening	45 dBA	50 dBA
		Night	40 dBA	45 dBA
	Urban	Day	60 dBA	65 dBA
		Evening	50 dBA	55 dBA
		Night	45 dBA	50 dBA
	Urban/Industrial Interface - for existing situations only	Day	65 dBA	70 dBA
		Evening	55 dBA	60 dBA
		Night	50 dBA	55 dBA
Area specifically reserved for passive recreation	All	When in use	50 dBA	55 dBA
Active recreation area (School playground, golf course)			55 dBA	60 dBA
Commercial premises			65 dBA	70 dBA
Industrial premises			70 dBA	75 dBA
<div>1. In accordance with the INP the assessment periods are defined as follows: Daytime is the period from 7am to 6pm - Monday to Saturday; or 8am to 6pm on Sundays and Public Holidays, Evening is the period from 6pm to 10pm and Night time is all remaining periods; and</div> <div>2. The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.</div>				

Table C.2 *Modification to Acceptable Noise Level (ANL) to Account for Existing Levels of Industrial Noise*

Total Existing LAeq Noise Level from Industrial Noise Sources	Maximum LAeq Noise Level for Noise from New Sources Alone, dB
≥ Acceptable noise level plus 2 dB	If existing noise level is likely to decrease in future acceptable noise level minus 10 dB If existing noise level is unlikely to decrease in future existing noise level minus 10 dB
Acceptable noise level plus 1 dB	Acceptable noise level minus 8 dB
Acceptable noise level	Acceptable noise level minus 8 dB
Acceptable noise level minus 1 dB	Acceptable noise level minus 6 dB
Acceptable noise level minus 2 dB	Acceptable noise level minus 4 dB
Acceptable noise level minus 3 dB	Acceptable noise level minus 3 dB
Acceptable noise level minus 4 dB	Acceptable noise level minus 2 dB
Acceptable noise level minus 5 dB	Acceptable noise level minus 2 dB
Acceptable noise level minus 6 dB	Acceptable noise level minus 1 dB
< Acceptable noise level minus 6 dB	Acceptable noise level
1. ANL = recommended acceptable LAeq noise level for the specific receiver.	

In assessing the noise impacts from industrial sources at residential receivers both criteria are considered. For each period (day, evening and night) the most stringent of either the intrusive or amenity criteria becomes the limiting criterion and forms the project-specific noise level for the industrial source.

If the existing ambient noise level is close to the acceptable noise level, a new source must be controlled to preserve the amenity of the surrounding area. If the overall noise level from the industrial source already exceeds the acceptable noise level for the affected area, the LAeq noise level from a new source should meet the conditions set out in Table 2.2 of the INP.

C.2.1 *INP - Project Specific Noise Levels*

The INP states that the criteria outlined in *Table C.1* and *Table C.2* have been selected to protect at least 90 per cent of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90 per cent of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

Table C.3 presents the methodology for assessing noise levels, which may exceed the INP PSNL.

Table C.3 *Noise Impact Assessment Methodology*

Assessment Criterion	Project Specific Noise Level	Noise Management Zone	Noise Affection Zone
Intrusive	Rating background level plus 5 dB	≤ 5 dB above project-specific criteria	≥ 5 dB above project-specific criteria
Amenity	INP based on existing industrial level	≤ 5 dB above project-specific criteria	≥ 5 dB above project-specific criteria

For the purposes of assessing the potential noise impacts the project-specific, management and affection criteria are further defined in the following sections.

Project Specific Noise Level

Most people in the broader community would generally consider exposure to noise levels that achieve the project-specific criteria acceptable.

Noise Management Zone

Depending on the degree, that levels exceed the project-specific noise level (1 dB to 5 dB) noise impacts in this zone could range from negligible to moderate. It is recommended that management procedures be implemented including:

- prompt response to any issues of concern raised by community;
- noise monitoring on-site and within the community;
- refinement of on-site noise mitigation measures and plant operating procedures where practical;
- consideration of acoustical mitigation at receivers; and
- consideration of negotiated agreements with property holders.

Noise Affection Zone

Exposure to noise levels corresponding to this zone (more than 5 dB above project-specific criteria) may be considered unacceptable by some property holders and implementation of the following measures may be required:

- discussions with relevant property holders to assess concerns and provide solutions;
- implementation of acoustical mitigation at receivers; and
- negotiated agreements with property holders.

These application notes are provided to assist industry and acoustical consultants develop noise impact assessments and apply the provisions of the [NSW Industrial Noise Policy](#) (INP), with the aim of reducing processing time. The full list of application notes are extensive and are not reproduced here to avoid presenting an exhaustive list of technical requirements. The application notes have however been considered as relevant to the site and the relevant application notes have been summarised below.

The EPA requires noise impact assessments to apply the provisions of the INP; alternative approaches are not acceptable. The process for identifying project-specific noise levels in Section 2 of the INP must be followed.

The level of mitigation that can be applied to a project is based on what is feasible and reasonable within the circumstances of that project. Valid factors include costs, aesthetics, community preferences, noise reduction achieved, etc. Noise level requirements in a licence are based on what the project can achieve using feasible and reasonable mitigation. For more information on feasible and reasonable levels of mitigation see:

- [NSW Road Noise Policy](#);
- Sections 1.4.5 and 7 of the INP; and
- [Interim Construction Noise Guideline](#).

C.3.1

Identifying the Existing Level of Noise from Industry

(See [INP](#) Section 2.2 and 3.2)

Table 2.1 Amenity Criteria (INP p. 16) sets out recommended cumulative noise levels for industry. In assessing the amenity effects of noise from a new development, it is essential to determine the level of noise already present.

Where the ambient noise levels are below the Acceptable Noise Level (ANL), then ideally the measurement of the existing level of noise should include only noise from industrial sources. In these situations, however, it may be acceptable to include noise from other sources (for example, roads, and neighbourhoods). The reasons for this are that:

- including noise from other sources typically results in assessing the worst case for impacts on amenity; and
- strictly excluding noise from sources other than industry can be difficult and costly and may not be necessary if the development meets the criteria.

However, where ambient noise levels are above the ANL then noise from other sources should be excluded in establishing existing levels of industrial noise. Where the level of road traffic noise is high enough to make noise from an

industrial source inaudible for the majority of the time or difficult to measure directly, it may be necessary to consider applying the assessment for areas of high traffic noise. Application note: amenity criteria in high traffic noise areas provide further guidance on this.

C.3.2 *Assessing Noise at Industrial/Commercial Receivers*

(see [INP](#) Section 2.2)

The INP does not require that intrusive noise be assessed at industrial or commercial premises. For industrial/commercial receivers, only the amenity criteria apply. Amenity noise levels should be assessed at the most affected point on or within the property boundary. This approach also applies to other non-residential receivers, such as educational facilities, hospitals and places of worship.

C.3.3 *Identifying the Appropriate Receiver Amenity Category*

(see [INP](#) Section 2.2.2)

Amenity criteria in Table 2.1 of the INP vary depending on the type of receiver. INP Section 2.2.2 provides guidance on identifying the appropriate receiver type. Where there is doubt or debate over which receiver category is appropriate, the proponent needs to seek the views of the relevant land use manager (for example, Council or Department of Planning and Infrastructure). Once the land use manager has identified the land use (e.g. zone, allowable density of development and land use patterns), the appropriate amenity criteria can be assigned.

C.3.4 *Identifying Which of the Amenity or Intrusive Criteria Apply*

(see [INP](#) Section 2.4)

The INP notes that the Project-Specific Noise Level (PSNL) is the more stringent of either the amenity or intrusive criteria. This is not necessarily just a matter of comparing the magnitude of the amenity criteria to the intrusive criteria because different time periods apply (intrusive criteria uses 15 minutes while the amenity criteria are over the day, evening or night period).

For example, where the same number applies to amenity and intrusive criteria, the intrusive criteria would typically be more stringent because it is determined over a much shorter period.

Where the predicted amenity noise level is lower than the intrusive level for the proposed development, the proponent needs to ensure that both levels will be satisfied. In this situation, noise limits specified in the licence conditions will include both the intrusive and amenity noise levels predicted to be achieved by the proposal to ensure that the community is protected from intrusive noise impacts at all times.

C.3.5 *Assessing Background Noise Levels*

(see [INP](#) Section 3.1)

To determine the Rating Background Level (RBL) and existing industry-contributed LAeq, the measurement of ambient noise levels should be undertaken in the absence of noise from the development under consideration.

C.3.6 *When the RBL for Evening or Night is higher than the RBL for Daytime*

(see [INP](#) Section 3.1)

The results of long term unattended background noise monitoring can sometimes determine that the calculated Rating Background Level (RBL) for the evening or night period is higher than the RBL for the daytime period. These situations can often arise due to increased noise from, for example, insects or frogs during the evening and night in the warmer months or due to temperature inversion conditions during winter. The objective of carrying out long-term background noise monitoring at a location is to determine existing background noise levels that are indicative of the entire year.

In determining project-specific noise levels from the RBLs, the community's expectations also need to be considered. The community generally expects greater control of noise during the more sensitive evening and night-time periods than the less sensitive daytime period. Therefore, in determining project-specific noise levels for a particular development, it is generally recommended that the intrusive noise level for evening be set at no greater than the intrusive noise level for daytime. The intrusive noise level for night-time should be no greater than the intrusive noise level for day or evening. Alternative approaches to these recommendations may be adopted if appropriately justified.

C.3.7 *Maximum Noise Levels during Shoulder Periods*

(see [INP](#) Section 3.3)

Noise levels in limit conditions for sleep disturbance would typically be set as a maximum noise level. The approach noted in the INP for developing intrusive criteria for the shoulder period is not appropriate for determining maximum noise levels for the shoulder period. That is, assigning a background noise level based on averaging daytime and night-time RBLs may be appropriate for determining intrusive criteria but it is not appropriate for assigning maximum noise levels. The reason for this is that the day or night RBL is based around the 90th percentile of LA90, which is quite different to an RBL based on an average. Additionally, setting maximum noise levels for the shoulder period based on the lowest LA90 during the period is not practical as it can result in the maximum noise limit being set lower than the intrusive noise limit.

In order to generate a statistically valid data set to derive the 90th percentile of LA90 for the shoulder period, a much larger sampling time (than the one week

typically applied) would be required, with associated cost and practicality implications. Therefore, a statistical approach to calculating the RBL for shoulder periods is not required by the INP.

It is the intention of the INP that appropriate noise targets for the shoulder period be negotiated with the regulatory/consent authority on a case-by-case basis. The focus of the INP is on avoiding or minimising noise of a high level and/or with intrusive characteristics, during the shoulder period, through the use of best practice.

Options available to the proponent for managing maximum noise levels during the shoulder period are to:

- avoid noise events during the shoulder period (or at least during the first half and then to meet RBL(shoulder period) +15 dB(A) during the second half of the shoulder period)
- collect sufficient data to calculate a statistically robust 90th percentile-based RBL for the shoulder period and use this to determine RBL+15 dB(A) as the maximum noise level limit
- conduct a detailed analysis of the number and noise level of noise events, and the exceedance of the background noise level, then, present a case comparing the results of the analysis and the research results contained in the [NSW Road Noise Policy](#).

C.3.8 *Tonality - Sliding Scale Test*

(see [INP](#) Section 4.2)

The sliding scale test for tonality outlined in Section 4 of the INP uses a linear (z-weighted) spectrum (that is, no frequency weighting on each of the octave or third octave bands).

C.3.9 *Duration Correction*

(see [INP](#) Section 4.2)

Section 4 of the INP provides guidance on the use of modifying factors to account for certain characteristics of a noise source. The duration factors in Table 4.2 are intended to increase the criterion that is acceptable, whereas the modifying factor corrections in Table 4.1 are intended to increase the measured or predicted level.

C.3.10 *Determining What Weather Conditions Should Be Used When Predicting Noise*

Background

(see [INP](#) Section 5)

The INP intends that the noise levels used in assessing noise impacts at the consent stage include the effects of any weather conditions that are a feature of the area when the development operates. This means that the effects of weather conditions such as temperature inversions and wind on the noise level experienced at sensitive receivers should be adequately assessed at the consent stage.

Wind can enhance noise propagation compared with calm conditions (where there is no wind). When a wind blows, friction causes the air to move more slowly close to the ground than at higher altitudes. This phenomenon of wind speed increasing with height is termed 'wind shear'. The increase in noise occurs because sound waves from the source are bent through this 'wind shear' back towards the ground.

Unlike temperature inversions, wind can enhance propagation during any time of the day, evening or night. Wind does not increase noise in all directions and can also reduce noise. For example, wind blowing from the south to the north (termed a 'southerly' wind) increases noise to the north of an industrial premise and also reduces noise to the south of that premise.

In some instances, where one or more significant weather conditions have been identified as part of a noise assessment, noise levels from the industrial premises under only these significant weather conditions have been assessed, but noise levels under calm conditions have not.

The INP describes in Section 5 when weather is 'significant' (i.e. it occurs more than 30% of the relevant time period) and how to apply this in the noise assessment. This approach may result in noise levels at some receivers being underestimated, as in the southerly prevailing wind scenario described above.

Recommended approach

This application note clarifies that in all cases at each receiver:

- noise levels from the premises under calm conditions as well as any significant weather conditions as defined in the INP should be predicted or measured
- the highest of the noise levels from Step 1 is to be used in the assessment for that receiver.

The intent of the INP is not to require that these conditions should be applied exclusively where the significant weather conditions act to reduce noise at a sensitive receiver.

For example, where a significant prevailing wind of speed less than three metres per second increases noise levels at a receiver to the north of a development (compared with those predicted under calm conditions), the noise levels predicted under that prevailing wind should be used at that receiver. For receiver(s) to the south of the same development, if the noise levels predicted

under calm wind conditions are higher than those predicted under the significant prevailing wind, the noise levels predicted under calm wind conditions should be used at the southern receiver(s).

The EPA has previously accepted (and will accept) noise predictions based on modelling noise emissions using long term weather data, as it can present a higher level of analysis than that required under the INP.

C.3.11 *How Calm Is Defined*

(see [INP](#) Section 5.1)

In the assessment of wind effects, the INP requires the assessment of wind speeds of up to 3 metres per second where these speeds are a feature of the area (they occur for 30 percent of the time or more) but does not specify the minimum wind speed that needs to be assessed. The calm condition is typically represented by wind speeds less than or equal to 0.5 metres per second as this is likely to be the lower limit of measurement.

C.3.12 *Presenting Predicted Noise Impacts*

(see [INP](#) Section 6.3)

In carrying out noise impact predictions for a particular development, predicted noise levels for calm conditions as well as any significant adverse weather conditions should generally be provided. It is particularly useful to provide predicted noise impacts for calm weather conditions where predicted noise impacts under adverse weather conditions exceed the project-specific noise levels. This allows for a better understanding of potential noise impacts from the development.

C.3.13 *Noise Impact Assessment for the Modification of Existing Industrial Premises*

Background

(see [INP](#) Section 10)

Section 10 of the INP outlines the application of the policy to existing industrial premises.

As well as being used to assess noise emissions from new industrial premises, the INP is also applied to situations where existing industrial premises are modified, expanded or upgraded.

Where a modification is proposed, the noise level targets for the premises (termed Project Specific Noise Levels) are to be determined firstly excluding any noise from the subject premises. The noise from the existing premises is then assessed against these targets to determine if there is a need to consider noise mitigation for existing operations. The predicted noise level from the

proposed modification is then assessed, both in isolation and in combination with noise from the existing premises.

The total noise emissions from the modified premises should ideally not exceed the Project Specific Noise Levels. If the existing premises cannot achieve these targets, the allowable noise emissions from the proposed modification will be set so that the modification does not significantly increase the existing noise emissions.

Recommended Approach

This application note outlines these processes together with the degree of information required to support a proper assessment of modifications to an existing industrial premises.

A noise impact assessment for the modification of existing industrial premises should include, as a minimum:

- existing noise criteria contained in consents, approvals or licences, that are applicable to the premises;
- Project Specific Noise Levels (PSNLs) for the premises determined in accordance with the INP and relevant application notes (see, for example, Appendix A4 of the INP). Note: care should be taken to exclude noise from the existing premises when quantifying background and existing industrial noise levels (further guidance is in the INP in Section 11.1.2);
- where application of the INP results in a PSNL more stringent than existing noise criteria, the PSNL should be adopted for noise assessment purposes. Note: the INP acknowledges that the PSNL is a goal sought to be achieved through the application of feasible and reasonable noise mitigation measures and is not necessarily applied as a statutory limit by default;
- measured or predicted noise levels from the existing premises at noise sensitive receiver locations;
- predicted noise contribution from the proposed modification, in isolation, at noise sensitive receiver locations; and
- cumulative noise levels from the entire premises (i.e. combined level from existing and proposed modification) compared to the PSNL.

C.3.14 *Where Noise from the Existing Premises Exceeds the PSNL*

Where it can be determined that noise from the existing premises alone is currently exceeding the PSNL, a preliminary analysis of potential noise mitigation measures, and conceptual noise reductions, needs to be undertaken for the existing premises. Note: this does not mean that in all circumstances noise mitigation to existing premises will be required as part of a modification. Decisions of this nature will be determined on a case-by-case basis, taking into

account various factors, for example, feasible and reasonable mitigation options, the absolute level of noise and existing measures of community impact, including complaints.

Once the conceptual mitigated level of noise performance of the existing premises (i.e. what can be achieved) has been determined, the contribution noise level goal for the modification can be determined. The noise level goal for the modification should be set at least 10dB below the PSNL, or where it has been determined that the existing premises cannot achieve the PSNL, it should be set at least 10dB below the conceptual mitigated noise performance of the existing premises.

This approach is designed to ensure that noise from the modification does not become the limiting factor in noise from the entire premises potentially meeting the PSNL.

C.3.15 *Prosecution Guidelines*

(see [INP](#) Section 11.1)

EPA's approach to prosecuting offences is described in [EPA prosecution guidelines 2012](#), particularly Sections 2.2.3 to 2.2.7 under 'Discretion' which states that 'not every breach of the criminal law is automatically prosecuted - the laying of charges is discretionary' and 'The EPA has a discretion as to how to proceed in relation to environmental breaches' and 'Each case will be assessed to determine whether prosecution is the appropriate strategic response'. Sections 2.2.8 under 'Factors to be considered' in the Guidelines describe factors that are considered when determining whether prosecution is required, such as 'whether the breach is a continuing or second offence', 'the availability and efficacy of any alternatives to prosecution' and 'the prevalence of the alleged offence and the need for deterrence, both specific and general'.

C.3.16 *Sleep Disturbance*

Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The INP does not specifically address sleep disturbance from high noise level events.

Research on sleep disturbance is reviewed in the [NSW Road Noise Policy](#). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research, the EPA recognised that the current sleep disturbance criterion of an L1, 1 minute not exceeding the L90, 15 minute by more than 15 dBA is not ideal. Nevertheless, as there is insufficient evidence to determine what

should replace it, the EPA will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or L1, 1 minute, that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night time period. Some guidance on possible impact is contained in the review of research results in the [NSW Road Noise Policy](#). Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur;
- time of day (normally between 10pm and 7am); and
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

The L1, 1 minute (in dBA) descriptor is meant to represent a maximum noise level measured under 'fast' time response. The EPA will accept analysis based on either L1, 1 minute or Lmax statistical parameters.

C.3.17 Addressing Privately Owned Haul Roads

Noise from privately owned haul roads is to be assessed as an industrial noise source according to the INP. The practice of treating access roads as part of the industrial premises with which they are associated is a long established part of noise management in NSW, which the INP has not changed. The basis for treating vehicles on private access roads as part of an industrial noise source lies in the relationship between the enterprise and the noise, and the community's response to noise from vehicles operating on private roads.

The Character of the Noise is Different to General Road Traffic Noise

Traffic on access roads is solely related to the operation of the site served by the access road and is usually composed almost entirely of heavy vehicles, producing noise of a different character to the typical public roadway where smaller vehicles typically predominate.

Factors that influence Community Response are different compared to Public Roads

The distribution of benefits from the operation of a private access road is typically perceived as being different than from a public road. Affected members of the public have been reported as questioning the equity of truck noise degrading their amenity for the benefit of others.

The degree of control possible for traffic on a private access road is typically perceived as greater than for a public road. The result is a higher level of

expectations that more can and should be done to reduce noise from the private road (than from a public one).

C.3.18 *Determining Noise Limits for Licence Conditions*

Where the proponent predicts that noise levels from the industrial development would be below the project-specific noise levels, then the noise limits specified in the licence/consent conditions should reflect the noise levels that the proponent states would be achieved (that is, the predicted noise levels, however a minimum intrusive criterion of 35 dB(A) still applies). This is for a number of reasons:

- to ensure that the best-management practices and best available technology described in the noise impact assessment report are actually adopted by the proponent
- to ensure that the level of achievable performance presented by the proponent to the public, through public documentation such as Environmental Impact Statements, is achieved
- to optimise the opportunity for further industrial development in the area without an unacceptable degradation of the acoustic amenity of the area
- to fulfil a general aim of the environmental assessment process to minimise environmental impacts.

It should be noted that noise limits would apply to the contributed noise levels from only the premise or site of concern. In setting noise limits, judgement needs to be made as to whether the predicted noise levels warrant noise limits on the licence/consent. Where the predicted noise levels from the premises of concern are well below the project-specific noise levels, there may be no need for noise limit conditions.

Any tolerances to the predicted noise levels should be addressed in the proponent's assessment of impacts so that the predicted noise levels can be applied in conditions.

Annex D

ICNG Methodology

D.1 NSW ICNG - NOISE IMPACT ASSESSMENT PROCEDURES

This ICNG has been developed by a number of agencies including the Department of Environment and Climate Change NSW (DECC), NSW Department of Planning, Roads and Traffic Authority, NSW (RTA), WorkCover NSW and NSW Health together with the Local Government and Shires Associations of NSW.

In preparing the document there was extensive public consultation. The views of industry stakeholders were sought at an early stage and have contributed significantly to this document. The Standards Australia committee was consulted to address any potential inconsistencies between the Guideline and relevant standards.

It recognises that construction noise (and vibration) is one of the major environmental noise issues in NSW; not only from building works but also from demolition, remediation, renewal and maintenance. Construction can occur close to residences or other sensitive land uses and be variable in times of occurrence. These aspects of construction can exacerbate noise levels and their effects. Construction noise by its nature is temporary, may not be amenable to purpose-built noise control measures applied to industrial processes, and may move as construction progresses.

With these constraints in mind, the ICNG has been developed to focus on applying a range of work practices most suited to minimise construction noise impacts, rather than focusing only on achieving numeric noise levels. While some noise from construction sites is inevitable, the aim of the Guideline is to protect the majority of residences and other sensitive land uses from noise pollution most of the time.

D.2 NOISE MANAGEMENT LEVELS

People's reaction to noise from construction will depend on the time of day that works are undertaken. Residents are usually most annoyed by work at night time as it has the potential to disturb sleep. Noise from work on evenings, Saturday afternoons, Sundays and public holidays can also be annoying to most residents as it may interrupt leisure activities.

D.2.1 Residential Receptors

Table 2 of the ICNG sets out management levels for noise at residences and how they are to be applied. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level. In Table 2, the RBL is used when determining the management level, consistent with the approach described for the INP. Table 2 of the ICNG is reproduced below.

Table D.0.1 Residential Receptors (NML)

Time of Day	Management Level	How to Apply
Recommended Standard Hours: Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, No work on Sundays or public holidays.	Noise affected RBL + 10 dB	<p>The noise-affected level represents the point above which there may be some community reaction to noise.</p> <ul style="list-style-type: none"> Where the predicted or measured LAeq (15 min) is greater than the noise-affected level, the proponent should apply all feasible and reasonable work practices to meet the noise-affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	<p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <ul style="list-style-type: none"> Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ul style="list-style-type: none"> 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise-affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise-affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

D.2.2 *Other Sensitive Land Uses*

Other sensitive land uses, such as schools, typically consider noise from construction to be disruptive when the properties are being used (such as during school times). Table 3 of the ICNG presents management levels for noise at other sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed. Table 3 of the ICNG is reproduced below.

Table D.0.2 *Other Sensitive Receptors (NML)*

Land Use	Management level, LAeq (15 min) (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level 45 dBA
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of worship	Internal noise level 45 dBA
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 65 dBA
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 60 dBA
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.

D.2.3 *Commercial and Industrial Receptors*

Due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories. As defined by the ICNG the external noise levels should be assessed at the most-affected occupied point of the premises:

- Industrial premises: external Leq, 15 minute \leq 75 dBA.
- Offices, retail outlets: external Leq, 15 minute \leq 70 dBA.
- Other businesses that may be very sensitive to noise, where the noise level is project specific as discussed in the ICNG.

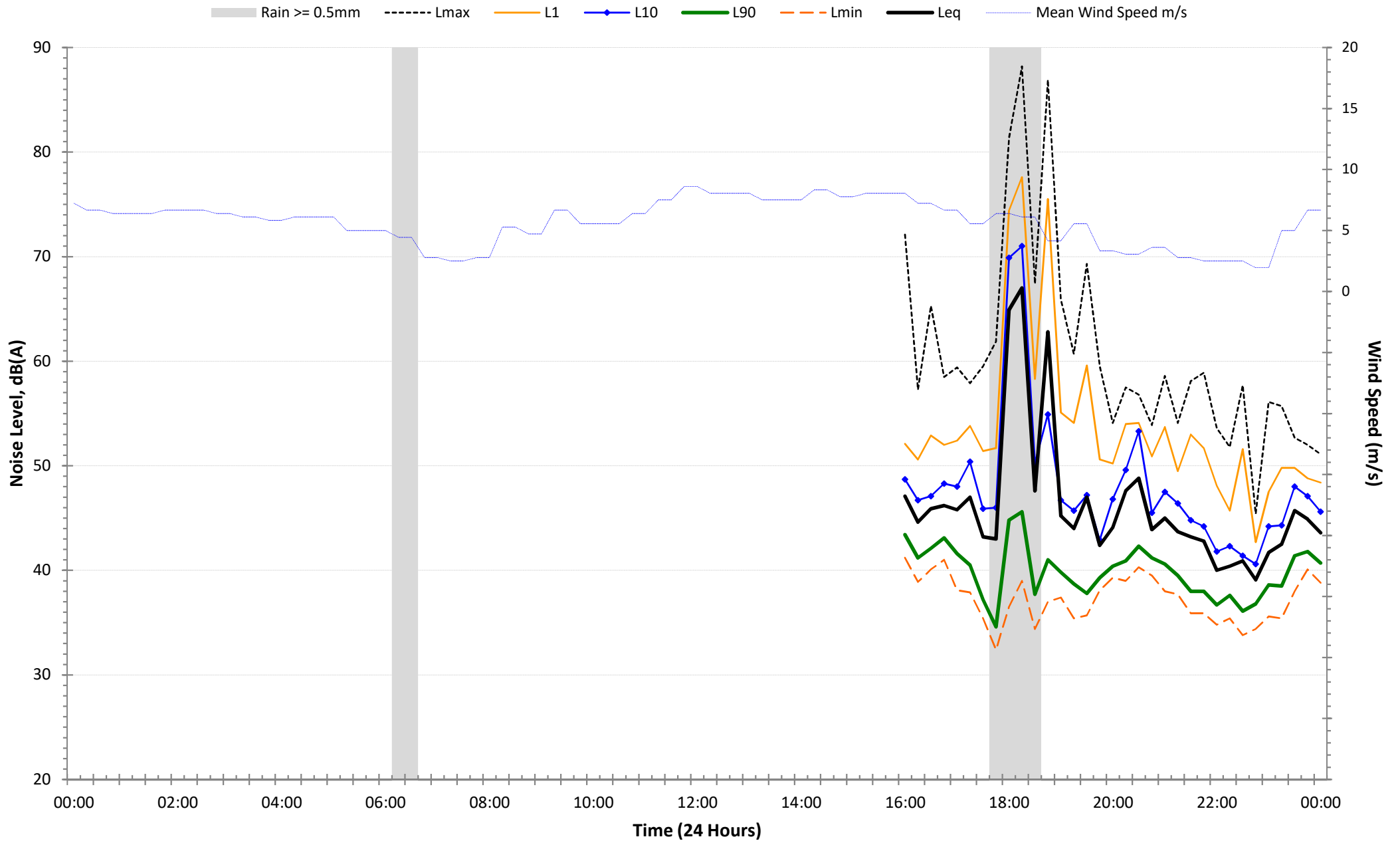
D.2.4 *Other Features*

The ICNG goes on to describe criteria for ground-borne noise but these values are not relevant to this assessment. The ICNG also references vibration standards however these are addressed separately by applicable guidelines.

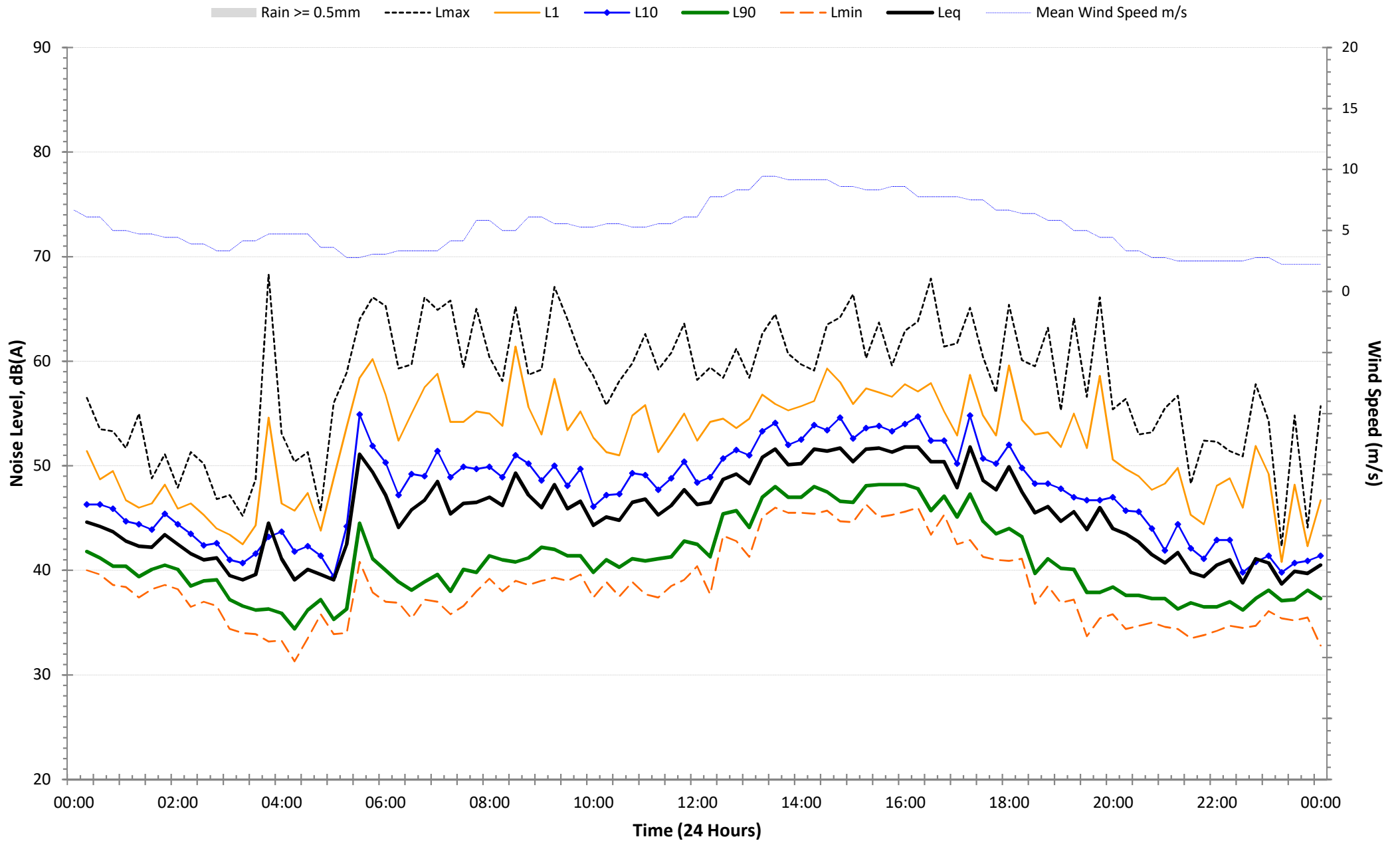
Annex E

Unattended Noise Logging Charts

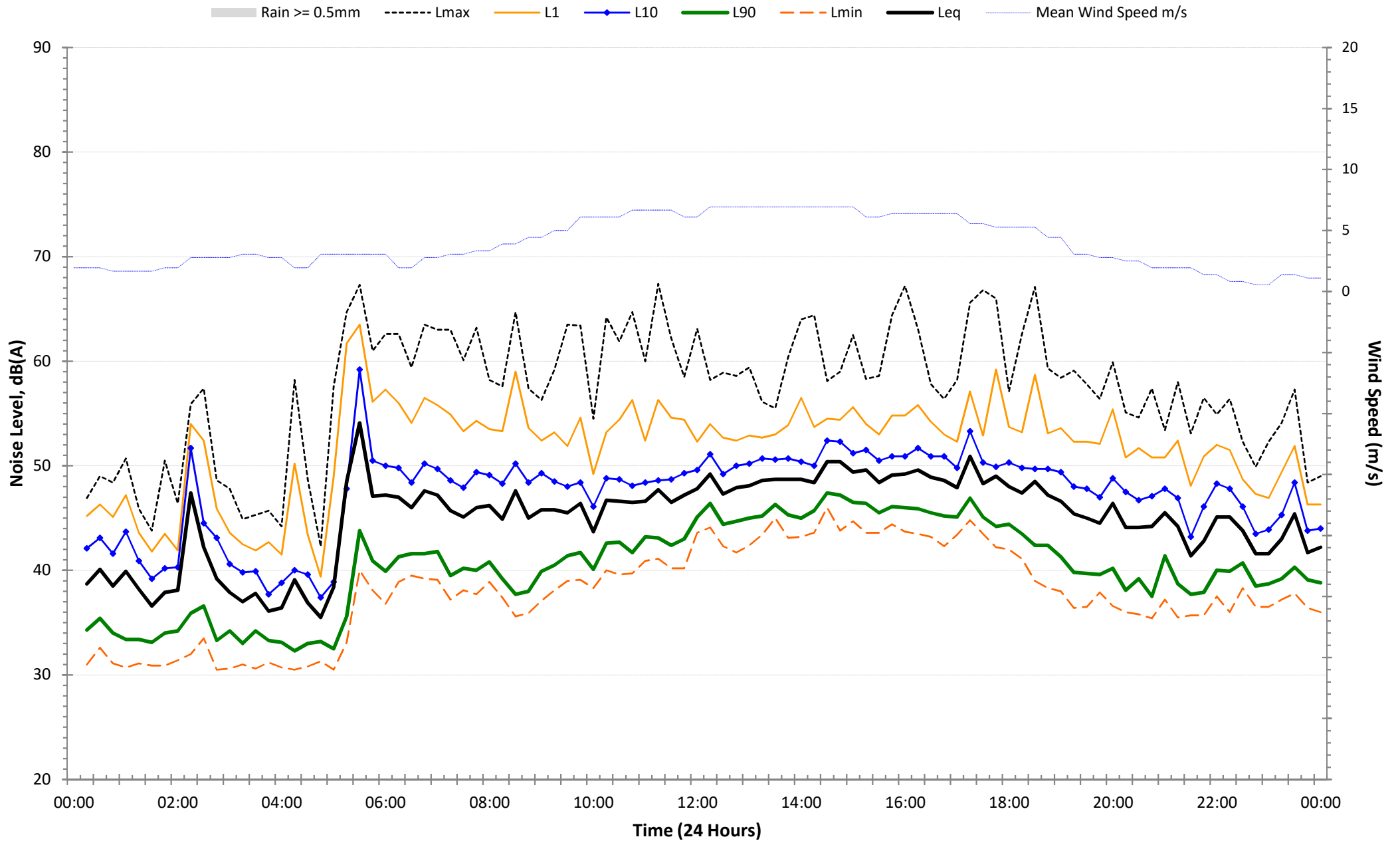
Measured Noise Levels
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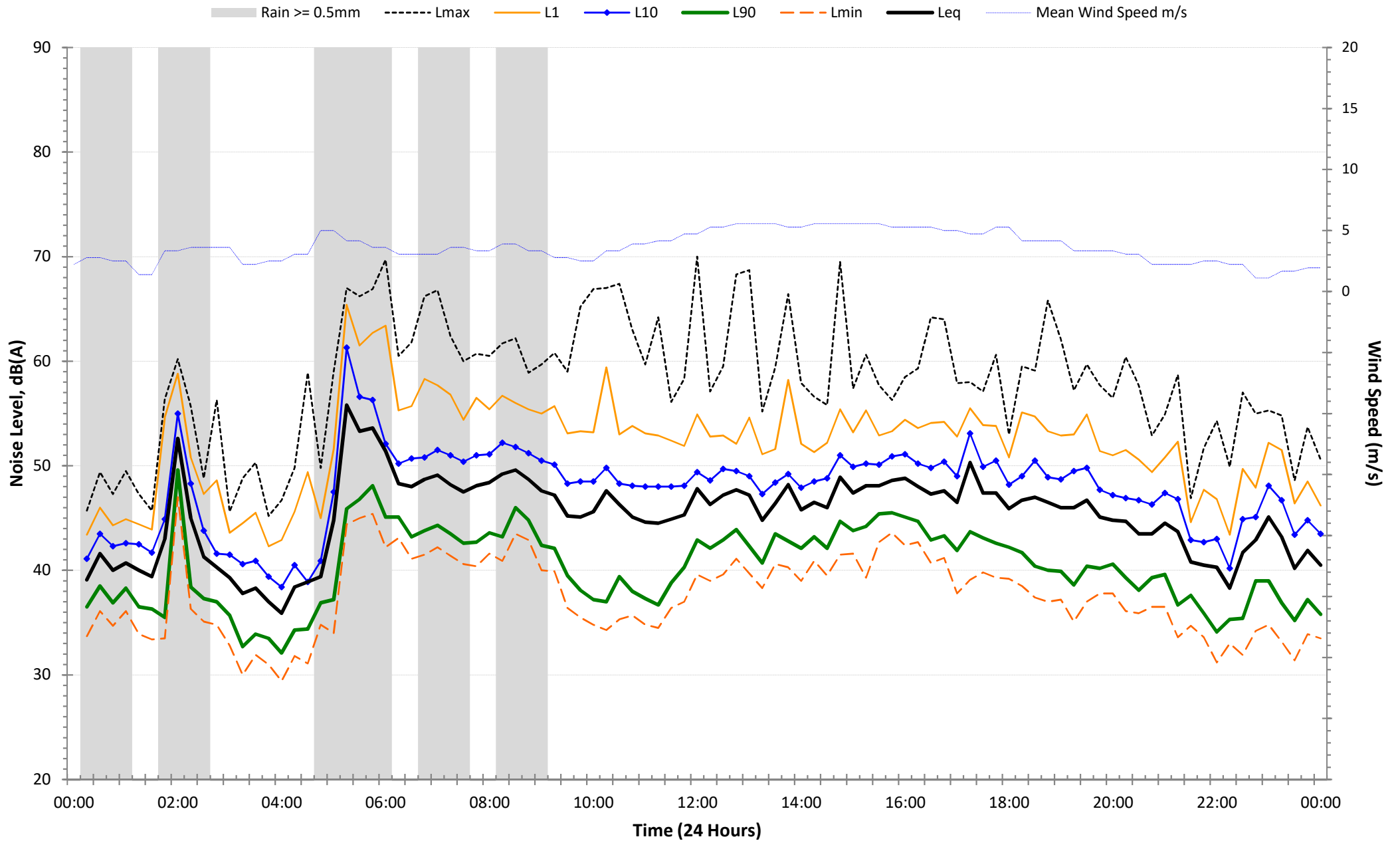
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L1 - Sancrox Quarry - Tuesday 7 November 2017



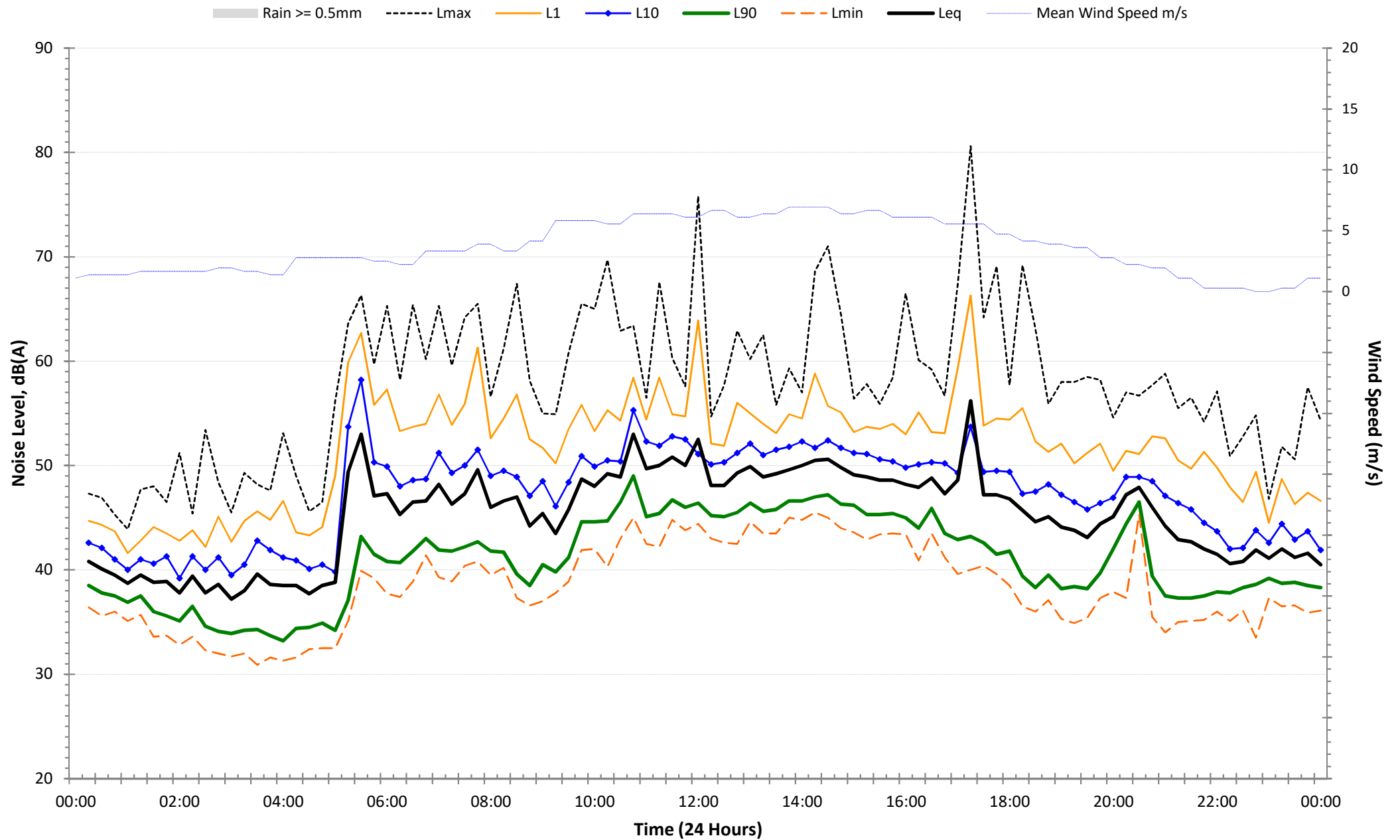
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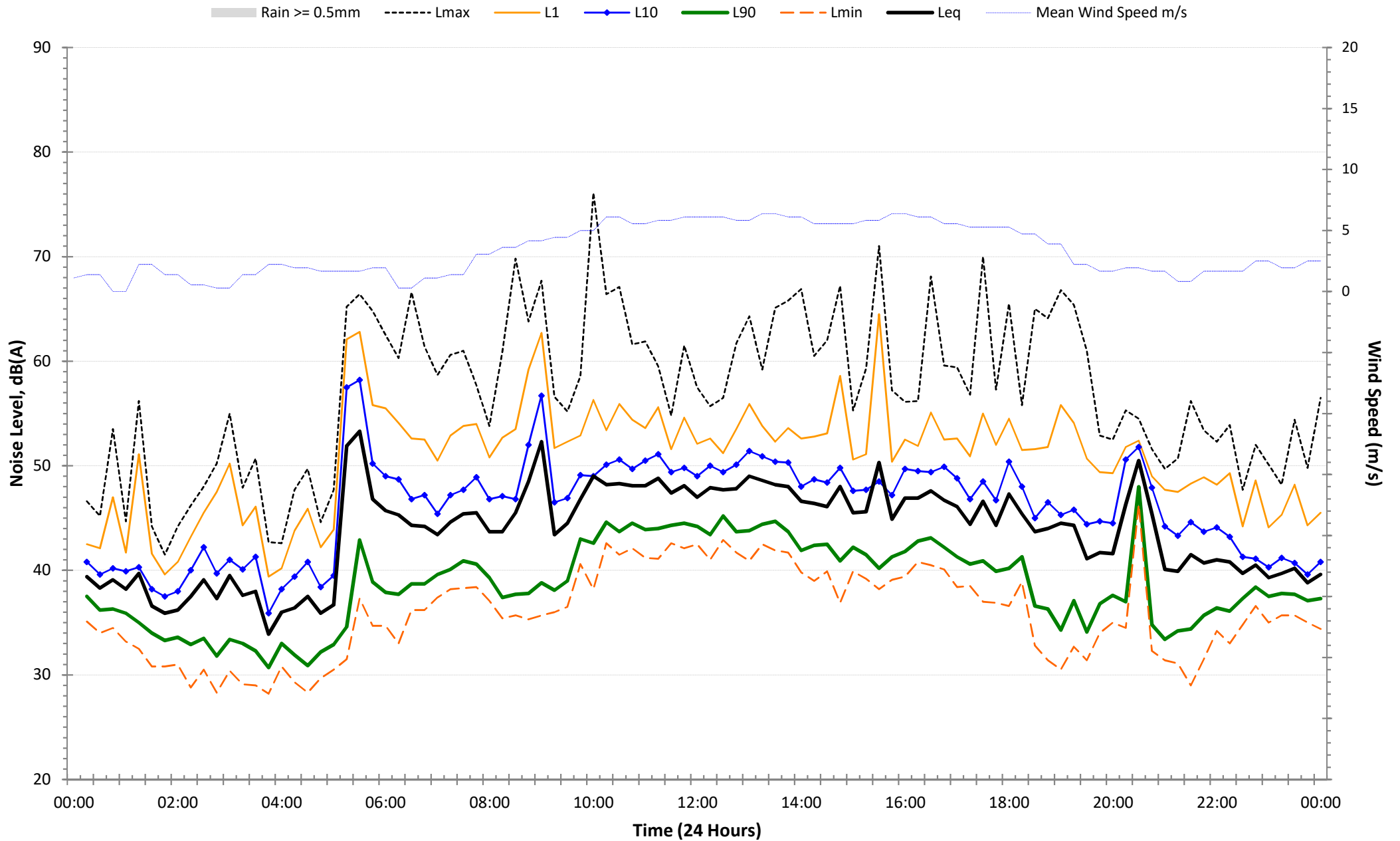
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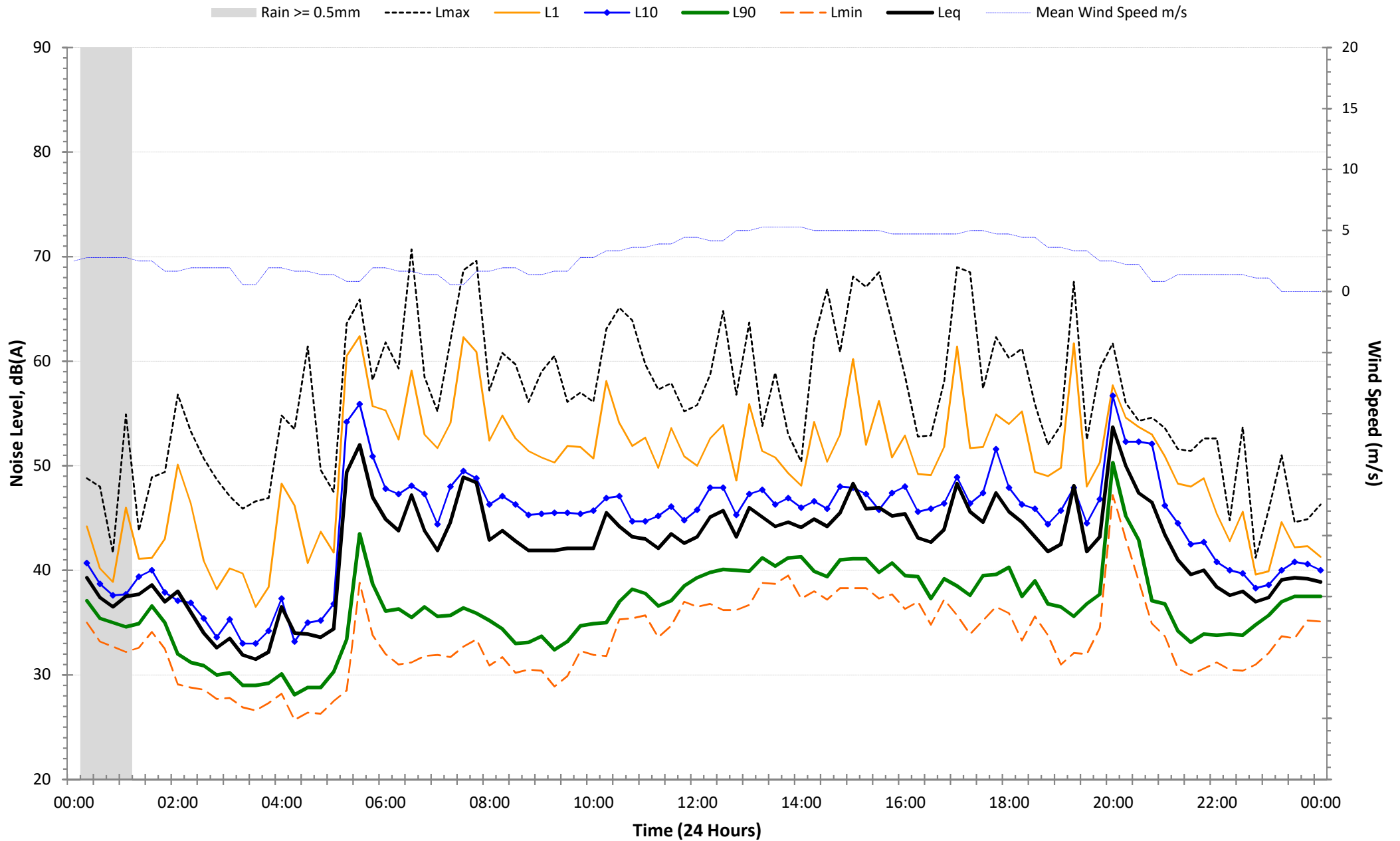
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L1 - Sancrox Quarry - Friday 10 November 2017



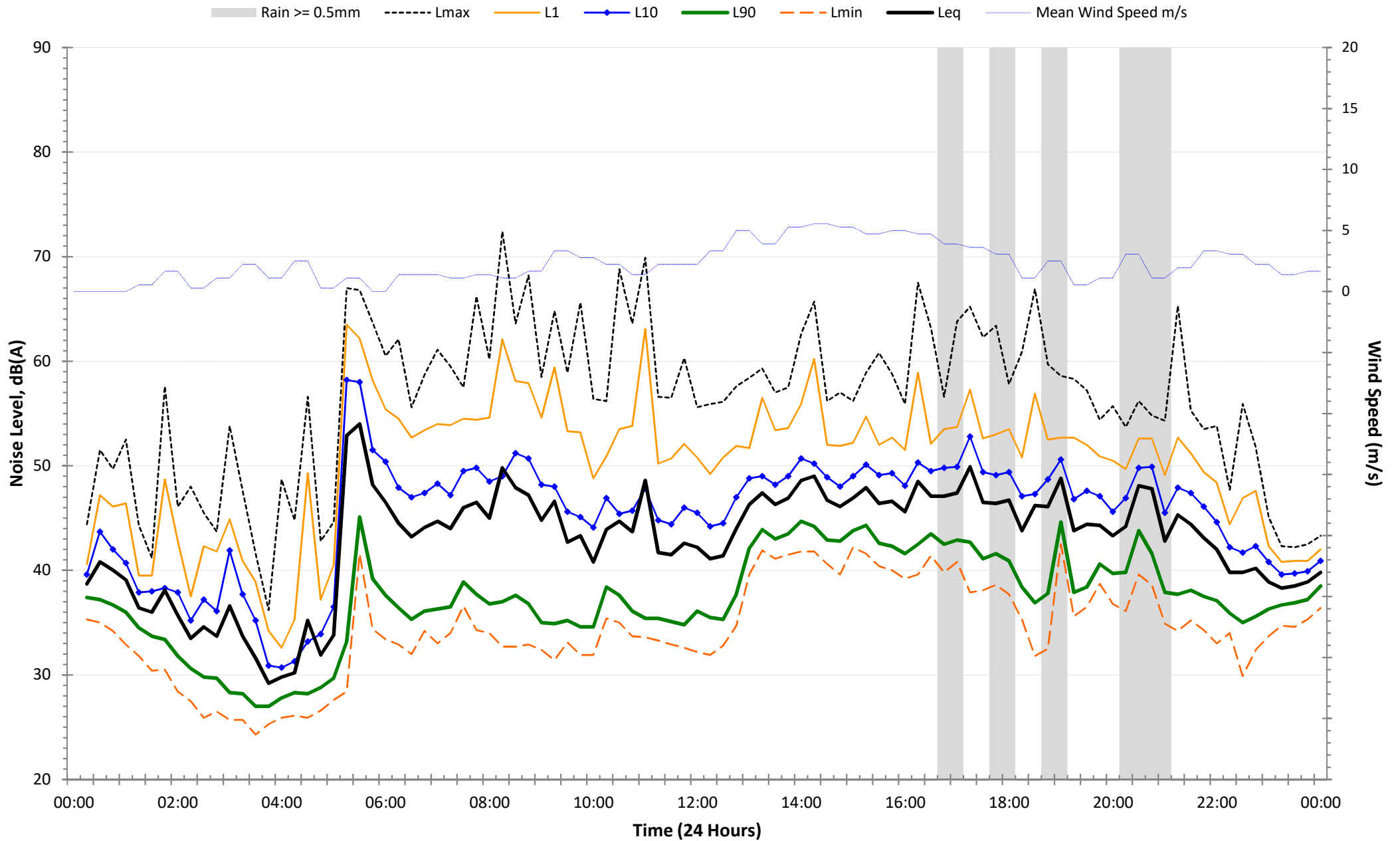
Measured Noise Levels
L1 - Sancrox Quarry - Saturday 11 November 2017



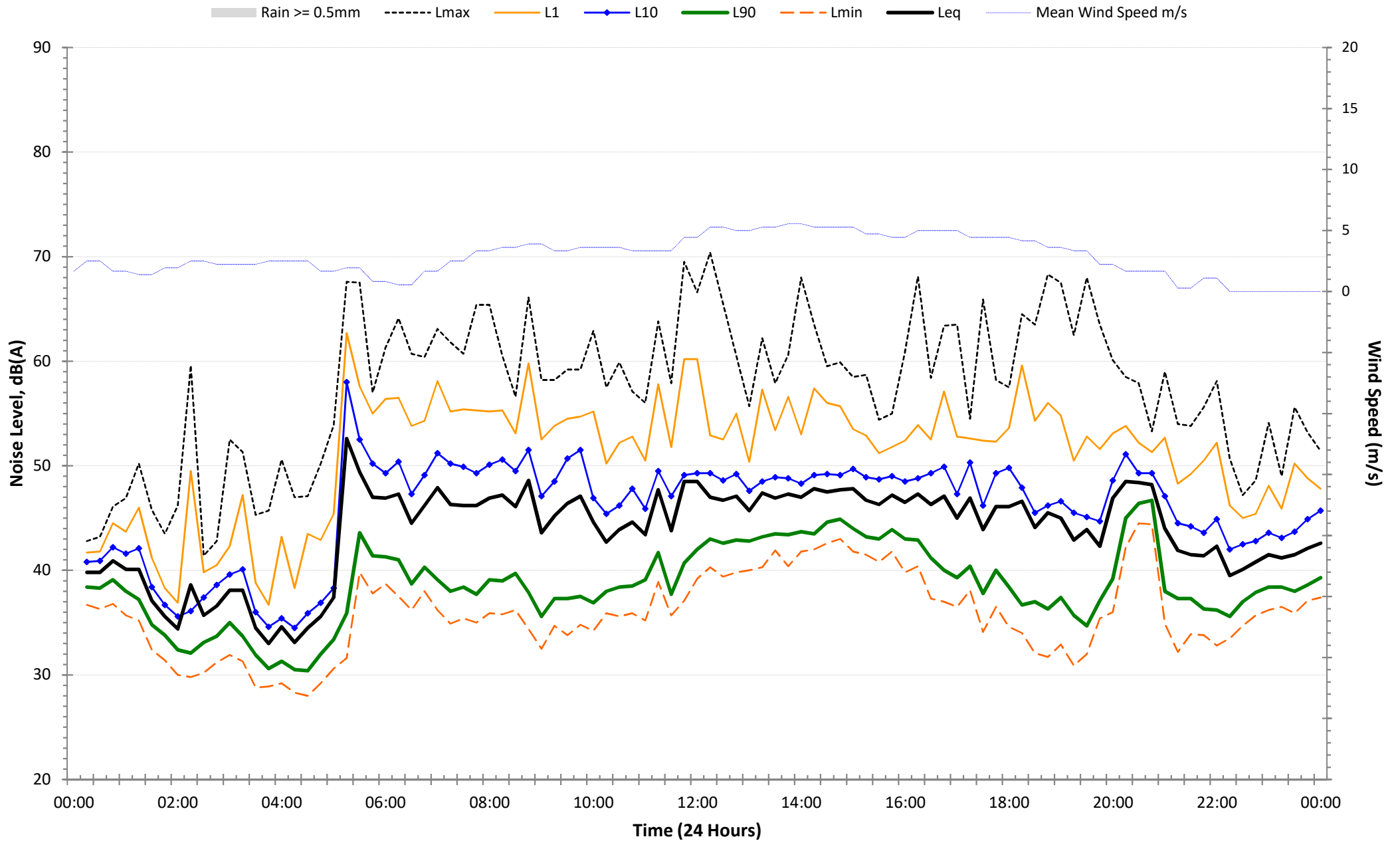
Measured Noise Levels
L1 - Sancrox Quarry - Sunday 12 November 2017



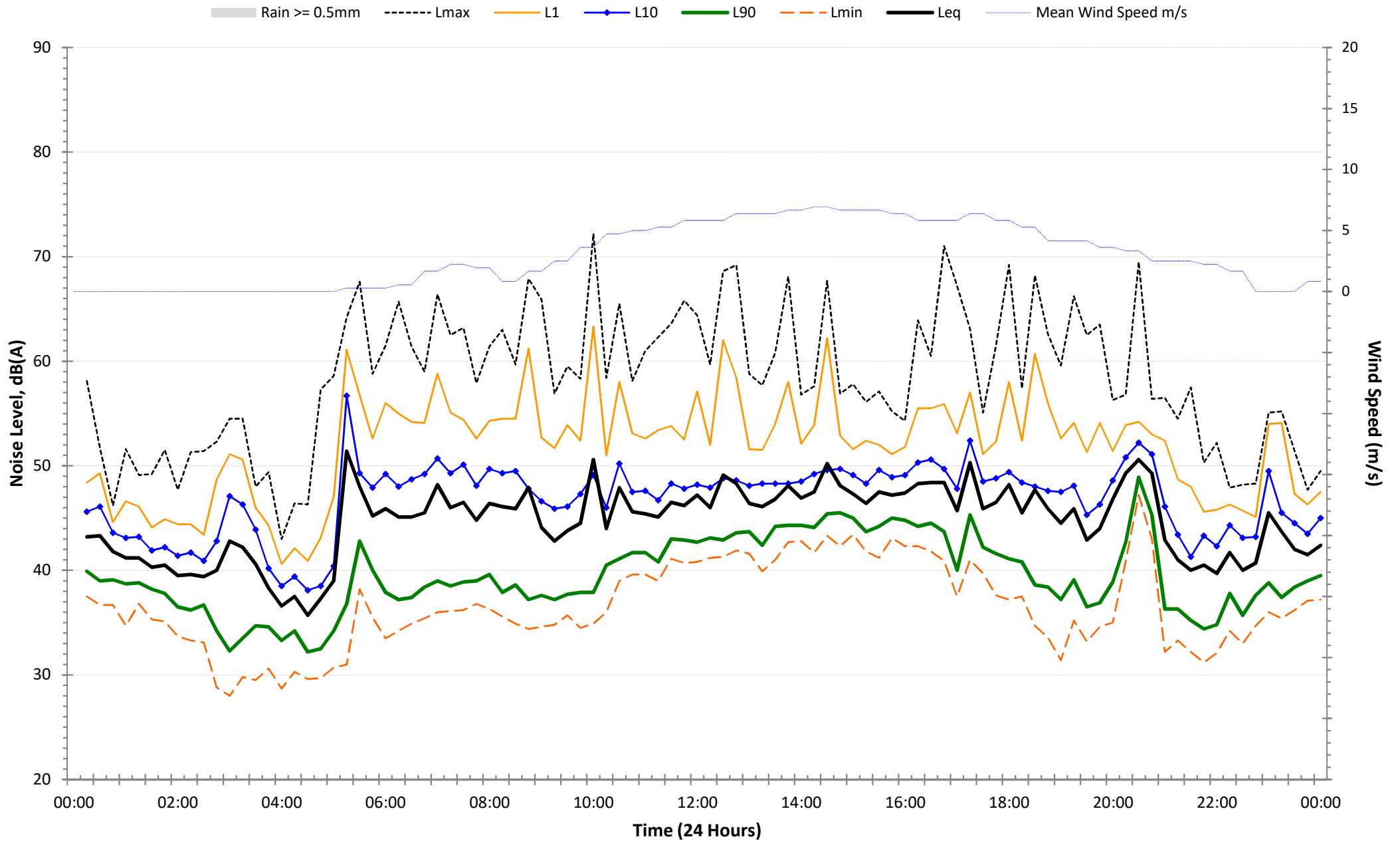
Measured Noise Levels
L1 - Sancrox Quarry - Monday 13 November 2017



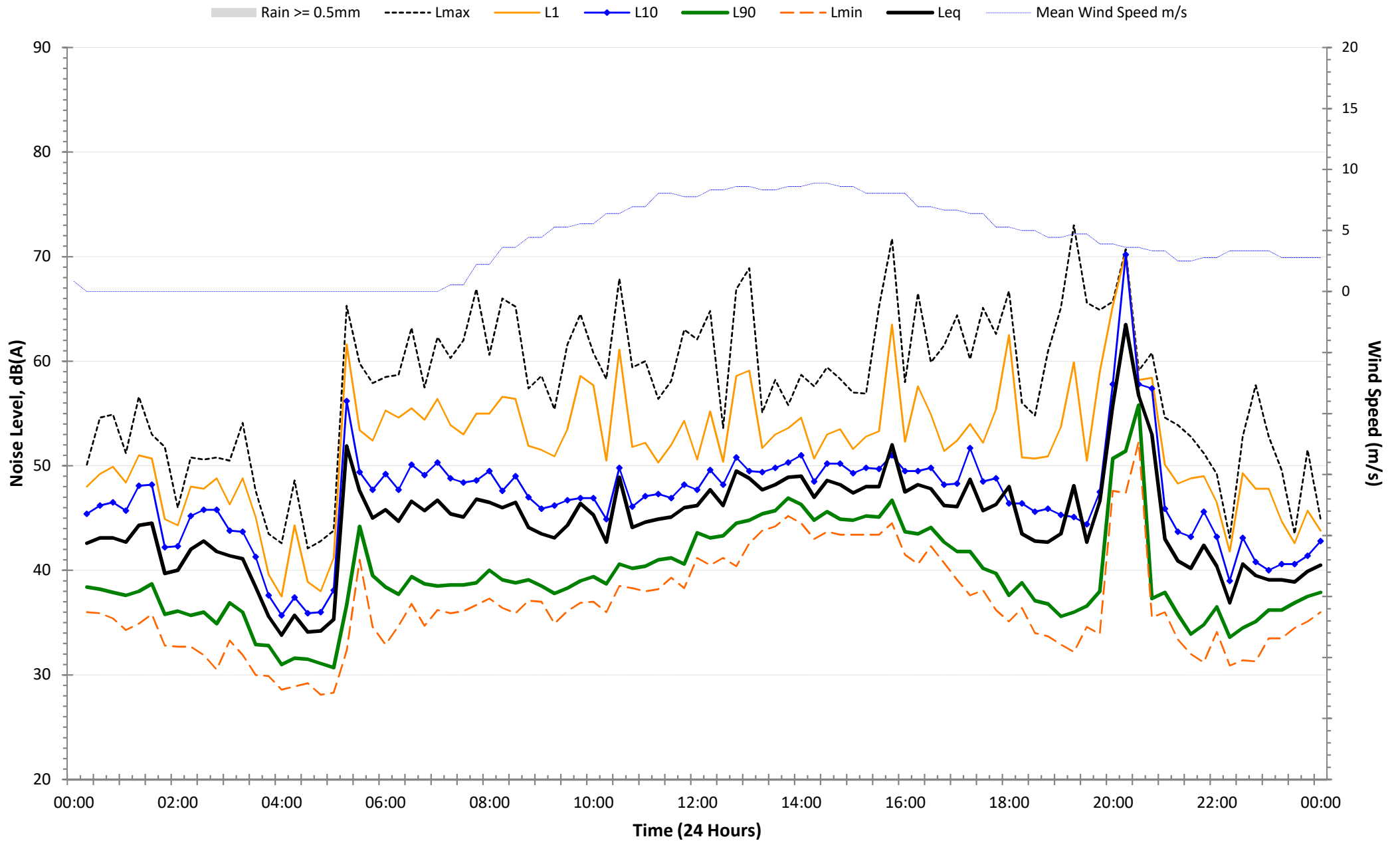
Measured Noise Levels L1 - Sancrox Quarry - Tuesday 14 November 2017



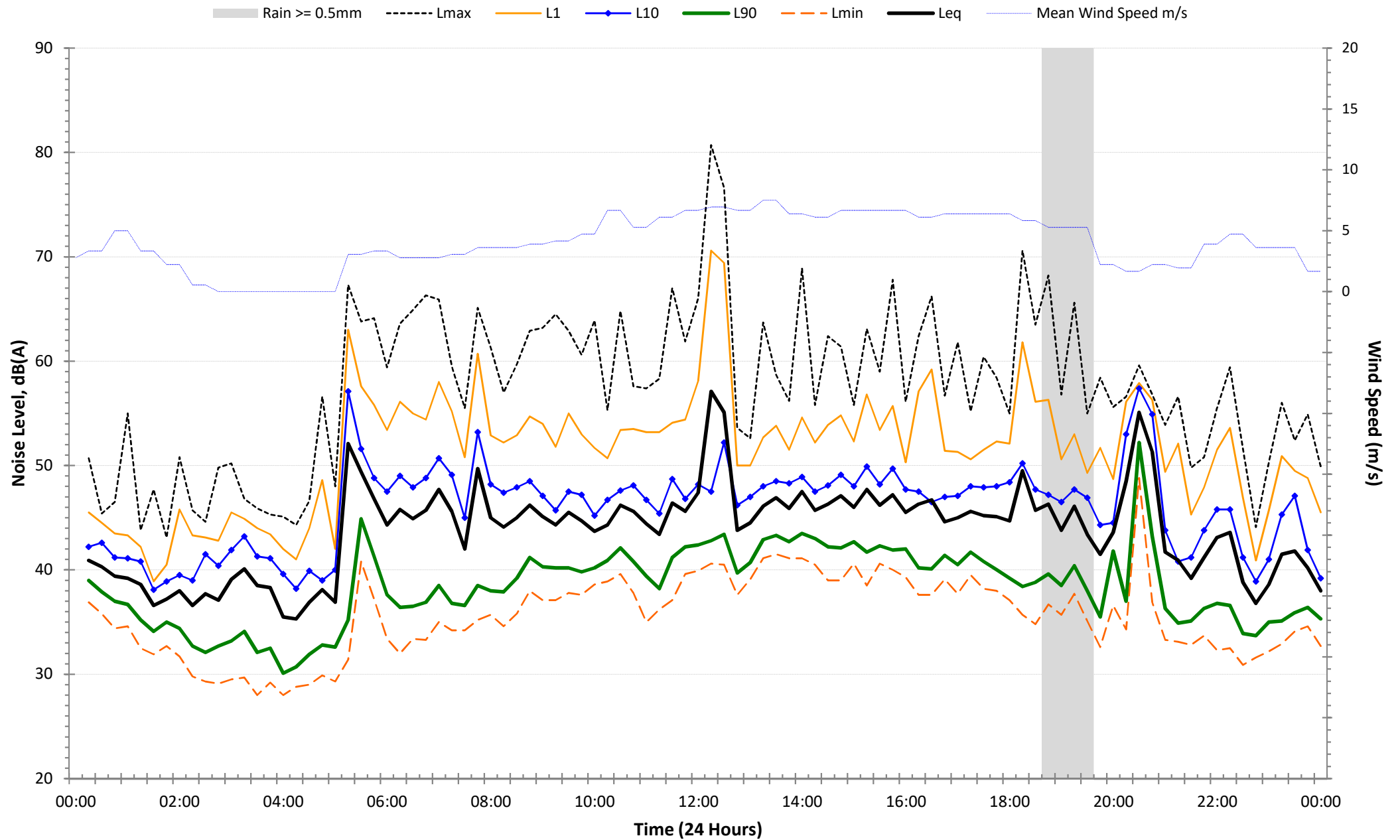
Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 15 November 2017



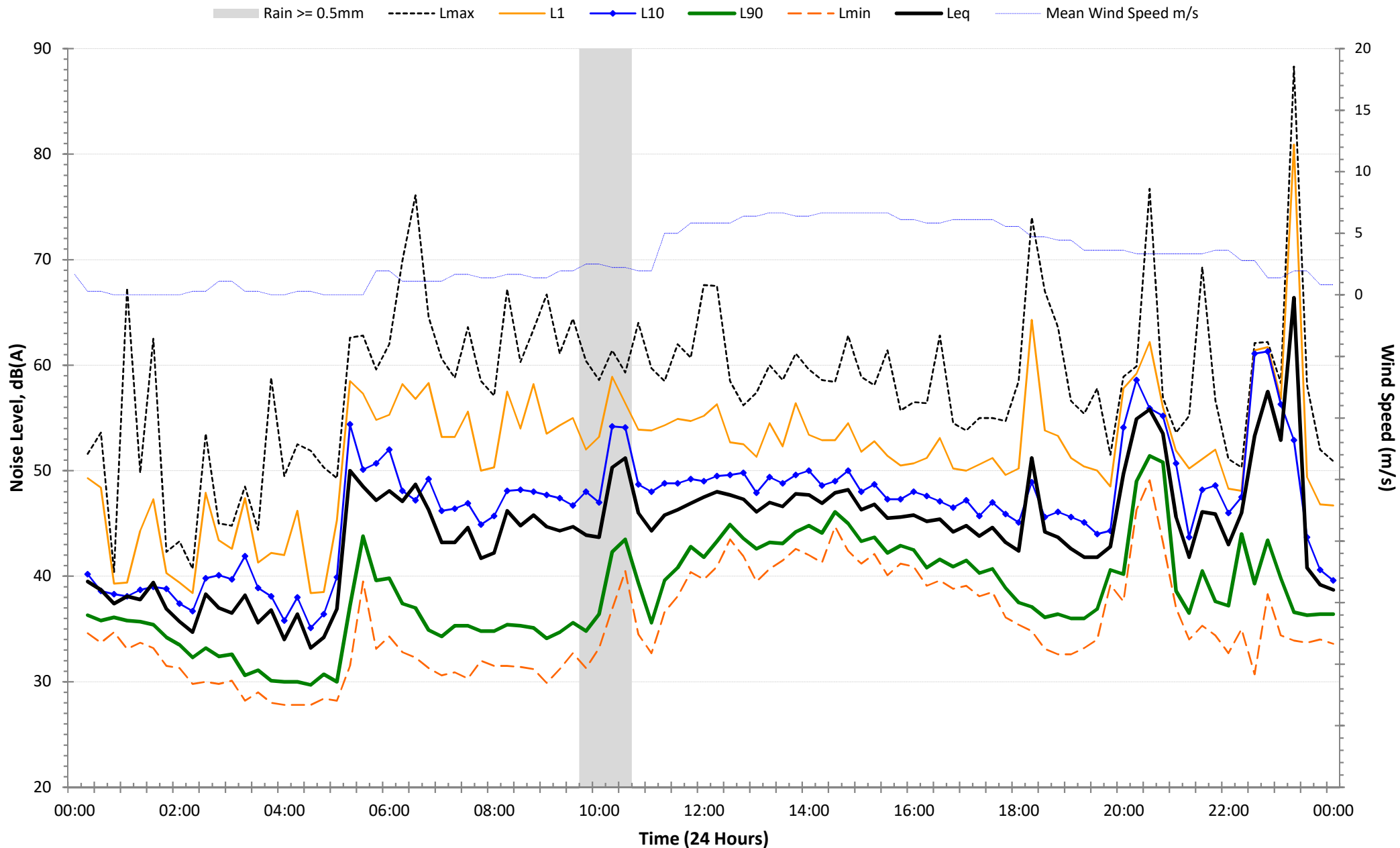
Measured Noise Levels
L1 - Sancrox Quarry - Thursday 16 November 2017



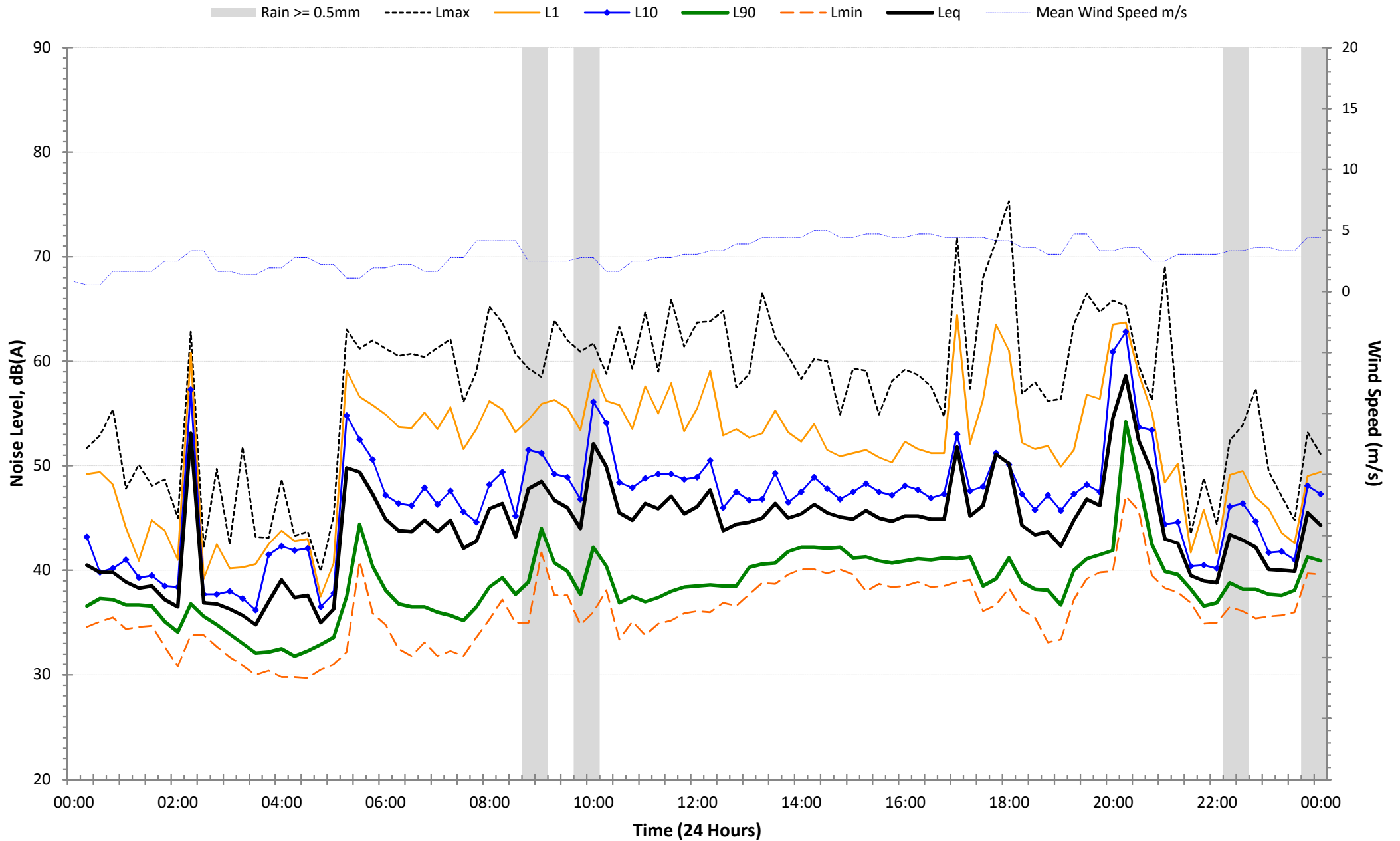
Measured Noise Levels
L1 - Sancrox Quarry - Friday 17 November 2017



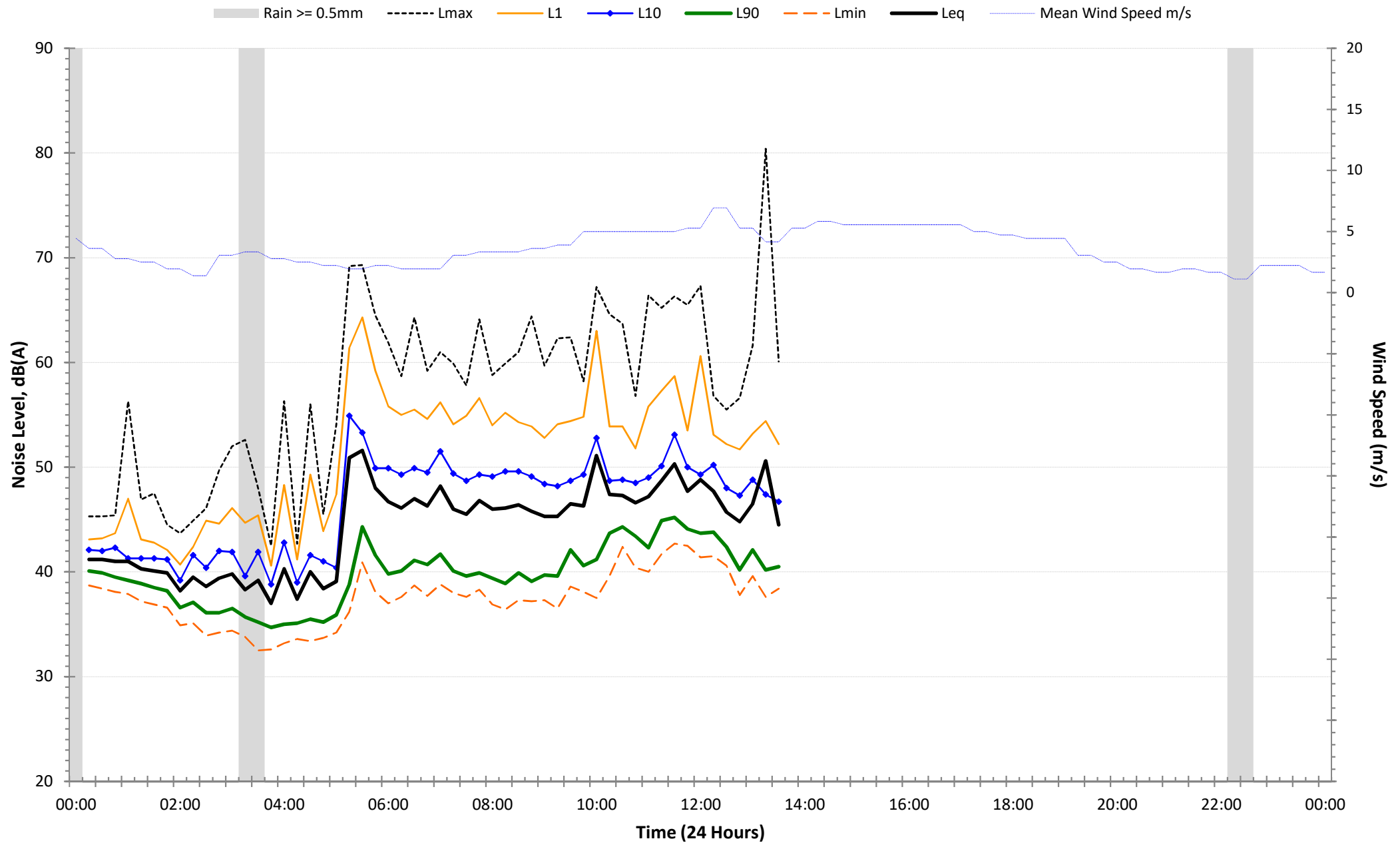
Measured Noise Levels L1 - Sancrox Quarry - Saturday 18 November 2017



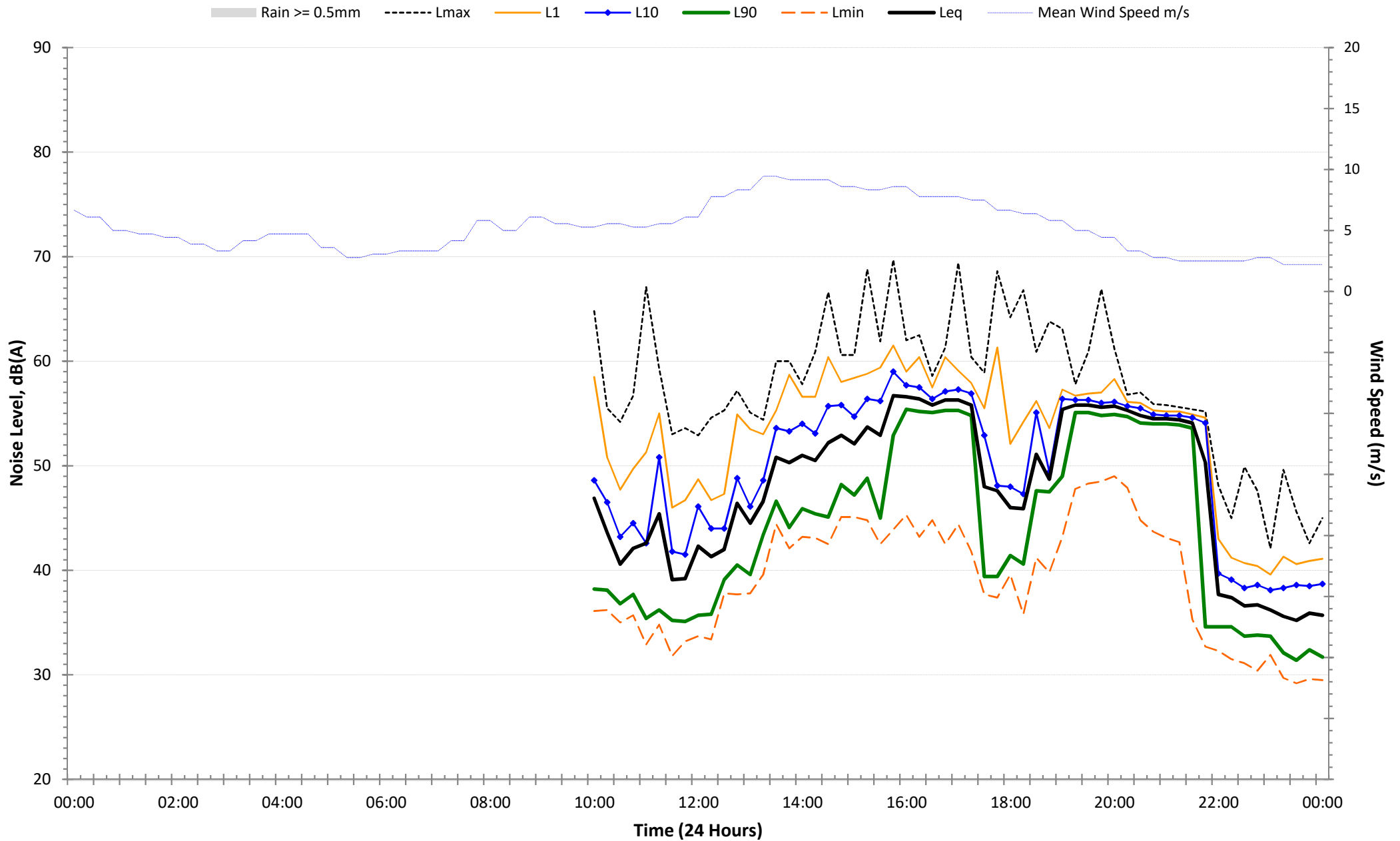
Measured Noise Levels
L1 - Sancrox Quarry - Sunday 19 November 2017



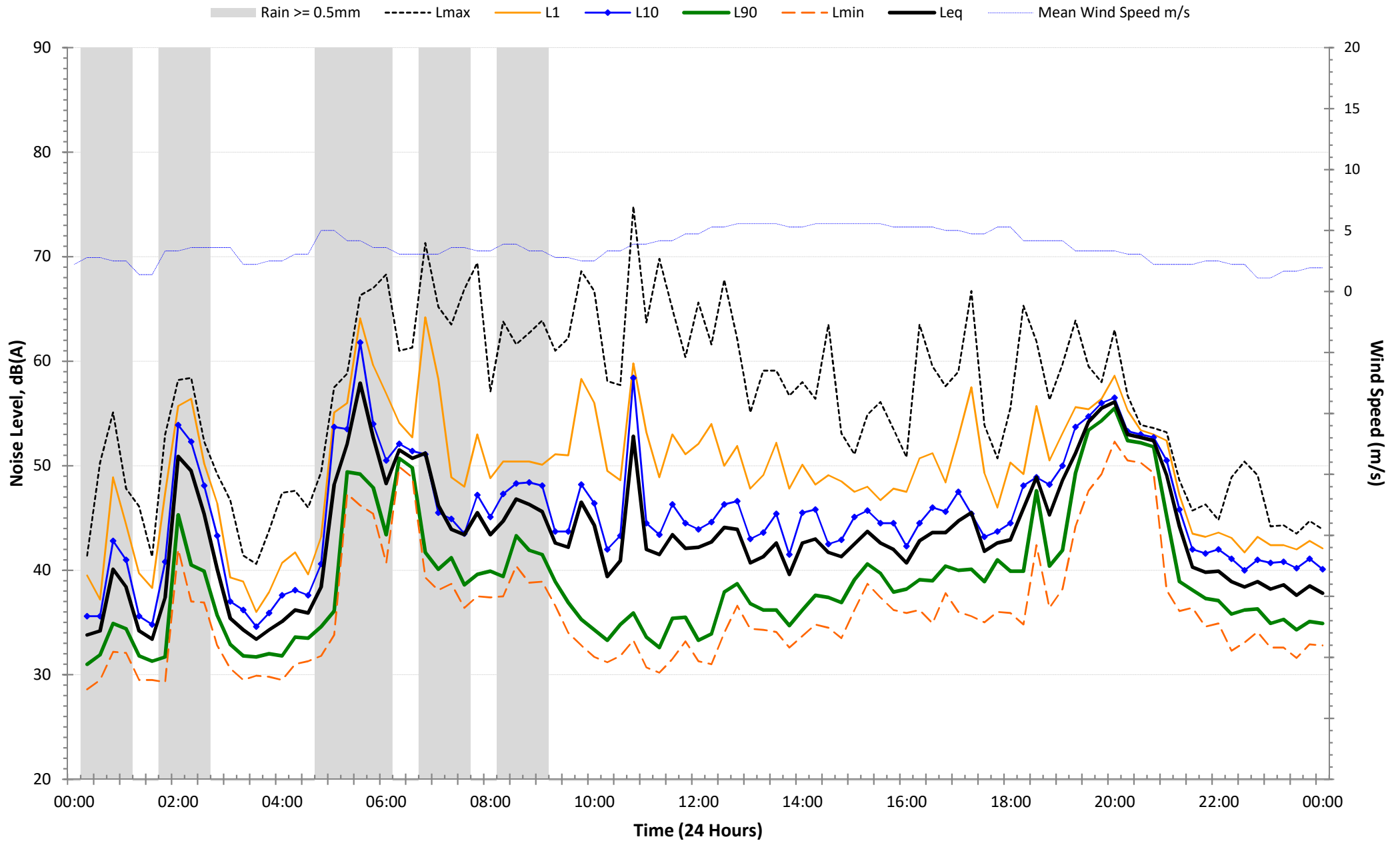
Measured Noise Levels
L1 - Sancrox Quarry - Monday 20 November 2017



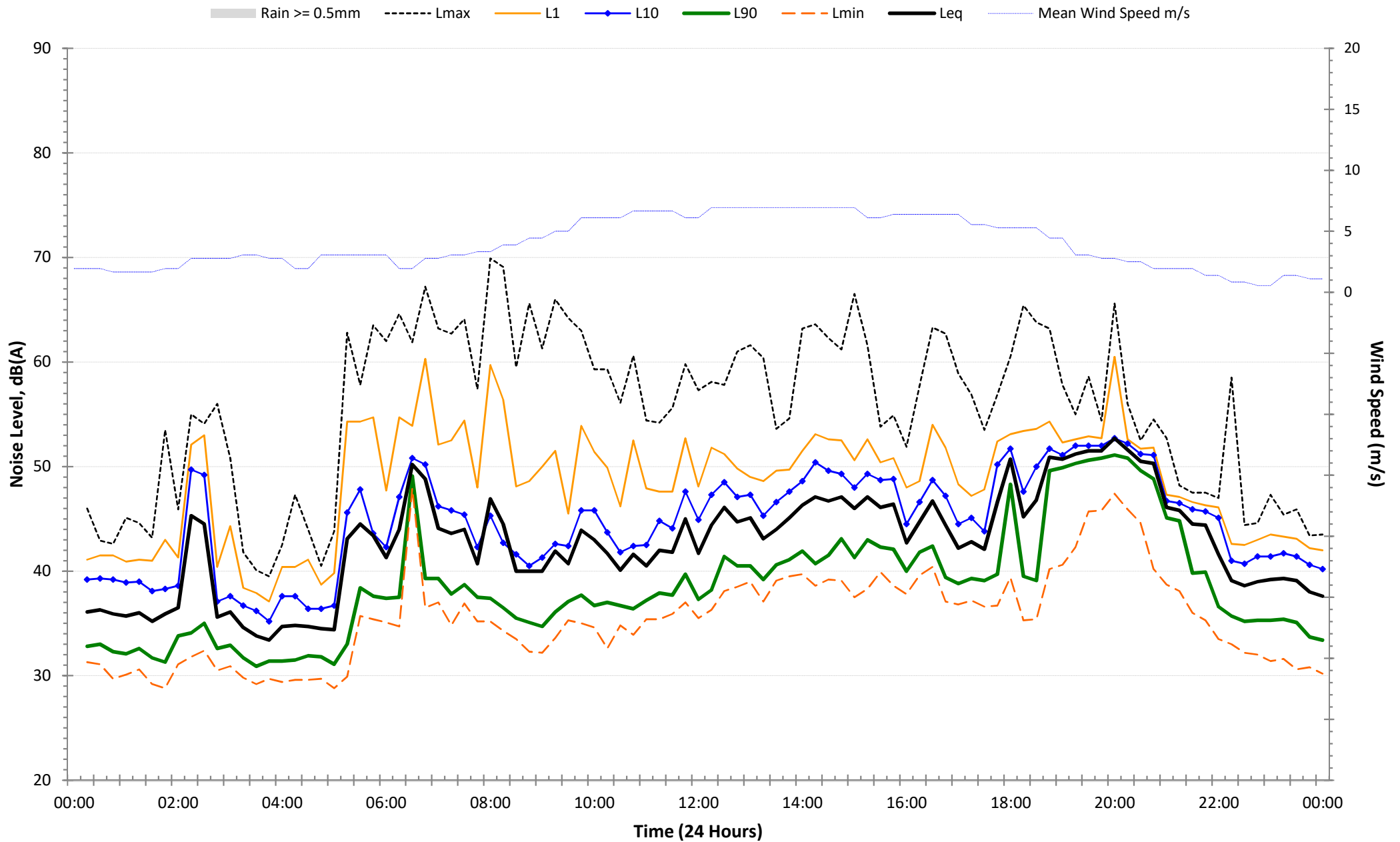
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 7 November 2017



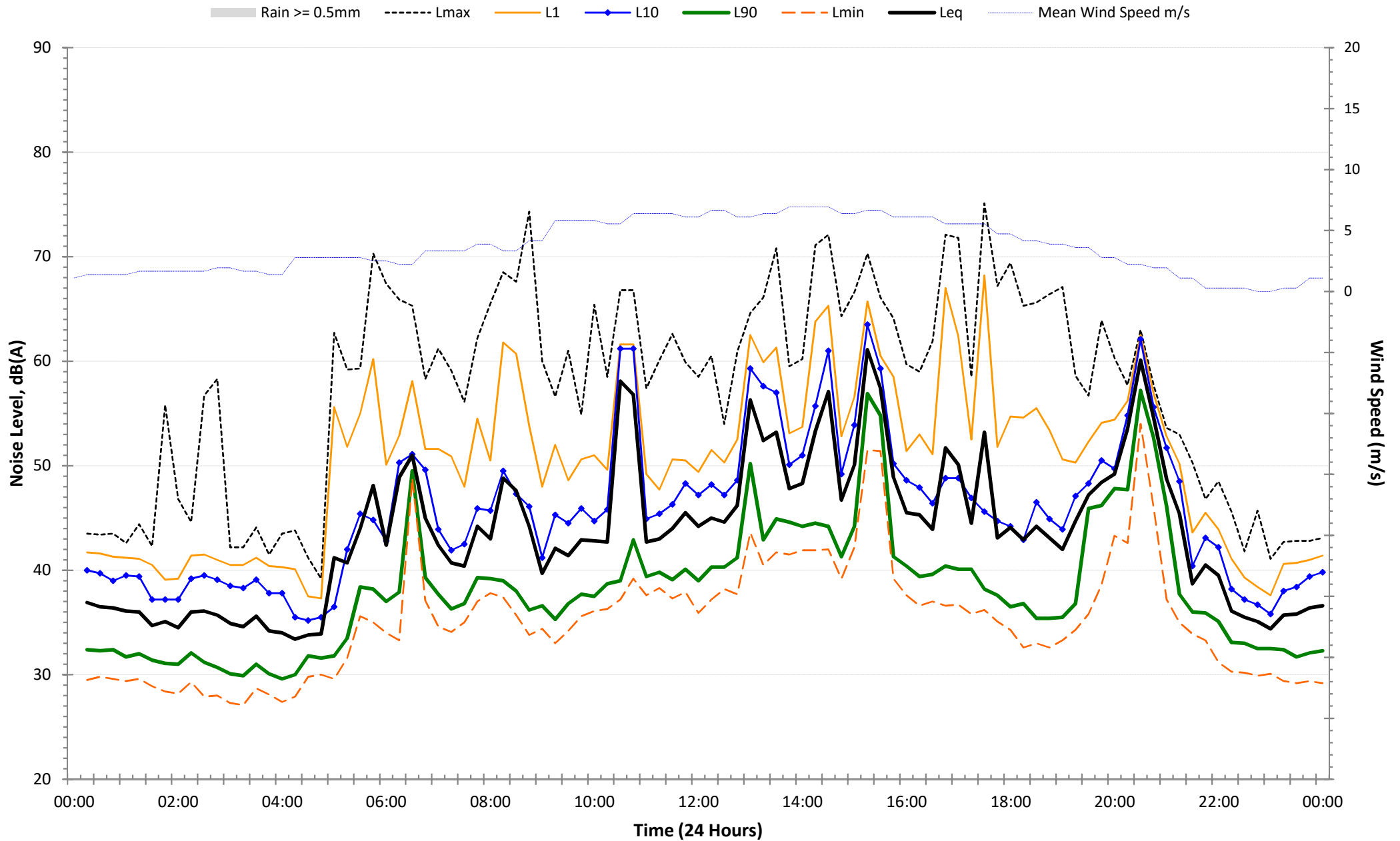
Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 8 November 2017



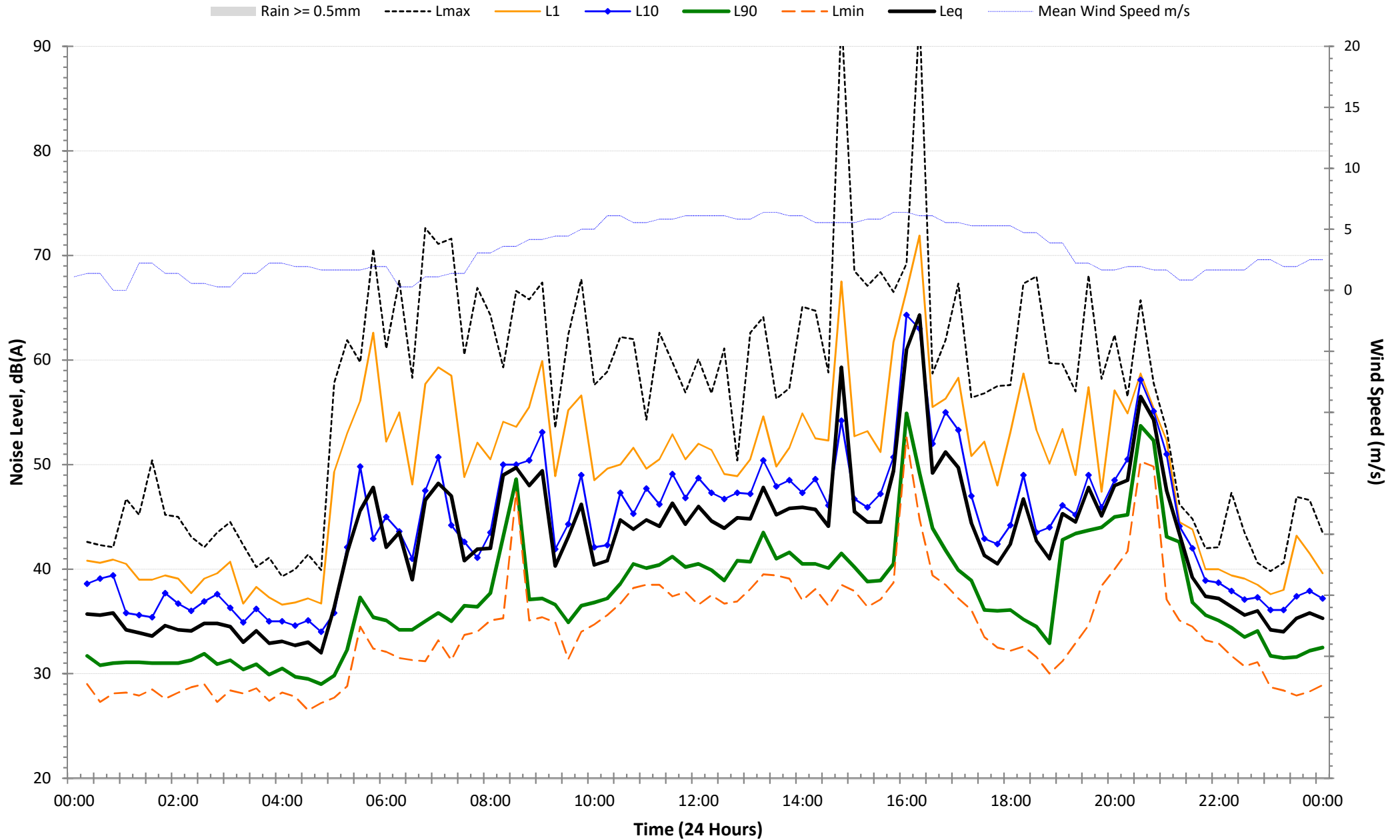
Measured Noise Levels
L2 - Sancrox Quarry - Thursday 9 November 2017



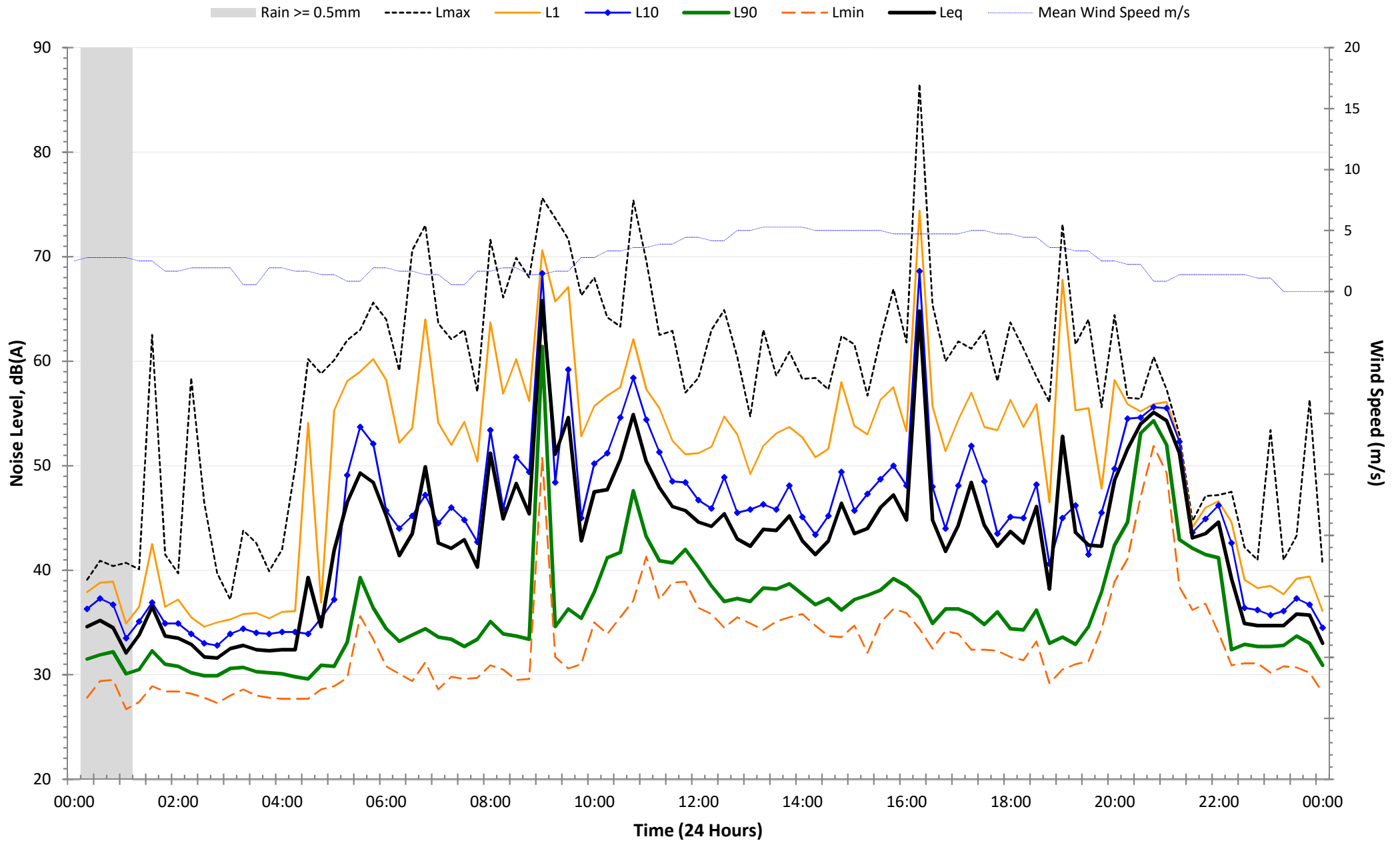
Measured Noise Levels
L2 - Sancrox Quarry - Friday 10 November 2017



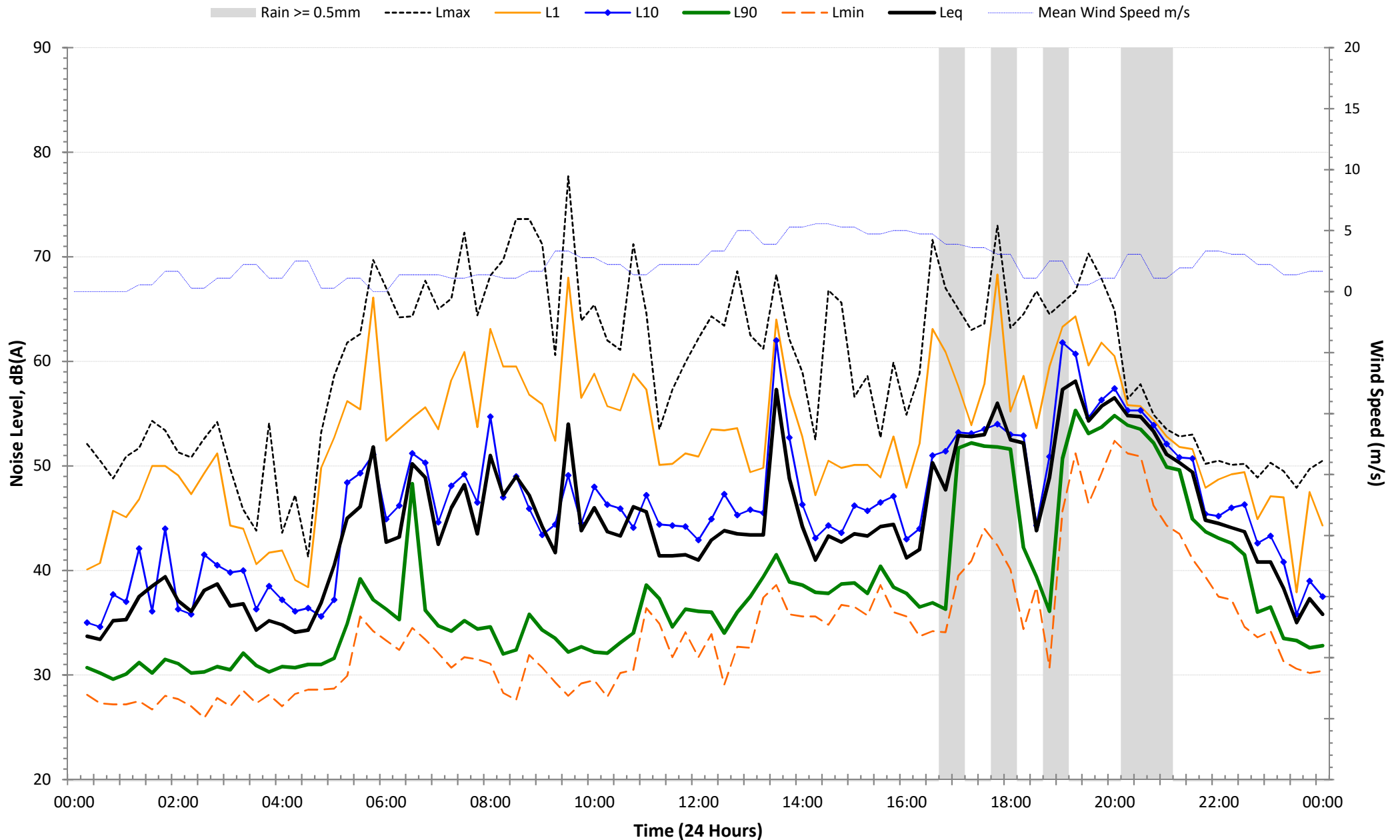
Measured Noise Levels
L2 - Sancrox Quarry - Saturday 11 November 2017



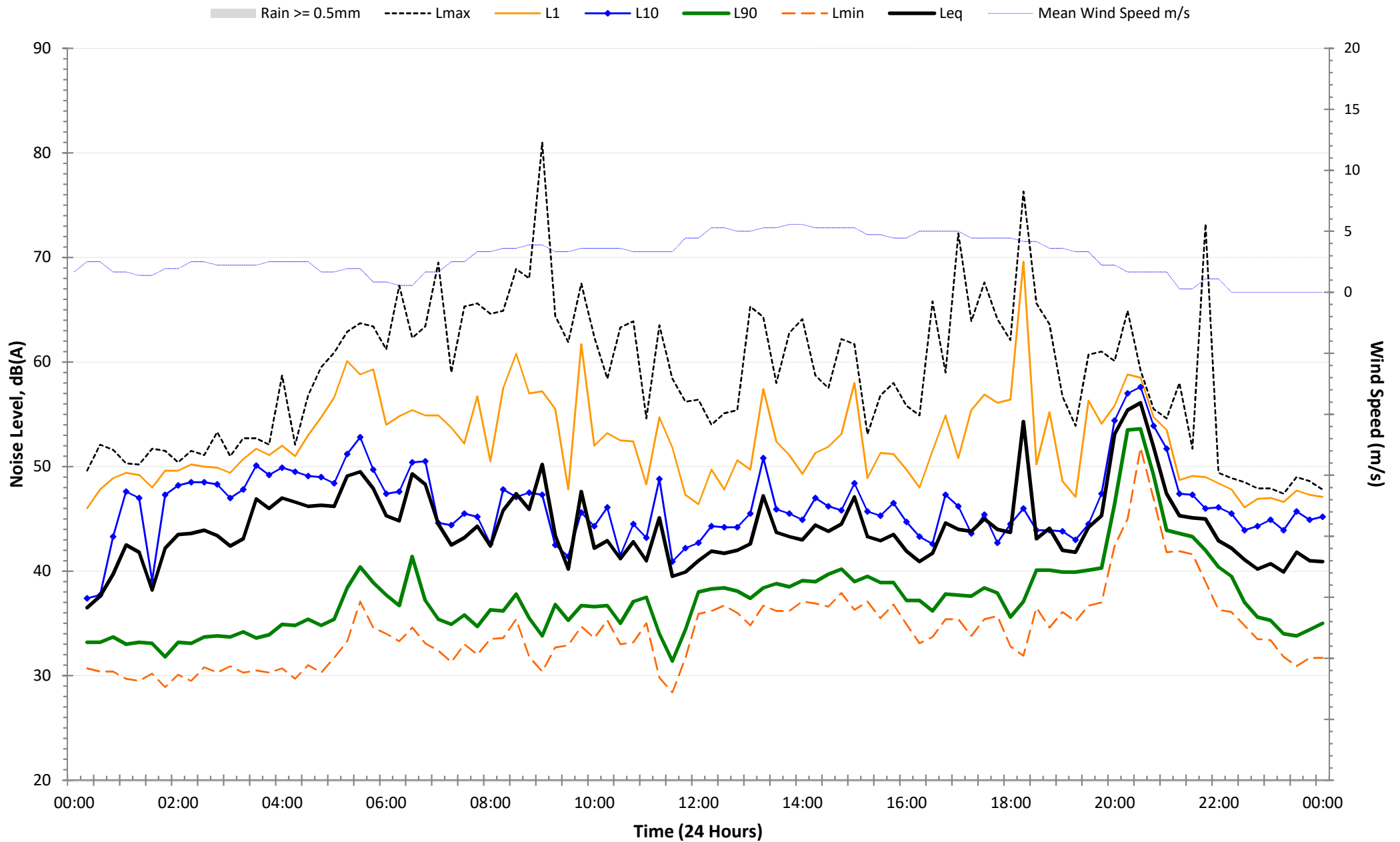
Measured Noise Levels
L2 - Sancrox Quarry - Sunday 12 November 2017



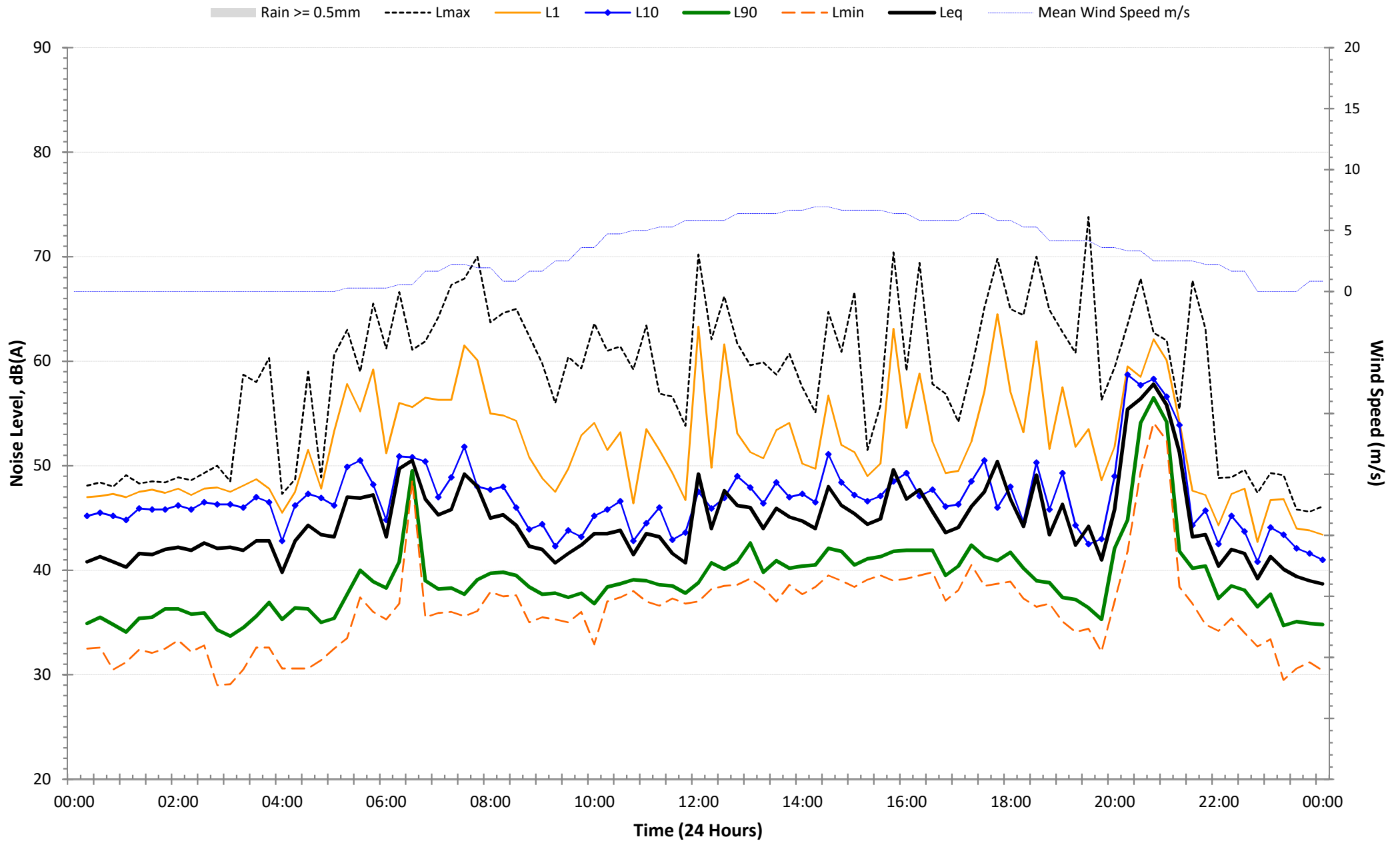
Measured Noise Levels L2 - Sancrox Quarry - Monday 13 November 2017



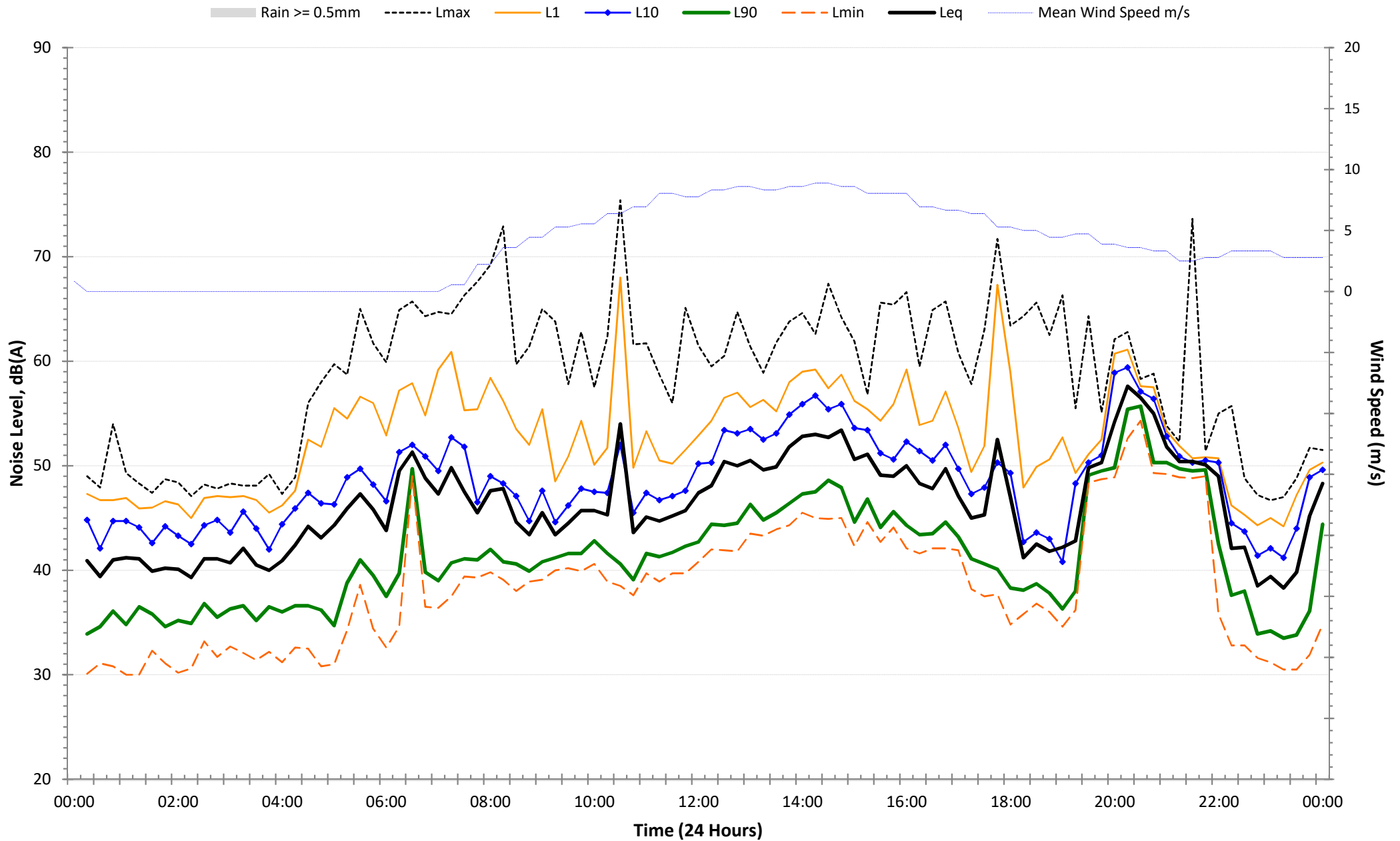
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 14 November 2017



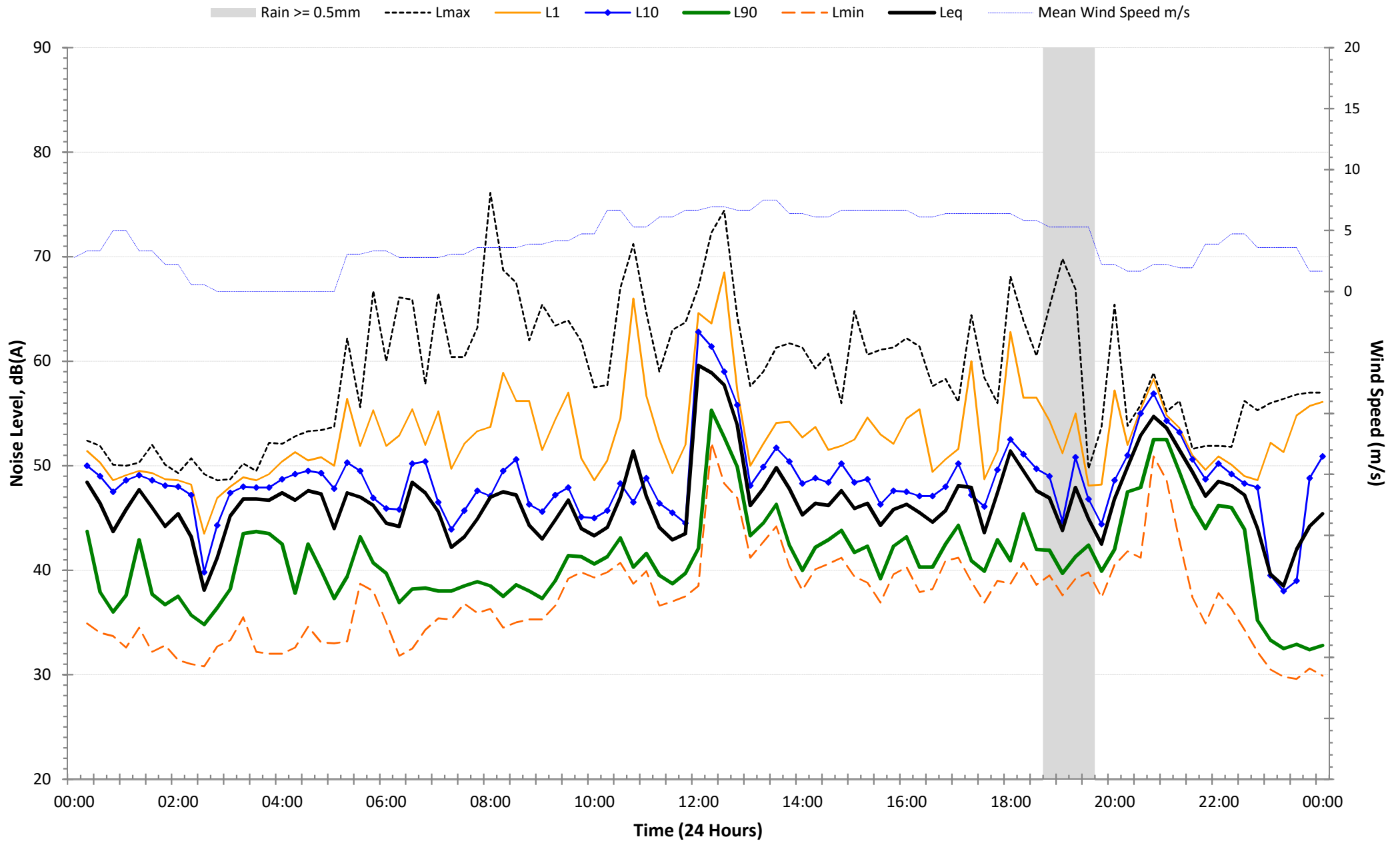
Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 15 November 2017



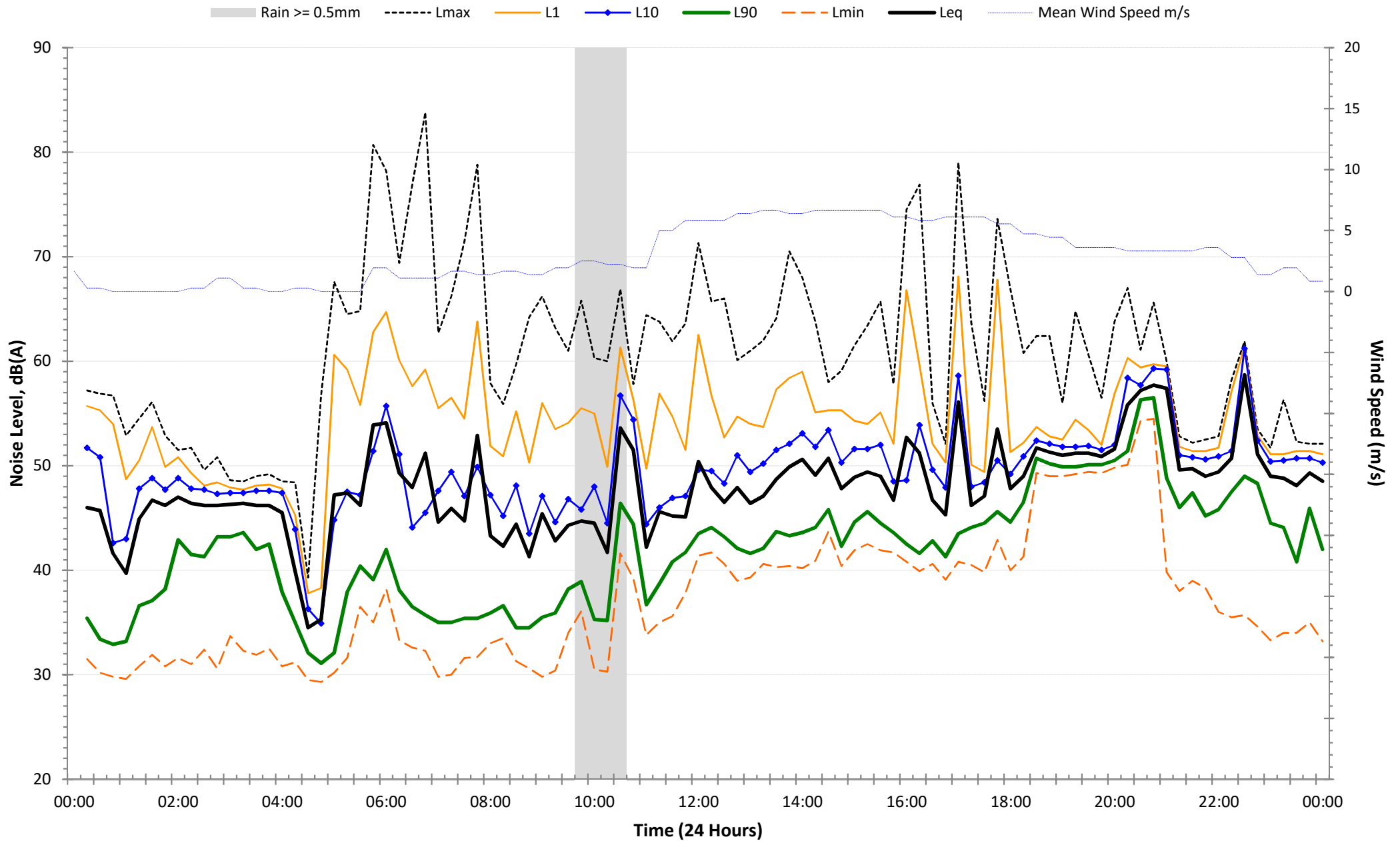
Measured Noise Levels
L2 - Sancrox Quarry - Thursday 16 November 2017



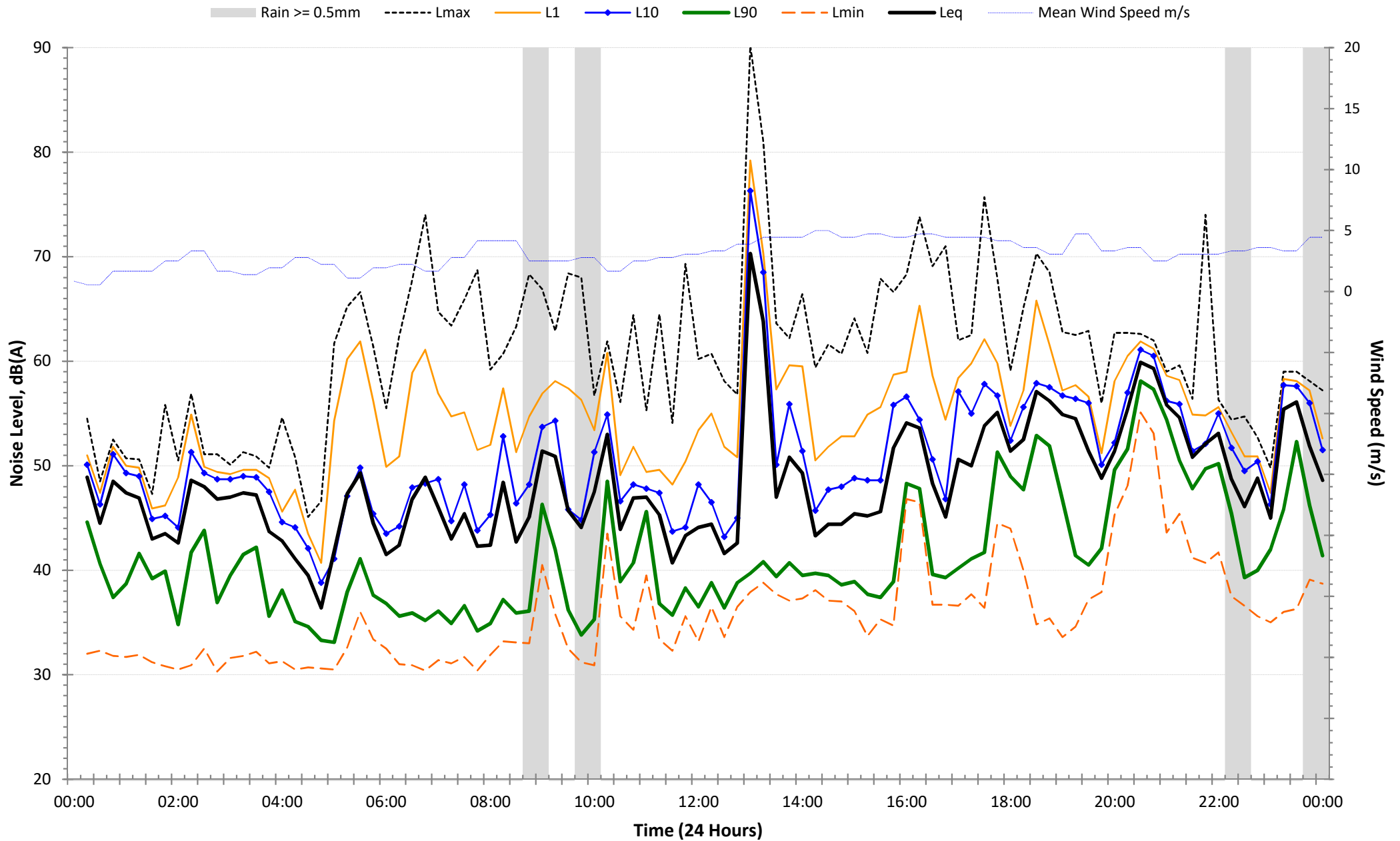
Measured Noise Levels
L2 - Sancrox Quarry - Friday 17 November 2017



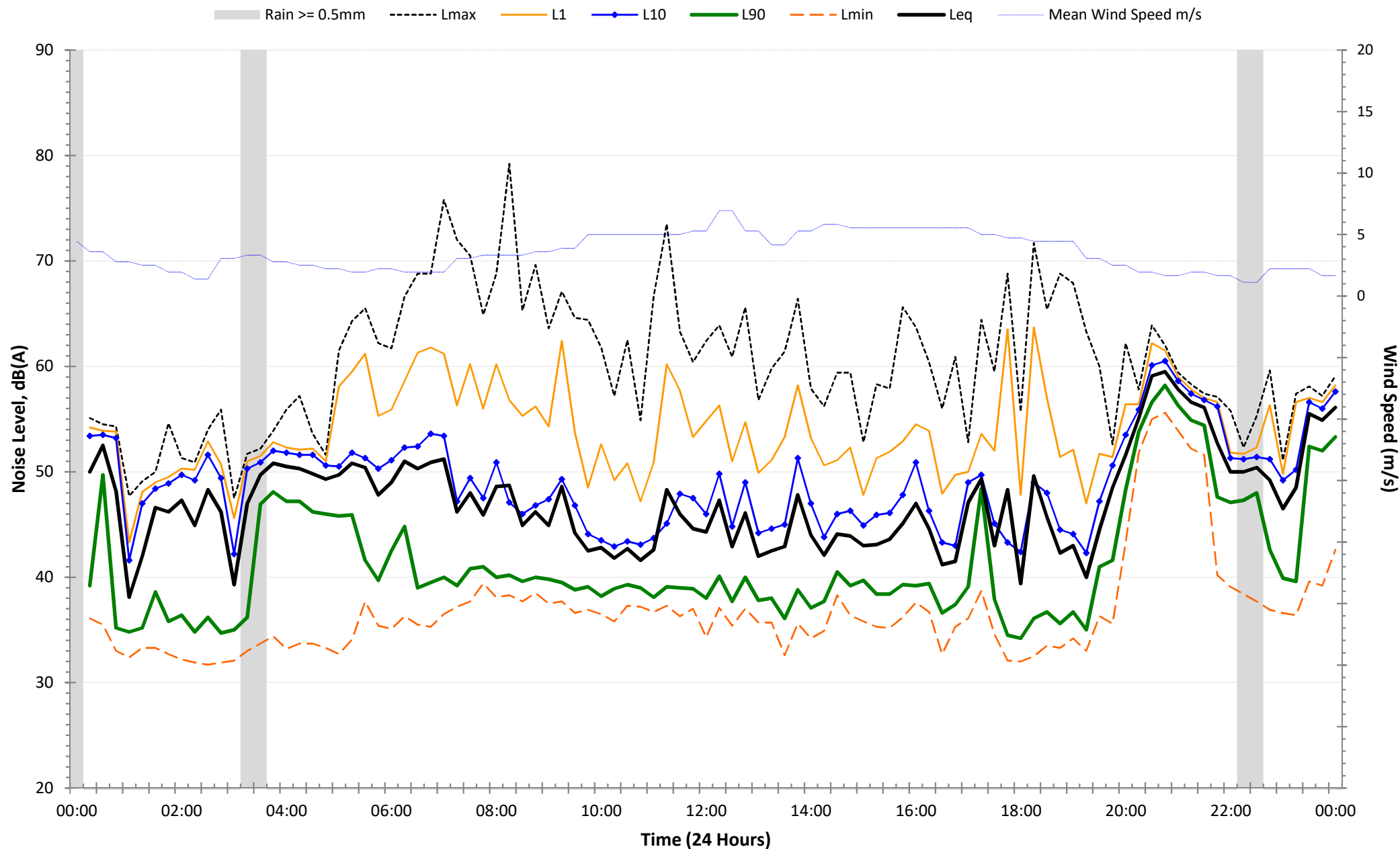
Measured Noise Levels
L2 - Sancrox Quarry - Saturday 18 November 2017



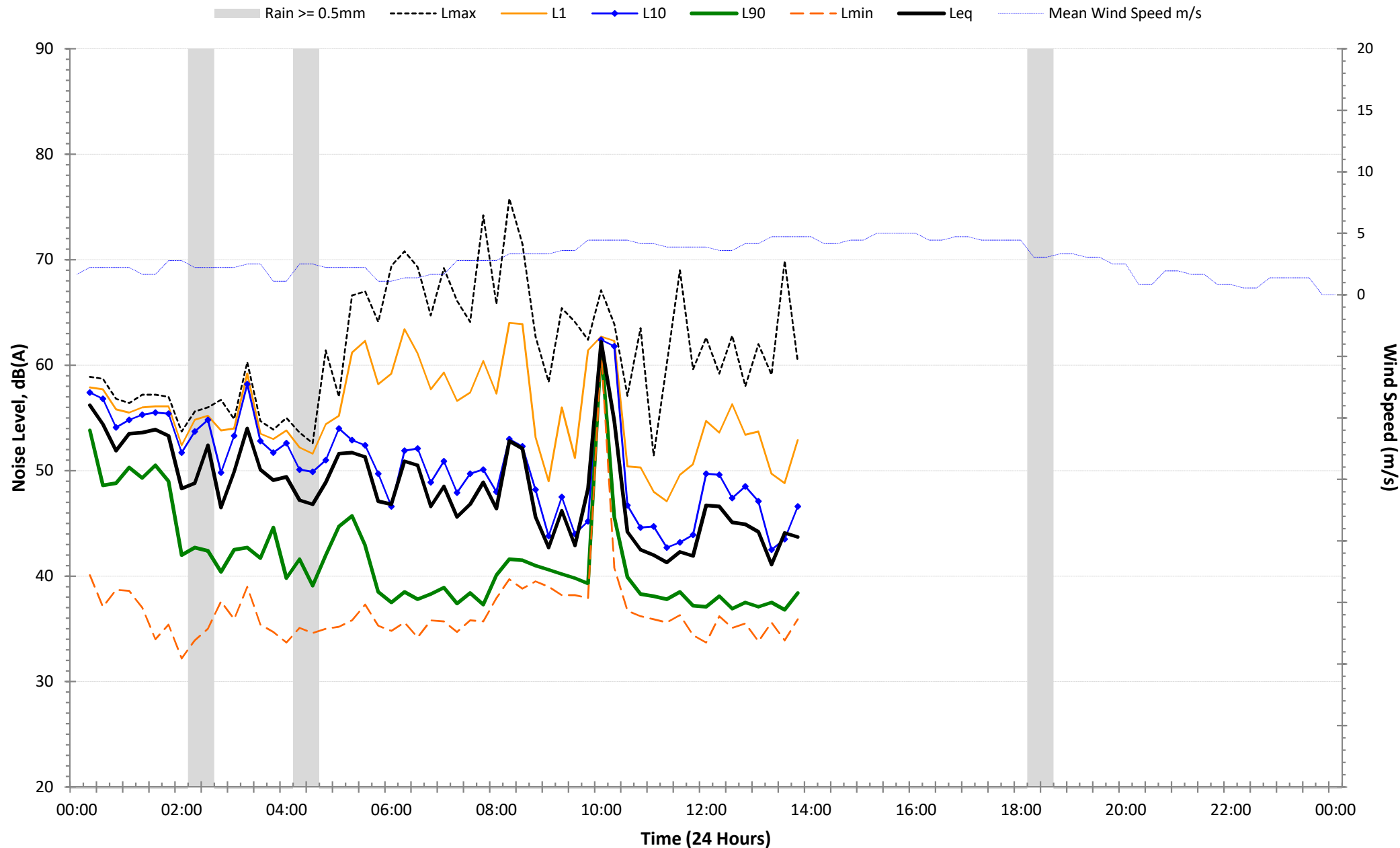
Measured Noise Levels
L2 - Sancrox Quarry - Sunday 19 November 2017



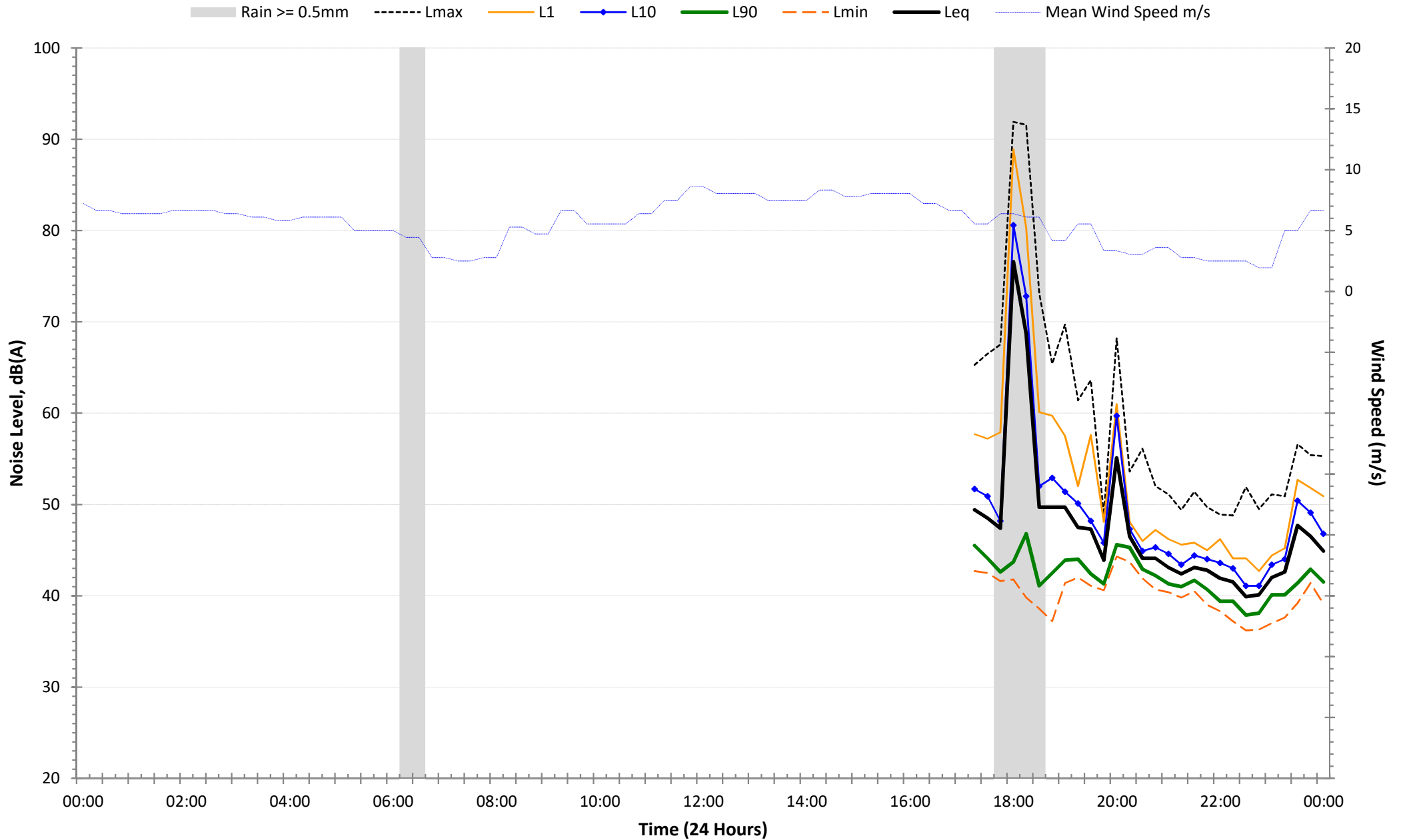
Measured Noise Levels L2 - Sancrox Quarry - Monday 20 November 2017



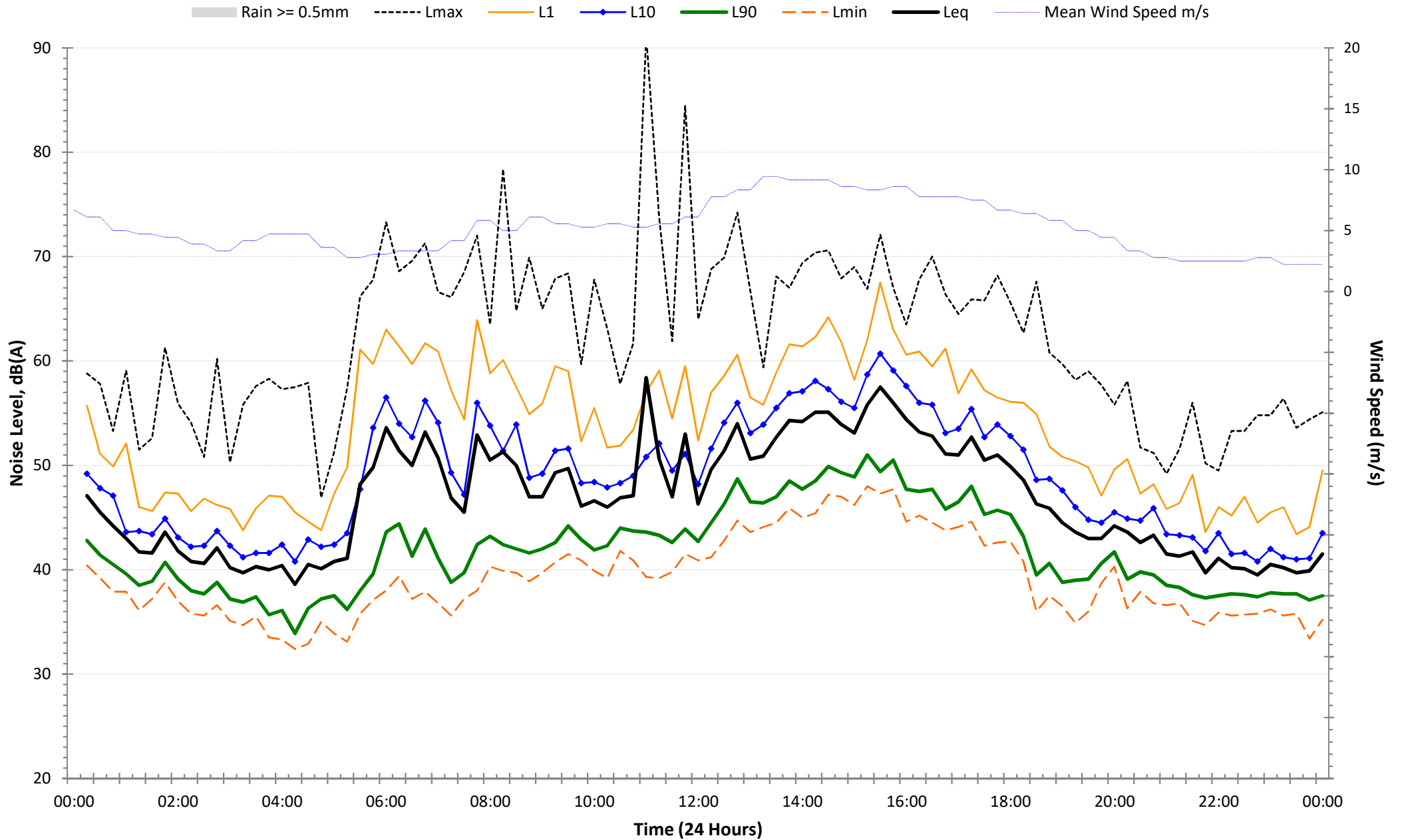
Measured Noise Levels L2 - Sancrox Quarry - Tuesday 21 November 2017



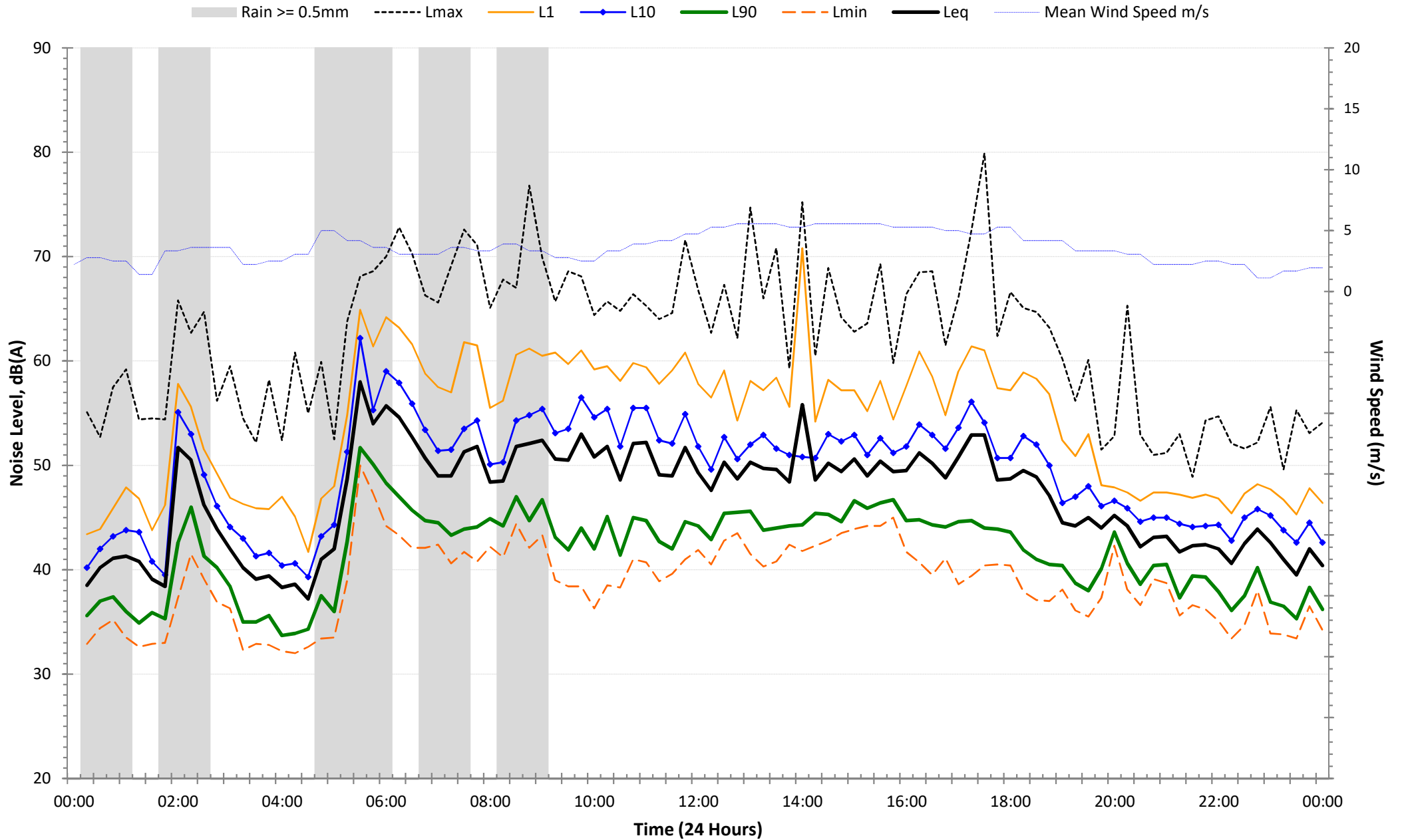
Measured Noise Levels
L3 - Sancrox Quarry - Monday 6 November 2017



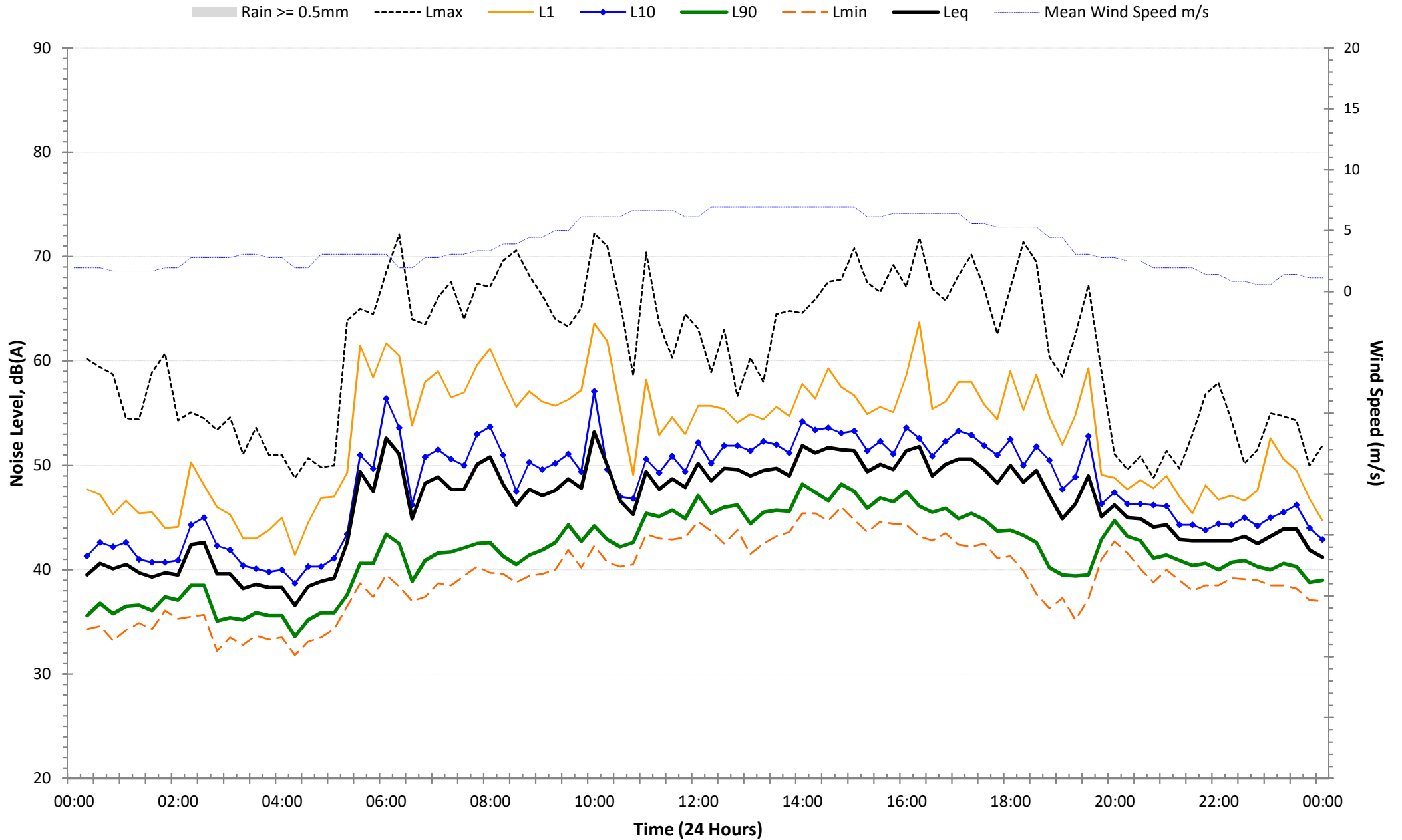
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 7 November 2017



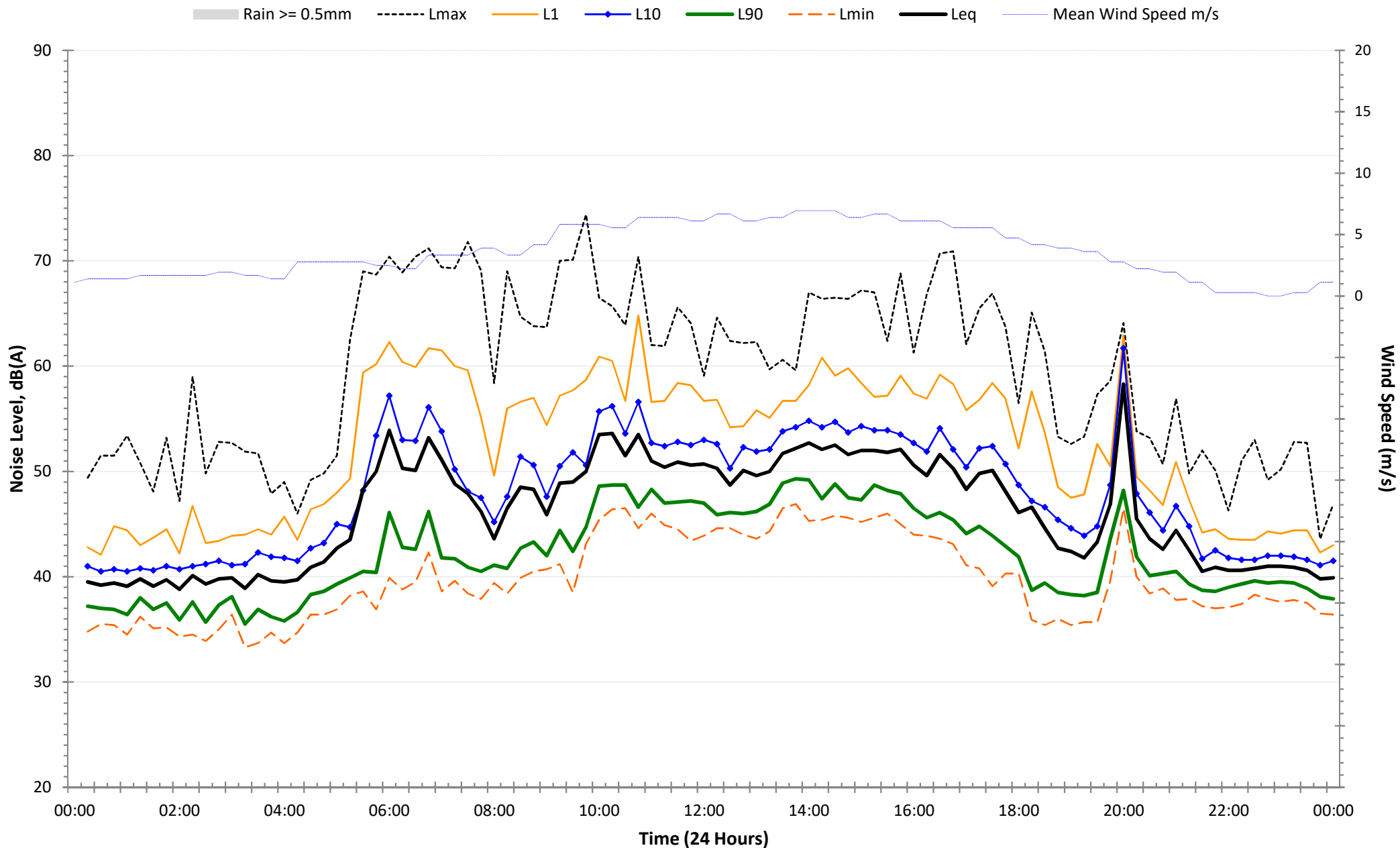
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 8 November 2017



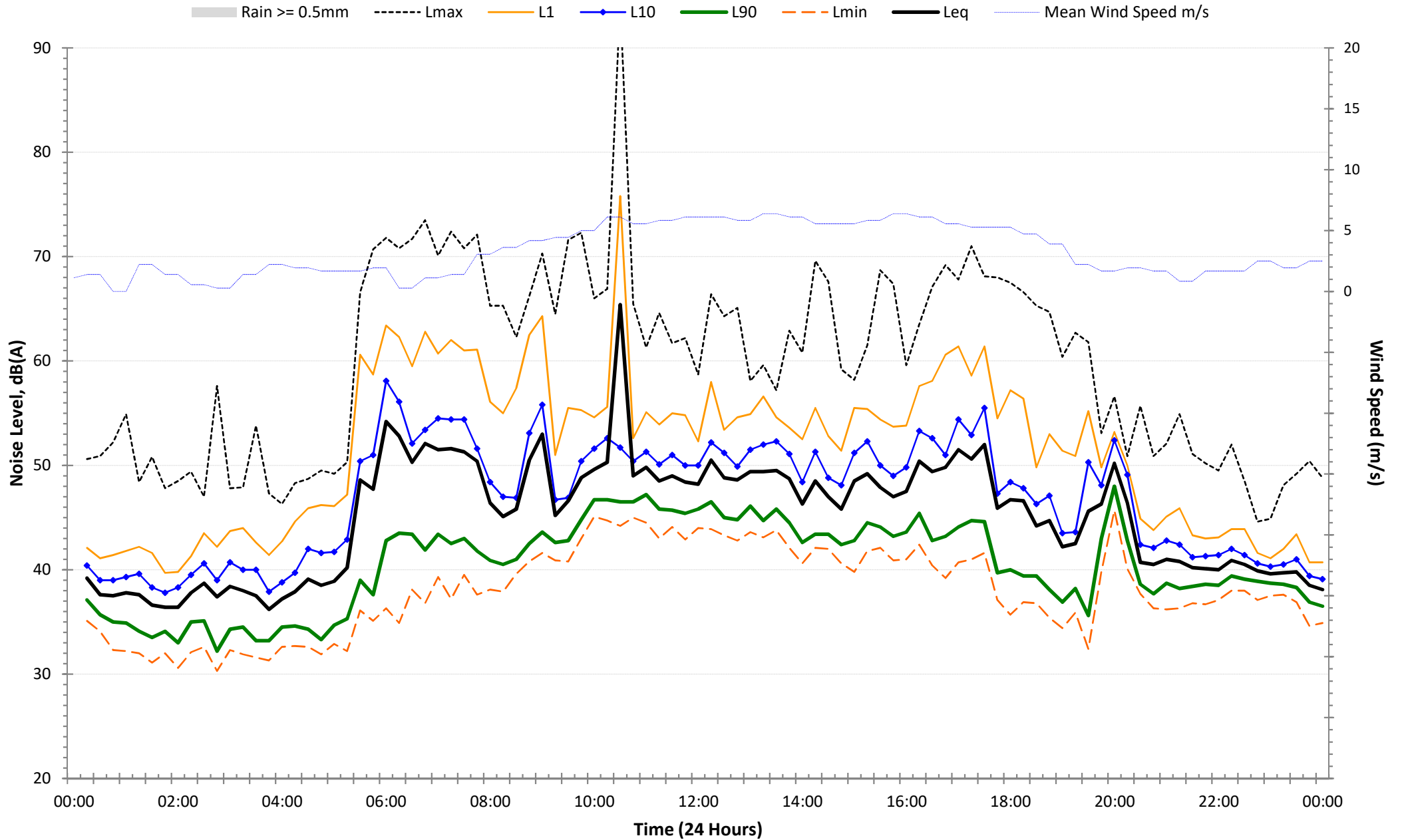
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 9 November 2017



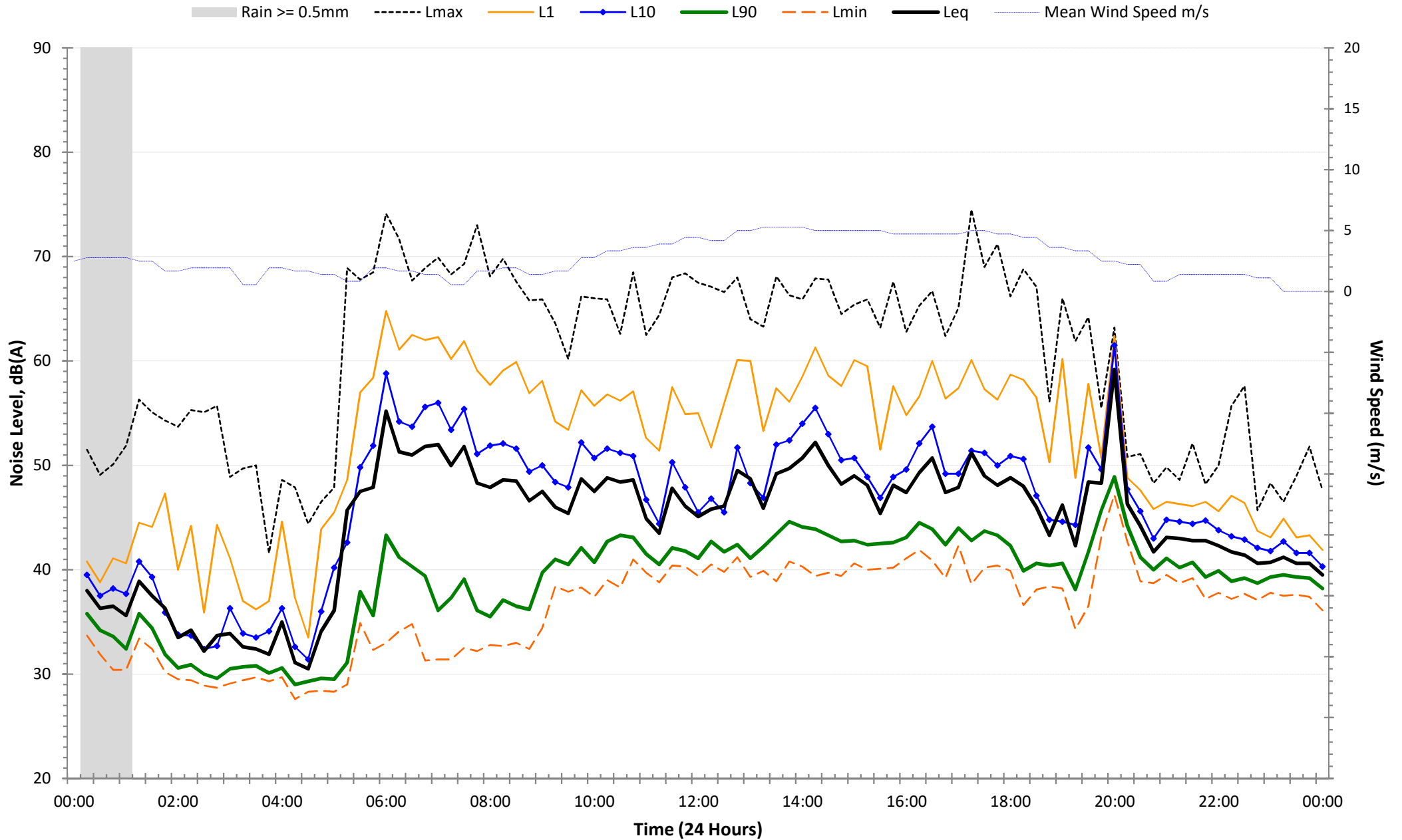
Measured Noise Levels L3 - Sancrox Quarry - Friday 10 November 2017



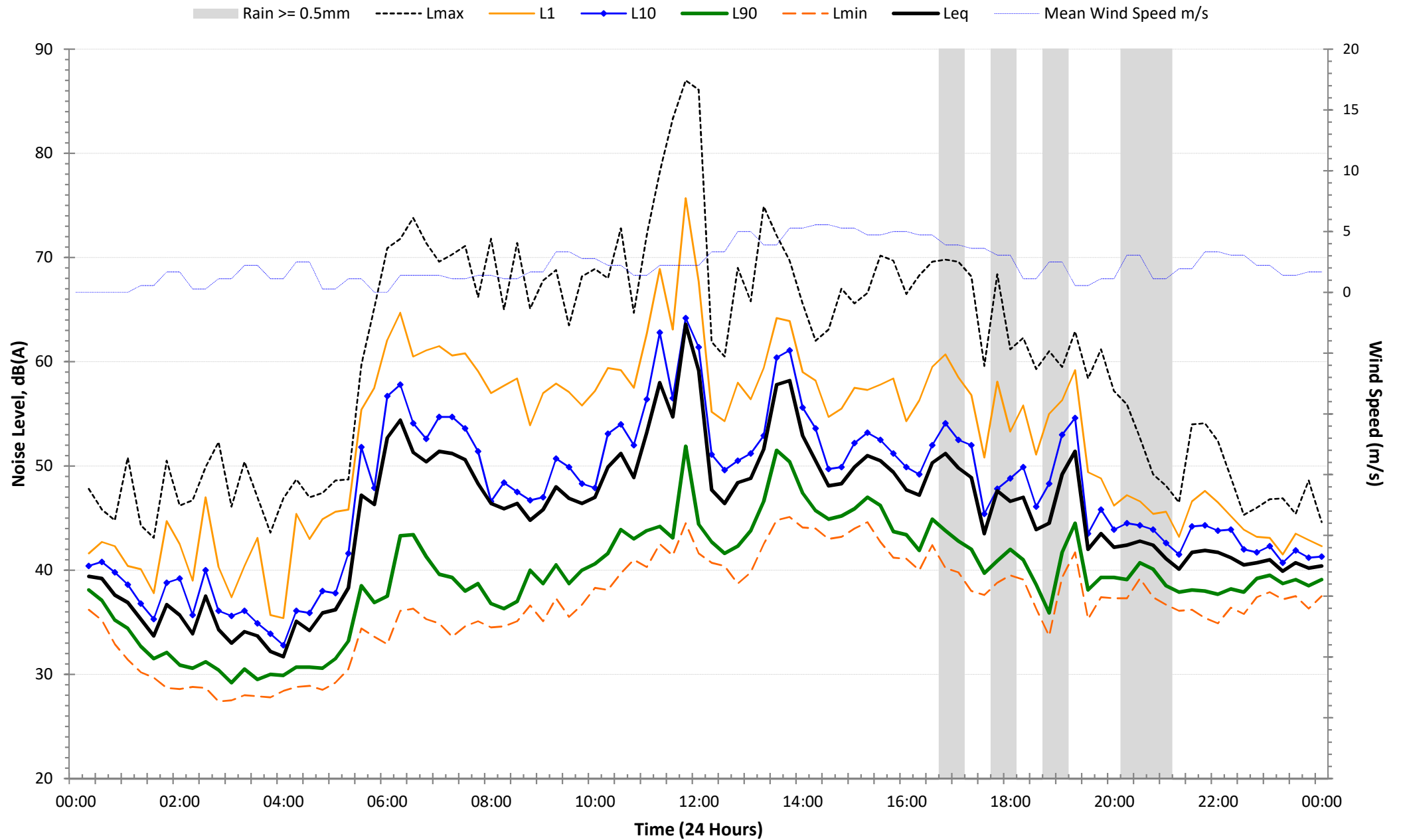
Measured Noise Levels
L3 - Sancrox Quarry - Saturday 11 November 2017



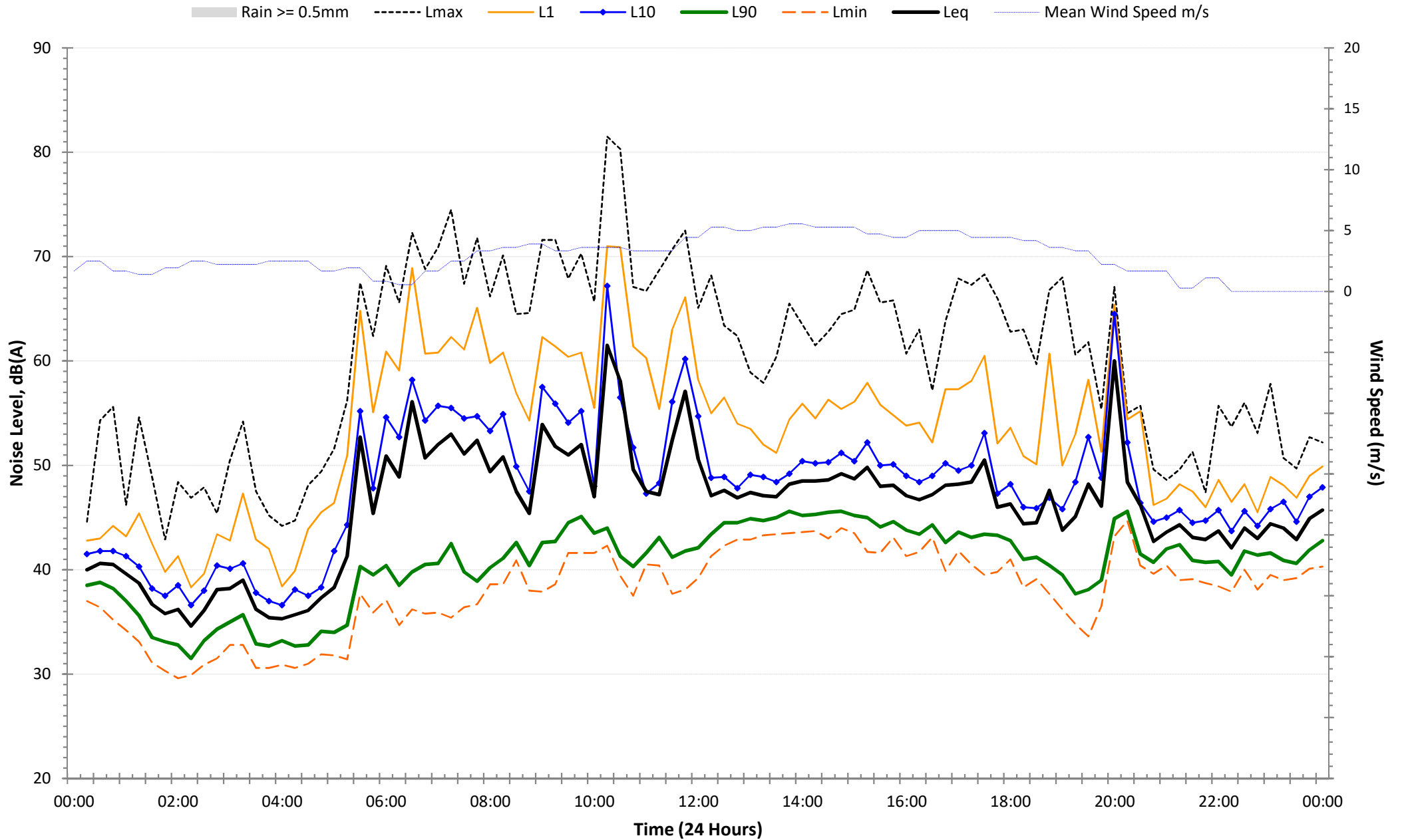
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 12 November 2017



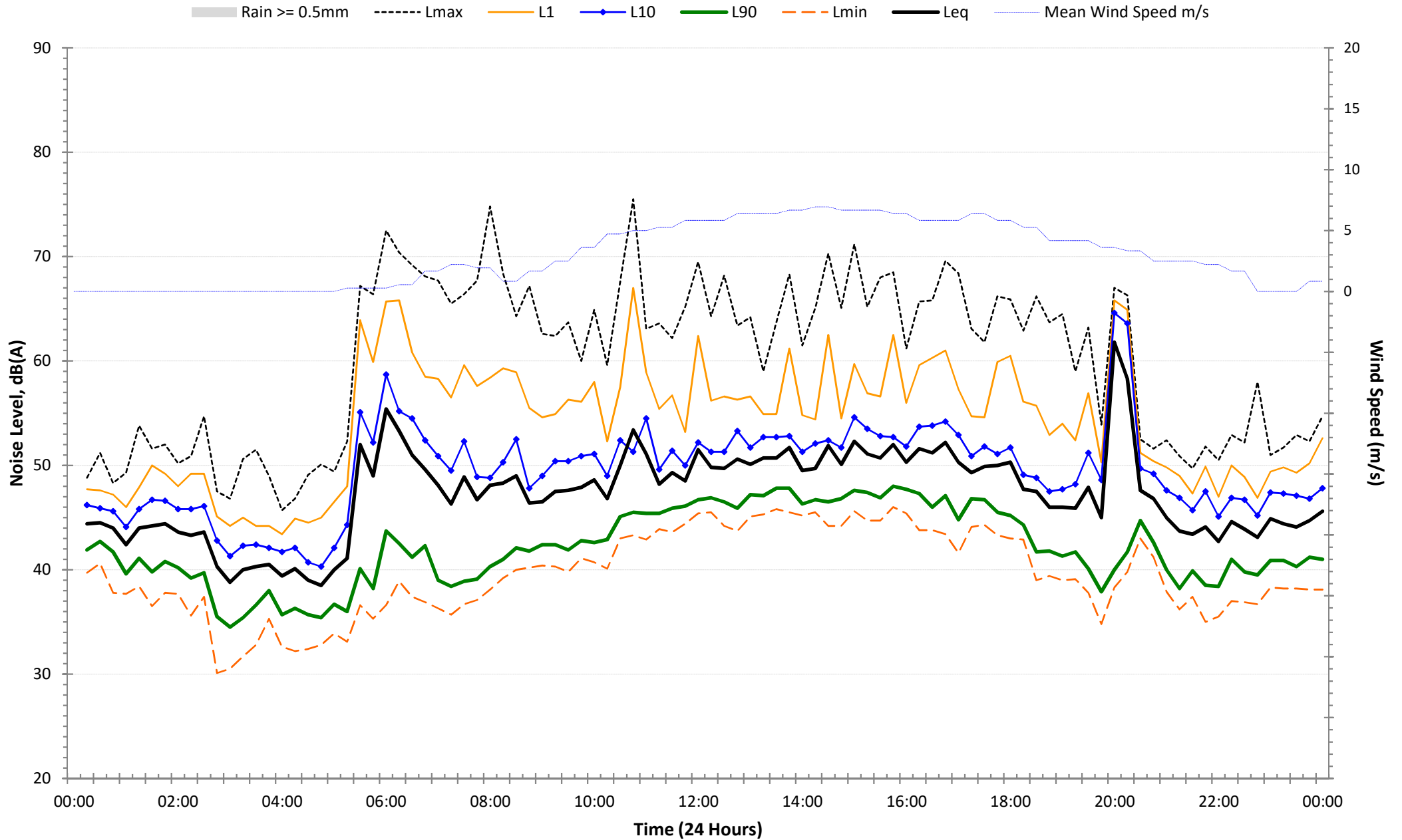
Measured Noise Levels
L3 - Sancrox Quarry - Monday 13 November 2017



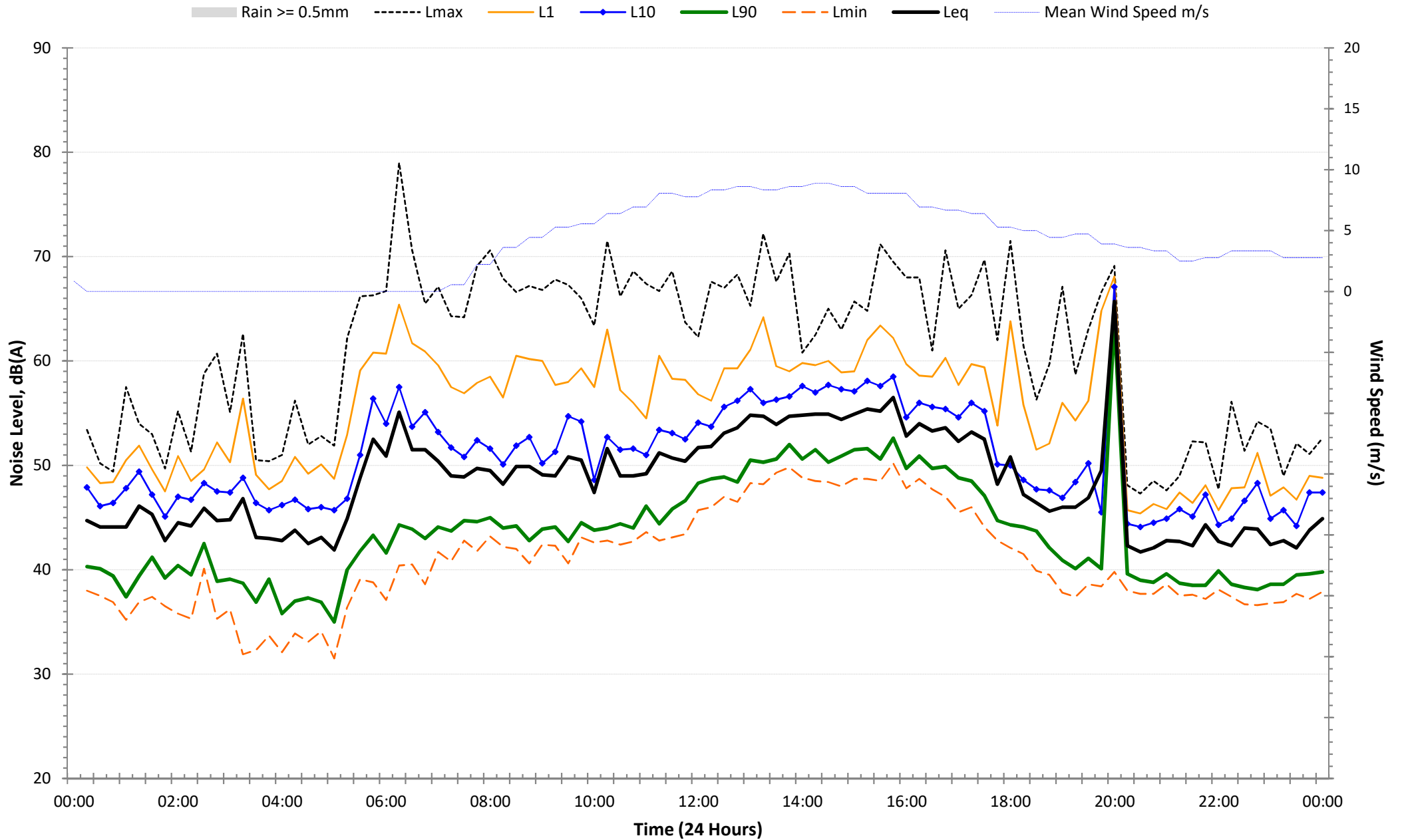
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L3 - Sancrox Quarry - Tuesday 14 November 2017



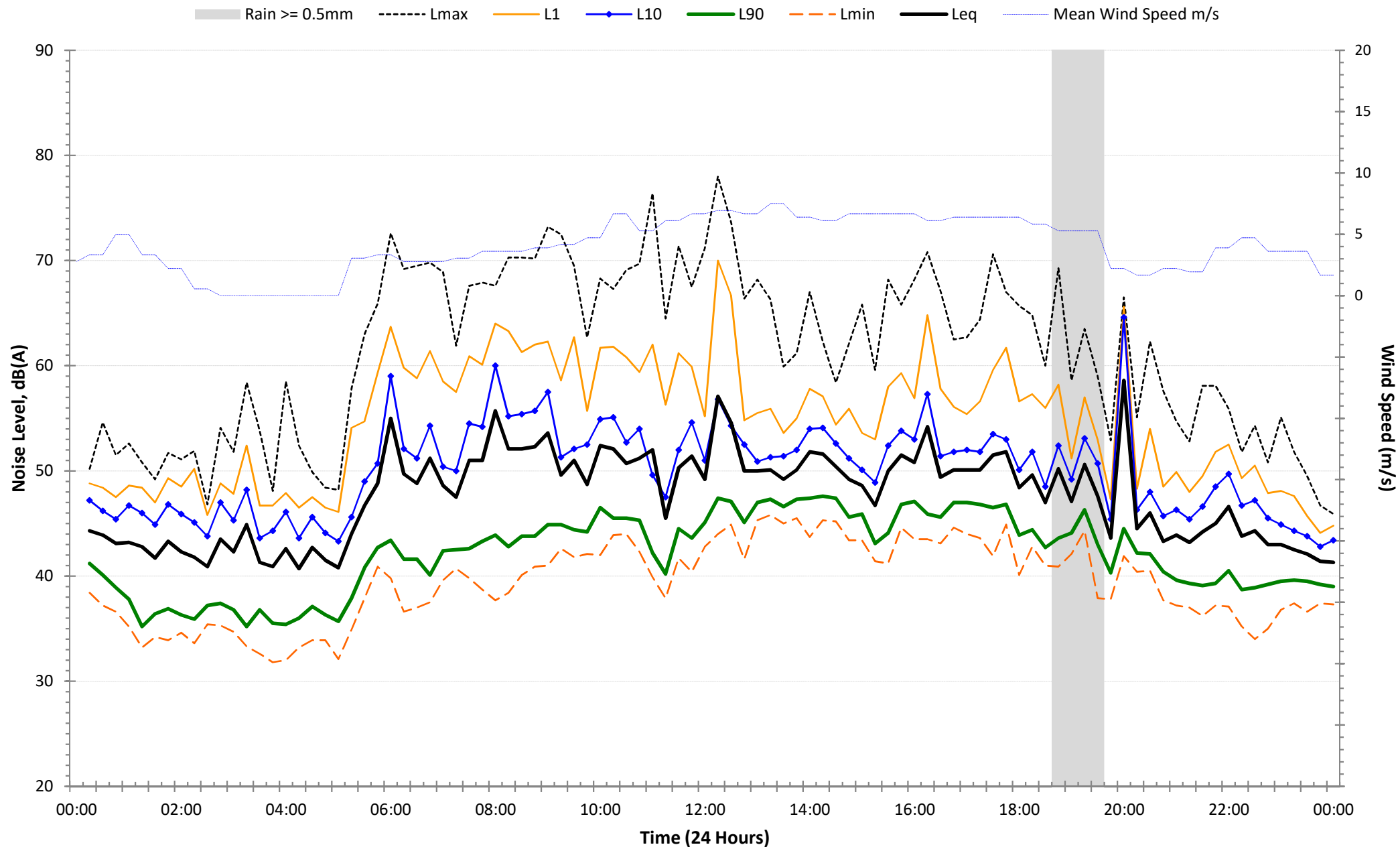
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 15 November 2017



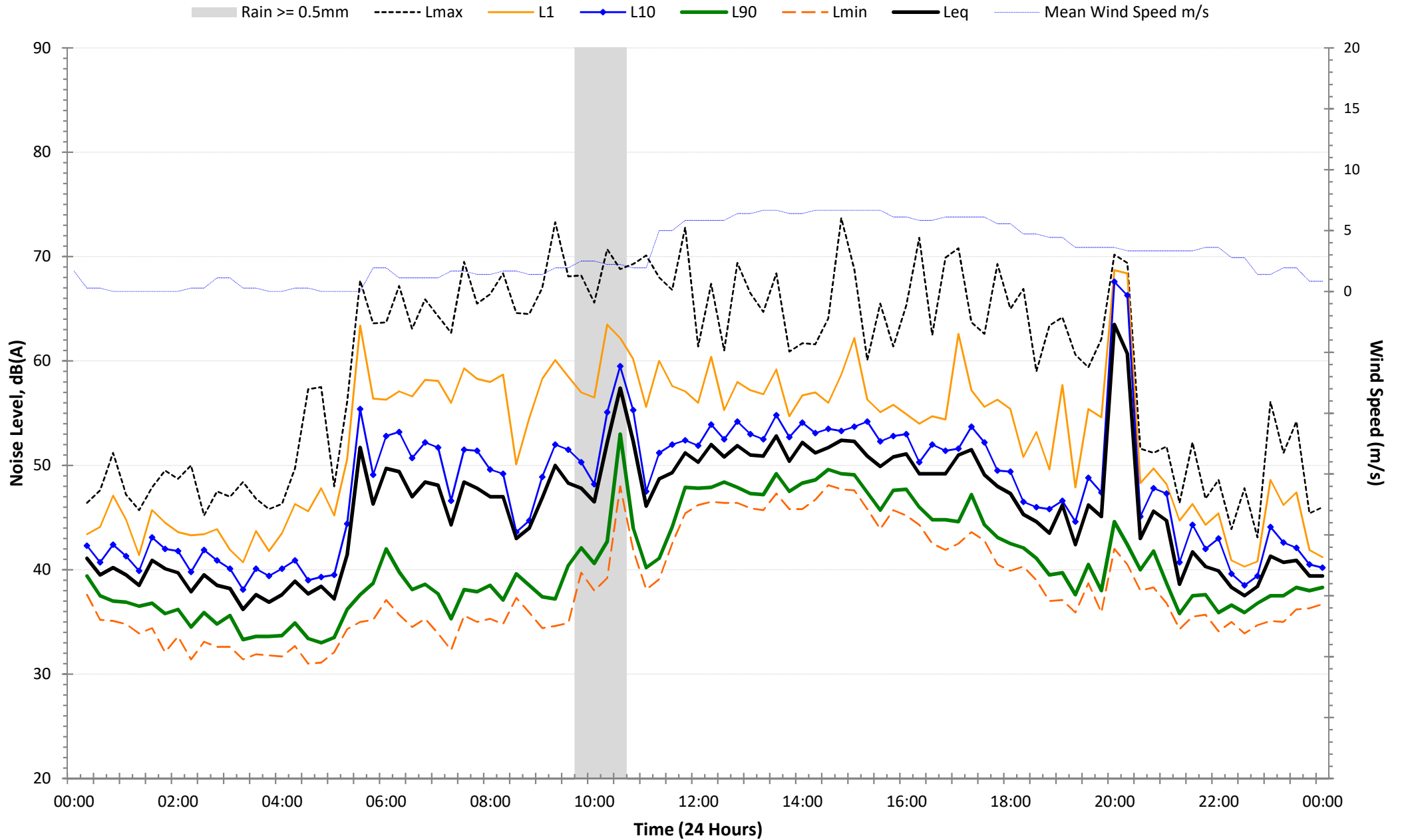
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 16 November 2017



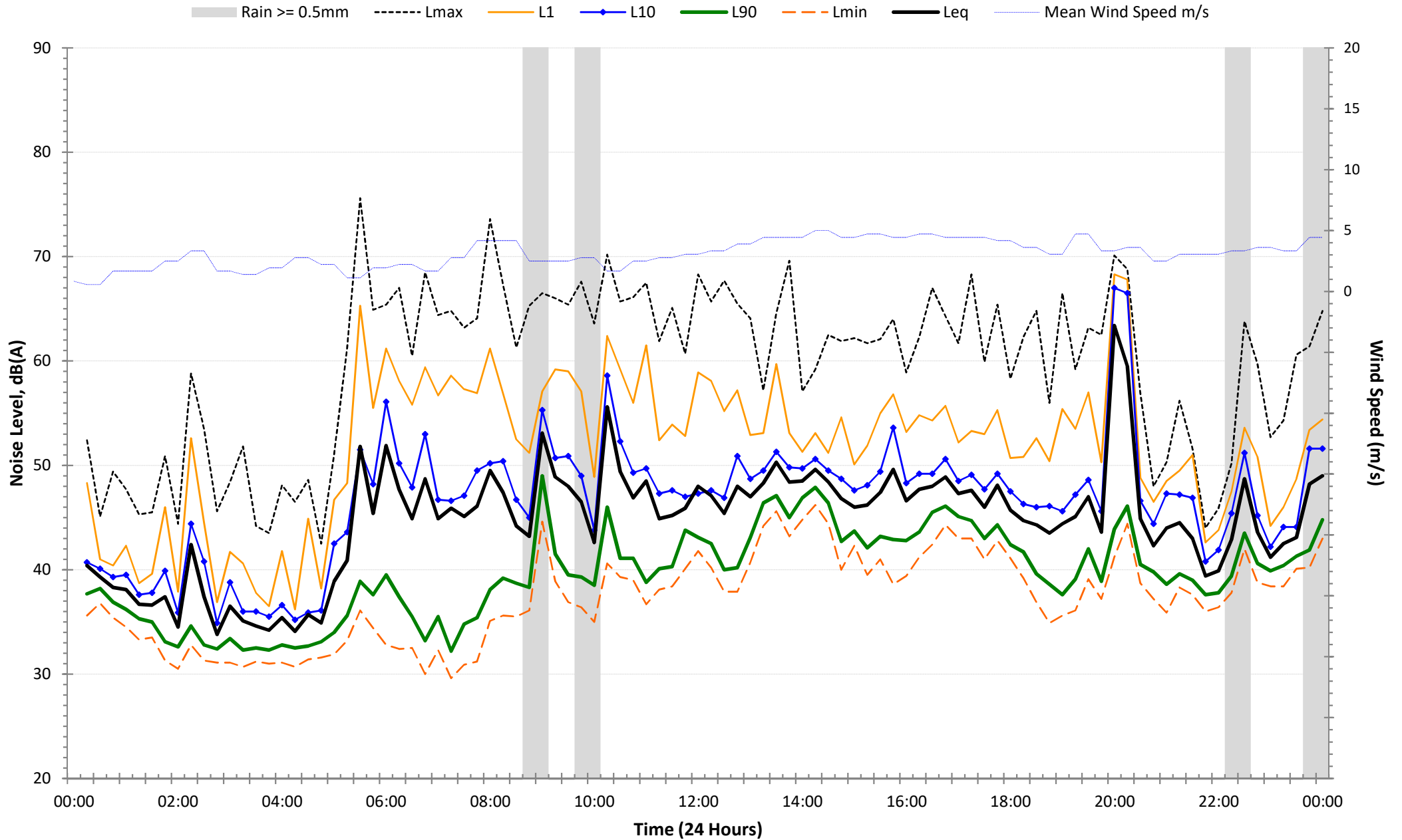
Measured Noise Levels
L3 - Sancrox Quarry - Friday 17 November 2017



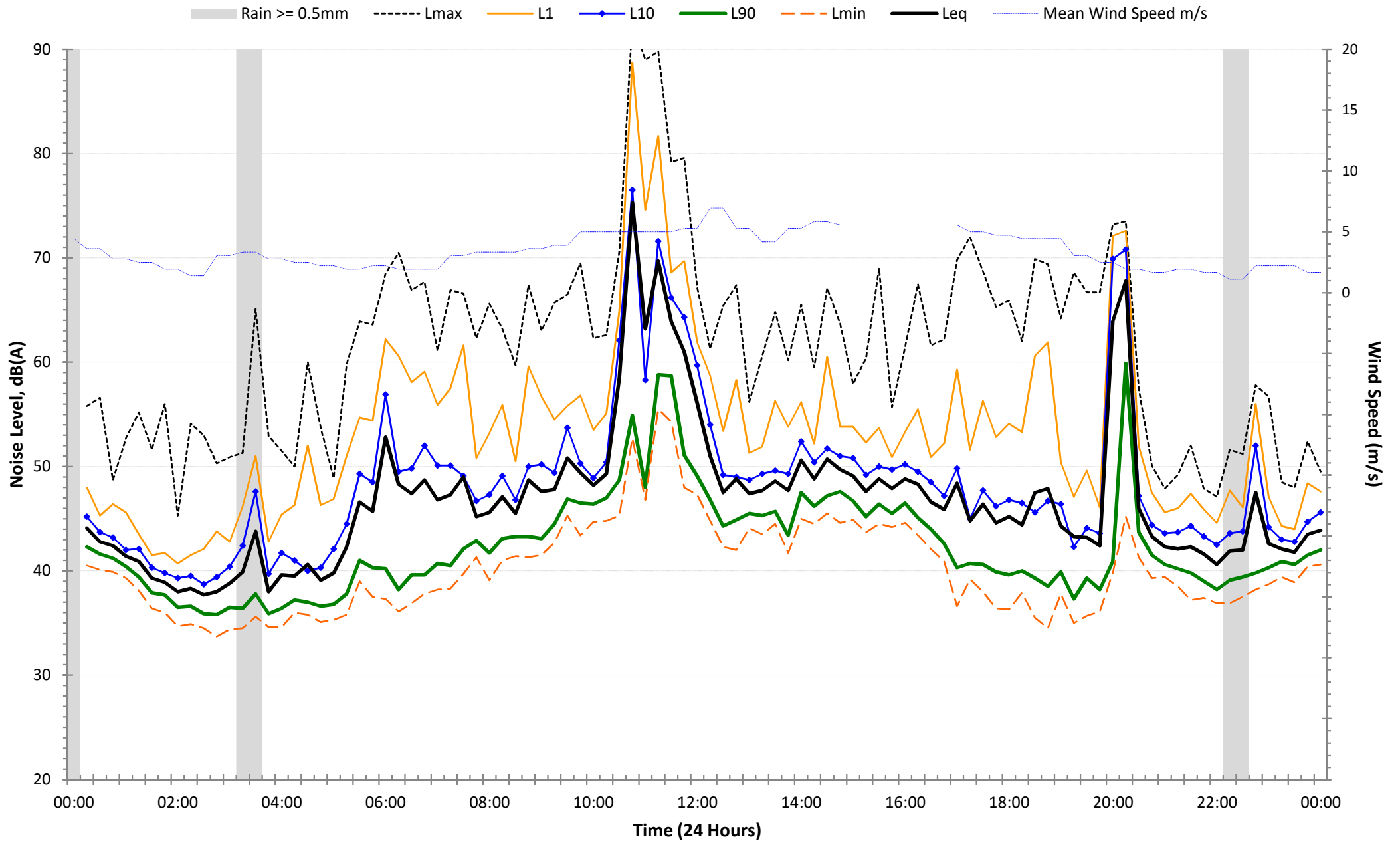
Measured Noise Levels
L3 - Sancrox Quarry - Saturday 18 November 2017



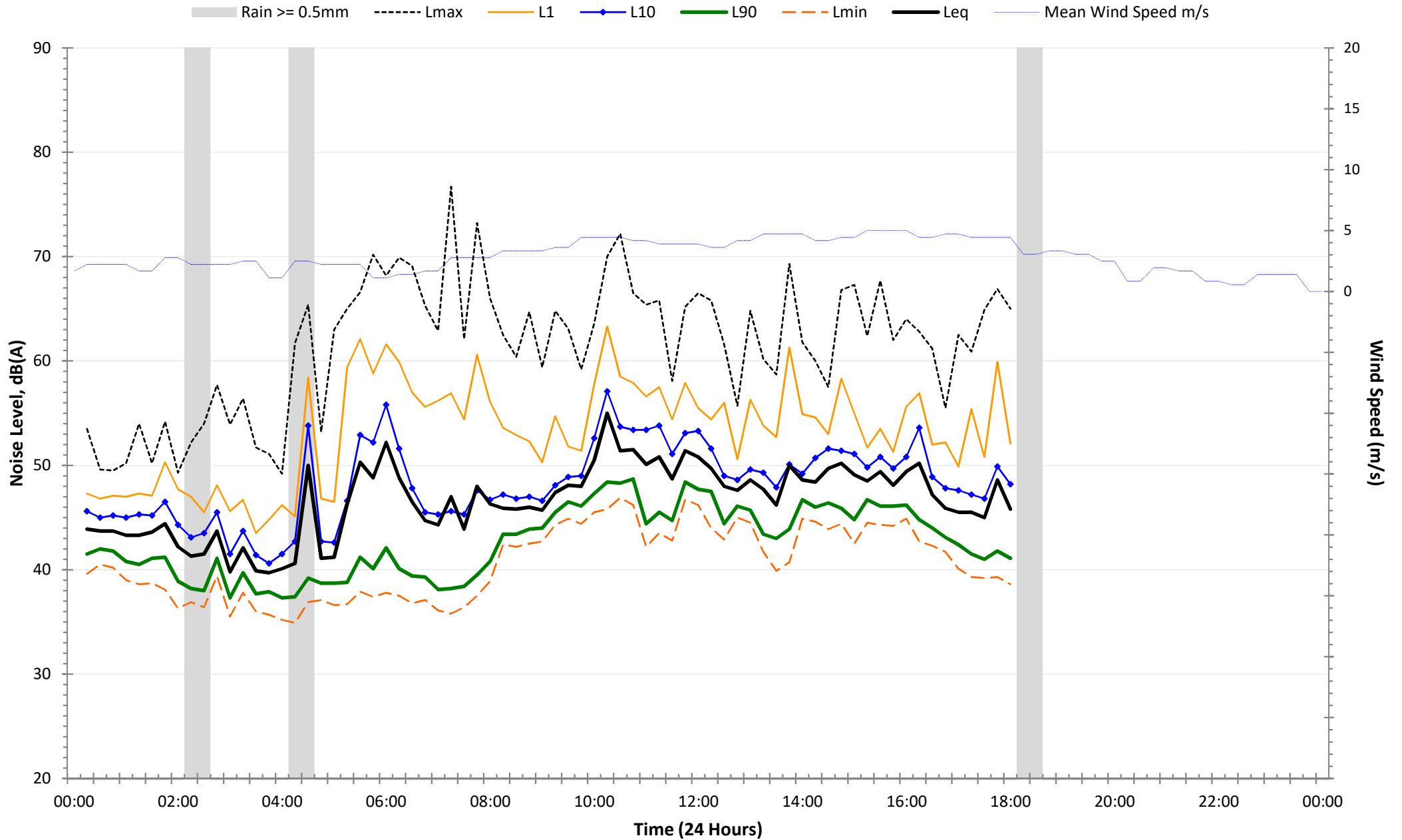
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 19 November 2017



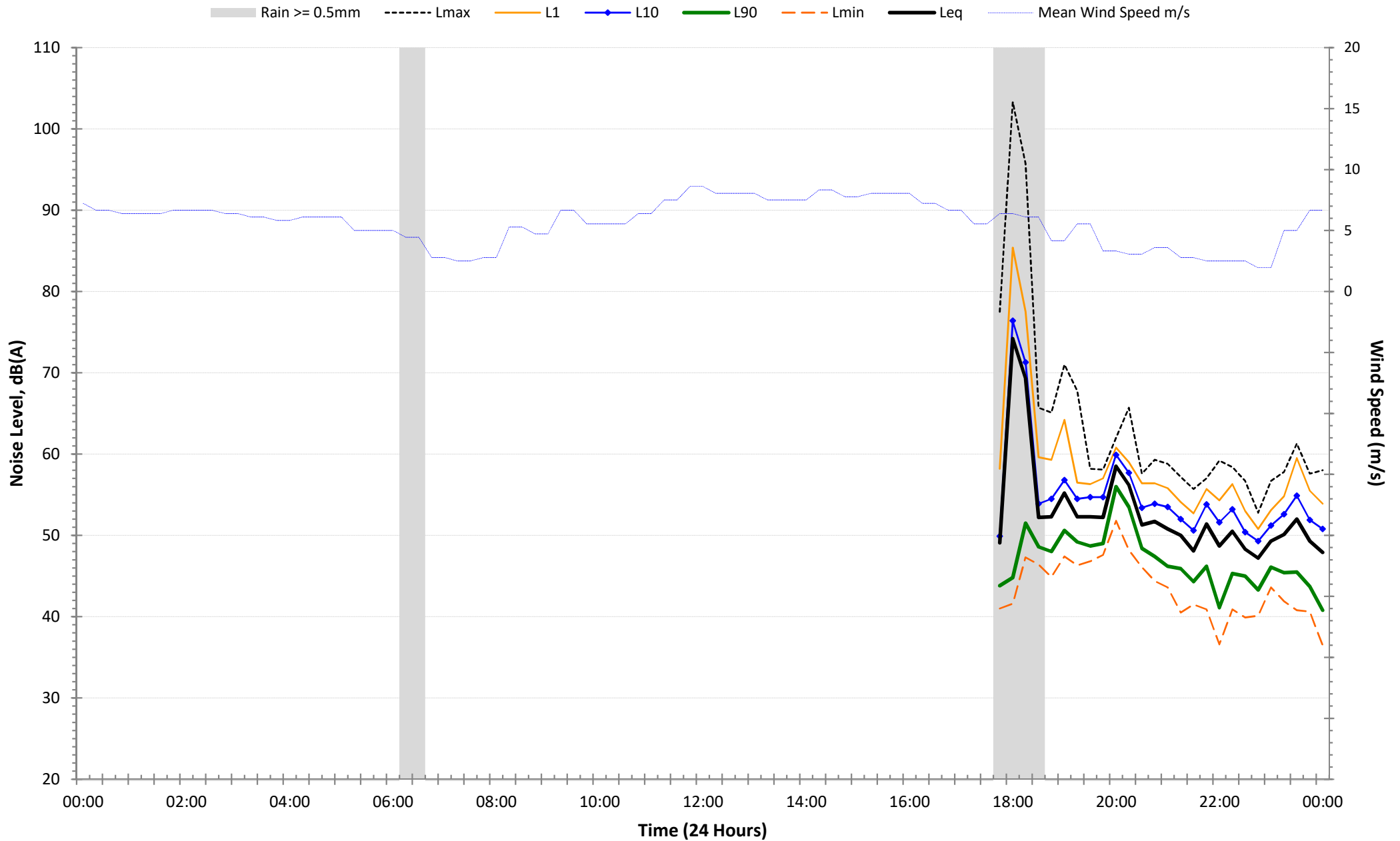
Measured Noise Levels
L3 - Sancrox Quarry - Monday 20 November 2017



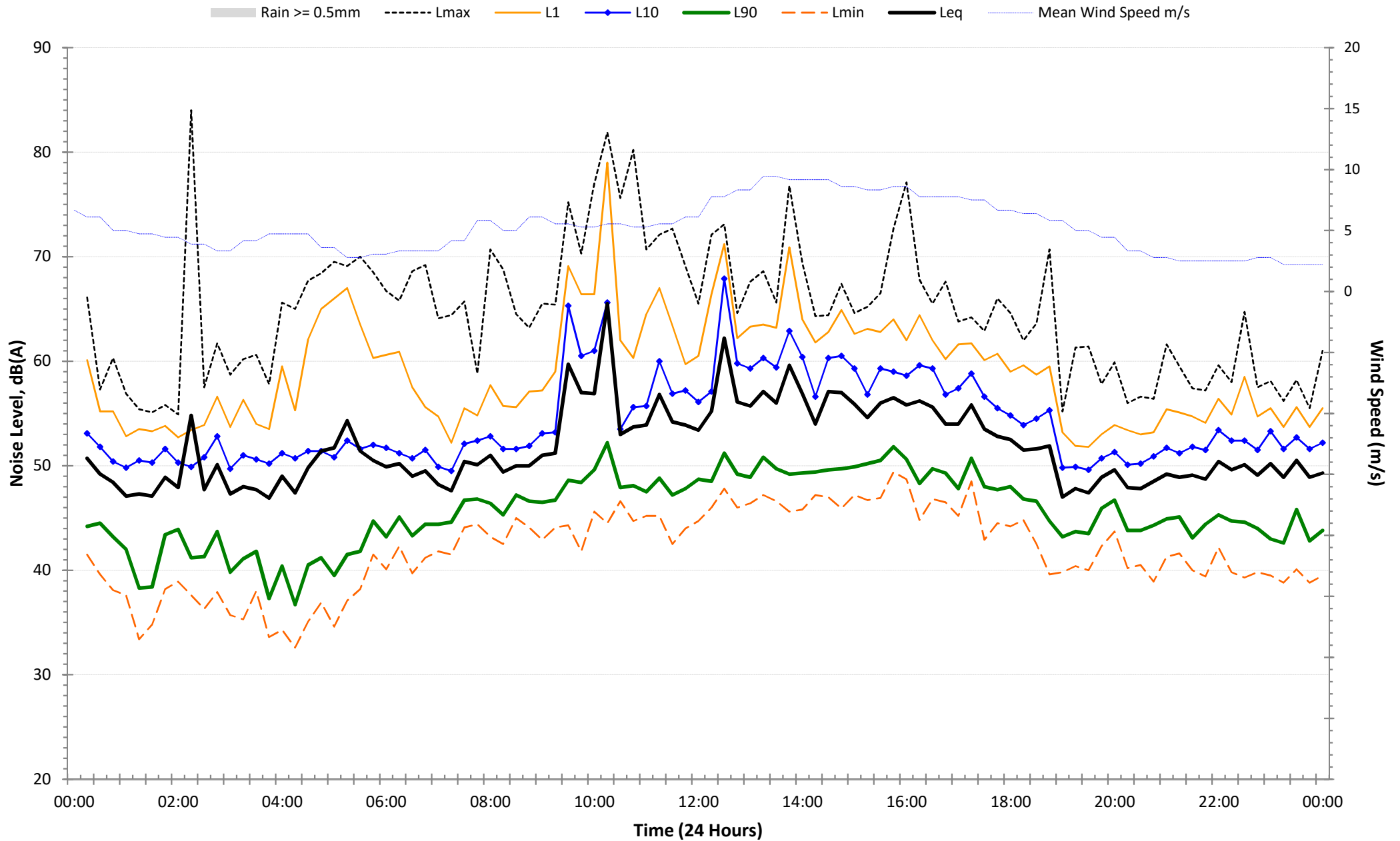
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 21 November 2017



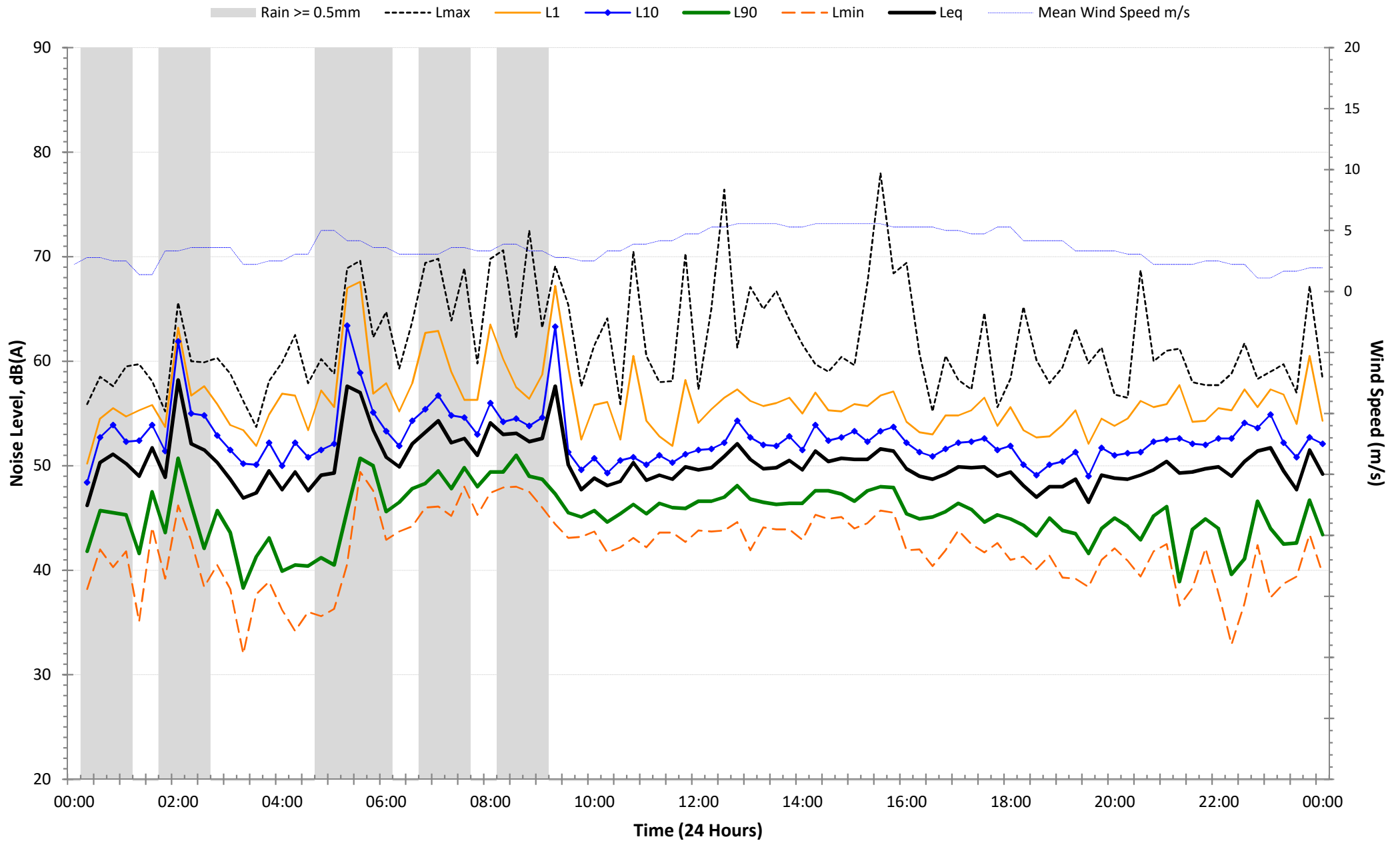
Measured Noise Levels
L4 - Sancrox Quarry - Monday 6 November 2017



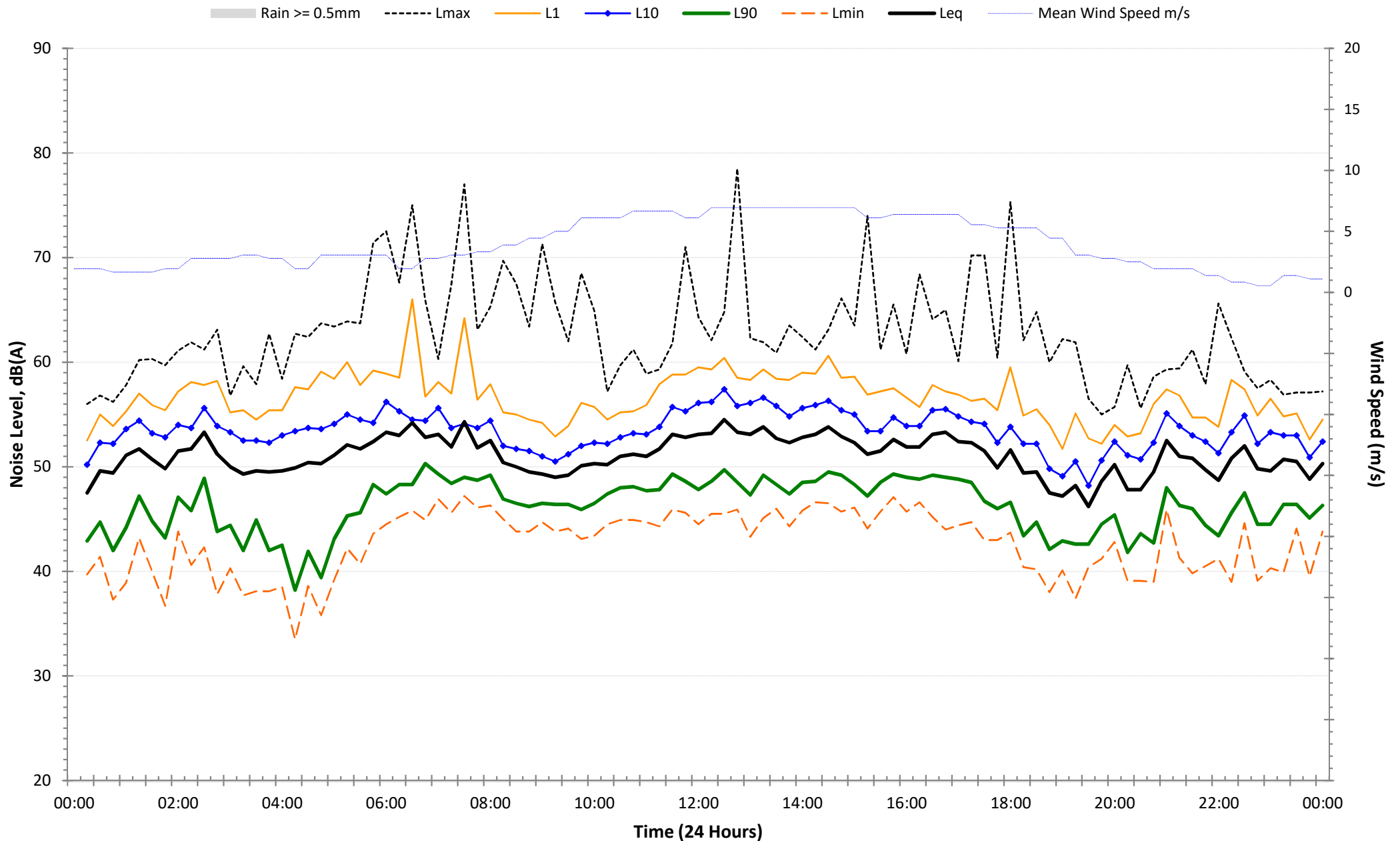
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 7 November 2017



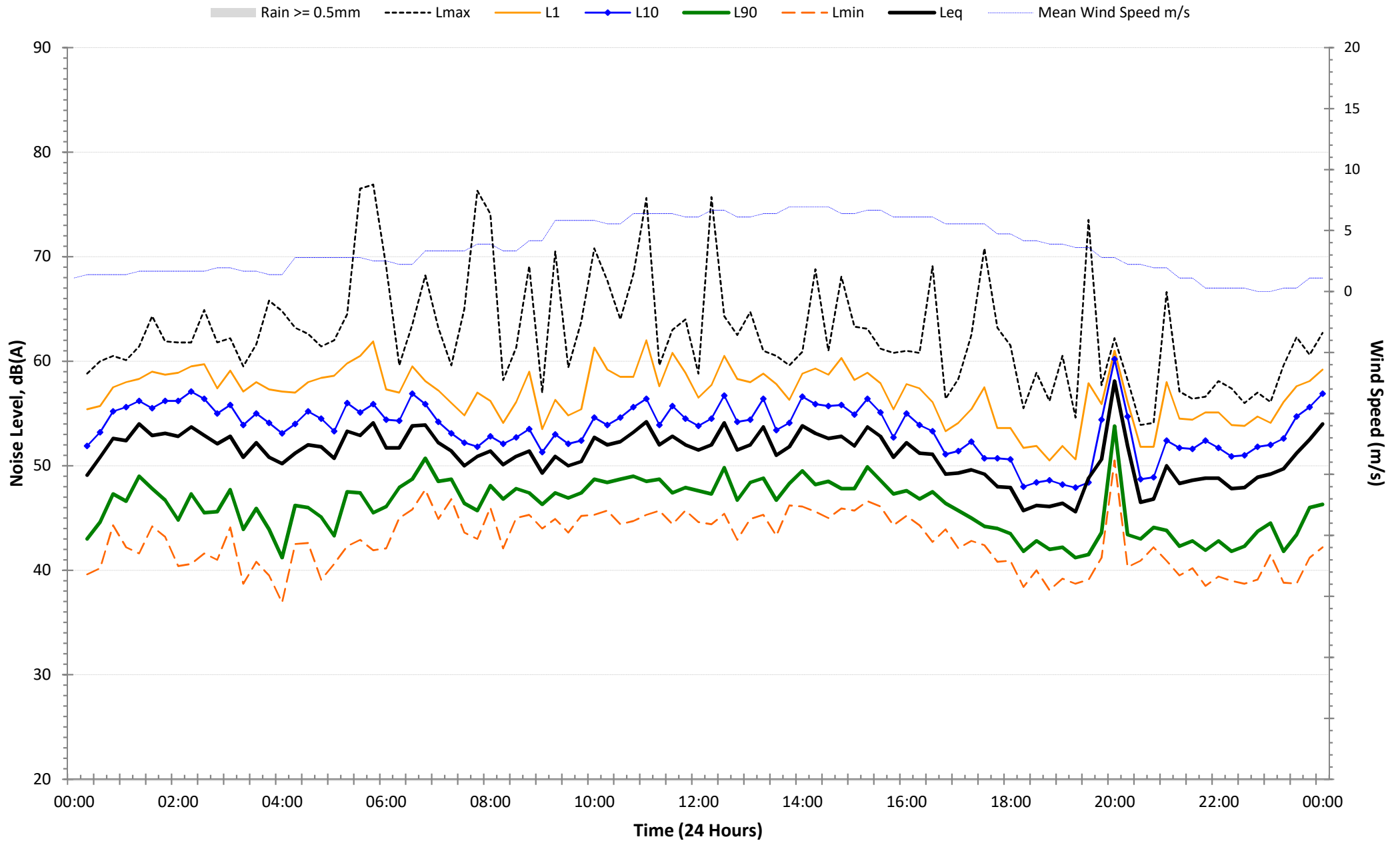
Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 8 November 2017



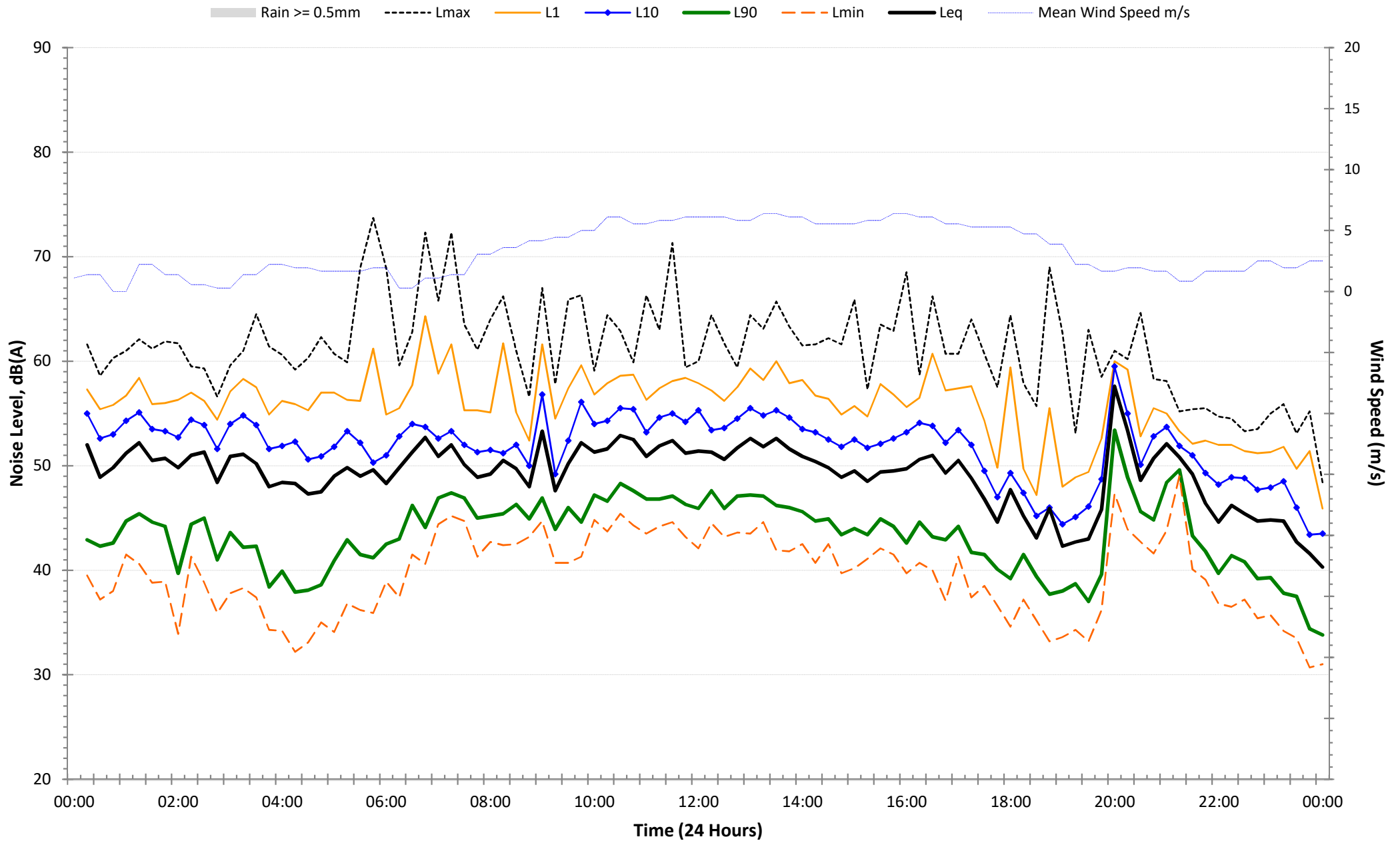
Measured Noise Levels
L4 - Sancrox Quarry - Thursday 9 November 2017



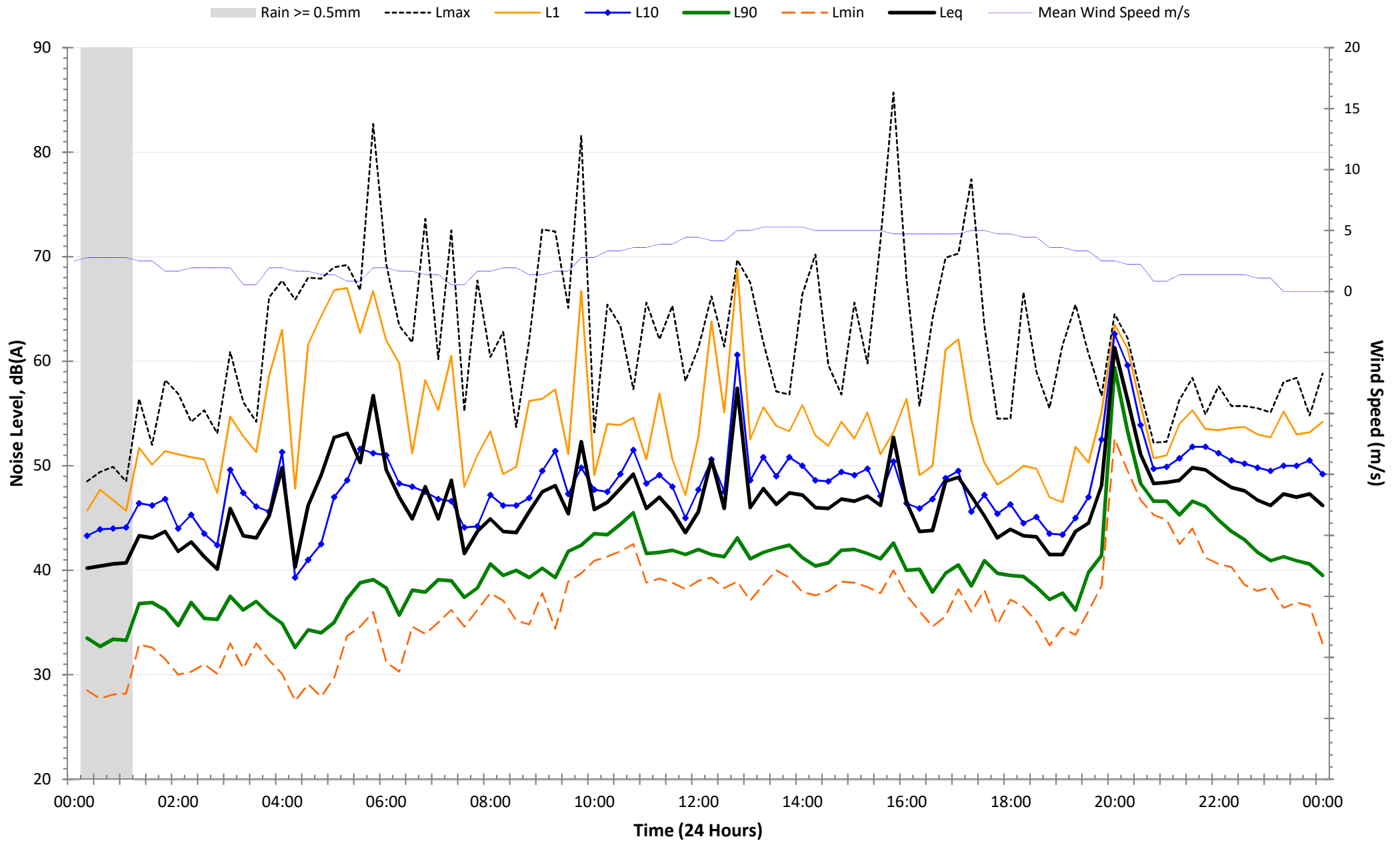
Measured Noise Levels
L4 - Sancrox Quarry - Friday 10 November 2017



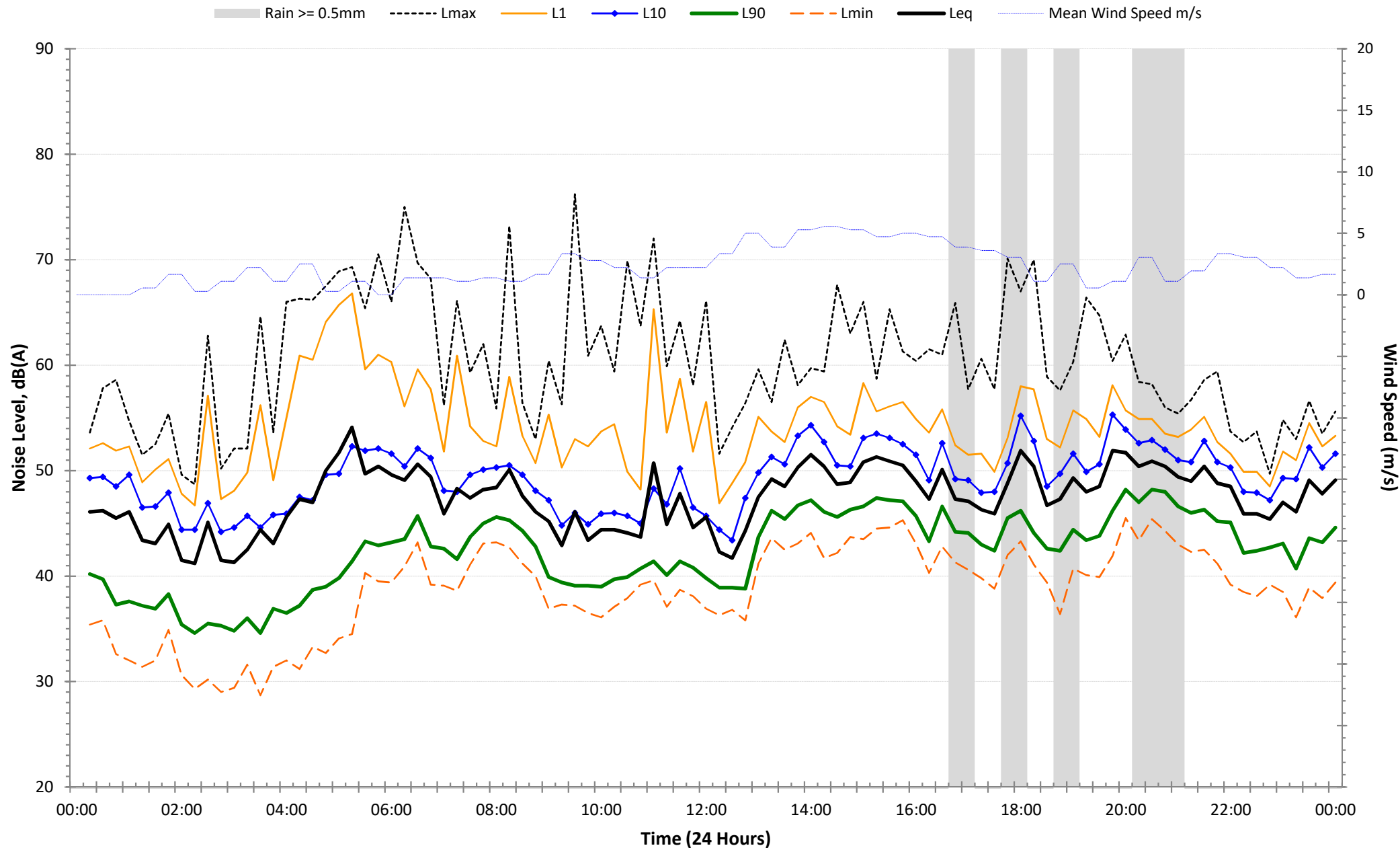
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L4 - Sancrox Quarry - Saturday 11 November 2017



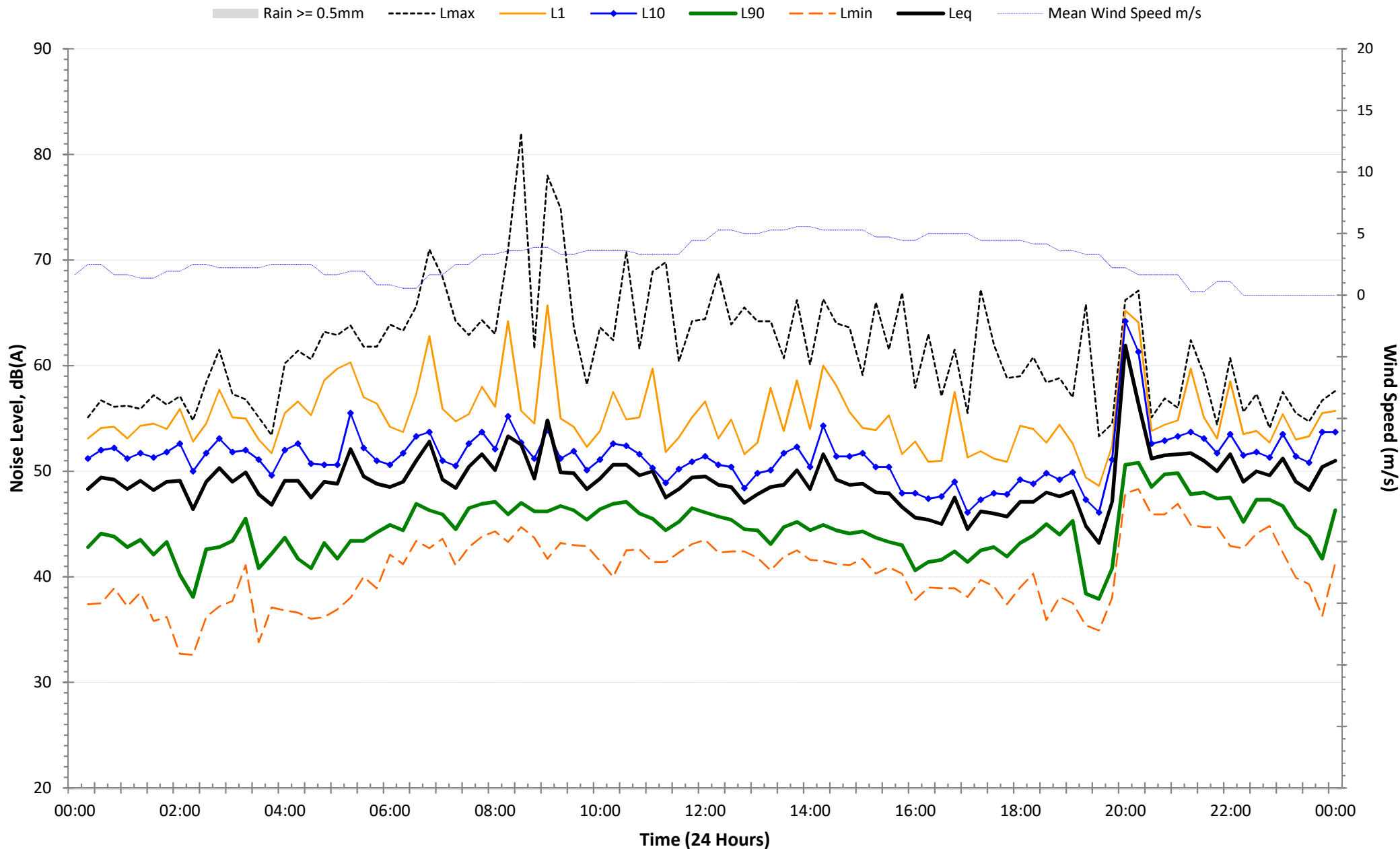
Measured Noise Levels
L4 - Sancrox Quarry - Sunday 12 November 2017



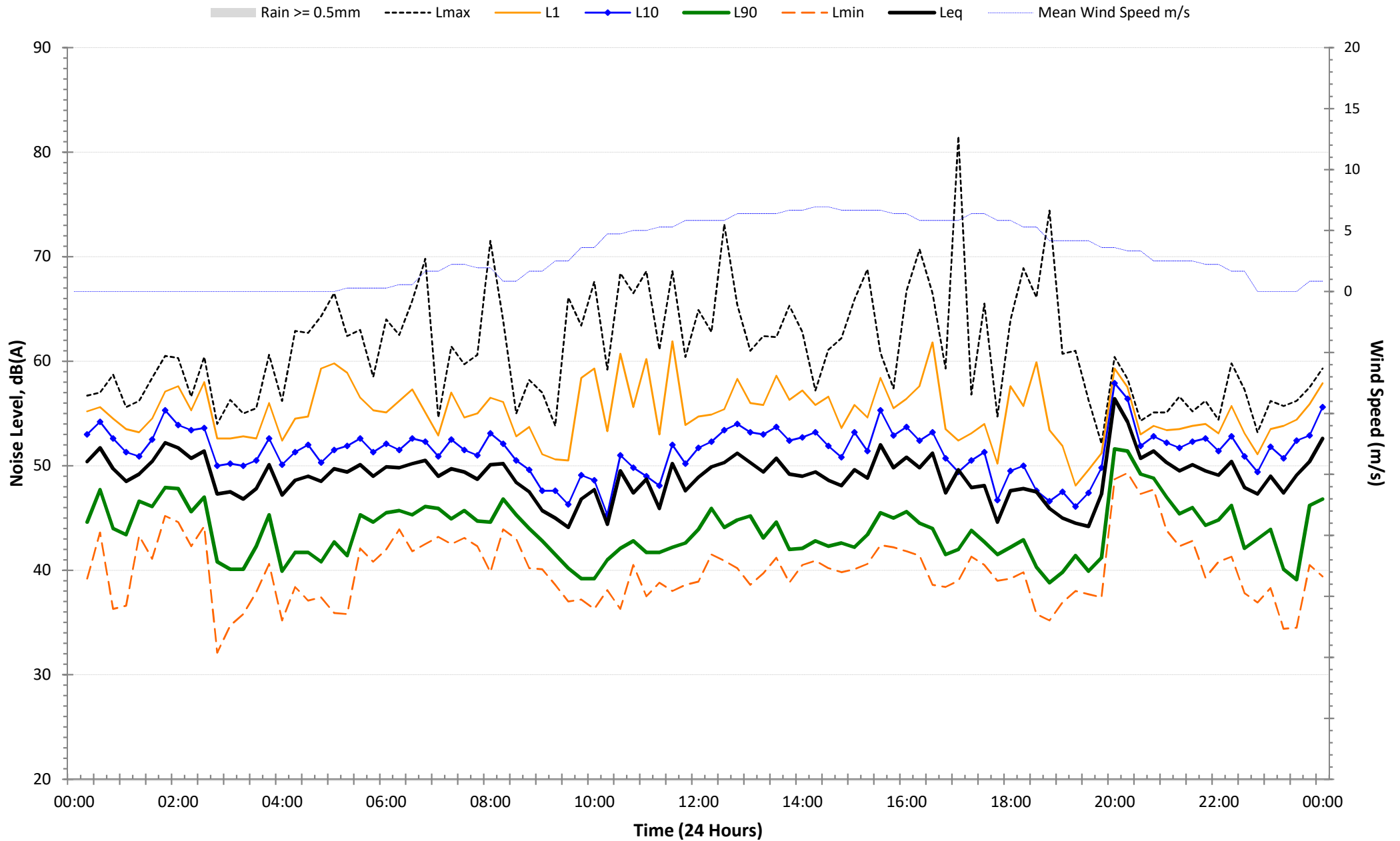
Measured Noise Levels
L4 - Sancrox Quarry - Monday 13 November 2017



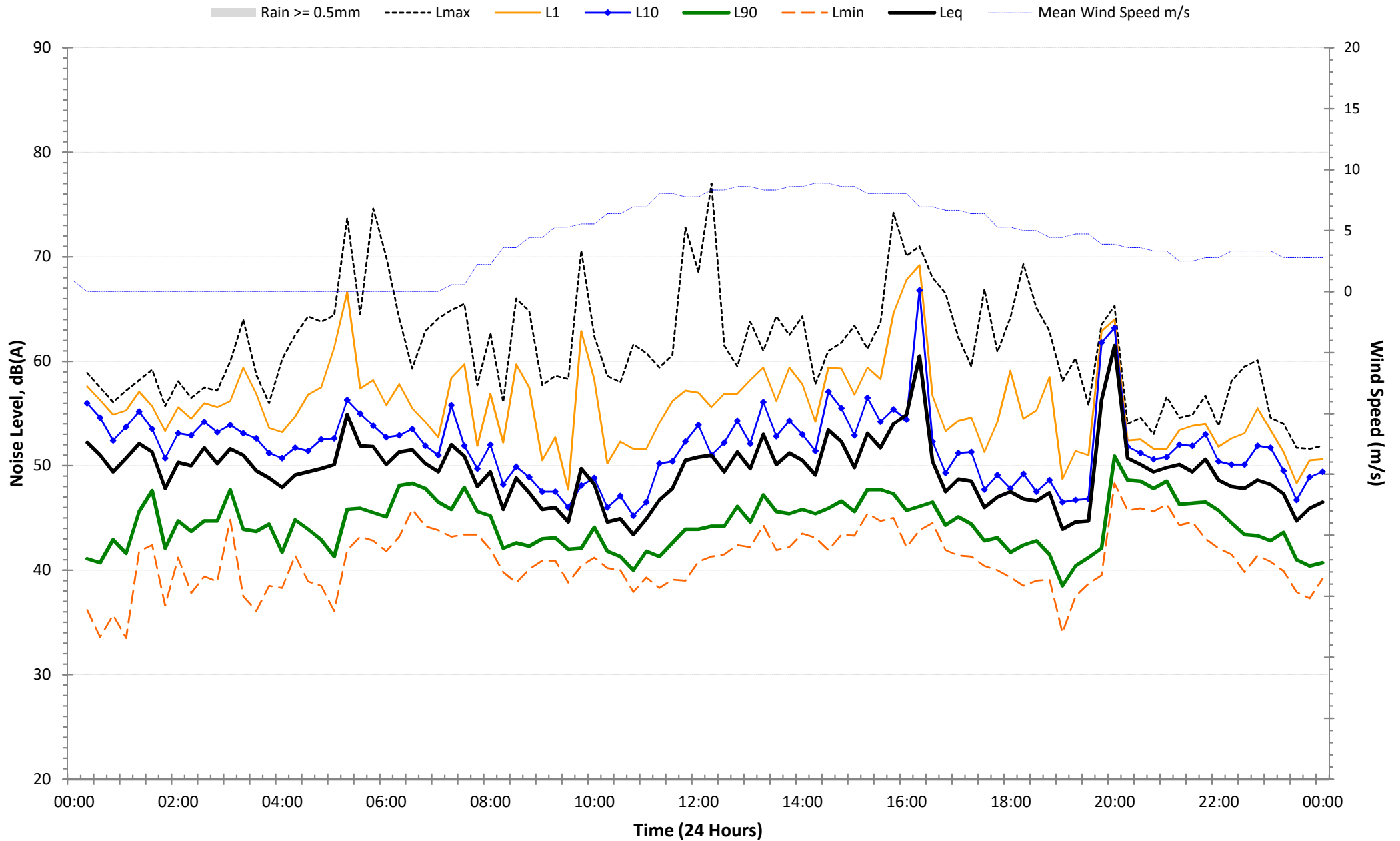
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 14 November 2017



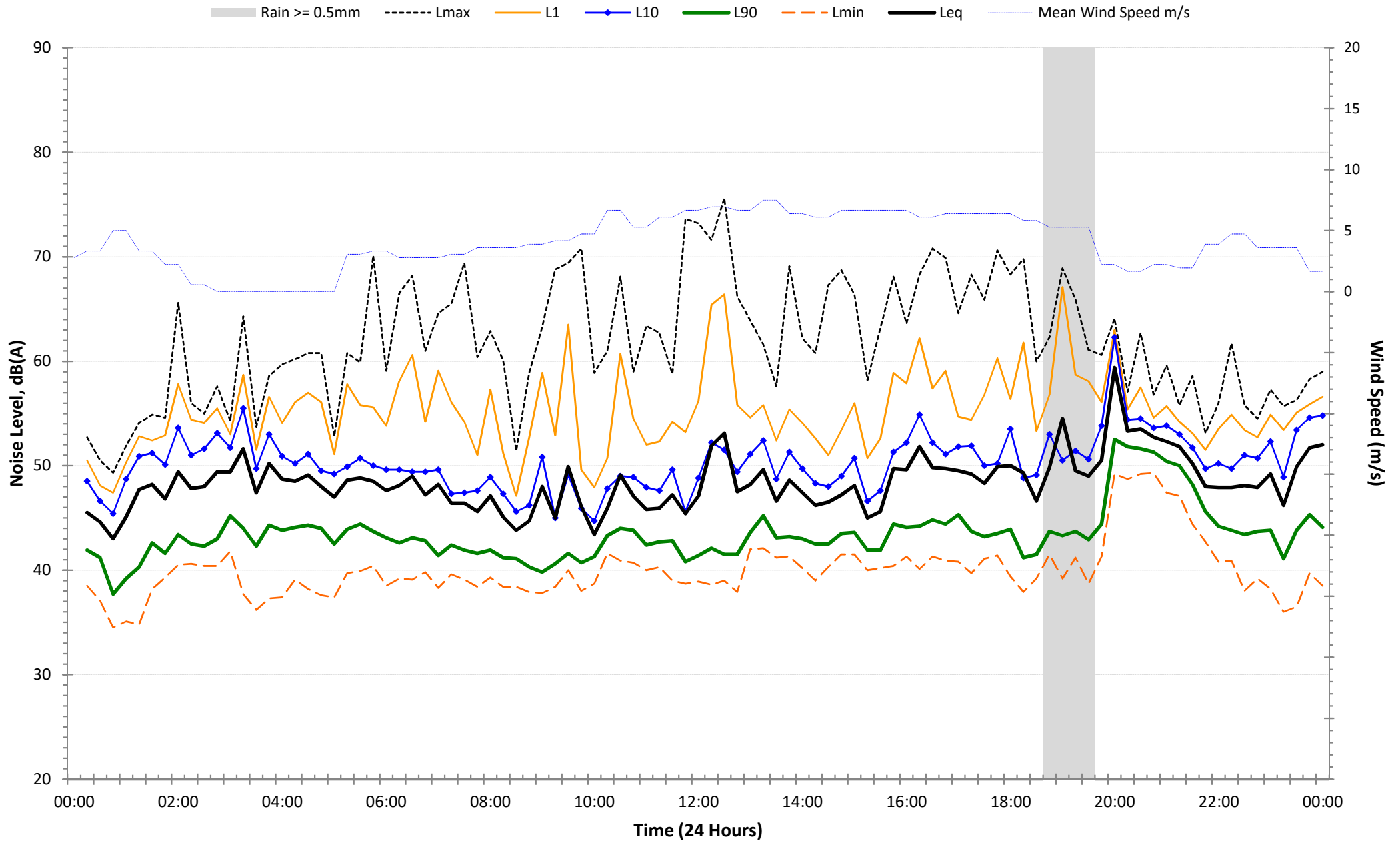
Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 15 November 2017



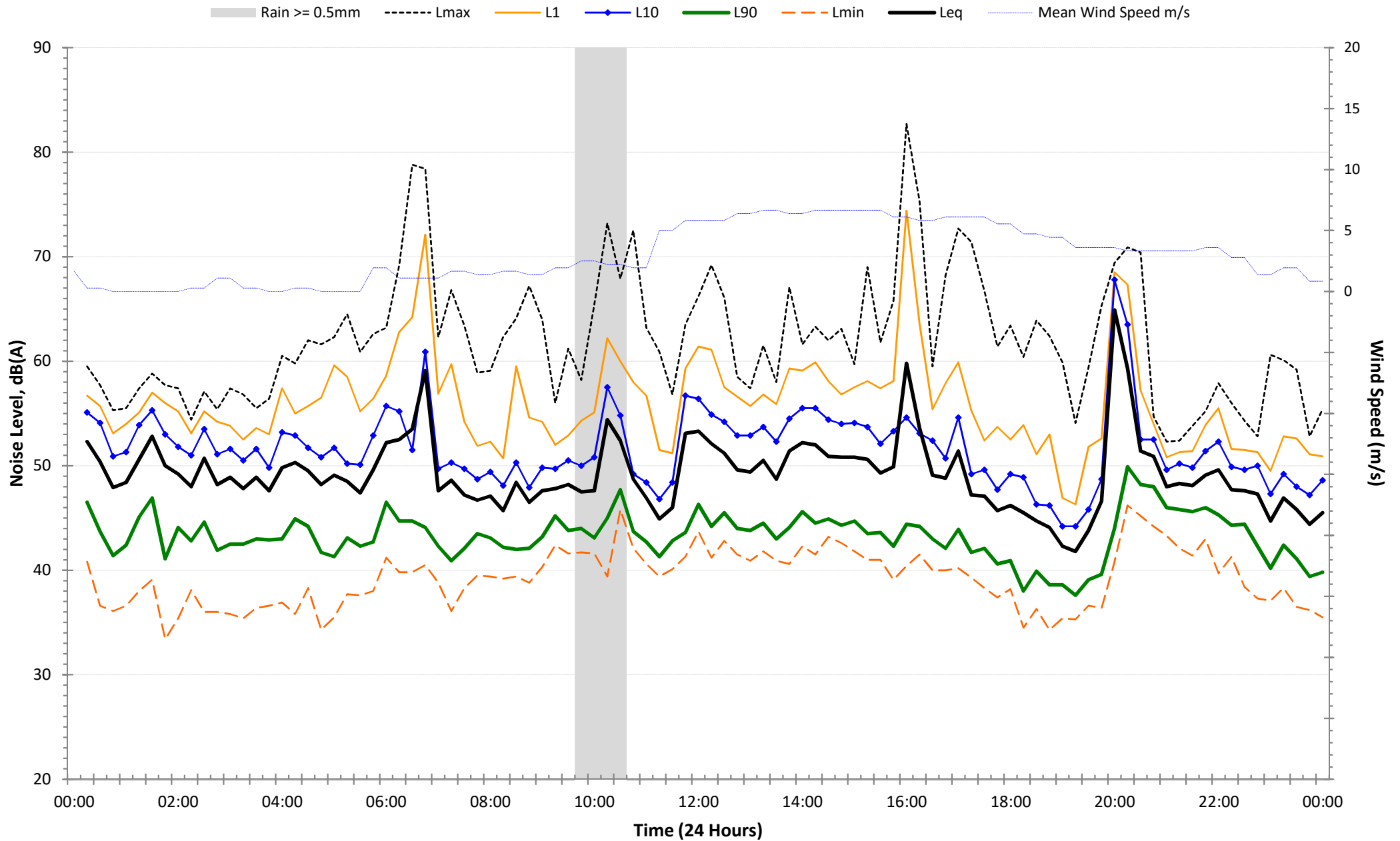
Measured Noise Levels
L4 - Sancrox Quarry - Thursday 16 November 2017



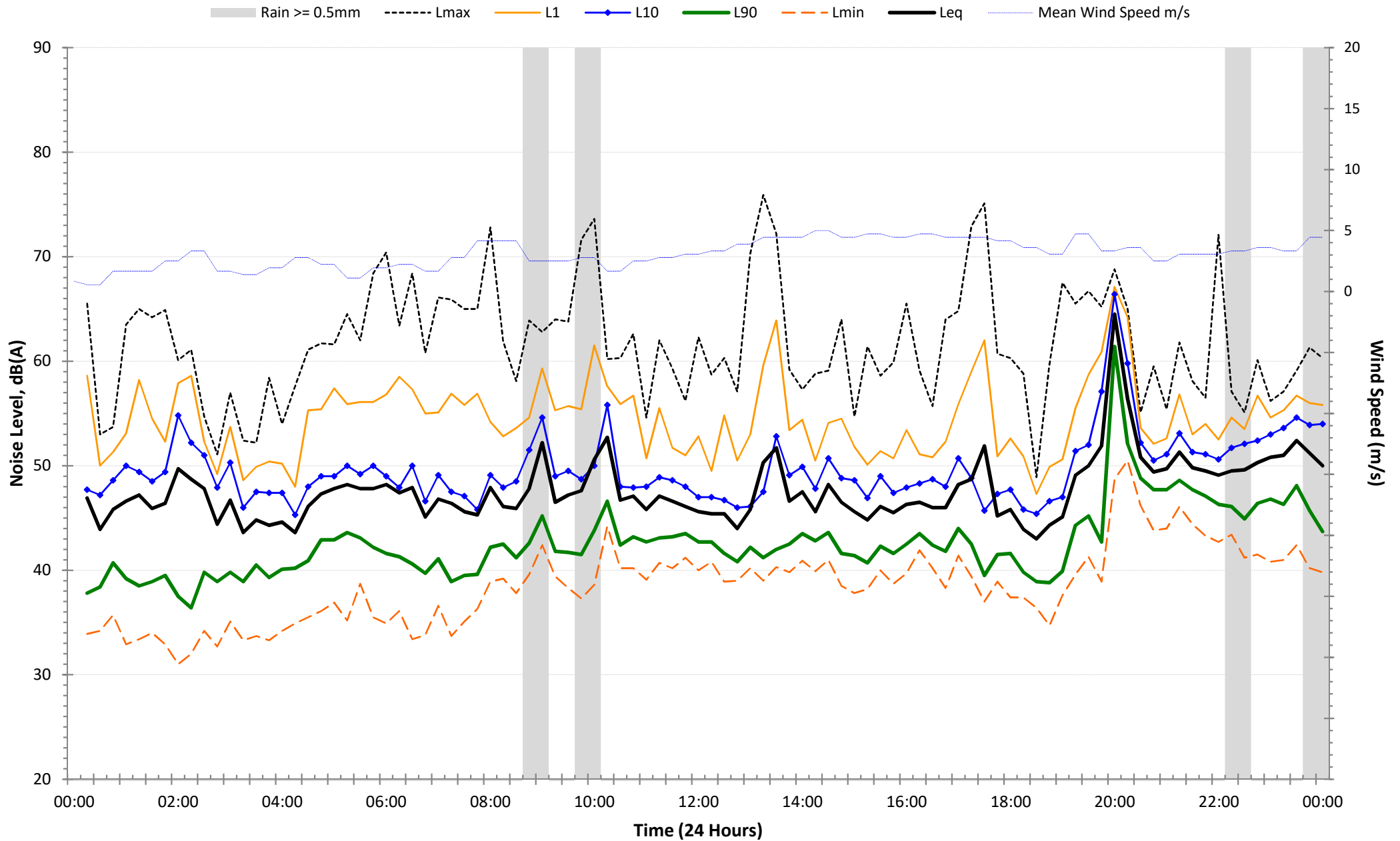
Measured Noise Levels
L4 - Sancrox Quarry - Friday 17 November 2017



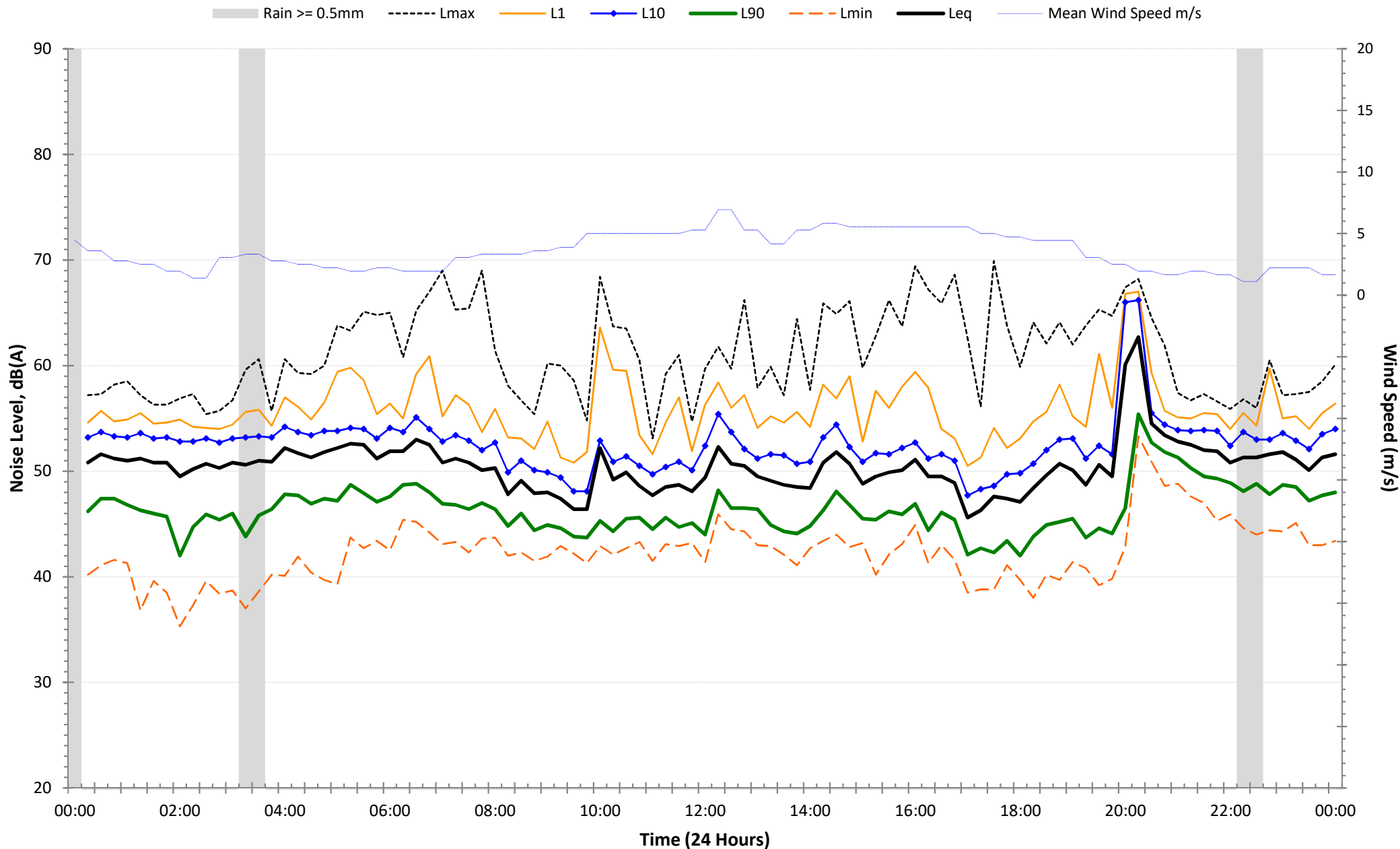
Measured Noise Levels
L4 - Sancrox Quarry - Saturday 18 November 2017



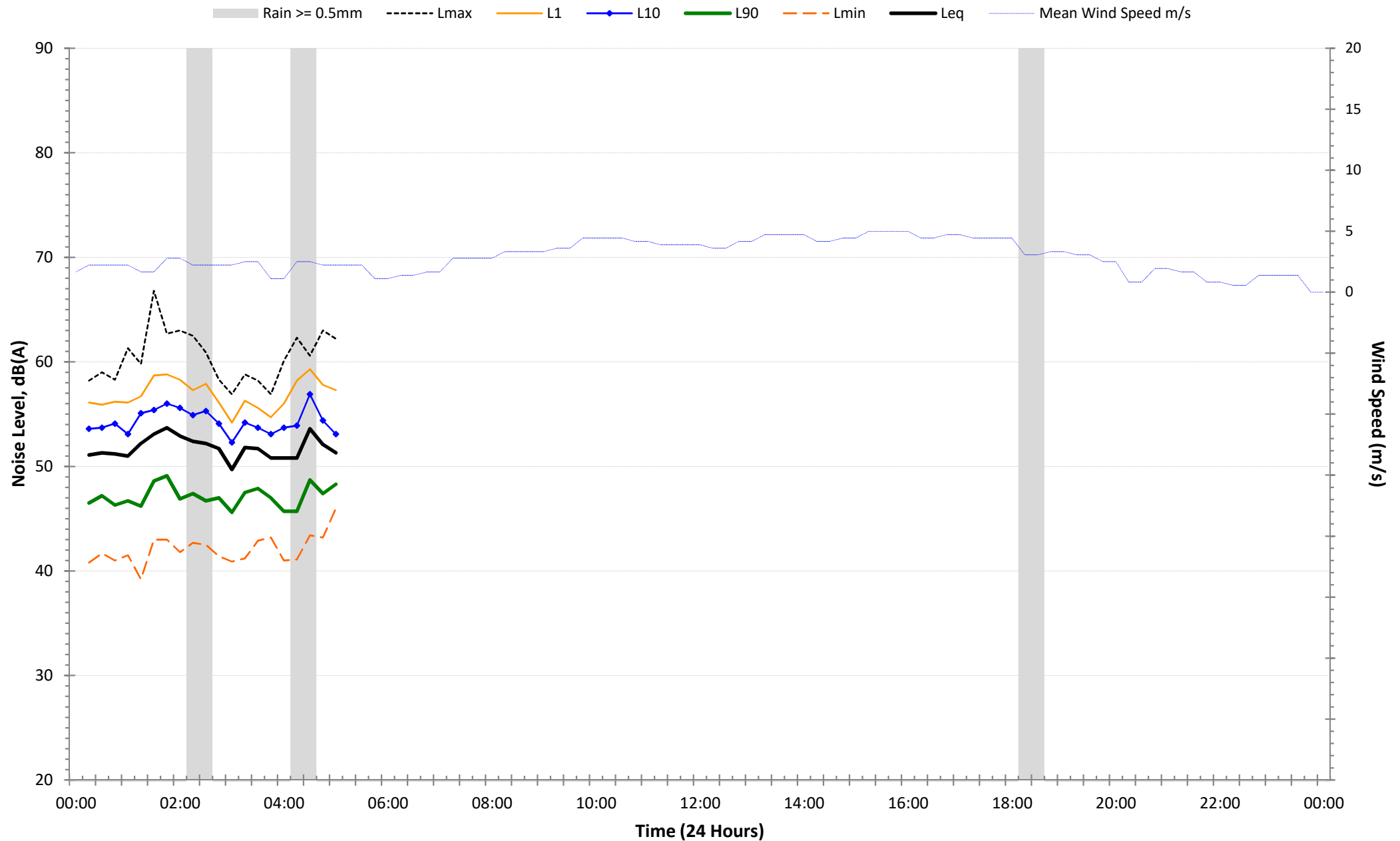
Measured Noise Levels
L4 - Sancrox Quarry - Sunday 19 November 2017



Measured Noise Levels L4 - Sancrox Quarry - Monday 20 November 2017



Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 21 November 2017



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