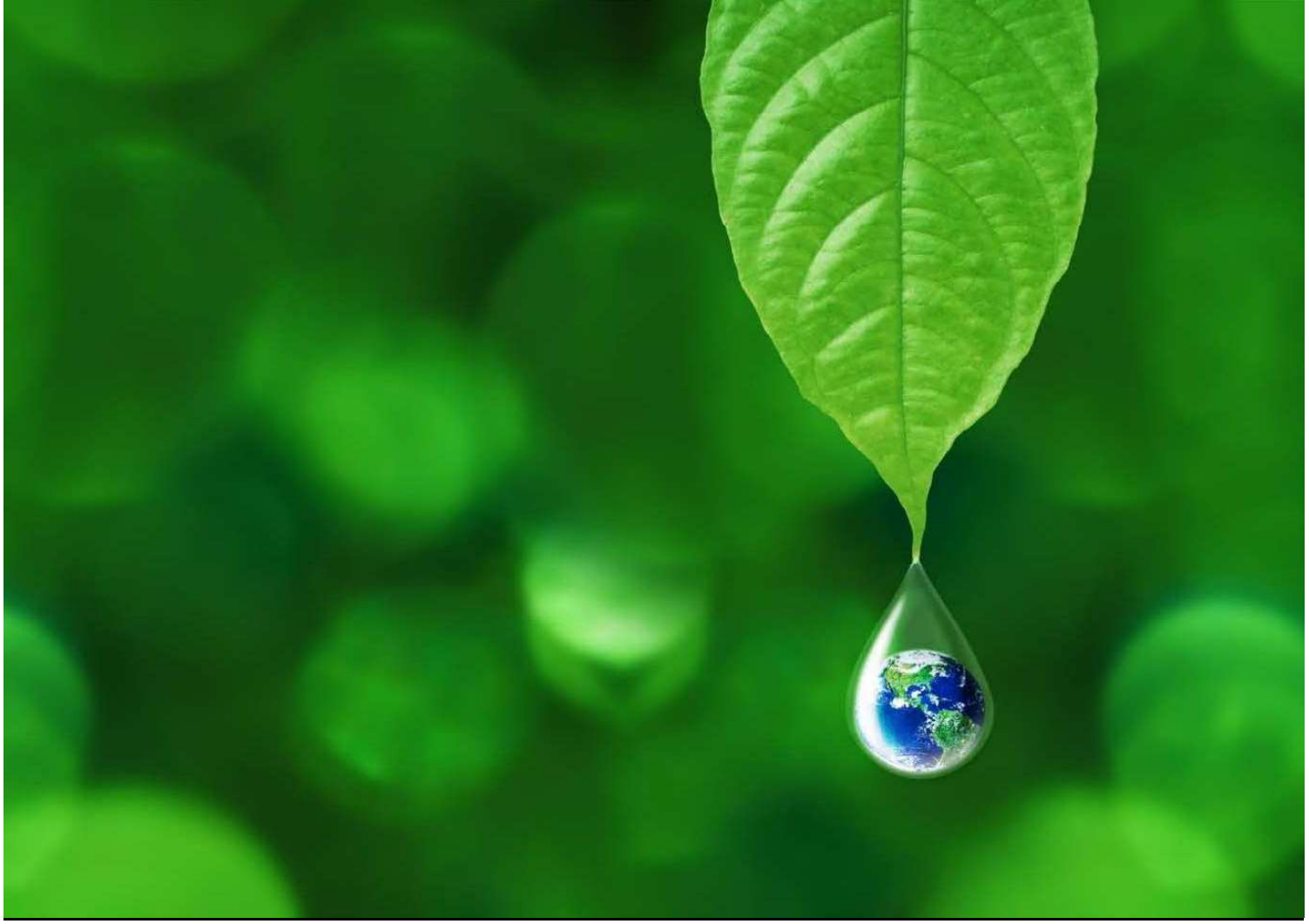

Hanson Construction Materials Pty Ltd

Sancrox Quarry Expansion Response to Submissions

Updated Noise and Vibration Impact Assessment

27 November 2020

Project No.: 0418291

The business of sustainability

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27 November 2020

Sancrox Quarry Expansion Response to Submissions

Updated Noise and Vibration Impact Assessment

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1. INTRODUCTION

1.1 Background

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Hanson Construction Materials Pty Ltd (Hanson) to conduct an updated Noise and Vibration Impact Assessment (NVIA) to inform the Environmental Impact Assessment (EIA) for the proposed Sancrox Quarry Expansion Project (the Project). This updated NVIA is to accompany the Response to Submission report that includes a revised quarry plan including staging.

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, Industry and Environment (DPIE) 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).

1.2 Project Description

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 enable operations to occur from 5 am to 10 pm, seven days a week for all site activities, and includes provisions for 20 nights of quarry operation for the following activities; Processing Plant, Asphalt Plant, Concrete Batching/Recycling Plant and associated transport (i.e. 10 pm to 5 am).

The proposed expansion is set to increase extraction from 185,000 tonnes per annum (tpa) to 750,000 tpa, with maximum daily throughput of 2,600 tpa of quarry material. The quarrying will be undertaken in four stages, with the first two extending the footprint of the quarry to the west, and the final two stages extending the footprint to the south 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.

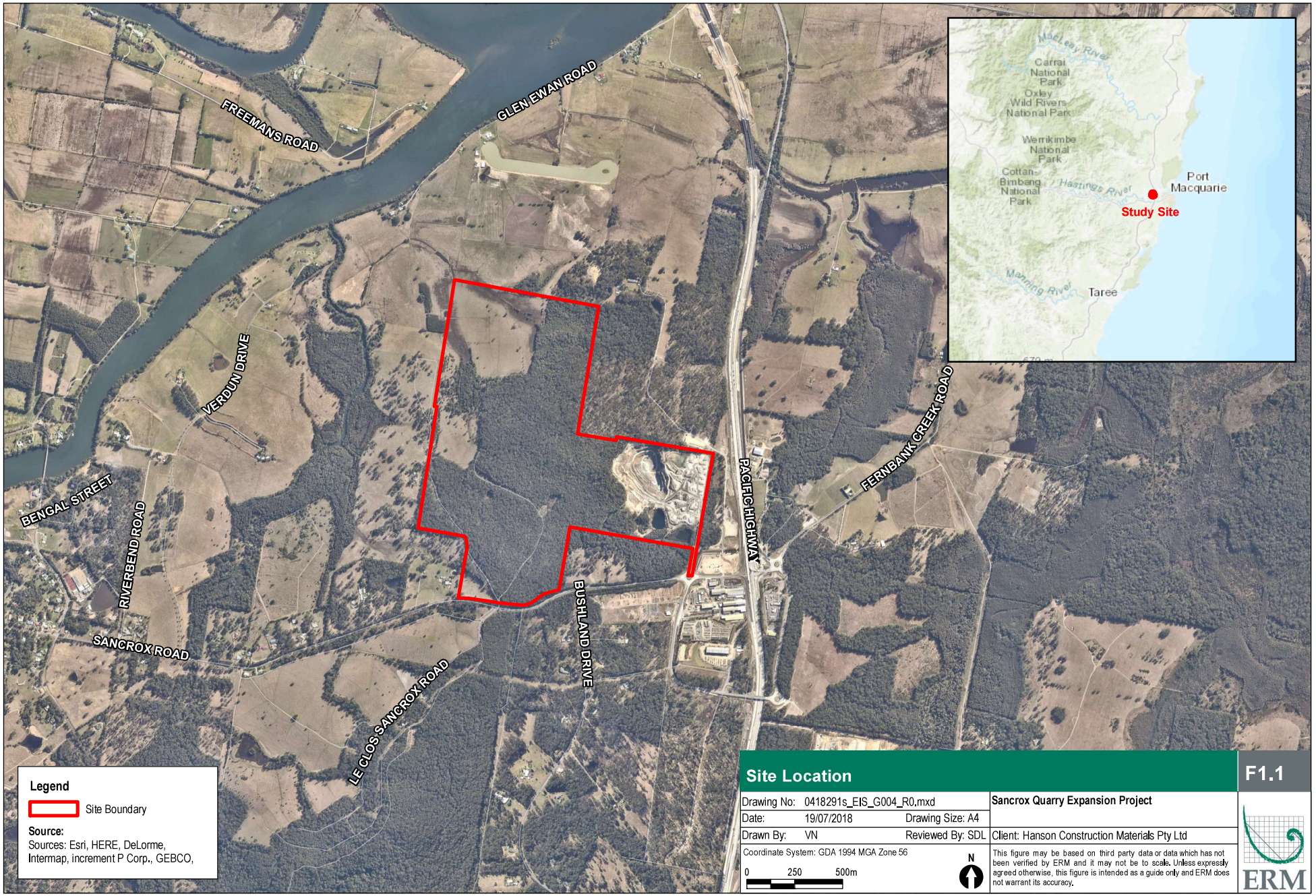
1.3 Project Locality

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 recently cleared vegetation is present along the eastern boundary, with 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 *Appendix A.*



Site Location

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Coordinate System: GDA 1994 MGA Zone 56

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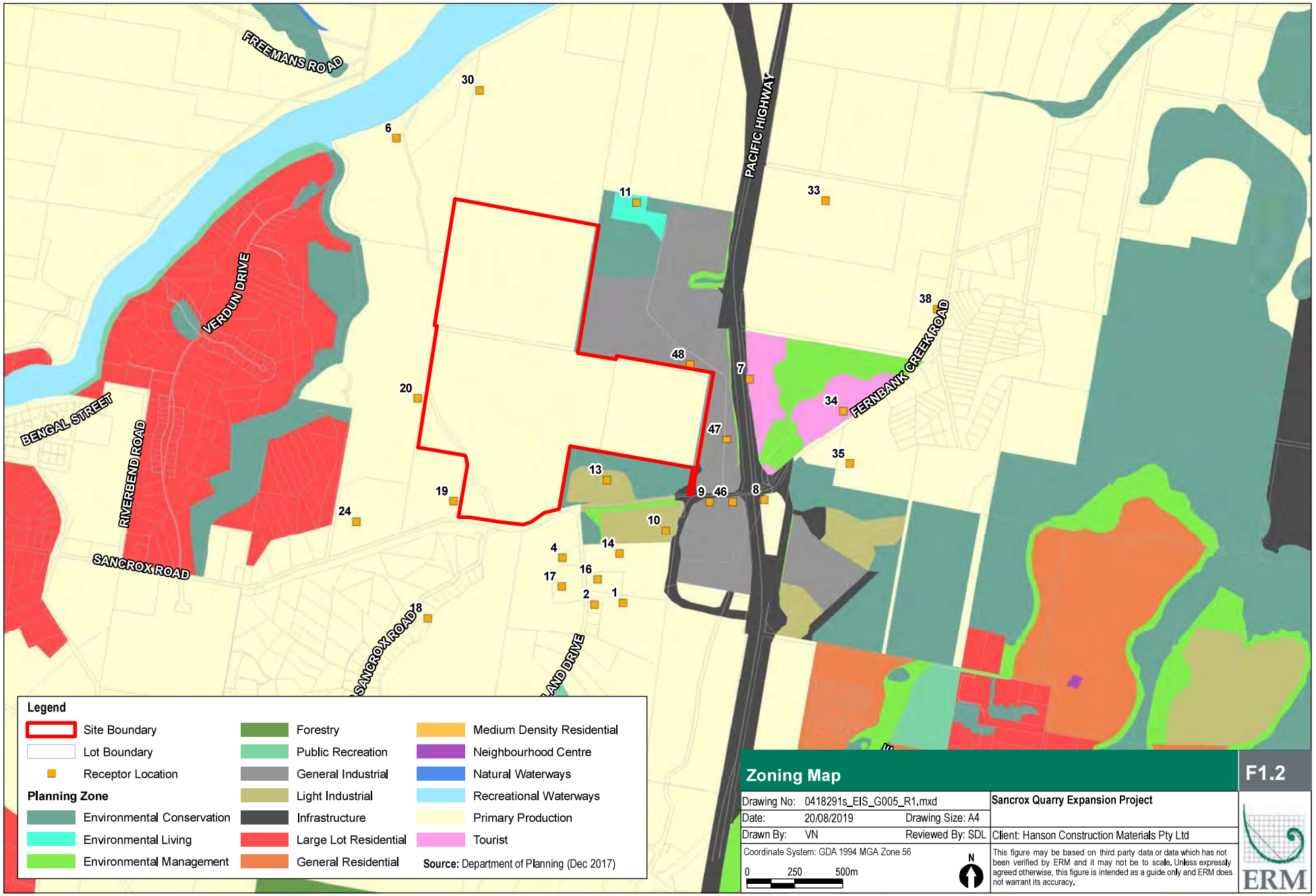
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Site Boundary
Lot Boundary
Receptor Location
Planning Zone
Environmental Conservation
Environmental Living
Environmental Management
Forestry
Public Recreation
General Industrial
Light Industrial
Infrastructure
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Natural Waterways
Recreational Waterways
Primary Production
Tourist
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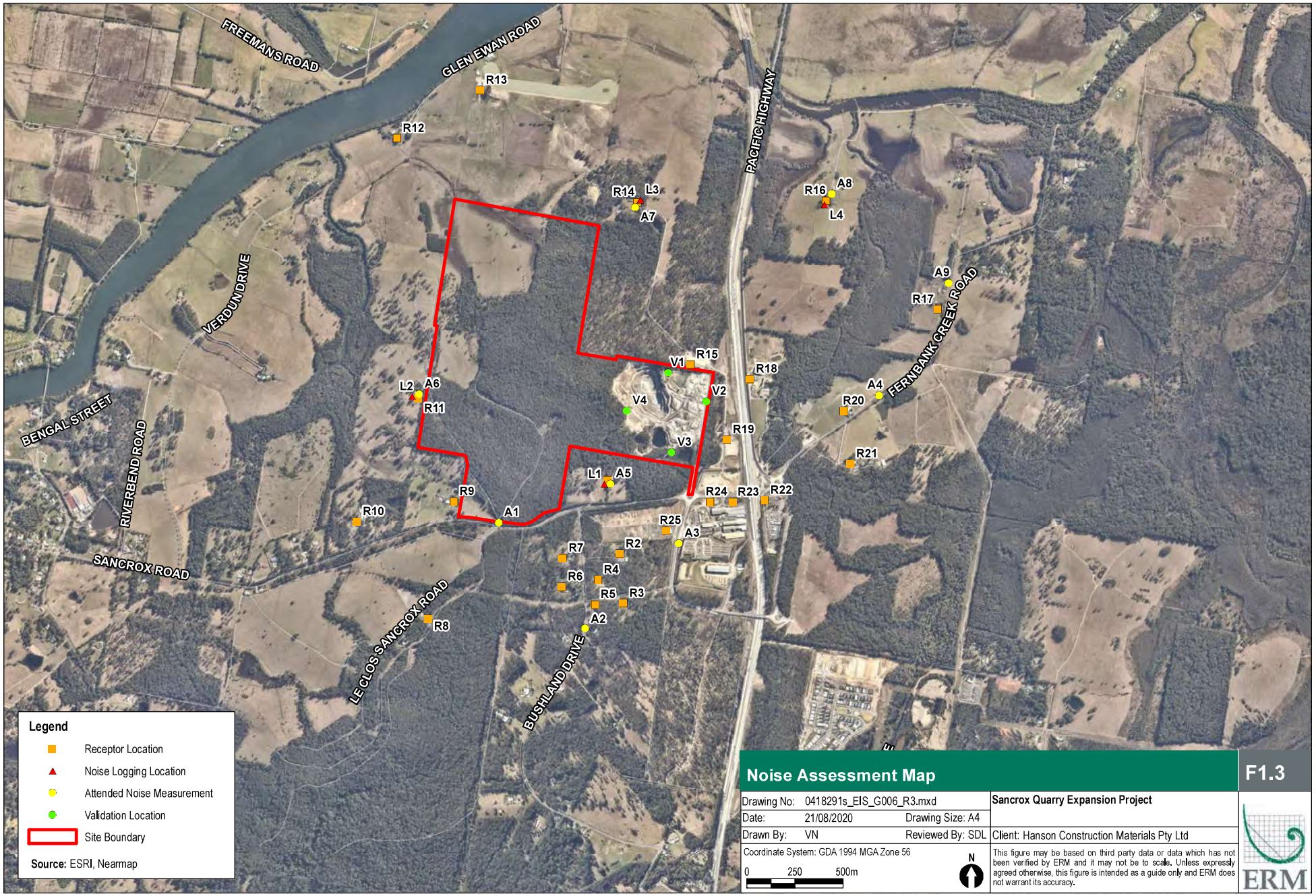
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R7
R2
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R5
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A2
R8
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Receptor Location
Noise Logging Location
Attended Noise Measurement
Validation Location
Site Boundary
Source: ESRI, Nearmap
Noise Assessment Map
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2. ASSESSMENT METHODOLOGY

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 *Appendix 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.
- Undertake operator attended noise measurements on the project site to measure sound power levels of significant noise generating equipment and to validate the existing operational noise model.
- 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.
- Undertake operator attended noise measurements in the vicinity of the project and unattended noise logger locations. This attended data will be utilised to understand the existing acoustics environment better and to support the unattended data.
- 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 Environment Protection Authority – Noise Policy for Industry (NPI, 2017), October 2017.
- 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 AS1259.2-1990™ (AS1259) – Acoustics – Sound Level Meters – Integrating Averaging as relevant to the device.
- Standards Australia AS/IEC 60942:2004/IEC 60942:2003 (IEC60942) – Australian Standard™ – Electroacoustics – Sound Calibrators.
- 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.

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 *Appendix 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)*".

Item 8 of the *Implementation and Transitional Arrangements for the Noise Policy for Industry (2017)* then states, *The NSW Industrial Noise Policy (2000) will continue to apply where it is referenced in existing statutory instruments (such as consents and licences), except for the NSW Industrial Noise Policy Section 4 modifying factors, which will be transitioned to the Noise Policy for Industry (2017) Fact Sheet C through a NSW Industrial Noise Policy application note. This approach has been taken because the Noise Policy for Industry (2017) modification factor approach reflects more recent understanding of the impact of tonal and low-frequency noise on the community.*

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. However, modifying factors have been considered in accordance with the NPI, 2017.

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 *Appendix 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 have been utilised along with long-term blasting data from the quarry (2015 to 2020), to determine average site constants relevant to the Sancrox Quarry for the AS2187.2 equations.

2.6.1 Estimated Charge Values

Each of the equations from AS2187.2 and presented below 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 January 2015 to February 2020 indicated that the average MIC (maximum instantaneous charge) value was 164 kg and the maximum MIC was 299 kg.

2.6.2 Air-Blast Overpressure

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

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

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 3.54 was adopted based on the average from historical monitoring data; 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:

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

2.6.3 Ground-Borne Vibration

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

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

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 524.71 was adopted based on the average from historical monitoring data; and
- **B** = a constant related to site and rock properties for estimation purposes, a value of 1.6 was adopted.

2.6.4 Flyrock

A Buffer Zone Assessment was prepared to understand the likely impacts of flyrock risk on existing and future quarry blasting operations (SKM, 2009).

Flyrock models were developed from basic trajectory theory coupled with a launch velocity determined from confinement parameters. The flyrock models assume that a continuous length of appropriate stemming material is loaded and that the burden consists of competent rock (i.e. does not consist of loose blocks or slabs).

The models are useful to assist in determining the size of the exclusion zone around a blast, which is discussed further in *Section 4.3.2* of this report.

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.

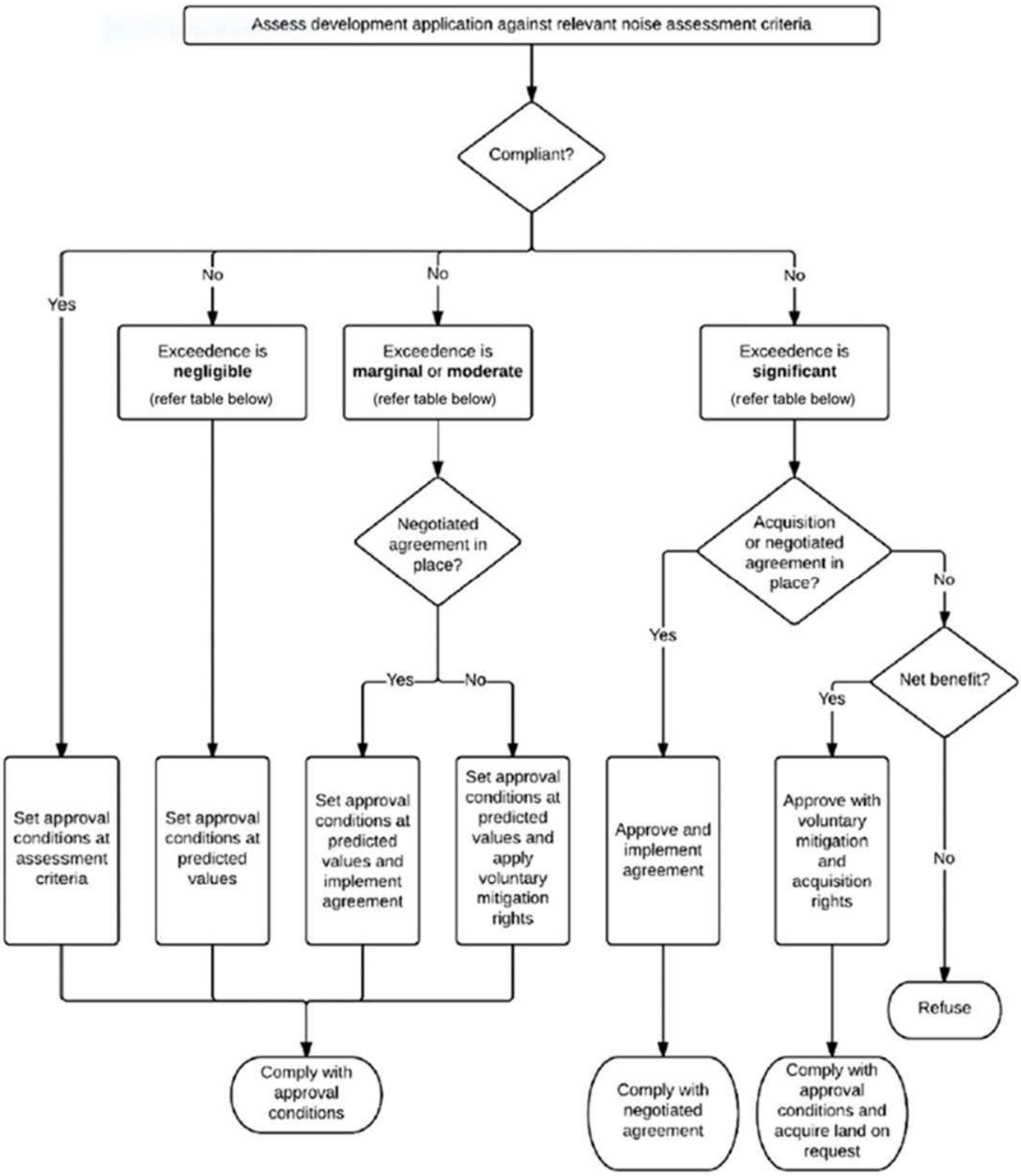

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Table 2.2 Characterisation of Noise Impacts & Potential Treatments

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	■ < 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.

Source: DP&E, 2018

2.9.1 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.

2.9.2 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

Key features, inputs and assumptions that have informed the noise modelling and assessment are reproduced or outlined in *Table 2.3* below.

The noise modelling and assessment conducted are of potentially “noisy” plant and equipment only. Non-noise generating plant/equipment does not form part of the noise modelling and assessment.

Further discussion regarding the effects of meteorological conditions is provided in *Section 2.11* as relevant to the assessment.

Table 2.3 Noise Modelling Features, Inputs and Assumptions

ID	Feature	Description
1	Noise modelling software	■ Brüel and Kjær's Predictor 7810 (Version 12) noise modelling software package was utilised to calculate noise levels using ISO 9613:2, 1996 noise propagation algorithms (international method for general purpose, 1/1 octaves). Meteorological corrections have been calculated via the CONCAWE method (*Report no. 4/18, The propagation of noise from petroleum and petrochemical complexes to neighbouring communities*, Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981). ■ The Predictor software package allowed 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. ■ Brüel and Kjær's Predictor 7810 (Version 12) software achieves the requirements of ISO 17534, 2015 as applicable to the ISO9613:2, 1996 calculative algorithm.
2	Construction and Operational Noise Level Predictions	■ Sound Power Level (LW, dBA) data incorporated into the Project-specific noise models was provided by Hanson, sourced from similar assessments, obtained from relevant Australian Standards or adapted from a proprietary source term database available at the time of the assessment. - This assessment has considered standard good-practice construction mitigation measures via noise modelling by adopting the AS2436, 2010 mid-point values for all sound power levels obtained from that standard. - LW data for existing operations and the existing equipment on site was determined through measured values from a site visit in November 2017. The existing operational noise model was then validated through additional measurements around the site boundary from a site visit in July 2020. Predictions at Site boundary were within 1 dBA of measured values. ■ 3D elevation, zoning and cadastre spatial data were obtained from the *NSW Government - Land and Property Information* (LPI). ■ Buildings near the project were included in the noise model based on this spatial data or manually digitised from aerial photography. Buildings within the project were included in the noise model based on plans provided for use in the assessment. ■ Potentially sensitive receptor locations were identified to assess noise impacts. These locations were selected to ensure the most affected points were evaluated. The receptor locations adopted for this assessment were shown in *Figure 1.3*, and are described further in *Table 3.1* of this report. ■ Noise levels were calculated at 1.5 metres m above ground level for all receptors, in accordance with the ICNG, 2009 and NPI, 2017 requirements. A ground factor of 0.8 was adopted for general modelling area, 0.0 is hard, 1.0 is soft.

ID	Feature	Description
2	Construction and Operational Noise Level Predictions *(Cont'd)*	■ In all cases, the noise has been assessed at the most-affected point at or within the residential property boundary or, if that is more than 30 metres from the property, at the most-affected point within 30 metres of the property. In assessing amenity noise levels at commercial or industrial premises, the noise level was assessed at the reasonably most-affected point on or within the property boundary. ■ To represent general construction emissions, capturing the size, layout and number of noise generating plant / equipment, "area sources" were utilised to predict $L_{eq,\ 15\ minute}$ noise levels in dBA. A separate area source was placed in the model for each phase of works, stage and activity to represent the distribution of noise across the broader project site. ■ For operational emissions, a combination of "point sources", "line sources" and "moving sources" were utilised with separate sources placed in the model for each key noise generating item of equipment. "Moving 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. ■ The construction and operational noise assessment scenarios and modelling data are summarised in *Sections 6* and *Section 7*. ■ All predicted noise level values have considered and applied the relevant ICNG, 2009 and NPI, 2017 modifying factors (penalties) for offensive noise characteristics (where applicable). ■ For road traffic noise, spreadsheet calculations were undertaken using the CoRTN calculative methods, as adapted to Australia conditions.
3	Meteorological Conditions	■ General meteorological conditions for the project-specific noise models included a temperature of 12.8°C (annual mean minimum), and humidity of 74% (annual mean for 9 AM statistics), representative of average conditions for the area. These temperature and humidity values were determined based on annual average weather data publically available from the Bureau of Meteorology (BOM) Weather Station situated at Port Macquarie Airport: - **Site number:** 060139; - **Location:** Latitude: 31.43° South / Longitude: 152.87° East; - **Elevation:** 4 metres. ■ The effects of noise-enhancing meteorological conditions, as applicable to the operational noise modelling and assessment, are described in *Section 2.10.1* below.

2.10.1 Noise Enhancing Meteorological Conditions

Noise enhancing 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.

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 (night) and westerly (evening and night) 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 (with reference to INP, 2000):

- **Daytime**: Calm wind conditions and a Pasquill–Gifford stability Category D, representing a neutral condition.
- **Evening**: 3 m/s wind condition for the westerly prevailing direction and Pasquill–Gifford stability Category D condition.
- **Night time (and morning shoulder)**: 2 m/s wind condition for the two prevailing directions and Pasquill–Gifford stability Category F, representing a temperature inversion.

For the construction noise model a Pasquill–Gifford stability Category D was adopted (representing a neutral condition) for all scenarios.

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 2.4* below) are achievable by using a combination of acoustic enclosures and suitable equipment selection/procurement i.e. with lower source emission values. This mitigation involves the following measures:

Boundary Mitigation:

- Earth Bunding (approximately 20 m in height and 450 m in length) is required along the southern boundary of the site to provide additional shielding from the processing plant and asphalt production plant. Note: Height and geology of earth bund to be finalised during detailed design, heights may be lower if processing and asphalt production plant areas have been levelled.

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 and impulsiveness.
- The key items of plant/equipment are presented in *Table 2.4*. The required LW reductions for these specific items of equipment/plant and the LW required to meet most stringent night time PSNL are presented in *Table 2.4*.
- Operational LW emissions should be at or below those presented in *Table 2.4* and *Table 7.1* of this report.

At Source Mitigation:

- Where LW values for plant/equipment outlined in *Table 2.4* are not reasonable or feasible, the operational design will incorporate acoustic enclosures/silencers to assist in reducing the noise emission of identified plant/equipment. Design of acoustic enclosures will also consider offensive noise characteristics as tonality and low frequency noise.

Table 2.4 below details the required LW 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.

Table 2.4 Lw mitigation required to meet most stringent PSNL

Equipment / Plant	Sound Power Level (Lw)	Reduction of Lw	Required/Mitigated Lw
Cone Crusher	111	12	99
Jaw Crusher	113	12	101
Barmac Crusher	101	10	91
Screens (1 to 4)	110	10	100
Blending Plant (Concrete Batch Plant)	106	10	96
Concrete Agitator (Concrete Batch Plant)	109	10	99
Concrete Pump (Concrete Batch Plant)	108	10	98
Bag House Fan (Asphalt Plant)	102	10	92

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*.

2.12 Consultation

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 2.5 Stakeholder Consultation

Relevant Stakeholder	Consultation Method	Response
Environment Protection Agency (EPA)	Letter advising that the EIS process is underway and the assessment will address the SEARs. Request for additional comments made.	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. 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.
Environment Protection Agency (EPA)	Email on 25 October 2019, inviting comments and recommending conditions in relation to proposed Sancrox Quarry Expansion Project (SSD 7293).	**Noise monitoring** 1. Justification for including data in the *Sancrox Quarry Expansion Noise and Vibration Impact Assessment, dated 28 August 2019, Environmental Resources Management Australia Pty Ltd, reference: 0418291_Final* (noise report) where wind speeds exceed 5 m/s. Alternatively the proponent could undertake further noise monitoring to record sufficient periods where wind speed is below 5m/s. The noise monitoring graphs in Annex E of the noise report appear to show that the measured wind speed at 10m was in excess of 5m/s for the majority of the monitoring period during the day period. The noise report states that the only measurements removed were when the wind speed at 10m was above 7m/s. 2. Explanation of how measurements and analysis of the noise monitoring data at monitoring location L02 accounted for extraneous

		noise affects in the evening and night periods and during the evening period at monitoring location L03. 3. Demonstration that the background noise monitoring was not influenced by existing operations at the premises. Table 7.2 of the noise report presents Leq,15min noise levels in excess of 40 dBA from the existing premises during the day period at a number of residential receivers. This indicates that the existing quarry has potential to influence the background noise levels at the nearest receivers. **Operational noise assessment criteria** 4. Information about the existing level of industrial noise during all assessment periods to appropriately derive the Project Specific Noise Levels (PSNL) and analyse the amenity level in the derivation of the PSNL. The assessment adopts the Industrial Noise Policy (INP) intrusiveness criteria. However, the INP requires that the most stringent level between the amenity and intrusiveness should be used. The quarry is situated in a location where there are existing and planned industrial developments. The INP requires the existing industrial noise levels in the area are determined in order to inform the project specific amenity level. Attended noise monitoring was not carried out during the evening and night periods and the noise report has not described the existing noise environment or quantified sources during the most sensitive periods of the proposed operation. Based on the current information in the report, it is not possible to determine if sole use of the intrusiveness criteria is appropriate. INP methodology requires the more stringent of the intrusiveness and amenity criteria be adopted as the PSNLs. **Noise modelling** 5. Explanation of how the specific meteorological conditions have been modelled. Meteorology conditions for the report's noise predictions were derived using the INP method. Specifically, calm conditions, G-class temperature inversions and specific wind speeds and directions have been stated in Chapter 2.10 as being modelled. Chapter 5 of ISO 9613-2 defines the meteorological conditions which apply to the standard. Some of the meteorological conditions used in the noise report appear to be outside of these conditions. 6. Validate the noise model to demonstrate that it is capable of predicting noise levels to a reasonable level of accuracy. The validation should compare measured noise levels with predicted levels of the same operating scenario(s) at reference points. 7. Provide a reference or other information to support the use of the assumed sound power level (SWL). The SPL of the CAT 980H loader is 105 dBA in Table 7.1. The EPA considers this low when compared to other data available in the public domain for this type of loader. **Noise modifying factor adjustments** 8. Assessment of modifying factors against the Noise Policy for Industry (NPfI) Fact Sheet C and adjustment at the receiver, based on the total noise level from the premises to be consistent with EPA Policies. Item 8 of the EPA's Transitional arrangements for the NPfI Fact Sheet C replaces INP Chapter 4 for modifying factors where the INP is referenced in existing statutory documents. The noise report repeatedly refers to applying penalties for annoying characteristics to the sound power level or sound source. However, the analysis and any applicable penalty for modifying factors is performed on the total noise emission level at the receiver, not the source or sound power level. **Noise mitigation measures** 9. Details of how noise mitigation measures will be achieved and implemented, and which items of plant can meet its sound power level requirements. **Blasting** 10. Justification of the approach not to use existing blast monitoring data to inform the assessment. The assessment relied on generic assumptions to calculate the blast over-pressure and ground vibration. The quarry is an existing operation that conducts regular blasting. Therefore, it is expected that existing blasting data would be used in the assessment. **Construction assessment** 11. Reassessment of any penalties to predicted noise levels using the Interim Construction Noise Guideline (ICNG). A note to Table 6.1 indicates that an INP penalty for annoying characteristics has been applied to the SWL of a noise source. However, there is no requirement in the ICNG to apply corrections for annoying characteristics from the INP. The ICNG does nominate a 5 dB

		penalty to the predicted level (i.e. not at the source) for certain activities on page 16 of the ICNG. 12. Inclusion of building the noise bunds in the construction noise assessment. The noise mitigation measures include very large bunds on the property boundary. The construction of these bunds is likely to temporarily increase noise levels and needs to be accounted for in the construction noise assessment. **Road traffic noise assessment** 13. Consideration of total traffic noise levels caused by the project, providing justification and evidence for the existing traffic noise levels. This should: a. consider both light and heavy vehicle movements generated by the quarry. b. provide the calculation method and detail the inputs and assumptions used to calculate the predicted road traffic noise. c. identify the roads considered in the assessment and identify which are the closest and most potentially affected receivers adjacent to these roads. d. address impacts of vehicle movements on public roads generated by the proposal during the night period. The project will generate traffic. The report has assumed that the existing traffic noise level is 5 dB below the RNP criteria, but provided no evidence that this is an appropriate assumption. Chapter 7.4 of the noise report states that there will be no road traffic noise movements during the shoulder or night period. However, in Chapter 7.3 of the noise report, night time truck movements have been included in the assessment. Chapter 12 of the EIS also includes references to trucks operating at night.
Department of Planning, Industry and Environment (DP&IE)	The Public Exhibition of the EIS (concluded on 11 December 2019).	The EPAs submission has identified departures from the INP procedures including the: 1. Collection of background noise data 2. Use of noise data collected under excluded meteorological conditions of high winds 3. Lack of attended noise measurements in the evening and night periods 4. Collection of noise data free of any contribution of the existing operations 5. Demonstration that the more stringent amenity criterion has been applied 6. Validation of the noise model to demonstrate that its predictions are reasonably accurate 7. Justification of the assumed sound power levels for mobile equipment used in noise modelling for the proposal The department strongly supports the EPAs request that details be provided for how noise mitigation measures will be achieved and implemented, and which items of equipment can meet their sound power level requirements. Please provide an assessment of the noise impacts that will be generated during the construction of the proposed noise mitigation bunds. Several community submission have raised concerns about the management of flyrock and vibration from the proposed blasting activities. Please provide further consideration of impact zones, road closure procedures and predicted impacts on local residences, industrial lands, the Pacific Motorway and the winery to the east of the Motorway.

3. EXISTING CONDITIONS

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*

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.

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 (Appendix 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.

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.

3.3.1.1 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.

3.3.1.2 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. Erroneous data was also manually excluded prior to 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 5 m/s (at 10 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.

3.3.1.3 Operator Attended Noise Measurements

Short-term operator attended noise measurements were conducted during the day time period at eight locations around the site on Monday, 6 November; Tuesday, 7 November and Wednesday 22 November 2017, identified as A1 to A8 in *Figure 1.3*. These locations were selected whilst in the vicinity of the project site to better understand the broader acoustical environment.

Additional short-term operator attended noise measurements were conducted during the evening and night time periods at the same locations (with exception to A8 which was substituted with A9) around the site on Monday, 20 July and Tuesday, 21 July 2020, identified as A1 to A9 in *Figure 1.3*. This additional monitoring was undertaken to confirm background noise levels in response to EPA comments (dated December 2019).

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}, L_1, L_{10} and L_{90} values captured as a minimum.

3.3.2 Unattended Noise Logging Results

The measured daily and overall, ambient (L_{eq}) and background (L_{90}) 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. All noise levels are dBA re 2 x 10^{-5} Pa. Summary RBL parameters are rounded to the nearest whole decibel (dB).

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. L_{90} 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 *Appendix E* of this report. The noise logging charts also present which data points have been excluded due to weather or manual exclusion.

Table 3.2 Unattended Environmental Noise Logging (L1)

Date	Measured Existing Noise Levels					
	ABL Day	ABL Evening	ABL Night	Leq Day	Leq Evening	Leq Night
Monday-6-Nov-17	-	38	36	-	52	44
Tuesday-7-Nov-17	39	37	34	47	43	42
Wednesday-8-Nov-17	37	36	33	47	45	44
Thursday-9-Nov-17	38	38	34	46	45	44
Friday-10-Nov-17	40	37	32	47	45	43
Saturday-11-Nov-17	38	34	29	47	44	43
Sunday-12-Nov-17	34	34	28	45	46	44
Monday-13-Nov-17	35	37	32	46	44	43
Tuesday-14-Nov-17	37	36	33	46	45	43
Wednesday-15-Nov-17	37	35	32	46	46	44
Thursday-16-Nov-17	39	35	32	46	54	43
Friday-17-Nov-17	37	35	30	46	48	43
Saturday-18-Nov-17	35	36	33	45	49	52
Sunday-19-Nov-17	38	37	35	47	50	44
Summary RBL Values	**37**	**36**	**32**	**46**	**48**	**45**

1. '-' indicates periods with too few valid samples due to weather or logger operation.
2. Excluded data is has been highlighted in the noise logging charts in *Appendix E*.

Table 3.3 Unattended Environmental Noise Logging (L2)

Date	Measured Existing Noise Levels					
	ABL Day	ABL Evening	ABL Night	Leq Day	Leq Evening	Leq Night
Tuesday-7-Nov-17	-	37	32	-	55	42
Wednesday-8-Nov-17	33	38	31	45	51	41
Thursday-9-Nov-17	35	40	30	43	50	42
Friday-10-Nov-17	36	35	30	45	51	40
Saturday-11-Nov-17	35	35	30	46	49	43
Sunday-12-Nov-17	35	33	30	54	50	42
Monday-13-Nov-17	32	42	33	48	53	45
Tuesday-14-Nov-17	35	40	34	44	50	44
Wednesday-15-Nov-17	38	37	35	45	52	44
Thursday-16-Nov-17	40	38	35	47	52	46
Friday-17-Nov-17	38	42	33	45	51	47
Saturday-18-Nov-17	35	46	35	47	53	48
Sunday-19-Nov-17	37	42	35	57	55	50
Monday-20-Nov-17	37	36	39	46	54	52
Tuesday-21-Nov-17	-	-	-	48	-	-
Summary RBL Values	**35**	**35**[2]	**33**	**49**	**52**	**46**

1. '-' indicates periods with too few valid samples due to weather or logger operation.
2. 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.
3. Excluded data is has been highlighted in the noise logging charts in *Appendix E*.

Table 3.4 Unattended Environmental Noise Logging (L3)

Date	Measured Existing Noise Levels					
	ABL Day	ABL Evening	ABL Night	Leq Day	Leq Evening	Leq Night
Monday-6-Nov-17	-	41	36	-	48	46
Tuesday-7-Nov-17	39	38	34	49	43	45
Wednesday-8-Nov-17	42	38	35	51	45	44
Thursday-9-Nov-17	41	40	36	48	45	46
Friday-10-Nov-17	41	38	33	47	48	45
Saturday-11-Nov-17	41	37	30	50	44	46
Sunday-12-Nov-17	40	40	30	48	49	45
Monday-13-Nov-17	38	38	33	53	45	46
Tuesday-14-Nov-17	40	39	36	52	50	47
Wednesday-15-Nov-17	39	38	37	49	53	47
Thursday-16-Nov-17	43	39	36	49	54	46
Friday-17-Nov-17	43	39	34	52	50	44
Saturday-18-Nov-17	37	37	33	48	54	44
Sunday-19-Nov-17	40	38	36	48	53.3	44
Monday-20-Nov-17	41	38	38	63	57	45
Tuesday-21-Nov-17	41	-	-	48	-	-
Summary RBL Values	**41**	**38**	**35**	**54**	**51**	**46**

1. '-' indicates periods with too few valid samples due to weather or logger operation.
2. Excluded data is has been highlighted in the noise logging charts in *Appendix E.*

Table 3.5 Unattended Environmental Noise Logging (L4)

Date	Measured Existing Noise Levels					
	ABL Day	ABL Evening	ABL Night	Leq Day	Leq Evening	Leq Night
Monday-6-Nov-17	-	45	39	-	53	50
Tuesday-7-Nov-17	45	44	40	50	49	50
Wednesday-8-Nov-17	45	42	42	51	49	51
Thursday-9-Nov-17	46	42	44	51	49	52
Friday-10-Nov-17	44	42	39	50	50	50
Saturday-11-Nov-17	45	38	34	51	50	48
Sunday-12-Nov-17	39	37	35	48	52	48
Monday-13-Nov-17	39	43	41	48	50	49
Tuesday-14-Nov-17	42	40	41	49	53	50
Wednesday-15-Nov-17	40	40	41	48	51	51
Thursday-16-Nov-17	42	41	41	49	53	48
Friday-17-Nov-17	40	44	42	46	53	51
Saturday-18-Nov-17	42	38	39	47	55	47
Sunday-19-Nov-17	41	39	46	47	54	51
Monday-20-Nov-17	43	44	-	49	55	50
Summary RBL Values	**42**	**42**	**41**	**49**	**52**	**50**

1. '-' indicates periods with too few valid samples due to weather or logger operation.
2. Excluded data is has been highlighted in the noise logging charts in *Appendix E.*

Discussion

The results of the noise logging at the four locations (L1 to L4) are considered representative of the surrounding noise environment. The results of the continuous unattended noise logging show levels typical of rural receptors in close proximity to the Pacific Highway during the daytime, evening and night-time. The dominant noise source contributing to the RBLs was observed to be the Pacific Highway traffic, wind-blown vegetation, some local traffic, birds and insects. The site noise was inaudible at the monitoring locations during installation, demobilisation and attended measurements. It should be noted that the operational hours of the quarry during noise logging and attended monitoring was 7am to 3pm, i.e. the site did not operate during the evening and night time periods.

The RBLs adopted for this assessment were also compared to the Sancrox RBLs from noise logging in the SLR (2016) *Pacific Highway Upgrade – Oxley Highway to Kundabung Operational Noise Management* report. In all cases it is apparent that RBLs of the Sancrox area are heavily influenced by the Pacific Highway traffic noise. As the noise logging locations adopted for this assessment were further from the highway than locations in the SLR, 2016 report, the RBLs presented here are lower, however they are considered representative of the receptors identified for the assessment.

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

ID	Date	Start time	Assess. Period	Measured Noise Levels, dBA						Estimated Site Noise (Leq, 15 min)
				LAmax	LAmin	LAeq	LA1	LA10	LA90	
A1	7/11/2017	10:30	Day	66	40	49	60	52	41	Site Inaudible
A1	20/07/2020	18:42	Evening	75	35	53	67	46	40	Site Inaudible
A1	20/07/2020	23:20	Night	59	30	36	41	38	33	Site Inaudible
A1	21/07/2020	8:45	Day	75	39	56	70	58	42	Site Inaudible
A2	7/11/2017	11:00	Day	84	37	55	61	49	40	Site Inaudible
A2	20/07/2020	19:08	Evening	73	36	46	55	45	39	Site Inaudible
A2	20/07/2020	23:40	Night	56	35	40	44	42	38	Site Inaudible
A2	21/07/2020	9:04	Day	79	39	53	61	53	41	Site Inaudible
A3	7/11/2017	11:30	Day	83	41	60	74	55	43	Site Inaudible
A3	20/07/2020	19:45	Evening	78	32	60	71	62	39	Site Inaudible
A3	21/07/2020	6:23	Morning Sh.	86	41	65	77	67	43	Site Inaudible
A3	21/07/2020	9:43	Day	86	41	64	77	67	45	35
A4	7/11/2017	12:00	Day	75	40	54	66	56	44	Site Inaudible
A4	20/07/2020	20:05	Evening	78	43	53	58	54	47	Site Inaudible
A4	20/07/2020	22:17	Night	60	37	52	58	55	44	Site Inaudible
A4	21/07/2020	10:02	Day	78	43	55	67	52	47	39
A5	6/11/2017	16:00	Day	57	41	47	54	50	43	Site Inaudible
A5	22/11/2017	13:45	Day	62	40	46	53	48	42	Site Inaudible
A5	20/07/2020	19:27	Evening	78	37	50	57	48	40	Site Inaudible
A5	20/07/2020	23:58	Night	75	32	47	53	38	34	Site Inaudible
A5	21/07/2020	9:23	Day	78	34	56	71	55	37	Site Inaudible
A6	7/11/2017	10:00	Day	64	35	46	55	47	38	Site Inaudible

ID	Date	Start time	Assess. Period	Measured Noise Levels, dBA						Estimated Site Noise (Leq, 15 min)
				LAmax	LAmin	LAeq	LA1	LA10	LA90	
A6	22/11/2017	13:00	Day	60	36	43	53	46	38	Site Inaudible
A6	20/07/2020	18:26	Evening	62	40	43	46	43	41	Site Inaudible
A6	20/07/2020	23:01	Night	63	30	37	44	37	32	Site Inaudible
A6	21/07/2020	8:25	Day	69	38	46	58	46	39	Site Inaudible
A7	7/11/2017	13:15	Day	63	44	52	58	55	48	Site Inaudible
A7	22/11/2017	12:00	Day	63	32	42	53	45	36	Site Inaudible
A7	20/07/2020	18:00	Evening	64	42	51	56	54	45	Site Inaudible
A7	20/07/2020	22:40	Night	63	41	51	57	55	44	Site Inaudible
A7	21/07/2020	8:02	Day	63	45	50	54	52	47	Site Inaudible
A8	22/11/2017	11:00	Day	58	36	42	47	44	39	Site Inaudible
A9	20/07/2020	20:25	Evening	66	41	50	55	52	45	Site Inaudible
A9	20/07/2020	22:00	Night	75	42	52	58	53	47	Site Inaudible
A9	21/07/2020	10:20	Day	79	41	53	64	49	43	Site Inaudible

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 in November 2017 and July 2020.

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 background noise levels presented in *Table 3.6* vary significantly, with background noise levels for daytime ranging between 36 and 48 dBA, evening ranging between 39 and 47 dBA and night time ranging between 32 and 47 dBA. This variation in measured noise levels was observed to be related to the proximity to the Pacific Highway. Most measurements were dominated by Pacific Highway traffic, wind-blown vegetation, some local traffic, birds and insects. Site noise was inaudible or barely audible for the majority of measurements. It should be noted that the operational hours of the quarry during noise logging and attended monitoring was 7am to 3pm, i.e. the site did not operate during the evening and night time periods.

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. As outlined in the monitoring discussions above, RBLs derived from logging data were not impacted by existing quarry operations.

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.

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.

Table 3.7 Rating Background Noise Levels

Receptor Location ID	Representative Noise Logger	Rating Background Noise Levels (RBL)			
		Day	Evening	Night	Morning Shoulder
13	L01	37	36	32	34
14	L01	37	36	32	34
1	L01	37	36	32	34
16	L01	37	36	32	34
2	L01	37	36	32	34
17	L01	37	36	32	34
4	L01	37	36	32	34
18	L02	35	35	33	34
19	L02	35	35	33	34
24	L02	35	35	33	34
20	L02	35	35	33	34
6	L02	35	35	33	34
30	L02	35	35	33	34
11	L03	41	38	35	38
48	L03	41	38	35	38
33	L04	42	42	41	41
38	L04	42	42	41	41
7	L04	42	42	41	41
47	L04	42	42	41	41
34	L04	42	42	41	41
35	L04	42	42	41	41
8	L03	41	38	35	38
46	L03	41	38	35	38
9	L03	41	38	35	38
10	L03	41	38	35	38

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;
   Night time is all remaining periods;
   The morning shoulder period is within the night time period, specifically between 5am and 7am.

4. NOISE MANAGEMENT LEVELS AND CRITERIA

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 $L_{eq,\ 15\ minute} \leq 75$ dBA.

The sleep disturbance criteria of RBL + 15 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 reply 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	47	42	41	37	39	47	49
14	Residential	47	42	41	37	39	47	49
1	Residential	47	42	41	37	39	47	49
16	Residential	47	42	41	37	39	47	49
2	Residential	47	42	41	37	39	47	49
17	Residential	47	42	41	37	39	47	49
4	Residential	47	42	41	37	39	47	49
18	Residential	45	40	40	38	39	48	49
19	Residential	45	40	40	38	39	48	49
24	Residential	45	40	40	38	39	48	49
20	Residential	45	40	40	38	39	48	49
6	Residential	45	40	40	38	39	48	49
30	Residential	45	40	40	38	39	48	49
11	Residential	51	46	43	40	43	50	53
48	Potential Future Industrial	75	75	75	75	75	-	-
33	Residential	52	47	47	46	46	56	56
38	Residential	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	52	47	47	46	46	56	56
35	Residential	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. $L_{eq,\ 15\ minute}$ noise level in dBA.
2. L_{max} noise level in dBA.
3. The HNAML ($L_{eq,\ 15\ minute} \leq 75$ dBA) applies to all residential receptors.

4.2 Construction and Operational Road Traffic Noise Criteria

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	Intrusiveness Noise Level ($L_{eq\ 15\ minute}$ in dBA)				Acceptable Amenity Noise Level ($L_{eq\ 15\ minute}$ in dBA)				Project-Specific Noise Level (PSNL) ($L_{eq\ 15\ minute}$ in dBA)				Sleep Disturbance Criteria (dBA)	
		Day	Evening	Night	Morning Shoulder	Day	Evening	Night	Morning Shoulder	Day	Evening	Night	Morning Shoulder	Night	Morning Shoulder
13	Residential	42	41	37	39	50	45	40	45	42	41	37	39	47	49
14	Residential	42	41	37	39	50	45	40	45	42	41	37	39	47	49
1	Residential	42	41	37	39	50	45	40	45	42	41	37	39	47	49
16	Residential	42	41	37	39	50	45	40	45	42	41	37	39	47	49
2	Residential	42	41	37	39	50	45	40	45	42	41	37	39	47	49
17	Residential	42	41	37	39	50	45	40	45	42	41	37	39	47	49
4	Residential	42	41	37	39	50	45	40	45	42	41	37	39	47	49
18	Residential	40	40	38	39	50	45	40	45	40	40	38	39	48	49
19	Residential	40	40	38	39	50	45	40	45	40	40	38	39	48	49
24	Residential	40	40	38	39	50	45	40	45	40	40	38	39	48	49
20	Residential	40	40	38	39	50	45	40	45	40	40	38	39	48	49
6	Residential	40	40	38	39	50	45	40	45	40	40	38	39	48	49
30	Residential	40	40	38	39	50	45	40	45	40	40	38	39	48	49
11	Residential	46	43	40	43	50	45	40	45	46	43	40	43	50	53
48	Pot. Future Industrial	--	--	--	--	70	70	70	70	70	70	70	70	-	-
33	Residential	47	47	46	46	50	45	40	45	47	45	40	45	56	56
38	Residential	47	47	46	46	50	45	40	45	47	45	40	45	56	56
7	Commercial	--	--	--	--	65	65	65	65	65	65	65	65	-	-
47	Pot. Future Industrial	--	--	--	--	70	70	70	70	70	70	70	70	-	-
34	Residential	47	47	46	46	50	45	40	45	47	45	40	45	56	56
35	Residential	47	47	46	46	50	45	40	45	47	45	40	45	56	56
8	Industrial	--	--	--	--	70	70	70	70	70	70	70	70	-	-
46	Commercial	--	--	--	--	65	65	65	65	65	65	65	65	-	-
9	Industrial	--	--	--	--	70	70	70	70	70	70	70	70	-	-
10	Industrial	--	--	--	--	70	70	70	70	70	70	70	70	-	-

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*.

4.3.2.1 Air Blast Overpressure

The air blast overpressure should not exceed 115 dBZ (Lpeak) 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 (Lpeak) at any time. The dBZ (Lpeak) 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%

4.3.2.2 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%

4.3.2.3 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.

4.3.2.4 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.

4.3.2.5 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*.

4.3.2.6 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.

The purpose of the flyrock buffer zone is to protect people and property from the possible impact of flyrock. The size of the buffer zone and blasting practice depend on the following factors:

- Containment of flyrock within the quarry boundary (Safety Factor = 1.0), but may sometimes project beyond the boundary.
- Permission of flyrock to be projected onto adjacent land, but not so far as to present a risk to people (Safety Factor = 4.0) ; this circumstance requires the permission of adjoining landowners.
- Ensure that flyrock does not to leave the quarry property under any circumstances; this situation applies if agreement cannot be reached with the adjoining landowner(s).

Hanson will continue to apply the above points and measures outlined in *Section 8* during blast design and management, to ensure an adequate buffer zone is in place prior to every blast.

4.3.2.7 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.

5. QUALITATIVE ASSESSMENTS

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. 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.

5.2 Vibration – Construction and Operation

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 ≥ 100m 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.

5.3 Ground-Borne Noise – Construction and Operation

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. CONSTRUCTION NOISE 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.
- Construction of Earth Bund.

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. The detailed noise modelling data and assessment scenarios are provided in *Appendix F.*

Table 6.1 Construction Noise Assessment Scenarios

Scenario	Description	Equipment	Quantity	Sound Power Level (Lw)
SCN01	Demolition of Existing Structures	Excavator (approx. 20 tonne)	2	105
		Excavator (approx. 40 tonne)	1	115
		Generator	1	99
		Jackhammer	1	113
		Front end loader	1	113
		Light Vehicle (idle)	6	95
		Heavy Vehicle (idle)	6	107
		Light Vehicle (moving)	6	95
		Heavy Vehicle (moving)	6	107
SCN02 a/b	Site Preparation and Establishment a) Concrete Batching Plant b) Processing Plant & Asphalt Production Plant	Excavator (approx. 20 tonne)	1	105
		Excavator (approx. 30 tonne)	1	110
		Concrete agitator truck	1	109
		Concrete pencil vibrator	1	103
		Concrete pump truck	1	108
		Scraper	1	116
		Roller	1	108
		Grader	1	110
		Light Vehicle (idle)	6	95
		Heavy Vehicle (idle)	6	107
		Light Vehicle (moving)	6	95
		Heavy Vehicle (moving)	6	107

Scenario	Description	Equipment	Quantity	Sound Power Level (Lw)
SCN03 a/b	General Construction of Infrastructure a) Concrete Batching Plant b) Processing Plant & Asphalt Production Plant	Cherry Picker	1	105
		Crane (mobile)	1	104
		Hand tools (electric)	6	102
		Hand tools (pneumatic)	1	116
		Welder	2	105
		Light Vehicle (idle)	6	95
		Heavy Vehicle (idle)	6	107
		Light Vehicle (moving)	6	95
		Heavy Vehicle (moving)	6	107
SCN04	Construction of Earth Bund	Excavator (approx. 20 tonne)	2	105
		Excavator (approx. 40 tonne)	2	115
		Dump Truck	2	117
		Light Vehicle (idle)	3	95
		Heavy Vehicle (idle)	3	107
		Light Vehicle (moving)	3	95
		Heavy Vehicle (moving)	3	107
Lmax	Maximum Noise Level Assessment	Peak noise events (e.g. Metal on Metal Contact)	3	123

1. Detailed noise modelling data and assessment scenarios (including L_W references and spectral data) are provided in *Appendix F.*

6.2 Predicted Construction Noise Levels

Based on the construction assessment scenarios and L_W values identified in *Table 6.1,* $L_{eq,\ 15\ minute}$ noise levels in dBA have been predicted at all receptors (via modelling). Predicted values are presented in *Table 6.2* below.

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 were 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 SCN04, Lmax)

ID	Type	Daytime Standard Hours NML	Non-Standard Hours - NML				Sleep Disturbance NML		Predicted Noise levels, $L_{eq,\ 15\ minute}$ in dBA						
			Daytime	Evening	Night	Morning Shoulder	Night	Morning Shoulder	SCN01	SCN02a	SCN02b	SCN03a	SCN03b	SCN04	Lmax
13	Residential	47	42	41	37	39	47	49	40	40	56	34	50	54	57
14	Residential	47	42	41	37	39	47	49	47	46	54	39	47	50	54
1	Residential	47	42	41	37	39	47	49	43	43	49	36	43	46	49
16	Residential	47	42	41	37	39	47	49	45	44	52	38	45	48	52
2	Residential	47	42	41	37	39	47	49	43	43	50	36	43	47	50
17	Residential	47	42	41	37	39	47	49	43	43	51	37	44	48	51
4	Residential	47	42	41	37	39	47	49	43	43	52	36	46	48	52
18	Residential	45	40	40	38	39	48	49	30	31	35	26	29	31	36
19	Residential	45	40	40	38	39	48	49	34	37	42	31	36	39	43
24	Residential	45	40	40	38	39	48	49	36	37	38	31	32	36	39
20	Residential	45	40	40	38	39	48	49	29	31	40	26	33	25	33
6	Residential	45	40	40	38	39	48	49	36	38	29	31	23	27	40
30	Residential	45	40	40	38	39	48	49	39	40	31	34	25	29	40
11	Residential	51	46	43	40	43	50	53	45	45	38	39	32	35	46
48	Potential Future Industrial	75	75	75	75	75	-	-	58	64	43	58	37	37	66
33	Residential	52	47	47	46	46	56	56	46	47	39	40	33	37	47
38	Residential	52	47	47	46	46	56	56	45	45	39	38	33	37	46
7	Commercial	70	70	70	70	70	-	-	59	59	46	53	40	44	60
47	Potential Future Industrial	75	75	75	75	75	-	-	57	54	49	48	43	46	56
34	Residential	52	47	47	46	46	56	56	52	51	44	44	38	44	53
35	Residential	52	47	47	46	46	56	56	50	50	46	43	39	44	52
8	Industrial	75	75	75	75	75	-	-	54	53	50	46	44	46	55
46	Commercial	70	70	70	70	70	-	-	56	55	53	48	46	45	57
9	Industrial	75	75	75	75	75	-	-	52	51	49	44	43	44	54
10	Industrial	75	75	75	75	75	-	-	46	45	54	39	47	49	54

1. The HNAML (Leq, 15 minute ≤ 75 dBA) applies to all residential receptors.
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.
4. Predicted noise levels for SCN01, SCN02a and SCN02b are inclusive of a 5 dBA penalty (ICNG, 2009)

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 23 and 64 dBA for noise generating construction works and activities associated with the Project.
- The predicted L_{max} noise levels range between 33 and 66 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 potential future industrial receptors 48 and 47, generally the first row of receptors to the north and east 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 by up to 9 dBA are predicted at residential receptors (south of the Project) for works within the recommended standard hours of construction during SCN02b, SCN03b and SCN04.
- All predicted $L_{eq,\ 15\ minute}$ noise levels are below the daytime HNML value of $L_{eq,\ 15\ minute} \leq 75$ 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 Lmax 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*.

6.2.5 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.

6.3 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. OPERATIONAL NOISE ASSESSMENT

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.

Mitigation and management measures identified for the Project are outlined in *Section 8.2*. The detailed noise modelling data and assessment scenarios are provided in *Appendix F.*

Table 7.1 Operational Noise Assessment Scenarios

Scenario	Description	Equipment	Quantity	Sound Power Level (Lw)
Existing	Existing Operation of Quarry (7 am to 5 pm Monday to Friday, 7am to 1pm Saturday)	Front End Loader (FEL) - Komatsu WA500	1	110
		Front End Loader (FEL) - CAT980H	1	105
		Dump truck - CAT769C	1	112
		Cone Crusher	1	111
		Jaw Crusher	1	113
		Barmac VSI Crusher	1	101
		Excavator - Komatsu PC350LC	1	107
		Excavator - Komatsu PC400LC	1	114
		Screen	4	110
		Conveyors (LW/m)	14	75
		Conveyor Motor	14	87
		Conveyor Transfer Point	11	95
		Water Cart	1	103
		Truck and Dog	2	105
Stage 1 to Stage 4	Quarry Processing Plant, Asphalt Production Plant, and Equipment operating in new locations. (5 am to 10 pm, plus 20 nights per year)	Front End Loader (FEL) - Komatsu WA500	1	110
		Front End Loader (FEL) - CAT980H	1	105
		Dump truck - CAT769C	1	112
		Cone Crusher (w/ enclosure)[2]	1	99
		Jaw Crusher (w/ enclosure)[2]	1	101
		Barmac VSI Crusher (w/ enclosure)	1	91
		Excavator - Komatsu PC350LC	1	107
		Excavator - Komatsu PC400LC	1	114
		Screen (w/ enclosure)	4	100
		Conveyors (LW/m)	21	75
		Conveyor Motor	21	87
		Conveyor Transfer Point	14	95
		Water Cart	1	103
		Truck and Dog	2	105
		Pugmill	1	94

Scenario	Description	Equipment	Quantity	Sound Power Level (Lw)
	Concrete Batching Plant & Recycling Facility (5 am to 10 pm, plus 20 nights per year)	Blending Plant (w/ enclosure) [2]	1	96
		Concrete Truck	1	109
		Concrete Agitator (w/ enclosure) [2]	1	99
		Concrete Pump (w/ enclosure) [2]	1	98
		Conveyors (LW/m)	2	75
		Conveyor Motor	2	87
		Conveyor Transfer Point	1	95
		Water Supply Pump	1	97
	Asphalt Plant (5 am to 10 pm, plus 20 nights per year)	Bag House	1	96
		Bag House Fan (w/ enclosure/silencer) [2]	1	92
		Burner / Blower	1	91
		Conveyor Motor	1	88
		Drum and Drum Drive	1	89
Lmax	Maximum Noise Level Assessment	Peak noise events (e.g. Metal on Metal Contact)	4	123

1. Detailed noise modelling data and assessment scenarios (including Lw references and spectral data) are provided in *Appendix F*.
2. Mitigation has been applied for equipment noted.

7.2 Validation of Existing Operations

Existing operational noise from the Sancrox Quarry was modelled based on the equipment listed in *Table 7.1* above. This information was provided by Hanson and observed on site during noise monitoring. The existing operational noise model was validated via measurement by undertaking 15 minute operator attended noise measurements at the northern, eastern, southern and western site boundaries. The noise model was then adjusted to ensure the correct locations and operating activities of existing equipment on site. A comparison of the predicted noise levels against noise monitoring data is provided in *Table 7.2* below, refer *Figure 1.3* for these monitoring locations (V1 – V4). The predicted existing operational noise model was within 1 dBA of the estimated site noise level at each validation monitoring location.

Table 7.2 Existing Operations Validation Data

Monitoring ID	Location	Validation Measurement	Noise Model
		Site Noise Level $L_{eq,\ 15\ min}$ in dBA	Predicted $L_{eq,\ 15\ min}$ in dBA
V1	North Boundary	62	63
V2	East Boundary	67	66
V3	South Boundary	44	45
V4	West Boundary	50	51

7.3 Predicted Operational Noise Levels

Based on the operational assessment scenarios and LW values identified in *Table 7.1*, noise levels have been predicted at all receptors (via modelling), and compared to the PSNL. 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.

Predicted noise levels for each operational scenario are provided in *Table 7.3* for standard meteorological conditions. Predicted noise levels for each operational scenario during noise enhancing meteorological conditions are provided in *Table 7.4* to *Table 7.6*. Predicted L_{max} values are also provided for comparison to the sleep disturbance criteria. Compliance with the most stringent night time PSNL indicates that compliance is achieved with other PSNL.

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 7.3 Predicted Operational Noise Levels – All Scenarios (Standard Meteorological Conditions) including conceptual mitigation

ID	Type	Project-Specific Noise Level (PSNL) ($L_{eq\ 15\ minute}$ in dBA)				Sleep Disturbance Criteria (dBA)		Predicted Noise levels - $L_{eq,\ 15\ minute}$ / L_{max} in dBA					
		Day	Evening	Night	Morning Shoulder	Night	Morning Shoulder	Existing	Stage 1	Stage 2	Stage 3	Stage 4	Lmax
13	Residential	42	41	37	39	47	49	27	33	31	33	33	44
14	Residential	42	41	37	39	47	49	37	35	35	34	34	47
1	Residential	42	41	37	39	47	49	34	32	32	32	31	44
16	Residential	42	41	37	39	47	49	35	33	33	33	33	46
2	Residential	42	41	37	39	47	49	34	32	32	32	32	45
17	Residential	42	41	37	39	47	49	33	31	31	32	32	44
4	Residential	42	41	37	39	47	49	32	32	32	32	32	43
18	Residential	40	40	38	39	48	49	13	18	28	30	29	39
19	Residential	40	40	38	39	48	49	19	29	29	26	26	38
24	Residential	40	40	38	39	48	49	23	28	27	28	27	39
20	Residential	40	40	38	39	48	49	19	27	28	35	34	45
6	Residential	40	40	38	39	48	49	28	24	24	24	25	41
30	Residential	40	40	38	39	48	49	30	24	24	25	25	41
11	Residential	46	43	40	43	50	53	37	28	28	28	29	46
48	Potential Future Industrial	70	70	70	70	-	-	50	39	39	40	39	-
33	Residential	47	45	40	45	56	56	38	29	29	29	34	47
38	Residential	47	45	40	45	56	56	37	28	29	29	28	46
7	Commercial	65	65	65	65	-	-	50	38	38	38	38	-
47	Potential Future Industrial	70	70	70	70	-	-	47	41	41	41	41	-
34	Residential	47	45	40	45	56	56	44	34	34	35	34	52
35	Residential	47	45	40	45	56	56	42	34	34	34	34	51
8	Industrial	70	70	70	70	-	-	46	38	38	38	38	-
46	Commercial	65	65	65	65	-	-	48	42	42	42	42	-
9	Industrial	70	70	70	70	-	-	43	43	43	43	43	-
10	Industrial	70	70	70	70	-	-	37	39	39	39	39	-

1. $L_{eq,\ 15\ minute}$ 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 7.4 Predicted Operational Noise Levels – All Scenarios (Evening - Prevailing W Wind) including conceptual mitigation

ID	Type	Project-Specific Noise Level (PSNL) ($L_{eq\ 15\ minute}$ in dBA)				Sleep Disturbance Criteria (dBA)		Predicted Noise levels - $L_{eq,\ 15\ minute}$ / L_{max} in dBA				
		Day	Evening	Night	Morning Shoulder	Night	Morning Shoulder	Stage 1	Stage 2	Stage 3	Stage 4	Lmax
13	Residential	42	41	37	39	47	49	31	30	32	32	41
14	Residential	42	41	37	39	47	49	34	34	34	34	41
1	Residential	42	41	37	39	47	49	31	31	31	31	38
16	Residential	42	41	37	39	47	49	31	31	31	31	39
2	Residential	42	41	37	39	47	49	29	29	30	30	40
17	Residential	42	41	37	39	47	49	28	28	28	28	38
4	Residential	42	41	37	39	47	49	29	29	29	29	38
18	Residential	40	40	38	39	48	49	14	24	27	25	32
19	Residential	40	40	38	39	48	49	26	25	23	22	33
24	Residential	40	40	38	39	48	49	24	24	24	24	31
20	Residential	40	40	38	39	48	49	23	25	31	30	38
6	Residential	40	40	38	39	48	49	21	21	21	21	34
30	Residential	40	40	38	39	48	49	21	21	21	22	35
11	Residential	46	43	40	43	50	53	27	27	28	28	41
48	Potential Future Industrial	70	70	70	70	-	-	40	40	41	40	-
33	Residential	47	45	40	45	56	56	32	32	32	32	48
38	Residential	47	45	40	45	56	56	31	31	32	31	46
7	Commercial	65	65	65	65	-	-	41	41	41	40	-
47	Potential Future Industrial	70	70	70	70	-	-	42	42	42	42	-
34	Residential	47	45	40	45	56	56	37	37	38	37	53
35	Residential	47	45	40	45	56	56	37	37	37	37	52
8	Industrial	70	70	70	70	-	-	41	41	41	41	-
46	Commercial	65	65	65	65	-	-	44	44	44	44	-
9	Industrial	70	70	70	70	-	-	44	44	44	44	-
10	Industrial	70	70	70	70	-	-	40	40	40	40	-

1. $L_{eq,\ 15\ minute}$ 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 Operational Noise Levels – All Scenarios (Night - Prevailing NW Wind) including conceptual mitigation

ID	Type	Project-Specific Noise Level (PSNL) ($L_{eq,\ 15\ minute}$ in dBA)				Sleep Disturbance Criteria (dBA)		Predicted Noise levels - $L_{eq,\ 15\ minute}$ / L_{max} in dBA				
		Day	Evening	Night	Morning Shoulder	Night	Morning Shoulder	Stage 1	Stage 2	Stage 3	Stage 4	Lmax
13	Residential	42	41	37	39	47	49	35	33	35	35	44
14	Residential	42	41	37	39	47	49	37	37	37	37	47
1	Residential	42	41	37	39	47	49	34	34	35	34	45
16	Residential	42	41	37	39	47	49	36	36	36	36	46
2	Residential	42	41	37	39	47	49	35	35	35	35	45
17	Residential	42	41	37	39	47	49	34	34	34	34	45
4	Residential	42	41	37	39	47	49	35	35	35	35	43
18	Residential	40	40	38	39	48	49	21	31	33	32	39
19	Residential	40	40	38	39	48	49	29	29	27	27	37
24	Residential	40	40	38	39	48	49	28	27	28	27	35
20	Residential	40	40	38	39	48	49	27	28	35	34	42
6	Residential	40	40	38	39	48	49	24	24	24	25	38
30	Residential	40	40	38	39	48	49	24	24	25	25	38
11	Residential	46	43	40	43	50	53	28	28	28	29	44
48	Potential Future Industrial	70	70	70	70	-	-	40	40	41	40	-
33	Residential	47	45	40	45	56	56	32	32	32	32	48
38	Residential	47	45	40	45	56	56	31	31	32	31	46
7	Commercial	65	65	65	65	-	-	41	41	41	40	-
47	Potential Future Industrial	70	70	70	70	-	-	42	42	42	42	-
34	Residential	47	45	40	45	56	56	37	37	38	37	53
35	Residential	47	45	40	45	56	56	37	37	37	37	52
8	Industrial	70	70	70	70	-	-	41	41	41	41	-
46	Commercial	65	65	65	65	-	-	44	44	44	44	-
9	Industrial	70	70	70	70	-	-	45	45	45	45	-
10	Industrial	70	70	70	70	-	-	41	41	41	41	-

1. $L_{eq,\ 15\ minute}$ 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 7.6 Predicted Operational Noise Levels – All Scenarios (Night - Prevailing W Wind) including conceptual mitigation

ID	Type	Project-Specific Noise Level (PSNL) ($L_{eq,\ 15\ minute}$ in dBA)				Sleep Disturbance Criteria (dBA)		Predicted Noise levels - $L_{eq,\ 15\ minute}$ / L_{max} in dBA				
		Day	Evening	Night	Morning Shoulder	Night	Morning Shoulder	Stage 1	Stage 2	Stage 3	Stage 4	Lmax
13	Residential	42	41	37	39	47	49	34	32	34	34	44
14	Residential	42	41	37	39	47	49	36	36	36	36	44
1	Residential	42	41	37	39	47	49	34	34	34	34	42
16	Residential	42	41	37	39	47	49	34	34	34	35	43
2	Residential	42	41	37	39	47	49	33	33	34	34	42
17	Residential	42	41	37	39	47	49	31	32	32	32	42
4	Residential	42	41	37	39	47	49	32	32	33	33	40
18	Residential	40	40	38	39	48	49	18	28	30	29	36
19	Residential	40	40	38	39	48	49	29	29	26	26	37
24	Residential	40	40	38	39	48	49	28	27	28	27	35
20	Residential	40	40	38	39	48	49	27	28	35	34	42
6	Residential	40	40	38	39	48	49	24	24	24	25	38
30	Residential	40	40	38	39	48	49	24	25	25	25	38
11	Residential	46	43	40	43	50	53	30	30	30	31	44
48	Potential Future Industrial	70	70	70	70	-	-	40	40	41	40	-
33	Residential	47	45	40	45	56	56	32	32	32	32	48
38	Residential	47	45	40	45	56	56	31	31	32	31	46
7	Commercial	65	65	65	65	-	-	41	41	41	40	-
47	Potential Future Industrial	70	70	70	70	-	-	42	42	42	42	-
34	Residential	47	45	40	45	56	56	37	37	38	37	53
35	Residential	47	45	40	45	56	56	37	37	37	37	52
8	Industrial	70	70	70	70	-	-	41	41	41	41	-
46	Commercial	65	65	65	65	-	-	44	44	44	44	-
9	Industrial	70	70	70	70	-	-	45	45	45	45	-
10	Industrial	70	70	70	70	-	-	41	41	41	41	-

1. $L_{eq,\ 15\ minute}$ 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.

7.3.2 Summary of Results

The predicted noise levels presented in *Table 7.2* to *Table 7.5* identify the following:

- The predicted $L_{eq,\ 15\ minute}$ noise levels for existing operations range between 13 and 50 dBA for general operational noise associated with the quarry (7am to 5pm Monday to Friday, 7am to 1pm Saturday), during standard meteorological conditions.
- The predicted $L_{eq,\ 15\ minute}$ noise levels for future operations range between 14 and 45 dBA for general operational noise associated with the quarry (5am to 10pm, plus 20 nights per year i.e. 10pm to 5 am).
- The predicted L_{max} noise levels range between 31 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 meteorological conditions. The highest levels are generally associated with the worst-case north-westerly and westerly wind conditions during evening and night time and are experienced at receptors to the south of the site across all scenarios (stages of operation).
- 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*.

7.3.3 Discussion of Findings

Preliminary results with no mitigation measures 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 (described in *Section 2.10.2*) 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*.

Modifying factors (penalties) for annoying noise characteristics such as tonality and low frequency components etc. were considered as per the requirements of NPI, 2017. Based on the noise source data presented in this assessment and model outputs, penalties were not applied to the results in this assessment.

7.3.4 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.

7.4 Road Traffic – Operation

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 vehicle movements that the quarry could be expected to generate. Existing road traffic volumes have been adopted from the SLR (2016) *Pacific Highway Upgrade – Oxley Highway to Kundabung Operational Noise Management* report. Conservative estimates were also prepared to determine the likely maximum number of vehicle movements per hour (as described in the EIS), to assess against the road traffic noise criteria for local roads. This data is presented in *Table 7.7* below.

Table 7.7 Traffic Data Inputs

Description		Daytime		Night-time	
		Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Period Volumes		**Daytime (15hr)**		**Night-time (9hr)**	
Existing Traffic Volumes	Pacific Highway (Sancrox to Blackmans Pt)	6940	2240	1000	920
	Sancrox Overbridge (Frogs Rd)	3200	50	400	180
Proposed Project Traffic Volumes	Sancrox Quarry Vehicles	50	300	50	25
Peak Volumes		**Daytime Peak (1hr)**		**Night-time Peak (1hr)**	
Existing Traffic Volumes	Pacific Highway (Sancrox to Blackmans Pt)	1110	358	106	147
	Sancrox Overbridge (Frogs Rd)	512	8	64	29
Proposed Project Traffic Volumes	Sancrox Quarry Vehicles	25	25	25	12

1. Existing traffic hourly volumes were estimated based on 16% of period traffic volumes, as described in the EIS traffic assessment.

Assumed posted speed limits of 110 km/h for sub-arterial roads and 60 km/h for local roads, have been adopted to predict quarry road traffic noise levels for comparison to the RNP criteria i.e. $L_{eq,\ 15\ hour}$, $L_{eq,\ 9\ hour}$ and $L_{eq,\ 1\ hour}$.

Based on the distance offsets to nearby residential receptors and operational traffic routes, road traffic noise levels were predicted for the closest/ potentially most affected receptors. These receptors are Receptor 14 (~250m from Frogs Road) and Receptor 33 (~400m from the Pacific Hwy).

Although truck movements are anticipated to occur primarily in the daytime period, 8% 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 morning shoulder period between 5am and 7am. The predicted operational road traffic noise levels for local and sub-arterial roads are presented in *Table 7.8* and *Table 7.9* below.

Based on a comparison of predicted operational road traffic noise levels to the applicable RNP criteria, the resultant noise levels from additional project vehicles on public roads 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.

Table 7.8 Predicted Operational Road Traffic Noise Levels: Compliance/Change (Highway)

Road + Category	Receptor / Distance in Metres	Noise Criteria in dBA (RNP, 2011)	Predicted Leq, 15 hour Noise Level in dBA		
			Existing	Existing + Project	Change in Noise
Pacific Highway: freeway/arterial/sub-arterial road	Receptor 33 / ~400m	Daytime Leq, 15 hour ≤ 60 (external)	48.6	49.1	0.5
		Night time Leq, 9 hour ≤ 55 (external)	45.8	46.0	0.2

RNP, 2011 Assessment period definitions:
1. *Daytime: 7am to 10pm, seven days a week.*
2. *Night time is 10pm to 7am, seven days a week.*

Table 7.9 Predicted Operational Road Traffic Noise Levels: Compliance/Change (Local Roads)

Road + Category	Receptor / Distance in Metres	Noise Criteria in dBA (RNP, 2011)	Predicted Leq, 15 hour Noise Level in dBA		
			Existing	Existing + Project	Change in Noise
Sancrox Overbridge (Frogs Road): Local Roads	Receptor 14 / ~250m	Daytime Leq, 1 hour ≤ 55 (external)	42.8	44.6	1.8
		Night time Leq, 1 hour ≤ 50 (external)	40.5	42.0	1.5

RNP, 2011 Assessment period definitions:
1. *Daytime: 7am to 10pm, seven days a week.*
2. *Night time is 10pm to 7am, seven days a week.*

7.4.2 Summary of Results

The noise levels presented in *Table 7.8* and *Table 7.9* identify that:

- The introduction of Project operational road traffic on the Pacific Highway is predicted to increase daytime noise levels by up to 0.5 dBA, and increase night-time noise levels by up to 0.2 dBA. Despite this predicted noise level increase, road traffic emissions will remain compliant at receptors along the Pacific Highway.
- The introduction of Project operational road traffic on Frogs Road is predicted to increase daytime noise levels by up to 1.8 dBA, and increase night-time noise levels by up to 1.5 dBA. Despite this predicted noise level increase, road traffic emissions will remain compliant at receptors along the Frogs Road.

7.4.3 Discussion of Findings

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) 300 quarry related heavy vehicle movements could occur on sub-arterial roads during the daytime (a 15 hour assessment period) and b) approximately 25 movements during the night time (a nine hour assessment period) without a major risk of overall road traffic noise levels impacting receptors.

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 25 quarry related heavy vehicles movements could occur during the daytime and approximately 12 movements during the night time without a major risk of overall road traffic noise levels impacting receptors.

Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice and an increase of 2 dBA is hardly perceivable, if at all. Differences in noise levels are not considered substantial until around 5 dBA. The worst-case predicted noise level change identified in *Table 7.7* and *Table 7.8* are below this 2 dBA perceptibility threshold.

The introduction of the Project's operational traffic is unlikely to be perceptible, if at all. On this basis, no further recommendations for operational road traffic noise reducing mitigation, management measures, safeguards and/or provisions for monitoring are warranted or provided in this report.

7.5 Sleep Disturbance

It is important to consider potential sleep disturbance noise impacts associated with operational noise sources and operational road traffic. Impacts associated with road traffic noise are not anticipated for night time / morning shoulder periods and L_{max} noise levels from general quarry 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.

7.6 Blasting

7.6.1 Overpressure and Vibration

At the closest receptor (approximately 340m from potential blasting locations), blasting overpressure is predicted to comply with the 115 dBZ (Lpeak) 5% threshold for blasts with MIC (maximum instantaneous charge) value up to 270 kg. Blasting vibration is also predicted to comply with the 5 mm/s (PPV) 5% threshold for blasts with MIC value up to 270 kg.

It should be noted that individual blast design should be based on meeting the criteria rather than restrictions on MIC as the blast design includes a number of variables including location, aspect if near an open face etc. therefore these MIC calculations are provided as a guide. These variables are easily managed through good blasting practices and the implementation of a Blast Management Plan (BMP). Blasting overpressure and vibration emissions can vary significantly but are easily manageable. Any potential for impacts can be minimised such that adverse effects are fully avoided.

7.6.2 Flyrock

A Flyrock assessment of Sancrox blasting specifications was undertaken as part of the Buffer Zone Assessment (SKM, 2009), which predicted maximum flyrock distances in front of the face of 51.6 m for a 3.0 m burden and 83.0 m for a 2.5 m burden.

This information was used to determine a clearance zone from a blast, which takes into account the following safety factors:

- For plant, equipment: Safety Factor = 2.0 (i.e. flyrock should be limited to a maximum of half the distance to buildings)
- For personnel, and quarry boundaries accessible by people: Safety Factor = 4.0 (i.e. flyrock should be limited to a maximum of a quarter the distance to areas accessible to people.)

The recommended minimum clearance distance for current blasting practices is presented in *Table 7.10* below. On the basis of current blasting practices (Specification 1), a buffer distance of 246 m behind the face is required to achieve a Safety Factor of 4.0.

Table 7.10 Flyrock Throw and Clearance Distances for Current Practice

Direction of Blast	Blasting Specifications 1			Blasting Specifications 2		
	Max Throw (m)	Factor of Safety 2	Factor of Safety 4	Max Throw (m)	Factor of Safety 2	Factor of Safety 4
Front of Face	51.6	103	206	83	166	332
Behind face (angle = 5º)	41.5	83	166	74.1	148	296
Behind face (angle = 10º)	53.3	107	214	95.3	190	380
Behind face (angle = 14º)	61.6	23	246	110	220	440

Source: SKM, 2009
1. Specifications 1 includes burden of 3 m and stemming height of 2.5 m
2. Specifications 2 includes burden of 2.5 m and stemming height of 2 m

Current blasting practice may result in the flyrock throws outlined above in *Table 7.10*. Therefore in order to reduce the throw, a change of specification is necessary. As outlined in SKM, 2009 the parameters that can be changed are burden, stemming height and hole angle. If the quarry can be developed such that all blasts face away from the boundary, then stemming height and hole angle influence the maximum throw behind the face. The variation in maximum throw and recommended clearance distance behind a blast for variations in stemming height are listed in *Table 7.11* below.

Table 7.11 Maximum Throw and Minimum recommended clearance distances behind a blast

Stemming Height (m)	Hole Ange = 5°		Hole Ange = 10°	
	Max Throw (m)	Min Clearance (m) F.O.S = 4.0	Max Throw (m)	Min Clearance (m) F.O.S = 4.0
2.0	74	294	95	380
2.5	41	164	53	212
3.0	26	104	33	132
3.5	17	68	22	88
4.0	12	48	16	64
4.5	9	36	12	48

Source: SKM, 2009

The purpose of the flyrock buffer zone is to protect people and property from the possible impact of flyrock. Ideally flyrock should be contained within the quarry boundary and not be projected onto land owned by others. As outlined in SKM, 2009, in some cases an agreement may be reached with the adjoining landowner for the adjacent land to be included in the blasting safety zone.

The size of the buffer zone and blasting practice required depends on whether the object is to:

- ensure that flyrock is generally contained within the quarry boundary (Safety Factor = 1.0), but may sometimes project beyond the boundary.
- permit flyrock to be projected onto adjacent land, but not so far as to present a risk to people (Safety Factor = 4.0) ; this circumstance requires the permission of adjoining landowners.
- ensure that flyrock does not to leave the quarry property under any circumstances; this situation applies if agreement cannot bereached with the adjoining landowner.

Where it is not permitted for flyrock to leave the quarry under any circumstances, the stemming heights presented in *Table 7.12* are required to maintain a 4.0 Safety Factor at the boundary.

Table 7.12 Stemming height requirements to contain flyrock within the quarry boundary

Distance from boundary (m) 4 times Maximum Throw	Stemming Height (m)
20	6.2
30	5.3
40	4.8
50	4.4
60	4.1
70	3.8
80	3.6
90	3.5

Source: SKM, 2009

7.6.3 Assessment Outcomes

Based on the findings summarised above, suitable blasting overpressure, vibration and flyrock 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.

8. RECOMMENDATIONS

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. 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.
- Where unforeseen works will occur in close proximity 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. Where it is possible tonal motion alarms should be replaced with broadband “squashed duck” motion alarms.
- If 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 determined by excluding 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.

8.2 Operational (Quarry) Noise

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 20 m in height and 450 m in length) is required along the southern boundary of the site to provide additional shielding from the processing plant and asphalt production plant. Note: Height and geology of earth bund to be finalised during detailed design, heights may be lower if processing and asphalt production plant areas have been levelled.

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 and impulsiveness.
- The key items of plant/equipment are presented in *Section 2.10.2*. The required L_W reductions for these specific items of equipment/plant and the L_W required to meet most stringent night time PSNL are presented in *Table 2.4*.
- Operational L_W emissions should be at or below those presented in *Table 2.4* and *Table 7.1* of this report. Detailed noise modelling data (including L_W references and spectral data) are provided in *Appendix F*.

At Source Mitigation:

- Where L_W values for plant/equipment outlined in *Table 2.4* are not reasonable or feasible, the operational design will incorporate acoustic enclosures/silencers to assist in reducing the noise emission of identified plant/equipment. Design of acoustic enclosures will also consider offensive noise characteristics as tonality, low frequency noise.

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. Where it is possible tonal motion alarms should be replaced with broadband "squashed duck" motion alarms.
- 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 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 determined by excluding 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, Concrete Batching/Recycling 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. A Blast Management Plan (BMP) must be prepared to ensure the adequate design and management of blasting activities on site.

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.

8.3.1 Flyrock

In accordance with Australian Standard *AS 2187.2*, a BMP must be prepared to ensure the adequate design and management of blasting activities on site. Blasting practices at the quarry are to be undertaken in a manner that will:

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

The following blast design and management measures will continue to be considered and applied during quarry operations:

- Consideration of stemming height and hole angle during blast design;
- Ensure an adequate buffer distance between quarry activity and the proposed Sancrox developments is maintained (with the inclusion of impact mitigation measures);
- Sensible land use design should consider locating non-sensitive land uses within nearest development areas to the quarry irrespective of the results of this assessment; and
- Undertake blast monitoring during every blast events carried out in or on the premises.

Hanson will continue to utilise a BPM prepared for Sancrox Quarry to manage blasting during quarry operations, and will continue to update the BPM as required.

8.4 Potential Monitoring Options

8.4.1.1 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.

8.4.1.2 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.

8.4.1.3 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. L_{eq}, L_{min}, L_{max}, L_1, L_{10} and L_{90}) 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 ($L_{eq, 15\ minute}$) 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.

8.4.1.4 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.

8.4.1.5 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 ($L_{eq, 15\ minute}$ in dBA) to a) the predicted values, and b) the criteria presented in this report.

The same will occur if noise complaints are received. All site noise levels would be determined by excluding 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.

9. CONCLUSION

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.

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APPENDIX A STAGING AND LAYOUT


Quarry sump
Silt Retention Dam
Concrete Batching Plant & Recycling Facility
Three tier sediment treatment train
Pit Floor
Old Processing Plant (to be relocated)
New Processing Plant
New Asphalt Production Plant
New Stockpile Area
Water Holding Dam 1 (WHD1)
Existing Site Office, Weightbridge & Workshop
Water Holding Dam (WHD2)
Noise Bund
Legend
Existing Property Ownership
Lot Boundary
Haul Roads
Infrastructure
Road Network
Source:
Spatial Data: DFSI DCDB/DTDB 2017
Imagery Data: nearmap April 2020
Ancillary Infrastructure
F-A1
Drawing No: 0418291s_HRA_G002_R4.mxd
Sancrox Quarry Expansion Project
Hydrology Assessment Report
Date: 24/08/2020
Drawing Size: A4
Drawn By: GC
Reviewed By: ME
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 25 50m
N
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.
ERM

Legend

- Existing Property Ownership
- Lot Boundary
- Road Network
- Watercourses

Quarry Staging:

- Stage 1 (RL-30m)
- Stage 2 (RL-30m)
- Stage 3 (RL-30m)
- Stage 4 (RL-40m)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap April 2020

Quarry Staging

F-A2

Drawing No:	0418291s_EIS_G002_R3.mxd		Sancrox Quarry Expansion Project
Date:	24/08/2020	Drawing Size: A4	
Drawn By:	LT	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 100 200m

N

ERM

Legend

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- Road Network
- Watercourses

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- Stage 2 (RL-30m)
- Stage 3 (RL-30m)
- Stage 4 (RL-40m)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap April 2020

Quarry Staging

F-A2

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Date:	24/08/2020	Drawing Size: A4	
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Coordinate System: GDA 1994 MGA Zone 56

0 100 200m

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- Stage 4 (RL-40m)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap April 2020

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F-A2

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Quarry Staging

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ERM

Legend

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Quarry Staging

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0 100 200m

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ERM

APPENDIX 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 disturbance[1] 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.

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 20μPa 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.

[1] Copyright © 2011 Oxford University Press

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 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.
- the existing noise level will not add significantly to the overall dB level.

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 L_{A90} 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 L_{A90} or L_{Aeq} 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.
- **dBC** – 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 $L_{eq,\ 15min}$ noise descriptor simply refers to the L_{eq} 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. $L_{10,\ 15\ minute}$) as required.

- **L_{max} -** the absolute maximum noise level in a noise sample.
- **L_N -** the percentile sound pressure level exceeded for N % of the measurement period calculated by statistical analysis.
- **L_{10} -** the noise level exceeded for 10 % of the time. It is approximately the average of the maximum noise levels.
- **L_{90}** - 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 (L_W)** - 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 (L_P)** - 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 L_{A90} 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 L_{Aeq} 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 L_{A90} 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 propose 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.

B.2.2 Vibration Descriptors

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/s^2;
- **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/s^2 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.

APPENDIX C INP METHODOLOGY

NSW INP - Noise Impact Assessment Procedures

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.

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

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
2. The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

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 L_{Aeq} noise level from a new source should meet the conditions set out in Table 2.2 of the INP.

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 Affectation 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 affectation 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 Affectation 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.

INP - Application notes

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.

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.

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.

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.

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.

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.

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.

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.

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).

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.

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.

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.

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.

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.

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.

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'.

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 $L_{1,\ 1\ minute}$ not exceeding the $L_{90,\ 15\ minute}$ 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 $L_{1,\ 1\ minute}$, 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 $L_{1,\ 1\ minute}$ (in dBA) descriptor is meant to represent a maximum noise level measured under 'fast' time response. The EPA will accept analysis based on either $L_{1,\ 1\ minute}$ or L_{max} statistical parameters.

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).

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, though 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.

APPENDIX D ICNG METHODOLOGY

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.

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.

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.10.1 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	The noise-affected level represents the point above which there may be some community reaction to noise. ■ 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	■ The highly noise affected level represents the point above which there may be strong community reaction to noise.

Time of Day	Management Level	How to Apply
	75 dBA	■ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: ■ 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. ■ 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	■ 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.

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.10.2 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.

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:

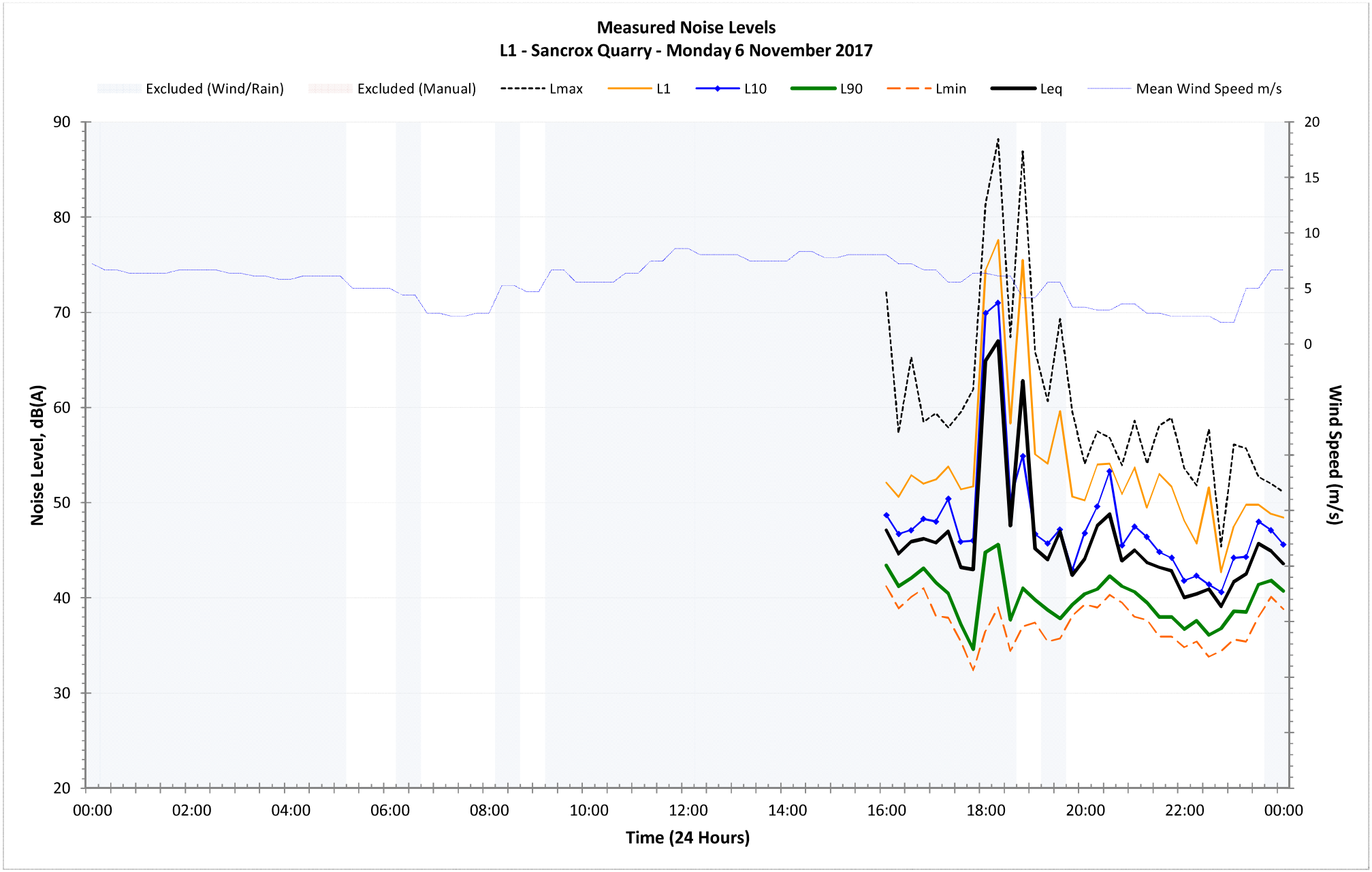
- Industrial premises: external $L_{eq,\ 15\ minute} \leq 75$ dBA.
- Offices, retail outlets: external $L_{eq,\ 15\ minute} \leq 70$ dBA.

Other businesses that may be very sensitive to noise, where the noise level is project specific as discussed in the ICNG.

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.

APPENDIX E UNATTENDED NOISE LOGGING CHARTS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Mean Wind Speed m/s
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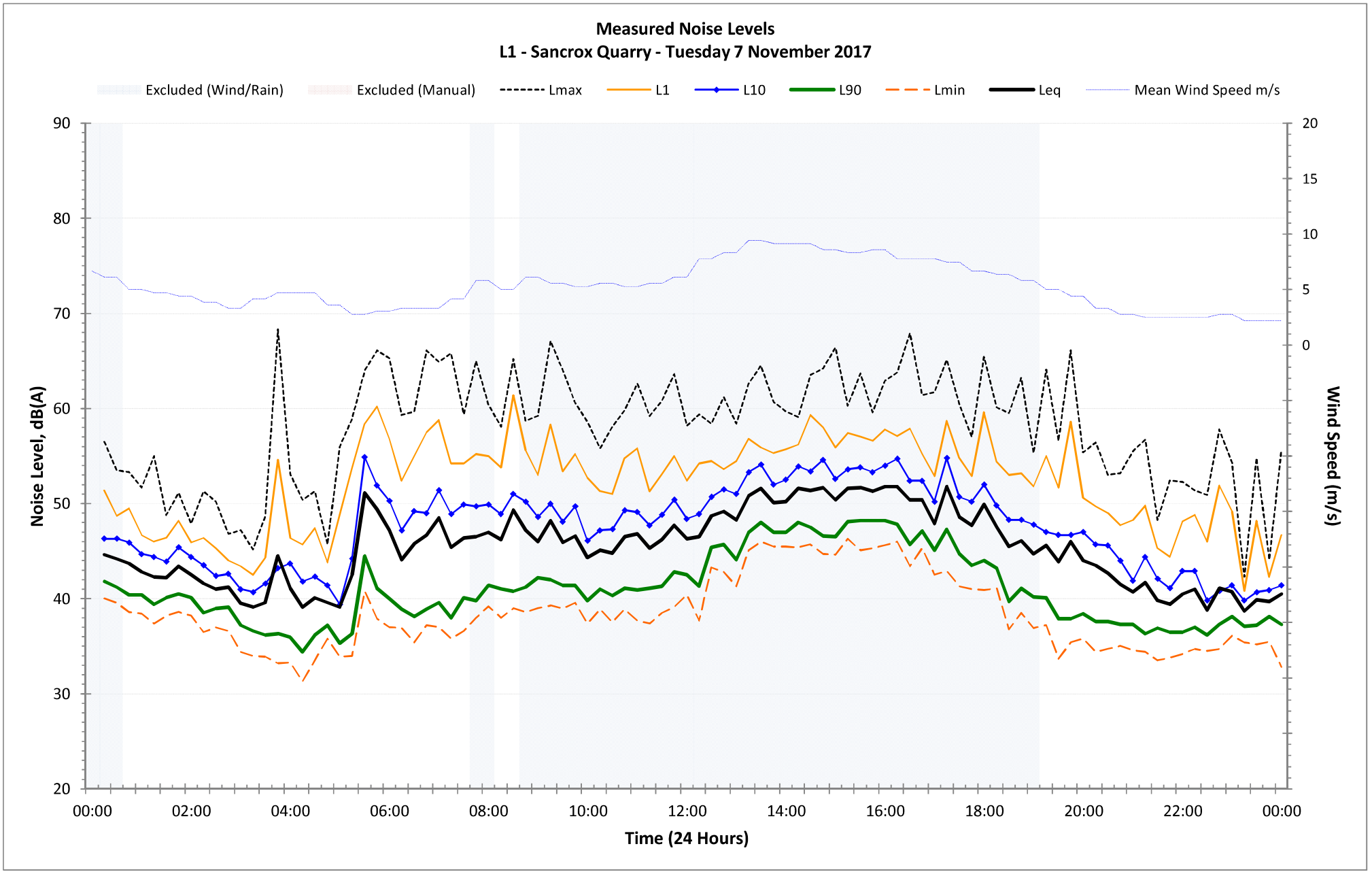
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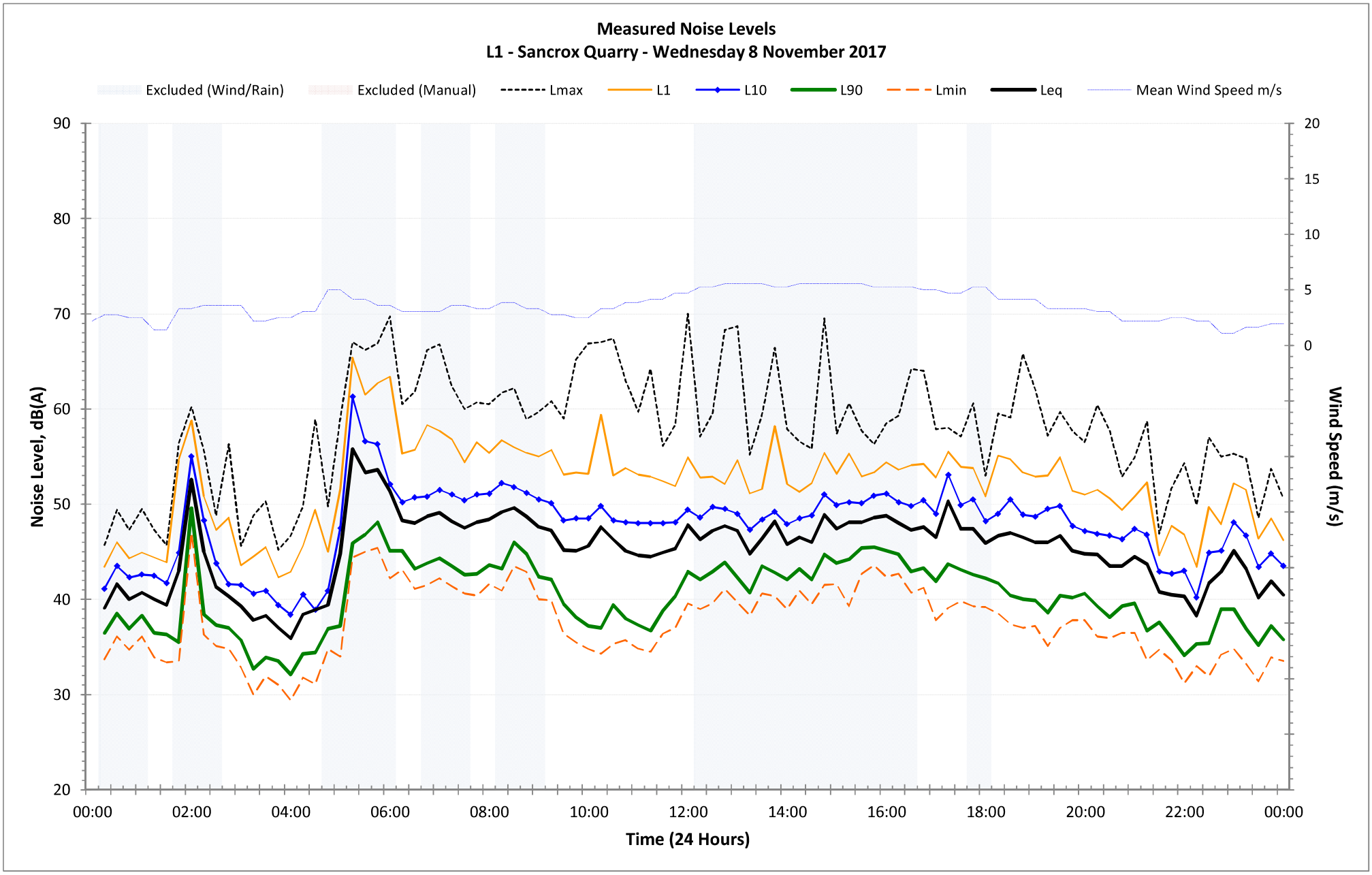
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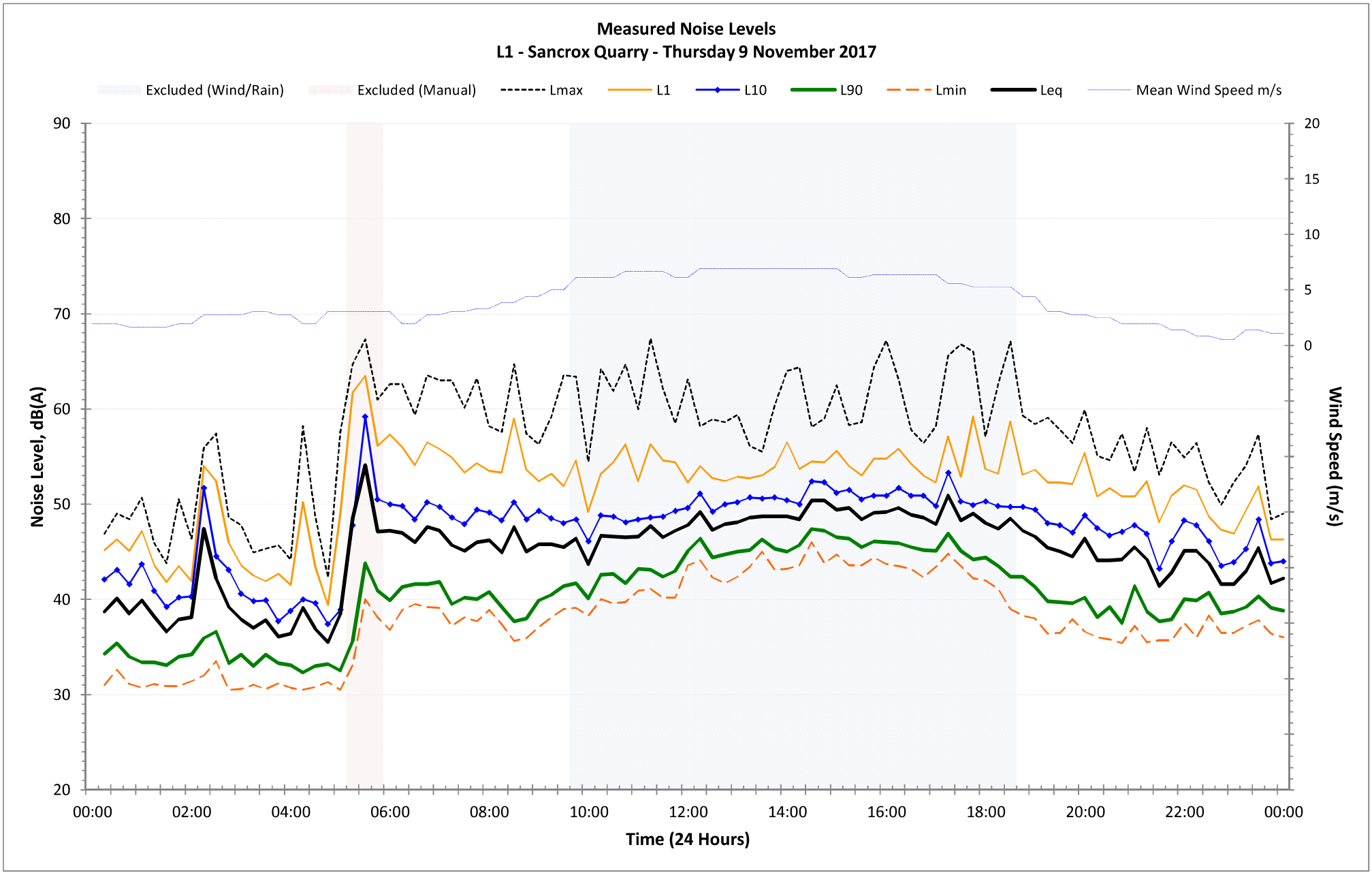
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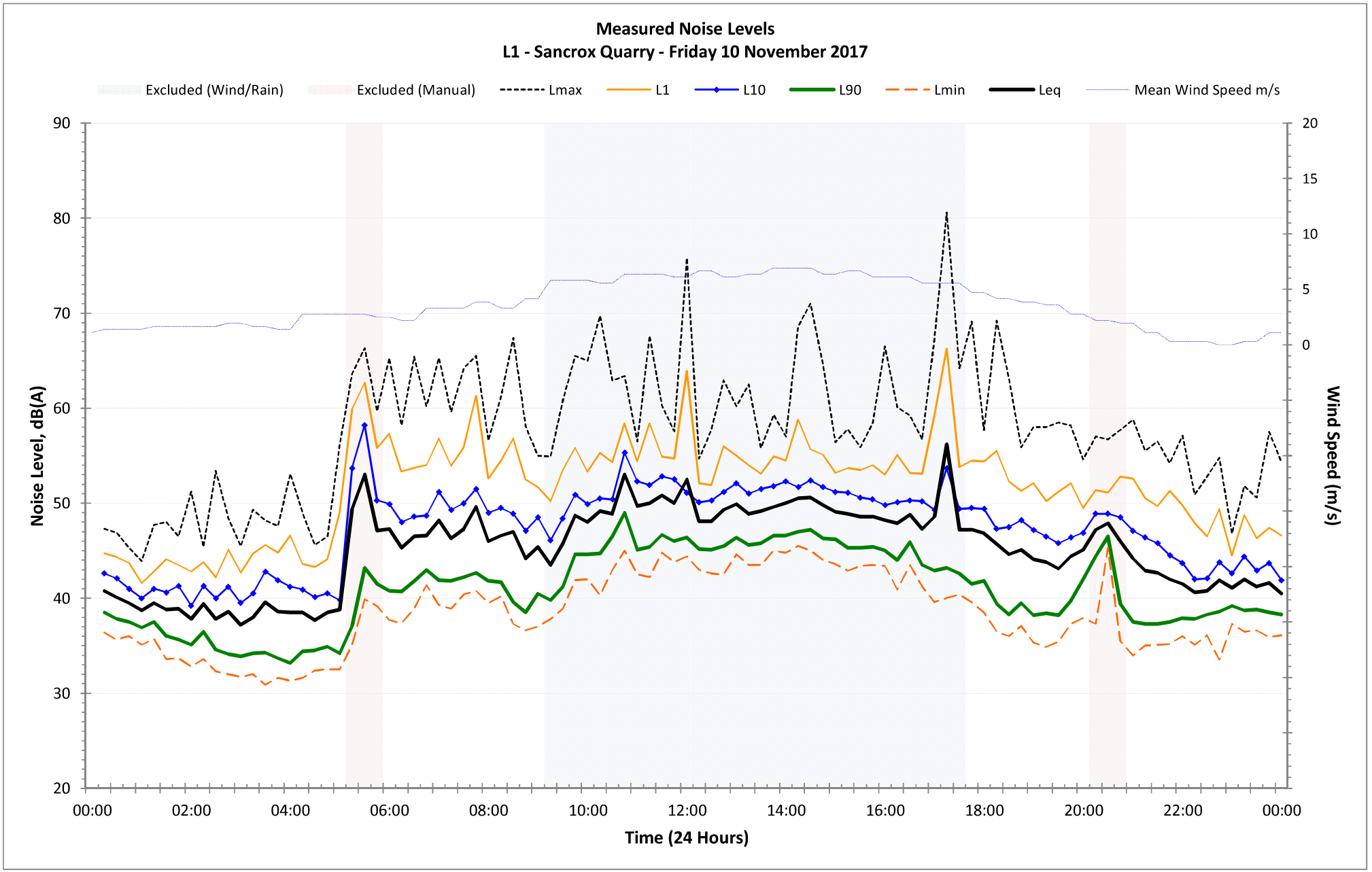
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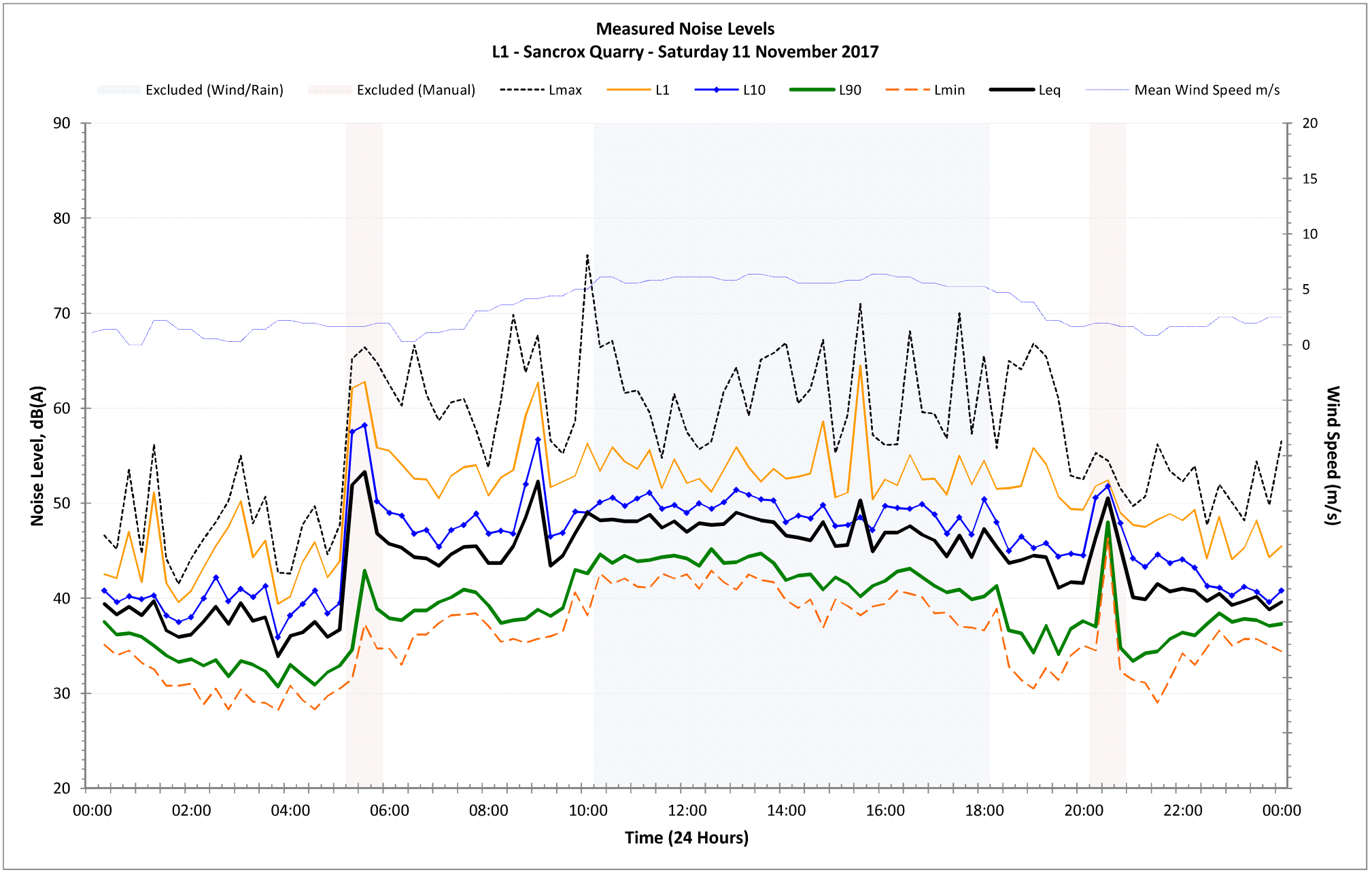
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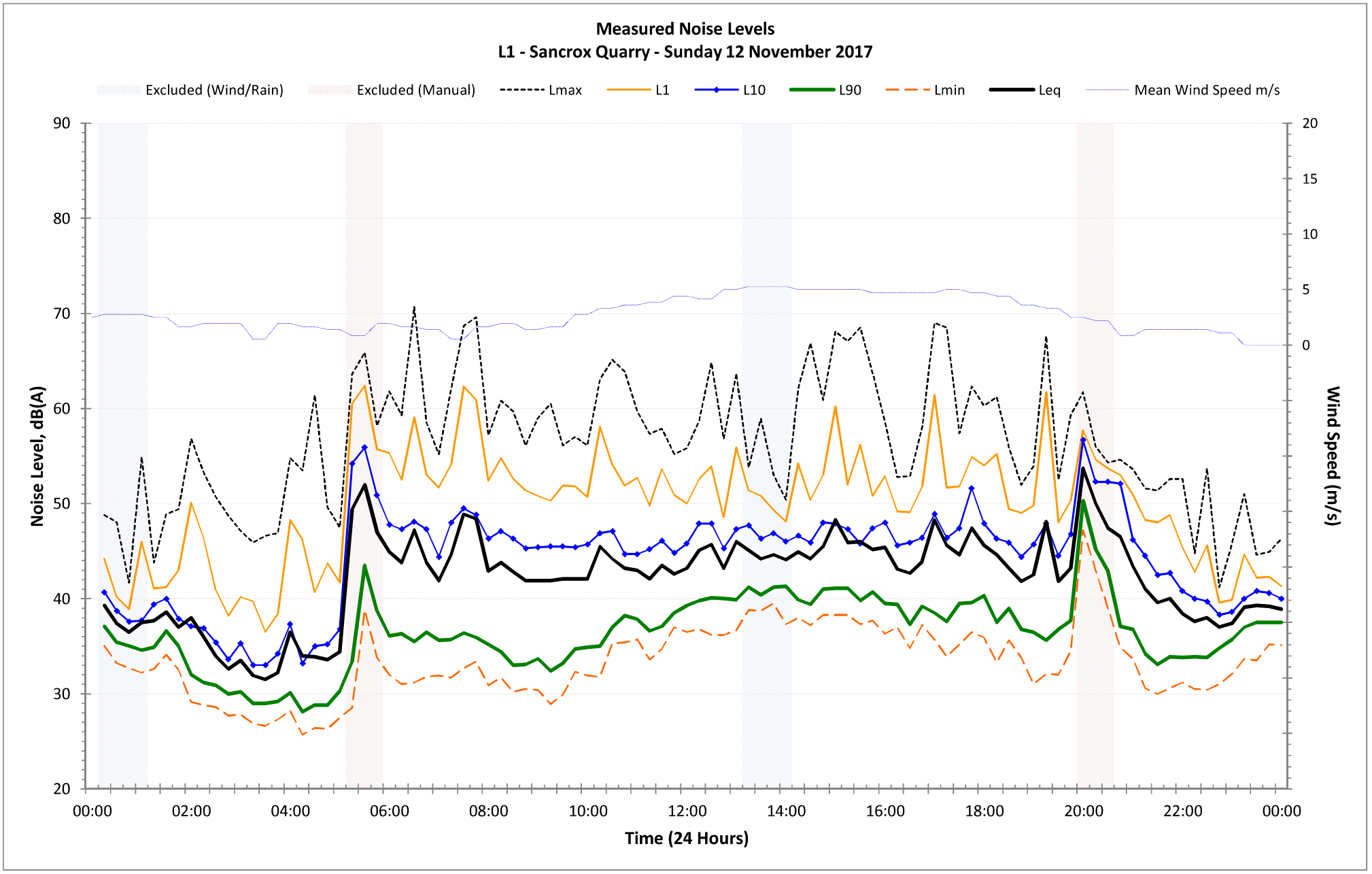
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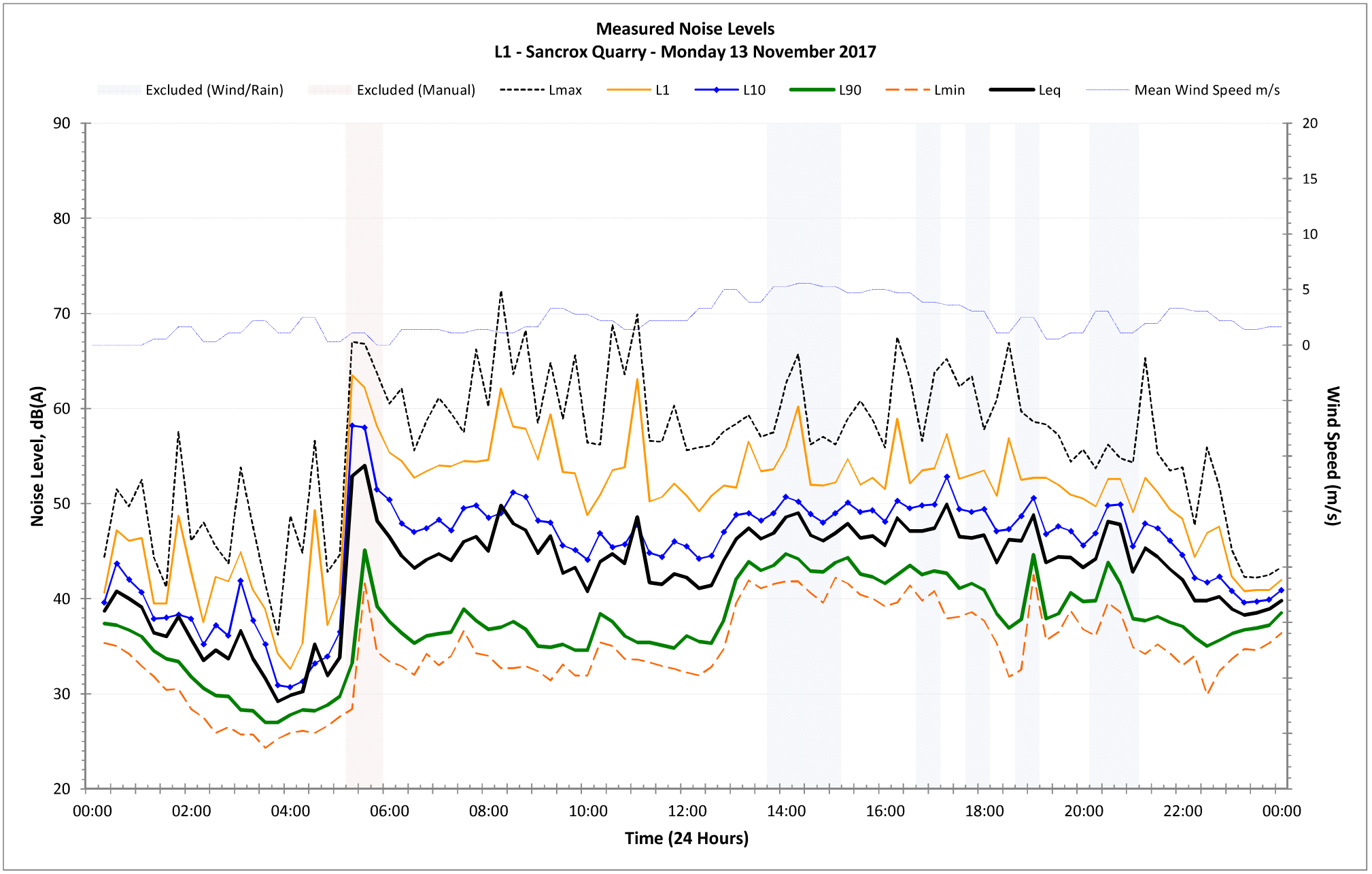
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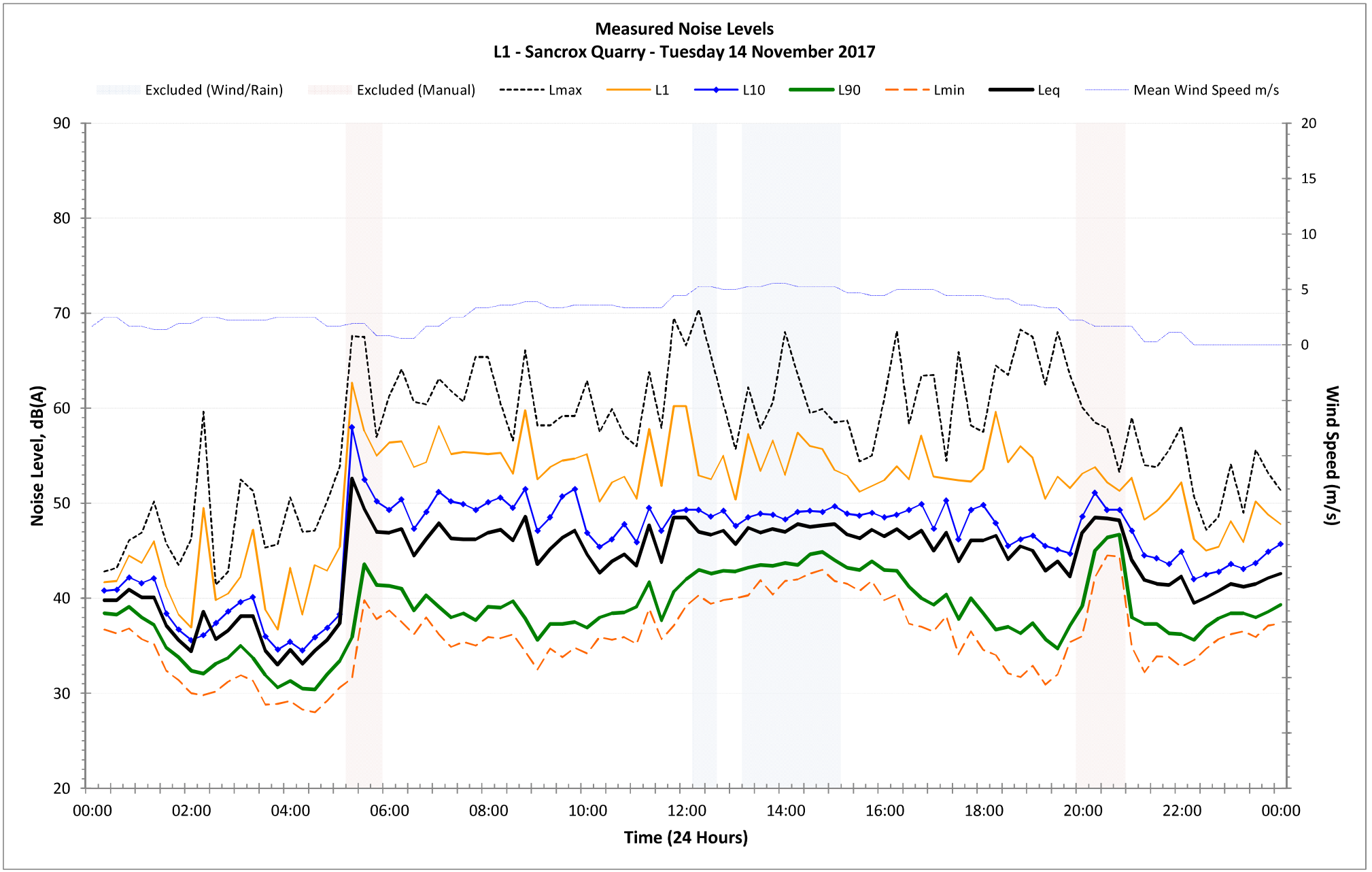
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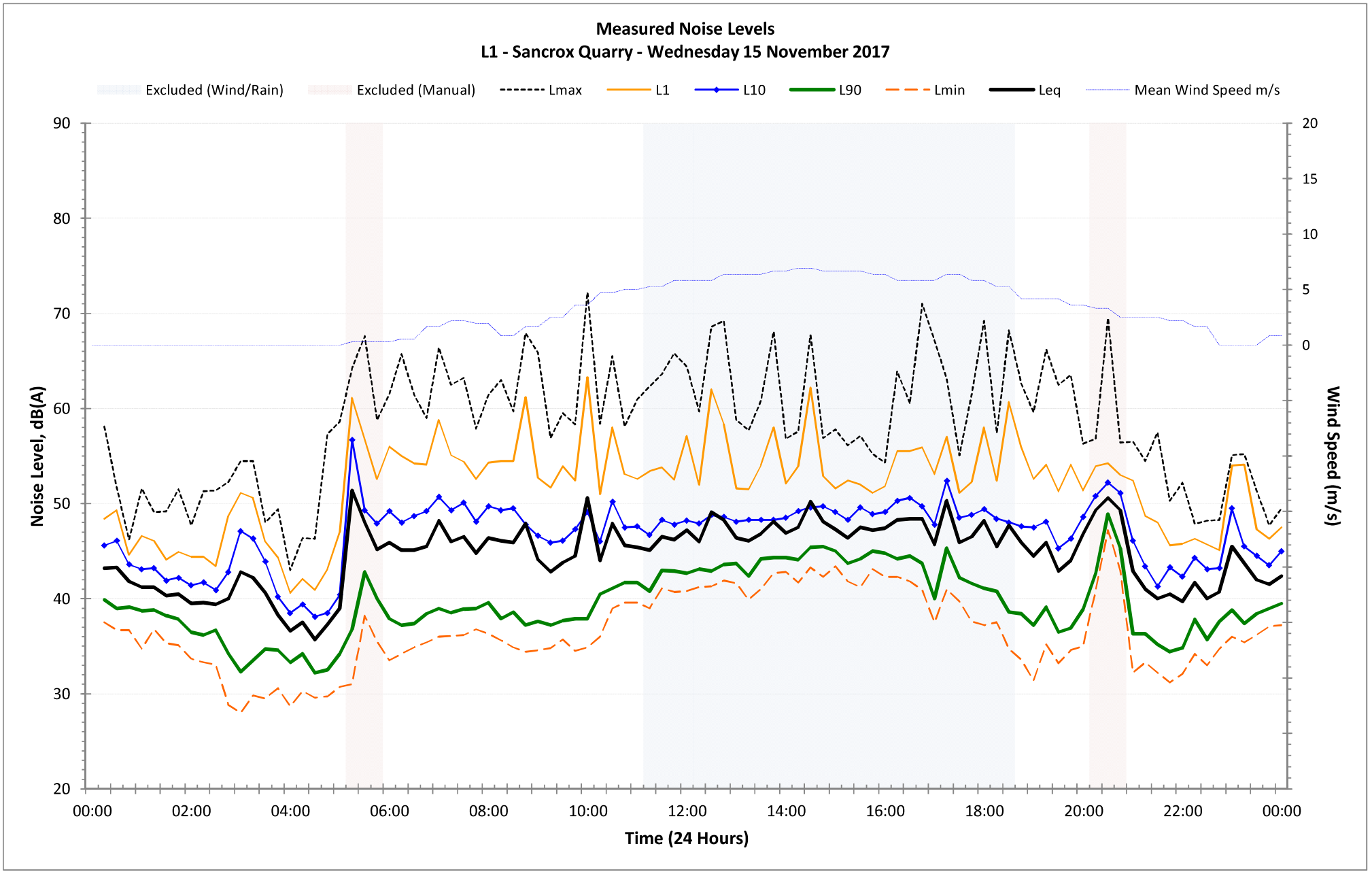
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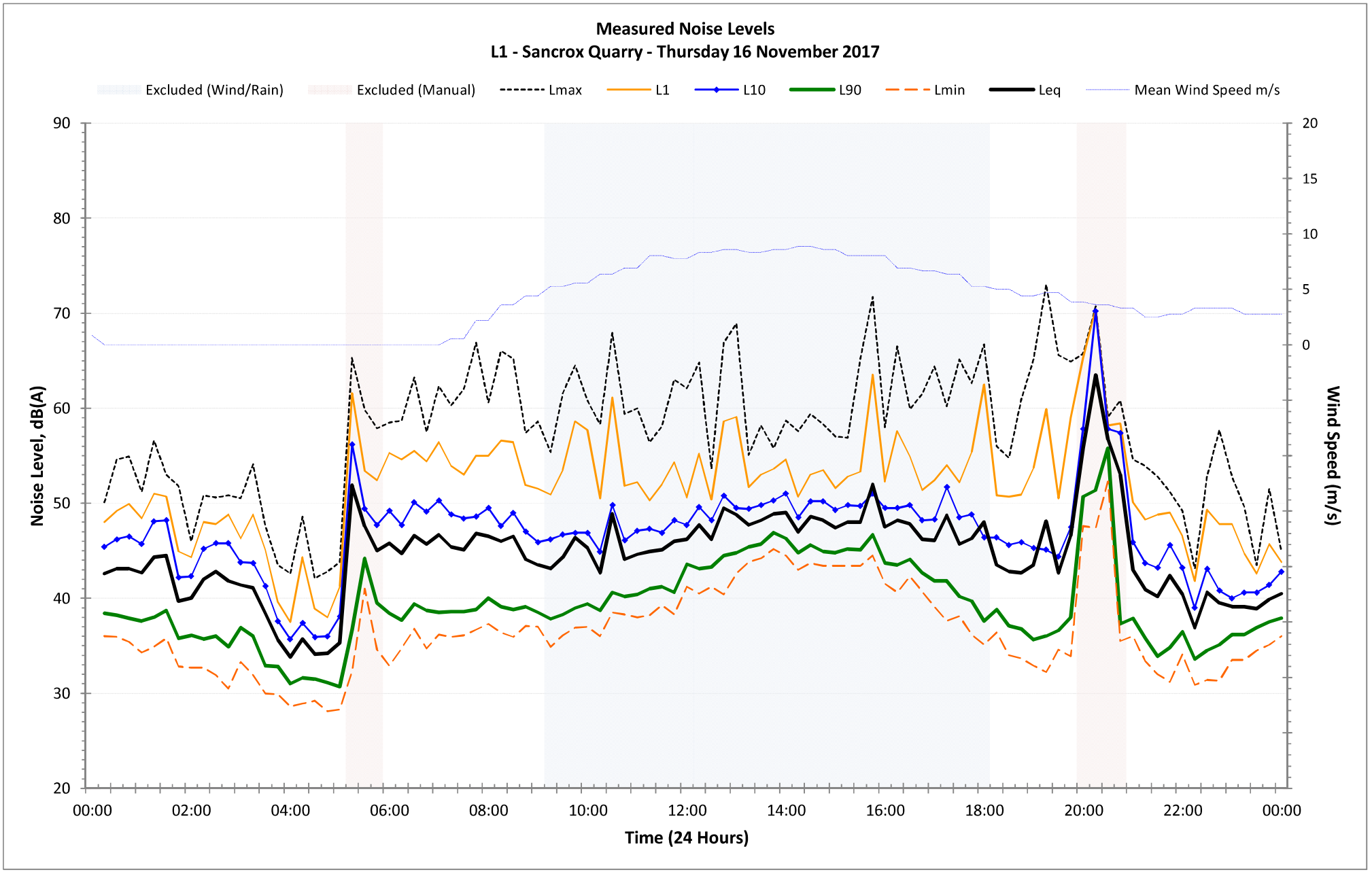
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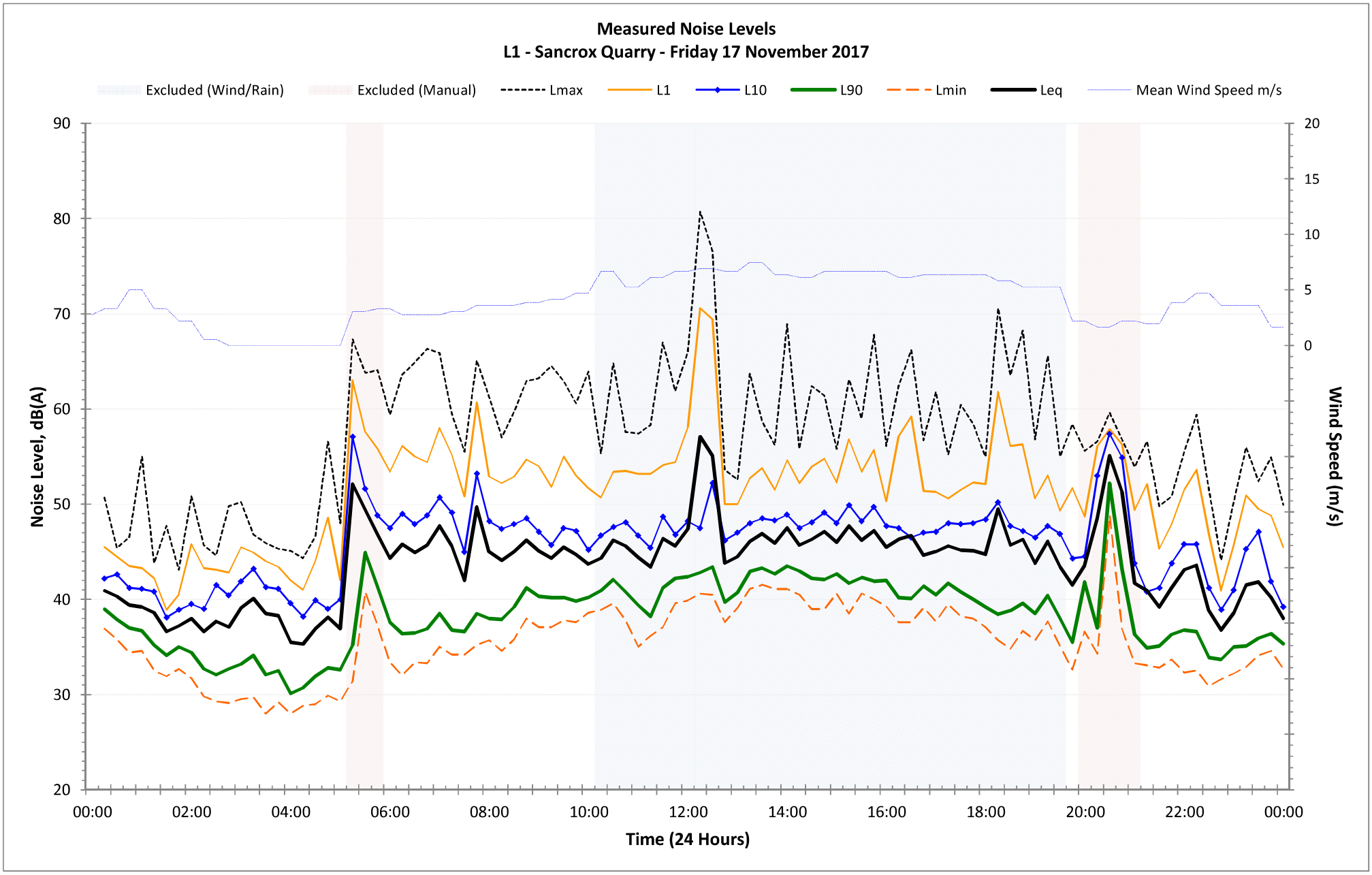
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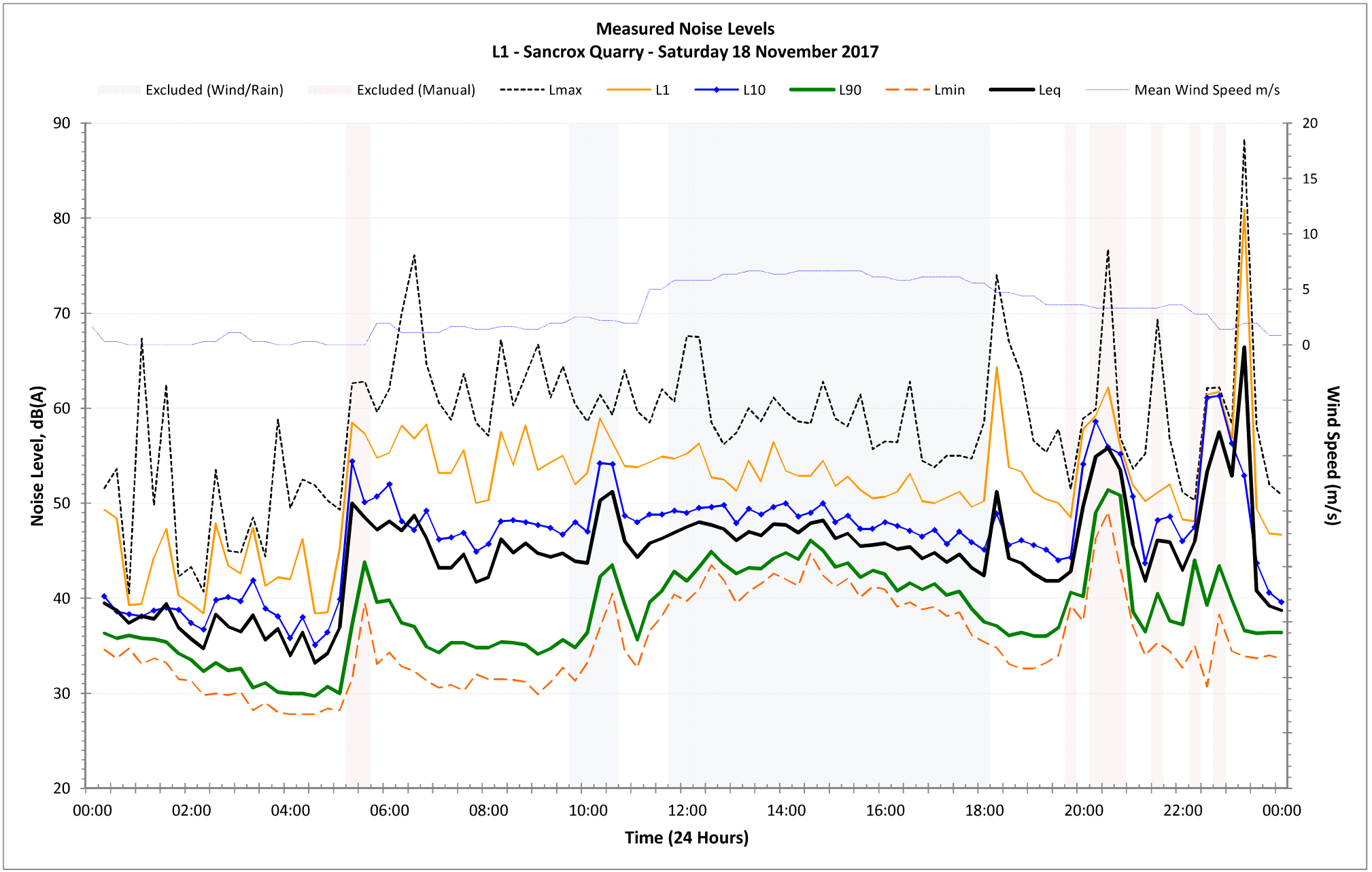
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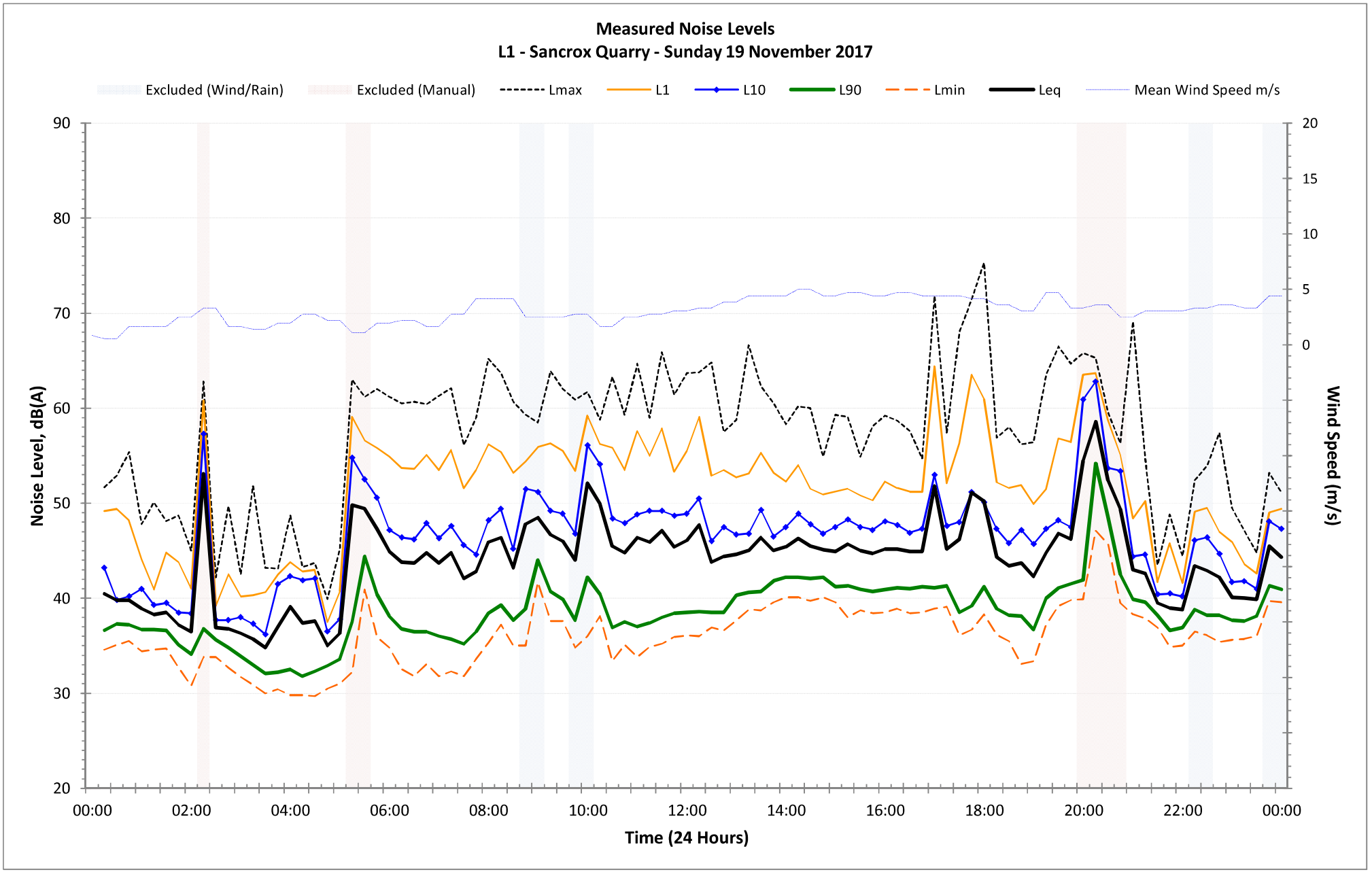
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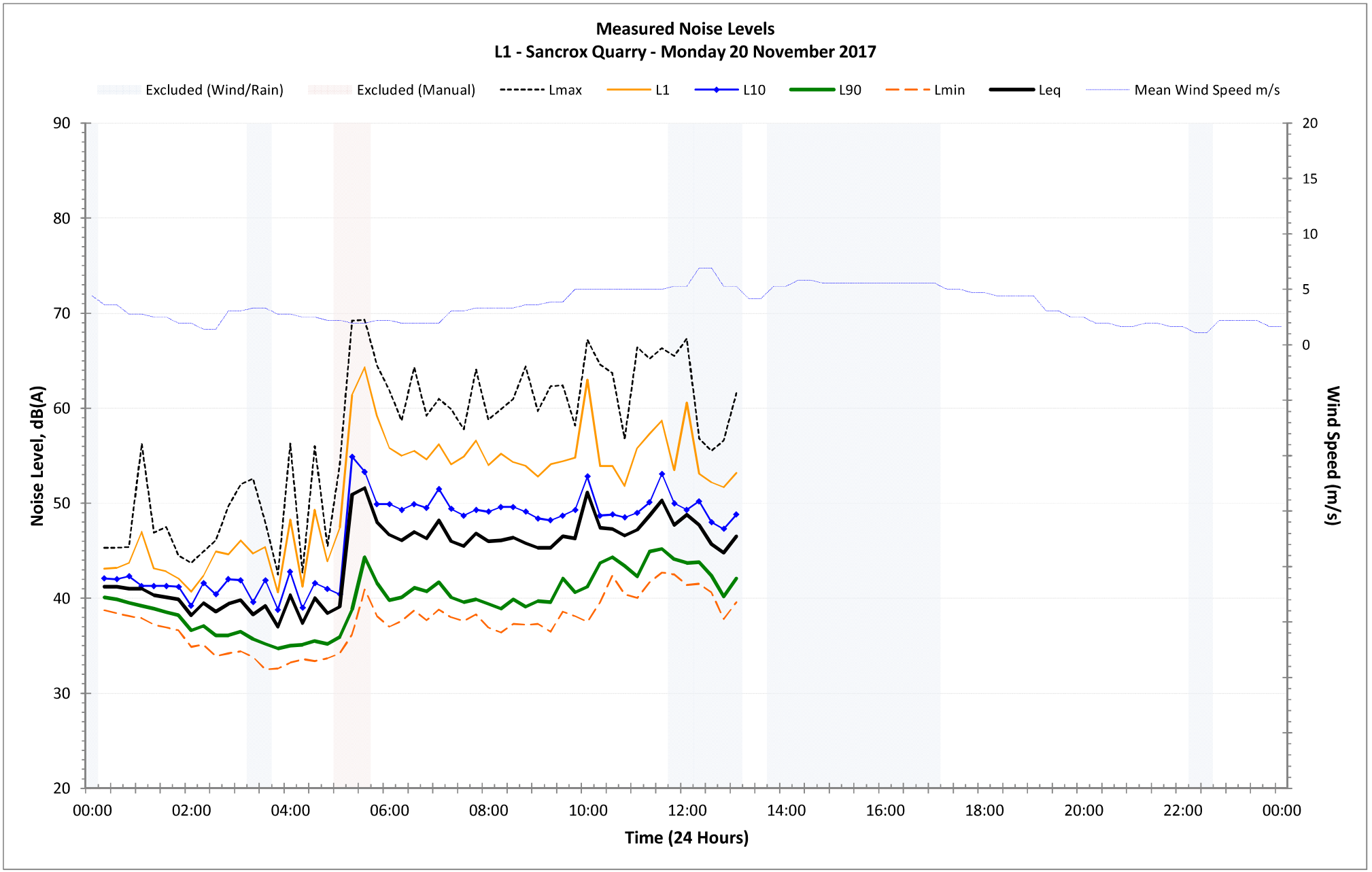
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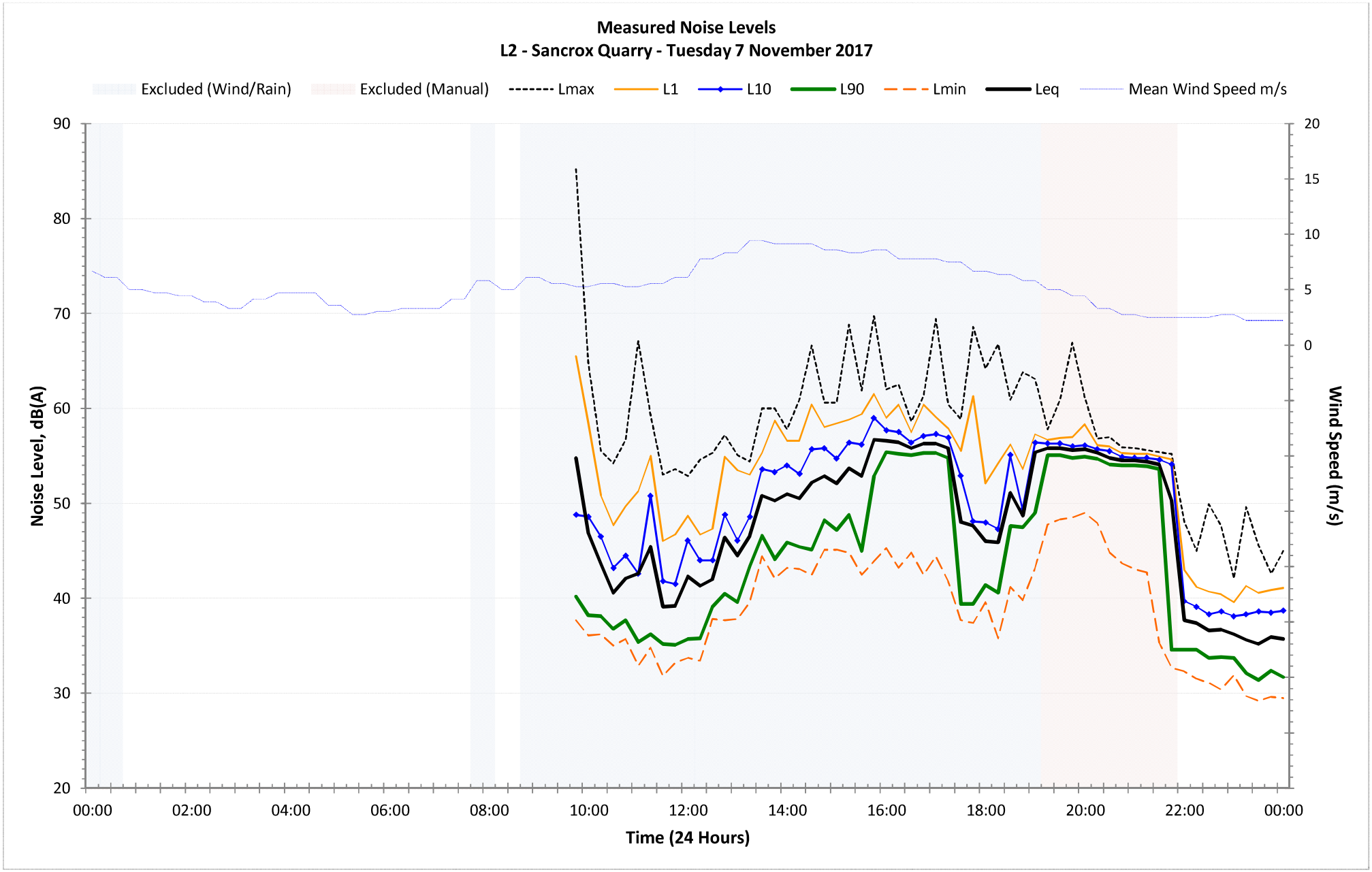
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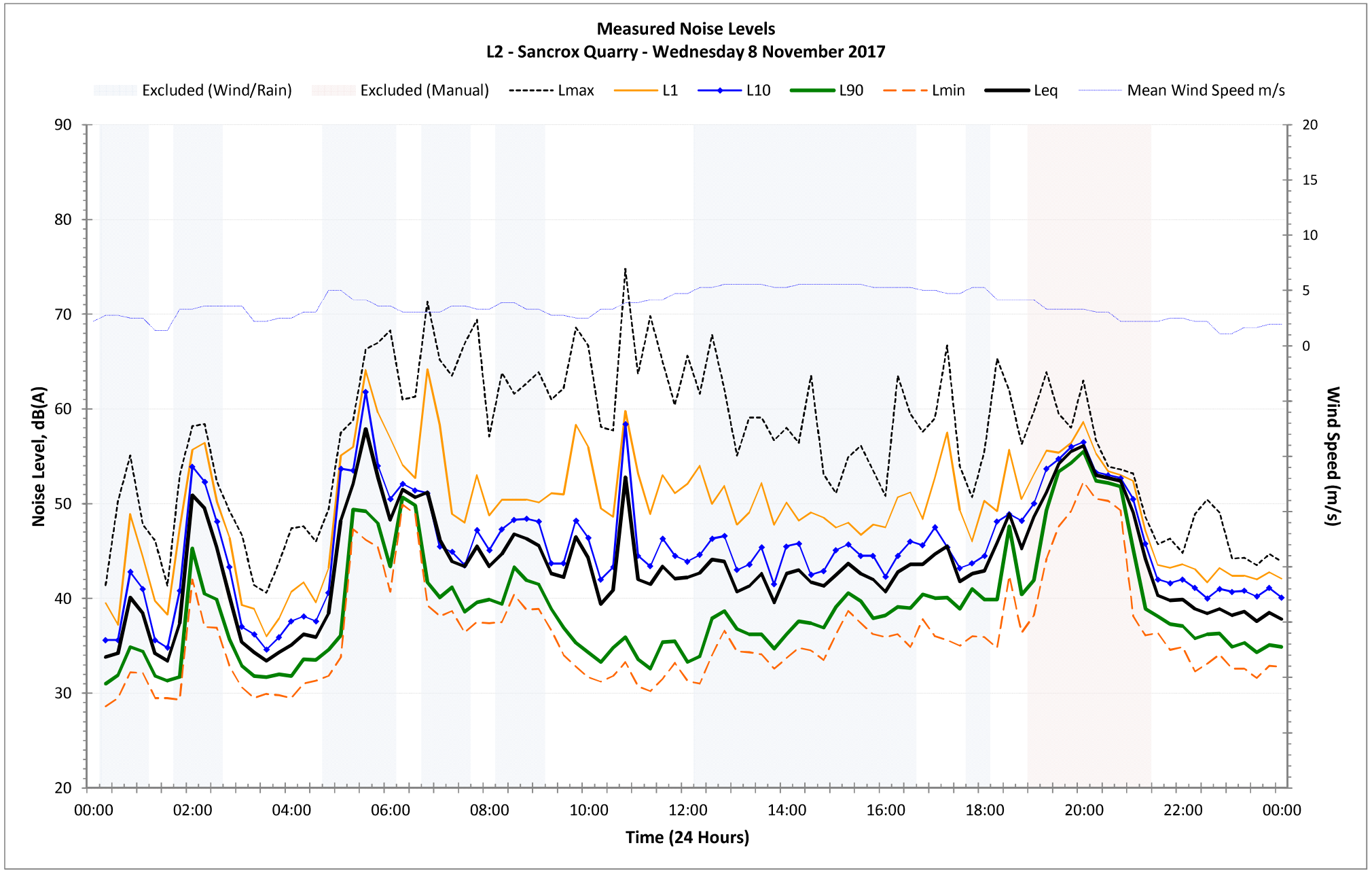
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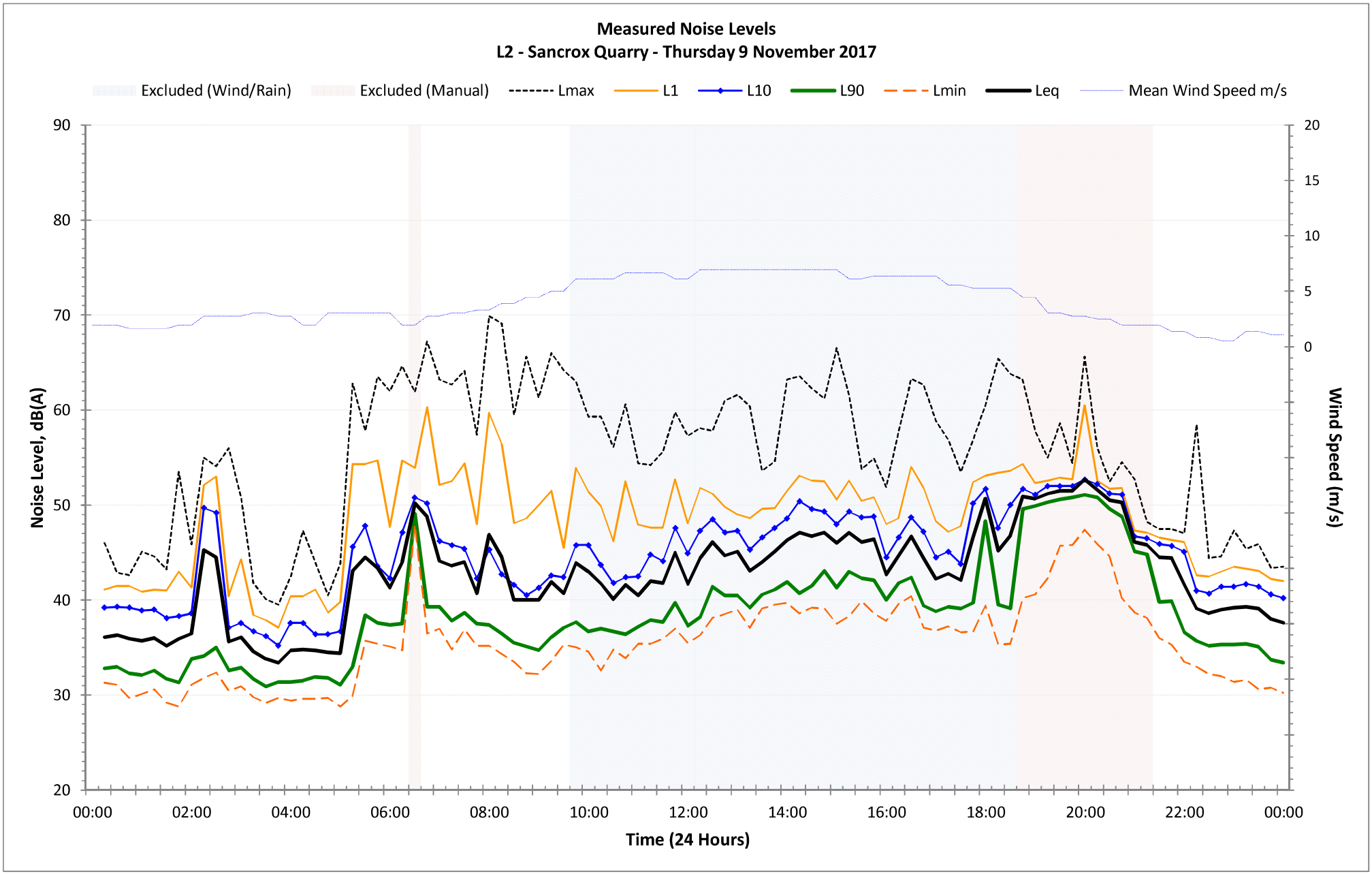
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Excluded (Wind/Rain)
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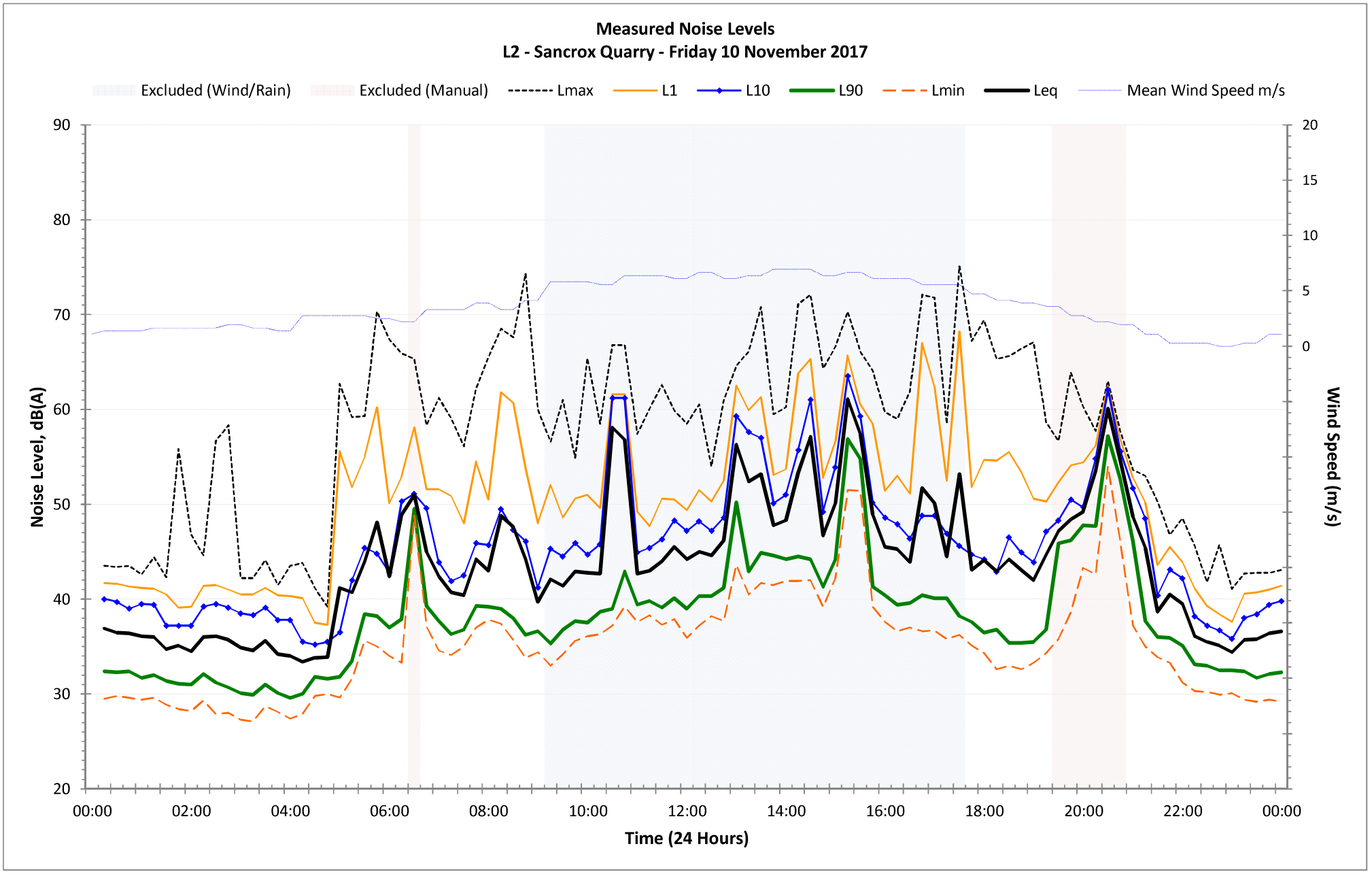
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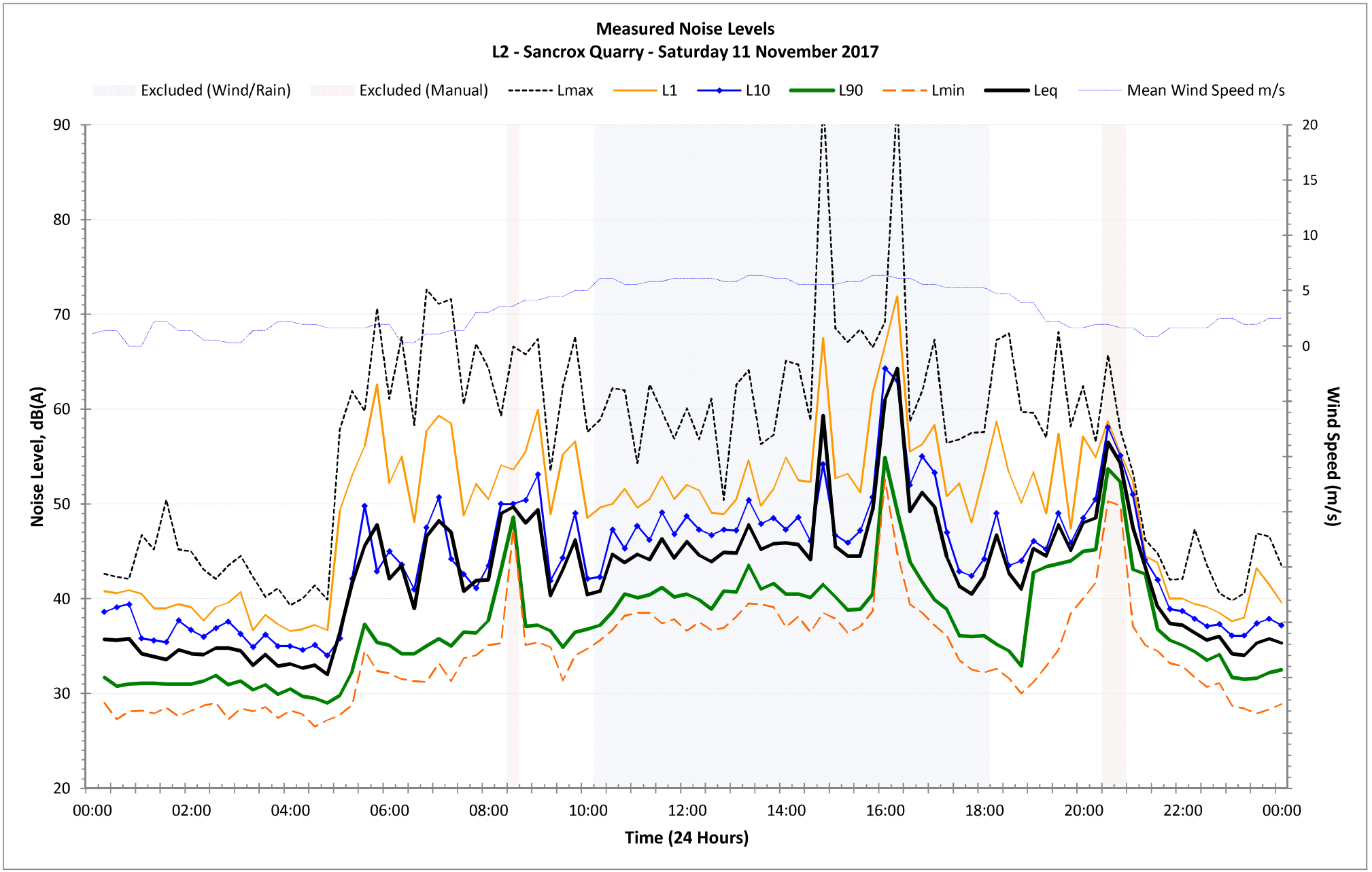
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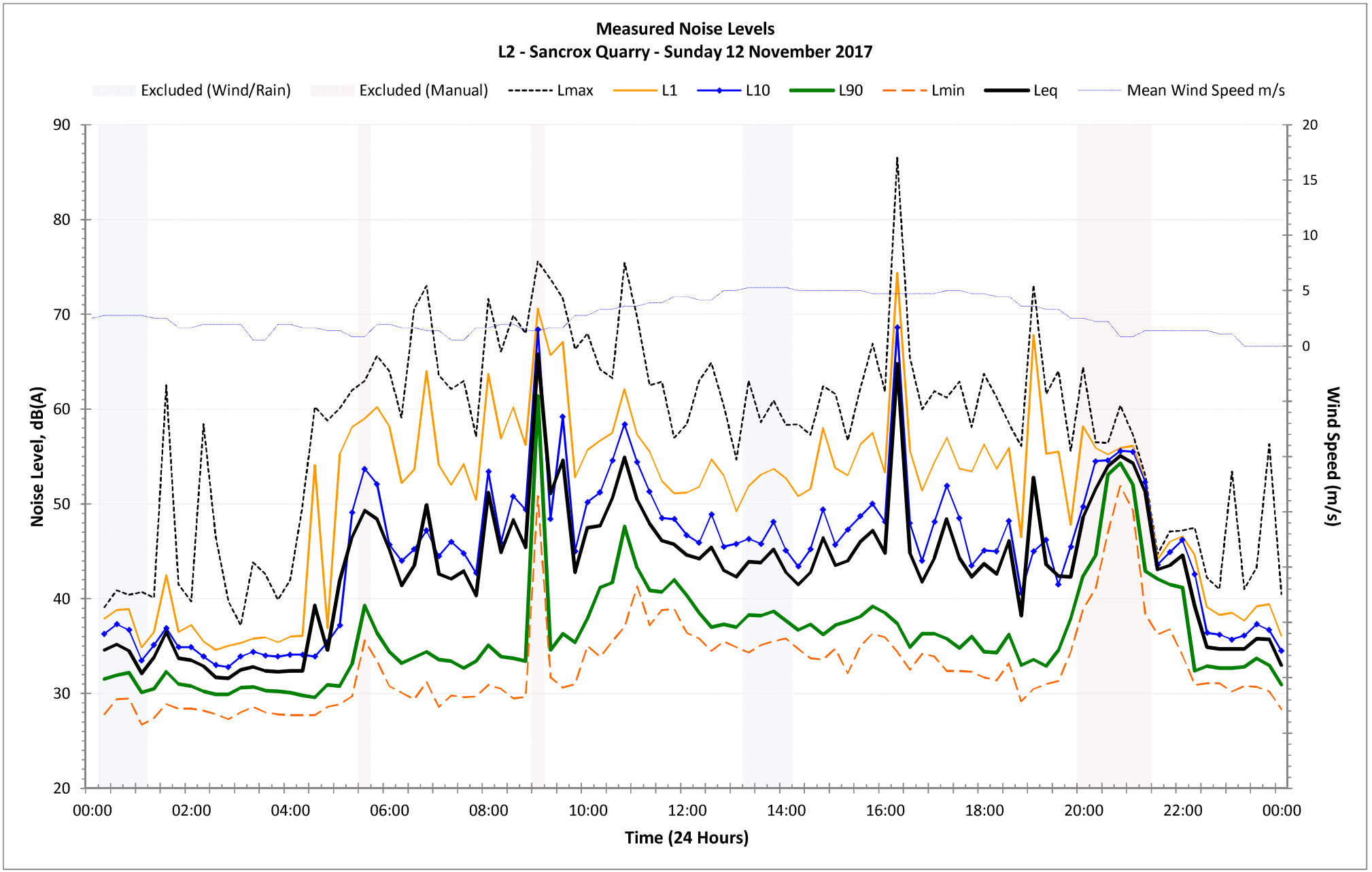
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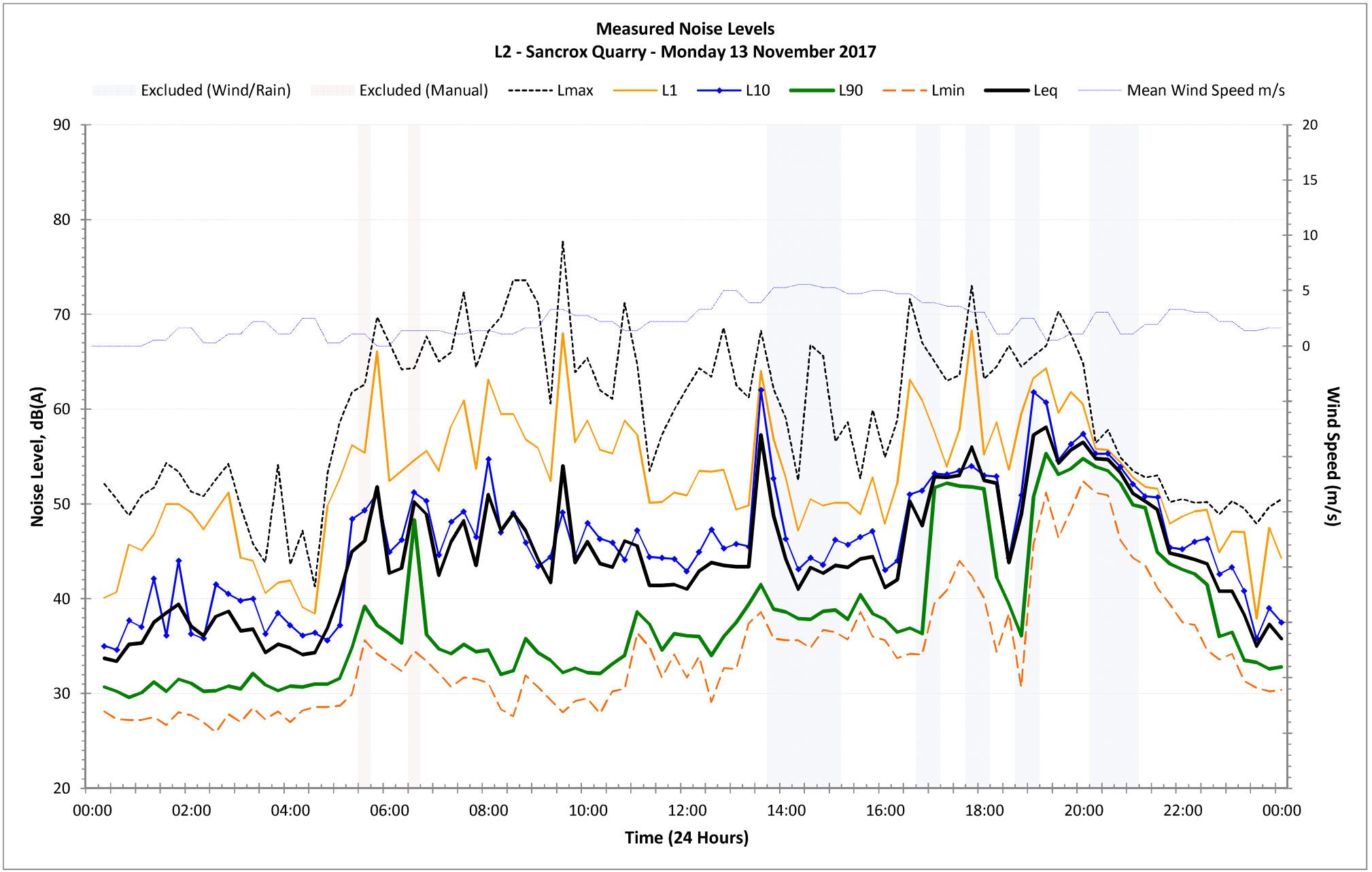
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Excluded (Manual)
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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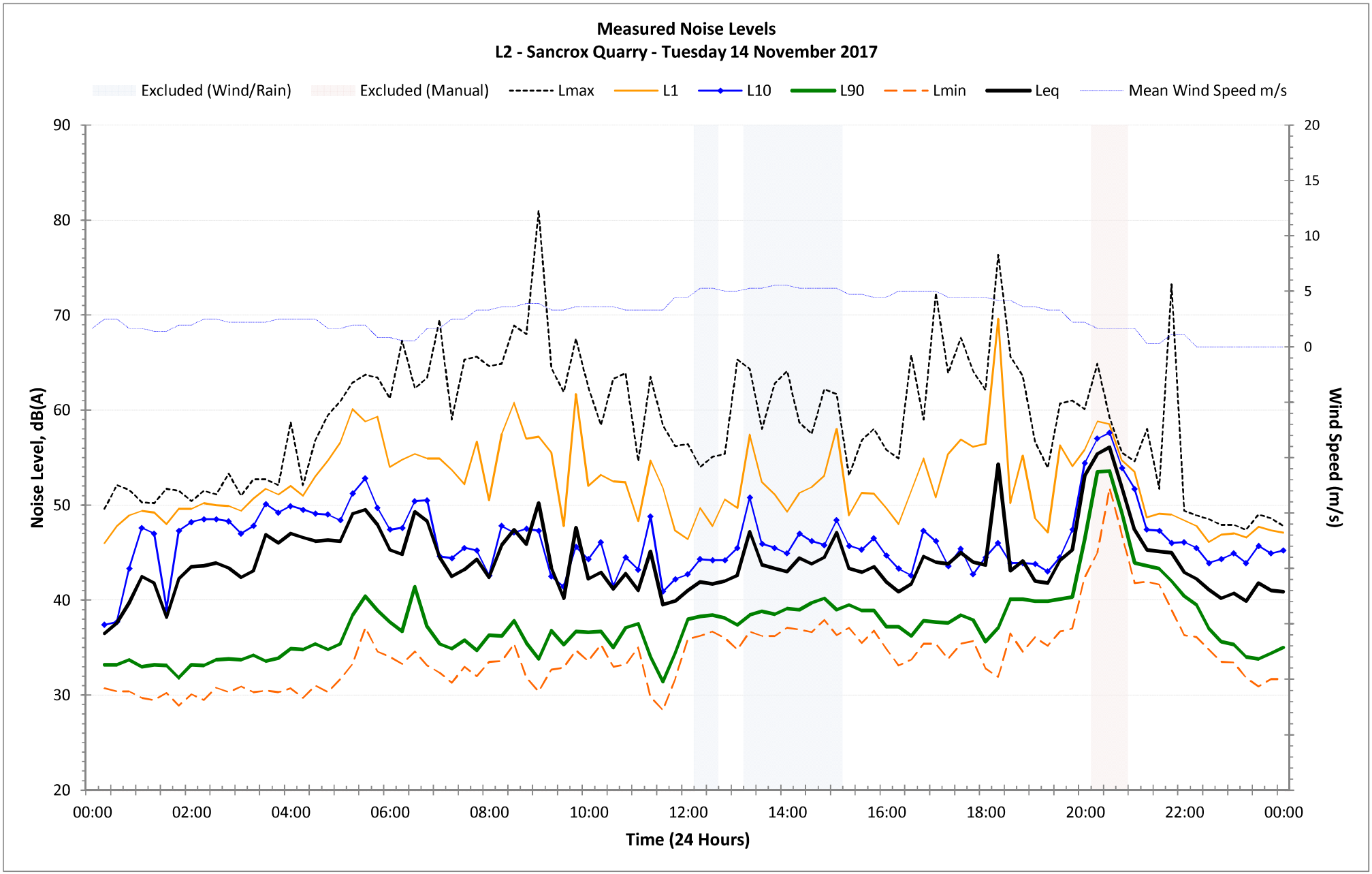
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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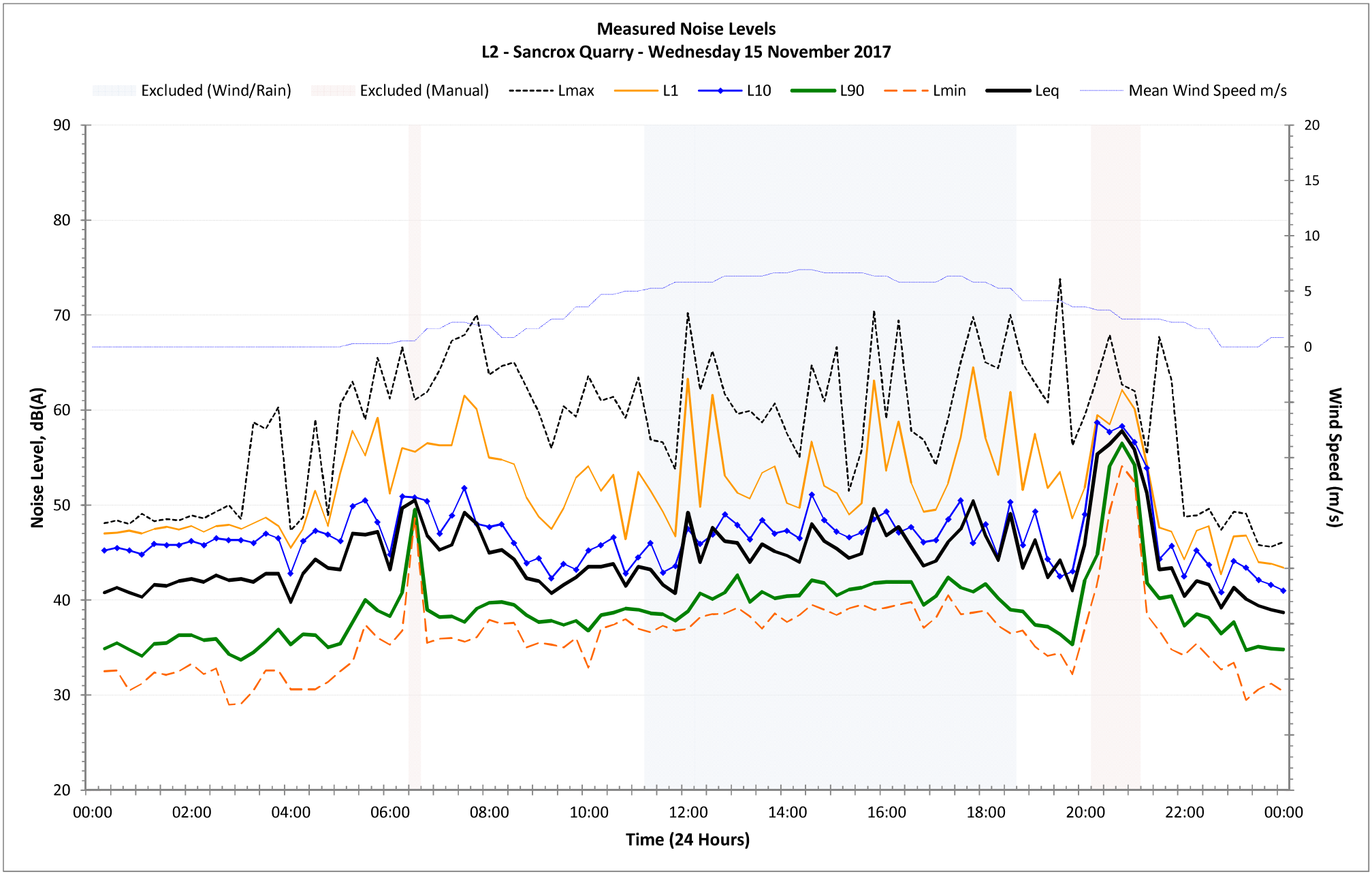
Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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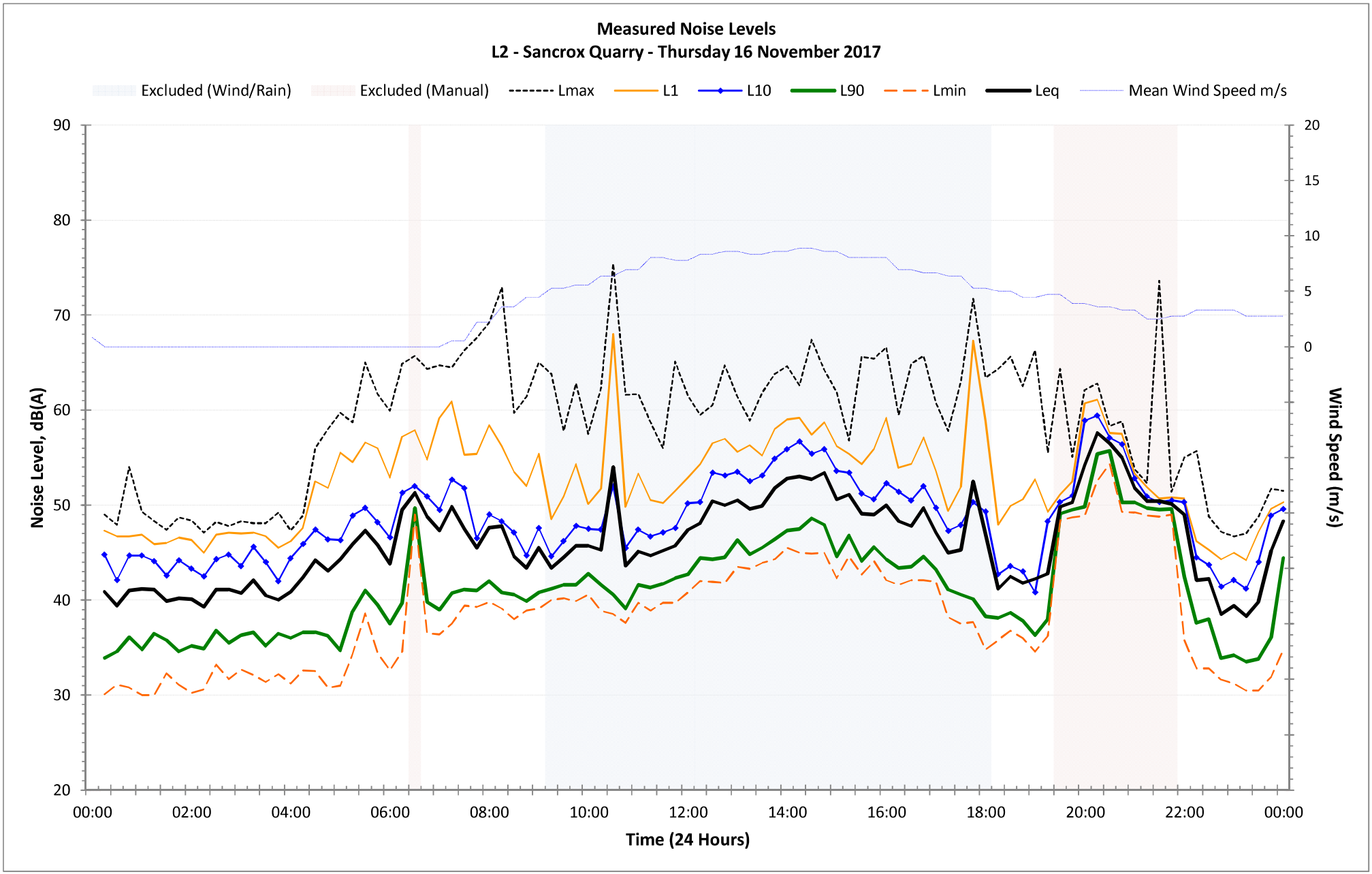
Measured Noise Levels
L2 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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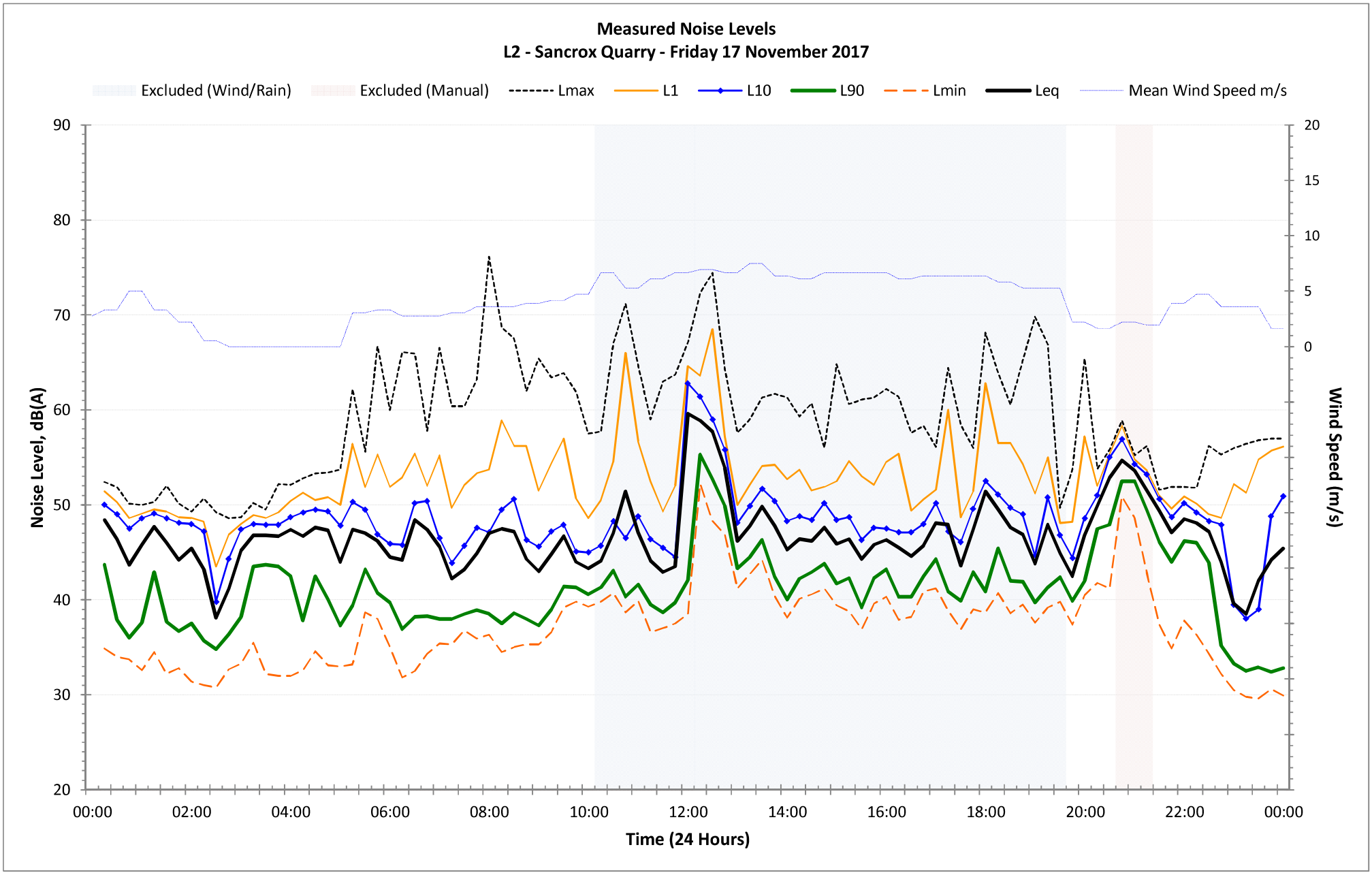
Measured Noise Levels
L2 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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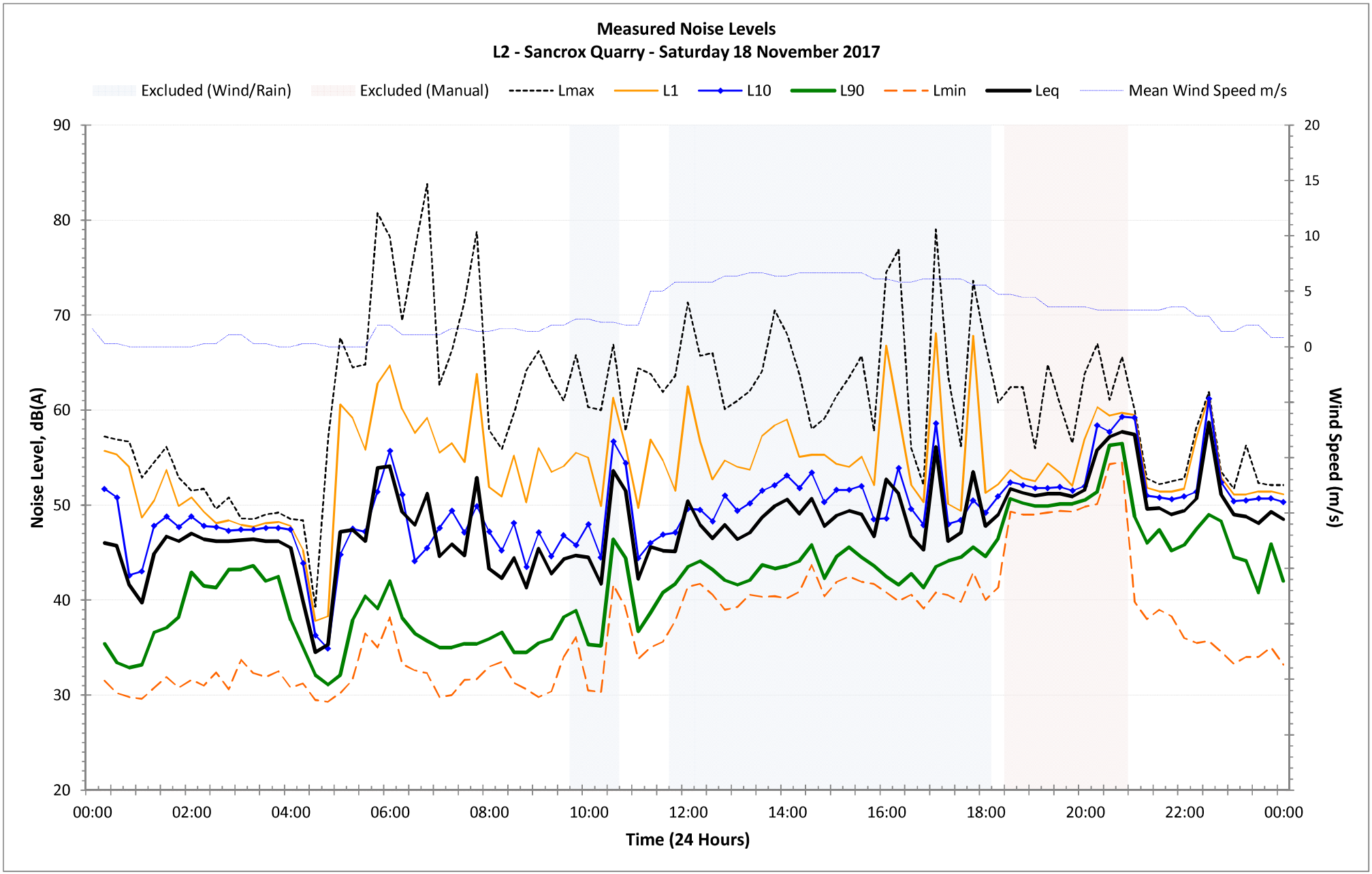
Measured Noise Levels
L2 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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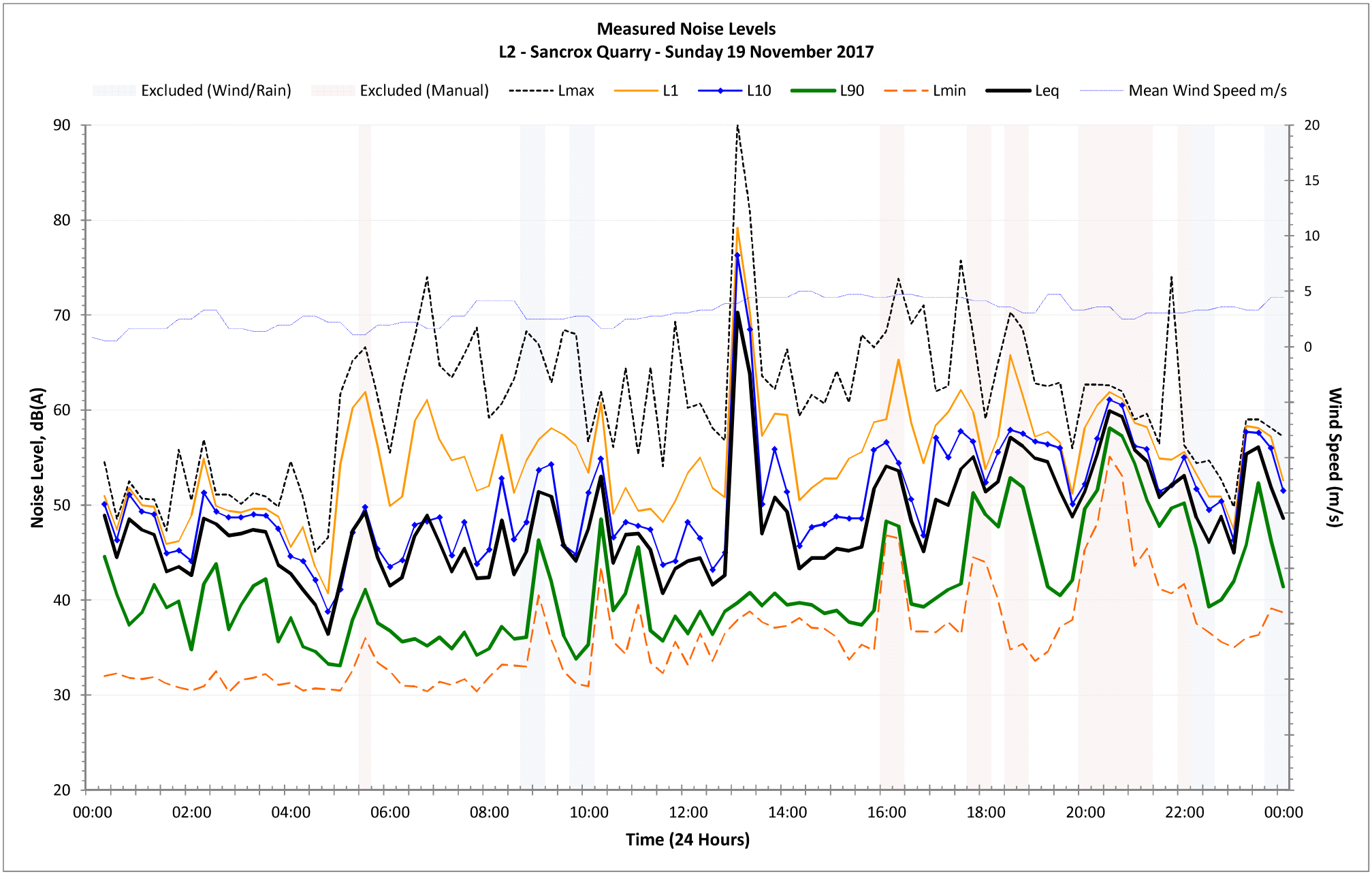
Measured Noise Levels
L2 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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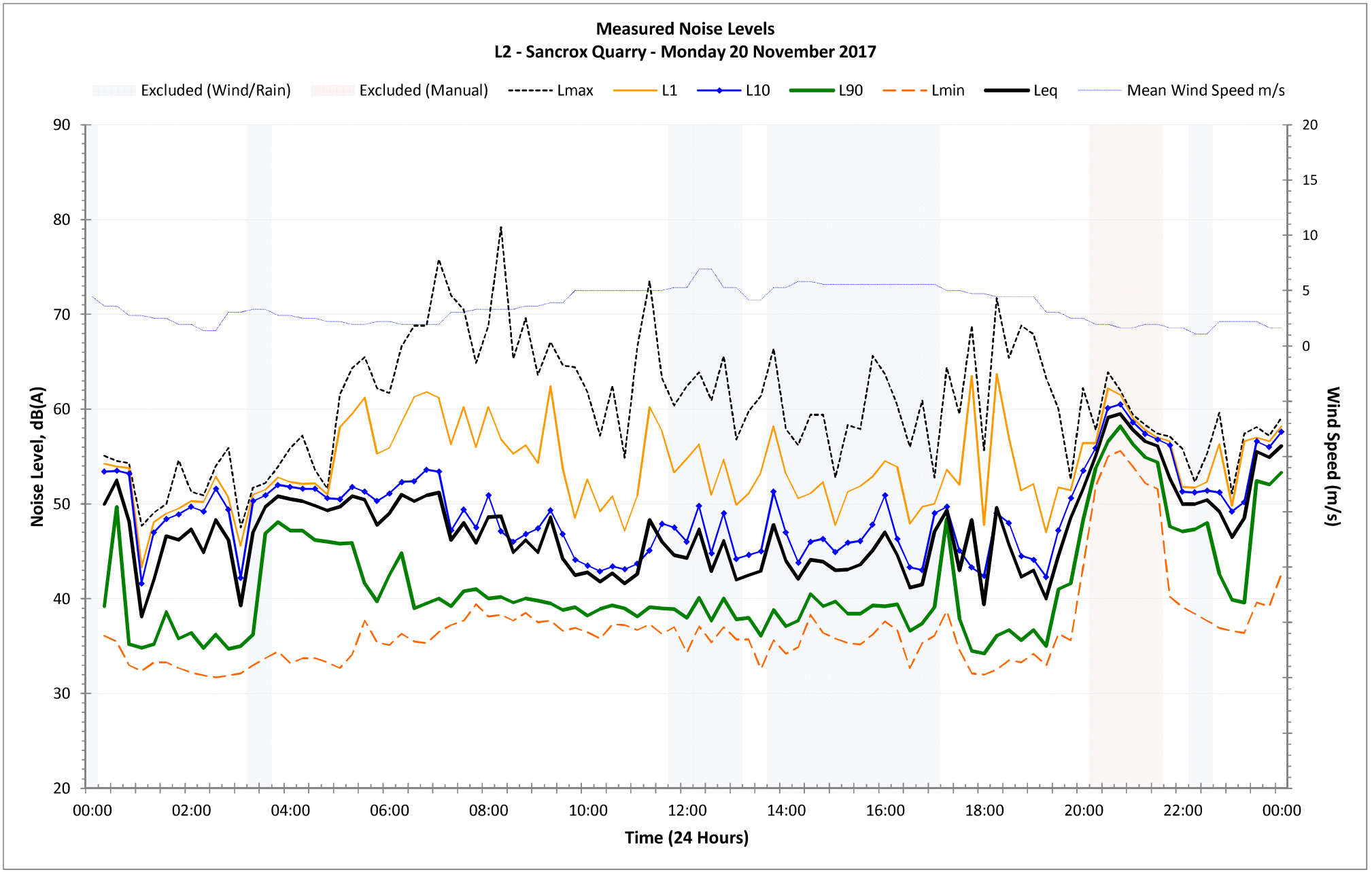
Measured Noise Levels
L2 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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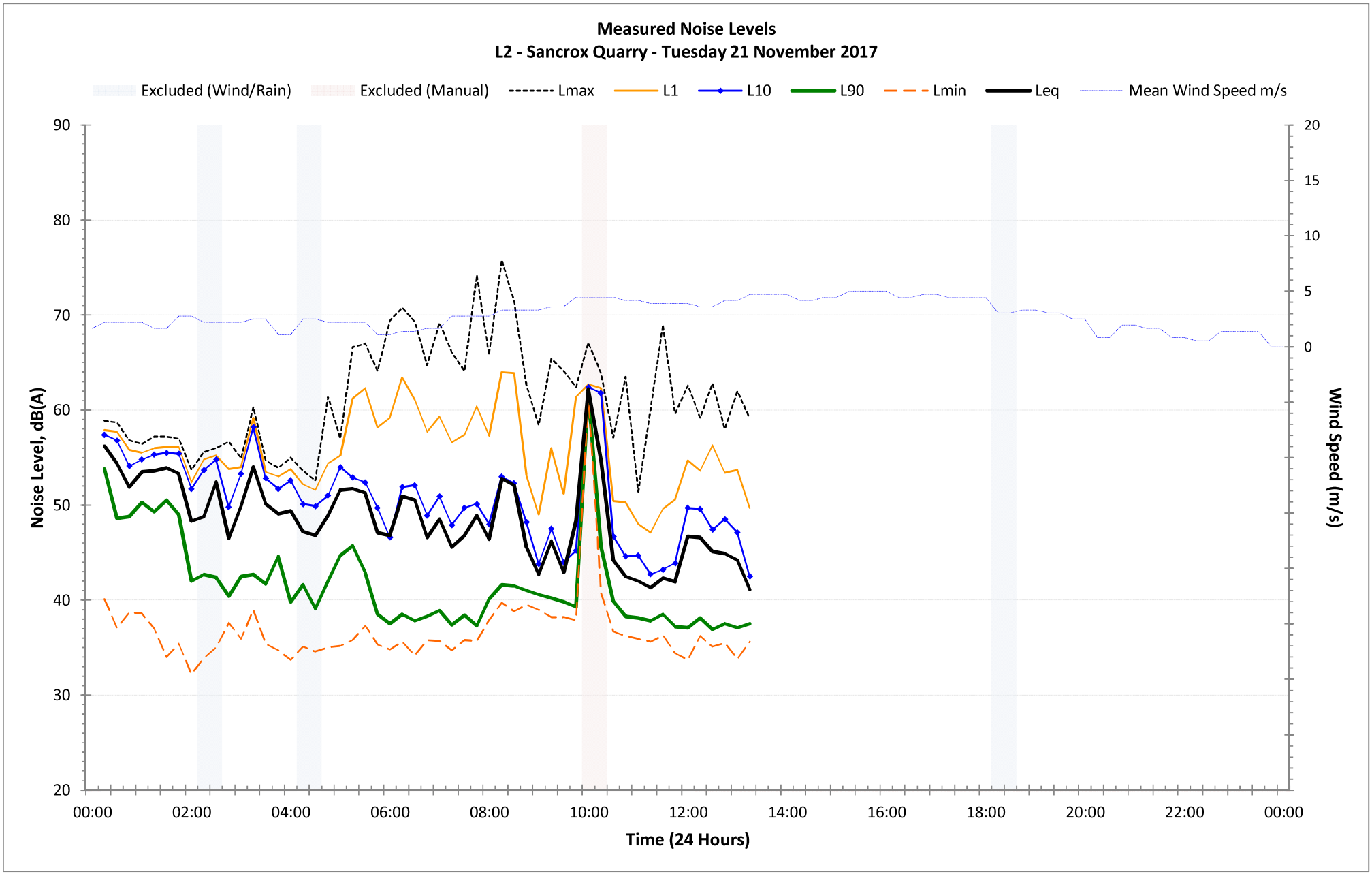
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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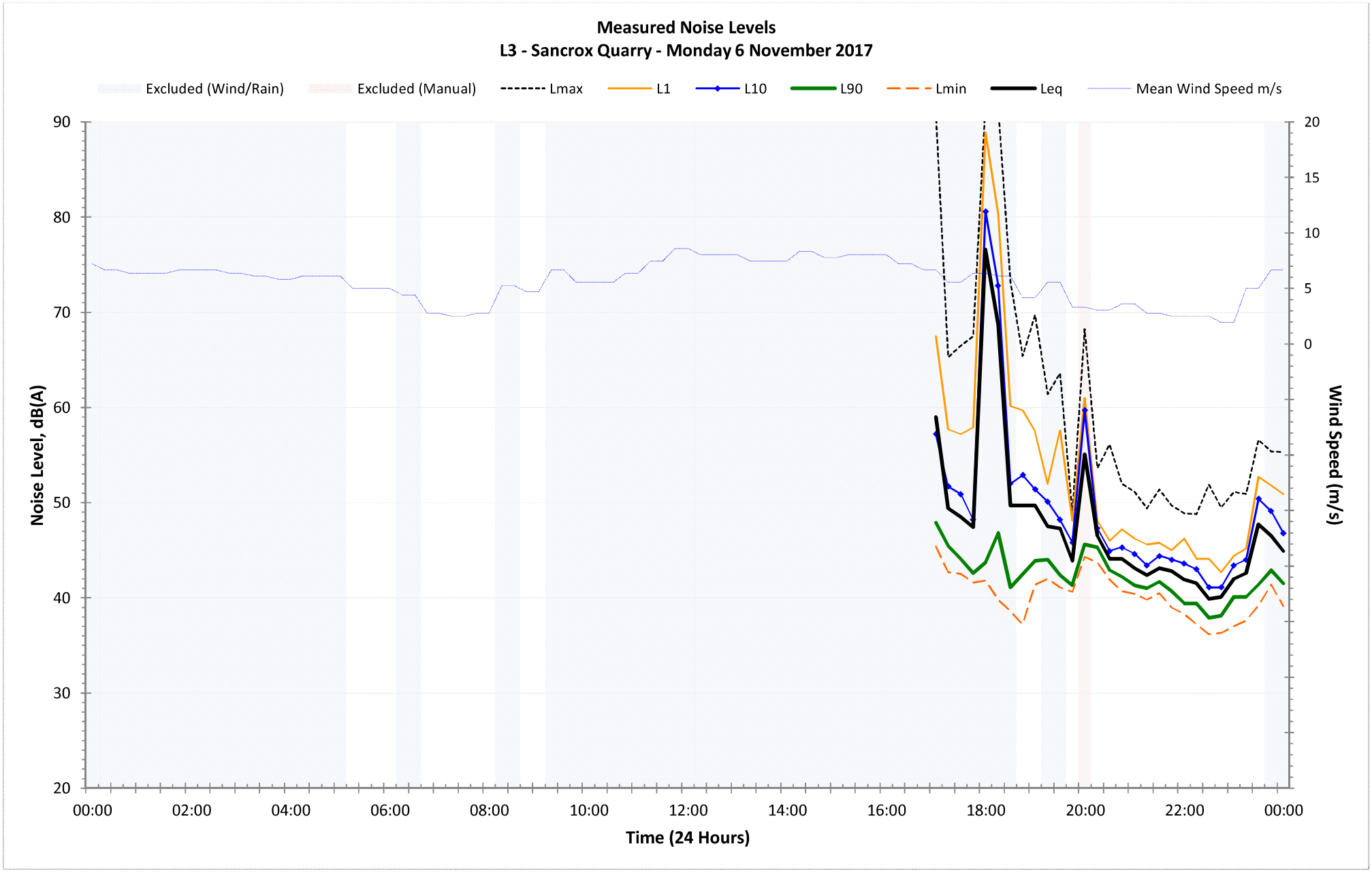
Measured Noise Levels
L3 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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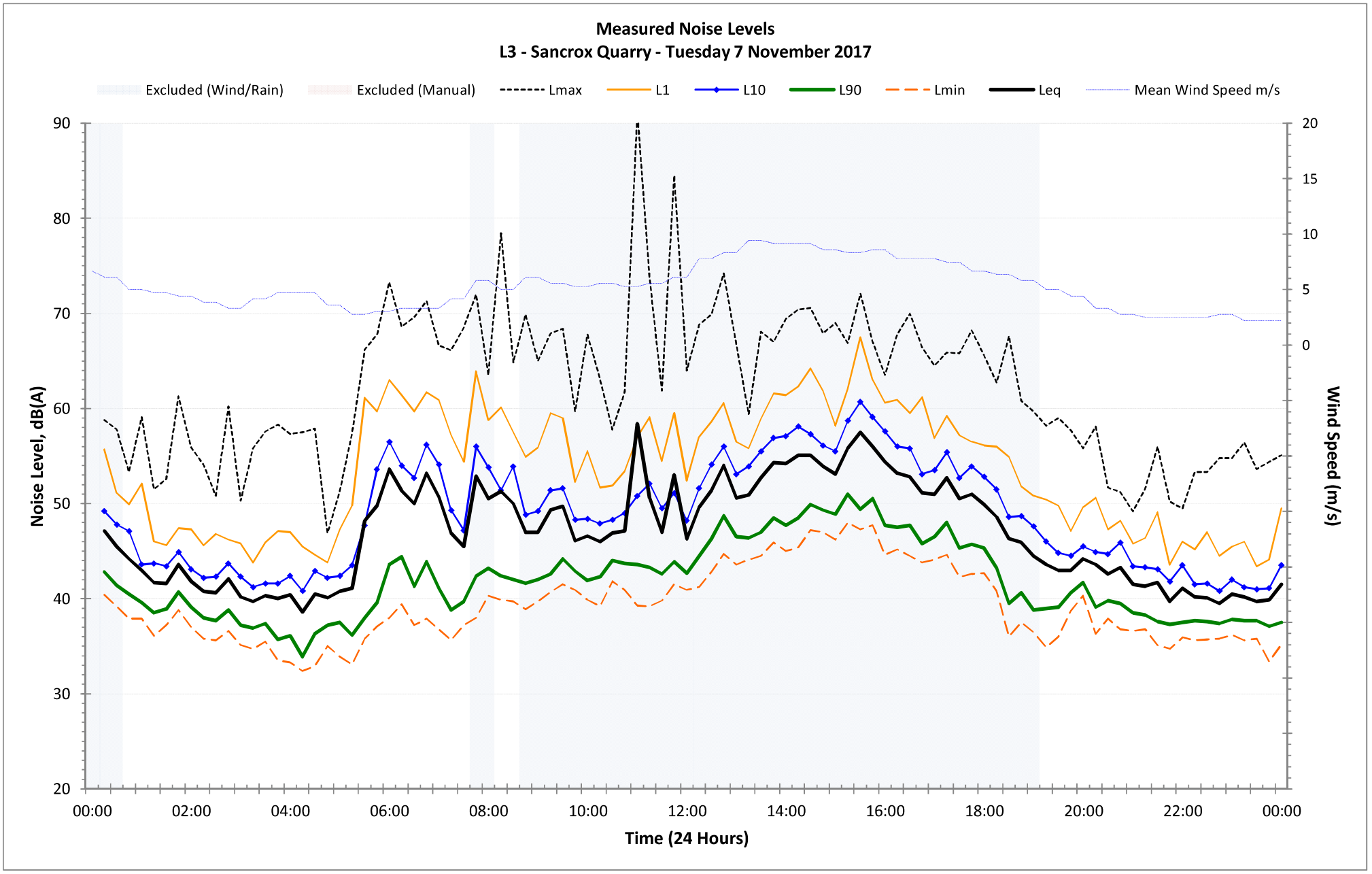
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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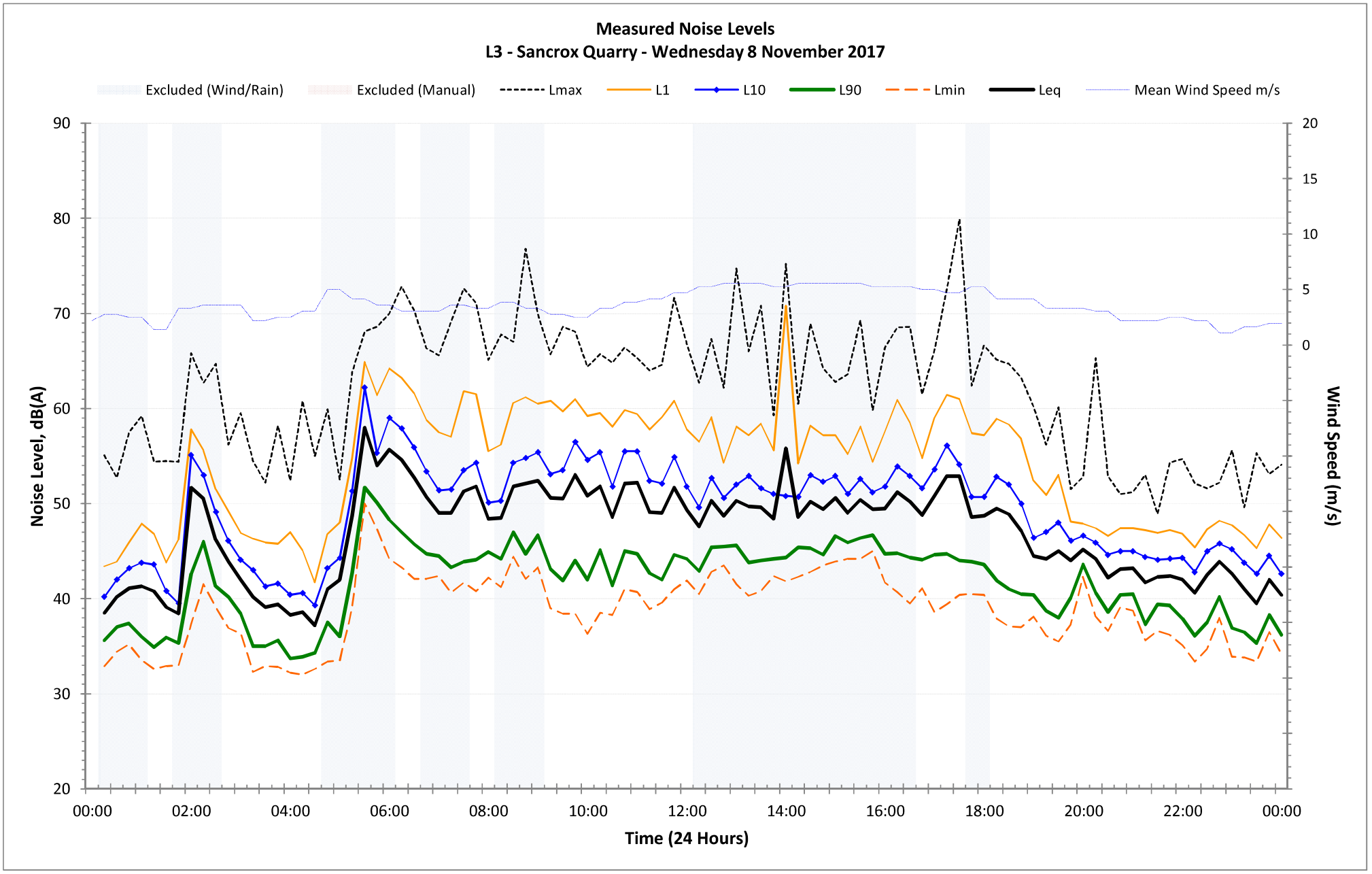
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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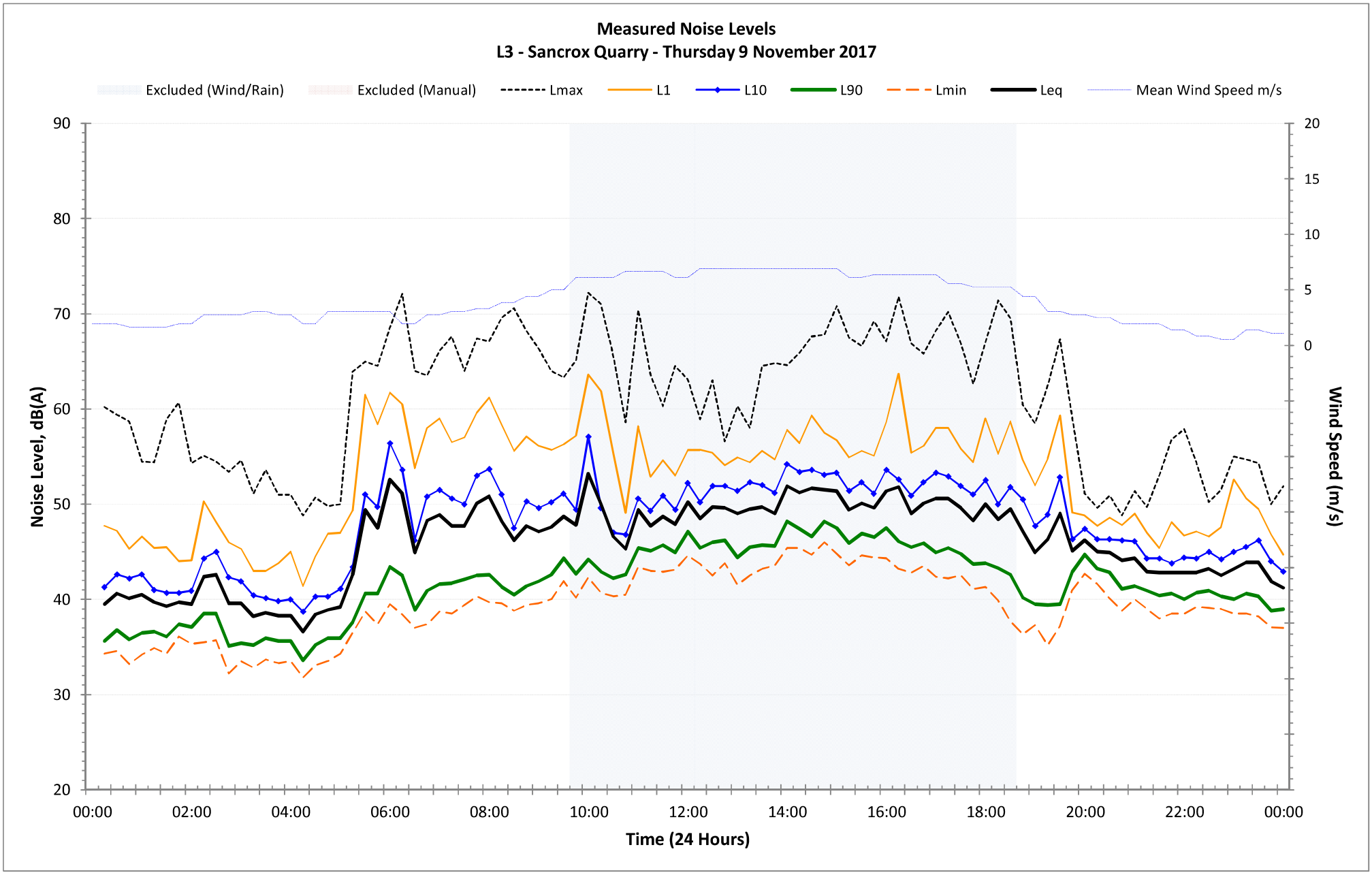
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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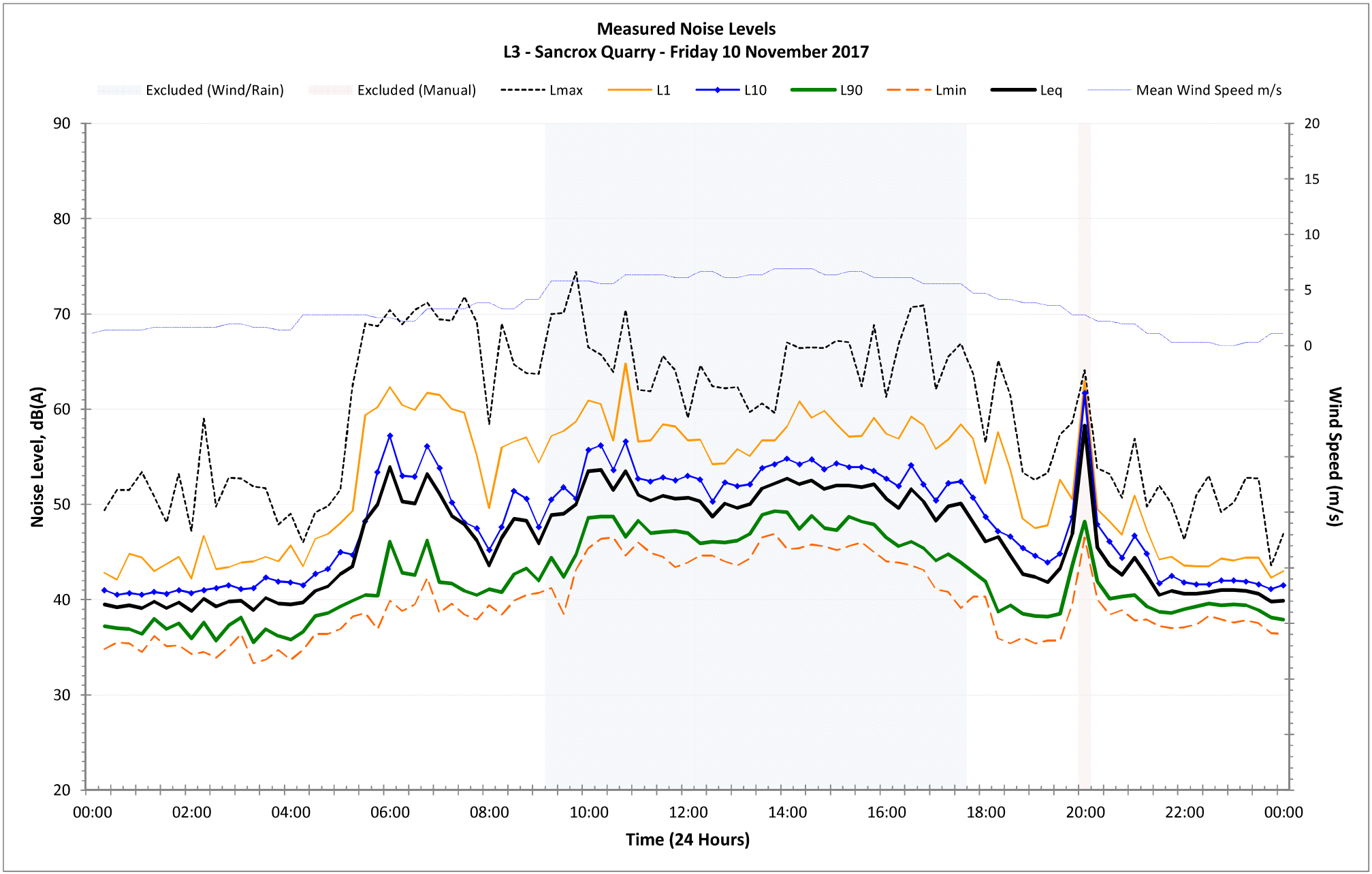
Measured Noise Levels
L3 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
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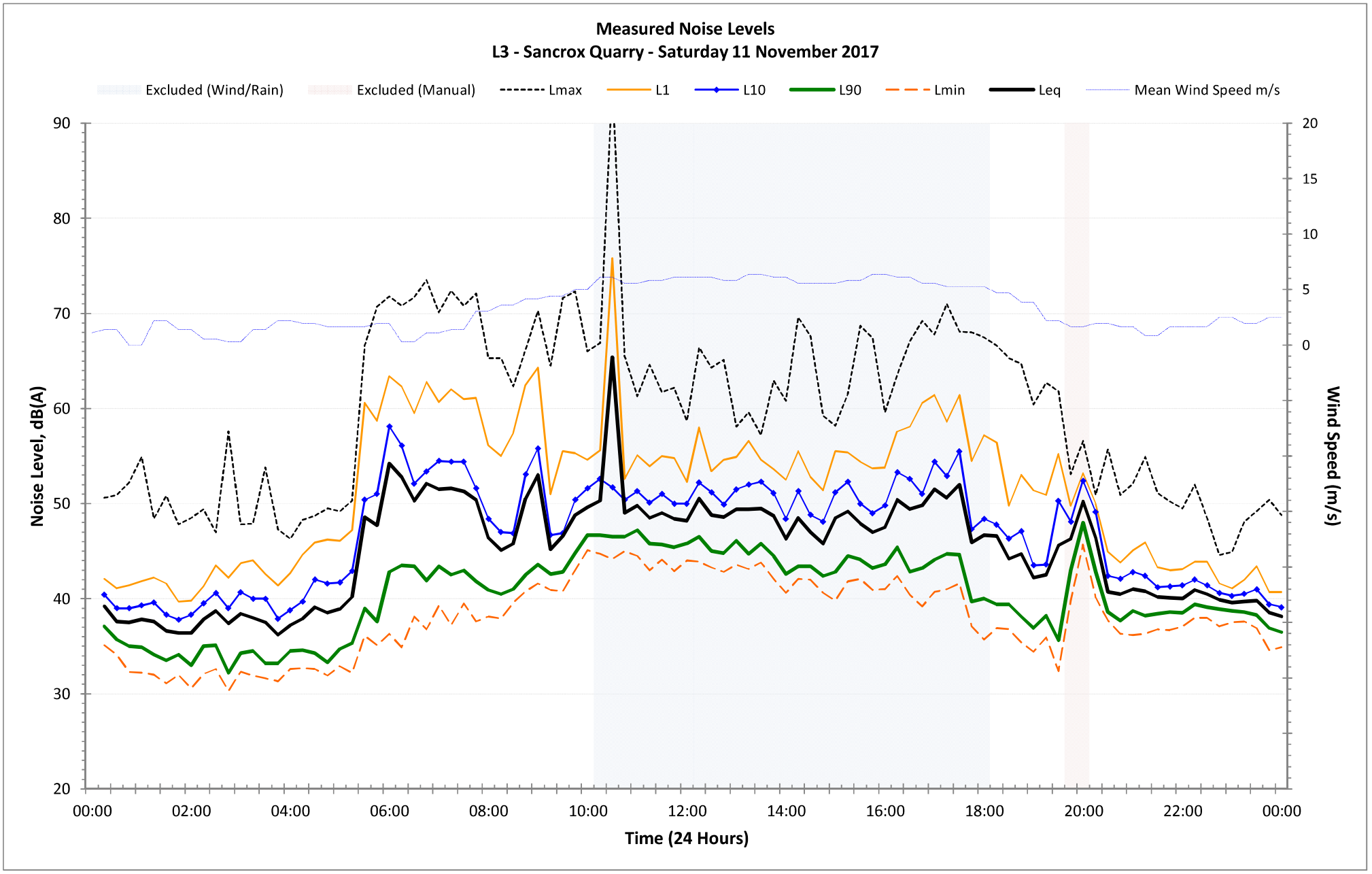
Time (24 Hours)


Measured Noise Levels
L3 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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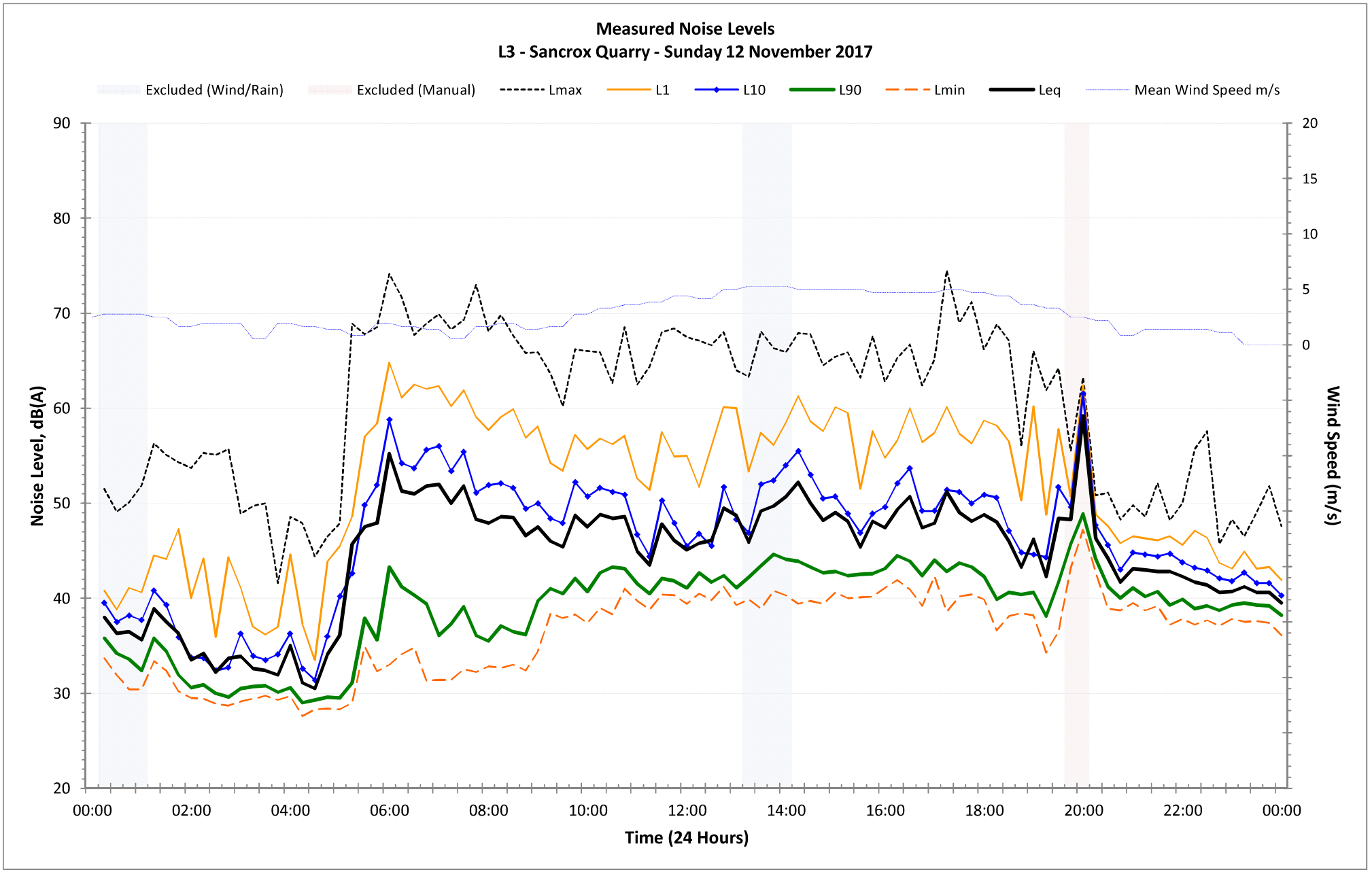
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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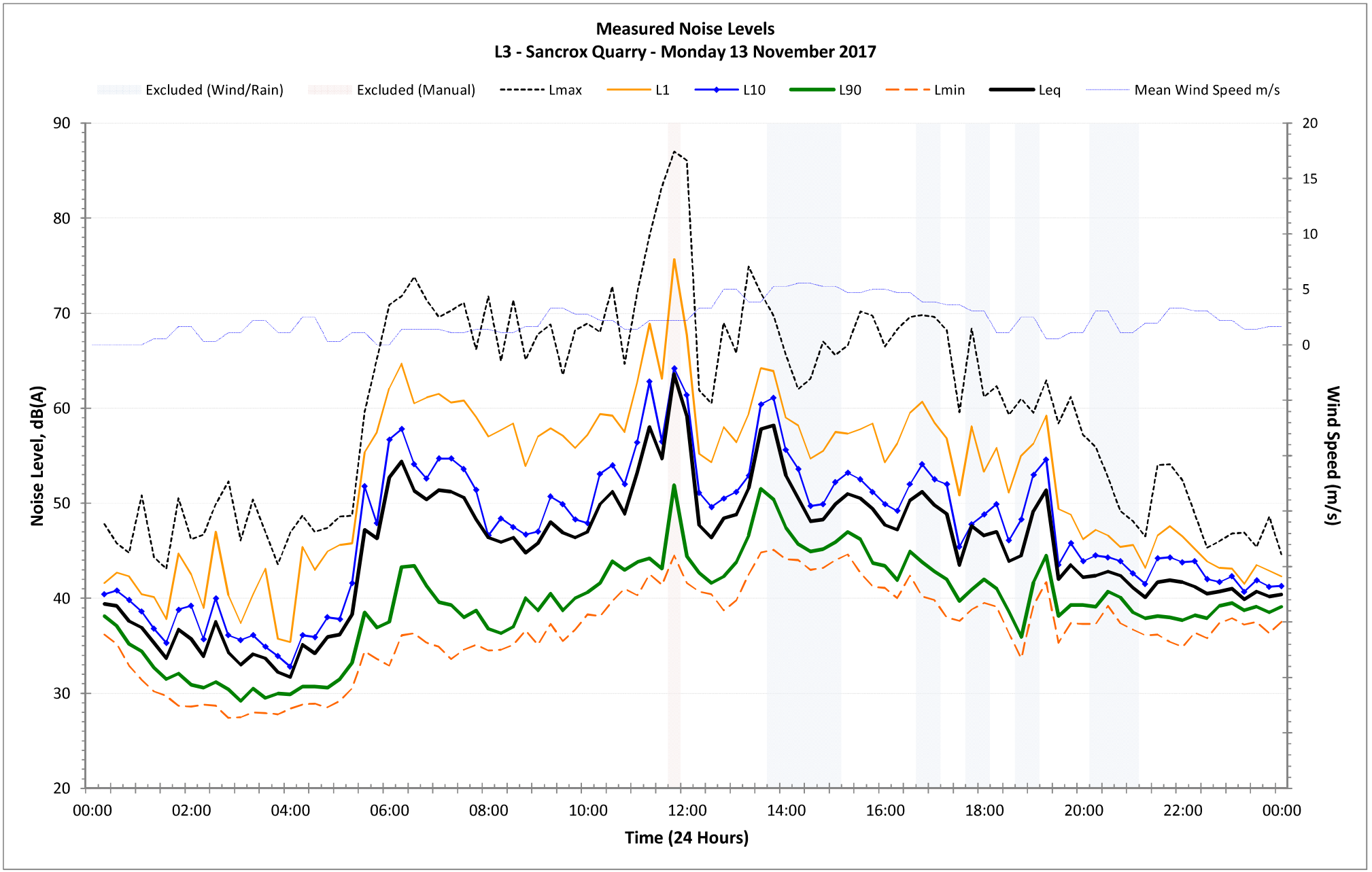
Measured Noise Levels
L3 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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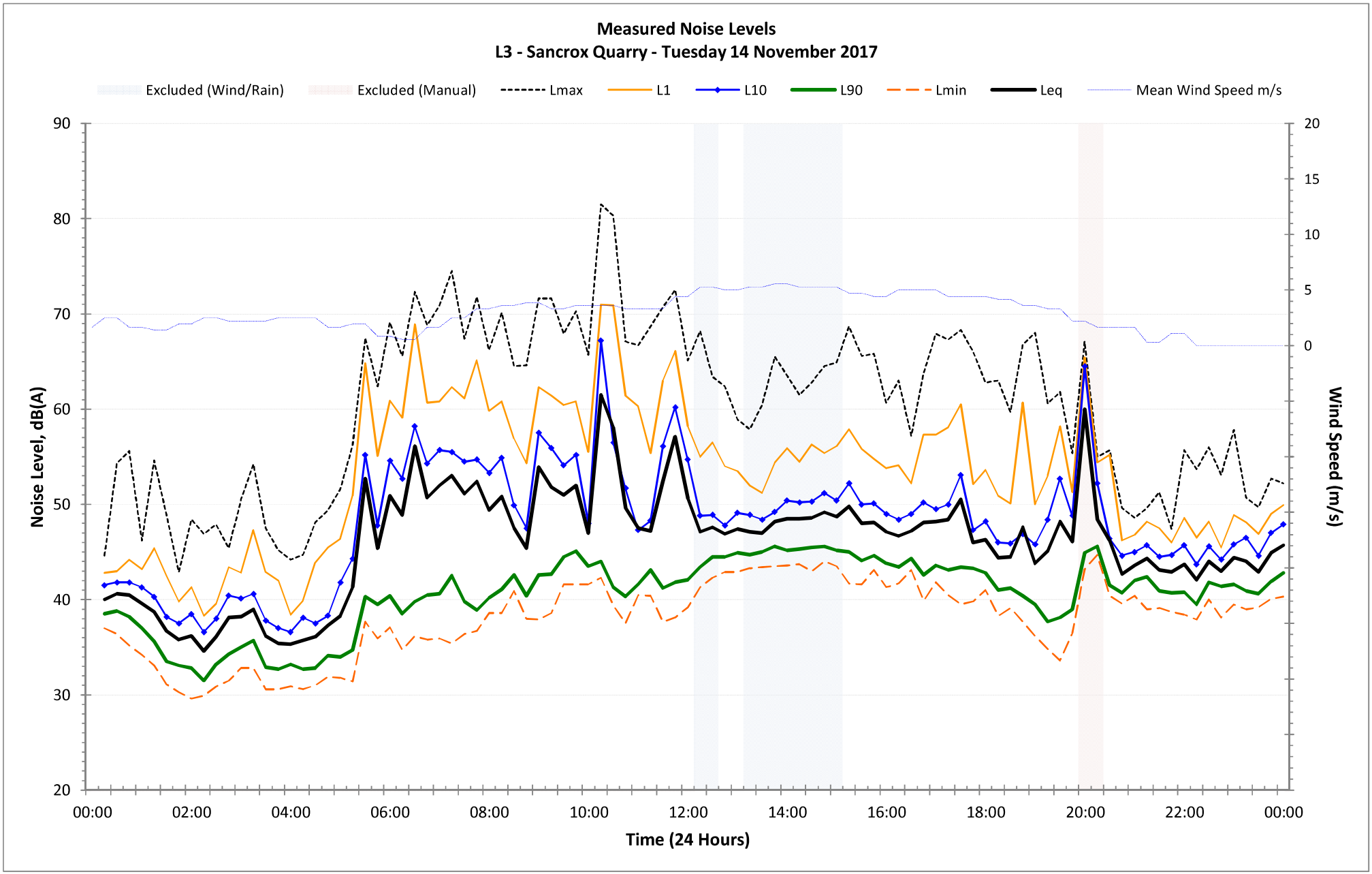
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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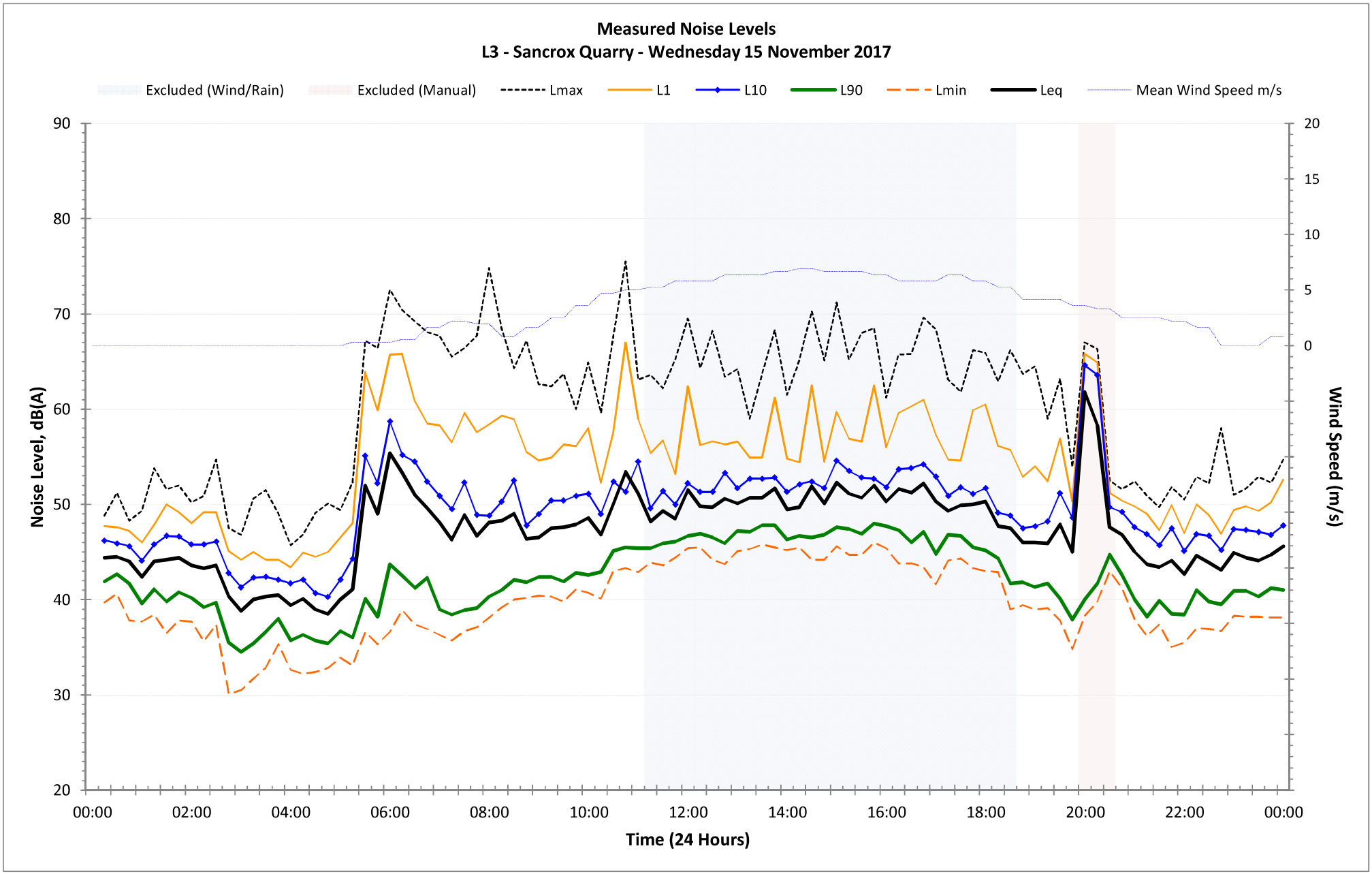
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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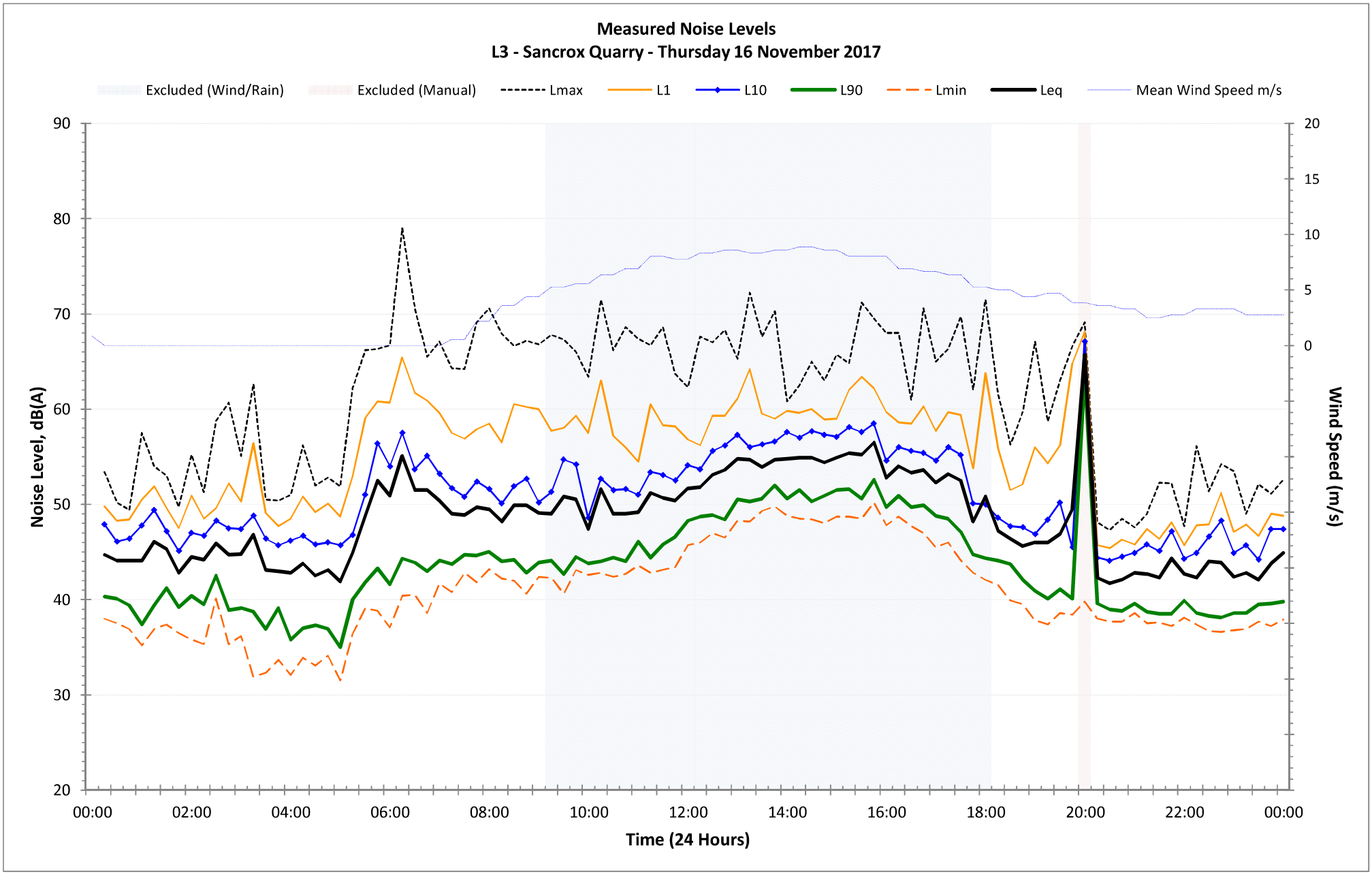
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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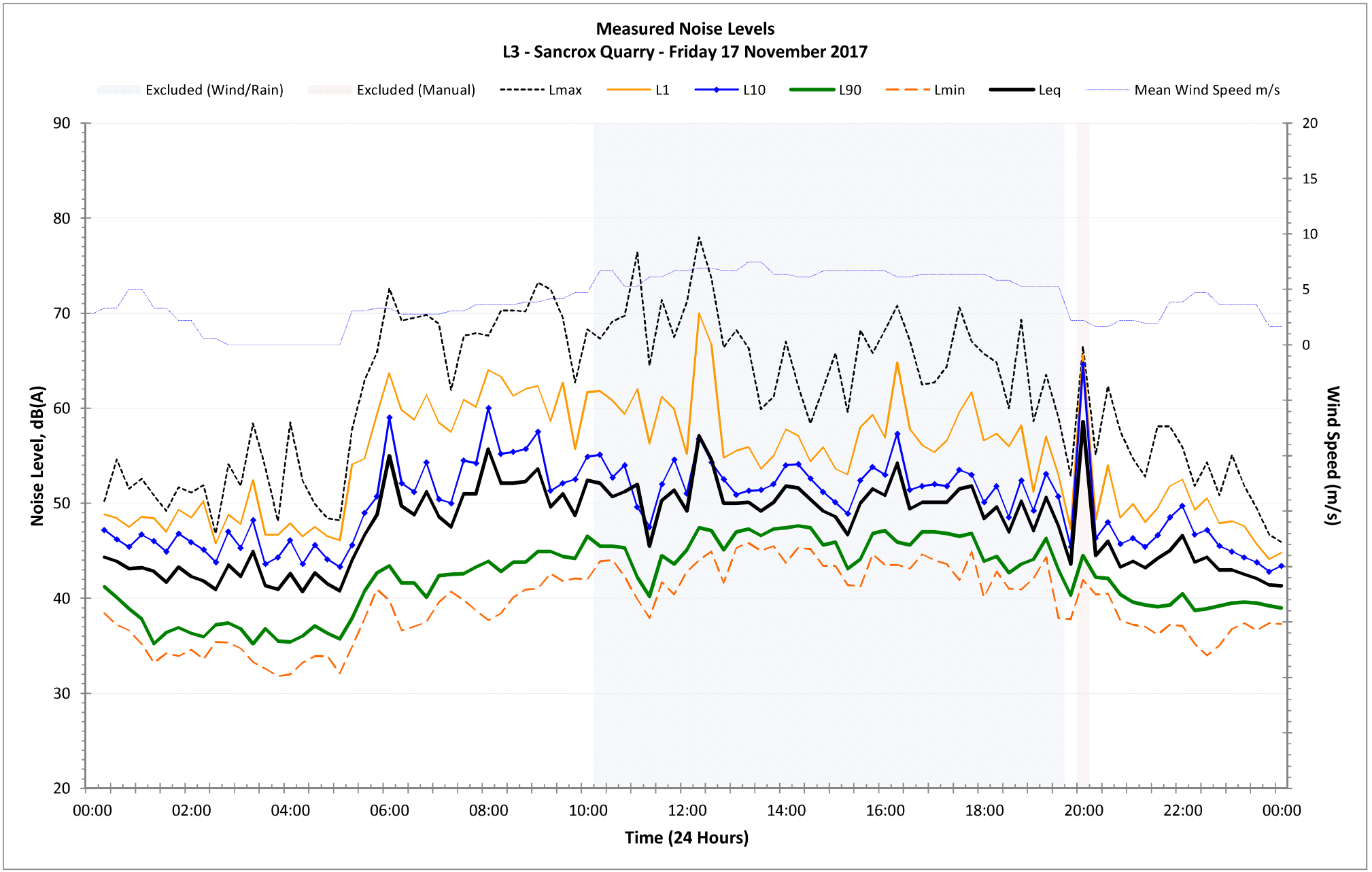
Measured Noise Levels
L3 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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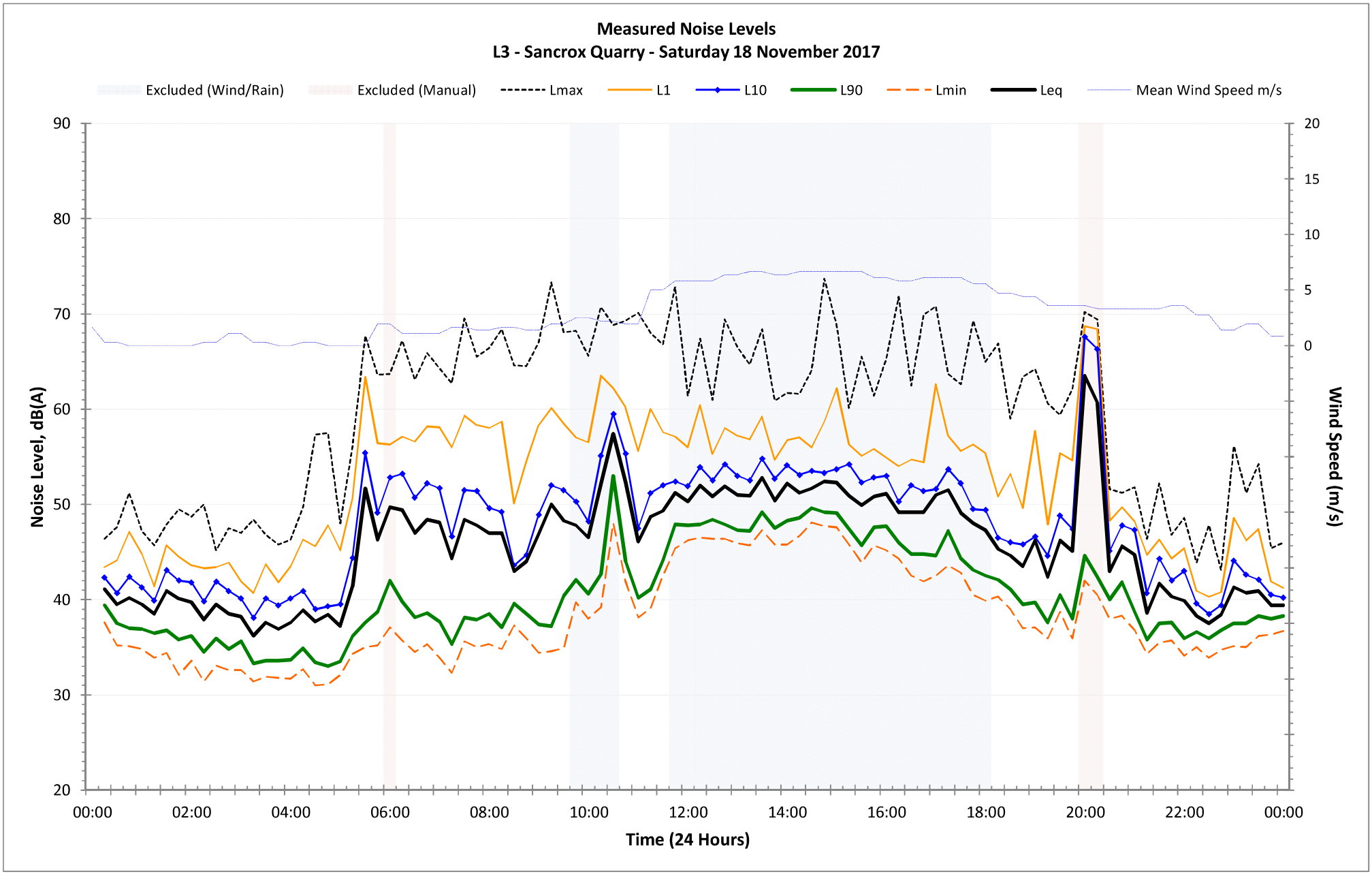
Measured Noise Levels
L3 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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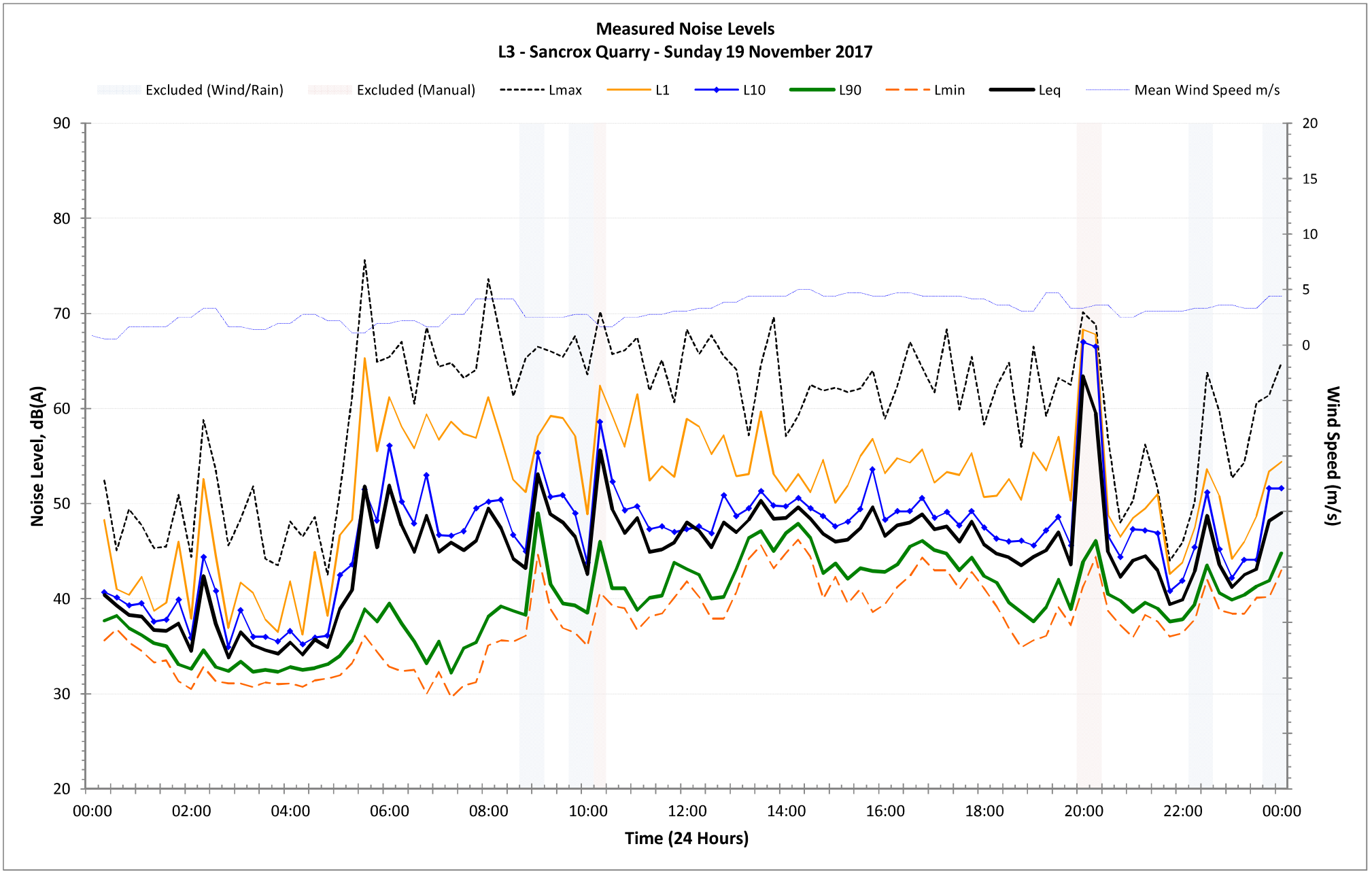
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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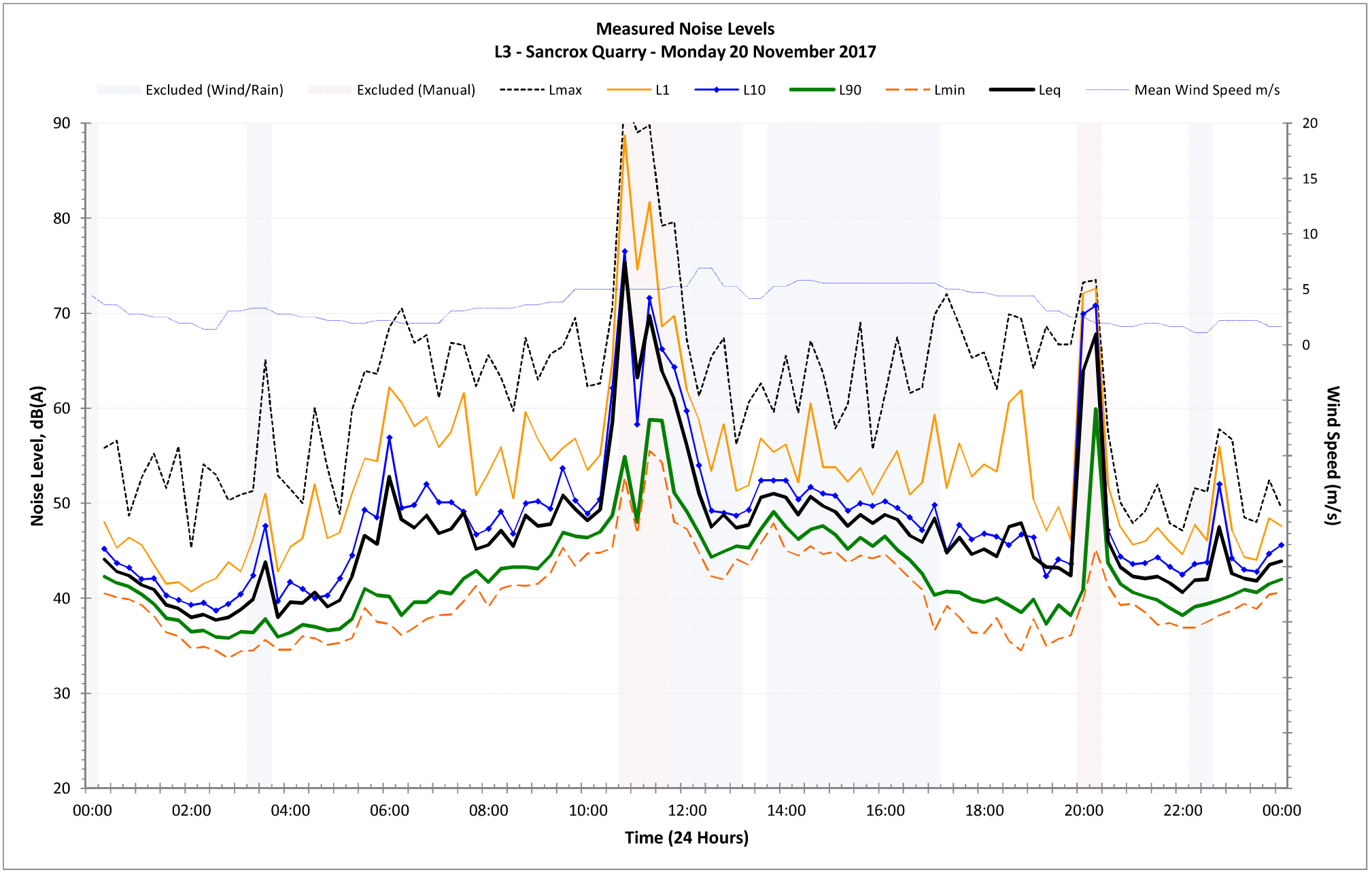
Measured Noise Levels
L3 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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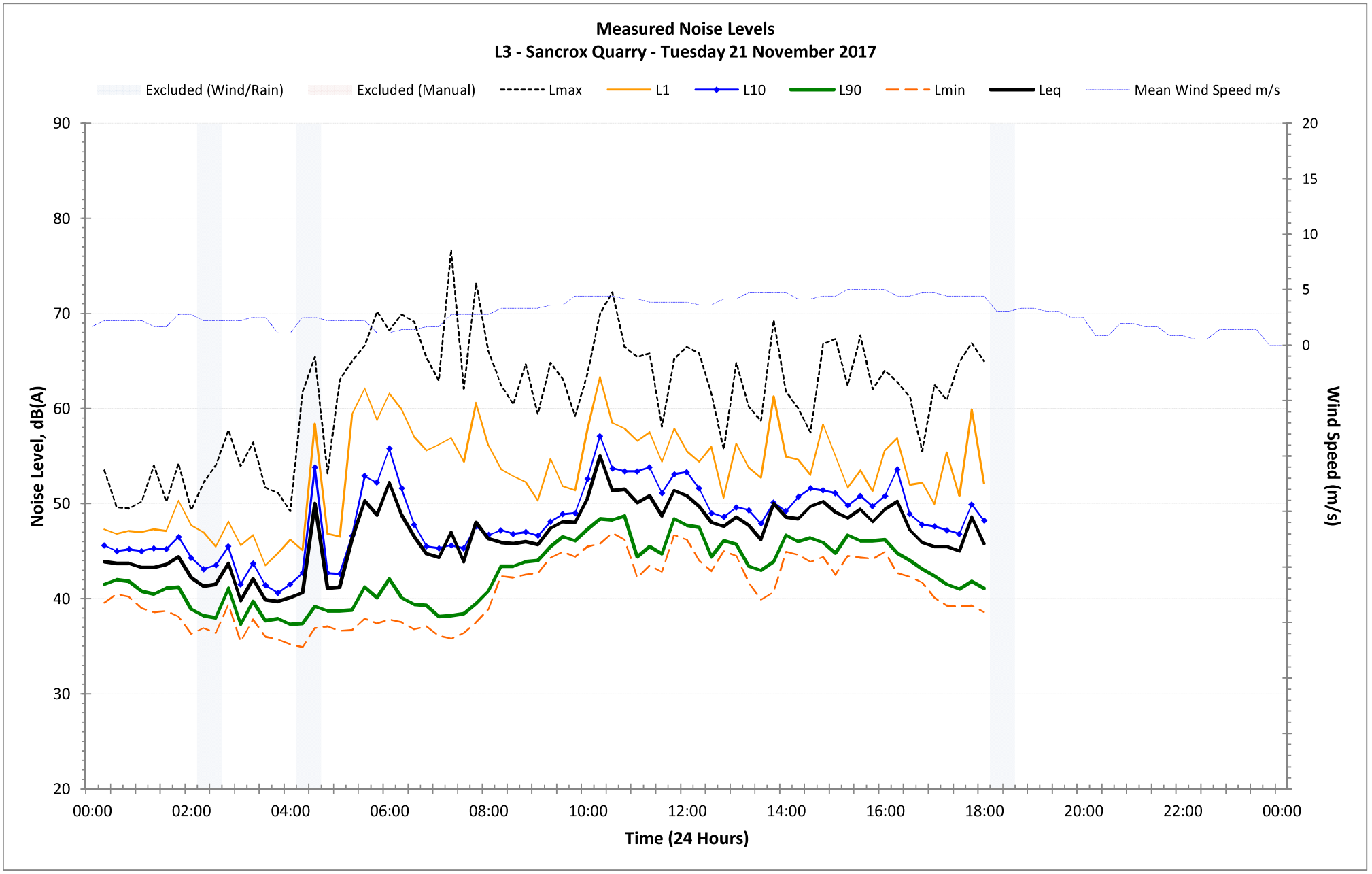
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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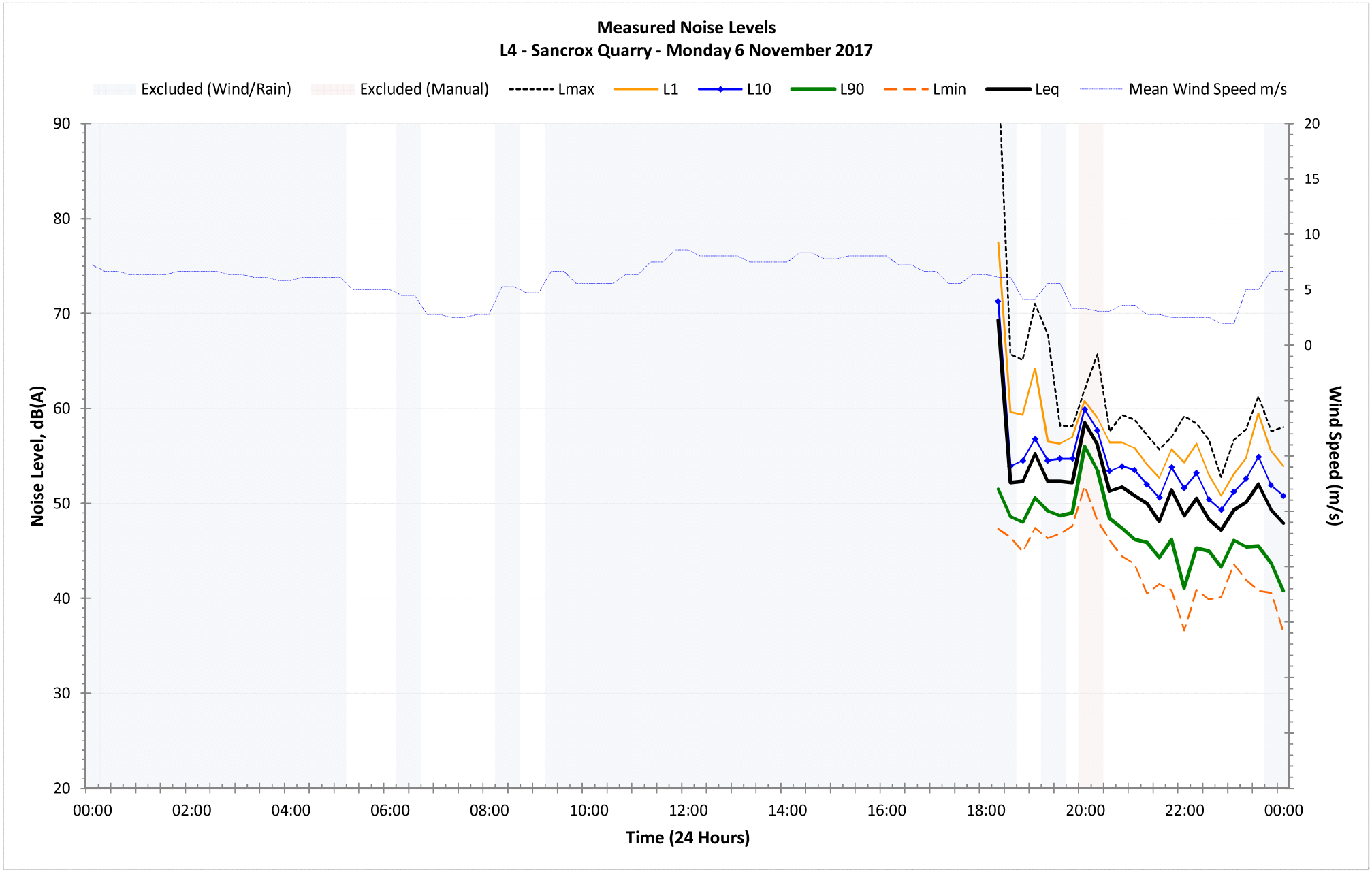
Measured Noise Levels
L4 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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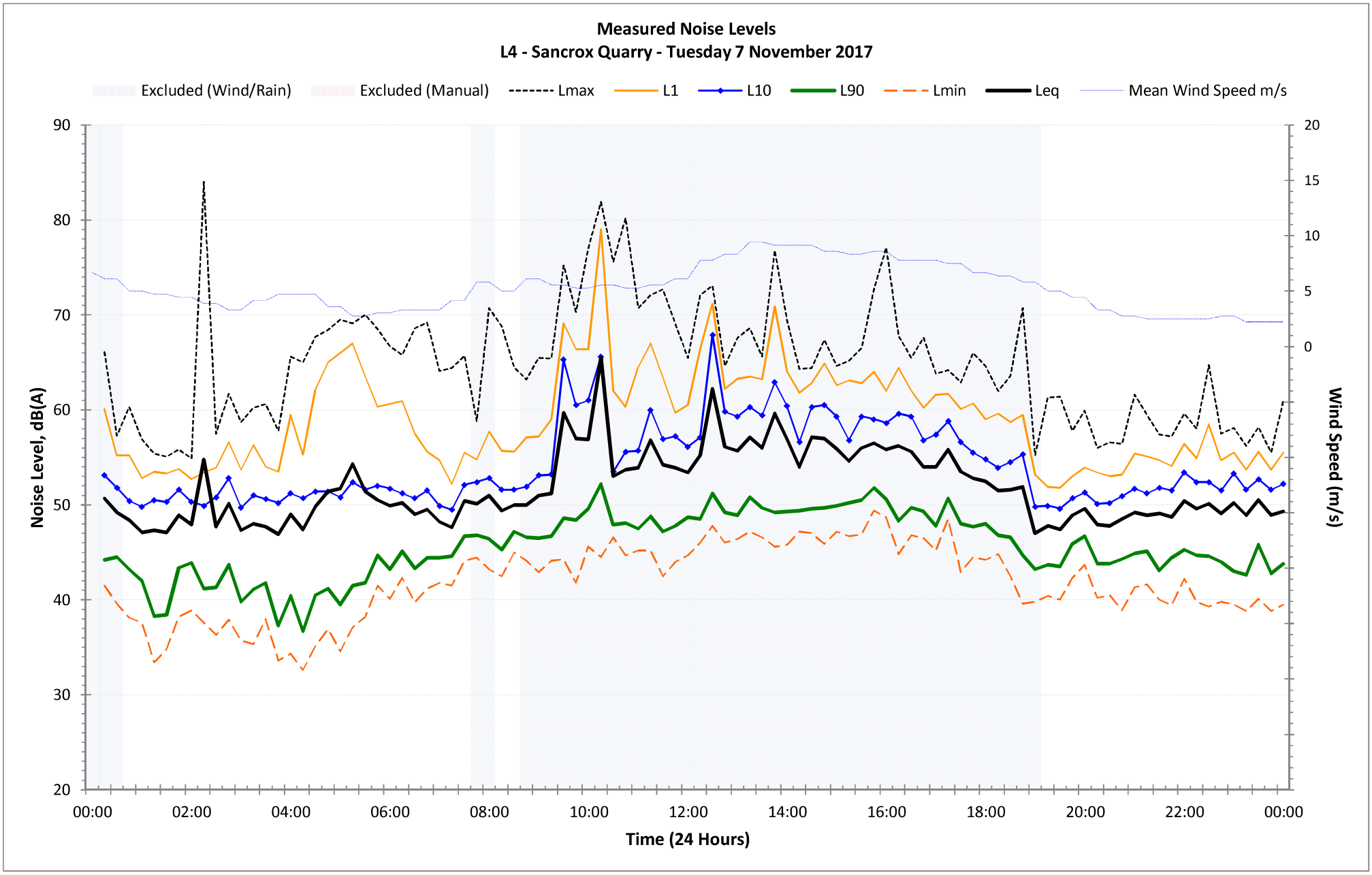
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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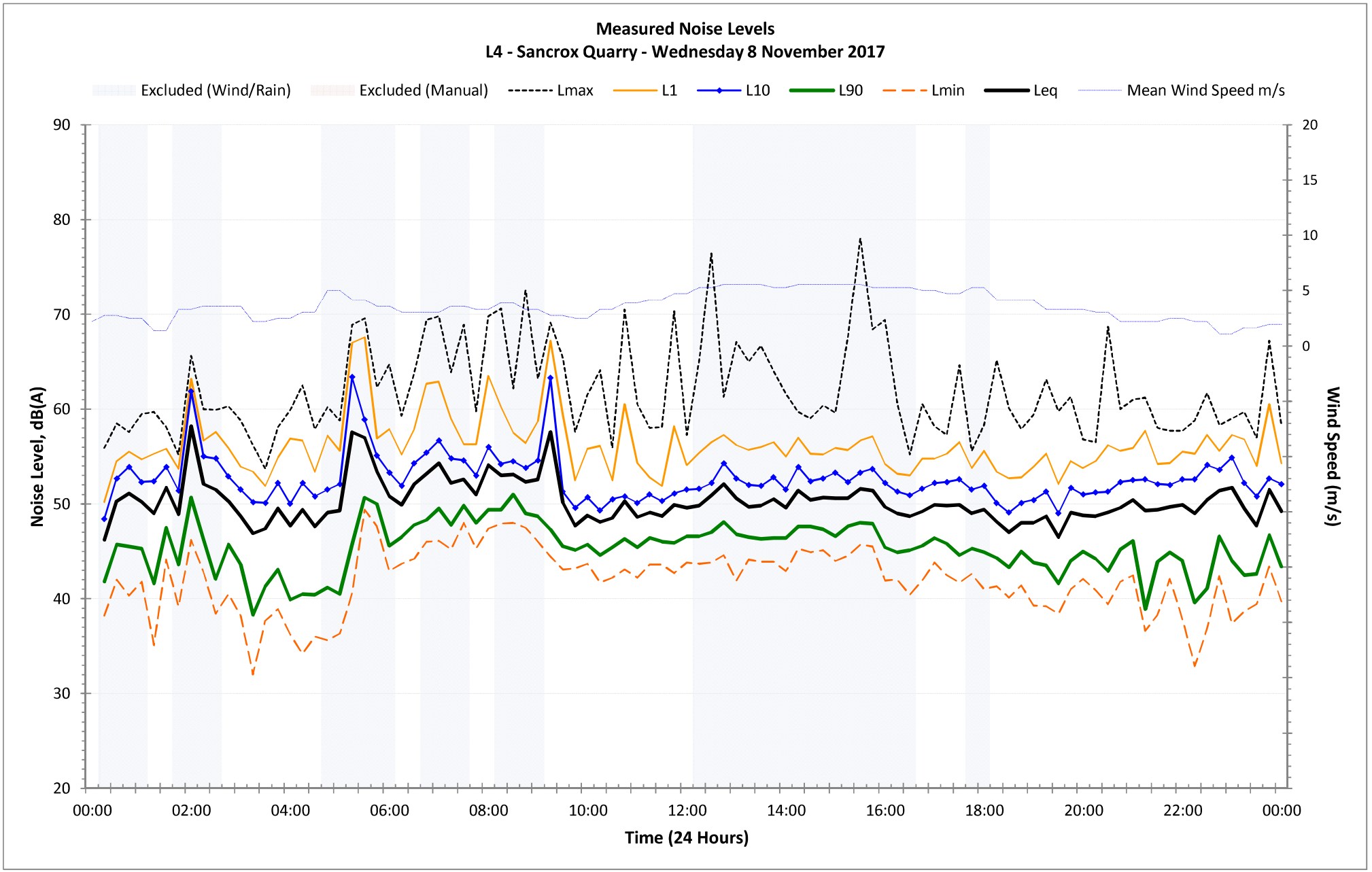
Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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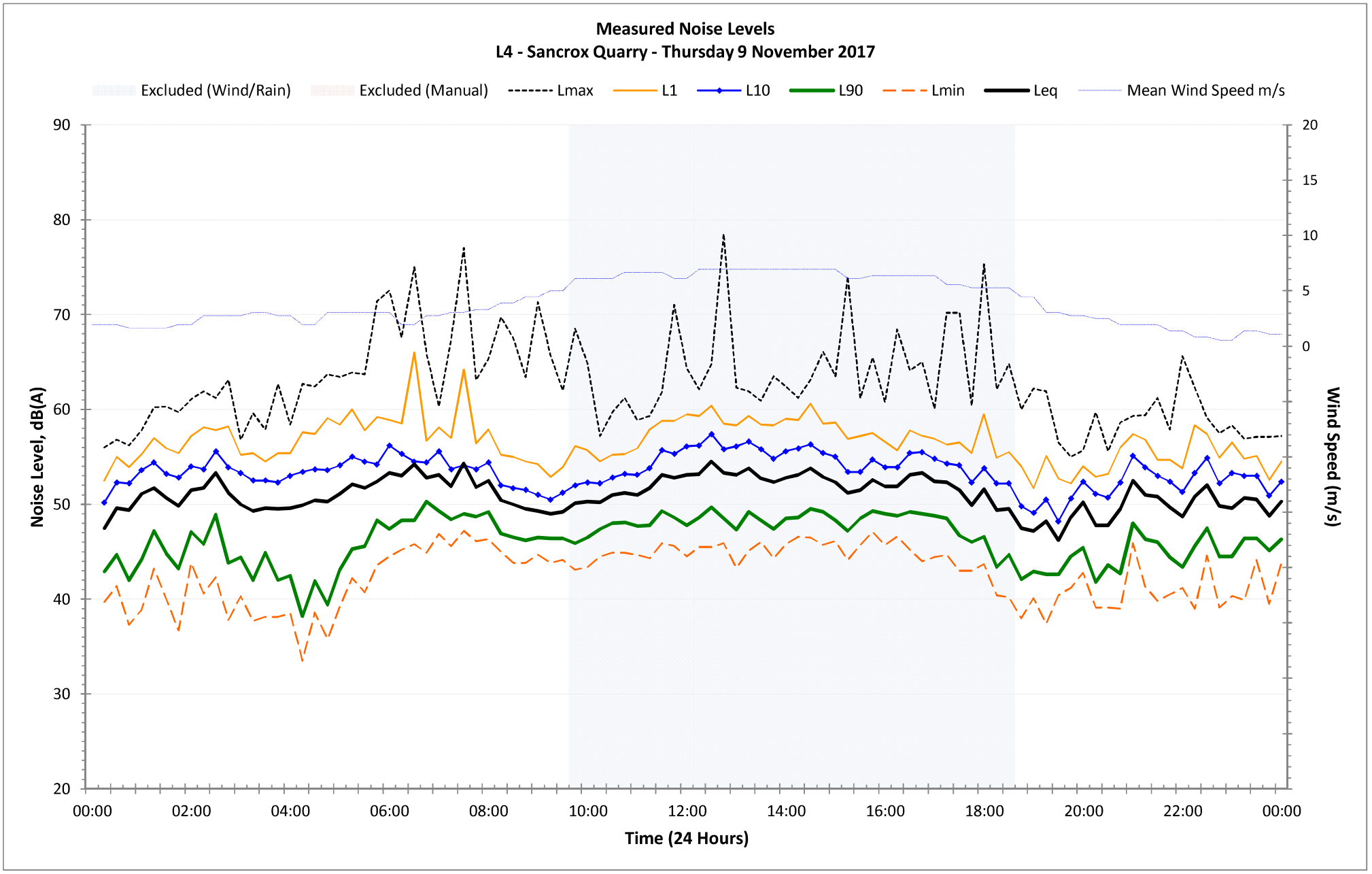
Measured Noise Levels
L4 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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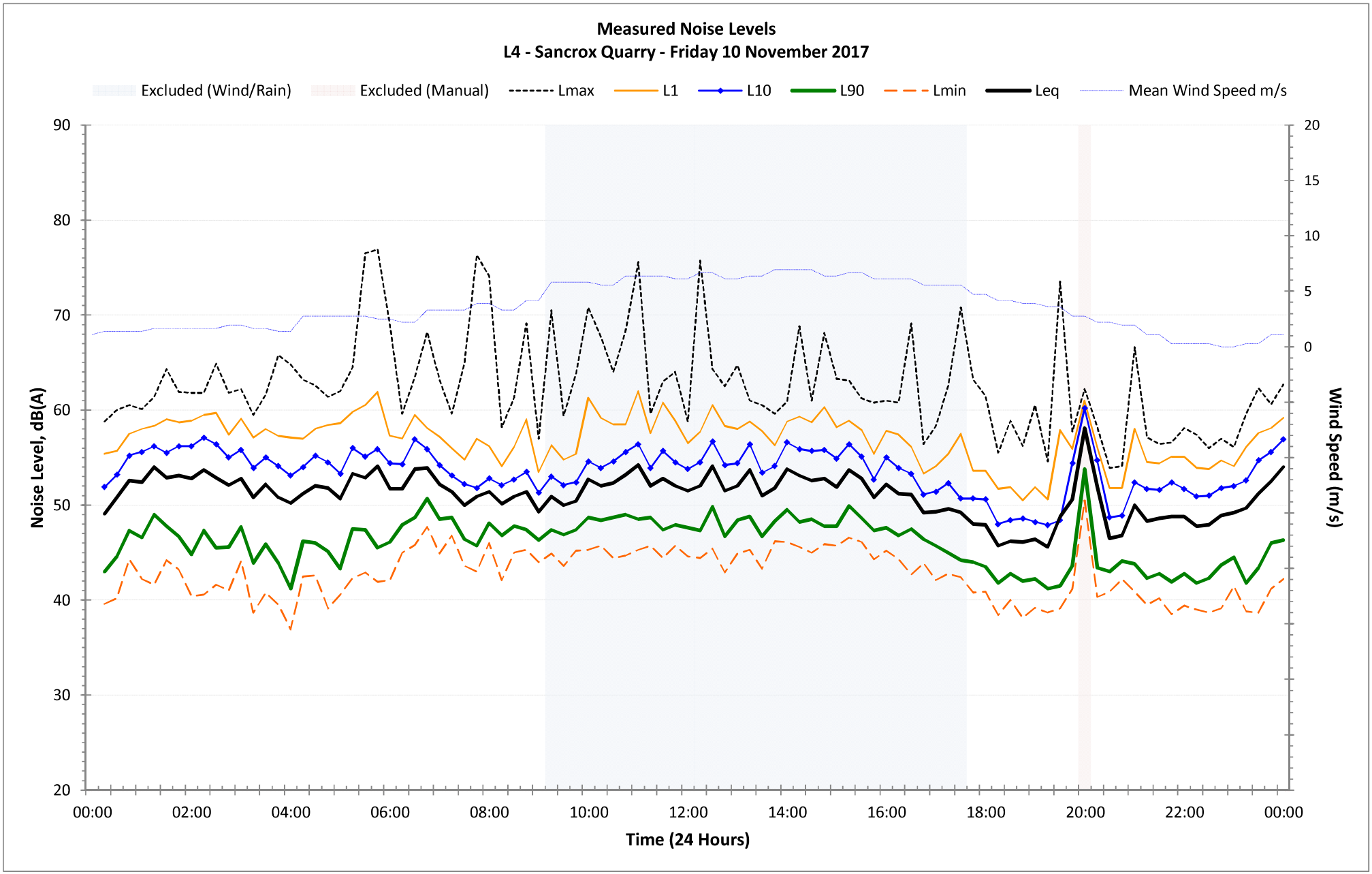
Measured Noise Levels
L4 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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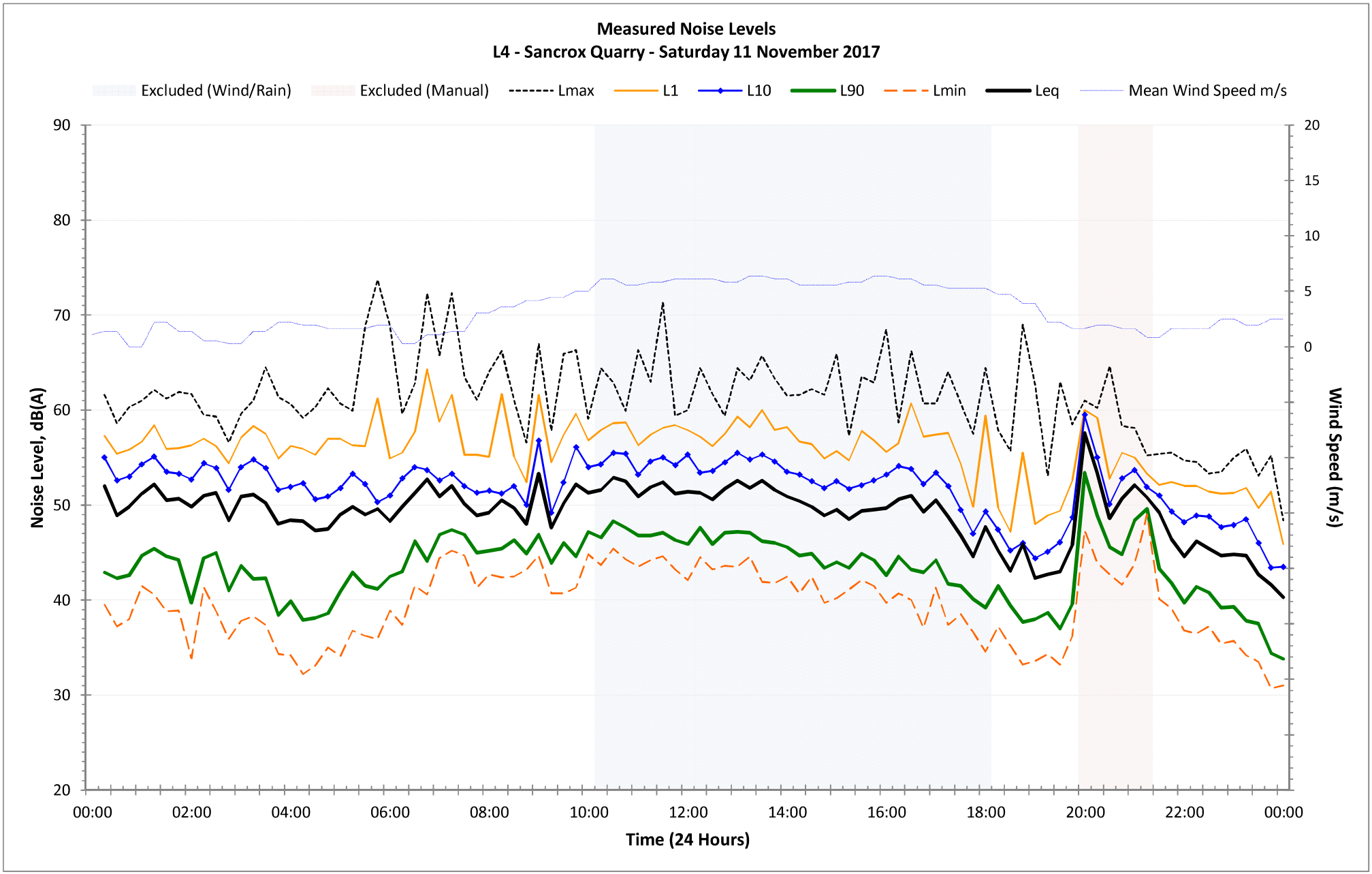
Measured Noise Levels
L4 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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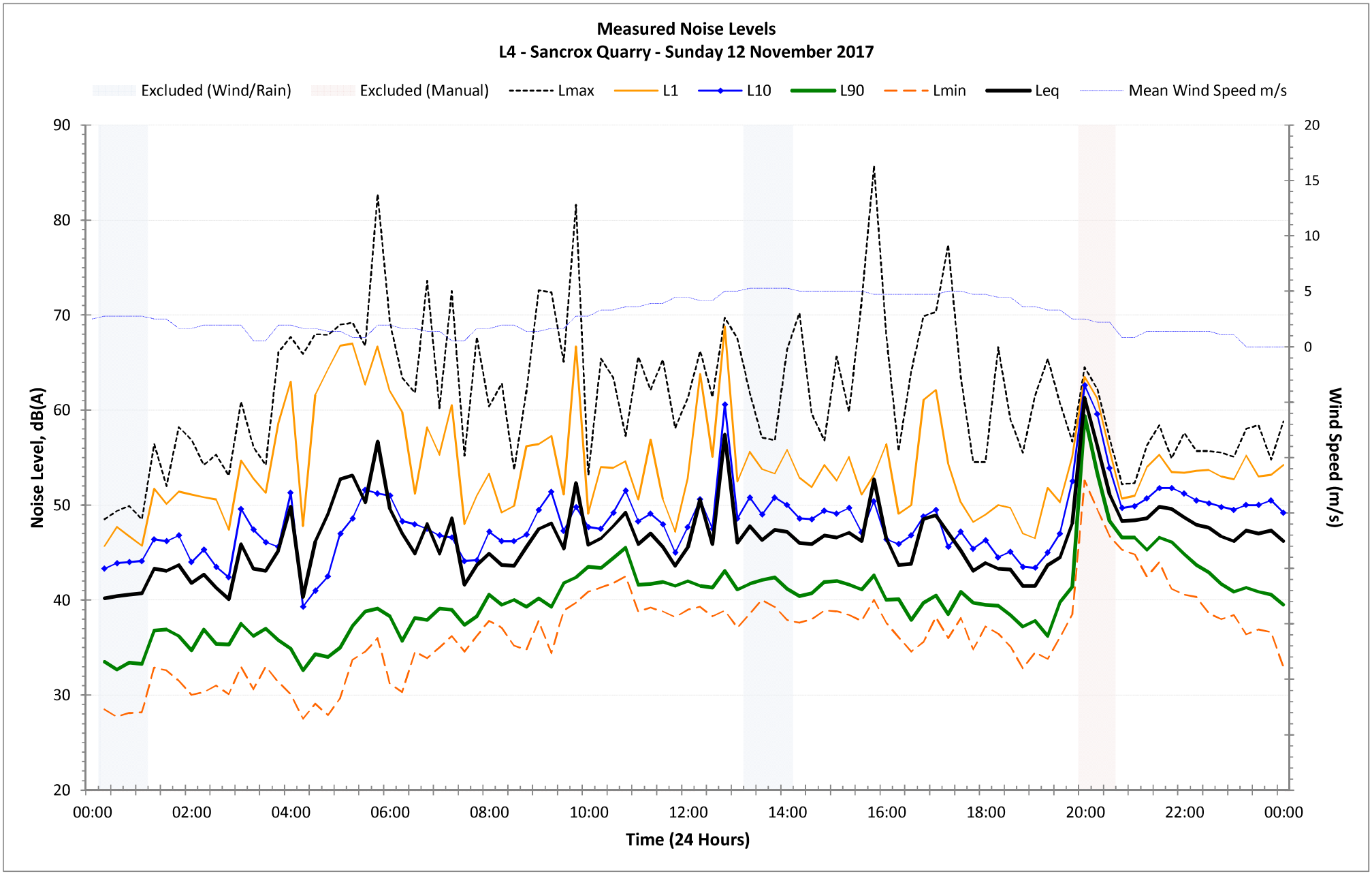
Measured Noise Levels
L4 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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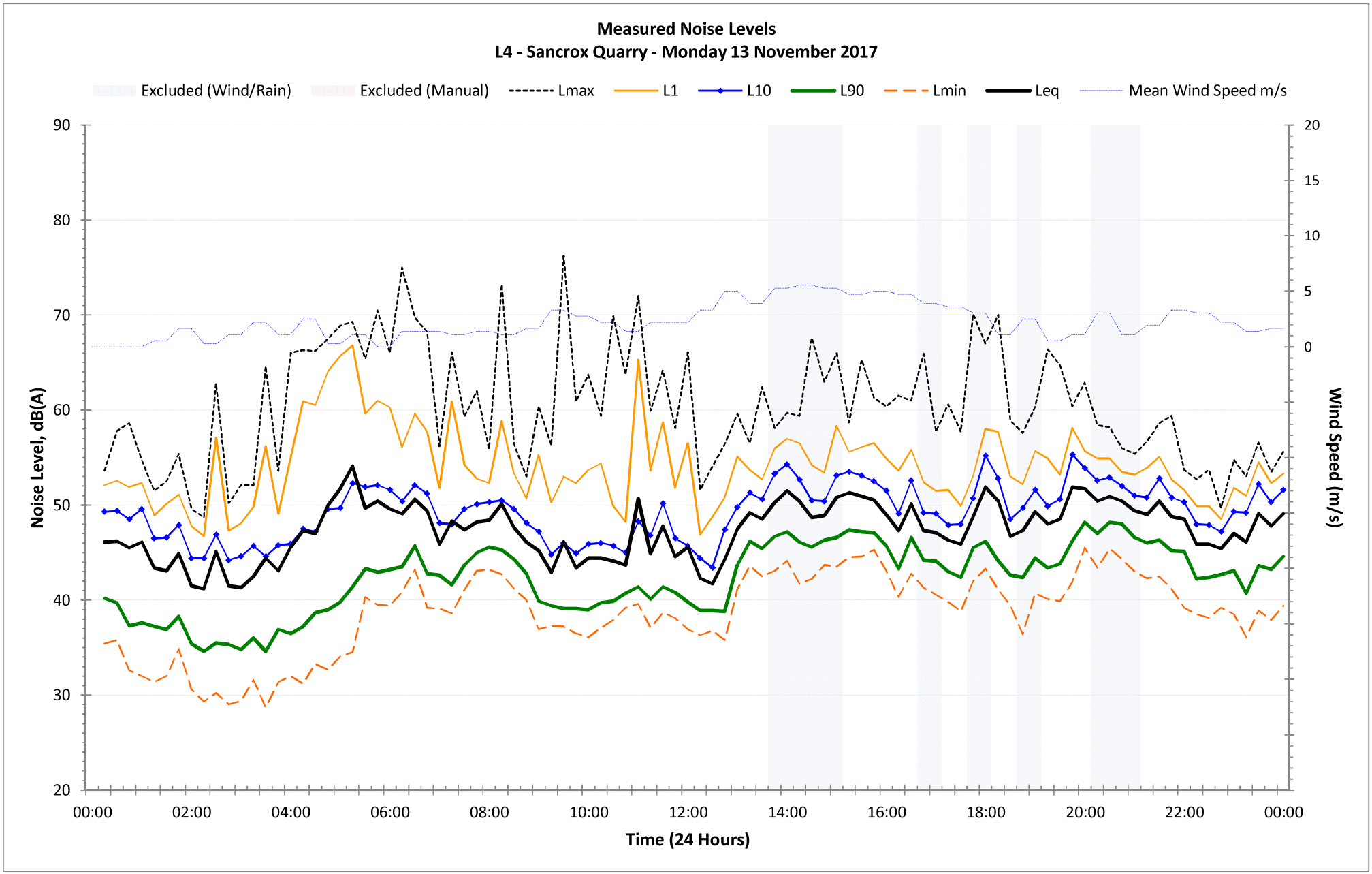
Measured Noise Levels
L4 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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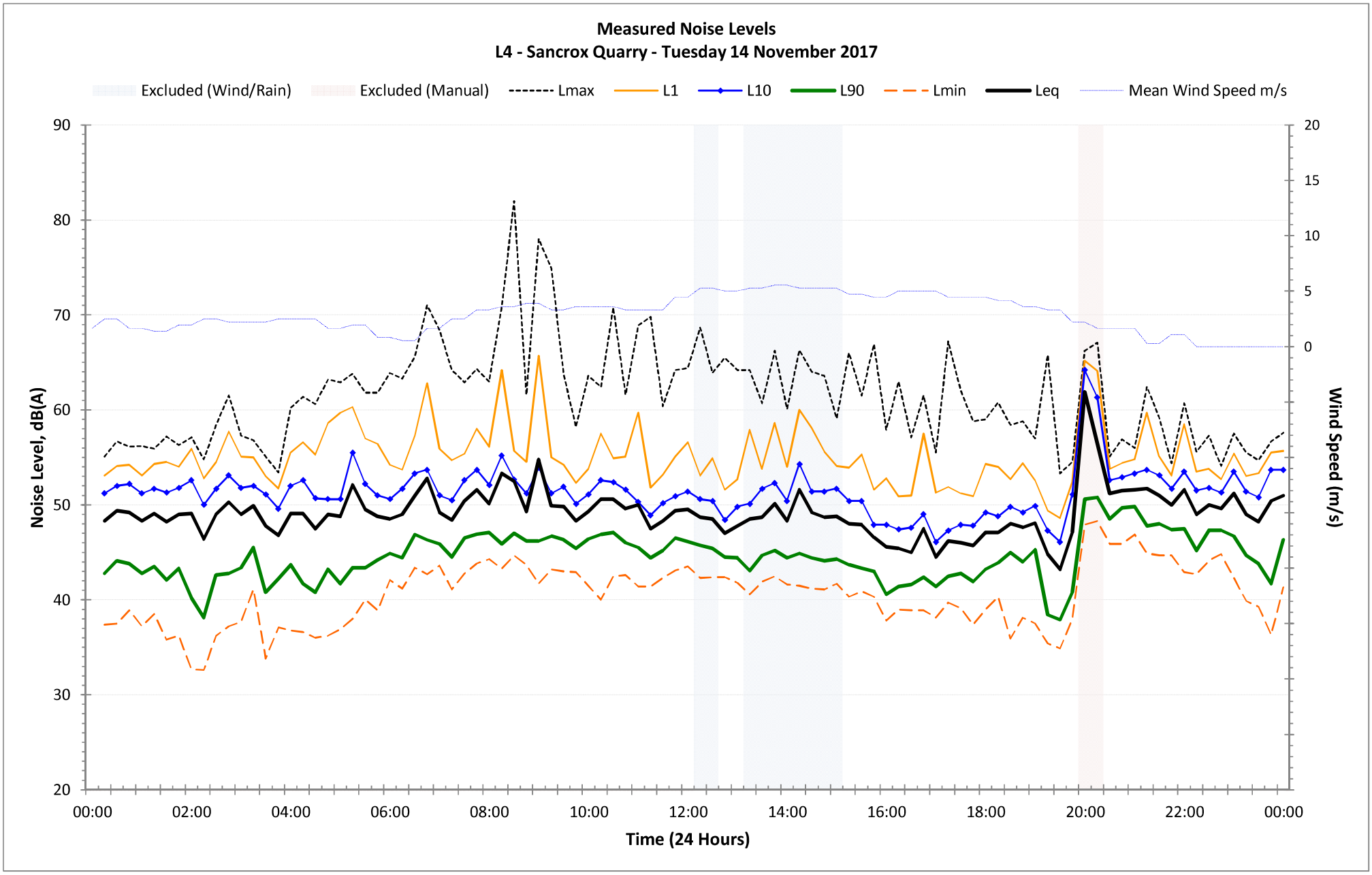
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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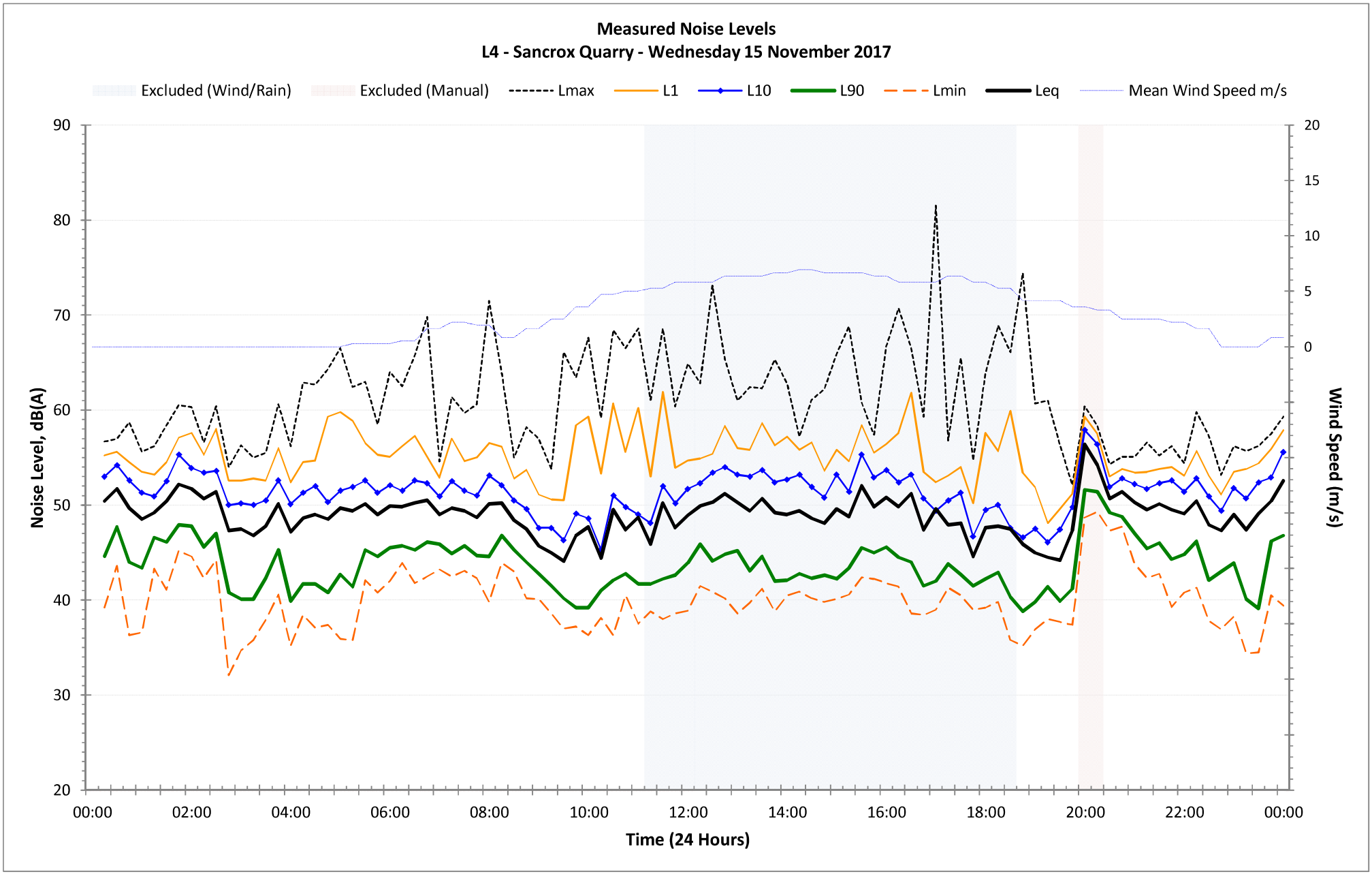
Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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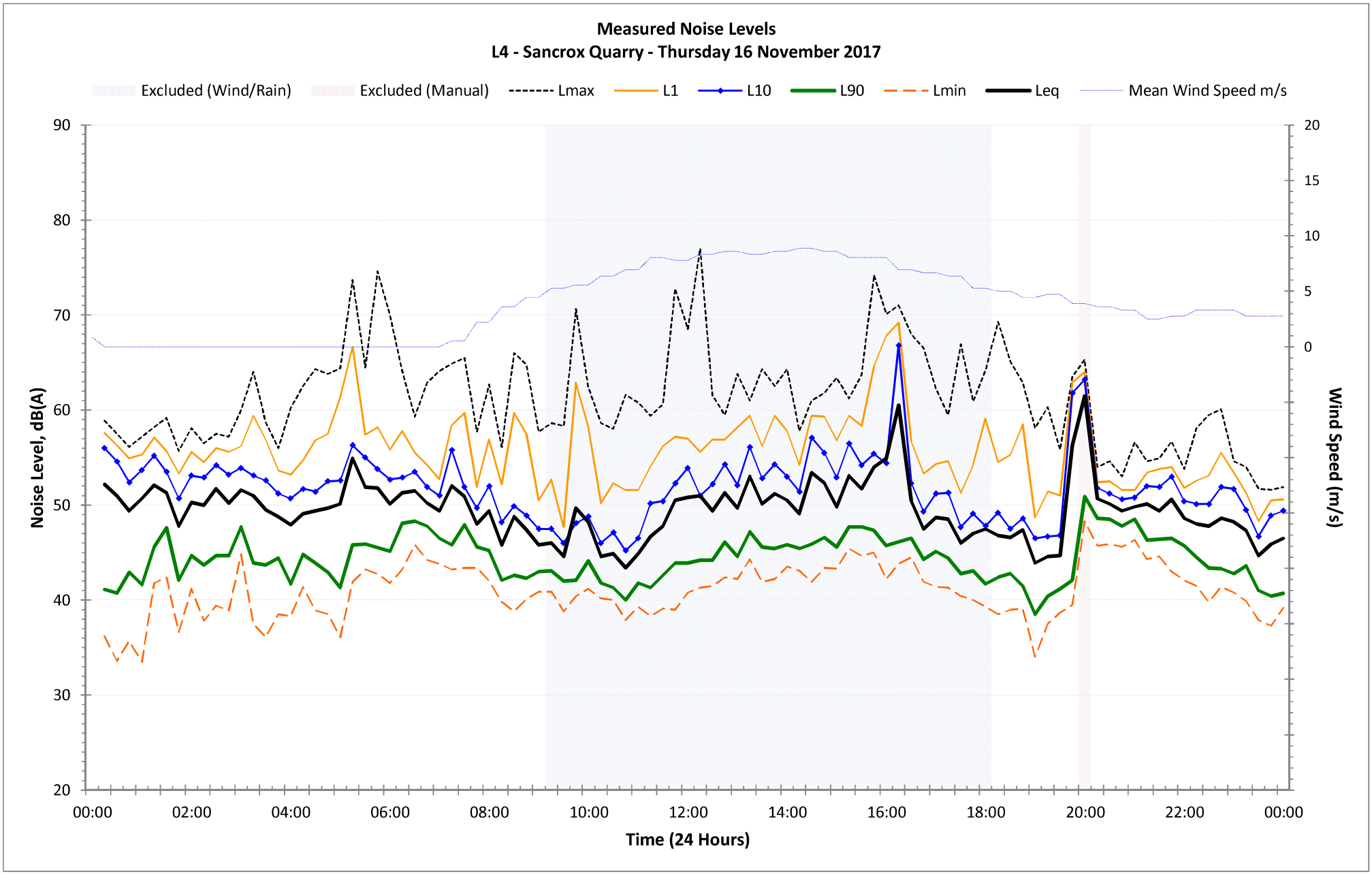
Measured Noise Levels
L4 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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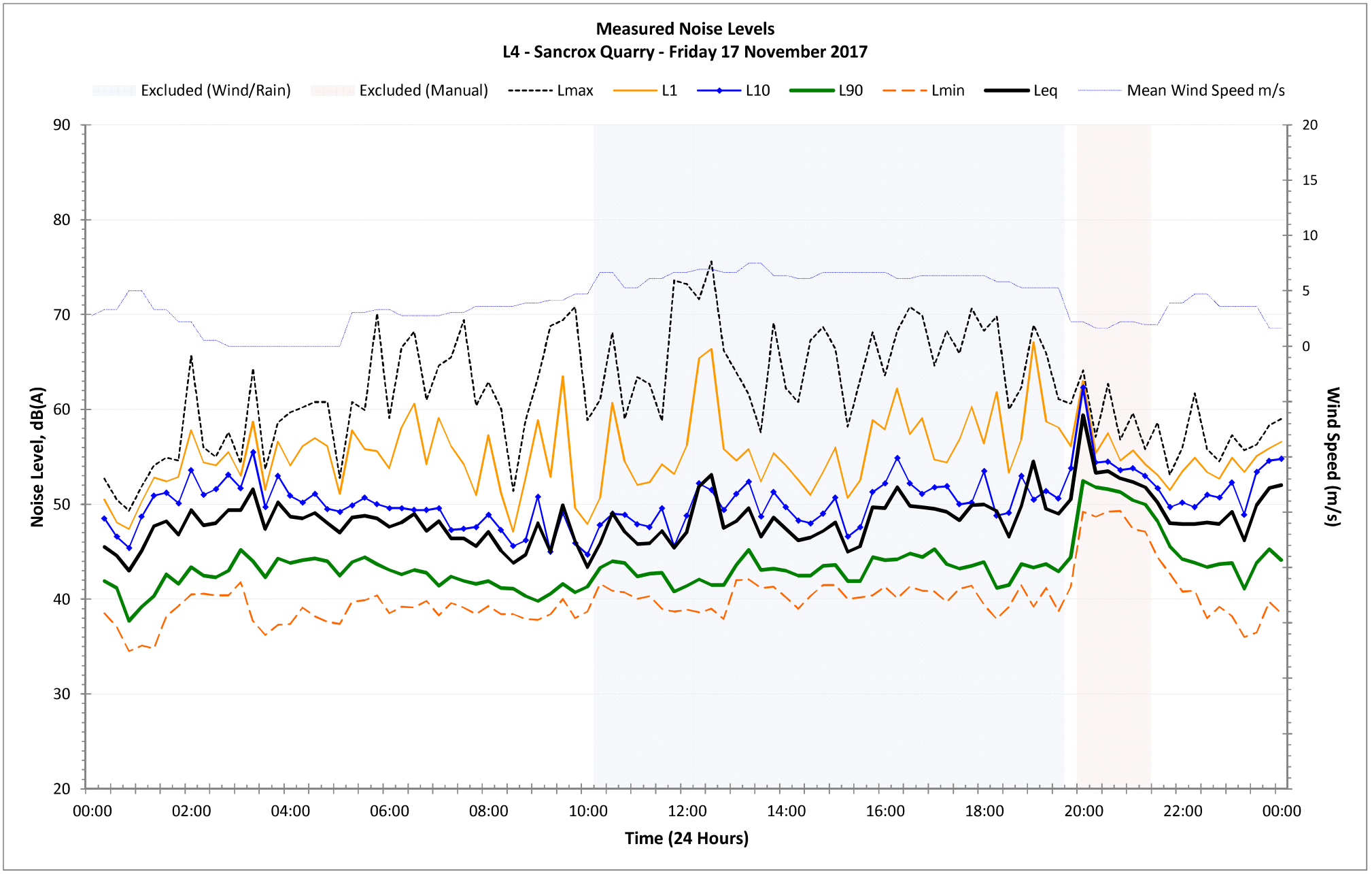
Measured Noise Levels
L4 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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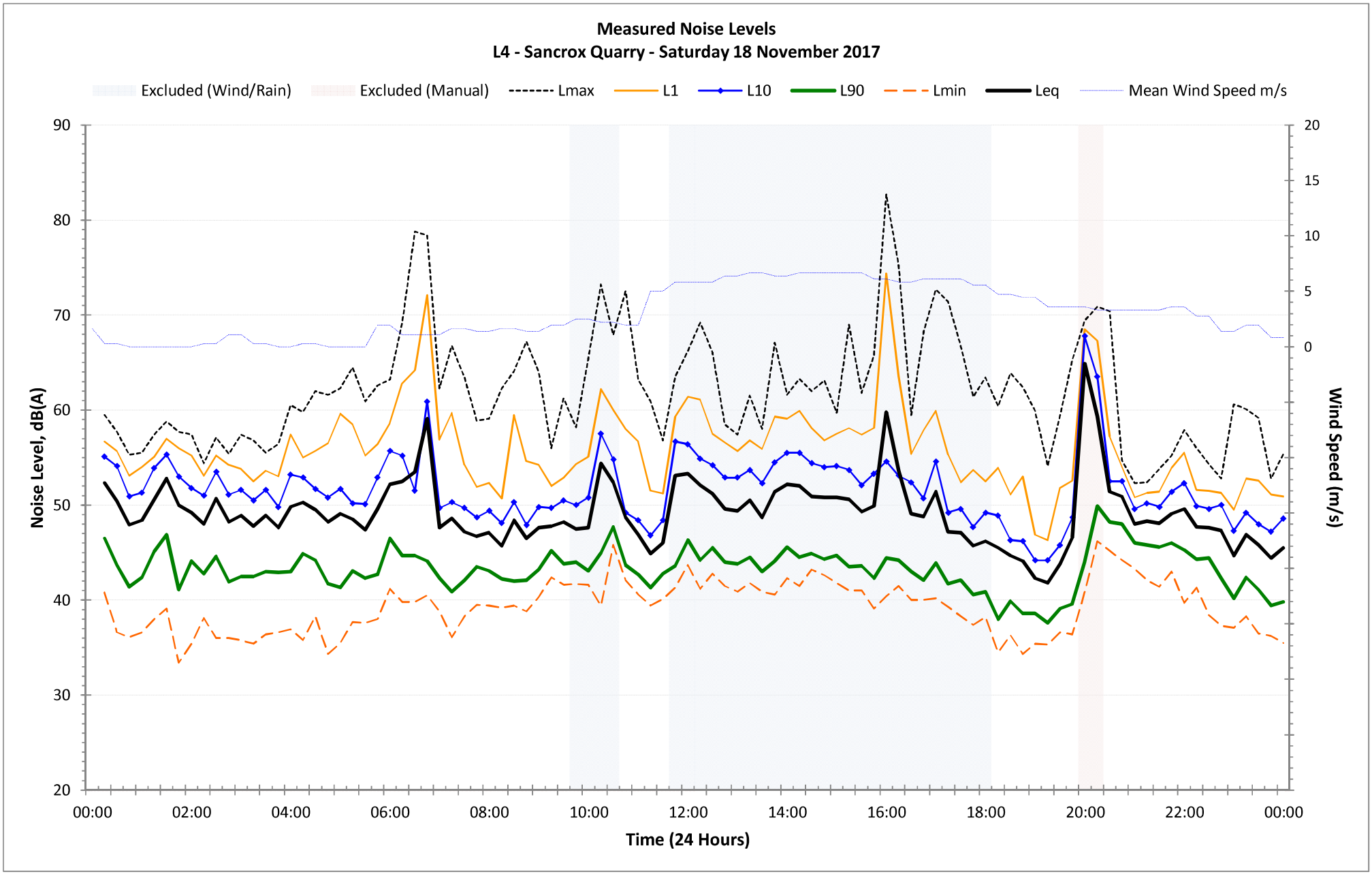
Measured Noise Levels
L4 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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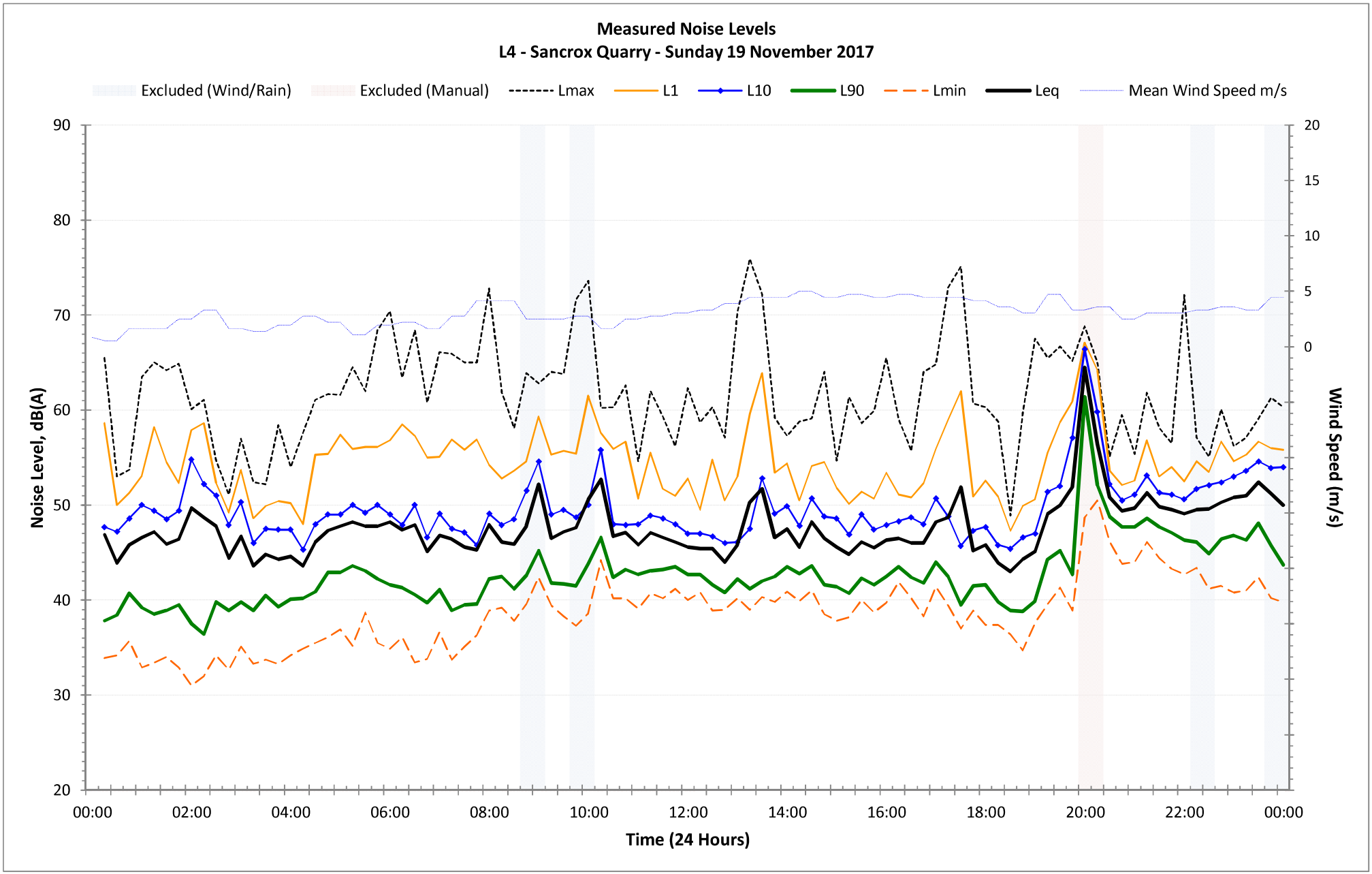
Measured Noise Levels
L4 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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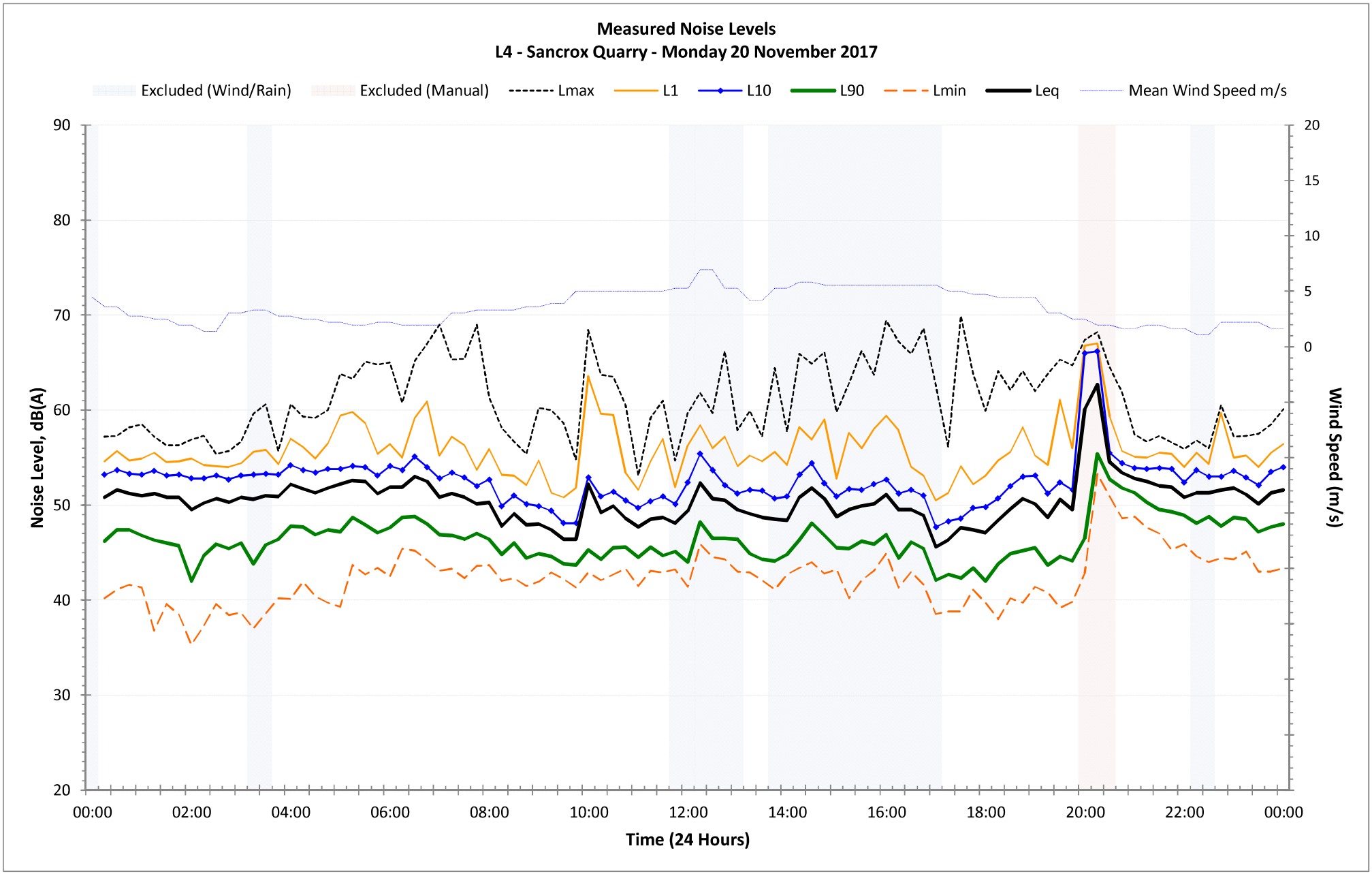
Measured Noise Levels
L4 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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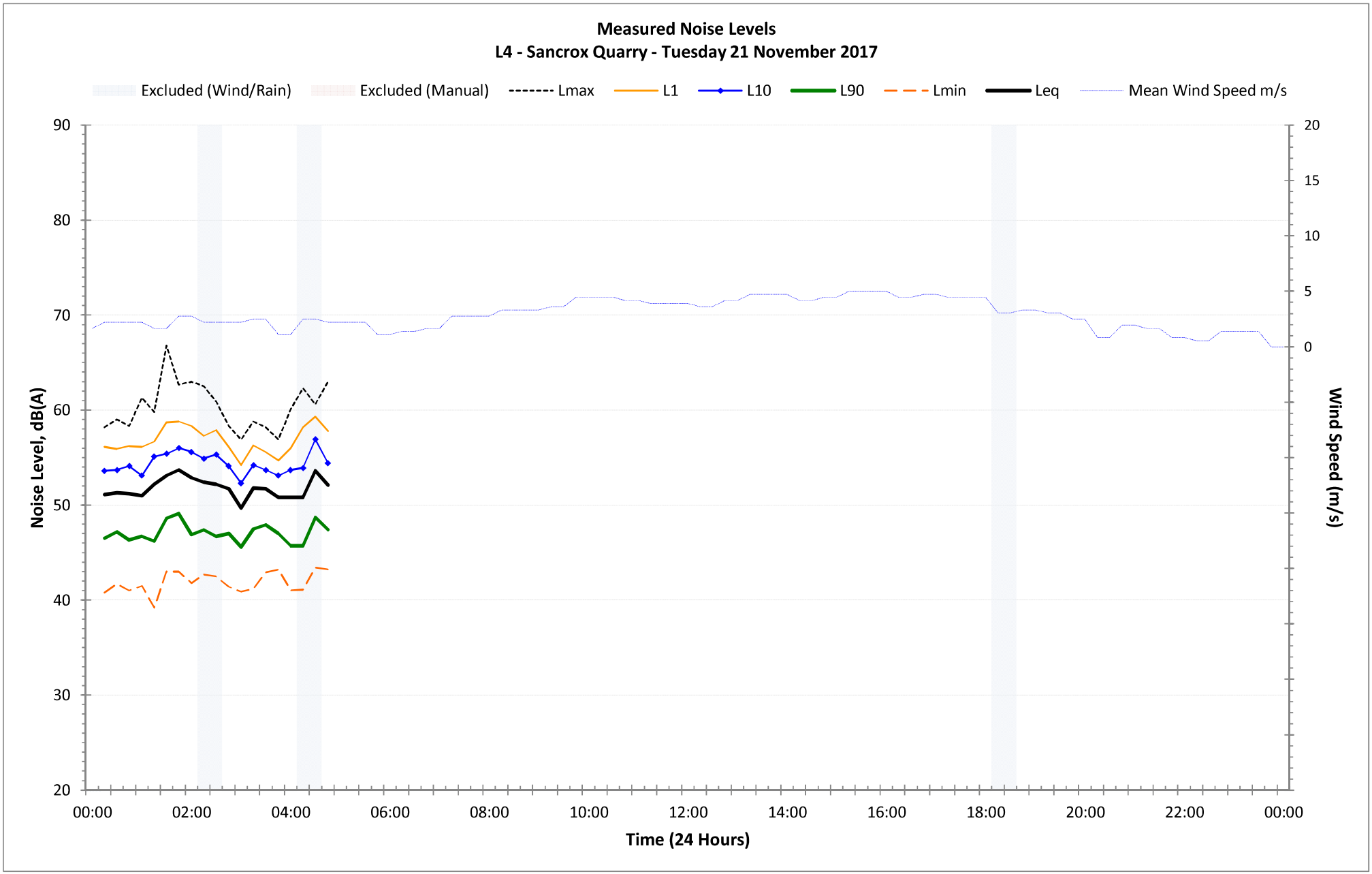
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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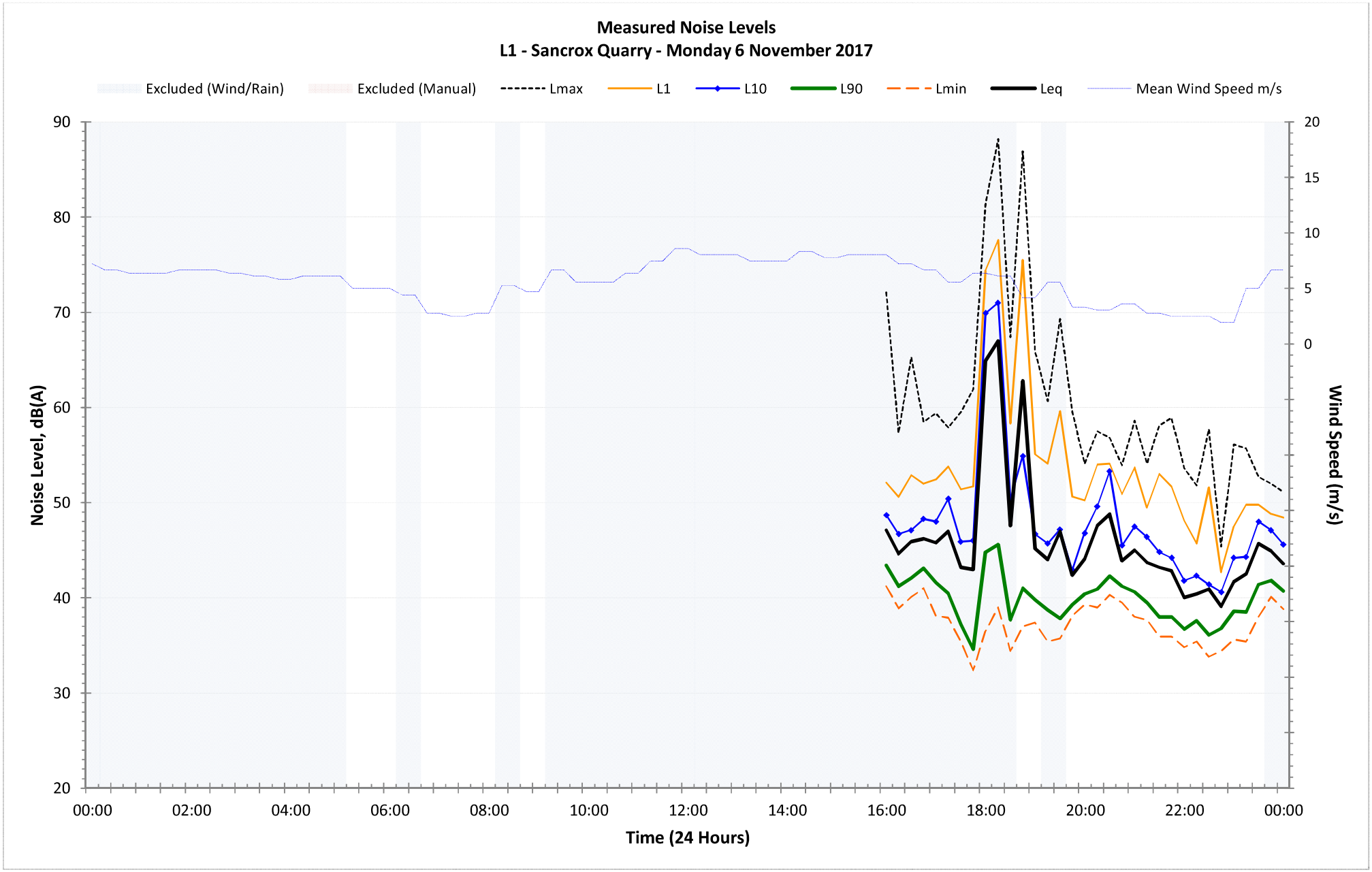
Measured Noise Levels
L1 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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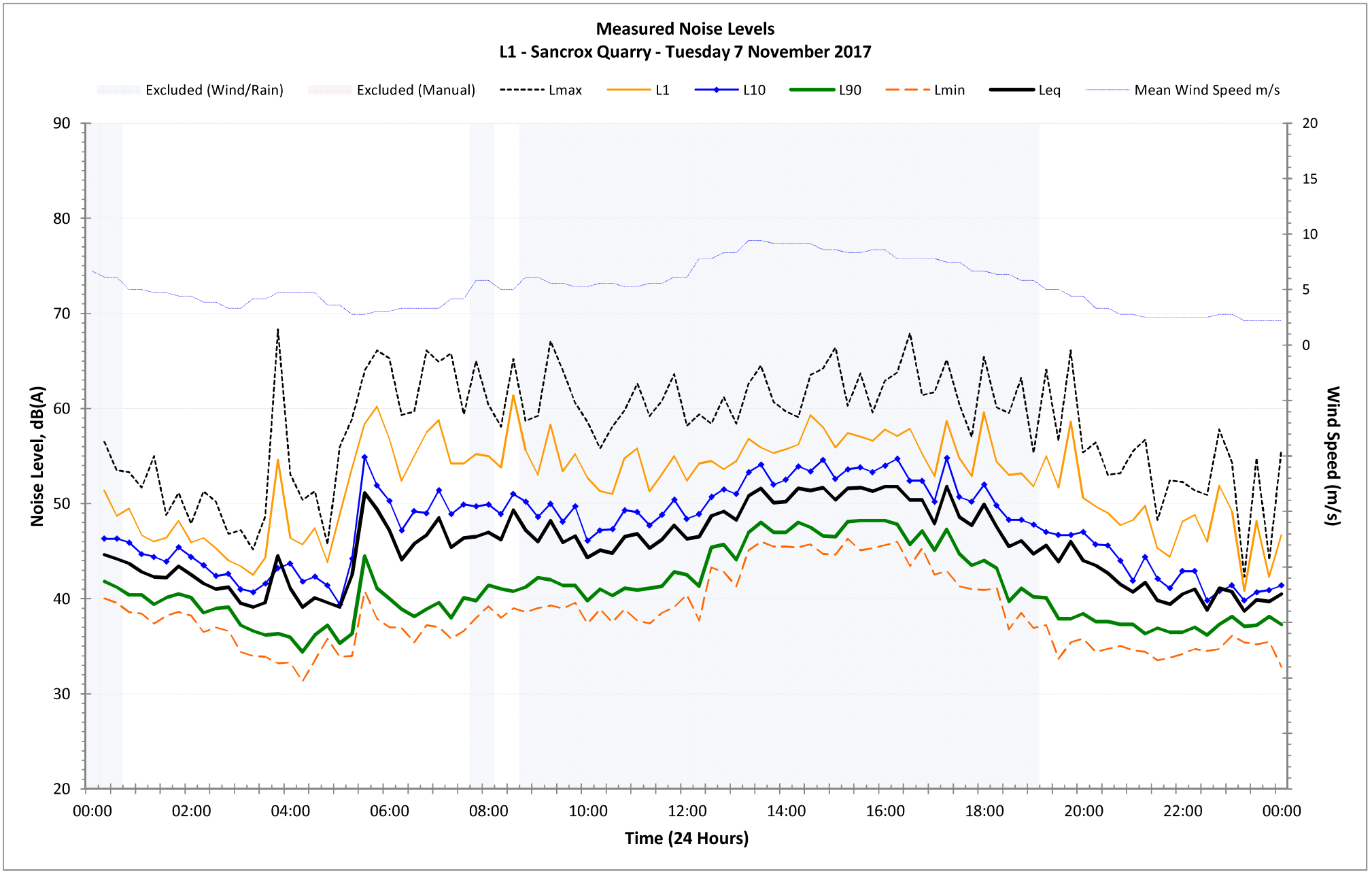
Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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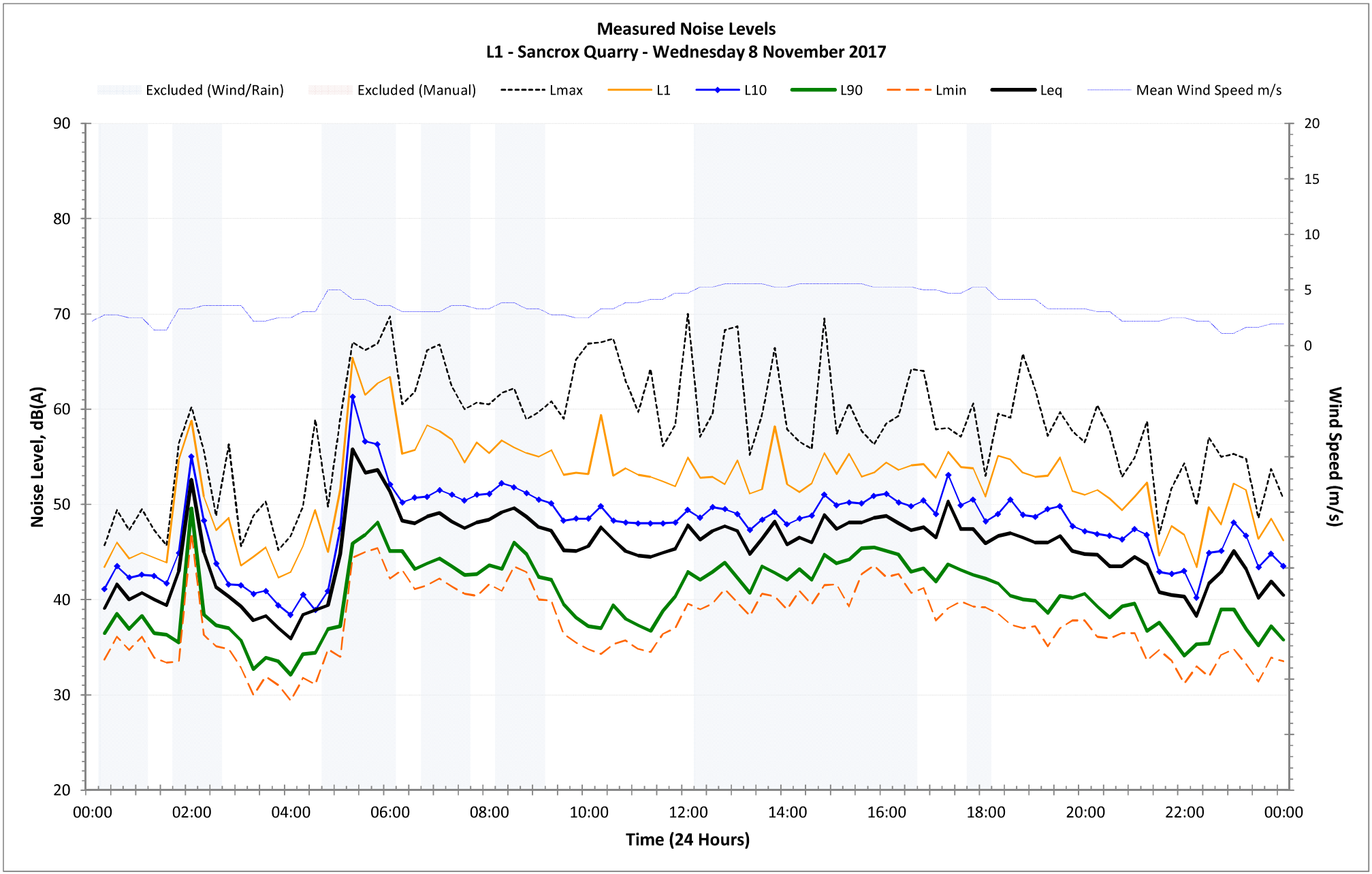
Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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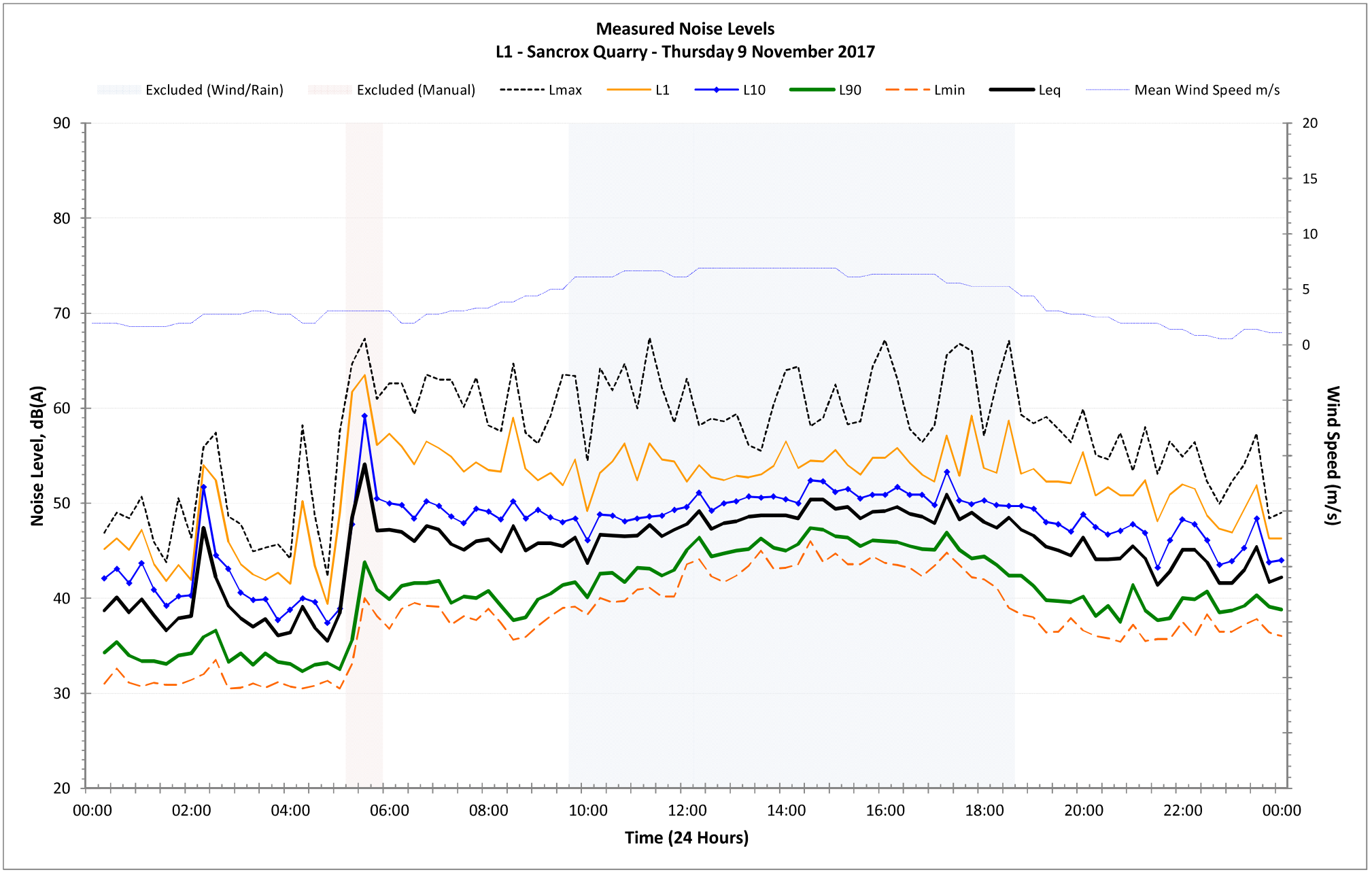
Measured Noise Levels
L1 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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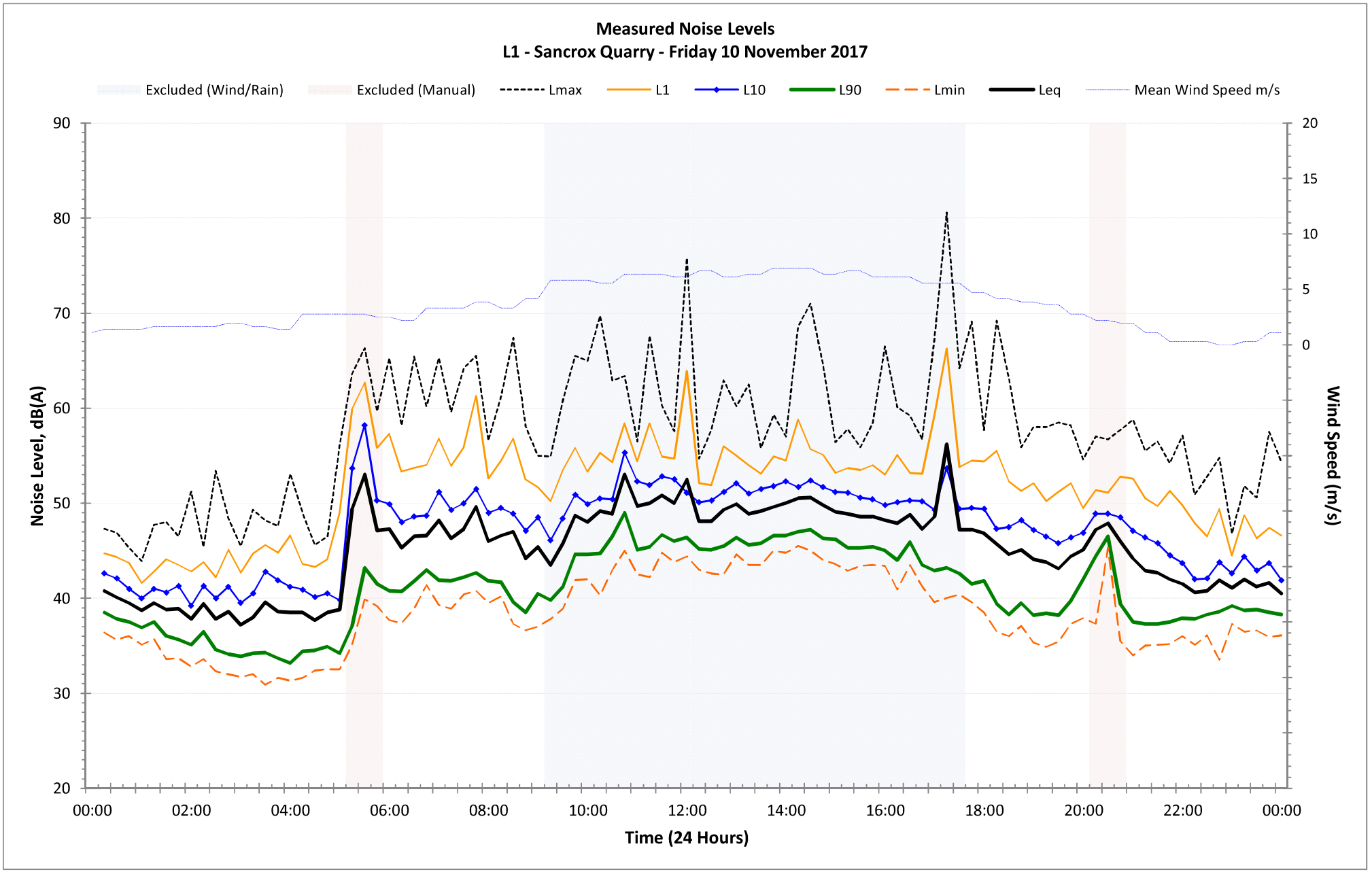
Measured Noise Levels
L1 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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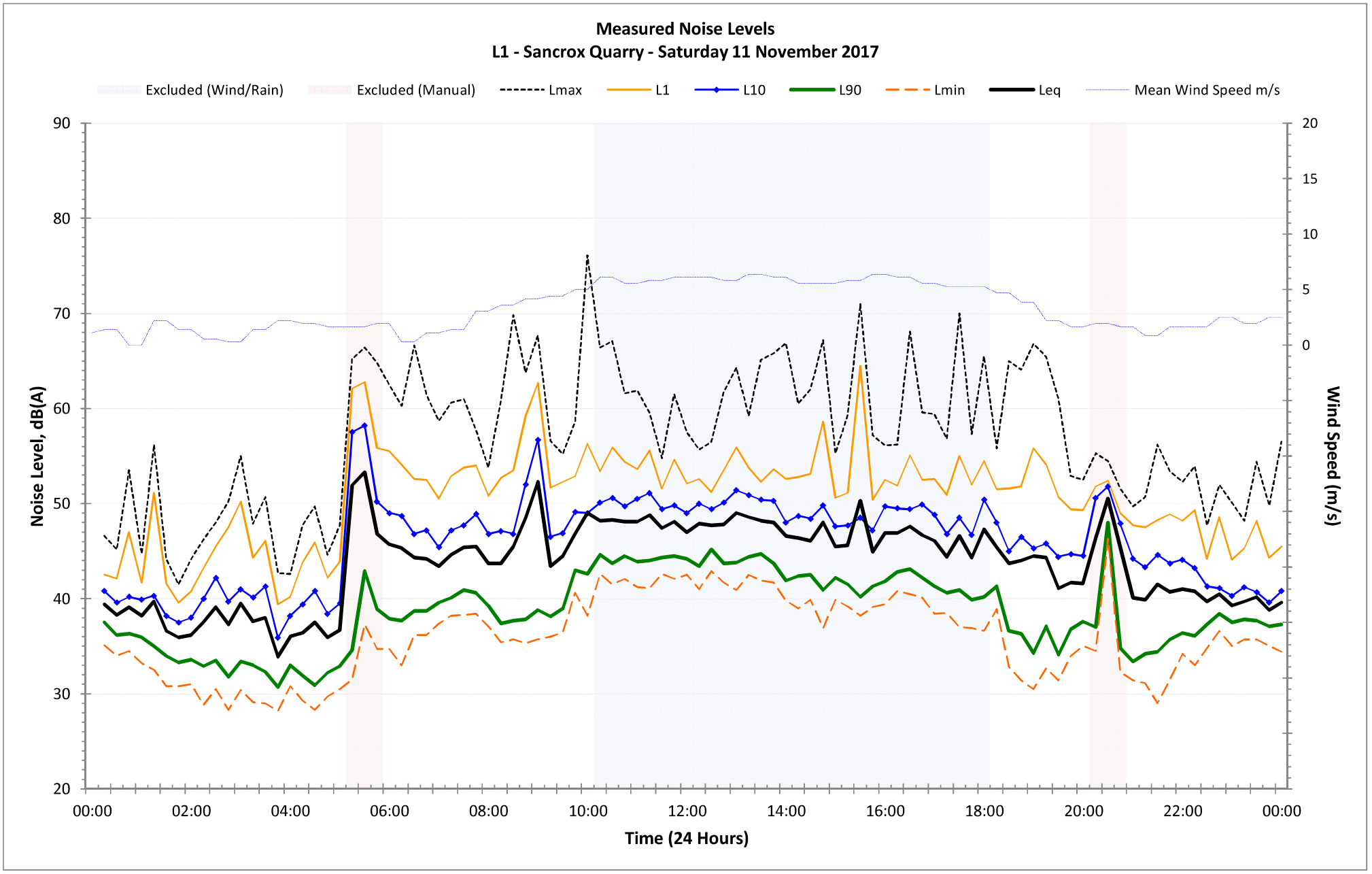
Measured Noise Levels
L1 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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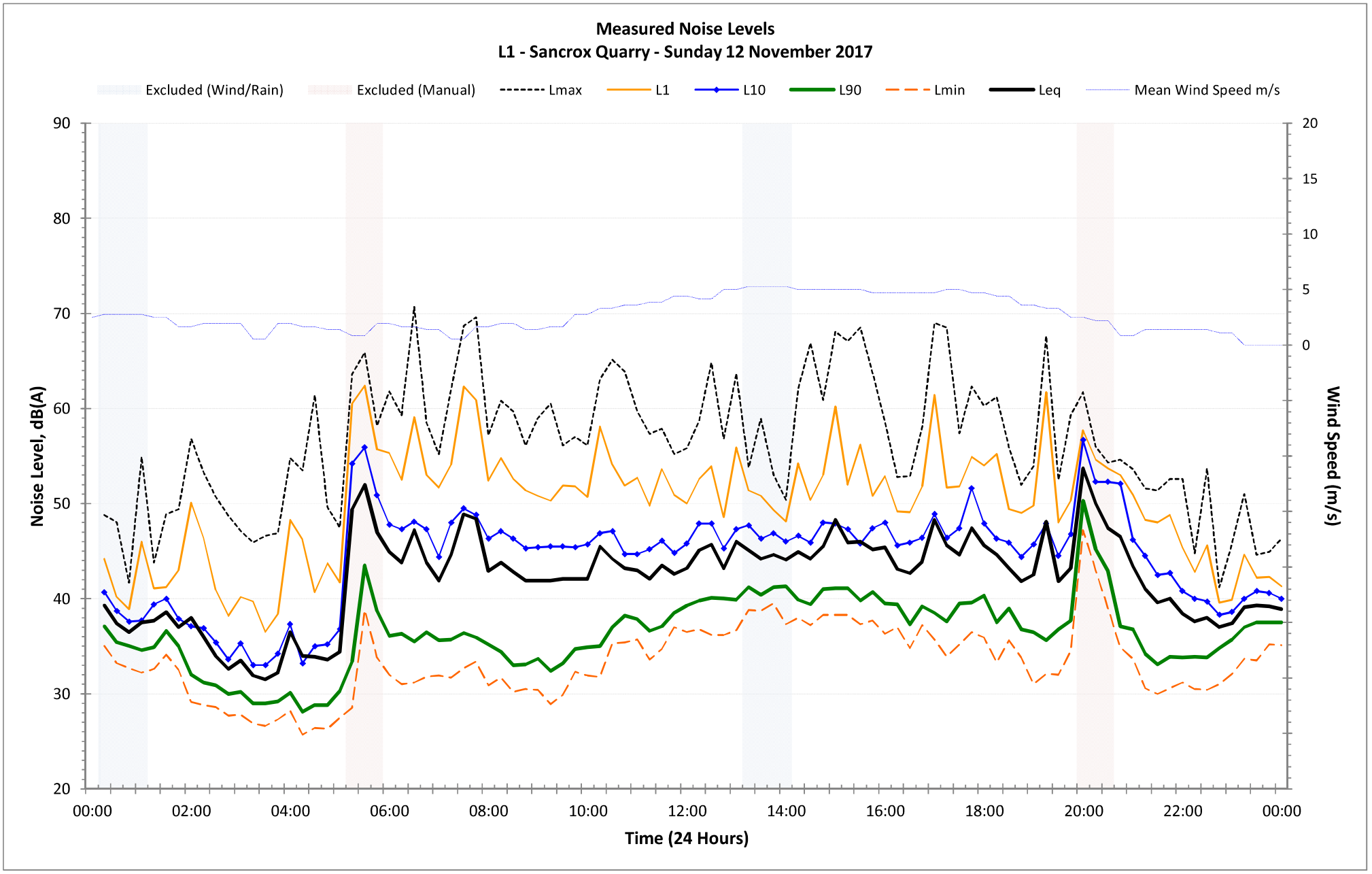
Measured Noise Levels
L1 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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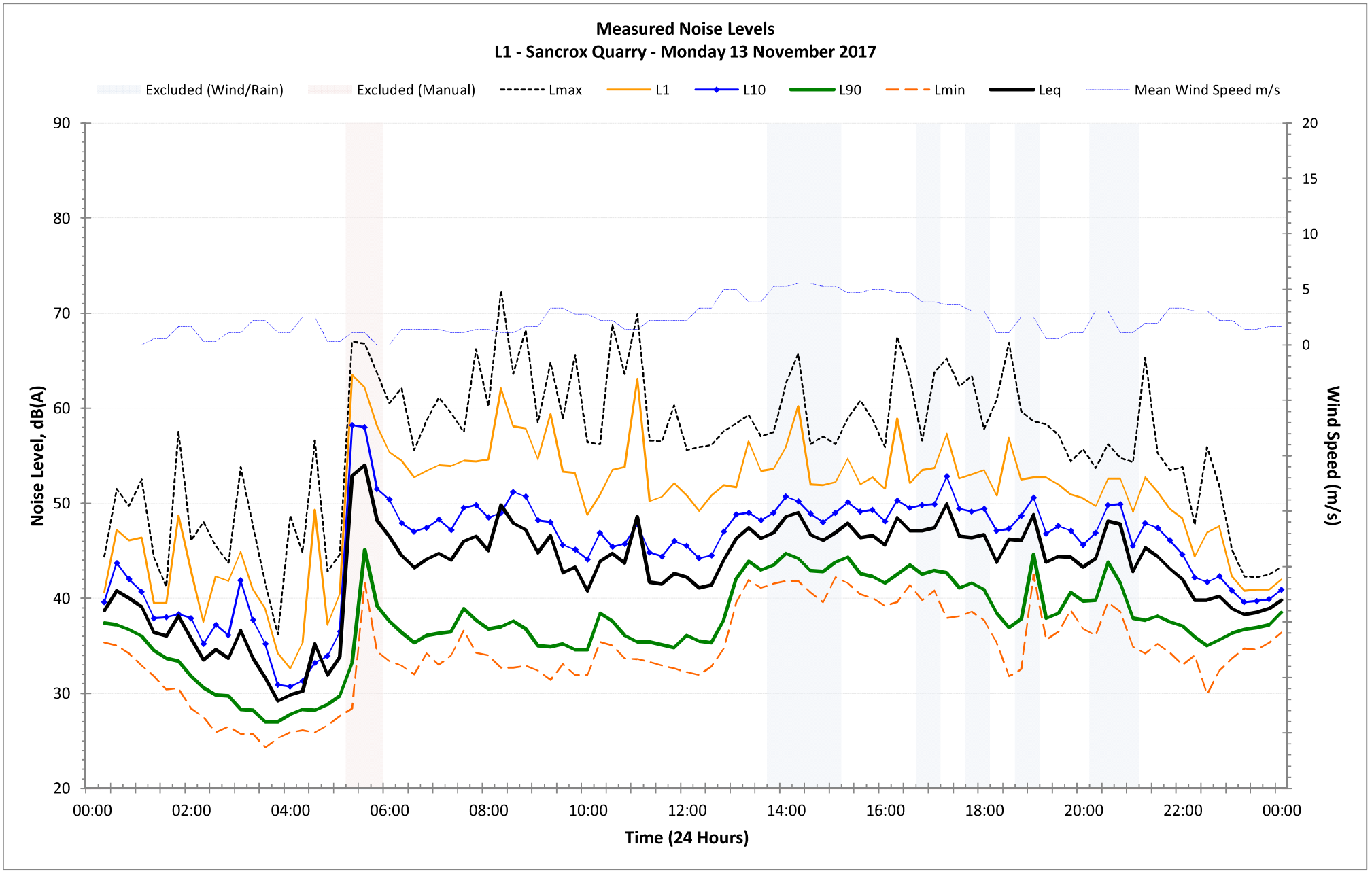
Measured Noise Levels
L1 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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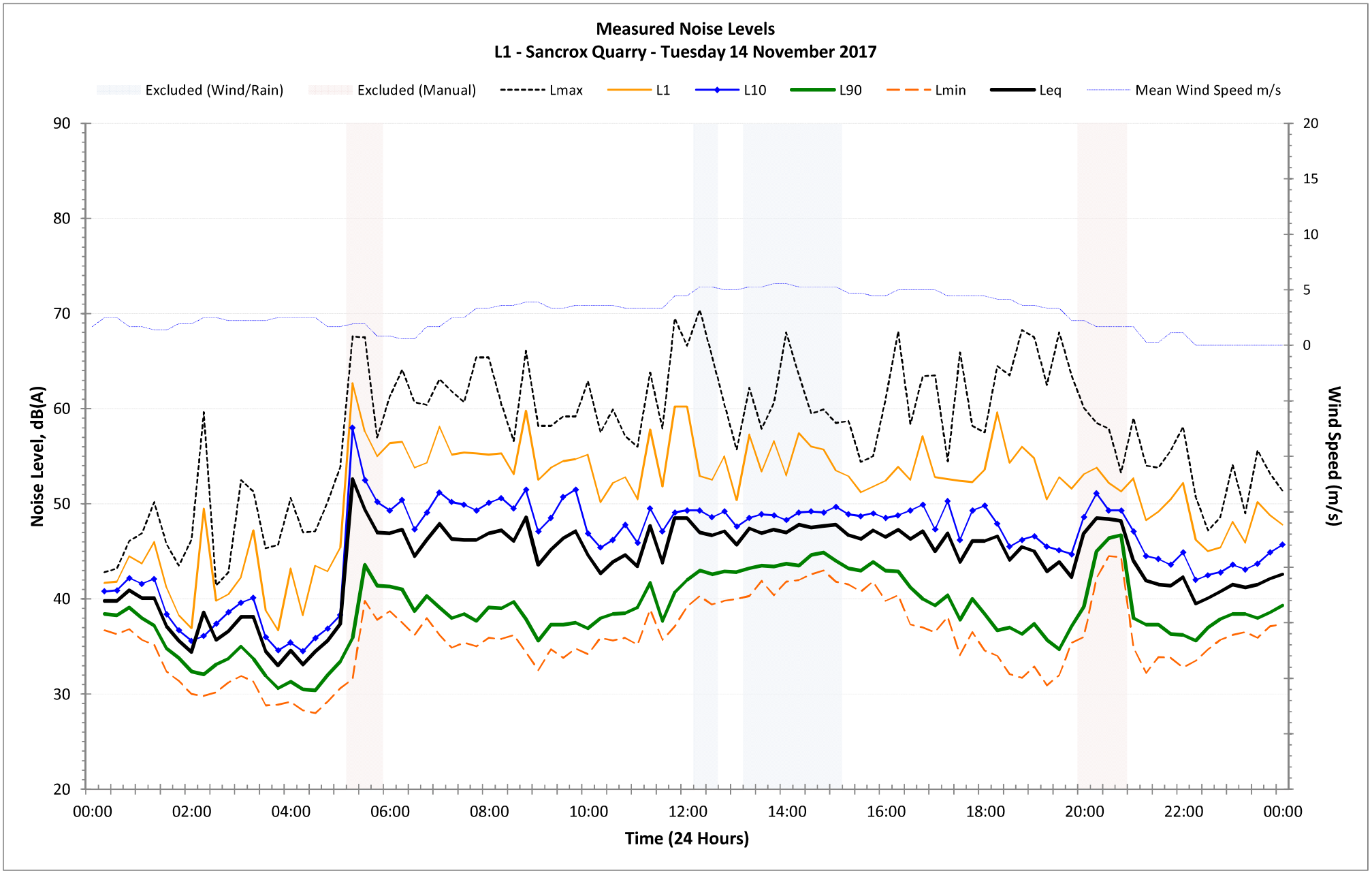
Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
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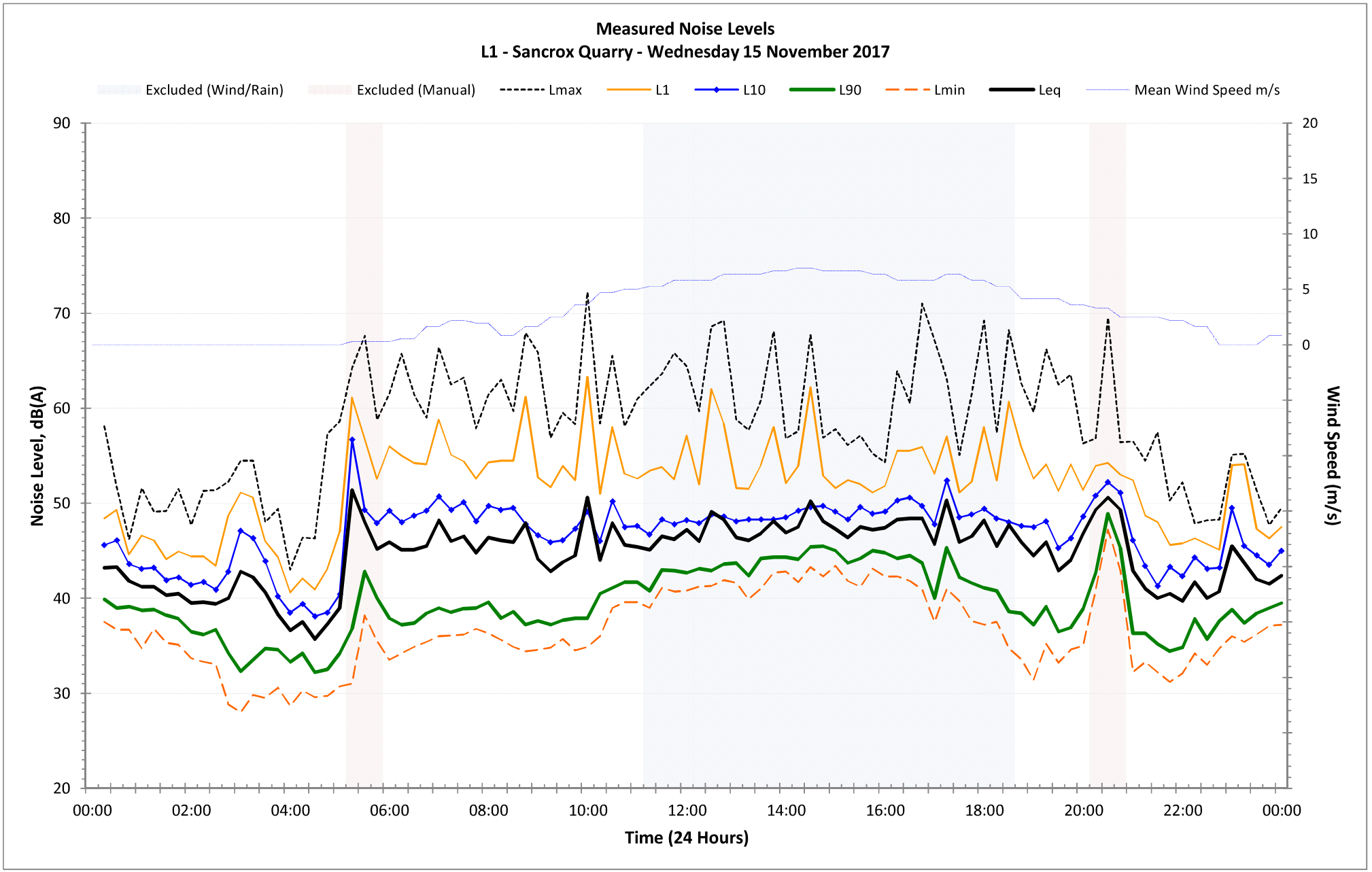
Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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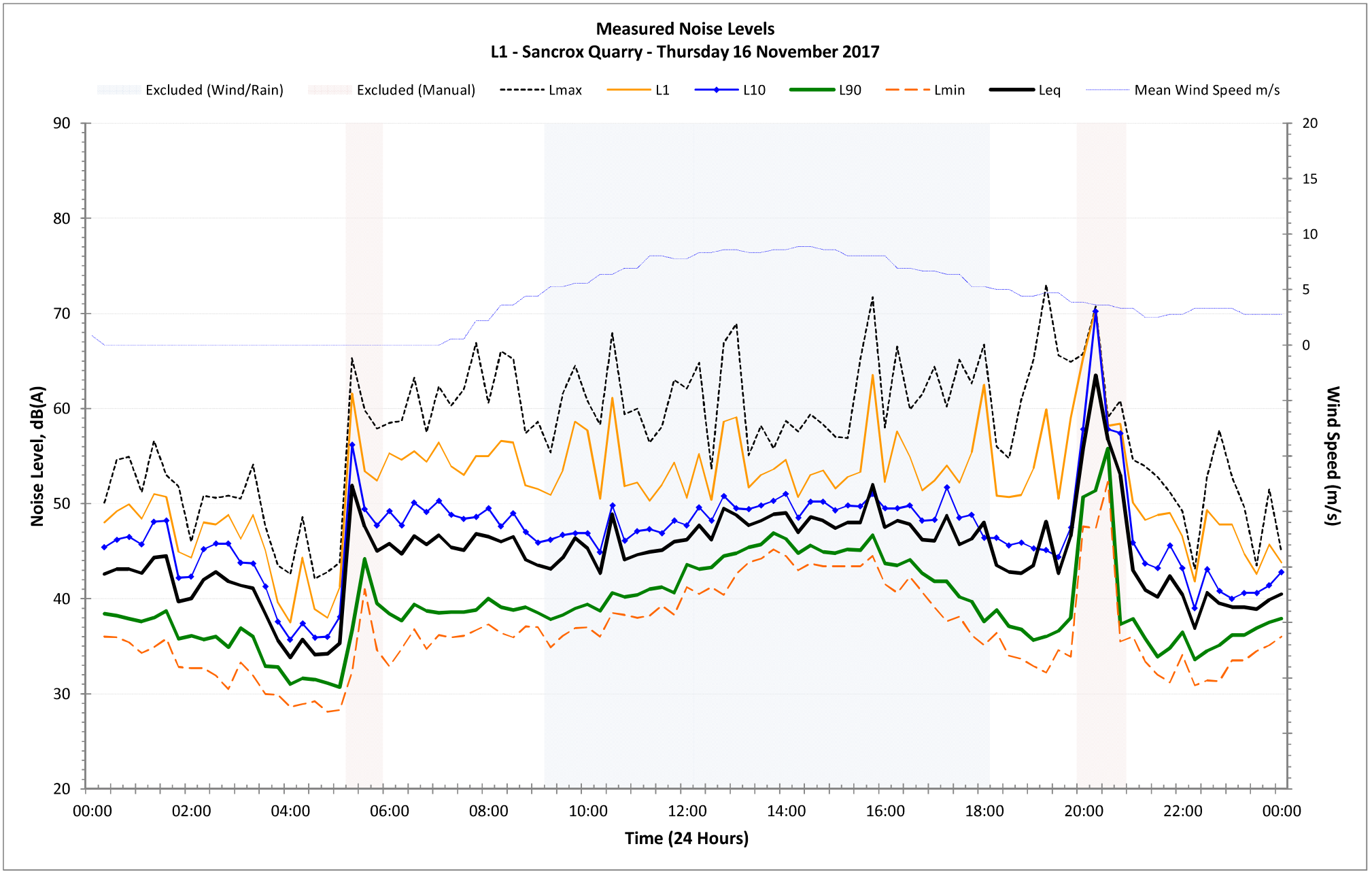
Measured Noise Levels
L1 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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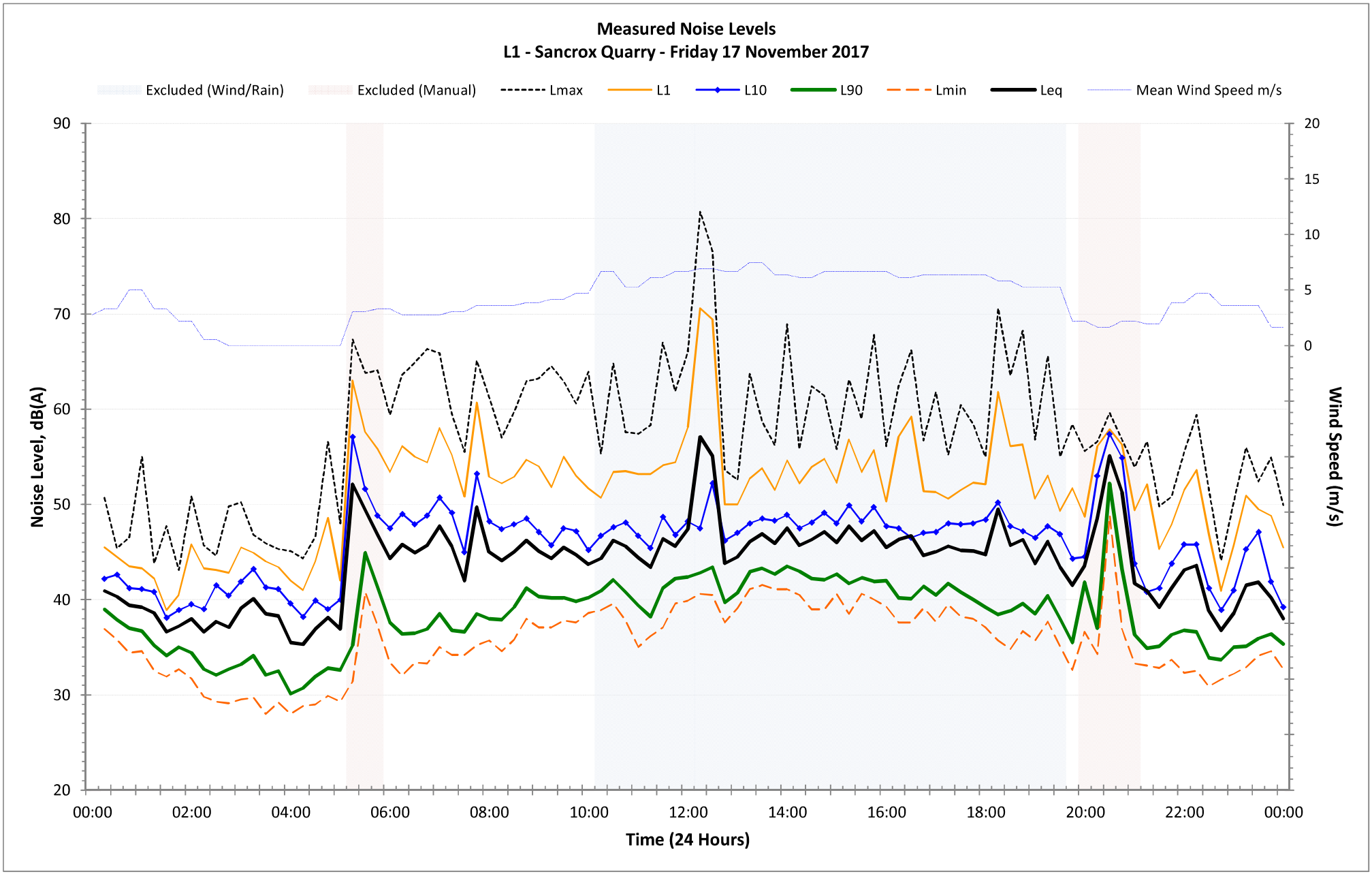
Measured Noise Levels
L1 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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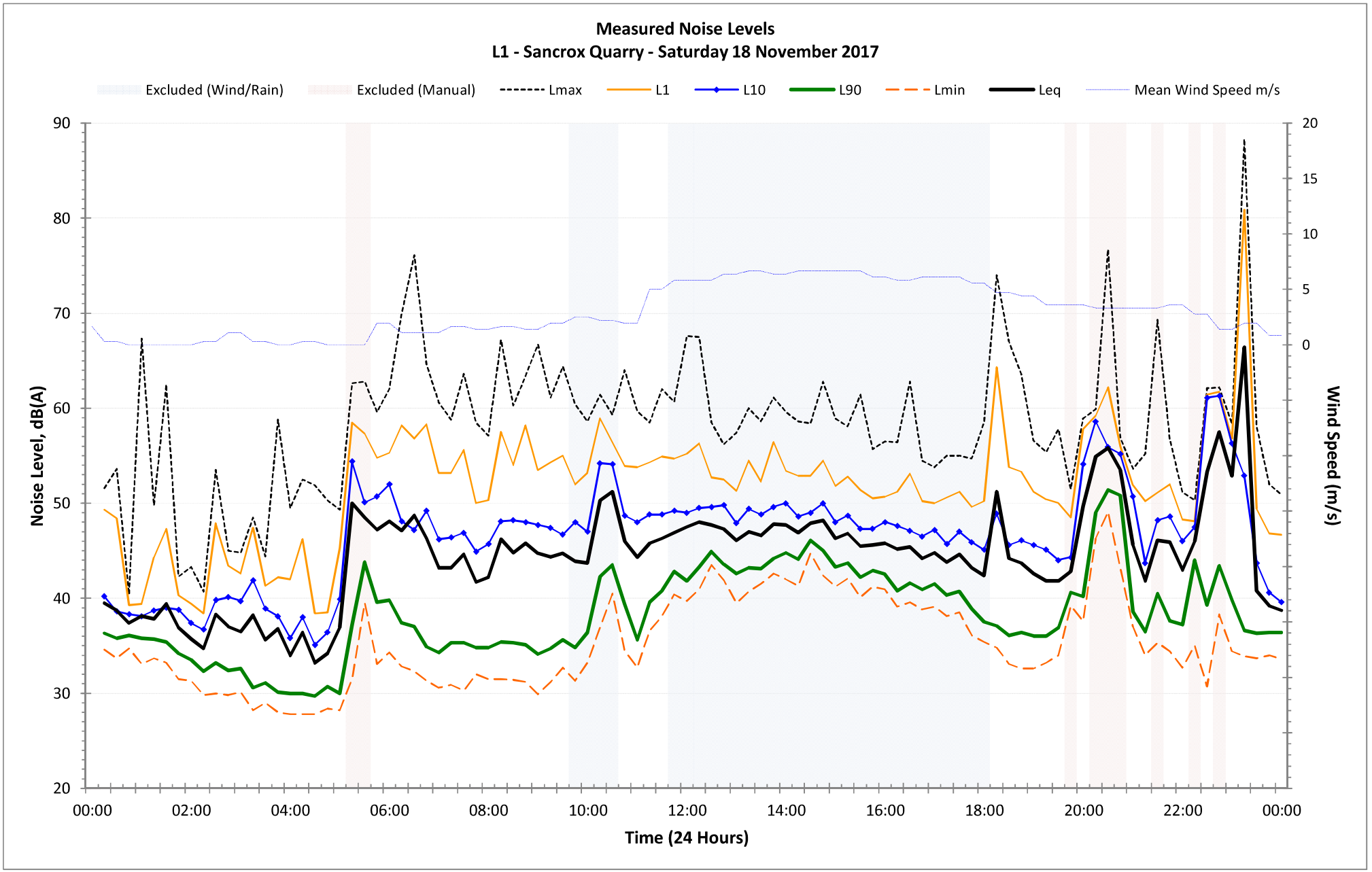
Measured Noise Levels
L1 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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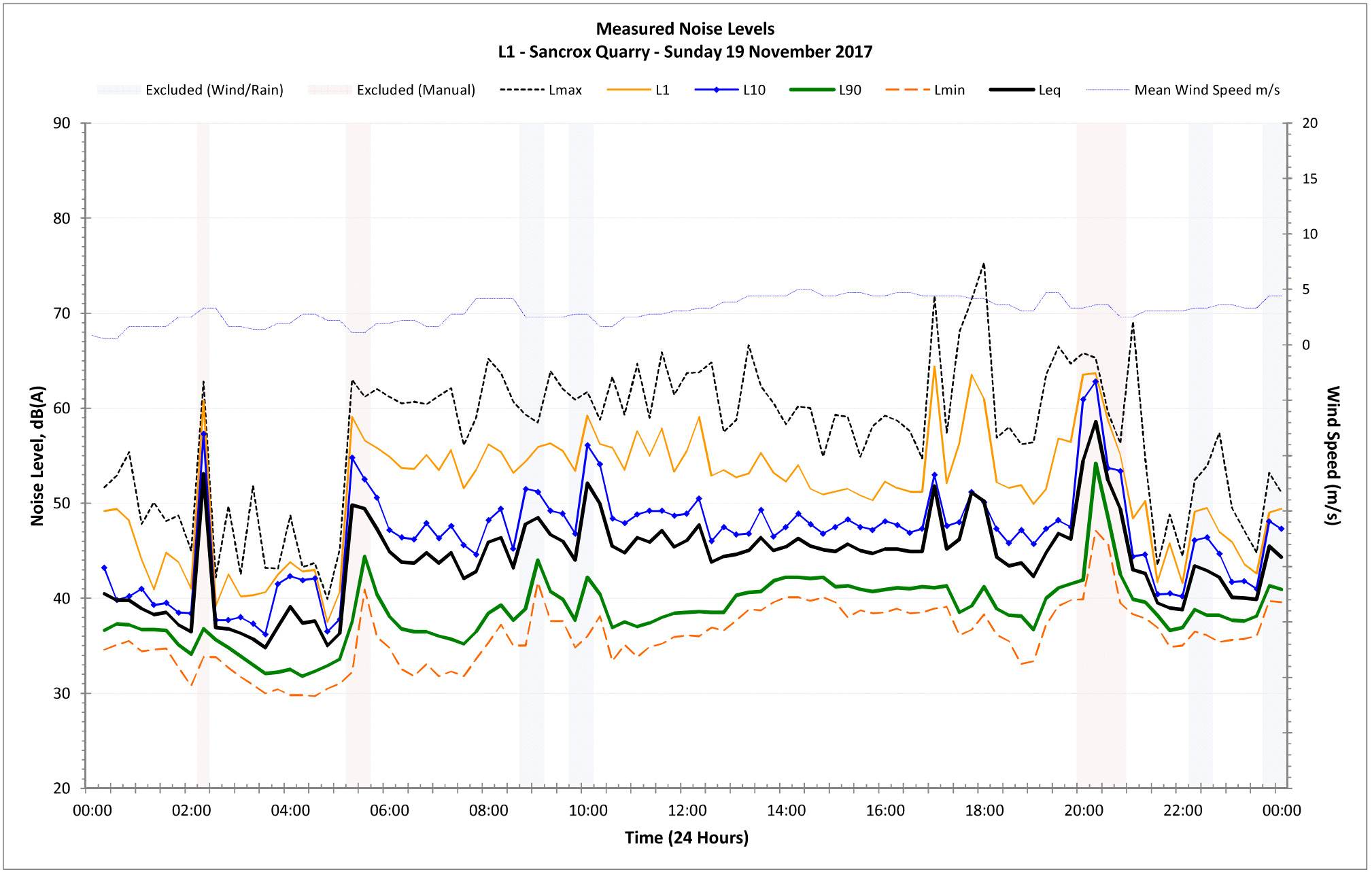
Measured Noise Levels
L1 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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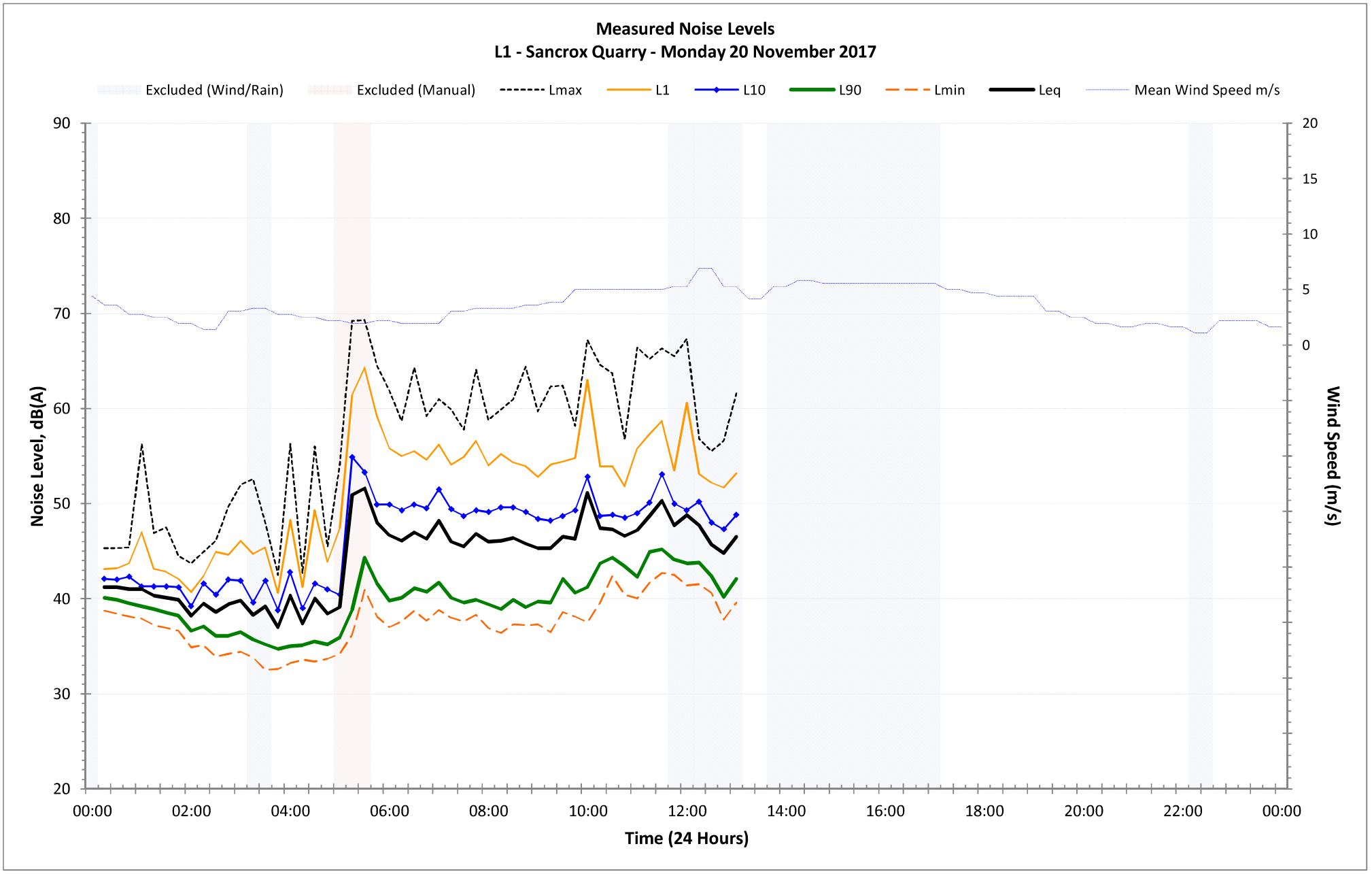
Measured Noise Levels
L1 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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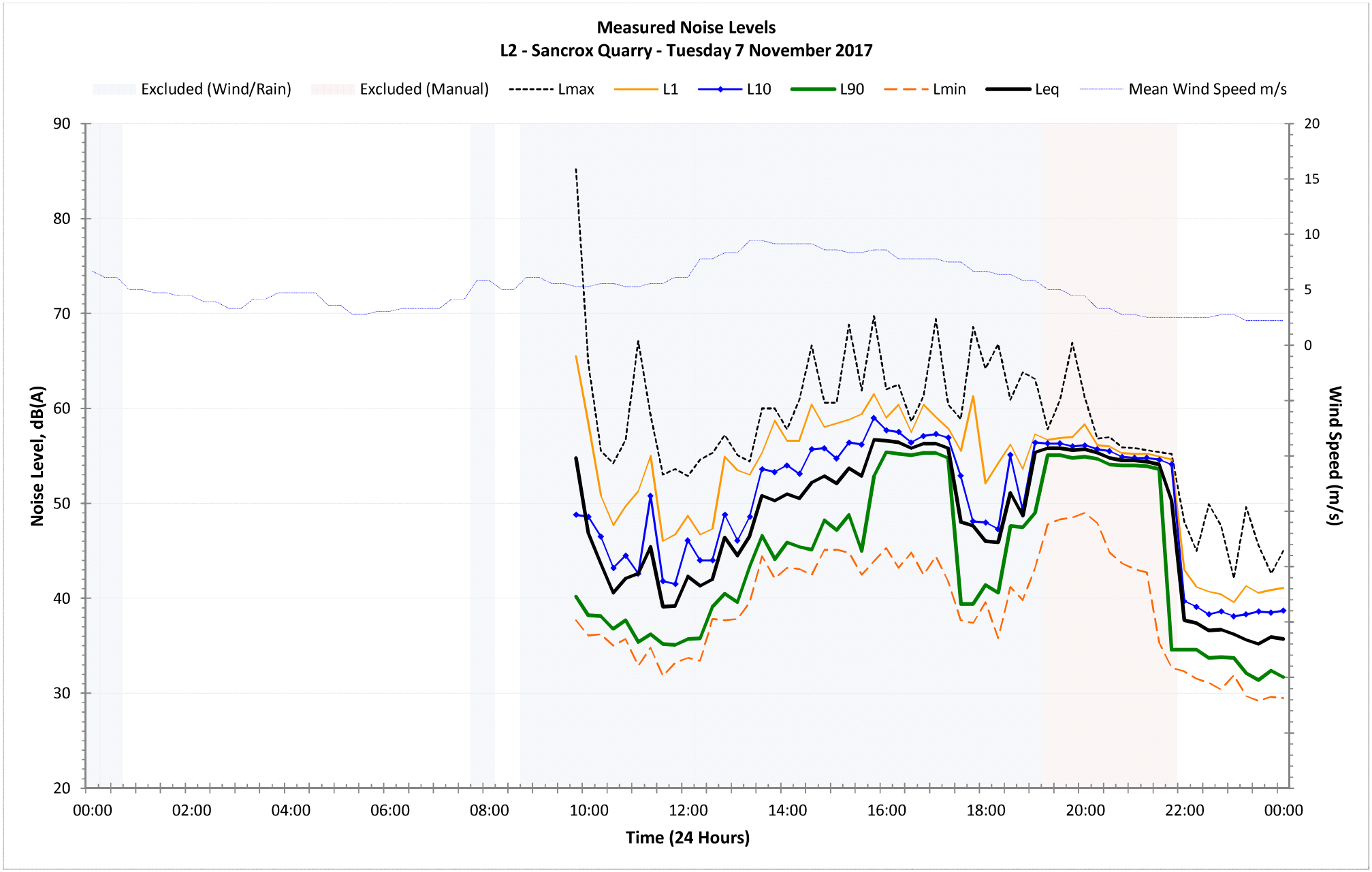
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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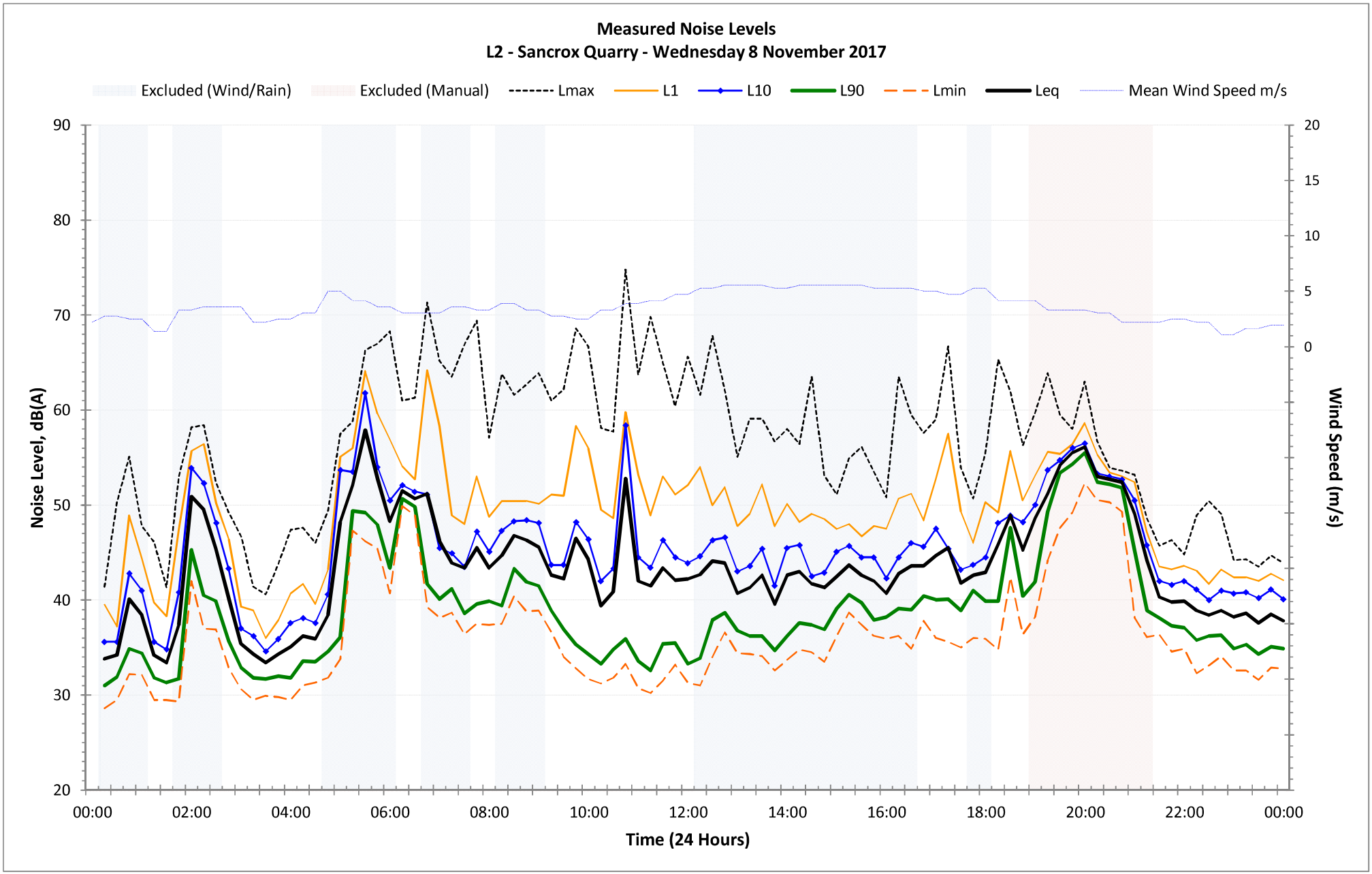
Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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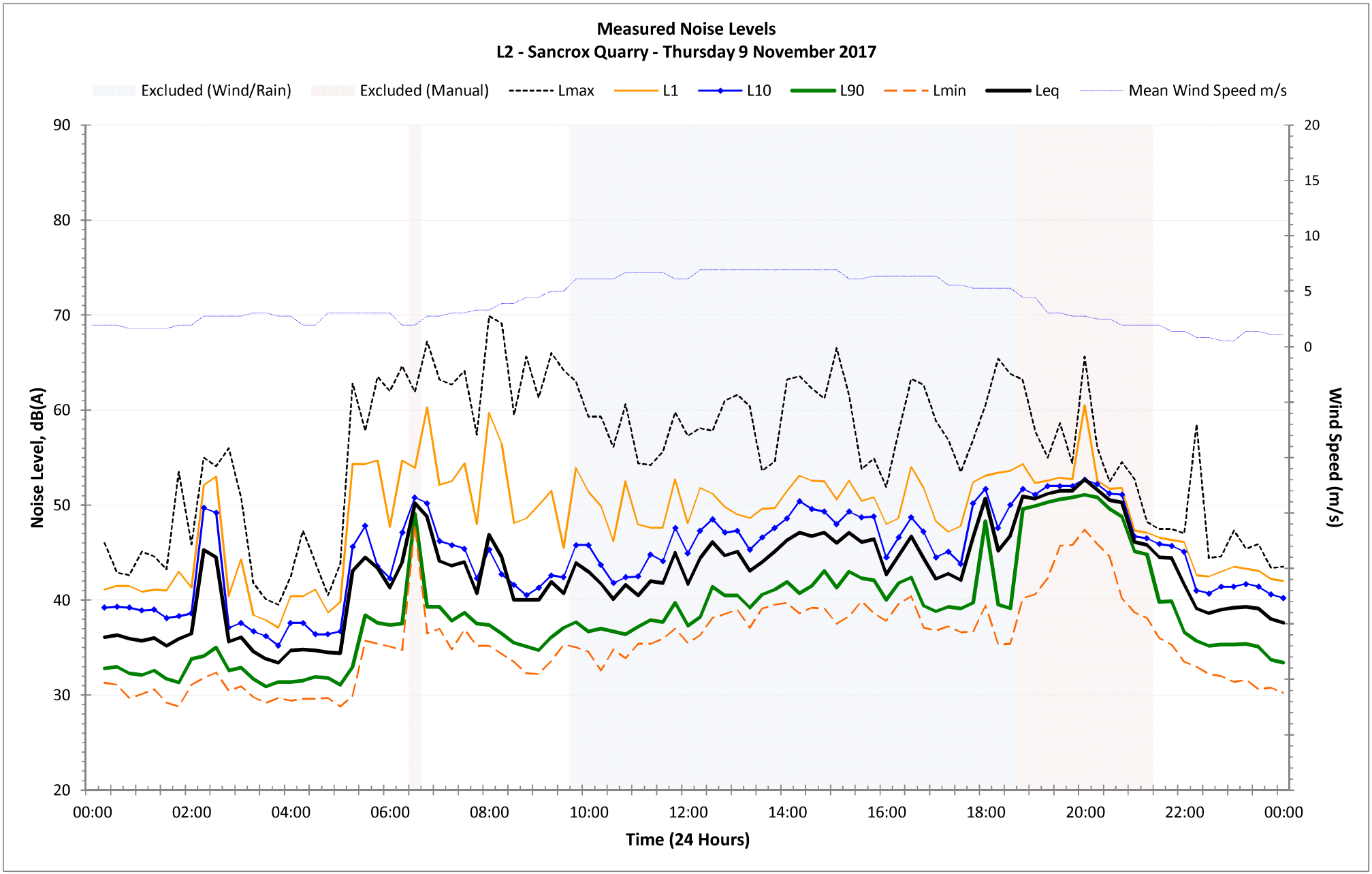
Measured Noise Levels
L2 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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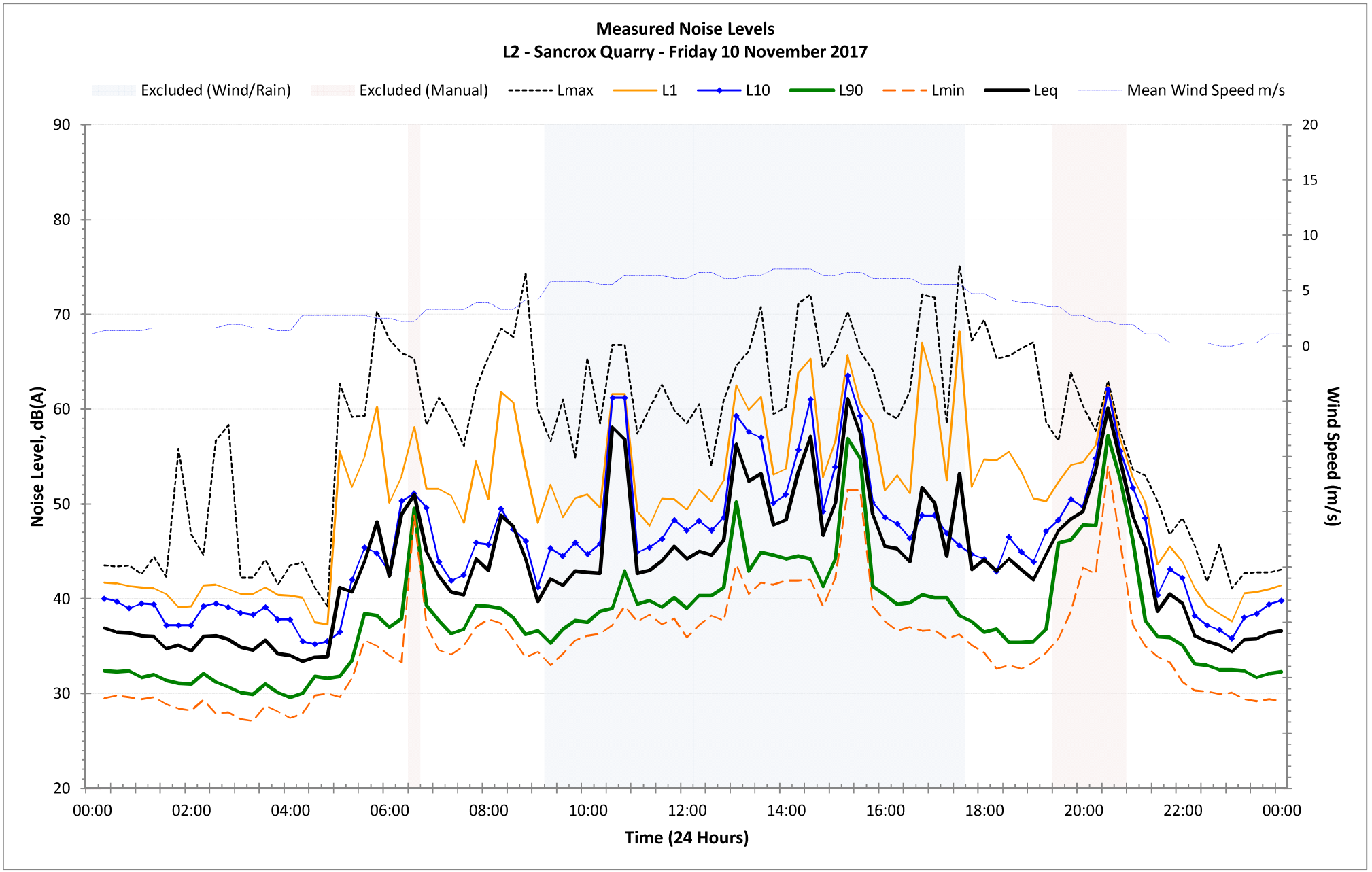
Measured Noise Levels
L2 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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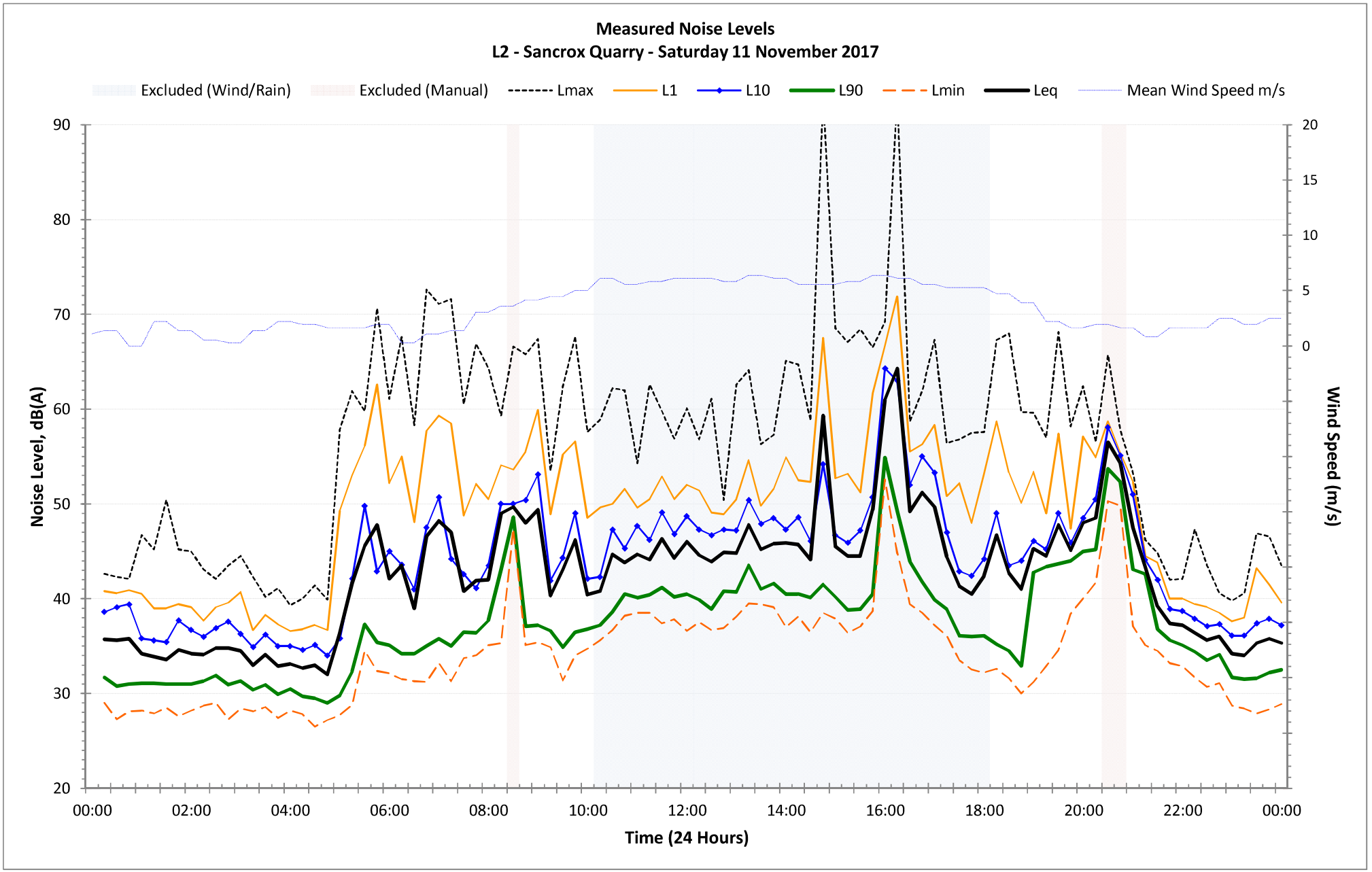
Measured Noise Levels
L2 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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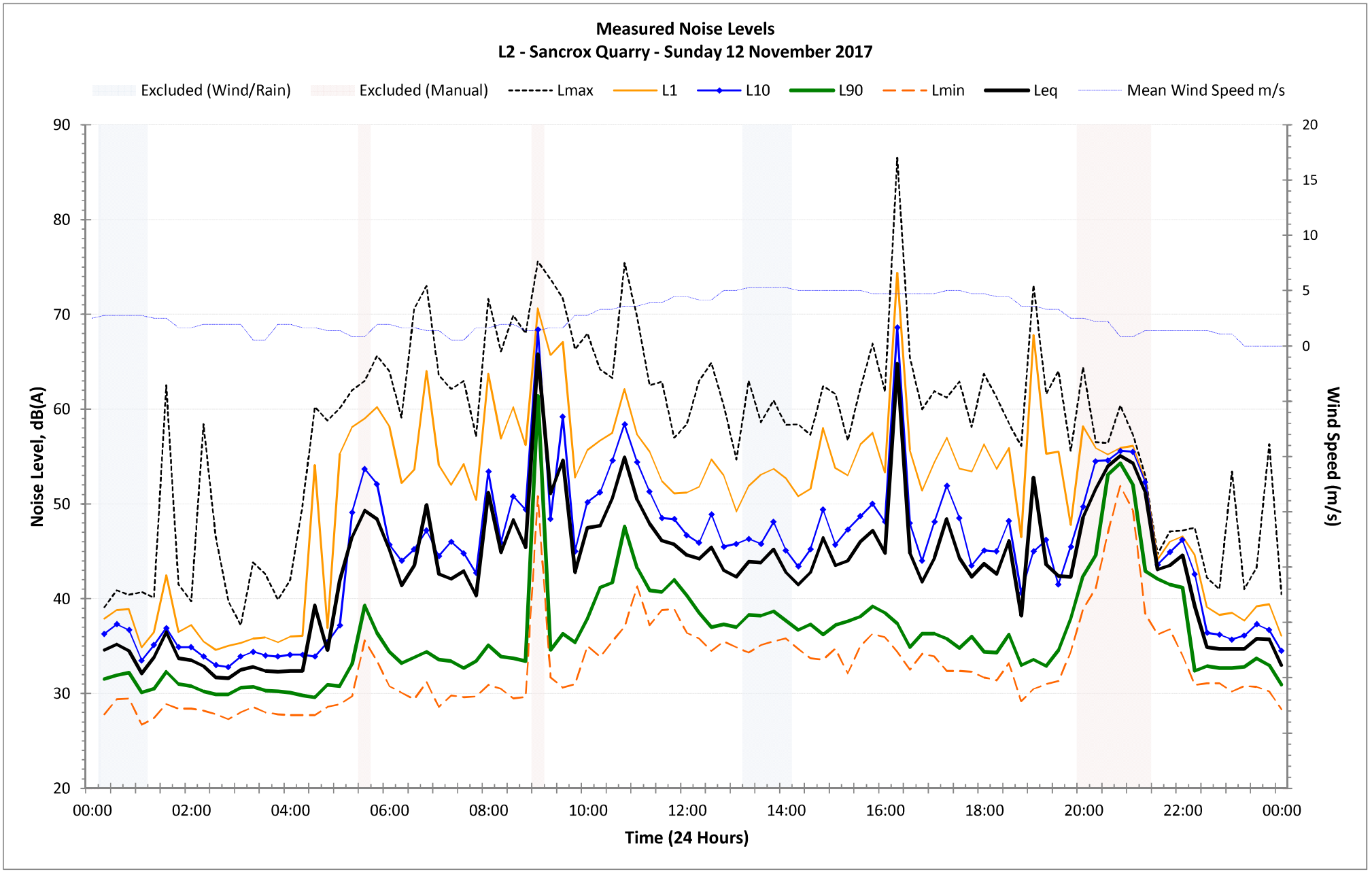
Measured Noise Levels
L2 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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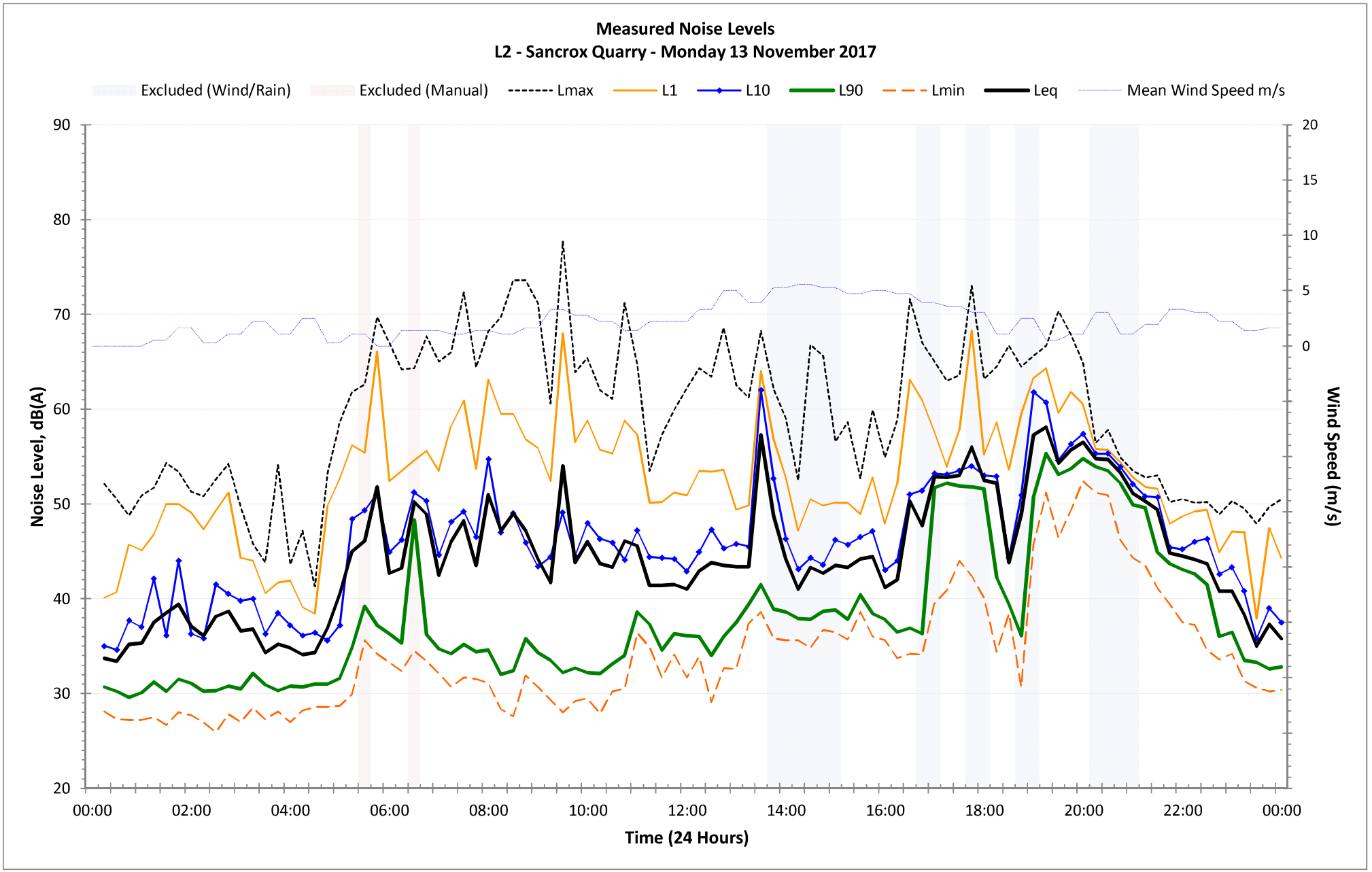
Measured Noise Levels
L2 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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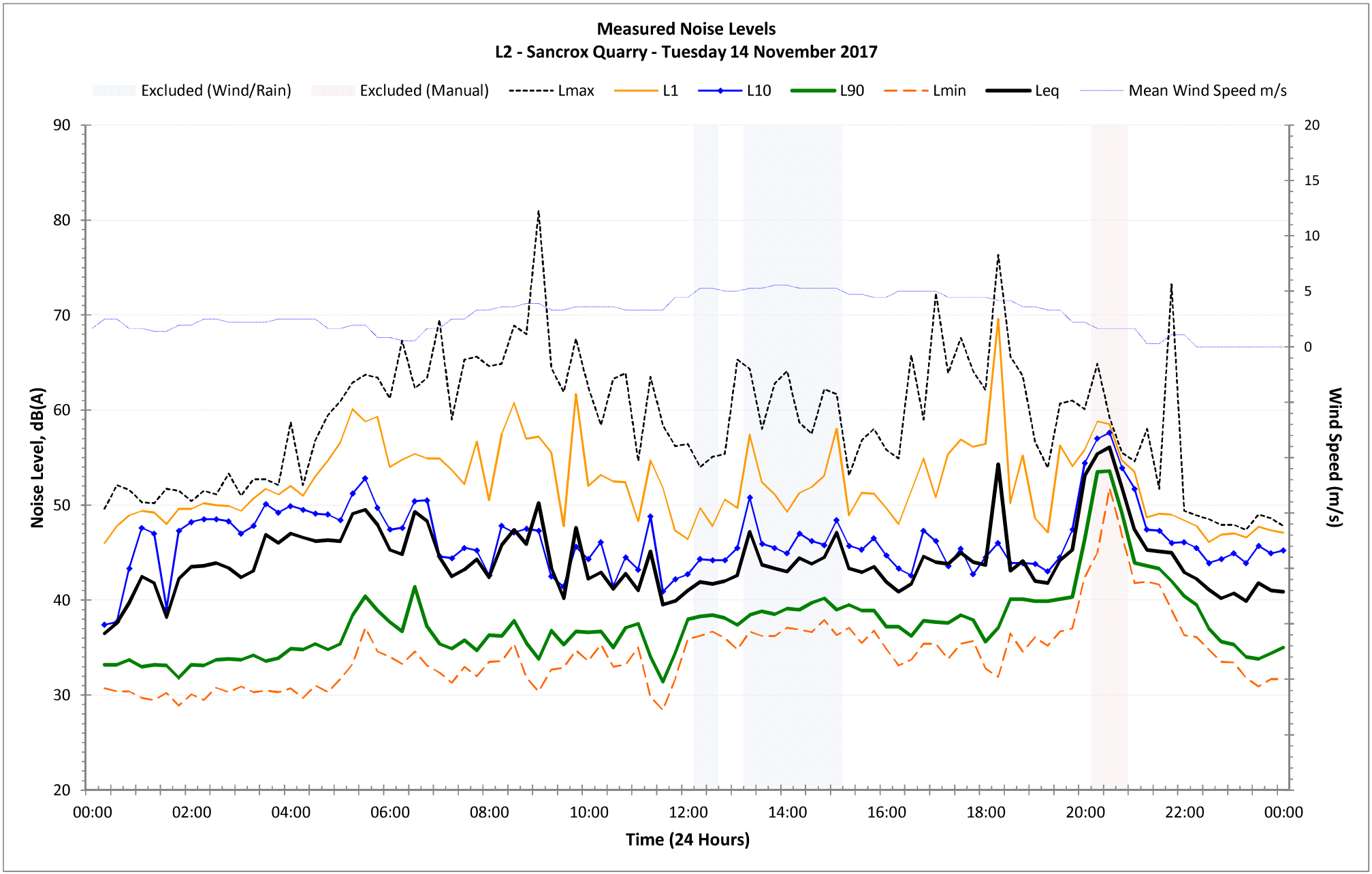
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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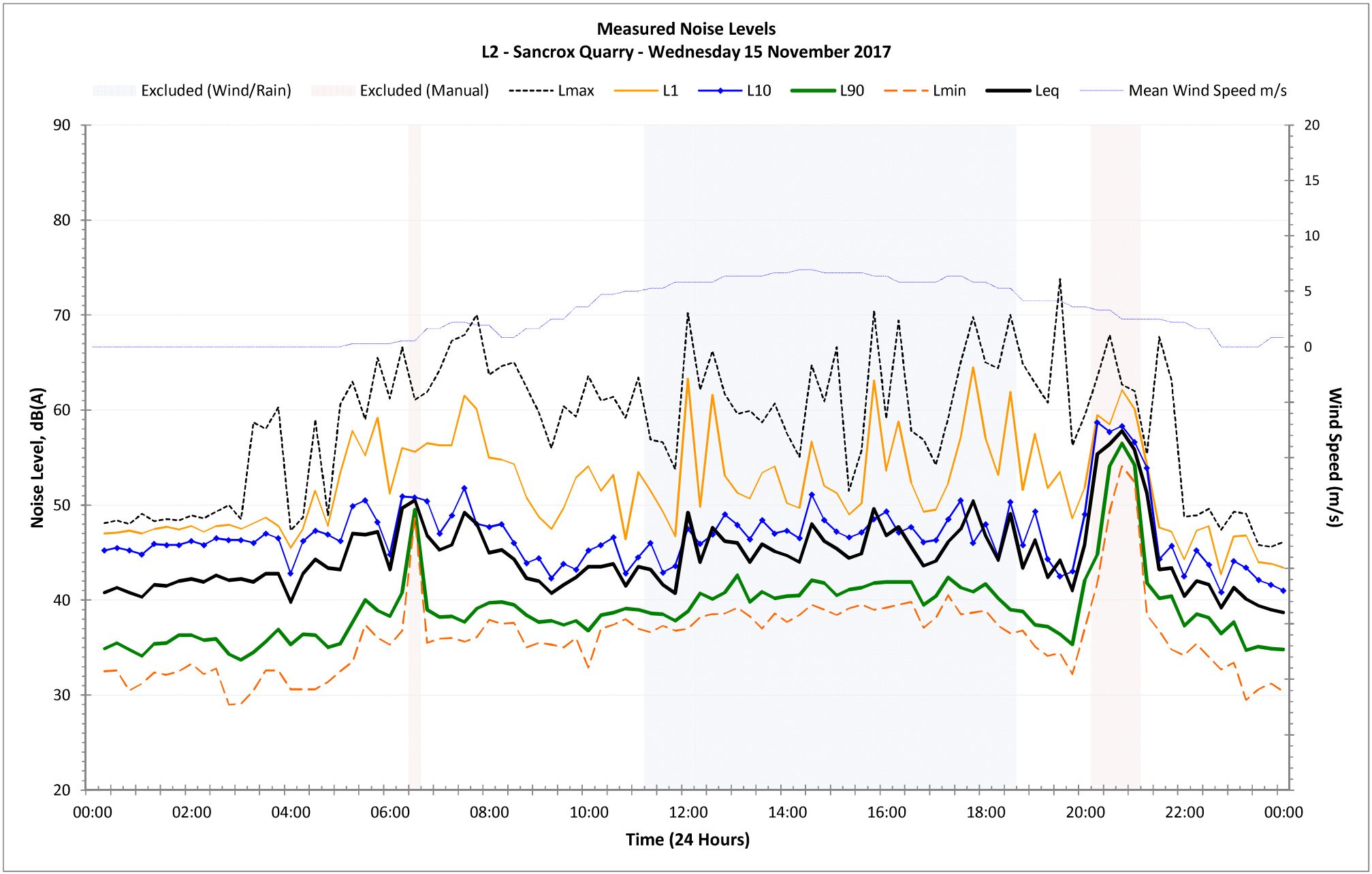
Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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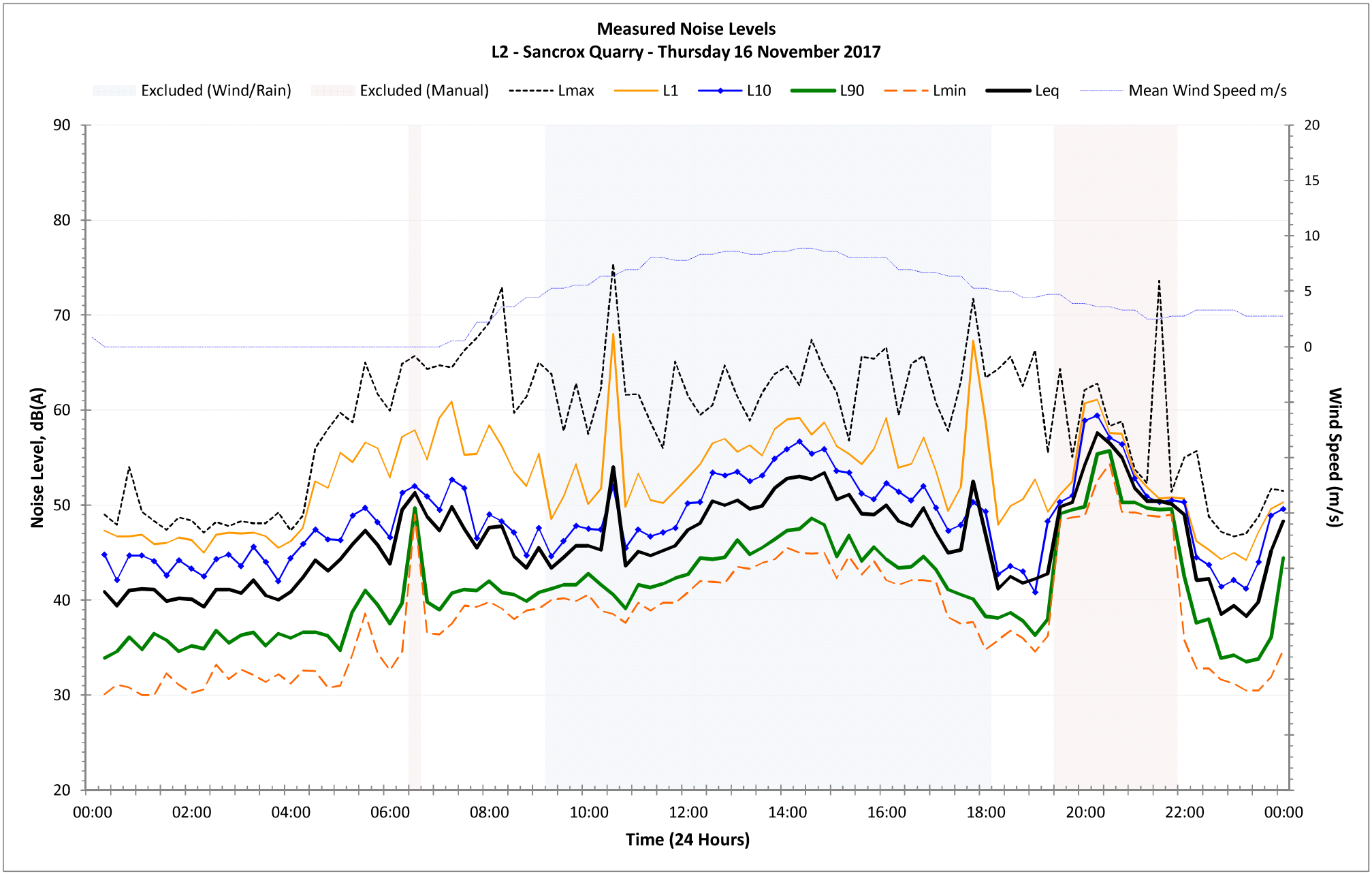
Measured Noise Levels
L2 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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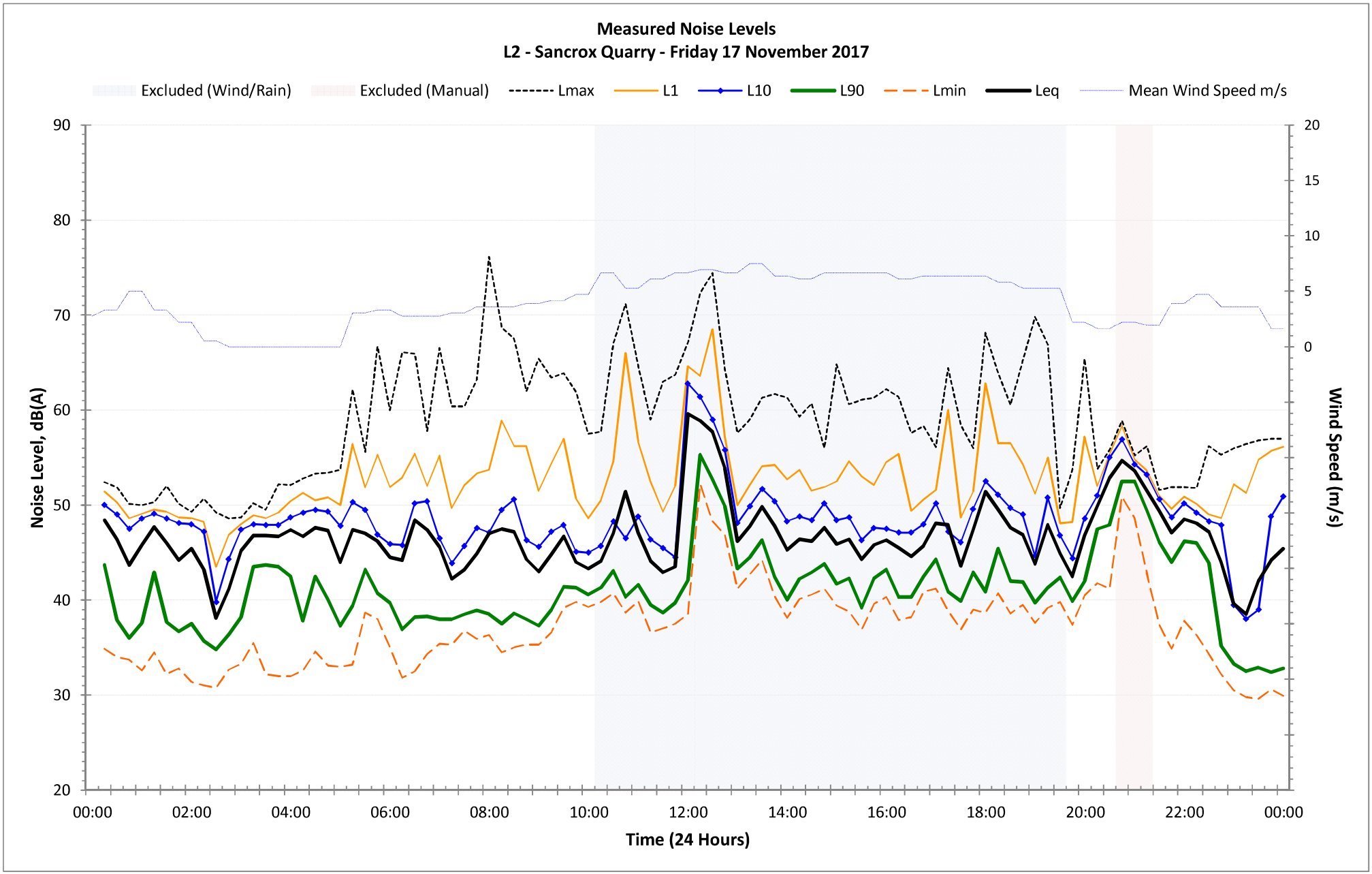
Measured Noise Levels
L2 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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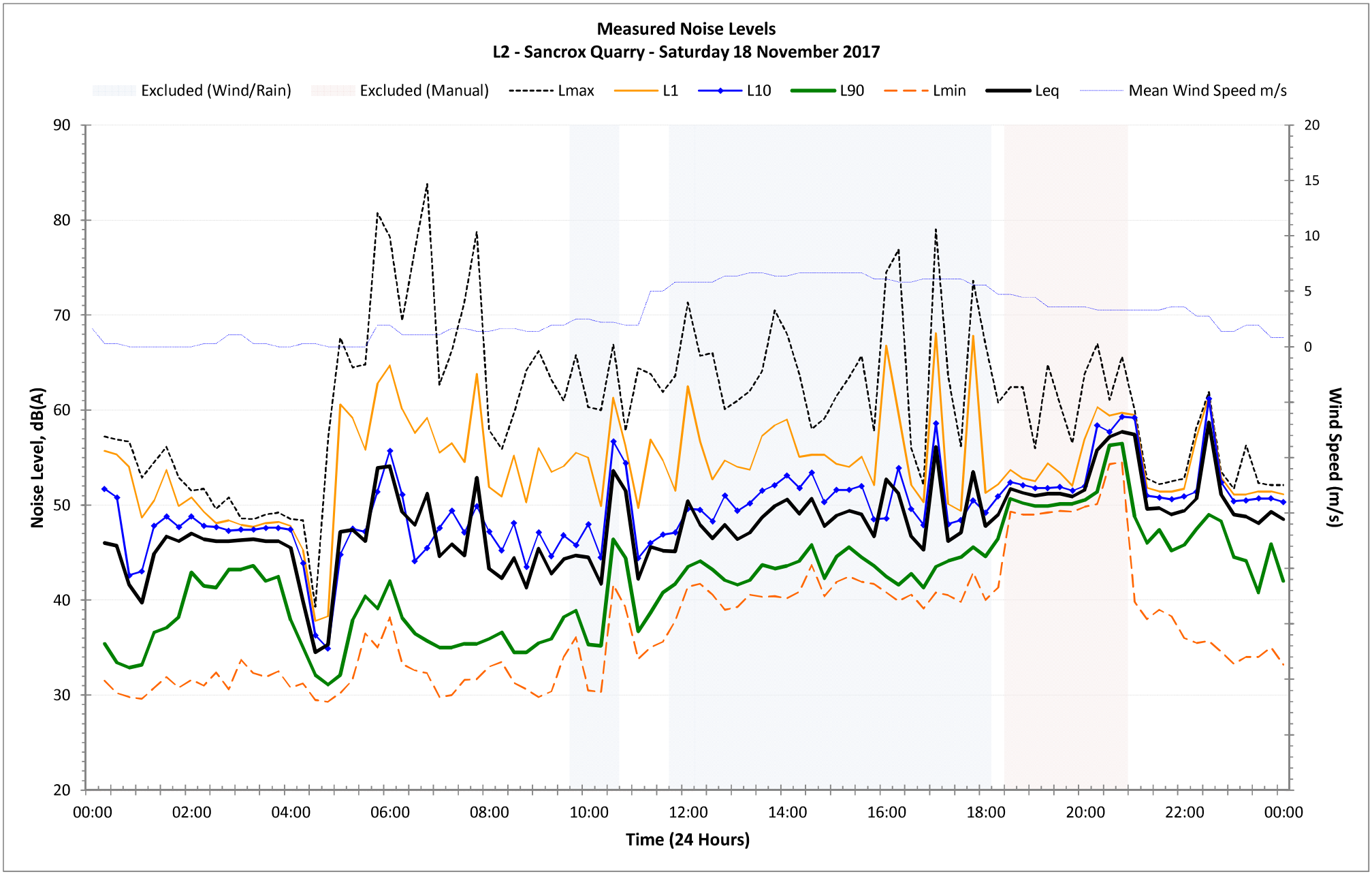
Measured Noise Levels
L2 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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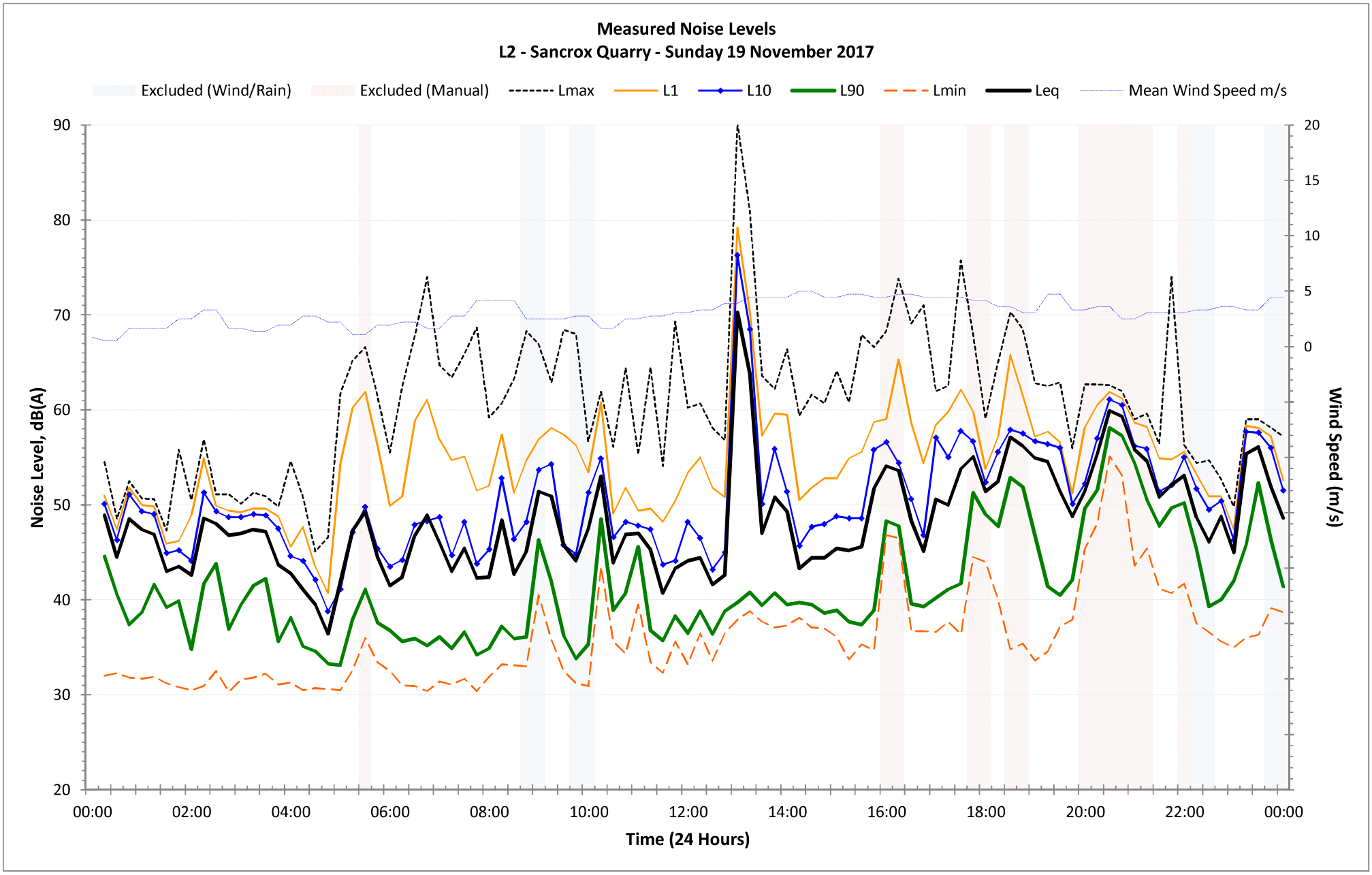
Measured Noise Levels
L2 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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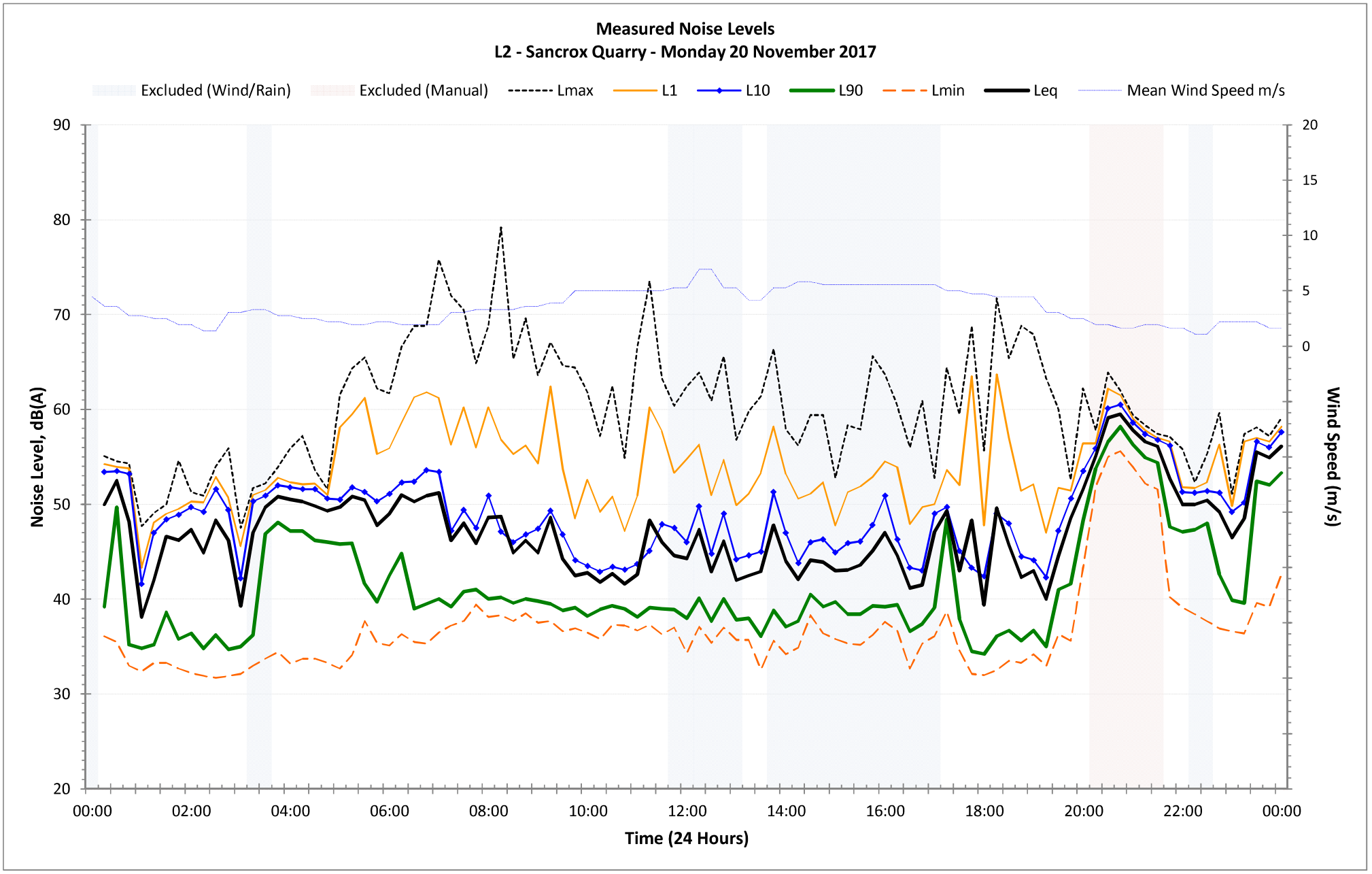
Measured Noise Levels
L2 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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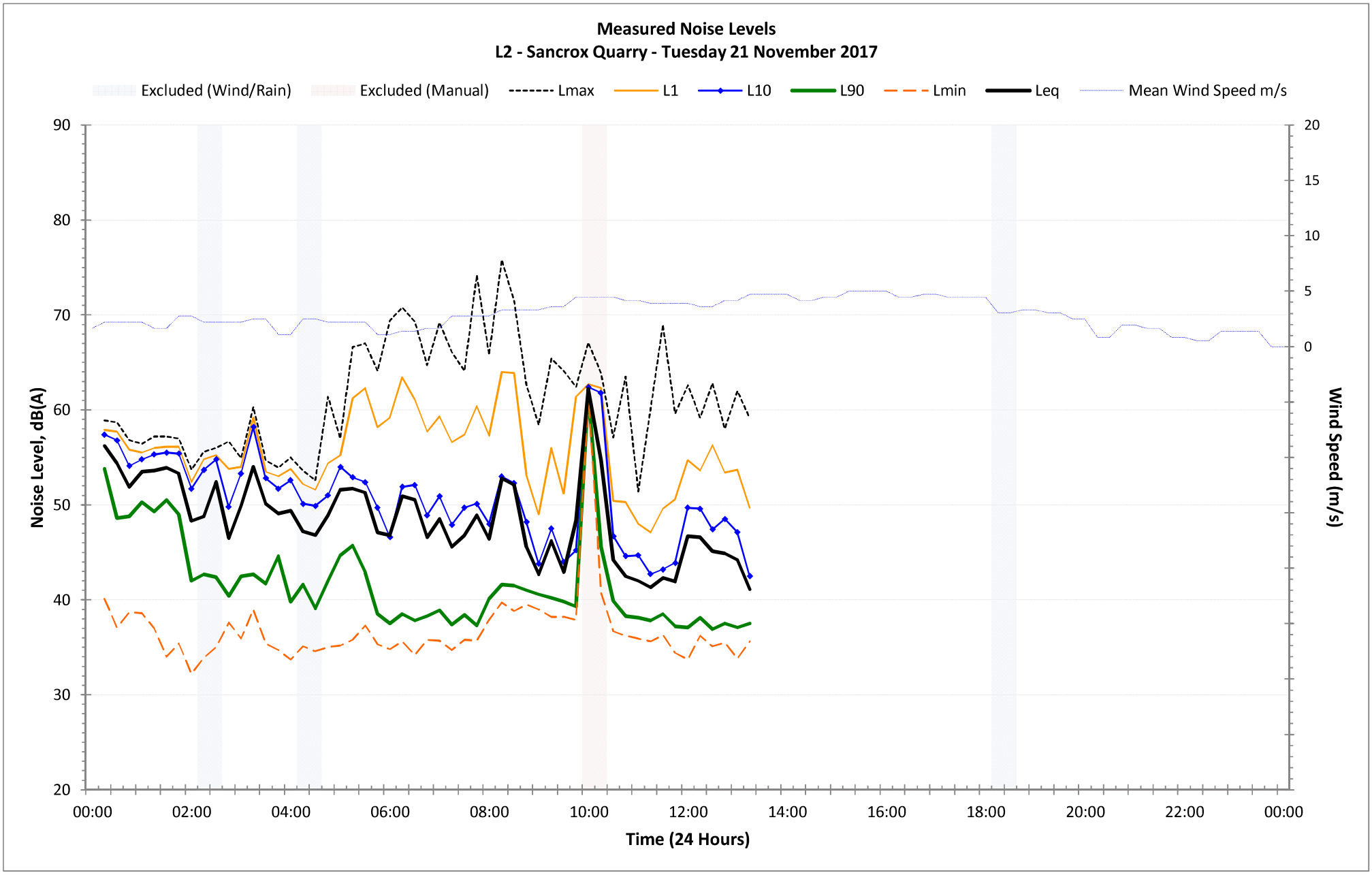
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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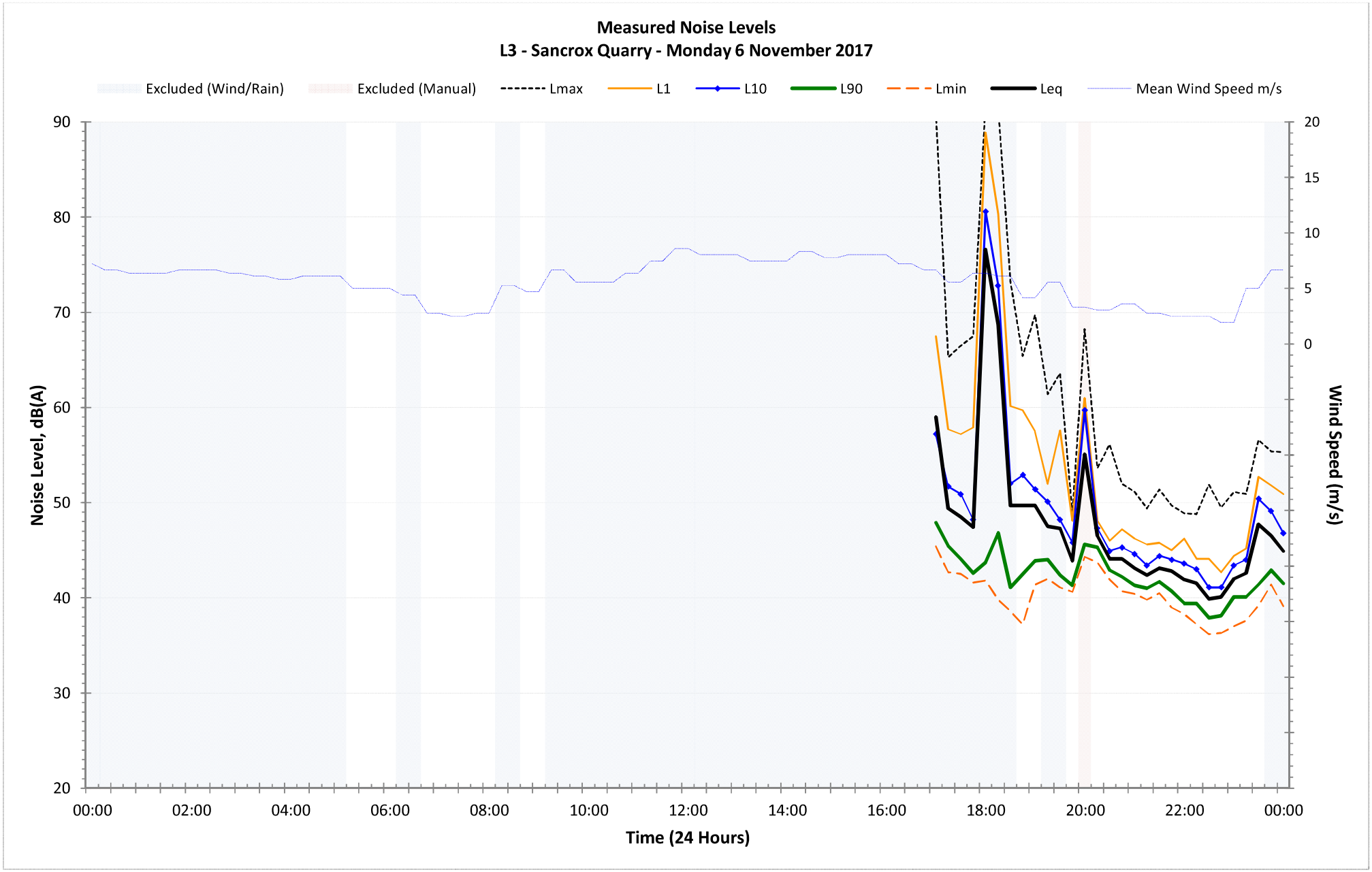
Measured Noise Levels
L3 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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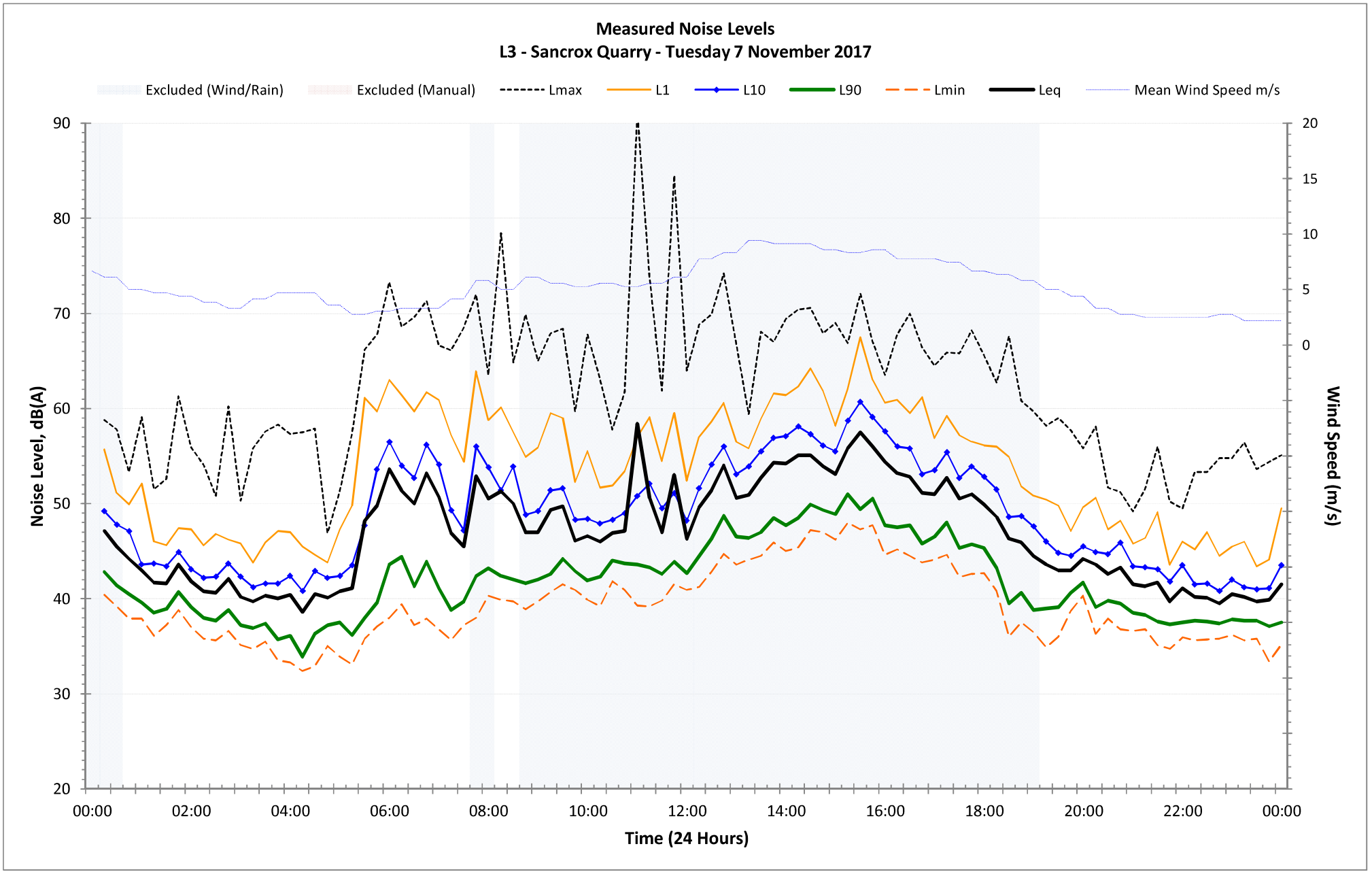
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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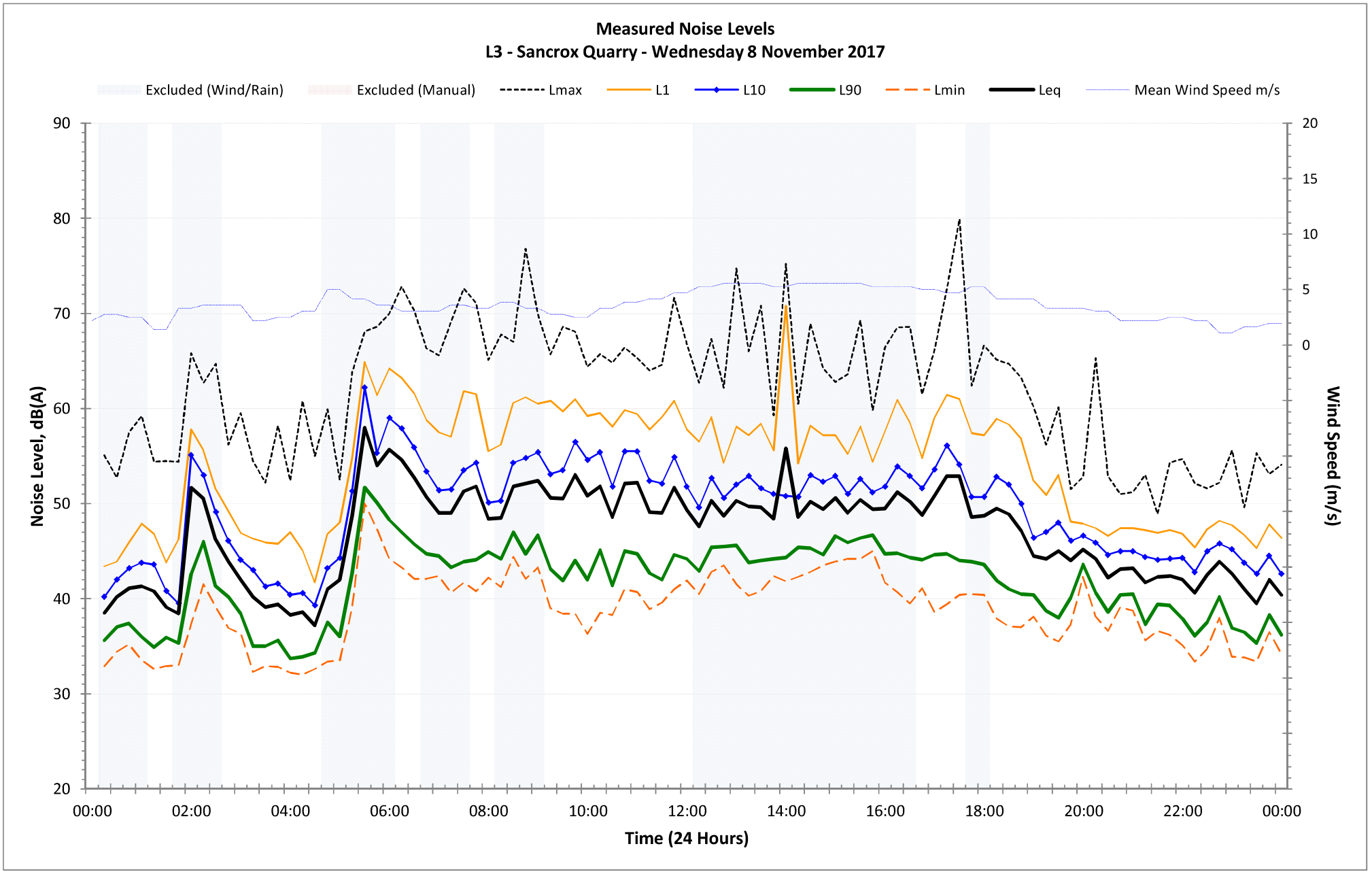
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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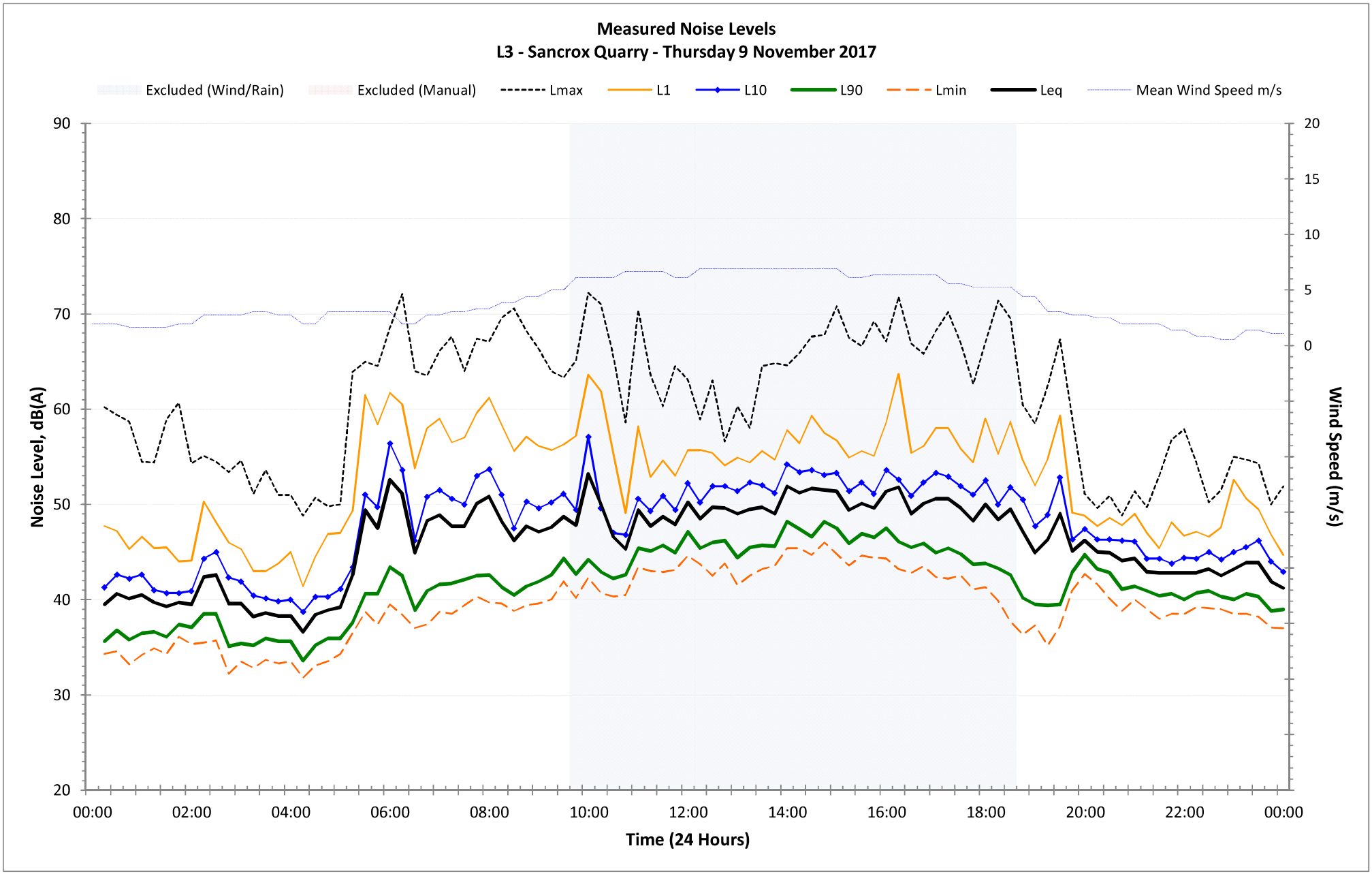
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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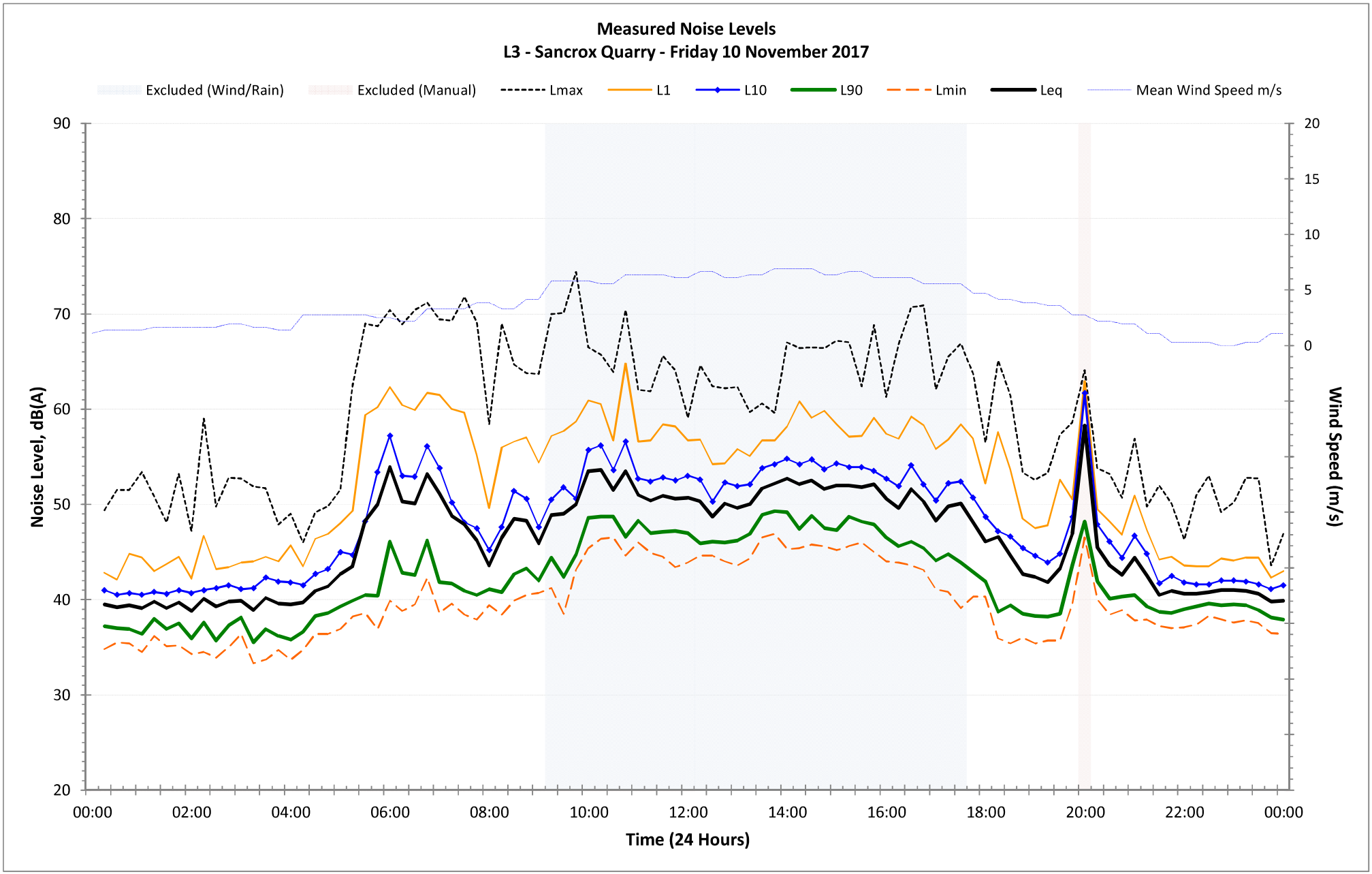
Measured Noise Levels
L3 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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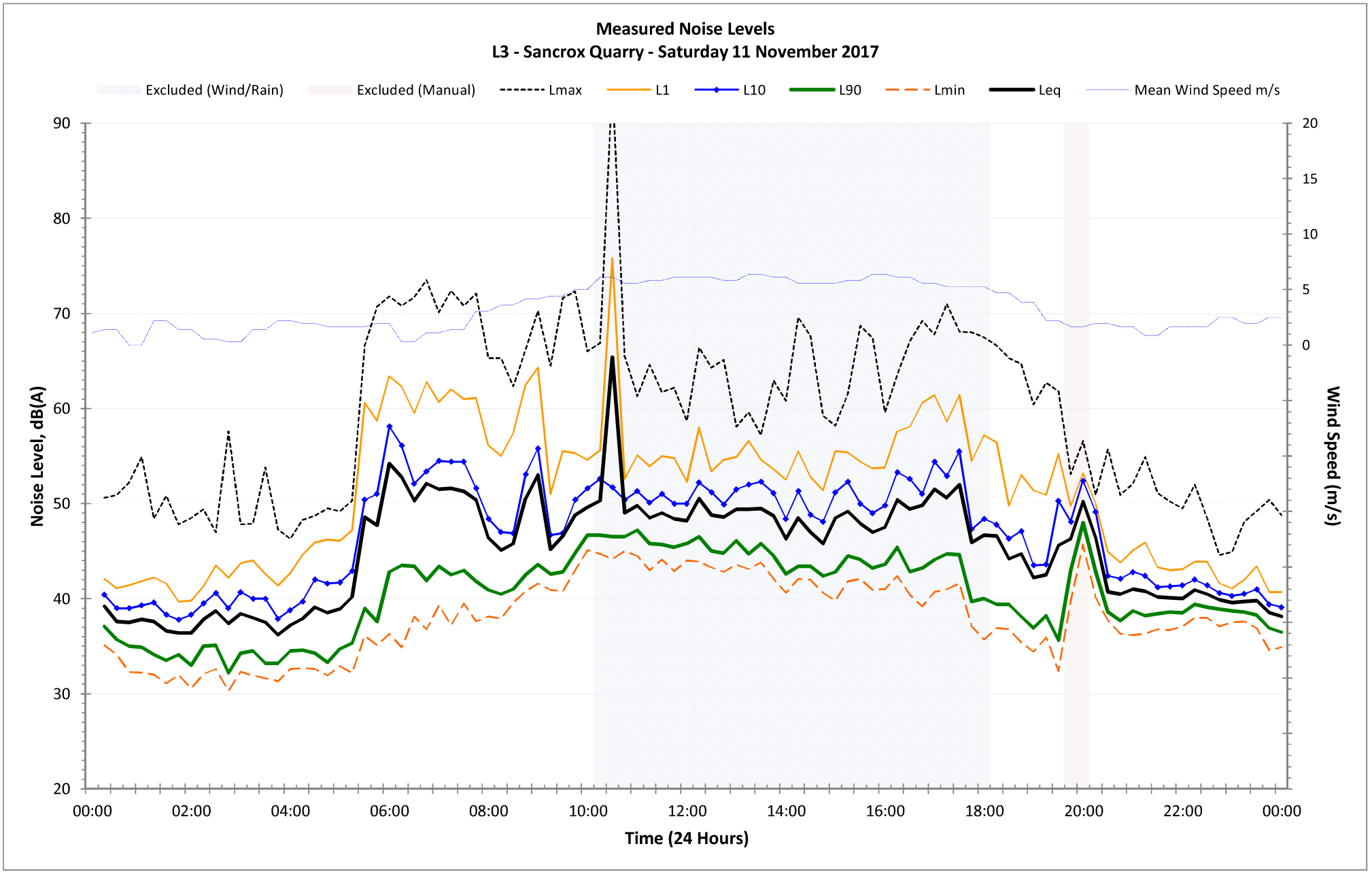
Measured Noise Levels
L3 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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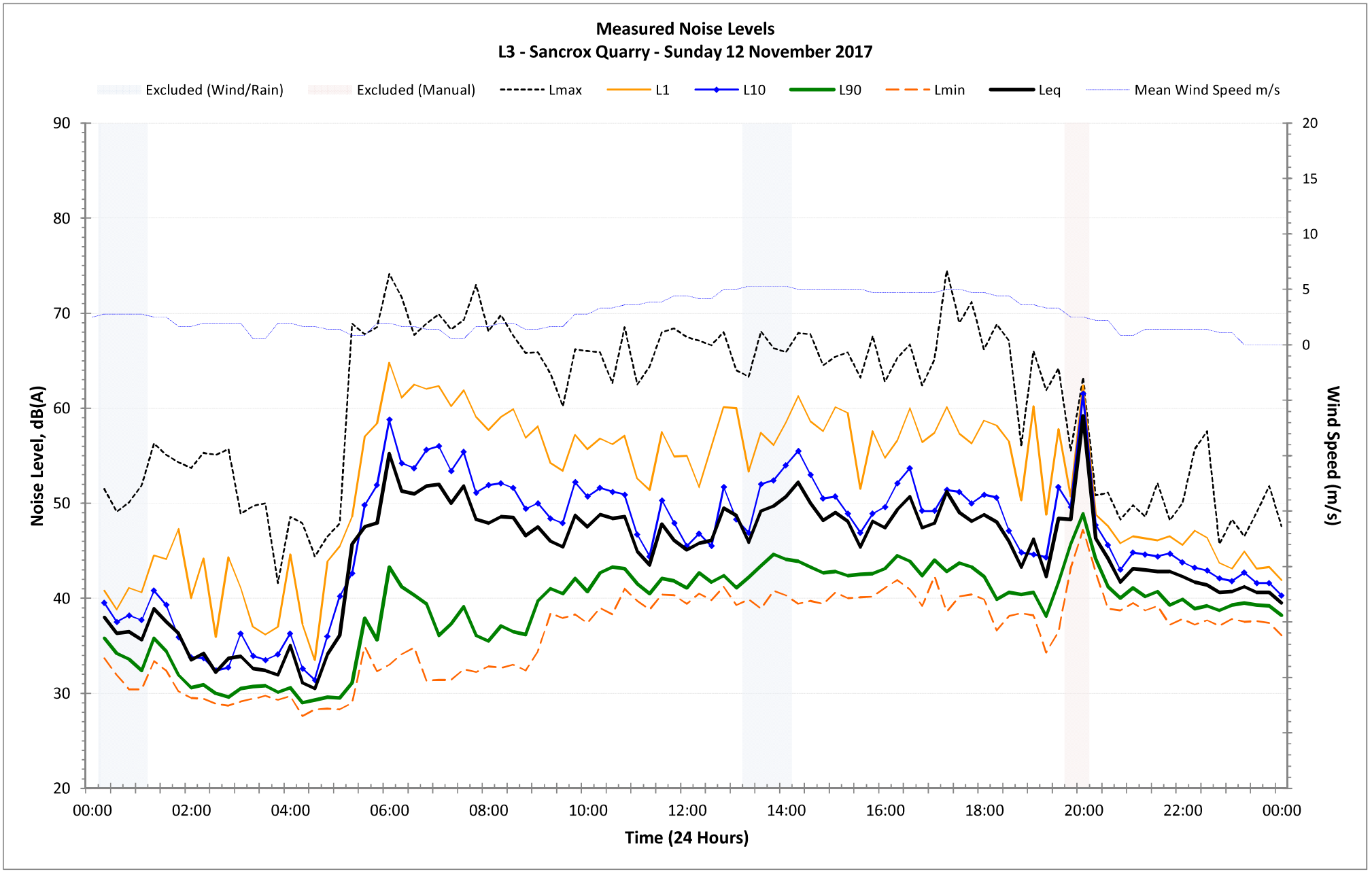
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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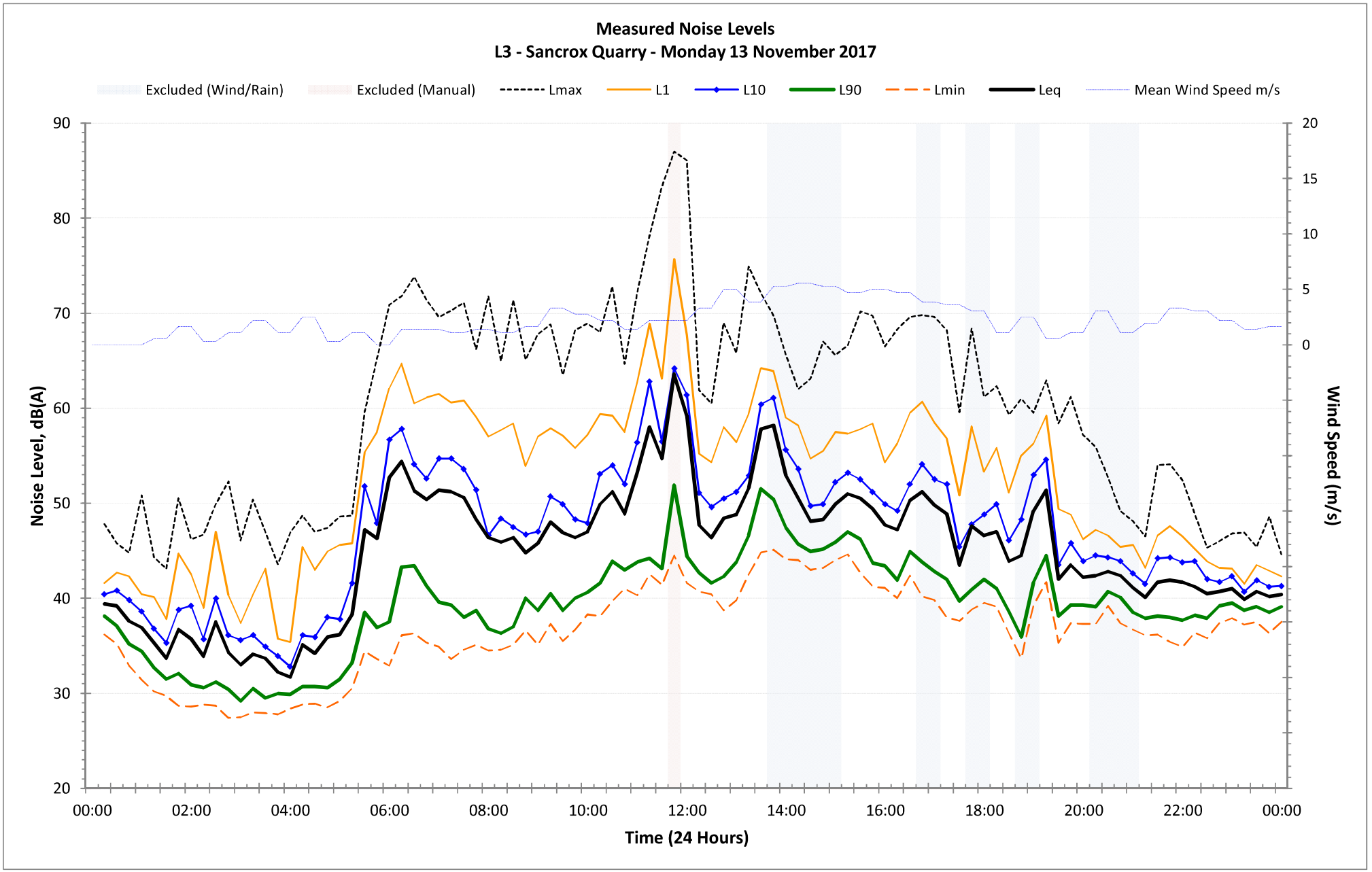
Measured Noise Levels
L3 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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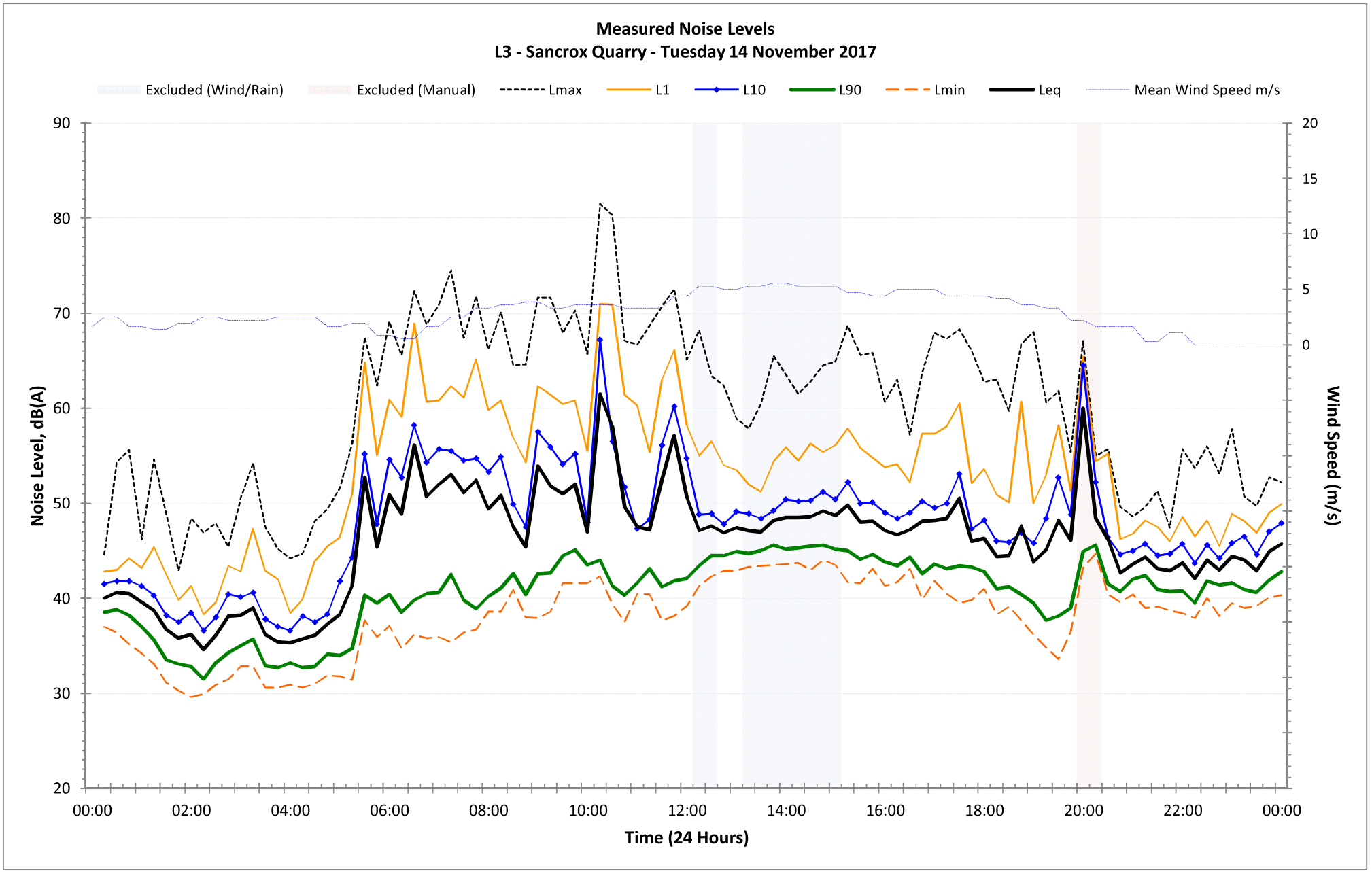
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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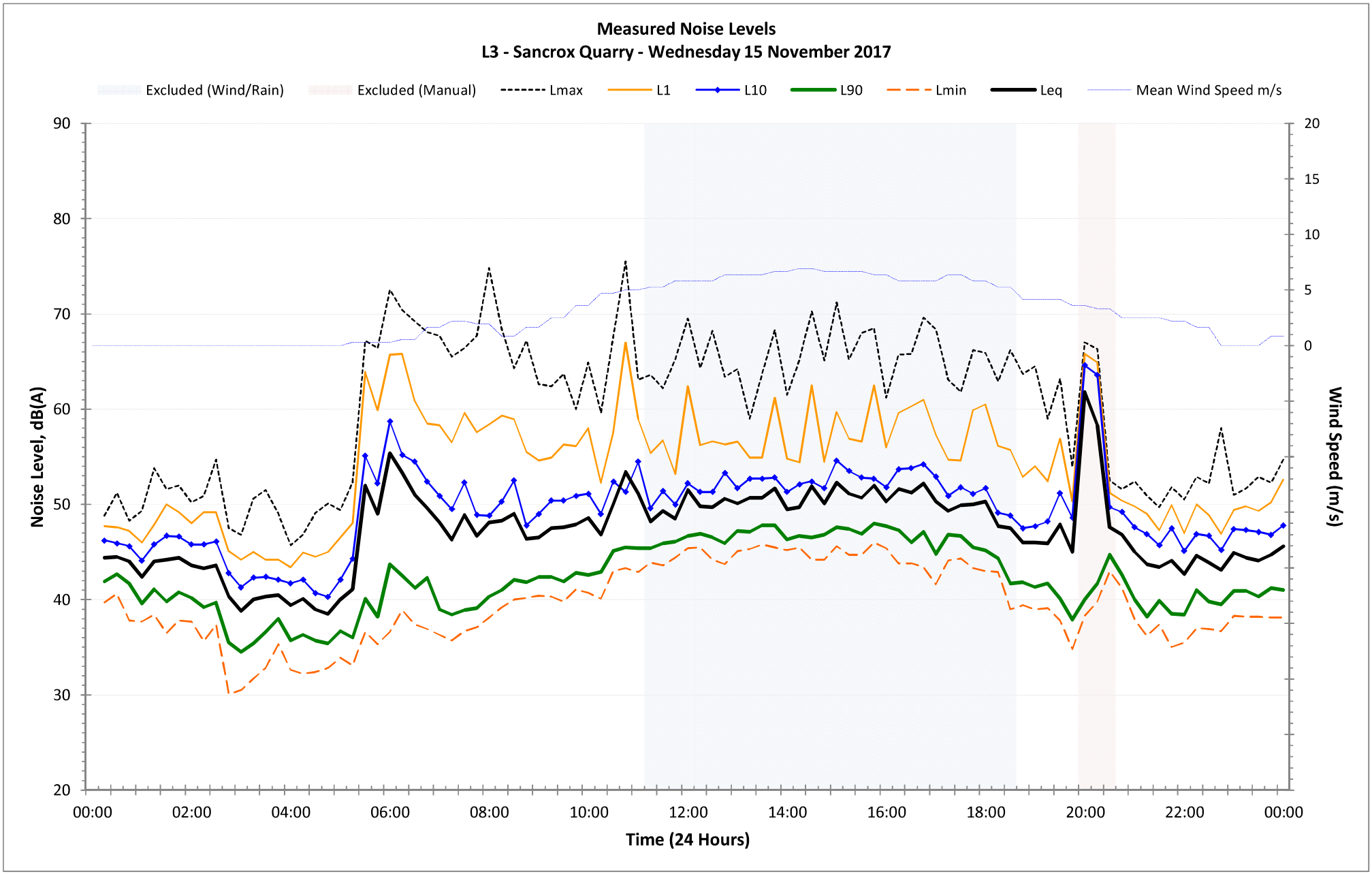
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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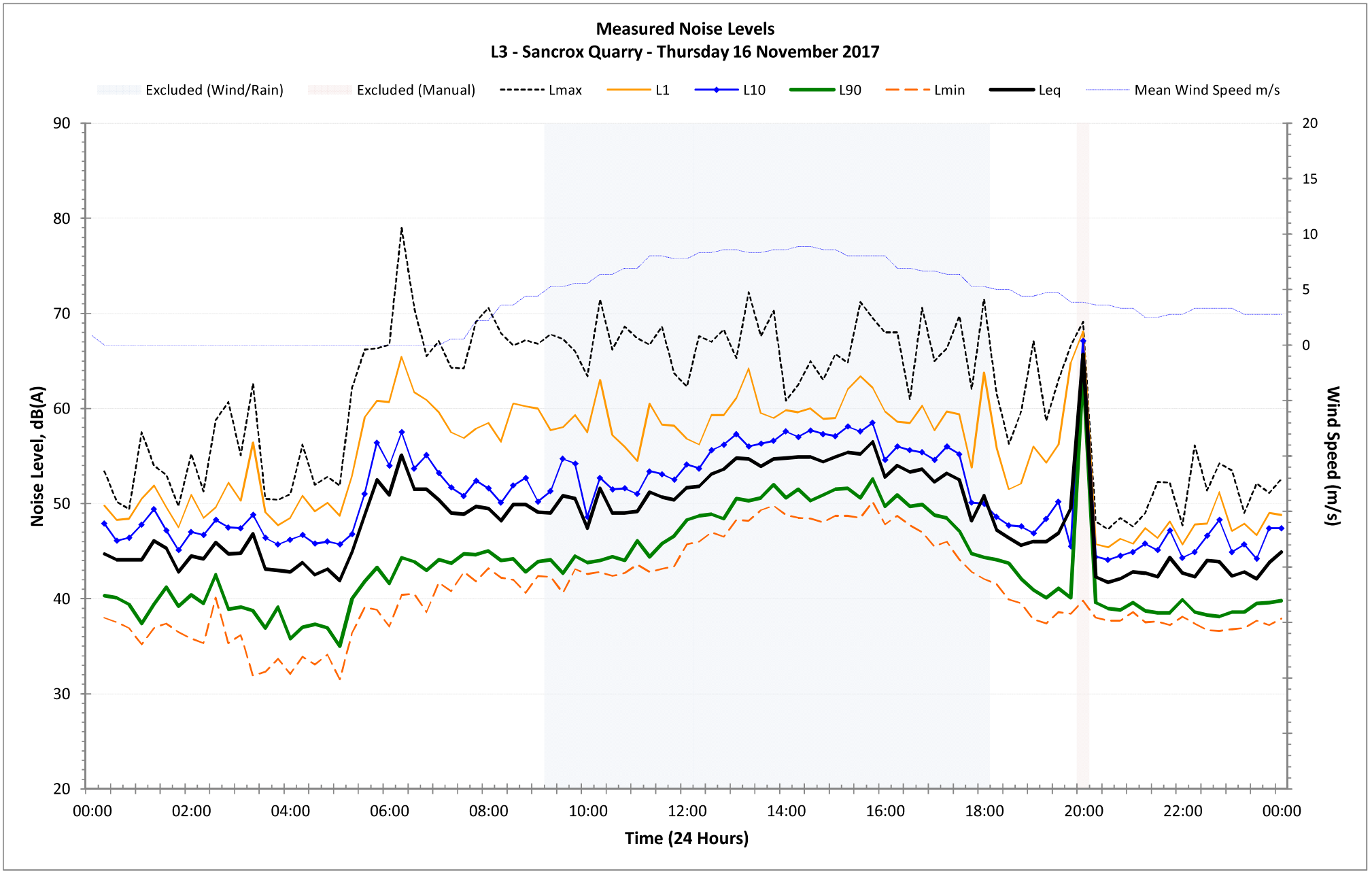
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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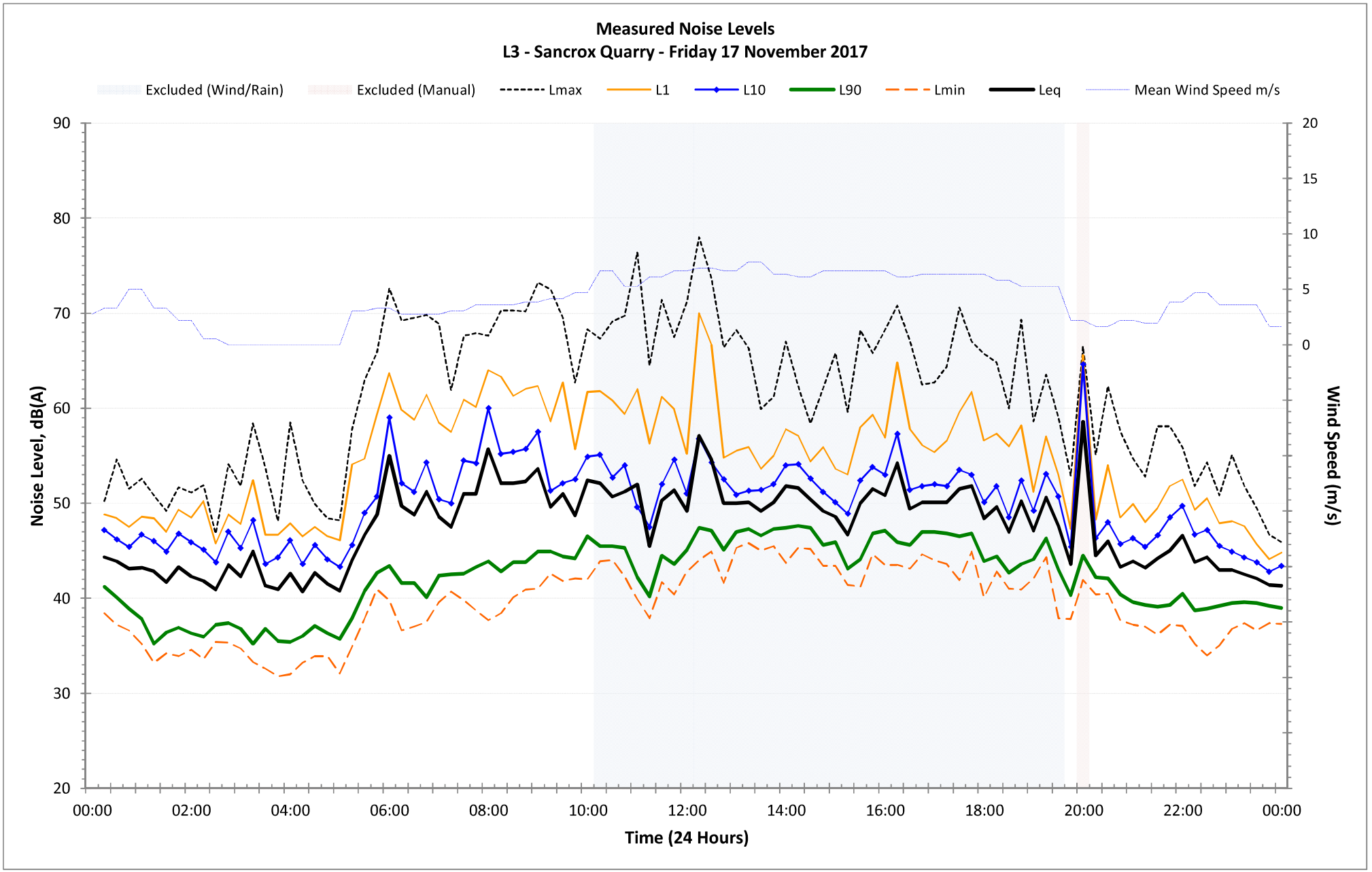
Measured Noise Levels
L3 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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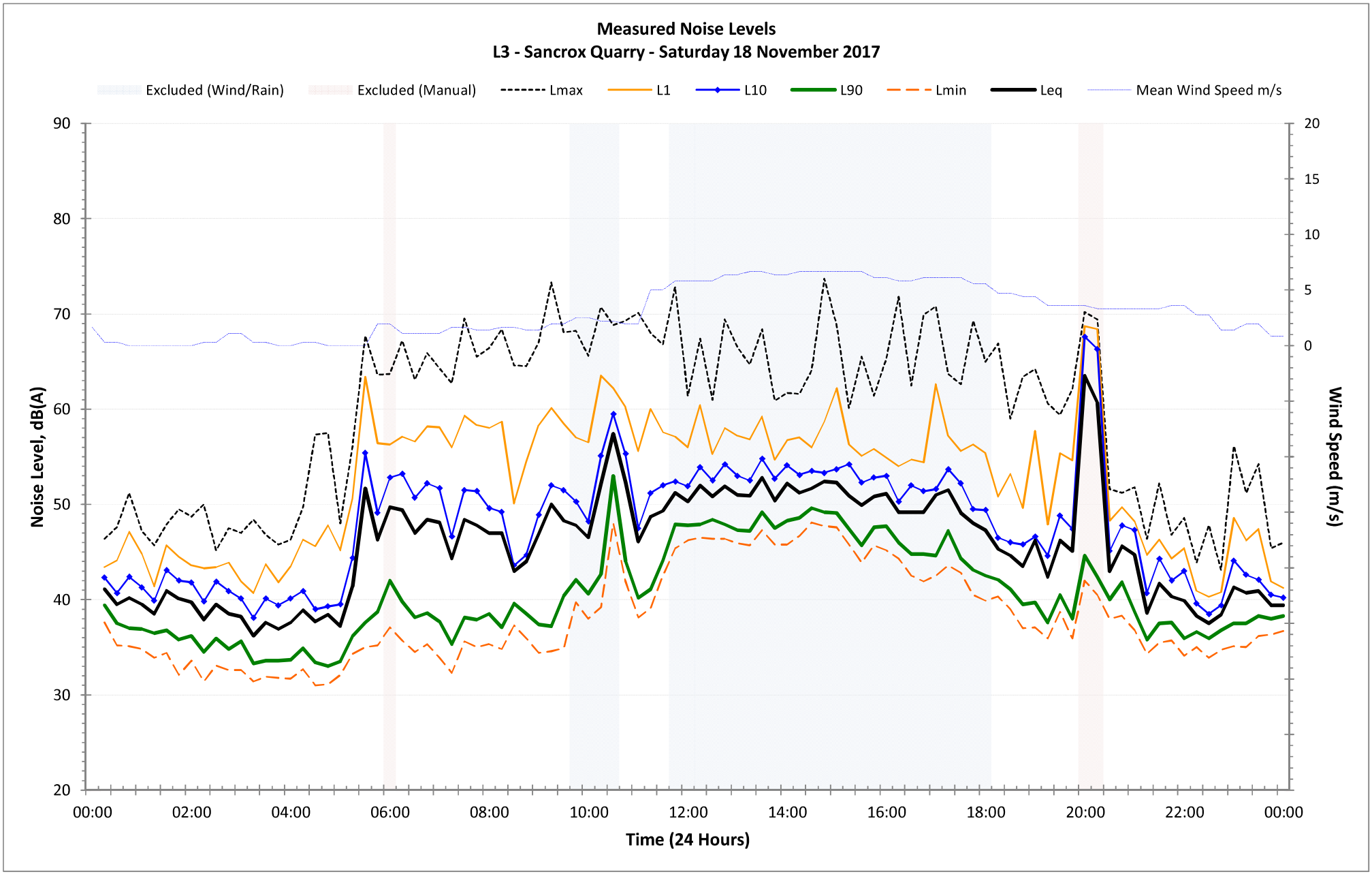
Measured Noise Levels
L3 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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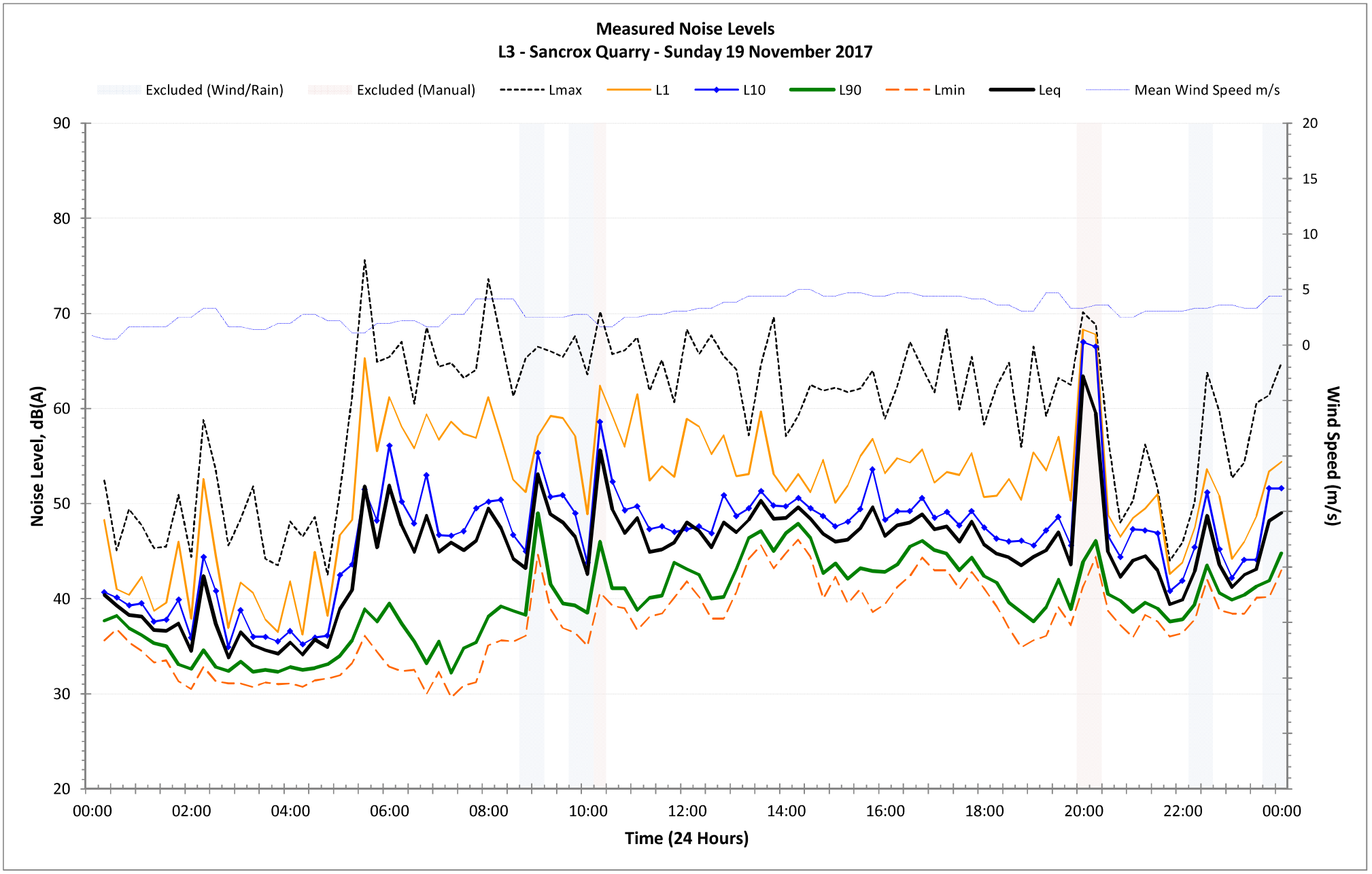
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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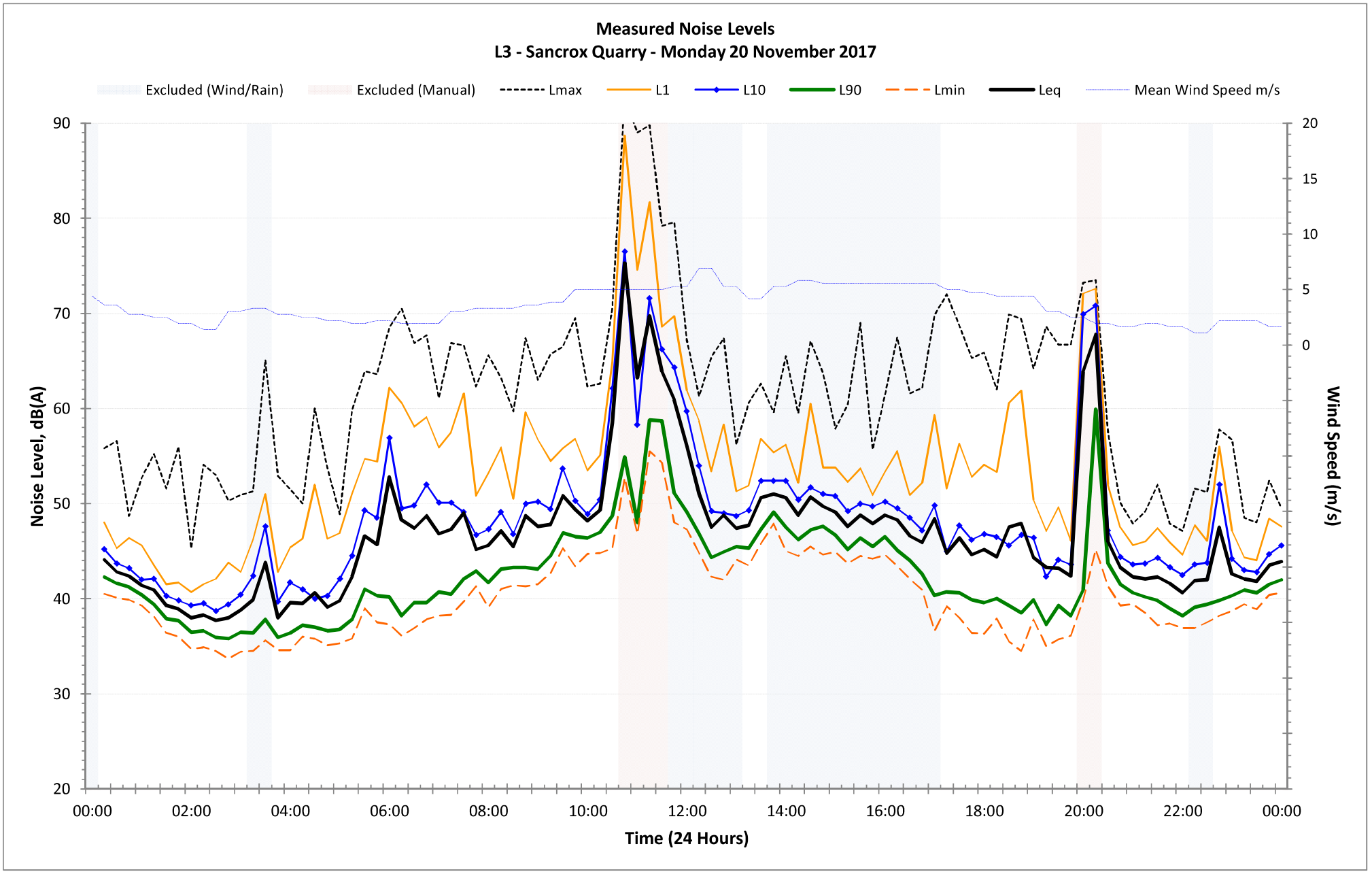
Measured Noise Levels
L3 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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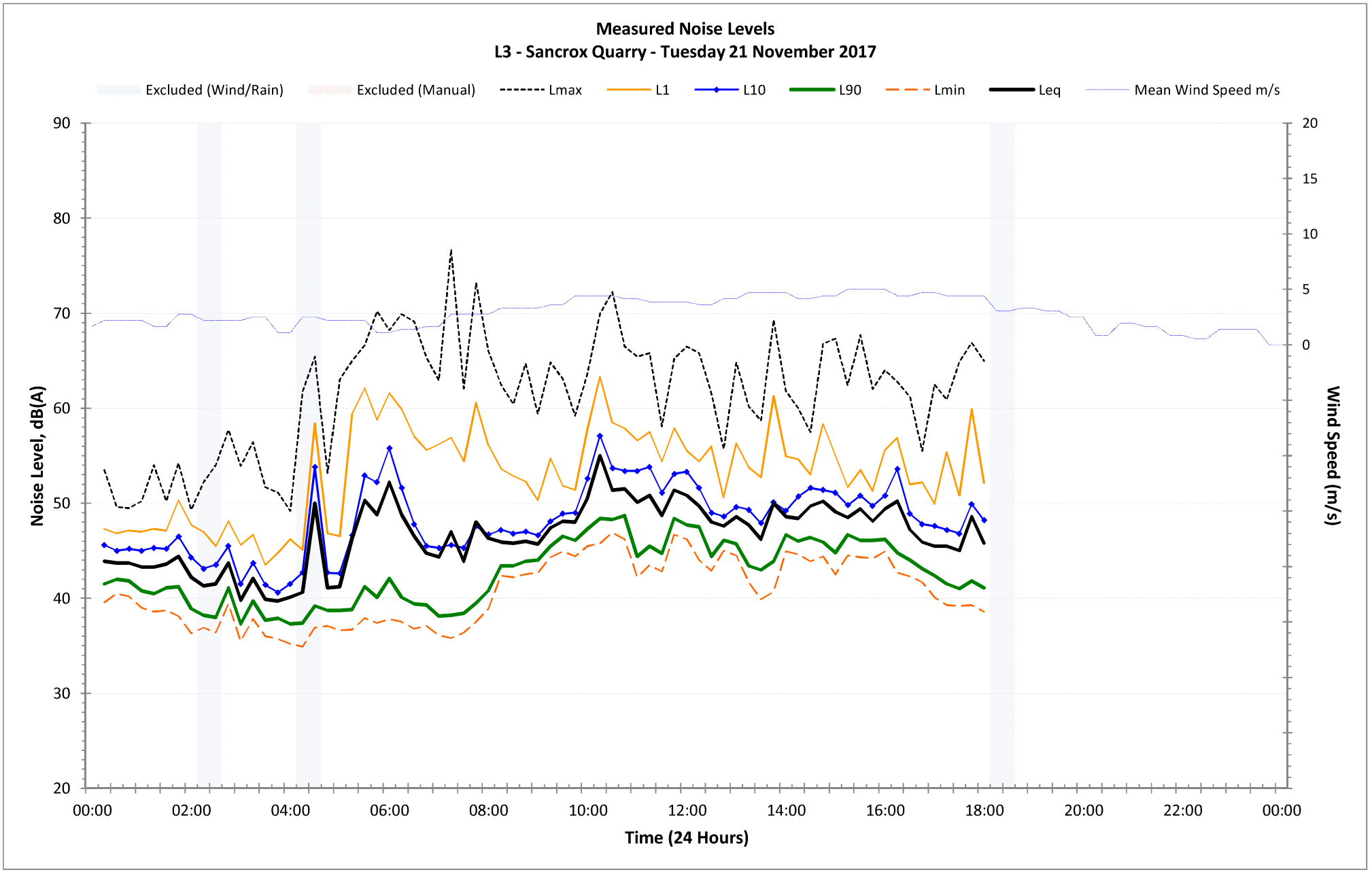
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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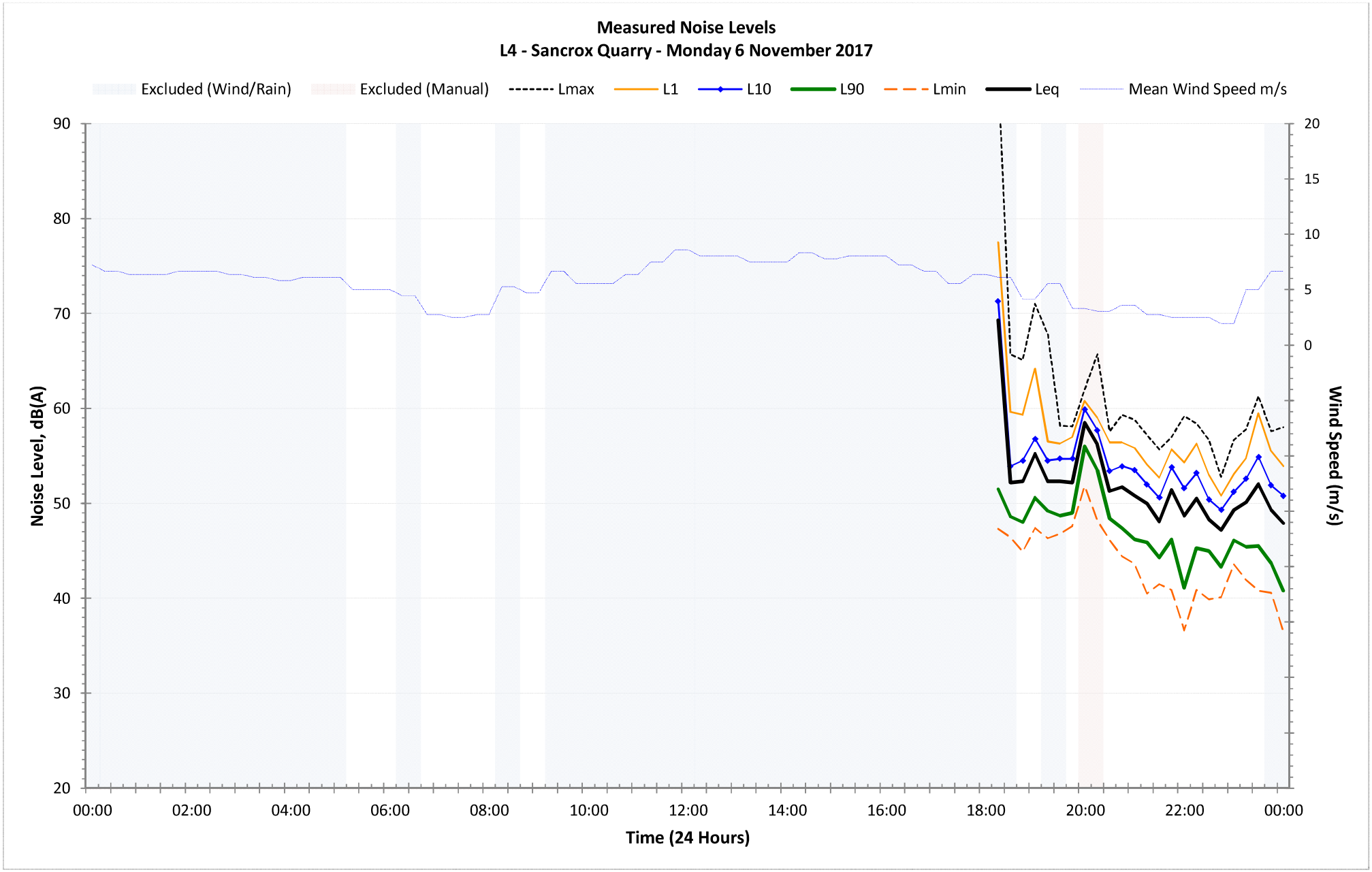
Measured Noise Levels
L4 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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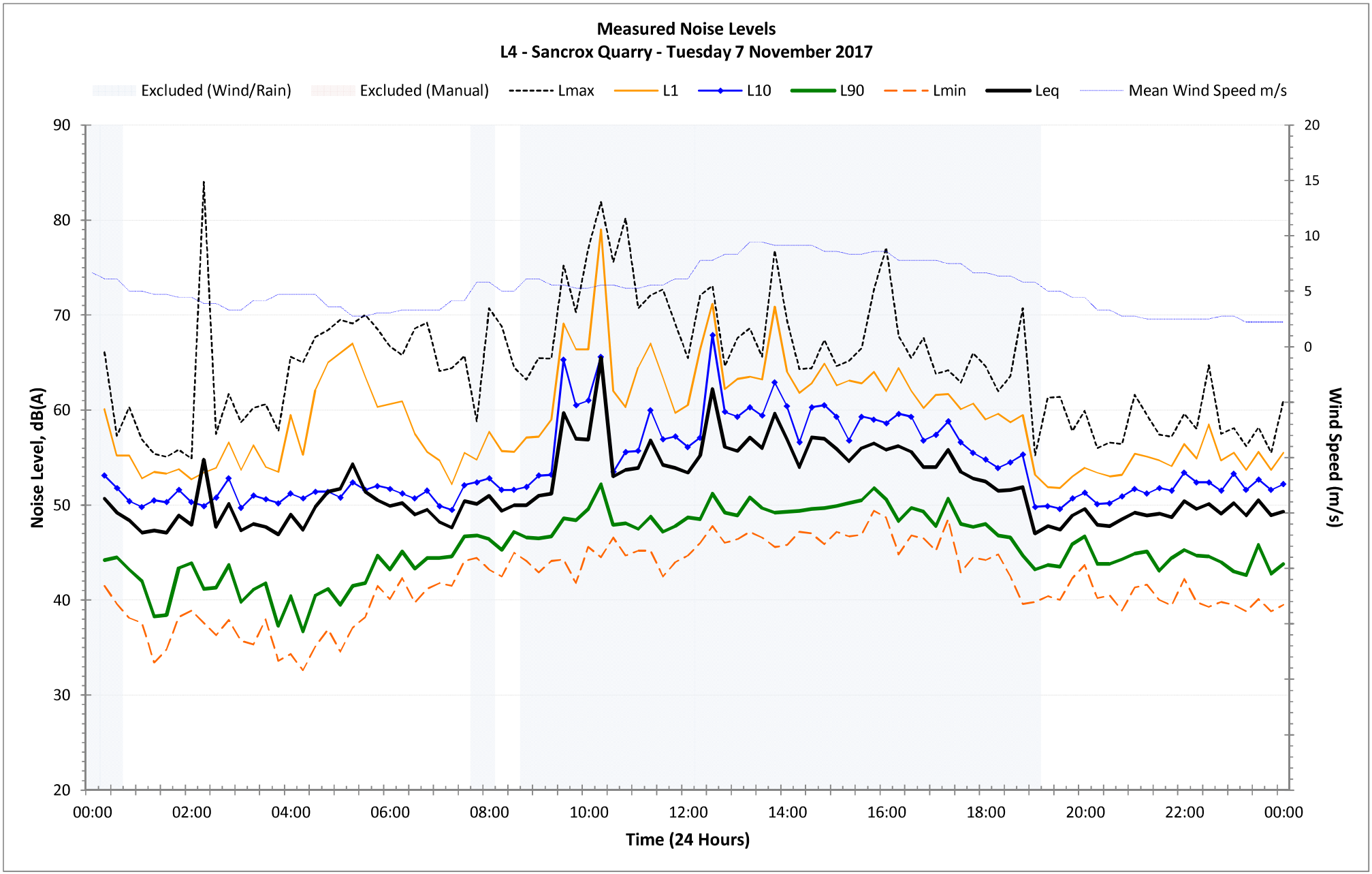
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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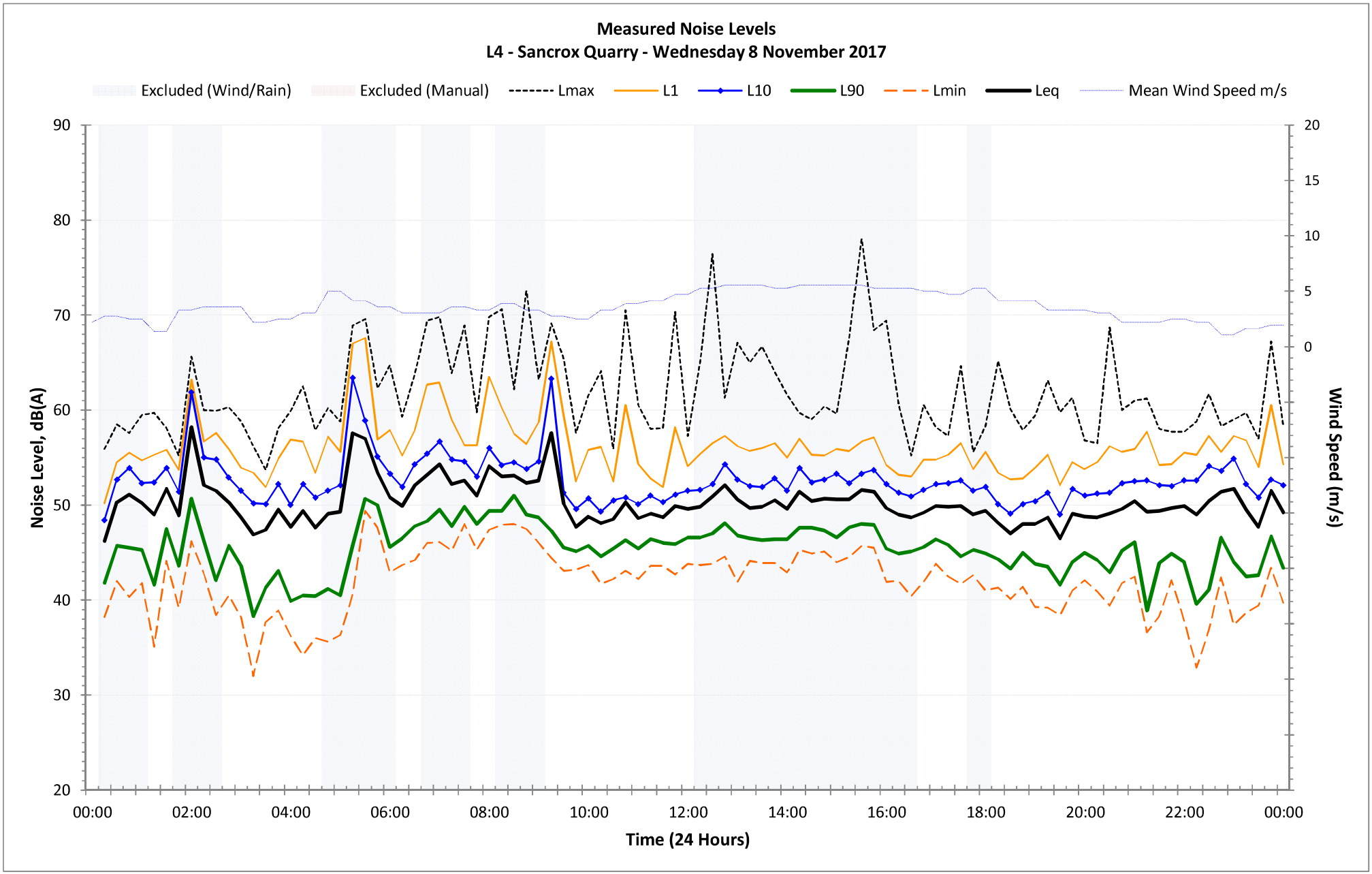
Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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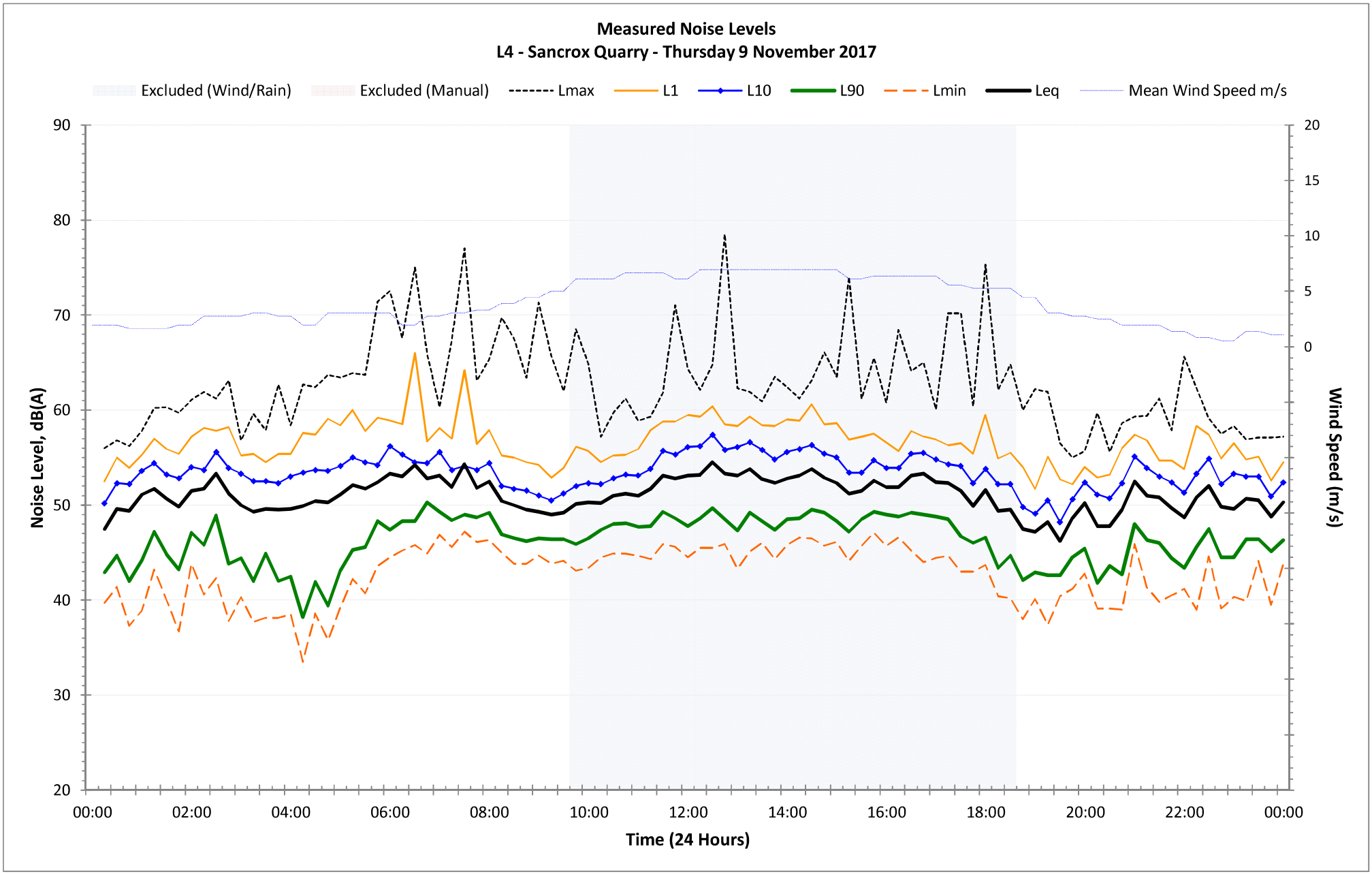
Measured Noise Levels
L4 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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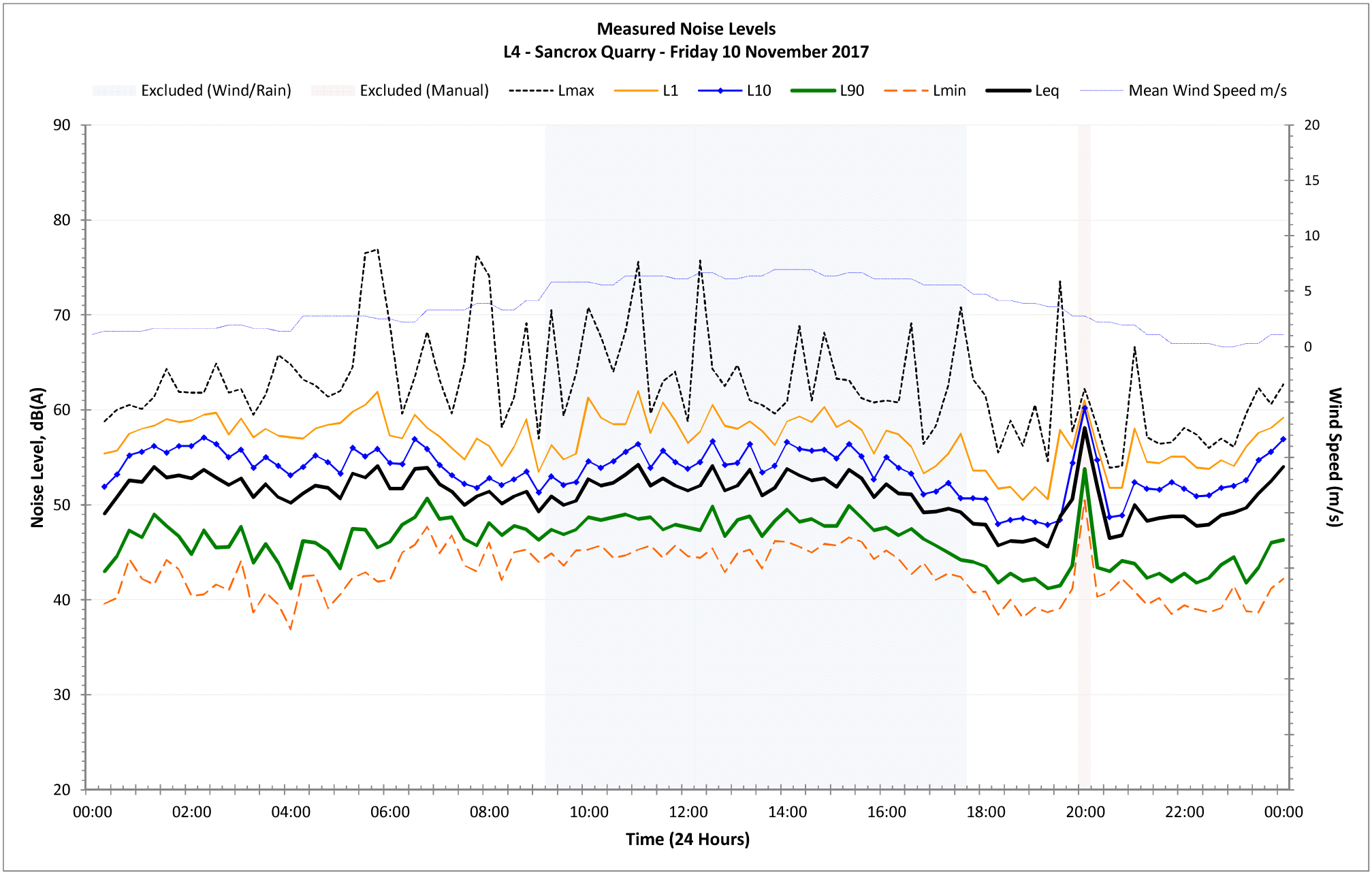
Measured Noise Levels
L4 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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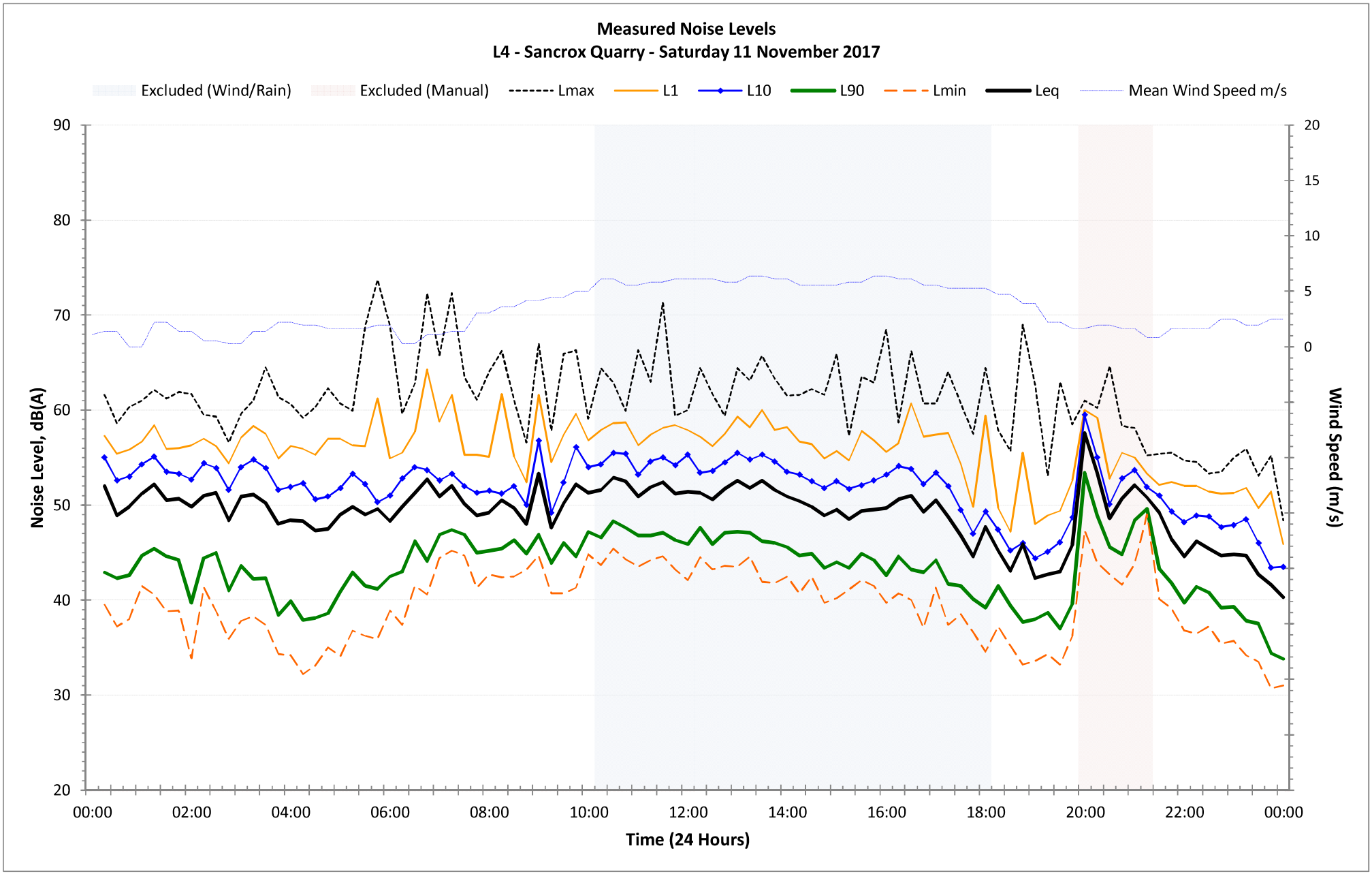
Measured Noise Levels
L4 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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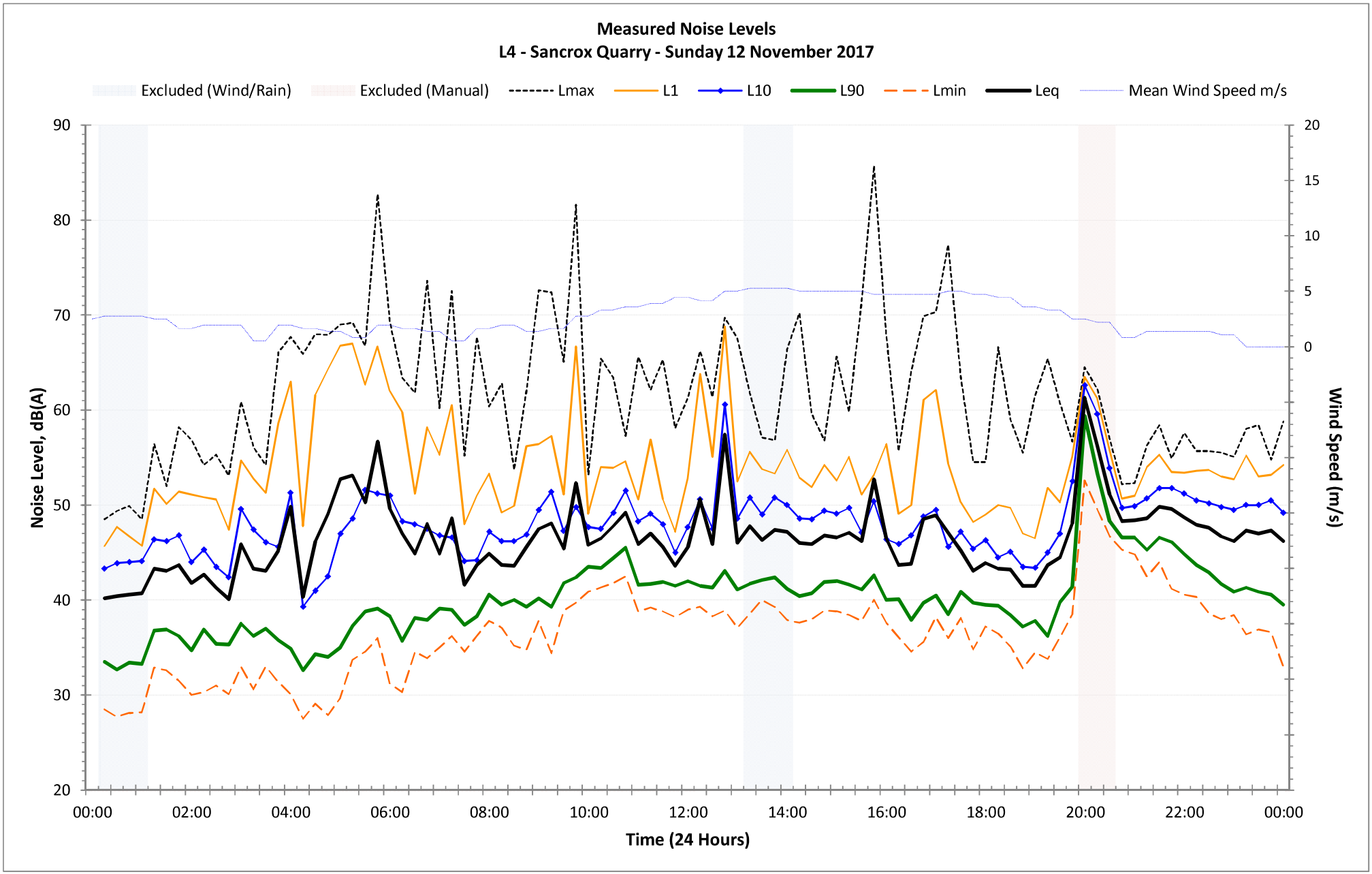
Measured Noise Levels
L4 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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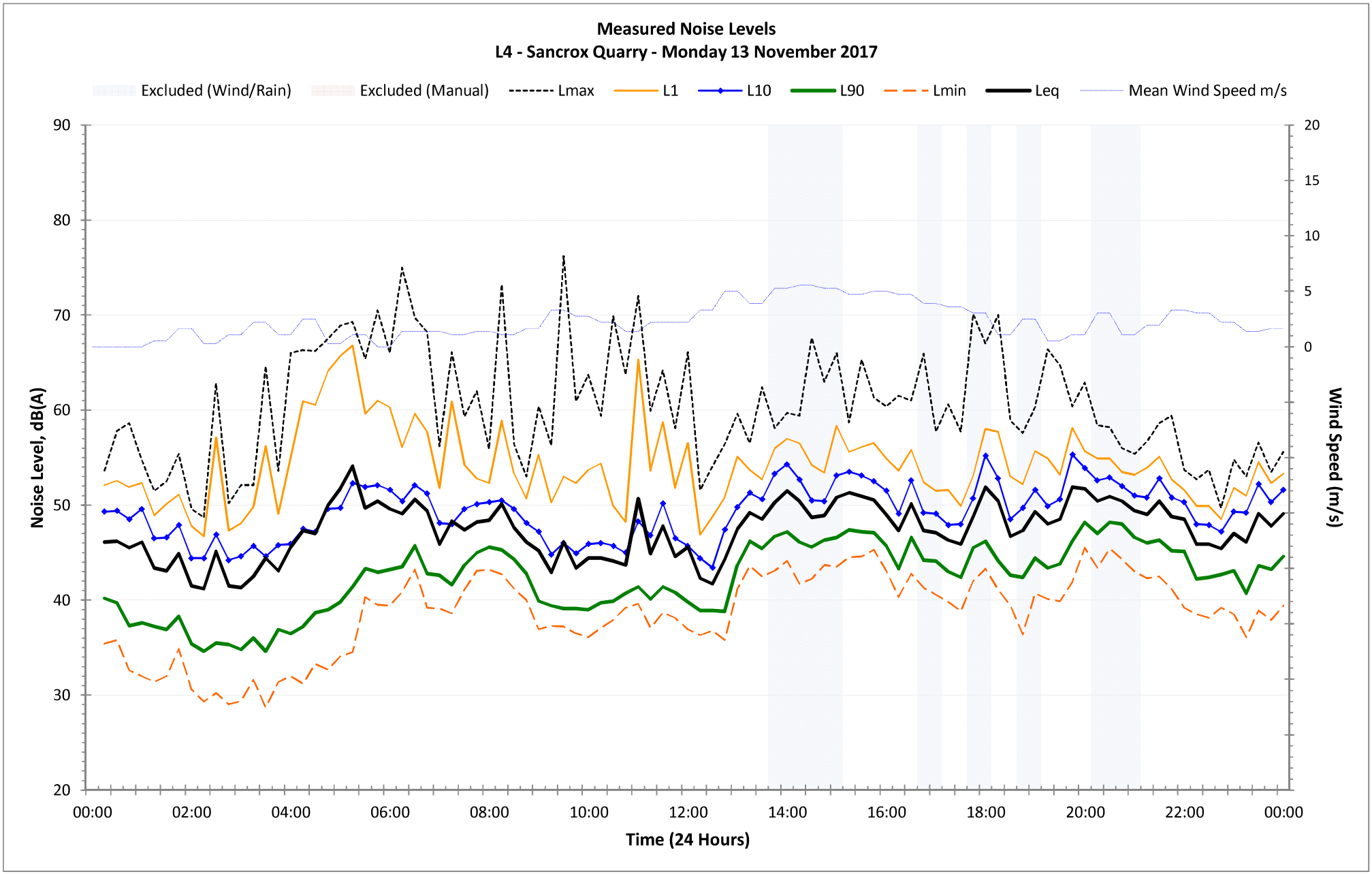
Measured Noise Levels
L4 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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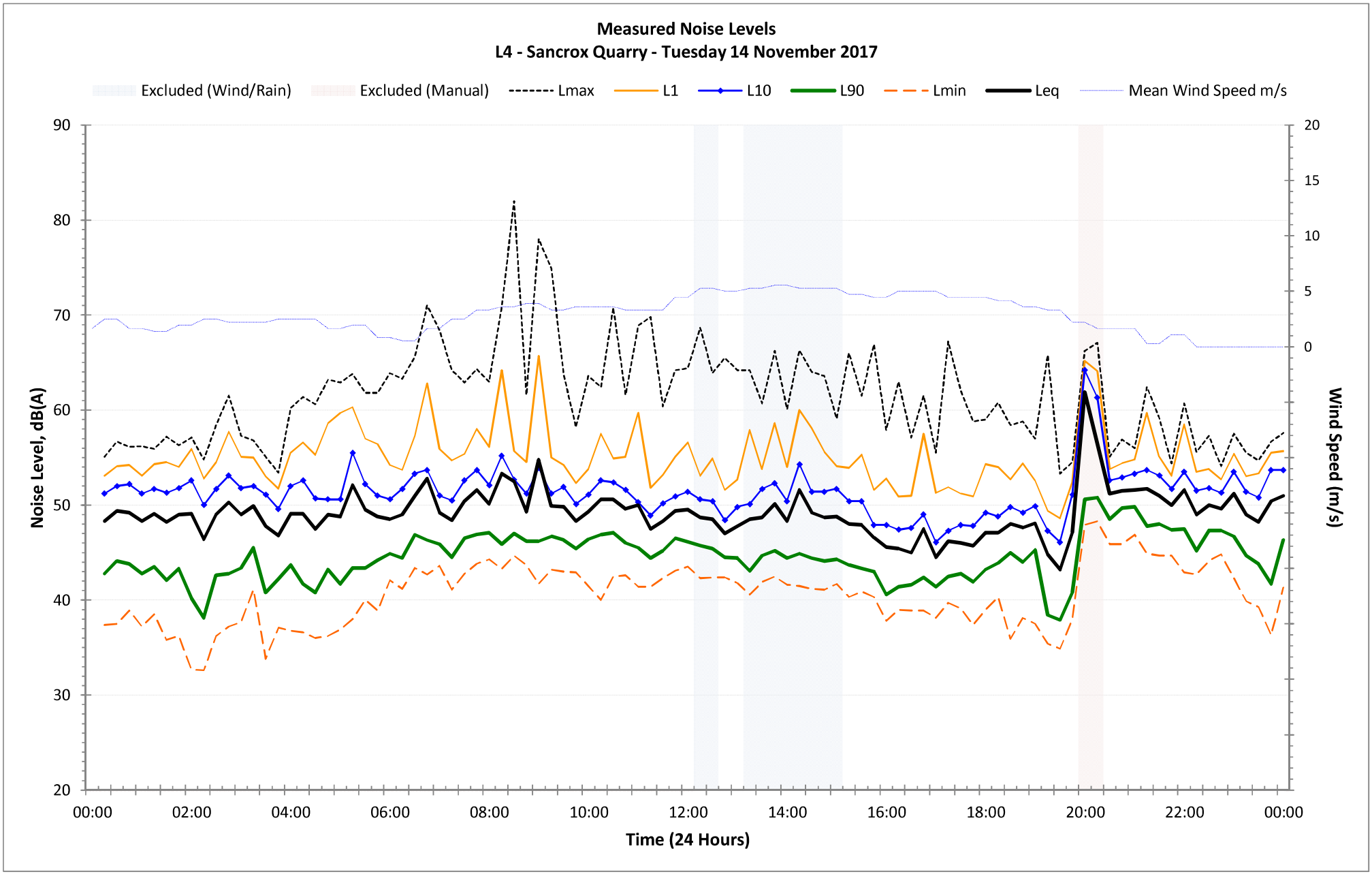
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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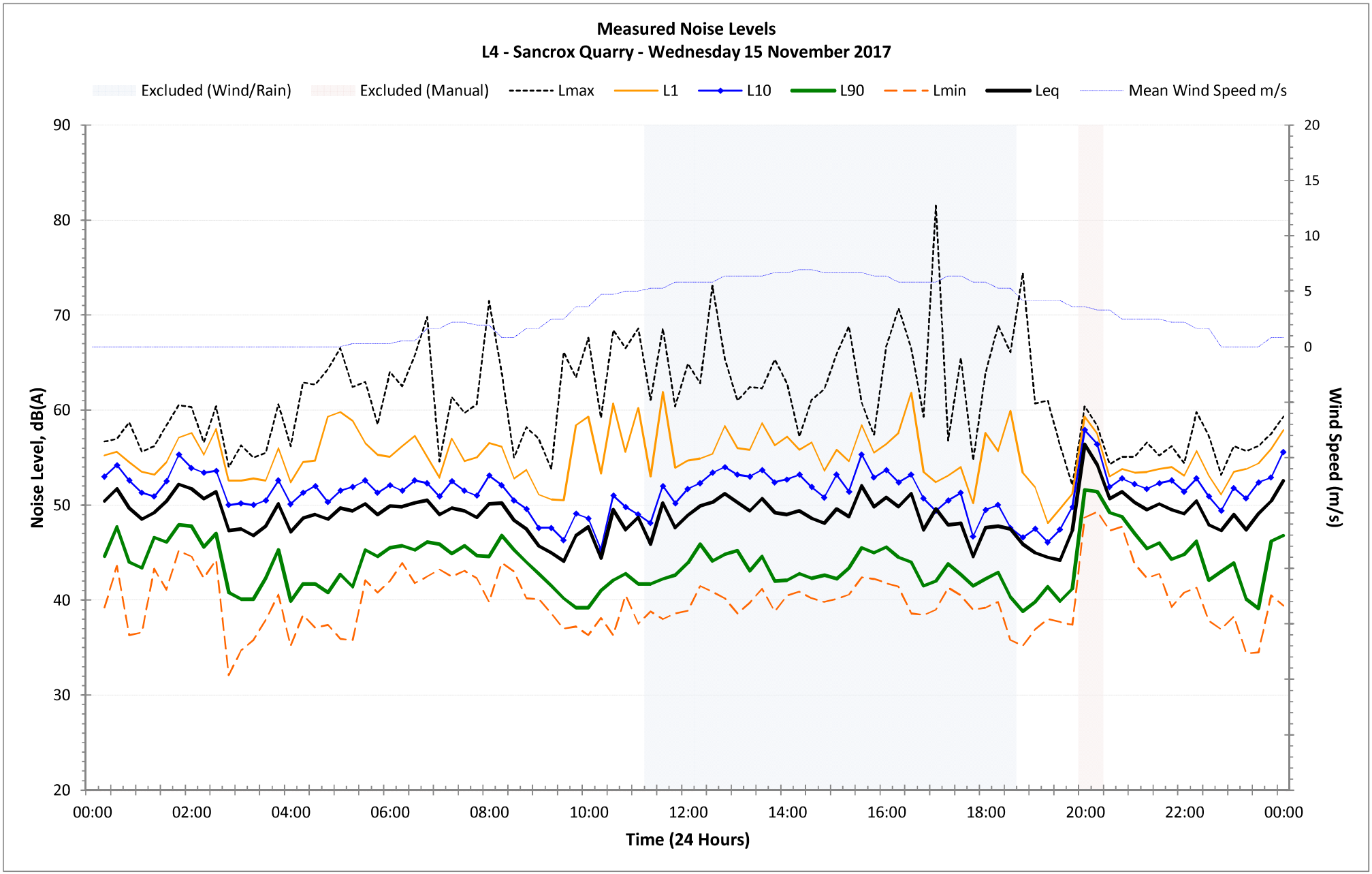
Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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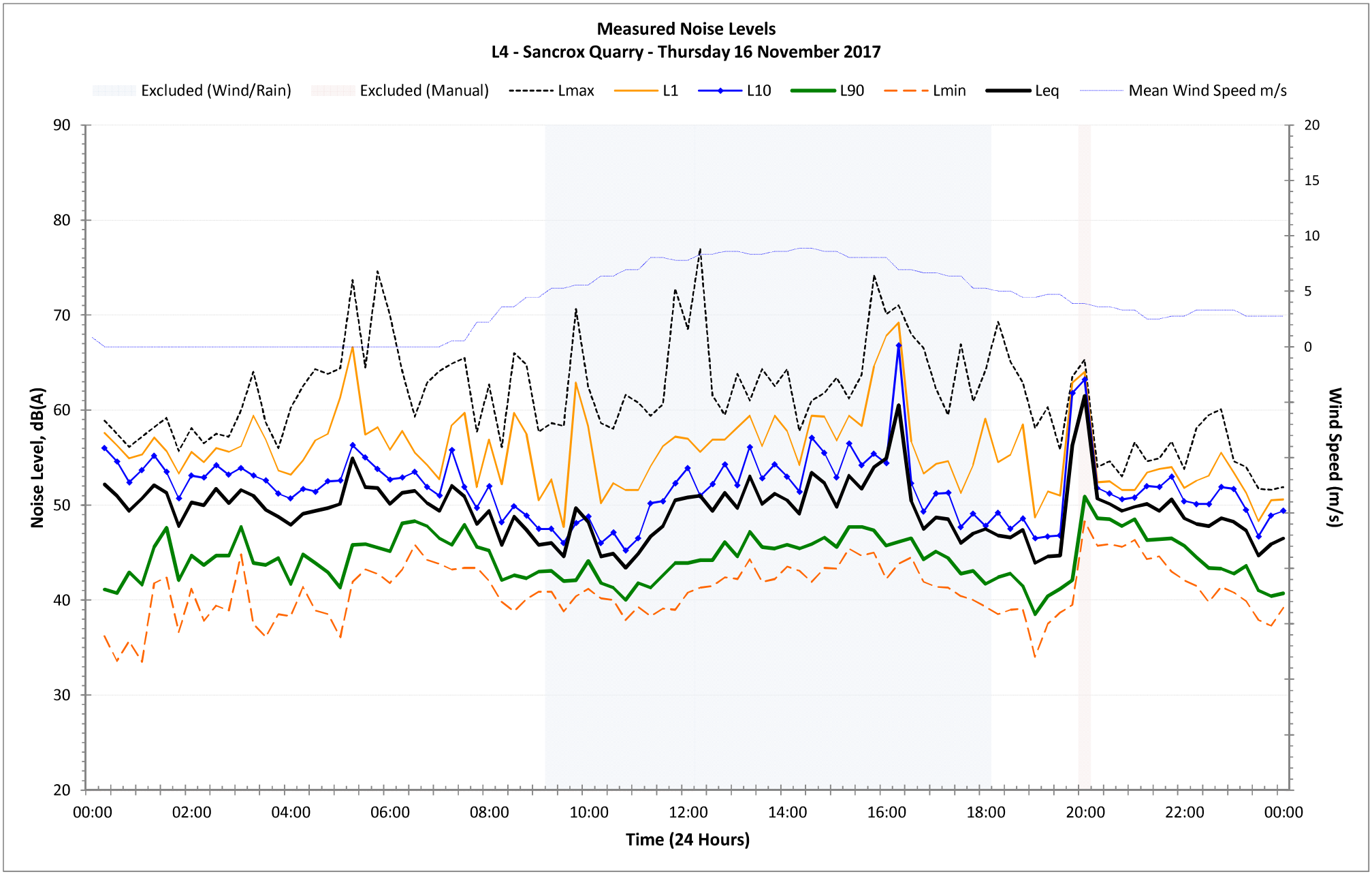
Measured Noise Levels
L4 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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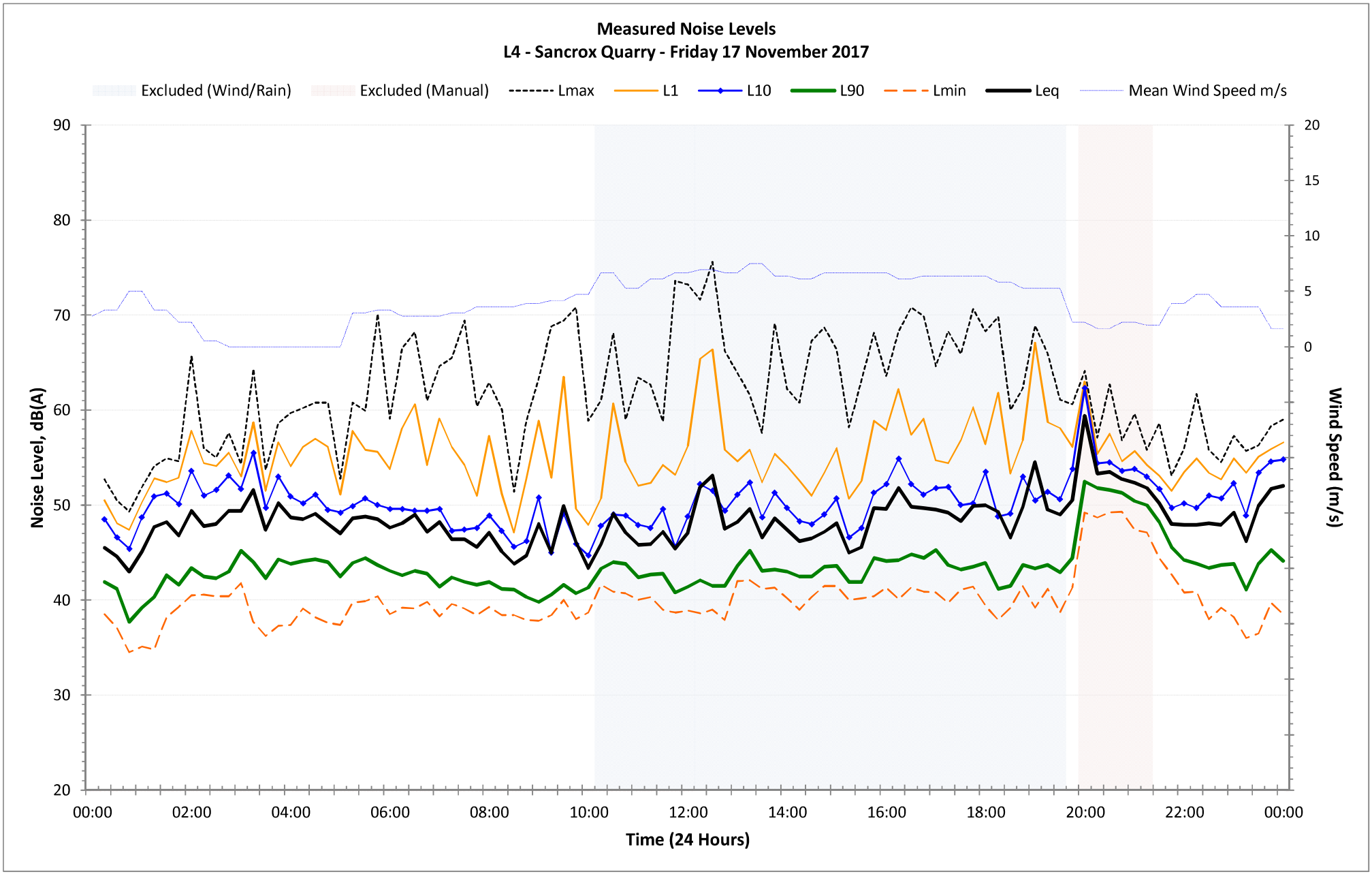
Measured Noise Levels
L4 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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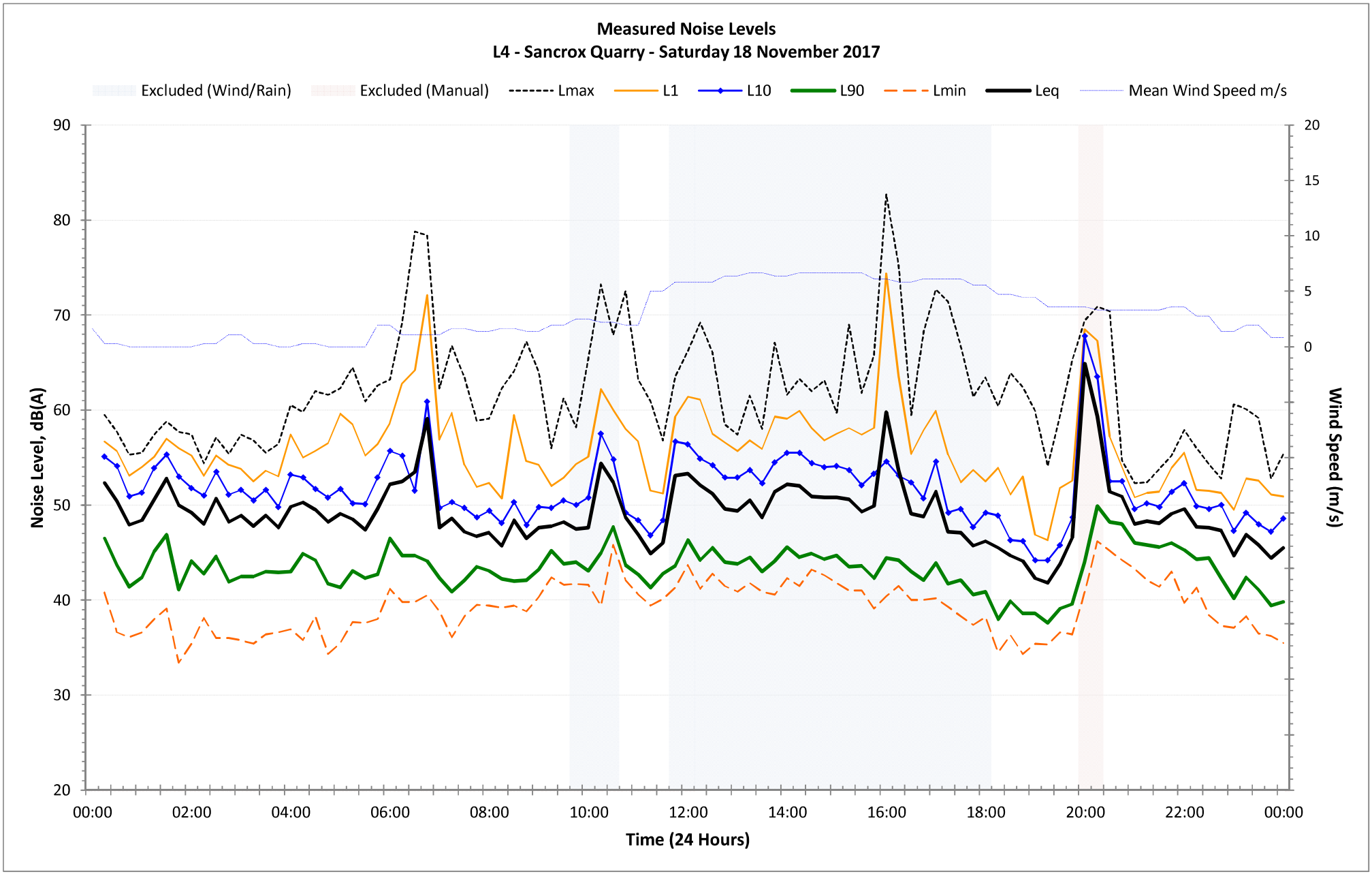
Measured Noise Levels
L4 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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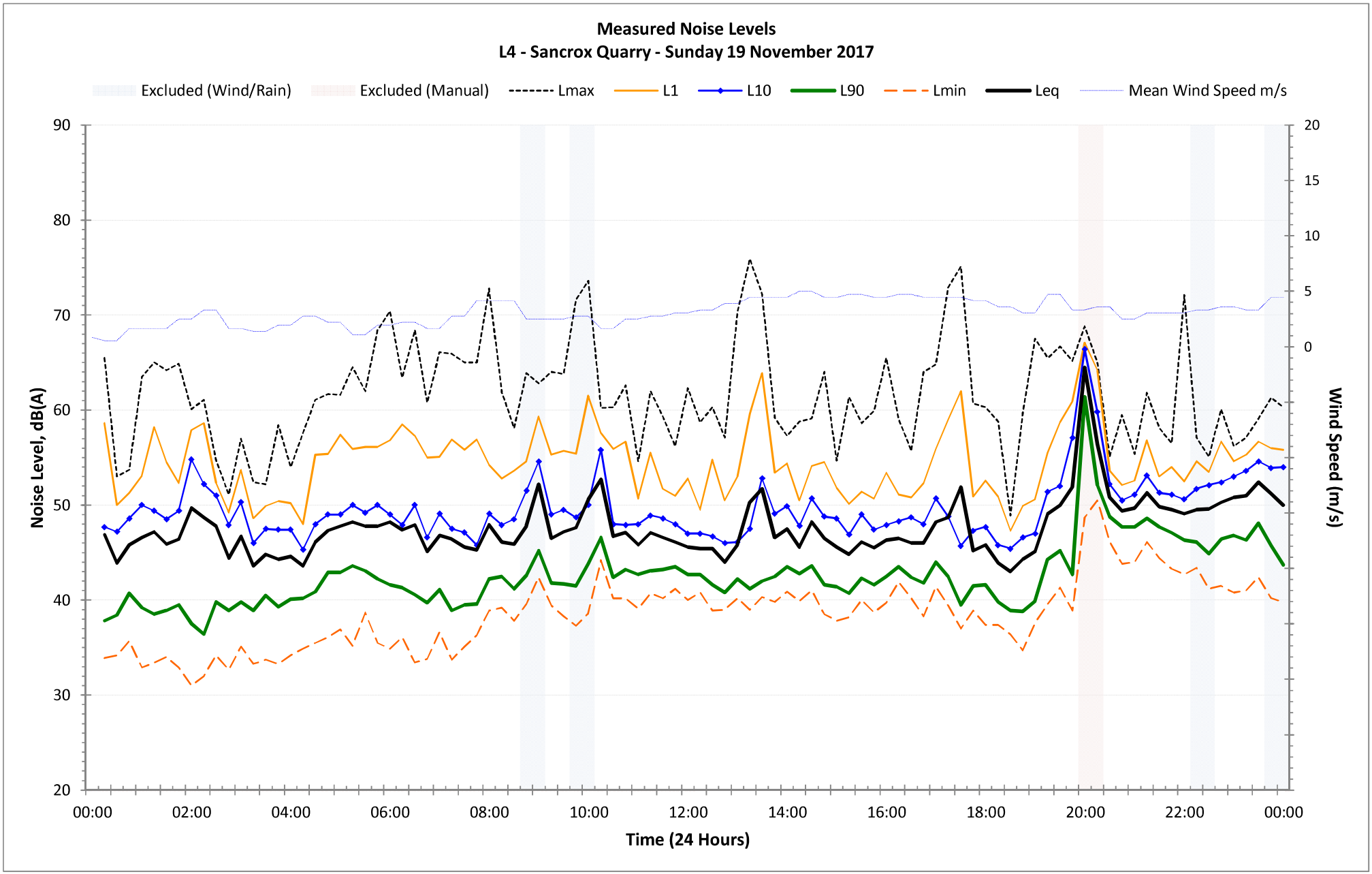
Measured Noise Levels
L4 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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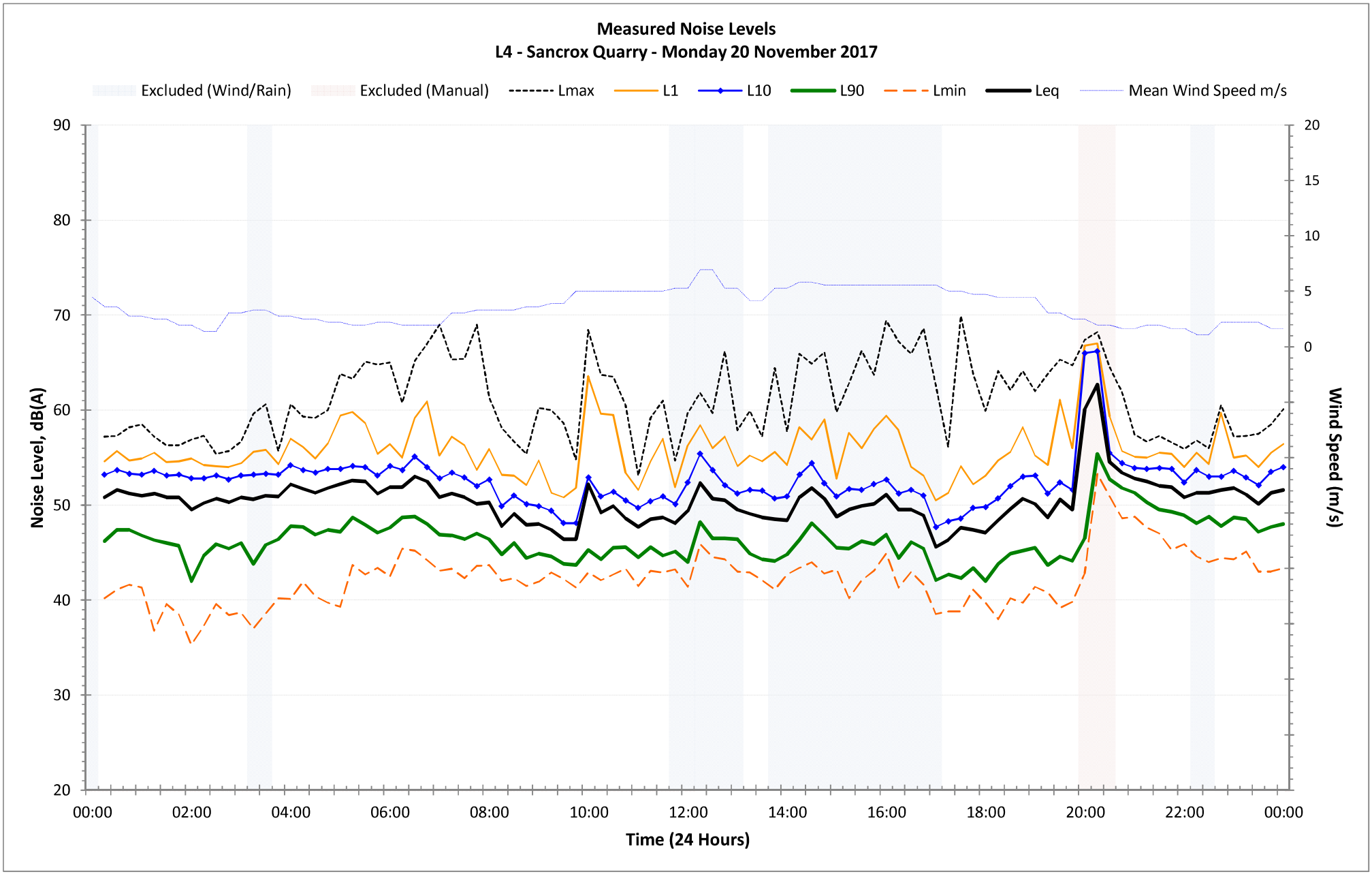
Measured Noise Levels
L4 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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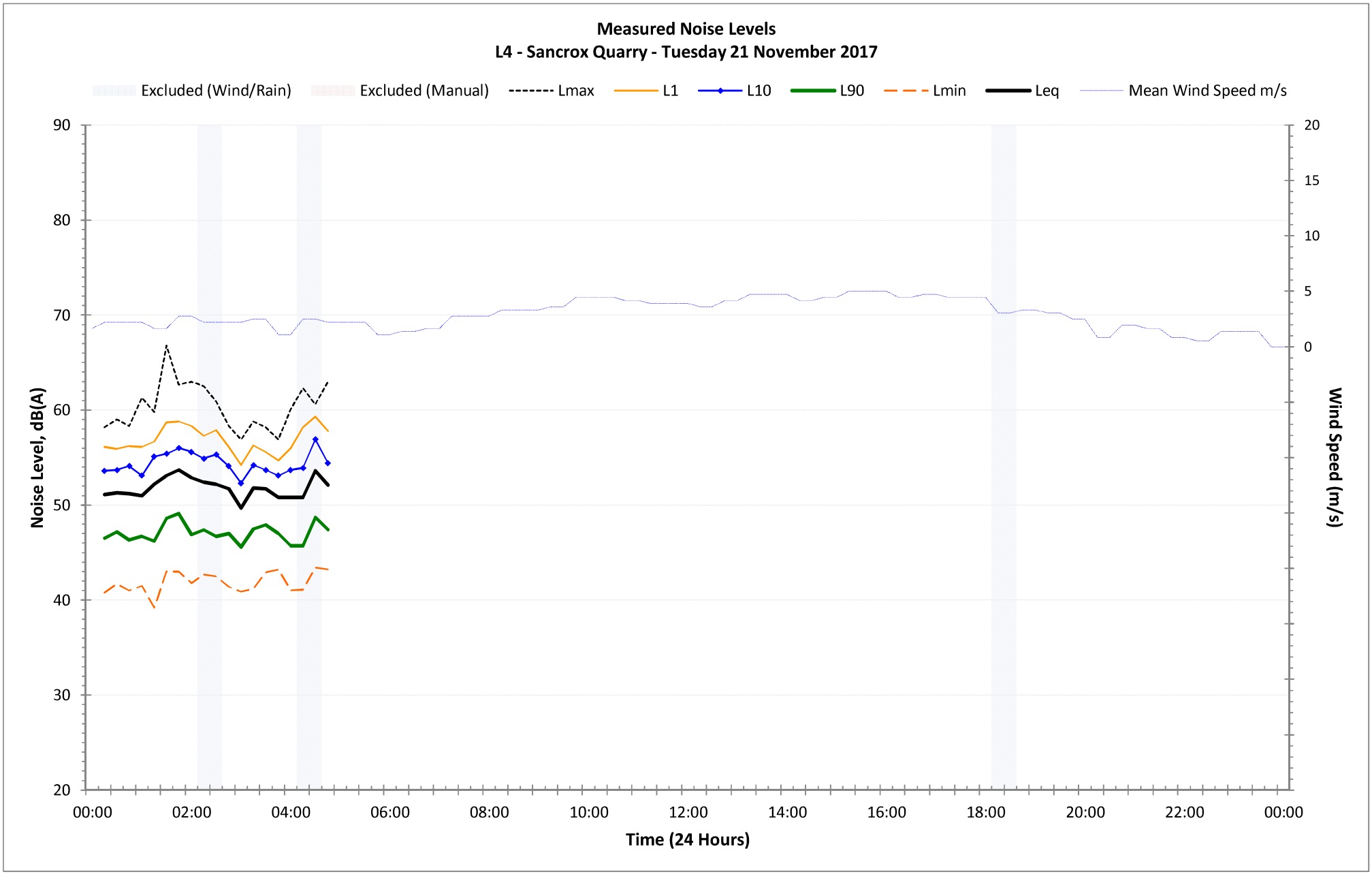
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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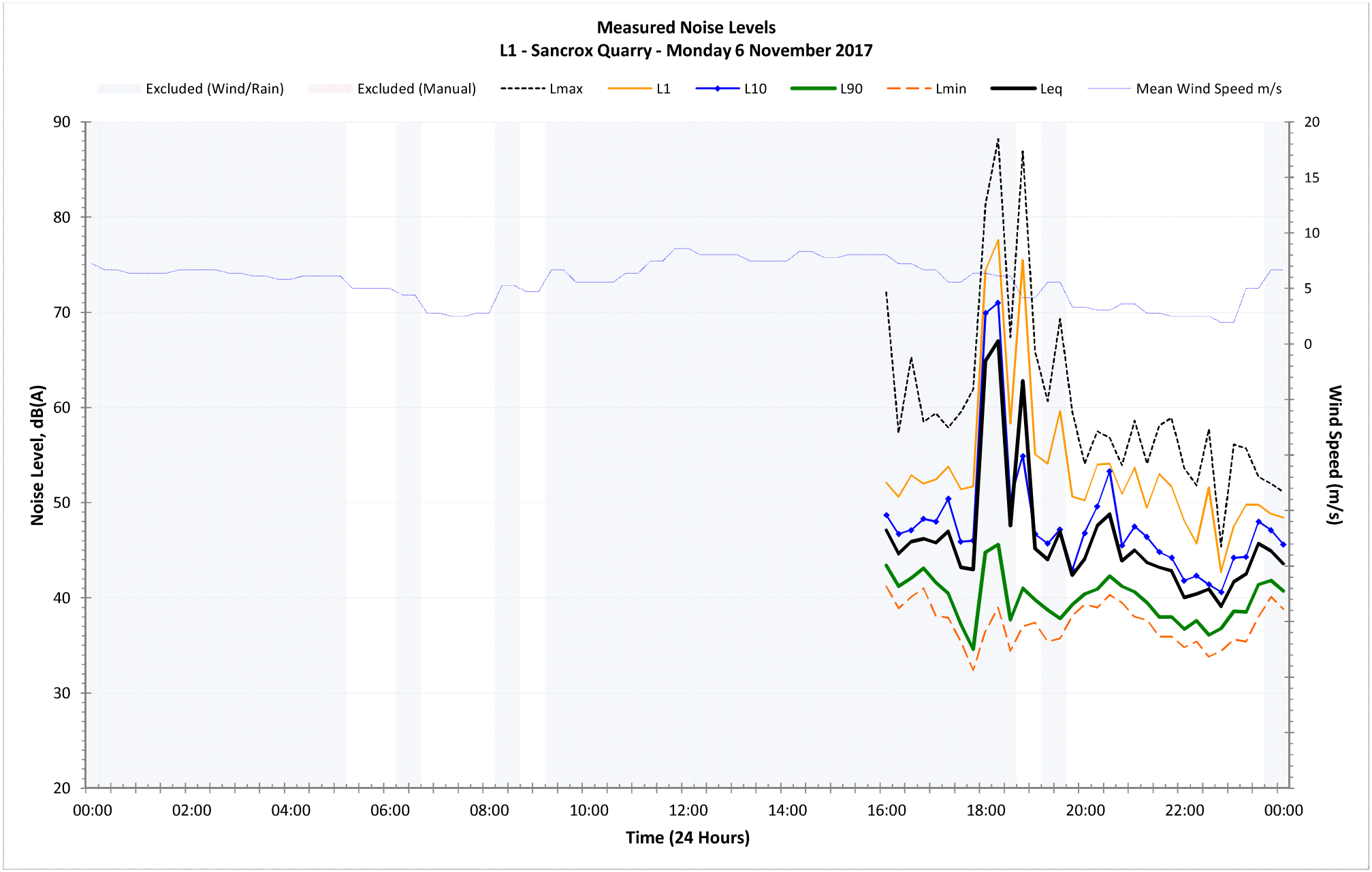
Measured Noise Levels
L1 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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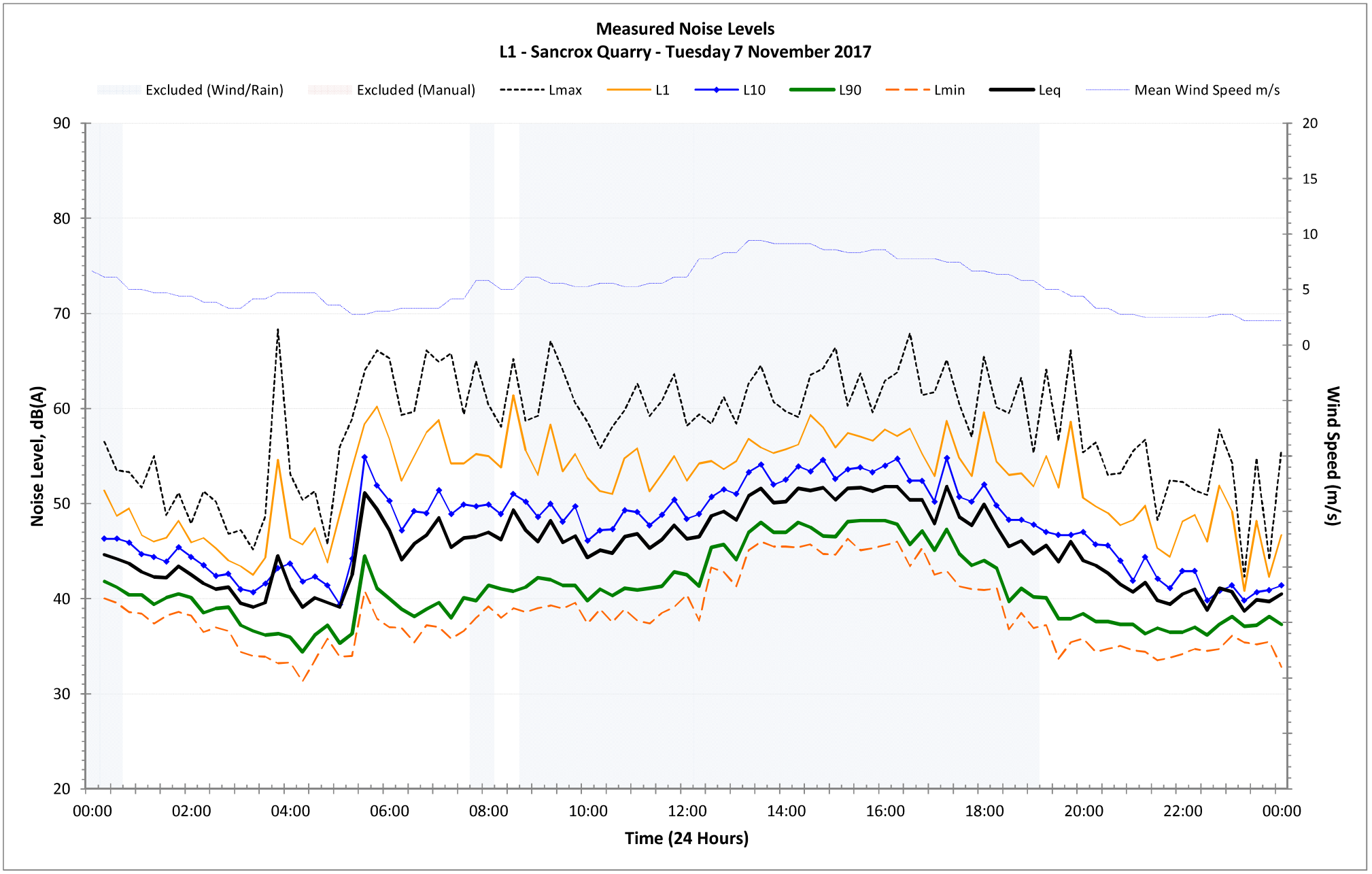
Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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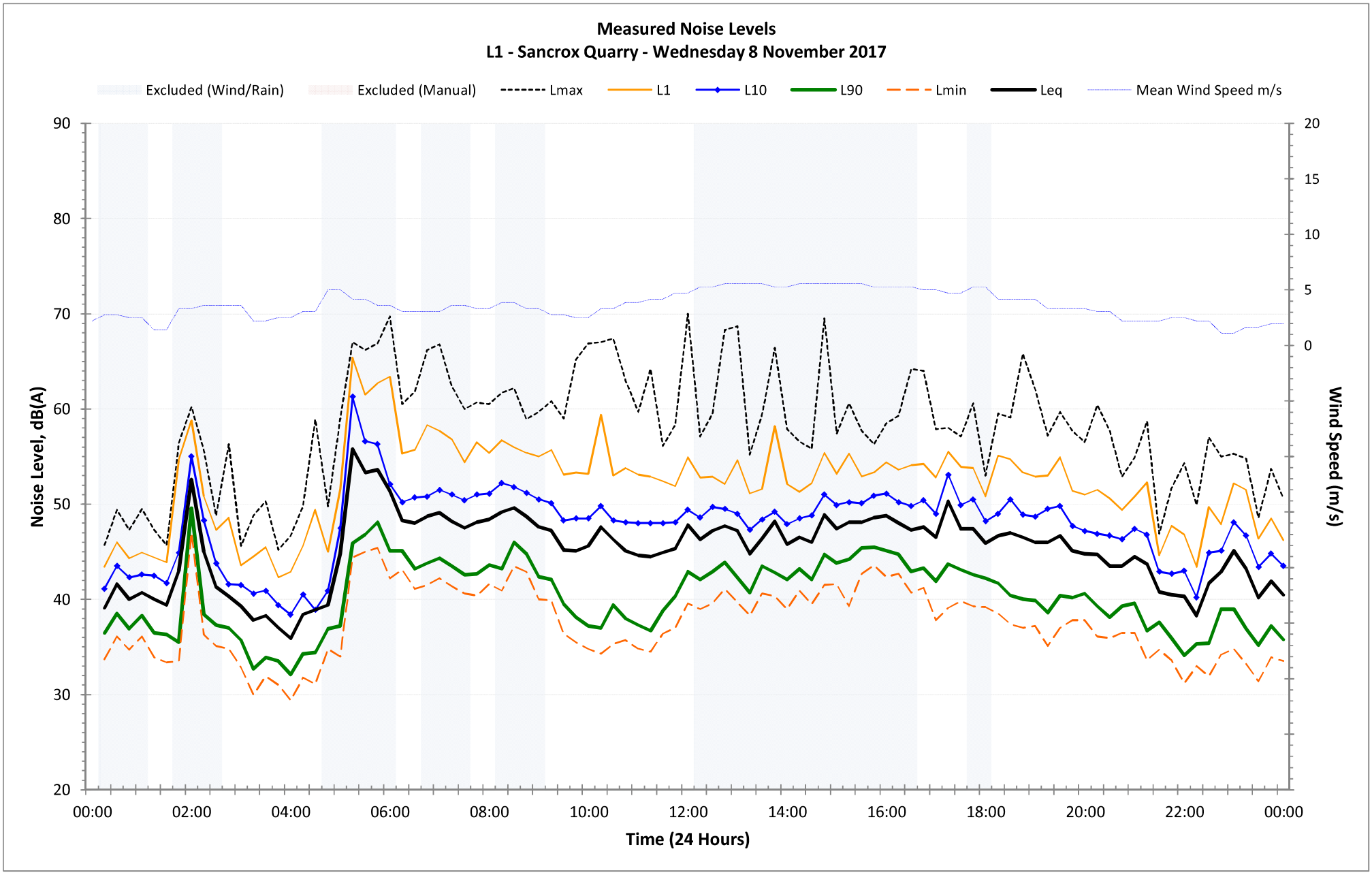
Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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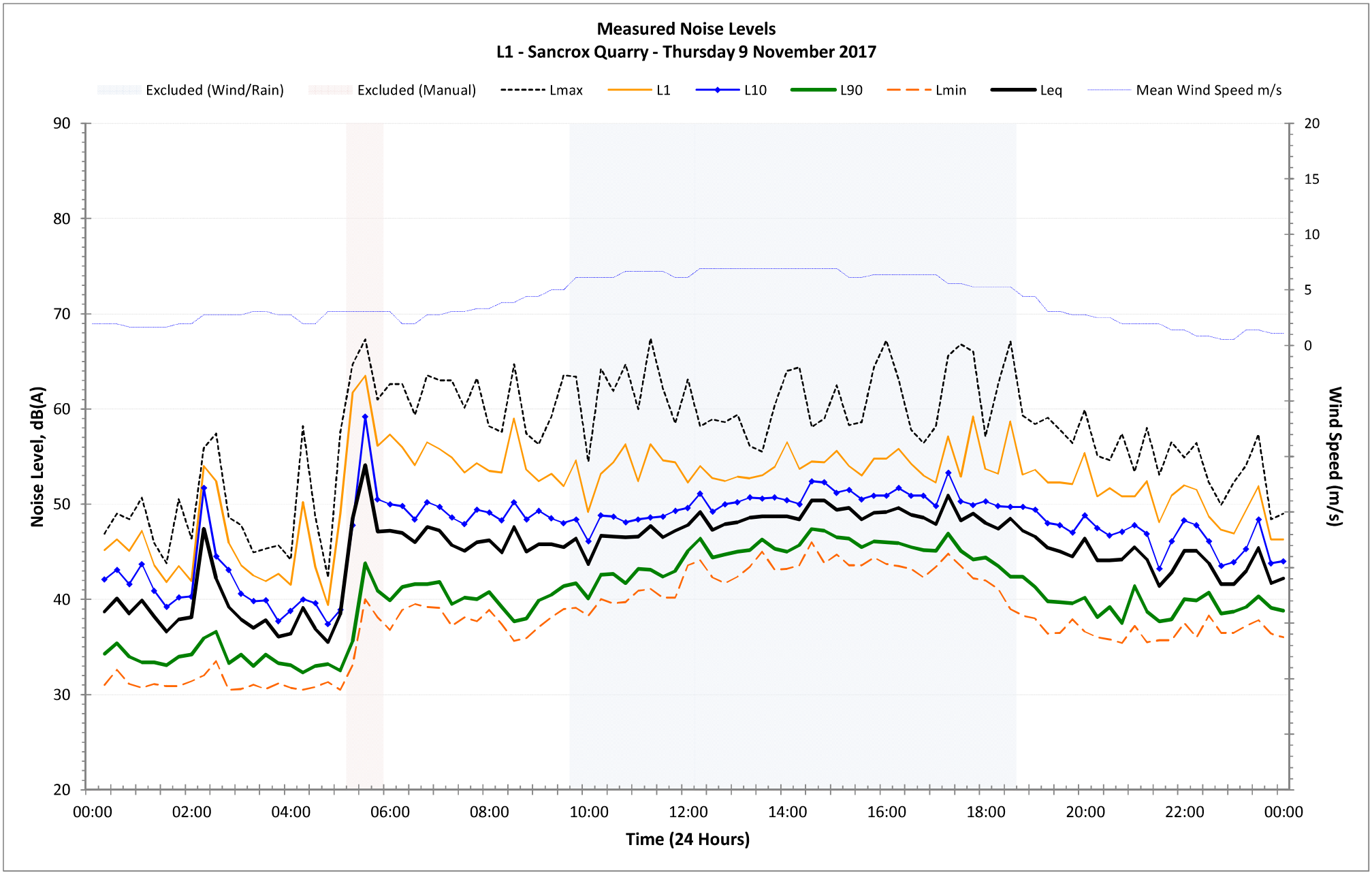
Measured Noise Levels
L1 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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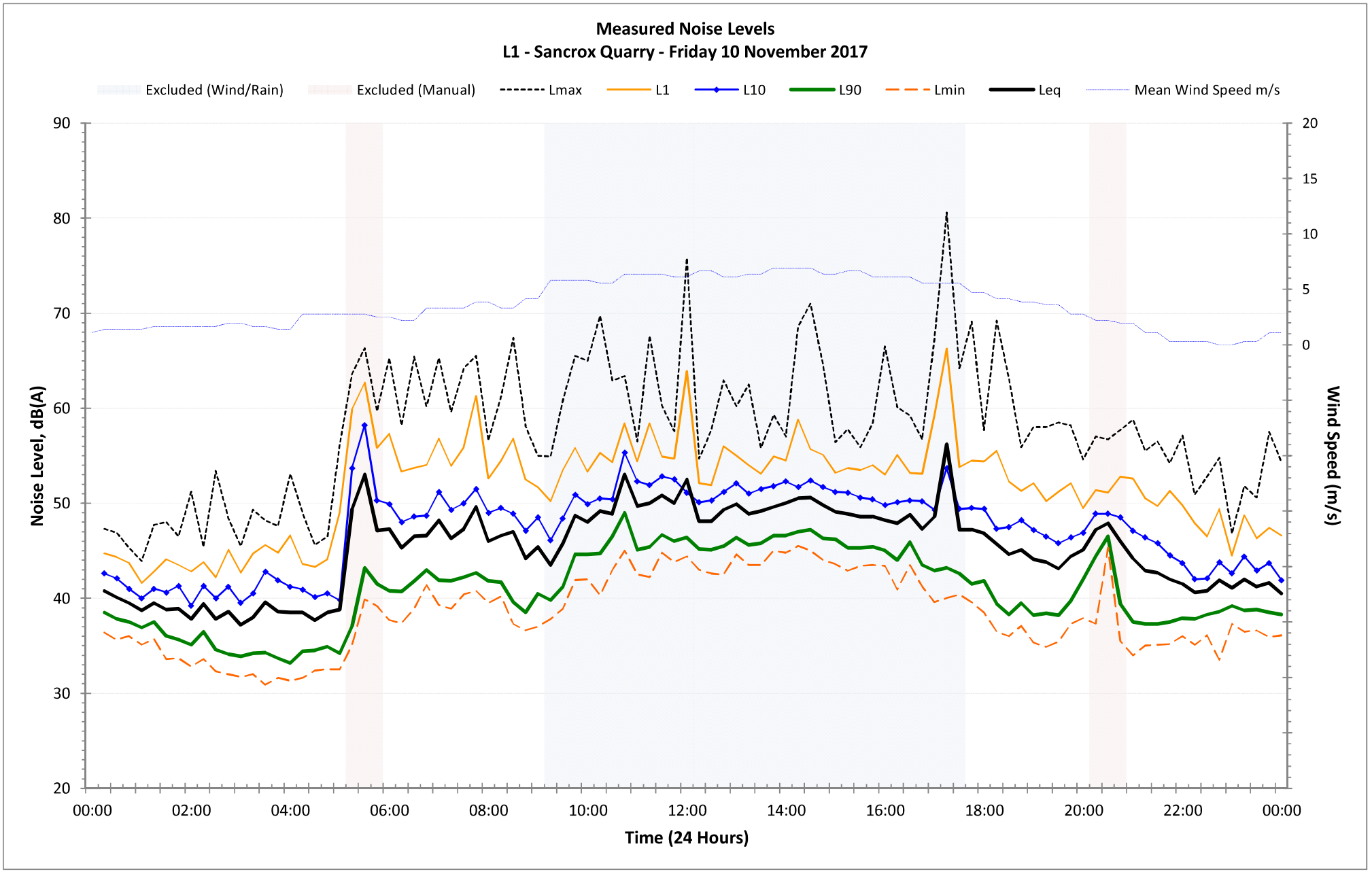
Measured Noise Levels
L1 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
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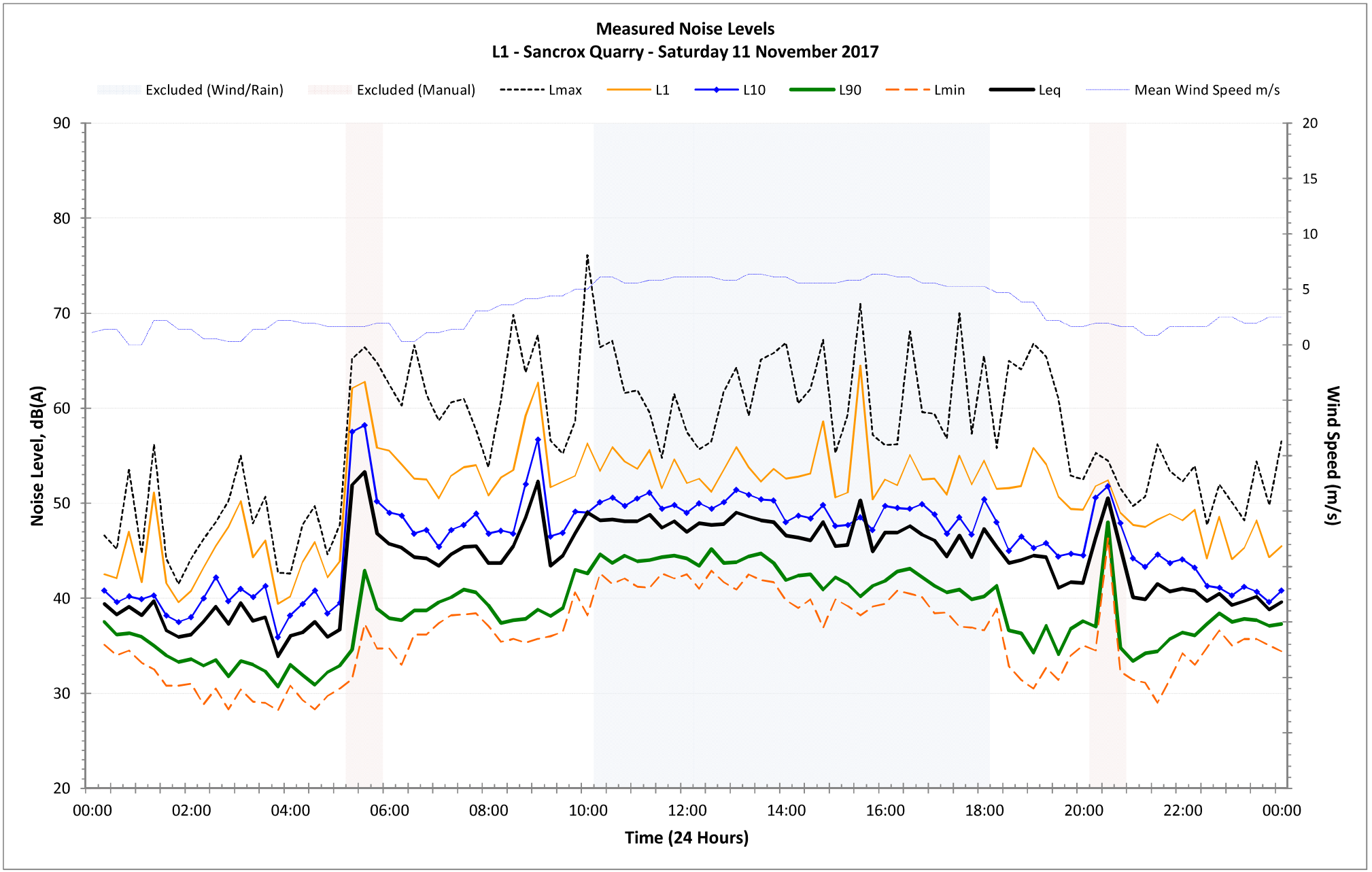
Time (24 Hours)


Measured Noise Levels
L1 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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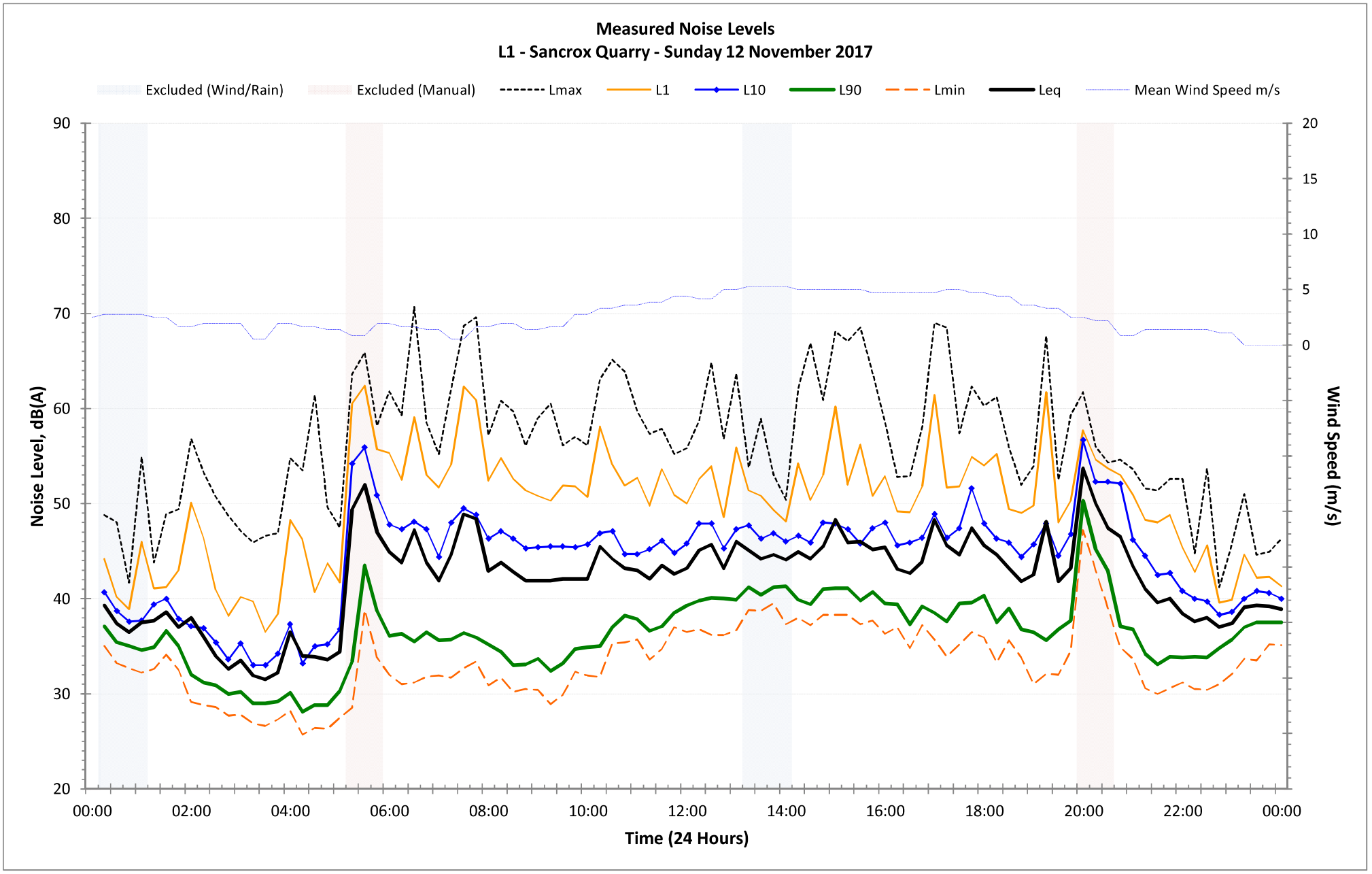
Measured Noise Levels
L1 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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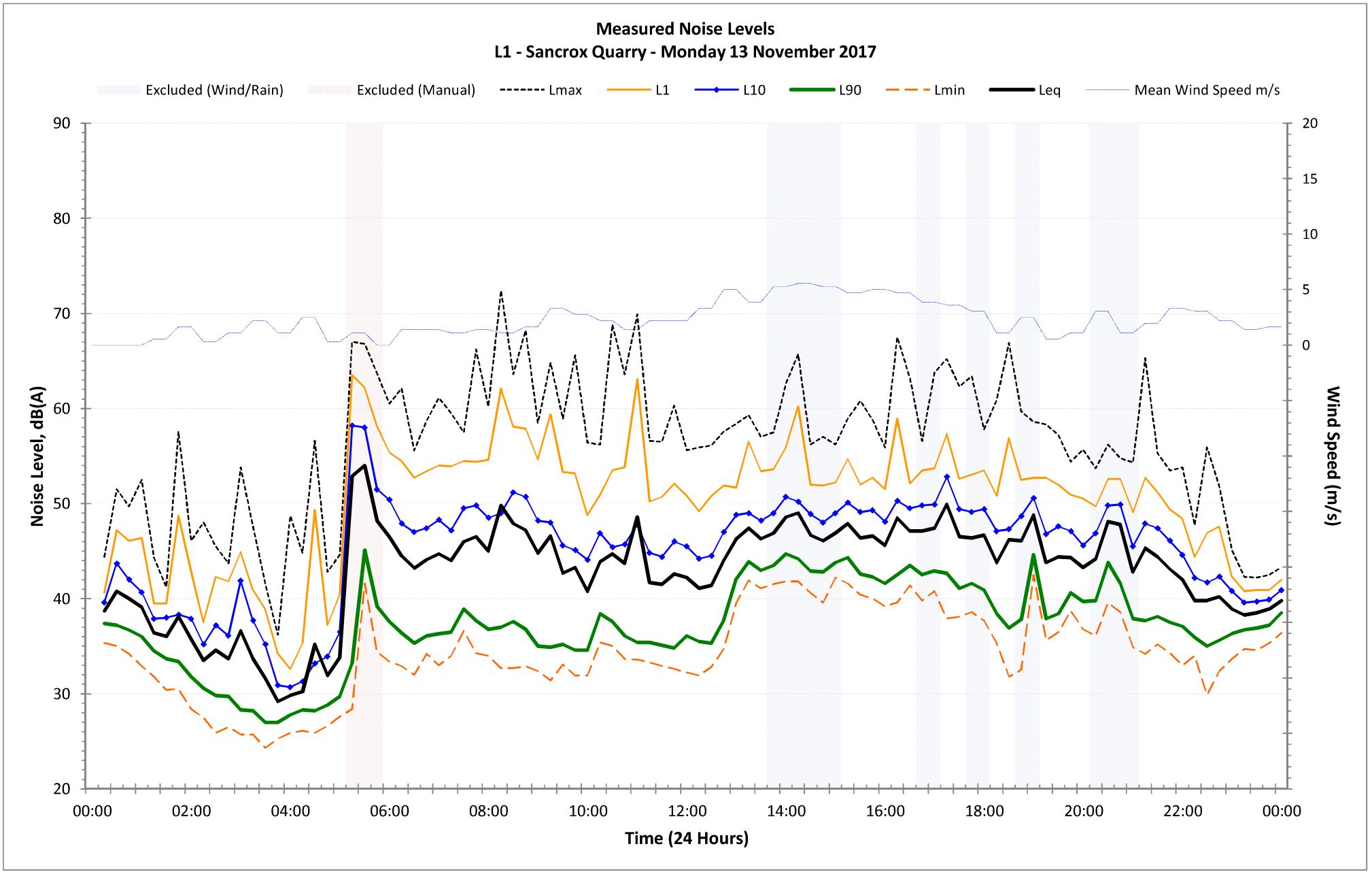
Measured Noise Levels
L1 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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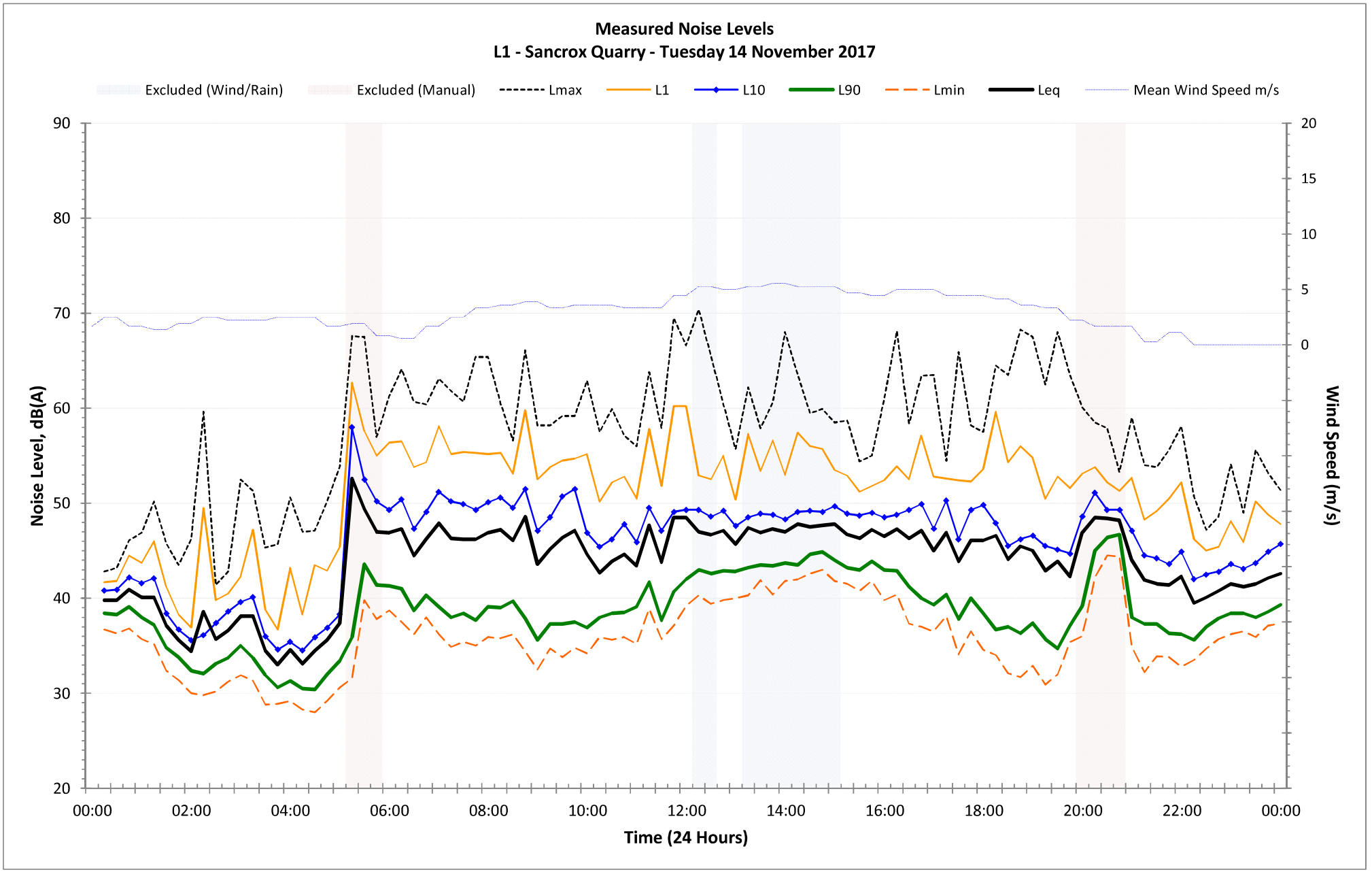
Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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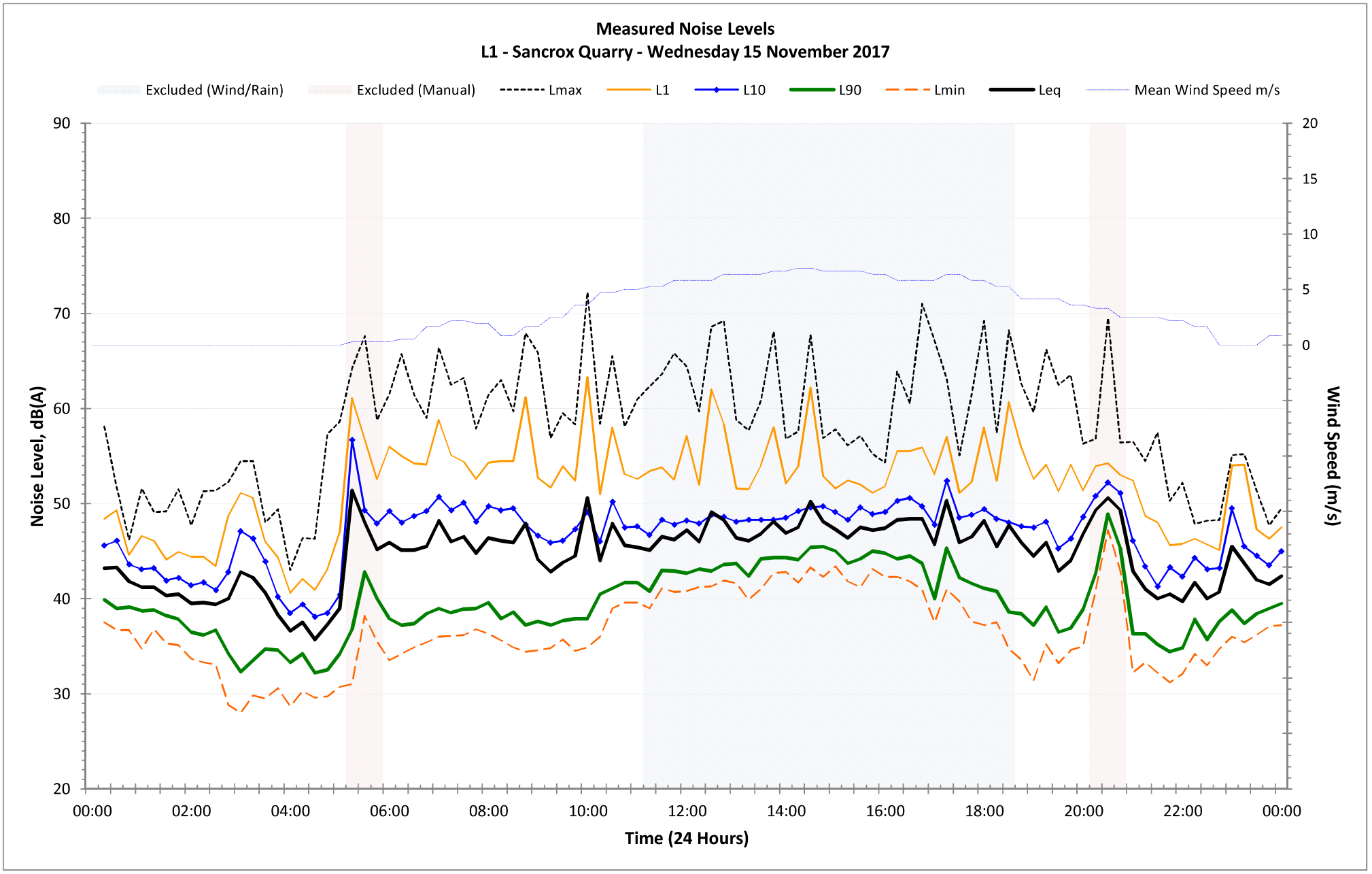
Measured Noise Levels
L1 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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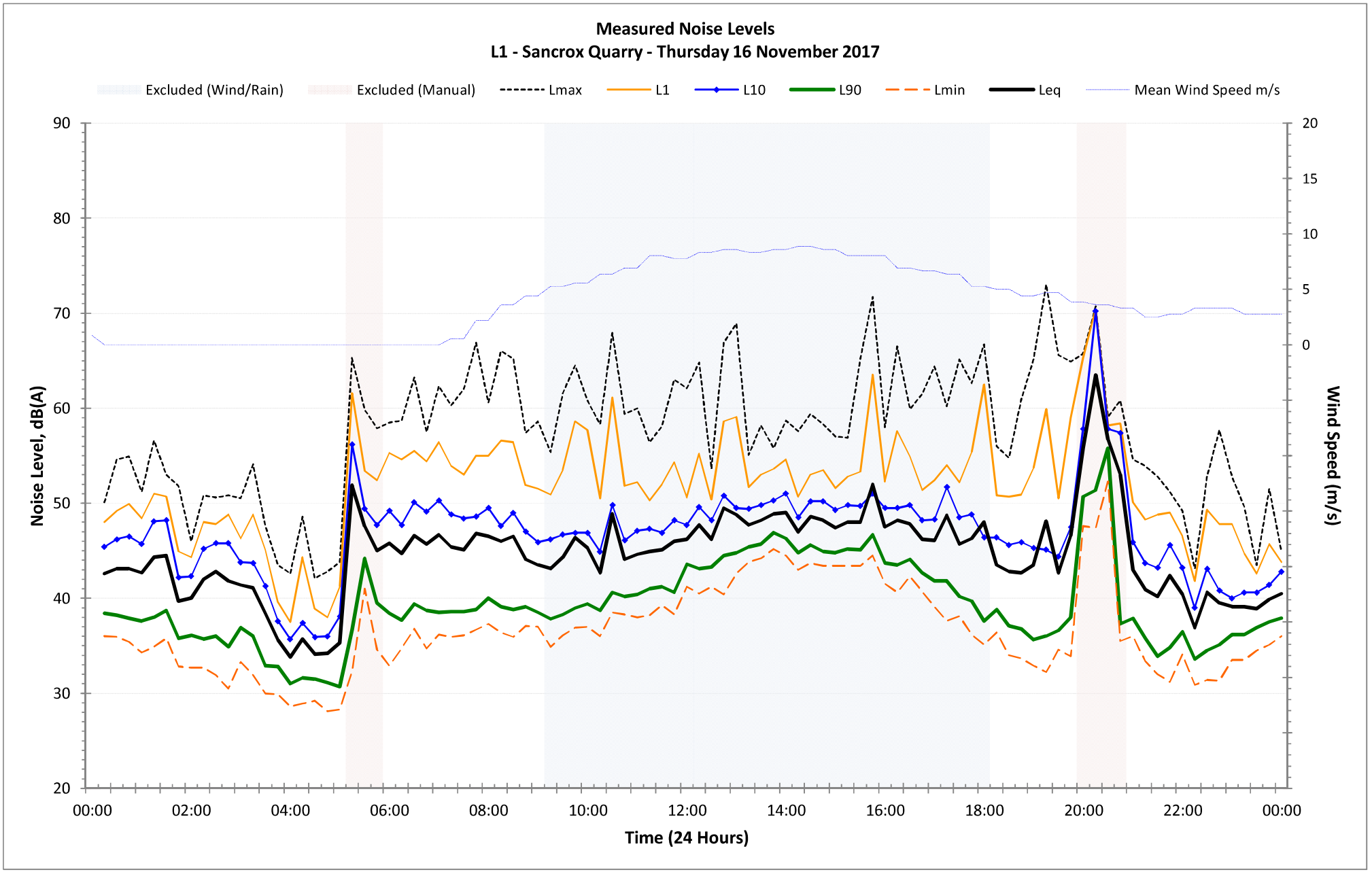
Measured Noise Levels
L1 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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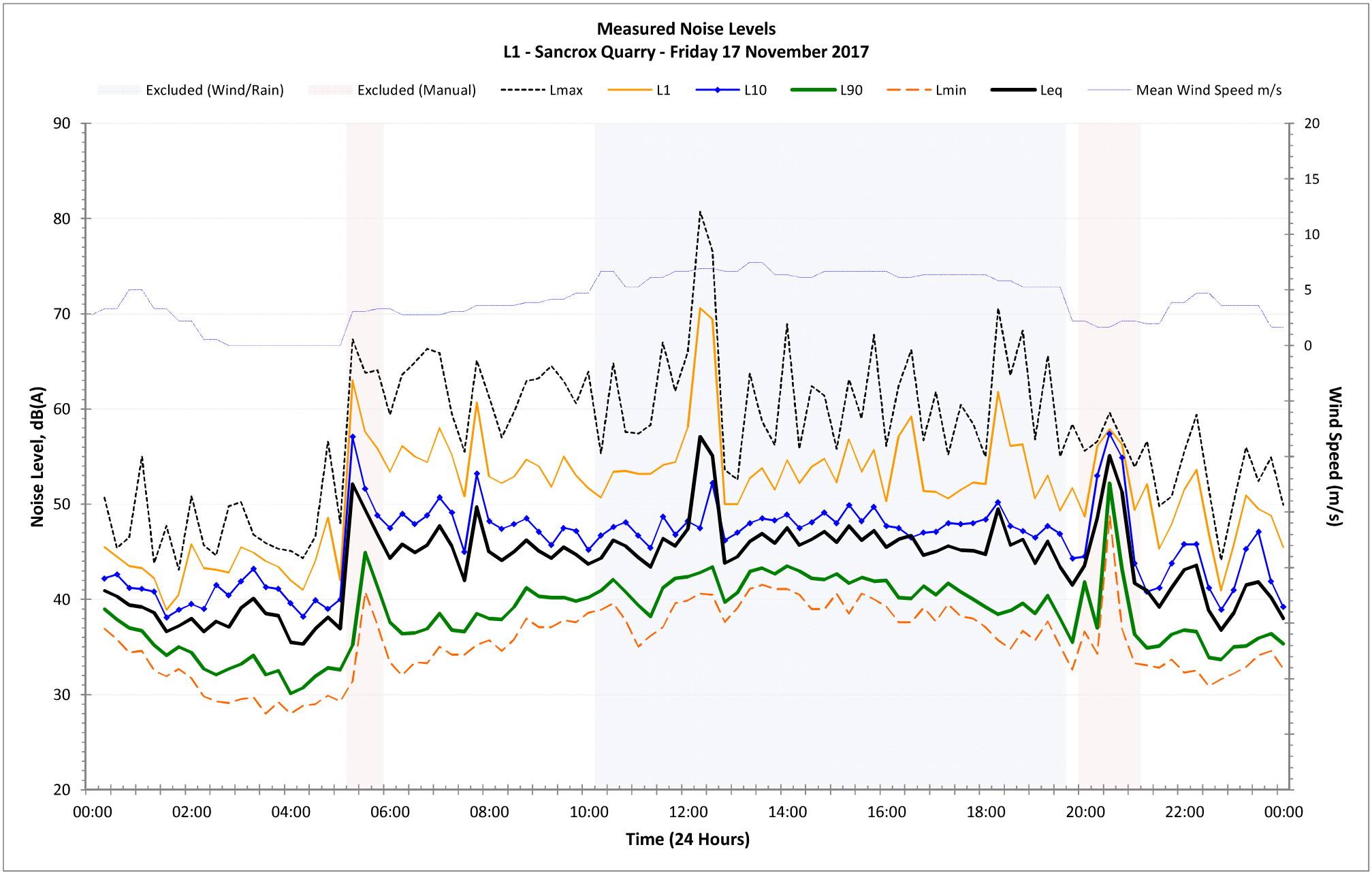
Measured Noise Levels
L1 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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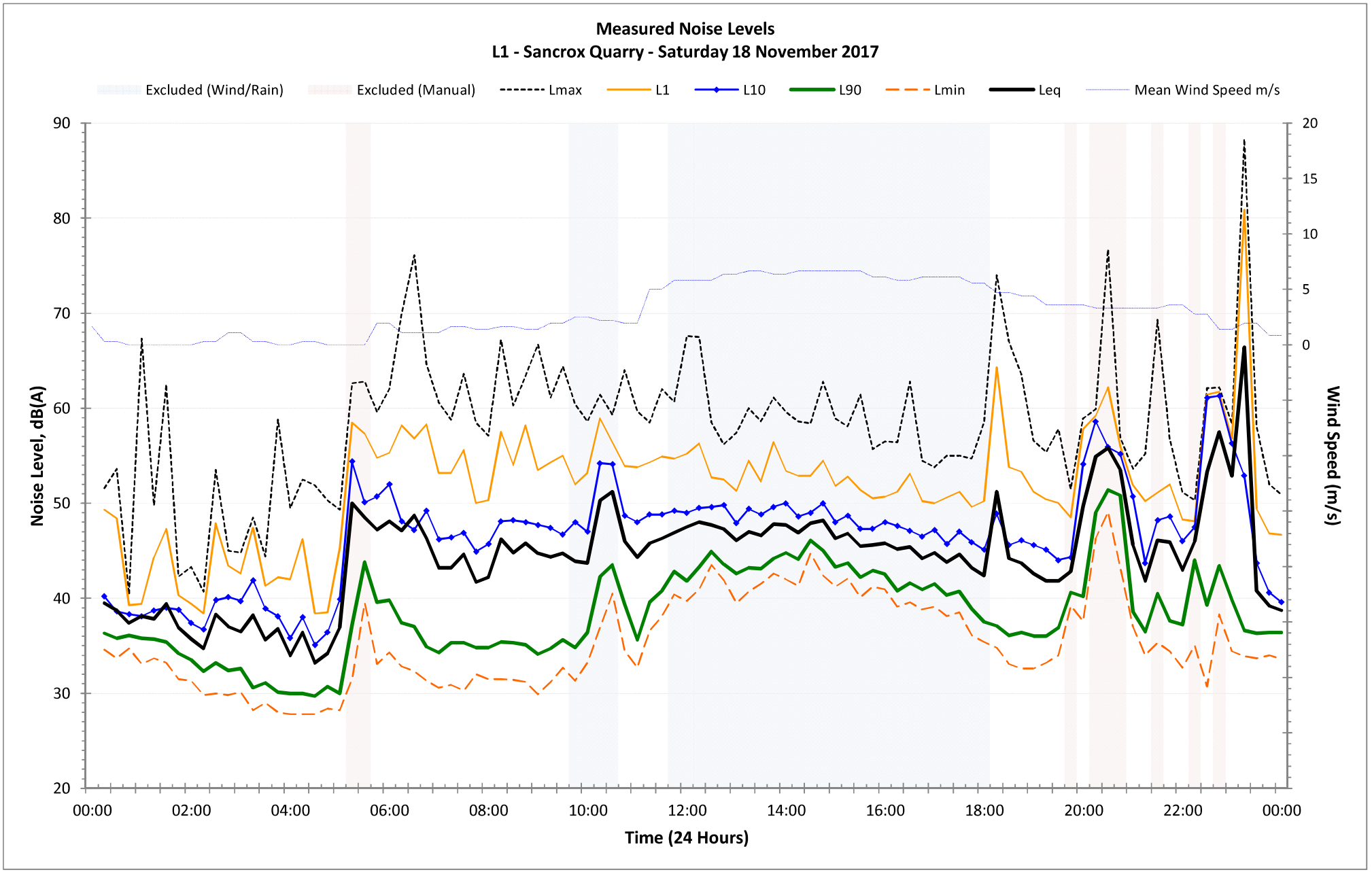
Measured Noise Levels
L1 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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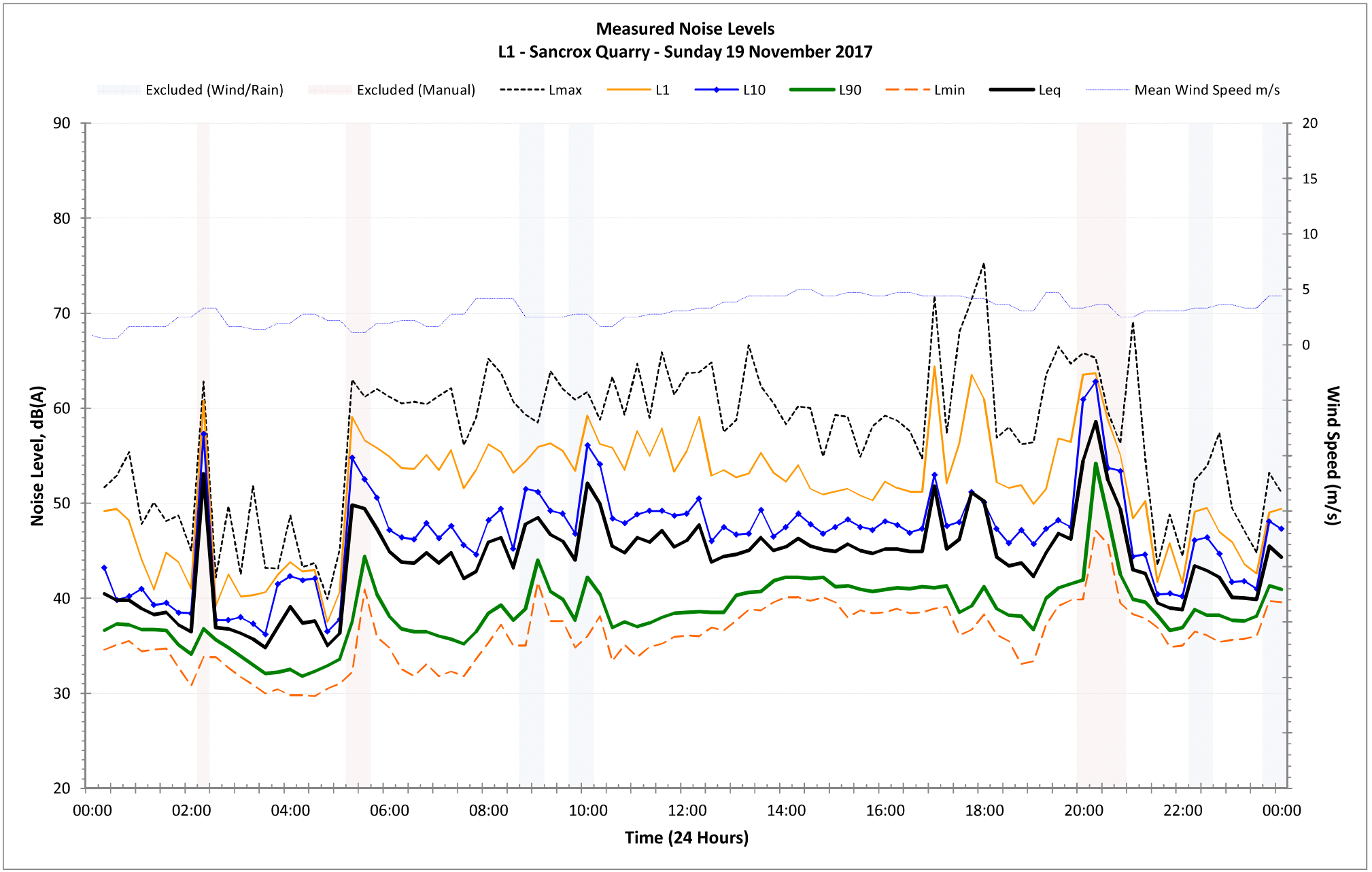
Measured Noise Levels
L1 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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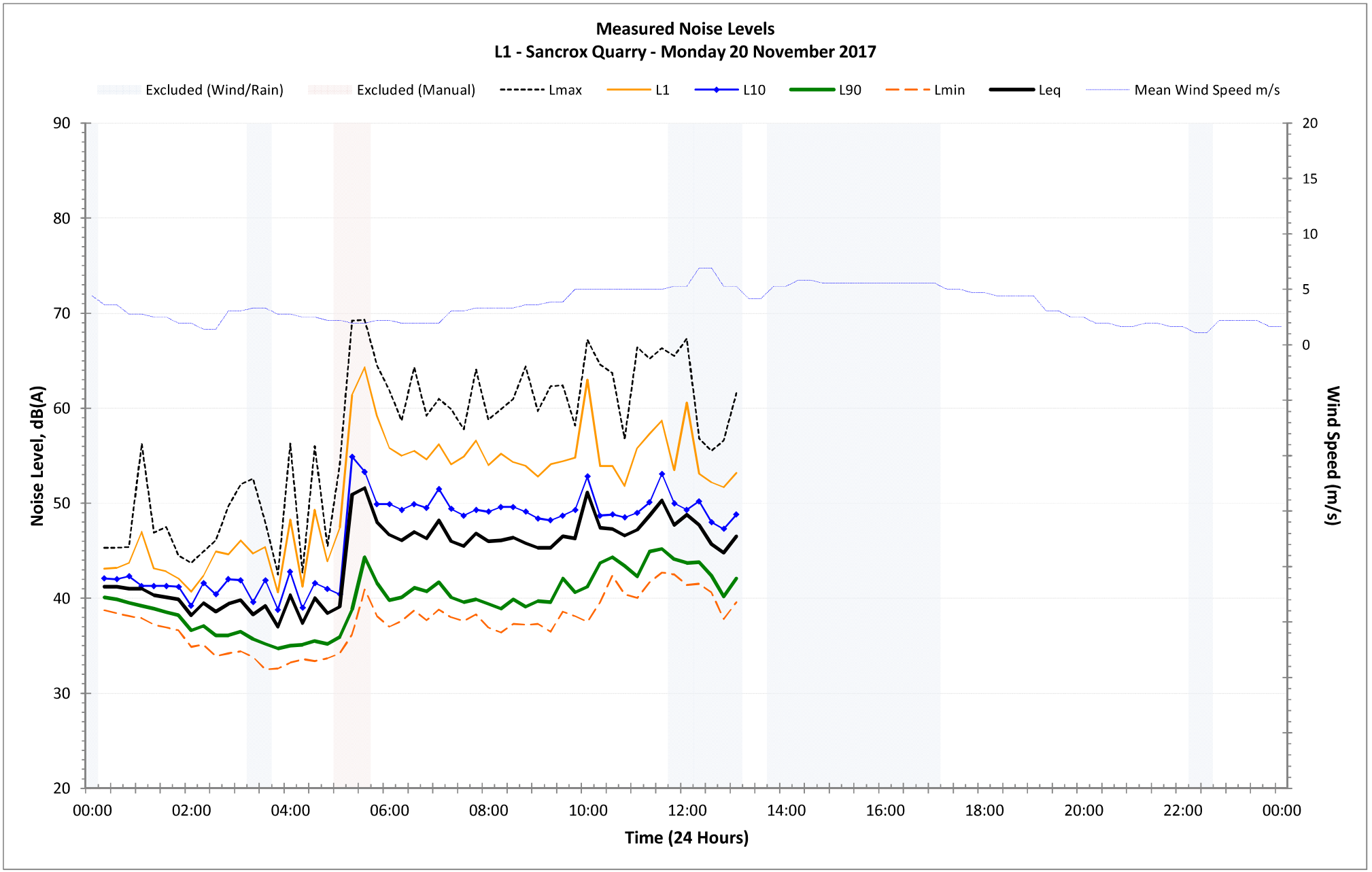
Measured Noise Levels
L1 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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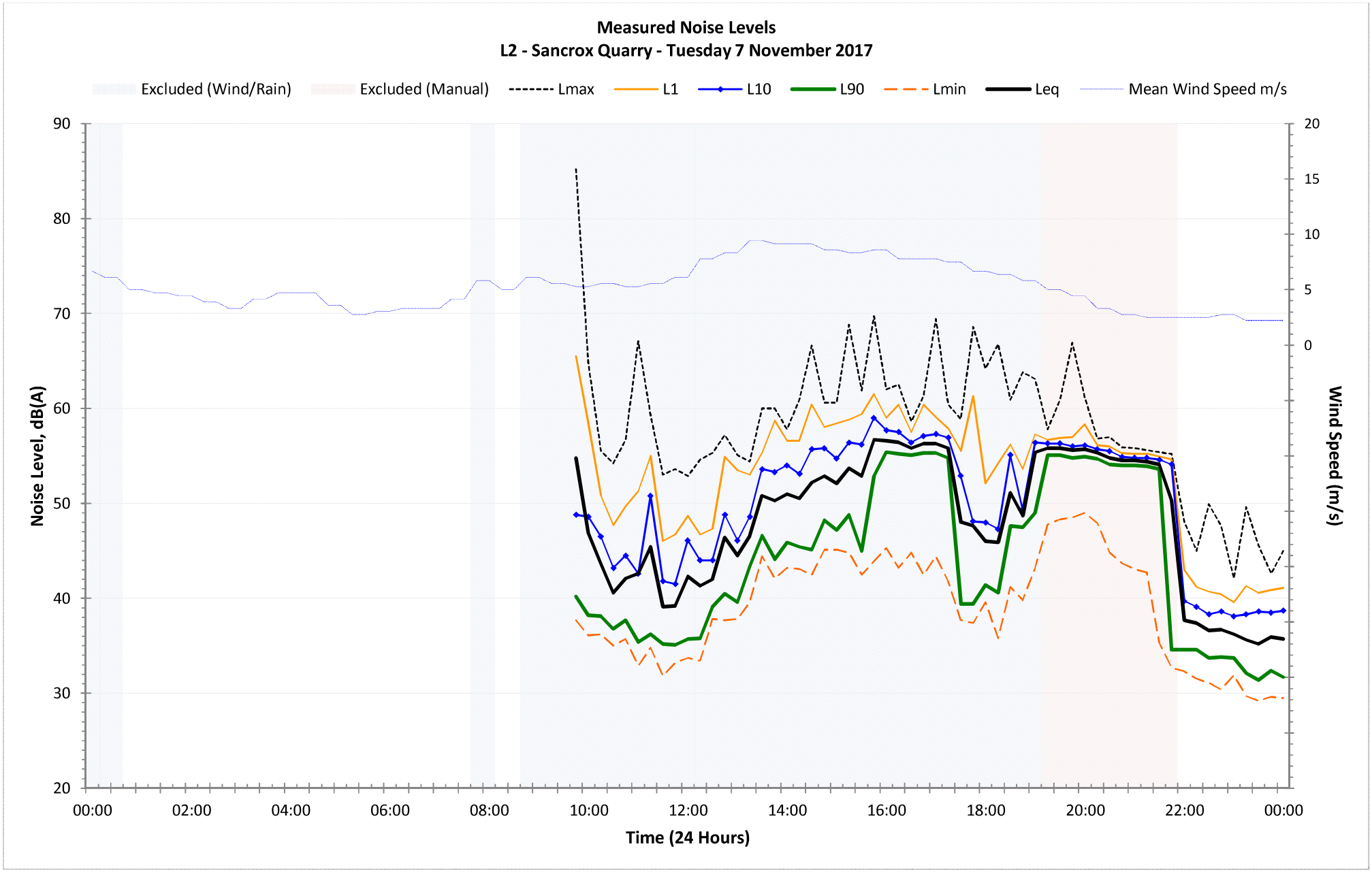
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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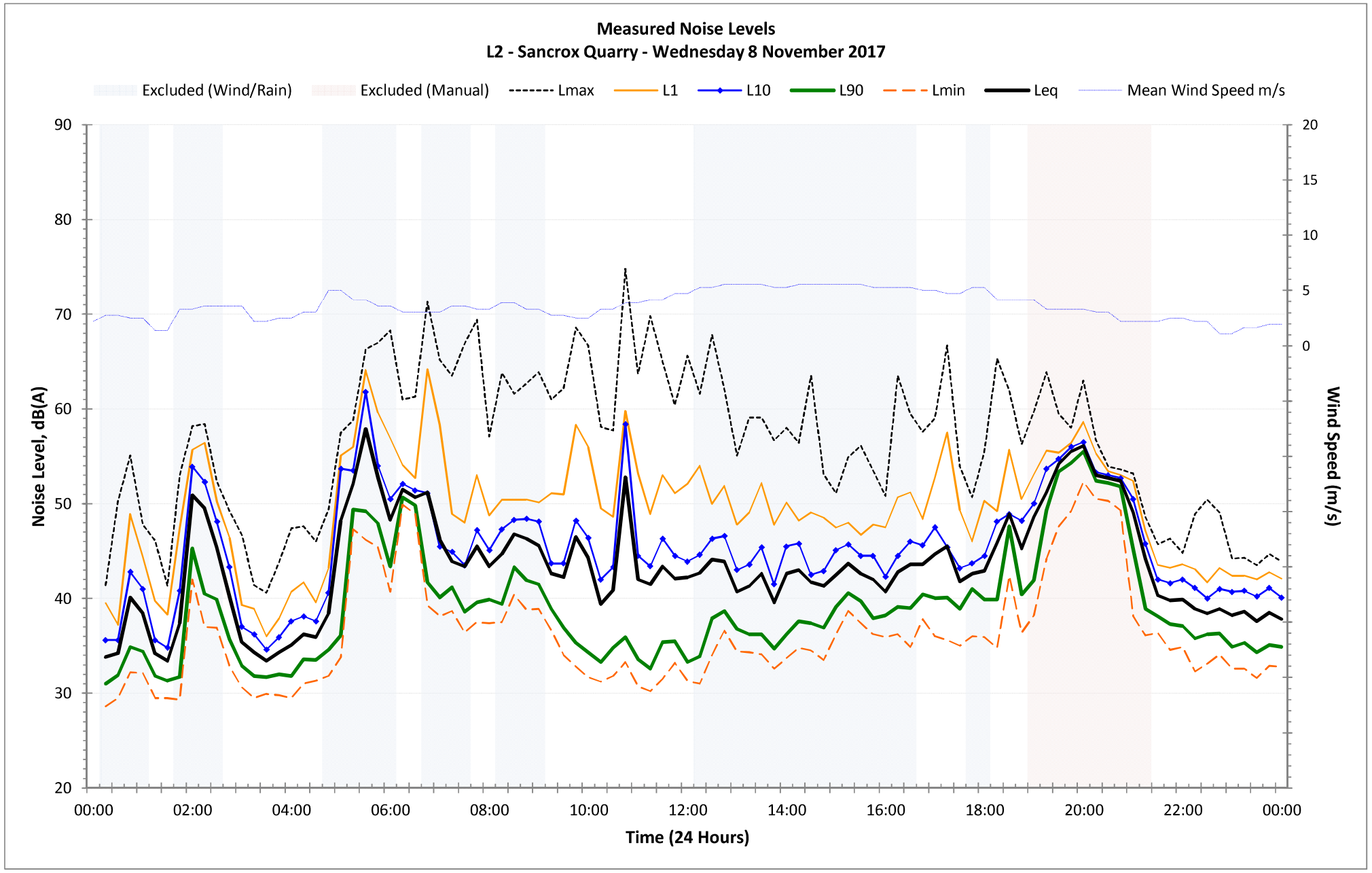
Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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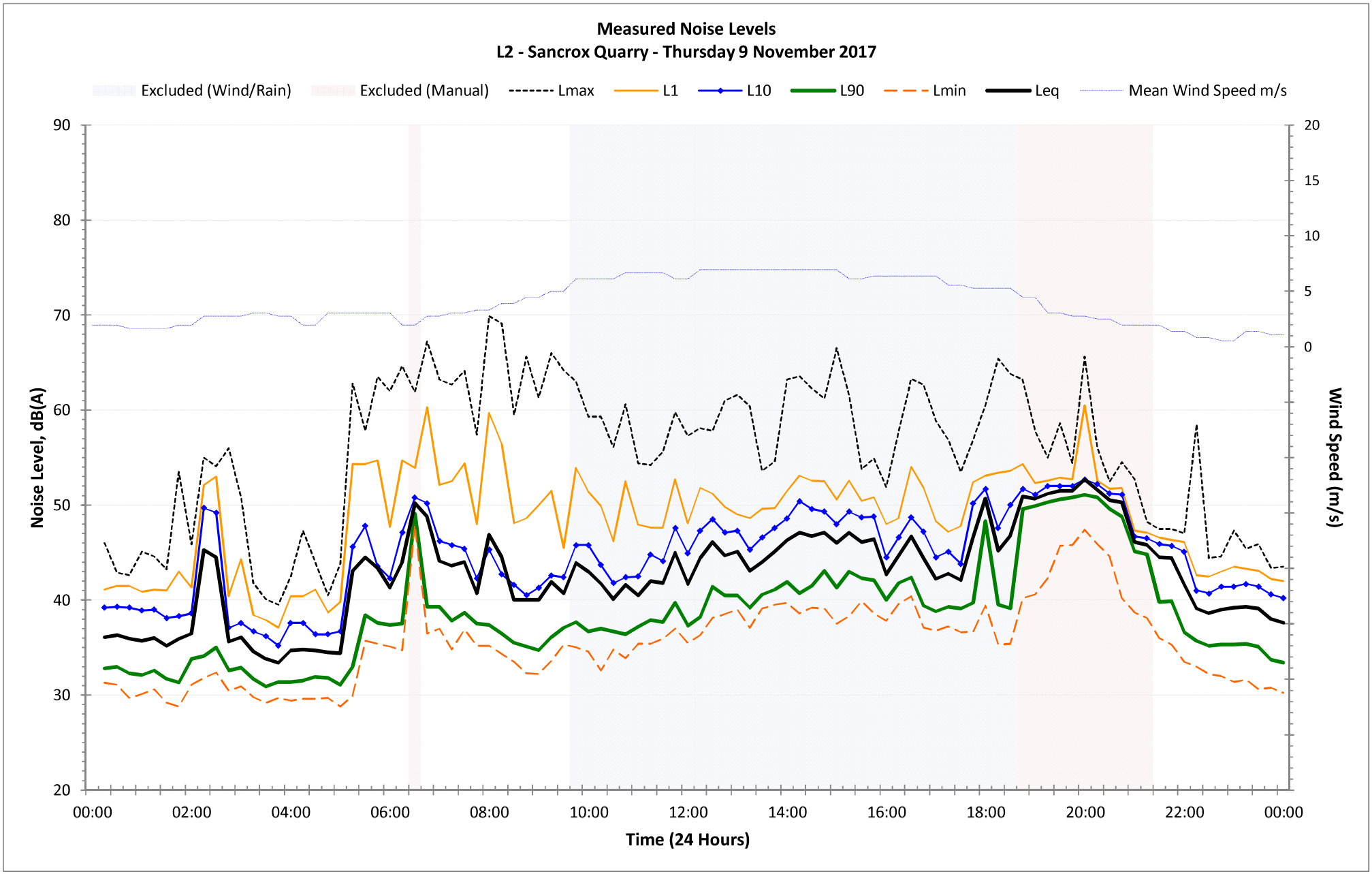
Measured Noise Levels
L2 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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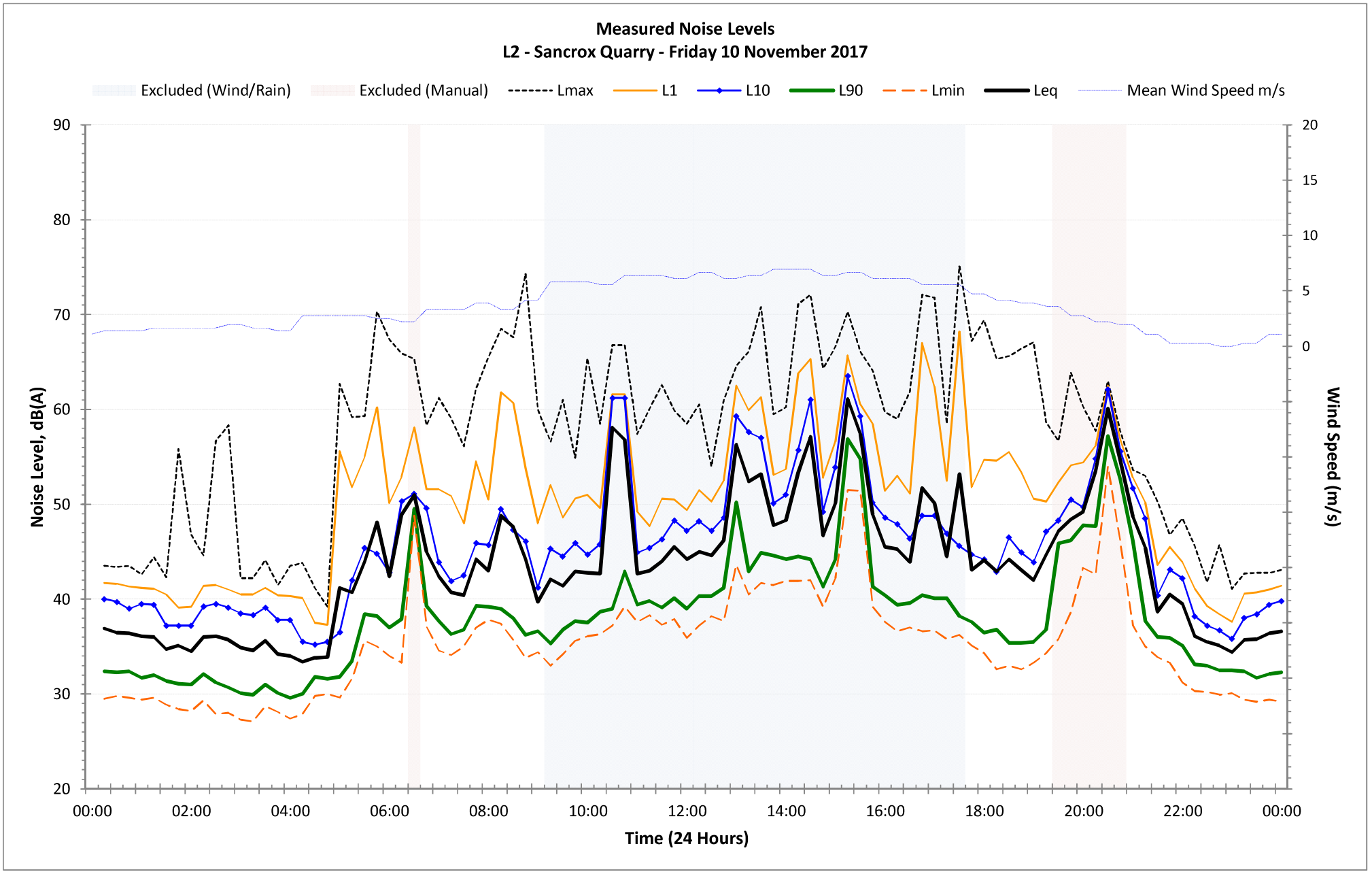
Measured Noise Levels
L2 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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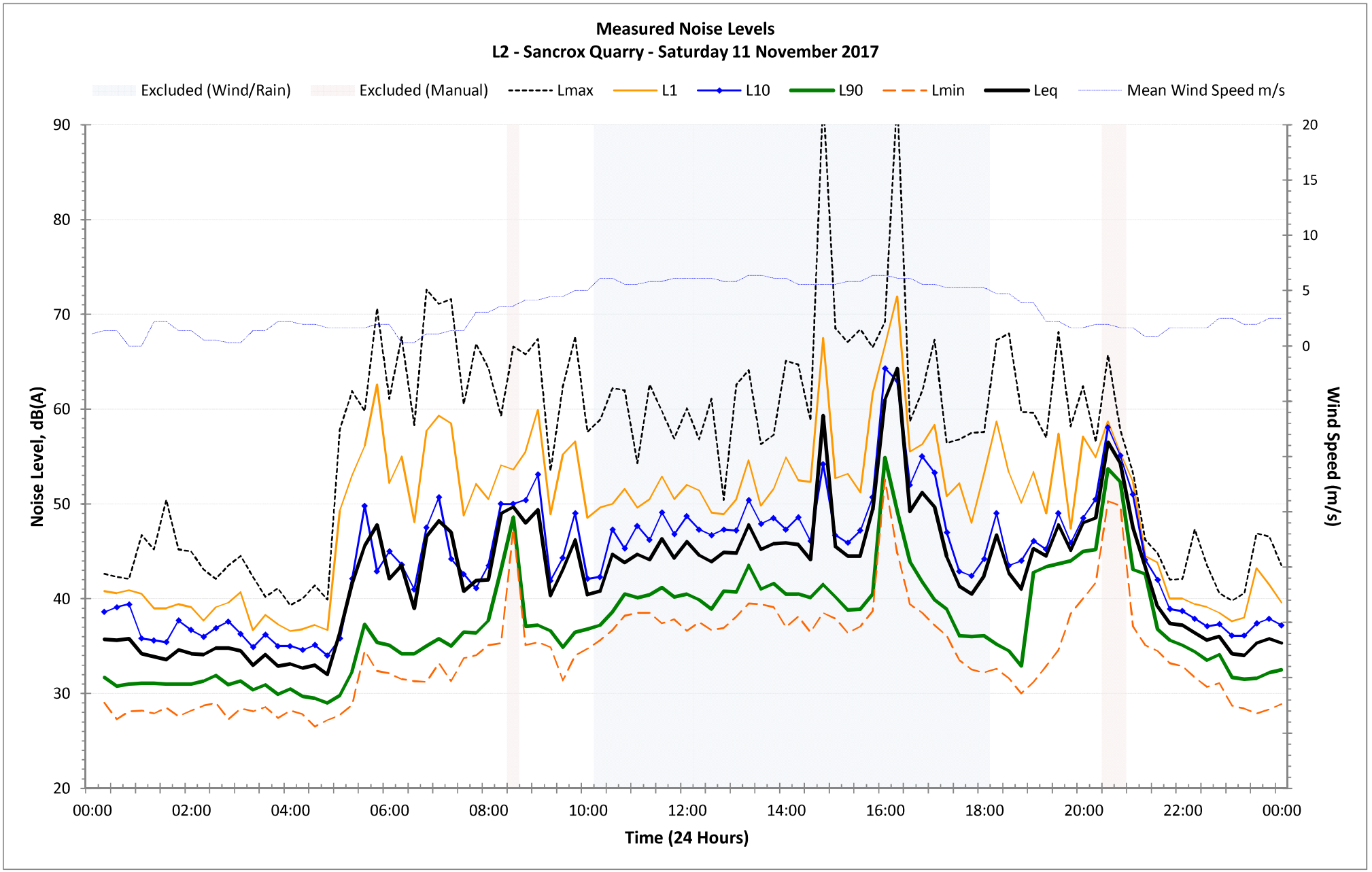
Measured Noise Levels
L2 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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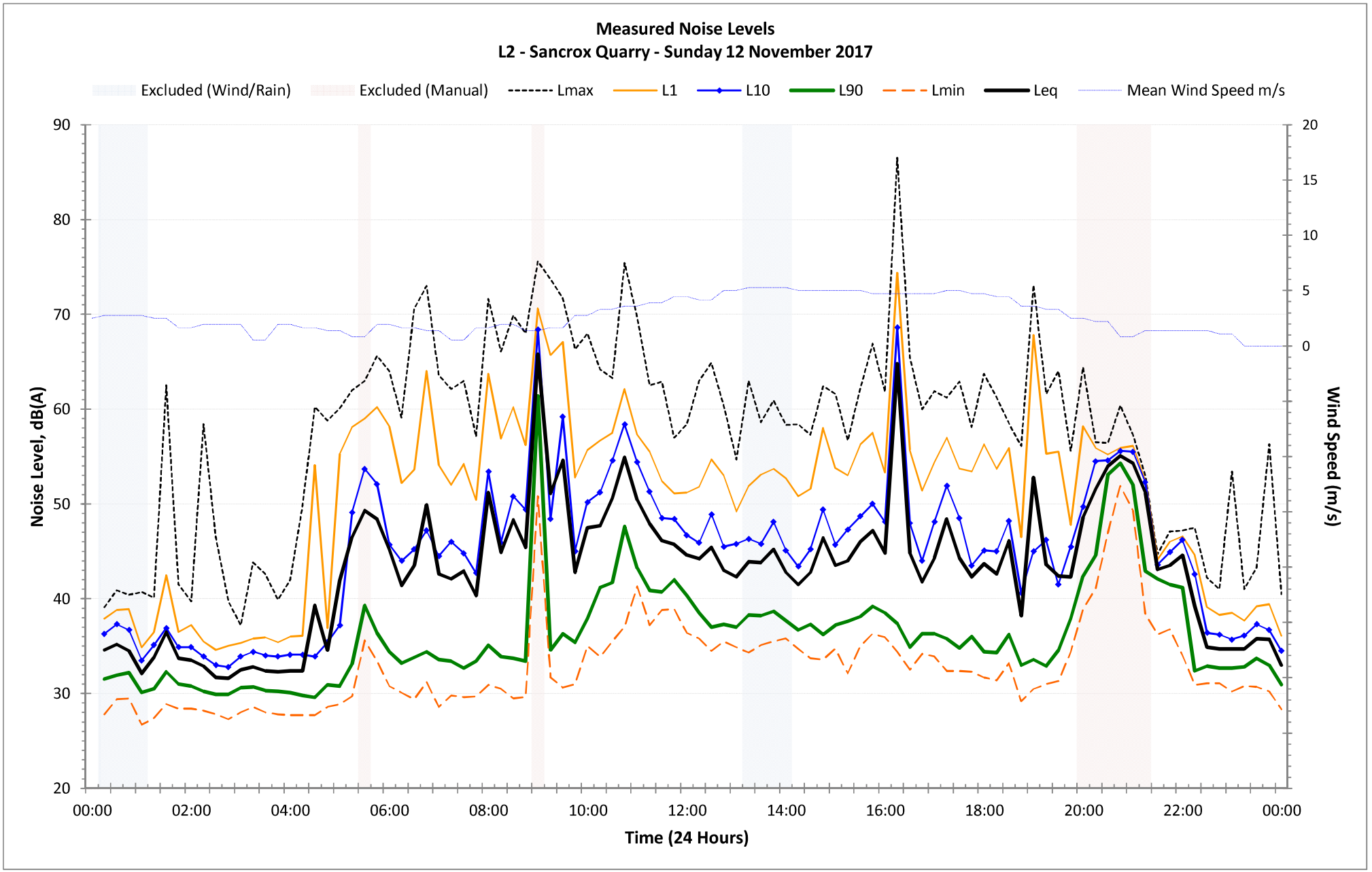
Measured Noise Levels
L2 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
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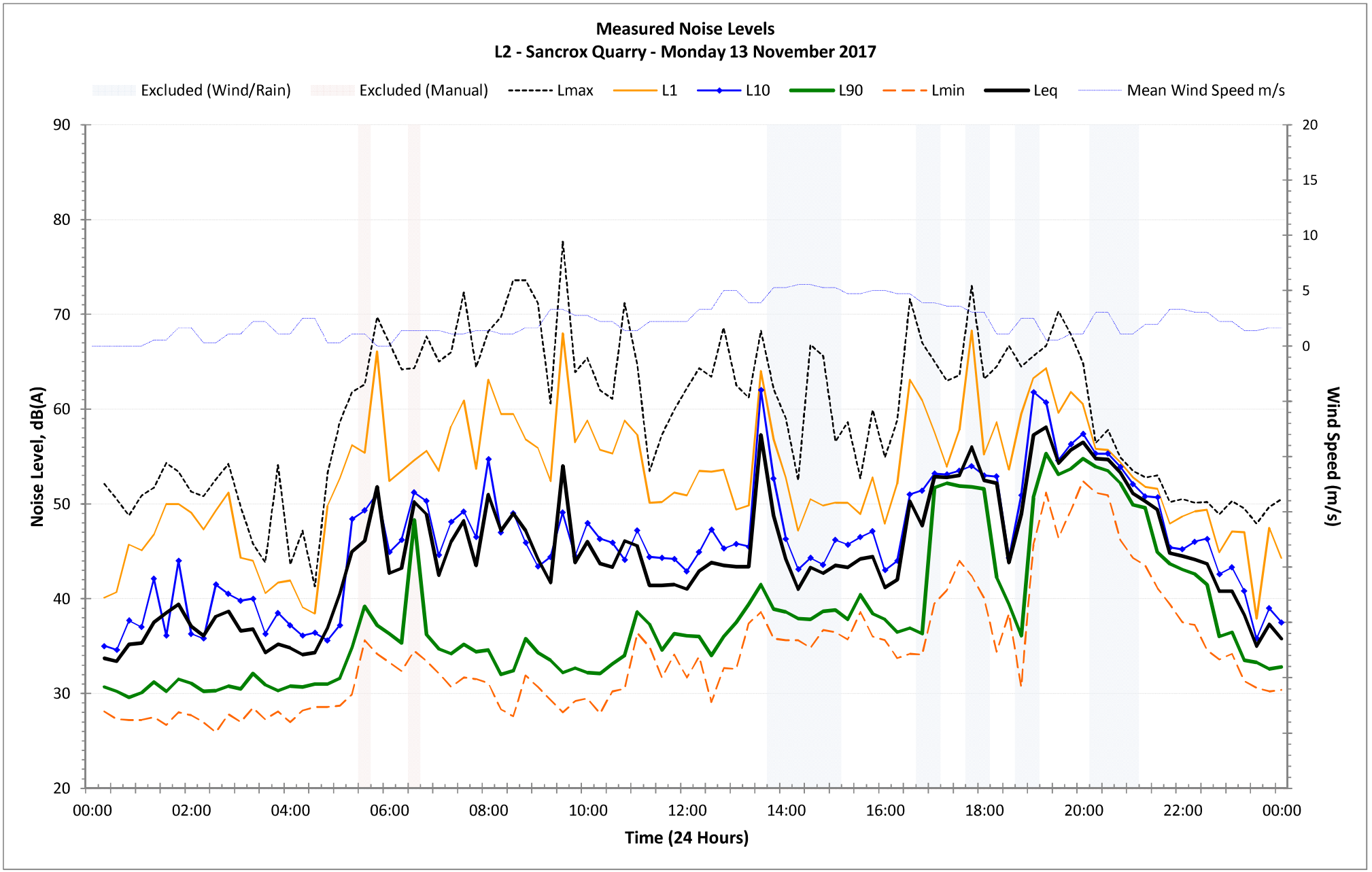
Measured Noise Levels
L2 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
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40
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20
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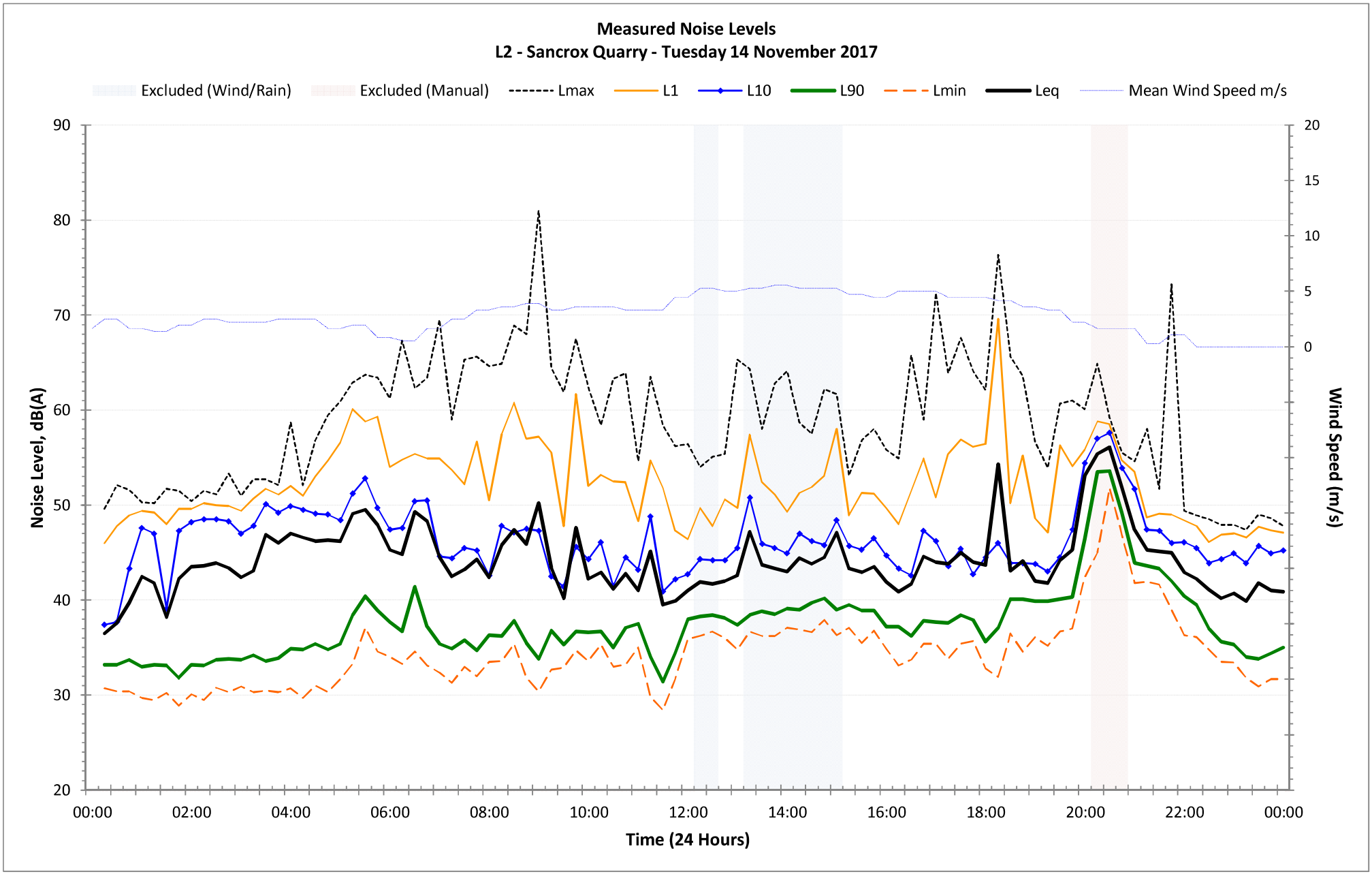
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
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60
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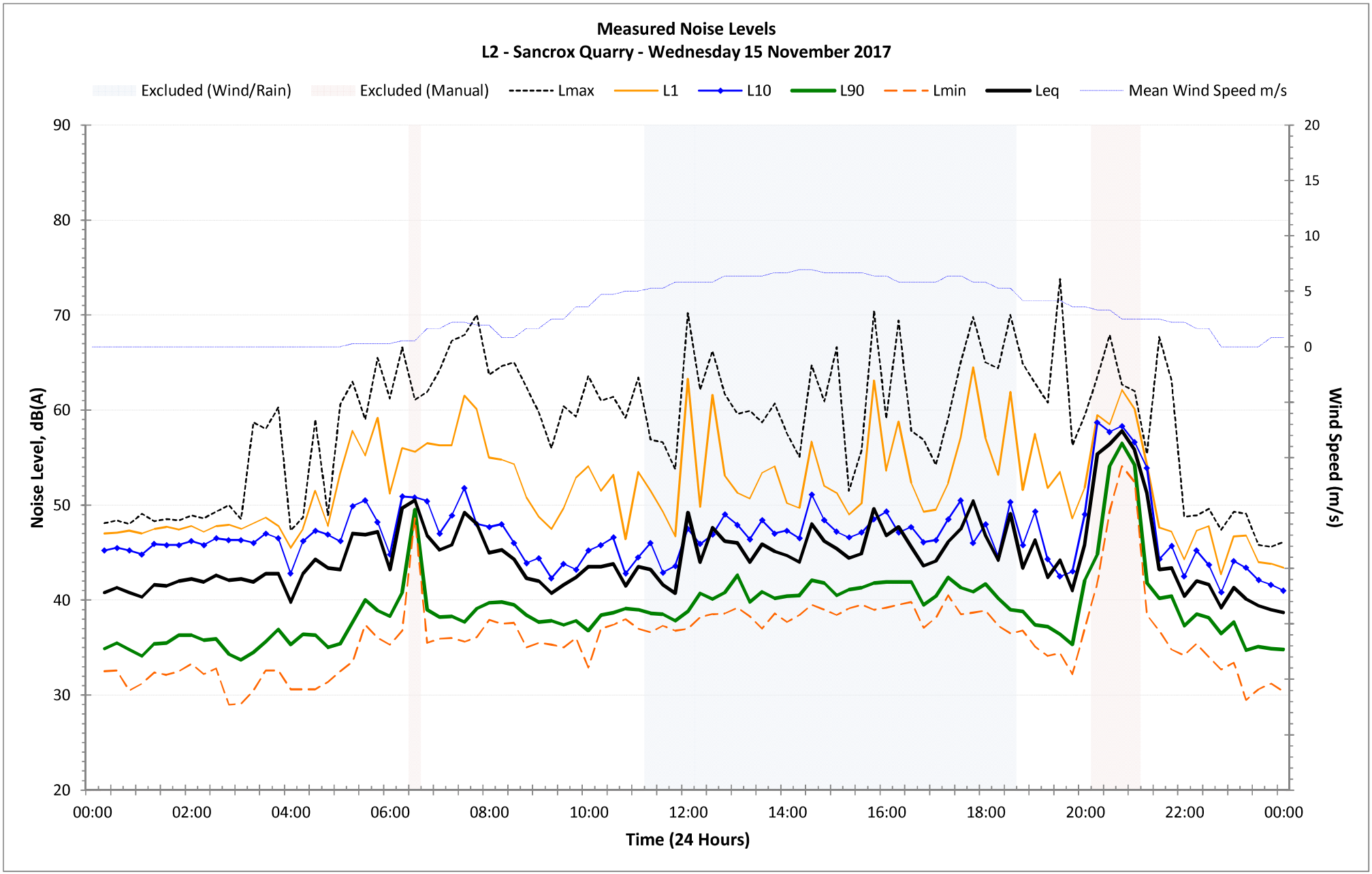
Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
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60
50
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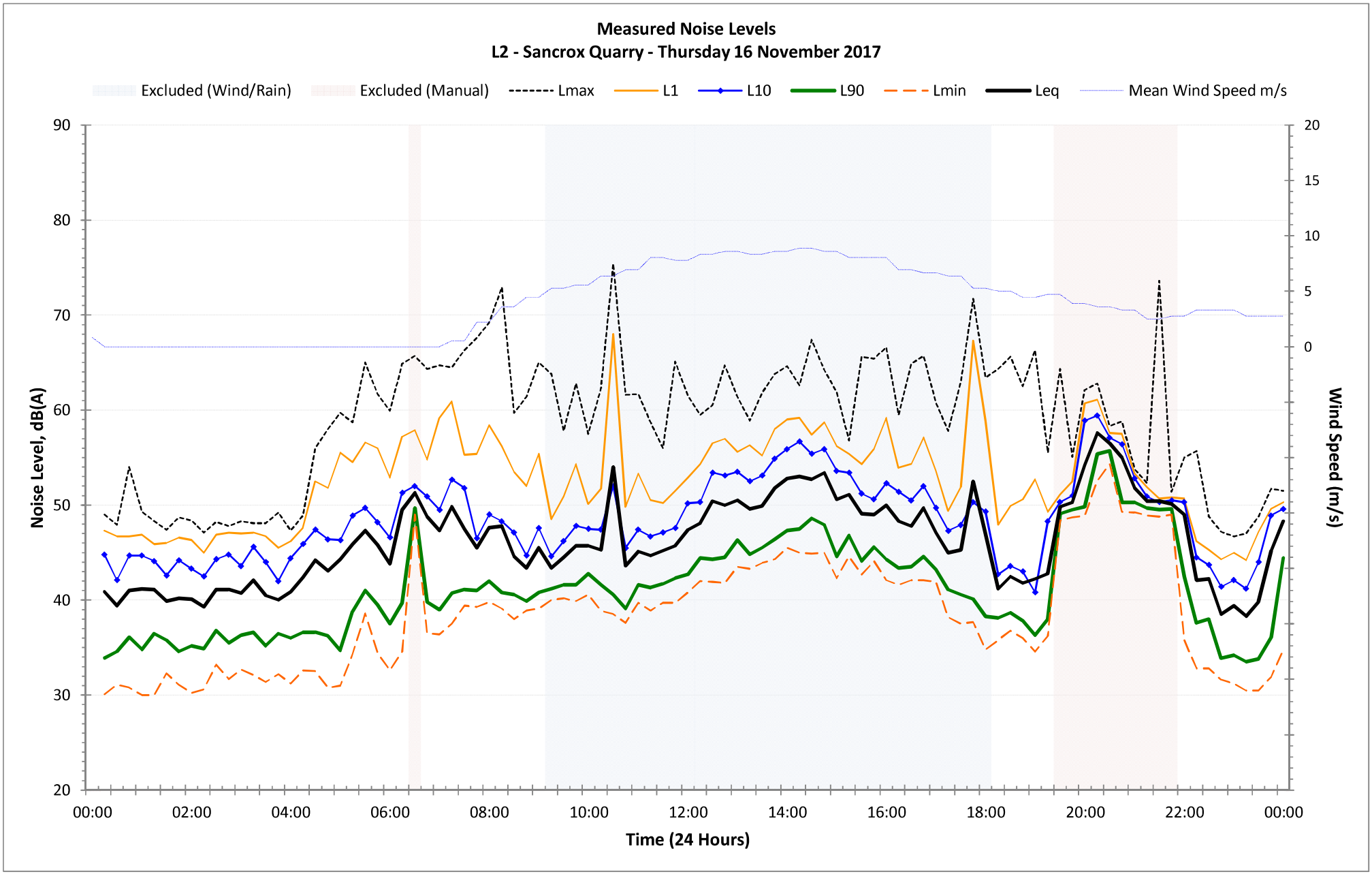
Measured Noise Levels
L2 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
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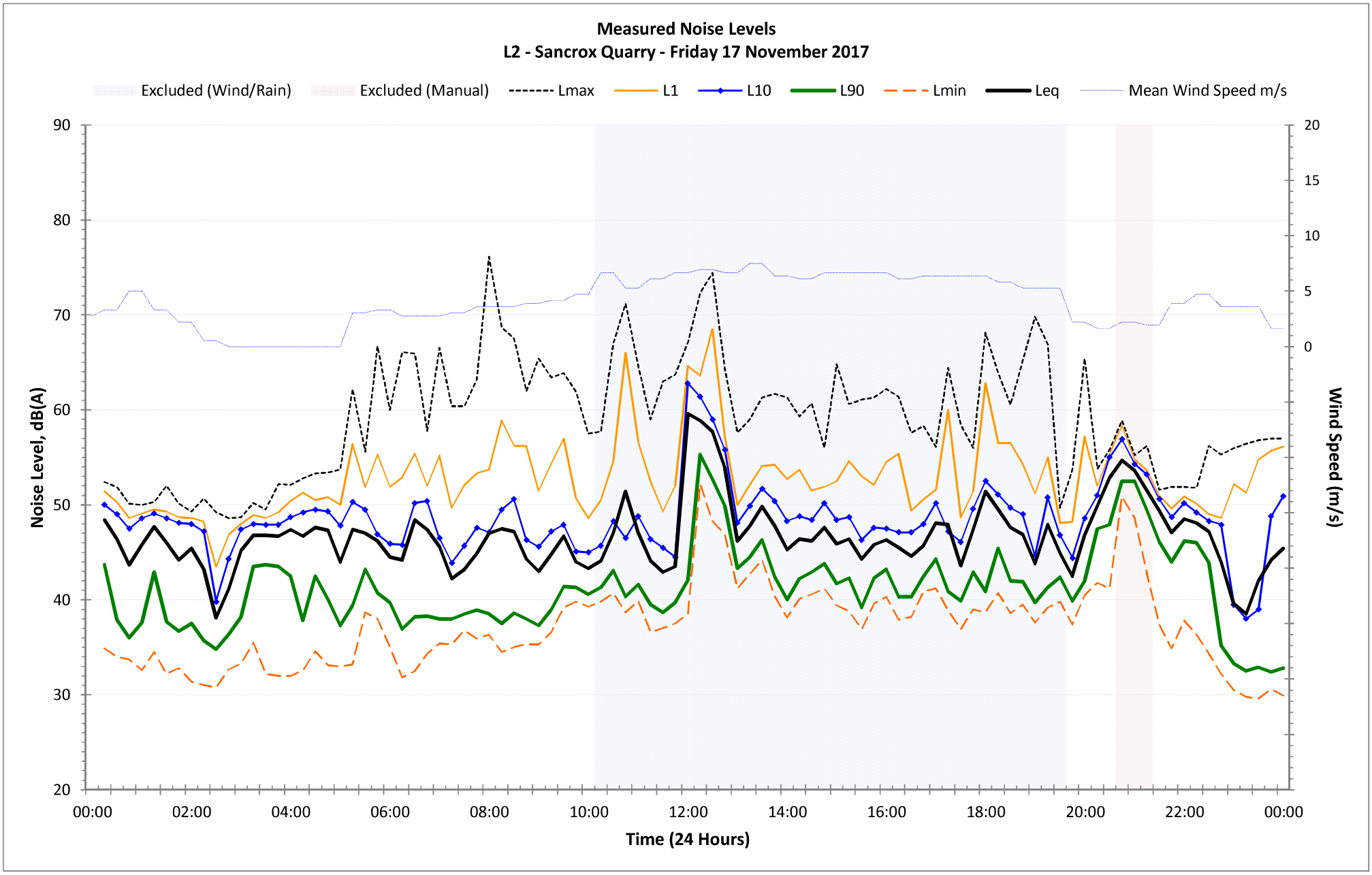
Measured Noise Levels
L2 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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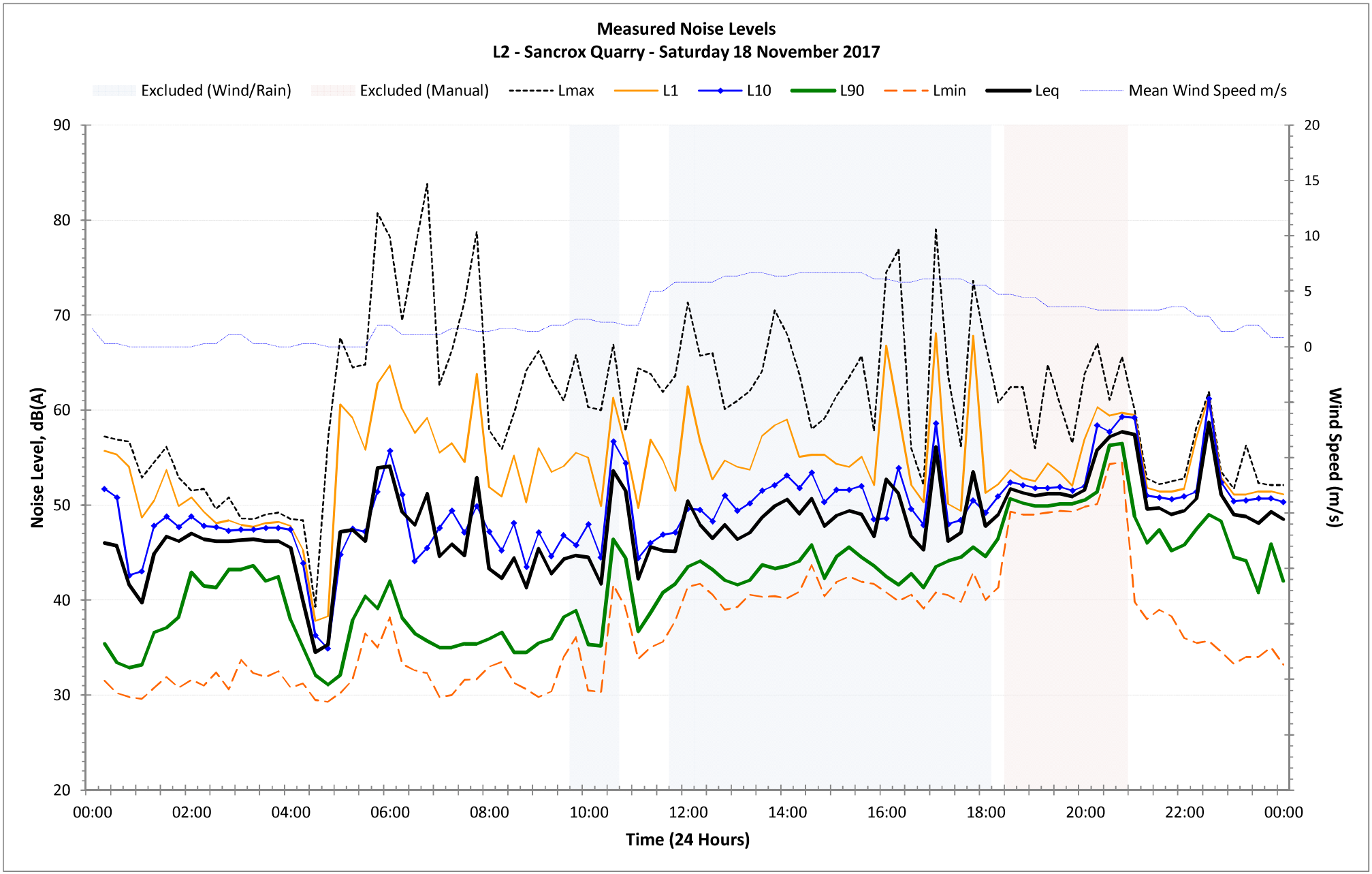
Measured Noise Levels
L2 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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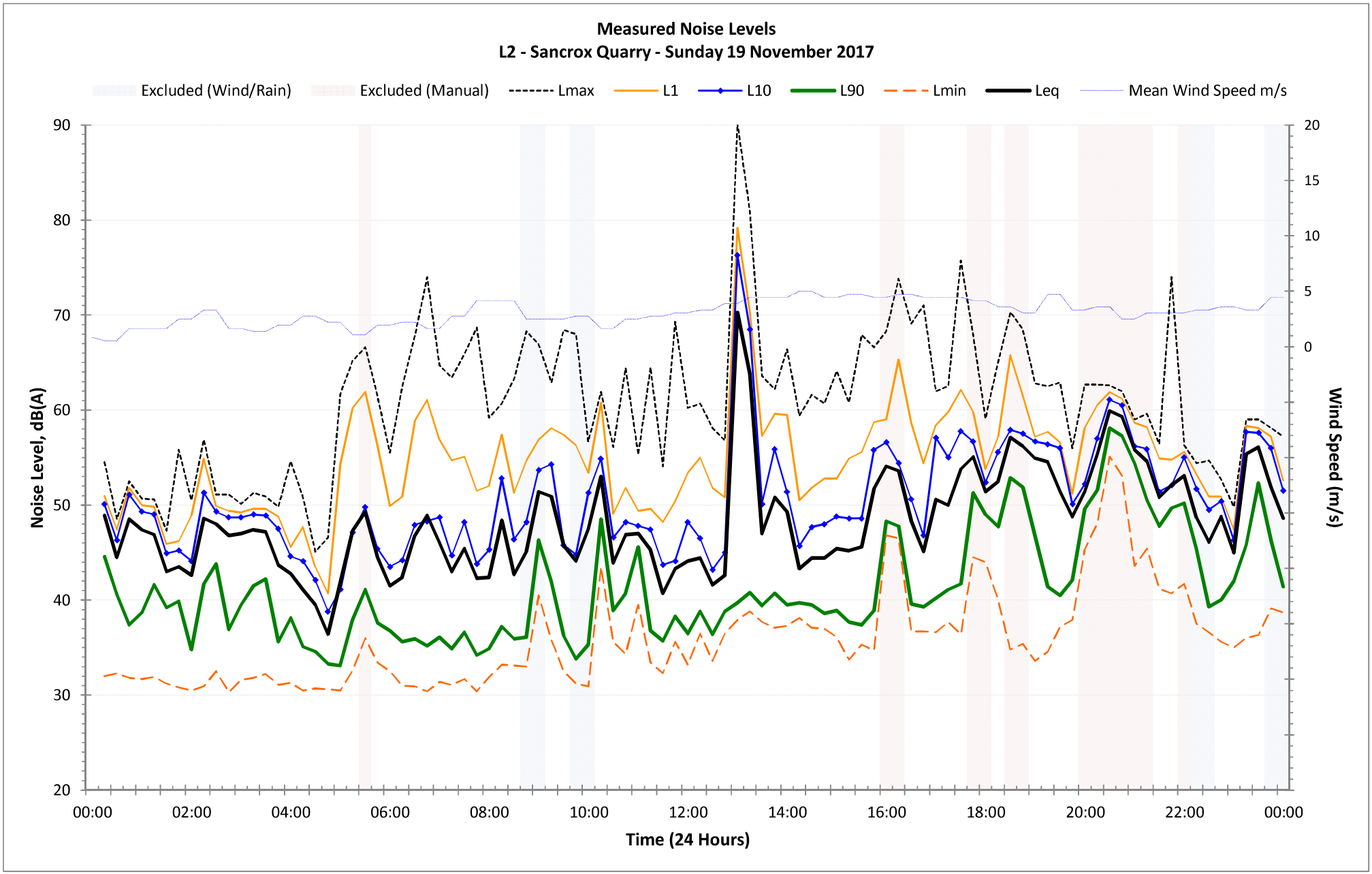
Measured Noise Levels
L2 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
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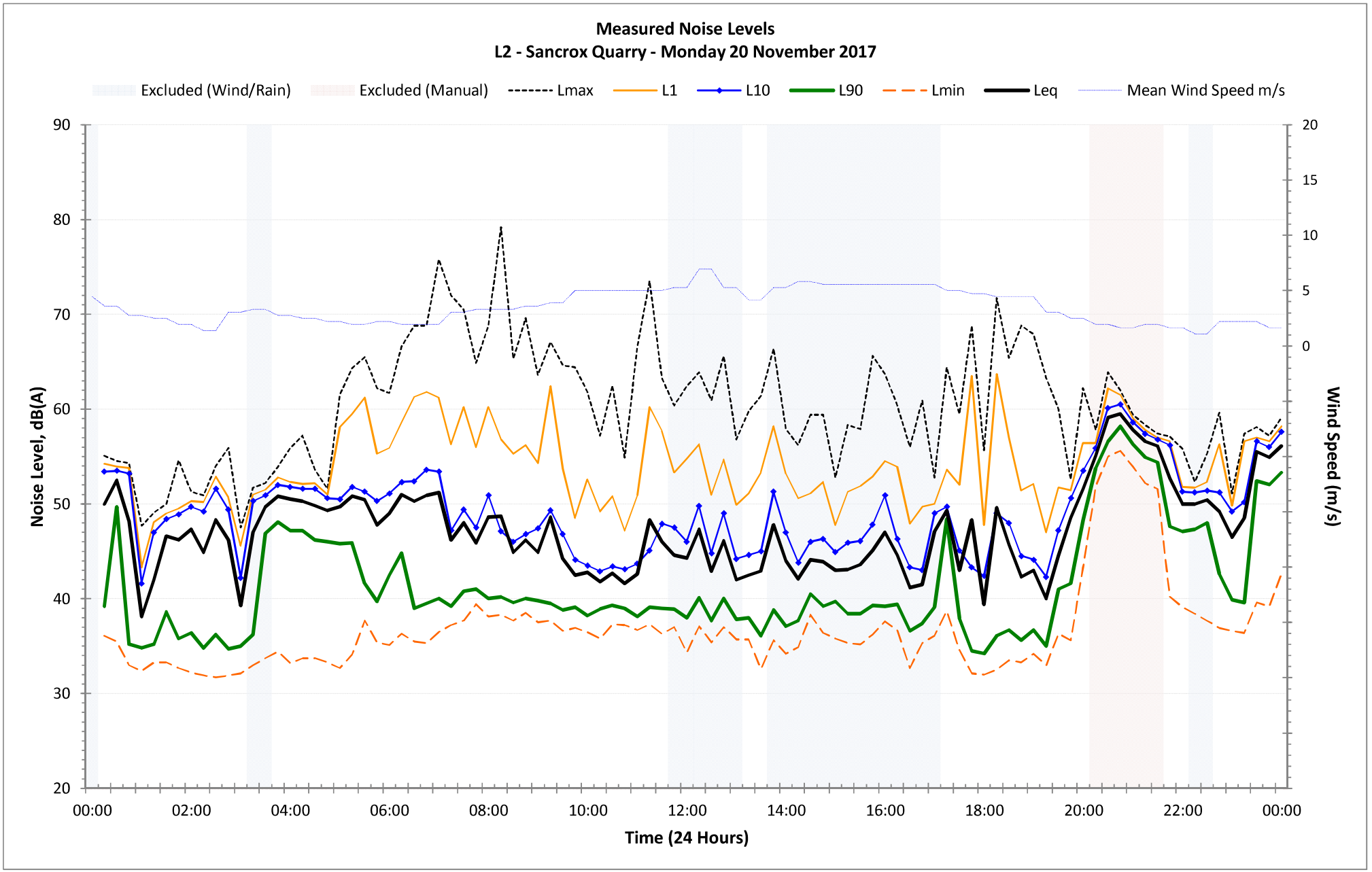
Measured Noise Levels
L2 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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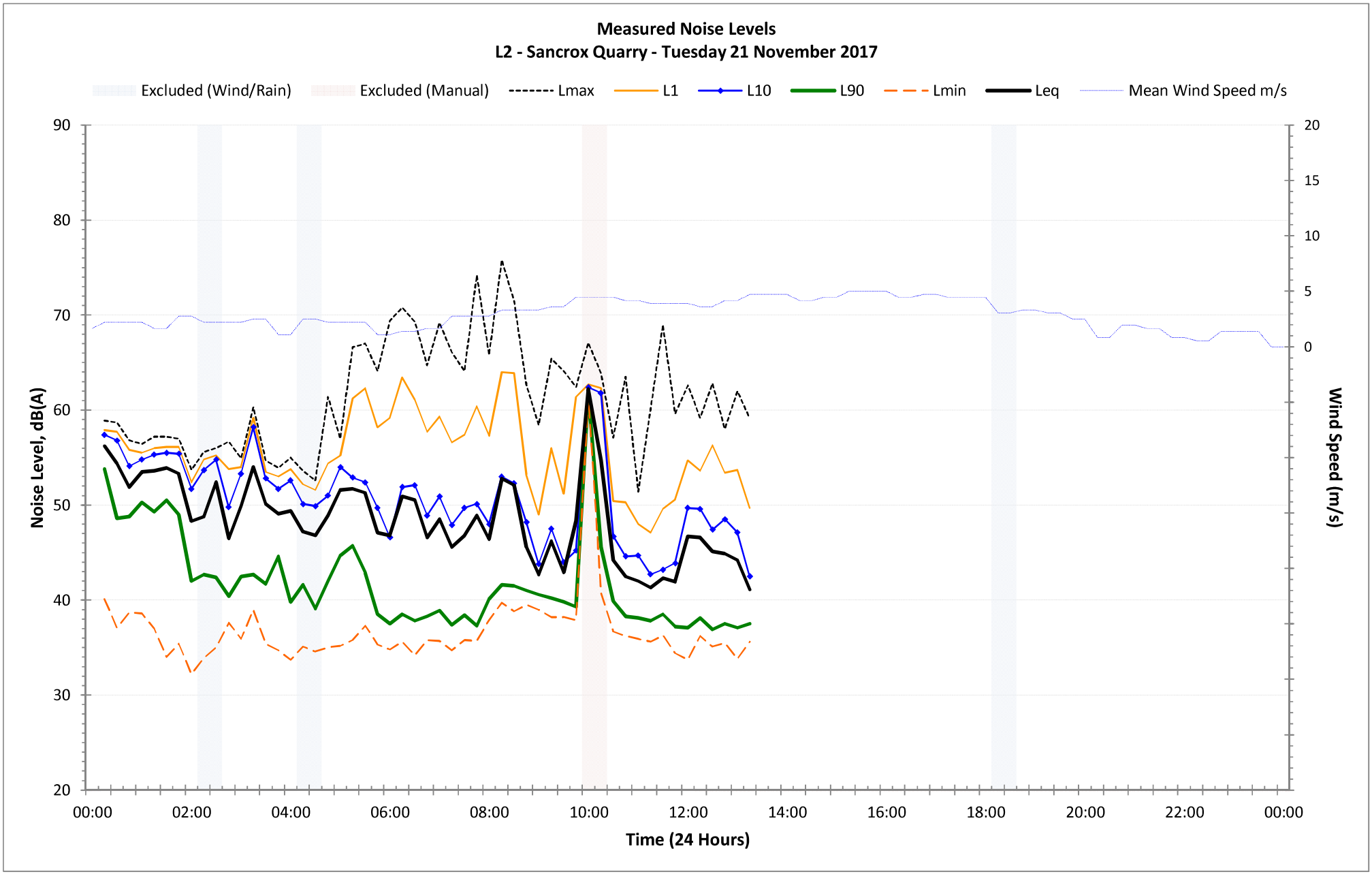
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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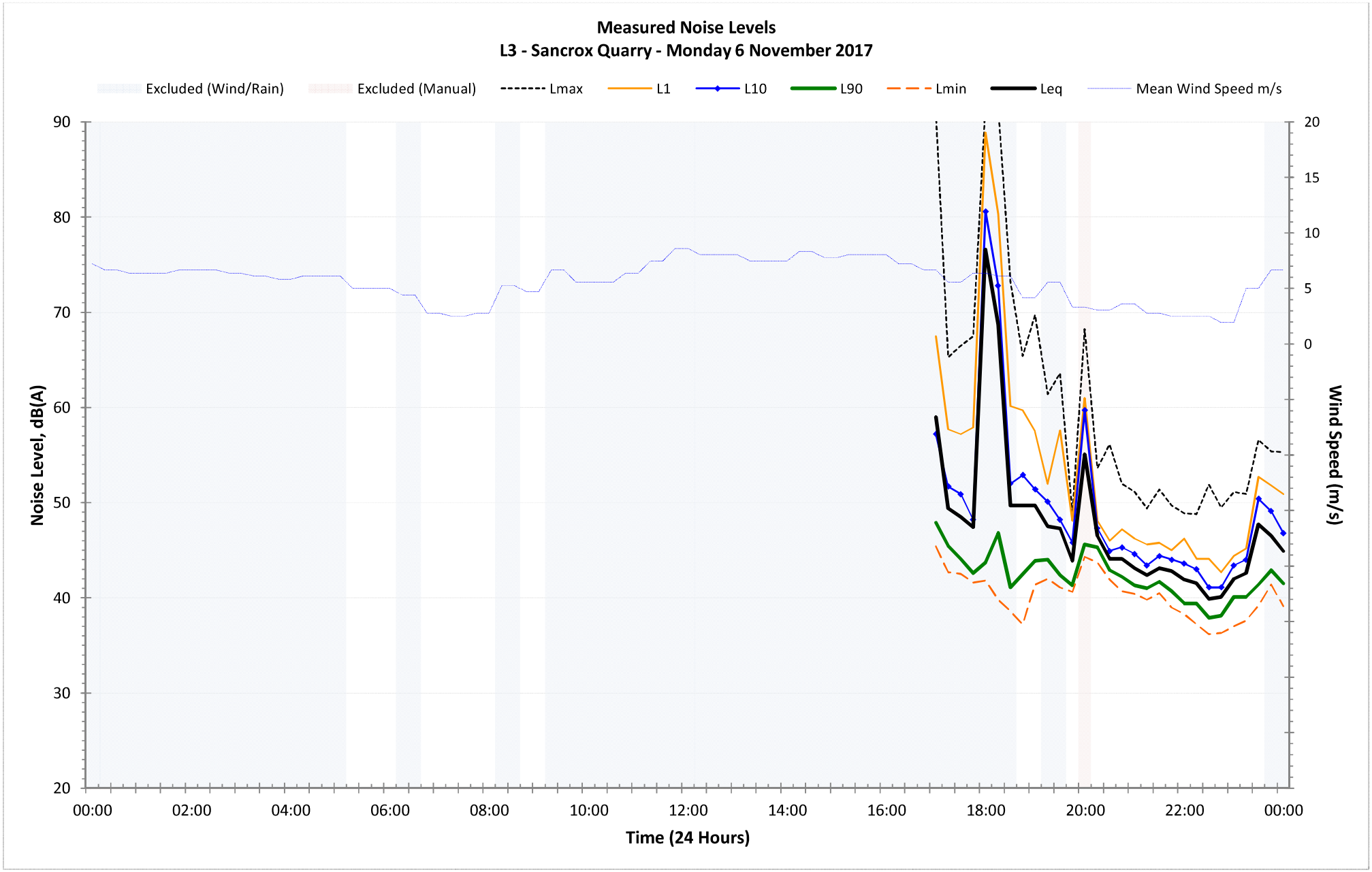
Measured Noise Levels
L3 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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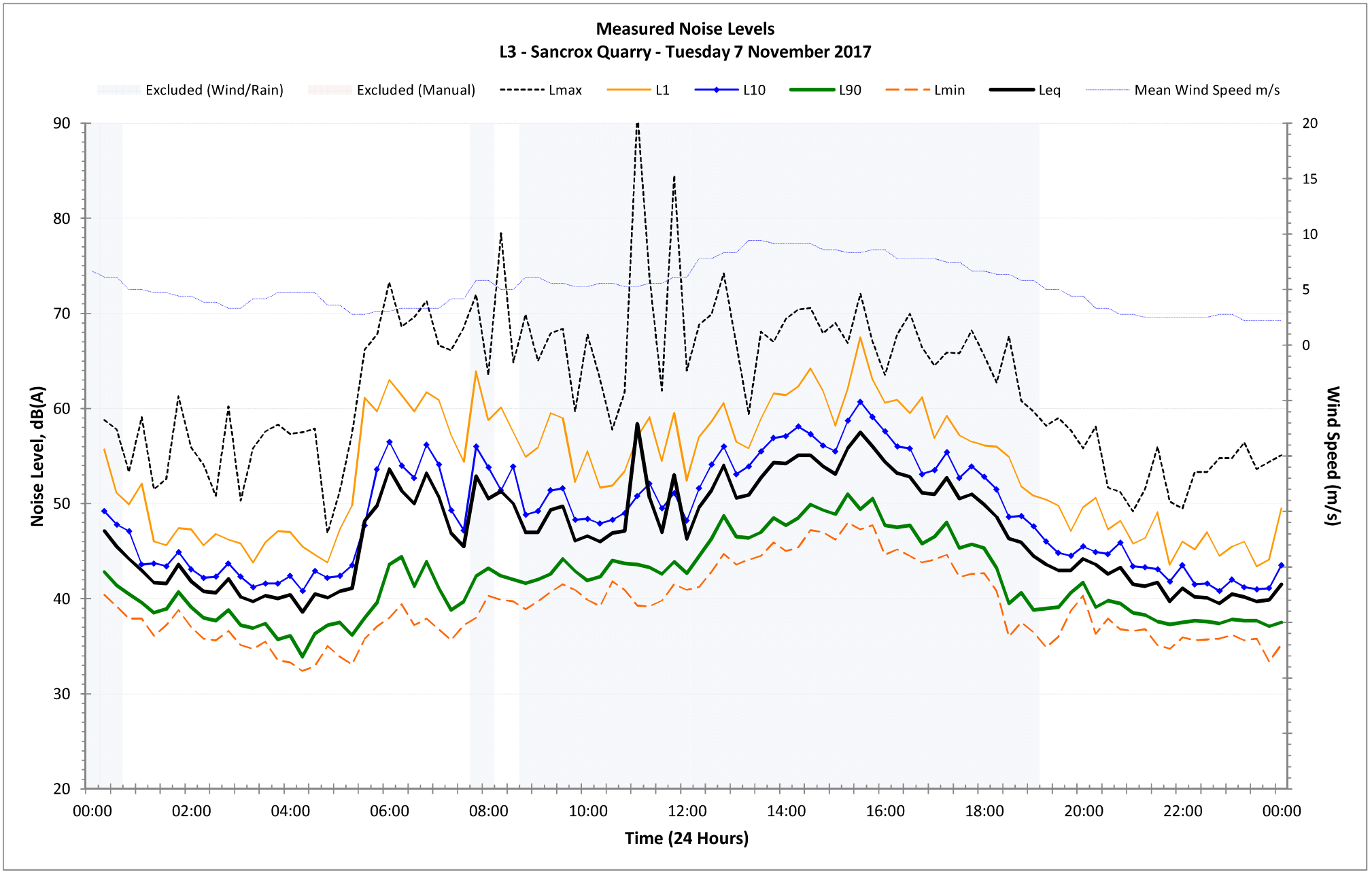
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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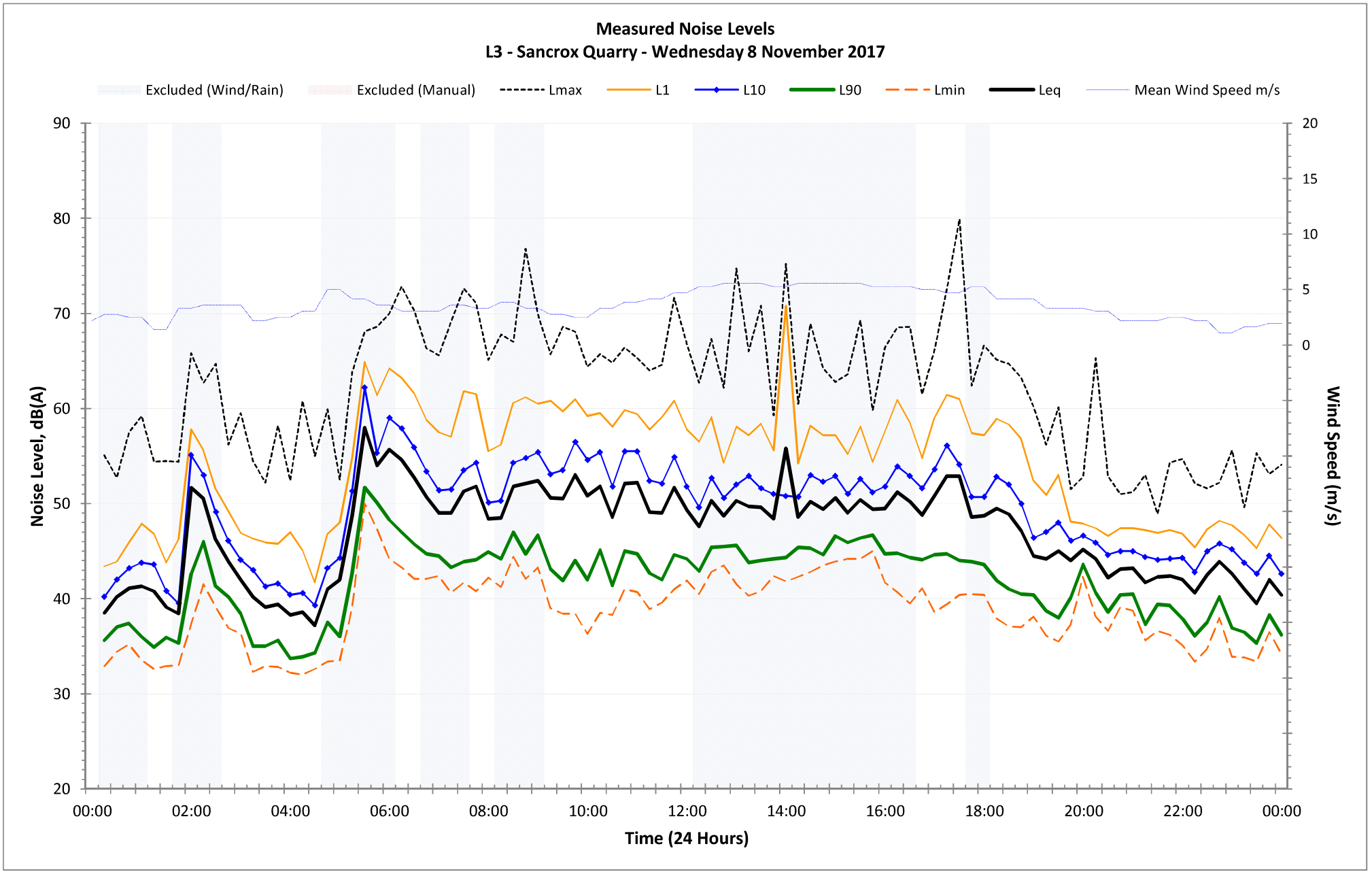
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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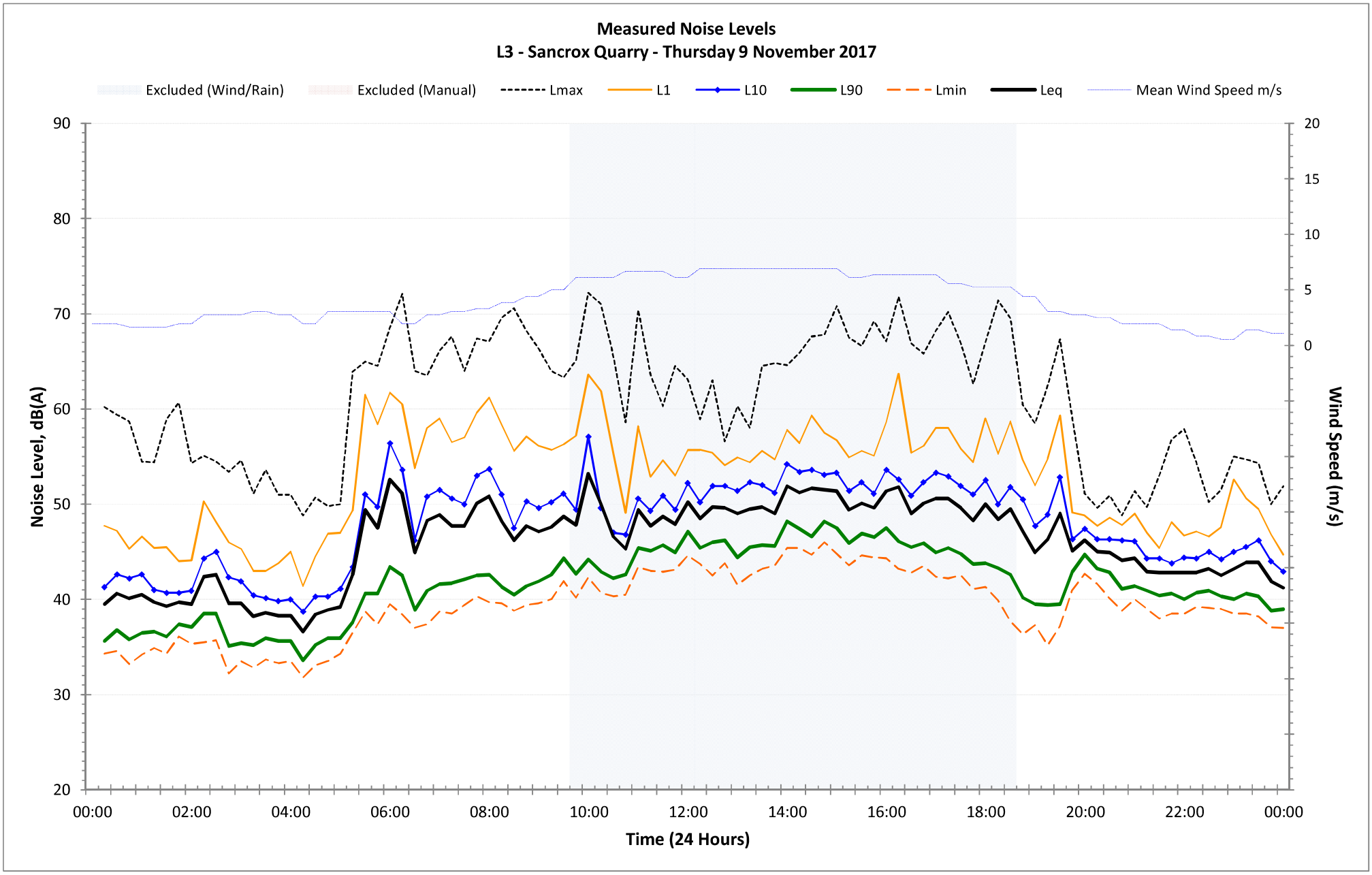
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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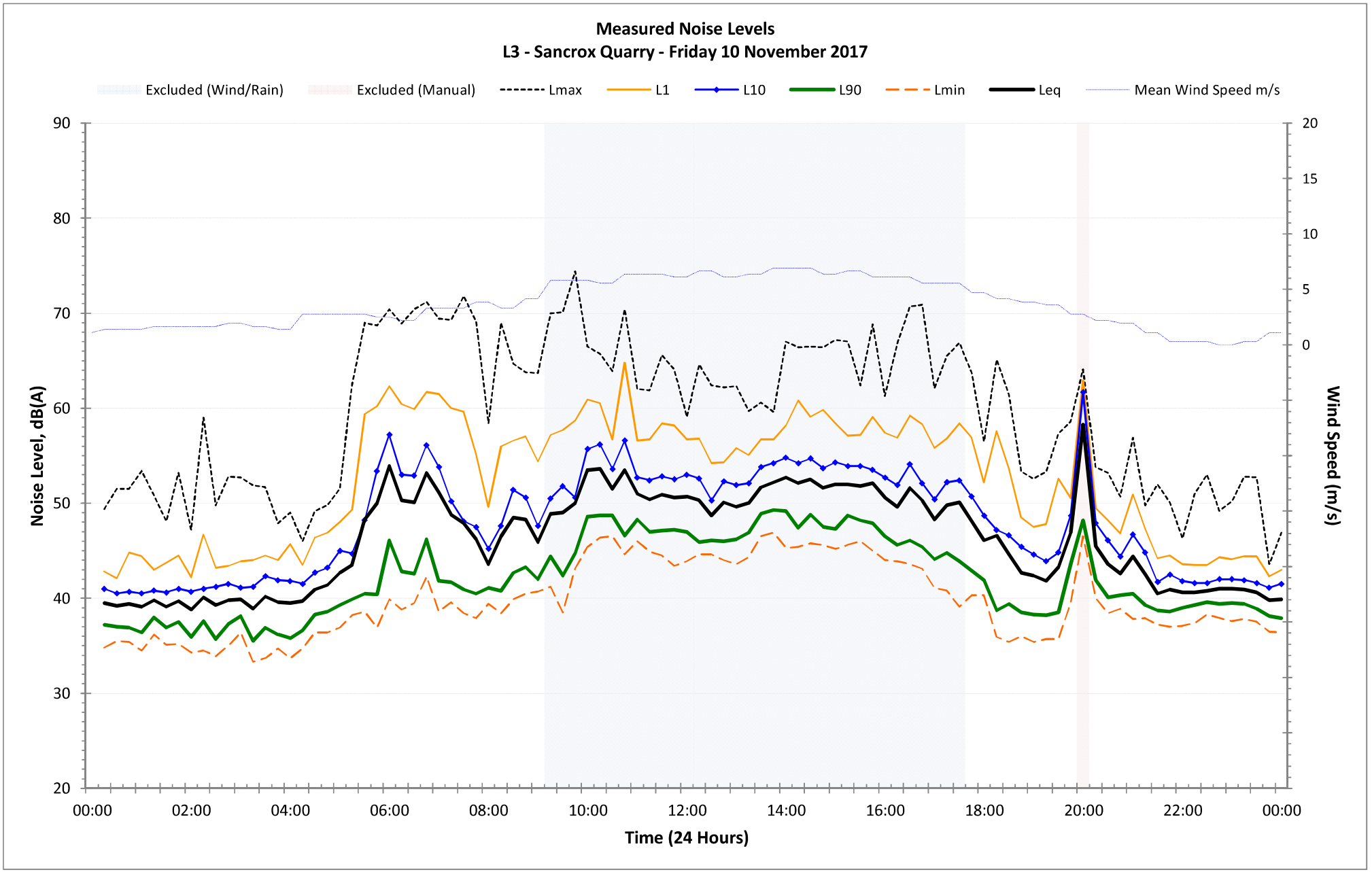
Measured Noise Levels
L3 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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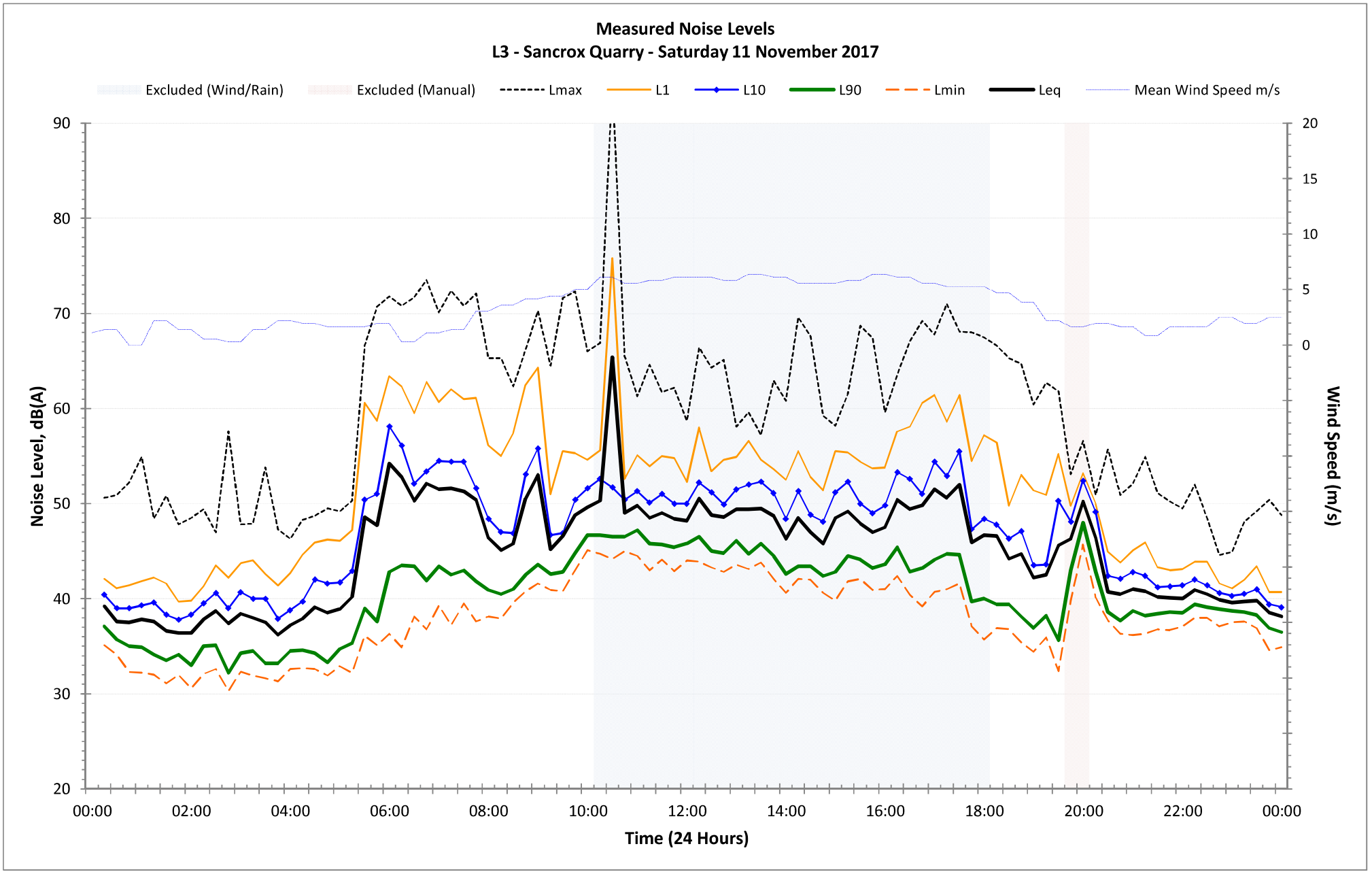
Measured Noise Levels
L3 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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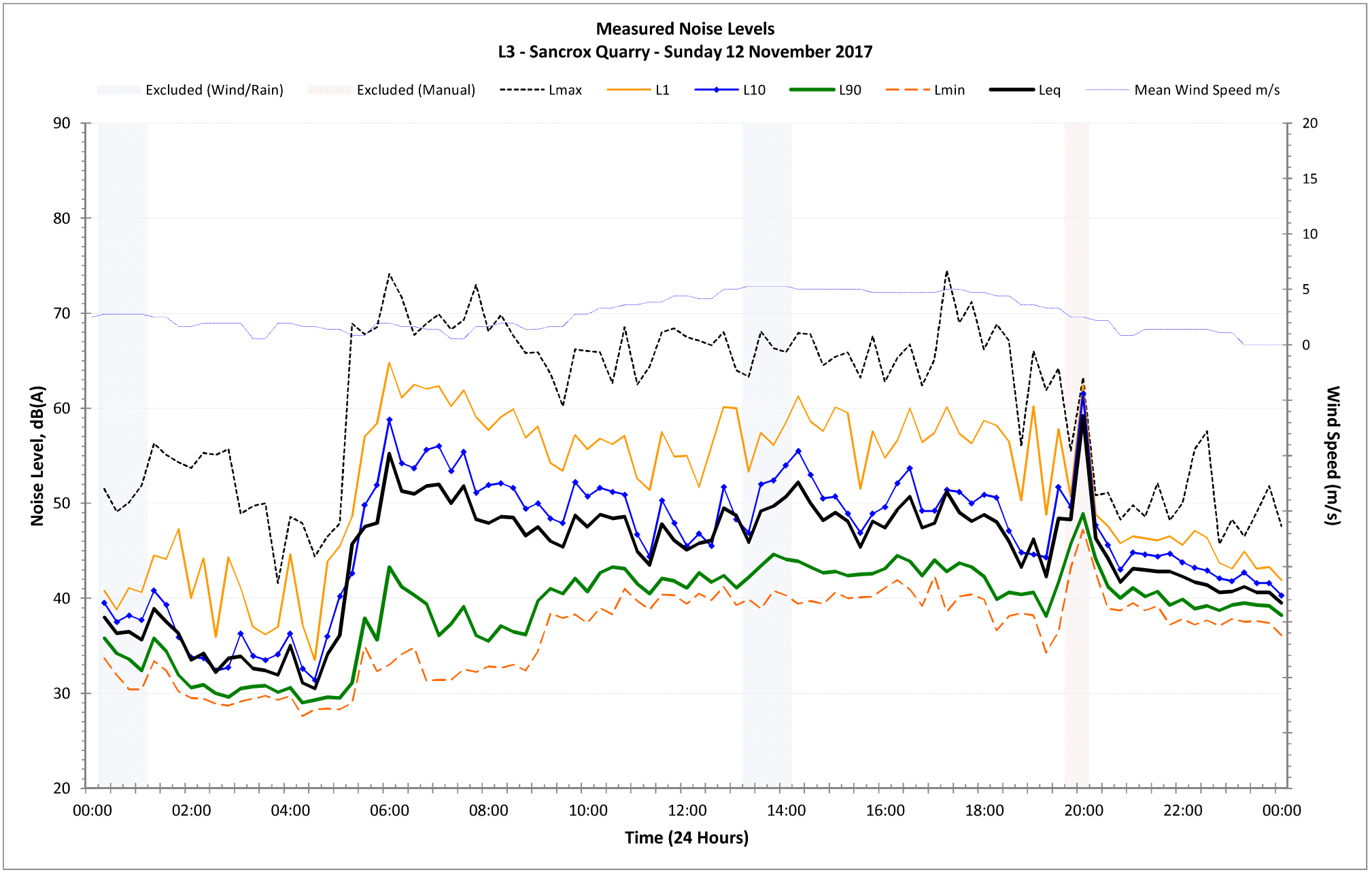
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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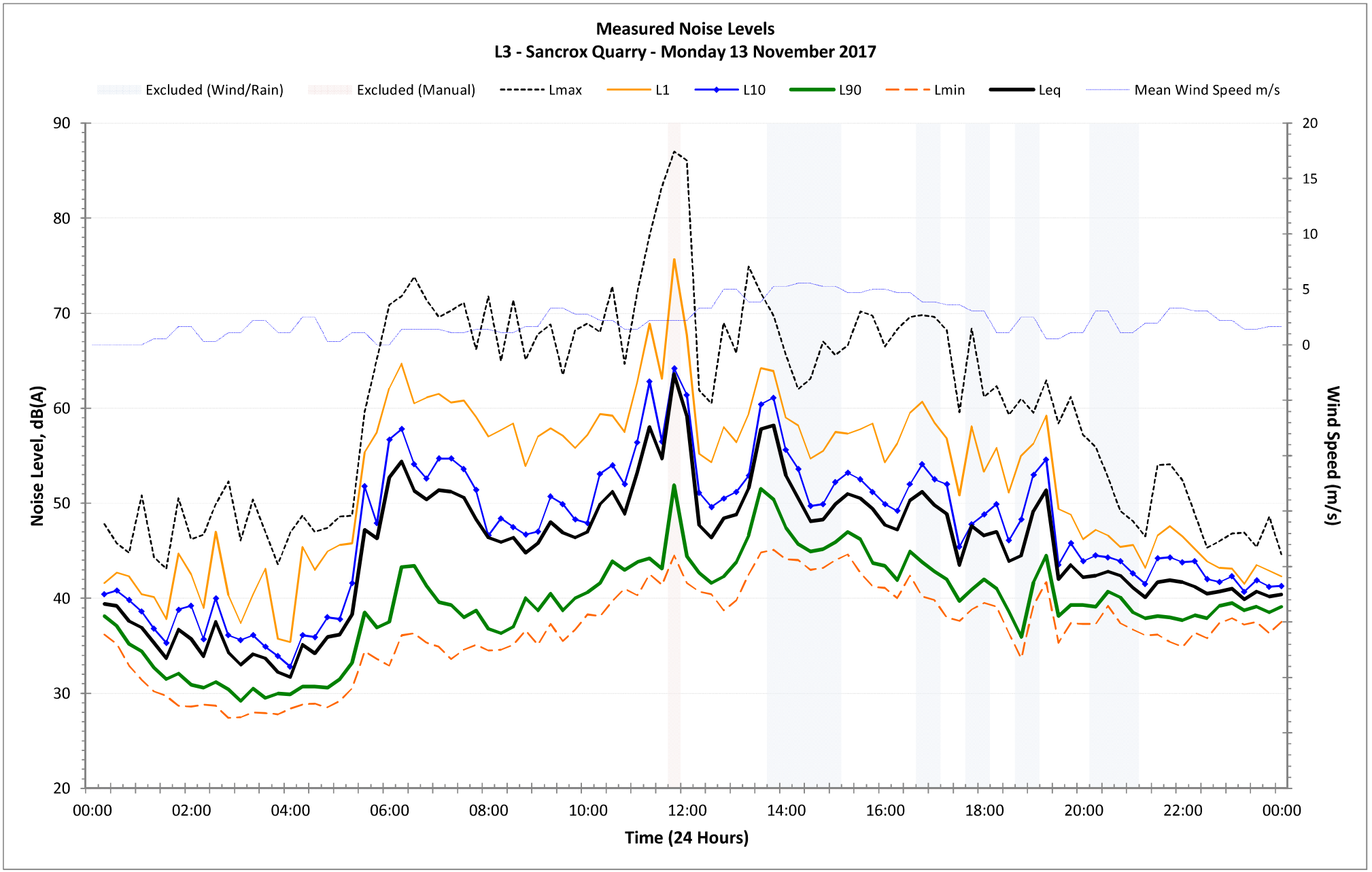
Measured Noise Levels
L3 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
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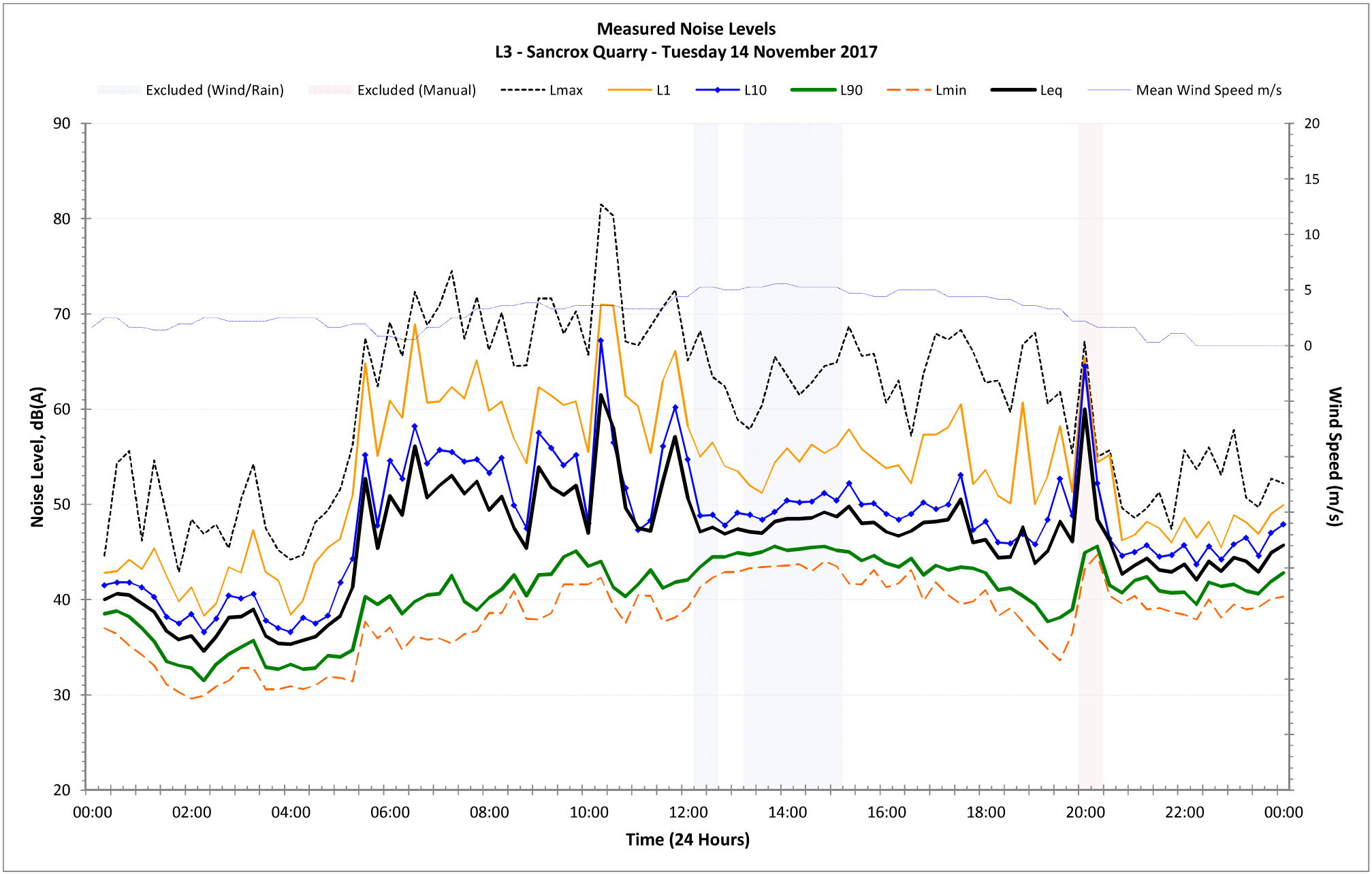
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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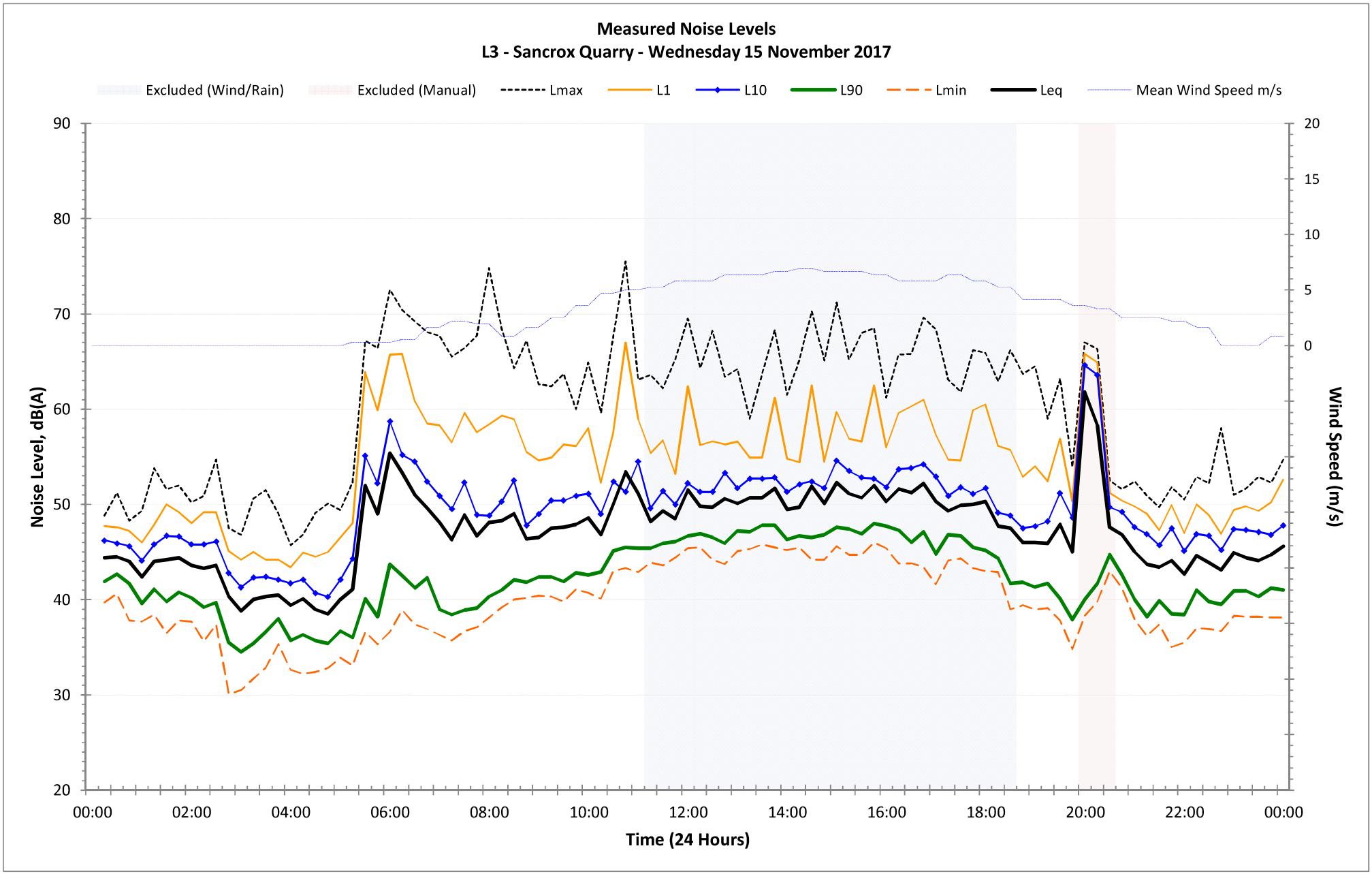
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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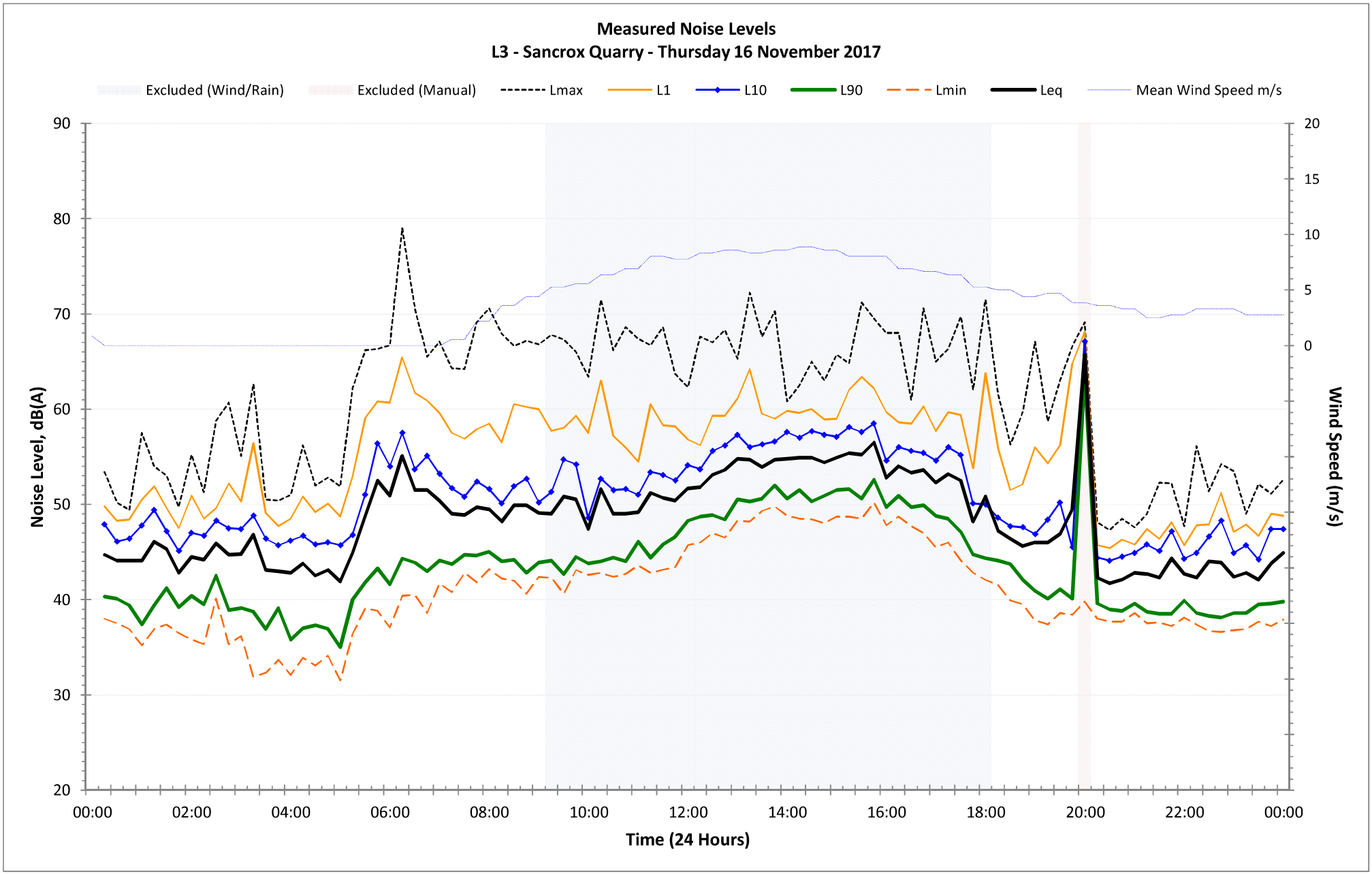
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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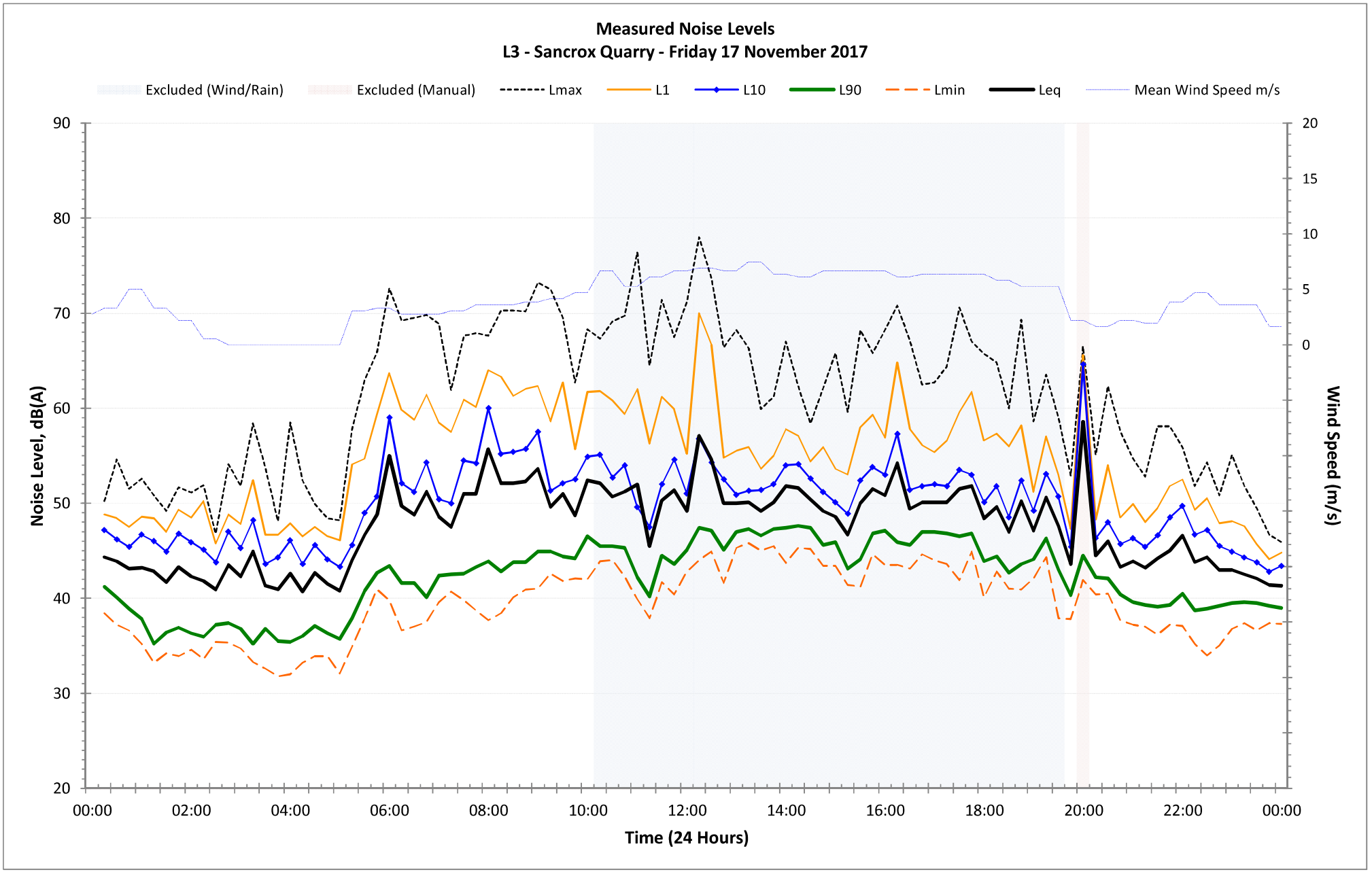
Measured Noise Levels
L3 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
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Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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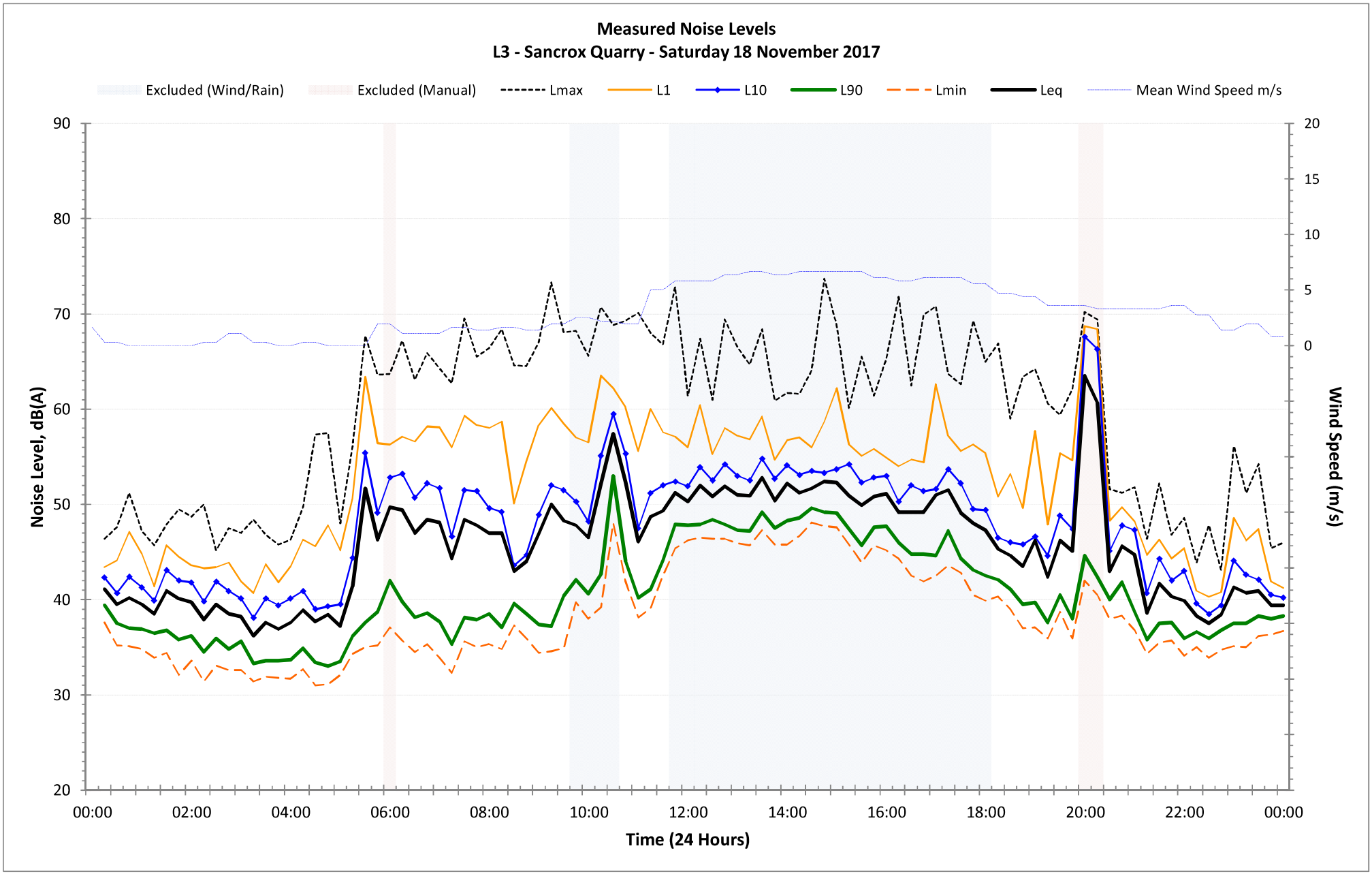
Measured Noise Levels
L3 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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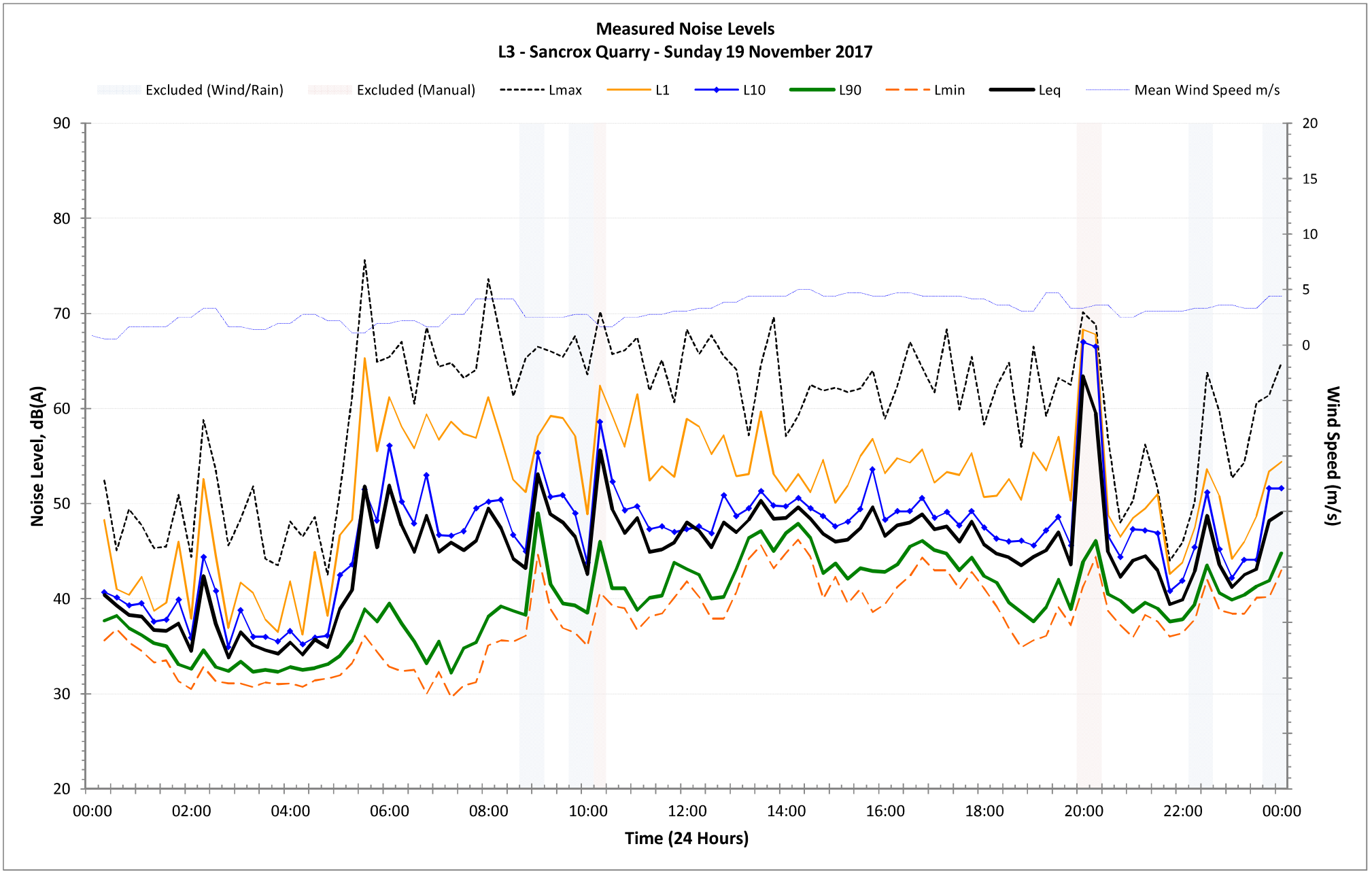
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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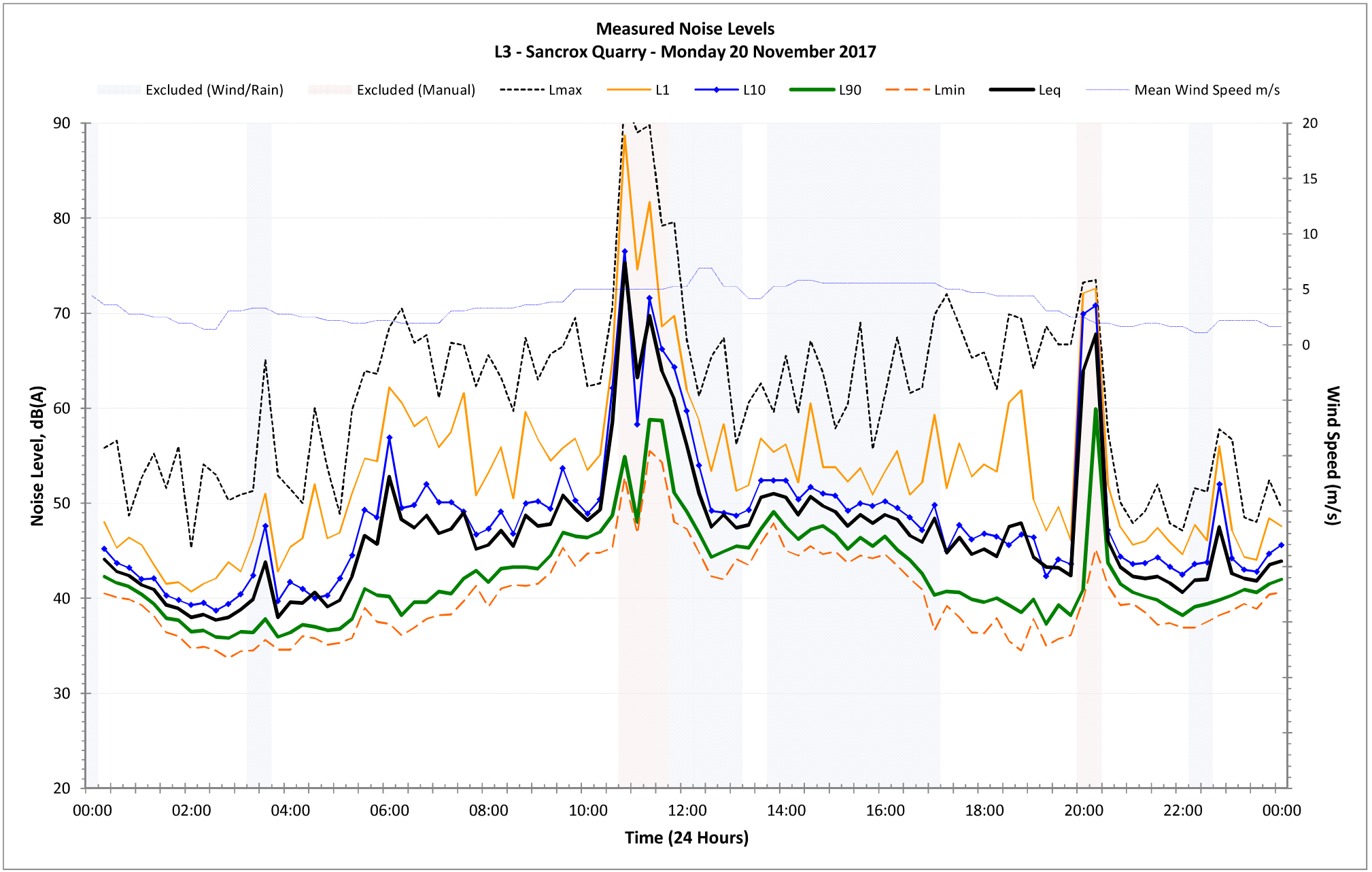
Measured Noise Levels
L3 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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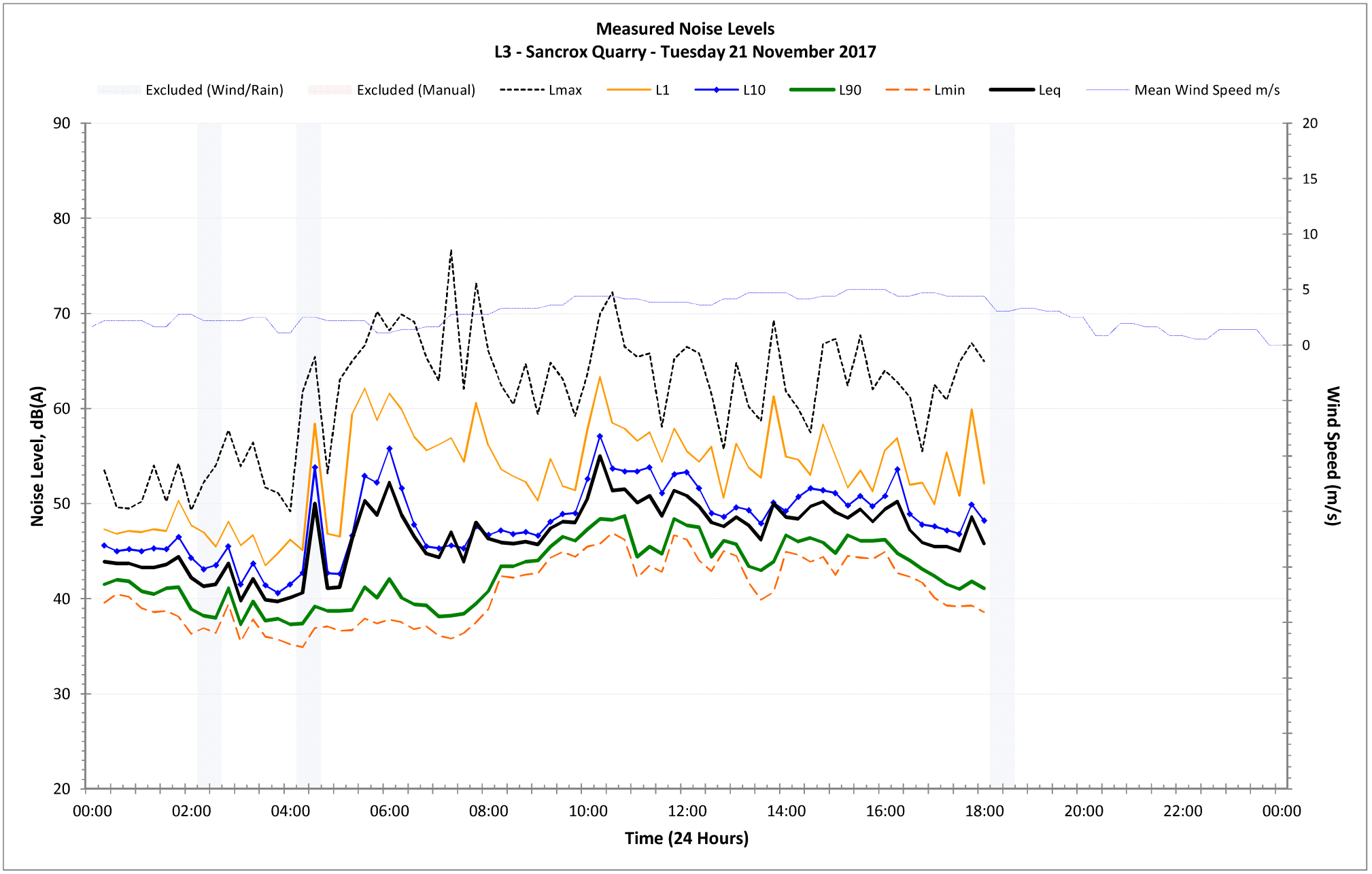
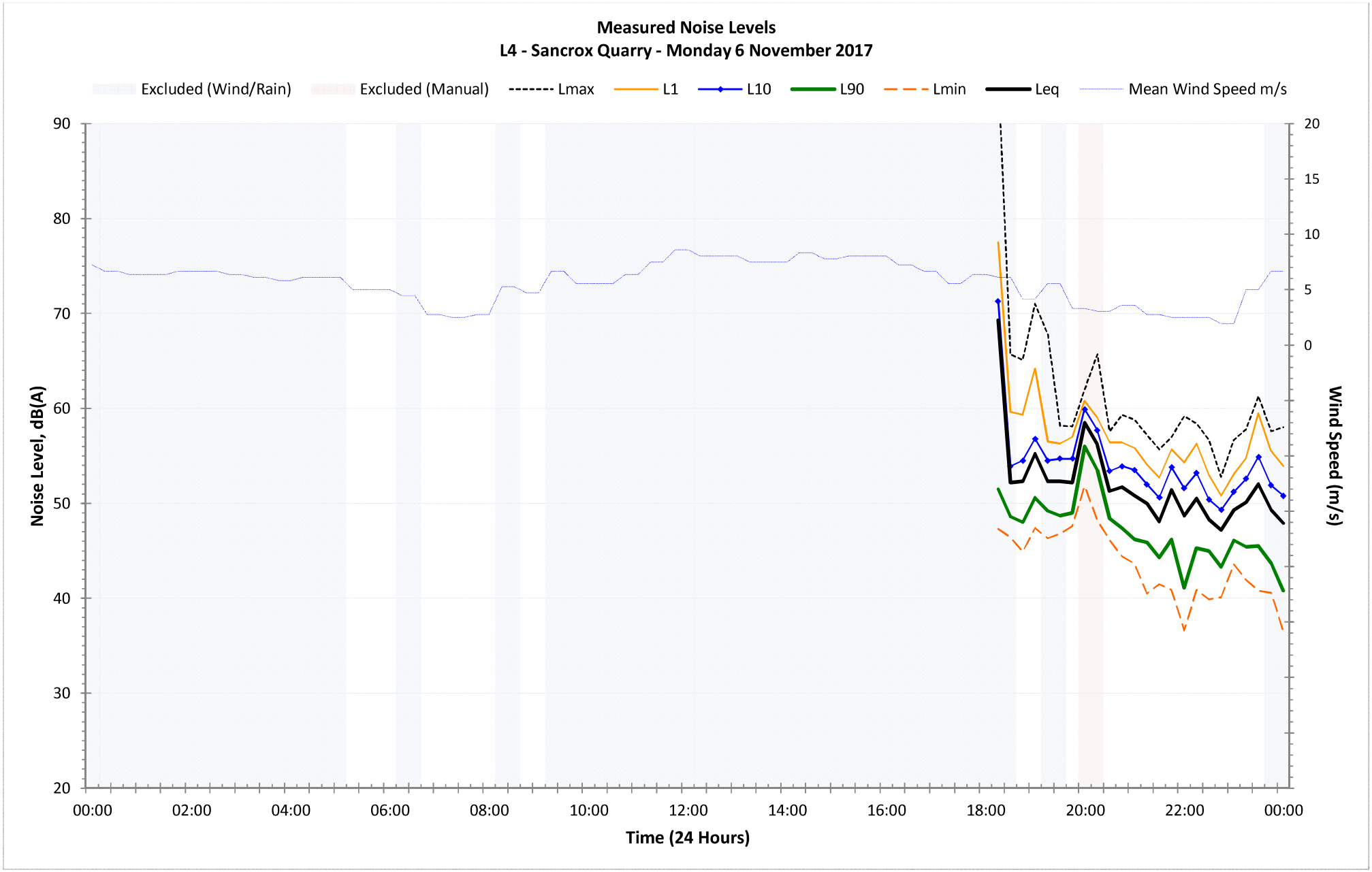

Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Monday 6 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
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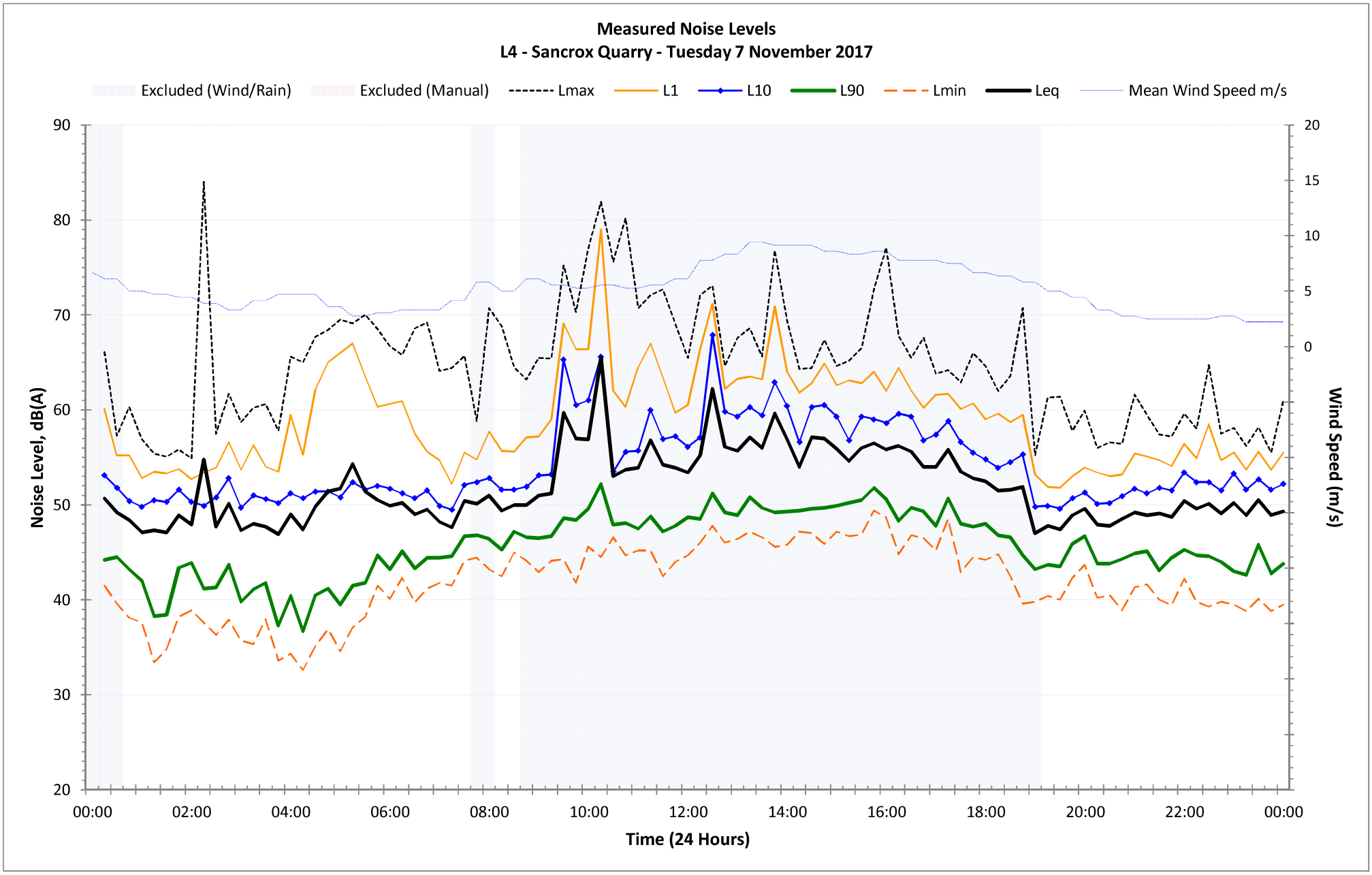
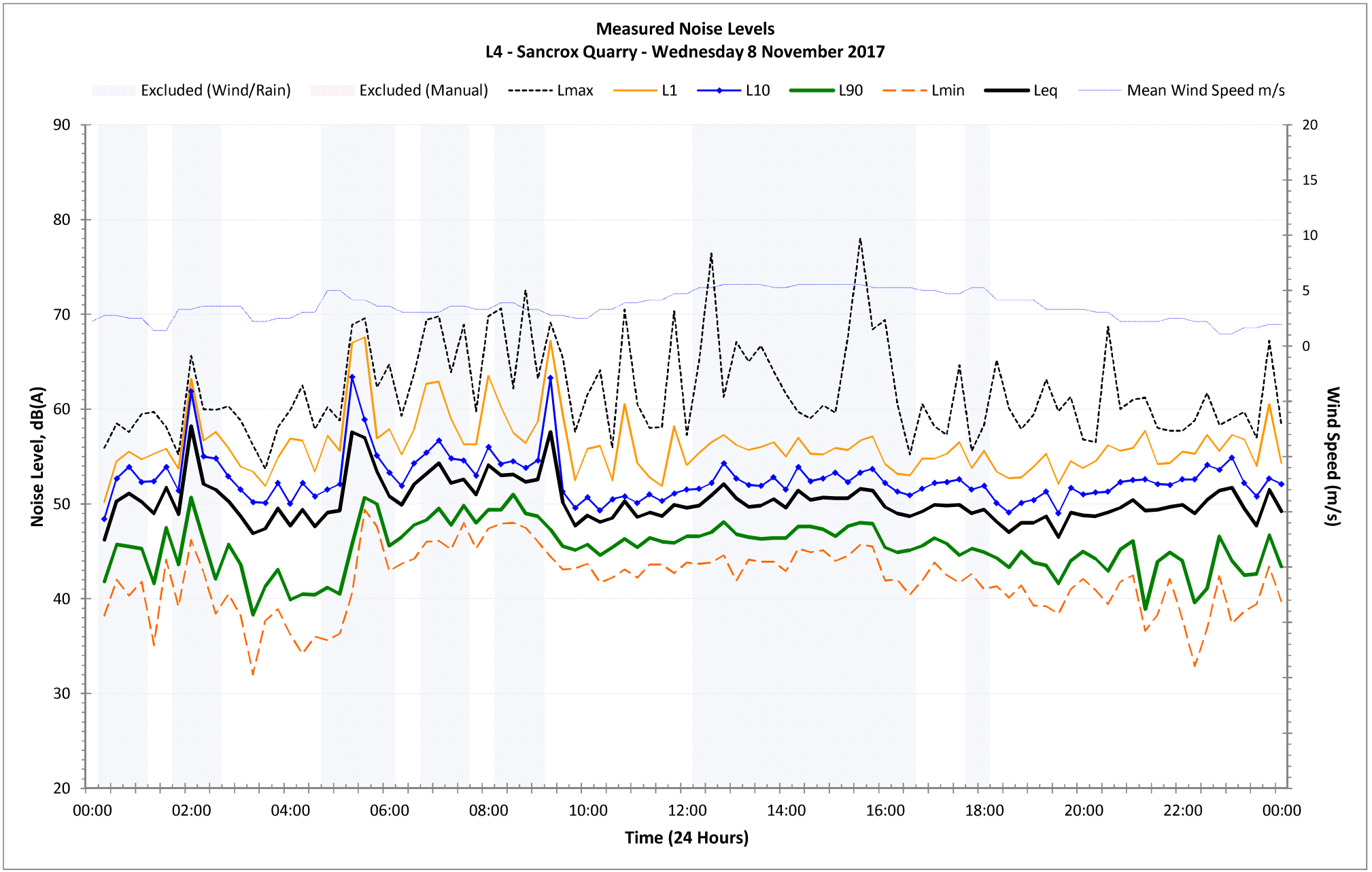
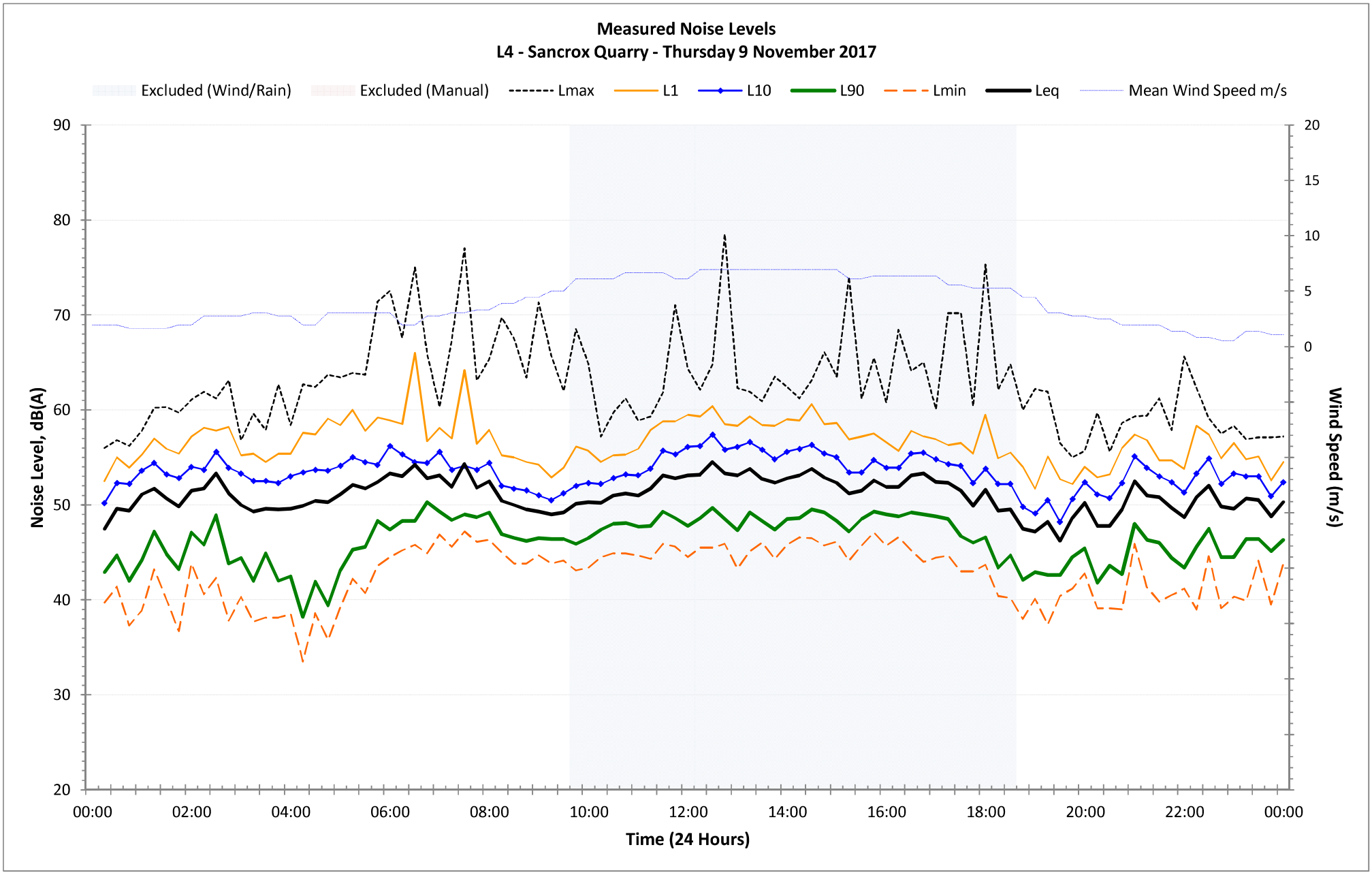

Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 7 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 8 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Thursday 9 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
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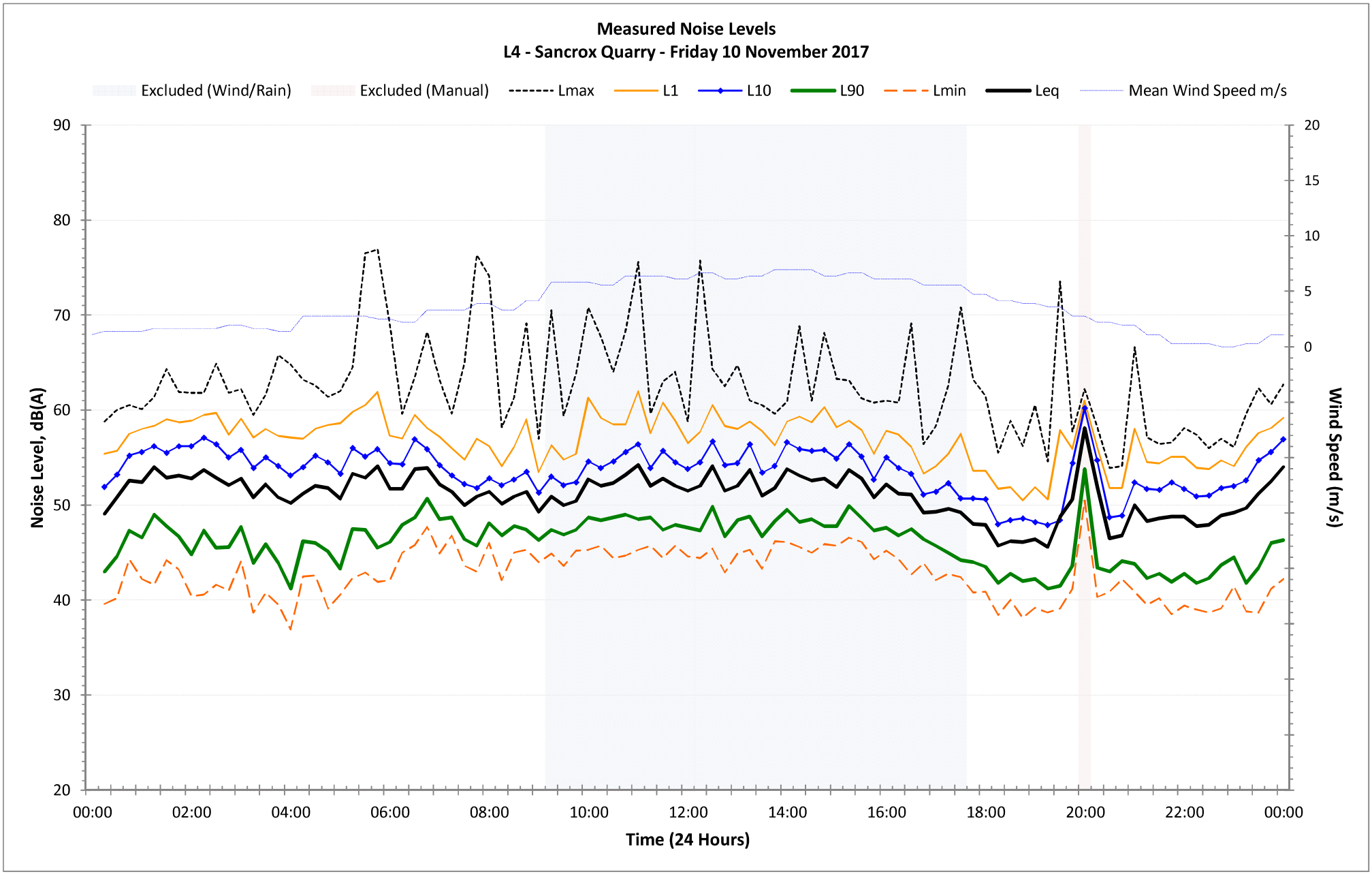
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Friday 10 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
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10:00
12:00
14:00
16:00
18:00
20:00
22:00
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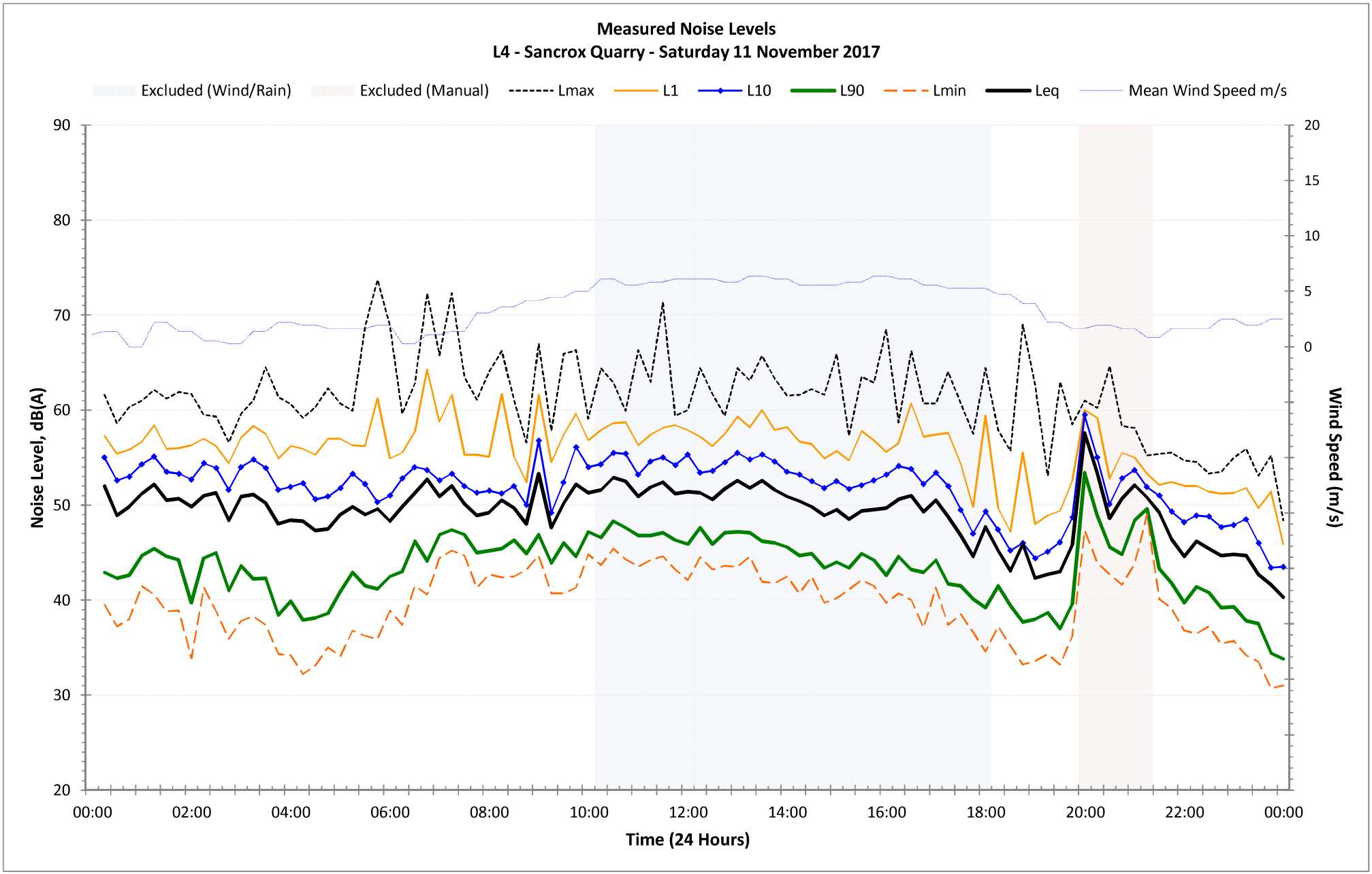
Measured Noise Levels
L4 - Sancrox Quarry - Saturday 11 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
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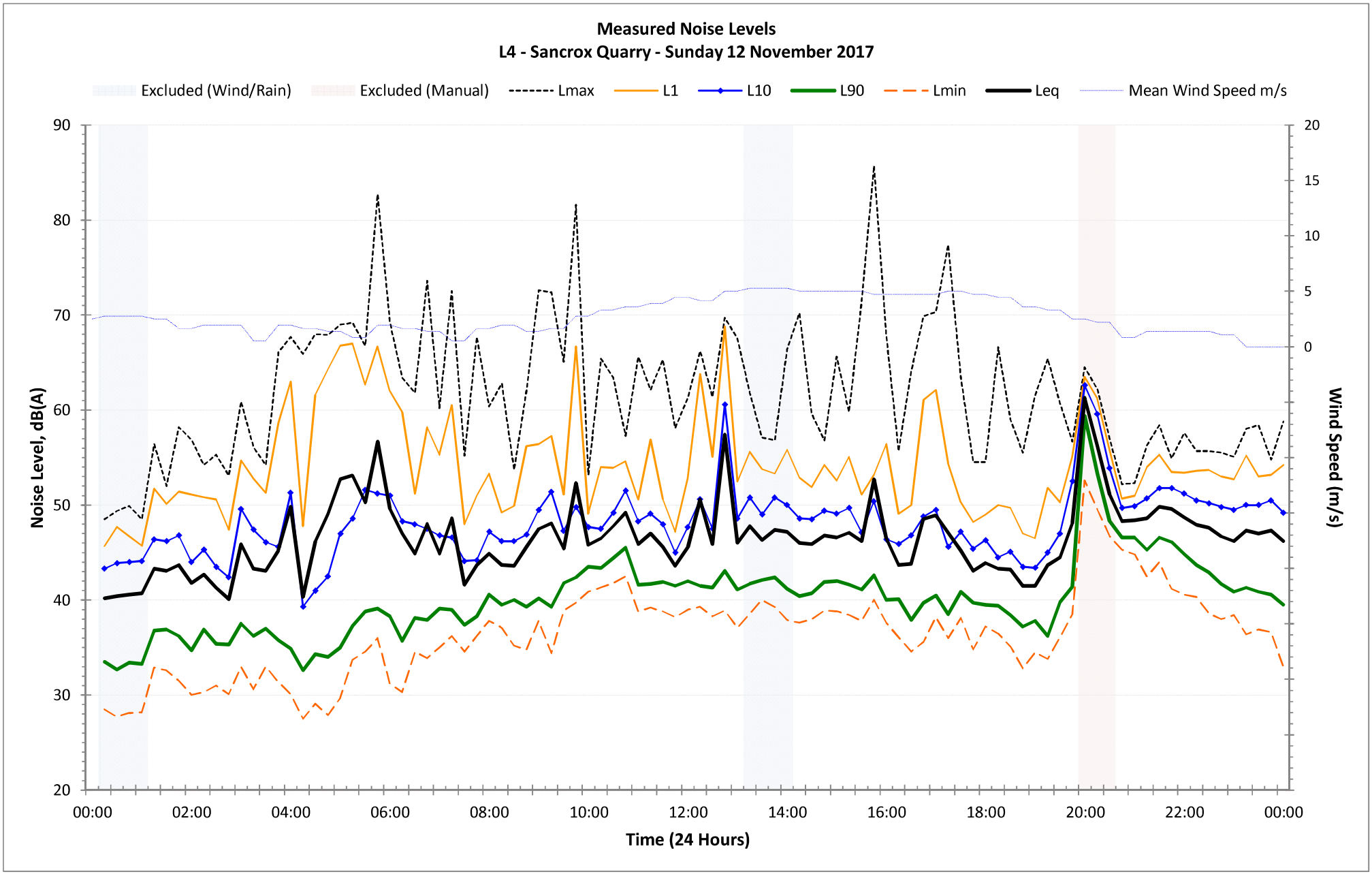
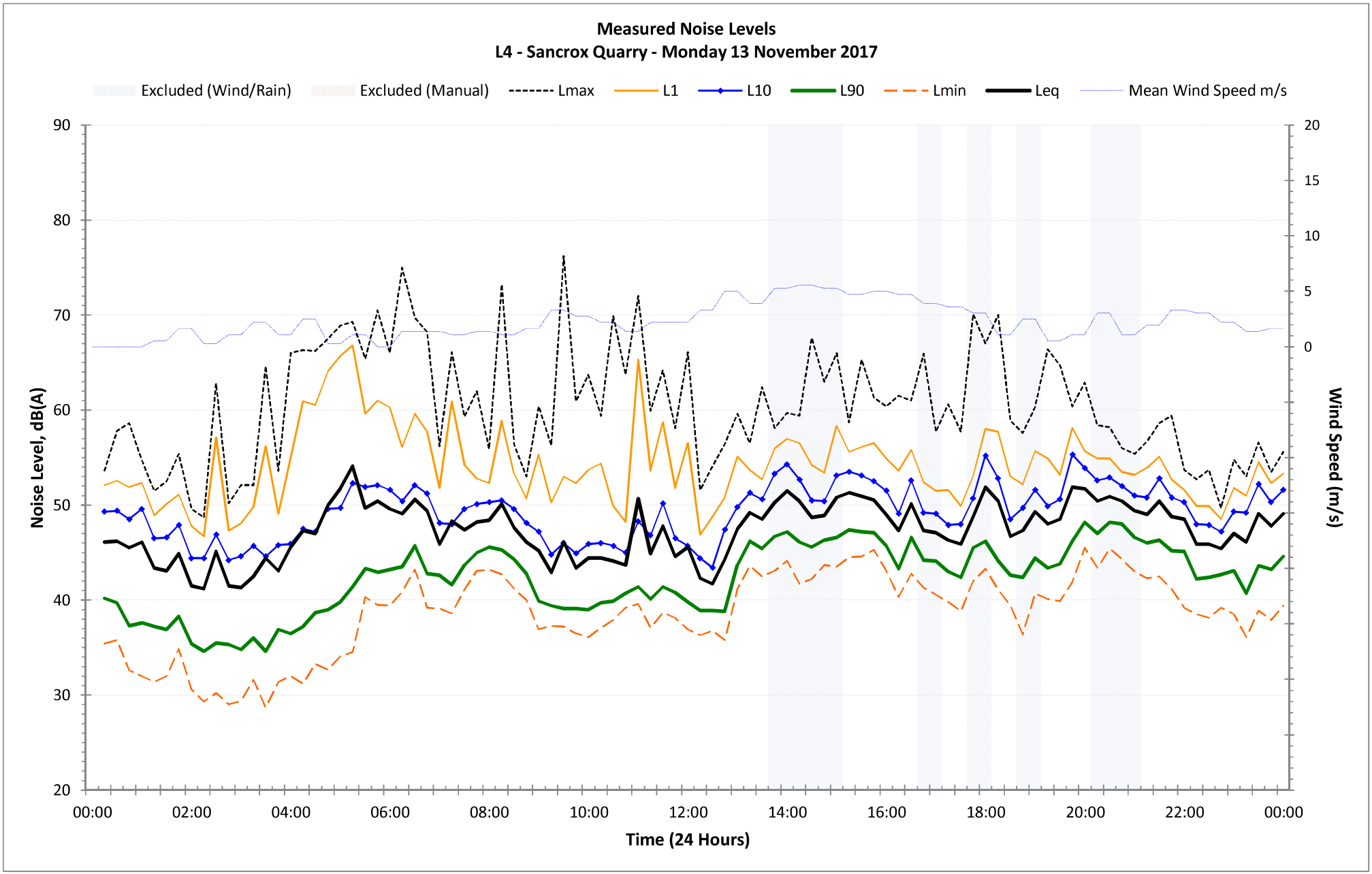
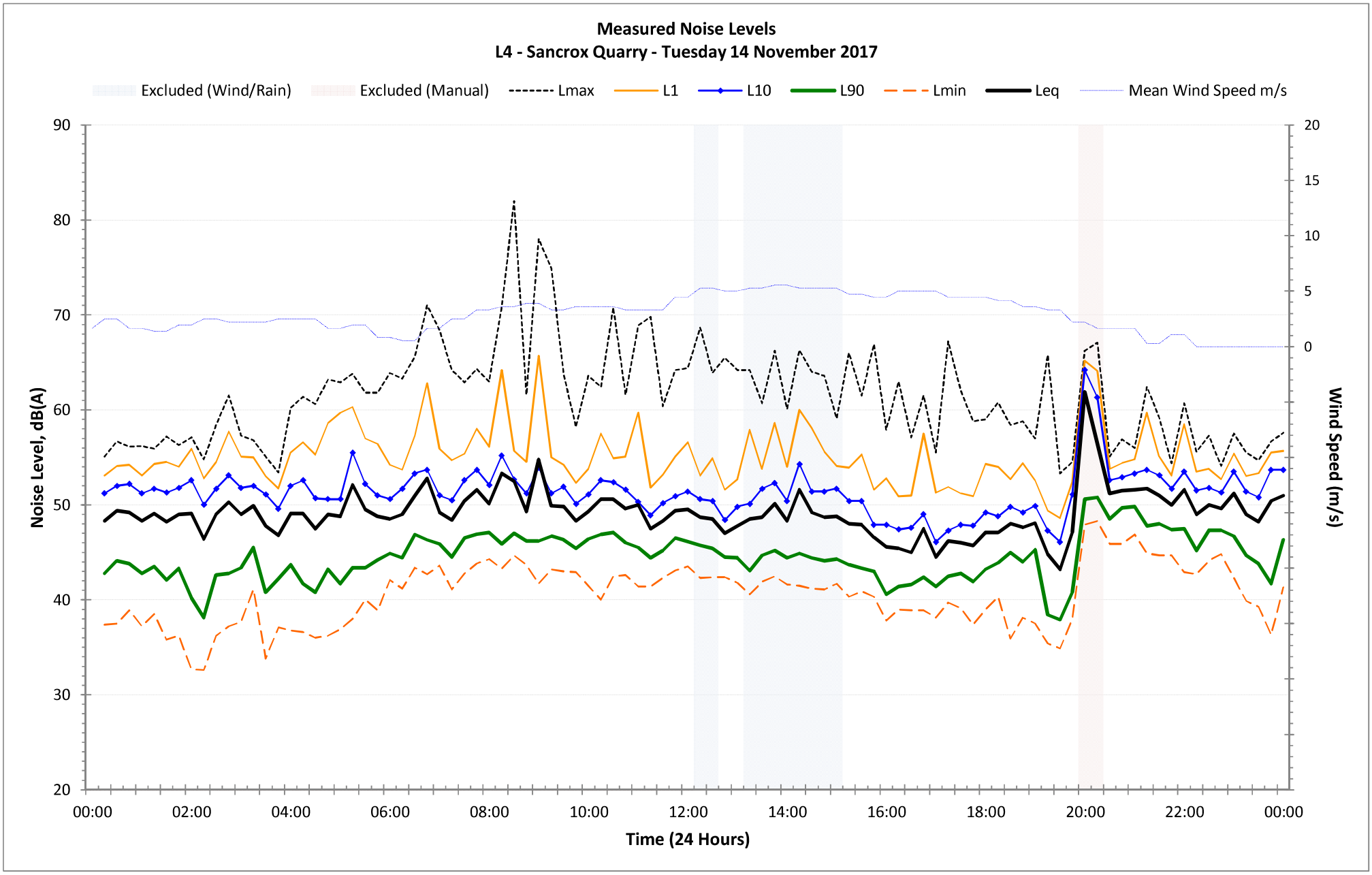
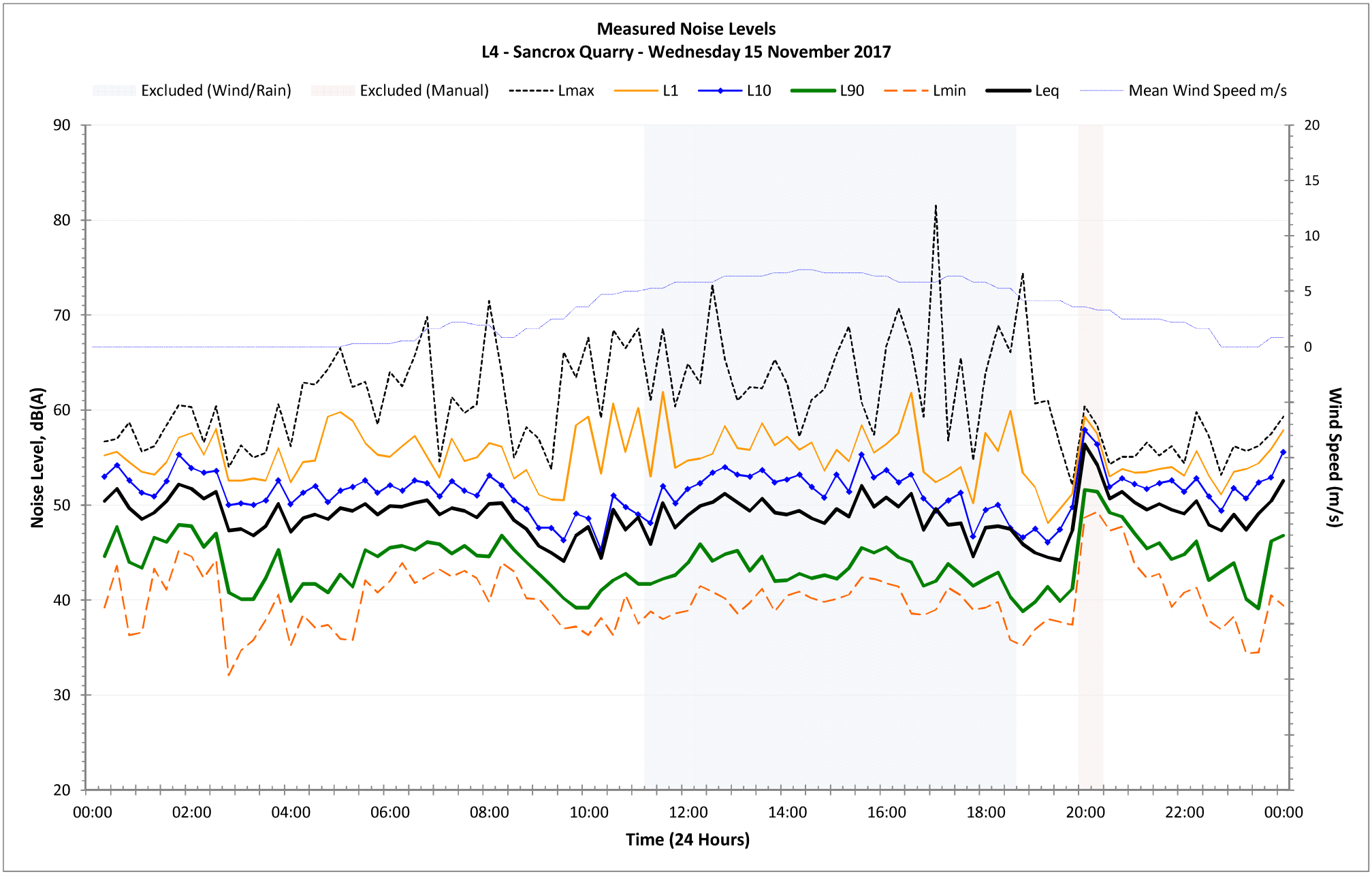
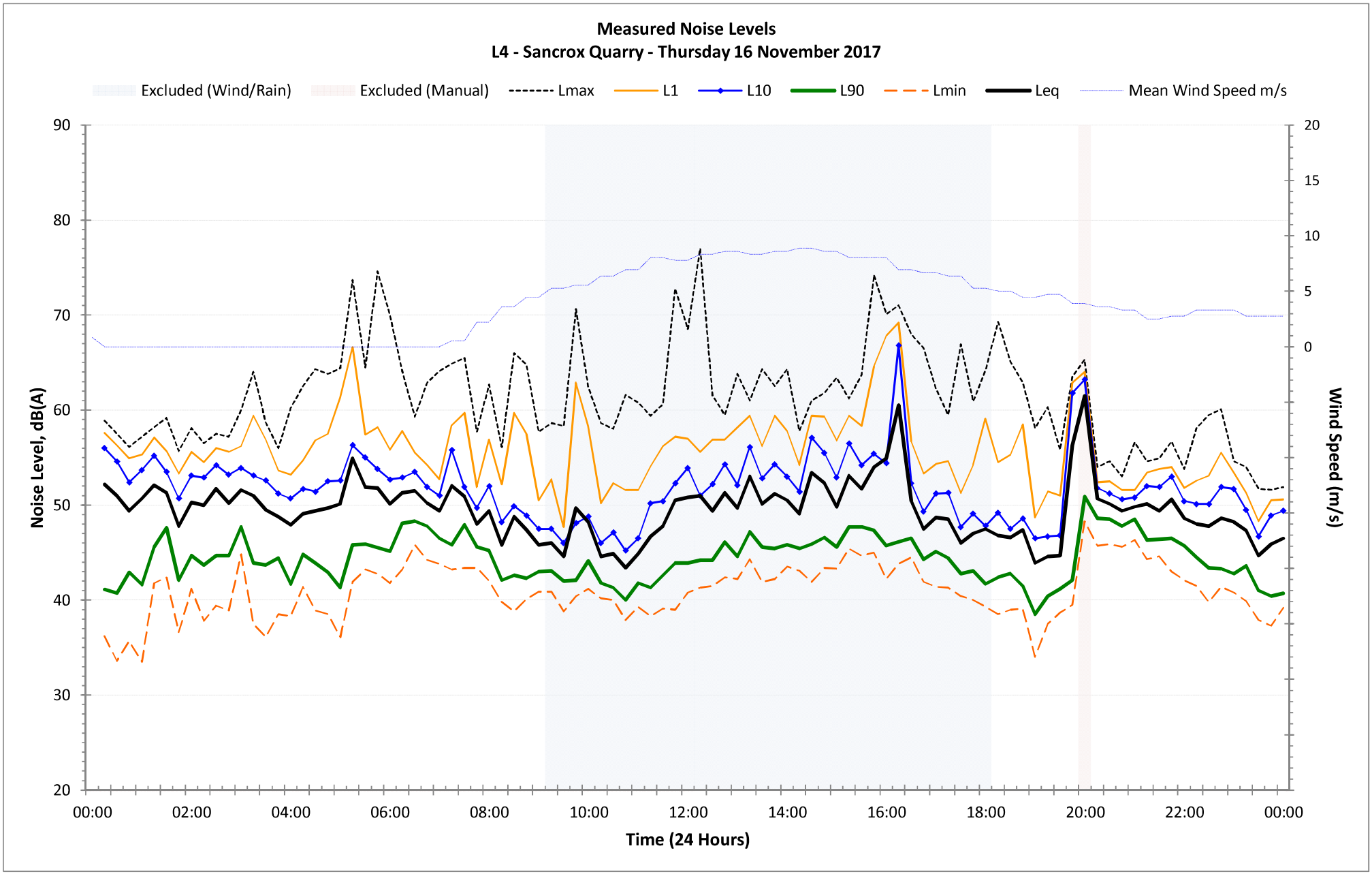

Measured Noise Levels
L4 - Sancrox Quarry - Sunday 12 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Monday 13 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 14 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 15 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Thursday 16 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
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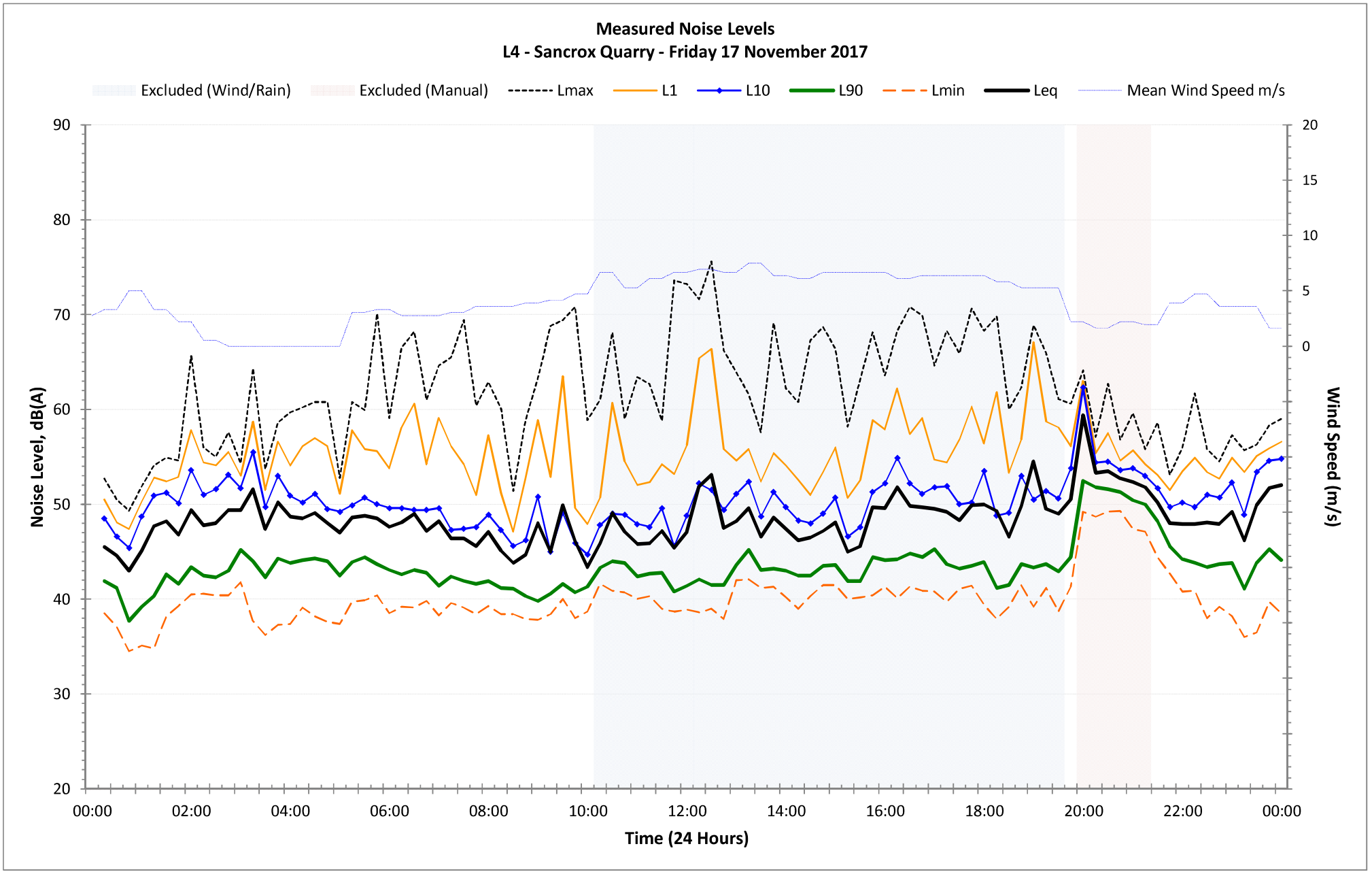
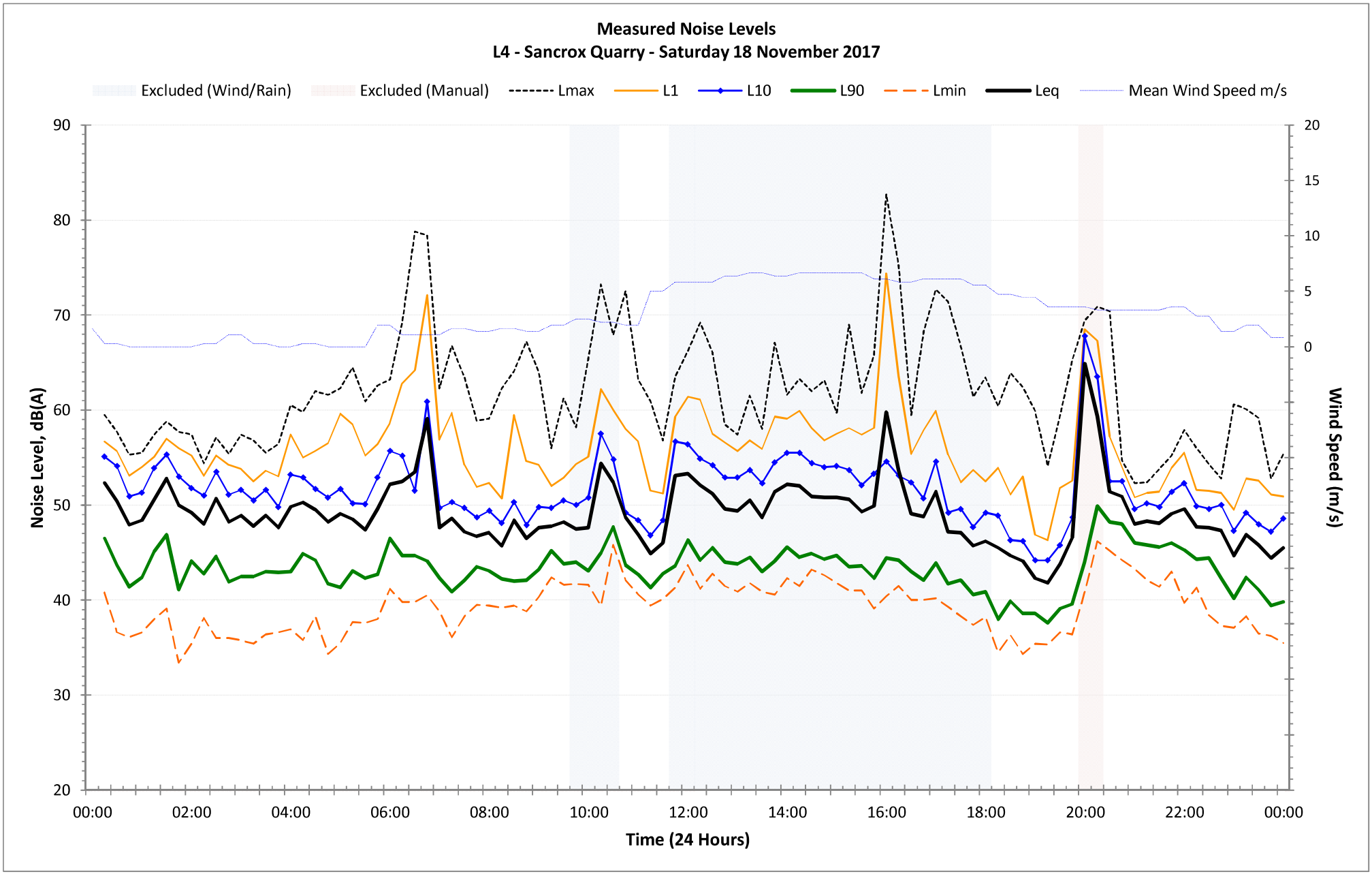
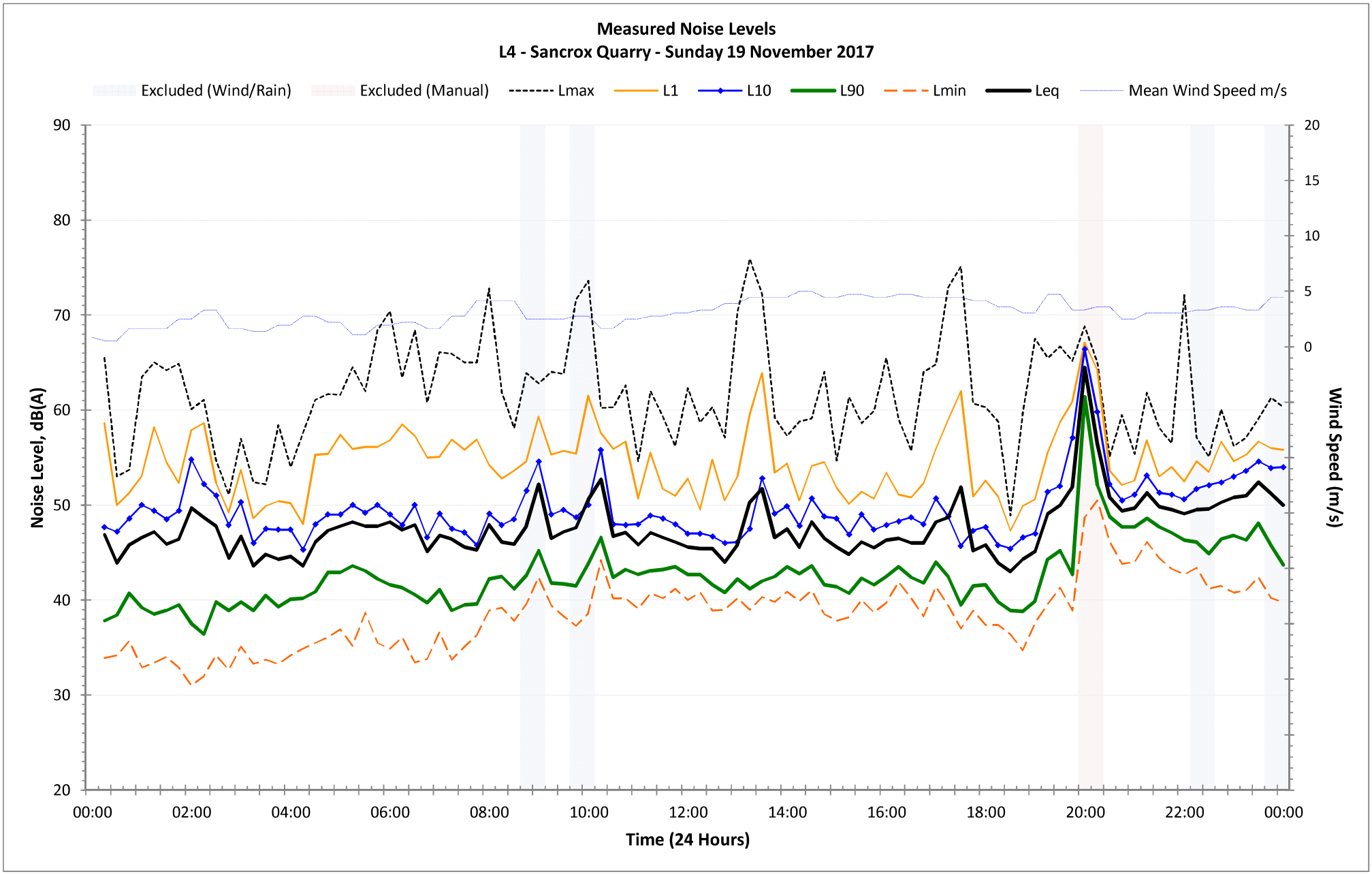
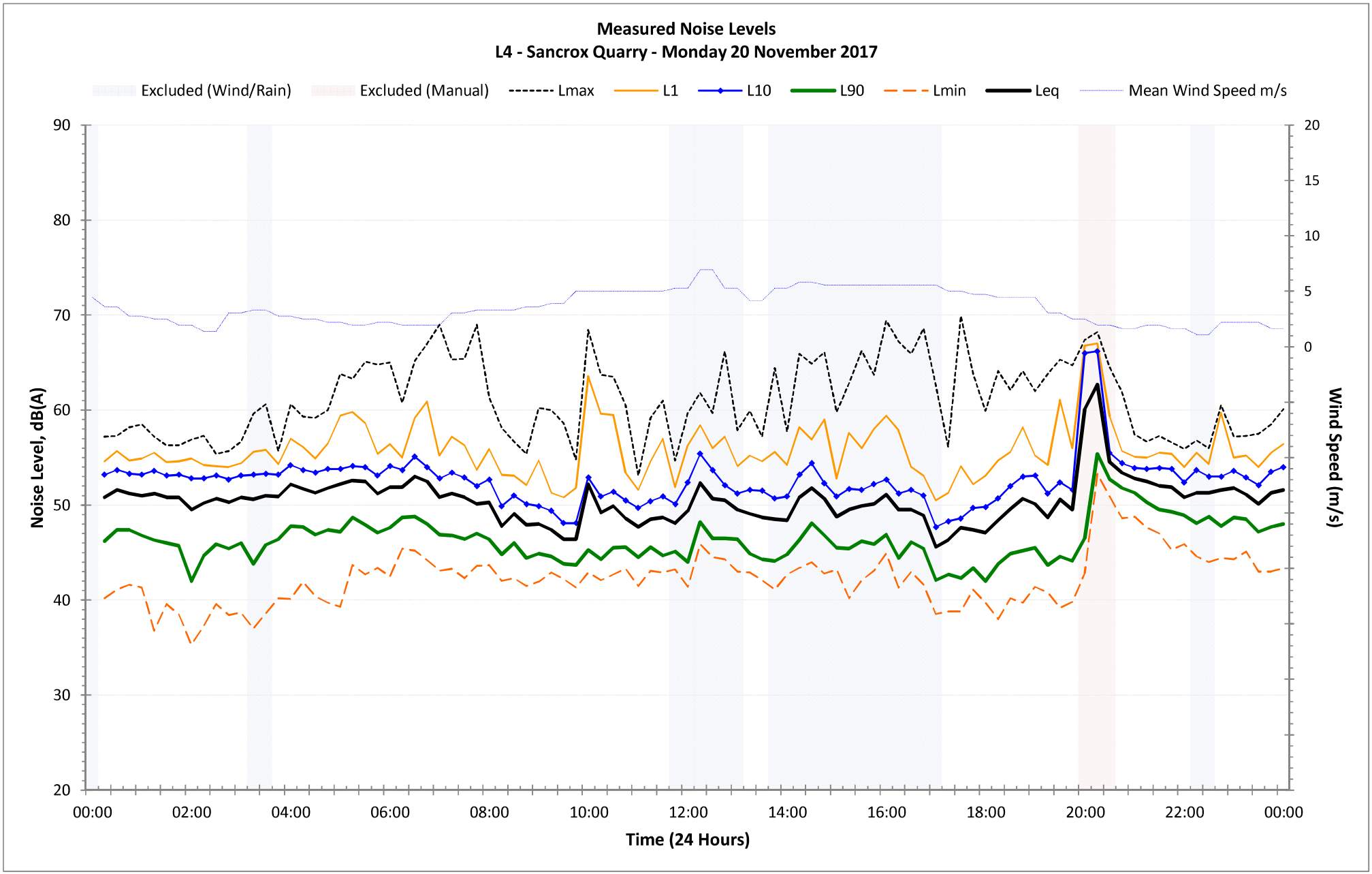
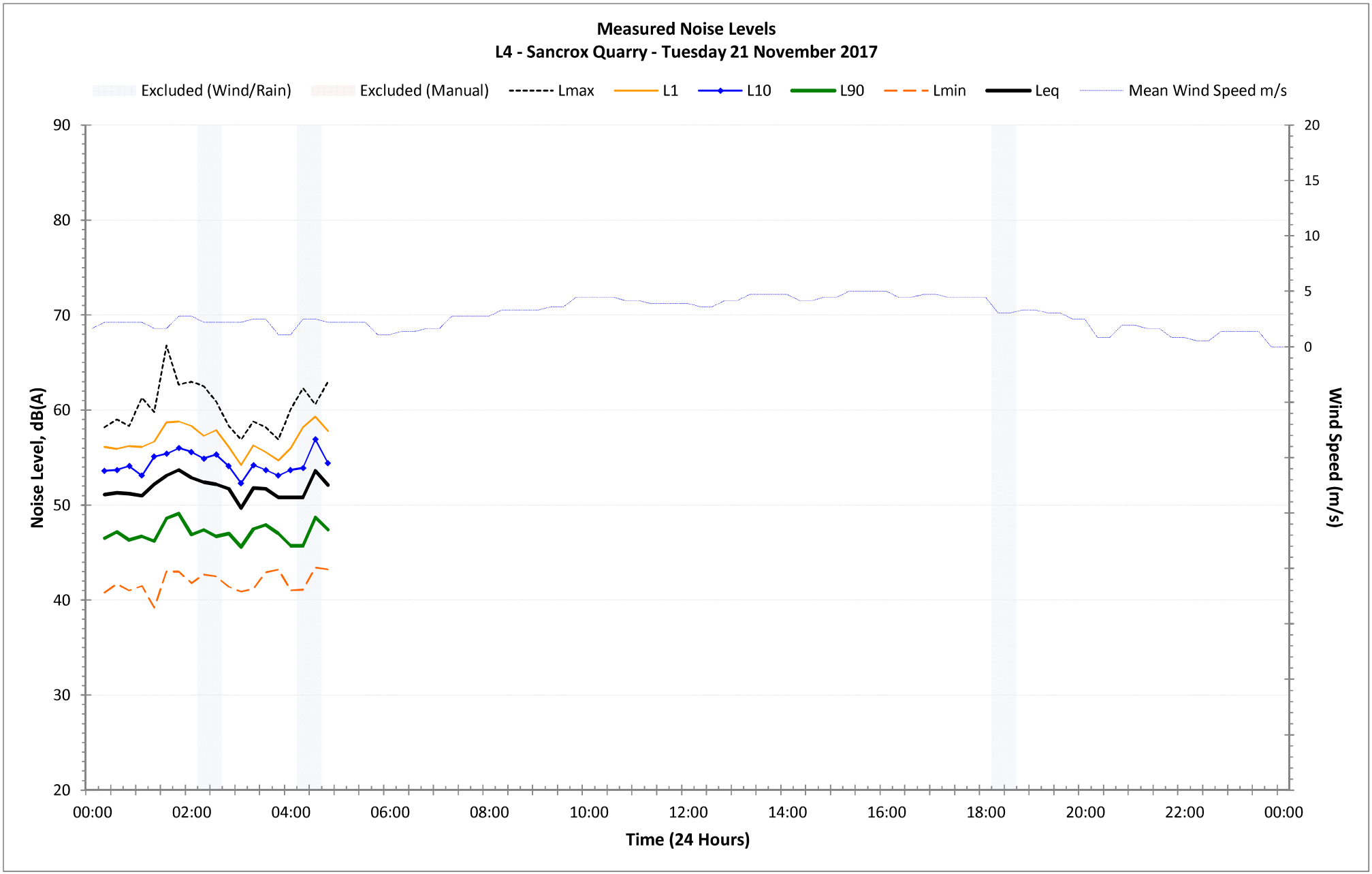

Measured Noise Levels
L4 - Sancrox Quarry - Friday 17 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Saturday 18 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Sunday 19 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Monday 20 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 21 November 2017
Excluded (Wind/Rain)
Excluded (Manual)
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

APPENDIX F DETAILED NOISE MODELLING DATA

Table F.1 Construction Noise Assessment Scenarios (Works, Activities and Equipment)

Scenario	Description	Equipment	Quantity	Duty Factor	Base Lw Value	Total Lw Value	Source	Individual Noise Source Term Data - Spectral Data, dB(A)									
								31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	LW Total, dB(A)
SCN01	Demolition of Existing Structures	Excavator (approx. 20 tonne)	2	100%	105	108.0	Adopted from Australian Standard AS2436	65.5	86.2	94.9	97.5	102.8	103.8	99.1	93.8	86.6	108.0
		Excavator (approx. 40 tonne)	1	100%	115	115.0	Adopted from TfNSW CNS	72.5	93.2	101.9	104.5	109.8	110.8	106.1	100.8	93.6	115.0
		Generator	1	100%	99	99.0	Adopted from Australian Standard AS2436	64.9	87.1	91.4	87.4	92.7	91.2	92.2	87.8	78.6	99.0
		Jackhammer	1	100%	113	113.0	Adopted from TfNSW CNS	74.1	88.9	101.6	104.3	105.8	107.7	106.8	99.9	92.2	113.0
		Front end loader	1	100%	113	113.0	Adopted from Australian Standard AS2436	74.2	85.4	101.5	106.7	105.5	106.7	106.7	98.3	94.2	113.0
		Light Vehicle (idle)	6	50%	95	99.8	ERM library of measured equipment	68.9	76.9	85.0	87.4	92.7	95.4	93.9	88.1	82.8	99.8
		Heavy Vehicle (idle)	6	50%	107	111.8	Adopted from Australian Standard AS2436	67.5	92.9	97.2	103.6	106.9	104.2	106.2	95.2	88.4	111.8
		Light Vehicle (moving)	6	70%	95	101.2	ERM library of measured equipment	70.3	78.3	86.4	88.8	94.1	96.8	95.3	89.5	84.2	101.2
		Heavy Vehicle (moving)	6	70%	107	113.2	Adopted from Australian Standard AS2436	68.9	94.3	98.6	105	108.3	105.6	107.6	96.6	89.8	113.2
		TOTAL	30	-	119	120.7	-	80.3	99.5	107.9	112.2	114.9	115.1	114.0	106.1	99.6	120.7
SCN02	Site Preparation and Establishment	Excavator (approx. 20 tonne)	1	75%	105	103.8	Adopted from Australian Standard AS2436	61.3	82.0	90.7	93.3	98.6	99.6	94.9	89.6	82.4	103.8
		Excavator (approx. 30 tonne)	1	75%	110	108.8	Adopted from Australian Standard AS2436	66.2	86.9	95.6	98.2	103.5	104.5	99.8	94.5	87.3	108.7
		Concrete agitator truck	1	50%	109	106.0	Adopted from Australian Standard AS2436	65.5	81.5	89.7	91.2	98.0	103.4	98.6	91.9	85.4	106.0
		Concrete pencil vibrator	1	50%	103	100.0	Adopted from Australian Standard AS2436	59.5	75.5	83.7	85.2	92.0	97.4	92.6	85.9	79.4	100.0
		Concrete pump truck	1	50%	108	105.0	Adopted from Australian Standard AS2436	74.1	82.1	90.2	92.6	97.9	100.6	99.1	93.3	88.0	105.0
		Scraper	1	75%	116	114.8	Adopted from Australian Standard AS2436	72.5	93.7	102.8	104.3	107.7	109.9	109.1	99.9	94.8	114.7
		Roller	1	100%	108	108.0	Adopted from Australian Standard AS2436	57.4	75.6	90.7	101.2	101.6	102.8	101.0	92.8	86.7	108.0
		Grader	1	75%	110	108.8	Adopted from Australian Standard AS2436	61.7	80.9	93	101.5	102.9	104.1	100.3	93.1	80	108.7
		Light Vehicle (idle)	6	50%	95	99.8	ERM library of measured equipment	68.9	76.9	85.0	87.4	92.7	95.4	93.9	88.1	82.8	99.8
		Heavy Vehicle (idle)	6	50%	107	111.8	Adopted from Australian Standard AS2436	67.5	92.9	97.2	103.6	106.9	104.2	106.2	95.2	88.4	111.8
		Light Vehicle (moving)	6	70%	95	101.2	ERM library of measured equipment	70.3	78.3	86.4	88.8	94.1	96.8	95.3	89.5	84.2	101.2
		Heavy Vehicle (moving)	6	70%	107	113.2	Adopted from Australian Standard AS2436	68.9	94.3	98.6	105	108.3	105.6	107.6	96.6	89.8	113.2
		TOTAL	32	-	119.8	120.0	-	79.4	99.2	106.3	110.9	114.1	114.6	113.8	104.9	98.7	120.0
SCN03	General Construction of Infrastructure	Cherry Picker	1	50%	105	102.0	Adopted from Australian Standard AS2436	67.9	90.1	94.4	90.4	95.7	94.2	95.2	90.8	81.6	102.0
		Crane (mobile)	1	75%	104	102.8	Adopted from Australian Standard AS2436	65.2	76.3	85.9	88.1	95.8	95.8	91.7	99.1	88.7	102.8
		Hand tools (electric)	6	50%	102	106.8	Adopted from Australian Standard AS2436	63.5	87.2	92.3	92	102.6	102.7	98	86.3	76.2	106.8
		Hand tools (pneumatic)	1	50%	116	113.0	Adopted from Australian Standard AS2436	74.1	88.9	101.6	104.3	105.8	107.7	106.8	99.9	92.2	113.0
		Welder	2	50%	105	105.0	Adopted from Australian Standard AS2436	70.9	93.1	97.4	93.4	98.7	97.2	98.2	93.8	84.6	105.0
		Light Vehicle (idle)	6	50%	95	99.8	ERM library of measured equipment	68.9	76.9	85.0	87.4	92.7	95.4	93.9	88.1	82.8	99.8
		Heavy Vehicle (idle)	6	50%	107	111.8	Adopted from Australian Standard AS2436	67.5	92.9	97.2	103.6	106.9	104.2	106.2	95.2	88.4	111.8
		Light Vehicle (moving)	6	70%	95	101.2	ERM library of measured equipment	70.3	78.3	86.4	88.8	94.1	96.8	95.3	89.5	84.2	101.2
		Heavy Vehicle (moving)	6	70%	107	113.2	Adopted from Australian Standard AS2436	68.9	94.3	98.6	105	108.3	105.6	107.6	96.6	89.8	113.2
		TOTAL	35	-	118	118.4	-	79.1	99.6	105.8	109.5	112.8	112.0	112.3	105.0	97.0	118.4
SCN04	Construction Earth Bund	Excavator (approx. 20 tonne)	2	100%	105	108.0	Adopted from Australian Standard AS2436	65.5	86.2	94.9	97.5	102.8	103.8	99.1	93.8	86.6	108.0
		Excavator (approx. 40 tonne)	2	100%	115	120.0	Adopted from TfNSW CNS	77.5	98.2	106.9	109.5	114.8	115.8	111.1	105.8	98.6	120.0
		Dump Truck	2	100%	117	120.0	Adopted from Australian Standard AS2436	50.8	75.8	100.8	108.8	116.9	113.8	110.8	107.8	100.8	120.0
		Light Vehicle (idle)	3	50%	95	96.8	ERM library of measured equipment	65.9	73.9	82.0	84.4	89.7	92.4	90.9	85.1	79.8	96.8
		Heavy Vehicle (idle)	3	50%	107	108.8	Adopted from Australian Standard AS2436	64.5	89.9	94.2	100.6	103.9	101.2	103.2	92.2	85.4	108.8
		Light Vehicle (moving)	3	70%	95	98.2	ERM library of measured equipment	67.3	75.3	83.4	85.8	91.1	93.8	92.3	86.5	81.2	98.2
		Heavy Vehicle (moving)	3	70%	107	110.2	Adopted from Australian Standard AS2436	65.9	91.3	95.6	102	105.3	102.6	104.6	93.6	86.8	110.2
		TOTAL	18	-	120	123.5	-	78.8	99.7	108.5	113.0	119.4	118.3	114.9	110.2	103.1	123.5
Lmax	Maximum Noise Level Assessment	Metal on Metal Contact	3	100%	123	127.8		82.8	102.6	110.1	114.0	117.3	117.5	116.4	108.7	101.7	123.0

1. Three Lmax sources modelled at representative locations onsite.
2. Location of noise sources based on proposed infrastructure and project design (refer Appendix A).
3. Areas sources were utilised in the noise model to predict the likely distribution of noise sources associated with each work area.

Table F.2 Operational Noise Assessment Scenarios (Activities and Equipment)

Scenario	Description	Equipment	Quantity	Duty Factor	Base Lw Value	Mitigation / Reduction of Lw	Total Lw Value	Source	Individual Noise Source Term Data - Spectral Data, dB(A)								
									31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	LW Total, dB(A)
EXIST	Existing Operation of the Quarry	Loader - Komatsu WA500	1	100%	110	-	110	LW derived based on measured activity: stock piling and loading out at Sancrox Quarry.	78.0	92.0	95.0	98.0	103.0	104.0	103.0	98.0	101.0	110
		Loader - CAT980H	1	100%	105	-	105	LW derived based on measured activity: stock piling and loading out at Sancrox Quarry.	78.0	94.0	94.0	92.0	97.0	100.0	98.0	92.0	87.0	105
		Dump truck - CAT769C	1	100%	112	-	112	LW derived based on measured activity: loading out at Sancrox Quarry.	72.0	86.0	91.0	96.0	106.0	107.0	107.0	100.0	92.0	112
		Cone Crusher	1	100%	111	-	111	Sancrox Quarry SoEE 2013	64.0	78.0	90.0	100.0	103.0	107.0	105.0	99.0	90.0	111
		Jaw Crusher	1	20%	113	-	106	Sancrox Quarry SoEE 2013	55.0	74.0	87.0	95.0	100.0	101.0	99.0	95.0	86.0	106
		Barmac VSI Crusher	1	100%	101	-	101	Sancrox Quarry SoEE 2013	59.0	71.0	81.0	89.0	93.0	96.0	96.0	93.0	88.0	101
		Excavator - Komatsu PC350LC	1	100%	107	-	107	Adopted from Australian Standard AS2436	64.5	85.2	93.9	96.5	101.8	102.8	98.1	92.8	85.6	107
		Excavator - Komatsu PC400LC	1	30%	114	-	109	LW derived based on measured activity: loading dump truck at Sancrox Quarry.	64.0	83.0	94.0	95.0	102.0	104.0	102.0	98.0	93.0	109
		Screen	4	100%	110	-	116	Sancrox Quarry SoEE 2013	41.9	63.9	85.9	93.9	106.0	103.9	100.9	102.9	88.9	110
		Conveyors (Lw/m)	14	100%	75	-	75 Lw/m	Peppertree Quarry NIA 2011	28.6	41.8	51.0	58.5	72.4	68.7	66.9	56.4	46.0	75
		Conveyor Motor	14	100%	87	-	98	ERM library of measured equipment	41.0	49.0	65.0	75.0	80.0	82.0	81.0	76.0	70.0	87
		Conveyor Transfer Point	11	100%	95	-	105	ERM library of measured equipment	72.0	80.0	86.0	83.0	89.0	90.0	88.0	80.0	60.0	95
		Water Cart	1	100%	103	-	103	Brandy Hill Quarry NVIA 2015	49.6	79.8	80.9	89.4	97.8	99.0	97.2	90.0	80.9	103
		Truck and Dog	2	-	105	-	105	Brandy Hill Quarry NVIA 2015	55.6	68.8	78.9	90.4	98.8	99.0	99.2	95.0	86.9	105
		TOTAL	54	-	120	-	120	-	-	-	-	-	-	-	-	-	-	-
STAGE 1 - STAGE 4	Quarry Processing Plant and Equipment operating in new locations.	Loader - Komatsu WA500	1	100%	110	-	110	LW derived based on measured activity: stock piling and loading out at Sancrox Quarry.	78.0	92.0	95.0	98.0	103.0	104.0	103.0	98.0	101.0	110
		Loader - CAT980H	1	100%	105	-	105	LW derived based on measured activity: stock piling and loading out at Sancrox Quarry.	78.0	94.0	94.0	92.0	97.0	100.0	98.0	92.0	87.0	105
		Dump truck - CAT769C	1	100%	112	-	112	LW derived based on measured activity: loading out at Sancrox Quarry.	72.0	86.0	91.0	96.0	106.0	107.0	107.0	100.0	92.0	112
		Cone Crusher	1	100%	111	12	99	Sancrox Quarry SoEE 2013	54.0	68.0	80.0	90.0	93.0	97.0	95.0	89.0	80.0	101
		Jaw Crusher	1	20%	113	12	94	Sancrox Quarry SoEE 2013	43.0	62.0	75.0	83.0	88.0	89.0	87.0	83.0	74.0	94
		Barmac VSI Crusher	1	100%	101	10	91	Sancrox Quarry SoEE 2013	49.0	61.0	71.0	79.0	83.0	86.0	86.0	83.0	78.0	91
		Excavator - Komatsu PC350LC	1	100%	107	-	107	Adopted from Australian Standard AS2436	64.5	85.2	93.9	96.5	101.8	102.8	98.1	92.8	85.6	107
		Excavator - Komatsu PC400LC	1	30%	114	-	109	LW derived based on measured activity: loading dump truck at Sancrox Quarry.	69.0	88.0	99.0	100.0	107.0	109.0	107.0	103.0	98.0	114
		Screen	4	100%	110	10	106	Blakebrook Quarry SoEE 2019	31.9	53.9	75.9	83.9	96.0	93.9	90.9	92.9	78.9	100
		Conveyors (Lw/m)	21	100%	75	-	75 Lw/m	Peppertree Quarry NIA 2011	28.6	41.8	51.0	58.5	72.4	68.7	66.9	56.4	46.0	75
		Conveyor Motor	21	100%	87	-	87	ERM library of measured equipment	41.0	49.0	65.0	75.0	80.0	82.0	81.0	76.0	70.0	87
		Conveyor Transfer Point	14	100%	95	-	95	ERM library of measured equipment	72.0	80.0	86.0	83.0	89.0	90.0	88.0	80.0	60.0	95
		Water Cart	1	100%	103	-	103	Brandy Hill Quarry NVIA 2015	49.6	79.8	80.9	89.4	97.8	99.0	97.2	90.0	80.9	103
		Truck and Dog	2	-	105	-	105	Brandy Hill Quarry NVIA 2015	55.6	68.8	78.9	90.4	98.8	99.0	99.2	95.0	86.9	105
		Pugmill	1	100%	94	-	94	Blakebrook Quarry SoEE 2019	49.6	66.8	68.9	82.4	88.8	90.0	87.2	83.0	72.9	94
		TOTAL	72	-	120	-	117	-	-	-	-	-	-	-	-	-	-	-
	Concrete Batching Plant & Recycling Facility	Blending Plant	1	100%	106	10	96	Rooty Hill NIA	63.6	83.8	82.9	85.4	89.8	91.0	87.2	80.0	87.9	96
		Concrete Truck	2	-	109	-	109	Adopted from Australian Standard AS2436	68.5	84.5	92.7	94.2	101.0	106.4	101.6	94.9	88.4	109
		Concrete Agitator	1	100%	109	10	99	Adopted from Australian Standard AS2436	58.5	74.5	82.7	84.2	91.0	96.4	91.6	84.9	78.4	99
		Concrete Pump	1	100%	108	10	98	Adopted from Australian Standard AS2436	67.1	75.1	83.2	85.6	90.9	93.6	92.1	86.3	81.0	98
		Conveyors (Lw/m)	2	100%	75	-	75 Lw/m	Peppertree Quarry NIA 2011	28.6	41.8	51.0	58.5	72.4	68.7	66.9	56.4	46.0	75
		Conveyor Motor	2	100%	87	-	87	ERM library of measured equipment	41.0	49.0	65.0	75.0	80.0	82.0	81.0	76.0	70.0	87
		Conveyor Transfer Point	1	100%	95	-	95	ERM library of measured equipment	72.0	80.0	86.0	83.0	89.0	90.0	88.0	80.0	60.0	95
		Water Supply Pump	1	100%	97	-	97	ERM library of measured equipment	57.9	75.9	82.4	80.5	91.0	93.0	90.3	84.4	79.4	97
		TOTAL	11	-	114	-	110	-	-	-	-	-	-	-	-	-	-	-
	Asphalt Plant	Bag House	1	100%	96	-	96	Blakebrook Quarry SoEE 2019	62.0	75.2	82.3	85.8	93.2	88.4	85.6	82.4	75.3	96
		Bag House Fan	1	100%	102	10	92	Blakebrook Quarry SoEE 2019	57.4	76.3	83.3	82.9	85.3	86.4	82.9	74.2	66.5	92
		Burner / Blower	1	100%	91	-	91	Blakebrook Quarry SoEE 2019	43.6	64.8	72.9	80.4	88.8	84.0	80.2	77.0	63.9	91
		Conveyor Motor	1	100%	88	-	88	Blakebrook Quarry SoEE 2019	42.0	50.0	66.0	76.0	81.0	83.0	82.0	77.0	71.0	88
		Drum and Drum Drive	1	100%	89	-	89	Blakebrook Quarry SoEE 2019	43.0	51.0	67.0	77.0	82.0	84.0	83.0	78.0	72.0	89
		Conveyors (Lw/m)	1	100%	75	-	75 Lw/m	Peppertree Quarry NIA 2011	28.6	41.8	51.0	58.5	72.4	68.7	66.9	56.4	46.0	75
		TOTAL	6	-	104	-	99	-	-	-	-	-	-	-	-	-	-	-
Lmax	Maximum Noise Level Assessment	Metal on Metal Contact	4	100%	123	-	129		82.8	102.6	110.1	114.0	117.3	117.5	116.4	108.7	101.7	123

1. Four Lmax sources will modelled at representative locations onsite.
2. Location of noise sources will be based on proposed infrastructure and project design (refer Appendix A).
3. A combination or 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.

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